



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

October 12, 2023

The Honorable Christopher T. Hanson  
Chair  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555-0001

**SUBJECT: SUMMARY REPORT – 708<sup>th</sup> MEETING OF THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS, SEPTEMBER 6-8, 2023**

Dear Chair Hanson:

During its 708<sup>th</sup> meeting, September 6-8, 2023, which was conducted in person and virtually, the Advisory Committee on Reactor Safeguards (ACRS) discussed several matters. The ACRS completed the following correspondence:

**LETTER REPORTS**

Letters to Christopher T. Hanson, Chair, U.S. Nuclear Regulatory Commission (NRC), from Joy L. Rempe, Chairman, ACRS :

- Review of Regulatory Guide 1.183, Revision 1, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors,” dated September 20, 2023, Agencywide Documents Access and Management System (ADAMS) Accession No. ML23256A179.
- Report on the Safety Aspects of the Subsequent License Renewal Application Review of St. Lucie Plant, Units 1 and 2, dated September 26, 2023, ADAMS Accession No. ML23257A271.

**MEMORANDUM**

Memorandum to Daniel H. Dorman, 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 2023, dated September 21, 2023, ADAMS Accession No. ML23256A194.

## HIGHLIGHTS OF KEY ISSUES

### a. Review of Regulatory Guide (RG) 1.183, Revision 1, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors”

The ACRS heard from the NRC staff and other stakeholders; the Committee issued a letter, dated September 20, 2023, with the following conclusions and recommendations:

1. RG 1.183 establishes alternative source terms (ASTs) for evaluating design basis accidents (DBAs) at nuclear power reactors. Revision 1 of RG 1.183 provides additional guidance for developing and applying ASTs in DBA dose consequence analysis, addressing new information since Revision 0. Revision 1 should be issued.
2. Because of the need for regulatory stability relative to the use of ASTs (including high burnup and high enriched fuels), a single version (Revision 2) of the regulatory guide should be developed. The schedule for this development should be aligned with the upcoming rulemaking on increased enrichment.
3. Staff should consider detailed comments in this letter related to alignment with emergency preparedness (EP) guidance, rationale associated with the regulatory guide, and the need for capturing lessons learned during implementation.

### b. Report on the Safety Aspects of the Subsequent License Renewal (SLR) Application of St. Lucie Plant, Units 1 and 2

The Committee heard from the NRC staff and Florida Power and Light (FPL) representatives; it issued a letter, dated September 26, 2023, with the following conclusion and recommendation:

1. The established programs and the commitments made by FPL to manage age-related degradation provides confidence that St. Lucie can be operated in accordance with its current licensing basis for the subsequent period of extended operation (SPEO) without undue risk to the health and safety of the public.
2. The FPL application for the SLR of the operating licenses for St. Lucie should be approved.

### c. Pressurized Water Reactor Owners Group (PWROG) Topical Report (TR) on Hydrogen Based Transient Clad Strain Limit

The Chairman announced that this subject, which was published as part of the agenda, would not occur due to the Subcommittee recommendation to not write a letter on this topic. This topic was discussed during the Planning and Procedures (P&P) Session of the Full Committee meeting (as documented below).

### d. NRC Volcanology Hazards Assessments for New Reactor Licensing

The Committee received a presentation from the Office of Nuclear Reactor Regulation (NRR) staff on generic application of RG 4.26, Revision 1, “Volcanic Hazards Assessment

for Proposed Nuclear Power Reactor Sites.” The Committee had previously written a letter report dated April 21, 2021 (ADAMS Accession No. ML21106A210) on RG 4.26 and concluded that: it provided reasonable guidance for conducting volcanic hazard assessments for nuclear facilities; it would benefit from trial application; and research is needed to establish the impact of volcanic hazards on the performance of systems, structures and components (SSCs) and personnel. The agency is in receipt of a white paper from NuScale Power, LLC, on behalf of the Carbon Free Power Project (CFPP), “Volcanic Hazards Analysis Methodology,” for an Idaho National Laboratory (INL) site, and a TR from TerraPower entitled “An Analysis of Potential Volcanic Hazards at the Proposed Natrium Site near Kemmerer, Wyoming.” The NRC conducted a regulatory and technical assessment of the white paper, finding that it appears to be consistent with the guidance in RG 4.26. The Committee was also informed that NuScale is coordinating efforts with a Senior Seismic Hazards Analysis Committee (SSHAC) process at the Idaho National Laboratory (INL) site to perform a probabilistic volcanic hazards analysis (PVHA). Both the white paper and TR are expected to inform subsequent submittals by the two entities. Committee reviews of these volcanic hazards assessment submittals, as well as the associated staff evaluations, are expected to take place in 2024.

