

Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 3604 (2020-12)

**Storage, Handling and Plant-internal Transport of
Radioactive Substances in Nuclear Power Plants
(with the Exception of Fuel Assemblies)**

(Lagerung, Handhabung und innerbetrieblicher Transport
radioaktiver Stoffe – mit Ausnahme von Brennelementen –
in Kernkraftwerken)

Previous versions of this Safety Standard
were issued 1983-06 and 2005-11

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

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KTA SAFETY STANDARD

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Storage, Handling and Plant-internal Transport
of Radioactive Substances in Nuclear Power Plants
(with the Exception of Fuel Assemblies)

KTA 3604

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PLEASE NOTE: Only the original German version of this safety standard represents the joint resolution of the 35-member Nuclear Safety Standards Commission (Kerntechnischer Ausschuss, KTA). The German version was made public in the Federal Gazette (Bundesanzeiger) of January 20th, 2021. Copies of the German versions of the KTA safety standards may be mail-ordered through the Wolters Kluwer Deutschland GmbH (info@wolterskluwer.de). Downloads of the English translations are available at the KTA website (<http://www.kta-gs.de>).

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

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Comments by the editor:

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

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

Basic Principles

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

(2) The licensing requirements pursuant to Sec. 7 AtG regarding the construction and operation of the plant are fulfilled by the facilities intended for the retaining of solid, liquid and gaseous substances in the planned enclosures, for the handling and the controlled transportation of the radioactive substances within the plant as well as for the transfer of radioactive substances via the planned paths. Safety standards of the series KTA 3600 specify the safety requirements for these facilities.

(3) The present safety standard contains requirements serving the purpose of fulfilling the protective goals of StrlSchG pertaining to the technical facilities and additional administrative measures regarding storage, handling as well as plant-internal transportation of radioactive substances with the exception of fuel assemblies, as well as to the design of the civil structures and installations.

(4) Requirements with respect to fire protection are specified in the three parts of safety standard KTA 2101.

(5) Products to be released from the plant are subject to the conditions derived from the legal regulations for the transportation of hazardous materials as well as from the currently applicable acceptance criteria of the receiving party.

(6) Requirements regarding the accounting system for radioactive waste are specified in Sec. 2 AtEV.

(7) Requirements with respect to the interim storage of radioactive waste with a negligible heat generation are specified in the similarly titled ESK-Ordinance (revised version of June 10, 2013).

1 Scope

(1) This safety standard applies to the storage, handling as well as plant-internal transportation and transfer of

- a) radioactive substances intended for waste management, e.g.,
 - aa) solid radioactive waste,
 - ab) liquid radioactive waste in as far as they do not fall under the scope of safety standard KTA 3603,
 - ac) radioactive substances intended for clearance pursuant to Secs. 31 through 42 StrlSchV

as well as

- b) radioactive components and component parts planned to be dismantled and re-installed with the exception of fuel assemblies and activated components in the reactor pressure vessel,
- c) radioactively contaminated tools and equipment,
- d) radioactivity sources

on the site of nuclear power plants with light-water reactors whereby the path leading to the transfer, reuse or waste management is comprised of partial processes.

(2) Radioactive substances intended for waste management however, for which the paths for utilization or waste management have not yet been specified, shall be subject to the same requirements as waste.

2 Definitions

(1) Waste, radioactive

Radioactive waste are radioactive substances that shall be disposed of in an orderly way.

(2) Waste container

Container for receiving waste products (e.g., barrel, concrete container, cast-iron container, container).

(3) Waste product

Waste product is the processed radioactive waste without packaging and waste container.

(4) Liquid radioactive waste

Liquid radioactive waste that shall be disposed of include the following liquids

- a) contaminated consumable liquids (e.g., oils, hydraulic fluids, cleaning agents and solvents, acids and lye)

and

- b) radioactive concentrates in liquid form from the facilities for the handling and treatment of radioactively contaminated water (e.g., evaporator concentrates, filter residues from a mechanical filtration, used up ion-exchanger resin).

