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# NUCLEAR SAFETY COUNCIL

## **1595** *Nuclear Safety Council Instruction IS-36, of January 21<sup>st</sup> 2015, on emergency operating procedures and the management of severe accidents at nuclear power plants.*

Article 2.a) of Law 15/1980, of April 22<sup>nd</sup>, creating the Nuclear Safety Council, attributes to this Public Body powers to «draw up and approve instructions, circulars and guidelines of a technical nature relating to nuclear and radioactive facilities and to activities relating to nuclear safety and radiological protection» in relation to the safe operation of nuclear and radioactive facilities, that is without undue risk for persons or the environment. This article has been reinforced by Law 33/2007, of November 7<sup>th</sup>, which incorporates promotion of the participation of stakeholders and the public in the process of drawing up these instructions.

Article 20 of the Regulation on Nuclear and Radioactive Facilities (approved by Royal Decree 1836/1999, of December 3<sup>rd</sup>, and modified by Royal Decree 35/2008, of January 18<sup>th</sup>) requires applications for nuclear facility operating permits to be accompanied by the Operating Regulation, among other documents, which will contain operating standards and procedures for both normal operation and accident conditions.

Operating procedures are necessary because they guarantee that the nuclear power plant is operated safely and without undesirable consequences for safety, since they indicate the way in which the plant systems are to be handled in the different possible operating situations.

The availability of a set of suitable operating procedures and guidelines for operation in the different possible situations that might arise during the lifetime of a nuclear power plant, from normal operation up to severe accidents, contributes significantly to increasing the safety of the facility, since these documents have a direct impact on the reliability of operator actions, notably reducing the probability of human error.

In this respect, the operating procedures and guidelines must be adequate in scope and have been developed taking into account all the associated technical aspects, including human factors engineering principles and techniques.

In order for the quality of the procedures and guidelines to be suitable, it is necessary for them to be subjected to processes of verification and validation, in order to guarantee the suitability of the transient and accident management strategies contained therein.

The users of these documents shall receive periodic education and training suitable for the correct performance of the applicable steps and strategies. The procedures and guidelines are living documents that must be revised. They are integrated in control of the configuration of the nuclear power plant, for which reason they must at all times reflect the current situation of the systems of the facility. Furthermore, in order to guarantee their technical quality and the suitability of their scope, they must be updated taking into account the operating experience of the plant itself and of others of similar technology, also considering new developments by the nuclear power plant owners groups or the supplier of the technology of the facility.

The present instruction establishes the requirements to be met by the Spanish nuclear power plants in relation to Emergency Operating Procedures (EOP's) and Severe Accident Management Guidelines (SAMG's), taking into account the issues mentioned in the previous paragraphs. The Instruction addresses the treatment to be given to both new EOP and SAMG development programmes (or major modifications to those already existing, such as for example general revisions) and to the maintenance of programmes already developed and in operation. In addition, the requirements applicable to the Extensive Damage Mitigation Guidelines (EDMG's) have been included.

This Instruction also includes an article containing the requirements applicable to guidelines and procedures for actions to address whatever emergency situations might arise with the nuclear power plant in the shutdown condition, which are not normally included in standard Emergency Operating Procedure sets. Each licensee shall justify compliance with the requirements of article 9 of this Instruction and, where necessary, initiate programmes for the development or improvement of the emergency action guidelines and procedures for shutdown situations.

Included in this Instruction are requirements for the management of severe accidents,

that is with significant degradation of the core, in areas relating to the instrumentation and protection of the containment. These requirements are closely related to the severe accident management guidelines, since the latter are designed for the optimum management of the design characteristics of the plant. The requirements applicable to the instrumentation and protection of the containment considered for the management of accidents in situations prior to the initiation of significant core degradation are not the subject of the present Instruction.

In drawing up this Instruction, consideration has been given to the standards in force in the countries of origin of the technology used at the Spanish plants and to those of the International Atomic Energy Agency (IAEA), as well as to the experience acquired by the CSN in relation to this issue.

