Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 2101.1 (2015-11)

Fire Protection in Nuclear Power Plants
Part 1: Basic Requirements

(Brandschutz in Kernkraftwerken
Teil 1: Grundsätze des Brandschutzes)

The previous version of this safety standard was issued in 2000-12

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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Contents

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 the Federal Gazette (Bundesanzeiger BAnz) of January 8, 2016.
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 and the Radiological Protection Ordinance (StrlSchV) and further detailed in the Safety Requirements for Nuclear Power Plants (SiAnf) and the SiAnf-Interpretations.

(2) The Safety Requirements for Nuclear Power Plants (SiAnf) Appendix 3 “Internal and external events as well as external hazards” states among others that protective measures against fires inside the nuclear power plant must be provided. The basic requirements regarding fire protection measures are detailed in the present safety standard. The fire protection of civil structures (also called “building structures” or “structural components”) is detailed in safety standard KTA 2101.2 and the fire protection of mechanical and electrical components in safety standard KTA 2101.3. All three parts of the safety standard series KTA 2101 must be considered in the planning and execution of fire protection measures. Explosion protection is dealt with in safety standard KTA 2103 and is not subject of the present safety standard.

(3) The following aspects are considered that can influences the occurrence, the propagation and the effects of a fire:

a) fire loads and ignition sources,

b) structural and equipment-related features,

c) possibilities for fire detection and alarms and firefighting.

(4) In this context, corresponding technical and organizational measures are specified. The extent and quality of the measures and the extent of the tests and inspections are determined according to their significance in respect to the fire protection goals specified under Section 1.

(5) The present safety standard is prepared based on the assumption that the building codes, fire protection laws and fire protection regulations of the individual German states (Länder), the German Workplace Ordinance, the German Accident Prevention Regulations (UVV) of the trade unions and other public law regulations are complied with. If the specifics of the nuclear power plant require deviations from laws, ordinances or other public law regulations or from the German Accident Prevention Regulations, then, in each individual case, the particular procedures specified in these regulations regarding deviations and exemptions must be followed.

(6) Certain requirements regarding fire protection are also specified in the following safety standards:

KTA 1201 Requirements for the Operating Manual

KTA 1301.1 Radiation Protection Considerations for Plant Personnel in the Design and Operation of Nuclear Power Plants; Part 1: Design

KTA 1301.2 Radiation Protection Considerations for Plant Personnel in the Design and Operation of Nuclear Power Plants; Part 2: Operation

KTA 1402 Integrated Management Systems for the Safe Operation of Nuclear Power Plants

KTA 1403 Ageing Management in Nuclear Power Plants

KTA 2103 Explosion Protection in Nuclear Power Plants with Light Water Reactors (General and Case-specific Requirements)

KTA 2207 Flood Protection for Nuclear Power Plants

KTA 2501 Structural Waterproofing of Nuclear Power Plants

KTA 3301 Residual Heat Removal Systems of Light Water Reactors

KTA 3403 Cable Penetrations Through the Reactor Containment Vessel

KTA 3501 Reactor Protection System and Monitoring Equipment of the Safety System

KTA 3601 Ventilation Systems in Nuclear Power Plants

KTA 3602 Storage and Handling of Fuel Assemblies and Associated Items in Nuclear Power Plants with Light Water Reactors

KTA 3604 Storage, Handling and Plant-internal Transport of Radioactive Substances in Nuclear Power Plants (with the Exception of Fuel Assemblies)

KTA 3605 Treatment of Radioactively Contaminated Gases in Nuclear Power Plants with Light Water Reactors

KTA 3701 General Requirements for the Electrical Power Supply in Nuclear Power Plants

KTA 3702 Emergency Power Generating Facilities with Diesel Generator Units in Nuclear Power Plants

KTA 3705 Switchgear Facilities, Transformers and Distribution Networks for the Electrical Power Supply of the Safety System in Nuclear Power Plants

KTA 3904 Control Room, Remote Shutdown Station and Local Control Stations in Nuclear Power Plants

(7) Requirements regarding quality assurance are specified in the following safety standards:

KTA 1401 General Requirements Regarding Quality Assurance

KTA 1404 Documentation During the Construction and Operation of Nuclear Power Plants

(8) Requirements regarding alarm facilities and lightning protection facilities are specified in the following safety standards:

KTA 2206 Design of Nuclear Power Plants Against Damaging Effects from Lightning

KTA 3901 Communication Means for Nuclear Power Plants

1 Scope

(1) This safety standard applies to nuclear power plants with light water reactors.

(2) It applies – during building-internal and building-external fires – in all operating phases to

a) the protection of plant components, the function of which are designed and necessary to meet the protective goals and radiological safety goals in accordance with SiAnf, Sec. 2.3 and Sec. 2.5, and which must be maintained, i.e.,

   aa) control of reactivity,

   ab) cooling of fuel assemblies,

   ac) confinement of radioactive materials, and

   ad) limitation of radiation exposure,

   as well as to

b) the protection of personnel working in the plant.

2 Definitions

Note:

Any terms identically defined in the conventional standards (cf. Basic Principles, para. (5)) are not included in the present safety standard.

(1) Acceptance and function test

The acceptance and function test is the testing and assessment of the construction of components and systems including the necessary auxiliary, supply and power systems as well as their functional behavior, these tests being performed within the framework of the accompanying inspections.

(2) Civil structure

A civil structure (also called “structural component” or “building structure”) is a ground-connected structure manufactured from construction products (e.g., building materials, structural elements).

(3) Plant component

A plant component is a structural, mechanical, electrical or process technological or other technical part of a power plant. Synonymous terms: equipment, system.

(4) Plant-internal fire

A plant-internal fire is a fire inside or outside of buildings on the power plant site.

(5) Fire compartment

A fire compartment is the region of the building between outer or inside walls which are designed as fire walls extending over all stories of the building.

(6) Firefighting sub-compartment

Firefighting sub-compartmenst (also called “firefighting sections”) are subsections of fire compartments that, because of an increased fire hazard or for the protection of equipment of the safety system and the emergency system or for the protection of persons are partitioned off by structural elements with a sufficient fire resistance capability such that a fire propagation to, or inadmissible fire effects on, other subsections or separated subsections is prevented.

(7) Fire load density

The fire load density is the sum of the fire loads in a room or a group of rooms divided by the respective floor space.

(8) Fire hazard

A fire hazard is understood to be the possibility of a fire damage without a specific requirement regarding damage extent and probability of occurrence.

(9) Fire hazard analysis (FHA)

A fire hazard analysis is a systematic deterministic analysis for the assessment of a possible threat to the safety of the power plant due to fire as well as of the existing fire protection measures regarding the required protective goals.

(10) Fire Load

The fire load is the combustion energy of combustible materials. It corresponds to the factorial product of mass and calorific value (net combustion heat).

(11) Fire load, protected

A fire load is considered as being protected if it is contained either in a closed system or otherwise enclosed, e.g., in a container. The term “protected fire load” is used exclusively when determining the required fire resistance time of components.

Note:

The determination of the required fire resistance time of structural elements is detailed in Appendix A of safety standard KTA 2101.2. Protected fire loads are further detailed in DIN 18230-1. This term is delimited by the term “encapsulation”, cf. definition (21).

(12) Fire protection, defensive

The defensive fire protection comprises technical firefighting measures for combating dangers to life, health and property caused by a fire.

(13) Fire protection, equipment-related

The equipment-related fire protection comprises components and equipment for fire detection and firefighting, for heat and smoke removal as well the fire protection measures for ventilation systems. The equipment-related fire protection also includes the associated controls and media supplies.

Note:

The equipment-related fire protection measures are not part of the safety system. However, according to the comments relating to the AtSMV (Nuclear Safety Officer and Reporting Ordinance), the fire protection equipment in all structural components containing safety-related systems and components do belong to the other safety-related systems and components.

(14) Fire protection, structural

Structural fire protection comprises building materials and structural elements that, due to their fire behavior and fire resistance prevent the occurrence and propagation of fire and ensure the usability of the rescue routes.

Note:

The structural fire protection measures are not part of the safety system. However, according to the comments relating to the AtSMV (Nuclear Safety Officer and Reporting Ordinance), the fire protection equipment in all civil structures containing safety-related systems and components do belong to the other safety-related systems and components.

(15) Fire protection, operational

The operational fire protection supports the structural and equipment-related fire protection. It serves to prevent the occurrence and propagation of fire and to uphold the usability of the rescue routes, to perform self-help measures in the event of fire and to support the fire department.

(16) Fire protection concept

A fire protection concept is a protective-goal oriented overall assessment of the structural, the equipment-related, the operational and the defensive fire protection measures and their mutual effectiveness.

(17) Equipment

The term “equipment” is considered a synonymous term for “plant component”.

(18) Event

An event is an incident that may impair the safety of a power plant.

Note:

These also include internal and external events in accordance with SiAnf.

(19) Postulated event

A postulated event is an incident that may actuate sequential events and that is used as basis for the safety-related design of a nuclear power plant.

(20) Functional capability

Functional capability is the ability of equipment to perform the prescribed task by performing corresponding mechanical, electrical or other functions. Integrity may be considered as such a function.

(21) Encapsulation

Encapsulation is a measure to protect combustible materials or individual equipment such that, in the event of fire within or outside of the encapsulation, an ignition of the materials is prevented, or the equipment is not inadmissibly damaged by the fire. Depending on the requirements, this measure may be implemented with or without a defined fire resistance time.

