
Significant Safety Event related to stress corrosion detection on auxiliary circuit pipe sections of several nuclear reactors

On September 16th, 2022, EDF declared a generic INES 1 Significant Safety Event concerning Civaux 1, Chooz 1, Penly 1 and Cattenom 3 reactors to the Nuclear Safety Authority, following the inspections and expert assessments carried out as part of the strategy to address the phenomenon of stress corrosion on auxiliary safety classified systems. This strategy was submitted to the Nuclear Safety Authority on July 13th, 2022.

EDF has engaged a comprehensive program of inspections and expert assessments in line with the overall strategy to address the stress corrosion phenomenon. EDF had also committed to update the initial generic Safety Significant Event as new data from the reactors in scope or new results from expert assessments are made available.

Accordingly, on March 6th, 2023, EDF updated the generic Significant Safety Event, considering the latest findings from the inspections and expert assessments carried out on the fleet. This revision incorporated two defects whose dimension is greater than the one considered in the calculations for these lines.

The first finding is a stress corrosion defect located in a weld examined in January 2023 on the Penly 1 reactor hot leg safety injection system (see information published on the Penly NPP website on February 24th, 2023). The presence of stress corrosion was confirmed after a thorough laboratory examination carried out on the portion of this circuit. The stress corrosion defect is characterized by a large depth (23 mm) located on a small portion of the weld.

This singular defect was observed in a zone of the weld previously repaired and was probably generated by “double repair” operations when the pipes were first assembled during the initial construction of the plant.

These initial repair operations on the weld probably contributed to a significant increase in the local residual stresses, favoring the appearance of a stress corrosion defect.

The second finding was due to thermal fatigue and was detected in a weld on the Penly 2 safety injection system. The maximum depth of the defect measured during the metallurgical expert assessment is 12 mm. The phenomenon of thermal fatigue is well known and has long been monitored under the preventive maintenance programs. Lessons learned on the location of this specific defect are being analyzed, as it is expected with these surveillance programs.

Examinations carried out on the other three lines of the Penly 1 and the Penly 2 safety injection systems have shown that there were no other defect.

In an accident situation, the reactor cooling function would have been ensured, including when postulating the failure of the lines on which the last stress corrosion faults were discovered. This situation is covered in the plant design, by means of the redundancy of the circuits and systems called by the cooling function.

At this stage of the inspection program carried out at the nuclear plants, EDF has confirmed the characterization of stress corrosion defects observed in the piping sections of the auxiliary systems of three other reactors, namely Civaux 2, Chooz 2 and Penly 2.

Defects resulting from thermal fatigue were characterized on the Cattenom 3 and Penly 2 reactor systems.

EDF notified the Nuclear Safety Authority on March 6th, 2023, of the update to the INES 1 generic Safety Significant Event, which was upgraded to an INES 2 level specifically for Penly 1 reactor.

EDF is reviewing its controls strategy to address these issues. It will be submitted to the Nuclear Safety Authority in the coming days.