



POLICY ISSUE

(Information)

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FOR: The Commissioners SECY-24-0020

FROM: Andrea D. Veil, 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 (the staff's) ongoing activities to license and regulate the nation's civilian use of advanced reactor technology, including non-light-water reactors (non-LWRs) and light-water small modular reactors (SMRs). The paper informs the Commission about the progress made during calendar year (CY) 2023, on the staff's advanced reactor licensing and readiness activities, such as addressing key technology-inclusive rulemaking and policy issues, interactions with current and prospective applicants and other stakeholders, and continued development of the expertise and regulatory processes necessary to allow innovation and the commercialization of advanced nuclear reactors. This paper does not address any new commitments or resource implications.

SUMMARY:

In 2023, the staff completed and continued progress on many activities related to licensing and regulating advanced reactor technologies, including licensing reviews, rulemakings, and guidance development. The staff completed one construction permit application review leading to the first construction permit issued by the NRC for a non-LWR technology since the NRC was established in 1975.¹ The staff continued its review of two non-LWR construction permit applications and a standard design approval application for an SMR design. Additionally, the staff reviewed numerous topical reports and white papers in support of preapplication engagement. The staff also developed a Commission paper regarding micro-reactor licensing and deployment considerations. The staff continued engagement and cooperation with domestic and international partners on topics such as joint reviews of non-LWR and SMR designs.

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¹ The Atomic Energy Commission previously issued construction permits for non-LWR technologies (e.g., the Fort Saint Vrain and Fermi Unit 1 facilities).

BACKGROUND:

To prepare for the licensing and regulation of a new generation of non-LWRs, the staff issued the report “NRC Vision and Strategy: Safely Achieving Effective and Efficient Non-Light Water Reactor Mission Readiness,” in December 2016 (Agencywide Documents Access and Management System Accession No. ML16356A670). To achieve the goals and objectives stated in that report, the staff developed the “NRC Non-Light Water Reactor Near-Term Implementation Action Plans” (ML17165A069) and “NRC Non-Light Water Reactor Mid-Term and Long-Term Implementation Action Plans” (ML17164A173), which were both issued in July 2017. The staff has achieved many of the goals outlined in these documents and continues to make significant progress on the remaining activities, many of which relate to requirements in section 103 of the Nuclear Energy Innovation and Modernization Act (NEIMA), which was signed into law on January 14, 2019 (Public Law 115-439).² Since 2018, the staff has prepared this annual Advanced Reactor Program Status paper (ML17334B217, ML18346A075, ML19331A712, ML20345A239, ML21337A377, ML22353A284) to update the Commission on advanced reactor activities.

This annual Advanced Reactor Program Status SECY paper is a focused and streamlined summary of the staff’s activities in 2023. The paper leverages real-time data on our public websites to provide a dynamic status of the staff’s regulatory infrastructure and licensing activities.

DISCUSSION:

The staff is actively reviewing advanced reactor licensing submittals as it continues to enhance its regulatory framework for future reviews. This paper summarizes the key accomplishments and activities during CY 2023 and discusses activities in the following areas:

- Regulatory Framework Advancement
- Licensing
- Analytical Tool Capabilities
- External Coordination and Communication
- International Collaboration
- Oversight

Enclosure 1 provides a summary of key accomplishments and activities in these areas.

Regulatory Framework Advancement

In 2023, the staff reached a significant milestone by completing a draft proposed rule containing an innovative regulatory structure for licensing commercial nuclear reactors, including non-LWRs and light-water SMRs. In addition, the staff continued to place a high priority on activities to develop guidance for advanced reactors, further enabling the near-term licensing of advanced reactors.

