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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 July-September 2018.

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, accesible 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. 14/04/2018: Loss of Division 1 offsite power causes partial loss of feedwater leading to ECCS injection and reactor scram (US / FERMI 2).
2. 20/04/2018: Indications on top head to upper center disc weld of reactor head identified due to new inspection standards (US / BRAIDWOOD 1).
3. 10/2017: Degradation of concrete in a bunkerised building (BELGIUM / DOEL 3 – TIHANGE 3 – DOEL 4 – TIHANGE 2).

Furthermore, this newsletter includes an update on the manufacturing issue affecting the reactor vessel at Flammanville 3. Even though this reactor is still under construction, this event may be of interest for operating plants.

The information provided is extracted from publicly available or 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 Loss of Division 1 offsite power causes partial loss of feedwater leading to ECCS injection and reactor scram

FERMI 2 – 14/04/2018

On April 14, a reactor scram on low reactor water level occurred due to a partial loss of feedwater accompanied by a reactor recirculation system scoop tube lock. The High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) systems automatically started in order to restore reactor water level as designed. Reactor water level was subsequently maintained using RCIC. No Safety Relief Valves actuated and the Primary Containment Isolation System responded as expected.

The partial loss of feedwater and scoop tube lock were caused by a loss of Division 1 electrical power which occurred following a trip of the normal feed to Transformer 64, a 13.8 kV breaker. Division 1 emergency diesel generators automatically started and energized Division 1 buses.

In addition, both Low Pressure Coolant Injection (LPCI) subsystems were declared inoperable while aligned to their alternate power source following loss of their normal power source. The LPCI subsystems were declared operable following realignment to their normal source after the diesel generators were started.

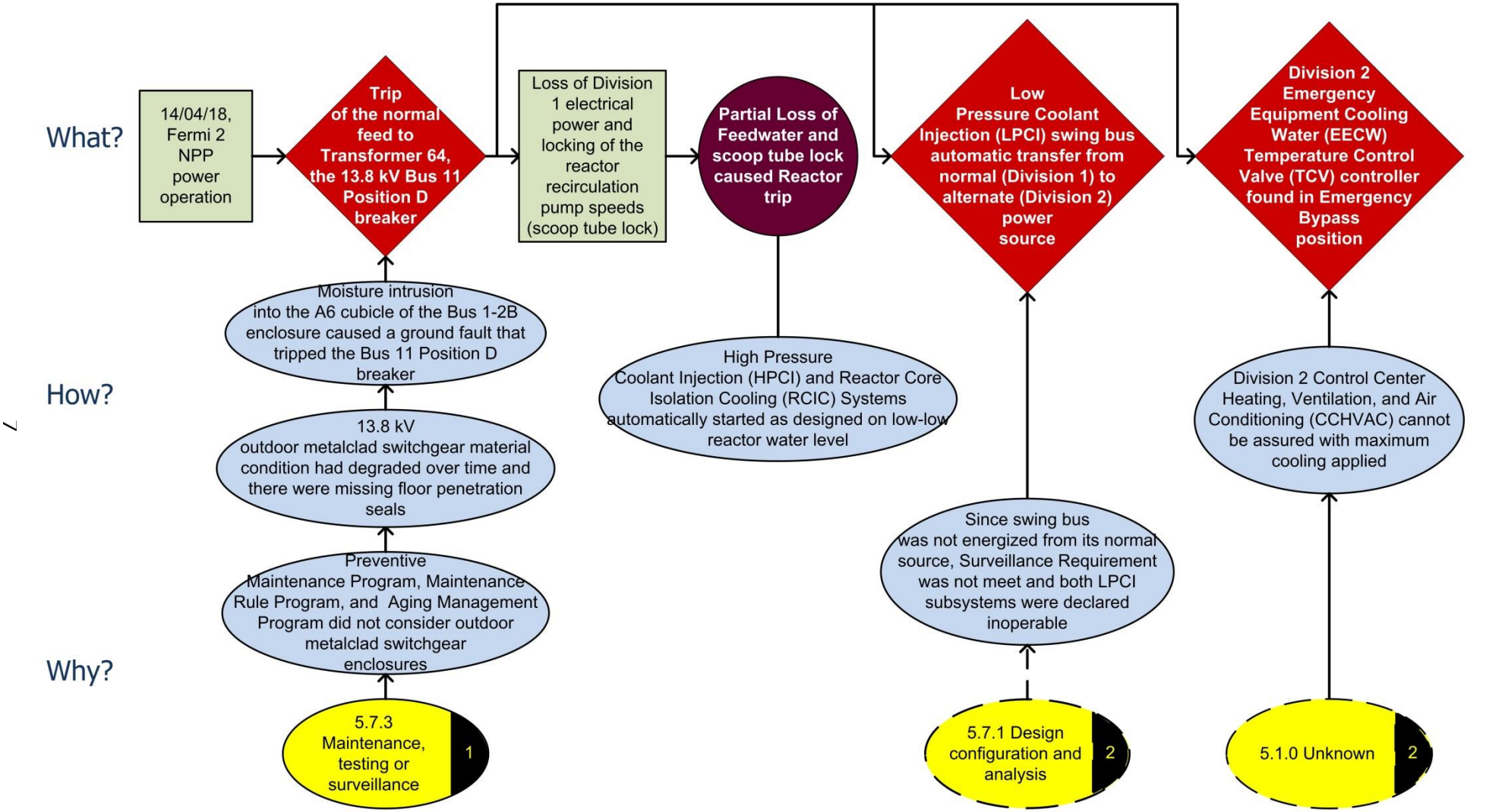
Investigation has determined the direct cause of this event to be moisture intrusion into one cubicle of the bus enclosure, which caused a ground fault that tripped the breaker. The root cause evaluation determined that the organization failed to recognize the degradation of the bus enclosure as a failure mechanism of the switchgear.

