



POLICY ISSUE

(Information)

February 1, 2021

SECY-21-0010

FOR: The Commissioners

FROM: Andrea D. Veil, Acting Director
Office of Nuclear Reactor Regulation

SUBJECT: ADVANCED REACTOR PROGRAM STATUS

PURPOSE:

This paper provides the Commission with an update on the U.S. Nuclear Regulatory Commission (NRC) staff's ongoing activities to make the safe use of advanced nuclear reactor technology possible. The paper informs the Commission about the progress and the path forward on its advanced reactor licensing and readiness activities such as the resolution of key technology-inclusive policy issues, development of risk-informed and performance-based licensing approaches, and interactions with prospective applicants and other stakeholders. This paper does not address any new commitments or resource implications.

BACKGROUND:

To prepare to review and regulate a new generation of non-light water reactors (non-LWRs), the NRC developed the vision and strategy described in the report "NRC Vision and Strategy: Safely Achieving Effective and Efficient Non-Light Water Reactor Mission Readiness," issued in December 2016.¹ To achieve the goals and objectives stated in that report, the staff developed an implementation action plan (the plan), dated July 12, 2017.² The plan identified specific activities the staff expects to conduct in the near-term (0–5 years), mid-term (5–10 years), and long-term (beyond 10 years) timeframes to achieve non-LWR readiness. The staff has made significant progress over the past year on its ongoing activities to support licensing advanced reactors. Many of these activities support those required by Section 103 of the Nuclear Energy Innovation and Modernization Act (NEIMA), which was signed into law on January 14, 2019.³

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¹ See ADAMS (Agencywide Documents Access and Management System) Accession No. ML16356A670.
² See ADAMS Accession No. ML17165A069 and ADAMS Accession No. ML17164A173.
³ See <https://www.congress.gov/bill/115th-congress/senate-bill/512>.

As required by Sections 103(b) and 103(c) of NEIMA, the NRC prepared reports on (1) expediting and establishing stages in the licensing process for commercial advanced nuclear reactors and (2) increasing, where appropriate, the use of risk-informed and performance-based evaluation techniques and regulatory guidance in licensing commercial advanced nuclear reactors within the existing regulatory framework. The NRC sent these two reports to Congress on July 12, 2019.⁴ In accordance with NEIMA Section 103(a)(2), the staff has developed and implemented strategies for the increased use of risk-informed, performance-based licensing evaluation techniques and guidance for advanced reactors within the existing regulatory framework for the resolution of policy issues. Also consistent with Section 103(a)(4) of NEIMA, the staff has continued efforts to establish a “technology-inclusive regulatory framework” for optional use by applicants for new commercial advanced nuclear reactor licenses. The staff has also enhanced its advanced reactor technical readiness in accordance with Section 103(a)(5) of NEIMA, which requires the NRC to provide for staff training or hiring of experts to support the activities specified in Section 103(a)(1)–(4) of NEIMA, as well as to support preparations for preapplication interactions and reviews of commercial advanced reactor license applications.

DISCUSSION:

As described in the plan, the staff has organized its non-LWR readiness efforts into six strategic areas:

- (1) staff development and knowledge management
- (2) analytical tools
- (3) regulatory framework
- (4) consensus codes and standards
- (5) resolution of policy issues
- (6) communications

Since issuing the plan, the staff has made significant progress on activities in all of these areas. This paper provides an overview of key accomplishments made through December 31, 2020. The enclosure provides a more detailed status of each of the staff’s activities in calendar year (CY) 2020 under each of the strategic areas. The staff described previous accomplishments and provided background information in the three previous annual updates: SECY-18-0011, SECY-19-0009, and SECY-20-0010, dated January 25, 2018,⁵ January 17, 2019,⁶ and January 30, 2020,⁷ respectively.

The staff is continuing its readiness activities in fiscal year (FY) 2021, prioritizing rulemaking to establish a technology-inclusive, risk-informed, and performance-based regulatory framework and associated guidance for advanced reactors, so that it can complete the rulemaking by the Commission-directed deadline of October 2024. The staff has begun rulemaking to develop a transformative, clear, reliable, yet appropriately flexible framework with regulations encompassing various attributes of advanced reactor technologies. The staff is scheduling a series of public meetings to engage stakeholders and the Advisory Committee on Reactor Safeguards (ACRS) in the development of a draft proposed rule for Commission consideration.

