

**Nuclear Safety Council
Instruction number IS-22,
of July 1st 2009, on safety
requirements for the
management of ageing and
long-term operation of
nuclear power plants**

Published in the Official State Gazette (BOE)
number 166 of July 10th 2009

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Law 15/1980, of April 22nd, creating the Nuclear Safety Council, reformed by Law 33/2007, of November 7th, attributes to this Public Entity powers to “draw up and approve technical instructions, circulars, and guides relating to nuclear and radioactive facilities and activities relating to nuclear safety and radiological protection” as regards the safe operation of nuclear and radioactive facilities, in other words without undue risks for persons or the environment.

In the limits and conditions of the nuclear power plant operating permits, the Nuclear Safety Council has required that the licensees of these facilities implement a process for management of ageing of the components of their plants, including management in the case of long-term operation beyond the design lifetime defined for each plant.

The approval of the present Instruction arises as a result of the need to generally regulate the criteria applied by the Nuclear Safety Council to require a structures, systems and components ageing management system, including the case of the long-term operation of the nuclear power plants.

In this respect, in 2004 the Nuclear Safety Council approved the document “Conditions for the long-term operation of nuclear power plants”, which contains the basic criteria applicable to requests for long-term operation and the legal and administrative framework for renewal of

long-term operating permits for nuclear power plants.

Pursuant to the above, and in keeping with the legal entitlement contemplated in article 2. section a) of Law 15/1980 of April 22nd, creating the Nuclear Safety Council, in the wording given by Law 33/2007 of November 7th, and following the appropriate technical reports and consultations with the affected sectors, this Nuclear Safety Council has agreed as follows during its meeting held on July 1st 2009:

One. Objective and scope of application

The objective of this Instruction is to establish the criteria for the management of ageing of nuclear power plant components, including management in the case of long-term operation. The requirements established in the Instruction are applicable to all plant operating conditions.

The Instruction is applicable to all nuclear power plants containing one or more power reactors of the PWR and BWR types.

Two. Definitions

The definitions of the terms and concepts contained in the present Instruction correspond to those included in the following legal texts:

- Nuclear Energy Act, Law 25/1964, of April 29th.
- Law 15/1980, of April 22nd, creating the Nuclear Safety Council.

– Royal Decree 1836/1999, of September 3rd, approving the Regulation on Nuclear and Radioactive Facilities.

Furthermore, the following definitions are applicable within the context of the present Instruction:

Time-limited ageing analyses, TLAA: analyses and calculations performed by the licensee, fulfilling the following conditions:

1. Are related to the structures, systems and components (SSC) considered within the scope of ageing management.
2. Take into account the effects of time and long-term operation.
3. Adhere to hypotheses of limited design lifetime.
4. Conclude with the capacity or not of the SSC to continue to operate, in accordance with their defined functions, after having exceeded the limited design lifetime hypotheses.
5. The calculation or analysis was considered to be relevant in a safety assessment.
6. The calculation or analysis is part of the current licensing basis of the facility.

Safety assessment: technical studies allowing for demonstration of the safety requirements imposed upon the facility. The safety assessments are performed using initial assumptions regarding the operating conditions of the facility. The validity of a safety study is limited by the set of assumptions used.

Licensing basis: is the set of obligatory requirements, regulatory commitments and exemptions deriving from both the initial

standards and those subsequently incorporated.

The licensing basis are included in the official operating documents of the plant, in the conditions associated with the approval of these documents and with the Operating Permit and in the commitments of the licensee to ensure compliance with the design basis of the safety-related systems (including the modifications performed).

Safety important elements: these include:

1. Those SSC whose malfunctioning or failure might give rise to an undue exposure to radiation for the site personnel or the members of the public.
2. Those SSC that prevent foreseen operating events from giving rise to accident conditions.
3. Those elements that are designed to mitigate the consequences of the malfunctioning or failure of structures, systems or components.

These are divided into “safety elements” (or “safety-related elements”) and “safety relevant elements”.

Safety element (or safety-related element): are the SSC to whose operation credit is given in design basis accident analysis to:

- Take the facility to safe shutdown conditions and keep it in these conditions in the long term; and
- Limit the radiological consequences of foreseen operating events and design basis accidents within the specified limits.

Safety relevant element: are the SSC, not forming part of a safety-related element, but:

- To whose operation credit is given for the mitigation of foreseen operating events or accidents or used in emergency operating procedures,
- To whose failure may prevent safety-related elements from fulfilling their safety function; or
- To whose failure may cause the actuation of a safety-related element.

Ageing: general process by which the characteristics of a system, item of equipment or component change with time or use. Ageing is manifested in the progressive degradation over time (continuously or discontinuously) of the materials and the capacity of the SSC's to perform their functions (both during normal operation and in the event of transients).

