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REPORT

WANO REPORT

RPT | 2017-06

December 2017

Analysis of Deficiencies in Operator Performance

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Revision History

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Reason for Changes:			

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Analysis of Deficiencies in Operator Performance

Executive Summary

The analysis results revealed a recurring negative trend in operating crew performance and weaknesses in basic operator activities such as managing reactivity, reactor coolant system inventory, and decay heat. In several events, non-conservative decision-making by operators significantly contributed to the severity of the consequences. Some operators are not adhering to industry high standards with a focus on reactor core parameters that includes conservative decision-making behaviours to trip the plant, or take appropriate actions like reducing reactor power, when faced with uncertain plant conditions.

Purpose

During the first WANO trend analysis meeting held at the WANO London Office on 31 August to 1 September 2017, the WANO regional centres and London Office staff identified key focus areas that would require further review and analysis. Operations performance was identified as the area of highest priority for analysis. WANO Performance Analysis Central Team (PACT) reviewed and analysed WANO event reports (WERs) and areas for improvement (AFIs) that revealed weaknesses in operator fundamental behaviours and conduct of operations areas. This report provides a summary of the causes, analysis insight and lessons learnt from these events.

Events

The following are a representative sample of events with weaknesses in managing reactivity, reactor coolant system inventory, and decay heat that were used to perform the analysis:

Primary Circuit Overheat during ΔI Control Process, Yangjiang 3 (WER PAR 16-0986)

On 15 December 2015, the Yangjiang Unit 3 operating crew was increasing power after performing load rejection and other transient tests during commissioning stage. Average temperature in the primary circuit and delta I increased due to xenon concentration change and a large load variation. The operators intervened through boration, rod control and power reduction, but an elevated primary circuit average temperature appeared during the transient. Inadequate reactivity management resulted in overheating of the primary coolant and an increase in reactor power to 102.5%. The direct causes were unstable reactor state, insufficient expectation on xenon poison, ineffective primary circuit temperature control, late boration and insufficient initial boration amount. The root cause was insufficient risk analysis and a lack of a unit power change reactivity control standard package. Contributing was a lack of operator knowledge.

Unexpected Loss of Reactor Coolant Water Level during Reactor Head Removal, Kori 3 (WER TYO 17-0324)

On 25 January 2017, when Kori Unit 3 was in outage, the operating crew observed during mid-loop operation six times at an interval of four hours about one foot decrease of reactor coolant system

(RCS) level. The RCS level was recovered by increasing the charging flow every time. The RCS water level dropped about five feet during the stud bolt final de-tensioning. Actual reactor coolant water level was significantly lower (5ft from the top of the reactor core) than what was indicated and operators were not aware of the actual level during an extended period of time. The direct cause was wrong level indications due to voids accumulation at the upper reactor head. The voids were generated at a charging pump outlet due to nitrogen pressurised at the top of the volume control tank. The root cause was inadequate procedure as there were no steps for establishing vent paths in the reactor head. A similar event occurred in 2014 but no corrective actions were taken. The contributing causes were lack of close monitoring and questioning attitude.

Cooling of Spent Fuel Pool not Meeting Requirement of Technical Specifications during a Test, Ling Ao 2 (WER PAR 17-003)

On 29 December 2016, when Ling Ao Unit 2 was in an outage with all fuel assemblies in the spent fuel pool (SFP), and while operators were performing a start-up of the component cooling system (CCS) train A, a miscommunication between operation staff left two manual isolation valves in closed position. As a consequence, cooling of the SFP was lost for one hour and 18 minutes. Water temperature in the SFP increased from 42.2℃ to 45.1℃. The direct cause was a human error due to ineffective communication. The apparent cause was that the status of the CCS was not adequately controlled during the outage. Contributing factor was a lack of operator attention to the CCS pump flow and to the abnormal increase of water temperature in the SFP.

Manual Reactor Scram Due to a Condensate Leak, Grand Gulf 1 (WER ATL 17-1167)

On 4 April 2017, Grand Gulf Unit 1 was manually scrammed due to a condensate leak with lowering condensate storage tank (CST) levels. As a result of the leak, operators were forced to secure all condensate and condensate booster pumps (trains A, B and C), completely securing normal injection sources to the reactor. The reactor core isolation cooling (RCIC) system had to be aligned to take suction from the suppression pool instead of the normal suction source to prevent the control rod drive pumps from tripping on the low suction pressure condition. This was a complicated scram, relying on the use of the RCIC system and operating in the containment control emergency procedure for 19 hours. Repair of the leak resulted in a 12 day outage. Further analysis indicated that the condensate leak might have existed since February 2017. Root cause of this event was that Operations staff failed to avoid complacency and failed to continuously challenge conditions when faced with an unidentified leakage. The failures in troubleshooting and operational decision making resulted in a lack of timely action to address the CST leakage, and the subsequent complicated scram.

Methodology

The analysis is based on events that were submitted to WANO and AFIs from WANO peer reviews in the period 2015- end of third quarter 2017. It focuses on the main causes and gaps within Operations Fundamentals (OP.1) and Conduct of Operations (OP.2) events classified by WANO PACT as Significant (SIG), Noteworthy (NOT) and Trending (TRE) and Operations AFIs from peer reviews. The purpose of the analysis was to identify any adverse trend in operator performance by correlating WERs, AFIs, Direct Causes and Root Causes. Some WERs used in this analysis are contained in the Level 1 IER, *Line of Sight to the Reactor Core*, issued by INPO.

Summary

Analysis of 87 SIG & NOT events and 103 AFIs identified in the area of Operations identified the following key findings:

- Gaps in Operator Human Performance was a main cause and driver for many consequential Operations events. The top ten most represented root causes for Operations events were related to Human Performance.
- Ineffective control of important parameters within specific bands and at specified rates, together with inadequate Operator monitoring were identified as gaps in more than 41% of Operations AFIs that were written between 2015 and the first quarter 2017. Behavioural gaps in Operator monitoring of key parameters contributed to the highest number of SIG events.
- More than 62% of all reported SIG/NOT Operations WERs (54 events) affected a set of nine important systems. Included in this list are three nuclear safety systems that are used in the WANO Performance Indicators SP1, SP2 and SP5.
- Almost 52% (45) of all reported SIG/NOT Operations WERs occurred in just 20 stations, from 12 members in total.

WANO continuously tracks and trends important industry events. After the occurrence of several significant events that highlighted weaknesses in knowledge, skills, behaviours and practices essential for operators to operate the plant safely and effectively, WANO issued Significant Operating Experience Event Report SOER 2013-1, *Operator Fundamentals Weaknesses*. Several years after issuing SOER 2013-1, **this analysis identified a recurring negative trend with similar weaknesses in operator performance that needs the immediate attention of WANO members. Effective implementation of the recommendations of SOER 2013-1, *Operator Fundamentals Weaknesses* would have reduced the number of events and minimized the consequences.**

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Analysis of Areas for Improvement (AFIs)

The WANO Peer Review (PR) teams conducted 140 PRs between January 2015 and September 2017, and WANO has issued final reports for 110 (covering the period up to Q1 2017) which were used in this analysis. From these 110 PR reports, the teams identified 1,121 AFIs in 45 WANO Performance Objectives and Criteria (PO&C) areas.

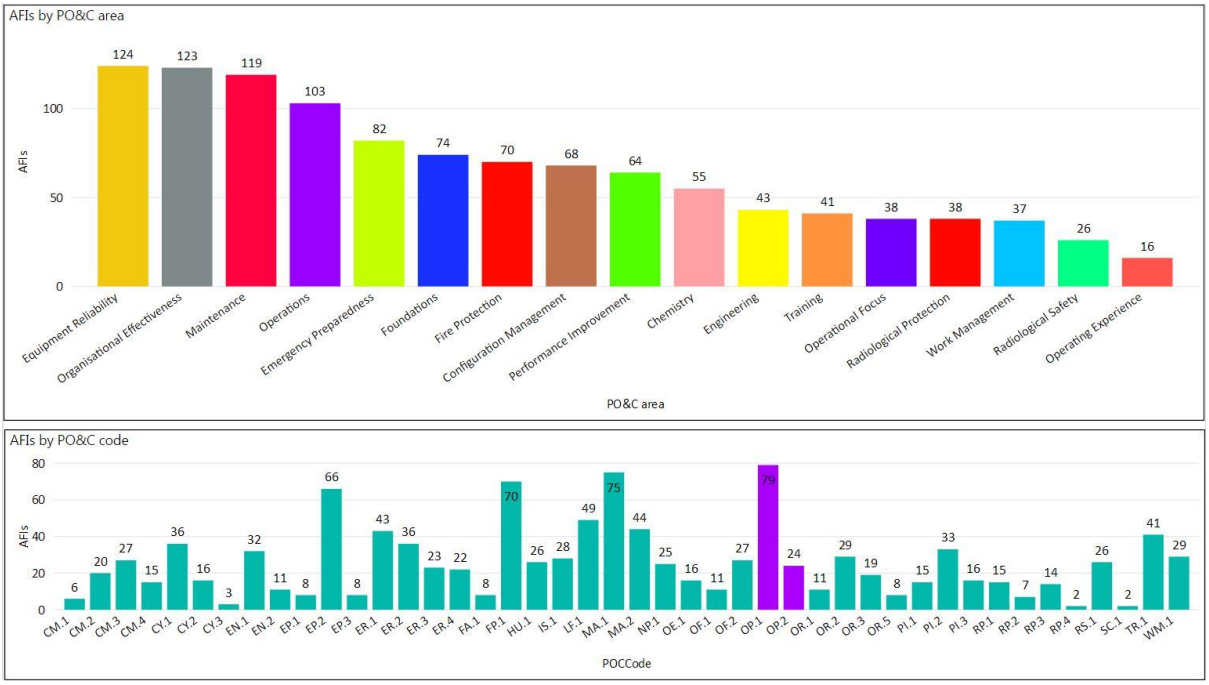

Figure 1: Distribution AFIs per PO&C area in years 2015, 2016 and Q1 2017

WANO teams identified 103 AFIs in the area of Operations from 82 PRs. 79 AFIs in the area of Operations Fundamentals (OP.1) and 24 in the area of Conduct of Operations (OP.2).

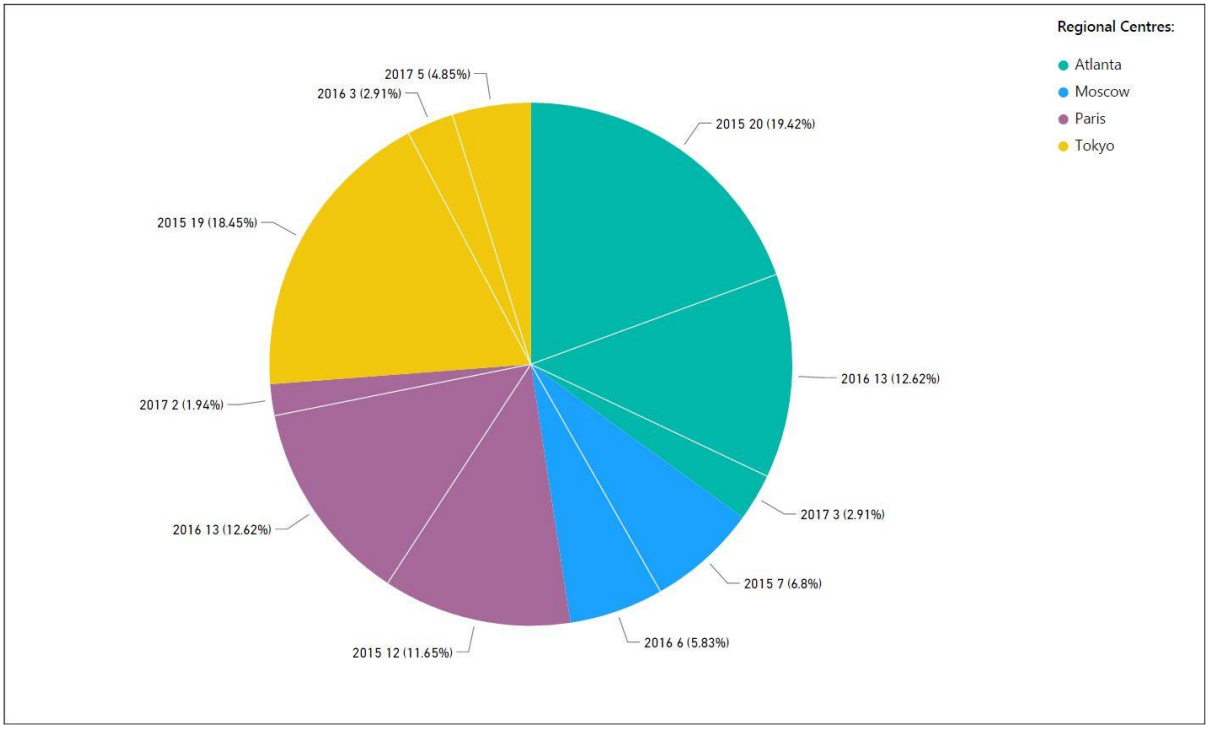

Figure 2: OP.1 and OP.2 AFIs per Regional centre in last years

The breakdown of 103 AFIs identified at 82 PRs revealed that 36 AFIs were found during 28 Atlanta Centre (AC) PRs, 13 AFIs during 10 Moscow Centre (MC) PRs, 27 AFIs during 21 Paris Centre (PC) PRs and 27 AFIs during 23 Tokyo Centre PRs.

Out of 103 AFIs, 38 were part of executive summaries of PR reports. AFIs mentioned in executive summaries require immediate and highest priority of attention from our members.

AFIs	WANO RCs				Total
	AC	MC	PC	TC	
OP.1	15	2	6	7	30
OP.2	1	1	5	1	8
Total	16	3	11	8	38

Figure 3: Number of Operations AFIs mentioned in PR's executive summaries

All 103 AFIs were closely analysed and, for each AFI, one main cause area was assigned. The cause areas were linked to OP.1 and OP.2 PO&C area sections.

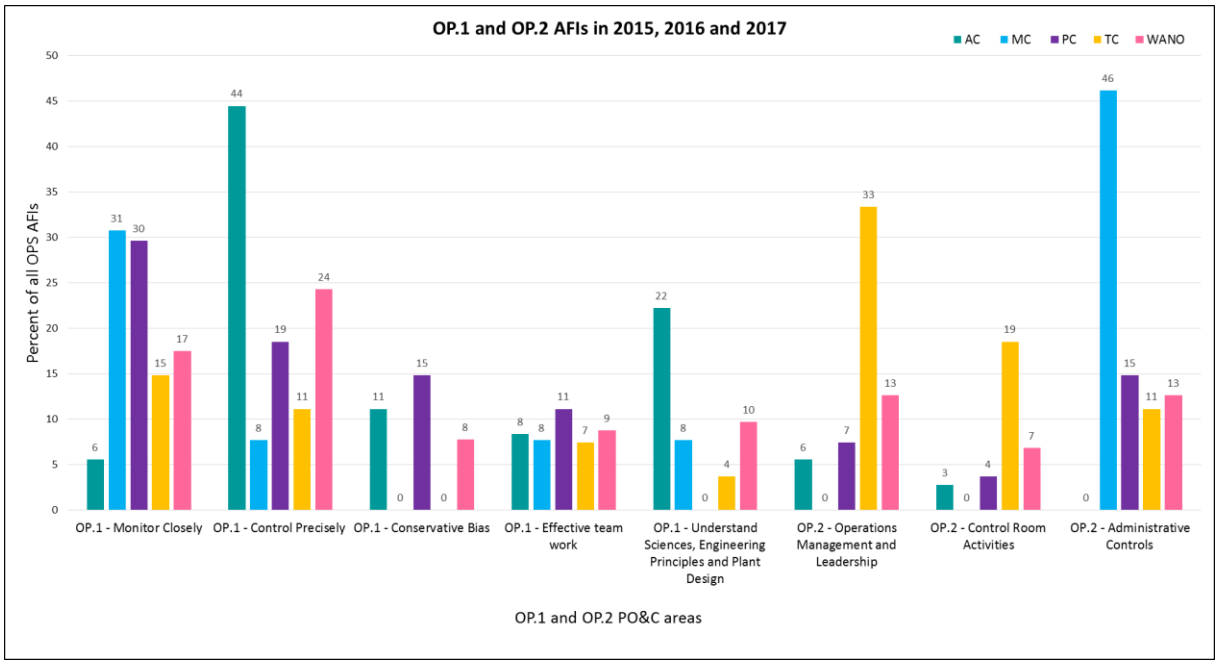

Figure 4: Main cause area for Operations AFIs

The results showed that despite the culture differences in how AFI gaps were identified and structured at all four regional centres, 41.8% of all Operations AFIs were related to just two cause areas, OP.1 *Monitor Closely* and OP.1 *Control Precisely*[1]. Attachment 1 provides the AFIs that identified specific deficiencies of Reactivity Management (RM) or non-Conservative Decision Making (CDM). There were at least nine AFIs that identified specific gaps in RM and four AFIs related to specific gaps in CDM. In addition, PACT identified 10 AFIs where one main cause was the lack of conservative bias.