Consideration has also been given in this Instruction to the work carried out by the Western European Nuclear Regulators' Association (WENRA), with a view to bringing into harmony the regulations of the different countries. As a result of these efforts, in 2006 WENRA established a set of common requirements known as «reference levels», which are to be reflected in the national standards; subsequently, in 2008, WENRA undertook the first revision of these requirements. The development of a Council Instruction contemplating these criteria is considered necessary, in order to bring some cohesion to the process of standards development undertaken by this organisation within the framework of the harmonisation programme.

The accident that occurred at Fukushima nuclear power plant in Japan has underlined the transcendental importance of issues relating to the capacities and resources required to manage a severe accident. During 2011 and 2012, stress tests and the corresponding peer reviews were carried out under the coordination of the European Union. In view of the results obtained, WENRA has revised the reference levels to incorporate new requirements associated with the lessons learned from the accident. This IS incorporates the most significant aspects of this revision as regards emergency operating procedures and severe accident management.

By virtue of the above, in compliance with the legal qualifications contemplated in article 2, section a) of Law 15/1980, of April 22nd, creating the Nuclear Safety Council and following consultation with the affected sectors and corresponding technical reports, this Council has agreed as follows during its meeting of January 21st 2015:

#### *One. Objective and scope of application*

The objective of the present Instruction is to regulate the requirements to be met by the nuclear power plants in relation to the procedures and guidelines applicable to emergencies, as well as to the management of severe accidents.

This Instruction shall be applicable to the licensees of the operating permits of the Spanish nuclear power plants.

## Two. *Definitions.*

The definitions of the terms and concepts contained in the present Instruction correspond to those regulated by the following provisions:

- Nuclear Energy Act, Law 25/1964, of April 29<sup>th</sup>
- Law 15/1980, of April 22<sup>nd</sup>, creating the Nuclear Safety Council
- Royal Decree 1836/1999, of December 3<sup>rd</sup>, approving the Regulation on Nuclear and Radioactive Facilities

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

Accident.– Deviation from the normal operating status that is more severe than a anticipated operating event. The definition includes design basis accidents (and those accidents that, being more severe than a anticipated operating event, are covered by design basis accidents) and beyond design basis accidents (among which are severe accidents).

Design basis accidents.- This is the set of accident conditions for which a nuclear facility is designed. Under these conditions, the criteria used for the design mean that the deterioration of nuclear materials and the release of radioactive materials remain within the authorised limits. These are occasionally known as «postulated accidents».

Beyond design basis accidents.- These are situations not considered in the initial design of the facility and that might give rise to consequences more serious than a design basis accident.

Severe accident.– An accident exceeding the design basis in which there is significant degradation of the core.

Shutdown emergency response guidelines (SRG).- This is a set of operating procedures and guidelines designed to address emergency situations arising in operational situations in which use of the EOP's is not typically prescriptive. This does not mean, however, that use of the EOP's might not be considered in the SRG's.

Severe accident management guidelines (SAMG).- Guidelines or procedures containing operating strategies designed to mitigate the consequences of a severe accident.

Extensive damage mitigation guidelines (EDMG).- Guidelines or procedures containing alternative operating strategies designed to prevent or mitigate the consequences of beyond design basis accidents in which there has been a long-lasting loss of power supply and/or of the ultimate heat sink or the loss of major areas of the plant.

Human factors engineering.- Application of knowledge of human capacities and limitations to the design of the plant, systems and equipment. Human factors engineering provides a reasonable guarantee that the design of the plant, systems and equipment, the human tasks and the working environment are compatible with the sensorial, perceptive, cognitive and physical attributes of the personnel operating, maintaining and supporting the plant.

Normal operation.- This concept includes all those operating modes in which the plant may routinely find itself, from shutdown for refuelling, in any of its phases, to operation at full power.

