Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 2101.1 (12/2000)

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 12/85

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

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KTA SAFETY STANDARD

December 2000	**Fire Protection in Nuclear Power Plants Part 1: Basic Requirements**	KTA 2101.1

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PLEASE NOTE: Only the original German version of this safety standard represents the joint resolution of the 50-member Nuclear Safety Standards Commission (Kerntechnischer Ausschuss, KTA). The German version was made public in Bundesanzeiger BAnz No. 106a on June 9, 2001. Copies may be ordered through the Carl Heymanns Verlag KG, Luxemburger Str. 449, 50939 Koeln, Germany (Telefax +49-221-94373603).

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Comments by the editor:

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

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

Fundamentals

(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 the damage arising from the construction and operation of the facility (Sec. 7 para. 2 subpara. 3 Atomic Energy Act), in order to attain the protection goals specified in the Atomic Energy Act and Radiological Protection Ordinance (StrlSchV) and which are further detailed in "Safety Criteria for Nuclear Power Plants" and in "Guidelines for the Assessment of the Design of PWR Nuclear Power Plants against Incidents pursuant to Sec. 28 para. 3 of the Radiological Protection Ordinance (StrlSchV) – Incident Guidelines".

(2) Criterion 2.7 "Fire and Explosion Protection" of the Safety Criteria for Nuclear Power Plants specifies that protection measures shall be taken against fires in nuclear power plants. In accordance with Table II of the Incident Guidelines, plant-internal fires belong to those design basis accidents (incidents) for which precautionary equipment-related measures must be taken and which on account of these measures do not have any relevance with respect to radiological effects on the environment.

The basic requirements regarding these precautionary measures are specified in this safety standard.

(3) To achieve the protection goals, the following aspects that can influences the occurrence, spreading and effects of a fire are, among others, taken into consideration:

a) fire loads and ignition sources,

b) structure-related and equipment-related features,

c) possibilities for fire alarms and fire fighting.

Corresponding technical and organizational measures are specified. The extent and quality of the measures and the extent of the tests and inspections are determined in accordance with the significance of fire protection in respect to the protection goals specified under Section 1.

(4) In setting up this safety standard it is assumed that the building codes, fire protection laws and fire protection regulations of the individual German states (Länder), the Workplace Ordinance, the German Accident Prevention Regulations of the trade unions and other regulations under public law are met. If the specifics of the nuclear power plant require deviations from laws, ordinances or other regulations under public law or from the German Accident Prevention Regulations (UVV), then the particular deviations and exemptions shall be handled on a case-by-case basis in accordance with the procedures specified in these individual regulations.

(5) The safety standard series KTA 2101 also comprises the following parts:

KTA 2101.2 Fire protection in nuclear power plants,
Part 2: Fire protection of structural plant components

KTA 2101.3 Fire protection in nuclear power plants
Part 3: Fire protection of mechanical and electrical plant components

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

KTA 1201 Requirements for the Operating Manual

KTA 2102 Rescue routes in nuclear power plants (in preparation)

KTA 2103 Explosion protection in nuclear power plants with light water reactors (general and case-specific requirements)

KTA 2501 Waterproofing of structures 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 of the equipment of the safety system

KTA 3601 Ventilation and air filtration systems in nuclear power plants

KTA 3602 Storage and handling of nuclear fuel assemblies, control rods and neutron sources in nuclear power plants with light water reactors

KTA 3604 Storage, handling and on-site transportation of radioactive substances (other than fuel assemblies) in nuclear power plants

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 3904 Control room, emergency control room and local control stations in nuclear power plants

(7) Requirements regarding quality assurance and regarding alarm facilities and lightning protection facilities 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

KTA 2206 Design of nuclear power plants against damaging effects from lightning

KTA 3901 Communication devices for nuclear power plants

1 Scope

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

It applies to the protection from building-internal and building-external fires, in particular, with respect to

a) plant components the safety function of which are necessary to meet the protection goals on which the Safety Criteria are based, i.e.,
   aa) control of reactivity,
   ab) cooling of fuel assemblies,
   ac) confinement of radioactive materials and
   ad) limitation of radiation exposure,

b) the structural plant components which enclose these plant components and

c) the plant personnel.

N o t e :
These structural plant components include, e.g., the reactor building, the reactor auxiliary building, the nuclear services building as well as the structural plant components of the service cooling water circuits, the emergency standby building, the emergency feed water building, the switch gear building, the turbine building of boiling water reactors, the emergency power generator building, the piping and cable ducts between the aforementioned buildings.

2 Definitions

N o t e :
Additional definitions are given in KTA 2101.2 and KTA 2101.3.

(1) Postulated Event

A postulated event is an event on which the safety related design of a nuclear power plant is based and which can set off an entire event sequence.

(2) Structural and Equipment-related Fire Protection

Structural and equipment-related fire protection includes structure-related and equipment-related fire protection measures that prevent the occurrence and spreading of fires and that make it possible for persons to escape and be rescued and that, also, make effective fire extinguishing activities possible.

a) Structure-related fire protection measures include measures that result from requirements regarding the fire behavior of structural materials and elements (e.g., walls, ceilings and isolating components), the location of fire compartments and arrangement of fire barriers, the location, arrangement and design of rescue routes as well as the on-site access roads and areas for the fire brigade.

b) Equipment-related fire protection measures include equipment and devices for the detection and fighting of fires (fire protection equipment and devices), insofar as these are permanently attached to the buildings, e.g., fire extinguishing devices, fire detection and alarm systems, heat and smoke removal systems. Equipment-related fire protection measures also include measures taken with the goal of preventing fires in mechanical and electrical plant components. These are, e.g., measures resulting from the fire behavior of components and systems including their operating media.

(3) Operational Fire Protection

Operational fire protection includes administrative measures (e.g. plant-internal fire brigade as well as instructions on the handling of combustible operating and working media) as well as mobile equipment for fire fighting (e.g., fire extinguishers) and for the escape and rescue of people(e.g., breathing apparatus).

Note:
Operational fire protection measures are described in the plant-internal Fire Protection Regulation.

(4) Fire Compartments

A fire compartment is the region of the building within its outer walls and/or inside walls which are designed as fire walls extending through all stories.

Note:
Requirements for the design of fire walls are specified in KTA 2101.2.

(5) Fire Sub-compartments

Fire sub-compartments are subsections of fire compartments that, on account of an increased fire hazard or for the protection of equipment of the safety system are partitioned off by sufficiently fire resistant structural elements such that fire spreading to, and having impermissible effects on, other subsections is prevented.

Note:
Regarding the design requirements, see KTA 2101.2.

(6) Fire Load

The fire load in the combustion energy (mass × specific combustion heat) of the combustible materials contained in , and belonging to, the room.

(7) Fire Load Density

Fire load density is the ratio of fire load to area of the room or of the group of rooms.

(8) Fire Damper

Fire dampers are active isolating devices against fire and smoke that are triggered by the fire variables “heat” or “heat and smoke”.

(9) Rescue Route

A rescue route is a route that leads from any place in the room if required via necessary corridors, protected corridors and necessary stairways into the open or into a protected area; it serves both as escape route and, from the outside, as rescue route.

(10) Functional Capability

Functional capability is the ability of a system or of one of its component parts (e.g., component, subsystem, train) including the necessary auxiliary, supply and power systems to perform the prescribed tasks.

(11) Authorized Expert

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

(12) Safety System

The safety system comprises all equipment of a nuclear facility that have the task of protecting the facility from an impermissible loading and, when a design basis accident (incident) occurs, to keep the effects on the plant personnel, on the facility and the environment within specified limits.

