CSN CONSEJO DE SEGURIDAD NUCLEAR

Follow-up
Spanish National Action Plan on Ageing Management
Topical Peer Review 2017

May 2021

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Abbreviations used in this report

Abbreviations	Definition
AMP	Ageing Management Programme
ANAV	Ascó and Vandellós II Nuclear Power Plants licensee
ASME	American Society of Mechanical Engineers
BMI	Bottom Mounted Instrumentation
BWR	Boiling Water Reactor
CSN	Spanish Nuclear Safety Council
ECT	Eddy Current Test
ENSREG	European Nuclear Safety Regulators Group
EPRI	Electric Power Research Institute
EQ	Environmental Qualification
HAZ	Heat Affected Zone
IAEA	International Atomic Energy Agency
IEEE	Institute of Electrical and Electronics Engineers
KWU	Kraftwerk Union
LOCA	Loss of Coolant Accident
LTO	Long-Term Operation
MRP	Pressurized Water Reactor Materials Reliability Program
NAcP	National Action Plan
NAR	National Assessment Report
NDE	Nondestructive evaluation
PWR	Pressurized Water Reactor
PWROG	PWR Owners Group
RO	Refuelling Outage
RPV	Reactor Pressure Vessel
R&D	Research and development
TPR	Topical Peer Review
UT	Ultrasonic Test
WENRA	Western European Nuclear Regulators Association

1. Objective

The purpose of this report is to update, in terms of the status of compliance and deadlines, by the end of May 2021, of the Spanish Action Plan of the first TPR on ageing management.

2. Introduction

In accordance with the Council Conclusions of the 18th March 2019 and the ENSREG decision of the 25th March 2019, countries that participated in the 1st Topical Peer Review (TPR) process should submit their National Action Plans (NAcPs) for Nuclear Power Plants and Research Reactors by the end of September 2019.

Directive 2014/87/EURATOM recognises the importance of peer reviews as a tool for the continuous improvement of nuclear safety. For this reason, it is stated as follows in its article eight:

> *The member States shall ensure the following in a coordinated manner:*
>
> *a. that a national assessment be carried out, based on a specific issue relating to the nuclear safety of nuclear facilities located in their respective territories;*
>
> *b. that all member States be invited to the national assessment peer review mentioned in letter a), along with the Commission, to attend as an observer;*
>
> *c. that adequate measures be adopted for the tracking of the respective results of the peer review process;*
>
> *d. that reports on the process be published, along with the main results when these become available.*

The member States had to ensure the existence of provisions allowing the first topical peer review to be initiated in 2017, with subsequent peer reviews performed at least once every six years.

The subject chosen for this first review was the ageing management of nuclear power plant.

In compliance with this mandate, the CSN drew up, by the end of 2017, the National Assessment Report (NAR), including analysis of the Overall Ageing Management Programme applicable to the Spanish nuclear power plants on the basis of the regulations in place in Spain, as well as its specific application for the systems, structures and components selected in the specification, which were the following four areas:

1. Electrical cables
2. Concealed piping
3. Reactor pressure vessels
4. Concrete containment structures.

The areas “calandria” and “pre-stressed concrete pressure vessel” were not applicable to Spain due to the existing NPP designs.

In accordance with the general process defined by ENSREG, between January and April 2018, the NAR reports prepared by the different participating countries (19 countries) were reviewed. The number of questions to Spain was 134, out of a total of 2329 questions asked. After this review, and considering the answers provided by the different countries, the established expert groups identified a series of preliminary findings, which would be discussed during the workshop held in Luxembourg between May 14 and 18, 2018, scheduled within the general TPR process.

As a result of the Workshop, the TPR Steering Committee (Board) issued the final report of the TPR that was approved in the plenary of ENSREG on the 04th of October of 2018. Next to the final report, another report was published, gathering the "findings" identified by countries for the general area of ageing management and for all the thematic areas selected in the TPR, with the exception of cables.

It is stated in the Directive 2014/87/Euratom recital 23, 3rd paragraph:

> *Member States should establish national action plans for addressing any relevant findings and their own national assessment, taking into account the results of those peer review reports.*

At the meeting of the ENSREG Plenary (25th of March, 2019) it was agreed that all countries participating in the TPR should prepare their national action plans (NAcPs) following a standard format across all participating countries, which should be sent by the end of September 2019.

This NAcP is intended to enable progress to be monitored against the range of findings emerging from the TPR and it will be also used in future TPR follow-up activities by ENSREG, such as communicating results of implementation in December 2023.

In order to draw up the NAcPs, the CSN requested each of the Spanish nuclear power plants a report responding to the aforementioned standard format by the 31st of August. This request was materialised through the sending of letters to each licensee [1].

As a result, each licensee performed a detailed analysis of the findings and subsequently submitted a report to the Spanish Nuclear Safety Council (CSN) by way of the letters [2].

On the basis of the reports submitted by the licensees, the CSN drew up the National Action Plan that was approved by the Council during its plenary meeting on 25th September 2019.

During the meeting of the ENSREG working group WG1, which took place on 14th November 2019, it was agreed that each Member State will submit an updated NAcP, including a summary of the implementation status of NAcP by end of May 2021 [5].

In order to prepare this NAcP Follow-up, the CSN has requested from each of the Spanish nuclear power plants an update of the status of compliance with the actions, indicating also the deadlines and the results in the cases in which the planned actions have already been

carried out. This request was materialised through the sending of letters to each licensee [6].

As a result, each licensee has submitted a letter [7] giving information regarding the status of compliance.

Section 4 of this report includes a table (updating the table included in section 7 of the NAcP) that summarizes the actions defined in the action plan established in 2019, as well as the current status of compliance with them.

3. NAcP Follow-up

This section includes the updating of the NAcP, focusing on the planned actions and their deadlines indicated in the table included in section 7 of the National Action Plan.

3.1. Reactor pressure vessel

In this chapter, two (2) areas for improvement were allocated to Spain, related to the reactor pressure vessel. These are the following:

3.1.1.TPR expected level of performance: Volumetric inspection for nickel base alloy penetration.