Emergency operating procedures (EOP).- Procedures containing the operating strategy and necessary actions, including local actions, to take the plant to a stable and safe long-term operational situation in the event of abnormal situations not leading to a severe accident. At the Spanish plants the scope of these procedures overall includes situations occurring with the unit in power operation or during certain phases of unit start-up and shutdown.

Anticipated operating event.- This is an operational condition that deviates from normal operation and that is expected to occur one or more times during the lifetime of the nuclear power plant. The criteria used in designing the plant mean that these events do not cause significant damage to items of importance from the point of view of safety or give rise to accident conditions.

Validation.- A process of assessment that uses tests based on observable behaviours to determine whether a product or service is suitable to satisfactorily undertake the function for which it has been designed.

Verification.- A process used to determine whether the quality or performance of a product or service is as specified and as required. Verification is closely related to quality assurance. In the case of operating procedures and guidelines, verification includes checking that they are written correctly and checking of their technical accuracy by contrasting them with all the documents constituting their source. This also includes the process by which the procedures are assessed in order to determine whether they acceptably meet the criteria of the human factors engineering design guidelines.

### Three. *Objectives and scope of EOP's and SAMG's*

3.1 Nuclear power plants shall have a coherent set of emergency operating procedures (EOP) for design basis and beyond design basis accidents, as well as severe accident management guidelines (SAMG).

3.2 The EOP's shall cover design basis and beyond design basis accidents up to the onset of significant degradation of the core. These procedures shall contain instructions appropriate to recover stable unit conditions, to re-establish and compensate for safety functions if these have been lost or are threatened, and to take the plant to safe conditions.

In the case of multiple unit sites, the EOP's shall be drawn up in such a way as to allow them to be applied in the event of several units being in an accident situation simultaneously, taking into account the dependencies between their systems and the availability of personnel to be assigned to each unit.

3.3 The SAMG's shall be drawn up with the objective of mitigating the consequences of severe accidents if the measures put into place through implementation of the EOP's have not been successful in preventing core damage.

In the case of multiple unit sites, the SAMG's shall be drawn up in such a way as to allow them to be applied in the event of several units being in an accident situation simultaneously, taking into account the dependencies between their systems and the availability of personnel to be assigned to each unit.

3.4 The EOP's for design basis accidents shall be based on symptoms or shall be a combination of symptom and diagnosis-based procedures. The EOP's for beyond design basis accidents shall preferably be based on symptoms.

3.5 The SAMG's shall be drawn up to address accidents occurring from any normal operating mode.

3.6 The nuclear power plant licensee shall draw up an implementation plan designed to meet the requirements set out in the previous paragraph.

### Four. *Contents of EOP's and SAMG's*

4.1 The EOP's shall be developed systematically and shall be based on realistic, plant-specific analyses. The EOP's shall be consistent with the rest of the plant operating procedures and with the SAMG's.

4.2 The structure of the EOP's shall allow the operator to rapidly recognise the accident situation to which they are applicable. The entry and exit conditions shall be defined in the EOP's in such a way that the operator may select the suitable procedures, move among the different EOP's and transition from the EOP's to the SAMG's.

4.3 The SAMG's shall be developed by means of a systematic process specific to each nuclear power plant. The SAMG's shall include the strategies necessary to mitigate the consequences of severe accidents.

4.4 The licensee's processes for the development and maintenance of the EOP's and SAMG's shall consider the principles and techniques of human factors engineering. The procedures and guidelines shall be technically correct and accurate, complete, explicit, user-friendly and reliable (verified and validated), and shall be integrated and consistent with the rest of the man-machine interfaces of the facility.

4.5 The setpoints corresponding to the process variables included in the EOP's and SAMG's for application of the operating strategies and decision-making shall be established taking into account the uncertainties of the associated instrumentation loops, in those cases in which this is necessary to guarantee the effectiveness of actions or the affected strategy.

4.6 The licensee of the nuclear power plant shall undertake a detailed analysis of the measures required to comply with the provisions of the previous paragraph and corresponding implementation plan.

