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

September 5, 2025

The Honorable David A. Wright
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: SUMMARY REPORT – 727th MEETING OF THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS, JULY 9 THROUGH 10, 2025

Dear Chairman Wright:

During its 727th meeting held July 9 through 10, 2025, which was conducted in person and virtually, the Advisory Committee on Reactor Safeguards (ACRS) discussed several matters. The ACRS completed the following correspondence:

LETTER

Letter to Michael F. King, Acting Executive Director for Operations, U.S. Nuclear Regulatory Commission (NRC), from Walter L. Kirchner, Chairman, ACRS, regarding X-energy, LLC's, Xe-100 Licensing Topical Report (TR) Mechanistic Source Term Approach, Revision 3, dated July 25, 2025, Agencywide Documents Access and Management System (ADAMS) Accession No. ML25204A121.

MEMORANDA

Memoranda to Micheal F. King, Acting Executive Director for Operations, U.S. NRC, from Marissa G. Bailey, Executive Director, ACRS:

- Documentation of Receipt of Applicable Official NRC Notices to the ACRS for July 2025, dated July 17, 2025, ADAMS Accession No. ML25197A800, and

- July 2025 ACRS Full Committee – Topical Reports, dated July 17, 2025, ADAMS Accession No. ML25196A201.

HIGHLIGHTS OF KEY ISSUES

A. X-energy, LLC's, Xe-100 Licensing TR Mechanistic Source Term Approach, Revision 3

The Committee heard from the applicant and NRC staff on this topic, deliberated on the relevant issues, and issued a letter on July 25, 2025, with the following conclusions and recommendations:

1. X-energy is developing a sequence-specific mechanistic source term (MST) through the use of a functional containment concept for their Xe-100 pebble bed reactor. This functional containment consists of the tristructural isotropic (TRISO) fuel kernel and coatings, the pebble matrix, and the helium pressure boundary.

2. The TR describes a reasonable conceptual plan for the development of an MST methodology and the staff safety evaluation (SE) should be issued.

3. As the methodology is further developed and implemented in future licensing applications, there are several concerns and gaps that will need to be addressed that we identify in this letter.

4. Validation of the source term methodology will be challenging due to the numerous models involved, their complexity, gaps in the historical database, and residual uncertainties associated with the constitutive relations (material properties). Furthermore, the uranium dioxide (UO_2) TRISO fuel performance models do not adequately describe uranium oxycarbide (UCO) TRISO fuel performance.

5. A parallel semi-empirical approach, tied more directly to the statistically significant failure data from the U.S. Advanced Gas-cooled Reactor UCO TRISO testing program with appropriate margins, may overcome these shortcomings.

B. Discussions During the Planning and Procedures Session

1. The Chairman and Executive Director led a discussion about the issuance of Executive Order (EO) 14300, "Ordering the Reform of the Nuclear Regulatory Commission," dated May 23, 2025, as well as the relevant parts of the Atomic Energy Act (AEA), ADVANCE Act, and the impact of future ACRS work. In accordance with the Sections 29 and 182b of the Atomic Energy Act (42 U.S.C. 2039, 2232(b)), the Advisory Committee on Reactor Safeguards (ACRS) *shall* "advise the Commission with regard to the hazards of proposed or existing reactor facilities and the adequacy of proposed safety standards." In June 2025, the ACRS implemented the Commission's direction for EO 14300, Section 4.(b), which states, in part, that the functions of the Advisory Committee on Reactor Safeguards (ACRS) shall be reduced to the minimum necessary to fulfill ACRS's statutory obligations and that review by ACRS shall focus on issues that are unique, novel and noteworthy. In its direction to the ACRS, the Commission affirmed the review and reporting on new reactor facilities and proposed safety standards are the minimum statutory functions of the ACRS under Sections 29 and 182b of the Atomic Energy Act. The ACRS will only undertake other work as directed by the Commission in accordance with the AEA.

   The ACRS will no longer undertake reviews on its own initiative; perform reviews of reactor safety research; and review amendments to reactor facilities licenses, including license renewals and subsequent license renewals unless directed by the Commission. The Committee discussed what work would be in scope for the ACRS in the future and what work would not be. A flow chart was developed and discussed that assists internal and external stakeholders in determining what work is in scope for ACRS.

New reactor applications and proposed safety standard reviews conducted by ACRS that are within scope of the EO 14300will focus on the unique, novel, and noteworthy aspects of the application or safety standard. Per Commission direction, work involving first-of-a-kind power uprates, the Palisades nuclear plant restart, and when requested, naval reactor reviews, will continue to be within scope for ACRS future work. Finally, even if a topic was not within the current scope of review for the Committee, the ACRS or NRC staff could request approval by the Commission to conduct a review.