Nickel alloy components are sensitive to primary water stress corrosion cracking (high tensile stresses, corrosive environment and susceptible material) in PWR plants. There has been Operational Experience of leakage in Bottom Mounted Instrumentation (BMI) penetrations and failure of those components. As noted by the TPR, it is necessary to implement volumetric in-service inspections to preventively detect the potential occurrence of a crack.

It was planned to implement an inspection programme based on the requirements established in MRP-372, rev. 1.

Position, actions taken by each nuclear power plant in the NAcP and follow-up

Almaraz NPP (AL.RPV-1 finding of the table included in section 4 of this Follow-up report)

a) Position and actions taken

Periodic visual examinations required by ASME Code Case N-722-1 are being performed in BMIs.

Additionally, as a consequence of this TPR, the following inspections will be carried out:

- Volumetric inspection (UT and ECT) from the inner diameter during the refuelling outages RO127 (March 2020) and RO226 (March 2021) for unit I and II, respectively, before LTO.

- Visual inspection of the J-weld, complementary to the main UT-ECT inspection, during refuelling outages RO128 (October 2021) and RO227 (November 2022) for unit I and II, respectively.

b) Follow-up

Compliance status:

Regarding the "finding" AL.RPV-1 relative to the inspection of the vessel nickel-based alloys penetrations, the volumetric inspection in unit I was carried out with satisfactory results in the 27th refuelling outage (RO).

The volumetric inspection in unit II has also been completed satisfactorily in the last 26th RO.

The results obtained in these inspections were in all cases acceptable.

Deadline: The original planification considered in the NAcP is maintained: to perform visual inspections in the 28th and 27th ROs of unit I and II, respectively.

Ascó NPP (AS.RPV-1 finding of the table included in section 4 of this Follow-up report)

a) Position and actions taken

Periodic visual examinations required by ASME Code Case N-722-1 are being performed in BMIs.

Additionally, as a consequence of this TPR, ANAV planned a volumetric inspection of the BMI welds before LTO:

- Ascó unit I: 1RO29 (2023).
- Ascó unit II: 2RO28 (2023)

b) Follow-up

Compliance status: inspection preparation phase (procedures, equipment, etc.)

Deadline: The deadlines for volumetric inspection of the BMIs in Ascó NPP is as planned as indicated in the NAcP.

Cofrentes NPP

Not applicable (BWR).

Trillo NPP

This NPP RPV by design (KWU) does not have bottom penetrations.

Vandellós II NPP (VA.RPV-1 finding of the table included in section 4 of this Follow-up report)

a) Position and actions taken

BMIs undergo the periodic visual examinations required by code case N-722-1 of the ASME code.

However, as a consequence of this TPR, ANAV has scheduled a volumetric inspection of the BMI welds prior to LTO:

• Before the LTO for Vandellós II NPP (2028).

b) Follow-up

Compliance status: inspection preparation phase (procedures, equipment, etc.)

Deadline: Volumetric inspection of BMI has been planned for RO27 (Fall 2025).

3.1.2.TPR expected level of performance: Non-destructive examination in the base material of beltline region.

Comprehensive NDE is performed in the base material of the beltline region in order to detect defects.

Position, actions taken by each nuclear power plant in the NAcP and follow-up

In some NPPs with RPV made from forged rings, defects in the base material of their RPV (hydrogen flaking) have been detected. Despite the fact that these defects were not related to any active degradation mechanism, many efforts have been devoted in order to demonstrate that the structural integrity of the RPV is fully maintained. The cause of hydrogen flakes was due to the manufacturing process. The diagnosis of hydrogen flaking, initiated during manufacturing in macro-segregated areas, was confirmed after thorough investigation, based on a root cause analysis of all potential causes. It was also concluded that the identified indications were stable and that they do not grow in service.

The licensees make reference to the WENRA document, where the activities carried out by the Member States are collected, following the recommendations related to the inspection findings in the RPVs of Belgian reactors (Tihange 2 and Döel 3). In particular, the following is stated:

> In this document, WENRA acknowledges that RPVs made from plates are much less prone to the "flaking" phenomena, and therefore this kind of vessels is excluded from the scope of the recommendations to inspect its base material. As an example, the document states: "Plate material is generally considered much less prone due to smaller ingot sizes and higher degrees of deformation during the rolling operation compared to forging. This results in a less sensitive microstructure. Therefore, components made from plates are outside the scope of further analyses and are not addressed in the recommendations by WENRA."

Regarding the analyses carried out by the U.S. nuclear industry in response to the findings in the RPVs of Belgian reactors (activities within the EPRI Materials Reliability Programme, included in documents MRP-367 and MRP-430), it must be taken into account that no recommendations were identified for the base material of RPVs made from plates.

Almaraz NPP (AL.RPV-2), Ascó NPP (AS.RPV-2) & Vandellós II NPP (VA.RPV-2) (findings included in the table included in section 4 of this Follow-up report)

a) Position and actions taken

The vessel of Westinghouse design PWR (PWR-W) (Almaraz I & II, Ascó I & II and Vandellós II NPP) are made from welded plates. Therefore, taking into consideration that the manufacturing process in the Spanish PWR-W is different from the manufacturing process in the affected plants, and that these defects do not appear in service, the PWR-W licensees consider that the Operating Experiences are not applicable and no further actions are needed.

However, it was agreed with the CSN, to review and to analyse the manufacturing processes used for the rolled plates of the reactor vessels, considering the defects that could be detected during this manufacturing process and to assess the mechanisms that may appear in service, defined in the actions included in the table attached in section 4 of this NAcP, actions: AL.RPV-2, AS.RPV-2 and VA.RPV-2.

b) Follow-up

Compliance status:

Spanish PWR Westinghouse design NPPs licensees have submitted the document PWROG-20001 rev. 0 - "*Position Relative to the Need for In-Service Inspection of the Reactor Vessel Beltline Base Material for Vessels Made of Low Alloy Steel Plate Material*" in compliance with the step 1 considered in the actions adopted in the NAcP.

