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Regulatory Oversight Report for Canadian Nuclear Power Generating Sites in Canada: 2021

Rapport de surveillance réglementaire des sites de centrales nucléaires au Canada : 2021

Commission Meeting

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Canada

Comments on

Regulatory Oversight Report
for Canadian Nuclear Power Generating Sites for 2021

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Executive Summary

The Canadian Nuclear Safety Commission (CNSC) agreed to my participation in the CNSC's proceedings and review of the Regulatory Oversight Report for Canadian Nuclear Power Generating Sites for 2021. My review provides comments on the Report through the lens of my professional background and experience. I wish to thank the CNSC for the opportunity to conduct this review and to share my observations and findings.

My review involved all the Detailed Event Reports for the year 2021 for all operating nuclear power plants in Canada: Bruce NGS, Darlington NGS and Point Lepreau NGS. The review focused on the Operating Performance safety control areas, and made recommendations in specific areas, including Fitness for Service and Operating Performance areas.

In the Operating Performance area, my review focussed on the Safe Operating Envelope (SOE) within which operation of the nuclear facility must meet the regulatory requirements and public risk limits. The review of Darlington NGS Event Reports for the year 2021 found that, between September and December 2021, an adverse trend has emerged revealing programmatic license non-compliance with requirements related to maintaining a SOE for the station. A recommendation is made to exhort Darlington NGS to conduct a rigorous review, system by system, of all safety analysis-based limits imposed on safety systems and address SOE program weaknesses on a high priority basis

In the Fitness for Service area, the review of the Bruce A &B Event Reports of the year 2021 identified apparent less-than-adequate performance in the management of the Preventive Maintenance (PM) program. Deficiencies were found in retention of nuclear records, missing PM tests, test deferrals not processed appropriately, and failure to provide the appropriate notification to the CNSC.

Lack of guidance for certain processes, gaps in oversight of workers engaged in the PM process and inadequate instructions to support regulatory commitments were identified among the causes of the weaknesses in the Bruce PM program.

A recommendation is made that CNSC launch a focussed inspection of the Preventive Maintenance program at Bruce NGS with emphasis on the organizational weaknesses associated with the general state of the program.

Adverse Trend in Implementing Safe Operating Envelope (SOE)

My review of Darlington NGS Event Reports for the year 2021 found that, between September and December 2021, an adverse trend has emerged revealing programmatic license non-compliance with requirements related to maintain a Safe Operating Envelope (SOE) for the station.

What is Safe Operating Envelope (SOE)?

The Safe Operating Envelope refers to those safety analyses limits or operational requirements for parameters or system conditions within which operation of the nuclear facility has been shown to meet the regulatory requirements and public risk limits, and which can be directly observed and/or controlled by the operator.

The safety limits are used to define the hardware functional requirements and limiting system parameter values in the hardware subsystems. They are also used to ensure there is sufficient margin to the nominal actuation setpoints to account for instrument error and uncertainty.

Requirements imposed by the safety limits on Nuclear Power Plant (NPP) systems must be routinely verified throughout the life of the plant. Verification that the requirements are met is usually demonstrated by hardware surveillance requirements.

How is the SOE Aligned with the Safety Analysis results?

When a new safety analysis is completed or an existing safety analysis is update, the impact of the change in the analysis on the affected systems is identified and all the relevant documents (such as the plant training and operational documents) must be updated based on the results of the new or updated analysis, to reflect the newly imposed limits or requirements. NPPs use certain processes to ensure the SOE is aligned all the time with safety analysis results. Among these processes is the Engineering Change Control (ECC).

Documenting the SOE, involves transposing the derived limits from the safety analysis to several of documents. This process must be done routinely and in a timely manner without delay. This represents a challenge to maintaining the validity of the SOE, as it requires update of several documents, each time a safety limit is revised in the safety analysis.

To address this challenge, NPPs usually consolidate all requirements and limits derived from the safety analysis in one controlled document called Operational Safety Requirement (OSR). CSA standard, section A.4.8.4.2 (b) describes one of the SOE implementation objectives: “Safe *operating limits, conditions of operability, actions and action times should be consolidated for each system in the applicable impairment manual or equivalent (e.g., operating manuals*) “.