2. The Committee discussed details of the near-term new reactor license applications including the Kemmerer construction permit application (CPA) (Terrapower Natrium design), the Long Mott CPA (X-energy design), and Clinch River CPA (General Electric BWRX-300 design).

   Regarding the Kemmerer CPA review, Member Roberts provided the following:

   a. Construction Permit Application under review,

   b. Subcommittee (SC) meetings reserved in 2025 for September 18 and 19, October 23 and 24, and November 20, and

   c. Full Committee (FC) session scheduled for December 2025 (November 2025 if possible).

   The NRC staff plans to issue the CPA by the end of this calendar year. The Committee can support the staff's schedule by finalizing the letter in the December 2025 FC meeting, or if necessary, a special FC meeting in November.

   This compresses the previous plan of seven ACRS meetings into three meetings:

   a. September – Review Licensing Modernization Project processes and portions of siting studies that are "unique, novel, or noteworthy." This corresponds to PSAR chapters 1-5. It would largely cover the proposed fourth focus area (adequacy of Probabilistic Risk Assessment (PRA)-centered approach) and provide background for the three fundamental safety functions.

   b. October – Review Structures, Systems, and Components (SSCs) and re-visit the Licensing Modernization Project processes considering the SSCs (i.e., how do the SSCs support the fundamental safety functions). This would complete the draft list of unique, novel, or noteworthy items.

   c. November – Time allocated to follow up on unique, novel, or noteworthy issues that arose from the September and October meetings and changes the applicant/staff made to the PSAR/draft SE in response to the first two meetings and the finalization of open items.

      Member Martin led a brief discussion of the status of the Long Mott CPA and stated that the application has been docketed, and tentative SC and FC dates have been reserved.

Member Harrington led a brief discussion of the status of the Clinch River CPA. The application was undergoing acceptance review and SC and FC dates will be reserved soon.

The following projects were briefly discussed but no SC or FC dates have been arranged due to the applications not yet being submitted: (1) Atomic Alchemy Light Water Reactor based technology – CPA for medical isotope production) (Member Palmtag lead), (2) OKLO Aurora combined license application (Chairman Kirchner lead), and (3) Fermi America combined license application (four AP1000 Units) (Member Sunseri lead).

3. The Committee discussed future work on new safety standards including the following: 10 CFR 50.55a(h), 10 CFR 53 final rule language, and increased enrichment final rule language.

   Member Roberts stated that he had an informal interaction with the NRC staff on the 10 CFR 50.55a(h) topic and that no further interactions were planned. Member-at-Large Petti stated that for the 10 CFR Part 53 final rule, a Subcommittee Engagement with the staff is scheduled for September 17, 2025. The increased enrichment final rule does not yet have a schedule and interaction dates for a Subcommittee Engagement will be arranged when the schedule is more concrete. Member-at-large Petti will take over as the lead for that project when Member Ballinger leaves the ACRS in August.

4. Member Sunseri led a discussion about future work on first-of-a-kind power uprates that are still in scope for ACRS reviews. He reminded the Committee of the draft memorandum to the Office of Nuclear Reactor Regulation describing that the ACRS is interested in those power uprates containing first-of-a-kind applications of analysis methodologies or fuel designs. The memorandum states that these applications should be referred to the ACRS for consideration per Commission direction; the ACRS would then decide whether to review these amendments and issue a letter report, or not, depending on the specifics of the license amendment request. This is consistent with EO 14300.

   The Committee authorized the Executive Director to sign the memorandum to the appropriate NRR division director to memorialize these expectations (ADAMS Accession No. ML25177B284).

5. Vice Chairman Halnon led a discussion of two other projects that are still within the scope of the Committees review. He stated that for the Palisades restart activities, a SC meeting is arranged for August 21, 2025, and a letter is planned for the September FC meeting. He also stated that for the Seabrook alkali-silica reaction (ASR) issue, the Committee will have a presentation from the NRC staff about the National Institute of Standards and Technology test data, and a letter is planned for the September FC meeting.

6. The Committee discussed work that was planned but that is no longer in the Committee's scope of work due to EO 14300 and Commission direction. The meetings that were previously scheduled but are now no longer in scope include:

a. License Renewal Application (LRA) Reviews

i. Perry LRA

ii. Diablo Canyon LRA

iii. Browns Ferry subsequent LRA

iv. Dresden subsequent LRA

v. Clinton LRA

b. Draft Guide on Fiber Optic Equipment - lead member engagement with staff completed

c. Artificial Intelligence Activities update - lead staff still maintaining contact with staff

d. Electric Power Research Institute Interactions

e. Probabilistic Flood Hazard Analysis Draft Guide (staff may not continue work on)

f. Regulatory Guides (RGs) 1.251 and 1.252

g. Advanced Logic System surveillance requirement elimination TR

h. Limerick Digital Instrumentation and Control License Amendment Request

i. Electric Power Research Institute High Energy Line Break TR

These meetings will be deleted from the ACRS future schedules.

