



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

December 21, 2021

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

**SUBJECT: SUMMARY REPORT – 690th MEETING OF THE ADVISORY COMMITTEE
ON REACTOR SAFEGUARDS, NOVEMBER 2-5, 2021**

Dear Chairman Hanson:

During its 690th meeting, November 2-5, 2021, which was conducted virtually due to the Agency's expanded telework capacities employed in response to the COVID-19 pandemic, the Advisory Committee on Reactor Safeguards (ACRS) discussed several matters. The ACRS completed the following correspondence:

LETTER REPORTS

Letter Reports to Christopher T. Hanson, Chairman, NRC, from Matthew W. Sunseri, Chairman, ACRS

- Biennial Review and Evaluation of NRC Safety Research Program, dated December 13, 2021, Agencywide Documents Access and Management System (ADAMS) Accession No. ML21327A072
- Draft Final Rule, "Emergency Preparedness for Small Modular Reactors and Other New Technologies," dated November 16, 2021, ADAMS Accession No. ML21316A252

LETTERS

Letters to Daniel H. Dorman, Executive Director for Operations (EDO), NRC, from Matthew W. Sunseri, Chairman, ACRS

- NUREG/CR-XXXX, "Fuel Qualification for Molten Salt Reactors, Draft Report for Comment," dated November 22, 2021, ADAMS Accession No. ML21313A361
- NUREG-2246, "Fuel Qualification for Advanced Reactors: Draft Report for Comment," dated November 23, 2021, ADAMS Accession No. ML21319A350

MEMORANDA

Memoranda to Daniel H. Dorman, EDO, NRC, from Scott W. Moore, Executive Director (ED), ACRS:

- Documentation of Receipt of Applicable Official NRC Notices to the Advisory Committee on Reactor Safeguards for November 2021, dated November 16, 2021, ADAMS Accession No. ML21312A536
- Regulatory Guides, dated November 16, 2021, ADAMS Accession No. ML21312A529

HIGHLIGHTS OF KEY ISSUES

1. Biennial Review and Evaluation of NRC Safety Research Program

The depth, breadth, and scope of the on-going safety research program continues to meet the Agency's current needs for regulatory decisions. The safety research program is keeping pace with anticipated and current Agency needs, balancing these needs well and maintaining an achievable scope. This conclusion is based, among other inputs, on the development of the future focused research program, establishment and implementation of non-light water reactor (LWR) integrated action plans, and the recent agency wide initiatives.

The Office of Regulatory Research programs position the Agency well for the changing environment, as illustrated by improving on-going processes, prioritizing projects, finding new ways to develop and maintain core competencies, and exploring ways to apply existing capabilities. These activities are all signs of a healthy research organization and should support the agency's broader efforts to transform itself into a modern risk-informed regulator.

In light of the Committee's findings regarding the health of the agency's research portfolio and the rate at which research results are obtained, the Committee recommends that the interval between its formal letter reports be increased from two to three years. The Committee will continue to have more frequent briefings on research topics of special interest and provide reports as necessary.

This letter was voted and approved by the Committee with the acknowledgement that Vice Chair Rempe and the ACRS staff would review the Appendices in detail prior to signature by the ACRS Chair.

2. Draft Final Rule, "Emergency Preparedness for Small Modular Reactors and Other New Technologies"

Currently, the NRC emergency planning regulations are found in Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.47 and Appendix E to 10 CFR Part 50. Over the last decade, several SECY papers proposed a framework to develop performance-based emergency plans for future small modular reactors (SMRs) and other new technologies (ONTs), culminating in the Commission's approval of the staff's plan to address the topic and direction to proceed with rulemaking in its staff requirements memorandum to SECY-16-0069.

The draft final rule establishes an approach to emergency planning that focuses on performance and results rather than an emphasis on emergency plans and procedures. The draft final rule has an accompanying regulatory guide (RG) 1.242, Revision 0.

During the extended public comment period, comments were received from over 2,200 individuals and organizations. The Committee commended the staff for working through many difficult topics. However, FEMA commented that they were not in agreement with reducing the federal government's oversight and assistance for planning and preparedness for this unique hazard and that this rule, as written, would hinder FEMA's ability to determine that offsite plans provide reasonable assurance that public health and safety are protected.