Note:

The term “encapsulation” is delimited by the term “protected fire load”, cf. definition (11).

(22) Rescue route

Rescue routes serve to support the self-rescue and emergency rescue of persons. Rescue routes lead from any place in the room into the open or into a protected area. They also serve as fire access routes for the fire department.

(23) Authorized expert

Authorized expert is an expert person or organization consulted in accordance with Atomic Energy Act, Sec. 20, by the licensing or supervisory authority.

(24) Airlock antechamber

An airlock antechamber is a room provided for the protection of persons before the entrance to the personnel airlock (in accordance with safety standard KTA 3402) in the containment vessel of a pressurized water reactor. It is a protected area.

(25) Safety system

The safety system comprises all equipment that have the task of protecting the facility from an inadmissible event and, when a design basis accident occurs, of keeping the effects on the facility, on the environment and on the plant personnel within specified limits.

(26) System

The term “system” is considered a synonymous term for “plant component”.

(27) Design review

Design review is the assessment of the original or changed documents prepared for manufacturing (e.g., plans, written instructions, drawings, calculations or proofs) with regard to their fulfilling legal directives and the requirements specified in standards.

(26) Ignition Sources

An ignition sources is a permanently or temporarily available possibility in an area of the plant which could release the amount of ignition energy required to ignite the existing combustible material.

(27) Random Failure

The random failure is a failure which occurs statistically independent of failures of other similar equipment.

3 Basic Requirements

3.1 General Requirements

(1) It shall be ensured that the fire protection goals specified under Section 1 are not endangered by plant-internal fires and their subsequent effects. This requires providing the following fire protection measures:

a) structural fire protection measures,

b) equipment-related fire protection measures,

c) operation fire protection measures, and

d) defensive fire protection measures.

These fire protection measures shall be specified and documented in a graduated fire protection concept as specified under Section 3.5

(2) To prevent the occurrence and propagation of a fire, fire loads and potential ignition sources shall be reduced to the minimum necessary for the safe operation (as a fire prevention measure).

(3) In this context, unavoidable fire loads shall

a) be – as far as this is structurally and operationally possible for the respective equipment – physically separated from unavoidable potential ignition sources such that a combustion of these fire loads is prevented,

b) be physically separated such that persons present in secured areas (e.g., necessary staircases or airlock antechambers) are not endangered.

c) basically, be physically separated such that the safety system and the emergency system cannot be inadmissibly affected. If such a physical separation is not possible due to system-technological or usage-related requirements, other fire protection measures with an equivalent level of protection shall be provided.

(4) In case of the presence of unavoidable fire loads that cannot be encapsulated, measures shall normally be taken to minimize smoke development (e.g., proper choice of materials).

(5) With regard to the fire hazard analysis specified under para. (8), data shall be gathered on the fire load in each compartment. These data may neglect the fire loads from permanently installed floorings, decontaminable coatings and fire protection coatings as well as negligible fire loads (e.g., flange gaskets, identification labels, paint coatings of technological components). In addition, potential ignition sources shall be identified (e.g., hot components, open switch gear).

(6) Protected fire loads shall be indicated separately in the fire hazard analysis specified under para. (8).

(7) The fire protection measures shall fulfill the requirements specified under Section 3.4 under consideration of the design principles specified under Section 3.2.

(8) A fire hazard analysis (FHA) shall be performed as specified under Section 3.6.

3.2 Design Principles

3.2.1 Fire loads

(1) Basically, only non-combustible building materials shall be used. Exempted are combustible building materials that are unavoidable for reasons of their technical purpose.

(2) Unavoidable combustible building materials shall basically be flame retardant. Exempted are “normally flammable” building materials that are unavoidable for reasons of their technical purpose.

(3) With regard to limiting the flammability, the decontaminable coatings and fire protection coatings shall at least meet the requirements of the “normally flammable” building material class.

(4) Basically, only non-combustible materials shall be used. Exempted are combustible materials that are unavoidable for reasons of their technical purpose.

Note:

Unavoidable combustible materials that are considered to be negligible fire loads are, e.g., flange gaskets, identification labels, paint coatings of technological components.

(5) In their fabricated state, the fire behavior of combustible materials should be comparable to flame retardant building materials.

(6) Inside the containment of light water reactors only such insulation materials of cables shall basically be used that would counteract rapid fire propagation and that, in the event of fire, do not release any corrosive combustion gases. Exemptions are admissible where special electrical requirements (e.g., measurement cables) or special mechanical requirements (e.g., flexibility) must be met. In the case of large assemblies of cables inside the containment that do not have the above characteristics, additional fire protection measures shall be provided.

(7) Basically, only non-combustible operating materials shall be used. Exempted are control fluids and lubricating materials as well as other combustible operating materials that are unavoidable for reasons of their technical purpose.

3.2.2 Occurrence of fire

(1) An ignition of the existing fire loads shall basically be taken into consideration. Exempted are encapsulated fire loads, provided, it is demonstrated that the encapsulation remains functional in the event of fire and the combinations specified under Section 3.3.

Note:

The assumption of the ignition of combustible materials serves to determine the maximum fire effects and, in turn, to determine the required fire resistance time of enclosing structural elements of fire compartment and firefighting sub-compartments. This assumption is not a boundary condition for the fire-development related accident analyses.

(2) Also exempted from the assumption under para. (1) are the combinations under Section 3.3, provided, plausibility considerations show that the combustible material cannot be ignited by the potential ignition sources.

(3) No fires need to be assumed within areas rendered inert, e.g., inerted BWR containment. The conditions of the de-inerting phase shall be considered.

3.2.3 Fire effects

(1) If the function (including equipment-related fire protection) of plant components or parts of civil structures is required even in the event of fire, the fire effects may be demonstrated based on suitable analytic or experimental procedures or based on analogy or plausibility considerations.

(2) The following fire effects shall be considered:

a) heat development in the fire area,

b) heat development outside of the fire area,

c) development and spreading of smoke,

d) flying sparks, burning droplets, and

e) increasing pressure in the fire area.

(3) The proof of fire effects shall at least take the following boundary conditions into consideration:

a) fire loads (even the protected fire loads or taking encapsulation into account),

b) area geometry and type of structural elements,

c) heat sinks and heat sources,

d) ventilation conditions, and

e) possibilities for fire detection and alarms and firefighting under consideration of the sequential development of the fire.

3.2.4 Fire during operating phases with a shutdown reactor

(1) The fire protection measures shall be reviewed with regard to whether they need to be modified or supplemented during this plant condition (modified requirements regarding functionality of safety equipment, additional combustible materials or a change of their location, possible ignition sources during repair work, changed number of personnel).

(2) The additional fire loads usually present during operating phases with a shutdown reactor shall be taken into consideration in selecting the fire protection measures and in performing the fire hazard analysis as specified under Section 3.6.

3.3 Combination of a fire with another event

3.3.1 General requirements

(1) Combinations of a fire with another event shall be assumed if the combined events are in causal relationship or if the simultaneousness of the events must be taken into consideration based on the occurrence probability and extent of damage.

(2) Combinations of a fire with another event shall be considered exclusively with respect to achieving the fire-protection goal specified under Section 1 para. (2) item a). Fire protection measures shall be provided for the considered combinations unless it can be shown that effective and reliable preventive measures have already been installed.

Note:

This requirement details the damage extent indicated above under para. 3.3.1 (1).

(3) It is necessary to distinguish between the following combination types:

a) Combination of causally related events:

   aa) Fire and a subsequent event, and

   bb) Postulated event and a subsequent fire

b) Combination of causally unrelated events:
   Postulated event and causally unrelated fire.

3.3.2 Combination of causally related events

3.3.2.1 Fire and a subsequent event

(1) The following combinations of a fire with a subsequent event shall be considered:

a) Fire and the subsequent failure of components:

aa) Failure (including a high-energy failure) of electrical components and equipment.

ab) Failure of mechanical components (e.g., fast rotating parts, prestressed springs).

ac) Failure (including a high-energy failure) of pressurized pipes and pressure vessels, the inherent failure of which cannot be ruled out.

aca) In the case of pressure vessels, pressurized components and plant components, the inherent failure of which can be ruled out because their quality characteristics, or the failure type of which is limited, measures shall be taken to prevent a fire near these vessels or plant components, or protective measures against the effects from fire events shall be installed, or it shall be demonstrated that, in the event of fire, those quality characteristics ruling out a failure or limiting a failure type are not inadmissibly impaired.

Note:

Such pressure vessels and pressurized components in pressurized water reactors are, e.g., reactor pressure vessel, steam generator, pressurizer, main coolant pumps and accumulators, and, in boiling water reactors, the reactor pressure vessel and the fast shutdown (scram) vessel. The respective plant components are, e.g., the containment, safety-related supports and structural plant components as well as the fuel pool for spent fuel assemblies. Such quality characteristics may be, e.g., utilization of the maximum stress. Limiting a failure type is achieved by, e.g., the basic-safety design in accordance with SiAnf.

acb) In the case of pressure vessels, pressurized components and plant components the inherent failure of which cannot be ruled out, basically, measures shall be taken either to prevent a fire, or to protect these pressure vessels, pressurized components and plant components against the effects from fire events. Alternatively, measures may be provided for the protection of the safety system against the simultaneous effect of a fire and the resultant events from the pressure vessels, pressurized components and plant components caused by the fire.

b) Fire and a resultant plant-internal explosion including radiolysis gas reactions in systems and components.