² <https://www.congress.gov/bill/115th-congress/senate-bill/512>

Rulemaking

10 CFR Part 53 Rulemaking

On March 1, 2023, the staff delivered the draft rulemaking package for the proposed Title 10 of the *Code of Federal Regulations* (10 CFR) Part 53 as SECY-23-0021, “Proposed Rule: Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors” (ML21162A093), to the Commission for consideration. The staff developed Part 53 in response to NEIMA, which directed the NRC to develop the regulatory infrastructure to support the development and commercialization of advanced nuclear reactors. Section 103(a)(4) of NEIMA directed the NRC to “complete a rulemaking to establish a technology-inclusive, regulatory framework for optional use by commercial advanced nuclear reactor applicants for new reactor license applications” by December 31, 2027. In SECY-23-0021, the staff requested approval to publish the draft proposed rule in the *Federal Register* for public comment. More information on this rulemaking can be found on the NRC’s Part 53 rulemaking website.³

Emergency Preparedness for SMR and Other New Technologies

On November 16, 2023, the staff published the final rule on “Emergency Preparedness for Small Modular Reactors and Other New Technologies” (ML23226A019). The final rule and associated guidance amended the regulations in 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” to include a risk-informed approach to emergency preparedness for SMRs and other new technologies. More information on this rulemaking can be found on the NRC’s Emergency Preparedness Rulemaking website.⁴

Rulemaking to Address Advanced Reactor Export Licensing Considerations

On March 29, 2023, the staff delivered a rulemaking plan, SECY-23-0029, “Rulemaking Plan for the Implementation of Changes to Reflect Advanced Reactor Export Licensing Considerations” (ML23037A818), to the Commission for consideration. On May 16, 2023, the Commission issued Staff Requirements Memorandum (SRM)-SECY-23-0029 (ML23136B263), directing the staff to proceed with rulemaking.

The staff is drafting a proposed rule to submit to the Commission in late 2024. If approved, the rule would more clearly incorporate advanced reactor concepts into the regulations that govern the export of nuclear material and equipment. Further, the rule would reduce regulatory uncertainties associated with the export of equipment and substances associated with advanced reactors and ensure predictability and efficiency in the NRC’s licensing reviews of export applications. More information on this rulemaking can be found on the NRC’s rulemaking public website.⁵

Policy Issues

Regulation of Fusion Energy Systems

On January 3, 2023, the staff delivered SECY-23-0001, “Options for Licensing and Regulating Fusion Energy Systems” (ML22273A178), to the Commission for consideration. On April 13, 2023, the Commission issued SRM-SECY-23-0001 (ML23103A449), directing the staff

³ <https://www.nrc.gov/reactors/new-reactors/advanced/modernizing/rulemaking-and-guidance/part-53.html>

⁴ <https://www.nrc.gov/reactors/new-reactors/advanced/modernizing/rulemaking-and-guidance/emergency-preparedness.html>

⁵ <https://www.nrc.gov/reading-rm/doc-collections/rulemaking-ruleforum/active/ruledetails.html?id=1169>

to conduct a limited-scope rulemaking to establish a regulatory framework for near-term fusion systems that augments the NRC's byproduct material framework in 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material." Additionally, the Commission directed the staff to develop a new volume of NUREG-1556, "Consolidated Guidance About Materials Licenses,"⁶ dedicated to fusion systems, so as to provide consistent guidance across the National Materials Program. The staff is currently developing the proposed rule and guidance. More information on the regulation of fusion systems can be found on the NRC's Fusion Systems website.⁷

Regulation of Factory-Fabricated Micro-reactors

On January 24, 2024, the staff delivered SECY-24-0008, "Factory-Fabricated Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory" (ML23207A250), to provide the Commission with options for regulating certain aspects of fuel loading and operational testing of commercial factory-fabricated micro-reactors. This paper also seeks Commission direction on whether a factory-fabricated micro-reactor that includes "features to preclude criticality" would require a facility operating license or a combined license when loaded with fuel.