This finding might be important input for Crew Performance Observation (CPO) missions, PRs and member support missions. Observations and support should focus on these essential parts of Operator Fundamentals, i.e. 'Monitor closely' and 'Control precisely'.

If during the PR the team identifies an Area for Improvement related to operator performance, the status of SOER 2013-1, *Operator Fundamentals Weaknesses* recommendation 5 should be reviewed as part of the development of the causes and contributors.

[1] The peak for MC's OP.2 Administrative Control is an artefact due to the small number of AFIs.

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Analysis of WANO Event Reports (WERs)

WANO members reported 4,994 WERs between 1 January 2015 and 30 September 2017 (33 months period) that were classified with significance Significant (SIG), Noteworthy (NOT) or Trending (TRE). During the PACT weekly screening meeting, the team identified 872 WERs from 176 stations where one of the main causes for the event was related to the area of Operations. This represent 19.4% of all screened SIG, NOT and TRE WERs in the selected period.

Out of 872 WERs, 325 were reported in 2015, 338 in 2016 and 209 in the first nine months of 2017. Further breakdown of the WERs per significance revealed that our members reported and the PACT screened 10 SIG WERs, 77 NOT WERs and 785 TRE Operations WERs.

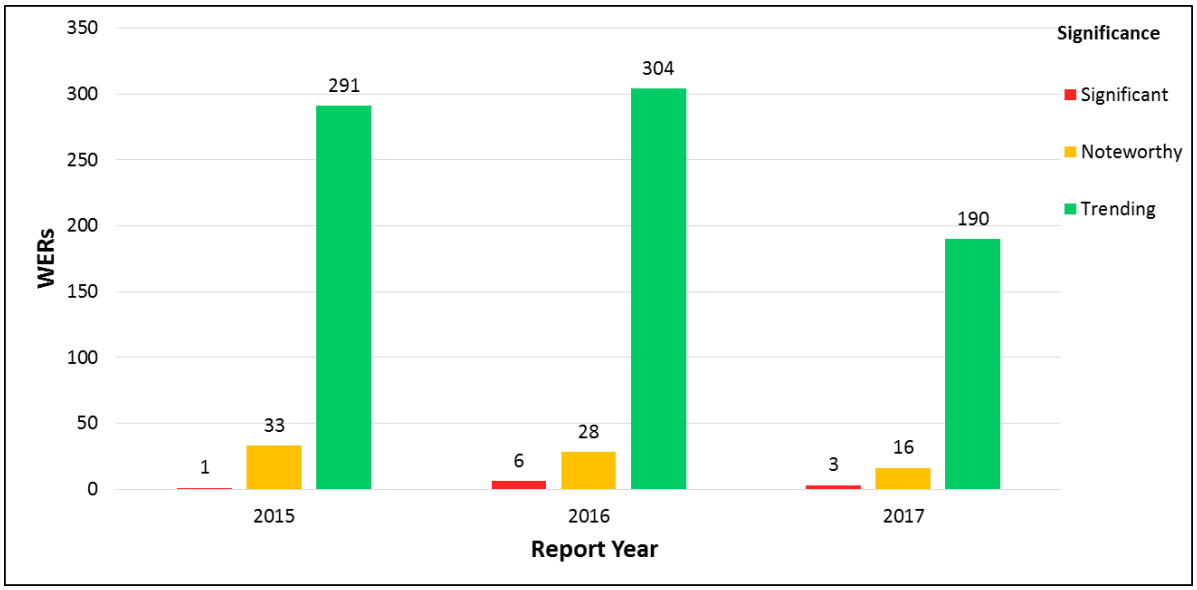

Figure 5: WERs reported in years 2015, 2016 and the first nine months of 2017

Figure 6 represents all Operations WERs normalised with all reported SIG, NOT and TRE WERs in the selected period.

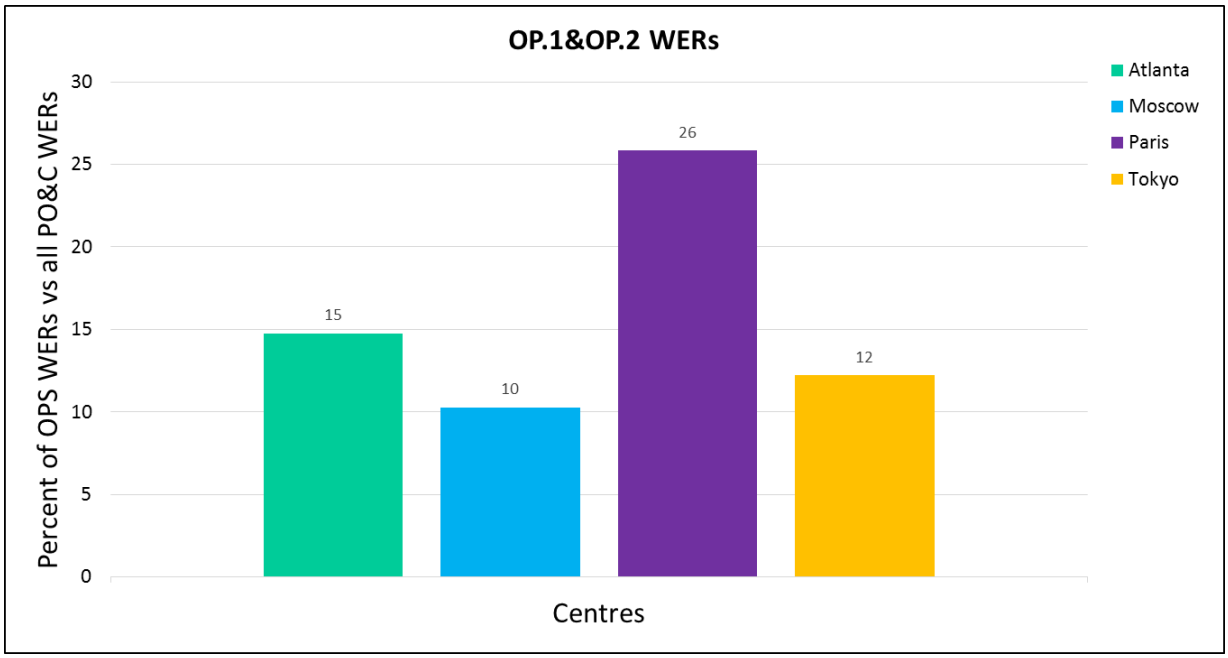

Figure 6: Reported Operations WERs reported in comparison with all PO&C WERs.

Figure 6 reveals that 26% of all reported SIG, NOT and TRE WERs had at least one Operations related cause for WANO PC members events, 15% for WANO AC members events, 12% for WANO TC members events and 10% for WANO MC members events.

For each Operations WER, our members identified one direct cause (DC) per WER. The analysis found 55 different DCs and reviewed all of them against the event consequences. The summary result was presented by the top 10 most represented DCs.

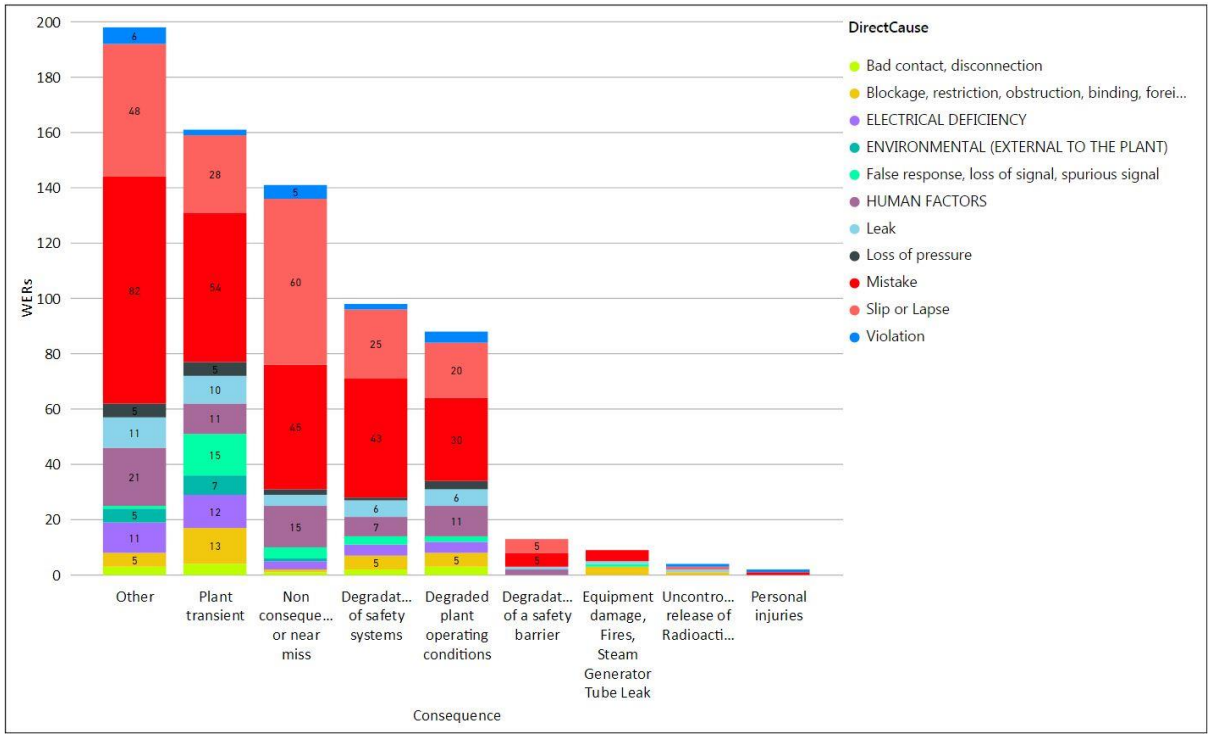

Figure 7: Top ten most represented DCs vs identified consequences from WERs

From 872 reported Operations WERs the main identified DC group was associated with Human Performance. Human Performance DCs combine Mistakes, Slips or Lapses, Human Factors and Violations. Human Performance DCs were identified in 514 WERs representing 58.9% of all Operations WERs.

Similar analysis approach was used for the WER apparent cause/root cause analysis. From 872 WERs, our members identified 1,858 root causes in total, classified in 168 different types. Some of the WERs had more than one root cause, however at least one root cause per WER was related to one Operations PO&C area.

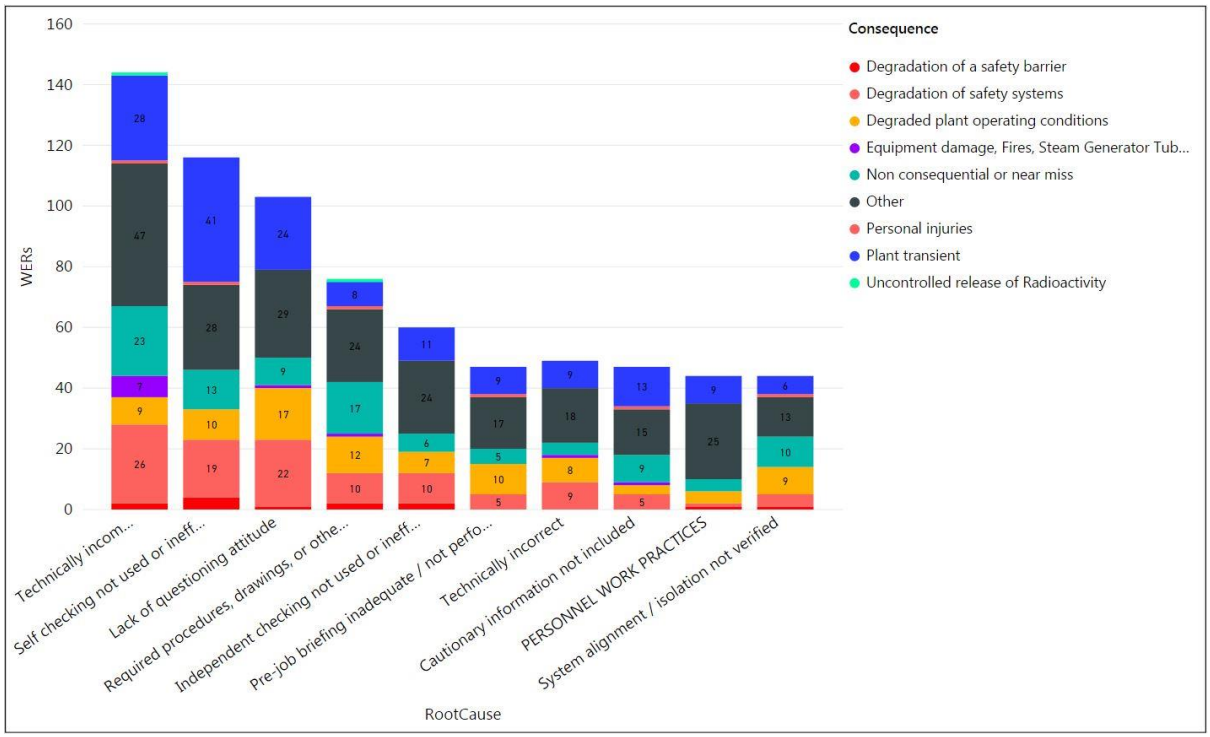

Figure 8: Top ten most represented root causes by consequences in Operations WERs

The results revealed that the top ten most represented root causes in Operations events were associated with Human Performance. Further investigation identified that 14 out of 15 top represented root causes from Operations events were associated with Human Performance. This fact confirmed important findings identified during review of the DCs that gaps in Operator Human Performance were the main causes and drivers for most consequential Operations events.

WANO regional centre staff should consider incorporating this information for the CPO missions, PRs and member support missions. During the preparation for the PRs, the team leader should consider prioritizing the review of the corrective actions of SOER 2013-1, *Operator Fundamentals Weaknesses* for those plants that have had Significant or Noteworthy events where operator performance was a major contributor.

One of the objectives of the analysis was to identify which systems have been most affected by Operations WERs.

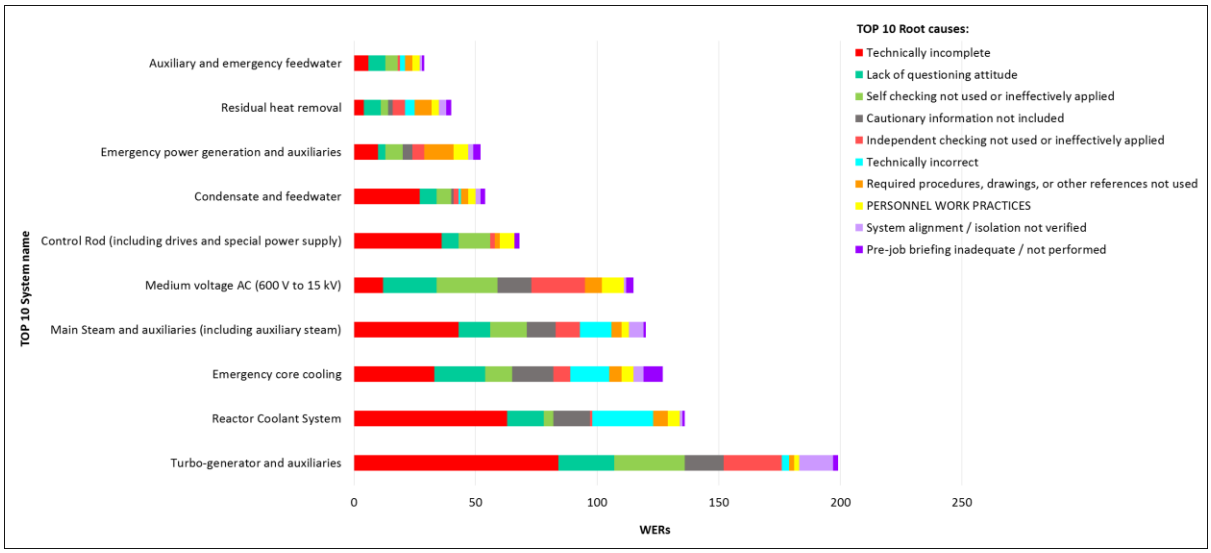

Figure 9: Top ten most affected systems by top ten identified root causes

In the top ten most affected systems by Operations WERs were also all three nuclear safety systems represented by WANO performance indicators (SP1, 2 and 5). This might be an indication that these systems require continuously our members' highest attention.

