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

November 10, 2020

The Honorable Kristine L. Svinicki
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: SUMMARY REPORT – 678th MEETING OF THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS, SEPTEMBER 9-11, 2020

Dear Chairman Svinicki:

During its 678th meeting, September 9-11, 2020, that was conducted virtually due to the COVID-19 pandemic, the Advisory Committee on Reactor Safeguards (ACRS) discussed several matters. The ACRS completed the following correspondence:

LETTER REPORT

Letter report to Kristine L. Svinicki, Chairman, U.S. Nuclear Regulatory Commission (NRC), from Matthew W. Sunseri, Chairman, ACRS:

- Observations and Lessons-Learned from ACRS Licensing Reviews Relevant to Future Advanced Reactor Applications, dated October 2, 2020, Agencywide Documents Access and Management System (ADAMS) Accession No. ML20267A655

- 10 CFR [Tile 10 of the *Code of Federal Regulations*] Part 53 Licensing and Regulation of Advanced Nuclear Reactors, dated October 21, 2020, ADAMS Accession No. ML20295A647

LETTERS

Letters to Margaret M. Doane, Executive Director for Operations (EDO), NRC, from Matthew W. Sunseri, Chairman, ACRS:

- Final Safety Evaluation Report for Topical Report, Framatome Topical Report ANP-10337, Revision 0, Supplement 1P, Revision 0, "Deformable Spacer Grid Element", dated October 6, 2020, ADAMS Accession No. ML20267A654

- Safety Evaluation for Topical Report NEDC-33910P, "BWRX-300 Reactor Pressure Vessel (RPV) Isolation and Overpressure Protection," dated October 5, 2020, ADAMS Accession No. ML20268B242

MEMORANDUM

Memoranda to Margaret M. Doane, EDO, NRC, from Scott W. Moore, Executive Director, ACRS:

- Documentation of Receipt of Applicable Official NRC Notices to the Advisory Committee on Reactor Safeguards for September 2020, dated October 15, 2020, ADAMS Accession No. ML20280A572

Note that there were no regulatory guides reviewed at this meeting.

HIGHLIGHTS OF KEY ISSUES

1. Observations and Lessons-Learned from ACRS Licensing Reviews Relevant to Future Advanced Reactor Applications

The Committee completed a self-assessment of the review of the NRC staff's advanced safety evaluation report (SER) with no open items for the NuScale Power, LLC (NuScale, the applicant), design certification application (DCA) and standard design approval application. This self-assessment was conducted as part of the Committee's continuing effort to become more effective and assist the agency in its transformation initiatives. The Committee considered its NuScale DCA review as supported by interactions with representatives of the NRC staff and the applicant. The Committee also reviewed its prior letter reports on the safety aspects of the NuScale small modular reactor; past reviews of design certification and early site permit applications; interactions with staff on new initiatives related to proposed non-light water reactor (LWR) advanced reactor licensing regulatory changes; and several recent reviews of topical reports for advanced reactor designs. The October 2, 2020, letter report provides observations and lessons-learned from this self-assessment for consideration during future license application reviews.

Committee Action

The Committee issued a letter on October 2, 2020, with the following conclusions and recommendations:

- A cross-cutting approach should be adopted by the staff and ACRS for conducting effective safety reviews of future applications, focused by initial chapter-by-chapter reviews that identify open items and significant cross-cutting design issues.

- To avoid significant delays late in the review process, critical topical reports should be submitted and reviewed early, particularly methodology reports that underpin the design bases and accident analyses for advanced reactors.

- Staff should ensure that the completeness of proposed new reactor designs is sufficient to demonstrate that all structures, systems, and components (SSCs) important-to-safety are appropriately identified and to support requested exemptions and waivers from the General Design Criteria.

- The time period of transient and accident analyses should be continued to the extent necessary to ensure that applicants demonstrate an effective and reliable means to place the plant in a safe, stable condition, with no ongoing degradation.

- The staff should develop guidance for the application of critical deterministic safety examinations, hazards analyses, and risk-informed methods, as well as the need for additional demonstration testing, which could include a prototype. These complementary tools would provide a more effective licensing framework for advanced reactor design applications and their review.

These items should be considered as the NRC embarks on future reviews of advanced reactor designs and in ongoing efforts related to 10 CFR Part 53 rulemaking.

2. Title 10 of the *Code of Federal Regulations* (10 CFR) Part 53 Licensing and Regulation of Advanced Nuclear Reactors

A number of issues have arisen since the Committee's reports on the staff's Non-light water reactor (LWR) Vision and Strategy Documents and Implementation Plans. Those issues surfaced during the Committee's review of lessons-learned from review of the NuScale design certification application and during our preliminary reviews of topical reports for two non-LWR designs.

Novel aspects of new technologies make the identification of hazards, initiating events, and scenarios challenging; systematic searches will be needed. A process for gaining confidence in safety calculations will also be needed that focuses on the theoretical and experimental basis for fully understanding the associated physics and chemistry of possible scenarios. The levels of design and knowledgebase completeness affect the Committee's ability to have confidence in the conservatism of assumptions in traditional transient and accident analyses as well as the calculated margins. Likewise, the lack of completeness provides a challenge for probabilistic risk assessment (PRA), which should assess the resulting uncertainties explicitly.