In this document it is performed an in-depth review of the manufacturing processes, the shop inspection and the potential defects that can appear during the manufacturing processes, and the pre-service and in-service inspections assessment.

As a result, the conclusions are summarized below:

- All the information and key aspects available have been reviewed to determine the methods and results in the manufacturing phase of the beltline of the vessels of Almaraz, Ascó and Vandellós II NPPs. The results conclude that the indications, in case of existing, are acceptable according to code and manufacturer criteria.

- The most probable defects that could be present in the steel plates have been identified, according to the methods and precautions considered during manufacturing.
- According to the morphology and other characteristics of the defects mentioned, it has been evaluated whether the inspection techniques used at that time had been capable of detecting them complying with the acceptance criteria of base metal discontinuities established in the manufacturer and Westinghouse requirements. The results conclude that the techniques and methods used during the manufacturing would have detected the indications found in Döel and Tihange, in the event that they exist and considering their distribution.
- Finally, a review of the results of the PSI and ISI of the welds and base metal of the vessel has been done, concluding that there are no evidences of relevant indications that could have remained unidentified in manufacturing.

Based on all the above, the analysis performed to fulfil the step 1, it is concluded that performing an additional inspection with advanced UT techniques in the beltline region is considered not necessary based on the justification of the absence of significant fabrication defects that may have not been detected during manufacturing and that could represent a challenge to vessel integrity.

Therefore, no further actions to those proposed by WENRA are considered needed, although if new information is made available, Spanish NPPs will evaluate this and open to re-evaluate its standpoint.

As a result of a preliminary analysis of this documentation submitted, it is concluded that an specific inspection to the base metal of the vessel is not necessary. Nevertheless, the CSN is considering to enlarge the inspection zone to both sides of the HAZ welds in the next scheduled 10-year inspection.

<u>Trillo NPP</u>

a) Position and actions taken

In the case of KWU PWR vessel (Trillo NPP), the beltline is made by 20 MnMoNi 55 forged rings (a material similar to ASME SA-508, class 3). This vessel base metal has been already inspected with satisfactory results. The inspection was closed in the presence of the Regulatory Body (CSN).

b) Follow-up

Not aplicable

Cofrentes NPP (CO.RPV-1 finding of the table included in section 4 of this Follow-up report)

a) Position and actions taken

In the case of the Cofrentes NPP RPV, none of the circumstances that could cause the existence of such indications in the beltline base material of the plates are presented:

Circumstances that makes a RPV prone to have indications.	**Cofrentes NPP justification.**
PWR design RPV.	Cofrentes NPP is a BWR design, and its RPV has lower thickness.
Forge manufacturing.	Cofrentes NPP RPV is made of plates welded axially.
Rings made of carbon steel SA-508.	Cofrentes NPP is made of carbon steel SA-533.
Inspections and tests made during manufacturing and prior to the start-up inconclusive or with inadequate records.	In Cofrentes NPP there have been 3 volumetric inspections of the base material performed with different techniques and procedures and performed by 3 different companies and no indications have been detected.

Therefore, according to the analysis performed, it can be concluded that volumetric inspections to the whole beltline base material are not necessary.

b) Follow-up

Cofrentes NPP has opted for Step 1 indicated for this action in the Action Plan, consisted of an analysis of the potential defects that may affect the base material of the RPV beltline region and the justification of the non-affection of these defects to the integrity of this region.

Compliance status

Cofrentes NPP licensee has submitted the document B13-5A889 "*Justification of the need to carry out inspections in the base material of the Cofrentes vessel*" in compliance with the step 1 considered in the actions adopted in the NAcP.

In this document it is performed an in-depth review of the manufacturing processes, the shop inspection and the potential defects that can appear during the manufacturing processes, and the pre-service and in-service inspections assessment.

The main conclusions of this report are summarized below, which justify that performing additional inspections on the base material of the reactor vessel is considered not necessary:

- During the different stages of the manufacturing process of the reactor vessel, multiple inspections, both volumetric and surface, were carried out, including UT, X-rays, penetrating liquids and magnetic particles. These inspections were documented in hundreds of inspection records that have been retrieved, digitized, and uploaded to the inspection and ageing management system of Cofrentes NPP.
- Even though the detection capabilities of the inspection techniques used today have greatly evolved compared to what existed 40 years ago when the Cofrentes reactor vessel was manufactured, the accessibility that can be achieved during the manufacturing process is definitely better than what could be achieved in a hypothetical future inspection in the actual operating conditions.
- The inspection techniques used during the manufacturing process have been able of detecting laminar defects which were subsequently confirmed visually. Therefore, there is no evidence that undetected defects could exist due to the use of non-qualified inspection techniques.
- Other potential defects have been analysed concluding that due to the manufacturing process and the results of the shop inspections there is no evidence of that kind of defects.
- Pre-service and in-service inspections carried out throughout the operating life have not detected the appearance of any additional relevant defect. All indications found are consistent with the records of the manufacturing process.
- Cofrentes NPP has all the original inspection and repair records corresponding to each of the phases of the manufacturing process. Therefore, there is evidence of the detection capability of the techniques used at that moment. Likewise, acceptance criteria or repair applied to all the defects found are documented.

Based on all the above, the analysis performed to fulfil the step 1, it is concluded that performing an additional inspection with advanced UT techniques in the beltline region is considered not necessary based on the justification of the absence of significant fabrication defects that may have not been detected during manufacturing and that could represent a challenge to vessel integrity.

Therefore, no further actions to those proposed by WENRA are considered needed, although if new information is made available, Spanish NPPs will

evaluate this and open to re-evaluate its standpoint.

As a result of a preliminary analysis of this documentation submitted it is concluded that an specific inspection to the base metal of the vessel is no needed. Nevertheless, the CSN is considering to enlarge the inspection zone to both sides of the HAZ welds in the next scheduled 10-year inspection.

3.2. Generic findings related to Electrical cables

In the subsections below, Spanish position for each finding related to electrical cables is detailed, and a summary presented of the actions that are planned to address it.

