Quarterly report on NPP events

July – September 2017
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Foreword

In the European Union, a regional network, the European Clearinghouse on Operating Experience Feedback for Nuclear Power Plants, has been established to enhance nuclear safety through improvement of the use of lessons learned from operating experience.

The European Clearinghouse is composed mainly of European nuclear safety regulatory authorities and their technical support organisations. It is operated by dedicated staff from the European Commission´s Joint Research Centre.
Abstract
This newsletter provides Feedback on Operating Experience (OEF) from significant safety related events at nuclear power plants (NPPs) worldwide, compiling the NPP events that were reported publicly in July-September 2017.
1 Introduction

This newsletter provides Feedback on Operating Experience (OEF) from significant safety related events at nuclear power plants (NPPs) worldwide, every three months. It is intended to provide timely information to the Clearinghouse members about recent significant events, with a real or potential impact on nuclear or radiation safety. The report is intended to be complementary to other international reporting systems such as the International Atomic Energy Agency (IAEA) IRS, rather than duplicate the information provided by it. Usually the information used to prepare the report is publicly available and the information is notified promptly, in advance of other reporting systems. Only events that are considered to be likely to have lessons applicable to EU NPPs are selected.

Event selection for reporting in this newsletter is a two stage process. All the information found on relevant web sites is initially screened and the events that match at least one of the following criteria are short-listed for further consideration:

— Unplanned or unexpected automatic or manual reactor trips;
— Events rated at INES Level 2 or above;
— Significant radiological events;
— Real or potential challenges to nuclear safety or defence in depth; including recurrent events and actuation of systems;
— Events with common cause failure aspects;
— Events with lessons learned worth being disseminated;
— Events requiring the entry into emergency operating procedures

Furthermore staff may occasionally short-list other events based on other criteria.

The final selection of the events is made by the JRC-IET Clearinghouse Selection Committee. The following criterion is adopted to guide the Committee’s final selection:

— Level of actual or potential effect on safety;
— Events rated at INES Level 2 or above; and
— Significance of lessons learned for EU NPPs.

Clearly the criteria above are open to a degree of interpretation and judgment and the selection committee is comprised of suitably qualified and experienced personnel who by applying engineering judgement and through consensus, arrive at the final selection.

Finally, no comparison should be made among countries with regards to the number and significance of events, as the number of nuclear power plants, the reporting criteria and, most significantly, the information made available to the public, varies widely among countries.
2 Events short-listed

Gathering event information for short-listing involves searching potential sources of operating experience information including relevant world-wide websites. When NPP related event reports are identified as potential candidates for the shortlist the information is translated into English for the purpose of screening and possible inclusion in this newsletter. The sources of the event information are referred to in an event list compiled for the purposes of screening which then results in the initial short-list.

The short-list of events considered for inclusion in this quarterly report are drawn from NPPs world-wide and can be found in the database on our website, accessible to Clearinghouse members. The following information is collected: title of the event; date of event or date of reporting if date of incident not available; event description; INES level (if available) and name of the NPP.
3 Events selected
Two events were selected from the short-list for this Newsletter:

1. 26/06/2017: Manual reactor trip due to decreasing steam generator levels caused by main boiler feedwater pump turbine low pressure governor valves failed closed (USA / INDIAN POINT 2)

2. 18/08/2017: Insufficient seismic resistance of a part of the Donzère-Mondragon canal embankment (FRANCE / TRICASTIN)

In addition to these two events, this newsletter provides an update on the current status of a previously reported event: Hydrogen flakes found in the reactor pressure vessels of Doel-3 and Tihange-2.

The information provided is extracted from publicly available sources. More detailed information on these events may become available in due course, either from the original source or through international operating experience sharing systems.