Note:
Although equipment-related fire protection measures can be relevant to safety, they are not part of the safety system.

(13) Ignition Sources

Ignition sources are the permanently or temporarily available possibilities in an area of the plant which could release the amount of ignition energy required to ignite the available combustible material.

(14) Random Failure

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

(15) Encapsulation

Encapsulation is a measure that is suitable to protect individual equipment or combustible materials such that, in the case of fire within or outside of the encapsulation, they will not become part of the fire scenario.

(16) Protected Area

A protected area is an area that is protected against the dangerous events that are at the root of the escape or of the rescue mission.

3 Design Principles

3.1 Basic Requirements

3.1.1 General

(1) Measures for the protection from fires and the subsequent effects shall be taken in nuclear power plants. These measures shall ensure that the protection goals specified under Section 1 are achieved.

(2) A minimization of fire loads shall be taken into account in specifying, both, the fire protection measures and the fire protection concept. Measures that are in correspondence with the chosen fire protection concept as specified under Section 3.1.2.1 shall be taken for the fire protective separation or encapsulation of combustible materials, for minimizing the smoke development as well as for preventing anticipated ignitions sources in the areas of open combustible materials.

(3) Its shall, basically, be assumed that the ignition of combustible materials is possible. An exception may be made in the case of the events specified in Section 3.2.2, provided, plausibility considerations prove that the combustible materials cannot be ignited as a result of these events. An exception may also be made if the combustible material is encapsulated

and it is proven that the encapsulation retain their functional capability during specified normal operation and during the postulated design basis accidents (incidents) – including fire.

Note:
This assumption, that combustible materials will ignite, serves to find the maximum fire effect for determining the required fire resistance rating of the fire enclosures of fire compartments and fire sub-compartments. It does not serve as boundary condition of fire-sequence related incident analyses.

(4) Fires do not have to be assumed to occur in inerted areas, e.g., the inerted BWR containment vessel. The situation during the non-inerted phases shall be taken into account.

(5) Structure-related fire protection measures of the structural and equipment-related fire protection, e.g. the creation of fire compartments, fire sub-compartments and areas separated by structures that are at least fire resistant, shall be given priority over equipment-related fire protection measures. Insofar as the above-mentioned structural measures cannot be implemented to the extent that the necessary protection is ensured in the case of fire, additional measures regarding the detection of fires (e.g. installation of additional fire detectors) as well as the fighting of fires (e.g. installation of stationary fire extinguishing systems) shall be taken.

(6) If safety-related reasons call for additional requirements regarding structural and equipment-related fire protection measures, e.g., radiation protection requirements, then their fire protection function shall be evaluated taking these additional requirements into account.

(7) Structural and equipment-related fire protection measures shall be designed such that a fire-related failure need not be assumed in case of their required operation.

In the case of fire in combination with other events in accordance with Section 3.2, the extent to which the structural and equipment-related fire protection measures may be damaged as a result of these events shall be examined, and it shall be determined whether further measures are necessary.

(8) Equipment of the safety system necessary for

a) shutting down the reactor,

b) maintaining long-term subcriticality,

c) removing residual heat,

d) retaining radioactive substances (adherence to the planning limits in accordance with Sec. 28 para. 3 StrlSchV)

shall be protected such that they can carry out their safety-related tasks to the required extent even in the event of fire. In the case of redundant equipment of the safety system, it shall basically be ensured that, in case of a fire in the area of one redundancy, the other redundancies will retain their functional capability. A failure of several redundancies as well as the failure of non-redundant equipment of the safety system in the event of a fire is permissible, provided, the simultaneous occurrence of a fire and the necessary safety-related operation of the respective equipment of the safety system does not have to be assumed.

Note:
Whether or not it is required that the nuclear power plant is shut down after a fire-related failure of equipment of the safety system is not subject of this safety standard.

(9) The fire protection design of anchors and supports of components shall be in accordance with the corresponding requirements of the components.

(10) The entirety of fire protection measures shall ensure that, in the case of a fire, a random failure of a single measure of the structure-related fire protection is not relevant to safety.

Note:
The basic measures required in this respect are specified in this safety standard and are dealt with in detail in safety standards KTA 2101.2 and KTA 2101.3. Accordingly, it is not required in the fire protection design to assume a random failure (single failure) of an individual fire protection measure.

Insofar as individual fire protection measures have special significance with regard to protecting the equipment of the safety system, their reliability shall be ensured by special measures that shall be specified on a case-by-case basis.

Note:
The special significance of individual fire protection measures and the resulting reliability requirements may be determined on the basis of probabilistic safety analyses. Special measures are, e.g., expanded test requirements, stationary fire extinguishing systems instead of manual fire fighting or automatic instead of manual triggering of the fire extinguishing systems.

(11) With regard to a fire in combination with other events as specified under Section 3.2, it is not required to assume the random failure of an individual fire protection measure.

3.1.2 Fire Protection Concept

3.1.2.1 General

A fire protection concept shall be developed and documented under consideration of the rules and regulations mentioned in Section Fundamentals (e.g., VBG 30, MBO, ArbStättV) as well as the requirements specified under Section 3.1.1. The fire protection concept shall be developed for full power operation including the maintenance tasks. Deviations on account of a shutdown reactor as well the starting up and shutting down time phases shall be taken into consideration.

All measures directed at achieving the protection goal shall be described in the fire protection concept.

3.1.2.2 Further Particulars on the Fire Protection Concept

The nuclear power plant specific demands on fire protection shall be incorporated in the fire protection concept. This includes the safety related evaluation of the plant components affected by the fire as well as of the fire protection requirements specified in the following sections, e.g., with regard to a reliable physical separation of redundancies and the design against earthquakes.

In the case of plant regions where Sections 3.2 requires that fire shall be analyzed in conjunction with a postulated other event, then the additional requirements or additional influences from this postulated event shall be specified.

Note:
The signal cables of the instrumentation and control system may be neglected when determining the potential ignition sources.

3.1.2.3 Investigation of Fire Effects

(1) If the safety related evaluation of the plant components affected by fire make it necessary to perform a detailed analysis of the fire effects, then corresponding data shall be given with respect to these fire effects.

This data may be derived from suitable analytical or experimental proofs, or may be proven with the help of analogy or plausibility considerations.

Note:
Refer to Sec. 3 KTA 2101.2.

(2) The following fire effects shall be considered:

a) heat development inside of the fire room or area,

b) heat development outside of the fire room or area,

c) development and spreading of smoke,

d) pressure buildup inside of the fire room or area.

(3) The analysis of fire effects shall take, e.g., the following parameters into account:

a) fire loads (taking encapsulations into consideration) and ignition sources,
b) spatial geometry and type of component, heat sinks and heat sources,
c) ventilation conditions,
d) possibilities for fire alarms and fighting the fire under consideration of the chronological sequence of the fire.

3.2 Fire and Postulated Events

3.2.1 Fire and Subsequent Event

(1) In the case of pressurized vessels and components as well as of plant components where an inherent failure can be excluded on account of the individual quality characteristics, or of the limitation of the type of failure, measures shall be taken either to prevent fires in the area of pressurized vessels or components or to protect against the effects of fires; it may, alternatively, be demonstrated that in the event of fire the quality characteristics making it possible to exclude an [inherent] failure or to limit the type of failure are not adversely affected in an impermissible way.

Note:
Such pressurized vessels and components are, in the case of pressurized water reactors, e.g., reactor pressure vessel, steam generators, pressurizers, primary coolant pumps and accumulators, and in the case of nuclear power plants with boiling water reactors the scram accumulator tanks.

Corresponding plant components are, e.g., containment vessel, safety-related supports and associated structural plant components as well as the storage pool for used fuel assemblies.