The Committee focused its review on four major categories:

- Emergency planning zone (EPZ) boundary selection and offsite planning and response,
- Hazards from non-nuclear, co-located facilities,
- Performance-based regulatory oversight of emergency response functions, and
- Event selection for sizing EPZ.

The Committee's detailed comments for each of these categories may be found in its letter dated November 16, 2021. Below are the Committee's comments on the EPZ boundary selection and offsite planning and response in the rulemaking language.

The rule does not specify a minimum size for the EPZ; instead, it relies on a performance-based calculation of dose to the public to establish the EPZ size. For currently anticipated SMRs and ONTs, in most cases, the resulting EPZ is expected to be smaller than that used by the existing LWR fleet because of estimated lower source terms associated with the new designs.

The new rule allows the applicant to propose an EPZ boundary that provides public protection from dose levels above a 10 mSv (1 rem) total effective dose equivalent threshold that is anticipated to be less than 10 miles. For designs with sufficiently low source terms, the EPZ could be bounded by the site boundary. In such a case, because the public is excluded from this area and it is under the control of the licensee, traditional predetermined protective actions within the EPZ by external agencies are not needed. If the EPZ is determined to be within the site boundary, the proposed revision to 10 CFR 50.47(f) exempts a Federal Emergency Management Agency (FEMA) review during the license application phase. The proposed 10 CFR 50.47(f) also exempts other planning attributes such as establishing arrangements for offsite services, dissemination of public information and radiological response training for offsite services such as fire, medical and law enforcement.

The primary basis for precluding normal and collaborative planning with agencies outside the site boundary is the concept that SMRs and ONTs are comparable in terms of the hazards associated with small research and test reactors (RTRs). Generally, there are no required offsite actions for RTRs due to the lower source term of the smaller reactors. However, this basis does not recognize the reduced operating experience with new nuclear technologies and differences in operating practices of commercial facilities versus RTRs. Emergency preparedness being the last line of defense for the health and safety of the public, precaution in the case of unforeseen events is prudent. Therefore, the Committee advises that the proposed revision to 10 CFR 50.47(f) be amended or deleted so that the longstanding engagement with FEMA reviewing offsite emergency plans is triggered by a new nuclear reactor license application.

When the EPZ is within the site boundary, FEMA review could be straightforward and, at least, informative of the new technology application to the various other federal, state, local and tribal stakeholders. This is especially important given the adoption of new and advanced nuclear technologies and the potential wide range of applications.

FEMA directs local and state agencies to have an all-hazards plan, commonly referred to as the emergency operations plan (EOP). Locals with an existing LWR nuclear plant have an additional radiological emergency plan (REP). Where an REP does not exist, the EOP has a radiological annex that should include radiological information from nearby nuclear material licensed facilities. Introduction of a new nuclear reactor in a community without an REP would certainly affect the content of EOPs and as such, should be reviewed specifically for the nuclear technology being introduced to the local region, regardless of the EPZ size.

One class of reactors that may not be adequately considered is transportable or mobile microreactors. Of concern are sites where a fueled reactor is moved into place and when expended, a new fully fueled reactor is moved onto the site co-present with the initial reactor. In addition to decommissioning implications, it is unclear how the source term, accident selection, release duration, and site EPZ boundary will be established in this case. The guidance in RG 1.242 should clearly indicate that for sites with transportable and mobile reactors, the proposed emergency plan must be set for the maximum number of modules, new arrivals, active, and shutdown or spent units. This ensures the emergency plan considers the cumulative on-site effect of all radiation sources during the full life cycle of the licensed site.