⁴ See letter to Senators Barrasso and Pallone from Chairman Svinicki, dated July 12, 2019 (ADAMS Accession No. ML19128A289).

⁵ See ADAMS Accession No. ML17334B184.

⁶ See ADAMS Accession No. ML18346A075.

⁷ See ADAMS Accession No. ML19331A712.

This rulemaking would create 10 CFR Part 53, “Licensing and Regulation of Advanced Nuclear Reactors,” in keeping with the NRC vision and strategy report and the statutory provisions in NEIMA Section 103(a)(4).

The staff is executing its vision to become a modern, risk-informed regulator by streamlining and optimizing reviews to enable the deployment of advanced reactor technologies. To this end, the staff has issued Regulatory Guide (RG) 1.233, Revision 0, “Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Approach to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors,”⁸ in June 2020, endorsing NEI 18-04 “Risk-Informed Performance-Based Technology-Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development”, Report Revision 1. The staff is also developing an advanced reactor generic environmental impact statement (GEIS) and associated rulemaking, and it is conducting additional rulemakings on emergency preparedness and physical security. The staff also continued other high-priority activities, including development of performance-based guidance for Content of Applications (Technology-Inclusive Content of Application and Advanced Reactor Content of Application Projects), development of inspection and oversight framework, endorsement of consensus codes and standards, and resolution of micro-reactor licensing and policy issues.

The level of activity in licensing has increased over the past year and is expected to continue to grow. On March 11, 2020, Oklo Power LLC (Oklo), a subsidiary of Oklo Inc., submitted a combined license (COL) application for its Aurora micro-reactor design, proposed to be constructed and operated at the Idaho National Laboratory. This is the first COL application for a non-LWR submitted to the NRC. The design uses metallic fuel to produce about 1.5 megawatts of electrical power. On June 5, 2020, the NRC informed Oklo of the staff’s plans to complete the review in a two-step process.⁹ As the first step, the NRC staff is engaging Oklo in public meetings, conducting regulatory audits, and issuing requests for additional information to reach a full understanding of four key safety and design aspects of the Aurora licensing basis: (1) the maximum credible accident, (2) the classification of systems, structures, and components, (3) the applicability of NRC regulations to the Aurora design, and (4) the quality assurance program scope. The Step 1 review is making progress, and approaches to the maximum credible accident and classification of structures, systems, and components are still being discussed with Oklo. On November 17, 2020, the staff issued two letters informing Oklo of the closure of the regulatory applicability item, consolidating the quality assurance program scope item with the classification of structures, systems, and components, and identifying information needed for the two remaining technical areas. After completing the first step, the staff will establish the schedule for the full detailed technical review. The staff is using data analytics to develop dashboards that will improve efficiency, transparency, and management oversight for this review. The staff plans to gain experience using these dashboards in order to further refine our efforts to inform our licensing activities through data analysis and enhance transparency with stakeholders.

The staff continues to implement flexible and multi-staged non-LWR regulatory review processes to engage with developers. In the past year, the staff has reviewed numerous white papers and topical reports. The staff is engaged with X-Energy, LLC, on its pebble-bed high-temperature gas-cooled reactor; Kairos Power on its pebble-fueled molten-fluoride-cooled

⁸ See ADAMS Accession No. ML20091L698.

⁹ See “Acceptance of the Application for a Combined License Application for the Aurora at Idaho National Laboratory,” dated June 5, 2020 (ADAMS Accession No. ML20149K616).

reactor; Terrestrial Energy on its molten salt reactor; and TerraPower on its sodium-cooled fast reactor. The NRC issued the final safety evaluations for the Electric Power Research Institute topical report on Uranium Oxycarbide (UCO) Tristructural Isotropic (TRISO) coated particle fuel performance and the Argonne National Laboratory topical report on the quality assurance program plan for the sodium-cooled fast reactor metallic fuel data qualification. The staff also continues preapplication engagement with X-Energy, LLC, for a planned fuel fabrication facility to produce TRISO fuel as well as review of the Centrus license amendment request to demonstrate the production of high assay low enriched uranium (HALEU)¹⁰ at its Piketon, OH, facility. On May 26, 2020, the staff issued Revision 15 of the Certificate of Compliance for the Daher-Transport Logistics International, Inc., Versa-Pac transportation package. The revision authorizes shipment of an advanced reactor fuel form (TRISO particles) with uranium enrichment up to 20 weight percent uranium-235. The review included revised criticality analysis for the higher enriched material. The staff is also supporting the preapplication efforts related to Abilene Christian University's plan to submit an application for a molten salt (liquid fueled) non-power research reactor. The staff expects the level of preapplication engagement to increase in CY 2021.

