



Non-LWR Regulatory Framework Modernization

September 2024

Changing the World's Energy Future

Jason Albert Christensen, Christopher Paul Chwasz, Jim C Kinsey, Scott E Ferrara



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Fiscal Year 2024

SEPTEMBER 2024

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Advanced Reactor Technologies



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Non-LWR Regulatory Framework Modernization

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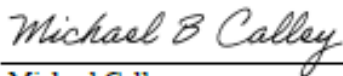


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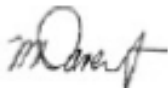
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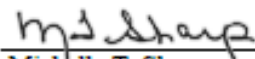
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SUMMARY

This report provides an end-of-year summary that reflects the progress and status of Idaho National Laboratory's (INL's) activities concerning the development of an advanced-reactor regulatory framework and its implementation in the United States (U.S.). The report also provides recommendations for work to be performed in Fiscal Year (FY)-25 and beyond. This work was completed in FY-24 and was supported by the U.S. Department of Energy (DOE) Regulatory Development sub-program. These activities are managed by INL on behalf of DOE.

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ACRONYMS

AMMT	Advanced Materials and Manufacturing Technologies
ANL	Argonne National Laboratory
ANR	advanced nuclear reactors
AR	advanced reactor
DOE	U.S. Department of Energy
EP	Emergency Planning
FY	Fiscal year
INL	Idaho National Laboratory
MSR	Molten-salt reactor
NEI	Nuclear Energy Institute
NGO	Non-governmental organization
Non-LWR	Non-light-water reactor
NRC	Nuclear Regulatory Commission
NTD	National technical director
TWG	Technical working group
U.S.	United States

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Non-LWR Regulatory Framework Modernization

Fiscal Year 2024

1. PURPOSE

This report provides an end-of-year summary that reflects the progress and status of Idaho National Laboratory's (INL's) Regulatory Development Group activities concerning advanced reactor (AR) (i.e., non-light-water reactor [non-LWR]) regulatory-framework development and implementation. This report was developed to address and satisfy the United States (U.S.) Department of Energy (DOE) milestone M3RD-24IN0702014, "Provide recommendations for R&D needed to establish licensing technical requirements and provide a summary of FY24 regulatory framework development outcomes," under INL work package RD-24IN070201, "Non-LWR Regulatory Framework Modernization."

2. OBJECTIVES

Non-LWR regulatory-framework modernization activities are intended to establish a clearly defined regulatory structure for the non-LWR community and help implement regulatory and licensing strategies for newly emerging commercial nuclear-power technologies. Additionally, this activity was initiated to engage in the progress of regulatory actions conducted by industry and government agencies and to interact with stakeholders on matters important to licensing in support of commercial deployments.

This activity coordinates DOE regulatory efforts with industry, non-government organizations, and Nuclear Regulatory Commission (NRC) staff and stakeholders, ensuring that DOE research and development (R&D) activities are appropriately aligned and that they adequately address aspects of licensing technical requirements that are incompatible or add uncertainty in an evolving regulatory environment.

3. SUMMARY OF COMPLETED ACTIVITIES

Non-LWR regulatory-framework modernization activities encompassed work performed by DOE and INL researchers to plan and develop new R&D activities, participate in industry and government interactions associated with AR development and near-term deployment, and coordinate interactions with DOE and NRC. The following subsections of this report summarize the work performed by INL's Regulatory Development group in FY-24.

3.1. Meetings and Interactions

Throughout FY-24, INL Regulatory Development Group staff regularly participated in a variety of meetings that supported AR development and deployment. Members of the group researched, attended, and participated in the hybrid AR stakeholder meetings that NRC held approximately every 6 weeks, typically attended virtually by NRC staff. Additionally, some INL staff attended and participated in the AR regulatory task-force meetings, which were usually held virtually by the Nuclear Energy Institute (NEI) 1 day prior to the NRC AR stakeholder meetings.

The engagement in and impact of these meetings proved essential to INL staff for maintaining currency in the nuclear industry and remaining knowledgeable about its state—especially in regard to ARs—thus allowing the staff to assist industry as it moves forward on regulatory activities. INL's Regulatory Development Department frequently communicated directly with NEI, NRC, DOE, individual applicants, and other national laboratories to engage and actively participate in development and near-term deployment activities related to regulatory development.

3.2. Industry-Led Technology Working Groups

The national technical directors (NTDs) and other key regulatory-development sub-program staff work to maintain a regular and open dialogue with established industry-led technical working groups (TWGs) for high-temperature gas-cooled reactors, fast reactors, and molten-salt reactors (MSRs). These interactions are critical to ensure that high-priority, high-impact regulatory-framework issues are clearly understood, efficiently integrated, and appropriately prioritized within the associated areas of the regulatory-development initiatives in direct support of the timely commercial deployment of these technology types. INL staff's attendance of these TWG meetings helped inform the Integrated Planning List for the regulatory-framework modernization area in FY-25.