Committee Action

The Committee issued a letter on November 16, 2021, with the following recommendations:

Prior to the issuance of the proposed rule and the new RG 1.242 the following changes should be made:

1. Revise proposed Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.47(f) to not exclude FEMA from being involved in reviewing emergency plans under this rule regardless of the boundaries of the EPZ to ensure applicable offsite agencies are capable to coordinate with onsite nuclear emergency organizations.
2. Revise RG 1.242 to:
 - a. Include additional clarifying guidance related to selection criteria for the spectrum of events to consider for determination of the source term that is to be applied for EPZ sizing.
 - b. Clearly indicate that for sites licensed for transportable and mobile reactors the license application review and associated proposed emergency plan must be set for the maximum number of modules, new arrivals, active, and shutdown or spent units. This ensures the emergency plan considers the cumulative on-site effect of all units during the full life cycle of the licensed site.
 - c. Include conforming changes regarding the changes made in response to Recommendation 1 above.

Note that Chairman Sunseri was not present for the vote on this letter report.

3. NUREG/CR-XXXX, "Fuel Qualification for Molten Salt Reactors, Draft Report for Comment"

The as-yet-unnumbered draft report is intended to provide guidance to both regulators and to designers about the challenges associated with molten salt fuel qualification. The detail in the document, with its numerous examples, provides context for the complexity associated with some of the challenges and the level of detail necessary (but not always obvious) to resolve the issue as it relates to fuel qualification. Some of those examples are summarized in this letter to highlight the significant differences in the challenges compared to solid fuel qualification.

The behavior of nuclear fuel under normal and off-normal conditions is a key part of the overall safety case for a nuclear reactor. For molten salt fueled reactor concepts, the fuel is dissolved in the molten salt coolant. This different configuration requires a new approach to fuel qualification for molten salt fueled reactors. The NUREG/CR draft report provides a reasonable and practical approach to developing a licensing basis for fuel qualification for molten salt fueled reactors.

The Committee's comments on the NUREG/CR draft report are that the following are needed:

1. Discussion on the alignment between molten salt safety functions and draft language in 10 CFR Part 53,
2. Additional discussion on beyond design basis fuel salt behavior,
3. More discussion on volatilization behavior from a chemical standpoint (e.g., the degree of ideality or non-ideality in the salt.),
4. Discussion on salt surface tension to needed list of material properties to model melt spreading in the event of a spill,
5. Discussion on the impact of thermal hydraulic phenomena associated with liquid fuel on reactivity control,
6. Discussion on reduction in delayed neutron fraction in molten fuel systems and impact of uncertainty on reactivity control,
7. Discussion of the need for spills to result in subcritical geometries, and
8. Additional discussion on rationale for the salt not having to be deeply subcritical upon shutdown.

The report should be issued once the comments are addressed.

Committee Action

The Committee issued a letter on November 22, 2021, with the following conclusions and recommendations:

1. The behavior of nuclear fuel under normal and off-normal conditions is a key part of the overall safety case for a nuclear reactor. For molten salt fueled reactor concepts, the fuel is dissolved in the molten salt coolant. This different configuration requires a new approach to fuel qualification for molten salt fueled reactors.
2. The NUREG/CR draft report provides a reasonable and practical approach to developing a licensing basis for fuel qualification for molten salt fueled reactors.
3. The NUREG/CR draft report should be issued once comments in the Committee's letter are addressed.

Note that Chairman Sunseri was not present for the vote on this letter.

4. NUREG-2246, "Fuel Qualification for Advanced Reactors: Draft Report for Comment"

NUREG-2246 provides a fuel qualification assessment framework that would satisfy regulatory requirements. This framework constitutes a top-down approach where high-level regulatory requirements, criteria, and relevant regulatory guidance are identified. The approach is similar to the Codes Scaling, Applicability and Uncertainty, and Evaluation Model Development and Assessment Process approaches. It starts with a top-level goal and breaks it down into subgoals and further sub-elements as necessary to completely define requirements to meet the higher-level goal. The bases for the identified goals and clarifying examples for the expected evidence used to satisfy those goals are provided. The report describes what the requirements are but does not delve into how these requirements can be met given the range of different advanced fuel systems under consideration.

The draft NUREG provides a logical approach to fuel qualification. The top-down approach is methodical and provides some assurance of completeness when a claim is made that a nuclear fuel is qualified. Key parts of the approach are identifying relevant experimental data and assessing associated safety margins.

