European Commission

JRC TECHNICAL REPORTS

Quarterly report on NPP events

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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 October- December 2019.

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 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 judgment 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

Three events were selected from the short-list for this Newsletter:

1. 11/09/2018: Pressurizer instrument nozzle leak due to primary water stress corrosion cracking (US / ST LUCIE 2).
2. 30/09/2018: Automatic reactor scram due to loss of two condensate pumps (US / PEACH BOTTOM 3).
3. 25/10/2018: Insufficient seismic resistance of a bolted assembly (FRANCE / CHINON B1/B2).
4. 08/11/2018: Late detection of loose electrical connections on several valves of the RHR system (FRANCE / CIVAUX 1).
5. 04/12/2018: Catwalks not compliant with seismic resistance requirements (FRANCE / MULTI-SITE).

The information provided is extracted from publicly available and other authorised 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 Pressurizer instrument nozzle leak due to primary water stress corrosion cracking

ST LUCIE 2 – 11/09/2018

During refueling outage augmented bare metal visual inspection activities, a through wall flaw was discovered on a pressurizer level instrument nozzle. The leak was small enough that it was not quantifiable in the daily reactor coolant system leak rate calculations and had not increased to the point where it was visible through the pressurizer insulation. The flaw was not circumferential.

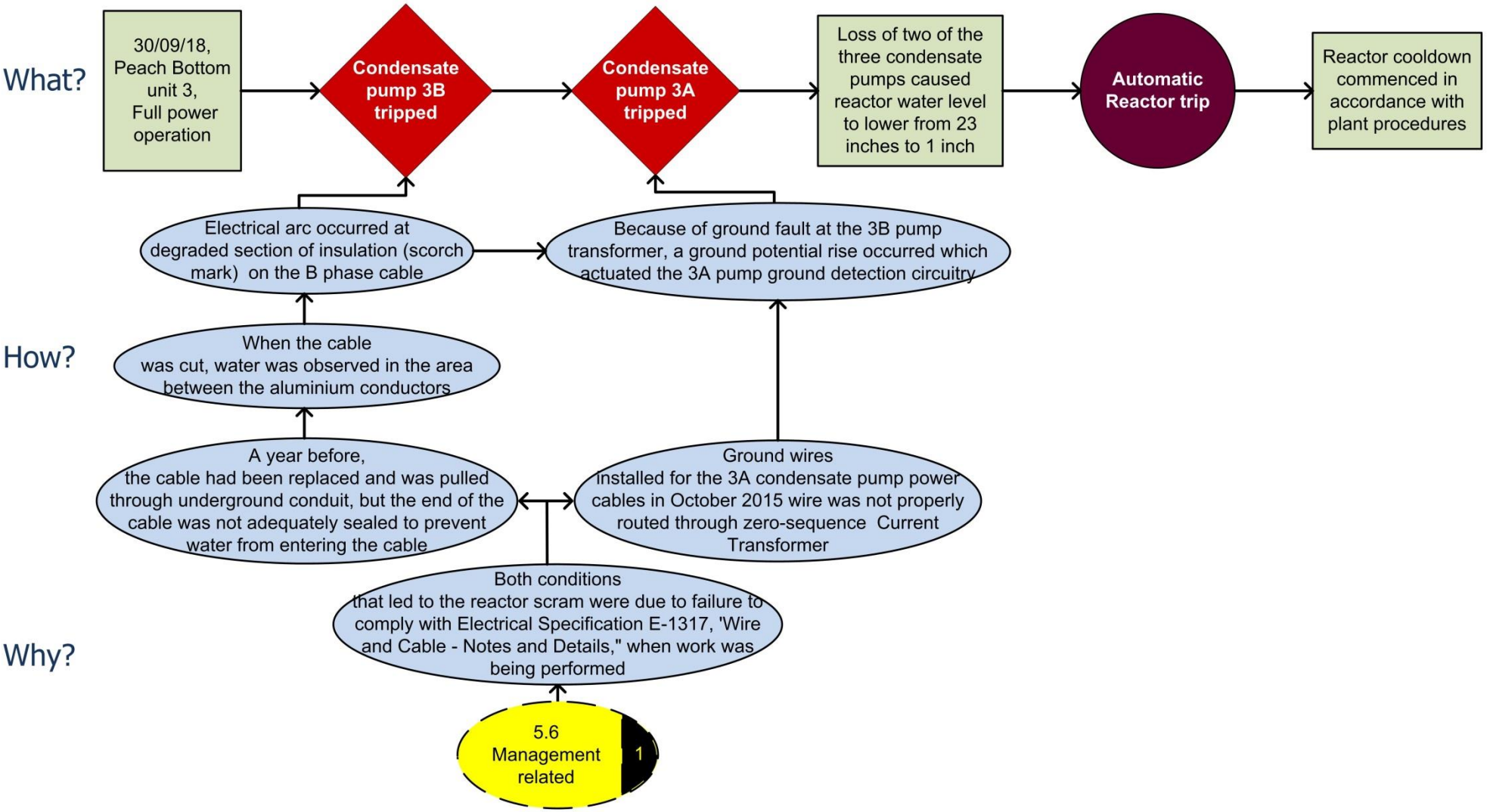
The flaw was most likely caused by primary water stress corrosion cracking (PWSCC), a known failure mechanism for Alloy 600/82 weld material. The affected small bore pressurizer nozzle was replaced prior to startup from the refueling outage. The lower temperature service conditions for the remaining Alloy 600 components support continued operation through the end of licensed life for the unit.

