Nuclear Safety Council Instruction number IS-23 on in-service inspection at nuclear power plants

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Nuclear Safety Council Instruction number IS-23 on in-service inspection at nuclear power plants

Article 2.a) of Law 15/1980, of April 22nd, creating the Nuclear Safety Council, in the wording given 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. This article has been reinforced by Law 33/2007, of November 7th, which incorporates promotion of the participation of the stakeholders and the public in the process of drawing up these instructions.

The set of periodic examinations and tests carried out on the structures, systems and components throughout the operating lifetime of the plant constitutes what is known as In-Service Inspection, and is aimed at verifying their structural integrity and functional capacity.

At present, and in view of the absence of Spanish standards governing these activities, the nuclear power plants carry out their in-service inspection programmes in accordance with the standards defined in the regulations of the country of origin of the technology and accepted in the operating permits, the basic standards applied being section XI of the code of the American Society of Mechanical Engineers (ASME) and the Operation and Maintenance code of this Association (ASME-OM), required by the Technical Specifications. Consequently, this code is considered to be an acceptable reference for the drawing up of the in-service inspection and testing programmes defined for these facilities, which are included in the document known as Manual of In-Service Inspection (MISI).

In accordance with the provisions of article 20 c) of the Regulation on Nuclear and Radioactive Facilities, approved by Royal Decree 1836/1999, of December 3rd, the operating permit of nuclear power plants must include, among other documents, the Technical Specifications, among them the programme for periodic revisions, calibration and inspection of the systems and components of the facility. In this respect, and as regards the safe operation of the nuclear power plants, the Nuclear Safety Council is empowered to require the establishment of an in-service inspection and testing programme in order to gain insight into the status of the structures, systems and components (SSC) and guarantee their functionality.

Consequently, the approval of this Instruction is based on the need to generally regulate the criteria applied by the Nuclear Safety Council regarding the management, drawing up and application of the programme «In-Service Inspection» of 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 November 4th 2009:

One. Objective and scope of application

The objective of this Instruction is to define the requirements made by the Nuclear Safety Council to the licensees of the nuclear power plants regarding the establishment of an In-Service Inspection programme guaranteeing that safety-related structures, systems and components (SSC), and certain safety significant SSC's, maintain their structural integrity and operating capacity such that they operate within the defined limits or, otherwise, that the licensees may implement the corrective measures required to restore the required safety conditions.

The requirements set out in the present Instruction are applicable to all the nuclear power plants throughout their operating lifetime.

Two. Definitions

The definitions of the terms and concepts used in the present Instruction shall be as set out in the following standards:

— Nuclear Energy Act, Law 25/1964, of April 29th (BOE No 107, of May 4th 1964).

– Law 15/1980, of April 22nd, creating the Nuclear Safety Council (BOE No 1000 of April 25th 1980).

– Royal Decree 1836/1999, of December 3rd, approving the Regulation on Nuclear and Radioactive Facilities (BOE No 313, of December 31st 1999).

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

Reactor coolant pressure boundary:
This is the overall set of components subjected to the pressure of the reactor and that form part of or are connected to its coolant system. The pressure boundary includes the following:

1. In US design plants:

— For systems with pipes penetrating containment, up to the outermost containment isolation valve.

— For systems not penetrating containment, up to the second of the two valves that are closed during normal operation of the reactor.

— For BWR reactors, the reactor coolant system includes up to the outermost containment isolation valve of the feedwater and main steam systems.

— The reactor coolant system relief and safety valves.

2. For German design pressurised water reactor plants:

— The piping connecting to the reactor coolant system, up to the first isolation valve.

— The reactor coolant system relief and safety valves.

Safety significant element. This includes:

1. Those structures, systems and components 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 structures, systems and components that prevent foreseen operating events from giving rise to accident conditions.

3. Those elements that are designed to mitigate the consequences of accidents caused by the malfunctioning or failure of structures, systems or components.

These are divided into “safety-related elements” and “safety significant elements”.

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

1. Take the facility to safe shutdown conditions and keep it in these conditions in the long term.

2. Limit the radiological consequences of foreseen operating events and design basis accidents within the specified limits.

Safety significant element: is an element not forming part of a safety-related element but:

1. To whose operation credit is given for the mitigation of foreseen operating events or accidents or used in emergency operating procedures.