Structures, systems and components (SSC): is the general term used to refer to all the elements of a facility. The structures are the passive elements: buildings, vessels, shielding, etc. A system consists of several components or structures assembled in such a way as to perform a specific function. A component is a specific item within a system, for example cables, transistors, integrated circuits, motors, relays, solenoids, pipes, accessories, pumps, tanks and valves.

Ageing management studies: analyses demonstrating that the effects of time are duly considered for the SSC included within the scope of ageing management, such that the functions defined in the licensing basis are maintained throughout their service lifetime.

Long-term operation: continued operation of the facility, maintaining an acceptable level of safety, beyond its design lifetime, following performance of a safety

assessment ensuring maintenance of the safety requirements applicable to its SSC.

Along with a ageing management review for the new period, the safety assessment that is required to support the long-term operation of the facility must include a review of the safety assessments with a design lifetime hypothesis equal to or longer than the design lifetime of the facility, assessing whether the conclusions of these analyses are valid taking into account the period of long-term operation.

Significant ageing mechanism: is a mechanism that, in view of its potential development, requires the existence of a control or mitigation activity to guarantee the function of the affected SSC throughout their service lifetime.

Design lifetime: in relation to an SSC, refers to the operating time assumed in the design, during which it is expected to fulfil its function in the terms established in the corresponding specifications.

In estimating the design lifetime, consideration is given not only to the period over which operation of the SSC will be required, but also to the conditions under which the SSC will operate and the transients to which it will be subjected.

The design lifetime of a facility is an enveloping concept limited by the time attributed in the design to the SSC's, which for technical or economic reasons are not considered to be replaceable.

In the case of nuclear power plants of a western design (basically North American and some European plants), some of the analyses supporting the plant safety assessment have been carried out using a design lifetime hypothesis of 40 years, for example in the case of components that cannot be replaced, such as the reactor

vessel and the containment building. As a result of this, 40 years is habitually considered to be the design lifetime of these facilities.

Remaining lifetime: period of time between the present and the end of the service lifetime.

The following schematic diagram clarifies these terms.

Service lifetime: referring to an SSC, is the period of time between the initiation of its operation and its removal from service.

The service lifetime may be longer than the design lifetime, as long as the actual conditions of operation have been less severe than those assumed in design. By comparing the design conditions and the actual operating conditions it is possible to determine the margin of remaining lifetime of a system, item of equipment or component.

Three. Scope of ageing management activities

The scope of the ageing management programme specified in point four of this

Instruction should include the following safety-related and relevant SSC's:

3.1. Safety-related elements that are required to continue operating during and after any design basis event that might occur, in order to guarantee the following functions:

- The integrity of the reactor coolant pressure boundary;
- The capacity to shut down the reactor and maintain it in safe shutdown conditions; or
- The capacity to prevent or mitigate the consequences of accidents, such that off-site radioactive exposures are kept below the established limits.

3.2. Safety relevant elements whose failure might prevent satisfactory compliance with any of the functions identified in previous section 3.1.

3.3. Safety important elements to which credit is given in the safety assessments of the facility, relating to the requirements on protection against fires, environmental qualification, pressurised thermal shock, transients without scram and loss of off-site power.

Four. Criteria for the surveillance of nuclear power plant ageing management, including management in the case of long-term operation

4.1. Ageing management within the design lifetime of the facility

Throughout the design lifetime of the facility, the licensee shall carry out the necessary plant SSC ageing management activities, such that these include measures for the surveillance, control and mitigation

of the ageing mechanisms affecting safety-related and safety relevant elements and their status, and identify the proposals for improvement (new inspection activities, tests, surveillance and maintenance) incorporated to detect these mechanisms and control their effects, the conclusions of this periodic review being incorporated to a Lifetime Management Plan.

4.2. Ageing management, including the period of long-term operation

Requests for renewal of the nuclear power plant Operating Permit beyond the period foreseen in the initial design should include, among other reports, an Integrated Ageing Assessment and Management Plan, made up of a series of ageing management studies providing a reasonable guarantee of the functionality of safety-related and safety relevant elements forming part of their scope, considering the new period of operation.

4.3. Ageing management within the period of long-term operation of the facility

Throughout the period of long-term operation, the licensee shall carry out the necessary plant SSC ageing management activities by way of the corresponding Ageing Management Programmes (AMP) identified during the process of ageing management review analyses, such that there be assurance of the surveillance, control and mitigation of the mechanisms of ageing and degradation of safety-related and safety significant elements, both the mechanisms identified in the Integrated Ageing Assessment and Management Plan and whatever new mechanisms might arise.

