Nuclear Safety Council's Instruction IS-30, of 19 January 2011, on the requirements of the fire protection programme at nuclear power plants

Article 2.a) of Law 15/1980, of 22 April, creating the Nuclear Safety Council, confers on this Public Entity the faculty to "prepare and approve Instructions, Circulars and Guides of a technical nature relating to nuclear and radioactive facilities and to nuclear safety- and radiological protection-related activities" to promote regulations that allow their safe operation, that is, without undue risks for people or the environment.

The Nuclear Safety Council has been individually requiring NPP licensees to implement a fire protection programme in accordance with the requirements placed on US nuclear power plants and the conditions included in the fire protection licence of each power plant in particular. The approval of this Council Instruction is due to the need to incorporate these requirements into the Spanish legal framework, under the provisions established in Article 8.3 of the Regulation Governing Nuclear and Radioactive Facilities (Royal Decree 1836/1999, of 3 December, modified by Royal Decree 35/2008, of 18 January).

The work carried out by the Western European Nuclear Regulators Association (WENRA) to harmonize the regulations across the different countries has been taken into account in the drafting of this Instruction. As a result of this effort, a set of common requirements known as "reference levels", which must be reflected in national regulations, has been established. It has been considered necessary to develop a Council Instruction that takes these requirements into consideration to give consistency to the process of regulatory development that has been undertaken by the CSN as a result of this harmonization effort.

In particular, WENRA's Reference Level document sets in its Chapter S (Fire Protection against Internal Fires) the basic requirements applicable to what is termed "Fire Protection at Nuclear Power Plants" in the terminology that has been traditionally employed within the Spanish documentary and legal framework.

Under the foregoing, and in accordance with the legal authorization envisaged in Section a) of Article 2 of Law 15/1980, of 22 April, creating the Nuclear Safety Council, this Council, after consultation of the affected sectors and after considering the appropriate technical reports, in its meeting of the 19th January 2011, has agreed the following:

First. ***Purpose and scope of application***

1. The purpose of this Council Instruction is to require nuclear power plant licensees to implement a fire protection programme and to define the criteria that must be fulfilled by such programme to ensure that a safe shutdown can be achieved and maintained in the event of any fire in any fire area of the power plant and the likelihood of off-site radioactive releases is minimized.

2. This Council Instruction shall apply to the licensees of all Spanish nuclear power plants with an operating license.

Second. ***Definitions***

The definitions of the terms and concepts contained in the present Council Instruction match those contained in the following Regulations:

- Law 25/1964, of 29 April, on Nuclear Energy.
- Law 15/1980, of 22 April, creating the Nuclear Safety Council.
- Royal Decree 1836/1999, of 3 December, approving the Regulation Governing Nuclear and Radioactive Facilities.

In addition, the following definitions apply within the context of the present Council Instruction:

Design-basis accident: the set of accident conditions against which a nuclear facility is designed. Under these conditions, the criteria used in the design help to keep the deterioration of nuclear materials and the release of radioactive materials within authorized limits. They are also known as “postulated accidents”.

Operator manual actions in case of a fire: all those actions needed to achieve and maintain the safe-shutdown condition after a fire and which are carried out:

- Outside the main control room or the remote shutdown panel, or
- To achieve the recovery of said capability from inside the control room.

Safe-shutdown analysis in case of a fire: the process or method for identifying and evaluating the structures, systems and components (SSCs) necessary to achieve and maintain safe-shutdown conditions in case of a fire.

Fire risk analysis: the analysis used to assess plant’s capacity to maintain safe-shutdown capability and to minimize off-site radioactive leaks in case of a fire. The analysis must include the following characteristics:

- The identification of permanent and transient fire risks.
- The identification and evaluation of the protection and prevention means relating to fire risks.
- The assessment of the impact of the fire on any area of the plant to achieve a safe shutdown and maintain shutdown conditions as well as to minimize and control the off-site release of radioactive material.