(5) Package

A package – for the purpose of the present safety standard – is the unit of container and radioactive substance, independent of the processing condition of the substance.

(6) Hot workshop

A hot workshop is a workshop specified to be used for working on radioactive parts that possess a license pursuant to Sec. 12 StrlSchG for their handling and treatment.

(7) Mobile conditioning facilities

Mobile conditioning facilities are closed process-oriented systems with defined interfaces. They are used for the discontinuous, i.e. campaign-oriented processing of raw waste or intermediary products that thus become waste products suited for intermediate or final storage. Such facilities are individually assembled for the respective conditioning campaign in a nuclear power plant and will be removed after conclusion of the campaign.

(8) Storing

Storing is the short- or longer-term storage of radioactive substances independent of the place of work activity. For the purpose of the present safety standard, a differentiation is made between short-term storing (usually less than or equal to 12 months) and longer-term storing (longer than 12 months)

- a) In case of short-term storing the storage of radioactive substances is not the focus of the partial process but rather part of another partial process.
- b) In case of longer-term storing the storage of radioactive substances is the primary goal of a partial process.

Note:

German practice has it that various terms are used synonymously to "storing" to better describe the objective of storing, e.g., to buffer, to stow, to make available, to prepare for transportation, to keep in a safe place, to let decay, to put into interim storage. For the purpose of the present safety standard, the term "storing" is restricted to meaning short-term and longer-term storage.

(9) Radioactive sources

Radioactive sources are – for the purpose of the present safety standard – sealed or unsealed radioactive substances pursuant to Sec. 5 StrlSchG, that are used for different purposes of testing in the nuclear power plant.

(10) Process / partial process

The process of waste management of radioactive substances is the sum of all partial processes and constitutes the entire path from the generating of the radioactive substance to the waste management objective. For the purpose of the present safety standard, a partial process is the objective-oriented treatment of radioactive substances directed toward the waste management objective, whereby storing is one of the individual partial processes.

Note:

Partial processes are, e.g., handling, putting into interim storage, storage, treatment and transportation of radioactive substances.

(11) Collection

Collection is the selective removal of those substances not required anymore in the individual work process, possibly directly at the location where and time when the substances accumulate.

(12) Sorting

Sorting is the selective separation of substance streams according to the criteria of their later use, processing and respective waste management objective.

(13) Interim storage locations for solid radioactive substances

Interim storage locations for solid radioactive substances ("interim storage locations" for short in the present safety standard) are compartments, or areas in compartments, where the containers with collected solid radioactive waste and the radioactive components and component parts as well as radioactively contaminated tools and equipment are stored until further handling and treatment.

(14) Packaging

Packaging is the insertion of a radioactive substance or a waste product into a container.

Note:

In Traffic Law, packaging is defined as the creation of a package.

3 Handling and Storage of Solid Radioactive Substances Intended for Waste management

Note:

To explain the text of the present safety standard, the handling and treatment of solid radioactive substances is visualized schematically in **Figure 3-1**.

3.1 Collection

(1) Any unsealed solid radioactive substance shall be collected. Collection should be carried out such that, under consideration of the necessary operating procedures and planned ways of waste management, the later sorting efforts are minimized.

(2) Substances intended for clearance pursuant to Secs. 31 through 42 StrlSchV shall be collected and stored separately to avoid contamination.

(3) Containers for the storage of solid waste shall enclose this waste such that any release is prevented under normal-operational loads.

Note:

Suitable containers can be, e.g., plastic bags, buckets, pots, barrels.

(4) The openings of the containers for the containment of solid waste shall be designed such that, even during filling of the containers, contamination is prevented as far as possible.

(5) The containers for storing solid waste shall be dimensioned and designed such that the collected waste can be introduced to further processing with the lowest possible number of handling steps.

(6) The containers for storing solid waste shall normally be located close to the place where these waste are created or accumulate.

(7) The containers for the containment of solid radioactive substances shall be visibly marked as such.

Note:

The marking can consist, e.g., of a sign saying, "Radioactive Waste".