3.1 Manual reactor trip due to decreasing steam generator levels caused by main boiler feedwater pump turbine low pressure governor valves failed closed

INDIAN POINT 2 – 26/06/2017

Plant operators commenced a downpower from 100 percent to 93 percent reactor power to support performance of the Main Turbine Stop and Control Valve Test. With reactor power at 94 percent the 22 Main Boiler Feed Pump Turbine (MBFPT) speed control trouble alarm annunciated coincident with pump speed swings of 800 revolutions per minute (rpm). The operators ceased the downpower and placed the pump in manual speed control to control the rpm swings, unsuccessfully. The MBFPT low pressure governor valves were observed to be cycling from full-closed to full-open. The decision was made to take local pneumatic control of the pump to stabilize its rpm. After two minutes with local control, the governor valves went to full closed and the pump was no longer delivering feedwater flow to the SGs.

An automatic main turbine runback signal should have been generated on a low speed signal, however there was no turbine runback actuation. In response the operators commenced a manual runback to reduce main turbine load but the decreasing SG levels reached 15 percent and a manual reactor trip was initiated. All control rods fully inserted and all required safety systems functioned properly.

The direct cause of the reactor trip was that the shoulder screws used on the governor valve servomotor linkage had backed out and detached. This caused governor valves to fail closed shutting off the turbine steam supply.

A contractor is hired by the utility during outages to perform overhaul work on major plant components, including the MBFPTs. The utility provides oversight of the work. The contractor had performed an overhaul of the 22 MBFP LP governor valve servomotor during Spring 2016 refueling outage, which consisted of a complete servomotor disassembly, inspection, replacement of worn components, and reassembly.

The piston shaft appeared to be very slightly twisted and not in its correct alignment. With the piston shaft misaligned, uneven forces were placed on the fulcrum bar, link pin, and shoulder screws, and this was evident by the wear found on the fulcrum bar. In addition, based on the drawing of the LP servomotor, the threads for the shoulder screws should have been staked to securely retain the screws. But the screws were not staked during the overhaul in the 2016 outage, or in any previous outage.
Manual Reactor trip due to decreasing Steam Generator level

What?
- On 23/06/2017, Indian Point 2 decreasing power to 93% to perform Main Turbine Valves test
- At 94% power, Main Boiler Feed Pump Turbine (MBFPT) trouble alarm
- The operators placed the 22 MBFP in Manual speed control
- Rpm swings continued - governor valves were fully cycling
- 2 min. after Establishing local pneumatic control, LP governor closed
- MBFP tripped and stopped delivering water to the SGs
- Main Turbine runback signal should be generated but runback didn’t occur
- SG levels reached 15%, and manual reactor trip was initiated

How?
- MBF pump speed swings of 800 revolutions per minute (rpm) due to failure of LP governor servomotor
- Servomotor piston shaft and linkage appeared to be slightly twisted
- Caution statement regarding the use of excessive twisting and other vital information were not transferred from inspection procedure to work order
- Contrary to the drawing, Service providing personnel had not staked the screws during previous refueling outage overhaul of LP servomotor
- During the investigation, the bistable for load limit valve 1 (LLV1) was tested and found to be not functioning, and the bistable for LLV2 was found with an out of tolerance setting and needed adjustment

Why?
- 5.5.2 Personnel work practices
- 5.5.7 Written procedures and documents
- 5.6.9 Management of contracted work
- 5.7.3 Maintenance, testing or surveillance
It was observed that a step text document was used in place of the normal utility inspection procedure. The step text reduced the complete overhaul of the LP servomotor (i.e., visual inspection, disassembly, cleaning, replacement of worn parts, reassembly) down to only two steps. The contractor is not accustomed to using the utility procedures, so the step text document was created to eliminate the confusion. However, many of the notes, caution statements, and required measurements were not transferred from the utility procedure to the step text document used by the contractor. Consequently, vital information was lost.

**Editor’s comment** – This event has been highlighted because of the significance of its lessons learned.

Simplified overhaul procedures prepared for contractors should be reviewed to make sure that all vital information from original documents is transferred to the documents actually used during the overhaul. Furthermore, proper writing of infrequently performed instructions is very important, as the instructions tend to be written at the same level (and assuming the same knowledge) as frequently performed instructions.