3.3.2.2 Postulated event and a resultant fire

The following combinations of a postulated event with a resultant fire shall be considered:

a) Component failures and a subsequent fire:

aa) High-energy failures (e.g., electric arcs) of electrical components and equipment (e.g., switch yards, transformers and high-voltage cables).

ab) High-energy failures of mechanical components (e.g., fast rotating parts, prestressed springs).

ac) High-energy failures of pressurized pipes and pressure vessels, the inherent failure of which cannot be ruled out. In this context, if steam is released no occurrence of a fire needs to be postulated.

b) Plant-internal explosion and a subsequent fire:

A plant-internal explosion, the subsequent fire of which inadmissibly affects safety functions shall be prevented. The prevention of safety functions being inadmissibly affected is considered achieved if the requirements in accordance with safety standard KTA 2103 are met.

c) Earthquakes and a subsequent fire:

ca) Inside civil structures which, because of their safety-related significance, shall be designed against earthquakes in accordance with KTA 2201.1, it shall be ensured that effects of a fire resulting from the earthquake are limited to such a degree that the specified normal functions of safety equipment are not inadmissibly affected. This requirement is considered as met if the equipment which, on losing integrity would release combustible materials or could cause ignition, are designed to resist the design-basis earthquake by choosing suitable materials and a proper mechanical design. If a fire cannot be excluded, structure-related fire protection measures shall be installed to ensure the individual safety functions required after an earthquake. If this is not possible due to system-technological or usage-related requirements, an equivalent protection level shall be ensured by the installation of equipment-related fire protection measures (e.g., a fire detection and alarm system) or by a combination of these measures.
The aforementioned structural and equipment-related fire protection measures themselves shall be designed against the design-basis earthquake by choosing suitable materials and a proper mechanical design. Due to the short strong-quake duration in Germany it may be presumed that a subsequent fire will only become effective after the earthquake has subsided.

cb) Insofar as the plant has been designed for a design-basis earthquake with a maximum intensity, I, of VI on the EMS-98 scale (European Macroseismic Scale), it may be assumed that the structural and equipment-related fire protection measures will be available even without sustaining the special design measures.

d) Lightning effects and subsequent fire:
A fire resulting from lightning effects which inadmissibly affects safety functions shall be prevented. The prevention of safety functions being inadmissibly affected is considered achieved if the requirements in accordance with safety standard KTA 2206 are fulfilled.

3.3.3 Combination of unrelated events

(1) Basically, no measures need to be provided for the combination of a presumed fire and the occurrence of an unrelated event.

Note:

This requirement is based on the assumption that

a) the probability of occurrence of such combinations is less than 1×10^{-5} per year,

b) such combinations are prevented by suitable precautionary measures, or

c) the unrelated event will not inadmissibly affect the fire prevention measures.

(2) Measures do have to be provided for the combination of a presumed fire with one of the following presumed events:

a) plant-internal flooding,

b) plant-internal or external electromagnetic events (except lightning),

c) earthquakes (including subsequent effects),

d) flood (high water), or

e) additional site-specific external events.

(3) Within one week from the occurrence of an event specified under para. (2), the fire protection measures necessary for achieving the fire protection goal specified under Section 1, para. (2), item a), in case of such a combination shall

either be again made available or shall be replaced by other suitable measures.

Note:

By observing the waiting period of one week, the probability of occurrence of the combination fire with the events specified under para. (2) is reduced to less than 1×10^{-5} per year.

(4) It is a valid presumption for the combination of a fire with an event specified under para. (2) above, that the measures specified under para. (3) can be provided within one week.

3.4 Requirements for Fire Protection Measures

3.4.1 General requirements

(1) Structural fire protection measures shall be given priority over equipment-related fire protection measures. If the structural measures cannot be provided to the extent that, in the event of fire, the required protection is ensured, additional equipment-related measures shall be provided regarding the early fire detection and alarms (e.g., installation of fire detectors), firefighting (e.g., installation of stationary fire extinguishing systems), or heat and smoke removal.

(2) Structural and equipment-related fire protection measures shall be designed such that, in the event of fire, their function required is ensured despite the fire effects specified under Section 3.2.3.

(3) With respect to the combinations specified under Section 3.3 it shall be checked how far the other event may inadmissibly affect the required functions of the structural and equipment-related fire protection measures and, thus, make it necessary to provide further measures.

(4) If for safety-related reasons additional requirements have to be met by the structural or equipment-related fire protection measures (e.g., radiation protection requirements), then the fire protection functions shall be assessed also regarding these additional requirements (e.g., sufficient shielding).

(5) The fire protection measures described in the fire protection concept shall be realized in a professional way and shall permanently remain functional. In the case of modification of the plant the retroactive effects on the fire protection measures shall be considered.

Note:

Requirements regarding accompanying inspections are dealt with in Section 7.3 and regarding inservice inspections in Section 7.4.

3.4.2 Requirements for rescue routes

(1) Rescue routes shall be established inside the buildings.

(2) The rescue routes shall be protected against effects from fire events such that they can be used sufficiently long for self-rescue and the rescue of other persons, and that they can be used for required safety-related manual actions by the personnel.

(3) Equipment and measures regarding early fire detection and fire alarms as well as for issuing of escape or evacuation orders shall be provided such that, in the event of fire, persons can reach a protected area or escape into the open and that persons can be rescued from outside.

Note:

Requirements for alarm equipment are detailed in safety standard KTA 3901.

3.4.3 Requirements concerning equipment of the safety system and of the emergency system

(1) All equipment necessary to achieve the goals specified under Section 1 para. (2) item a) subitems aa) through ad) shall be designed to be able to fulfill their required safety-related tasks even in the event of fire.

Note:

Whether a plant shutdown becomes necessary after a fire-related failure of safety system equipment is not within the scope of the present safety standard.

(2) It shall basically be ensured that, in the event of fire in one redundancy, all redundants in the other redundancies remain functional. If this is not possible due to system-technological or usage-related requirements, a failure of redundants due to the fire in the not from the fire affected redundancies is admissible, provided, achievement of the goals specified under Section 1, para. (2), item a), subitems aa) through ad), is ensured with the remaining safety functions.

Note:

The terms “redundancy” and “redundants” are defined in SiAnf.

(3) The failure of non-redundant equipment caused by fire is admissible, provided, achievement of the goals specified under Section 1, para. (2), item a), subitems aa) through ad), is ensured with the remaining safety functions.

(4) The anchors and supports of components of the safety system or components of the emergency system and components, the fire-related failure of which would lead to an inadmissible impairment of safety system equipment as specified under para. (1) shall be designed or protected considering the expected fire effects specified under Section 3.2.3.

(5) The entirety of fire protection measures shall ensure that the fire protection goal specified under Section 1, para. (2), item a), is achieved in the event of fire even in case of a random failure of a single structural or equipment-related fire protection measure.

(6) If the measures specified in safety standards KTA 2101.2 and KTA 2101.3 are observed, no random failure (single failure) within an individual fire protection measure needs to be assumed in the fire protection design.

(7) Regarding the combinations specified under Section 3.3, no random failure of structural or equipment-related fire protection measures needs to be assumed.

(8) If the performance of safety-related tasks of the equipment of the safety system or the emergency system requires particularly important fire protection measures, the reliability of these fire protection measures shall be ensured by extraordinary measures to be specified in each individual case. The particular importance of the individual fire protection measures and the resulting reliability requirements shall be determined.

Note:

These particularly fire protection measures are, e.g., extended tests, stationary fire extinguishing systems instead of manual firefighting, automatic instead of manual actuation of the fire extinguishing systems.

3.5 Fire Protection Concept

3.5.1 General requirements

A fire protection concept shall be drawn up and documented. Any modifications of the plant shall be assessed regarding their retroactive effect on the actual fire protection concept, and the fire protection concept shall be updated accordingly.

3.5.2 Objective and extent

(1) The fire protection concept shall comprise all individual measures within the framework of the structural or equipment-related fire protection as well as of the defensive and operational fire protection. In this context, the individual fire protection measures and their interaction shall be described

and as far as necessary demonstrated with regard to achieving the fire protection goals specified under Section 1.

Note:

An exemplary structure of a fire protection concept is presented in Appendix B (informative).

(2) The following shall be considered in the fire protection concept:

a) its utilization,

b) the fire hazard,

c) the possible extent of damage due to fire,

d) the possible combinations specified under Section 3.3, and

e) all operating phases.

3.6 Fire Hazard Analysis

3.6.1 General requirements

To check whether the fire protection goal specified under Section 1, para. (2), item a), is achieved considering the measures described in the fire protection concept, and whether the design principles specified under Section 3.2 are observed, a fire hazard analysis shall be drawn up and documented. The fire hazard analysis shall be kept up-to-date.

3.6.2 Extent

(1) The fire hazard analysis shall contain adaptions regarding the respective operating phases.

(2) In the fire hazard analysis, it shall be presumed that a fire will occur wherever combustible materials are temporarily or permanently stored and the ignition of which is possible.

(3) It may be assumed that only one fire at a time will occur.

(4) For each fire assumed, the fire hazard analysis shall also consider the possibilities for fire propagation.

(5) The combinations specified under Section 3.3 shall be considered.