Fire areas or compartments: sections of an entire building, separated by fire-resistant barriers, that ensure that a fire cannot propagate from this area to another one or vice versa during the specific fire-resistance time.

Fire-resistant barriers: building components (walls, enclosures, structural floors), as well as seals, doors, dampers, fire-resistant electrical raceway covering, etc., that are qualified by approved labs as fire-resistant within a certain range and are used to delay the propagation of fires for a minimum time equal to that for which they have been qualified.

Equipped fire hose: an assembly consisting of a valve, a hose, a nozzle, a pressure gauge and an isolation valve, permanently connected to a water supply and intended for fire protection.

Fire brigade: a group of people trained and taught to adopt the necessary measures in case of a fire.

Second intervention or backup fire brigade: a group of people having the necessary fire protection training and knowledge to help the fire brigade during fire extinction tasks.

Associated circuits in the field of fire protection: safety related and non-safety related electrical circuits – class 1E and non-class 1E – which may adversely affect the safe shutdown of a power plant due to a fire. These associated circuits are those that:

1. Do not meet the separation criteria indicated in Article 3 of this Council Instruction, and

2. Fulfil one of the following conditions:

a) Share a power supply with the (redundant or alternative) safe-shutdown equipment that is not electrically protected by means of properly coordinated circuit breakers, fuses or other devices.

b) Are connected to circuits of equipment whose spurious operation may adversely affect the safe-shutdown capability (e.g. interface valves between the residual heat removal system and the reactor cooling system, automatic depressurization system valves, pressurizer relief valves, other relief and safety valves, steam dump valves for flushing the steam generators, instrumentation, steam dump, etc.).

c) Share a common enclosure (e.g. electrical raceways, panels, junction boxes) containing (redundant or alternative) shutdown cables and are not electrically protected by means of circuit breakers, fuses or devices or allow fires to propagate.

Firewalls: physical barriers that prevent the linear propagation of a fire along a combustible item. When the material existing on one side of the firewall is consumed, the other end of the item is not affected by the temperature. They differ from fire barriers in that the latter protect the area or equipment from the effects of an external-exposure fire.

Fire detection: the action of revealing the existence of a fire by means of items sensitive to some of the phenomena associated with fire.

Structures, systems and components (SSCs): a general term that encompasses all items of a facility. Structures are the passive elements: buildings, vessels, shielding, etc. A system comprises several components or structures assembled in such a way as to perform a specific function. A component is a specific item of a system. Some of examples are cables, transistors, integrated circuits, motors, relays, solenoids, pipes, fittings, pumps, tanks and valves.

Safety (or safety-related) structures, systems and components: those items whose operation is taken into consideration in the analyses of design-basis accidents for:

1. Bringing the facility to a safe condition and keeping it in said condition in the long term.
2. Keeping the radiological consequences of anticipated operational occurrences and of design-basis accidents within their specified limits.

Structures, systems and components important to safe shutdown in case of a fire: those items that perform the functions required to achieve and maintain a safe shutdown in that scenario.

Structures, systems and components important to safety: the following is included in this concept:

1. Those structures, systems and components whose malfunction or failure could lead to an undue exposure to radiation of site personnel or members of the public;
2. Those structures, systems and components that prevent anticipated operational occurrences from leading to accident conditions;
3. Those items that are provided to mitigate the consequences of accidents caused by a malfunction or failure of structures, systems or components.

Fire: the process of violent oxidation of combustible material with the release of flames, heat or gases.

Ignition source: any process or piece of equipment that gives off sparks, flames or enough heat to cause a combustible or flammable material to ignite.

Hydrant: a connection for hoses or monitor, located outdoors, whose water supply provides enough flow and pressure to extinguish fires during their most intense phase. They can either be dry-piping or wet-piping hydrants.

Fire: the rapid ignition of combustible materials, with an abundant presence of an oxidizer, initiated by a flame or an ignition source.