(8) The dose rate emitted from the collected waste shall be monitored. If it becomes necessary, suitable radiation protection measures shall be provided (e.g., transfer to an interim storage location, setting up of shielding, cordoning off) and current dose rate values shall be posted.

(9) The collection of combustible substances shall be carried out observing the required fire protection measures specified in safety standard KTA 2101.3 (e.g., encapsulating the fire load within metallic collection containers).

(10) As soon as operating procedures allow, filled up containers for storing solid waste shall be removed and, if necessary, replaced by empty ones.

(11) Unless the content of filled up solid waste containers is immediately subjected to further handling and treatment, the containers shall be marked on the surface of the container with respect to the type of solid waste, the dose rate and the date the dose rate was measured.

3.2 Interim Storage Location for Solid Radioactive Waste

(1) The solid radioactive waste or the radioactive components and component parts collected in containers as well as radioactively contaminated tools and equipment shall be stored at an interim storage location until their further handling and treatment.

(2) Interim storage locations shall, basically, be located in a controlled area. Interim storage locations shall be connected to an air conditioning facility that, during specified normal operation, is suited for the controlled discharge or retention of radioactive substances. Filled in suitable containers, the waste may, temporarily, also be stored in the supervised area, provided, the containers are designed such that radioactive substances cannot be inadvertently released.

(3) The useable storage area in the interim storage locations shall be dimensioned such that they are sufficient for storing the increased volume of solid waste briefly occurring during specified normal operation.

(4) The interim storage locations shall normally be conveniently located with regard to delivery and processing of the collected solid waste.

(5) The load capacity of the interim storage location floor shall be designed for a load per unit area of at least 10 kN/m² and, additionally for temporary shielding, for a load per unit length of at least 10 kN/m for a maximum length of 5 meters at the least favorable location.

(6) Interim storage locations shall be provided with the necessary auxiliary equipment for the storage and transportation (e.g., storage racks, lifting equipment, forklifts) that would help to keep the radiation exposure of the personnel as low as possible.

(7) A remote-controlled loading and unloading of interim storage locations shall be monitored by optical and, if necessary, additional acoustical means.

(8) Interim storage locations shall normally be designed and furnished such that they can be easily decontaminated.

(9) The dose rate in interim storage locations shall be monitored.

(10) Interim storage locations shall be cordoned off and marked as being an interim storage location. It shall normally be possible to lock up the interim storage location. In addition to the information required pursuant to Sec. 85 para. (1) StrlSchV, the marking shall normally also list the following points:

- a) identification of the compartment,
- b) dose rate at the door or at the cordon,
- c) if necessary, notice regarding contamination,
- d) point in time of the measurements.

3.3 Handling and Treatment

(1) After collection or storage, it shall be checked whether a further handling and treatment of the radioactive substances is required. The objectives can be:

- a) preparation for conditioning,
- b) longer-term storage in the nuclear power plant,
- c) transfer into an interim storage facility or a federal repository,
- d) clearance pursuant to Secs. 31 through 42 StrlSchV.

(2) The handling and treatment methods shall be pursuant to the requirements of the product control regarding storage in a federal repository, with the requirements regarding interim storage or with the requirements regarding clearance pursuant to Secs. 31 through 42 StrlSchV.

(3) The handling and treatment of radioactive waste may be carried out with stationary or mobile facilities. As far as applicable, these facilities shall meet the following requirements:

- a) sufficient size of the set-up location,
- b) supply of operating media (e.g., electrical power, water, pressurized air),
- c) integration into the wastewater and vent air systems,
- d) radiological requirements (e.g., dose rate limit),
- e) acceptance and function tests prior to commissioning.

Note:

Requirements that are independent of the set-up location of the mobile handling and treatment facilities may be specified in an individual handling license pursuant to Sec. 12 StrlSchG.

(4) The facilities for sorting, shredding, densifying, compacting, drying, embedding into matrices, packaging, etc., shall be operated inside a controlled area. The spatial and logistical framework regarding the delivery and removal transportation of waste, and the allocation of waste and waste products shall be specified taking the radiation exposure of the personnel into consideration.