In accordance with the Alloy 600 Management Program, the remaining Alloy 600/82/182 components and weld materials are ranked for susceptibility to PWSCC when prioritizing the augmented inspections. The primary susceptibility factor is temperature, with susceptibility being directly proportional to temperature.

Editor´s comment *– This event has been highlighted because of the potential significance of its lessons to be learned.*

This event illustrates the benefits of an effective operating experience program. The augmented inspections revealed the flaw in the small bore pressuriser piping before it could cause any significant disturbance in plant operation or safety.

Automatic Reactor Scram due to Loss of two Condensate Pumps



3.2 Automatic reactor scram due to loss of two condensate pumps

PEACH BOTTOM 3 – 30/09/2019

An automatic reactor scram occurred due to low reactor vessel water level following the loss of two condensate pumps. Plant equipment responded properly. The High Pressure Coolant Injection and Reactor Core Isolation Cooling systems automatically initiated on reactor low water level and restored level, in addition to the third condensate pump and feedwater system. Reactor cooldown commenced in accordance with plant procedures.

The cause of the event was determined to be due to an electrical fault in the power cable for the second condensate pump and actuation of ground protective circuitry for the '3A' condensate pump. The electrical fault in power cables for the '3B' pump caused a ground current transient that raised the ground potential of the '3A' condensate pump transformer, resulting in a trip of the '3A' pump. Subsequently, power cables for the `3B' pump were replaced and ground circuitry for the '3A' pump was corrected to prevent such interaction.

Upon investigation, water was observed in the area between the aluminum conductors on the '3B'pump cable. The cable had been replaced in October 2017 and was pulled through underground conduit. The end of the cable was not adequately sealed to prevent water from entering the cable during the cable pull.

Ground fault detection circuitry for the '3A' condensate pump uses a zero-sequence current transformer (CT), which requires the ground wire for the cable shield to pass through the CT. When ground wires were installed for the '3A' condensate pump power cables in October 2015, the ground wire was not properly routed through the CT, which explains the trip of the '3A' pump.

There were no actual safety consequences as a result of this event. The '3C' condensate pump and reactor feedwater remained available for post-scram recovery.