With regard to the mentioned quality characteristics, this can pertain to, e.g., stress limit usage. A limitation of the type of failure is given, e.g., in case of a basic safety design in accordance with RSK-Guidelines for Pressurized Water Reactors.

(2) In the case of pressurized vessels and components as well as of plant components where an inherent failure cannot be excluded, measures shall be taken either to prevent fires or to protect these pressurized vessels and components as well as the plant components against the effects of fire. Alternatively, measures may be taken to protect the equipment of the safety system against the simultaneous impact of a fire and of a consequential event resulting from the above-mentioned vessels, components and plant components on account of the fire.

3.2.2 Postulated Event and Consequential Fire

3.2.2.1 Earthquakes and Consequential Fire

(1) Inside structural plant components which, because of their safety-related significance, are designed against earthquakes in accordance with KTA 2201.1, either the equipment which, on losing integrity, would release combustible materials or the equipment which could cause ignition shall basically also be designed to resist the effects of these events by selecting suitable materials and by an appropriate design.

Note:
By implementing this requirement, a consequential fire due to earthquakes need not be assumed.

The individual building parts shall be specified in the fire protection concept.

(2) If the equipment mentioned in para. 1 has not been correspondingly designed, then structural and equipment-related fire protection measures shall be provided which shall themselves be designed to resist the effects of these events by the selection of suitable materials and mechanical design. In this case, the consequential fire shall be considered to occur only after the earthquake has subsided.

Note:
The individual fire protection measures shall be specified in the fire protection concept.

(3) Insofar as the intensity, I, of the presumed earthquake is presumed to be less than or equal to 6 (on the MSK scale), it may be assumed that the structure-related and operational fire protection measures will remain available even without special design measures.

3.2.2.2 Plant-internal Events and Consequential Fire

(1) The structure-related fire protection measures shall be carried out such that in the case of redundant equipment of the safety system any fire assumed to be a direct consequence of a plant-internal event will, basically, remain restricted to a single redundancy of this equipment. The failure of several redundancies as well as the failure of non-redundant equipment of the safety system is permissible in substantiated exceptional cases, provided, the simultaneous occurrence of a fire and the required safety-related operation of the respective equipment of the safety system does not have to be assumed.

(2) In this context, the occurrence of a fire does not have to be assumed for design basis accidents (incidents) involving the release of steam.

3.2.3 Postulated Event and an Unrelated Fire

Note:
This section does not in any way affect the requirements specified under Section 3.2.2.1.

(1) The simultaneous occurrence of an external event (earthquake or high water) or of an internal event and an unrelated fire, basically, does not have to be assumed because the occurrence probabilities of such combinations are sufficiently small. However, if the combination of the hundred-yearly high water with a fire and restricted access conditions of the plant has a safety-related significance, then this combination shall be postulated.

(2) An unrelated fire shall, basically, not be excluded after an earthquake or high water. In this case, however, only those structure-related or operational fire protection measures need to be available or be made available which are necessary to for retaining the functional capability of the equipment specified under Section 3.1.1 para. 8.

Note:
In his case it is permissible to also fall back on help external to the nuclear power pant site.

The following shall apply to this equipment:

a) With respect to minor earthquakes up to the inspection level in accordance with KTA 2201.6, the availability of the structure-related fire protection measures shall, basically, be maintained by engineering means (e.g., by adhering to the pipe routing provisions approved in the licensing procedure).
b) Insofar as the intensity, I, of the above-mentioned earthquakes are presumed to be smaller than or equal to 6 (on the MSK scale), it may be assumed that the structure-related and operational fire protection measures will remain available even without special design measures.
c) The structure-related and operational fire protection measures need not be designed against larger earthquakes up to the design-basis earthquake, provided, it is ensured that after the occurrence of a design-basis earthquake the possibly failed structure-related or operational fire protection measures can be made available or be replaced by suitable measures immediately after the event.

Note:
"Immediately after the event" refers to a maximum time period of one week.

Regardless of these requirements, in case of post-earthquake tasks with special fire hazards (e.g. heat intensive tasks) additional administrative fire protection measures (e.g. mobile fire pumps, fire guard) shall be provided.

3.3 Reactor in the Shutdown Condition

(1) The structure-related and operational fire protection measures shall be reviewed with regard to whether or not they shall be modified or supplemented in view of the modified operating conditions during this plant condition (shutdown reactor, possible additional combustible materials or a change of their location, possible ignition sources during repair work, additional personnel during inspection, servicing and repair work).

(2) The additional fire loads usually present during the revision phase shall be taken into consideration in selecting the structure-related fire protection measures.

(3) The fire protection concept shall reflect the changed conditions regarding fire protection, shall describe the basic measures and shall indicate that additional measures may become necessary and that these measures, then, shall be specified in each individual case.

Note:
These measures include, in particular, operational fire protection measures such as fire guard, the availability of additional fire extinguishers and restrictions on bringing in additional fire loads. In this regard, also refer to Section 4.2.5.4.

4 Structural and Equipment-related Fire Protection Measures Against Building-internal Fires

4.1 Structure-related Fire Protection Measures

4.1.1 Fire Load

(1) The fire load shall be kept as small as possible.

(2) Non-combustible construction materials in accordance with Class A DIN 4102-1 shall basically be used. If combustible materials are used it shall be demonstrated that suitable non-combustible materials are not available.

(3) Combustible construction materials shall, basically, be flame retardant in accordance with Class B 1 DIN 4102-1. With regard to smoke development, they shall, basically, comply with the requirements in accordance with Class A 2 DIN 4102-1. They shall be taken into consideration in determining the fire loads.

Note:
Specifications regarding the requirements for the fire behavior of decontaminable coatings and cold-water insulations are dealt with in Sec. 7.3 para. 3 KTA 2101.2 and Sec. 3.12 KTA 2101.3.

(4) Fixed flooring and decontaminable coatings may be ignored as fire load, provided, it is proven that they would contribute only negligible amounts to the fire scenario on account of their type, amount and condition of installation. Fire protection coatings (e.g. intumescent coatings) may be ignored as fire load, provided, it proven that, under consideration of the fire exposure from unprotected fire loads, they would contribute nothing or only negligible amounts to the fire scenario.

4.1.2 Encapsulation

(1) Encapsulations are permissible. These can be in the form of sheet metal jackets, fire protection plates or intumescent coatings.

(2) It shall be shown that the individual technical encapsulation measures are suitable with regard to the objective of the fire protection concept. This shall take into consideration the type of combustible material to be protected, the installation, amount and distribution of the unprotected and other fire loads as well as the operating conditions to be observed and, in this connection, the general restrictions to be taken into consideration.

4.1.3 Fire Protective Separation

Note:
Further details regarding fire protective separation are contained in KTA 2101.2.
The formal requirements to be taken into consideration when deviating from regulations under public law are described in Section Fundamentals para. 4.

(1) The individual structures in a nuclear power plant shall be separated from one another either by sufficient distances or by sufficiently fire resistant structural elements.

(2) The structural components shall basically be subdivided into fire compartments taking the requirements imposed by systems engineering into consideration.

(3) The individual fire compartments shall be subdivided basically into single-story fire sub-compartments under consideration of the fire load densities, the requirements with regard to system engineering and operation as well as the redundancies and rescue routes.

In case systems engineering requires a configuration of multi-story fire sub-compartments, then additional fire protection measures shall be taken in order to achieve an equivalent protection condition.

(4) The walls, ceilings and isolating components of fire sub-compartments shall have a sufficient resistance to fire.

