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

July 24, 2025

Commissioner Annie Caputo
Commissioner Bradley R. Crowell
Commissioner Matthew J. Marzano
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: SUMMARY REPORT – 726th MEETING OF THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS, JUNE 4 THROUGH 5, 2025

Dear Commissioners:

During its 726th meeting held June 4 through 5, 2025, which was conducted in person and virtually, the Advisory Committee on Reactor Safeguards (ACRS) discussed several matters. The ACRS completed the following correspondence:

MEMORANDA

Memoranda to Michael King, Executive Director for Operations (Acting), U.S. NRC, from Marissa G. Bailey, Executive Director, ACRS:

- Documentation of Receipt of Applicable Official NRC Notices to the Advisory Committee on Reactor Safeguards for June 2025, dated June 12, 2025, Agencywide Documents Access and Management System (ADAMS) Accession No. ML25162A114, and

- June 2025 ACRS Full Committee – Topical Reports, dated June 12, 2025, ADAMS Accession No. ML25162A110.

HIGHLIGHTS OF KEY ISSUES

a. Draft Final Interim Staff Guidance: Content of Risk Assessment and Severe Accident Information in Light-Water Power Reactor Construction Permit Applications

The Committee discussed the subject topic, which was led by Subcommittee Chairman, Member Bier.

The Regulatory Rulemaking, Policies, and Practices Subcommittee met with the NRC staff and a representative of the Nuclear Energy Institute (NEI) on May 21, 2025, to discuss draft Interim Staff Guidance (ISG), "Content of Risk Assessment and Severe Accident Information in Light-Water Power Reactor Construction Permit Applications," (ADAMS Accession No. ML25115A038). The NRC staff developed this ISG to further clarify the scope and depth of their review of the content of risk assessment and severe accident information in a construction permit (CP) application for a light-water power reactor. The NRC anticipates the submission of power reactor CP applications based on pre-application engagement initiated by several prospective applicants and vendors. The review of these applications falls within the two-step licensing process under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," and involves the issuance of a CP before an operating license (OL). Part 50 does not require development of a probabilistic risk assessment (PRA) for a CP application, as reiterated by the Commission in its Staff Requirements Memorandum for SECY-22-0052. This ISG provides guidance in cases where a CP applicant uses risk assessment and severe accident information to support its application.

We expect that light-water reactor applicants will be afforded the same flexibility in level of detail given to advanced reactor applicants (consistent with Appendix A, "Acceptability of a Probabilistic Risk Assessment That Supports a Non-Light-Water Reactor Construction Permit Application Based on the Licensing Modernization Project Methodology," in Regulatory Guide 1.253, Revision 0, "Guidance for a Technology-Inclusive Content-of-Application Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors").

An NEI representative suggested that the table on "Additional Elements for CP Application," should include a column allowing for traditional deterministic approaches for some hazards, since applicants may conceivably want to "mix and match" (e.g., using deterministic approaches for some hazards, and PRA or alternative risk evaluations for others). This approach seemed reasonable to the Subcommittee members.

The Subcommittee recommended issuance of the draft ISG and did not recommend writing a letter on the topic. This was because no crucial safety issues were presented by the CP ISG, applicants would still be expected to submit a complete PRA as part of the operating license application (if required), and any safety issues would presumably be identified at that time. Therefore, any potential issues with the CP ISG pose only business risks for applicants, not safety risks, and the Committee approved the Subcommittee recommendation.

Member Bier recommended that this summary write-up serve as a record of the Subcommittee meeting.

The Committee agreed with the recommendation.

b. Discussions During the Planning and Procedures Session

1. The Committee discussed the full Committee (FC) and Subcommittee (SC) schedules through November 2025, as well as the planned agenda items for FC meetings.

2. The ACRS Executive Director led a discussion of significant notices issued by the Agency since the last Full Committee meeting in May 2025. The Executive Director documented this activity in a memorandum dated June 12, 2025, ADAMS Accession No. ML25162A114.