4 Structural Fire Protection

4.1 General Requirements

The structural fire protection measures include, e.g.,

a) utilization of non-combustible or, at least, flame retardant building materials (cf. Section 3.2.1),

b) design regarding the fire resistance capability of structural elements,

c) construction of fire compartments and firefighting sub-compartments,

d) encapsulation (cf. Section 3.2.2), and

e) establishment of rescue routes (cf. Section 3.4.2),

Note:

Detailed requirements concerning these points are specified in safety standard KTA 2101.2.

4.2 Fire Behavior of Structural Elements

(1) Supporting, strengthening and enclosing structural elements of sections with space-enclosing functions shall be designed regarding their sufficient fire resistance capability such that, in case of demand, their failure due to fire does not need to be assumed.

(2) The sufficient fire resistance capability shall be demonstrated for the fire effects to be presumed as specified under Section 3.2.3.

(3) Regarding the combinations specified under Section 3.3, it shall be checked in how far it is possible that the other events can inadmissibly impair the required function of the respective structural fire protection measures and, therefore, necessitate that additional measures are taken.

4.3 Fire Protective Physical Separation

(1) The individual civil structures shall be constructed as fire compartments from structural elements with a sufficient fire resistance capability, or they shall be physically separated from each other by a sufficient distance to counteract a propagation of fire.

(2) Regarding necessary openings in the outer walls, it shall be ensured that a propagation of fire from one fire compartment to another is prevented. Appropriate protective measures shall be specified for each individual case.

(3) On-site fire loads outside of buildings shall be separated from the civil structures by structural elements with a sufficient fire resistance capability, or they shall be separated from each other by a sufficient distance.

(4) The distances between civil structures or the distances between fire loads outside of the civil structures are considered to be sufficient if a propagation of fire due to the fire effects specified under Section 3.2.3 is not to be expected.

(5) Provided, the requirements regarding a fuel fire from a plane crash in accordance with SiAnf, Appendix 3, are fulfilled, no further measures are required regarding building-external fires in connection with the combinations specified under Section 3.3.

(6) The inside of civil structures shall basically be designed in the form of fire compartments. If system-technological or usage-related requirements either make it necessary to go beyond the fire compartment size basically prescribed by the building code or make it impossible for individual structural elements to fully meet the fire protection requirements approved by the building inspection, then, to achieve comparable protection conditions, additional fire protection measures as specified under Sections 5 or 6 shall be provided.

Note:

Typical examples for these exceptions are the reactor building, reactor auxiliary building, turbine building of boiling water reactors, nuclear services building.

(7) The individual fire compartments shall basically be subdivided as single-story firefighting sub-compartments by structural elements with a sufficient fire resistance capability. In case, due to system-technological or usage-related requirements, it is necessary to construct multi-story firefighting sub-compartments, then, to achieve comparable protection conditions, additional fire protection measures as specified under Sections 5 or 6 shall be provided.

(8) Penetrations of cable installations as well as openings in enclosing structural elements between fire compartments and firefighting sub-compartments shall basically be partitioned off with a sufficient fire resistance capability. The fire resistance capability of the fire shields shall correspond to the fire resistance of the separating structural elements. It is admissible that in the event of fire the openings close automatically or that the closures are opened up for the duration of pressure equalization. In case, due to system-technological or usage-related requirements (e.g., pressure equalization openings), it is not possible to install such partitions, then additional fire protection measure shall be provided as specified

under Sections 5 and 6 to achieve comparable protection conditions.

(9) Compartment areas with considerable fire loads (e.g. large assemblies of cables in cable compartments, fuel storage compartments for the emergency power diesel generator) shall basically be physically separated by structural elements with a sufficient fire resistance capability. In case, due to system-technological or usage-related requirements, a physical separation is not possible, then, to achieve comparable protection conditions, additional fire protection measures as specified under Sections 5 or 6 shall be provided.

(10) Redundant equipment of the safety system or redundant emergency systems shall basically be physically separated by structural elements with a sufficient fire resistance capability such that the requirements specified under Section 3.4.3, para. (2), are met. In case, due to system-technological or usage-related requirements, this is not possible then other suitable fire protection measure shall be provided to achieve a comparable protection condition (e.g., physical separation by sufficient distance, encapsulation, function-sustaining cable systems, fire extinguishing systems, or a combination of these measures).

(11) If a fire protective physical separation is the only measure ensuring the functional capability of the safety system equipment in the event of fire, then the room isolation (including stability) by the necessary structural elements shall be demonstrated considering the fire effects specified under Section 3.2.3 as well as the additional requirements stemming from the analyses of the combinations specified under Section 3.3.

N o t e :

Aside from the ceilings and walls, the necessary structural elements also include fire shields and the closing elements for the openings in these structural elements.

5 Equipment-Related Fire Protection

5.1 General Requirements

(1) The equipment-related fire protection measures include

a) equipment for fire detection, fire signaling and fire alarms,

b) firefighting equipment, and

c) ventilation systems and equipment for heat and smoke removal.

(2) In context with the equipment-related fire protection measures including their triggering and actuation, the freedom from retroaction with required safety functions shall be ensured even considering the combinations specified under Section 3.3.

(3) If firefighting measures are required to ensure functional capability of the equipment of the safety system and the emergency system in the event of fire, the functional capability of the required equipment-related fire protection measures shall be demonstrated considering the fire effects specified under Section 3.2.3 and the requirements specified under Section 3.3.

5.2 Equipment for Fire Detection, Fire Signaling and Fire Alarms

(1) A fire detection and alarm system (also called “fire alarm facility”) shall be provided regarding early fire detection and fire signaling. The number and location of the fire detectors shall be chosen taking the following aspects into account:

a) fire load density,

b) location of combustible material in the rooms,

c) fire behavior of the combustible material (flame propagation and smoke development),

d) room geometry and ventilation conditions,

e) safety-related importance of the monitored systems and components,

f) protection of personnel (ensuring their rescue), and

g) criteria for actuating the fire protection equipment.

(2) The fire detection and alarm system shall normally ensure localizing the fire and shall normally ensure a corresponding display at the local fire detection centers (also called “local fire alarm centers”).

(3) The necessary display and control equipment for the fire detection and alarm system shall be installed in the control room. At least one group annunciation of the fire detection and alarm system shall be installed in the control room within the visual range of the personnel.

(4) Regarding fire detection and alarm systems in civil structures that also contain equipment of the emergency system, optical and acoustical group alarms for fires and for failures of the fire detection and alarm system shall additionally be installed in the remote shutdown station.

(5) Equipment and measures shall be provided regarding the alarming in the event of fire.

N o t e :

Requirements for alarm equipment are detailed in safety standard KTA 3901.

(6) It is admissible to manually trip the equipment for alarming in the event of fire. In this case, one actuation point shall be located in the control room.

5.3 Firefighting Equipment

5.3.1 Firefighting water supply

(1) An amply dimensioned firefighting water main loop system shall be installed for the supply of firefighting water to the hydrants and to the wall hydrants in civil structures as well as to the stationary water-based fire extinguishing systems.

(2) Regarding the firefighting water supply, either a natural source of water such as rivers, streams, lakes, or an artificial source of water such as firefighting water ponds, water wells or vessels with sufficient quantities of water shall be available.

(3) Hydrants or wall hydrants shall be located such that a fire on the plant site or in the civil structures can be manually combatted.

(4) All civil structures accommodating equipment of the safety system or of the emergency system shall be provided with wet firefighting water mains. It shall be ensured that, in the case of water release due to a loss of integrity of such mains, the required functional capability of the equipment of the safety system or of the emergency system is retained.

(5) Redundant pumps with an emergency power backup or a net-independent power supply and a pressurizing system shall be provided for the firefighting water supply system. The fire pumps shall be spatially separated (by a sufficient distance) or shall be protected such that the failure of an individual pump or an individual supply line to the firefighting water main loop system will not lead to a failure of the required water flow rate in case of demand.

(6) In case of pressure loss in the firefighting water system, the firewater pumps shall be switched on line automatically. It shall be possible to monitor and operate the pumps from the control room. It shall normally only be possible to manually switch off the pumps.

(7) It shall be possible to reopen the containment vessel penetration valves of the firefighting water supply system after their closure was triggered by the reactor protection system.

(8) Any equipment and auxiliary means shall be kept available that are required for setting up an additional firefighting water supply (e.g., to feed water into the firefighting water main loop system or into civil structures).

5.3.2 Fire extinguishing systems

(1) In the case of existing fire loads that can lead to any inadmissible fire effects as specified under Section 3.2.3 (e.g., effects on enclosing structural elements, on equipment of the safety system or the emergency system), stationary fire extinguishing systems shall be installed, or equivalent fire protection measures shall be provided.

(2) Stationary fire extinguishing systems shall also be installed wherever manual firefighting would lead to an inadmissible endangerment of the firefighting personnel due to difficult accessibility, high local dose rates or insufficient smoke removal.

(3) In the case of cables with insulating materials to counteract fire propagation and that in the event of fire do not emit any corrosive fire gases and in case of encapsulated cables and cable ways that in the event of fire are not required to continue functioning, it shall be demonstrated in the individual case whether stationary fire extinguishing systems may be dispensed with.

(4) Stationary fire extinguishing systems shall basically be triggered automatically. Remotely controlled or on-site manually triggered fire extinguishing systems are admissible, provided, the possible fire effects specified under Section 3.2.3 can be kept under control up to the moment when these fire extinguishing systems become effective.