- e. Draft Revision 9 of Standard Review Plan (NUREG-0800), Branch Technical Position (BTP) 7-19, “Guidance for Evaluation of Defense in Depth and Diversity to Address Common-Cause Failure (CCF) Due to Latent Design Effects in Digital Safety Systems”

The staff briefed the Committee on the draft BTP 7-19 prior to it being issued for public comment. This BTP is intended for staff reviews of digital instrumentation and control (DI&C) safety systems with (1) proposed modifications that require implementation of a license amendment, and (2) applications for construction permits, operating licenses, combined licenses, design certifications, standard design approvals, and manufacturing licenses.

The purpose of this revision to the BTP is to reflect expansion of the current SRM-SECY-93-087 Commission’s policy and its four staff positions on how potential CCFs should be addressed in DI&C systems as proposed in SECY-22-0076, dated August 20, 2022, and the Commission approval in SRM-SECY-22-0076 with edits, dated May 25, 2023. The proposed expansion to the current policy for DI&C CCFs incorporates the allowance to use risk-informed approaches to demonstrate the appropriate level of defense-in-depth, including not providing any diverse automatic actuation of safety functions. This expanded policy would apply to requests for new or amended licenses and design approvals, for all nuclear power plant types, under Title 10 of the Code of Federal Regulations (10 CFR) Part 50, “Domestic Licensing of Production and Utilization Facilities,” and 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.” The BTP revision is applicable only to Light Water Reactors (LWRs); further revision to documents, such as “Design Review Guide (DRG): Instrumentation and Controls for Non-Light-Water Reactor (Non-LWR) Reviews,” would be needed to reflect this expanded policy for non-LWRs.

During this discussion, members identified several inconsistencies, both within the document and with other regulatory guidance for application of risk-informed principles. In addition, Members Brown and Roberts provided written comments that are attached to the

transcript for this Full Committee session. Members agreed their oral and written comments do not have to be resolved before releasing for public comment but would appreciate these items being addressed as part of the public comment resolution. Prior to the revised BTP being released for use, members noted they plan to review the final draft (subsequent to incorporation of public and member comments).

Consequently, the Committee agreed to not write a letter on this subject at this time.

f. Discussions at the P&P Session

1. The Committee discussed the Full Committee and Subcommittee schedules through February 2024 as well as the planned agenda items for Full Committee meetings.
2. The ACRS Executive Director led a discussion of significant notices issued by the Agency since the last Full Committee meeting in July 2023 (this activity is documented in the memorandum dated September 21, 2023). There were no RG reviews by the Committee for the month of September.
3. Members Ballinger and Halnon led a discussion about the Seabrook Alkali-silica Reaction issue and mentioned that a Plant Operations Subcommittee meeting will likely be scheduled for some time next calendar year.
4. Member Halnon led a discussion about TR review guidance for ACRS members. Specifically, he discussed the following addition to the guidance (as Item 2.4.4 Attachment III "Member Guidance – III Design-Centered Subcommittee Reviews" in the ACRS Subcommittee Structure document posted on <https://www.nrc.gov/about-nrc/regulatory/advisory/acrs.html>):

In considering the review of TRs, the following should also be kept in mind when making the decision whether to formally review:

- Primarily be concerned with the safety of the reactor, core/fuel integrity, risk to reactor accidents, occupational safety, and health and safety of the public, especially for novel concepts and new technologies.
- Consider the risk, when reviewing the PSAR [preliminary safety analysis report] or SAR [safety analysis report], the ACRS may disagree with approaches that were previously approved by the staff in earlier TR safety evaluations. This would result in schedule challenges late in the NRC review process that could have been avoided if the ACRS had raised its issues during the specific TR review.

The Committee discussed this issue, and some members had further recommendations. Member Roberts volunteered to provide input to Member Halnon on this issue. Hence, members agreed to delay updating the guidance. During this discussion, Chairman Rempe observed it would be more efficient if updates to the guidance were coordinated with changes in the Subcommittee Structure document (because it would reduce staff efforts to upload this document to the ACRS public website). As a follow-up to one item

identified in the August ACRS retreat, Chairman Rempe also requested members notify her within the next week if they wished to be removed from any of their current Subcommittee assignments.

5. Member-at-large Petti led a discussion about the status of the Kairos 2 construction permit (CP) application review. He noted that NRR had accepted for review the Hermes 2 CP application and was working on an acceptance letter. The review schedule is expected to be available in one month or sooner, and the review will likely be on a 12-month schedule. The staff is working on a white paper to inform the Committee on the differences between the Hermes CP application and the Hermes 2 CP application (the Committee may receive this white paper in October 2023). The first ACRS Subcommittee meeting will likely happen in late spring or summer 2024. The staff also expects to receive an updated Kairos regulatory engagement plan this fall.
6. Vice Chair Kirchner led a discussion about several aspects of the NuScale standard design approval (SDA) application review.