3.3. Molten-Salt Reactors

During FY-24 the INL regulatory development team followed the MSR Program as well as research and industry groups. The INL team interfaced with the MSR Program, researchers, vendors, and industry groups to maintain understanding of the regulatory challenges facing that technology area. This relationship resulted in FY-24 Regulatory Framework Development-funded work on MSR fuel-salt qualification, which has been socialized among the MSR Program, the Electric Power Research Institute, French government researchers (at the Commissariat à l'énergie atomique et aux énergies alternatives [CEA]), and the NRC to warm reception. Continuing engagement within the MSR technology area is vital to support this area of lower technological and regulatory readiness for future deployment.

3.4. Physical Security

The INL Regulatory Development Team has followed developments associated with changing regulations and guidance associated with the physical security of advanced and small modular reactors for the last several years. In particular, NRC rulemaking NRC-2017-0227, "Alternative Physical Security Requirements for Advanced Reactors," and NRC-2019-0062, "10 CFR Part 53: Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors," have presented new licensing pathways and draft guidance that provide pathways that could dramatically change the regulatory landscape for reactors within the scope of physical security. The INL team interfaced with regulators, industry groups (e.g., the NEI) and reactor vendors to understand the challenges they see and opportunities for regulatory clarity and guidance.

4. RECOMMENDATIONS FOR FUTURE ACTIVITIES

Information obtained through attendance and/or participation in meetings, activities, and conferences is critical to the identification of recommended activities for FY-25 and beyond. This year, the following items were identified for potential funding in FY-25.

Under the regulatory-framework modernization task, the INL Regulatory Development Team evaluated and prepared the work scope for FY-25 and beyond to include a DOE Integrated Planning List. The group participated in extensive interactive dialogue with DOE laboratories and interacted with industry stakeholders and researchers across the DOE laboratory complex in order to develop R&D and regulatory-development work scopes and to determine resource requirements. This included review and incorporation of items from the NEI Industry Priorities List. Additionally, the group worked to identify and prioritize industry and government needs, using them as the basis for developing a work scope for FY-25. By coordinating with industry stakeholders, DOE, and NRC, INL staff successfully identified areas of near-term R&D needs for current and near-future AR licensing-support activities that generally align with industry goals and priorities.

4.1. Multi-Lab Regulatory Coordination and Integration Group

Founded and continued through previous fiscal years, this group has been very successful at providing comments and recommendations for reports from the NEI and other non-governmental organizations (NGOs), licensing activities, and regulations developed by the NRC for ARs. Funding for this group will continue into FY-25 when the main focus will be review of the updated 10 CFR Part 53 regulations.

4.2. Molten-Salt Reactors

Continued interfaces with the MSR Program, vendors, regulators, and researchers will support understanding of developing regulatory gaps and challenges. FY-24's work on fuel qualification identified near-term projects to provide regulatory clarity. Work in FY-25 will seek identification of additional challenges and opportunities to address near-term issues.

4.3. Performance-Based Physical-Security Analysis

Interactions and interfaces with regulators, licensees, reactor designers, and industry groups for FYs-20–24, as the NRC rulemaking “Alternative Physical Security Requirements for Advanced Reactors” have developed, have supported the identification of potential guidance documents. The INL group drafted a proposal for FY-25 to develop regulatory guidance to assist applicants and licensees in meeting the proposed physical-security rules and regulations under Part 73 and draft Part 53. These proposed performance-based frameworks would require license-application formatting that matches the requirements and new methods proposed for regulatory compliance. This effort is anticipated to be supported by both the Regulatory Framework Modernization and the Advanced Reactor Safeguards Programs. Continued attention to developments within physical security will allow the informing of feedback and public comment to regulators and understanding of industry concerns in this fluid space.

4.4. Advanced-Materials and Manufacturing Technologies Support

During FY-24, it was identified that the Advanced Materials and Manufacturing Technologies (AMMT) Program will likely need regulatory support in the near future to support its obtaining endorsement of codes and standards and regulatory approval of other work performed by the program. After discussion with the AMMT NTD, it is recommended that the Regulatory Development Program provide funding for INL staff to work with AMMT staff and attend meetings such as the AMMT annual program review to help determine areas of possible future support as well.

4.5. Sodium Fast-Reactor Consensus Standards

Starting in FY-23, the Regulatory Development Program began funding work to review and make recommendations for redevelopment of the ANS-54 series of consensus standards, which specifically pertained to sodium fast reactors. A majority of these standards were withdrawn in the year 2000 after there was little need for them. Today, the need for these standards has been identified, and in FY-24, the Regulatory Development Program funded work to revive ANS-54.8, “Liquid Metal Fire Protection in LMR Plants.” This specific standard had been identified by stakeholders as necessary to AR design and construction. To revive the standard, Argonne National Laboratory (ANL) engaged the ANS-54.8 Working Group to expedite the revival process. ANL provided significant historical information to the committee and became participants of the group. Work on the revival of this standard will continue into FY-25 through funding from the Regulatory Development Program. The main goal for FY-25 will be to reissue the consensus standard. This will include addressing comments and suggestions for ANS-54.8. Full approval and implementation of this standard is expected to be completed in September 2025.