(5) If the requirements of systems engineering lead to the requirement that the fire compartments must be larger than in accordance with the building code or that the fire protection requirements of individual structural elements cannot be completely met, then other suitable measures (e.g., creation of fire sub-compartments, encapsulation of fire loads, object-related fire alarms, stationary fire extinguishing systems) shall be taken if these measures help to achieve the protective goals.

Note:
Examples of this are: reactor building, reactor auxiliary building, turbine building, reactor service building.

(6) Insofar as pressure equalization openings are necessary for the control of design basis accidents (incidents), openings in structural partitions are permissible, provided, they comply with fire protection requirements.

In this case, it is permissible that the openings are closed automatically only in case of fire or that the closures are opened only in case of pressure equalization. The corresponding protection measures shall be specified in each individual case.

(7) In the case of necessary openings in outer walls, it shall be ensured that the spread of fire from one fire compartment to another is prevented. The corresponding protection measures shall be specified in each individual case.

(8) Ventilation ducts and pipes which pass through the partitions between fire compartments or fire sub-compartments shall be designed such that a fire cannot spread from one area to another. The fire resistance rating of the special elements employed for this purpose shall comply with the fire protection requirements for the partitioning structural elements.

(9) Penetrations for cables and pipes through fire walls or through separating walls or ceilings of other fire sub-sections shall be provided with fire barriers. The fire resistance capability of these fire barriers shall be equal to that of the partitioning structural elements.

After working on the fire barriers of cables and pipes, it shall be ensured that these fire barriers either remain in functioning order or are again returned to this state.

(10) In the case of ventilated pipe and cable ducts that are sectionalized for fire protection purposes, the ventilation openings shall be provided with fire dampers or fire protection isolating components. Their fire resistance capability shall correspond to that of the partitioning structural elements.

(11) Redundant equipment of the safety system shall be protected either by sufficiently fire resistant structural elements (at least F 90-A in accordance with DIN 4102-2) or by physical separation such that a failure of several redundancies as a result of a fire can be excluded under the boundary conditions mentioned in Section 3.1.1 para. 8. In well founded exceptional cases this same protection goal may be achieved by encapsulation (ensuring continuation of functionality) or by cable systems with ensured continuation of functionality or by fire extinguishing systems or by combination of these measures.

(12) Insofar as physicals separation is the only suitable fire protection measure in accordance with Section 3.1.1 to ensure necessary functional capability of the equipment of the safety system in case of fire, then

a) the stability of the ceilings and walls used for this purpose as well as
b) the functional capability of the fire protection isolating components and fire barriers required in each individual case

shall be demonstrated under consideration of the requirements resulting from the analyses in accordance with Sections 3.2.1, 3.2.2 and 3.2.3.

Note:
It shall be assumed that the fire protection closures and fire barriers are in specified normal condition at the point in time of the aforementioned loading.

(13) In the case of substantial fire loads, e.g., large assembly of cables in cable rooms, fuel storage compartments for the emergency power diesels, separate sufficiently fire resistant areas (at least F 90-A in accordance with DIN 4102-2) shall normally be provided.

4.1.4 Areas and Fire Access Routes for the Fire Brigade

It shall be ensured that, with regard to the preparation for an intervention by the fire brigade, the required free movement areas for the fire engines, for the positioning of equipment and for the preparation of rescue and fire fighting operations including the necessary fire access routes and fire entries are available. DIN 14 090 shall basically be applied in this connection.

Note:
Exceptions are dealt with in Sec. 4 KTA 2101.2.

Fire access routes for the fire brigade and rescue routes shall be kept clear of obstructions.

Note:
In particular, the rescue routes provided in accordance with KTA 2102 are considered as fire access routes for the fire brigade.

4.2 Equipment-related Fire Protection Measures

4.2.1 Fire Load

(1) Basically, only non-combustible operating media shall normally be used. Exceptions are permissible for hydraulic and lubrication fluids as well as for other combustible materials, provided, they are unavoidable for operational reasons. It is recommended to use flame retardant hydraulic fluids.

Note:
Corresponding details are specified in safety standard KTA 2101.3.

(2) Basically, only non-combustible materials shall be used. However, the use of combustible materials is permissible, provided, they are unavoidable from a design standpoint, e.g., insulating materials around cold piping, decontaminable coatings. The combustible materials shall basically correspond to Class B 1 DIN 4102-1. The use of combustible materials required from a design standpoint is permissible without certification, provided, only a negligible increase of the fire hazard is incurred, e.g., internal coatings, underground-routed cables outside of buildings, seals and small parts.

Note:
Under comparable conditions, materials can be classified as combustible and non-combustible in accordance with DIN 4102-1.

(3) Negligible fire loads (e.g., flange gaskets, identification tags, coatings of mechanical components) may be ignored. The determined fire loads may be ignored in the fire protection design, provided,

a) they are stored inside the components in a condition where an ignition can – even under an external fire influence – be precluded, or
b) the components – depending on the external or internal ignition possibilities – are designed against possible loadings during specified normal operation and retain their functional capability during the postulated design basis accidents (including fire), or
c) it is proven that under consideration of effects of the fire the combustible materials will not be set free.

(4) In the containment vessel of light water reactors, only such cables shall basically be used that counteract rapid fire spreading and that do not release corrosive gases in the case of fire (e.g., special halogen-free cables).

Note:
Requirements for such cables are specified in safety standard KTA 2101.3.

Exceptions are permissible where special electrical properties (e.g. measuring cables) or special mechanical properties (e.g. flexibility) are required. In case of an amassing of cables inside the containment vessel that do not have the above mentioned characteristics, then the protection goal shall be achieved by other suitable means.

4.2.2 Fire Alarm

(1) A fire detection and alarm system with automatic fire detectors shall be provided. The extent and arrangement of the automatic fire detectors depend on the following aspects:

a) fire load density,
b) arrangement of the combustible materials in the rooms,
c) burning behavior (spreading of flames, smoke development) of the combustible materials,
d) safety relevance of the components or systems,
e) personnel protection (ensuring escape and rescue),
f) criteria for triggering fire dampers, fire protection isolating components,
g) criteria for triggering stationary fire extinguishing systems.

Note:
Corresponding details are specified in safety standard KTA 2101.3.

(2) The fire detection and alarm system shall normally be designed to ensure a sufficiently exact location of a fire including the identification at the fire alarm boards.

Note:
Details are specified in safety standard KTA 2101.3.

(3) Interference levels due to, e.g., soiling of the automatic fire detectors shall normally be automatically compensated for.

(4) Erroneous alarms shall not trigger impermissible control signals. This pertains, in particular, to earthquakes and plant-internal design basis accidents (incidents).

(5) It shall be possible, depending on the fire protection concept, to control the fire protection equipment from the fire alarm boards.

(6) Insofar as fire fighting measures are necessary in the case of fire to ensure the required functional capability of equipment of the safety system, it shall be demonstrated that the fire detection and alarm system retains its functional capability even under consideration of the requirements resulting from the analyses in accordance with Sections 3.2.1, 3.2.2 and 3.2.3.

(7) The displays and controls necessary for the head of fire actions shall be installed in the control room or in a control room annex. At least one group alarm of the fire detection and alarm system shall be installed in plain view of the control room personnel.

(8) Overview plans indicating the alarm zones, the access routes and the locations of fire fighting equipment as well as instructions regarding proper behavior in the case of fire alarms and of malfunctions of the fire detection and alarm systems shall be provided in the direct vicinity of the control room.

Note:
Computer printouts are permitted, provided a documentation is available in the direct vicinity of the control room.

4.2.3 Fire Water Supply

(1) A sufficiently large fire water system shall be provided.

Note:
Corresponding details are specified in safety standard KTA 2101.3.