Combustible material: any substance susceptible of combining with oxygen in a rapid and exothermic reaction.

Non-combustible material: any material which, in the form and conditions used, does not ignite or burn, withstands combustion or does not give off flammable vapours when it is subjected to the action of fire or heat.

Alternative shutdown: the shutdown strategy used for those zones or areas where, due to a fire, the redundant trains are not free from damage and systems that have been rerouted, relocated or modified to achieve and maintain a safe shutdown are used.

Dedicated shutdown: the shutdown strategy that uses the system or set of equipment specifically installed to achieve and maintain safe shutdown by means of a separate way or train.

Cold shutdown: the state, condition or mode of operation of the reactor fulfilling the conditions defined on the matter in the power plant Technical Specifications.

Safe shutdown: a plant situation where the reactor is kept in a subcritical state, according to the definition in the power plant's Technical Specifications, the removal of residual heat and the control of core coolant inventory being guaranteed, and no off-site radioactive releases take place.

Fire protection programme: the collection of components, analyses, procedures, activities, personnel and resources needed to define and carry out all those fire protection activities that guarantee, given any fire in any fire area of the power plant, that safe shutdown can be achieved and maintained and that the likelihood of off-site radioactive releases is minimized. This includes the fire protection system itself, the design of the facility, fire prevention, detection, alarms, confinement, extinction, administrative controls, the fire-fighting organization, inspection and management, training, quality assurance, testing, etc.

Fire-resistant: characteristics that certain materials show when subjected to the specific conditions of the standard time-temperature curve.

Access and escape route: a properly marked path that allows entering and exiting any fire zone or area of a facility.

Spurious signal in the field of fire protection: a signal that causes an unwanted actuation of an equipment or component – considering all possible functional states thereof – and which might affect the capability to achieve and maintain safe shutdown.

Safe-shutdown earthquake: an earthquake of the maximum intensity considered in the design of the power plant such that the latter may be taken to a safe-shutdown condition in case the former occurs.

Fire protection system: the collection of detection, alarm and extinction structures, systems and components that have been designed, installed and serviced according to the fire protection programme.

Postulated initiating event: an event identified during design as being capable of leading the facility to the conditions of an anticipated operational event or accident.

Redundant train: the set of equipment or components of a system that are capable, independently, of performing the safety function of the system.

Fire zone: any subdivision made inside a fire area or compartment that is used as a unit of study for the installation of the specific active protection (detection, control and extinction) systems. The criteria for laying out the fire zones are based on the type of existing combustible material, the assessment of the fire risk and the anticipated severity of the fire.

Third.–The Nuclear Safety Council's criteria for fire protection at nuclear power plants.

3.1 *Fire protection objectives.*

3.1.1 The holder of the operating licence of a nuclear power plant must adopt the principle of defence in depth in fire protection, implementing measures to prevent a fire before it starts, to detect, control and extinguish it as soon as possible in case it occurs, and to prevent the propagation thereof to other areas that might affect safety.

3.1.2 The holder of the operating licence of a nuclear power plant must guarantee, by means of confinement in fire areas, that, when faced with a fire that cannot be extinguished, the fire will not damage at least one of the redundant safe-shutdown trains such that the power plant may achieve and maintain such safe shutdown and the likelihood of off-site radioactive releases is minimized.

3.2. *Design bases.*

3.2.1 Structures, systems and components important to safety must be designed and located such that the likelihood of the occurrence of a fire and its consequences is minimized and that the safe-shutdown capability is achieved and maintained during and after a fire. The power plant shall be provided with non-combustible and heat-resistant materials, and detection and extinction systems suitable for preventing fires and explosions at their source or, failing that, minimizing the consequences thereof shall be installed in fire areas containing structures, systems and components important to safety.