Innovative Approach for Construction Permit Environmental Reviews

On September 13, 2023, the staff delivered SECY 23-0080, "Environmental Review Approach for the Kairos Power, LLC, Hermes 2 Construction Permit Application" (ML23214A165), to the Commission. The paper informed the Commission of the staff's intent to prepare an environmental assessment to determine whether a finding of no significant impact is justified or whether an environmental impact statement is necessary, fulfilling the NRC's National Environmental Policy Act obligations as part of the Hermes 2 environmental review. Because the resources required to issue an environmental assessment for this project are much less than those required for an environmental impact statement, particularly where the staff issued an environmental impact statement for the Kairos Hermes 1 at the same site approximately six months ago, this innovation is expected to yield schedule advantages for the project. More information on the status of the Hermes 2 environmental review can be found on the NRC's Hermes 2 website.⁸

Guidance

During 2023, the staff issued numerous guidance documents to support near-term advanced reactor applications. Enclosure 1 contains a comprehensive list of key advanced reactor-related guidance documents issued by the NRC in 2023.

Contents of Applications

In May 2023, the staff issued nine Advanced Reactor Content of Application Project (ARCAP) interim staff guidance (ISG) documents (ML22048B544, ML22048B542, ML22048B545, ML22048B541, ML22048B543, ML22048B547, ML22048B549, ML22048B546, ML22048B548) and DG-1404, Revision 0, "Guidance for a Technology-Inclusive Content-of-Application Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors" (ML22076A003), for public

⁶ <https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1556/index.html>

⁷ <https://www.nrc.gov/materials/fusion-energy-systems.html>

⁸ <https://www.nrc.gov/reactors/non-power/new-facility-licensing/hermes2-kairos/dashboard.html>

comment. In August 2023, the staff issued Draft Regulatory Guide DG-1404, Revision 1 (ML23194A194), which provided additional guidance for the level of detail for the probabilistic risk assessment for construction permit applications, for public comment.

The ARCAP ISGs and DG-1404 provide applicant and staff guidance for licensing-modernization-project (LMP)-based, non-LWR applications for a construction permit or operating license under 10 CFR Part 50, or for a combined license, manufacturing license, standard design approval, or design certification under 10 CFR Part 52. The LMP methodology focuses on identifying licensing basis events; classifying and establishing performance criteria for structures, systems, and components; and evaluating defense in depth for advanced reactor designs. The staff is evaluating the public comments received on the ARCAP ISGs and DG-1404 as well as the Advisory Committee on Reactor Safeguards (ACRS) December 20, 2023, letter report, “Review of Advanced Reactor Content of Application Project/Technology-Inclusive Content of Application Project Guidance” (ML23348A182). The staff will address this feedback as it prepares the final versions of the ARCAP ISGs and the DG-1404 regulatory guide. More details on these documents can be found on the NRC’s Advanced Reactor Content of Application Project website.⁹

Non-LWR Materials

On January 31, 2023, the staff published NUREG-2245, “Technical Review of the 2017 Edition of ASME Code, Section III, Division 5” High Temperature Reactors” (ML23030B636) and Regulatory Guide (RG) 1.87, Revision 2, “Acceptability of ASME Code, Section III, Division 5, ‘High Temperature Reactors’” (ML22101A263), which endorsed, with conditions, the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPV Code), Section III, “Rules for the Construction of Nuclear Facility Components,” Division 5, “High Temperature Reactors.”

On February 28, 2023, the staff published draft DANU-ISG-2023-01, “Material Compatibility for non-Light Water Reactors” (ML22203A175), for public comment. The draft guidance identified areas of staff review for a submittal seeking to use materials allowed under ASME Code, Section III, Division 5.

More details on these documents can be found on the NRC’s advanced reactor rulemaking and guidance website.¹⁰

Reactor Siting

On October 18, 2023, the staff published DG-4034 (RG 4.7, Revision 4), “General Site Suitability Criteria for Nuclear Power Stations” (ML23123A090), for public comment. The revision included alternative approaches to the population-density criterion and expanded the regulatory guidance developed for large light-water-reactor technology with appropriate modifications for advanced reactor designs. The staff plans to issue the final regulatory guide in early 2024.