(5) When assessing an automatic actuation, the disadvantages of erroneous actuation shall be taken into consideration (e.g., failure of safety-related equipment, erroneous triggering in case of steam leakage, contamination of the firefighting water and the effects of the fire extinguishing agent on parts with high surface temperatures.

(6) In case massive quantities of water during the fire extinguishing procedure must be accounted for (e.g. in the case of spray-water extinguishing systems), possibilities for removing the water, if necessary by means of mobile pumps, shall be available. Firefighting water from the controlled area shall basically be discharged only under controlled conditions and after a detailed assessment of its radioactivity. Exceptions are permissible in the case of temporarily established controlled areas, provided, no release of radioactive substances is to be expected.

5.4 Ventilation Systems and Equipment for Heat and Smoke Removal

5.4.1 General requirements

(1) With regard to fire, the ventilation systems shall meet the requirements specified in safety standard KTA 3601 and, as far as necessary to achieve the fire protection goals specified in Section 1, shall also meet requirements regarding

a) preventing the spreading of smoke and radioactivity,
b) continuing a possibly necessary ventilation of non-affected redundancies,
c) preventing smoke accumulation in necessary staircases and airlock antechambers,
d) allowing a manual firefighting, and
e) removing of smoke and heat.

N o t e :

These ventilation systems are as itemized below or consist of a combination thereof:

a) operational ventilation systems, i.e.,
   aa) facilities for the operational heat removal in areas not affected by the fire,
   ab) facilities for sustaining a sub-atmospheric pressure,
   ac) facilities for ventilating the control room and the remote shutdown station, and
   ad) facilities for the removal of heat transmitted from neighboring redundant regions in the event of fire.
b) heat and smoke removal systems, and
c) facilities for the prevention of smoke accumulation in necessary staircases.

(2) Ventilation systems that are intended to be used in the event of fire, shall be designed such that equipment of the safety system and of the emergency system are not inadmissibly affected and persons are not endangered by the fire.

5.4.2 Requirements for ventilation systems

(1) When designing ventilation systems, the following points shall be taken into consideration:

a) radiation protection issues (e.g., sustaining sub-atmospheric pressure during accidents, preventing the spreading of radioactivity), and
b) sustaining the functional capability of the safety system and of the emergency systems.

(2) In the event of fire, a spreading of smoke and radioactivity into non-affected areas shall be prevented.

(3) In the case of redundant equipment of the safety system or of the emergency system, the redundancies of which are separated from each other by structure-related fire protection measures, the associated ventilation systems shall be arranged and constructed such that a fire of one redundancy does not affect the functionality of the other redundant equipment.

(4) The air supply to the control room and the remote shutdown station shall be ensured even in the case of a fire in directly adjacent fire sub-compartments. This does not apply to a fire in a ventilation system itself that supplies the control room or the remote shutdown station.

N o t e :

In the event of a fire in this ventilation system, a continued operation of the control room and remote shutdown station can be ensured by manual means.

(5) The ventilation equipment for ensuring a secure containment (e.g., quick-closing valves in the containment vessel) should be located and protected such that even in the event of fire it will be possible to close one valve in each of the ventilation ducts.

N o t e :

In this context, it does not need to be presumed that simultaneous fires occur both inside and outside of the containment vessel.

(6) Any penetration of smoke and hot fumes from a fire through the ventilation systems into the individual civil structures that house equipment of the safety system or the emergency systems shall be prevented.

5.4.3 Equipment for heat and smoke removal

5.4.3.1 Equipment for heat and smoke removal from civil structures outside of the controlled area

Measures for the heat and smoke removal or equivalent measures shall be provided for civil structures outside of the controlled area wherever fire loads are present that can lead

to inadmissible fire effects (e.g., on enclosing structural elements or on equipment of the safety system) as specified under Section 3.2.3.

5.4.3.2 Equipment for heat and smoke removal from civil structures within the controlled area

(1) A smoke removal from civil structures within the controlled area is basically admissible, provided, this is necessary for firefighting and to rescue people and it is carried out via the paths designated for the discharge of radioactive substances during specified normal operation.

Note:

A large-volume smoke removal from within the reactor building is not feasible regarding the control and mitigation of a loss-of coolant accident.

(2) A heat and smoke removal via other than the specified normal operation discharge paths (e.g. via the smoke and heat dissipation dampers to the outside) from those areas which are separated from the controlled area regarding fire protection and ventilation (e.g., necessary staircases) as well as from the turbine building (of a BWR) is admissible, provided, these areas have been demonstrated to be radiologically irrelevant.

5.4.3.3 Keeping necessary staircases or airlock antechambers free of smoke

In the event of fire, the necessary staircases and airlock antechambers shall be kept at low smoke levels.

Note:

It may become necessary, within the reactor building, that the ventilation must be switched off for safety-related reasons and that as a result the necessary staircases or airlock antechambers cannot be kept entirely clear of smoke.

5.5 Displays and Controls of Equipment Relevant to Fire Protection

(1) The remote controls and displays for the feedback and malfunction signals of equipment relevant to fire protection (e.g., position signals of the fire dampers, operation of ventilation systems with fire protection functions, of equipment relevant to fire protection and fire extinguishing systems), shall be installed in the control room and to the necessary extent in the remote shutdown station, unless superordinate requirements call for their installation in separate local control stations. At least one optical and one acoustical group alarm of each individual fire-protection equipment shall be installed in the control room.

Note:

Equipment-related reasons (e.g., ventilation technology, flooding, pressure equalization) may lead to additional requirements regarding feedback signals.

(2) The displays and signals of process-technological systems and components that monitor the function of systems and component and, additionally, fulfill fire-protection tasks (e.g., monitoring the bearing temperature of pumps or motors, leakage monitoring, Buchholz relays) shall be correlated to the monitoring equipment of these systems and components considering process-technological aspects.

6 Operational Fire Protection Measures and Defensive Fire Protection

6.1 General Requirements

(1) Operational fire protection measures shall be taken that counteract any development of fires.

Note:

Requirements in this context are specified under Sections 3.1 and 3.2.

(2) By regulating the responsibilities as well as by creating suitable operating documents proper measures shall be provided such that, in the event of fire, timely and goal-oriented defensive measures can be triggered and can be performed.

(3) Suitable precautions and measures regarding defensive fire protection shall be taken that are necessary regarding firefighting as well as regarding the control and mitigation of the fire effects specified under Section 3.2.3.

6.2 Operational Fire Protection

6.2.1 Fire protection officer

(1) In each nuclear power plant one suitably trained person shall be appointed as fire protection officer. Organizationally, this person shall have the right to report directly to the plant management.

(2) The duties of this person shall, particularly, include the supervision regarding compliance with fire prevention measures, e.g., with regard to storage of combustible materials or the execution of welding tasks. In addition, the fire protection officer shall take part in the regular fire drills and participate in the creation and regular review of

a) the fire protection concept specified under Section 3.5,
b) the plant-internal fire protection regulation specified under Section 6.2.2,
c) the fire protection plans specified under Section 6.2.3, and
d) the deployment plans for the fire department specified under Section 6.2.4.

(3) The fire protection officer shall be enabled to acquire the initial and continued training required for the respective tasks under consideration of the plant-operational issues.

6.2.2 Plant-internal fire protection regulation

A plant-internal fire protection regulation shall be drawn up as part of the operating manual in accordance with safety standard KTA 1201 specifying the measures for fire prevention and firefighting as well as the substitute measures in situations where the structural and equipment-related fire protection measures are not available; also included shall be regulations regarding conduct of personnel in the event of fire.

6.2.3 Fire protection plans

(1) Fire protection plans shall be drawn up that shall contain at least the following information:

a) space usage and fire-protection-related partitions,
b) areas monitored by automatic fire detectors,
c) areas where stationary fire extinguishing systems are installed,
d) areas for which heat and smoke removal equipment are available,
e) arrangement of rescue routes, and
f) locations of respirators intended for self-rescue and the rescue of others.

(2) The fire protection plans shall be kept up-to-date.

6.2.4 Deployment plans for the fire department

(1) Regarding orientation and situation assessment in the event of fire, the plant fire brigade specified under Section 6.3.1 together with the authorized public bodies shall establish plans for the deployment of the fire department that

shall detail the plant site and civil structures. These plans shall include at least the following information that is necessary for the tactical maneuvers by the fire department.

(2) The general layout plan of the plant site shall show at least

a) the location of the civil structures together with their plant-specific names and their number of floor levels,
b) the connection of the plant site to public traffic areas as well as the public traffic areas directly adjoining the plant site,
c) the access roads including barriers, streets and road ways on the site, the staging and free movement areas for the fire department, the no-entry areas, the route restrictions and the fenced-in areas,
d) the firefighting water supply locations (e.g., hydrants, vessels, open water bodies) together with their capacity as well as the locations for feeding fire extinguishing agents into rising mains and fire extinguishing systems,
e) the main entrance ways for the fire department, the designated gathering points and the dangerous areas including the controlled areas, and
f) the location of the depots for auxiliary equipment and materials for the fire department.