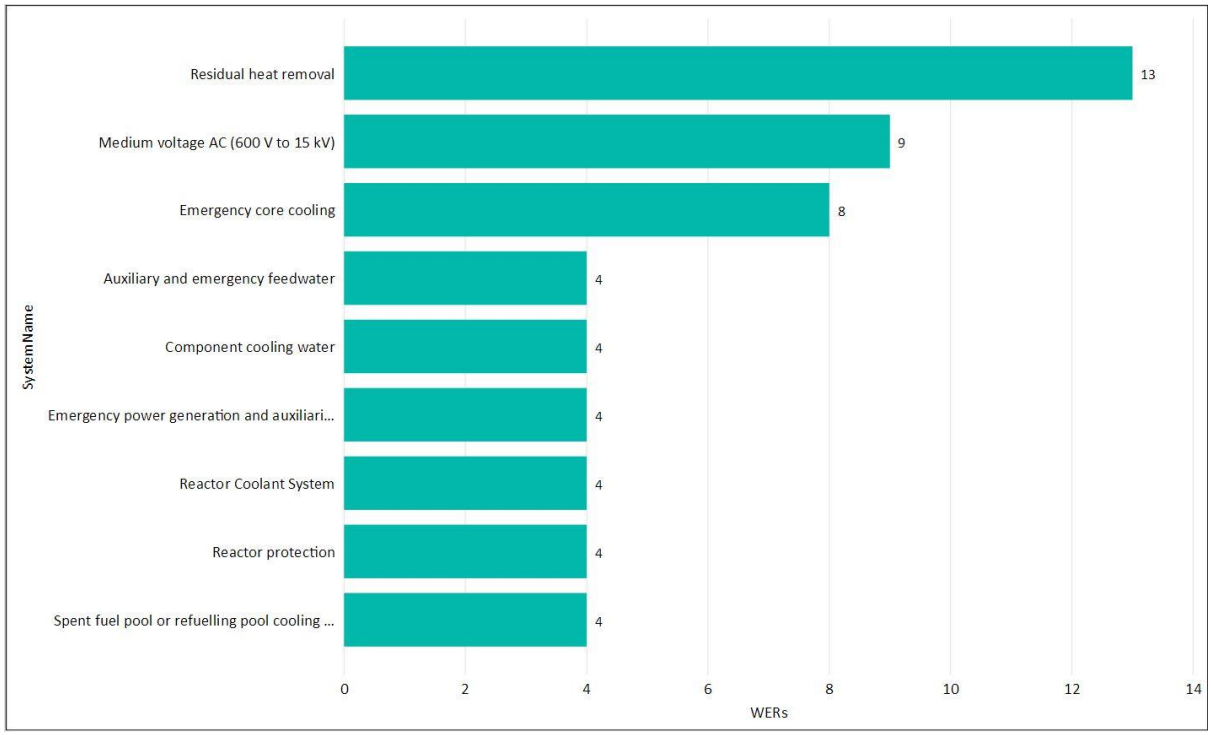

Figure 10: Top nine most affected systems by SIG or NOT Operations WERs only

The analysis identified that nine important systems experienced 54 of the NOT/SIG WERs representing 62% of all NOT/SIG Operations WERs. The residual heat removal systems, medium voltage AC (600V to 15kV) systems and emergency core cooling systems were involved in highest number of the most significant NOT/SIG Operations WER.

WANO members may need to further verify that all important systems especially those important for nuclear safety receive sufficient attention in the risk recognition and the risk mitigation during

the system health assessments or prior to receiving granted permissions for work that might affect their availability[2]. In addition, **this finding might be useful input for regional centre staff for the prioritisation areas for member support missions.**

The last part of the analysis was focused on finding similarities in causes between identified gaps in AFIs and WERs. For this purpose, the analysis closely looked at 87 SIG and NOT WERs and, based on identified apparent/root causes per WER by our members, the PACT assigned one main cause area for each WER. The analysis identified an important difference between how our members and in some cases regional centre staff records WERs. This became clearly evident when PACT tried to compare the WER cause results across the whole WANO.

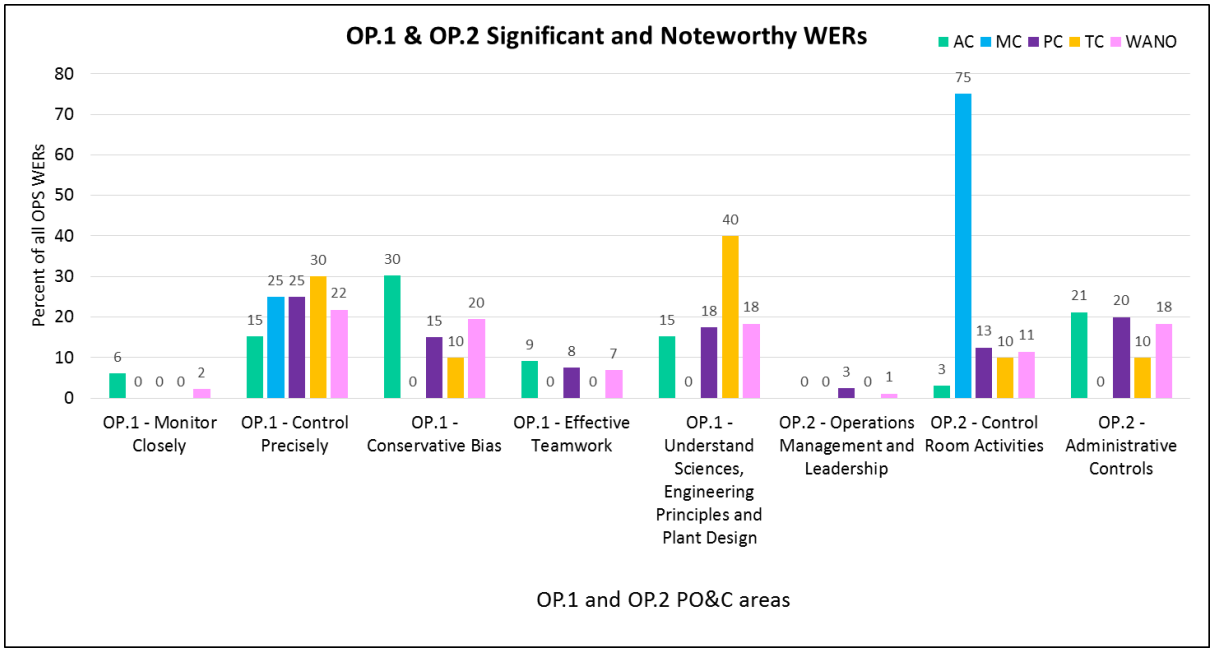

Figure 11: SIG and NOT Operations WERs as a function of the main Operations cause area assigned per WER

One of the main findings was that three cause areas OP.1 Control Precisely, OP.1 Understand Sciences, Engineering Principles and Plant Design, and OP.2 Administrative Controls were most frequently identified as the main cause for Operations events. Behavioural gaps in Operator monitoring of key parameters contributed to the highest number of SIG events. Attachment 2 provides the events that identified specific deficiencies in areas of RM or CDM. There were a least five NOT WERs that identified specific gaps in RM, two SIG WERs and nine NOT WERs with specific gaps in CDM. In addition, PACT identified 17 WERs where one potential main cause could be lack of conservative bias.

The analysis also identified that 42 members reported from 62 stations at least one NOT or SIG Operations WER; 27 stations were members of WANO AC, four stations were members of WANO MC, 25 stations were members of WANO PC and 10 stations were members of WANO TC. Twenty stations from 12 members in total reported 45 NOT or SIG WERs representing 51.7% of all reported SIG and NOT Operations WERs. These 12 members reported in total 53 NOT or SIG WERs representing 60.9% of all reported SIG and NOT Operations WERs. **WANO will review if the corrective actions after these events are sustainable to prevent repeat events.**

[2] Further information about effective risk management is available in WANO SOER 2015-2, Risk Management Challenges and WANO PL 2013-2 (Rev 1), Excellence in Integrated Risk Management.

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Attachment 1: List of 103 Operation AFIs from final PR Reports Identified in 2015, 2016 & 2017

Year of PR:	Analysis description:	Cause area assigned by PACT:
2015	During complex simulated transients, reactor operators (ROs) are not timely in recognizing some abnormal equipment alignments and parameter trends that deviate from expected recovery conditions.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
2015	Field operators and authorized nuclear operators improperly position components or do not control parameters as intended when performing some common evolutions. This contributed to a turbine trip, work protection events and plant control challenges. Contributing, supervisors do not sufficiently coach or monitor operators to improve their preparation and recognition of potential risks of some commonly performed evolutions.	OP.1 - Control Precisely
2015	In some instances, field operators improperly operate plant components during operational tasks. This has resulted in operators causing an unplanned heavy water transfer and testing an incorrect heat transport low-flow trip loop. Contributing to the problem, operators sometimes do not apply the expected error-reduction behaviours, such as methods for verification and procedure use, when operating plant components.	OP.1 - Control Precisely
2015	Licensed operators demonstrate weaknesses in reactor water level and pressure control when mitigating simulated anticipated transient without scram (ATWS) transients. These weaknesses resulted in a water level increase that caused a rapid change in reactor power and a water level decrease that affected the ability to maintain steam cooling water level. Contributing, the importance of maintaining control within established reactor water level and pressure bands is not effectively reinforced or critiqued during ATWS training.	OP.1 - Control Precisely
2015	Operating crews do not correctly implement some emergency operating procedure (EOP) actions during simulated transients.	OP.1 - Control Precisely
2015	Operating crews do not maintain precise control of important systems during some evolutions and events. This has resulted in a turbine trip, reactivity transients, and a simulated manual reactor scram and excessive reactor coolant system (RCS) cooldown. Contributing, licensed operators are not fully prepared to respond to some situations	OP.1 - Control Precisely

2015	Operations personnel do not adequately control some important outage evolutions. This resulted in operators taking non-conservative actions when a void was discovered in the vessel head and the potential to render the normal charging pump non-functional. Contributing to this is operations teams, including supervisors and managers, make decisions to continue with evolutions without all needed information.	OP.2 - Control Room Activities
2015	Operations personnel do not verify whether system alignments support planned configuration changes before performing some outage or maintenance evolutions. This has resulted in the loss of a critical safety function, inaccurate level indications during drain-down of the reactor coolant system, and perturbation of primary plant pressure. Contributing, operators do not thoroughly question or validate assumptions.	OP.2 - Control Room Activities
2015	Operator behaviours are not consistent with fundamental principles of strong reactivity management during some plant activities and transients. As a result, rod misalignment during physics testing required a reactor trip and non-conservative control rod manipulation following a secondary transient occurred. Contributing is managers and supervisors have not enforced robust standards for reactivity control.	OP.2 - Control Room Activities
2015	Operator lapses in precise control of evolutions have resulted in consequential events. These events include inadvertent steam admission to the high pressure coolant injection (HPCI) room sump, a dispositioned control rod, and an unplanned half-scram condition during turbine testing.	OP.1 - Control Precisely
2015	Operators demonstrate shortfalls in precise control during some simulated and plant evolutions and transients. This has resulted in an unplanned dilution in the plant and a large reactor coolant system (RCS) temperature mismatch between actual and target temperatures during a simulated transient. Contributing to these events is insufficient reinforcement of standards for controlling key reactivity parameters during situations outside of steady- state operation.	OP.1 - Control Precisely
2015	Operators do not adhere to operating procedures in some cases. This has resulted in the inoperability of emergency core cooling system (ECCS) accumulators and a challenge to the operability of a safety-related electrical bus. Contributing is operators make assumptions regarding procedure actions without first obtaining alignment from supervisors or other involved personnel.	OP.1 - Control Precisely
2015	Operators do not apply the appropriate strategies to water level and pressure control during a few actual and simulated transients. This caused excessive cycling of safety relief valves (SRV), automatic isolation of reactor core isolation cooling (RCIC), and restarting a core spray pump in excess of motor start limitations. Contributing is the control room supervisors (CRS) and shift managers (SM) do not prioritize actions to maintain key parameters within bands and limit potential damage to important equipment.	OP.1 - Understand Sciences, Engineering Principles and Plant Design

2015	Operators do not properly operate or restore some plant components. This contributed to an automatic reactor trip and resulted in operation of a refuelling water pump with the suction isolation valve closed and a reactor coolant pump bearing cooling flow alarm.	OP.1 - Control Precisely
2015	Operators do not use existing procedures consistently when responding to some simulated and plant transients or evolutions. This caused a safety injection alignment not in accordance with the emergency operating procedure and a challenge to turbine generator integrity. Contributing is that operations managers have not established clear procedure use standards.	OP.1 - Control Precisely
2015	Operators incorrectly align system components during some important activities. This has resulted in an automatic reactor trip, cooling water system damage following a pressure transient, and a turbine-driven auxiliary feed water (AFW) pump trip following condensation build-up. Contributing, operators sometimes do not challenge assumptions regarding plant conditions and task complexity.	OP.1 - Control Precisely
2015	Reactor operators (ROs) do not precisely control some important plant parameters during simulated transients. As a result, the reactor coolant system (RCS) cooldown rate was exceeded during a faulted steam generator event, and the pressurizer was overfilled during a small-break loss of coolant accident. Contributing, operations managers have not established clear standards for identifying and communicating critical parameter control bands	OP.1 - Control Precisely
2015	Senior Reactor Operators (SROs) do not recognize the adverse impact of some actions or directions. This has contributed to a secondary plant transient, an inadvertent steam generator blowdown isolation and an unplanned inoperability of a containment penetration. Contributing, SROs do not thoroughly challenge subject matter experts and peers to verify an accurate understanding of the potential consequences of some work activities.	OP.1 - Conservative Bias
2015	Shift managers (SMs) and shift technical advisors (STAs) do not provide effective oversight at times during simulated emergency events. As a result, SMs and STAs are missing opportunities to correct crew shortfalls in emergency operating procedure (EOP) implementation and contingency planning. Contributing, SMs and STAs sometimes allow specific tasks to detract from their oversight roles.	OP.2 - Operations Management and Leadership
2015	Shortfalls in control room crew oversight, coordination and communication resulted in a manual reactor trip and ineffective reactor power control. Contributing to this is managers do not adequately identify shortfalls in effective crew teamwork by considering broader behavioural contributors.	OP.2 - Operations Management and Leadership