Risks of Operation Outside the SOE

Safety systems, for example, are required to automatically initiate reactor shutdown before the safety limit associated with any trip parameter is exceeded. If these limits are not aligned with the limits determined by the safety analysis, shutdown systems may not have sufficient negative reactivity depth inserted within the required timing as assumed in the safety analysis. If this deficiency is discovered, the safety system is declared unavailable, otherwise the deficiency may remain in the safety system as a "dormant failure"

NPPs, throughout their operational life, must have undergone many engineering changes, several updates to their safety analyses and lately plant upgrades as part of the refurbishment and upgrade projects. The accumulation over the years of plant changes, if combined with less-than-adequate processes to implement the impact of the changes, may have resulted in a situation where the SOE is not aligned with the safety analysis results. In this case, its likely that some of the safety systems may not be effective in performing there intended function when called upon.

The SOE is considered part of the licensing basis. Changes that may reduce safety margins require Commission approval prior to implementation. In addition, any changes to the safety and control measures listed in the SOE documentation require prior written notification, subject to operating license conditions.

The Adverse Trend Identified at Darlington in 2021

An adverse trend has been identified at Darlington, between September and December 2021, where changes (and lack of changes) have been made to operational documentation that have not been aligned with the implementation and maintenance of SOE documentation. This adverse trend constituted a programmatic license non-compliance and contributed to issues with SOE compliance required as part of the station's Power Reactor Operating Licence.

A review of events, which contribute to the adverse trend, identified legacy discrepancies between the OSRs and operational documents (i.e.: Abnormal Incident Manuals, AIMs), and some examples involved the lack of prior engagement and notifications to CNSC staff in accordance with regulatory requirements.

CNSC Staff Inspection Findings Related to SOE at Darlington

The extent of the adverse trend has been examined also by the CNS staff who pointed to several weaknesses in the Darlington SOE program. Darlington Event Report D-2021-19117, for example, alluded to three CNSC inspection findings related to the SOE.

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In a “Type II” CNSC staff provided three (3) Notices of Non-Compliance. One of the notices documented issues with the reporting of changes to SOE documentation to CNSC staff prior to implementation.

In a “Field Inspection” CNSC staff concluded that the issues observed were systemic in nature, indicating a programmatic failure of the SOE program to ensure compliance with the requirements of CSA N290.15 “Requirements for the safe operating envelope of nuclear power plants” and the requirements for licensing basis changes specified in the Licence Conditions Handbook (LCH) for Darlington.

In a “Baseline Inspection” it was found that a non-conservative change of a Safe Operating Limit for the Negative Pressure Containment System, had resulted in operation outside of the licensing basis. Safety Margins were reduced and CNSC staff were not notified of the changes to SOE documentation

Causes of the Adverse Trend at Darlington

Darlington Event Report D-2021-19117 highlights the causes of the adverse trend; among them:

- Lack of clarity and sufficient direction in the governance documents on the type of actions that need to be taken for the maintenance of SOE.
- A contributing cause is some legacy gaps in the implementation of the Darlington SOE program.

Safe Operating Envelope at Bruce A and B

Issues of maintaining the SOE do not appear to be limited to Darlington NGS. CMD 22-M34 Section 3.5.3 “Operating Performance” at Bruce page 99 indicates that CNSC staff performed a SOE inspection of BNGS A and B containment parameters. CNSC staff determined that SOE limits were compliant with SOE limits and conditions. However, the inspection identified that the uncertainties are not adequately considered and incorporated; delays in the production or update of SOE documentation were also observed.

Conclusion

The Safe Operating Envelope (SOE) represents the safety analysis limits or operational requirements for system conditions within which operation of the nuclear facility must meet the regulatory requirements and public risk limits. If any safety system was found, through routine testing or fortuitus reasons, to operate outside the SOE, the safety system is declared unavailable, otherwise the deficiency may remain in the safety system as a “dormant failure”. Maintenance of the SOE, therefore, should be taken seriously and should be assigned the highest priority in scheduling regulatory inspection.