(3) The plans of the floor levels of civil structures shall show at least

a) the plant-specific name of the floor level shown and what the level is used for,
b) the permanently established boundaries of the controlled areas and exclusion areas,
c) the firewalls and other room-enclosing walls including specification of their respective fire resistance,
d) the fire and smoke-related room isolating devices as well as the openings without fire isolating devices in other room-enclosing ceilings and walls,
e) the entrances and exits, the elevators for the fire department and other elevators as well as the staircases and stairs (including travel direction and reachable floor levels),
f) the operating locations for fire protection and operational facilities that must be operated by the fire department within the framework of hazard mitigation,
g) the firefighting water taps in rising mains (wet or dry) and the regions with stationary fire extinguishing systems together with information on the fire suppression agents as well as the locations of central controls or local supply points,
h) the location and number of compressed-gas containers and pressure vessels,
i) information on existing dangerous, including radioactive, substances,
j) the rooms and areas of building engineering facilities for heating, ventilation, power supply as well as electrical operation rooms, and
k) the warnings regarding rooms and areas where specific fire suppression agents may not be used, or which may not be accessed.

(4) The plans for the deployment of the fire department shall be kept up to date. On copy of the plans for the deployment of the external fire brigade shall be available in the control room, in the remote shutdown station, at the main gate as well as with the plant fire brigade.

6.2.5 Special requirements for rescue routes

(1) Rescue routes shall always be kept feely accessible.

(2) Within the containment vessel and within so-called trapped rooms, operating-phase related suitable respirators shall be provided for the flight. The number of respirators and their locations shall be based on the required hazard assessment.

6.2.6 Areas and fire access routes for the fire department

In preparation for the deployment of the fire department, the necessary staging and free movement areas for fire engines, for the readying of equipment and the planning of rescue and firefighting missions as well as the necessary fire department access routes and entry points shall be prepared and kept freely accessible.

N o t e s :

(1) Detailed requirements are specified in safety standard KTA 2101.2.

(2) Main access routes of the fire department are the rescue routes required as specified under Section 3.4.2.

6.3 Defensive Fire Protection

6.3.1 Plant fire brigade

(1) For the purpose of firefighting, a sufficiently effective plant fire brigade shall be established, equipped and sustained in accordance with local State laws (*Landesrecht*).

(2) The commander of the plant fire brigade shall not be part of the responsible shift personnel.

(3) Technical communication measures shall be available at the deployment site.

6.3.2 Fire Extinguishers

For the initial-response firefighting, suitable fire extinguishers in sufficient number shall be placed at well accessible locations.

N o t e :

Detailed requirements are specified in safety standard KTA 2101.3.

7 Tests and Inspections

7.1 General Requirements

(1) Before the construction or modifications of structural and equipment-related fire protection measures, the measures shall be evaluated regarding their safety-related importance, their effectiveness and their design. In this context, documents in accordance with statutory provisions shall be made available that will enable the assessment and demonstration of the appropriate design, construction and function of the measures as well as their freedom from retroaction.

(2) To ensure the necessary quality characteristics, construction supervision shall be provided, and assembly tests performed, during the construction or modifications of structural and equipment-related fire protection measures.

(3) An acceptance and function test shall be performed to prove that the construction or modifications of structural and equipment-related fire protection measures have been completed, that the functioning of these measures is ensured and that they do not have inadmissible retroactive effects on the plant.

(4) In the course of regular operation, regular and, in suitable time intervals recurring, inservice inspections shall performed to demonstrate that the individual test object continuous to meet the specified quality characteristics and that sufficient provisions are available to ensure that these quality

characteristics will continue to be met until the next inservice inspection.

7.2 Inspections in Accordance with Statutory Provisions

(1) Before the construction or modifications of structural and equipment-related fire protection measures, the following documents may be required for inspection in accordance with statutory provisions:

a) fire protection concept,
b) fire protection plans,
c) lists of the existing fire loads correlated to the individual rooms,
d) listing of the intended potential ignition sources including the safety-related assessment regarding those plant components possibly affect by a fire,
e) description and related documentation for building elements and building types required by the building inspection (e.g., general approval under construction supervision legislation, general certification under construction supervision legislation, marks of conformity with declaration of performance – CE- and Ü-marks),
f) description of the ventilation systems with details regarding schematics, technical drawings, controls concept and – insofar as required – ventilation rates,
g) description of the heat and smoke removal facilities as well as proof of their proper design,
h) description of the fire extinguishing systems as well as proof of their proper design,
i) description of the fire detection and alarm systems as well as proof of their adequate design,
j) schematic of the staging areas for the fire department.

(2) These documents shall be reviewed to ensure that they are complete, mutually compatible and that the designs they incorporate are suited to the respective functions.

7.3 Accompanying Inspections

(1) The accompanying inspections include:

a) design reviews,
b) construction supervision and assembly testing, and
c) acceptance and function tests.

(2) The required tests and inspections are specified in **Table 7-1**. Type and extent of the tests depend on the specific circumstances of the plant and shall be specified for the individual case. The test instructions for the acceptance and functional testing shall be made available early before the date of testing.

Note:

The term “early” is understood to mean a time span that is sufficient for a coordination between the parties involved.

7.3.1 Design reviews

Design reviews shall be performed as specified in **Table 7-1**.

7.3.2 Construction supervision and assembly testing

(1) The building materials and structural elements shall be checked during construction and assembly. It shall also be checked whether the plant components and equipment are fabricated and erected in accordance with the reviewed documents.

(2) Insofar as the manufacture of the structural materials, structural elements, plant components and equipment is already subject to tests in the manufacturing plant and is properly documented, no additional tests are required.

7.3.3 Acceptance and function tests

(1) Acceptance and function tests shall be performed as specified in **Table 7-1.**

(2) During acceptance testing, the completeness of the fire protection measures shall be checked.

(3) After repairs and modifications, acceptance and function tests of the respective structural elements, plant components and equipment shall be repeated to the necessary extent.

7.4 Inservice Inspections

(1) The type of tests and the testing intervals of the licensee regarding inservice inspections shall basically be as specified in **Table 7-2**. The licensee shall ensure that the tests and inspections are properly performed. Insofar as suitability certificates require shorter testing intervals, these intervals shall be specified in each individual case.

(2) When specifying other testing intervals than those listed in **Table 7-2,** the experience from inservice inspections as well as the specific design characteristics and quality assurance measures required in nuclear power plants shall be taken into consideration.

Note:

Deviations from the testing intervals specified in **Table 7-2** are checked within the nuclear licensing procedure.,

(3) If, for reasons of, e.g., limited accessibility, these tests can only be performed during reactor shutdown (e.g., refueling or maintenance), a prolongation of the testing interval is permissible.

Note:

Deviations from the testing intervals specified in **Table 7-2** are checked within the nuclear licensing procedure.

(4) In accordance with safety standard KTA 1202, testing instructions shall be drawn up for the individual test objects listed in **Table 7-2**. These shall specify, particularly, the plant-related and equipment-related individual testing steps.

Note:

Details of the test requirements are contained, e.g., in the approvals under construction supervision legislation, in the function certificates or in the relevant standards and guidelines.

(4) The existing combustible materials shall be subjected to inservice inspections regarding correspondence with the approved fire protection concept specified under Section 3.5. Within the framework of the fire protection inspection walkthrough after every maintenance, it shall be checked and documented that the additionally introduced fire loads have been properly removed.

7.5 Removal of Deviations

The licensee shall ensure that any deviations determined during testing are removed.

7.6 Documentation

(1) Test records shall be drawn up as proof of the performance of the tests and inspections specified under Section 7.4. These test records shall, particularly, contain an assessment of the test results, the detected deviations, any necessary time limits for the removal of deviations and the signature of the tester and the date of the test.

Note:

Respective details are specified in safety standards KTA 1202 and KTA 1404.

(2) The test records of the inservice inspections shall be kept in safe storage by the licensee.

No.	Test Object	Design Review [1)]	Construction Supervision / Assembly Testing	Acceptance and Function Tests
1	Structural Materials	X	X	–
2	Room-Isolating Structural Elements with Fire-Protection Related Requirements			
2.1	Walls, ceilings and support structures	X	X	X
2.2	Fire shields for cables and pipes	X	X	X
2.3	Fire protection closures (e.g., doors, hatches)	X	X	X
2.4	Other isolating elements (e.g., joints, glass windows)	X	X	X
3	Fire Protection Measures for Mechanical and Electrical Components			
3.1	Special measures regarding separation of redundancies (e.g., encapsulation, coating systems, heat insulation)	X	X	X
3.2	Measures regarding reducing the fire hazard of components (e.g., oil pans, splatter protection, special protection of cables)	X	X	X
3.3	Cable facilities with integrated functional integrity	X	X	X
4	Smoke Removal Systems, (exclude are mechanical smoke extractors)	X	X	X
5	Fire Detection and Alarm Systems	X	X	X
6	Fire Protection Measures for Ventilation Systems			
6.1	Ventilation systems with functions in the event of fire, including the functions of necessary fire protection dampers, the corresponding controls and signaling			
	a) equipment-related heat and smoke removal systems	X	X	X
	b) ventilation systems to keep necessary staircases and airlock antechambers free of smoke	X	X	X
6.2	Fire protection dampers and smoke removal dampers including the corresponding controls and signaling	X	X	X
6.3	Fire resistant ventilation and smoke removal ducts (excluded are concrete ducts)	X	X	X
7	Firefighting Water Supply	X	X	X
8	Fire Extinguishing System	X	X	X
9	Mobile Fire Extinguishers Inside Civil Structures	X	–	X
10	Mobile Auxiliary Equipment Inside Civil Structures for the Fire Department	X	–	X
11	Markings and Accessibility of Rescue Routes	–	–	X

X Tests by authority or authorized expert.