Incorporating the concept of 10 CFR Part 50 general design criteria (GDC) into the framework of the proposed 10 CFR Part 53 rulemaking is important. The GDC were developed and included in 10 CFR Part 50 to improve the predictability and efficiency of NRC reviews of licensing applications. The GDC established requirements for design, fabrication, construction, testing, and performance, to ensure that needed structures, systems, and components remain functional during and following identified design basis events.

The Committee supports the direction planned by the staff for the development of the new rule 10 CFR Part 53. The Committee looks forward to many interactions with the staff, as they develop the new rule. In particular, the Committee hopes to see language that stresses the importance of searching for events without preconceived expectations and that provides a defined pathway for prototype facilities including clarity on the kinds of test programs, monitoring, and license limitations that may be required, before such plants can enter the period of full commercial operations.

Committee Action

The Committee issued a letter on October 21, 2020, with the follow conclusions and recommendations:

- The staff's proposed approach for developing the 10 CFR Part 53 rule is viable.

- The staff should ensure that applicants compensate for novel designs with uncertainties due to incompleteness in the knowledge base by performing systematic searches for hazards, initiating events, and accident scenarios with no preconceptions that could limit the creative process.

- The rule should provide a pathway for licensing prototype facilities, when uncertainties in the knowledge base and lack of operating experience suggest that additional testing and monitoring are needed.

3. Final Safety Evaluation Report for Topical Report, Framatome Topical Report ANP-10337, Revision 0, Supplement 1P, Revision 0, "Deformable Spacer Grid Element"

The staff provided a presentation to the Committee on Supplement 1 to AREVA Topical Report ANP-10337P which addresses evaluation of fuel spacer grid performance to a seismic (safe-shutdown earthquake) or loss-of-coolant accident (LOCA) events. The evaluation must ensure that regulatory requirements are met with respect to fission gas release, fuel rod structural integrity, control rod insertability and core coolability. The approved ANP-10337P remains acceptable and applicable for many grid designs. However, some modern grids behave differently under external loads and may be outside the applicability limits of ANP-10337P. Supplement 1 implements an advanced spacer grid model and associated changes to the base methodology to support these new grid designs. The deformable grid element (DGE) was developed to represent the behavior of new spacer grid designs and to predict spacer grid residual deformation under seismic and LOCA conditions. The procedure to define the numerical models to capture the dynamic response of the fuel assembly was altered by the inclusion of the advanced grid element. The primary outputs from the analysis are the spacer grid deformations due to spacer grid impacts, and the deflections experienced by the fuel assemblies.

Supplement 1 defines specific spacer grid behavior that must be satisfied for the methodology to be applicable. In their review, the staff explored topics such as test data requirements, the applicability of the confidence limit, and the impact of mixed cores. An independent analysis led to the staff imposing limitations and conditions on the size of the residual deformation and the applicability of the new methodology.

Committee Action

The Committee issued a letter on October 6, 2020, with the follow conclusions and recommendations:

- Supplement 1 provides an adequate description of the addition of a non-linear deformable grid element (DGE) to the base cases described in the approved AREVA Topical Report ANP-10337P. The DGE provides for increased accuracy of grid deformation during seismic and Loss-of-Coolant Accident (LOCA) events.

- The advanced methodology proposed in Supplement 1 allows analysis of advanced spacer grid designs in response to seismic and LOCA events, subject to the limitations and conditions specified in the SER.

- The staff SER should be issued

4. Safety Evaluation for Topical Report NEDC-33910P, "BWRX-300 Reactor Pressure Vessel (RPV) Isolation and Overpressure Protection"

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.

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 and ICS actuation.

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.

Committee Action

The Committee issued a letter on October 5, 2020, with the follow conclusions and recommendations:

- The design requirements for RPV isolation and overpressure protection and the proposed loss-of-coolant accident acceptance criteria documented in NEDC-33910P are consistent with applicable regulatory requirements.

- The safety evaluation should be issued.

SIGNIFICANT ACTIONS/DISCUSSIONS AT THE PLANNING AND PROCEDURES SESSION

The Committee approved actions to support potentially bringing on a consultant to assist in the SHINE operating license application review

The Committee voted to support Member Kirchner's proposal to draft a document laying out the Committee's position regarding the NRC staff response to the ACRS letter on NuScale boron redistribution. The Committee will review this draft document during the October Full Committee Meeting

The Committee discussed the conduct of virtual meetings at least through January 2021 with the caveat to discuss at future meetings as the situation evolves

SCHEDULED TOPICS FOR THE 679th ACRS MEETING

The following topics are on the agenda for the 679th ACRS meeting scheduled for October 8-10, 2020:

- Framatome's licensing topical report ANP-10323P, Revision 1, "GALILEO Fuel Rod Thermal Mechanical Methodology for Pressurized Water Reactors."

- NuScale Topical Report, "Improvements in Frequency Domain Soil-Structure-Fluid Interaction Analysis," TR-0118-58005

- Information Session on External Hazards Center of Expertise

Sincerely,

Matthew W. Sunseri

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Date: 2020.11.10 17:53:39 -05'00'

Matthew W. Sunseri,
Chairman

November 10, 2020

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