3. The Committee briefly discussed the SC meetings that were held since the last ACRS FC meeting in May 2025, which included the following:

   - May 21, morning session: Regulatory Rulemaking, Policies, and Practices SC meeting on the draft interim staff guidance on construction permit applications and PRA [Member Bier];

   - May 21, afternoon session: Human Factors, Reliability, and PRA SC meeting on the use of PRA for advanced reactor applications [Member Bier]; and

   - June 3: X-energy topical reports on Mechanistic Source Term Approach, Revision 2 (ADAMS Accession No. ML24131A149), Transient and Safety Analysis Methodology, Revision 2 (ADAMS Accession No. ML25077A288), and GOTHIC and Flownex Analysis Codes Qualification, Revision 3 (ADAMS Accession No. ML25076A053) [Member Martin].

4. There were no Regulatory Guides discussed this month.

5. The ACRS Executive Director led a discussion of three topical reports that were reviewed by a lead member who gave recommendations to the Committee about the need to review the documents. The Executive Director documented this activity in a memorandum dated June 12, 2025, ADAMS Accession No. ML25162A110.

6. Member Palmtag led a discussion of the review of ANP-10350P, Revision 0, “Framatome Methodology for Boiling Water Reactors: Evaluation and Validation of AP0LL02-A/ARTEMIS-B, ADAMS Accession No. ML22186A070.”

   On May 6, 2025, the Accident Analysis Subcommittee of the ACRS reviewed the Framatome Topical Report (TR) ANP-10350P, Revision. 0, presenting the generic application of the APOLLO2-A/ARTEMIS-B code system to boiling water reactor (BWR) steady-state modeling to replace their previously approved BWR evaluation model (EMF-2158PA, Revision 0, “Siemens Power Corporation 41 Methodology for Boiling Water Reactors: Evaluation and Validation of 42 CASMO-4/MICROBURN-B2) applying CASMO-4/MICROBURN-B2.” This TR extends the methods in NRC-approved ARCADIA methodology for pressurized water reactors (PWRs) to BWRs, with tools for neutronic, thermal-hydraulic, and fuel performance modeling during normal reactor operations. This review also covers supplemental information submitted by Framatome for increased enrichment and burnup (ANP-10350 Revision 0, Q3P, Revision 1, “Supplemental Information for Increased Enrichment and Burnup," ADAMS Accession No. ML24057A358).

   APOLLO2-A is a lattice physics computer code that generates few-group cross-sections for BWR lattices. APOLLO2-A will replace CASMO-4 in Framatome BWR nuclear design work and will allow Framatome to have a single lattice physics code that can be used for both BWR and PWR applications. Both APOLLO2-A and

CASMO-4 use modern neutron transport solvers (the Method of Characteristics) and have a long history of use in the industry. One difference of note is that APOLLO2-A uses the JEFF cross section library developed in Europe, as opposed to the ENDF/B cross section library traditionally used in the United States.

ARTEMIS-B is a three-dimensional full-core nodal simulator and will replace the previous MICROBURN-B2 computer code used by Framatome in BWR nuclear design work. The neutronic solver in ARTEMIS-B is very similar to the ARTEMIS computer code used for PWR analysis, and the BWR thermal-hydraulic solver in ARTEMIS-B is based on the previous MICROBURN-B2 computer code. The staff performed a very comprehensive review of all the major methodology differences between MICROBURN-B2 and ARTEMIS-B.

The TR includes significant verification and validation (V&V) cases to give confidence that the codes are modeling BWR reactors correctly. There are many V&V cases included in the TR, but of significance were 8 BWR reactors with 110 fuel cycles. Two observations were made by the Subcommittee in the V&V cases. The first is that there are a limited number of isotopic measurements (9 fuel rods) with relatively large measurement uncertainties. The lack of isotopic measurements is not an issue specific to Framatome and is an issue for all light-water reactor vendors. A campaign to obtain additional and better isotopic measurements with better characterization would help all vendors, especially for cases at high burnups and with modern 10x10 and 11x11 BWR fuel design arrays. Additional isotopic measurements would help industry increase the confidence of BWR analysis methods, especially at high burnups. The second observation is that, while acceptable, the errors in BWR eigenvalue predictions are relatively high across the industry. Again, this is not an issue specific to Framatome. Additional research to understand what is driving the issues with eigenvalue predictions would improve confidence in the ability to model the physics occurring in a BWR reactor core.