A formal procedure should be contemplated for the identification and implementation of proposals for improvement (new inspection, testing, surveillance and maintenance activities)

incorporated to control the effects of new mechanisms identified or to optimise the management of those already existing, the conclusions of this periodic review being incorporated in a long-term Ageing Management Plan.

4.4. Requirements

The requirements to be met by the Lifetime Management Plan, the Integrated Ageing Assessment and Management Plan and the long-term Ageing Management Plan should be as follows:

a) Selection criteria.

The Lifetime Management Plan, the Integrated Ageing Assessment and Management Plan and the long-term Ageing Management Plan are applicable to those structures and components that form part of the scope defined in point three of this Instruction and that also meet the following requirements:

a.1) They are passive components (they have no moving parts or parts that change their configuration or properties), since the application of the Maintenance Rule (regulated in Nuclear Safety Council Instruction IS-15, of October 31st 2007) to active components guarantees that the critical functions of components defined within its scope are within the acceptance levels.

These structures and components:

— Include (without limitation to) the reactor vessel, reactor coolant pressure boundary, steam generators, pressuriser, piping, pump casings, valve bodies, core barrel, component supports, pressure retaining boundaries, heat exchangers, fan casings, ventilation ducts, containment buildings, containment metallic liner, electrical and mechanical penetrations, equipment locks, Category I seismic

structures, cables and electrical connections, cable trays and electrical boxes.

— Exclude (without limitation to): pumps (except the casing), valves (except the body), motors, diesel generators, air compressors, snubbers, control rod drive mechanisms, ventilation dampers, pressure transmitters, pressure indicators, level indicators, breakers, fans (except the casing), batteries, switches, relays, power inverters, electronic boards, battery chargers and electrical feed sources.

a.2) Are not included in any replacement programme based on qualified lifetime maintenance or any other replacement programme.

b) Identification of ageing mechanisms. For each component included within the scope defined above in point a), the potential ageing mechanisms and their possible causes and consequences should be analysed.

Once the structures and components with long-lived passive functions have been identified, as indicated in the previous section, they may be analysed individually or as families (commodities), considering their design and/or functional similarity.

In particular, the ageing management of the reactor pressure vessel and its welds will take into account all the relevant factors, including embrittlement, thermal ageing and fatigue, with a view to comparing their performance with the predictions of the analyses throughout the lifetime of the component.

As a result of the aforementioned analyses, the ageing effects and mechanisms considered to be significant and requiring surveillance, control or mitigation activities to ensure that the functionality of the

structure or component is not limited during its service lifetime, will be determined.

c) Evaluation of maintenance practices. The objective of this activity will be to determine whether the causes and consequences of ageing (significant ageing effects and mechanisms) are duly overseen, controlled and mitigated by the maintenance practices, bearing in mind that these do not include only predictive and preventive maintenance practices themselves but also inspection, testing, the control of operating parameters, surveillance, etc.

Maintenance, inspection and testing activities required by the current licensing basis will be valid for the ageing management of the affected SSC, with respect to the ageing effects and mechanisms dealt with therein.

Evaluation of the maintenance practices will consist of a comparison between the surveillance and mitigation activities suitable for each ageing effect and mechanism (significant for each structure or component) and the actual content of the maintenance practices performed on that structure or component. The result of the evaluation will include the improvements to the maintenance processes necessary to establish an adequate ageing management and, where required, the implementation of new management practices.

d) Analyses performed using defined design lifetime hypotheses (TLAA). In the case of ageing management considering long-term operation, all the analyses and calculations performed by the licensee, meeting the definition of TLAA included in section two shall be identified, and these TLAA shall be evaluated in the case of SSC affected by the following criteria:

d.1) The results of the analyses affect the design basis that guarantees the safety function of a component or structure included within the scope of the Integrated Ageing Assessment and Management Plan and affected by significant ageing mechanisms.

d.2) The lifetime hypothesis defined in the original analysis is shorter than the lifetime that would be applicable with the new operating permit requested. The evaluation of these TLAA analyses shall be performed using one of the following methods:

— Verification that the current analyses continue to be valid for the new operating period proposed and, therefore, no new analysis is required. In this respect there shall be a demonstration that the hypotheses and conditions of the analysis already consider the management of ageing effects for the period of long-term operation and that the acceptance criteria provide a reasonable margin to ensure compliance with the function throughout this period.

— Re-evaluation or repetition of the analysis for the new lifetime period requested and verification that the established acceptance criteria are fulfilled.

— Demonstration that the effects of ageing may be adequately managed during the new operating period by an AMP.