#### NuScale Quality Assurance (QA) Program Description TR

NuScale submitted for staff review TR-121172-NP, Revision 0, "Carbon Free Power Project (CFPP) Nuclear Quality Assurance Program Description," on behalf of CFPP, LLC.

The staff has completed their evaluation of this TR. The staff forwarded the associated safety evaluation report (SER) to the ACRS Executive Director for a review decision by ACRS on July 20, 2023. The Committee previously made a review decision on another NuScale QA program description TR in April 2023. That TR was a limited scope QA program description to support CFPP procurement and limited work authorization activities. This TR is a full scope QA program description that covers the 18 criteria in Appendix B that will support the SDA application.

The staff asked if the Committee wanted to review this NuScale TR and the associated staff safety evaluation. Lead Member Kirchner recommended not to review this TR. The Committee concurred with this recommendation.

#### CFPP Limited Work Authorization

CFPP applied for a limited work authorization (LWA) on July 31, 2023. CFPP requests in the LWA to begin remediation work on the Reactor Building and the Radiological Waste Building. The Committee is not scheduled to review this application. The documents are provided for information. The Committee will review the design of the Reactor Building and the Radiological Waste Building, including seismic and other external hazards, such as volcanology, as part of the SDA application review.

#### NuScale Density Wave Oscillation TR and Staff Acceptance for Docketing SDA Application

NuScale submitted the density wave oscillation TR on July 17, 2023, and a report that summarizes information that was provided in response to the staff's request for supplemental information. The SDA application is now complete. The staff issued its

letter accepting for docketing the NuScale SDA application on July 31, 2023 (ADAMS Accession No. ML23198A163). The staff letter states that the expected safety review supports issuance of a final SER by July 31, 2025 (i.e., 24 months from docketing). The staff also states that it expects to complete Phase C, "ACRS Review of the Advanced Safety Evaluation Report (ASER)," by May 2025. The staff is working on a more detailed schedule showing dates the TRs and the SDA Chapter SERs will be submitted for ACRS review. ACRS staff will work with NRR staff to incorporate this information into the Committee Engagement Plan for this design center as soon as this schedule is available.

7. Member Ballinger led a discussion about the PWROG TR on hydrogen based transient clad strain limit.

During the August 24, 2023, meeting of the Fuels, Materials and Structures Subcommittee, the Subcommittee reviewed the NRC staff's SER, approving PWROG-21001-P, Revision 0, "Hydrogen-Based Transient Cladding Strain Limit." The TR presented a proposal for an alternate method, based on cladding hydrogen content, to estimate the cladding strain limit during a Condition II transient. This method replaces the current criterion that the permanent strain (plastic) of the cladding during the transient should not exceed 1%. It should be noted that, while the 1% strain limit has served the industry well, the origin of this limit is unknown and apparently based on engineering judgement.

The rationale for the PWROG-21001-P method is that cladding Uniform Elongation (UE) is a measure of cladding strain to plastic instability and is also a function of hydrogen content. While the actual data base supporting the analysis is limited, the functional dependence proposed is supported by first principles and a larger data base, developed by the Pacific Northwest National Laboratory, for dry storage of zirconium-clad spent nuclear fuel. The developed empirical correlation bounds the actual data at the 95/95 confidence level and is thus deemed acceptable by the staff draft SER with appropriate limitations and conditions, the most important of which are that it be limited to ZIRLO® and Optimized ZIRLO® cladding, that the distribution and orientation of precipitated hydrides be largely circumferential and that it be used only for Condition II transients.

While it is proposed that the strain limit be an alternative to the empirical 1% strain limit, the development of the hydrogen-based strain limit represents the first data-driven strain limit and is thus an important advancement in the estimation of actual fuel performance during Condition II transients. The use of this limit will likely allow for more flexibility, with no decrease in safety, in core loading. Subcommittee members proposed that documentation of the review in the summary report for this Full Committee meeting would be sufficient and that a formal letter is not required.

The Committee agreed with the Subcommittee's proposal.

8. Member Roberts lead a discussion on a Terrapower Sodium design TR.

The Design Centered Subcommittee for the TerraPower Sodium reactor design met on August 23, 2023, to review the TerraPower, LLC (TerraPower) TR, NATD-LIC-RPRT-0001 Revision 0, "Regulatory Management of Sodium Nuclear Island and Energy Island Design Interfaces." During the meeting, the Subcommittee heard from the NRC staff and TerraPower representatives.