2015	Deficiencies exist in the defect management system. Operating personnel of departments do not always record equipment defects. Cases exist when equipment defects are repaired by shift maintenance personnel, but are not recorded in the electronic defect data base. Cases are observed when failures in room lighting and door locking are not recorded, which complicates equipment maintenance or increases probability of its damage. Lighting failures in the rooms housing safety significant components are recorded as low level events (LLE), and not as defects. Deficiencies in defects recording potentially prevent from getting full information on equipment condition and perform assessment and analysis of defect causes.	OP.2 - Administrative Controls
2015	During simulated abnormal and emergency situations in the simulator, shortfalls in the understanding and use of some operator fundamentals have resulted in operator errors and worsening of plant conditions such as loss of an RCP, unnecessary safety injection, an increase in reactor power with one control rod dropped into the core.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
2015	Operating procedures for plant evolutions do not always contain comprehensive information for personnel clear understanding and performing work effectively. Not every operating procedure, work program and/or switchover check-list clearly details consequences of required actions. Sometimes information necessary to carry out works safely is not included into operating procedures and comprehensive evolutions are carried out without switchover check-lists. Not all switchover check lists and programmes have possibility for step-by-step verification during plant evolutions. This may bring to ambiguous understanding of processes by the staff and lead to errors.	OP.2 - Administrative Controls
2015	Some of operating procedures do not systematically provide clear and precise guidance for both MCR and field operators. Criteria for step-by-step confirmation type operating procedures are not defined formally. Some check-lists for systems line-up, components start-up and switch-over are not developed systematically. Some operating procedures lack detailed scope of parameters to be checked by field operators before tests and system line-ups. Shortfalls in operating procedures could deteriorate human performance during operation.	OP.2 - Administrative Controls
2015	Sometimes field operators do not identify and record components deficiencies. Such deficiencies as oil and grease leakages, insulation defects, missing, damaged and hand written labels were not noticed by field operators sometimes. Not identifying and recording equipment deficiencies may degrade the plant safety and reliability performance.	OP.1 - Monitor Closely
2015	Switchovers (plant evolutions) are not always performed in a deliberate, thorough and controlled way. The cases of peer checking absence and absence of senior operating personnel leadership, works implementation without required procedures, use of obsolete documents, shortfalls in communication and monitoring of equipment status were observed. Such practice may result in operator's errors and may affect safe operation of the unit.	OP.1 - Effective team work

2015	Technical process details are not always clearly described in Plant operations documentation. Some operations documentation does not fully and sequentially describe personnel actions. Some operations documentation does not fully cover the scope of work performed. There are deficiencies in maintaining the operations documentation. Such practice may lead to ambiguous personnel understanding of plant processes and could result in errors during its operation.	OP.2 - Administrative Controls
2015	Anomalous plant conditions are not always identified by the periodic test process due to shortfalls in: the quality of test procedures, testing rigour, and the analysis of results. Operators do not consistently identify abnormal plant indications during periodic testing of safety related equipment, and supervisors do not question and analyse such deviations when reviewing test results. This could adversely affect safety system margins and availability, and in one occasion safety report requirements were not met during a periodic test.	OP.1 - Monitor Closely
2015	Anomalous plant conditions are not always identified by the plant test process due to shortfalls in: the quality of test procedures, testing rigour, and the analysis of results. Plant test procedures do not always specify the safety case design limits and conditions, operators do not consistently identify abnormal plant indications during testing of safety related equipment, and supervisors and engineers do not question and analyse such deviations when reviewing test results. This could adversely affect safety system margins and availability.	OP.2 - Administrative Controls
2015	Control room operators are sometimes undertaking critical actions, such as load and reactivity changes, surveillances tests and pump changeovers, without effectively monitoring the implications, requesting peer checks or with no supervision. This also includes not recording pertinent information in logs, sharing information with the team mates and reviewing logs and alarms thoroughly at shift change over.	OP.2 - Control Room Activities
2015	Field operators do not consistently identify and report plant deficiencies. Defects on instrumentation and leakages (oil, fuel, water), some on safety related systems, are not always reported and addressed.	OP.1 - Monitor Closely
2015	In the Central Control Room in excess of hundred standing High Priority Alarms were present.	OP.2 - Control Room Activities
2015	Operations personnel did not sufficiently apply procedures with the expected level of rigour. Furthermore, shortfalls in crew communication practices did not ensure information was always shared effectively. This had led to safety significant events, a SCRAM, and challenged crew awareness of plant status.	OP.1 - Control Precisely
2015	Operations standards and expectations such as Reactivity Management, are not always clearly defined or being applied. As a result reactivity is not always managed on a deliberate and controlled manner, which led to an event, the control room is not always kept serene and field operator rounds are limited in knowledge of safety systems.	OP.2 - Control Room Activities

2015	Operators in the main control room and on the simulator do not always use procedures, communicate effectively or use human performance tools. This has led to a scram and technical specification LCO entries.	OP.1 - Control Precisely
2015	Procedures are not always comprehensive enough to avoid Operational errors. This has led to a SCRAM and plant configuration events.	OP.2 - Administrative Controls
2015	Shift Supervisors and Shift Managers did not always have clear oversight, or ensure compliance with technical specifications. Furthermore, they did not have an effective supervisory presence in the control room. This led to safety significant events, losses of oversight, late and unplanned limited conditions of operation, and shortfalls during frequently performed operations.	OP.2 - Control Room Activities
2015	Shortfalls in monitoring of safety related parameters evolution prevent operations shift teams from early detection of adverse trends revealing abnormal component behaviour. In addition, some safety related parameters are recorded with errors or not recorded by the shift teams. This also could lead to delay defective equipment repair or not defining the appropriate corrective actions.	OP.1 - Monitor Closely
2015	The station is not proactive enough to anticipate potential risks. Risk analyses are seldom performed before troubleshooting activities and mitigation measures are not always comprehensively defined. Tech Specs management can be challenged by a lack of proactive monitoring in the control room or in the field. This has already led to Technical Specifications violation.	OP.1 - Conservative Bias
2015	Field operators do not perform detailed monitoring of equipment in a consistent manner during their activities. As a result, degrading equipment conditions may not be identified and corrected at an early stage. Contributing to this is management expectations for conduct of rounds, monitoring equipment and leak identification are not understood by the operators.	OP.1 - Monitor Closely
2015	Gaps in the response to a simulated anticipated transient without scram (ATWS) condition increase the potential for core damage. In a few instances the ATWS emergency operating procedure (EOP) does not meet industry standards and during a simulator scenario operators did not implement an optimum strategy for controlling critical parameters. Contributing, operations and training personnel did not question whether the accepted mitigation strategy was appropriate and actions to be taken were supported by current industry practices.	OP.2 - Administrative Controls
2015	In a few instances, activities involving changes in reactivity were not conducted with sufficient attention on critical parameters .This could lead to unexpected reactivity a power transience. Contributing to this is that the station has not set up high expectation for reactivity management on relevant practices.	OP.1 - Conservative Bias

2015	In some cases, operators do not precisely control and monitor important plant parameters. This resulted in an event during which there was an unplanned power change of twenty percent and a technical specification for reactor coolant system temperature was exceeded. In another event, there was an unintended actuation of a low temperature over pressurization relief valve. Contributing, recommendations of SOER 2013-1, Operator Fundamentals Weaknesses, which require in-field monitoring, coaching, tracking, trending, and corrective actions for operator performance weaknesses, have not been effectively implemented.	OP.1 - Control Precisely
2015	Operations personnel do not use human performance tools with the expected level of rigor. This behaviour during plant and main control room activities has contributed to three reactor scrams in 2015. Contributing to this is current standards allow the use of reference procedures for some important plant evolutions such as refuelling. This does not meet industry best practices.	OP.2 - Control Room Activities
2015	Operators do not always control important plant parameters in accordance with established plant procedures. This has resulted in a delayed reduction in power to address a steam generator tube leak, isolation of safety-related valves without thorough evaluation, and primary parameters outside of established control bands during plant down power. Contributing to this is that operations leaders are not consistently providing coaching when behaviours do not meet expectations.	OP.1 - Control Precisely
2015	Operators do not effectively monitor and control key parameters to ensure they remain in allowed limits during some simulated plant events. This contributed to an automatic scram, reactor power exceeding the rated power limit, and standby liquid control system not initiated when required. Contributing, shift supervisors and deputy shift supervisors do not establish clear parameter limits and action points to align the crew for effective monitoring and priority response.	OP.1 - Monitor Closely
2015	Several fundamental weaknesses of operator performance, such as procedure use, alarm response, and use of 3-way communication impact the ability to prevent human error. This has resulted in human error event. Contributing to the problem is that Operation management does not effectively reinforce management expectation and standard for operators.	OP.2 - Control Room Activities
2015	Shift supervisors do not consistently provide sufficient oversight of control room crew performance and operational activities. As a result, control room crew was not always aligned in plant operation and response to simulated transients. Contributing to this is that the station management have not established strong expectations for supervisory oversight of shift supervisor.	OP.2 - Control Room Activities
2015	Shortfalls exist in crew command and confirmation of actions and alarms during a simulated scenario of steam generator tube rupture. This would reduce the reliability of crew response to the transients. Contributing is that the command and oversight expectations are not clearly established.	OP.1 - Effective team work

2015	Shortfalls in equipment and area labelling have potential to increase human errors for wrong unit operations. Station had several events related to wrong unit operation, including a reactor trip and has potential for similar events to recur. Contributing to this is that management expectation for equipment labelling is not effectively reinforced and expectation for area labelling has not been clearly set by operation management.	OP.1 - Control Precisely
2015	Some field operating staff demonstrate shortfalls in identifying and reporting deficiencies related to equipment readings that are outside the range of reference value parameters. This can lead to situations when equipment deficiencies or system abnormalities remain unaddressed. Standards and expectations related to operator rounds are not sufficiently enforced.	OP.1 - Monitor Closely
2015	Sometimes control room operators are not applying a high level of operator fundamentals during control room and simulator training activities, and field operators are not identifying and reporting issues during field activities. This has led to invalidating some plant tests, inadequate response to simulated transients and equipment deficiencies. Contributing is that operator fundamentals self-assessments have not been effectively implemented.	OP.1 - Monitor Closely
2015	Station emergency operating procedures (EOPs) that direct operator actions are not aligned with current industry and owner's group standards. During simulated emergencies, these differences contributed to delayed reactor depressurization, delayed reactor water level reduction to lower reactor power, and high pressure core spray use when other injection systems were available. Contributing, operations managers have not maintained awareness or benchmarked current industry and owner's group practices.	OP.2 - Administrative Controls
2015	Station's clearance and tagging program and it implementation does not guarantee that the equipment and personnel working on systems isolated under this program are always protected. Errors in the implementation of several key elements of the program were observed which can lead to personal injuries, equipment damage or plant transients. The clearance and tagging program does not contain sufficient detailed guidance to perform tagging activities to ensure worker and equipment safety; which contributes to this issue	OP.1 - Control Precisely
2015	Supervisor's not demonstrating consistent standards for crew oversight and command have contributed to gaps in parameter monitoring and control and in crew communications during some simulator training on abnormal and emergency events. This detracts from crew performance and could lead to consequential errors. Contributing to this problem is that standards and expectations have not been clearly defined for and understood by the shift crews.	OP.2 - Control Room Activities
2015	Weaknesses exist in control room panel monitoring and communication among operators during simulated transients. During simulated scenarios, this has resulted in inappropriate equipment restoration and missed information sharing of reactor power changes. Contributing to this, operations management have not established and reinforced clear expectations for monitoring and communication under transients.	OP.1 - Monitor Closely

2015	Weaknesses exist in the areas of plant monitoring in Main Control Room and in the field. This has the potential to challenge the safety and reliability of plant operation. Contributing to this shortfall is lack of reinforced plant expectations for operational practices.	OP.1 - Monitor Closely
2015	Weaknesses in the control and oversight of some operations activities reduce the effectiveness of operations crew performance. This has resulted in an unexpected reactor scram event and increases the potential for events caused by human performance shortfalls. Contributing to this problem is that operations management does not set the standard on shift management clearly.	OP.1 - Control Precisely
2016	Control room operators do not effectively work as a team during some actual and simulated transients. This has resulted in an inadvertent recriticality during a shutdown, complication of a simulated fuel handling event, and reactor water level transients.	OP.1 - Effective team work
2016	Control room operators do not precisely control the plant when responding to some equipment malfunctions and system transients. This resulted in two plant trips, exceeding the core-operating limit for reactor coolant system (RCS) hot leg temperature, and complicating simulated events.	OP.1 - Control Precisely
2016	In some instances, reactor operators do not sufficiently control critical system parameters to obtain desired system response during actual and simulated plant transients. This has resulted in a delay in establishing shutdown cooling and in a trip of high-pressure coolant injection following a plant scram.	OP.1 - Conservative Bias
2016	Nuclear equipment operators do not thoroughly understand the necessary actions to properly align or manipulate system components in some instances. This resulted in not establishing required controls for hazardous energy, tripping an instrument air compressor, and it also increases the potential for events with greater consequence.	OP.1 - Conservative Bias
2016	Operating crews do not control and monitor the plant during some evolutions and transients. This contributed to pressurizer pressure and level being out of allowed bands, reactor coolant system temperature lowering near allowed limits during a down power, and operators not recognizing the technical specification implication of an alarm.	OP.1 - Monitor Closely
2016	Operations standards inappropriately allow use of the scram test panel to support plant operations. In one instance during the review period, operators inappropriately reduced power using the scram test panel for manual insertion of individual control rods. This method can increase vulnerability to rod-movement errors and is inconsistent with industry boiling water reactor (BWR) practices.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
2016	Operators are not anticipating plant response before taking action during some off-normal or transient situations. This resulted in an entry into the technical specification for minimum temperature for criticality, an unplanned load reduction, and a delay in tripping the reactor after a loss of feed water.	OP.1 - Conservative Bias

2016	Operators do not recognize system configuration problems or coordinate actions when aligning some plant systems. This resulted in water hammer, isolation of fire protection equipment with no compensatory measures in place, and a turbine start up without exciter cooling.	OP.1 - Monitor Closely
2016	Operators perform activities, at times, without establishing effective barriers to prevent or mitigate undesirable consequences. This has resulted in inadvertent depressurization of a safety injection tank, challenge to the reactor coolant system (RCS) pressure boundary, and damage to a new fuel assembly.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
2016	Operators sometimes do not recognize when they need to escalate issues or do not convey all relevant information to other members of the team. This has resulted in a heavy-water spill into the vault, impairment of an outage backup heat sink, and fuelling limited to one machine for 24 hours.	OP.1 - Conservative Bias
2016	Operators sometimes take action outside of procedures or differently than written when responding to simulated transients and plant evolutions. This contributed to delays in establishing desired operating margins following a simulated recirculation pump trip and contributed to the unplanned start of an engineered safeguards fan.	OP.1 - Control Precisely
2016	Operators, at times, do not implement available guidance when responding to plant transients during simulated scenarios. These shortfalls resulted in potential increased radiation exposure to plant personnel in the affected area, delays in implementing actions to mitigate challenges to primary and secondary containment and not validating required actions were executed following a seismic event.	OP.1 - Control Precisely
2016	Unit supervisors, in some instances, do not correctly prioritize actions and align crews to successfully coordinate important evolutions. This resulted in a manual reactor trip during a simulated steam generator tube leak, residual heat removal pump flow oscillations during vacuum fill, and complications when responding to a simulated tube rupture.	OP.1 - Effective team work
2016	Alarm response procedures, normal operation and emergency operating procedures do not provide clear and concise guidance to operate plant's equipment. Abnormal operating procedures are not in the step-by-step format. Operational procedures/programmes are not validated at simulator before their first use at the unit. Alarm response procedures are not fully implemented. Cases of absence of sufficient information in operational procedures were revealed. It may result in increase of human errors.	OP.2 - Administrative Controls
2016	Effective response to process alarm initiation is not always provided. Operators do not always properly respond to alarms and do not always take the actions necessary in case of alarm malfunction or inoperability; there are also weaknesses in the operational documentation related to directions on actions in response to anticipated or frequently occurring alarm signals. Lack of appropriate response to process alarm signals can cause failures to timely detect deficiencies of safety related equipment.	OP.1 - Control Precisely