3.2.2 Buildings containing cable raceways and/or equipment important to safety shall be designed to be resistant to fires and subdivided into fire areas in such a way that redundant cable raceways and/or equipment important to safety are separated from each other by barriers of a fire resistance of, at least, three hours. When this is not possible, fire zones containing compensatory active and passive means (detection and extinction systems, distances, fire-resistant raceway covering, etc.) – duly justified in the fire risk analysis – must be used.

3.2.3 At least, means for protecting structures, systems and components important to safe shutdown in case of fires must be provided. These devices must be capable of limiting the damages caused by a fire such that:

a) One train of the systems required to achieve and maintain safe-shutdown conditions from the control room or emergency control room(s) is undamaged by the fire; and

b) The systems needed to achieve and maintain cold shutdown from the control room or emergency control room(s) can be repaired within the first 72 hours following the start of the fire.

3.2.4 In order to comply with that indicated in the preceding Article 3.2.3, one of the following conditions must be fulfilled in fire areas where all redundant safe-shutdown trains (including their associated circuits) converge:

1) One of the following measures shall be used outside the containment building:

a) Separation of the cables, equipment and associated circuits (safety and non-safety) of redundant trains by barriers with a fire resistance of three hours. Structural steel belonging or supporting such fire-resistant barriers must be protected to achieve as well a three-hour fire resistance.

b) Separation of the cables, equipment and associated circuits (safety and non-safety) of redundant trains by a horizontal distance of more than 6 m, without combustible material or ignition sources in between. In addition, fire detectors and an automatic fire suppression system must be installed in the area.

c) Confinement of the cables, equipment and associated circuits (safety and non-safety) of redundant safety trains inside a barrier with a fire resistance of one hour. In addition, fire detectors and an automatic fire suppression system must be installed in the area.

2) One of the measures listed in the previous section or one of the following measures shall be used inside non-inerted containment buildings:

a) Separation of the cables, equipment and associated circuits of redundant trains by a horizontal distance of more than 6 m, without combustible material or ignition sources in between.

b) Installation of a fire detection system and a fire suppression system in the area.

3.2.5 Should it be not possible to comply with that laid down in the preceding Article 3.2.4, there shall be an alternative or dedicated shutdown capability independent from the cables, components and systems of the area under consideration.

3.2.6 Those associated circuits which, due to a fire, may cause failures or reduce the capacity of any of the redundant safe-shutdown trains to perform their function must be protected in accordance with Articles 3.2.3 and 3.2.4.

3.2.7 A valid alternative to meet the requirements of Articles 3.2.2 to 3.2.6 or other requirements specifically approved by the CSN is to follow a “risk-informed and performance-based” methodology previously accepted by the CSN. In order to opt for this methodology, the holder of the operating licence of the nuclear power plant must formally apply for a change in its licensing basis.

3.2.8 The use of manual operator actions in case of a fire as an alternative to that indicated in Articles 3.2.3 to 3.2.6 requires CSN's explicit approval.

3.2.9 Unless it is conveniently justified in the fire risk analysis, buildings containing radioactive materials or materials that can affect the safety of the plant in case of a fire must be fire-resistant and be provided with a controlled ventilation system ensuring that no off-site release of radioactive smoke occurs after a fire.

3.2.10 The access and escape routes necessary to evacuate facility personnel and facilitate the actions of the personnel in charge of the emergency operation and fire-fighting must be set in place.

3.3. *Fire risk analysis.*

3.3.1 A fire risk analysis that proves that fire safety objectives are fulfilled, design bases are complied with, active and passive fire protection systems have been properly designed and administrative controls have been properly implemented must be conducted and kept up to date.

3.3.2 The fire risk analysis shall be conducted in a deterministic manner and shall at least cover:

1. A single fire and its propagation to any place in the plant where there is permanent or transient combustible material that is used in normal operations such as power operation, refuelling activities, maintenance or modifications.
2. The consideration of the combination of a fire with other initiating events independent on the fire and caused thereby (e.g. the loss of outside power).
3. The consideration of the loss of outside power for those fire areas to which that indicated in Article 3.2.5 applies.
4. The analysis of associated circuits that might adversely affect safe shutdown.