Editor´s comment *– This event has been highlighted because of the potential significance of its lessons to be learned.*

When selecting areas for environmental monitoring, all plant areas containing cables with safety functions should initially be selected. In general, the parameters of the environmental conditions to be measured are mainly temperature and radiation dose. Nevertheless, other potential localized degradation factors not directly measurable such as the presence of water, steam, flooding and chemical agents should be identified.

Unanticipated operating conditions are caused by defective installation, operation or manipulation of the cable, which can lead to enhanced degradation. Such operating conditions can be prevented through the performance of well prepared and executed plant walkdowns.

3.3 Insufficient seismic resistance of a bolted assembly

CHINON B1/B2 – 25/10/2018

The unit 2 was shutdown for refuelling and the licensee was conducting inspections on the seismic resistance of different structures, on request from the regulatory body, and in the presence of regulatory inspectors. The inspections revealed that the thickness of a bolted assembly located above the pumps of the Essential Service Water system (ESWS) of both units was below the minimum required value.

The licensee could later show that the assembly would have resisted the SMHV (maximum historically feasible earthquake, considering around 1000 years), but the integrity would not have been ensured in case of a SMS (which is equal to the SMVH increased by half a point).

As soon as the anomaly was detected, the licensee began the repairs to reinforce the bolted assemblies concerned on at least one of the ESWS trains on units 1 and 2.

The event has been provisionally rated as INES 1, pending additional information requetsed by the regulator.

Editor´s comment *– This event has been highlighted because of the potential significance of its lessons to be learned.*

This event, together with another event event related to seismic resistance (see below) reveals that many minor auxiliary structures such as catwalks or access platforms, often located outside the reactor containment, could become a common cause failure mode have a major impact on safety if they become a threat for the integrity of other safety related structures or systems in case of earthquake.

3.4 Late detection of loose electrical connections on several valves of the RHR system

CIVAUX 1 – 08/11/2018

During an inspection of the Residual Heat Removal RHR system with the reactor shutdown, the operators noted a number of loose electrical connections on several valves of the system train B. This prevented the remote operation of the valves. As a result, the train B of the system was considered unavailable. The loose connections were caused by a maintenance operation carried out in 2017.

Furthermore, the licensee discovered as well loose connections on two valves of the train A. However, in this case the remote operation of the valves was still possible, in spite of the loose connections. Therefore, the availability of the RHR train A would have allowed to cool down the reactor in case of accident.

As soon as these conditions were discovered, the licensee took action to restore the valves to their nominal configuration.

The event has been rated as INES 1.

Editor´s comment *– This event has been highlighted because of its potential effect on safety.*

Clearly, this event had the potential to compromise the availability of both redundant trains, if the defective connections on Train A had prevented the remote operation of the valves, as in the case of train B. A near miss that can be useful to prevent further similar occurrences in the future.

3.5 Catwalks not compliant with seismic resistance requirements

BELEVILLE 2, CATTENOM 2/3/4, FLAMANVILLE 1/2, GOLFECH 1, PALUEL 1/2/3/4, PENLY 1/2 AND ST ALBAN 1/2 – 04/12/2018

The licensee could not exclude the posibility that certain catwalks on a number of sites could damage other systems located close or below them in case of an earthquake. In particular, these catwalks could damage the sections of steam generators feedwater piping and main steam piping outside the reactor containment building. An earthquake could then lead to a situation not considered in the plant safety case.

The licensee has begun the works for reinforcing the catwalks, and has defined a schedule that the regulatory body considered acceptable in view of the effect on nuclear safety. For those reactors where the catwalks have not yet been reinforced, the regulator has instructed to carry out the works according to the schedule proposed.

Because of the potential consequences on the nuclear safety in case of earthquake, the regulator has rated this event at INES 1 for all 15 reactors concerned.

Editor´s comment *– This event has been highlighted because of the potential significance of its lessons to be learned.*

See the comment above for the event at Chinon.

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