2. Whose failure may prevent safety-related elements from fulfilling their safety function.

3. Whose failure may cause the actuation of a safety-related element.

Structures, systems and components (SSC):
this is the general term that covers all the elements of a nuclear power plant that contribute to protection and safety, with the exception of human factors. 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 snubbers, piping, accessories, pumps, tanks and valves.

Qualification of a person: this is the demonstration of the training, professional knowledge, skill and experience that makes a person suitable for the correct performance of inspection or testing tasks.

Qualification of inspection equipment or systems: this is the demonstration of the capacity of inspection equipment or systems to perform an inspection or test, achieving the objectives set out and guaranteeing the performance required.

Non-destructive Examination (NDE): any type of test applied to a material in order to establish a characterisation that does not permanently alter its physical, chemical, mechanical and dimensional properties.

Defect indication: any unintentional imperfection or discontinuity in the material detected as a result of a non-destructive test and to be analysed using the applicable acceptance criteria.

Pre-service inspection: examination performed prior to the placing in service of a system or component in order to obtain data complementing the manufacturing or construction data and establish a reference basis for comparison with subsequent in-service examinations.

Interference: physical obstruction by elements foreign to the component to be examined or the very configuration of the component that prevents examination of the volume or surface as required. This may be avoidable or unavoidable.

Inspection interval: this is the time during which the in-service inspection programme established is to be performed in its entirety.

Examination method: the application of a physical non-destructive principle for the performance of a test.

Inspection period: each of the approximately equal periods of time into which the inspection interval is divided and during which certain maximum and minimum percentages of the inspection programme are to be completed.

Leakage test: test performed at the rated pressure of the system, in order to detect leaks.

Integrated containment leakage rate test: test performed to verify the overall leaktightness of the primary containment, by determining the integrated leak rate.

Local containment leakage test: set of tests performed to verify the leaktightness of certain containment components, such as penetrations (expansion bellows, electrical penetrations, etc.) and containment lock and isolation valve seals, by determining their specific leak rate.

Functional test: process performed to determine the operability of a component or system under given conditions.

Hydrostatic test: test performed with the installation or system out of service at a pressure higher than the operating pressure of the system, in accordance with the applicable code or standard.

Temporary repair: repair valid for an SSC to remain in service until the next scheduled outage of more than 30 days but not later than the next refuelling outage.

NDE technique: the specific utilisation of an NDE method.

Inspection system: all the parts making up a Non-Destructive Examination (NDE) system; i.e., the inspection procedures, associated equipment and personnel in charge of their operation and analysis of the data acquired.

Three. Scope of in-service inspection programmes at nuclear power plants

Each nuclear power plant operating permit licensee shall oversee the performance or status of safety significant structures, systems and components (SSC) by applying systematic inspection and testing programmes defined by the licensee himself on the basis of what is specified in section four of this Instruction.

The scope of the programme shall include the following:

— The reactor coolant pressure boundary.

— Safety-related SSC's.

— Safety significant SSC's considered as a result of the application of specific programmes (risk-informed inspection programmes, erosion-corrosion programmes, etc.) or others required by the CSN.

Four. Nuclear Safety Council criteria for the establishment of in-service inspection programmes at nuclear power plants

4.1. Each licensee shall draw up an in-service inspection and testing programme including representative samples of all the SSC's included within the scope defined in section three of this Instruction.

In addition to these requirements, the programmes shall include those arising as a result of the temporary application of a standard, of the conditions of the operating permit in force, of licensee commitments or of other requirements defined in instructions or requirements issued by the CSN as a result of the operating experience of the plant or the nuclear industry and requiring systematic performance.

4.2. The in-service inspection and testing programmes shall be defined for an inspection interval and shall be developed in detail in a document known as «Manual of In-Service Inspection» (MISI). This document shall include at least the following programmes:

— Non-destructive Examination (NDE) programme.

— Supports and snubbers programme.

— Pump and valve testing programme.

— Pressure testing programme.

— Containment testing programme.

— Steam generators programme (at those plants where this is applicable).

The definition of the programmes for each interval, as regards scope, frequency and inspection or testing methods, shall meet to the requirements of the Technical Specifications (TS), the standards applicable in each case or defined by the CSN in the Operating Permit or instructions or requirements issued by the CSN.

The inspection intervals have a duration of ten years as from the entry into commercial operation of the plant and shall be maintained throughout the service lifetime of the facility. The duration of the interval may be increased or decreased by no more than 12 months depending on the operating conditions of the plant, as long as this is permitted by the applicable standards.