3.3.3 Licensees must develop a safe-shutdown analysis that demonstrates that, under a postulated fire in any fire area of the power plant, it is possible to achieve and

maintain safe shutdown and to have recovered, within the first 72 hours following the start of the fire, all equipment and systems required to achieve and maintain cold shutdown. The analysis shall identify the safe-shutdown and cold-shutdown systems, components and circuits existing in any fire area and must prove that the requirements included in Article 3.2 of this Council Instruction are fulfilled.

3.3.4 The fire risk analysis must prove that the possible consequences and effects of both the intentional and spurious actuation of fire extinction systems has been taken into consideration.

3.3.5 The fire risk analysis shall be completed with a level-1 fire probabilistic analysis at power operating mode.

3.3.6 For nuclear power plants taking advantage of that indicated in Article 3.2.7, this fire risk analysis may also be carried out according to the “risk-informed and performance-based” methodology previously accepted by the CSN.

3.4 *Fire protection system.*

3.4.1 Every fire area and/or zone containing structures, systems and components or cables important to safety must be fitted out with fire detection and local alarm means and with an alarm and indication of the location of the fire for control room personnel. These means must be fed by a main electric current supply and another alternative, independent autonomous power supply by means of batteries with 4 hours of lifetime and such that it is possible, within the first 4 hours from the start of the fire, to connect the power supply to a class-1E emergency power supply. In addition, cables resistant to flame propagation shall be used.

3.4.2 Fixed or portable, manual or automatic extinction systems must be installed as justified in the fire risk analysis. These systems must be designed and located such that their failure, breakdown or spurious or inadvertent operation does not hinder the ability of structures, systems or components important to safety to perform their functions.

3.4.3 The distribution of water for fire protection shall be carried out by means of a main outer ring exclusive to this service having a dual connection to buildings containing safety structures, systems or components and isolation valves by section and locked in the open position, whose purpose shall be to isolate part of the main ring for maintenance or repair without having to simultaneously cut off the water supply to primary and support extinction systems that serve areas containing equipment important to safety.

3.4.4 The fire protection ring must be capable of supplying the hydrants outside the buildings, the equipped fire hose protecting the inside of the buildings of the plant and the fixed extinction systems.

3.4.5 The HVAC system must be designed so as to allow a fire area to be isolated from the others in case of a fire.

3.4.6 The elements of the ventilation system (ducts, fans or filters) located outside fire areas must have the same fire resistance as these areas or be capable of isolating them with fire dampers of the same fire resistance.

3.4.7 Even though fires or fire protection-system failures concurrent with design-basis accidents or the most severe natural phenomenon have not been postulated, in the event of a safe-shutdown earthquake (SSE), there must be an extinction system (seismic subsystem) capable of supplying water to equipped fire hose in those fire areas containing equipment necessary to shutdown the plant in a safe manner (either located indoors or with supply).

3.5 *Quality assurance programme.*

3.5.1 A quality assurance programme applicable to the design, acquisition, assembly, testing and the administrative controls for fire protection systems of areas important to the safety of the facility shall be developed and implemented. The quality assurance

programme must be in agreement with Council Instructions applicable to quality assurance.

3.6. *Maintenance and administrative controls.*

3.6.1 Procedures must be established for controlling and minimizing the amount of combustible material and ignition sources that might affect structures, systems and components important to safety as well as for setting up the necessary inspections, maintenance and testing of active and passive fire protection components (fire-resistant barriers, detection and extinction systems, etc.).

3.6.2 Post-fire safe-shutdown procedures must be established for those areas where an alternative or dedicated shutdown is required; in addition, they shall contemplate a possible 72-hour loss of outside power.