#### Five. *Severe accident management aids*

5.1 The licensee of the nuclear power plant shall have available instrumentation to be used under severe accident conditions, allowing for adequate tracking of the SAMG's. The information provided by this instrumentation shall be available in the control room and in the main emergency response centre at the plant, or technical support centre, and shall be displayed in such a way as to allow for evaluation of the status of the unit and of the functions considered to be critical for safety under severe accident conditions, as well as for adequate tracking of the SAMG's.

5.2 The licensee of the nuclear power plant shall have available suitable means to protect the containment against the consequences of a selected set of beyond design basis accidents, such that:

- The capacity to isolate the containment is available. If containment isolation cannot be guaranteed, there shall be means available to allow for mitigation of the consequences of loss of this safety function.
- The capacity to maintain containment leaktightness for a reasonable time following occurrence of the accident and as a result of it is available.
  - The capacity to control containment pressure and temperature is available.
  - The capacity to control combustible gases is available.
  - The containment is protected against overpressure conditions.
  - The probability of high-pressure molten core ejection scenarios is prevented or minimised.
- Degradation of the containment as a result of molten core attack is prevented or mitigated to the extent possible.

When these means are based on equipment, systems and components already contemplated in the design, they shall be evaluated and, where necessary, modified for performance of the new function. If new equipment, systems or components are included for the performance of these functions, they may be designed using realistic criteria.

The selection of beyond design basis accidents shall be carried out considering a combination of deterministic and probabilistic analyses and engineering judgement. Consideration shall be given in these analyses to internal and external events.

5.3 The nuclear power plant licensee shall have available portable equipment to address situations of long-lasting loss of a.c. power or of the ultimate heat sink, in order to prevent damage to the reactor core and spent fuel pool and to mitigate the consequences of a severe accident. Permanent, and where necessary redundant, connection points shall be installed, such that this equipment may fulfil its function quickly and efficiently and with a high degree of reliability.

#### Six. *Verification and validation of EOP's and SAMG's*

6.1 The verification and validation of the EOP's and SAMG's shall be carried out, to the extent possible, in the same way as they will need to be used in practice, in order to ensure that they are administratively and technically correct, that they meet the criteria of the human factors engineering design guidelines acceptably and that they are adequate for the personnel to carry out the necessary tasks, allowing them to satisfactorily perform the function for which they are designed, that they support acceptably the safe operation of the plant and are compatible and integrated in the environment in which they will be used.

6.2 The process for plant-specific verification and validation of the EOP's and SAMG's shall be in keeping with the available methodologies and good practices and shall be duly documented. During the process of verifying the procedures and guidelines, technical accuracy and the incorporation of the principles of human factors engineering shall be revised. Validation of the EOP's shall be based on simulations representative of the accident situation, using a suitable full-scope simulator accepted by the CSN for initial and on-going training and licence examinations wherever feasible.

6.3 Whenever there are modifications to the EOP's or SAMG's, the affected procedures and guidelines shall be subjected to a process of verification and/or validation, as appropriate. The scope shall be established depending on the importance of the modifications.

#### Seven. *Revision and updating of EOP's and SAMG's*

7.1 The EOP's and SAMG's shall at all times be in keeping with the actual configuration and design of the unit.

7.2 The nuclear power plant licensee shall draw up an EOP and SAMG maintenance and updating control plan in order to ensure that they continue to be adequate and suitable for compliance with their objectives throughout the service lifetime of the plant.

7.3 The nuclear power plant licensee shall establish processes to guarantee that the EOP's and SAMG's are updated in accordance with internal operating experience and that of other nuclear power plants and with the recommendations of owners groups with similar nuclear power plants or of the main supplier of the technology.

#### Eight. *Training on EOP's and SAMG's*

8.1 The nuclear power plant licensee shall design an initial and periodic on-going training programme for all the personnel responsible for performing manoeuvres included in the EOP's and SAMG's, in accordance with an analysis of the tasks and responsibilities assigned to each job post. The frequency of the on-going training shall be in keeping with the safety significance and complexity of the manoeuvres to be covered in the training.

