

Safety Standards

of the

Nuclear Safety Standards Commission (KTA)

KTA 2103 (2022-11)

**Explosion Protection in Nuclear Power Plants with
Light Water Reactors (General and Case-Specific
Requirements)**

(Explosionsschutz in Kernkraftwerken mit
Leichtwasserreaktoren – allgemeine und fallbezogene
Anforderungen)

Previous versions of this safety standard were
issued in 1989-06, 2000-06 and 2015-11

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

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Explosion Protection in Nuclear Power Plants with Light Water Reactors (General and Case-Specific Requirements)

KTA 2103

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PLEASE NOTE: Only the original German version of the present safety standard represents the joint resolution of the 35-member Nuclear Safety Standards Commission (Kerntechnischer Ausschuss, KTA). The German version was made public in Bundesanzeiger (BAnz) of July 25, 2023.

Copies of the German versions of KTA safety standards may be mail-ordered through Wolters Kluwer Deutschland GmbH (info@wolterskluwer.de). Downloads of the English translations are available at the KTA website: www.kta-gs.de

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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 AtG, in the Radiation Protection Act (StrlSchG) and the Radiation Protection Ordinance (StrlSchV) and further detailed in the Safety Requirements for Nuclear Power Plants (SiAnf) and the SiAnf-Interpretations.

(2) In accordance with SiAnf, Annex 3, protective measures must be provided to counter fires and explosions in a nuclear power plant. Fire protection in Nuclear Power Plants is dealt with in the safety standard series KTA 2101 and is, therefore, not within the scope of the present safety standard.

(3) The present safety standard presumes that the German Industrial Safety Ordinance (BetrSichV) and the Hazardous Substances Ordinance (GefStoffV) together with the associated technical standards (TRBS and TRGS) are observed. Furthermore, it is assumed that the regulations of the German Social Accident Insurance (DGUV), and that standard DIN EN IEC 60079-10-1 as well as other regulations under public law are observed. Detailed information on the zone-classification of potentially explosive areas are contained in the collection of examples of standard DGUV 113-001. Exceptions are admissible in well-founded cases.

(4) To meet the objectives of explosion protection in nuclear power plants with light water reactors, the present safety standard specifies such explosion protection measures that will help to sustain the safety-related tasks of plant components including the structural components under consideration that the precautionary measures under para. (2) are taken. In this context, technical and administrative measures are specified. The extent and quality of these measures as well as the associated inspection effort are dependent on the importance of the explosion protection with regard to achieving the protective goals and radiological safety goals in accordance with SiAnf, Secs. 2.3 and 2.5.

1 Scope

(1) This safety standard shall be applied to nuclear power reactors with light-water reactors.

(2) It deals with the protection from explosions and their detrimental effects. It shall be applied under all operation phases for the protection of equipment and structural components, the specified normal function of which serve to

- a) safely shut down the reactor and keep it in a shutdown condition,
- b) remove the residual heat, and
- c) prevent a release of radioactive substances.

Note:

By applying this safety standard, the protection of personnel working in the power plant is ensured (cf. Basic Principles, para. (3)).

(3) This safety standard shall be applied to explosion hazards from substances that are able to generate an explosive atmosphere or other explosive mixtures if these substances can be brought to, or penetrate into, the nuclear power plant site or if they can be created inside or outside of buildings on the nuclear power plant site.

(4) This safety standard does not apply to protective measures against explosion hazards that may occur

- a) when handling substances in accordance with SprengG, Sec. 1, para. 1,
- b) when releasing ignitable gases or vapors outside of the nuclear power plant site; excepted are the requirements specified in Section 5 of this safety standard regarding the deployment of gas warning equipment,
- c) due to hydrogen released during a beyond-design-basis accident, or
- d) due to disruptive actions or another interference by third parties that involve explosive materials.

Note:

Details in the context of para. (4) are dealt with in GL SEWD LWR.

2 Definitions

(1) Work place

A work place is a local area designated for a specific work procedure even if more than one person is involved.

(2) Atmosphere, explosive

Explosive atmosphere is an explosive mixture under atmospheric conditions admixed with air. Atmospheric conditions are characterized by an overall pressure between 0.8 bar and 1.1 bar and a mixture temperature between - 20 °C and + 60 °C as well as an oxygen content of no more than 20.95 % by volume.

(3) Atmosphere, dangerously explosive

A dangerously explosive atmosphere is an explosive atmosphere that occurs in such an amount (hazardous amount) that special protective measures are needed to maintain the protection of the safety and health of working personnel or other persons.

(4) Area, potentially explosive

A potentially explosive area is an area in which a dangerously explosive atmosphere can occur. An area in which an explosive atmosphere cannot occur in such amounts that special protective measures would be required is not considered to be a potentially explosive area. Regarding the definition of "potentially explosive areas within zones", cf. GefStoffV and technical standard TRGS 722.

(5) Provision of ignitable gases and flammable liquids

The provision of ignitable gases and flammable liquids means making these materials available for the anticipated task (not for longer than 24 hours) at or near the work place in the required amounts.