2016	Field operators do not always report safety related plant deficiencies during their walk-downs which is resulting in deficiencies being unresolved. In addition, in line with current plant expectations, field operators accept low criteria of defect reporting or potential seismic risk during their operator rounds.	OP.1 - Effective team work
2016	Identification of operational issues and low level deviations is not efficient enough. Occasions were noted when alarm panels were on for long periods, indications of direct-reading instruments were unstable, and low level deviations were tolerated. This can cause higher level problems to occur.	OP.1 - Effective team work
2016	Shortfalls exist in regard to field operators and line managers walk-downs. Operators do not always identify deficiencies in the field, such as minor oil leakages, tagging or equipment condition issues. Sometimes identified deficiencies are not reported in a defect database. Rooms and equipment are not always correctly secured. Low attention and awareness to these operating conditions could decrease the reliability of systems and components, as well as negatively affect operational safety.	OP.1 - Monitor Closely
2016	The existing deficiencies of the equipment walk down and inspection practice do not allow timely responding to deviations and non-compliances. Field operators do not always carefully perform inspections and walk downs and take timely measures to eliminate the identified deviations. Some weaknesses are identified in detection of deviations in the state of equipment by the field operators, both in their own area of responsibility and in the equipment owned by other departments of the plant. This can result in accumulation of deviations that fail to be timely detected and eliminated, and ultimately to failures of important components.	OP.1 - Monitor Closely
2016	Delays in detection of plant abnormalities, caused by control room operators not always closely monitoring, not always using appropriate alarm response practices and not performing trending of parameters, has led to events.	OP.1 - Monitor Closely
2016	Field operators did not always monitor nuclear safety related equipment. Degraded plant conditions may not be identified that could challenge safe plant operations.	OP.1 - Monitor Closely
2016	Gaps in operator fundamentals exist at the Station such as field operators not recognising anomalies or reporting defects, incomplete recording and log keeping, procedure use, and inconsistent handovers. These have contributed to operational margins being eroded and line up deficiencies leading to safety significant events. It was identified that individual risk perception and the decision to delay implementation of operator fundamentals by leaders have contributed to this AFI.	OP.1 - Monitor Closely
2016	In simulated scenarios, mainly during accidental situations, the shifts were not supervised and coordinated effectively by shift leads. In addition, the shifts did not comprehensively decide and prioritize actions in abnormal plant situations. This has led to solid steam generator condition during a steam generator tube rupture scenario with the potential risk of releases to the atmosphere, and lack of monitoring in reactivity changes.	OP.1 - Effective team work

2016	Main control room operators did not always sufficiently control plant. In addition, plant monitoring and alarm management was not always consistent. This had led to nuclear safety significant events.	OP.1 - Control Precisely
2016	Operation personnel do not rigorously apply plant standards when performing activities in the field such as reporting defects, line ups and tag-outs activities and has contributed to repeat significant plant event, long standing defects and degraded plant conditions.	OP.1 - Control Precisely
2016	Operational Control room standards, Supervision, Oversight and approval of operations are not always robust or rigorously applied and operational margins are not always maximised. There is a lack of serenity in the control room and an inconsistent approach to shift handover. Oversight, supervision and approval of operations is not robustly applied. This, in conjunction with shortfalls in log-keeping and alarm handling has resulted in important information being lost.	OP.1 - Effective Team work
2016	Safety analyses performed by Operations, are not always done in a comprehensive in-depth manner to validate the availability of safety related systems. All possibilities that could have a potential impact on the operability of safety related systems are not always taken into account, and the failure of periodic tests does not lead to a systematic analysis about the potential challenge on the system availability. This has led to Technical Specification breaches, with associated reductions in the safety margins, and challenges to some safety systems such as Main Steam Relief system GCTa.	OP.2 - Operations Management and Leadership
2016	Shortfalls in panel indication monitoring and in alarm acknowledgement resulted in Limited Condition of Operations and reportable events.	OP.1 - Monitor Closely
2016	Technical specifications have not always been correctly taken into account during work preparation. This has led to shortfalls in operating activities, especially during tagging outs and deviations from Technical Specifications.	OP.2 - Administrative Controls
2016	There are weaknesses in parameters monitoring both in the MCR and in the field. In addition, there are instances when shift teams do not effectively exchange information and operators do not stay in their role. This may lead to loss of important information regarding safety-related equipment, and untimely identification of deviations.	OP.1 - Monitor Closely
2016	There is a lack of rigour in main control room monitoring, panel walk-downs and response to alarms. This could lead to a loss of overview of plant status and has led to safety related events.	OP.1 - Monitor Closely
2016	There is a tolerance to sub-standard plant conditions such as operations burdens and personnel behaviour not being addressed, shift handovers, briefs and plant monitoring carried out without the expected rigour. This has contributed to operator errors leading to events.	OP.1 - Effective Teamwork

2016	Operations personnel do not consistently apply proper self-checking and peer-checking behaviours during some plant evolutions and simulated scenarios. This has resulted in consequential errors including loss of shutdown cooling, inoperability of equipment important to safety and unexpected equipment operation. The primary contributor is inconsistent monitoring and coaching by operations managers and supervisors to correct shortfalls in self-checking and peer-checking behaviours.	OP.2 - Control Room Activities
2016	Operators do not precisely control the plant during some simulated events. As a result, mitigating actions for a steam generator tube rupture (SGTR) were delayed, degrade conditions on the auxiliary feed-water (AFW) system were not addressed, core reactivity plans and contingencies were not discussed, and forced primary cooling was prematurely removed after a unit trip and safety injection. Contributing to this is that use of procedure is not reinforced during the response to the events and is, in some cases, compromised.	OP.1 - Control Precisely
2016	Weaknesses in the shift supervisor (SS) oversight function in the main control room potentially impact safe control of plant operation. Contributing to this is the operations management does not sufficiently and continuously reinforce expectations in main control room oversight. These behaviour deficiencies are reflecting a shortfall in personal accountability one of healthy nuclear safety culture traits.	OP.2 - Control Room Activities
2017	Operators and operations supervisors do not validate plant conditions or apply mitigating measures needed to control some evolutions and component manipulations. This has resulted in unexpected rod motion, unplanned power reductions and making an emergency diesel generator inoperable. Contributing, operations supervisors sometimes do not focus crews on important fundamentals before beginning evolutions or correct low-level operator performance gaps.	OP.1 - Conservative Bias
2017	Operators are not appropriately using equipment labels and line-ups for equipment manipulations and verifications. This has resulted in unloading of a station air compressor, tripping of an electrical bus, and inadvertent re-energising of a danger-tagged electrical circuit. Contributing is ineffective leadership reinforcement of human error-prevention tools.	OP.1 - Control Precisely
2017	Unit supervisors do not effectively involve appropriate members of the operating crew in implementing off-normal and emergency procedures during some simulated events. This contributed to delaying the mitigation of a steam generator tube rupture (SGTR), removing power from a safety-related emergency bus when not required, and running a safety-related river water pump with its discharge valve closed. Contributing, shift managers and shift technical advisors sometimes do not maintain their oversight role.	OP.1 - Effective Teamwork

2017	Although deviations on safety systems that are required by technical specifications are all assessed, potential deviations from acceptance criteria are not always properly documented when they occur. Consideration of limited condition of operation (LCO) is sometimes not immediate until further investigation is completed to verify that the equipment is available or not. In addition, during scenarios in the simulator, LCO entries were not always considered. This could lead to operating with potentially unavailable safety-related equipment until the investigation is complete.	OP.1 - Conservative Bias
2017	Operation personnel demonstrated shortfall in application of technical specifications and conservative decision making. Technical specifications lack of precision and quality were identified. As a result, station personnel did not always understand the safety impact of actions required by technical specification to prevent safety degradations. This has led to LCO not being entered as required and to not always comply with the LCO requested actions.	OP.1 - Conservative Bias
2017	Field operators (FO) frequently do not demonstrate sufficient attention to detail during monitoring of equipment performance and conditions during operator rounds and periodic tests. This has contributed to a diesel driven auxiliary feed water pump full flow test failure, and could lead to unrecognised and uncorrected equipment degradation with potential safety consequences. Contributing to this is that operations management does not rigorously reinforce expectations for monitoring fundamentals, or routinely identify and correct weaknesses in FO performance.	OP.1 - Monitor Closely
2017	Gaps that exist in precise control and monitoring of important equipment have the potential to adversely impact plant safety and reliability. This has resulted in 5th EDG over speed trip and not identifying 5th EDG fuel oil leakage by field operator (FO) during surveillance test. Contributing to this is that the operations management has not clearly established the expectations for Operator Fundamentals and not reinforced the expectations to the operators.	OP.1 - Control Precisely
2017	The ability to safely respond to transients is hampered by weaknesses in review of post-transient response and vulnerabilities in the crew composition. This may cause errors in response and delay or hinder safe plant stabilisation and jeopardise crew performance improvement for a possible transient. The primary cause to the problem is the fact that the station operations management is satisfied with the performance including the transient response because no major operator-related incidents were experienced during 47 years of operation.	OP.2 - Operations Management and Leadership
2017	Weaknesses in operating crew decisions and priority setting during simulated transients resulted in challenges to reactivity control, risk of increased radiation exposure, and a delay in restoring reactor level above top of active fuel (TAF).	OP.1 - Effective Teamwork

2017	Weaknesses in precise control and oversight within the main room (MCR) have impacted the safe station operations. As a result, reactor trip on primary heat transport (PHT) pressure high and manual tripping of reactor for investigation and rectification of generator transformer protection occurred at Unit 6. Contributing to this is that the operations management do not rigorously reinforce the expectations to the operators.	OP.1 - Control Precisely

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Attachment 2: List of 87 Reported Operations WERs Screened with Significant and Noteworthy between 1 January 2015 and 30 September 2017

WER Number:	OECT Summary:	OECT Cause:	Cause area assigned by PACT:
Significant WERs			
WER ATL 16-0349	During an outage and while installing a jumper to bypass the 135 psig shutdown cooling (SDC) isolation for a residual heat removal (RHR) pump, a fuse blew causing loss of power to the isolation logic and closing the isolation and return valves. This resulted in tripping of the RHR pump. The event is Significant because it resulted in a loss of shutdown cooling for 78 minutes and an uncontrolled increase in reactor coolant temperature from 106 to 196°F. It also led operators to make a procedure change for conditions not to worsen.	The direct cause was an arc flash due to operator error during jumper installation, blowing a fuse. The root causes were failure to sustain corrective actions from a similar event in the past and use of wrong type of jumper. The contributing cause was deficiency in procedure use and adherence and oversight.	OP.1 - Control Precisely
WER ATL 16-0150	While shutting down the reactor for an outage, a shutdown cooling (SDC) relief valve opened and failed to reseat, resulting in exceeding the emergency action level limit for primary circuit leakage rate. A notification of an unusual event was declared. This event is classified as Significant because of shortfalls in operator fundamentals and ineffective monitoring that resulted in a significant leakage (approximately 75,000 litres) from the primary circuit for about three hours. Indications of leakage were available but not	The cause of the relieve valve lifting and failing to reseat was that the pressure set point was exceeded due to air in the SDC system. Air in the SDC system had not been vented since the previous outage. The shift crew did not identify the leak due to inadequacies in the areas of oversight, verifications, use of operating procedure and tools, operating procedures and pre-job briefing.	OP.1 - Control Precisely

	recognised by the operating crew.		
WER MOW 15-0105	During an outage and while filling the reactor vessel, approximately 1.5 m3 of the primary coolant spilled over the control rod drive position indicator. Core cooling was lost for six minutes. This event is classified as Significance because of loss of shutdown cooling, reactor coolant leakage and extended outage for recovery. Weaknesses in nuclear safety culture were evident during this event.	Insufficient management decision making and oversight in removing and returning equipment to service resulted in a reactor coolant leak and a loss of shutdown cooling. Basic human error prevention tools were not used including independent checking, effective communication, questioning attitude procedure and adherence.	OP.2 - Control Room Activities
WER PAR 17-0291	At the end of an outage with reactor coolant at flange level, the power supply for the 118 V alternating current distribution centre for vital class instrumentation was lost. The loss of power supply generated a closing command on the residual heat removal system (RHR) suction valves on both trains, causing the loss of shutdown cooling and an entry into a limiting condition for operation. This event is Significant because the RHR system did not cool the core for four minutes and core temperature increased by 4°C to 52°C. At the beginning of the same outage, the station experienced another loss of shutdown cooling (see WER PAR 17-0173).	The direct cause was failure of three fuses and opening of a breaker. The root cause was fault in the control circuits of an inverter. The other root cause was inadequate administrative control and management of safety tagout causing misalignment of the suction valves. Contributors include inadequate test procedures.	OP.2 - Administrative Controls
WER PAR 17-0173	With the unit in an outage with reactor coolant system 200mm below the flange and the safeguard buses de-energised, the presence of degraded voltage in the 6.2 kV safeguard buses for over 70 seconds generated a minimum voltage signal and two emergency diesel generators (EDG) started automatically. A limiting	The direct cause was the presence of degraded voltage in the safeguard buses. The root cause was lack of adherence to procedure.	OP.1 - Control Precisely

	condition of operation was entered. Core cooling was lost for 1.5 minutes during the transient and the reactor coolant temperature increased by about 4°C, with the highest temperature being 56C. The EDGs were in operation for about 1.8 hours. This event is Significant as human errors caused transients on the power supply system resulting in loss of core cooling when the reactor coolant system was 200mm below the flange.		
WER PAR 16-0670	During normal operation, a fire broke out in the supply cabinet for an inverter. This resulted in the regulated 220V panel going offline and lead to an automatic scram, start-up of all auxiliary feed water pumps on low low steam generator (SG) level and safety injection (SI) actuation on high steam flow on two SGs coupled with a low T_{avg} temperature. This event is Significant due to complications started with a fire, continued with abnormal conditions on secondary and primary systems, SI actuation and challenges to operators for stabilising the unit.	The direct cause for the fire was a malfunction of the inverter and ageing equipment and/or inadequate preventive maintenance. The direct cause for low low SG level, high level of steam on two steam generators and low T_{avg} was inadequate monitoring of alarms and parameters in the main control room. The root causes were lack of operator knowledge and inadequate operator training.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
WER PAR 16-0185	During normal operation, a closed cooling water system tank overflowed flooding the switchgear rooms. This caused a number of faults on one train of reactor protection system (RPS) including unavailability of containment pressure sensor, ground fault on 125 V DC power system, failure of rod movement and unavailability of a rectifier. This resulted in entry into a combination of limiting conditions of operation (LCO). The reactor power was reduced using boron as the control rods were stuck. Average reactor	The cause was overflowing of a tank into a common manifold which was blocked by large amounts of debris due to corrosion inside the pipes. This caused pipes to fill up and resulted in water flooding the room housing the electrical building and control room main ventilation system. Openings that were designed to be leak tight failed and allowed water to flow from the control room level down to the electrical rooms.	OP.1 - Control Precisely

	coolant temperature dropped below its technical specification limit for power operation. The event is classified as Significant because it resulted in unavailability of one train of RPS, inability to move control rods, entry into a number of LCOs requiring reactor shutdown and potential for common mode failure of multiple trains of safety related equipment. (Note the manual scram function was not impacted.)		
WER PAR 16-0095	During operation at 85% and while performing a periodic inspection of a motor generator as power supply to control rod driving mechanism (CRDM), two generators of CRDM power supply were tripped due to overcurrent protection actuation. This resulted in an automatic scram. Subsequently, the requested boron addition to the primary circuit was not complied with for about two days and the operator responsible for a human error that started the event did not admit the error for three days. This event is classified as Significant because of several non-compliances with technical specifications involving several operation shift managers, shift technical advisors and station managers.	The root cause of the scram was human error. The blocking manager pressed the push off button instead of pressing the push on button. Incomplete operation procedure information, insufficient risk assessment and inadequate self-checking were contributors. The lack of boration was due to a wrong decision by station management that wanted to restore power quickly. A contributor was the management level was not questioned or challenged. The root causes were weak nuclear safety awareness and low nuclear safety culture.	OP.1 - Control Precisely
WER TYO 16-0012	During normal operation, one main feed water pump stopped. After the operator started the standby pump to recover the steam generator level, two trains of high pressure heater tripped due to high level signal. The main feed water temperature reduced, leading to reactor power increase, which reached the set point of excess power. As a result, reactor automatically	The direct cause was the failure of digital control system (DCS) control module of one main feed water pump. The root causes were that after starting the standby pump, cold water entered the high pressure heater and after the trip of high pressure heater, feed water without heating entered the steam generator. The DCS	OP.1 - Control Precisely