To support the Department of Energy (DOE) Advanced Reactor Demonstration Program (ARDP), the staff is preparing for increased licensing activity. In October 2020, the DOE selected two teams, one led by TerraPower and the other led by X-energy, to receive initial funding under the demonstration program which will lead to applications within the next couple of years. In addition, in December 2020 the DOE selected five teams to receive initial funding under the risk reduction program and three U.S. based teams to receive funding under the Advanced Reactor Concepts 20 program. These awards will generate preapplication engagement for multiple advanced reactor designs.

Extensive stakeholder engagement and cooperation with other federal agencies, international counterparts and industry organizations continues to inform the staff's activities. In 2020, the staff conducted over 20 public meetings to obtain stakeholder feedback on a variety of advanced reactor topics. On October 6, 2020, the DOE held a public forum on developing a regulatory framework for commercial fusion reactors. The NRC staff and the Fusion Industry Association (FIA) helped organize and moderate the forum. The staff will continue to collaborate with the DOE, the FIA, and other stakeholders in 2021 to support developing options for Commission consideration on a framework for regulating commercial fusion facilities. Frequent engagement with counterparts at the DOE on projects such as the Versatile Test Reactor (VTR) and at the U.S. Department of Defense (DoD) on Project Pele under memoranda of cooperation is ongoing. The staff also interacts with the Air Force on its potential use of microreactors. The staff chairs the Nuclear Energy Agency's Working Group on the Safety of Advanced Reactors and the NRC is collaborating with the Canadian Nuclear Safety Commission (CNSC) on advanced reactor and small modular reactor (SMR) technical review approaches and preapplication activities under a memorandum of cooperation.¹¹ The NRC and CNSC Subcommittee members have met with several advanced reactor and SMR vendors that have activities underway at both the NRC and the CNSC and have approved work plans for cooperation in preapplication review activities on several designs. Working groups have been formed for these projects, and joint review activities on the selected topics are in progress. Common reports on two of these projects are expected in spring of 2021.

¹⁰ HALEU is uranium enriched up to 20 percent and is used in several advanced reactor fuel designs.

¹¹ See ADAMS Accession No. ML192750578.

The NRC continues to develop expertise and tools to enhance our readiness to efficiently and effectively review advanced reactor applications. During the year, the staff had opportunities to learn about various technical topics related to advanced reactor technologies. The staff updated software to strengthen technical bases for regulatory decisions, while increasing review agility. To this end, the staff completed its assessment of existing computer codes and tools that may meet non-LWR review and other regulatory application needs. In October 2019, when the Office of New Reactors merged with the Office of Nuclear Reactor Regulation (NRR), the NRC created a new Division of Advanced Reactors and Non-Power Production and Utilization Facilities (DANU) to increase focus on advanced reactor readiness activities and to increase staff capacity to support advanced reactor licensing. In FY 2021, the staff plans to continue to fill vacancies, so as to further increase organizational capacity to support the projected advanced reactor workload. As in previous years, the NRC will seek information from prospective near-term applicants to ensure that technology-inclusive readiness activities will support their plans.

