Translation of ASN Letter reference: CODEP-DCN-2021-040400

Montrouge, 15 September 2021

To the Director of the EDF DIPNN

22-30 avenue de Wagram
75382 Paris cedex 8

Subject: EPR 2 reactor project

Topic: Application of a break preclusion approach

References:

[1] EDF letter of 15 April 2016

[2] EDF letter referenced ENM-PPPPPP-00006-ASNDCN of 30 January 2018

[3] Order of 7th February 2012 amended, setting the general rules concerning basic nuclear installations.

[4] ASN Guide No? 22 on the design of pressurized water reactors

[5] ASN Opinion 2019-AV-0329 of 16 July 2019

[6] EDF letter referenced ENM-PPPPPP-00012-ASNDCN of 30 September 2019: EPR 2 –Transmission of the safety baseline requirements associated with the "non-ruptible components" and the "break preclusion" approach

[7] EDF letter referenced ENM-PPPPPP-00017-ASNDCN of 4 May 2020: EPR 2 – Transmission of the memos "benefits and consequences of the approach" and "organisational aspects"

[8] EDF letter referenced ENM-PPPPPP-00034-ASNDCN of 29 July 2021: EPR 2 – Break preclusion – Scope of renewal of the approach

[9] EDF letter ENM-PPPPPP-00027-ASNDEP of 2 September 2021 – Examination of the theme EDR CNR – Formalisation of the examination discussions instruction – mechanical part

[10] EDF letter ENM-PPPPPP-00029-ASNDEP of 30 June 2021 – EPR2 – Documentation associated with the early examination of the theme DDS / Situations and work loads

For the attention of the Director,

In application of article R. 593-14 of the Environment Code and by letter reference [1], EDF asked ASN for its opinion on the main safety options of a project for a new reactor model derived from the Flamanville EPR and called EPR New Model (EPR NM). Through letter reference [2], EDF informed ASN of its decision to upgrade the chosen technical configuration to a new version, called EPR 2.

The safety options dossier (DOS) provided to underpin this request presented the safety baseline requirements applicable to this reactor project and the main design options being studied. More specifically, as was the case with the Flamanville EPR reactor, it provided for application of a break preclusion approach on certain pipes in the main primary and secondary systems.

The principle of the break preclusion approach applied to pipes consists in not examining the consequences of the break of a pipe in the nuclear safety case because such a break is rendered extremely improbable with a high level of confidence. Application of this approach must lead to the reinforcing of the first two levels of the defence in depth principle mentioned in article 3.1 of the order reference [3].

After examining your dossier, and in view of the recommendations of the guide reference [4], ASN considered in its opinion reference [5] that the adoption of a break preclusion approach on certain pipes of the primary and secondary systems was not acceptable at this stage, in the absence of additional information. This additional information, which must take account of experience feedback from the Flamanville EPR reactor, concerned:

- demonstrating that the break preclusion approach will allow the achievement, with a high level of confidence, of a high quality of design, manufacture and in-service monitoring;
- demonstrating the licensee's ability to ascertain that the safety baseline requirements are correctly applied by EDF and its service providers;
- demonstrating that this design choice is reasonable considering the advantages and drawbacks it brings to the overall level of safety of the installation and to radiation protection.

Through letters references [6] and [7] you provided additional information which was the subject of technical discussions between EDF, IRSN and ASN [8]. In letter reference [9], you sum up the additions made to the application baseline of the break preclusion approach and the methods of integrating them into the safety analysis report.

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You also made proposals aiming to step up the level of requirements with regard to the design, manufacture, in-service monitoring, and the guarantees of effectively achieving this.

Quality of design and manufacture

With regard to design and manufacture, the approach presented is more structured and better substantiated than that of the Flamanville EPR reactor and enables the targeted level of requirements to be better assessed. I also note several design and manufacturing changes reflecting integration of the lessons learned from the Flamanville EPR reactor.

For the main primary system pipes, these changes concern the installation of more forged branch connections in place of certain welded branch connections, and optimisation of the sizes of ingots used to manufacture these pipes, bringing an improvement in forging quality.

For the main secondary steam pipes, these changes more specifically concern the replacement of elbows by bent sections, the choice of a one-piece penetration cover improving the inspectability of welds, control of strain aging mechanisms by the appropriate choice of materials and manufacturing processes, and demonstration of the ductile behaviour of the materials in their operating range. With regard to welding, preparing weld materials files, making use in priority of automatic welding and weld inspection processes, performing the work in shop rather than on site, and limiting the number of repairs by welding also represent positive changes. The competitive dialogue that you undertake with the service providers and suppliers will enable you to select the best technical solutions for the manufacture of the pipes with regard to the break preclusion baseline requirements.

Nevertheless, some provisions of the break preclusion approach application baseline requirements are dependent on satisfactory completion of ongoing work. I would draw your attention to the examination of this baseline which is still to be carried out, and which shall enable ASN to issue a position statement regarding the appropriateness of your proposals.