	scrammed. This event is classified as Significant because reactor power increased to 108%.	modules may require periodic replacement.	
WER TYO 17-0324	During cold shutdown, an inadvertent trip of residual heat removal (RHR) pump B occurred, causing a loss of shutdown cooling (SDC) for 22 minutes. As a result, reactor coolant temperature increased by 18°F indicated on reactor recirculation system loop A. This event is Noteworthy due to a loss of residual heat removal.	The root cause was a design vulnerability and subsequent operation of the SDC system resulted in a trip of two SDC suction valves due to sub-cooling and flashing in the RHR or reactor recirculation system. Contributing cause was incomplete procedure guidance with respect to potential impacts of operating SDC.	OP.2 - Administrative Controls
Noteworthy WERs			
WER ATL 17-0305	During normal operation, the potential transformer primary fuses on a 4.16 kV safety related bus were found blown, resulting in half of the loss of power (LOP) instrumentation relays tripping on the bus. This caused the LOP instrumentation and a division 1 emergency diesel generator (EDG) being inoperable. After 14 days, the reactor was shut down to replace the fuses. During this period the division 2 EDGs were inoperable six times for planned surveillances. Failure to enter applicable LCOs due to inoperability of EDGs resulted in a condition prohibited by technical specification. This event is Noteworthy because it resulted unavailability of EDGs and in 10.5 days of forced outage.	The direct cause of the LOP instrumentation being inoperable was an open circuit caused by the low energy transient event. The cause of the LOP instrumentation incorrect operability determination and not entering the required LCOs was operators unfamiliarity with the equipment condition.	OP.2 - Administrative Controls
WER ATL 17-0242	During normal operation and while performing a work permit, a field operator closed an isolation valve of the liquid injection shutdown system helium supply pressure system while the other valve was already closed. The field operator then opened the helium supply line vent valve as	The apparent cause was inadequate operating procedure. The contributing causes were inadequate pre-job briefing and the field operator did not have adequate knowledge about the interlock.	OP.2 - Administrative Controls

	per procedure. As a result, the pressure on high pressure helium supply tank dropped to 5.9 MPa(g). This event is noteworthy because it caused a level 1 impairment of the shutdown system 2 for approximately 10 minutes.		
WER ATL 17-0019	During normal operation, a high pressure feed water heater (FWH) normal drain started closing due to an actuator air supply failure but an operator incorrectly concluded that the drain to the condenser was failing open and therefore isolated it to maintain the FWH level. This caused high level in the FWH, resulting in the FWH isolation, decrease in feed water temperature and consequently increase in reactor power. The unit power was reduced to 93%. The event is Noteworthy because it resulted in a reactor power excursion to 102.2%.	The cause was human error as the operators did not correctly diagnose the failure of an air operated FWH drain valve. The other cause was that the operators did not use the senior reactor operator risk recognition process.	OP.1 - Control Precisely
WER ATL 16-1488	During normal operation, the steam propagation door to one chiller room was discovered propped open, leading to inoperability of both trains of chilled water due to a potential high energy line break. This rendered both trains of high head safety injection inoperable and an entry into a shutdown technical specification. This event is Noteworthy because of the inoperability of both trains of the high head safety injection and the potential loss of a safety function.	The apparent cause was that test specialist was unaware that the chiller lockout tagout containing the high energy line break dampers was fully cleared late in the previous shift. Other causes were inadequate communication between work control and specialist and incorrect communication on shift turnover.	OP.1 - Effective Teamwork
WER ATL 16-1208	During a protective relay functional test carried out at full power about two years ago, the plant was placed in a configuration where both 4kV emergency buses would have been prevented from	The root cause was that the decision to perform testing online instead of cold shutdown lacked sufficient rigor to ensure compliance with technical specifications. The contributing cause was ineffective corrective	OP.1 - Understand Sciences, Engineering Principles and Plant Design

	automatically transferring to start-up transformer or emergency diesel generators in case of a reactor scram, turbine trip, loss of offsite power or loss of coolant accident. This was a violation of technical specifications. The event is Noteworthy because of loss of ability to automatically transfer emergency buses on back-up power sources for nearly two years.	actions in resolving identified risks with the online testing. The other contributing cause was inadequate knowledge of senior reactor operators regarding limiting condition of operations.	
WER ATL 16-1137	While fuel was being discharged from the fuelling machine into the irradiated fuel discharge machine (IFDM), a fuel bundle was stranded in air. The IFDM head was subsequently flooded per procedure but resulted in fuel damage. This event is Noteworthy due to a lack of cooling to a fuel bundle and its potential consequences.	The cause was that a fuel handling operator training in the field resulted in the field trainer interrupting power supply to a fuel machine trolley. The root cause was procedure inadequacy which allowed misinterpretation by the control room operator. Contributing factors include inadequate training material on system knowledge and operator fundamentals, and insufficient supervisor reinforcement of fundamentals.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
WER ATL 16-1024	During operation at 65% power, a conservative action to manually scram the reactor was not taken when reactor power, pressure and level oscillated over a 44 minute period due to closing of two turbine control valves. The reactor scrammed automatically on a neutron monitoring system oscillation power range monitoring trip. The event is Noteworthy because reactor power oscillations continued for 44 minutes and shift manager did not conservatively scrammed the reactor.	The direct cause was failure to take conservative action by the control room supervisor. The root cause was ineffective implementation of a comprehensive conservative decision making strategy by the management. The contributing cause was ineffective shift management and oversight roles.	OP.1 - Conservative Bias
WER ATL 16-0889	During a plant transient prior to a manual scram, the high pressure coolant injection system was manually overridden as directed by the unit	The causes were that operating procedures were not followed and the mistake was not	OP.1 - Effective Teamwork

	supervisor, resulting in loss of the single train safety system. This event is Noteworthy because human error caused inability of the automatic function of an emergency core cooling system.	corrected due to weaknesses in teamwork and oversight.	
WER ATL 16-0254	During an outage and while performing the moderator filling procedure, the operator incorrectly selected the auto drive mode for the hand switch of a shutoff control rod bank instead of the required manual drive mode. This caused a bank of 16 shutoff rods to drive out of core by 5% and a reactivity management event. The event is Noteworthy because it led to unexpected extraction of 16 out of 32 shutoff rods and the error was not identified immediately but only while manipulating another rod.	The direct cause was human error. The apparent causes were deficiencies in the conduct of just in time training, procedure adherence and supervisory oversight. Inadequate training documents, insufficient use of human performance tools and procedure deficiencies contributed to the event.	OP.2 - Control Room Activities
WER ATL 16-0100	During normal operation and while performing nuclear instrumentation calibration for reactor protection system (RPS) channel 2 with channel 1 in trip state, an automatic reactor scram occurred due to actuation of channel 4. After the scram, main steam isolation valves closed and high level in a steam generator (SG) occurred and SG relief valves lifted. Two of the relief valves did not properly reseat until main steam header pressure was lowered manually. One offsite power circuit automatically isolated unexpectedly at the time of scram. The event is classified as Noteworthy because of complications after the scram.	The direct causes were a spurious failure of a protective fuse and continuing plant operation with RPS channel 1 inoperable. The root cause was a manufacturing/design defect in the protective fuse. A contributing cause was an inadequate evaluation of trend of fuse failures.	OP.1 - Conservative Bias

WER ATL 16-0072	During normal operation and while performing a containment system test, a level one impairment to the containment system occurred when in service vapour recovery driers fans tripped resulting in no flow across the vault air activity monitors. In addition, the test jumpers which were installed to disable the moderator temperature control and prevent moderator crash cool-down during the test were left in place and were removed after 5.5 days. The event is classified as Noteworthy because two important functions (loss of containment isolation followed by moderator crash cooling) were unavailable.	The cause was slow opening of a containment pneumatic valve which caused low differential pressure across the dryer beds. The apparent cause was that the work order to fix the valve opening problem was not worked in the last two years due to inadequate risk assessment. The jumpers were left in place from the containment button up test due to human error. The contributing causes include inadequate procedure and inadequate design of alarm annunciation for low flow in main control room.	OP.1 - Conservative Bias
WER ATL 15-1319	During start-up from cold shutdown, it was discovered that both level switches used in one of two reactor protection system (RPS) trip systems for initiation of a reactor scram on low reactor pressure vessel (RPV) water level observed to be off-scale high. The switches were declared inoperable and a half scram was generated on the RPS trip system, resulted in violating technical specifications (TS). This event is classified as Noteworthy because of a loss of the safety function.	The channel indicating switches were mechanically bound against the rubber snubber. The cause was that the procedure for switch setup and calibration was not consistent with the vendor manual. Lack of preventive maintenance was a contributor.	OP.2 - Administrative Controls
WER ATL 15-0939	During refuelling outage with fuel in the core, a jumper placed across incorrect terminals caused a loss of a 4kV bus and essential load centre, leading to tripping the residual heat removal pump. This even is Noteworthy because it resulted in the loss of shutdown cooling and the vessel water temperature rose 10°F.	The root cause was that operations failed to implement effective barriers for preventing loss of power to the load centre and subsequent loss of shut down cooling. Contributors were inadequate work order and lack of clear expectations to reduce human errors.	OP.1 - Conservative Bias

WER ATL 15-0926	With Unit 1 in cold shutdown and Unit 2 in normal operation, service water (SW) back flowed from the circulating water discharge tunnel through a component cooling water heat exchanger following a maintenance activity to replace an expansion joint. This resulted in over 2ft of SW accumulating in safeguards basement which then overflowed into the auxiliary building and resulted in the submergence of equipment located in the safeguards basement. This event is classified as Noteworthy because of the potential to reduce nuclear safety defence-in-depth. Had the water not been successfully isolated by operators, shutdown cooling could have been lost on Unit 1. In Unit 2, a loss of charging and component cooling water could have degraded the reactor coolant pump pressure boundary.	The root cause was inadequate procedure guidance resulting in an improperly revised tag out boundary that allowed service water to flow through an opening in a pipe and flood the safeguards basement area. A contributing cause was human error regarding the decision to revise the tag out.	OP.2 - Administrative Controls
WER ATL 15-0913	During normal operations and while restoring a clearance in the control room air condition chiller, one train of the essential service water was made inoperable resulting in the inoperability of one train of the motor driven auxiliary feed water pump (MDAFP). The other train of the MDAFP was already inoperable for planned maintenance. This event is Noteworthy because it resulted in both MDAFP trains being inoperable at the same time.	The direct cause was human error. The apparent cause was inadequate work scheduling and process controls to recognize and mitigate risks. Contributors were weak modification process controls for coordinating post modification test with operations and ineffective administrative controls for the operation of critical valves.	OP.1 - Conservative Bias
WER ATL 15-0779	During normal operation, an abnormal reading on standby gas treatment (SBGT) flow indication resulted in the train B being declared inoperable. During troubleshooting, the initial touch of a wire bundle to determine the correct wire	The causes were inappropriate human actions and inadequate decision-making. The operating crew failed to ask the basic intrusiveness initiative questions and prevent the event. Maintenance failed to exhaust other potential causes prior to	OP.1 - Conservative Bias

	resulted in the wire coming out of the crushed lug on the train A flow controller. This resulted in two trains of SBGT system becoming inoperable at the same time causing the station to enter a shutdown technical specification action statement. This event is Noteworthy because both trains of a safety system were inoperable at the same time.	involving the operable train in data gathering efforts.	
WER ATL 15-0758	During an outage and while raising reactor pressure vessel level, a control room operator aligned incorrectly the condensate system to control injection rate, resulting in a reactor pressure vessel (RPV) high-pressure and isolation of a train of residual heat removal for five minutes due to an RPV high-pressure isolation signal. This event is classified as Noteworthy because of the human error involved that resulted in a loss of shutdown cooling.	The direct cause was an operator did not follow the procedure and missed steps. Contributing to the event was that the operator did not inform the crew of the actions in progress, and control room supervisor oversight was inadequate. Self-induced time pressure contributed to the event.	OP.1 - Control Precisely
WER ATL 15-0612	During cold shutdown and while performing a reactor protection system channel functional testing, an operator failed to de-energise residual heat removal (RHR) and reactor water cleanup (RWCU) internal isolation valves per procedure. This event is classified as Noteworthy because the RHR system and the RWCU system were isolated for approximately 35 minutes and the coolant temperature rose from 78°C to 90°C.	The root cause was inadequate personnel work scheduling, working considerable number of hours. The reactor operator who was in charge of the surveillance testing had been working continuously during 13.40 hrs. Contributing factors were insufficient self-checking and procedures deficiencies.	OP.1 - Conservative Bias
WER ATL 15-0592	During normal operation, a post-test review identified that the recorded auxiliary feed water pump discharge pressure was below the acceptance criteria, resulting in entry into a limiting condition of operation (LCO). The low pressure was not	The root cause was inadequate communication between operator crews of an operable but degraded/nonconforming condition. The contributing causes were inadequate trending and weakness in	OP.1 - Effective Teamwork

	initially recognised and LCO was not recorded for seven days. This event is classified as Noteworthy because long-term unavailability of a safety related and high risk significant pump.	prioritising and scheduling maintenance.	
WER ATL 15-0304	Two emergency coolant injection (ECI) storage tank level transmitter (LT) impulse lines froze, resulting in two of the four LT loops indicating off-scale high. It would have prevented the ECI automatic changeover to recirculation mode on low ECI tank level, affecting all six units in case of LOCA. This event is classified as Noteworthy due to potential loss of ECI in six units.	The apparent cause was low ambient temperature, concurrent with degraded heat tracing.	OP.1 - Conservative Bias
WER ATL 15-0300	While performing reactor coolant system check valve test, all four safety injection (SI) accumulator outlet valve breakers were unlocked and closed contrary to the requirements in technical specification. As a consequence, all four SI accumulators were declared inoperable. This event is classified as Noteworthy due to loss of critical safety function (accumulators inadvertently isolated preventing injection of borated water into the core during a design basis accident).	The direct cause was an operator human error. The testing procedure did not specify the conditions necessary to maintain safety injection accumulator operability. The operator did not follow place keeping as required.	OP.2 - Administrative Controls
WER ATL 15-0291	During normal operation, a clearance order erroneously closed two residual heat removal valves, rendering both trains inoperable and entry into a technical specification. This event is classified as Noteworthy because improper operation resulted in loss of a safety function.	The apparent cause was that operators did not recognise that current plant conditions could not support the proposed activity. The contributing cause was the clearance order preparer did not ensure that all relevant information related to technical specifications were included on the clearance order detail page.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
WER ATL 15-0258	During operating at 100% power, reactor power was lowered to 61% following a recirculation	The direct cause was the operating crew failed to recognise the importance of	OP.2 - Administrative Controls

	pump trip due to a leak of cooling water from the pump. Loss of heater drains resulted in decreasing feed water temperature which caused reactor power increase to approximately 74% over the following 10 minutes. The reactor automatically scrammed due to actuation of the reactor protection system function of oscillation power range monitor (OPRM) upscale. This event is classified as Noteworthy because entered into an approximate 17 day forced outage, and weaknesses in operator actions while operating in a condition more susceptible to core hydraulic instabilities.	timely insertion of the CRAM Array following the trip of recirculation pump from high power. The root cause was operator actions, as directed by procedure, did not provide timely mitigating actions when the reactor was operating in a condition more susceptible to core thermal hydraulic instabilities (THI). Contributing to this delay were organisational and programmatic issues, including less than adequate procedures and training, resulting from an over reliance on the OPRM function to protect the fuel from THI.	
WER MOW 16-0119	During maintenance on a 6kV electrical equipment, a short circuit occurred in a cubicle and smoke was seen. This event is Noteworthy because two workers were badly burnt and taken to the medical facility by ambulance.	The direct cause was operations errors during transformer insulation resistance measurement. The root cause was violation industrial safety rules and operating instructions. Lack of supervisory oversight was a contributor.	OP.1 - Control Precisely
WER MOW 15-0205	During a refuelling outage, one fuel assembly was recognised erroneously put into a position in the core. This event is classified as Noteworthy because it had potential to damage the fuel.	The direct causes were refuelling machine software error and a lack of independent checking. The root causes were failure to use policies, inadequate team communication, insufficient quality control, and deficiency in training.	OP.2 - Control Room Activities
WER MOW 15-0183	During start up, the group six of the control rods dropped below the limit value for an hour. The personnel achieved conformity with the limit by dosing boron acid into suction of primary circuit make-up pumps. This even is classified with Noteworthy because of an unplanned dilution causing a reactivity management event and could have been prevented	The direct cause was failure to control the position of control rods and unplanned reactor coolant system dilution with pure condensate. The root causes were inadequate oversight and enforcement of reactivity control standards, non-conservative reactivity control, and lack of an independent monitoring.	OP.2 - Control Room Activities