3.2.1. TPR expected level of performance: methods for monitoring and directing all AMP-activities

Methods to collect NPP cable ageing and performance data are established and used effectively to support the AMP for cables.

Position, actions taken by each nuclear power plant in the NAcP and follow-up

Almaraz and Trillo NPPs

a) Position and actions taken

The inspections and tests to be carried out on the cables at Almaraz and Trillo NPPs, based on the programme activities, as well as their results, are included in the corresponding monitoring reports.

There is also a Database that includes the scope of the programmes, containing the necessary data on the cables in question, as well as the associated monitoring activities, frequency, applicable procedure and results of the inspections and tests (directly or by reference to the monitoring report). In addition, the results of application of these activities are included in each AMP monitoring report.

b) Follow-up

Not applicable

Ascó and Vandellós II NPPs

a) Position and actions taken

At Ascó NPP and Vandellós II NPP, the inspections and tests to be conducted on cables according to the activities required by the programmes, as well as their results, are included in the Technical Management Database (GESTEC), just like all other electric and non-electric components.

This Database integrates and relates the component tags with the associated activities, frequencies, applicable procedures and inspection or test results

(directly or by referring to the results report). Additionally, ANAV's in-plant Operating Experience modules are interrelated with the GESTEC component tags.

Having other different databases in parallel to GESTEC to include only certain types of components (cables) is not considered to be necessary or convenient, given that the organisation works with work orders exclusively generated by GESTEC, in accordance with the organisation's Quality Assurance processes.

Therefore, there are adequate resources and means to assure that the management programmes' activities are scheduled, performed and documented, and they are integrated in the corporate Technical Management system (GESTEC). Accordingly, compliance with the requirements of the AMPs and the Quality Assurance requirements are ensured, and the information required to implement the periodic monitoring reports for each programme is provided.

b) Follow-up

Not applicable

Cofrentes NPP: (CO.EC-1 finding of the table included in section 4 of this Follow-up report)

a) Position and actions taken

At Cofrentes NPP, cabling inspections and tests, as well as their results, are included (similarly to other electrical and non-electrical components) in the Maintenance Management Database (SAP-GESMAN), in line with programme activities.

This Database integrates and connects, among others, electrical components with cables connected to linked monitoring activities, frequencies, applicable procedures and inspection and test results (directly or by referring to the results report). Additionally, applicable results from these activities are included within the follow-up report performed for each cable AMP.

Cofrentes NPP has a cable layout database which was recently expanded to include cable ageing management aspects, such as cable features and materials, environmental conditions in cable locations, as well as monitoring activities and their results. This database, currently being reviewed and validated, is expected to serve as a control tool that supports future cable ageing management at Cofrentes NPP.

In summary, Cofrentes NPP currently has processes and means to ensure that the activities considered within cable-related management programmes are properly coordinated by the integrated Maintenance Management system (SAP-GESMAN), enabling programme activities to be scheduled, implemented

and their results documented so that accurate programme feedback can be obtained. However, cables are often not recorded as an individual database input component; instead, they are associated to the main instrument or electrical equipment they supply or are connected to. To address this issue, the cable layout database was expanded so that cables can appear as individual input components, with the aim to provide more accurate information on the activities and condition of cables included within the programme scope.

Action CO.EC-1 adopted in the action plan

As an improvement action, Cofrentes NPP proposes the development of an operational cable database that includes relevant ageing management information for each cable, as well as results obtained during individual cable monitoring activities. The tentative database implementation programme foresees full database operability in late 2020.

b) Follow-up

Compliance status

Cofrentes NPP is in process to develop an application named DYALEC since a previous application that collects the data of cable routes in trays and conduits and their characteristics, equipment connected to and properties of cables. To this application will be added the following information:

- Identification of the applicable AMP,
- Activities considered in each AMP,
- Inspection parameters of each cable and their results

This action, CO.EC-1, has been included within the actions derived from the Periodic Safety Review which expected time to be finished is by the end of 2021.

3.2.2.TPR expected level of performance: consideration of uncertainties in the initial EQ

The accuracy of the representation of the stressors used in the initial Environmental Qualification is assessed with regard to the expected stressors during normal operation and Design Basis Accidents.

Position, actions taken by each nuclear power plant in the NAcP and follow-up

Common answer to all Spanish NPPs. Generic issue addressed in a sectorial level (findings AL.EC-1, TRI.EC-1, AS.EC-1, VA.EC-1 and CO.EC-2 included in the table included in section 4 of this Follow-up report).

a) Position and actions taken

Position

This Expected Level of Performance requires to check whether the sources of uncertainties in the original environmental qualification processes entail a risk to cable safety with regard to operation during and after a design basis accident. In this sense, specific processes of the ageing and accident simulation phases are identified, for which there might be non-conservative assumptions.

In Spain, the nuclear industry association project ES-27 "Monitoring and evaluation of the condition of electric cables in Spanish NPPs" has been running for several years, with the objective of checking the qualified condition of a sample of cables with Environmental Qualification requirements that, as representative of large families of electric cables, have been in service and installed at the plants since commissioning.

After the selected cables have been removed, a series of precautions are planned during the testing phase in order to reduce uncertainties in the processes as much as possible in a manner consistent with recent documentation issued as part of this framework. The most relevant considerations planned for this are the following:

- Given the difficulty of implementing combined accelerated ageing (thermal and radiological), it will be performed sequentially, first radiologically and subsequently thermally (as specified in document IAEA NP-T-3-6 "Assessing and Managing Cable Ageing in Nuclear Power Plants).
- Low ageing acceleration factors will be applied. Unlike several tests which formed part of the original qualification processes, the dose rates and ageing temperature will be relatively low, so that the degradations induced in the electric cables will be as realistic and as close as possible, to the most unfavourable conditions of the cables installed in plant.
- Very low activation energy values of the materials to be aged are adopted (≤ 1.1 eV), so that the ageing caused is higher than that actually experienced by the cables in the field.
- In the post-LOCA test phase, the chamber will be supplied with air aiming at not preventing cable oxidation processes.