Member Palmtag recommended that this summary write-up serve as a record of the Subcommittee meeting.

The Committee agreed with the recommendation.

7. Member-at-Large Petti led a discussion of a revised review schedule for the final version of 10 CFR Part 53, "Risk-Informed, Technology-Inclusive Regulatory Framework for Commercial Nuclear Plants," (Part 53) rulemaking. He relayed the information that the staff have been directed to accelerate the Part 53 rulemaking schedule to make it final by January 2026. To support this schedule, it is likely that only one Subcommittee meeting is possible and a final letter, if necessary, would need to be written during the October 2025 Full Committee meeting. There was some discussion regarding the need for a letter given the (1) multiple letters written by the Committee on the draft rule language and (2) the specific direction from the Commission. Also discussed were possible impacts resulting from the public availability of the draft final rule.

   A Subcommittee meeting is scheduled for September 17, 2025, and a Full Committee session is scheduled for the October Full Committee meeting.

8. Members Roberts, Martin, and Harrington gave updates on their construction permit application reviews for Kemmerer (Natrium), Long Mott (X-energy), and Clinch River (BWRX-300).

   The Kemmerer review has been accelerated due to Executive Order 14300, with a possible final letter in November 2025. Member Roberts and ACRS staff will meet with the NRC staff to coordinate Subcommittee dates to support the schedule

   The Long Mott application has just been accepted and Member Martin and ACRS staff will meet with the NRC staff to determine Subcommittee and Full Committee meeting dates.

   The Clinch River application is undergoing acceptance review and Member Harrington and the ACRS staff will meet with the NRC staff to discuss possible Subcommittee and Full Committee dates.

9. Member Bier led a discussion of a Human Factors, Reliability, and PRA SC meeting held on May 21, 2025. The purpose of the meeting was to discuss the use of PRA in support of advanced reactors, including potential improvements or additions to available guidance. Members Bier and Dimitrijevic presented the technical issues that were identified as needing to be addressed for advanced reactor applicants; in particular, risk importance measures, PRA completeness, uncertainty analysis, and cliff edge effects. Additionally, ACRS Consultant Bley presented on cliff edge effects. Staff also presented on the following topics: 1) Relative and Absolute Risk Importance Measures; 2) PRA Completeness; 3) Staff and Industry Guidance Under Development; 4) Cliff Edge Effects; and 5) Uncertainty Analysis. It was evident that the staff have considered these topics in great detail and the discussion was productive. The Subcommittee observations on the various topics after the meeting are summarized below:

   Risk Importance Measures: There was extensive discussion of absolute versus relative importance measures. In the history of advanced-reactor development, there were competing goals under consideration: (1) preserving the enhanced levels of safety provided by new reactors; and (2) providing greater operational flexibility for new reactors with enhanced safety features. The staff stated that they continue to be open to additional ideas as they develop the recommended integrated risk-informed approach. However, staff emphasized that the identification of safety-significant components was not driven exclusively by the quantitative values of importance measures but also included holistic considerations such as defense in depth and the identification of risk-significant functions.

   Uncertainty Analysis: It was recognized by staff that, in addition to parametric uncertainty, model uncertainty and completeness uncertainty could be extremely important, potentially more important for advanced reactors than for the current light-water reactor fleet, where there is already extensive operating experience. Often, advanced designs rely on passive or inherent means (e.g., natural physical processes such as natural convection, thermal conduction, radiation, etc.) to maintain safety. Because of lack of data and experience, characterization of the uncertainties in success criteria and passive functional reliability may require special attention.

Cliff Edge Effects: The discussion clarified that focusing on a specific scenario cutoff frequency as a way to search for cliff edge effects seems to be both ineffective (since it may not capture some cliff edge effects), and also inefficient and overly burdensome for applicants (since there can be a large number of scenarios above any cutoff frequency). Some documents provide at least partial guidance for more qualitative approaches in looking for cliff edge effects; e.g., "Probabilistic Risk Assessment Standard for Advanced Non-Light Water Reactor Nuclear Power Plants" (ASME/ANS RA-S-1.4-2021), and "An Approach for Risk-Informed Performance-Based Emergency Planning," NEI 24-05, Revision 0, (regarding emergency planning zones). However, these documents are PRA related. Staff confirmed that in their view, because of concerns with PRA completeness, PRA is not adequate as the only means of identifying cliff-edge effects. There was extensive discussion of the value of engineering analysis based on phenomenological considerations to complement the PRA. Guidance consolidating the various aspects of this process might be worthwhile.