7. The Committee discussed the FC and SC schedules through December 2025 as well as the planned agenda items for FC meetings.

8. The ACRS Executive Director led a discussion of significant notices issued by the Agency since the last FC meeting in June 2025. The Executive Director documented this activity in a memorandum dated July 17, 2025, ADAMS Accession No. ML25197A800.

9. The Executive Director noted that no SC meetings were held since the June FC meeting.

10. There were no RGs to discuss this month.

11. The ACRS Executive Director also led a discussion of seven TRs that were reviewed by a lead member who gave a recommendation to the Committee about the need to review the documents. The Executive Director documented this activity in a memorandum dated July 17, 2025, ADAMS Accession No. ML25196A201.

12. Member Martin led a discussion about two X-energy TRs including Transient and Safety Analysis Methodology (TSAM), Revision 2 (ML25077A288), and GOTHIC and

Flownex Analysis-Code Qualification (GFQ), Revision 3 (ML25076A053). He mentioned that these two TRs were discussed in an X-energy SC meeting on June 3, 2025.

These TRs describe preliminary evaluation models that support the Xe-100 CPA, including transient response analysis and system-level thermal-hydraulic code qualification. The TSAM establishes the Evaluation Model framework used to analyze design-basis accidents in the Xe-100, consistent with RG 1.203. The GFQ presents verification and validation results for the GOTHIC and Flownex codes, which are used to model long-term and short-term plant responses, respectively.

At the SC meeting, X-Energy and NRC staff presented the scope and basis of the revised methodology. X-Energy emphasized the use of TRISO-X proprietary particle fuel and a passive reactor cavity cooling system as the dominant safety features of the design. X-Energy described how the Xe-100 Evaluation Model was developed in alignment with applicable regulatory guidance for advanced reactors, identifying fuel temperature and system pressure as the principal safety figures of merit (FOMs). X-Energy expects that additional FOMs and safety criteria will be identified in future submittals. The requirements for the transient analysis model were established via Phenomena and Key Parameter Identification and Ranking Tables across seven transient categories. Final closure of these Phenomena and Key Parameter Identification and Ranking Tables, which, per the staff's review require state-of-knowledge assessments, is deferred to the operating license review phase.

The NRC staff concluded that the revised TSAM and GFQ reports support preliminary evaluations at the CPA stage, subject to limitations and conditions (L&Cs). For the TSAM, staff imposed three limitations and 14 conditions to constrain its use to preliminary analyses and require future documentation of additional high-temperature gas-cooled reactor specific validation and verification, and scaling and uncertainty treatments. For the GFQ report, one L&C was imposed to confirm the quality assurance implementation and ensure code inputs reflect actual plant operating conditions.

The Committee discussed several technical topics during the meeting, including: the adequacy of passive shutdown assumptions, the scaling basis for code validation in a pebble-bed reactor context, and the completeness of the proposed safety FOMs. The Committee acknowledged that key elements of the evaluation model, such as the final phenomena identification and ranking table processes and uncertainty treatment, remain under development and are expected to be completed in the operating license phase.

The Committee concludes that X-energy's preliminary safety analysis methodology and supporting code qualification are consistent with applicable regulatory guidance for CPA evaluation models. The methodology provides a reasonable foundation for future safety case development, subject to the staff's L&Cs.
Member Martin recommended that this write-up serve as the record of the SC meeting and that an ACRS letter report not be prepared.
The Committee agreed with the recommendation.

13. Chairman Kirchner led a discussion of potential changes to the SC structure to better align with the Atomic Energy Act. The new SCs will be as follows:

    a. New Reactors: Proposed Chairman – Chairman Kirchner (individual design center lead Members could be maintained)

    b. Reactor Safety Standards: Proposed Chairman – Member-at-Large Petti (individual topics could be led by specific Members)

    c. Plant Operations: Proposed Chairman – Vice Chairman Halnon. This work would include Palisades restart (Vice Chairman Halnon topic lead), and power uprates (Topic lead – Member Sunseri)

    The ACRS leadership will keep the Committee informed and will discuss future changes to the SC structure.

14. The Executive Director updated the Committee on changes to governing and guidance documents for the ACRS due to EO 14300. She mentioned that the meeting procedures will be updated in a future Federal Register Notice to allow closed engagements with the staff to have discussions of pre-decisional information such as rule language. Other documents that will be updated include: the Charter, Bylaws, ACRS Executive Director and Executive Director for Operation Memorandum of Understanding, Management Directives 6.3 (Rulemaking) and 9.3 (ACRS), and the ACRS public websites.