It should also be noted that, as the ongoing project is common to all plants, the accident profiles cover all of them, so that the pressure and temperature conditions in LOCA as well as the radiation doses in ageing and accident conditions are greater than expected in the plants in general.

Actions adopted in the action plan

The plan to address this Expected Level of Performance is to continue with the ES-27 project in order to:

- Obtain cable-samples that have been installed and naturally aged in the plant during operation, and subject them to subsequent accelerated ageing, at different interval of 10 years up to 60 years of ageing. The corresponding inspections and tests are performed in each different steps (10 years).
- After the samples have been aged up to 60 years subject them to LOCA test and conduct the inspections and functional tests applicable to check the qualified condition during the remaining operation time.

If the functionality of the cables is verified during and after the LOCA defined for the test, it can be reasonably assumed that the original qualification process, in accordance with IEEE 383-74, maintains safety margins that cover the uncertainties associated with the testing processes carried out during commissioning.

b) Follow-up

Compliance status:

The consideration of the potential uncertainties associated with the original Environmental Qualification processes is dealt with through the project "Monitoring and assessment of the status of electrical cables in the Spanish NPPS" (ES-27).

In the 1st stage of the ES-27 project, the population of Environmentally Qualified cables has been identified and the information related to them has been collected, as well as their operating history in each of the Spanish power plants. Later, in the 2nd stage, a representative sample of cables (13 types considering different materials and manufacturers, both low voltage and instrumentation and control) has been selected to be used in Stage 3 or the testing stage. The sample has covered 85% of the common insulation and jacket materials that are present in the cables installed in the NPPs. 10 out of the 13 cables chosen for testing, are cables that have been in service at the different plants and the remaining three are cables obtained from the storage.
Both stages 1 and 2 are finished, and the stage 3 is currently ongoing.

Stage 3 or testing stage aims to complete the natural ageing of the cables, through the application of accelerated ageing tests (thermal and radiation) and accident test (radiation and LOCA), for the Spanish NPPs enveloping conditions. Likewise, a series of tests and "condition monitoring" tests will be performed (insulation resistance, polarization index, dielectric factor, elongation at break, "indenter" test, hardness and oxidation induction time) in the cables prior to being aged and after each one of the intermediate ageing stages, so that the progression of the effects of radiological and thermal degradation can be assessed, as well as in the different phases of the accident simulation.

This stage began at the beginning of 2020 and its activities have been completed with the initial visual inspections, as well as the functional tests and "condition monitoring" tests.

For each of the selected type of cables, irradiation ageing is in progress in Jacobs laboratories, in the UK. Irradiation ageing up to 30 years for samples has been concluded.

The "condition monitoring" tests will be carried out soon after the irradiation phase of these samples and then, thermal ageing will begin.

The project is progressing well, although some delay attributed to the pandemic and cross-border administrative processes has been accumulated. In any case, planning changes are being considered to reduce this delay as much as possible.

Deadline:

As indicated in the project report, and in accordance with the latest available update, activities last from 2020 until the fourth quarter of 2024.

3.3. Concealed pipework

3.3.1. Good practice: use of results from regular monitoring of the condition of civil structures.

In addition to providing information on soil and building settlement, the results from regular monitoring of the condition of civil structures are used as input to the ageing management programme for concealed pipework.

The allocation by the TPR to Spain in this finding has been BLANK.

In the final version of the TPR report this good practice was not identified for Spain. Spanish plants monitor the condition of civil structures through the control of the settlement of buildings and structures. There is a specific AMP about surveillance of civil structures.

Position, actions taken by each nuclear power plant in the NAcP and follow-up

Almaraz and Trillo NPPs

a) Position and actions taken

At Almaraz NPP, there is a programme "Structures Monitoring" that, within the structures monitoring activities, includes the control of settlements of the main buildings and structures of the Plant. Within this programme, quarterly topographic controls of 37 control points are carried out, which include the main buildings of the Plant (Containment, Fuel Building, Safeguards, Electric and Turbines). Periodic evaluation of the monitoring and trend analysis data is carried out and the surveillance procedures of applicable structures establish the limit values and acceptance criteria for their evaluation. This programme provides detailed information for the assessment of the condition and evolution of the structures of the Plant.

At Trillo NPP there is an equivalent programme that includes the control of settlements of the buildings and main structures of the plant. It includes 127 control points which settlement control is carried out periodically from quarterly to annual frequency. It includes all the significant structures of the Plant, from main buildings to buried pipe galleries.

The information is evaluated monthly and an annual report is issued where trends are analysed and measured values are compared with limits and criteria established in structure monitoring procedures.

Action considered in the NAcP: No further action has been planned.

b) Follow-up

Not applicable.

Ascó and Vandellós II NPPs

a) Position and actions taken

With regards to Ascó NPP, there is an AMP that includes a surveillance manual for soil settlement effects (Soil Movement Monitoring Manual). This programme sets forth a series of activities, including monitoring of control points, parameters for measurement and analysis, calculation methods for control of magnitudes and established values for precaution and critical limits. Based on the values measured and the trends observed, the condition of structures and components potentially affected by soil settlement is verified. Ascó NPP has AMP on surveillance of structures and a specific AMP plant on ground movement surveillance.

With regards to settlement control at Vandellós II NPP, the activities of the procedure "Structures Monitoring" is integrated in a specific AMP. They include a programme with a series of activities associated with monitoring survey control points for recently constructed structures associated with the Technological Safeguards Cooling Water System (EJ system) and the turbine pedestal. In the initial years of operational life it was demonstrated that the remaining structures did not experience this type of movements. Based on the values measured and the trends observed, the condition of the previously mentioned structures is verified.

Action considered in the NAcP: No further action has been planned.

b) Follow-up

Not applicable.

Cofrentes NPP (CO.CP-1 finding of the table included in section 4 of this Follow-up report)

a) Position and actions taken

To date, no significant results were obtained from the periodic building settlement measurements and detection of building support cracks. Having said that, this good practice will be taken into consideration during upcoming reviews of AMP manuals for piping systems.