4.3. Prior to the placing in service of an SSC, either at the beginning of plant operation or following a repair, replacement and/or modification, a pre-service examination shall be performed, in accordance with the requirements of the applicable standards, as a complement to those performed in adherence to the construction or manufacturing requirements and serving as a reference for comparison with the successive SSC examination carried out in service. To the extent possible, this examination shall be performed using the same methods, techniques and equipment that will be used for in-service examinations.

This examination shall be performed on all the SSC's included within the scope defined in section 3 and potentially subject to in-service inspections.

4.4. The parts of SSC's subject to in-service inspection (examination areas) shall be examined using one or more NDE methods (visual, surface and volumetric). In addition, pressure retaining systems and components, including those exempt from examination, shall be subjected to periodic pressure tests.

4.5. The frequency of inspection of the SSC examination areas shall be at least once every ten years (duration of interval).

The inspections scheduled for the interval shall be distributed uniformly throughout this interval, with the exception of those areas in

which inspection is allowed at the end of the interval, such that the minimum and maximum percentages required in each inspection period are fulfilled.

The sequence of inspection to be adhered to throughout the service lifetime of the plant shall, to the extent possible, be the same as that applied during the first inspection interval, which shall have been selected considering conservative hypotheses such that any deterioration of the most exposed component is detected before its failure may occur.

The examinations shall preferably be carried out during refuelling outages, although performance during normal plant operation shall also be acceptable, as long as the conditions of accessibility and operation allow for this and do not interfere with the examination results.

4.6. The NDE methods and techniques used shall be selected with consideration given to the different characteristics and nature of the SSC's, defect typologies, conditions of accessibility and different radiation levels and the degree of automation of the equipment used for performance of the examinations. These methods and techniques shall be suitably described in procedures.

The inspection systems used in in-service inspections shall be qualified in accordance with the methodology accepted by the CSN and shall have the scope established therein.

4.7. The evaluation of the results of these inspections shall consist of a comparison between the results obtained and the applicable acceptance criteria. These results shall also be compared to the results obtained with the reference inspection (pre-service) and previous in-service inspections performed, the changes observed being analysed and/or justified.

In the event of results exceeding the acceptance criteria being detected, additional inspections shall be performed in order to guarantee to the extent possible that there are no SSC's of the same or an analogous type affected.

No credit shall be given to the inspections performed as a result of the extended sampling referred to in the previous paragraph as regards compliance with the inspection programme.

SSC's presenting unacceptable indications shall be repaired before being returned to service, or accepted using the methods included in the applicable standards. Likewise, a root cause analysis shall be performed to determine the nature or possible origin of these indications in the shortest time possible, with a view to applying adequate solutions.

4.8. Any interference that fully or partially prevents coverage of the inspection volume or surface required by the applicable standard shall be recorded and analysed, the causes, percentage interfered with and corrective actions to be adopted being determined, including replacement with another analogous inspection area, and shall be documented in the corresponding inspection reports. If it is not possible to adopt any solution, the interference shall be considered unavoidable and, if the percentage affected exceeds the limit defined by the applicable standards, it shall be treated as a code exemption and explicitly identified in In-Service Inspection Manual in force for the interval.

4.9. The functional testing of pumps and valves shall be performed in accordance with written procedures describing in detail the test process, the applicable requirements, the reference values and associated limits and the acceptance criteria specified in the standards, which shall be coherent with the design basis documents, the safety assessments and the TS, depending on which are applicable.

The reference values referred to in the previous paragraph shall be established by way of a pre-service test, in the case of components so requiring according to the standards. This test shall be performed under the same conditions, or conditions as close as possible to, those that will foreseeably exist for in-service testing.

The results of these tests shall be documented and evaluated, in order to detect

trends that might lead to unsatisfactory performance, even though all the applicable acceptance criteria have been fulfilled. Likewise, the root cause of repeated faults shall be analysed.

4.10. Pressure retaining systems and components, except the containment, included within the scope of the programme shall be subjected to the following pressure tests:

— Leakage or hydrostatic test as part of pre-service inspection.

— Reactor coolant system leakage test after each refuelling outage and before the reactor becomes critical.

— Leak testing of safety-related systems, other than the reactor coolant system, during each inspection period.