Thus, with regard to design, you will have to set ambitious margin targets and make sure they are maintained in the detailed verification calculations of the pipe design. To ensure consistency, the same approach shall be applied for the "non-ruptible" (non-breakable) equipment

In this respect, before starting to design the equipment, the exhaustiveness of the inventory of loads to which they can be subjected and its consistency with the safety case, along with the particularly conservative characterisation of these stresses, must be demonstrated. I have noted that you sent me a description of your approach in this respect in your letter reference [10]; its examination will begin shortly.

With regard to manufacture, some complements to the break preclusion approach application baseline are required (codification of the base material of the main secondary pipes, improvement in the management of production control coupons, etc.). Some technical solution must moreover be confirmed (one-piece cover and double bend), along with the results of the competitive dialogue. Lastly, the achievability of these requirements must be confirmed on the basis of the results and lessons learned from the ongoing application of the baseline requirements of the Flamanville EPR reactor.

Ability of the licensee to check proper operational application of the baseline requirements

In order to provide guarantees concerning the operational application and achievement of these requirements, and in view of the experience feedback from the Flamanville EPR reactor, you have reviewed the organisation of the EPR 2 reactor project and defined organisational procedures concerning the management of skills, monitoring, the management of deviations and the management and traceability of requirements.

These provisions concern more specifically the reinforcing of technical skills and project management, enhancing awareness of the break preclusion requirements among the personnel of EDF and its service providers involved in the manufacturing and inspection operations, improving the clarity of the contractual requirements and the resulting technical specifications, tightened monitoring of the activities relating to the equipment concerned, listing and monitoring the deviations detected by the suppliers via a computer tool and the implementation of a system engineering approach.

The direct involvement of EDF as regulatory manufacturer of the main secondary steam pipes also constitutes a simplification of the industrial scheme. Lastly, you have started to deploy the welding quality control plan stemming from Excell, your sector transformation plan, and you are involved in the special processes qualification initiative under way at your manufacturer Framatome. These steps are likely to bring the desired guarantees.

Nevertheless, these changes must be effectively implemented and their effectiveness must be proven and monitored by appropriate measures. Furthermore, the EPR 2 programme must take into account all the operating experience feedback from the nuclear pressure equipment of the Flamanville EPR reactor, which at present is still being collected.

Quality of in-service monitoring

With regard to in-service equipment monitoring, the measures you propose provide for the monitoring of more parts of the installation compared with the EDF reactors currently in operation, which is consistent with application of the break preclusion approach. In this respect I take positive note of the aim of inspecting all the welds of pipes subjected to the break preclusion baseline requirements. *On the other hand*, I consider your proposal concerning the welds of the secondary section of the steam generators, which is based on random inspections, to be insufficient.

In conclusion, I consider that the undertakings of the break preclusion approach application baseline requirements, supplemented by those taken during the examination, constitute design, manufacturing and in-service monitoring choices that are likely to provide sufficient guarantees, with a high level of confidence, of the extremely improbable nature of a break in the equipment concerned, and of the achievability of the requirements associated with the break preclusion approach.

Advantages and drawbacks of the break preclusion approach for safety and radiation protection

The approach you are considering is comparable with the approaches applied by other countries on the main primary and secondary system pipes. It improves equipment accessibility for maintenance and inspection in service and therefore reduces the dosimetry in operation, and it also provides line routings that reduce the mechanical stresses which is favourable in terms of safety.

Further to the ASN opinion reference [5], and notwithstanding the choice of a break preclusion approach, you have studied the measures that could be put in place on the reactor to mitigate the consequences of a break. Thus, as concerns the main secondary system steam lines, you have planned [8]:

- to put in place, within the reactor building containment, anti-whip devices and to separate adjacent lines by a concrete wall;
- to add pressure outlets in the safeguard auxiliaries buildings, so that their structural integrity is preserved in the event of a line break.

You have also planned to conduct studies of the guillotine break of a steam line and to analyse its consequences in order verify that there is no cliff effect in terms of off-site radiological consequences.

Given that this is a design derived from the EPR reactor, I consider that these undertakings enable the drawbacks of the break preclusion approach to be reduced as much as reasonably possible and to an acceptable level.

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Further to the examination of the complements and the undertakings you have transmitted to ASN in response to its opinion reference [5], I now consider that the adoption of the break preclusion approach for the main primary system pipes and the secondary system steam lines of the EPR 2 reactor is acceptable.

The break preclusion approach and its application must be integrated in the preliminary safety analysis report.

The examination of its application baseline requirements and the organisational provisions must be continued and a letter setting out additional requirements will be sent to you in the near future. I would draw your attention to the need to respond to this letter sufficient early so as to have stabilised baseline requirements within time frames compatible with their examination by the Advisory Committee for Nuclear Pressure Equipment before filing an authorization application for the creation of a basic nuclear installation.

Yours sincerely,

Signed by Bernard DOROSZCZUK, Chairman of ASN