The Committee's comments on the draft NUREG include:

1. Addressing the misalignment in the safety functions in the draft NUREG with those being developed as part of draft 10 CFR Part 53
2. Rewording to accommodate other environmental degradation mechanisms beyond irradiation and discussing relevant chemical phenomena, as appropriate
3. Assuring empirical approaches are acceptable as an evaluation model
4. Expanding on the use of AFQ in the overall assessment framework
5. Applying appropriate quality standards to fuel qualification activities

6. Assuring that the final integral effects tests should use fuel produced at pilot or production scale under prototypic fabrication conditions with prototypic procedures and trained staff.

After addressing these items, the report should be finalized.

Committee Action

The Committee issued a letter on November 23, 2021, with the following conclusions and recommendations:

1. The draft NUREG report provides a logical approach to fuel qualification. The top-down approach is methodical and provides some assurance of completeness when a claim is made that a nuclear fuel is qualified. Key parts of the approach are identifying relevant experimental data and assessing associated safety margins.
2. After the comments provided in this letter are addressed, the draft NUREG report should be finalized.

5. Discussions at the Planning and Procedures (P&P) Session

The Committee discussed the Full Committee and Subcommittee schedules through March 2022 as well as the planned agenda items for Full Committee meetings.

The ACRS Executive Director also led a discussion of significant notices issued by the Agency since the last Full Committee meeting in October 2021 (this activity is documented in the memorandum dated November 16, 2021).

The Committee discussed recommendations on review of several draft and final regulatory guides (DGs and RGs), as documented in the memorandum mentioned above, dated November 16, 2021.

The ACRS ED and Chairman led a discussion of the planned re-entry of the Agency on November 7, 2021. The ACRS plans to hold an in-person (hybrid) Full Committee meeting November 30 – December 3, 2021. At the time of this current meeting, all Subcommittee meetings through February 2022 will be virtual. Alesha Bellinger, Chief of ACRS' Program Management, Policy Development, and Analysis Branch (PMDA) noted that PMDA would be sending out information about the facility [WFN complex] to the Members.

Member Petti led a discussion of planned interactions on the 10 CFR Part 53 issues including the idea of writing several letters on various aspects of this rulemaking such as: (1) staffing qualifications, (2) PRA and use of deterministic evaluations, (3) TICAP/ARCAP, and (4) source term.

Member Halnon led a discussion about a proposal to interact with the staff on a license amendment request submitted by Southern Nuclear Company that would seek to reduce the number of main steam isolation valves per steam line to one single automatic valve (inboard) and one single manual valve (outboard). This is a unique request and one that would set precedence. The Committee agreed with the proposal to arrange a Subcommittee meeting on this subject.

ED Moore led a discussion of the procedures that will be undertaken to carry out the election of officers at the next Full Committee meeting in accordance with the bylaws. The vote will likely be conducted by ballot for those Members who are present at the meeting and electronically by those Members who attend virtually. The staff will provide more information prior to conduct of the vote. ED Moore and Larry Burkhart, Chief of ACRS' Technical Support Branch, reminded Members that if they did not wish to be considered for next year's Chair or Vice-Chair positions, they needed to inform ED Moore in writing (i.e., by email) not later than November 19th.

6. Member Brown led a discussion of a reconciliation of the staff's response to the Committee's letter on the proposed draft Regulatory Guide 1.9, Revision 5, "Application and Testing of Onsite Emergency Alternating Current Power Sources in Nuclear Power Plants"

7. Scheduled Topics for the 691st ACRS Meeting

The following topics were on the agenda for the 690th ACRS meeting scheduled for November 30 – December 3, 2021:

- Research Information Letter on Fuel Fragmentation, Relocation and Dispersal during LOCA
- Proposed DG-5061 (Revision 1 to RG 5.71), "Cyber Security Programs for Nuclear Power Reactors"
- Kairos Topical Report on Mechanistic Source Term Methodology

Sincerely,



Signed by Sunseri, Matthew
on 12/21/21

Matthew W. Sunseri
Chairman

December 21, 2021

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COMMITTEE ON REACTOR SAFEGUARDS NOVEMBER 2-5, 2021

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