



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

April 21, 2022

Mr. Daniel H. Dorman
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: SAFETY EVALUATION FOR TOPICAL REPORT NEDO-33914, REVISION 1,
"BWRX-300 ADVANCED CIVIL CONSTRUCTION AND DESIGN APPROACH"

Dear Mr. Dorman:

During the 694th meeting of the Advisory Committee on Reactor Safeguards (ACRS), April 6-8, 2022, we completed our review of topical report NEDO-33914, Revision 1, "BWRX-300 Advanced Civil Construction and Design Approach," and the associated safety evaluation (SE). Our BWRX-300 Design-Centered Subcommittee reviewed this matter on March 18, 2022. We have had the benefit of discussions with representatives of the NRC staff and GE-Hitachi Nuclear Energy Americas, LLC (GEH or the applicant). We also benefited from the referenced documents.

CONCLUSION AND RECOMMENDATION

1. The proposed civil construction and design guidelines documented in NEDO-33914, Revision 1, subject to the staff-imposed limitations and conditions, are appropriate to support the safe design of the BWRX-300, including its below-grade reactor building.
2. The SE report should be issued.

BACKGROUND

BWRX-300 is an evolutionary light water reactor based on the certified Economically Simplified Boiling Water Reactor (ESBWR) design and on the operating experience of the boiling water reactor fleet. Rated at 300 MW-electric, it is a natural-circulation small modular reactor being developed by GEH. 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.

Topical report NEDO-33914, Revision 1, provides design, analysis, and monitoring guidelines and requirements for the BWRX-300 construction, including the below grade reactor building, which is the main seismically qualified building in the design. The report provides requirements and recommendations for site investigation and subsurface materials lab testing programs as well as seismic analyses methodologies.

DISCUSSION

The BWRX-300 design is not yet complete, but the concept is novel in that the reactor building is placed in a vertical right-cylinder shaft and located below-grade to mitigate effects of possible external events, including aircraft crashes, adverse weather, flooding, fires, and earthquakes. This poses unique considerations to the structural analysis. The staff review is based on guidance in the NUREG-0800 (Standard Review Plan), supplemented by guidance in NUREG/CR-7193.

The staff review of the proposed methodology is thorough and provides confidence that all regulatory requirements are satisfied. The staff identified several items that will be reviewed once an application is submitted with site-specific soils, configuration, and seismic characteristics. These pending items are covered under the limitations and conditions section of the SE report.

The scope of the staff review includes, among others, the following topics: applicable regulatory basis; guidelines and requirements for characterizing subsurface conditions; requirements and guidelines for performing foundation interface analysis; acceptance criteria and guidelines for the analysis and design of the deeply embedded reactor building, including ensuring the stability of the reactor shaft; approach for addressing the interactions between the Seismic Category I reactor building with surrounding structures and foundations; and the generic seismic and geotechnical design parameters that ensure applicability at the majority of potential North American sites.

The staff review focused on the following: the appropriateness of the proposed approach; similar experience in previous applications; limitations of the approach; soundness of the testing methods used to derive needed parameters; and inherent assumptions that need verification. Based on their review, the staff concluded that the proposed BWRX-300 construction and design approaches, as described in NEDO-33914, Revision 1, are acceptable. We concur.

The staff has imposed five limitations and conditions. They ensure that once a site is selected, the soil characteristics are adequate. They also address novel methodology applications that are not yet fully developed. In particular, the staff SE requires:

1. Testing of large-size samples collected to ensure that the measured fracture and interface strength and deformation parameters are acceptable.
2. Ensuring that the shaft excavation is stable and has no unstable blocks in its surrounding that may slide and impinge on the reactor building.
3. Ensuring that the proposed site has rock mass with isotropic and homogeneous properties that are consistent with the analysis assumptions.
4. Auditing the new approach proposed by GEH to define "Hazard Consistent Strain-Compatible Properties", once fully developed, because it will be the first ever application to a nuclear reactor project.
5. Reviewing, on site-specific applications, the use of nonlinear sensitivity soil-structure-interaction analyses.

The staff limitations and conditions are adequate to ensure that site-specific applications of the proposed methodology satisfy all regulatory requirements.

SUMMARY

The proposed civil construction and design guidelines documented in NEDO-33914, Revision 1, subject to the staff-imposed limitations and conditions, are appropriate to support the safe design of the BWRX-300, including its below-grade reactor building. The SE report should be issued.

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

Sincerely,



Signed by Rempe, Joy
on 04/21/22

Joy L. Rempe
Chairman

REFERENCES

1. GE-Hitachi Nuclear Energy, NEDO-33914, Revision 0, "BWRX-300 Advanced Civil Construction and Design Approach," January 2021 (ML21020A137).
2. GE-Hitachi Nuclear Energy, NEDO-33914, Revision 1, "BWRX-300 Advanced Civil Construction and Design Approach," November 2021 (ML21322A214).
3. United States Nuclear Regulatory Commission, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," March 2007 (ML070730593, ML070640306, ML070640311).
4. United States Nuclear Regulatory Commission, NUREG/CR-7193, "Evaluations of NRC Seismic-Structural Regulations and Regulatory Guidance, and Simulation-Evaluation Tools for Applicability to Small Modular Reactors," March 2015 (ML15083A178).

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