(5) Controlled area compartments in which these facilities are operated shall be connected to an air conditioning facility.

(6) A localized exhaust shall be provided if radioactivity can be inadvertently released to the room air during handling and treatment of waste, especially during densifying, compacting and drying.

(7) With regard to the characteristics of the waste products relevant to a final or intermediate storage, the corresponding process parameters (e.g., pressure, temperature, condensate volume) shall be documented over the course of the handling and treatment process.

(8) The design and operation of drying facilities shall take the fire and explosion hazards into account.

(9) The compartment and the facilities for packaging shall normally be designed such that they can be easily decontaminated.

(10) During packaging of solid waste, care shall be taken that none of the specified limit values for the following are exceeded:

- a) radioactivity inventory at the time of transfer to the receiving party,
- b) mass of a filled container, and
- c) dose rate at the specified distances.

(11) Before and during work in compartments where solid waste is handled and treated, the radioactivity concentration in the room air and the dose rate shall be measured. The radioactivity concentration may be measured by collecting dust specimens and, subsequently, evaluating them in a laboratory.

(12) If it is to be expected that gases, heat or corrosive substances develop in the solid waste, then either the packaging shall be delayed until an inadmissible damage or distortion of the container can be excluded, or pressure relieving measures (e.g., sintered metal filters) shall be provided, or suitable container types shall be used.

(13) The handling and treatment of radioactive substances intended for clearance pursuant to Secs. 31 through 42 StrlSchV by abrasive procedures (e.g., high-pressure water jetting, and dry ice or sand blasting) and by chemical pickling shall be carried out in controlled areas. Decay storage, allocation storage for the release measurement, and the release measurement itself may be carried out in supervised areas.

(14) In the case of radioactive substances that are intended for clearance pursuant to Secs. 31 through 42 StrlSchV only after a decay storage, the expected duration of the storage shall be determined and specified.

3.4 Storage

(1) Solid waste shall be stored in an on-site waste storage facility until their further handling and treatment, or until their transfer to an external interim storage facility or to a federal repository.

(2) Waste storage facilities shall be designed or equipped such that the waste can be stored according to their respective categories.

Note:

The categories are specified according to respective operational aspects with possible criteria being, e.g., the dose rate at the surface, the activity content, the storing duration or the decay behavior.

(3) Waste storage facilities shall be designed and equipped such that the storing and removal from storage of each waste category is possible and unhindered with the planned transport equipment.

(4) Within the framework of general planning of a nuclear power plant, waste storage facilities shall be conveniently located with regard to delivery and removal transportation of the waste.

(5) The regular loading and unloading of a waste storage facility for solid waste shall normally be carried out by remote-controlled means if the entire waste storage facility must be categorized as exclusion area.

(6) The remote-controlled means for loading and unloading of waste storage facilities shall be monitored by optical and, if necessary, additional acoustical means.

(7) If waste storage facilities are not loaded by remote-controlled means they shall be designed such that they can be partitioned off using mobile shield walls.

(8) The load capacity of the waste storage facility flooring shall be designed for a loading from the items to be stored and from the means of transportation involved. If shielding measures are required in operationally accessible waste storage facilities, the design shall take an additional load per unit length of at least 10 kN/m for a maximum length of 5 meters at the least favorable location into account.

(9) Floors, walls and the furnishings of waste storage facilities shall normally be designed such that they can be easily decontaminated. The floor screed and the coating of the flooring in the waste storage facility shall be sufficiently resistant to pressure and abrasion.

(10) Waste storage facilities shall be protected against inward water seepage.

(11) Waste storage facilities shall normally contain only such furnishings, components or equipment that are required in carrying out the storing, handling and transportation tasks or that are required for fire protection of the storage facility.

(12) Waste storage facilities shall be connected to an air conditioning facility unless it can be ensured that, due to the packaging of the waste, a release of radioactive substances can be ruled out.

(13) General planning shall ensure that maintenance tasks within waste storage facilities can be kept at a minimum.