3.7 *Fire-fighting organization and fire brigade.*

3.7.1 The licensee must set up, within the fire protection programme, the organization that shall carry out the actions derived from fire-fighting and the fire risk analysis. In order to comply with the requirements related to fire protection (maintenance, control of combustible material, training, testing, exercises and drills, design modifications, etc.), the people responsible for complying with such requirements must be identified within this organization.

3.7.2 A properly equipped and trained fire brigade must be set up. Emergency procedures that clearly define the duties, responsibilities and actions of the people in charge of fire-fighting (fire brigade) in response to a fire at the plant must be established and kept updated. A fire-fighting strategy that covers any area where a fire might affect structures, systems and components important to safety must be developed and kept updated including the necessary training.

3.7.3 Fire drills shall be conducted at the plant such that the brigade may practice as a team. These drills must be carried out at regular intervals not exceeding three months and such that every brigade member takes part, at least, in two drills per year. At least one drill per year must not be previously announced, which must be conducted on a rotating basis such that a different brigade shift takes part in it every year. In addition, one drill per year must be carried out by the second intervention or backup fire brigade. Likewise, the local fire department must participate in at least one of the annual drills.

3.7.4 There must be an off-site organization available (e.g. local fire departments) to support the power plant in fire-fighting. Appropriate coordination between plant personnel and said off-site personnel shall be provided to ensure the latter become familiar with the means and risks of the plant.

3.7.5 The requirements about organization, minimum knowledge, equipment, physical condition and training of the fire brigade must be documented, and the aptitude of its members shall be approved by a competent person.

Fourth. *Infractions and sanctions*

The present Nuclear Safety Council Instruction is binding in accordance with that established in Article 2.a) of Law 15/1980, of 22 April, creating the Nuclear Safety Council. Failure to comply shall be sanctioned in accordance with the provisions of Chapter XIV (Articles 85 to 93) of Law 25/1964, of 29 April, on Nuclear Energy.

Additional provision

For the case of new nuclear power plants, it shall be deemed from the first stages of design that Condition 1) of article 3.2.4 shall not be taken into account among the fire protection requirements for being capable of achieving and maintaining safe shutdown and minimizing the likelihood of off-site radioactive releases, such that outside the containment building, the redundant safe-shutdown trains, including their associated circuits, must be located in different fire areas. In addition, their design must minimize or eliminate the use of

alternative or dedicated shutdown systems, except for the case of the main control room. Likewise, the execution of operator manual actions in case of a fire shall be avoided, and the use of fire-resistant covering in electrical raceways shall be minimized.

First transitory provision

A period of adaptation of one year from the publication of this Council Instruction is set for that established in Articles 3.6.2, 3.7.4 and 3.7.5 to come into force.

Second transitory provision

A period of adaptation of two years from the publication of this Council Instruction is set for that established in Articles 3.3 and 3.4.7 to come into force.

Third transitory provision

A period of adaptation of three years from the publication of this Council Instruction is set for correcting the deviations from the requirements of Articles 3.2.3, 3.2.4 and 3.2.6 related to associated circuits only for those reported to the CSN during the first calendar year from the publication of this Council Instruction. For these deviations previously reported to the CSN, a specific treatment shall be applied for three years from the publication of this Council Instruction to the programme for monitoring findings and indicators that might be derived from the adaptation of the plant to these requirements, provided that they are not considered of high risk significance (red findings) or that they are not malicious acts. Likewise, for this case it is deemed that an appropriate way of complying with the notification criteria called for in Council Instruction IS-10 during this first year is to send all the information required by this Council Instruction in a single Reportable Event Report, which shall be updated on a quarterly basis until the end of this first year.

Sole Repealing Provision

Any rule of equal or lower level that is opposed the present Council Instruction is repealed.

Sole Final Provision

The present Council Instruction shall come into force on the day following that of its publication in the “Official State Gazette” (BOE, 16/02/2011).

In Madrid, on the 19th of January of 2011.–Carmen Martínez Ten, President of the Nuclear Safety Council.