In a discussion on considerations for reviewing licensing applications, topics suggested by members included:

Risk metrics across a plant's lifecycle, from design to operation: What is the role of PRA-informed Structures, Systems, and Components (SSC) classifications in configuration risk management, especially where safety-related classification may not map directly to operational significance? Is existing guidance sufficient to help licensees manage the unavailability of risk-significant but non-safety-related SSCs?

The role of deterministic guardrails in risk-informed, performance-based applications: How much flexibility should applicants have to apply risk-informed performance-based (RIPB) arguments to containment analysis? Should containment remain as a domain for deterministic conservatism? What is the role of deterministic elements in RIPB more generally?

Advanced reactors and PRA: What are the roles of risk importance measures (e.g., Risk Achievement Worth, Fussel-Vesely) vs. defense in depth and safety margin for plants with extremely low risk profiles? Should such plants have greater operational flexibility, and if so, what is the role of operating experience in justifying that?

The Committee discussed these issues in light of the recently issued Executive Order 14300 and will revisit it if future ACRS action is needed on this topic.

Member Bier recommended that this summary write-up serve as a record of the Subcommittee meeting.

The Committee agreed with the recommendation.

10. Member Harrington led a discussion of possible review of draft ISG 2025-01 for treatment of certain loss-of-coolant accident (LOCA) locations as beyond design basis. 10 CFR 50.46 states the following in paragraph (a)(1)(i) regarding the selection of the spectrum of LOCAs for emergency core cooling system (ECCS) evaluation purposes:

> ECCS cooling performance must be calculated in accordance with an acceptable evaluation model and must be calculated for a number of postulated loss-of-coolant accidents of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated LOCAs are calculated.

The draft ISG would support the staff in determining that the LOCA spectrum defined in an application or other licensing action is sufficient under 10 CFR 50.46 despite specific potential break locations being defined as beyond design basis (generally based on mechanistic arguments), and thus an exemption from 10 CFR 50.46 would not be needed. The ISG is structured around specific locations within a given design, and it appears that the guidance could also be applied "generically" to a limited number of essentially identically configured locations within a given design. However, it would not apply to a class of similarly configured locations that vary on some parametric basis, such as a range of pipe sizes as reflected in the large break LOCA definition or the transition break size approach.

Member Harrington recommends reviewing this document after public comments are received. The Committee discussed and, generally, agreed with the recommendation. But also discussed the need to incorporate the implications of issuance of Executive Order 14300.

11. There were no reconciliations this month.

12. A closed session was conducted to discuss proprietary and administrative information.

13. The following topic was on the agenda of the 727th ACRS Full Committee meeting, which was held on July 7 through 9, 2025:

   - X-energy topical report on mechanistic source term approach.

Sincerely,

Walter L Kirchner Signed by Kirchner, Walter on 07/24/25

Walter L. Kirchner
Chairman

Enclosure:
List of Acronyms

July 24, 2025

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Accession No: ML25196A311 **Publicly Available (Y/N):** Y **Sensitive (Y/N):** N
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LIST OF ACRONYMS

ACRS	Advisory Committee on Reactor Safeguards
ADAMS	Agencywide Documents Access and Management System
BWR	Boiling Water Reactor
CP	Construction Permit
ECCS	Emergency Core Cooling System
FC	Full Committee
ISG	Interim Staff Guidance
LOCA	Loss-of-Coolant Accident
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
PWRs	Pressurized Water Reactors
PRA	Probabilistic Risk Assessment
RG	Regulatory Guide
RIPB	Risk-Informed Performance-Based
SC	Subcommittee
SSC	Structures, Systems, and Components
TR	Topical Report
V&V	Verification and Validation