(14) The solid waste stored in a waste storage facility shall be secured against tilting and rolling.

(15) Waste storage facilities shall be kept locked. Only authorized personnel may be allowed to access these facilities.

(16) The design of the containers for longer-term storage of solid radioactive waste, and their materials (possibly, corrosion protection) shall, for the specified duration of storage, be such that the manageability of the packages is not impaired and that any release of radioactive substances is prevented.

(17) The containers to be stored in the waste storage facility shall be clearly, durably and visibly marked. In addition to the information required for the waste pursuant to Appendix Part B of AtEV, the marking shall also list the following points:

- date of having been placed into storage,
- storage position, and
- name of the person responsible regarding this information.

Note:

Usual practice is a numeric marking in connection with a written account.

(18) Written accounts shall be kept on all procedures relating to storage and removal from storage.

Note:

Insofar as requirements ensue from the electronic record system pursuant to Sec. 2 AtEV, these shall be taken into account.

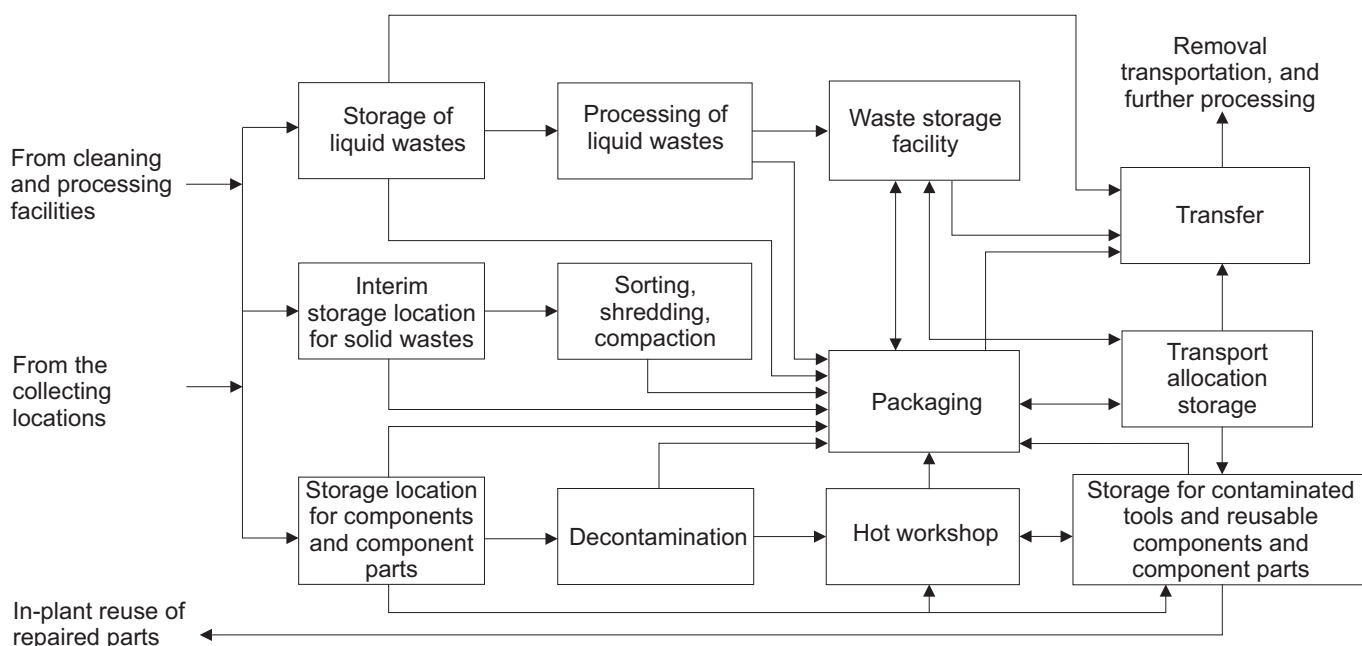


Figure 3-1: Schematic flow diagram of handling, of storage and transfer
(In an actual facility, not all of the shown stations and connections need to be realized.)