Immediate corrective actions were completed to eliminate moisture intrusion into the bus enclosure. Corrective actions to prevent recurrence include developing and implementing a preventive maintenance strategy for outdoor metal clad switchgear.

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

This event may be of interest to any organisation involved in the definition, review and supervision of preventive maintenance and ageing programs of outdoor metal-clad switchgear enclosures.

Loss of Division 1 Offsite Power Causes Partial Loss of Feedwater Leading to ECCS Injection and Reactor Scram



3.2 Indications on top head to upper center disc weld of reactor head identified due to new inspection standards

BRAIDWOOD 1 – 20/04/2018

On April 20, a scheduled ultrasonic test was performed on the top head to upper center disc weld of the Unit 1 reactor head. The test identified nineteen indications, nine of which exceeded the acceptance criteria.

The cause of this event was the application of new inspection standards, which required the use of new procedures, personnel qualifications and equipment during the spring 2018 refueling outage reactor vessel inspection. This resulted in the identification of subsurface flaws not previously identified using techniques applicable to prior standards.

An evaluation concluded the nine indications met the criteria and the existing indications were deemed acceptable for two additional operating cycles. A planned corrective action is to perform an evaluation to extend acceptance of the nine indications beyond the next two operating cycles.

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

The techniques for non destructive inspection are constantly evolving, gradually improving the capability of flaws detection, particularly in the case of the reactor vessel, as illustrateted by the recent cases in Belgium and Switzerland. This event is an additional example proving that new techniques improve the confidence in flaw capability detection, in this case on the reactor vessel head.

During the EU topical peer review of ageing management, in a workshop held in Luxembourg last May, it was recognised that continuously maintain periodic non-destructive in service inspections techniques at the qualified state of the art level remains a challenge for some countries.

3.3 Degradation of concrete in a bunkerised building

DOEL 3/4 - TIHANGE 2/3 – 10/2017

During the scheduled outages of Doel 3 (October 2017) and Tihange 3 (April 2018), the licensee detected during inspections a degradation of the concrete in bunkerised buildings housing 2nd level backup systems, such as emergency pumps and bunker diesel generators, which are used only in case of problems with the 1 tier systems.

In both cases, this deterioration could call into question the resistance of these buildings in case of an external event.

After further reactive inspections carried out in similar areas of the other reactors potentially concerned by this phenomenon (Tihange 2 and Doel 4), a degradation of the concrete was also observed in hese two reactors.

The degradation has been observed on the ceilings of rooms housing the discharge of the secondary circuit steam dump valves to the atmosphere, therefore subject to hot and humid conditions. In the case of Tihange 3, the removal of the degraded concrete allowed to discover certain anomalies in the building reinforcement structures, which were present since the initial construction of the building.

In October, the Belgian regulatory body decided to classify the issue in all four reactors (Doel 3, Doel 4, Tihange 2 and Tihange 3) at level 1 of the INES scale.

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

The design of these four reactors include bunkerised buildings housing the discharges of the secondary circuit steam dump valves to the atmosphere. This particular design is not common, as in most nuclear plants the steam dump is discharged directly to the atmosphere, instead of being released in a room provided with vent openings in the walls. Therefore, the applicability of the lessons learned from this event to other plants might remain limited to some extent. However, some general aspects linked to organisational issues (like ownership and responsibility in the preservation of civil structures) might still be of interest to all nuclear plants in general.

3.4 Reactor vessel and reactor vessel head steel chemical composition anomalies

In late 2014, the company responsible for the construction of Flammanville EPR reactor reported anomalies in the chenical composition of the steel used in the reactor vessel bottom head and reactor vessel head.

The subsequent investigations revealed further manufacturing anomalies in other equipment (steam generators) used at currently operating plants. All these defects refer to the phenomenon called carbon macro seggregation: a variation in the content of carbon above or below the nominal value over large length scale, which may appear during the manufacturing of the steel ingot, for different reasons.

In June 2018, WENRA recommended its members to perform investigations based on the following two-step verification of materials quality and structural integrity of the components as described below:

Step 1 - Review by the licensees, on request of the safety authorities, of components which may be affected by macro-segregation.

Step 2 - Evaluation of the results of the review by the national safety authorities.

On 9th October 2018, the French regulatory body authorised the commissioning and operation of the Flamanville EPR reactor pressure vessel, subject to the performance of a test programme to monitor the thermal ageing of the steel in the residual carbon positive macro-segregation zone, plus specific inspections during operation of the facility.

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