This improvement action will be proposed as an action to be included in the next manual revision. A two-year period is foreseen.

Action adopted in the NAcP: Consideration of the buildings settlement surveillance support reports results in the piping systems AMPs.

b) Follow-up

The proposed action consists of considering the results of the surveillance inspections of the settlement of buildings in the AMPs that has pipelines within their scope to evaluate if they are affected by the buildings settlement in the penetrating section.

During 2020 the AMP “structures monitoring” has been revised to include the following action: In the event that the activity of measuring differential settlements of buildings considered in the AMP “structures monitoring” detects an increase in relative movement greater than usual, or that the state of the boundary walls between buildings may induce defects and/or ageing mechanisms in the embedded pipes penetrating them, it will be taken into account in those AMPs which have pipes within their scope and that may be affected.

4. Table: Summary of the planned actions

This table contains the planned actions mentioned through the previous chapters for each reactor in Spain, the associated deadlines and the monitoring process by the CSN and the information transmitted by the Spanish NPPs regarding their current status for the development of this follow-up NAcP report.

Table: Planned actions, deadlines, the monitoring process by the CSN and follow up by May 2021

Installation	Thematics	Finding	Planned action	Deadline	Regulator's Approach to Monitoring	FOLLOW UP May 2021
ALMARAZ NPP	03. Electrical cables	***AL.EC-1*** ***Consideration of uncertainties in the initial EQ***	The plan to implement this Expected Level of Performance is to continue with the nuclear industry association project ES-27 "Monitoring and evaluation of the condition of electric cables in Spanish NPPs": - Obtain cable samples that have been installed and naturally aged in the plant during operation, and subject them to subsequent accelerated ageing, at different interval of 10 years up to 60 years of ageing. The corresponding inspections and tests are performed in each different steps (10 years). - After the cables are aged to 60 years, the LOCA enveloping accident is simulated and the applicable functional inspections and tests are performed to check the current qualified condition and the remaining operating time. - If the functionality of the cables is verified during and after the LOCA defined for the test, it can be reasonably assumed that the original qualification process, in accordance with IEEE 383-74, maintains safety margins that cover the uncertainties associated with the testing processes carried out during commissioning.	Approx. December 2024	CSN is in process of participating actively in this R&D project. So, the monitoring of this planned action will be performed according to the future project schedule activities	**IN PROGRESS** The nuclear industry association project ES-27 "surveillance and assessment of the electrical cable condition in Spanish NPPs" is in progress and since 2021 with the participation of the CSN. According to the last available update, the activities will last since 2020 to the las term of 2024.
	05. RPV	***AL.RPV-1*** ***Volumetric inspection for nickel base alloy penetration***	In order to comply with the requirements established in MRP-372 Rev. 1, Almaraz NPP will carry out the following inspections: - Volumetric inspection (UT and ECT) from the inner diameter during refuelling outages RO127 (March 2020) and RO226 (March 2021) for unit I and II, respectively. - Visual inspection of the J-weld, as a complement to the main UT-ECT inspection, during refuelling outages RO128 (October 2021) and RO227 (November 2022) for unit I and II, respectively.	- Volumetric inspection: Unit I: RO127 (March 2020). Unit II: RO226 (March 2021). - Visual inspection: Unit I: RO128 (October 2021). Unit II: RO227 (September 2022).	CSN Basic Inspection Plan	**IN PROGRESS** The volumetric inspection has been performed in both units with satisfactory results: - Unit I: RO 27 (2020). - Unit II: RO 26 (2021). The visual inspection is planned as stablished in the NAcP: - Unit I: RO 28. - Unit II: RO 27.

Table: Planned actions, deadlines, the monitoring process by the CSN and follow up by May 2021

Installation	Thematics	Finding	Planned action	Deadline	Regulator's Approach to Monitoring	FOLLOW UP May 2021
ALMARAZ NPP	05. RPV	***AL.RPV-2*** ***Non-destructive examination in the base material of beltline region***	Step 1: To carry out an analysis of the potential defects that could affect the base material of the RPV "beltline" region and, on the basis thereof, to submit to the CSN a technical justification for the non-affectation of the integrity of the vessel by such defectology, which may be based, among others, on manufacturing documentation, results of inspections performed, operational experience and the international state of art. The analysis must be completed one year before the scheduled date for the planned inspection of the vessel for compliance with the applicable requirements in the current inspection interval, unless there is substantiated justification of the feasibility of the deadlines, in accordance with the planning of cycles and specific refuelling of the plants. Step 2: If such technical justification would not allow the possible affectation of the vessel base material to be excluded, licensee shall submit an inspection plan of the base material (beltline region) to be performed preferably at the next scheduled inspection of the vessel referred to in Step 1, or duly justified alternative scheduling.	Analysis must be completed **one year before the planned date** for the inspection of the vessel for compliance with the applicable requirements in the current inspection interval. Vessel inspection: RO128 (October 2021) and RO227 (September 2022) for unit I and II, respectively.	Assessment and Oversight and Control Integrated System	**IMPLEMENTED** The first step associated to the finding AL.RPV-2 regarding the RPV base material had been completed with the submission of the technical justification of the non-affection of the hydrogen "flaking" phenomena, therefore no further actions to those proposed by WENRA are considered needed, although if new information is made available, Spanish NPPs will evaluate this and open to re-evaluate its standpoint. The CSN is considering to enlarge the inspection zone to both sides of the HAZ welds in the next scheduled 10-year inspection.