— A hydrostatic test at the end of the interval, or as close to this moment as is reasonably possible, when required by the applicable standards.

The systems and components included within the scope of this test shall be examined visually under the pressure and temperature conditions established in accordance with the testing objectives. These conditions shall be maintained a sufficient period of time to ensure that an evidence of leakage is detected. In the event of any evidence of leakage being detected, this leakage shall be located and analysed, this including the performance of whatever additional examinations might be appropriate.

4.11. The containment in-service inspection programme shall contain the examinations and tests required to control leaktightness and integrity, in accordance with the applicable standards. This programme shall include all or some of the following activities, depending on the design of each individual plant:

— Integrated containment leakage rate test.

— Local containment leakage test.

— Inspection for the surveillance of structural integrity, including metallic and concrete surfaces.

— Post-tensioning surveillance.

— Containment structural integrity testing.

4.12. Repair and replacement activities shall be carried out in accordance with the applicable standards and shall be documented in accordance with the process defined at each plant for these activities. These activities shall be performed in compliance with the quality assurance system established at the plant, such that their complete traceability is ensured.

4.13. The testing instruments and equipment used for the performance of the inspections and tests shall be of a range and accuracy appropriate to demonstrate compliance with the examination and testing requirements established. These items of equipment and instruments shall be suitably identified in the calibration records and the period of validity of the calibration shall be regularly verified by the licensee in accordance with the plant quality assurance programme.

4.14. The in-service inspection activities shall be set out in a management procedure defining, among other aspects, the organisation and the responsibilities of the intervening persons and departments, the issuing, revision and approval of the documentation generated and the quality programme defined for such activities.

4.15. All the documents associated with in-service inspection activities, documents generated for the tracking of such activities, procedures for the performance of inspections and tests, records, repairs, etc. shall comply with the operations quality assurance programme. The licensee shall ensure the application of the requirements of his programme, as appropriate, to any activity carried out by external organisations (contractors or sub-contractors).

4.16. The licensee shall keep all procedures applicable to in-service inspection activities updated, in accordance with the standards defined, during the interval in force. In the event of the inspection interval being

changed, the necessary updating of the procedures may extend to 12 months as from the end of the previous inspection interval. Nevertheless, if the requirements established by the new standards are more conservative, these shall be applied from the beginning of the new interval.

Five. Documentation

5.1.The licensees shall draw up the MISI document including the programme of inspections and tests to be carried out over an interval of 10 years. This document shall be updated at least at the beginning of each interval, the applicable standards being used for this task.

Updating for other reasons, such as changes in the programmes as a result of new requirements, design modifications, detected errors, corrections, etc., shall be reported to the CSN six months prior to the beginning of each refuelling outage, including in each case the corresponding justification.

Three months before the refuelling outage, the licensee shall submit the revised MISI, or failing this, the sheets that constitute the new revision, in accordance with the provisions of the previous paragraph and with the comments of the CSN were they to exist.

These changes shall be suitably identified and justified.

5.2. The licensees shall submit the documentation associated with the inspection and testing programmes for each refuelling outage and operating cycle and with the corresponding results.

The final results reports corresponding to years in which an inspection period comes to an end shall include a specific chapter recapitulating on the inspections and tests performed throughout this entire period, specifying compliance with the applicable requirements, inspection percentages, testing requirements, etc. and evaluating the results obtained, root cause analyses where required and corrective actions deriving therefrom.

The scope and terms of this documentation shall comply with the provisions of Nuclear Safety Council Instruction number IS-02, of September 1st 2004, regulating documentation on refuelling activities at light water nuclear power plants, and subsequent error correcting addenda (BOE of October 11th 2004 and BOE of July 26th 2005).

Six. Exemptions

The licensees of the nuclear power plants may request full or partial temporary exemption from compliance with any of the requirements included in the applicable standards and relating to the scope of this Instruction, adequately justifying the reasons for such request and identifying the alternative method to be used to comply with the said requirements, in order to maintain an adequate level of quality and safety. These exemptions shall be subject to acceptance by the Nuclear Safety Council.

Seven. Infringements 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 the infringement the requirements of the system of penalties set out in the Nuclear Energy Act, Law 25/1964, of April 29th.

Eight. Single derogatory provision

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

Nine. Single final provision

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

Madrid, November 4th 2009
The President of the Nuclear Safety Council,
Carmen Martínez Ten