Note:

Provision in itself does not comprise the actual storage (cf. Definition (18)). Additional information regarding the term "ignitable" can be found in the European regulation EG 1272/2008.

(6) Explosion

Explosion is a sudden oxidation reaction or decomposition reaction with an increase of temperature, of pressure or of both.

(7) Explosion protection

Explosion protection comprises all measures taken for the protection from the hazards caused by explosions.

(8) Explosion protection, structural

Structural explosion protection comprises structural measures that limit the effects of an explosion to an extent that they can be considered as harmless (cf. GefStoffV, Sec. 11, TRGS 724).

(9) Liquids, flammable

Flammable liquids – for the purpose of the present safety standard – are all liquids with a flash point lower or equal to 100 °C; these include, especially, ignitable, highly ignitable, or extremely ignitable liquids with a flash point lower or equal to 55 °C.

(10) Gases, ignitable

Ignitable gases – for the purpose of the present safety standard – are all gases and gas mixtures that have an explosive range in air near 20 °C and a standard pressure of 1.013 bar and that are marked as Hazard Class 2.2 with hazard warnings H220 or H221 in accordance with CLP-VO EG 1272/2008.

(11) Mixture, explosive

An explosive mixture is a mixture of flammable gases, vapors, mists or dusts in which, after ignition has occurred, the combustion process spreads to the entire unburned mixture.

(12) Mixture, dangerously explosive

A dangerously explosive mixture is an explosive mixture that occurs in such an amount (hazardous amount) that special protective measures are needed to maintain the health and safety of working personnel or other persons. Other explosive mixtures – for the purpose of the present safety standard – are all dangerously explosive mixtures that are not categorized as dangerously explosive atmospheres.

(13) Equipment groups and equipment categories

Equipment groups and equipment categories categorize equipment and protective systems relative to their degree of freedom from ignition sources in accordance with 11thProdSV.

(14) Maintenance

Maintenance encompasses the entirety of measures to maintain and restore the required condition as well as to determine and assess the actual condition.

Note:

Maintenance is subdivided into inspection, servicing, and repairs.

(15) Nuclear power plant site

The nuclear power plant site is the tract of land within corresponding boundaries that belongs to the single-unit or multi-unit nuclear power plant.

Note:

The nuclear power plant site – for the purpose of the present safety standard – extends to all facilities inside the outer security area but not to the generally accessible areas such as information center, outdoor switchyard and parking lots.

(16) Storage depots and storage equipment

Storage depots – for the purpose of the present safety standard – are buildings, areas or rooms inside or outside of the buildings that meet specific requirements regarding the protection of working personnel or other persons and that are intended for storing hazardous substances and that meet the requirements in accordance with technical standard TRGS 510. This also includes storage equipment such as containers or cabinets that meet the requirements in accordance with technical standard TRGS 510 as well as safety cabinets in accordance with technical standard TRGS 510, Appendix 1.

(17) Storage facilities

Storage facilities – for the purpose of the present safety standard – are rooms or areas with the exception of gas stations inside or outside of buildings that are intended for storing stationary or transportable containers for flammable, highly flammable or extremely flammable liquids.

(18) Storing

In accordance with GefStoffV, Sec. 2, para. 6, storing means safe keeping for later (self) use as well as for a disposal to others. Storing includes the provision for transport if the transport does not occur within 24 hours after the provision or on the following workday. If this workday is a Saturday, the period expires at the end of the following workday.

(19) Standard state (regarding volume data of gases)

The volume of gases in the standard state is its volume at 1.013 bar and 0 °C.

3 General Requirements**3.1 Basic Principles of Explosion Protection**

(1) In terms of a graduated approach regarding the safety concept, the explosion protection shall be ensured by measures ranked as follows:

1. Preventing the formation of dangerously explosive mixtures.
2. Avoiding the ignition of dangerously explosive mixtures (avoiding effective ignition sources).
3. Structural design measures for explosion protection (including structural measures), that limit the effects of an explosion to an extent that they can be considered as harmless.

Note:

Basic principles of conventional explosion protection are contained in TRGS 722, TRGS 723 and TRGS 724.

(2) The operator of the nuclear power plant shall, in accordance with GefStoffV, Secs. 6 and 11, perform a risk assessment regarding explosion hazards. If, regarding the requirements of GefStoffV, Secs. 6 and 11, the formation of a dangerously explosive atmosphere cannot be ruled out, the necessary protective measures shall be specified in course of a risk assessment in accordance with BetrSichV, Sec. 3, and an explosion protection document shall be crafted. The explosion hazards shall be assessed in accordance with technical standards TRBS 1111 and TRGS 720 ff. In the case of other dangerously explosive mixtures, the procedure followed shall be analogous to the one described in GefStoffV, particularly its Appendix 1, No. 1.

Note:

The risk assessment and the explosion protection document may be presented as one document.

(3) Substances that can lead to the formation of an explosive atmosphere or other explosive mixtures may only be stored in storage facilities or storage equipment intended for this purpose. Only limited amounts of these substances may be made available outside of these storage facilities and storage equipment. After completion of the work task with these substances, they shall be returned to the storage facilities or storage equipment without delay.