The status of the NRC's advanced reactor readiness activities is available on the agency's public Web site (<https://www.nrc.gov/reactors/new-reactors/advanced.html>). The Web site has been reorganized to improve access to information and increase transparency with stakeholders. The Web site is routinely reviewed and updated to ensure that it is current. To provide better visibility and clarity on the staff's activities, an integrated schedule is also included on the site. It shows the ongoing regulatory activities within each strategy in the advanced reactor program. The integrated schedule is updated prior to each periodic advanced reactor stakeholders meeting.¹²

In the area of licensing light water SMRs, the staff has made significant strides in reviewing submittals from developers in 2020. The staff completed the technical review of the NuScale design certification (DC) application ahead of schedule, issued a Standard Design Approval (SDA), and initiated efforts to draft the *Federal Register* Notice and associated SECY for the NuScale DC proposed rule. NuScale has also initiated pre-application activities for a new SDA for a modified 12 module 720 MWe design. NuScale plans to submit a series of Topical Reports (TRs) in the 2020-2022 timeframe describing the design changes. The staff has completed its review of one TR in 2020 and is currently reviewing two TRs that will support the SDA application. Four additional TRs will be submitted by NuScale during CY 2021, and three TRs are planned for 2022, thus completing NuScale's proposed SDA pre-application phase.

The staff is also engaged with General Electric-Hitachi (GEH) regarding their Boiling Water Reactor (BWR) X-300 design and SMR, LLC (a Holtec International Company) (Holtec) regarding their SMR-160 design. The GEH BWRX-300 design is a scaled-down version of the certified ESBWR design. In 2020, the NRC staff completed reviews of two TRs and the staff anticipates completing another three TRs in 2021 in order to support a future application by GEH which currently is anticipated in 2023. Holtec submitted their first TR in December 2020 regarding their 160 MWe design and plans to submit five additional TRs in the 2021-2022 timeframe.

The staff will focus on numerous high priority activities in 2021 consistent with the integrated action plan. The staff will continue its review of the Oklo Aurora COL application. The staff will also continue developing the Part 53 Rulemaking and other actions required by NEIMA, the advanced reactor GEIS, guidance for Content of Applications, and the inspection and oversight framework. The NRC will continue preapplication engagement with ARDP selectees

¹² <https://www.nrc.gov/reactors/new-reactors/advanced/adv-rx-integrated-schedule.pdf>

and other developers. Other high priority activities include continued guidance development activities, such as endorsement of consensus codes and standards and continued activities associated with the Emergency Preparedness and Security Rulemakings. As part of the NRC's goal of being a modern risk-informed regulator and building strong partnerships, as well as optimizing resource use and leveraging experience, the staff will continue extensive engagement and cooperation with its counterparts at the DOE on projects such as the VTR and the DoD on Project Pele. The staff will also continue engagement and coordination with the CNSC and other international counterparts.

CONCLUSION:

The staff has made significant progress in activities related to each of the six strategic areas. The staff is continuing its advanced reactor readiness activities in FY 2021, with a priority on advancing risk-informed and performance-based licensing approaches, addressing key policy issues, and continuing to engage in preapplication interactions with prospective applicants.

The staff will keep the Commission informed of the status of its readiness activities, plans for potential licensing applications, and advanced reactor policy topics, and will seek Commission decisions where appropriate.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objections.

Andrea D. Veil, Acting Director
Office of Nuclear Reactor Regulation

Enclosure:
Non-Light Water Reactor Implementation
Action Plan Progress Summary and
Future Plans

SUBJECT: ADVANCED REACTOR PROGRAM STATUS DATED: February 1, 2021[SRM-M170511-4](#)**ADAMS Accession Nos.: ML19331A034 Package ML20345A239 SECY-012**

OFFICE	NRR/DANU/UARP	NRR/DANU/UARP	NRR/DANU/UARP	QTE
NAME	MKhan	ACubbage	JSegala	JDougherty
DATE	11/30/2020	11/30/2020	12/7/2020	11/27/2020
OFFICE	NRR/DANU/UARL	NRR/DANU/UART	NRR/DANU	NMSS/DFM
NAME	BBeasley	MHayes	MShams	AKock
DATE	12/8/2020	12/8/2020	12/14/2020	12/22/2020
OFFICE	NSIR/DPR	NSIR/DPCP	RES/DSA	RES/DE
NAME	KBrock	SHelton	MCase	LLund
DATE	12/17/2020	12/18/2020	12/23/2020	12/18/2020
OFFICE	RES/DRA	OCFO/DOB	OGC	NRR
NAME	MCheck	FMiller	MCarpenter	AVeil (RTaylor for)
DATE	12/14/2020	12/15/2020	1/25/2021	2/1/2021

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