⁹ <https://www.nrc.gov/reactors/new-reactors/advanced/modernizing/rulemaking-and-guidance/advanced-reactor-content-of-application-project.html>

¹⁰ <https://www.nrc.gov/reactors/new-reactors/advanced/modernizing/rulemaking-and-guidance/asme-bpv-code-section3-div5.html>

Licensing

In 2023, the staff achieved several significant accomplishments in its reviews of advanced reactor permits, licenses, certifications, and other submittals. The staff saw a substantial increase in these activities in 2023, as compared to prior years. These accomplishments demonstrate the staff's ability to review applications for novel technologies and that the agency is ready for the increasing number of advanced reactor applications that are expected in the near term.

The agency is using "core teams" and interdisciplinary review teams to maximize efficiencies and focus on the most safety-significant and risk-significant aspects during application reviews for advanced reactors. Comprised of project managers, policy experts, and technical reviewers from various disciplines, and augmented by subject matter experts, core teams result in an integrated approach that supports a holistic review of the application. Furthermore, core teams help facilitate streamlined decision-making, leading to a reduction in overall review timelines.

As discussed below and in the enclosure, the staff has completed the review of nearly 100 topical reports and white papers since 2018. These reviews have been completed on average 33 percent faster than the generic milestone schedules established as part of the NRC's implementation of NEIMA for topical reports.

Non-Light-Water Reactors

The staff is engaged in review activities for the reactor projects listed below. Information on these projects can be found on the New Facility Licensing website.¹¹ Information on the NRC's execution of the review of these applications can be found on the Advanced Reactors Licensing Dashboards website.¹²

Kairos Power Hermes 1 Test Reactor Facility

The staff completed its safety review of the Kairos Hermes 1 test reactor construction permit application under budget and ahead of schedule. The review was completed in 18 months, ahead of a published 21-month schedule, and well ahead of the 36-month generic milestone for construction permit application safety reviews. From a resource perspective, the direct cost to the applicant for the review was approximately six million dollars. On October 19, 2023, an uncontested hearing was held regarding the Hermes 1 construction permit application. The staff issued the construction permit on December 14, 2023 (ML23338A258), as authorized by Commission Order CLI 23-05, dated December 12, 2023 (ML23346A068).

The Construction Permit Application Review Documents for Hermes—Kairos Power website¹³ provides access to the construction permit application for Hermes 1 and other documents that Kairos Power, LLC (Kairos), submitted to support the review of the application. The website also lists key documents published by the NRC as part of the application review, including the "Safety Evaluation Related to the Kairos Power LLC Construction Permit Application for the Hermes Test Reactor" (ML23158A268), and NUREG-2263, "Environmental Impact Statement for the Construction Permit for the Kairos Hermes Test Reactor" (ML23214A269). The

¹¹ <https://www.nrc.gov/reactors/non-power/new-facility-licensing.html>

¹² <https://www.nrc.gov/reactors/new-reactors/advanced/how-were-executing/project-status.html>

¹³ <https://www.nrc.gov/reactors/non-power/new-facility-licensing/hermes-kairos/documents.html>

Hermes—Kairos Project Status Dashboard website¹⁴ contains details on the NRC’s performance of the review.

Abilene Christian University Research Reactor

Throughout CY 2023, the staff remained engaged with Abilene Christian University (ACU) in regulatory audits to support the staff’s review of ACU’s Molten Salt Research Reactor (MSRR) construction permit application. If licensed, the ACU MSRR would be used by students, staff, faculty, and outside collaborators for molten salt reactor research, education, and training. During the audit process, the staff identified information needs to support the necessary regulatory findings. During the review, ACU also informed the staff of planned changes to the preliminary safety analysis report that would be significant and would affect multiple areas or chapters in the document. Because of the significance of these changes, on September 14, 2023, the staff issued a letter to ACU (ML23249A095) to inform the applicant of the need to reassess the application review schedule because the timeline for the resolution of the remaining technical topics and the corresponding changes was uncertain. The staff continues to work with ACU to resolve open technical issues to support establishing an updated schedule. On December 21, 2023, the staff issued “Abilene Christian University – Transmittal of Requests for Additional Information” (ML23348A196), which requests information needed to address open technical issues and establish a revised schedule and level of effort estimate.

The NRC website¹⁵ for ACU’s MSRR construction permit application documents provides access to documents that support the review. The Project Status Dashboard website¹⁶ provides overall project status.

