



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
WASHINGTON, DC 20555 - 0001**

October 05, 2020

Ms. Margaret M. Doane  
Executive Director for Operations  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

**SUBJECT:** SAFETY EVALUATION FOR TOPICAL REPORT NEDC-33910P,  
"BWRX-300 REACTOR PRESSURE VESSEL (RPV) ISOLATION AND  
OVERPRESSURE PROTECTION"

Dear Ms. Doane

During the 678<sup>th</sup> meeting of the Advisory Committee on Reactor Safeguards, September 9-11, 2020, we completed our review of topical report NEDC-33910P, "BWRX-300 Reactor Pressure Vessel (RPV) Isolation and Overpressure Protection," and the associated safety evaluation (SE). Our Accident Analyses Thermal-Hydraulic Subcommittee also reviewed this SE on July 20, 2020. We met with the staff and representatives from the applicant. We also had the benefit of the referenced documents.

**CONCLUSIONS AND RECOMMENDATIONS**

1. The design requirements for RPV isolation and overpressure protection and the proposed loss-of-coolant accident (LOCA) acceptance criteria documented in NEDC-33910P are consistent with applicable regulatory requirements.
2. The safety evaluation should be issued.

**BACKGROUND**

BWRX-300 is an evolutionary light water reactor based on the certified Economically Simplified Boiling Water Reactor (ESBWR) design. Rated at 300 MWe, it is a natural-circulation small modular reactor (SMR). It is being developed by GE Hitachi Nuclear Energy (GEH) in the United States and Hitachi-GE Nuclear Energy Ltd. (HGNE) in Japan. The Applicant has employed risk-informed design principles with the goal of reducing overall plant size and minimizing the highest risk contributors from the ESBWR design. The major improvements to achieve these goals are: reduction in the number and size of RPV nozzles to minimize the potential of LOCA events; addition of safety features to minimize the consequences of LOCAs; simplification of safety-significant structures, systems, and components; prioritization of the use of proven components and the supply chain; and simplification of plant construction.

## **DISCUSSION**

Topical report NEDC-33910P provides the design requirements, acceptance criteria, and regulatory basis for the BWRX-300 RPV isolation and overpressure protection design functions. It includes design requirements for: automatic actuation of the RPV isolation valves; automatic actuation of the passive Isolation Condenser System (ICS); and the overpressure protection provided by the Reactor Protection System (RPS) and ICS actuation.

BWRX-300 uses inherent margins and other design features, such as automatic actuation of the ICS, to passively mitigate system challenges (e.g. LOCAs) and increase safety. The large RPV volume of the BWRX-300 relative to its operating power, enhanced by the relatively tall chimney region, provides a substantial reservoir of water above the core. This increases the likelihood that the core remains covered and cooled following transients involving feedwater flow interruptions or LOCAs. The large RPV volume also reduces the pressurization rate for overheating events, such as: sudden reactor isolation at power operating conditions; station blackout; anticipated transient without scram; and LOCAs. Overpressure protection for BWRX-300 will be evaluated in accordance with ASME Boiler Pressure Vessel Code, Section III, when an application is submitted. Instrumentation to monitor conditions within the RPV will be incorporated to cover the full range of reactor power operation. The licensing review will need to incorporate detailed transient and thermal-mechanical analyses of these novel features that were not included in previous BWR designs.

The topical report specifies conservative LOCA acceptance criteria needed to demonstrate compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.46(b). Two criteria are proposed: (1) the reactor water level is maintained above the top of active fuel, or (2) the fuel cladding remains within the normal-operating temperature range at full-power and pressure conditions. The staff has evaluated these criteria and finds them acceptable.

The topical report also specifies design requirements for RPV isolation functions. These include: applicable ASME Boiler and Pressure Vessel Code sections for each component; valve types, configuration, reliability, and failure modes; actuators and actuation signals; and required closing time. The main acceptance criteria ensure that the peak pressure does not exceed 110% of the design pressure during upset conditions and sufficient coolant inventory is maintained in the RPV to ensure adequate core cooling. The staff has evaluated these requirements and criteria and finds them acceptable.

Overpressure protection is achieved by the RPS and ICS. The ICS trains are redundant, diversely actuated, and have a large heat removal capacity relative to the expected decay heat levels. The RPV design pressure has been increased to provide additional margin for Over-Pressure transients. The staff has evaluated these requirements and finds them acceptable.

The staff has evaluated the topical report for compliance with the requirements of 10 CFR Part 50, Appendix A, General Design Criteria (GDC) numbers 1, 2, 4, 14, 30, 31, 33, 35, and 37. The staff concludes that these GDCs are relevant to overpressure and isolation functions, and the design requirements proposed in the topical report, when implemented, will satisfy them.

## **SUMMARY**

The design requirements for RPV isolation and overpressure protection and the proposed LOCA acceptance criteria documented in NEDC-33910P are consistent with applicable regulatory requirements. The safety evaluation should be issued.

We are not requesting a formal response from the staff to this letter report.

Sincerely,

Matthew W. Sunseri  
Chairman

## **REFERENCES**

1. U. S. Nuclear Regulatory Commission (NRC), "Safety Evaluation For GE-Hitachi Nuclear Americas, LLC, Licensing Topical Report, NEDC-33910P, Supplement 2, 'BWRX-300 Reactor Pressure Vessel Isolation and Overpressure Protection'," Revision 0, June 26, 2020 (ADAMS Accession No. ML20176A450 (Proprietary), ML20176A449 (Non-proprietary)).
2. GE-Hitachi Nuclear Americas, LLC, Licensing Topical Report, NEDC-33910P, "BWRX-300 Reactor Pressure Vessel Isolation and Overpressure Protection," Revision 0, Supplement 2, June 30, 2020 (ADAMS Accession No. ML20174A576 (Proprietary), ML20174A577, (Non-proprietary)).
3. U.S. Nuclear Regulatory Commission, Title 10 of the *Code of Federal Regulations (CFR)*, Part 50 (10 CFR Part 50), "Domestic Licensing of Production and Utilization Facilities," 10 CFR 50.34(f); 10 CFR 50.46; and 10 CFR 50.55a.
4. U.S. Nuclear Regulatory Commission, Title 10 of the *Code of Federal Regulations (CFR)*, Part 50 (10 CFR Part 50), "Domestic Licensing of Production and Utilization Facilities," Appendix A, General Design Criteria for Nuclear Power Plants.

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Accession No: **ML20268B242**

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