It is suggested that CNSC exhort Darlington NGS to conduct a rigorous review, system by system, of all safety analysis-based limits imposed on safety systems and address SOE program weaknesses on a high priority basis.

Organizational Weaknesses of the Preventive Maintenance Program at Bruce NGS

A review of the Bruce A &B Event Reports of the year 2021 identified apparent less-than-adequate performance in the management of the Preventative Maintenance (PM) program. The following Event Reports highlights the findings related to the PM process.

Event Report B-2021-93701 “Pressure Relief Device Test and Repair Reports Filing Non-Conformance”, revealed that in a 3.5 year period between January 2018 and July 2021, Pressure Relief Valve (PRV) test and repair reports were not filed as Nuclear Records. Hundreds of records could not be located.

In Event Report B-2021-69550 “Fire Protection Preventive Maintenance Missed” it was discovered that the annual test for certain fire panels have not been conducted since commissioning in June 2018. As such, the annual tests for 2019 and 2020 were missed, resulting in potential for an undetected impairment of fire protection systems.

Event Report B-2021-66138 “Safety System Test Not Deferred” indicates that due to delays in administratively identifying Safety System Tests (SST) as a partial completion, a deferral of the portion of the SST was not processed in accordance with approved procedures.

In Event Report B-2021-58453 “Relief Valve Testing Not Completed” during review of a scheduled Relief Valve (RV) work, it was discovered that the RV had passed its five-year mandatory due date.

In Event Report B-2021-40701 “Heat Transport Header Pressure Transmitter Calibration Missed” it was found that in 2016 and in 2018 the PM Work Orders (WOs) were signed off incorrectly as the calibration could not be completed due to a passing upstream isolation valve. As a result, WO occurrences in 2016 and 2018 were credited in error without calibrating the transmitter itself.

Event Report B-2021-104153 “Emergency Filtered Air Discharge System Charcoal not Replaced within Committed Timeline” reported that the PM for the EFADS Charcoal Filter Replacement was deferred previously without providing prior notification to the CNSC.

Causes of the Weaknesses in the PM Program

- Insufficient priority assigned to the requirement for submitting completed Test and Repair Reports for proper retention as Nuclear Records at the Line Management level.
- A lack of oversight of PRV Report submission and tracking.
- No verification process to ensure PRV Reports are submitted for retention as Nuclear Records.

- Apparent lack of qualified individuals to be responsible for the review, assessment, and submission of PRV Test and Repair Reports
- No interim oversight of regulatory Licensing and Mandatory PM requirements in-place for certain projects.
- Guidance for certain processes does not prompt consideration of readiness to execute PMs when issuing final approvals.
- Less than adequate PM Program integration with other processes.
- Gaps in Oversight and ownership/proficiency of workers engaged in the PM Process.
- Gaps in monitoring practices of some key stakeholders.
- Guidance for review of PM deferral requests with regulatory impacts is insufficient.
- The governance, including related procedure that provides direction to PM strategy owners for their review of PM deferral requests does not include adequate instruction to support determination of regulatory Commitments.

Impact of the PM Weaknesses on Safety

- Potential for an undetected impairment of safety systems
- Delays in administratively identifying partial completion with the deferral of portion of test not processed, leads to increased predicted future unavailability of systems.
- Inability to recognize or address regulatory commitments when determining timelines for the execution of the PMs.
- Difficulty identifying PMs with regulatory significance resulted in the CNSC commitment being inadvertently missed.

Conclusion

A review of the Bruce A &B Event Reports of the year 2021 identified apparent less-than-adequate performance in the management of the Preventative Maintenance (PM) program. Deficiencies were found in retention of nuclear records, missing Preventive Maintenance (PM) tests, test deferrals not processed appropriately, and failure to provide the appropriate notification to the CNSC.

Lack of guidance for certain processes, gaps in oversight of workers engaged in the PM process and inadequate instructions to support regulatory commitments were identified among the causes of the weaknesses in the Bruce PM program.

It is recommended that CNSC launch a focussed inspection of the Preventive Maintenance program at Bruce NGS with emphasis on the organizational weaknesses associated with the general state of the program.