Kairos Power Hermes 2 Test Reactor Facility

On July 14, 2023, Kairos submitted a construction permit application for the Hermes 2 test reactor facility (ML23195A121), a proposed two-unit test reactor facility. On September 11, 2023, the staff accepted the application for review (ML23233A167). On October 11, 2023, the staff issued the “Kairos Power LLC—Hermes 2 Construction Permit Application Review Schedule and Resource Estimate” (ML23269A176), outlining the schedule and resource estimates necessary to support review of the application. This project would include two test reactors on the same site as Hermes 1, using the same fluoride salt-cooled high-temperature reactor technology as Hermes 1. As such, the staff was able to establish an aggressive 14-month review schedule. Both the safety and environmental reviews are progressing on schedule and budget. The Construction Permit Application Review Documents for Hermes 2—Kairos Power website¹⁷ provides the construction permit application for Hermes 2, other documents submitted by Kairos to support the review of the application, and key documents published by the NRC as part of the application review. The NRC’s Hermes 2—Kairos Project Status Dashboard website¹⁸ provides information regarding the current project status, including status updates on the staff’s progress towards completion of the safety and environmental reviews.

¹⁴ <https://www.nrc.gov/reactors/non-power/new-facility-licensing/hermes-kairos/dashboard.html>

¹⁵ <https://www.nrc.gov/reactors/non-power/new-facility-licensing/msrr-acu/documents.html>

¹⁶ <https://www.nrc.gov/reactors/non-power/new-facility-licensing/msrr-acu/dashboard.html>

¹⁷ <https://www.nrc.gov/reactors/non-power/new-facility-licensing/hermes2-kairos/documents.html>

¹⁸ <https://www.nrc.gov/reactors/non-power/new-facility-licensing/hermes2-kairos/dashboard.html>

Non-LWR Preapplication Reviews

The staff is engaged in preapplication interactions with numerous non-LWR developers and prospective license applicants. The workload in this area is steadily increasing as interest in non-LWR licensing continues to grow and the projected submittal dates for applications approach, including projects supported by the U.S. Department of Energy (DOE).

Substantial preapplication engagement continued with both of DOE's Advanced Reactor Demonstration Program projects, X-energy's Xe-100 reactor, and TerraPower's Natrium reactor. The staff conducted a readiness assessment of X-energy's draft preliminary safety analysis report (PSAR) portion of its planned application for a construction permit for the Xe-100 reactor in late 2023. The staff issued a report documenting its observations on February 7, 2024 (ML24011A071). In addition, the staff received letters from TerraPower, LLC, regarding its proposed Natrium demonstration reactor that would be sited in Kemmerer, Wyoming. The letters updated the anticipated submittal date for its construction permit application (ML23214A199), and requested the staff conduct a preapplication readiness assessment of safety and environmental topics (ML23304A148). The readiness assessment began on January 10, 2024 (ML23352A102).

The staff is also engaged in preapplication interactions with the following entities:

- ARC Clean Technology—ARC-100 Sodium-Cooled Fast Reactor
- General Atomics—Energy Multiplier Module (EM2)
- General Atomics-Electromagnetic Systems—Fast Modular Reactor
- Kairos Power, LLC—Kairos Power Reactor Design
- Oklo, Inc.—Aurora Powerhouse
- Radiant Industries, Inc.—Kaleidos Microreactor
- TerraPower, LLC—Molten Chloride Fast Reactor
- Terrestrial Energy USA, Inc.— Molten Chloride Fast Reactor
- Westinghouse Electric Company LLC—eVinci™ Microreactor
- University of Illinois at Urbana-Champaign and Ultra Safe Nuclear Corporation— High-Temperature Gas-Cooled Test Reactor

These interactions include meetings, design familiarization activities, and reviews of white papers and topical reports on a variety of technical and programmatic topics including principal design criteria, licensing approaches, emergency preparedness, fuel qualification, source term, and seismic design. Additional information can be found on the Preapplication Activities website.¹⁹