The TR sets out to make the case that all structures, systems, and components (SSCs) relied upon for reactor safety are on the nuclear island (NI), and events on the energy island (EI) are sufficiently decoupled from the nuclear reactor to classify the EI as not safety significant and not require use of reactor safety standards in design and construction. The draft SER prepared by NRC staff agrees in principle with the TR and provides limitations and conditions on its use, including (among others) that the applicant must demonstrate adequate independence is maintained between the NI and EI in the final Sodium design (as the design evolves from its current conceptual state).

The Subcommittee concluded that the TerraPower submittal and the staff's safety evaluation were thorough and complete given the current conceptual status of the Sodium design. Several questions were asked to better understand the design concept and the processes TerraPower intends to use in developing safety justification. Of note, TerraPower stated they were using the overall process defined in NEI 18-04 ("Risk-Informed Performance-Based Guidance for Non-Light Water Reactor Licensing Basis Development") as endorsed by the NRC staff in Regulatory Guide 1.233; TerraPower representatives stated this process is "arduous" but is a good, defensible, process for classifying equipment and selecting licensing basis events.

Attending Subcommittee members concluded that it is not necessary to refer this topic to the Full Committee for a report. The Subcommittee did not identify any open issues or unresolved questions. Noting that the SER limitations and conditions would require confirmation of NI-to-EI independence in subsequent safety analysis reports that will be reviewed by the ACRS, the Subcommittee recommended that additional review by the Full Committee is not necessary at this time.

The Committee agreed with the Subcommittee's recommendation.

9. Member Ballinger led a discussion regarding the NRC staff's interim staff guidance (ISG) on material compatibility issues.

The Fuels, Materials, and Structures Subcommittee had an information briefing from the staff on August 23, 2023, about NANO-ISG-2023-01, "Material Compatibility for Non-Light Water Reactors." The purpose of the ISG is to provide guidance for non-LWR developers regarding materials selection that goes beyond ASME Section II, Division 5, "High Temperature Reactors" requirements. In particular, the ISG provides guidance for material qualification with respect to environmental effects that are not included in the ASME code. The non-LWR environment will likely see corrosion and other materials degradation phenomena that are very different from the LWR environment. It is also likely that significant gaps will exist in terms of data and operating experience. These gaps will require that monitoring programs be implemented to ensure that system performance will be as expected. During the presentation, the staff provided an expanded discussion of the basis for materials selection. Additionally, the ISG provides three examples as "exemplars": (1) molten salt reactors, (2) liquid metal reactors and (3) high temperature gas reactors.

Member Ballinger proposed that no additional interactions on this ISG are needed at this time. The Committee agreed with his recommendation.

10. Member Ballinger led a discussion on the logistics associated with the September 19 and 20, 2023, Fuel, Materials, and Structures Subcommittee visit to the Westinghouse Columbia Fuel Fabrication Facility in Hopkins, South Carolina. Various logistical issues were discussed.
  11. Member March-Leuba led a discussion on the revision to the introduction to SRP Chapter 15, which is out for public comment. It was decided that an Accident Analysis – Thermal Hydraulic Subcommittee meeting would be scheduled on November 1, 2023, to discuss this topic. [Subsequently, it was determined that this meeting would be delayed until January 2024.]
  12. Member-at-large Petti led a discussion on the Technology Inclusive Content of Application Project/Advanced Reactor Content of Application Project (TICAP/ARCAP) guidance documents. These documents, which are currently being publicly reviewed, are scheduled to be discussed at a Regulatory Policies and Practices – Part 53 Subcommittee meeting on November 17, 2023, and to the Full Committee for Letter Writing at the December meeting. Member-at-large Petti discussed the need for a substitute member to lead Letter Writing at the December meeting due to his planned absence. Member Sunseri volunteered to fill in for him. [Subsequently, when it was learned that Member Sunseri would be virtually attending the December meeting, Member Halnon agreed to lead Letter Writing on this matter.]
  13. The Committee approved Member Ballinger's attendance at the EPRI Extended Storage Collaboration Program (ESCP) Meeting scheduled to take place in Charlotte, North Carolina, October 23 – 26, 2023.
  14. There were no reconciliations this month.
  15. There was a closed session of the P&P to discuss proprietary Committee Engagement Plans as well as sensitive administrative and personnel issues.
- g. Scheduled Topics for the 709<sup>th</sup> ACRS Meeting

The following topic is on the agenda for the 709<sup>th</sup> ACRS meeting scheduled for October 3-6, 2023:

- NRC staff white paper on microreactor licensing and deployment considerations.

Sincerely,



Signed by Rempe, Joy  
on 10/12/23

Joy L. Rempe  
Chairman



October 12, 2023

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