ADVISORY COMMITTEE OF EXPERTS
FOR NUCLEAR PRESSURE EQUIPMENT

Opinion concerning EDF's approach to the processing of deviations affecting the break preclusion category welds on the main steam lines on the Flamanville EPR reactor

Meeting held in Montrouge on 09 and 10 April 2019

I

In accordance with the ASN request in its letter CODEP-DEP-2019-011267, the Advisory committee for Nuclear Pressure Equipment met on 9 and 10 April 2019 to examine the approach to the processing of deviations affecting the break preclusion category welds on the main steam lines (VVP lines) of the Flamanville EPR reactor. Members of the Advisory Committee for Reactors also took part in the session and in the work.

II

The Advisory Committee familiarised itself with the conclusions of the examination by the rapporteur of the file transmitted by EDF and the opinion of IRSN, which it contacted in order to produce its report. The Advisory Committee examined the deviations processing approach proposed by EDF concerning the containment penetration welds produced in the workshop.
The Advisory Committee familiarised itself with the conformity restoration scenarios for these welds presented by EDF and its position regarding the risks associated with these scenarios. The Advisory Committee also familiarised itself with the difficulties expressed by EDF regarding the abandonment of the break preclusion approach for the pipes concerned.
The Advisory Committee also examined the scenario involving acceptance asis if repairs were to entail technical constraints such as to make them impossible or prejudice safety. For this purpose, the Advisory Committee examined the substantiating evidence produced by EDF in order to meet the various design and production objectives underpinning the break preclusion approach, with a high level of confidence.

The Advisory Committee more particularly examined

- The adequacy of the mechanical tests performed during manufacture and the test programmes proposed by EDF:
    - to acquire an understanding of the behaviour of the material as used, more particularly enabling the low toughness values and the inversion of the tensile strength values between the ambient temperature and hot tests to be explained and reproduced;
    - to obtain characterisation, with a high level of confidence, of the properties of the materials of the welds produced, taking account of the results of qualification of the welding procedure or production control assemblies, as well as the nature and number of the deviations detected and the repairs made;
- the adequacy of the volumetric non-destructive inspections performed or planned by EDF in the light of the high level of confidence required concerning the compactness of the materials, more particularly in terms of the nature and size of detectable flaws;
- the acceptability of the harmfulness calculation approach proposed by EDF to justify maintaining the non-volumetric flaw as-is on a break preclusion weld, which also has degraded mechanical properties;
- more generally, given the number and nature of the deviations detected, the possibility of demonstrating that the break preclusion approach objectives are reached by means of a justification approach based on a fast fracture mechanical analysis and greater in-service monitoring, plus, as applicable, on the input data for the fast fracture mechanical calculation and the conservative margins which would then be adopted.

III

I. Deviations

The Advisory Committee observes a particularly high number of deviations encountered in the technical choices, the production processes, the acceptance results and in the external monitoring,

which come on top of inappropriate filler material choices, leading to a level of quality well below that which was required. These deviations are notably indicated by certain very low toughness values obtained on test specimens. These points represent major obstacles to application of a break preclusion approach.

These deviations arise more particularly from shortcomings from specification up to monitoring, including deviations processing. The Advisory Committee considers that it is essential to analyse this situation in depth and that the various parties involved draw the relevant conclusions.

II. Processing approach

The Advisory Committee notes that, in the light of the current uncertainties regarding the industrial feasibility and time needed to carry out conformity work on the penetration welds, EDF envisages using an approach finalised by a fast fracture resistance calculation to guarantee that the integrity of these welds would be maintained for the lifetime of the facility, in order to justify accepting them as-is.

The Advisory Committee considers that unless EDF agrees to waive all or part of the break preclusion process, it must carry out conformity work on these penetrations.

Given the risks put forward by EDF for the conformity work scenarios presented, it is essential to broaden the scope of the investigations.

III. Understanding the behaviour and characterisation of the welded joints material

Examination of the deviations processing file on the VVP lines penetration welds led the Advisory Committee to observe that the "material file" was extremely incomplete for the welded joints on these lines.

In this respect it formulated recommendation N° 1 appended.

IV. Compactness of welded joints

The Advisory Committee notes that in accordance with the provisions of the ESPN order, the manufacturer specified the flaws it considers to be unacceptable with regard to the control of its manufacturing processes and that it has defined non-destructive testing (NDT) to enable them to be detected.

It considers that the data provided by EDF to justify performance of the NDT with respect to detection of the flaws considered by the manufacturer as unacceptable with regard to the control of its processes, are incomplete. This led the Advisory Committee to formulate recommendation N° 2 appended.

Advisory Committee Recommendations

Recommendation N° 1

With regard to the "material file" for the VVP line welds, the Advisory committee recommends that the understanding of the phenomena observed in terms of strain ageing and variations of the mechanical properties with the main welding parameters needs to be examined in greater depth. It recommends that the manufacturer provide quantification data for these phenomena, in particular with regard to toughness.

Recommendation N° 2

The Advisory Committee recommends that EDF demonstrate that the volumetric NDT processes (RT and UT) are able to detect and identify the indications with the characteristics defined by the manufacturer for unacceptable flaws and that the manufacturer's file on "unacceptable flaws with regard to the control of processes" mentions the implementation of UT NDT to detect non-volumetric flaws.

Appendix
GPESPN members who took part in drafting the opinion:

Mr.	SCHULER	Chairman
Mr.	SORRO	Vice Chairman
Mr.	AUTRET	
Mr.	BUISINE	
Mr.	CHAMPIGNY	
Mr.	COUPLET	
Mr.	CREIS	
Ms.	DROBYSZ	
Mr.	JENDRICH	
Mr.	LEBLANC	
Mr.	LONGIN	
Mr.	MARIGNAC	
Mr.	MONNOT	
Mr.	MUTIN	
Mr.	NEDELEC	
Mr.	PAYEN	
Mr.	PERRAT	
Mr.	PERRIN	
Mr.	PITOISET	
Mr.	PLANTEVIN	
Mr.	ROTTER	
Mr.	ROUSSEL	

GPR members who took part in drafting the opinion:

Mr.	QUENIART	Vice Chairman
Mr.	BOSSU	
Mr.	CHARLES	
Mr.	DE L'EPINOIS	
Mr.	DUBOIS	
Mr.	RAYMOND	