5. CONCLUSIONS

During FY-24, the INL regulatory development department used funding provided under the regulatory-framework modernization activity to support many critical activities while also achieving measurable results that aid in reactor deployments. The funding has been critical to maintaining relationships and interactions with the AR community, including with industry partners, applicants, DOE, and NRC. This report discusses these activities and provides recommendations for activities to be performed in FY25. These activities include:

- Continued funding of the Multi-Lab Coordination and Integration Group,
- Support for the molten salt reactor campaign,
- Work in performance-based physical security analysis,
- Interactions with the AMMT program to determine future regulatory needs for the program, and
- Continued funding of the sodium reactor consensus standards development.

Activities planned to be performed in FY25 will ensure that the Regulatory Development Program has a strong impact on the nuclear industry, NRC, and other organizations.

6. REFERENCES

Bucknor, M. 2024. "FY24 Efforts to Revive the ANS-54.8 Liquid Metal Fire Protection in LMR Plants Standard." ANL/NSE-24/66, Argonne National Laboratory, Lemont, IL.

Appendix A

Meetings and Conferences Attended

A-1. Ongoing

- Every other Wednesday: ART Leads Update Meeting

A-2. Attended

- October 19, 2023: NRC Commission Meeting for Kairos Power (<https://www.nrc.gov/reading-rm/doc-collections/commission/tr/2023/index.html>)
- October 24-26, 2023: NRC Advanced Manufacturing Technologies Workshop (<https://www.nrc.gov/pmns/mtg?do=details&Code=20231129>)
- October 25, 2023: NRC Advanced Reactor Public Meeting (<https://www.nrc.gov/pmns/mtg?do=details&Code=20230810>)
- October 27, 2023: NRC Public Meeting on Draft RG 4034 “General Site Suitability Criteria for Nuclear Power Stations” (<https://www.nrc.gov/pmns/mtg?do=details&Code=20231171>)
- November 15, 2023: HTR TWG Meeting
- November 17, 2023: Nuclear Innovation Alliance NGO Coordination Call on Part 53
- November 30, 2023: NEI Advanced Reactor Forum (Will look for slides)
- December 6, 2023: ACRS Meeting (<https://www.nrc.gov/docs/ML2330/ML23307A110.pdf>)
- December 7, 2023: FY23 4th Quarter Performance Evaluation
- December 7, 2023: NRC Advanced Reactor Public Meeting (<https://www.nrc.gov/pmns/mtg?do=details&Code=20230812>)
- January 17, 2024: New Reactor Regulatory Working Group
- January 17, 2024: HTR TWG Meeting
- January 24, 2024: NRC AR Public Meeting (<https://www.nrc.gov/pmns/mtg?do=details&Code=20231097>)
- February 6-8, 2024: DOE-NE-52 ART Fast Reactor Program Review
- February 14, 2024: NRC/DOE/Lab Followup Conversation
- February 21, 2024: FY 24 First Quarterly Performance Evaluation Review Presentation
- February 28, 2024: NRC ARCOP Public Meeting (<https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML24047A274>)
- February 5-7, 2024: DOE-NE Microreactor Program Review
- March 11, 2024: NEI Advanced Reactor Forum (Held in Bethesda North Marriott)
- March 12-14, 2024: NRC Regulatory Information Conference
- March 14, 2024: New Reactor Regulatory Working Group (Held at Bethesda North Marriott, Bethesda, Maryland)

- March 27, 2024: Advanced Reactors Public Meeting
(<https://www.nrc.gov/pmns/mtg?do=details&Code=20240086>)
- April 23-25, 2024: NRIC Program Review (attended sections)
- May 1-2, 2024: LMP Construction Workshop (attended May 1)
- May 6, 2024: Regulatory Framework Modernization Program Review
- May 7, 2024: FY24 2Q Performance Evaluation
- May 22, 2024: NEI New Reactor Regulatory Working Group
- May 23, 2024: NRC Advanced Reactors Public Meeting
(<https://www.nrc.gov/pmns/mtg?do=details&Code=20240427>)
- June 18, 2024: NEI Advanced Reactor Forum (in person)
- June 26, 2024: RHDRA Discussion with Advanced Reactor Regulatory Task Force members
- July 16-18, 2024: ART GCR Program Review Meeting (attended sections)
- July 24, 2024: NRC Advanced Reactors Public Meeting
(<https://www.nrc.gov/pmns/mtg?do=details&Code=20240753>)
- July 29, 2024: New Reactor Regulatory Working Group (virtual)
- September 9, 2024: NEI New Reactor Regulatory Working Group (Philadelphia, Pennsylvania)

A-3. Planned at Time of Report Development

- September 18, 2024: NRC Advanced Reactor Public Meeting
(<https://www.nrc.gov/pmns/mtg?do=details&Code=20240791>)
- September 25, 2024: NRC Standards Forum (attending for NRC-INL collaborative effort)