Either a natural source of water such as rivers, streams, lakes, or an artificial source of water such as a fire water pond in accordance with DIN 14 210, a fire water well in accordance with DIN 14 220, or a fire water tank in accordance with DIN 14 230 with a sufficient quantity of water shall be available as fire water supply. The water may be fed into the fire water system by means of fire pumps or high-level storage tanks.

(2) A fire water ring line system shall be installed on the site in the vicinity of the buildings and shall be kept permanently under pressure. It shall be possible to subdivide the ring line system such that, even in case of a break at any point, basically all structural plant components specified in Section 1 can be supplied with sufficient amounts of fire water; the exceptions are the cooling-water intake and outfall structures.

(3) The underfloor hydrants in accordance with DIN 3221 and the pillar hydrants in accordance with DIN 3221 shall also be connected to the fire water ring line system. Hydrants shall be located near the entrances to buildings and, outside on the site, in close vicinity of the buildings.

Note:
The hydrants may, alternatively, be supplied from a dedicated separate system, provided, its design is equivalent to that of the ring line system.

(4) All buildings accommodating equipment of the safety system shall basically be provided with wet rising mains. It shall be ensured that, in the case of loss of integrity of such mains, the functional capability of the equipment of the safety system is retained to the extent that they can still fulfill their specified functions in the case of design basis accidents (incidents). Wall hydrants in accordance with DIN 14 46-1, DIN 14 461-6, DIN EN 671-1 and DIN EN 671-2 shall be located such that all possible fire sources can be reached by the fire water jet.

(5) The fire pumps shall be redundant and shall be equipped with a protected or independent power supply; a pressurizer system shall be provided. Fire pumps or high-level storage tanks shall be spatially separated or protected such that an event causing the failure of an individual fire pump, high-level storage tank or supply line to the ring line system does not lead to a failure of supplying the required amount of water in case of required operation.

(6) The fire pumps or high-level storage tanks shall be switched on line automatically if there is a pressure drop in the fire water system. In addition, it shall be possible to monitor and operate them from the control room. It shall normally be only possible to switch off the pumps by manual action.

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

4.2.4 Fire Extinguishing Systems

(1) Stationary fire extinguishing systems shall be provided for in the case of large unprotected fire loads either from easily combustible operating media or that are seen in a combination with, e.g.,

a) difficult access (e.g., cable duct, rooms with a high local dose rate) or

b) rapid fire propagation or

c) inadequate smoke or heat removal.

(2) Fire extinguishing systems shall be designed such that, in case of malfunctions and operating errors upon required operation, the functional capability of the safety system is retained to the extent that it can perform its specified normal function in the case of design basis accidents (incidents). If, in case of fire, the necessary functional capability of the equipment of the safety system is ensured exclusively by means of fire extinguishing systems, then the functional capability of these fire extinguishing systems shall be demonstrated under consideration of the conditions resulting from the analyses specified under Sections 3.2.1, 3.2.2 and 3.2.3. In selecting the fire extinguishing agent, care shall be taken to ensure that the equipment of the safety system to be protected is not rendered inoperable as a result of the effects cause by the fire extinguishing agent.

(3) Insofar as stationary fire extinguishing systems are provided as exclusive fire protection of the equipment of the safety system, their reliability shall be ensured in accordance with Section 3.1.1 by means of special measures to be specified in each individual case.

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

Note:
In the assessment of an automatic activation due consideration shall be given to the disadvantages of an erroneous activation, e.g., the failure of safety-related equipment, an erroneous activation in the case of steam leakage, contamination of the fire water and the effects of the fire extinguishing agent on the parts with high surface temperatures.

(5) If cables with an improved behavior in case of fire are used, e.g., special halogen-free cables or cables and cable

ducts with a fire protection coating (e.g. intumescent coatings), then it shall be demonstrated in the individual case whether stationary fire extinguishing systems are necessary or not.

Note:
Also refer to Section 4.2.1 para. 4.

(6) Insofar as large quantities of water must be expected during the fire extinguishing procedure, e.g. in the case of spray water suppression systems, possibilities for removing the water, if necessary by means of mobile pumps, shall be available.

Fire water from the controlled area shall basically only be discharged under controlled conditions. Exceptions are permissible in the case of temporarily installed controlled areas, provided, the release of radioactive substances is not to be expected.

(7) In the case of remotely controlled fire extinguishing systems, the electrical triggering devices shall be installed either in the control room or in a control room annex.

4.2.5 Heat and Smoke Removal

4.2.5.1 General Requirements

(1) The ventilation systems may be used in case of a fire for the mechanical smoke removal. When used for this purpose, the requirements to be specified for the temperature and pressure resistance of individual structural elements of the ventilation systems may be specified under consideration of the mixture temperature attained in the ventilation pipes.

(2) If ventilation systems are planned to be used for heat and smoke removal, they shall be arranged such that smoke is not carried into the air supply.

(3) If mechanical heat and smoke removal equipment is used, it shall be ensured that this does not endanger persons nor any equipment of the safety system in other areas separated by fire protection measures from the area affected by the fire.

(4) The measures to be taken in the individual case shall be specified depending on the local conditions. Specific aspects are:

a) location of the room,
b) the possibilities for air supply and air exhaust with the ventilation system,
c) objective of the smoke removal, e.g., ensuring mobile fire fighting activities,
d) restrictions regarding radiation protection, e.g., small air supply and exhaust volume.

4.2.5.2 Heat and Smoke Removal from Structural Plant Components Outside the Controlled Area

Heat and smoke removal systems shall be provided for those structural plant components specified in Section 1 that are outside the controlled area unless it is ensured through other fire protection measures that the heat and smoke removal is not required for fire fighting. The available ventilation systems may be used for this purpose if they are appropriately designed and constructed.

4.2.5.3 Heat and Smoke Removal from Structural Plant Components Inside the Controlled Area

(1) Smoke removal from the structural plant components of the controlled area is allowed to the extent required for fire fighting and to rescue people. This shall basically carried out only via the paths designated for the discharge of radioactive substances during specified normal operation.

Note:
Depending on its location and duration, a fire can lead to circumstances which must be classified either as abnormal operation or as a design basis accident (incident). A large-volume smoke removal is not possible from the interior of the reactor building because of the requirements regarding control and mitigation of a loss-of coolant accident.

Nuclide-specific measurements are not necessary since the environmental radiological exposure can be determined to sufficient accuracy by other ways after the smoke has been removed.

(2) The heat and smoke removal via paths other than the discharge paths for specified normal operation (e.g. via built-in dampers for the heat and smoke removal to the outside) is permitted from those sub-areas of the controlled area which are separated in terms of fire protection and ventilation and which have been demonstrated to be radiologically irrelevant (e.g. necessary stairways); it is also permitted from the turbine building (BWR).

(3) If the ventilation system is provided with air filtration units, it shall be ensured that, e.g, temperature, pressure, fire products or fire extinguishing agents do not have impermissibly adverse effects on the air filtration units.

Note:
For example, under consideration of the expected environmental radiological exposure, provisions can be made to bypass the filter unit.

(4) It shall be ensured that the removal of cold smoke after a fire will be possible. This smoke may also be removed via the existing ventilation system. Prior to the discharge of cold smoke, a sample shall be taken and analyzed with respect to its content of radioactive substances

4.2.5.4 Keeping Rescue Routes Free of Smoke

(1) In the case of plant-internal fires, protected corridors and necessary stairways shall be kept free of smoke to such extent that there is enough air for breathing and adequate visibility for orientation.

Note:
Inside the reactor building interior, it may become necessary that the ventilation of the rescue routes must be switched off for reasons of radiological protection and that as a result the rescue routes will not be entirely clear of smoke.