– No tests required. In case this applies to the column Acceptance and Function Tests, the respective acceptance test record shall be created during assembly testing.

1) Insofar as components with a certification of functionality (e.g., with a general building inspection approval) exist, only these approval certificates need to be presented.

Table 7-1: Testers and test objects regarding initial testing

No.	Test Object	Type of Test	Testing Interval Licensee	Remarks
1	Room-Isolating Structural Elements with Fire-Protection Related Requirements			
1.1	Fire shields for cables	S	2 a	extent of tests may be chronologically subdivided
1.2	Fire shields for pipes	S	2 a	extent of tests may be chronologically subdivided
1.3	Fire protection closures (e.g., doors, hatches)	F	1 a	
2	Fire Protection Measures for Mechanical and Electrical Components			
2.1	Special measures regarding separation of redundancies (e.g., encapsulation, coating systems, heat insulation)	S	2 a	
2.2	Measures regarding reducing the fire hazard of components (e.g., oil pans, splatter protection, special protection of cables)	S	2 a	
2.3	Cable facilities with integrated functional integrity	S	2 a	
3	Smoke Removal Facilities, (excepted are mechanical smoke extractors)	F	6 m	
4	Fire Detection and Alarm Systems			
4.1	Fire detectors	F	1 a	
4.2	Data buses	F	3 m	Deviations in accordance with DIN VDE 0833-1 are admissible
4.3	Fire detection centers, including power supply	F	3 m	
4.4	Control equipment a) for forwarding signals to the control room and for processing the signals	F	6 m	
	b) for automatic triggering of fire protection equipment	F	6 m	
	c) for triggering the fire-detection forwarding equipment to external organizations	F	6 m	
4.5	Locking systems of fire protection closures	F	1 m	
5	Fire Protection Measures for Ventilation Systems			
5.1	Ventilation systems with functions in the event of fire, including the functions of necessary fire protection dampers, the corresponding controls and signaling a) equipment-related heat and smoke removal systems	F	1 a	
	b) ventilation systems to keep necessary staircases and airlock antechambers free of smoke	F	1 a	
5.2	Fire protection dampers and smoke removal dampers including corresponding controls and signaling	F	1 a	
5.3	Fire resistant ventilation and smoke removal ducts (excluded are concrete ducts)	S	1 a	
6	Firefighting Water Supply			
6.1	Triggering and power supply of the equipment under No. 6.2	F	1 w	
6.2	Fire pumps including pressurizer and water make-up equipment	F	1 m	
6.3	Pressure vessels	in accordance with BetrSichV		

Table 7-2: Test objects and testing intervals of inservice inspections

No.	Test Object	Type of Test	Testing Interval Licensee	Remarks
6.4	Pipe network regarding overall supply capacity	F	2 a	
6.5	Valves and fittings in the pipe network	F	1 a	
6.6	Building isolation valves and penetration valves	F	1 m	
6.7	Hydrants on the plant site	F	1 a	
6.8	Wall hydrants	F	1 a	Including flow pressure measurement at the highest point
7	Spray Water Fire Extinguishing System			
7.1	Remotely controlled valves (including pneumatic and hydraulic valves)	F	6 m	
7.2	Pipe networks and spray nozzles	S	1 a	
7.3	Pipe networks and spray nozzles, water or pressurized air supply as applicable	F	5 a	
7.4	Triggering / Signaling	F	6 m	
8	Sprinkler Systems			
8.1	Dry-run-alarm valve station, rapid openers, rapid air removal	F	6 m	
8.2	Pipe networks and sprinklers	S	6 m	
8.3	Triggering / Signaling	F	6 m	
9	Fire Extinguishing Foam System			
9.1	Overall plant including mechanical seals of the admixture facility	S	1 m	
9.2	Initiation system	F	6 m	
9.3	Triggering / Signaling	F	1 m	
10	Fire extinguishing Gas System			
10.1	Overall plant	F	6 m	
10.2	Triggering and alarm system	F	6 m	
10.3	Pressure vessel	in accordance with BetrSichV		
11	Mobile Fire Extinguishing Equipment Inside Civil structures	S	1 a	if necessary, additional test in accordance with BetrSichV
12	Mobile Auxiliary Equipment Inside Civil structures for the Fire Department	S	1 a	if necessary, additional test in accordance with BetrSichV
13	Markings and Accessibility of the Rescue Routes	S	1a	
14	Plant Walk-Through Regarding Fire Protection	S	at end of maintenance	
15	Checking Fire Protection Concept whether it is up to date	S	4 a	

F function test (including visual inspection)

S visual inspection (comparison of the actual condition to the required condition, check regarding damage-free condition, check of the local measurement locations)

w testing interval in week(s)

m testing interval in month(s)

a testing interval in year(s); admissible deviations are tests in inaccessible areas that must be performed during refueling

Table 7-2: Test objects and testing intervals of inservice inspections (Continuation)

Appendix A

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 hazards (Atomic Energy Act – AtG) of December 23, 1959, revised version of July 15, 1985 (BGBl. I, p. 1565), most recently changed by Article 307 of the Act of August 31, 2015 (BGBl. I 2015, No. 35, p. 1474)
AtSMV	(2010-06)	Ordinance on the nuclear safety officer and the reporting of accidents and other events (Nuclear Safety Officer and Reporting Ordinance - AtSMV) of October 14, 1992 (BGBl. I 1992, No. 48) most recently changed by Article 1 of the of the Ordinance of June 8, 2010 (BGBl. I, p. 755)
BetrSichV	(2015-02)	Ordinance updating the requirements for work protection during use of work tools and hazardous substances (Article 1, Ordinance on industrial safety and protection of health using work tools (Industrial Safety and Health Ordinance (BetrSichV)) most recently changed by Article 2 of the updated Hazardous Materials Ordinance of February 3, 2015 (BGBl. I, p. 49)
StrlSchV	(2012-02)	Ordinance on the protection from damage by ionizing radiation (Radiological Protection Ordinance – StrlSchV) of July 20, 2001 (BGBl. I, p. 1714; 2002 I, p. 1459), most recently changed by Article 5 of the Act of December 11, 2014 (BGBl. I, p. 2010)
SiAnf	(2015-03)	Safety requirements for nuclear power plants of November 22, 2012, revised version of March 3, 2015 (BAnz AT of March 30, 2015 B2)
SiAnf Interpretations	(2015-03)	Interpretations of the safety requirements for nuclear power plants of November 22, 2012, revised version of March 3, 2015 (BAnz AT of March 30, 2015 B3)
KTA 1201	(2009-11)	Requirements for the Operating Manual
KTA 1202	(2009-11)	Requirements for the Testing Manual
KTA 1301.1	(2012-11)	Radiation Protection Considerations for Plant Personnel in the Design and Operation of Nuclear Power Plants; Part 1: Design
KTA 1301.2	(2014-11)	Radiation Protection Considerations for Plant Personnel in the Design and Operation of Nuclear Power Plants; Part 2: Operation
KTA 1401	(2013-11)	General Requirements Regarding Quality Assurance
KTA 1402	(2012-11)	Integrated Management Systems for the Safe Operation of Nuclear Power Plants
KTA 1403	(2010-11)	Ageing Management in Nuclear Power Plants
KTA 1404	(2013-11)	Documentation During the Construction and Operation of Nuclear Power Plants
KTA 2101.2	(2015-11)	Fire Protection in Nuclear Power Plants; Part 2: Fire Protection of Civil Structures
KTA 2101.3	(2015-11)	Fire Protection in Nuclear Power Plants; Part 3: Fire Protection of Mechanical and Electrical Plant Components
KTA 2103	(2015-11)	Explosion Protection in Nuclear Power Plants with Light Water Reactors (General and Case-Specific Requirements)
KTA 2201.1	(2011-11)	Design of Nuclear Power Plants Against Seismic Events; Part 1: Principles
KTA 2206	(2009-11)	Design of Nuclear Power Plants Against Damaging Effects from Lightning
KTA 2207	(2004-11)	Flood Protection for Nuclear Power Plants
KTA 2501	(2010-11)	Structural Waterproofing of Nuclear Power Plants
KTA 3301	(2015-11)	Residual Heat Removal Systems of Light Water Reactors
KTA 3402	(2014-11)	Airlocks on the Reactor Containment of Nuclear Power Plants - Personnel Airlocks
KTA 3403	(2010-11)	Cable Penetrations Through the Reactor Containment Vessel
KTA 3501	(2015-11)	Reactor Protection System and Monitoring Equipment of the Safety System
KTA 3601	(2005-11)	Ventilation Systems in Nuclear Power Plants

KTA 3602	(2003-11)	Storage and Handling of Fuel Assemblies and Associated Items in Nuclear Power Plants with Light Water Reactors
KTA 3604	(2005-11)	Storage, Handling and Plant-internal Transport of Radioactive Substances in Nuclear Power Plants (with the Exception of Fuel Assemblies)
KTA 3605	(2012-11)	Treatment of Radioactively Contaminated Gases in Nuclear Power Plants with Light Water Reactors
KTA 3701	(2014-11)	General Requirements for the Electrical Power Supply in Nuclear Power Plants
KTA 3702	(2014-11)	Emergency Power Generating Facilities with Diesel Generator Units in Nuclear Power Plants
KTA 3705	(2013-11)	Switchgear Facilities, Transformers and Distribution Networks for the Electrical Power Supply of the Safety System in Nuclear Power Plants
KTA 3901	(2013-11)	Communication Means for Nuclear Power Plants
KTA 3904	(2007-11)	Control Room, Remote Shutdown Station and Local Control Stations in Nuclear Power Plants
DIN VDE 0833-1	(2014-10)	Alarm systems for fire, intrusion and hold-up - Part 1: General requirements
DIN 18230-1	(2010-09)	Structural fire protection in industrial buildings - Part 1: Analytically required fire resistance time

Appendix B (informative)

Content and Structure of a Fire Protection Concept for Nuclear Power Plants

B 1 Basics

(1) The fire protection concept of a nuclear power plant comprises the individual measures regarding

– structural fire protection,
– equipment-related fire protection,
– operational fire protection, and
– defensive fire protection.