Small Modular Reactor Licensing

The staff continued its efforts to review SMR applications and conduct preapplication activities. In this paper, SMRs are light-water reactors that are significantly different in size and design from the current operating fleet of commercial reactors. General information on these designs and projects can be found on the NRC's SMR website.²⁰

¹⁹ <https://www.nrc.gov/reactors/new-reactors/advanced/who-were-working-with/pre-application-activities.html>

²⁰ <https://www.nrc.gov/reactors/new-reactors/smr.html>

NuScale

On January 19, 2023, the NuScale SMR design certification final rule was published in the *Federal Register* (88 FR 3287).

Also in 2023, the staff began its review of the standard design approval application for the NuScale US460 SMR design, consisting of up to six modules rated at 77 MWe (megawatts electric) each, submitted on January 1, 2023. In 2023, the staff completed the acceptance review and issued a docketing and resource estimate letter. (ML23198A163) The staff's goal is to conduct an efficient, high-quality safety review to support issuance of a final safety evaluation report by July 31, 2025. To achieve this goal, the NRC staff is performing a risk-informed technical review to: (1) identify focus areas for the review; (2) grade the review scope and schedule; and (3) support resolution of challenging technical issues. Benefits of the staff's risk-informed review are evident in the completion of the safety evaluation without open items for multiple chapters and in the review progressing consistent with the resource estimates. Current information on NuScale licensing activities is available on the public Current Licensing Reviews of New Reactors website.²¹

SMR Preapplication Reviews

The staff is engaged in preapplication interactions with several SMR developers and prospective license applicants. These interactions include conducting meetings, reviewing white papers, and topical reports. Notably, the staff provided observations on the Tennessee Valley Authority's annotated outline of the construction permit application for the Clinch River site and subsequently initiated a readiness assessment of both the construction permit and environmental report. The staff also engaged with the Canadian Nuclear Safety Commission (CNSC) on a joint review of GE-Hitachi's Steel Composite Containment Vessel and Reactor Building Structural Design Topical Report in support of a future licensing application for the BWRX-300. The staff continued robust engagements with SMR, LLC (Holtec) on their design,²² including 30 public meetings on topics such as instrumentation and controls, seismic methodology, and technical specifications. Additional information on these preapplication interactions can be found on the SMR Preapplication Activities website.²³

The staff is also engaged in preapplication interactions with the following SMR developers and prospective license applicants:

- Duke Energy—Belews Creek site
- Westinghouse Electric Company LLC—AP300

Fuel Cycle Licensing

TRISO-X

In 2023, the staff continued the licensing review of the TRISO-X, LLC, license application for a proposed Category II TRISO fuel fabrication facility. On August 28, 2023, the staff approved a related exemption for TRISO-X to allow the storage and transportation of fabricated fuel in shipping containers as Category III material (ML23187A629). More details on this and other

²¹ <https://www.nrc.gov/reactors/new-reactors/smr/licensing-activities/current-licensing-reviews.html>

²² In September 2023, SMR, LLC (Holtec) announced its SMR-160 was being updated to 300 MWe; it was subsequently renamed the SMR-300.

²³ <https://www.nrc.gov/reactors/new-reactors/smr/licensing-activities/pre-application-activities.html>

project documents can be found on the NRC's TRISO-X website²⁴ and on the TRISO-X Project Status Dashboard website.²⁵

Transportation Packages

The staff approved two certifications of transportation packages this year that are related to advanced reactors, the DN30-X, and the OPTIMUS-L. The NRC issued a new certificate of compliance for the DN30-X package in March 2023 that allows for shipment of uranium hexafluoride enriched up to 20 weight percent uranium-235 and amended the certificate of compliance for the OPTIMUS-L package in December 2023 for shipment of TRISO fuel up to 20 weight percent uranium-235. More information on these activities and the package certification process can be found on NRC's Nuclear Materials Transportation Package website.²⁶