(2) Necessary stairways may be kept clear of smoke by natural convection or by mechanical equipment. Mechanical equipment shall be provided for the protected corridors. Outside of the rescue routes specified under para. 1, the air supply lines to these rescue routes shall basically be of a fire resistant design. The air supply lines should have the same fire resistance rating as those building elements enclosing the protected rescue routes. Air exhaust lines shall normally have the same fire rating as the corresponding air supply lines.

Regarding the reactor building interior, equipment-related special features shall be taken into consideration.

Note:
Details regarding fire rating are specified in safety standard KTA 2101.2.

The installation of air supply and exhaust openings for natural convection may be complicated by other requirements, e.g. regarding radiological protection or plant security.

In general, natural convection is only effective in stairway sections above ground level.

(3) Technical measures shall normally be provided with regard to airlock annexes in the reactor building interior and the stairways connected to these annexes such that, under conditions prevailing during major inspections (e.g. unlocked and open airlock doors of personnel airlocks), a sufficient ventilation of these annexes and stairways is achieved for the duration required for the escape from the containment vessel.

Restrictions arising from radiological protection considerations shall be taken into consideration. In the case of a fire, the entire air supply shall normally be fed directly into the above-mentioned annexes and stairways.

4.2.6 Displays and Controls of Other Equipment Relevant to Fire Protection

The remote controls and the check-back and malfunction displays of other equipment relevant to fire protection, e.g., position detectors of the fire dampers, shall be installed in the control room or in a control room annex. At least one group alarm of the fire alarm system shall be installed in the control room or control room annex and to the required extent in the remote shutdown station. At least one optical and acoustical collective alarm shall be located in the control room.

Note:
Details regarding displays and controls of the other equipment are specified in Sec. 9 KTA 2101.3.

4.3 Fire Protection Measures for Ventilation Systems and Exhaust-Gas Systems

4.3.1 General Requirements for Ventilation Systems

(1) The ventilation systems shall be designed such that they shall basically be designed to be in conformity with the building supervision guidelines.

Exceptions are permitted as specified under Section Fundamentals para. 4 for the following reasons:

a) radiation protection (e.g., maintaining subatmospheric pressures during design basis accidents (incidents)),
b) physical separation of redundancies with the goal of being able to operate the unaffected redundancy,
c) prevention of the spreading of smoke,
d) possibilities for the removal of smoke,
e) keeping the protected corridors and necessary stairways free from smoke.

(2) In the event of fire, a spreading of smoke and radioactivity into unaffected areas shall be prevented as long as possible.

Note:
This may be achieved, e.g., by avoiding air circulation operation or by proper control of the fire dampers.

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

(4) The ventilation of the control room and the emergency control center and their annexes shall be ensured even in the case of a fire in directly adjacent fire compartments. This does not apply to a fire in the ventilation system itself.

(5) It is recommended that the ventilation equipment provided to ensure the containment closure (quick-closing valves on the containment vessel) be arranged or protected such that the closing of one valve per ventilation duct is possible even in the case of fire.

Note:
In this case, it does not have to be assumed that fires break out simultaneously inside and outside of the containment vessel.

(6) The fans in those ventilation systems the function of which shall be ensured in the case of fire shall be provided with a reliable power supply. An auxiliary power supply in accordance with safety standard KTA 3701 may be considered as sufficiently reliable. The fans do not have to be redundant for fire protection reasons.

(7) Superordinate safety related requirements forbid that the accident filtration systems controlled by the reactor protection system be blocked off by fire dampers. In such cases, a spreading of fire into other fire compartments shall be prevented by the type and routing of the ducts.

4.3.2 Fire Dampers

(1) In cases where spreading of smoke is not permissible, thermal activation of the fire dampers shall be supplemented by other possibilities, e.g., activation by a fire detection and alarm system, manual activation onsite outside of the fire room or area, remote activation from the control room. In this respect, effects from erroneous activations shall be taken into account.

(2) The controls of those fire dampers which, for reasons of safety, may only be activated in the case of fire but shall otherwise remain in the “open“ position, shall be designed such that their erroneous activation either does not have to be assumed or that, in individual cases, they can be reopened within a predetermined time period.

Note:
Corresponding details are specified in safety standard KTA 2101.3.

(3) Position indicators shall normally be located in the control room area. At least one group alarm shall be located in plain view of the control room personnel.

4.3.3 Activated Charcoal Filters

Suitable measures shall be taken to prevent the occurrence and spreading of fires of activated charcoal in the filters of the ventilation and exhaust gas systems and to contain such fires.

Note:
Corresponding details are specified in safety standards KTA 2101.2 and KTA 2101.3.

5 Structural and Equipment-related Fire Protection Measures Against Building-external Fires

(1) The fire loads stored as specified on the nuclear power plant site outside of buildings shall be separated from the individual buildings of the nuclear power plant by a sufficient distance or by sufficiently fire-resistant structural elements.

(2) The penetration of smoke and hot fire fumes into the individual buildings via the ventilation systems shall basically be prevented (cf. Construction Supervision Guideline “Ventilation Systems“). The prevention of the penetration of smoke and hot fire gases does not have to be proven in the case of building areas which do not contain equipment of the safety system and which do not have to be occupied by personnel for safety reasons.

(3) Further measures related to the combination of events as specified under Sections 3.2.1, 3.2.2 and 3.2.3 may be disregarded, provided, the requirements in accordance with Sec. 19.1 RSK Guidelines for PWR are met concerning fuel fires in the case of an aircraft crash.

6 Operational Fire Protection Measures

6.1 Responsibilities

(1) In each nuclear power plant one person shall be appointed to be responsible for fire protection. Organizationally, this person shall report directly to the plant management.

(2) The duties of this person shall in particular include the supervision regarding compliance with fire protection measures, e.g., in the case of the storage of combustible materials

or in the course of welding tasks, as well as the supervision of the plant-internal fire brigade, of the maintenance of all equipment-related fire protection measures, of the performance of regular fire drills, of the cooperation with the public fire departments, of the preparation and regular verification of fire alarm and fire fighting plans as well as of verifying that the rescue routes and fire brigade areas are kept clear of obstructions.

(3) The person responsible for fire protection measures shall have a fire protection knowledge at least in accordance with Level B 3 BMI Guideline “Necessary Knowledge“.

6.2 Fire Brigade

In accordance with the State codes a plant-internal fire brigade shall be available for the fighting of fires.

6.3 Fire Protection Regulation

A fire protection regulation in accordance with Sec. 6.7 KTA 1201 shall be drawn up as part of the operating manual specifying the measures for fire prevention and fire fighting as well as the substitute measures in situations where the measures of structure-related and equipment-related fire protection are not available as well as the behavior of personnel in case of fire. The fire protection regulation shall also contain information on the location of the supervisory control station in the case of fire.

6.4 Fire Fighting Plans

(1) Fire fighting plans for the nuclear power plant site and for individual structural plant components as agreed upon with the responsible fire department shall be drawn up, e.g., in accordance with DIN 14 095-1, with regard to a rapid orientation and assessment of the situation in the event of fire. These plans shall contain all necessary details for the tactical actions (cf. Sec. 1.3 DIN 14 095-1). They shall, in particular, contain details on the measures regarding the structure-related fire protection, e.g., the number and arrangement of the fire compartments, the manually operated fire dampers, and on the systems and equipment for the detection and fighting of fires.

(2) A copy of the fire fighting plans shall be provided at least in the control room, at the main entrance, with the plant-internal fire brigade and with the person responsible for fire protection.