	by effective use or OE in SOER 2007-1.		
WER PAR 17-0247	During an outage and in preparation of works on a reactor coolant pump (RCP), the train B of the low head safety injection system (RIS BP) was isolated to protect workers during the work on the RCP. After interrupting the work, the cells were left racked out. This resulted in the unavailability of train B of RIS BP and in entry into a limiting condition of operation. This event is Noteworthy because the unavailability of a safety related system was not noticed for 57 hours.	The causes were a deviation in the site tagging rules, insufficient knowledge for conditions authorising racking out of the low head safety injection cells in outage, unclear work permit and inadequate control room monitoring.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
WER PAR 17-0226	During hot shutdown after an automatic reactor scram (see WER PAR 17-0203), the accumulated limiting conditions of operations required that the reactor be shut down in one hour when the level for the auxiliary feed water tank dropped below the shutdown requirements. Operations staff misinterpreted the shutdown requirements and exceeded the required time to shut down the unit by five hours and 19 minutes. This event is Noteworthy because the required shutdown was delayed due to misunderstanding of the technical specification requirements.	The cause was that the shift crew were not prepared for this type of infrequent unplanned safe shutdown and the shutdown procedure was not adequate. Inadequate coordination of all participants caused incorrect understanding of the shutdown deadline.	OP.2 - Operations Management and Leadership
WER PAR 17-0072	During start-up of the reactor, I&C staff was allowed to perform a test without knowing that control rods are withdrawn and that the test generates a reactor scram signal. As a result, the reactor scrammed. Operators did not notice the scram and	The root cause was inadequacies in scheduling and test procedures. The other causes were inadequate alarm response and rod positions monitoring.	OP.2 - Control Room Activities

	failed to close two valves of the degassed water system to prevent dilution as required by technical specifications (TS). The valves were not closed for seven hours. The event is Noteworthy because of inadequate control room behaviour and inadequate monitoring of core status that resulted in not taking TS required actions for seven hours.		
WER PAR 17-0003	During an outage with all fuel assemblies in the spent fuel pool (SFP) and while performing a start-up of the component cooling system (CCS) train A, a miscommunication between operation staff left two manual isolation valves in closed position. As a consequence, cooling of the SFP had been lost for one hour and 18 minutes. Water temperature in the SFP increased from 42.2°C to 45.1°C. This event is Noteworthy due to loss of spent fuel pool cooling during outage.	The direct cause was a human error due to ineffective communication. The apparent cause was status of the CCS was not adequately controlled during outage. Contributing factor was lack of operator's attention to the CCS pump flow and abnormal increase of water temperature in the SFP.	OP.1 - Effective Teamwork
WER PAR 16-1134	During an outage with the reactor core defueled, a 500 kV power supply was lost due to the opening of the alternator bus bar because of a thermomagnetic switch restoration in a peripheral tele-command. The standby diesel generators and the alternative bus bar switch were out of service for maintenance. This event is Noteworthy because of loss of offsite power and loss of spent fuel bay cooling for 30 minutes with an increase in the water temperature of less than 1°C.	The cause was inadequate operating manual.	OP.2 - Administrative Controls

WER PAR 16-0986	During commissioning stage and while increasing power after performing load rejection and other transient tests, xenon poison changed to poison reducing status due to large load variation during the tests resulting in increase in primary circuit average temperature and shift in delta I. The operators intervened through boration, rod control and power reduction but too high primary circuit average temperature appeared during the transient. The event is Noteworthy because of inadequate reactivity management resulting in overheating of primary coolant and increase in reactor power to 102.5%.	The direct causes were unstable reactor state, insufficient expectation on xenon poison, ineffective primary circuit temperature control, late boration and insufficient initial boration amount. The root cause was insufficient risk analysis and lack of unit power change reactivity control standard package. The contributing factor was lack of operator knowledge.	OP.2 - Administrative Controls
WER PAR 16-0979	While conducting full power auxiliary power shedding transient test, the average temperature of primary reactor coolant exceeded 310°C for a period of 22 minutes. The primary temperature once hit a peak at 313.7°C, exceeding the limit required in the final safety analysis report (FSAR). This event is Noteworthy because of operator mistakes that resulted in a plant transient that exceeded the FSAR.	The direct cause was boration rate was set too low during the period of power increase and Xe poison extinction. The root cause was inadequate operator skill for controlling the axial power distribution and insufficient knowledge for setting during boration. The contributors were inadequate test schedule and Xe poison monitoring as well as ineffective use of operating experience.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
WER PAR 16-0651	During a refurbishment outage with only external power supply for plant operation and while performing a switch alignment in the 500kV switchyard, a wrong manoeuvre performed by the transmission grid company (TGC) resulted in loss of offsite power. It resulted in loss of spent fuel bay (SFB) heat sink for nine minutes. This event is classified as Noteworthy because of loss of offsite power and SFB heat sink.	The cause was that TGC shift manager jumped a few steps from the procedure. The other cause was inadequate communications between the station and TGC.	OP.1 - Conservative Bias

WER PAR 16-0606	During an outage and while priming and venting the component cooling system, improper operator action caused level drop in both component cooling tanks. This resulted in both residual heat removal pumps stopping at the same time. This event is Noteworthy because it resulted in loss of residual heat removal for six minutes and spent fuel cooling for 17 minutes.	The cause was human error as the operator failed to implement the procedure. Before starting priming and venting, the operator did not make preparations as required. Lack of system knowledge was a contributor. The field operators did not understand the method of system priming and venting, which led to a valve opening too much. Inadequate use of OE feedback was a contributor. This event was identified during an internal inspection. It was not recorded in station logs or reported to WANO because of weakness in nuclear safety culture.	OP.1 - Control Precisely
WER PAR 16-0565	During an outage and while performing tagging prior to a modification of train B 380V AC switchboard, inappropriate opening of train A 48V feeder caused the train A diesel generator (EDG) to be unavailable when the train B was already inoperable. This resulted in entry into multiple limiting conditions of operation. The event is Noteworthy due to unavailability of both EDGs and loss of redundancy in power supply for 30 minutes.	The cause was human error as the tagging supervisor forgot to remove the 48 V supply from the work permit. The risk assessment on electrical component isolation and modification impacts were inadequate.	OP.1 - Conservative Bias
WER PAR 16-0562	During an outage in hot shutdown mode, both residual heat removal pumps were tagged out at the same time despite being scheduled in series. Entry into a group 1 limiting condition of operation (LCO) was detected only during the next shift. This event is Noteworthy because of unavailability of both trains of residual heat removal and multiple weaknesses in operational focus.	The causes were inadequate shift hand over, inadequate communication between the operator and the tagging supervisor and inadequate procedure of the monitoring operator with insufficient knowledge and experience.	OP.1 - Effective Teamwork

WER PAR 16-0465	During normal operation and while performing maintenance activity to repair a generator power limiter, the risk of triggering a temperature adjustment control rod bank was not identified. As a consequence, the rod bank inserted and remained under the calibration curve for 44 minutes. The control room operator made boron dilution without identifying the issue. A group-1 limiting condition of operations was entered only afterwards during analysis of the event. The event is Noteworthy because operators did not perform a risk analysis before the maintenance activity, the shift team managed the transient without identifying the over-insertion of a control rod bank which resulted in non-adherence with the procedure and a dilution of the reactor coolant system.	The cause of implementing dilution was the operating procedure was not followed. The cause of not identifying the risk of the rod insertion was shortfalls in risk analysis and independent reviews. Using the incorrect diagram and insufficient human performance tools contributed to the event.	OP.1 - Control Precisely
WER PAR 16-0145	During a refuelling outage and while changing the line-up of spent fuel pool cooling heat exchangers from parallel to series configuration, a component cooling system valve was not opened by mistake. This resulted in loss of spent fuel pool cooling for about six hours and increase in the pool temperature to 36.6°C. This event is classified as Noteworthy because of loss of cooling of the spent fuel.	The causes were inadequate use of error reduction tools, lack of pre-job brief, procedure deficiency and lack of communication.	OP.2 - Control Room Activities
WER PAR 16-0132	During start-up at 14% nuclear power and while performing feed water system switchover from low to high flow, low load of the feed water flow occurred due to the closure of the high flow valves. The operators increased primary power to authorise opening of the high-flow feed water valves, resulting in steam generator level drops,	The cause was the inadequate analysis led to an erroneous position of the feed water high flow control valves. The high-flow manual isolation valves should have been open to allow the controls to work. Deficiencies in operating procedures, operators' communications and knowledge	OP.1 - Understand Sciences, Engineering Principles and Plant Design

	prompting the shift team to quickly reduce power. As a result of primary temperature increase, the temperature control rod bank dropped and remained below the insertion limit for 17 minutes. This event is classified as Noteworthy due to the complication challenging the operator response and the reduced shutdown margin.	regarding rod withdrawal contributed to the event.	
WER PAR 16-0109	During hot shutdown, a line-up error (two steam supply valves were closed) occurred during removal of tagging from the turbine-driven auxiliary feed water pump and the hydro test pump turbine generator set resulting in accumulated group 1 limiting condition of operations. The deviation was detected after two shift turnovers despite the presence of the auxiliary feed water alarm for two steam isolation valves not open on the steam generator. This event is Noteworthy because operational errors in valve line-up degraded two safety systems and missing the alarm for two shifts.	The causes were inadequate team communication, lack of questioning attitude, technically incomplete and lack of conservative approach in control room.	OP.1 - Effective Teamwork
WER PAR 16-0009	During hot shutdown, and while performing a safety injection (SI) train test, a safety valve was declared inoperable resulting in entry into a group 1 limiting condition of operation (LCO). The group 1 LCO was wrongly cleared by resetting the thermal trip function without checking the operability of the valve. Further investigation revealed the unavailability of the valve and one low pressure SI train was declared unavailable. A group 1 LCO was entered and the unit was taken to intermediate shutdown condition. This event is Noteworthy because the intermediate shutdown initiation	The valve was stuck because of malfunction of the limit switch. The decision making process was ineffective. A lack of record keeping and inadequate oversight resulted in late LCO entry. The thermal protection function was cleared without input from the maintenance department.	OP.1 - Conservative Bias

	time was delayed by 23 hours and exceeded the technical specification required action time due to inadequate decision making.		
WER PAR 15-0908	During normal shutdown mode, a circulating cooling water (CCW) pump was switched off prematurely assuming that the unit was in the shutdown condition for maintenance. The event resulted in CCW A-train out of service for one hour and nine minutes and reactor coolant temperature increased by 4°C. The event is classified as Noteworthy because it resulted in loss of shutdown cooling.	The cause was human error as the operator failed to check whether the mode change was effective after performing his manipulation.	OP.1 - Control Precisely
WER PAR 15-0891	During normal operation, and while performing a periodic testing of partial closing of main steam isolation valves, inappropriate action by a field operator led to the closing of one steam isolation valve, causing a low level in a steam generator (SG) and an automatic reactor scram. During transient four SG safety valves opened and were then reclosed. This event is classified as Noteworthy because failure of the SG safety valve to close would have resulted in a sudden overcooling of the reactor and increased reactivity.	The direct cause was human error, as the action on the closing the limit switch caused the closure of the valve.Malfunction of the opening limit switch of the steam isolation valve was known but had not been dealt with. A similar event had already occurred at another plant. Lack of knowledge of the main steam isolation valve circuitry design and inadequate procedures were contributors.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
WER PAR 15-0841	During an outage with one diesel generator (DG) tagged out for maintenance, the other DG was declared unavailable due to the presence of fuel in one of the hoses on the injector return of the fuel circuit, resulting into group 1 limiting condition of operation (LCO). During post-maintenance testing after repair, the engine oil temperature was	The cause of high oil temperature was that heat could not be sufficiently removed due to a too quick shutdown of DG. The causes of violation of LCO were inadequate ground rules for analysis of equipment anomalies, insufficient questioning attitude and unsuitable human resources.	OP.2 - Administrative Controls

	beyond criterion, so the LCO could not be lifted, resulting in a violation of technical specification. This event is classified as Noteworthy because of unavailability of all DGs for 9 hours and 35 minutes.		
WER PAR 15-0764	During a refuelling outage, fault in reconnection of power supply to a reactor cavity and spent fuel pit cooling pump resulted in shutdown of the pump for two hours leading to elevation of the spent fuel pit temperature by 3.5°C. The other spent fuel pit cooling pump was available and cooled the spent fuel pit. The event is classified as Noteworthy because of loss of spent fuel cooling for two hours.	The cause was inadequate use of error reduction tools by operators and modification of procedure by the operator without approval.	OP.2 - Control Room Activities
WER PAR 15-0740	During refuelling mode with complete core in spent fuel pit and while performing post-maintenance testing of a nuclear sampling system valve, component cooling system flow to heat exchangers of reactor cavity and spent fuel pit cooling systems was interrupted for 11 minutes. The event is classified as Noteworthy because of the loss of spent fuel pool cooling.	The direct cause was that an operator actuated two reactor protection system push buttons simultaneously during the test which triggered the train A containment spray order and consequently led to isolation of train A component cooling system with train B already shutdown. The root cause was inadequate risk assessment and pre-job brief during post maintenance testing.	OP.1 - Control Precisely
WER PAR 15-0535	While only one emergency power train was available and during installation of one train of the new emergency power system (EPS) in cold shutdown, a moderator coolant pump for the decay heat removal tripped on high temperature when the operation staff was attempting to restore component cooling to that pump. This event is noteworthy because reactor core forced cooling was lost for 14 minutes and the primary-	The cause of the trip of the component cooling pump was an involuntary contact between earth and cabinet measuring slot during maintenance for the new EPS. The cause of the overheating of the moderator pump was a human error by the operators that did not notice a closed valve.	OP.1 - Control Precisely

	moderator system temperature rose by 4°C.		
WER PAR 15-0471	While starting-up the reactor at 15% thermal power, and when adding boric acid to correct the control rods position, the control rods were automatically withdrawn more and faster than expected. The operators tried to compensate the reactivity increase by increasing thermal power, which is a non-conservative decision. The transient lasted for approximately 4 minutes before the control rods were at the pre-established set point. Thermal power reached 33% during the transient. The event is classified as noteworthy because it is a reactivity event as result of not applying the recommendation of SOER 2007-1.	The cause was that reactivity was not well controlled when adding boron in too large batches using the Boric Acid Addition system (KBC) because the injection flow required in these types of manoeuvres was below the measuring scale of the flow gauge installed and the homogenisation of the boron takes time. Root cause was that there was no operative instruction which regulated the injection strategy, wait time and KBC system valve opening percentage.	OP.2 - Administrative Controls
WER PAR 15-0300	During a refuelling outage and while fuel was fully removed, a forest fire 5km away from the plant resulted in loss of offsite power followed by loss of 6.6 kV switchboard. Only one emergency power supply was available which was started. The event is classified as Noteworthy because it was a complicated event that operators had some difficulty with. Also, the spent fuel cooling was interrupted for 1 hour 15 minutes although temperature only increased by 1.6°C.	The root cause was that after maintenance of main transformer, a 6.6 kV switchboard was not timely switched to power supply by the main transformer and there was no emergency scheme available against loss of all external power supply. The contributing cause was lack of operator's knowledge.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
WER PAR 15-0190	During construction and while performing maintenance, a contractor had an electric shock while opening a movable door baffle to clean the contacts on a 6.6 kV switchboard compartment. He lost his consciousness and was sent to a	The cause was that the isolation boundary failed due to inconsistency in the work permit and the work order. In addition, contractor workers cleaned the contactors beyond the working boundary. Deficiencies were also analysed in the areas of lacking	OP.2 - Control Room Activities

