Montrouge, the 9th march 2016

Technical notice: description of the event

On 9th April 2014 at 16h40, while a cooling system tank (SNO tank) in the reactor 1 turbine hall (non-nuclear part) of the Fessenheim NPP was being filled with water, the level of water in this tank exceeded the maximum specified level. The surplus water is drained off via the tank's overflow system, specifically designed to evacuate water in the event of over-filling. The water drain pipe was blocked at ground level by a mixture of mud and rust and the pipe therefore filled, with the water backing up in other pipes before overflowing into the room located next to the reactor 1 control room.

At 17h00, the EDF staff noticed water in the corridor in front of the reactor 1 control room, located 15 metres above the ground. They immediately stopped tank filling. Water nonetheless ran down into the rooms on the lower floors, which in particular house the electrical cubicles. The subsequent analysis of the event showed that the openings, which were designed to prevent water runoff to the lower floors, were not leaktight and were unable to stop water from passing.

The water splashed onto the electrical equipment leading to several items becoming unavailable with tripping of the alarms in the control room. In particular, train A of the RPR[1] system and the control rods visual position indicator were no longer available. However, train B of the RPR system was unaffected: the reactor protection functions performed by the RPR system continued to be guaranteed.

The EDF personnel applied normal reactor operating rules and initiated reactor shutdown. As the control rods position indicator was not available, it was impossible to control reactor power by varying the insertion of the control rods in the core. The EDF staff thus used the addition of boron to the reactor coolant system to gradually bring down the reactor power. Manual or automatic shutdown of the reactor by complete insertion of the control rods remained operational at all times during the event, but it was not necessary to resort to this measure.

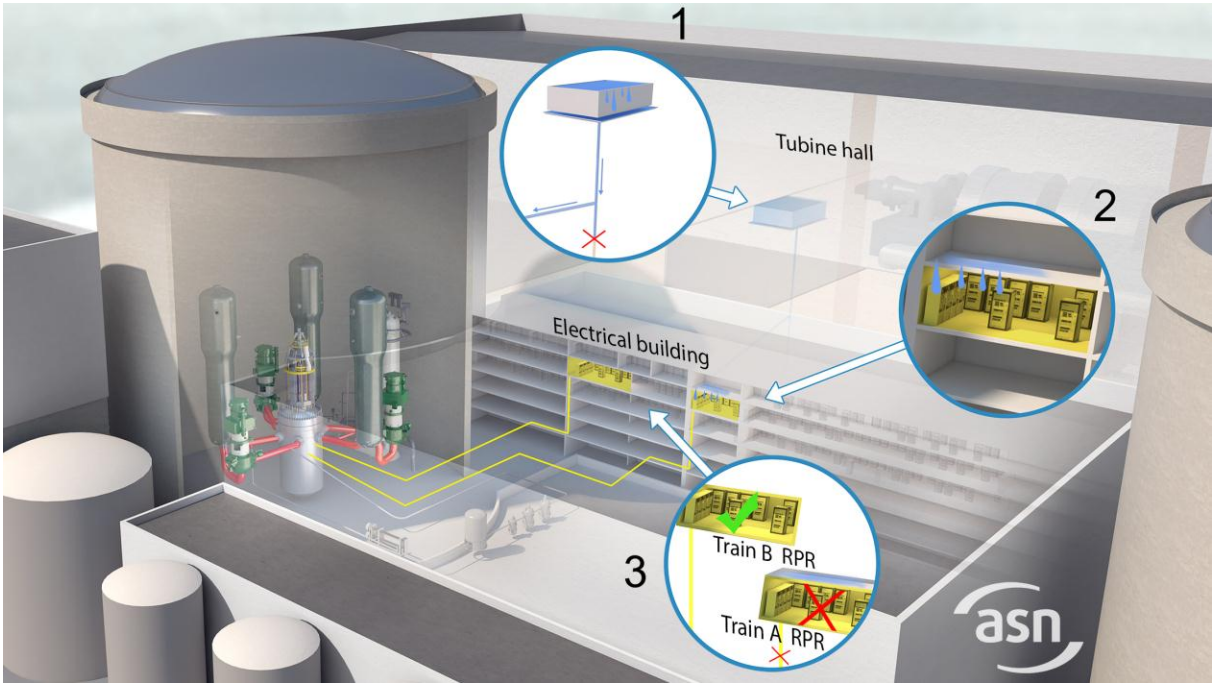
In the hours which followed, in accordance with the reactor normal operation rules, the pressure and temperature of the reactor coolant system were lowered until a "maintenance cold shutdown" state was reached in the morning of 11th April 2014.