6.5 Fire Extinguishers

Fire extinguishers shall be placed at convenient locations in accordance with ZH 1/201 and ASR 13/1,2.

7 Tests and Inspections

7.1 Tests Prior to Licensed Construction

(1) The license applicant shall submit the following documents for review and examination before he may receive the respective license:

a) fire protection concept,

b) blueprints with details of the fire protection subdivision and lists with a room-by-room compilation of the existing fire loads and ignition sources – the latter insofar as required under Section 3 – as well as safety-related evaluations of those plant components which could possibly be affected by fire,

c) technical drawings of the areas monitored by automatic fire detection and alarm systems and the areas where fires can be suppressed by stationary fire extinguishing systems,

d) description and – insofar as required – proof of suitability of the fire protection related materials, structural elements and constructions,

e) description of the ventilation systems with details on the schematics, technical drawings, controls concept and – insofar as required – ventilation rates,

f) description of the heat and heat removal equipment as well as proof of their adequate design,

g) description of the fire extinguishing systems as well as proof of their adequate design,

h) description of the fire detection and alarm systems as well as proof of their adequate design,

i) schematic of the areas for the fire brigade.

(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.

Note:
See also “Compilation of the Documents Required for the Testing of Nuclear Facilities by Construction Supervision Authorities” of November 6, 1981 (GMBl. 1981, page 518).

7.2 Accompanying Inspection

(1) This includes:

a) design review,

b) construction supervision and assembly testing,

c) acceptance and functional testing.

(2) The required tests and inspections are specified in **Table 7-1**. Type and extent of the tests depend on the specific condition of the plant and shall be specified in each individual case. The test instructions shall be presented in good time before acceptance and functional testing.

Note:
See also “Compilation of the Documents Required for the Testing of Nuclear Facilities by Construction Supervision Authorities” of November 6, 1981 (GMBl. 1981, page 518).

7.2.1 Design Review

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

7.2.2 Construction Supervision and Assembly Testing

(1) The construction materials and structural elements shall be checked in the course of construction and assembly. It shall also be checked that the plant components and equipment are manufactured and erected in accordance with the reviewed documents.

(2) Insofar as the manufacture of the construction materials, structural elements and equipment were already subject to tests in the manufacturing plant, no further testing in this regard is necessary.

7.2.3 Acceptance and Functional Testing

(1) Acceptance and functional test 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 functional testing of the respective structural elements, plants and equipment shall be repeated to the extent necessary.

7.3 Inservice Inspections

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

When specifying other testing intervals than the ones listed in **Table 7-2** the experience from inservice inspections as well as the special design characteristics and quality assurance measures required in nuclear power plants shall, in close coordination with the nuclear supervisory authority, be taken into consideration.

(2) A prolongation of the testing interval is permissible, provided, for reasons of, e.g., accessibility, certain tests are possible only during refueling or reactor shutdown. However, the proper authority must consent to the prolongation of operation then required

(3) In accordance with safety standard KTA 1202 testing instructions are required for individual test objects listed in **Table 7-2**. These shall, in particular, specify the pant-related and equipment-related individual testing steps.

Note:
Test requirements are contained in the approvals and test certificates under construction supervision legislation and in the relevant standards and guidelines.

(4) The existing combustible materials shall be checked at least every three years regarding their correspondence with the licensed fire protection concept as specified under Section 3.1.2.2. Within the framework of the fire protection round after every major revision, it shall be checked that the additionally introduced fire loads have been properly removed.

7.4 Removal of Defects

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

7.5 Documentation

(1) Test records shall be prepared as proof of the performance of the tests in accordance with Section 7.3 para.3. These test records shall, in particular, contain an evaluation of the test results, the detected defects, any necessary time limits for the removal of defects and the signature of the tester and the date of the test.

Note:
Details are specified in safety standards KTA 1202 and KTA 1404.

(2) The test records of inservice inspections shall be stored by licensee.

No.	Test Object	Design Review [1)]	Construction Supervision / Assembly Testing	Acceptance and Functional Testing
1	Structural Materials	X	X	–
2	Room Isolation Components with Requirements Related to Fire Protection			
2.1	Walls, ceilings and support structures	X	X	X
2.2	Cable and pipe isolation structures	X	X	X
2.3	Fire protection closures (e.g., doors, hatches)	X	X	X
2.4	Other isolating components (e.g., joints, glass windows)	X	X	X
3	Other Equipment-related Fire Protection Measures			
3.1	Specific measures for the separation of redundancies (e.g., encapsulation, coating systems, heat insulation)	X	X	–
3.2	Measures related to reducing the fire hazard of components (e.g., oil pans, splatter protection, special protection of cables)	X	X	–
4	Smoke Removal Systems, with the exception of mechanical smoke removal	X	X	X
5	Fire Alarm System	X	X	X
6	Fire Protection Measures in the Case of Ventilation Systems			
6.1	Ventilation systems with functions in the event of a fire, including functions of the necessary flaps, the corresponding controls and signaling equipment			
	a) equipment-oriented heat and smoke removal systems	X	X	X
	b) ventilation equipment to keep the rescue routes free from smoke	X	X	X
6.2	Fire dampers, smoke protection flaps, smoke removal flaps including the corresponding control and signaling equipment	X	X	X
6.3	Fire resistant ventilation and smoke removal ducts (excluded are concrete ducts)	X	X	X
7	Fire Water Supply	X	X	X
8	Fire Extinguishing System	X	X	X
9	Mobile Fire Extinguishers inside Buildings	X	–	X
10	Mobile Equipment inside Buildings for the Fire Brigade	X	–	X

X Tests performed by proper authority or authorized expert.

– No tests required. In case this applies to the column Acceptance and Functional Testing, the respective acceptance test record shall be created in the course of assembly testing.

1) Insofar as components with a certification of functionality are employed, e.g., with a general certification under building legislation, it is only required that these certificates be presented.

Table 7-1: Testers and Test Objects Regarding Accompanying Inspection

No.	Test Object	Type of Test	Testing Interval		Remarks
			Licensee	Authorized Expert [1)]	
1	Room Closure Components with Requirements Related to Fire Protection				
1.1	Cable isolation structures	S	1 a	2 a	
1.2	Pipe isolation structures	S	2 a	2 a	
1.3	Fire protection closures (e.g., doors, hatches)	F	1 a	2 a	
2	Other Equipment-related Fire Protection Measures				
2.1	Specific measures for the separation of redundancies (e.g., encapsulation, coating systems, heat insulation)	S	2 a	2 a	
2.2	Measures related to reducing the fire hazard of components (e.g., oil pans, splatter protectors, special protection of cables)	S	2 a	2 a	
3	Smoke Removal Systems, with the exception of mechanical smoke removal	F	6 m	1 a	
4	Fire Alarm System				
4.1	Fire detectors	F	1 a	1 a	
4.2	Primary lines	F	3 m	1 a	
4.3	Fire alarm centers including power supply	F	3 m	1 a	
4.4	Control equipment a) for forwarding alarms to the control room and for evaluating the alarms	F	6 m	1 a	
	b) for automatic triggering of fire protection equipment	F	6 m	1 a	
	c) for triggering the forwarding equipment of fire alarms to external authorities	F	6 m	1 a	
4.5	Locking systems of fire protection closures	F	1 m	1 a	
5	Fire Protection Measures in the Case of Ventilation Systems				
5.1	Ventilation systems with functions in the event of a fire, including functions of the necessary flaps, the corresponding controls and signaling equipment a) equipment-related heat and smoke removal systems	F	1 a	2 a	
	b) ventilation equipment to keep the rescue routes free from smoke	F	1 a	2 a	
5.2	Fire dampers, smoke protection flaps, smoke removal flaps including the corresponding control and signaling equipment	F	1 a	1 a	
5.3	Fire resistant ventilation and smoke removal ducts (excluded are concrete ducts)	S	1 a	2 a	
6	Fire Water Supply				
6.1	Triggering and power supply of the equipment under No. 6.2	F	1 w	1 a	
6.2	Fire pumps including pressurizer and water make-up equipment	F	1 m	1 a	