15. The Executive Director led a discussion of two reconciliations of NRC staff responses to ACRS letter reports including the TerraPower Natrium emergency planning zone sizing TR [Member Roberts] and the Terrestrial USA TR, "Principal Design Criteria for Integrated Molten Salt Reactor (IMSR) Structures, Systems, and Components," [Member Palmtag]. The Committee discussed the staff's responses to the ACRS letters for both topics and decided that, with respect to the Terrapower emergency planning zone sizing TR, the Committee will take no further action. Regarding the Terrestrial Principal Design Criteria topic, the Committee discussed the issue of the applicant's proposal on the criterion to have a safety-related shutdown system and the design's reliance on the negative temperature coefficient to place the reactor in a safe state. The Committee decided to further discuss this issue at the September FC meeting.

16. The Committee discussed a recent SC meeting on PRA completeness, uncertainty analysis, and cliff edge effects. At the May 2025 SC meeting, ACRS Consultant Bley presented on cliff edge effects. The NRC 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 phenomenological considerations to complement the PRA Guidance consolidating the various aspects of this process might be worthwhile.

    In a discussion on topics to consider in reviewing licensing applications, topics suggested by ACRS members included:

Risk metrics across a plant's lifecycle, from design to operation: What is the role of PRA-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 arguments to containment analysis? Should containment remain as a domain for deterministic conservatism? What is the role of deterministic elements in risk-informed performance-based analyses more generally?

Advanced reactors and PRA: What are the roles of risk importance measures (e.g., Risk Achievement Worth, Fussell-Vessely Importance) versus 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 considering the recently issued EO 14300 and will revisit if future ACRS action is needed on this topic.

17. The Committee received a comment from a member of the public prior to closing the planning and procedures meeting. Dr. Edwin Lyman of the Union of Concerned Scientists expressed "great dismay at what is happening and being forced" onto the NRC and ACRS, as a result of EO 14300. Dr. Lyman highlighted that the NRC is an independent agency that is now having an "artificially imposed schedule for new reactor design timelines imposed on it for reactors that may have difficult technical issues." Dr. Lyman urged the ACRS and NRC staff to ensure that if they did not have enough time to deliberate on a new reactor design that this be raised to the Commission. Dr. Lyman stated that the American public is counting on the ACRS's review as "the last bulwark to independent reactor safety reviews in the United States." Dr. Lyman also expressed his disagreement with EO 14300 Section 4.(b) that will now require the ACRS to parse out and focus its reviews on what is novel and noteworthy. Dr. Lyman also expressed disagreement with the future ACRS reviews on reactor safety standards. Specifically, draft rulemaking information has been shared publicly in ACRS Subcommittee meetings for the past 50 years on rules and now that information will only be shared in non-public meetings between the ACRS and NRC staff. Dr. Lyman expressed dismay that the information exchange on reactor safety standards will be lost to the American public. Dr. Lyman summarized that public confidence and trust will be eroded in nuclear safety as a result. Finally, Dr. Lyman expressed concern for outside interference with ACRS deliberations and urged the Committee to continue to conduct thorough reviews in the public to the extent that the Committee members can.

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

19. The following topics are on the agenda for the 728th ACRS FC meeting, which will be held September 3 through 5, 2025:

    a. Wrap-up of current ACRS activities on the Seabrook alkali-silica reaction topic, and

    b. Palisades nuclear plant restart.

Sincerely,

Walter L Kirchner Signed by Kirchner, Walter on 09/05/25

Walter L. Kirchner
Chairman

Enclosure:
List of Acronyms

September 5, 2025

SUBJECT: SUMMARY REPORT – 727th MEETING OF THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS, JULY 9 THROUGH 10, 2025

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LIST OF ACRONYMS

ACRS	Advisory Committee on Reactor Safeguards
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act
CPA	Construction Permit Application
EO	Executive Order
FC	Full Committee
FOMs	Figures of Merit
GFQ	GOTHIC and Flownex Analysis-Code Qualification
IMSR	Integrated Molten Salt Reactor
L&Cs	Limitations and Conditions
LRA	License Renewal Application
MST	Mechanistic Source Term
NRC	Nuclear Regulatory Commission
PRA	Probabilistic Risk Assessment
PSAR	Preliminary Safety Analysis Report
RG	Regulatory Guide
SE	Safety Evaluation
SC	Subcommittee
SSCs	Structures, Systems, and Components
TR	Topical Report
TRISO	Tristructural Isotropic
TSAM	Transient & Safety Analysis Methodology
UCO	Uranium Oxycarbide
UO_2	Uranium Dioxide