8.2 The operating shift personnel, both control room and auxiliary operators, shall be periodically trained on all the EOP and SAMG tasks and manoeuvres for which they are responsible.

8.3 The personnel of the main emergency response centre at the plant, or technical support centre, shall be trained periodically on strategies and use of the SAMG's, within their realm of responsibilities.

8.4 Training on the transition from the EOP's to the SAMG's shall be included in the initial and on-going training programme for the operating shift and plant technical support centre personnel.

8.5 Within the process of initial and on-going training on the EOP's, a full-scope replica simulator considered by the CSN to be adequate for initial and on-going training and for licence examinations shall be used. Within the process of initial and on-going training on the SAMG's, severe accident calculation programmes and simulators shall be used wherever feasible.

Nine. *Shutdown emergency response procedures (SRG)*

9.1 In addition to the EOP's dealt with in the previous articles, the nuclear power plants shall have specific SRG's. The respective areas of application of the EOP's and SRG's shall be clearly identified for each of the different possible operating situations of the plant.

9.2 The accidents for which the SRG's are to be developed shall be selected depending on their safety significance, taking into account analyses of risks during plant shutdown, among other aspects.

9.3 The SRG's shall take into account the special characteristics associated with these situations: detection and diagnosis of the situation, potential inhibition of protection signals and alarms activated, potential increase in the probability of human error, greater unavailability of systems and instrumentation and specific manual actions for each operating situation.

9.4 The requirements relating to EOP's included in articles four, six, seven and eight of this Instruction shall be applicable to the SRG's, with a scope in keeping with the safety significance of the situations for which they are developed, with the exception of those relating to use of the full-scope simulator, which shall be used to the extent possible and taking into account its actual scope.

9.5 The nuclear power plant licensee shall draw up a plan for the implementation of the actions required to comply with the present article.

Ten. *Extensive damage mitigation guidelines (EDMG)*

10.1 The nuclear power plants shall have available EDMG's.

10.2 The requirements relating to EOP's and SAMG's included in articles four, six, seven and eight of this Instruction shall be applicable to the EDMG's, with the exception of those relating to use of the full-scope simulator.

Eleven. *Infringements and sanctions*

The present Council Instruction shall be binding, in compliance with the requirements of article 2.a) of Law 15/1980, of April 22<sup>nd</sup>, creating the Nuclear Safety Council, as a result of which non-compliance will be penalised as set out in Chapter XIV (articles 85 to 93) of the Nuclear Energy Act, Law 25/1964, of April 29th.

Twelve. *Exemptions.*

The licensees of nuclear power plants may request that the CSN grants exemption from any of the requirements of this Instruction, as long as they provide accreditation of the impossibility of complying with them, incorporating the corresponding justification, and the alternative applied to ensure compliance with the nuclear safety and radiological protection criteria applicable to the requirement for which exemption is sought.

Single additional provision

The CSN shall require that the licensees of nuclear power plants implement the specific improvements set out in article 5.2, depending on the operational circumstances of each plant, through the Complementary Technical Instructions associated with the Operating Permits.

#### Single transitory provision

Without prejudice to what is established in the single final provision, the licensees of nuclear power plants shall be entitled to the terms for compliance indicated below:

- Until December 31<sup>st</sup> 2015 for compliance with the provisions of articles 3.6, 4.6, 5.1 and 9.5.
- Until December 31<sup>st</sup> 2016 for submittal to the CSN of the analysis for the selection of beyond design basis accidents, as specified in article 5.2.

#### Single derogatory provision

All provisions of equal or lower rank that oppose what is set out in the present Instruction are hereby repealed.

#### Single final provision

The present Instruction shall enter into force six months after the date of its publication in the «Official State Gazette», with the exception of what is set out in the single transitory provision.

Madrid, January 21<sup>st</sup> 2015.– The President of the Nuclear Safety Council, Fernando Marti Scharfhausen.