Table: Planned actions, deadlines, the monitoring process by the CSN and follow up by May 2021

Installation	Thematics	Finding	Planned action	Deadline	Regulator's Approach to Monitoring	FOLLOW UP May 2021
TRILLO NPP	03. Electrical cables	***TRI.EC-1*** ***Consideration of uncertainties in the initial EQ***	The plan to implement this Expected Level of Performance is to continue with the nuclear industry association project ES-27 "Monitoring and evaluation of the condition of electric cables in Spanish NPPs". See finding AL.EC-1 in this table.	Approx. December 2024	CSN is in process of participating actively in this R&D project. So, the monitoring of this planned action will be performed according to the future project schedule activities	**IN PROGRESS** The nuclear industry association project ES-27 "surveillance and assessment of the electrical cable condition in Spanish NPPs" is in progress and since 2021 with the participation of the CSN. According to the last available update, the activities will last since 2020 to the las term of 2024.
ASCÓ NPP	03. Electrical cables	***AS.EC-1*** ***Consideration of uncertainties in the initial EQ***	The plan to implement this Expected Level of Performance is to continue with the nuclear industry association project ES-27 "Monitoring and evaluation of the condition of electric cables in Spanish NPPs". See finding AL.EC-1 in this table	Approx. December 2024	CSN is in process of participating actively in this R&D project. So, the monitoring of this planned action will be performed according to the future project schedule activities	**IN PROGRESS** The nuclear industry association project ES-27 "surveillance and assessment of the electrical cable condition in Spanish NPPs" is in progress and since 2021 with the participation of the CSN. According to the last available update, the activities will last since 2020 to the las term of 2024.

Table: Planned actions, deadlines, the monitoring process by the CSN and follow up by May 2021

Installation	Thematics	Finding	Planned action	Deadline	Regulator's Approach to Monitoring	FOLLOW UP May 2021
ASCÓ NPP	05. RPV	***AS.RPV-1*** ***Volumetric inspection for nickel base alloy penetration***	Perform a volumetric inspection of all BMI inconel-600 welds before LTO	Unit I: RO129 (2023) Unit II: RO228 (2023)	CSN Basic Inspection Plan	**IN PROGRESS** The planification established in the NAcP is maintained: - Unit I: RO 29 (spring 2023) - Unit II: RO 28 (fall 2023)
		AS.RPV-2 ***Non-destructive examination in the base material of beltline region***	Step 1: To carry out an analysis of the potential defects that could affect the base material of the RPV "beltline" region and, on the basis thereof, to submit to the CSN a technical justification for the non-affectation of the integrity of the vessel by such defectology, which may be based, among others, on manufacturing documentation, results of inspections performed, operational experience and the international state of art. The analysis must be completed one year before the scheduled date for the planned inspection of the vessel for compliance with the applicable requirements in the current inspection interval, unless there is substantiated justification of the feasibility of the deadlines, in accordance with the planning of cycles and specific refuelling of the plants. Step 2: If such technical justification would not allow the possible affectation of the vessel base material to be excluded, licensee shall submit an inspection plan of the base material (beltline region) to be performed preferably at the next scheduled inspection of the vessel referred to in Step 1, or duly justified alternative scheduling.	Analysis must be completed **one year before the planned date** for the inspection of the vessel for compliance with the applicable requirements in the current inspection interval. Unit I: RO130 (fall 2024) Unit II: RO229 (spring 2025)	Assessment and Oversight and Control Integrated System	**IMPLEMENTED** The first step associated to the finding AS.RPV-2 regarding the RPV base material had been completed with the submission of the technical justification of the non-affection of the hydrogen "flaking" phenomena, therefore no further actions to those proposed by WENRA are considered needed, although if new information is made available, Spanish NPPs will evaluate this and open to re-evaluate its standpoint. The CSN is considering to enlarge the inspection zone to both sides of the HAZ welds in the next scheduled 10-year inspection.

Table: Planned actions, deadlines, the monitoring process by the CSN and follow up by May 2021

Installation	Thematics	Finding	Planned action	Deadline	Regulator's Approach to Monitoring	FOLLOW UP May 2021
VANDELLÓS II NPP	03. Electrical cables	***VA.EC-1*** ***Consideration of uncertainties in the initial EQ***	The plan to implement this Expected Level of Performance is to continue with the nuclear industry association project ES-27 "Monitoring and evaluation of the condition of electric cables in Spanish NPPs". See finding AL.EC-1 in this table.	Approx. December 2024	CSN is in process of participating actively in this R&D project. So, the monitoring of this planned action will be performed according to the future project schedule activities	**IN PROGRESS** The nuclear industry association Project ES-27 "surveillance and assessment of the electrical cable condition in Spanish NPPs" is in progress and since 2021 with the participation of the CSN. According to the last available update, the activities will last since 2020 to the las term of 2024
	05. RPV	***VA.RPV-1*** ***Volumetric inspection for nickel base alloy penetration***	Perform a volumetric inspection of all BMI inconel-600 welds before LTO	Before 2028	CSN Basic Inspection Plan	**IN PROGRESS** Volumetric inspection of BMI has been planned for RO27 (Fall 2025).

Table: Planned actions, deadlines, the monitoring process by the CSN and follow up by May 2021

Installation	Thematics	Finding	Planned action	Deadline	Regulator's Approach to Monitoring	FOLLOW UP May 2021
VANDELLÓS II NPP	05. RPV	***VA.RPV-2*** ***Non-destructive examination in the base material of beltline region***	Step 1: To carry out an analysis of the potential defects that could affect the base material of the RPV "beltline" region and, on the basis thereof, to submit to the CSN a technical justification for the non-affectation of the integrity of the vessel by such defectology, which may be based, among others, on manufacturing documentation, results of inspections performed, operational experience and the international state of art. The analysis must be completed one year before the scheduled date for the planned inspection of the vessel for compliance with the applicable requirements in the current inspection interval, unless there is substantiated justification of the feasibility of the deadlines, in accordance with the planning of cycles and specific refuelling of the plants. Step 2: If such technical justification would not allow the possible affectation of the vessel base material to be excluded, licensee shall submit an inspection plan of the base material (beltline zone) to be performed preferably at the next scheduled inspection of the vessel referred to in Step 1, or duly justified alternative scheduling.	Analysis must be completed **one year before the planned date** for the inspection of the vessel for compliance with the applicable requirements in the current inspection interval. Vessel inspection: RO29 (fall 2028)	Assessment and Oversight and Control Integrated System	**IMPLEMENTED** The first step associated to the finding VA.RPV-2 regarding the RPV base material had been completed with the submission of the technical justification of the non-affection of the hydrogen "flaking" phenomena, therefore no further actions to those proposed by WENRA are considered needed, although if new information is made available, Spanish NPPs will evaluate this and open to re-evaluate its standpoint. The CSN is considering to enlarge the inspection zone to both sides of the HAZ welds in the next scheduled 10-year inspection.
COFRENTES NPP	03. Electrical cables	***CO.EC-1*** ***Methods for monitoring and directing all AMP-activities***	Having an operational database for cables that includes relevant information on aging management for each cable.	End of 2020	CSN Basic Inspection Plan	**IN PROGRESS** This action, CO.EC-1, has been included within the actions derived from the Periodic Safety Review, which is expected to be finished by the end of 2021.