Five. Documentation

The licensees of the nuclear power plants shall draw up periodic reports including the activities carried out in compliance with points three and four of the present Instruction. These reports shall be submitted to the Nuclear Safety Council

with the content and in the time periods indicated below:

5.1. Annual reports on ageing management within the design lifetime of the facility

Within the first six months of each calendar year a report shall be submitted including the activities of the Lifetime Management Plan of the facility, which shall cover the surveillance, control and mitigation of the ageing mechanisms affecting safety-related and safety relevant elements within the scope of lifetime management, as defined in section 3, and the status of these elements, and identify the proposals for improvement (new inspection, testing and surveillance activities) incorporated or to be incorporated to detect these mechanisms and control their effects.

The scope and content of the Lifetime Management Plan of the facility shall be at least as determined in the methodology of the North American standard 10 CFR 54, “Requirements for renewal of the operating permit”, articles 54.3, 54.4 and 54.21, until such time as the plant reaches the end of its design lifetime, with the exception of the requirements of articles 54.3.a and 54.21.c on specific time limited analysis (TLAA) of components. Only if the plant opts for long-term operation will it be necessary also to fulfil the requirements of the aforementioned standard as regards definition of the applicable TLAA.

Likewise, within the scope, content and period for submittal of the documentation relating to the Periodic Safety Review (PSR) of the facilities, a revision of the Lifetime Management Plan shall be included to confirm that during the period considered by the PSR:

— The ageing and degradation mechanisms of safety-related and safety

relevant elements have been taken into account, within the scope of lifetime management as defined in section 3.

— Consideration has been given to unexpected ageing mechanisms and effects.

— New relevant information emerging and new aspects arising have been incorporated in the Lifetime Management Plan.

— The most adequate methods and tools available for ageing management have been used, and

— The effectiveness of maintenance management has been assessed, in accordance with the results of the practices implemented at the facility.

5.2. Report on ageing management, including the period of long-term operation

An Integrated Ageing Assessment and Management Plan report shall be submitted, containing the analyses of ageing management (scope, selection, identification of ageing mechanisms, evaluation of maintenance practices and proposals for improvement) and the TLAA analyses necessary for the revision of the analyses performed with defined design lifetime hypotheses, allowing for reasonable guarantee of the functionality of the structures, systems and components included within its scope. The reference for this Plan shall be the US regulations contained in standard 10 CFR 54 “Requirements for renewal of the operating licenses” and in its enacting documents, both those of the US regulatory agency and those of the nuclear industry, known respectively as the “Standard review plan for licence renewal applications” (NUREG-1800), the “Generic ageing lessons learned report” (NUREG-1801) and Guideline No 95-10 of the American Nuclear Industry Association.

The Integrated Ageing Assessment and Management Plan report shall be accompanied by a supplement of the Safety Analysis Report, including studies and analyses justifying the management of SSC ageing at the plant during the period of long-term operation, and a revision of the Technical Specifications, including the changes required to maintain safe operating conditions during this new period.

The minimum period for submittal of the documentation relating to the Integrated Ageing Assessment and Management Plan shall be three years prior to the date for renewal of the operating permit, an update of these documents, including the modifications made at the plant, being submitted a year before the date of renewal of the aforementioned permit.

5.3. Annual reports on ageing management within the period of long-term operation of the facility

During the first six months of each calendar year a report shall be submitted containing the activities of the long-term Ageing Management Plan of the facility, which shall include the surveillance, control and mitigation of the ageing and degradation mechanisms of safety-related and safety relevant elements, both those identified in the Integrated Ageing Assessment and Management Plan and those new mechanisms that might arise, identifying the proposals for improvement (new inspection, testing, surveillance and maintenance activities) incorporated to control the effects of these mechanisms. The scope and content of the long-term Ageing Management Plan report of the facility shall be at least as determined in the methodology of the North American standard 10 CFR 54, “Requirements for renewal of the operating permit”, articles 54.3, 54.4 and 54.21, including the requirements of the said standard as

regards the TLAA studies applicable thereto.

The President of the Nuclear Safety Council,
Carmen Martínez Ten

Six. Exemptions

The licensees of the nuclear power plants covered by the present Instruction may request full or partial temporary exemption from compliance with any of its requirements, adequately justifying the reasons for such request and identifying the alternative method to be used to fulfil the established criteria.

Seven. Violations and penalties

The present Nuclear Safety Council Instruction shall be binding, in keeping with the requirements of article 2.a) of the Law creating the Nuclear Safety Council, Law 15/1980, of April 22nd, for which reason non-compliance therewith shall constitute a violation of a legal requirement and shall be penalised as set out in Chapter XIV, articles 85 to 93 inclusive, of the Nuclear Energy Act, Law 25/1964, of April 29th, in the wording given by Law 33/2007, of November 7th.

Eight. Derogatory provision

All legal standards of equal or lower standing and opposing the present Instruction are hereby annulled.

Nine. Final provision

The present Instruction shall enter into force on the day following the date of its publication in the Official State Gazette.

Madrid, July 1st 2009