[1] The role of the RPR (or reactor protection system) is to ensure that the reactor is protected by triggering a series of automatic actions. Based on the information supplied by various types of sensors (temperature, water level, pressure, etc.), electronic processing decides on whether to actuate reactor automatic shutdown and safety systems. The pressurised water nuclear reactors operated by EDF are also protected by redundant systems and equipment. The electrical power supplies and I&C for the RPR system are thus provided by two electrical systems, referred to as train A and train B, which are separate and independent. Each of these trains can perform the reactor protection functions on its own.

EDF then carried out repair and requalification of the equipment affected by the splashed water, between 11th April and 20th May 2014. After the restart operations and testing of the repaired equipment, EDF reactor 1 was reconnected to the grid on 28th May 2014.

This event has no consequences on the personnel, nor on the environment of the installation. Owing to the deterioration of the protection equipment, which led to shutdown of reactor 1, it was rated level 1 on the INES international nuclear events scale.

Understanding the event



1. Overflow of SNO tank
2. Splashing of electrical cubicles
3. Redundant RPR system: channel A unavailable / channel B available

SNO tank filling procedure

The analysis of the event revealed an anomaly in the SNO tank filling procedure, which indicated a maximum level of 2.20 m, whereas the overflow system is in fact situated at a level of 2.05 m. This explains why the EDF staff reached the overflow level during the tank filling operation on 9th April 2014.

Following this event, the procedure in question was corrected and the level indicator transmitted to the control room was modified to improve its ergonomics.

Control rods / Boron concentration in the reactor coolant system

In a nuclear reactor, the control rods have two functions:

- To adjust the reactor power, by varying the extent to which they are inserted into the reactor core;
- Reactor automatic or manual operator shutdown in a few seconds by gravity drop.

During the event of 9th April 2014, owing to the water that had splashed onto the electrical equipment, this first control rod function was no longer operational. This is why the EDF personnel carried out gradual shutdown of the reactor by injecting boron into the reactor coolant system. Although using boron alone to shut down a reactor is relatively uncommon, it does comply with the normal operating procedures.

In any case, the second function of the control rods remained operational for the duration of the event. Shutdown of the reactor in a few seconds by dropping the control rods was available, but it was not necessary to resort to this measure to manage the event.

Organisation put into place by EDF

In order to manage this event, the Fessenheim site on the one hand reinforced the operating team present in the control room and, on the other, called in technical support from the EDF head office departments.

Throughout the event, reactor normal operating procedures were applied. At no time was the reactor in a situation requiring implementation of emergency operating procedures. Moreover, no reactor safety system was activated.

In accordance with the installation's operating rules, the on-site emergency plan was not triggered.

Temperature of the reactor coolant system at reactor shutdown

When the reactor was shut down, the temperature of the reactor coolant system fell below the specified limit for 14 minutes (temperature fell to 282°C with a limit set at 286°C). An increase in power demand from the grid during reactor shutdown caused this temperature drop.

The actions of the EDF personnel enabled the temperature to be restored to a level compliant with the operating rules within 14 minutes. In addition, the reactor coolant system temperature is permanently measured by the reactor protection systems. It should be noted that in the event of a larger temperature drop, the RPR system would have triggered automatic reactor shutdown.

INES level

A level 1 event on the INES scale is defined as being "an anomaly outside the authorised operating conditions". Level 2 is defined as being an "incident with significant failures in safety provisions".

With respect to the event of 9th April 2014, the reactor remained within the scope of application of normal operating rules at all times. At no point was it necessary to apply emergency procedures and none of the reactor safety systems were activated, even though they were all operational. Consequently, this event was rated level 1 on the INES scale.