(2) Under consideration of, particularly,

– the plant-related risks,
– the fire risks,
– the extent of damages to be expected, and
– the safety-related significance of expected damages,

the fire protection concept describes the measures and their interconnections with regard to achieving the protective goals of the building codes and the goals specified in Section 1. Thus, the fire protection concept presents a goal-oriented overall assessment of the fire protection for the respective power plant. In addition to the goals mentioned above, further protection goals may become significant for the fire protection concept (e.g., any derived from other public law regulations as well as from requirements by the designer, the constructors, the operator or the insurer of the power plant).

(3) The fire protection concept must be correlated to the individual case. In this context, any necessary deviations and simplifications regarding building codes and the requirements of nuclear safety standards shall be identified and assessed.

(4) In the procedures of creating, updating or amending and documenting the fire protection concept, the requirements in accordance with safety standard KTA 1401 shall be observed.

(5) When preparing the fire protection concept, proof is required that for a specified time span

– the function of the safety system equipment, or
– the function of structural or equipment-related fire protection measures (e.g., stability of load-carrying and supporting structural elements, accessibility of rescue routes, possibility of an effective firefighting)

is ensured despite effects from fire events; this proof may be achieved by applying validated procedures of fire protection engineering considering all-embracing input data and assumptions.

(6) For each individual case

– the applied validated procedures,
– the all-embracing simplifying assumptions made in the procedure,
– the all-embracing input data used in the procedure, particularly, the fire hazard scenarios,
– the resulting uncertainties of the results (e.g., due to uncertain or variable input data as well as due to uncertainties of the assumptions and modelling)

shall be completely, comprehensibly and verifiably described and assessed in the fire protection concept.

B 2 Scope of the Fire Protection Concept

(1) The fire protection concept serves as the basis for the documentation and assessment of fire protection within

– the nuclear licensing and surveillance procedures,
– the licensing procedures under building code,
– the fire safety inspections by official fire protection departments.

(2) Regarding operational concerns, the fire protection concept serves as the basis for

– the technical planning, construction and coordination by the different trade disciplines,
– the acceptance tests and inservice inspection,
– the planning and execution of modifications to the power plant,
– the risk assessment under private law,
– the organization of the operational fire protection, and
– the fire action planning for the defensive fire protection.

(3) In addition, the fire protection plan can be used for the training of external and internal proper personnel.

B 3 Content of the Fire Protection Concept

The fire protection concept shall normally contain the assessment details regarding the partial aspects cited in the following sections even if these reveal that no respective measures are necessary.

B 3.1 General Requirements

B 3.1.1 Description of the power plant

– Description of the location of the power plant including naming site-related positive factors (e.g., proximity to the fire department) and site-related risks (e.g., neighboring establishments with higher fire and explosion hazards).
– Description of the accessibility of the plant site from public roadways (e.g., entrances, access routes).
– Description of the on-site civil structures including specifying the locally present equipment-related hazards (e.g., controlled areas, open plant components under voltage, storage or usage of hazardous materials).

B 3.1.2 Assessment criteria

– Description of the current state of planning and the legal basis (State Civil Ordinance, Atomic Energy Act).
– Description and assessment of the goals (cf. Section B 1).
– Description of the operating phases considered in the fire protection concept.

B 3.2 Requirements Regarding Fire Protection

– Building-specific description of those fire events and their combinations to be considered including their correlation to the operating phases.
– System-specific description of the equipment of the safety system and the safety functions including the fire-protection-specific requirements including their correlation to the operating phases, events and combination of events (e.g., in tabular form).

B 3.3 Fire Hazards and Major Risk Factors

– Building-specific description and assessment of the fire hazards and ignition sources including their correlation to the operating phases.

– Building-specific description and assessment of the special fire risks including their correlation of effects to the operating phases.

B 3.4 Fire Protection Measures

B 3.4.1 Structural fire protection

– Description of the fire behavior of the building materials and structural elements.
– Description of the fire resistance time of structural elements (e.g., stability, room isolation, separation).
– Description of the fire resistance time of closures for openings in fire compartment enclosing structural elements.
– Building-specific description of the arrangement of fire compartments and other fire-protection related subsections.
– Description of the arrangement and construction of smoke-control compartments (e.g., smoke barriers, smoke protection doors).
– Description of the entrances to civil structures when coming from the plant site.
– Description of the rescue routes and their construction.
– Building-specific data regarding the design of structural fire protection measures against those fire events and their combinations to be considered.
– Building-specific data and assessment regarding the deviations and simplifications.

B 3.4.2 Equipment-related fire protection

– Description of the fire detection and alarm systems including the building-specific naming of the monitored areas, of the fire hazard characteristics and the fire protection measures to be triggered.
– Description of the sequential handling of fire alarms,
– Description of the alarm equipment including the description of the actuation and functional behavior.
– Description of firefighting water supply and the retention of firefighting water.
– Description of the technical fire protection equipment such as wet rising mains, wall hydrants, pressurizer facility, semi-stationary fire extinguishing systems and firewater supply points for the fire department.
– System-related description of the stationary fire extinguishing systems naming the type of fire extinguishing system and the protected areas as well as the description of the controls and signals.
– System-related description of the ventilation systems
  a) for the prevention of a fire-related spreading of smoke and radioactivity,
  b) for the continued ventilation of redundancies not affected by the fire,
  c) for keeping rescue routes free of smoke,
  d) for facilitating manual firefighting, and
  e) for the removal of fire-related heat,

  naming the respective system types and describing their triggering and signaling in the event of fire.
– Specification of the protected areas for the heat and smoke removal equipment.
– Description of how functions of the fire protection measures are sustained including the backup power supply.
– Description of the lightning and over-voltage protection facilities (in accordance with safety standard KTA 2206).
– Description of the safety and emergency lighting.
– Building-specific information regarding the elevators (e.g., controls in the event of fire, emergency call response, elevators for the fire department).
– Building-specific information regarding the design of the technological and constructional fire protection measures against those fire events and their combinations to be considered.
– Building-specific information regarding the deviations and simplifications including their assessment.

B 3.4.3 Operational fire protection

– Description of the fire protection measures.
– Information regarding the tasks of the fire protection officer and of the plant fire brigade commander as well as regarding their organizational positions within the plant.
– Information regarding the integration of radiation protection.
– Information regarding the plant-internal alarm regulation and fire protection regulation (in accordance with safety standard KTA 1201).
– Information regarding the fire protection plans and the deployment plans for the fire department.
– Information regarding the rescue plans as well as the marking of rescue routes and safety equipment.
– Description of the areas for the fire department (staging and free movement areas)
– Information regarding initiating and documenting the required design reviews, construction supervision, assembly testing, acceptance and function tests as well as in-service inspections.
– Information on the plant-internal regulations regarding those fire events and their combinations to be considered.
– Description and assessment of whether the requirements regarding operational fire protection are met.

B 3.4.4 Defensive fire protection

– Information regarding the preparatory measures for firefighting (e.g., specifying the areas in which restrictions regarding the use of certain fire extinguishing agents exist or in which firefighting may only be carried out under certain operating conditions).
– Information regarding the establishment of a plant fire brigade.
– Information regarding the staffing and technical equipment of the plant fire brigade as well as its response time.
– Information regarding the external fire departments that can be requested as support for the plant fire brigade as well as their collaboration in regular fire drills.
– Information regarding the collaboration of external fire departments in the event of fire and naming the central engagement points for these fire departments.
– Description of the building-specific telecommunication facilities that can be used in the event of fire by the fire fighters of the collaborating fire departments.
– Information regarding provision of small fire extinguishing equipment (fire extinguishers) and regarding the training of personnel in the handling of these small fire extinguishers.
– Information regarding ensuring the defensive fire protection for those fire events and their combinations to be considered.
– Description and assessment regarding whether the requirements of the defensive fire protection are met.

B 3.4.5 Interaction of fire protection measures

– Description and assessment of whether the fire protection requirements are met, especially, regarding the interaction of the individual measures, thereby ensuring the goals specified under Section B 1.

B 4 Applying and Updating the Fire Protection Concept

In order to properly apply and update the fire protection measures specified in the fire protection concept, a smooth interaction during construction and the considered operating phases (e.g., including larger modification measures, maintenance and extended shutdown periods) may require that

– special fire protection measures are specified according to the construction progress or the operating phase,
– the responsibilities and duties are defined (e.g., construction supervisor, fire protection specialist, construction firm, contractor),
– the qualification of each construction firms is described, and
– information regarding proper execution is presented (e.g., the required certifications).