Table: Planned actions, deadlines, the monitoring process by the CSN and follow up by May 2021

Installation	Thematics	Finding	Planned action	Deadline	Regulator's Approach to Monitoring	FOLLOW UP May 2021
COFRENTES NPP	03. Electrical cables	***CO.EC-2*** ***Consideration of uncertainties in the initial EQ***	The plan to implement this Expected Level of Performance is to continue with the nuclear industry association project ES-27 "Monitoring and evaluation of the condition of electric cables in Spanish NPPs". See finding AL.EC-1 in this table.	Approx. December 2024	CSN is in process of participating actively in this R&D project. So, the monitoring of this planned action will be performed according to the future project schedule activities	**IN PROGRESS** The nuclear industry association Project ES-27 "surveillance and assessment of the electrical cable condition in Spanish NPPs" is in progress and since 2021 with the participation of the CSN. According to the last available update, the activities will last since 2020 to the las term of 2024

Table: Planned actions, deadlines, the monitoring process by the CSN and follow up by May 2021

Installation	Thematics	Finding	Planned action	Deadline	Regulator's Approach to Monitoring	FOLLOW UP May 2021
COFRENTES NPP	04. Concealed Piping	***CO.CP-1*** ***Use of results from regular monitoring of the condition of civil structures***	Consideration of the results of the buildings settlement surveillance support reports in the piping systems AMPs	End of 2021	CSN Basic Inspection Plan	**IMPLEMENTED** During 2020 the AMP "structures monitoring" has been revised to include the following action. In the event that the activity of measuring differential settlements of buildings considered in the AMP "structures monitoring" detects an increase in relative movement greater than usual, or that the state of the boundary walls between buildings may induce defects and/or ageing mechanisms in the embedded pipes that penetrate buildings, it will be taken into account in those AMPs having pipes within their scope that may be affected.

Table: Planned actions, deadlines, the monitoring process by the CSN and follow up by May 2021

Installation	Thematics	Finding	Planned action	Deadline	Regulator's Approach to Monitoring	FOLLOW UP May 2021
COFRENTES NPP	05. RPV	***CO.RPV-1*** ***Non-destructive examination in the base material of beltline region***	Step 1: To carry out an analysis of the potential defects that could affect the base material of the RPV "beltline" region and, on the basis thereof, to submit to the CSN a technical justification for the non-affectation of the integrity of the vessel by such defectology, which may be based, among others, on manufacturing documentation, results of inspections performed, operational experience and the international state of art. The analysis must be completed one year before the scheduled date for the planned inspection of the vessel for compliance with the applicable requirements in the current inspection interval, unless there is substantiated justification of the feasibility of the deadlines, in accordance with the planning of cycles and specific refuelling of the plants. Step 2: If such technical justification would not allow the possible affectation of the vessel base material to be excluded, licensee shall submit an inspection plan of the base material (beltline zone) to be performed preferably at the next scheduled inspection of the vessel referred to in Step 1, or duly justified alternative scheduling.	Analysis must be completed **one year before the planned date** for the inspection of the vessel for compliance with the applicable requirements in the current inspection interval. Vessel inspection: RO23 (November 2021)	Assessment and Oversight and Control Integrated System	**IMPLEMENTED** The first step associated to the finding CO.RPV-1 regarding the RPV base material had been completed with the submission of the technical justification of the non-affection of the hydrogen "flaking" phenomena, therefore no further actions to those proposed by WENRA are considered needed, although if new information is made available, Spanish NPPs will evaluate this and open to re-evaluate its standpoint. The CSN is considering to enlarge the inspection zone to both sides of the HAZ welds in the next scheduled 10-year inspection.

5. References

[1] Letters sent to licensees requesting information to perform the NAcP:
- CSN/C/DSN/AL0/19/29
- CSN/C/DSN/AS0/19/15
- CSN/C/DSN/COF/19/20
- CSN/C/DSN/TRI/19/14
- CSN/C/DSN/VA2/19/33

[2] Letters received from licensees with their NAcP proposals:
- ANA/DST-L-CSN-4078 / CNV-L-CSN-6878 (reference NAcP report for Ascó NPP and Vandellós II NPP).
- Z-04-02/AT-CSN-000132 (reference NAcP report for Almaraz and Trillo NPPs: CI-IN-004877).
- Z-04-02/AT-CSN-000133 (Additional NAcP report for Almaraz and Trillo NPPs).
- 1999983302377 (reference NAcP report for Cofrentes NPP).

[3] HLG_p(2018-37)_160_1st_Topical_Peer_Review_Report, 28-10-2018.

[4] Updated Report Activities in WENRA countries following the Recommendation regarding flaw indications found in Belgian reactors (2017), 2 November 2017. WENRA.

[5] HLG_p(2019-39)_163 ENSREG 1 st TOPICAL PEER REVIEW Action Plan

[6] Letters sent to licensees requesting information to perform the NAcP follow-up:
- CSN/C/DSN/AL0/21/15
- CSN/C/DSN/AS0/21/21
- CSN/C/DSN/COF/21/08
- CSN/C/DSN/TRI/21/08
- CSN/C/DSN/VA2/21/08

[7] Letters received from licensees with their follow-up actions defined in the NAcP:
- Z-04-02 / ATA-CSN-016303
- ANA/DST-L-CSN-4416
- 2199983301069
- Z-04-02 / ATT-CSN-013371
- CNV-L-CSN-7211