As contractors used during overhauls in refueling outages may not be familiar with the original plant documentation, there may be a need to prepare ad hoc documents focused on the specific activities to be performed by the contractor. While this practice may be fully justified, it is essential not to lose important information in the process, and always ensure an effective contractor oversight by the plant operator.

### 3.2 Insufficient seismic resistance of a part of the Donzère-Mondragon canal embankment

**TRICASTIN – 18/08/2017**

The Tricastin NPP lies by the right bank of the Donzère-Mondragon canal, with most of the site at an elevation around six meters below the normal water level on the canal. An embankment protects the site from the flooding risk, together with additional embankments for the cooling water intake and discharge channels. An adjacent major AREVA site hosting diverse fuel cycle facilities is protected by these embankments as well.

![Figure 1](source: IRSN [RD1])

**Figure 2. Schéma de principe du profil en travers au droit de la centrale nucléaire du Tricastin.**

The embankments for the intake and discharge channels were built between 1974 and 1978, using silt materials from the canal bed, covered with gravel. However, a sector of the embankment close to the NPP is built with a sand-gravel mix of backfilling material, called the «gravel embankment».
In accordance with applicable regulations, the safety case of the NPP considers an earthquake (Seisme majoré de sécurité, SMS) with a level above the maximum historically feasible earthquake (SMHV). This is generally considered to be associated to a return period of 1000 years. For the site of Tricastin, the SMHV found is VII-VIII in the scale MSK, or 4.7 in the Richter scale (based on an earthquake occurred at 13 km from the site in 1873). This level has been augmented up to 5.2 in the Richter scale to establish the SMS.

According to the studies recently achieved by the operator about the effects of such an earthquake on the embankment, the possibility of partial liquefaction of the embankment, followed by breach of the embankment and flooding of the site cannot be excluded. The portion of embankment affected is about 400 m long. The same studies show that an earthquake up to the intensity of the SMHV would not cause however the breach of the embankment.

The degradation of the embankment would be caused by a phenomenon of partial liquefaction of the backfill material, subject to local density, granulometry and water level, leading to structural instability of the embankment.

The resulting flooding would lead to the loss of offsite and onsite power sources, as well as the core cooling and spent fuel cooling functions. In addition to this, certain equipment located at low elevations could be lost as well, including reactor instrumentation and other emergency systems. This could lead to a nuclear fuel melt accident in the four reactors of the Tricastin NPP and would make it particularly difficult to implement on-site and off-site emergency management resources.

At the request of the French regulator ASN, EDF was given a hearing on 26 September 2017 and provided additional data. ASN considers that these data are unable to rule out the risk in the short term.

EDF has been required to conduct further geotechnical investigations in order to make a more detailed characterisation of the composition of the part of the embankment concerned and carry out the necessary reinforcement works before the reactors are restarted, to ensure that the embankment is able to withstand the maximum earthquake considered in the nuclear safety case.

Editor’s comment – This event has been highlighted because of the INES 2 rating assessed by the French regulator.
3.3 Updated information on the event "Hydrogen Flakes found in the Reactor Pressure Vessels of Doel-3 and Tihange-2"

The Belgian nuclear regulatory authority FANC required that Electrabel must carry out re-inspections of the reactor pressure vessels (RPV) of Doel-3 and Tihange-2 at regular intervals, at least every three years.

The first re-inspections were carried out in November 2016 on the Doel 3 RPV and in April 2017 in the case of the Tihange 2 RPV. These inspections were conducted using an ultrasonic testing technique with a view to monitoring the population of hydrogen flakes. The inspection results have been published recently in the FANC Website (http://afcn.fgov.be/fr). On the basis of the statistical analyses, the documents published clearly show that there is no growing of defects. There are a number of indications not reported in the previous 2014 inspections. These "new indications" are not really new. The indications are small and close to the threshold of detection. As the ultrasonic records kept after every inspection include data recorded below the reporting threshold, indications not primarily classified as flakes by any examination can be retrieved and processed subsequently, making it possible to verify that no evolution occurs in the flaw population.

REFERENCES

[RD1] Note d´information, IRSN, 28th September 2017
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