	local hospital for treatment. This event is classified as Noteworthy since the multiple safety barriers were broken while working on high voltage, posing potential of severe personal injury.	communication, violation of electrical work code, insufficient personnel experience and insufficient use of operating experience.	
WER PAR 15-0038	During hot shutdown and while performing a safety injection system (SIS) surveillance test, levels of the reactor building sumps were discovered below the expected criterion. As a result, both trains of the SIS and the containment spray system were declared unavailable and the reactor was brought to cold shutdown. This event is classified as Noteworthy because of the unavailability of both trains of a safety system.	The direct cause was that the SIS sump suction lines were partially drained due to dispositioned valves after previously conducted surveillance tests, and that level of the sumps were not checked after the surveillance tests. A similar event had already occurred at another plant.	OP.1 - Control Precisely
WER TYO 17-0042	With the plant in shutdown state, a total of 6.6m3 of rainwater entered into the emergency electric equipment room and other areas including controlled areas of reactor building. It led to a temporary actuation of an alarm indicating a short circuit in the normal and emergency lightening power distribution panels. This event is Noteworthy because there was a potential impacts on emergency core cooling function if other sections of the building were flooded during operations.	The causes were deficiencies in building water tight sealing application, building penetration management, drainage pump capacity, operator's response and sharing climate information. There were organizational aspects related to the events.	OP.1 - Control Precisely
WER TYO 16-0451	During an outage and after a main cooling pump was started, the temperature of the main pump thrust bearing bush increased rapidly. The pump was stopped from the main control room. The event is Noteworthy because it resulted in an outage extension of 12 days to replace the auxiliary thrust bearing bush of the pump motor.	The direct cause was serious wear and tear of the auxiliary thrust bearing bush. Before the start of the main pump, the rotor was not jacked up, and no effective oil film was established between the auxiliary thrust bush and the thrust plate, which caused boundary friction and dry friction. The root cause was incorrect design input by the supplier of the main pump led to excessive load imposed on the	OP.1 - Understand Sciences, Engineering Principles and Plant Design

		auxiliary thrust bearing bush before the start of the main pump. A contributor was that the main pump supplier and the power plant operator did not have sufficient understanding on the optimum working conditions during main pump start-up.	
WER TYO 16-0174	During normal operation and while isolating a start-up transformer (SUT), a human error resulted in tripping of a primary coolant pump and initiation of reactor setback. Primary heat transport (PHT) pressure increased and reactor scrammed automatically on high PHT pressure followed by turbine generator trip. This resulted in loss of offsite power due to unavailability of both SUT and unit transformer. The event is Noteworthy because it resulted in reactor scram and complete loss of offsite power.	The cause was human error as the operators racked out wrong bus potential transformer (PT) without confirming equipment nomenclature painting on the PT cubicle cover. The other cause was that order to operate procedure was not used. The root cause was non adherence to the use of human error prevention tools.	OP.1 - Control Precisely
WER TYO 15-0046	During the first day of an outage and while performing shutdown cooling pipeline (SCCP) warm up, the reactor water drained to the radwaste tank via the SCCP open valve and the reactor level dropped. This resulted in actuation of reactor protection signals and the residual heat removal system isolation. This event is classified as Noteworthy due to failing to maintain reactor level caused by unnoticed flow path.	The direct cause was insufficient pipe venting causing air binding. An emergent maintenance inspection closed the SCCP valve momentarily, resulting in air binding in the system.	OP.1 - Control Precisely
WER TYO 15-0038	During an outage, a temporary loss of power to a reactor protection system (RPS) train occurred while another train was off for maintenance, resulting in actuation of the primary containment isolation system (PCIS) and the reactor protection system. This event is classified noteworthy because the residual	The cause was misinterpretation of RPS bus power supplied by an alternative source. The task was not adequately reviewed and researched.	OP.1 - Understand Sciences, Engineering Principles and Plant Design

	heat removal operation mode was suspended due to the PCIS actuation, causing loss of shutdown cooling and the primary coolant temperature increase.		
WER PAR 15-0617	After checking emergency diesel generator (EDG) operability tests conducted during a previous outage, it was noticed that an instrument air compressor did not disconnect from a safety busbar before the diesel was coupled as designed while safety injection signal and undervoltage at the safety busbar were coincident. This resulted in EDG functional failure. This event is classified as Noteworthy because it was not possible to guarantee the operability of one EDG train in both plants due to the failure to disconnect the air compressor from the safety busbar (the air compressor is connected to one bar only therefore the other bar would have been operable).	The direct cause was inadequate coordination between the activation times of the relays which coupled the diesel generators to the safeguards busbars, and the undervoltage relays of the power units that initiated load disconnections. The test results from 9 and 12 August were incorrectly analysed.	OP.2 - Control Room Activities
WER ATL 17-0081	During a refuelling outage with fuel in the core and both trains of decay heat removal system in operation, a 0.125 gallon per minute un-isolable leak was identified in the decay heat system due to a cracked weld on a one inch common drain pipe. The event is Noteworthy because it resulted in inoperability of both trains of the decay heat removal system.	The direct cause was fatigue cracking of the socket weld due to vibration. The other causes were inadequate design of the drain pipe and insufficient corrective actions for previous socket weld cracks. The contributing causes include inadequate operating procedure and inadequate operators training regarding precaution to limit decay heat system flow.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
WER PAR 17-0300	During an outage, drained water exited a cut pipe and reached the cabinets housing the supply breakers of a service bus. This caused thick smoke which actuated the fire detection system. A short circuit occurred in the service bus, resulting in opening of the supply breakers	The direct cause was a short circuit in the service bus due to leaking water from a pipe cut two days earlier to repair a leak in a low pressure heater. The root cause was risk assessment was not adequate because no repairs was required when initial identification of water coming	OP.1 - Conservative Bias

	of the start-up auxiliary transformers. As a consequence, a loss of the offsite power occurred and a diesel generator started. The emergency plan was entered. The event is Noteworthy because fire initiated by water intrusion caused complete loss of offsite power.	out from system. The other causes were deficiencies in planning, tag outs and work practice.	
WER PAR 15-0247	During normal operation, the pressure at the discharge of the operating charging pump decreased progressively. The charging pump was declared inoperable and, since another charging pump had been inoperable for more than a year, the reactor was shut down in accordance to technical specifications. This event is classified as Noteworthy because it resulted in a 25-day reactor shutdown for repair and redundancy of safety injection was degraded.	The direct cause was a crack in the shaft area between the last stage impeller and the balance drum whilst due to high cycle stress fatigue. The root causes were failure to use operating experience; failure in operating the pump within its design limits; failure to keep the purchasing technical specifications updated and lack of acceptance criteria for the internals of the pump.	OP.1 - Control Precisely
WER ATL 16-0013	During normal operation with a quarterly containment leak rate test (QLRT) in progress, a heat transport system (HTS) pressure gradually dropped due to a faulty check valve. The HTS pressuriser heaters failed to start up automatically and the pressure continued to drop below the 8.95 MPa limit, resulting in dual impairment of both shutdown systems. This event is classified Noteworthy because both shutdown systems SDS1 and SDS2 were impaired for approximately 16 hours.	Known problems were not corrected in a timely way. Similar occurrences of the check valve opening had occurred in the past. The procedure for the QLRT did not contain all necessary actions to avoid the risk of both shutdown system impairment.	OP.2 - Administrative Controls

WER PAR 15-0690	During a refuelling outage, spent fuel pool (SFP) cooling was interrupted for 16 minutes during switchover from one train of the component cooling system/essential service water system to the other train. The event is classified as Noteworthy because of a complete loss of the SFP cooling.	The direct cause was a computer-based lockout/tag out system planning sheet failed to request re-opening the standardised isolation valves for lockout removal of the train. Inadequate procedures were a contributor.	OP.1 - Conservative Bias
WER PAR 15-0765	During an outage and while performing a surveillance test, the turbine generator set (TGS) for a safety injection (SI) pump was deemed to be available without monitoring of load shed indication light. The TGS was confirmed to be unavailable after 106 days. This event caused unavailability of the SI pump for 48 days when the TGS of the other unit was out of service for maintenance. This event is classified as Noteworthy due to unavailability of the TGS and the SI pump for long period and the SI pump could not fulfil the reactor coolant pump seal injection function in case of station blackout.	The cause of the load shed malfunction was a relay fault. The cause of the late detection of the problem was the indication light was not visible locally and assessment on availability of the TGS was done without I&C expertise. Out of date documentation was used to study the availability of the TGS.	OP.1 - Conservative Bias
WER ATL 16-1189	During cold shutdown, an inadvertent trip of residual heat removal (RHR) pump B occurred, causing a loss of shutdown cooling (SDC) for 22 minutes. As a result, reactor coolant temperature increased by 18°F indicated on reactor recirculation system loop A. This event is Noteworthy due to a loss of residual heat removal.	The root cause was a design vulnerability and subsequent operation of the SDC system resulted in a trip of two SDC suction valves due to sub-cooling and flashing in the RHR or reactor recirculation system. Contributing cause was incomplete procedure guidance with respect to potential impacts of operating SDC.	OP.1 - Understand Sciences, Engineering Principles and Plant Design
WER ATL 17-1080	During normal operation, two residual heat removal (RHR) pumps minimum flow isolation valves were found sealed closed since last four months. This resulted in declaring two RHR pumps inoperable and entry into three limiting conditions of	The direct cause was human error. The root cause was inadequate operations department standards related to human performance and configuration control.	OP.2 - Control Room Activities

	operation. During this period, division 2 RHR had also been inoperable on various occasions. The event is Noteworthy because of loss of a safety function during the period when both divisions of RHR were inoperable.		
WER ATL 17-0319	During normal operation, water intruded into the main generator automatic voltage regulator (AVR) cabinet due to a stuck open roof vent during a heavy rainstorm. This resulted in a main generator lockout, main turbine trip and automatic reactor scram. Following the reactor scram, the auxiliary feed water system actuated on high steam generator level. This event is Noteworthy because of water intrusion in critical components that required an unplanned shutdown for 10 days.	The root causes was that the station management failed to recognise the corrective action programme of roof vent rain issue as a potential imminent risk to generation and operations did not advocate adequate and timely compensatory actions. A contributor was that the cabinet of the AVR was replaced in 2014 and was vulnerable to water intrusion.	OP.1 - Conservative Bias
WER PAR 16-0867	During normal operation while lowering the spent fuel pool (SFP) water level for maintenance, a fluctuation of the cooling flow was observed when the level reached the running cooling pump suction line. As a result, the transfer and cooling pump was stopped. This event is Noteworthy because the SFP cooling lost for about four and half hours with a water temperature rise from 23.5°C to 26°C.	The root cause was that a required minimum level for the SFP with spent fuel inside was not mentioned in the technical specification. The contributing cause was inadequate work planning and insufficient training on the design deference.	OP.2 - Administrative Controls
WER PAR 17-0424	During normal operation, increase in vibration was detected on a main boiler feed pump. The reactor was shut down to inspect and repair the pump. The event is Noteworthy because it resulted in a 37-day outage.	The direct cause was failure of the third stage impeller due to prolonged operation within speed bands that produce large oscillations/vibrations. The root cause was ineffective operating experience and corrective action programme. The contributory cause was inadequate operating procedure which did not include	OP.2 - Administrative Controls

		cautionary information relating to operation of the pump within high risk speed band.	
WER ATL 17-1167	During normal operation, power was reduced to 75% to respond to lowering of the condensate storage tank (CST) level. Subsequently, the reactor was manually scrammed due to a leak in condensate with lowering CST. The reactor core isolation cooling (RCIC) system was aligned to take suction from the suppression pool instead of the normal suction source to prevent the control rod drive pumps from tripping on the low suction pressure condition. It resulted in 12 days outage. This event is Noteworthy because leadership and team effectiveness shortfalls resulted in use of RCIC and 19 hours of operations in the containment control emergency procedure.	The direct cause of the CST pipe leak was a failed turbine controls circuit card that resulted in the cycling of the water injection valves, causing the loosening of the flange bolts on a restricting orifice. Operations did not identify the CST leakage in a timely manner due to inadequate troubleshooting and insufficient operation decision making interventions.	OP.1 - Monitor Closely
WER TYO 15-0016	During normal operation, a small leakage was identified on a steam generator (SG) tube. While reducing reactor power for repairs, the reactor automatically scrammed on the departure from nuclear boiling ratio (DNBR) low signal at 14.2% power. This event is noteworthy because of delayed identification and isolation of the leaking SG because all N-16 monitors were not working properly and the SG blowdown radiation monitor sampling line was clogged. It took operators 22 hours to identify the leaking SG. The N-16 measurements had not been fully operational for many years because of miscalibration.	The direct cause of the SG tube leak was due to a foreign material. Delayed identification of the leaking SG tube and miscalibration of N-16 monitors (procedure error) and clogged SG blowdown radiation monitor sample line (lack of preventive maintenance). The cause of the reactor scram was exceeding the qualified axial shape index limit.	OP.1 - Monitor Closely
WER PAR 17-0583	During an outage and while performing turbine deluge testing, a pressure surge occurred on the fixed jet fire	The direct cause of the pressure surge was water hammer as a result of significant volume of air accumulated in the FJFS Main.	OP.1 - Understand Sciences, Engineering

	system (FJFS) which resulted in a significant flange leak from a common section of FJFS pipework. The isolation of the leak resulted in the unavailability of all 5 FJFS pumps and entry into a four-hour shutdown limiting condition of operations on all units. As a consequence, the other unit in operation was manually shut down. A large influx of water entered the turbine hall basement and wetted a number of electrical components. The event is Noteworthy due to total loss of the FJFS and the total loss of generation of over 0.5TWh from the two units.	The root cause was failure to spot two separate defects that caused accumulation of air in the system. The contributing causes were the lack of understanding of the system operation, inadequate preparation and the build-up of debris in the pipeline.	Principles and Plant Design
WER ATL 15-0763	During normal operation, the charging pump suction header became voided when one of the discharge dampener ruptured, resulting in a total loss of charging flow and gas binding of all charging pumps. The loss of all three pumps challenged reactor coolant system inventory and pressure control, resulting in entry into shutdown limiting condition of operation. This event is classified as Noteworthy because of gas binding in all three charging pumps and resulted in a pressuriser level and pressure transient requiring a power reduction by 20%.	The cause was a galled poppet stem due to wear, which allowed the bladder to become pinched and torn. Less than adequate mitigation strategy to recover from a gas binding of all charging pumps was a contributor. There was no preventive maintenance in place to replace the poppet and plug assemblies.	OP.1 - Conservative Bias
WER ATL 17-0034	During normal operation, a standby generator (SG) tripped during a test and became unavailable while another SG was also unavailable due to planned maintenance. While these two SGs were unavailable, the remaining SG was connected to the class III electrical bus which resulted in its unavailability to respond to a total loss of the electrical power. This event is noteworthy due to	The direct cause was not identified. The apparent cause was that the test procedure did not adequately address the safe state for the remaining SDGs when one of the SGs is not available.	OP.2 - Administrative Controls

	the complete unavailability of the standby emergency power generating system for two units.		
WER TYO 16-0466	During normal operation and while transferring heavy water between two tanks, heavy water overflowed from a heavy water tank exhaust pipe and entered to the heavy water vapour recovery dryers. As a result, unexpected tritium level occurred in the multiple rooms and the highest tritium level was above 40 DAC. Consequentially, a total of 3.06 TBq tritium was released into the environment. This event was noteworthy due to substantial amount of unplanned tritium release to environment and unexpected dose exposure to event recovery team.	The direct cause was the defective level switch on the level measurement control loop of heavy water tank. The root cause was lack of heavy water transfer risk controls in the heavy water management procedures.	OP.1 - Conservative Bias
WER PAR 15-0555	During normal operation, a reactor building containment isolation valve of the ventilation system failed closed. The shift team took insufficient action to have the valve repaired within the action time defined in the technical specifications (TS). The shift team decided to block the valve open in order to ensure cooling of the reactor until the valve was repaired. This did not comply with the TS as the containment safety function was no longer guaranteed. This event is classified as Noteworthy because of the non-conservative decision-making.	The valve closed because of a failure of a remote control board. The direct cause for the TS violation was improper interpretation of the TS during the night shift. The root cause was several weaknesses in nuclear safety culture (lack of questioning attitude, improper decision making).	OP.1 - Understand Sciences, Engineering Principles and Plant Design
WER TYO 16-0321	During normal operation and while performing a periodic test of the shutdown system (SDS), the reactor automatically scrammed because a liquid (gadolinium) was unexpectedly injected into the neutron	The direct cause was an internal leak of one SDS quick opening valve (QOV) and the unexpected opening of another SDS QOV on the same injection line. The apparent cause of the leaking QOV was that improper	OP.1 - Control Precisely

	moderator system. This event is Noteworthy due to an unplanned outage of 21 days.	maintenance and operation on the valve caused inadequate sealing and disk damage. Maintenance prior to the test failed to address the leak. The apparent cause of the unexpected opening of another QOV was insufficient tightness of the opening prevention measure due to inadequate part selection review process.	

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