No.	Test Object	Type of Test	Testing Interval		Remarks
			Licensee	Authorized Expert [1)]	
6.3	Pressure vessels	in accordance with DruckbehV			
6.4	Pipe network with regard to overall supply capacity	F	2 a	2 a	
6.5	Valves and fittings in the pipe network	F	1 a	2 a	
6.6	Building isolation and penetration valves	F	1 m	1 a	
6.7	Outside hydrants	F	1 a	2 a	
6.8	Hose reels	F	1 a	2 a	Includes measurement of the flow pressure at the highest location (Sec. 9.2 DIN 14 461-1)
7	Spray Water Fire Extinguishing System				
7.1	Remotely controlled valves (including pneumatic and hydraulic valves)	F	6 m	1 a	
7.2	Pipe networks and spray nozzles	S	1 a	1 a	
7.3	Pipe networks and spray nozzles, either, water or pressurized air supply	F	5 a	5 a	
7.4	Alarm system	F	1 w	1 a	
8	Sprinkler Systems				
8.1	Pre-action alarm valve station, rapid openers, rapid air removal	F	6 m	1 a	
8.2	Pipe networks and sprinklers	S	6 m	1 a	
8.3	Alarm system	F	1 w	1 a	
9	Foam Extinguishing System				
9.1	Overall plant including mechanical seals of the admixture facility	S	1 m	1 a	
9.2	Triggering system	F	6 m	1 a	
9.3	Alarm system	F	1 w	1 a	
10	Gas Extinguishing System				
10.1	Overall plant	F	6 m	1 a	
10.2	Triggering and alarm system	F	6 m	1 a	
10.3	Pressure vessel	in accordance with DruckbehV			
11	Mobile Fire Extinguishing Equipment inside the Buildings	S	1 a	2 a	if necessary, additional test in accordance with DruckbehV
12	Mobile Equipment for the Fire Brigade inside the Buildings	S	1 a	2 a	if necessary, additional test in accordance with DruckbehV

F functional test (including visual inspection)

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

w week(s) testing interval

m month(s) testing interval

a year(s) testing interval; tests are to be performed during refueling in case of inaccessible areas

1) The authorized expert (as defined under Section 2 para. 11) also checks the tests performed by licensee in the form of inspecting the test records of licensee. Tests by experts authorized under other fields of legislation shall be taken into consideration, provided, they correspond to nuclear legislation with respect to type and goal of the tests.

Table 7-2: Responsibilities and Testing Intervals Regarding Inservice Inspections

Appendix

Regulations Referred to in this Safety Standard

Regulations referred to in this safety standard are only valid in the version 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.

Atomgesetz		Act on the peaceful utilization of atomic energy and the protection against its hazards (Atomic Energy Act) of December 23, 1959 (BGBl. I, p. 814) as amended on July 15, 1985 (BGBl. I, p. 1565), most recently changed by law on April 6, 1998 (BGBl. I, p. 694)
DruckbehV		Ordinance for pressure vessels, pressurized gas bottles and filling facilities (Pressure Vessel Ordinance – DruckbehV) of April 21, 1989, (BGBl. I, p. 843) most recently amended by Law of June 23, 1999, (BGBl. I, p. 1435)
StrlSchV		Ordinance on the protection from damage by ionizing radiation (Radiological Protection Ordinance - StrlSchV) of October 13, 1976, (BGBl. I p. 2905, 1977 p. 184, 296),in the version published on June 30, 1989 (BGBl. I, 1989, p. 1321), corrected October 16, 1989 (BGBl. I, 1989, p. 1926) most recently changed by ordinance of August 18, 1997 (BGBl. I, p. 2113)
ArbStättV		Ordinance on working places (Working Place Ordinance – ArbStättV) of March 20, 1975 (BGBl. I, p. 729) most recently changed by law of December 4, 1996 (BGBl. I, p. 1841)
VBG 30	(01/87)	Accident prevention regulation – Nuclear power plants
MBO	(10/81)	Specimen building code (Special Commission on Construction Surveillance of the ARGEBAU)
Construction Supervision Guideline ”Ventilation Systems“	(01/84)	Construction supervision guideline on fire protection requirements regarding ventilation systems (initial draft version)
BMI-Guideline “Necessary Knowledge“	(10/80)	Guideline relating to the assurance of the necessary knowledge of the persons otherwise engaged in the operation of nuclear power plants of October 30, 1980 (GMBl. 1980, p. 652)
RSK-Guidelines for PWR	(10/81)	RSK-Guidelines for Pressurized Water Reactors, 3rd edition of October 14, 1981 (BAnz. No. 69 of April 14, 1982, Supplement No. 19/82)
Incident Guidelines	(10/83)	Guidelines on the evaluation of the design of nuclear power plants with pressurized water reactors against incidents in terms of Sec. 28 para. 3 Radiological Protection Ordinance (Incident Guidelines) of October 18, 1983 (BAnz. No. 245 of December 31, 1983)
Recommendation – Accident Management Measures	(10/77)	Recommendations on the planning of accident management measures by the operator of nuclear power plants of December 27, 1976 (GMBl. 1977, p. 48), most recently changed by ordinance of October 18, 1977 (GMBl. 1977, S. 664)
KTA 1201	(06/98)	Requirements for the operating manual
KTA 1202	(06/84)	Requirements for the testing manual
KTA 2201.1	(06/90)	Design of nuclear power plants against seismic events Part 1: Principles
KTA 2201.6	(06/92)	Design of nuclear power plants against seismic events Part 6: Post-seismic measures
KTA 3701	(06/99)	General requirements for the electrical power supply in nuclear power plants
DIN 3221	(01/86)	Fire hydrants, under ground
DIN 3222	(01/86)	Fire hydrants, above ground
DIN 4102-1	(05/98)	Fire behaviour of building materials and building components - Part 1: Building materials; concepts, requirements and tests
DIN 4102-2	(09/77)	Fire behaviour of building materials and building components; building components; definitions, requirements and tests

DIN 14 090	(06/77)	Areas for the fire brigade on premises
DIN 14 095	(08/98)	Ground plans of buildings for fire brigade use
DIN 14 210	(11/82)	Water pool for fire fighting
DIN 14 220	(04/91)	Fire wells
DIN 14 230	(04/91)	Underground water-tanks for fire fighting
DIN 14 461-1	(02/98)	Delivery valve installation - Part 1: Hose reel with semi-rigid hose
DIN 14 461-6	(06/98)	Delivery valve installation - Part 6: Dimensions of cabinets and installation of hose reels with lay-flat hoses according to DIN EN 671-2
DIN EN 54-1	(10/96)	Fire detection and fire alarm systems - Part 1: Introduction; German version EN 54-1:1996
DIN EN 671-1	(02/96)	Fixed firefighting systems - Hose systems - Part 1: Hose reels with semi-rigid hose; German version EN 671-1:2001
DIN EN 671-2	(02/96)	Fixed firefighting systems - Hose systems - Part 2: Hose systems with lay-flat hose; German version EN 671-2:2001
ASR 13/1, 2	(06/97)	Fire extinguishing equipment (BArbBl. 1997, Nr. 7/8, p. 70-73)
ZH 1/201	(1996)	Rules for the equipment of work places with fire extinguishers