HALEU Enrichment

On March 30, 2023, the staff issued an amendment to Centrus in support of its high-assay low-enriched uranium (HALEU) fuel demonstration project at the American Centrifuge Plant (ML23083B962, ML23083B964, ML23083B966). The amendment allows Centrus to produce up to 600 kilograms of HALEU enriched up to 20 weight percent uranium-235 in the form of uranium hexafluoride through December 31, 2024. On June 12, 2023, the NRC authorized Centrus to commence enrichment up to the Category III quantity of special nuclear material. On September 21, 2023, the NRC authorized enrichment up to a Category II quantity of special nuclear material. On October 11, 2023, the American Centrifuge Plant commenced operations and is now the first operating Category II fuel facility. On November 7, 2023, Centrus made its first delivery of HALEU to the DOE.

Analytical Tool Capabilities

The staff has developed the safety evaluation tools it needs to conduct reviews of anticipated non-LWR technology designs. The staff continues to assess the design information, experimental data, and analytical tools necessary for non-LWR reviews across the variety of technologies. The staff's approach to completing code validation and assessment relies on information from sources such as international organizations, DOE, and the non-LWR vendors.

In 2023, the staff made significant progress on the development and application of computer codes and analytical methods to support safety analyses for non-LWR designs. Using its own improved codes and leveraging advances in available DOE codes, the staff completed 13 proof-of-concept reference plant models. Development of the reference plant models facilitated the maturation and advancement of the NRC's reactor safety analysis suite of codes. Additionally, this research enabled the staff to build specialized models and expertise to be leveraged during licensing reviews, as was successfully done during the Hermes 1 construction permit review. The staff also led many internal and public workshops to communicate progress in this area to stakeholders. Enclosure 1 provides details on work related to these codes and analytical tools that was completed in 2023.

²⁴ <https://www.nrc.gov/info-finder/fc/triso-x.html#panel216>

²⁵ <https://www.nrc.gov/info-finder/fc/triso-x/project-status.html>

²⁶ <https://www.nrc.gov/materials/transportation/certification.html>

External Coordination and Communication

In 2023, the staff continued to engage with the public, industry, and other government agencies in a variety of ways. These efforts help increase public and industry involvement, enhance awareness of the staff's activities in advanced reactor licensing and regulatory framework development, and coordinate activities with related government agency programs and projects.

Public Engagement

NRC Advanced Reactor Website

To support effective communication with the public, the staff continued to update the NRC advanced reactor readiness public website.²⁷ This website includes information on the status of ongoing rulemakings, guidance development, and licensing projects. A restructuring of this website to enhance the user interface and experience was completed in late 2023. Among several new features, the redesign enables users to more easily find licensing review execution information.

Also in 2023, the staff launched a new Integrated Review Schedule website,²⁸ providing the status and schedule of the staff's infrastructure development activities. The new site presents the staff's focus areas and enables users to search for documents by keywords or by regulatory applicability and to identify associated documents. Additionally, users can see the development stage for each document.

Communication and Outreach

The staff proactively communicates to stakeholders its accomplishments and ongoing efforts in the areas of advanced reactor licensing and regulatory infrastructure. The staff uses a variety of communications tools, including social media posts, GovDelivery distributions, and newsletters. This enhanced communication effort is aimed at building confidence in the NRC's readiness to efficiently, reliably, and clearly license the next generation of nuclear reactors.

In 2023, the staff continued to communicate regularly with stakeholders, including prospective applicants, industry groups, and non-governmental organizations to seek feedback on a variety of advanced reactor activities. The staff held over 140 public meetings on advanced reactor topics. Of these meetings, seven were Periodic Advanced Reactor Stakeholder public meetings. These meetings are widely attended by external stakeholders such as potential applicants and industry groups. Examples of meeting topics this year included: environmental center of expertise licensing review overview and enhancements, regulatory treatment of non-core sources of radioactivity associated with advanced reactor designs, insights on the role of ACRS during initial licensing reviews, and advanced reactor materials interim staff guidance. More information on these meetings can be found on the NRC's Advanced Reactor Stakeholder Meetings website.²⁹ The staff also held public meetings on a wide variety of topics, including the

²⁷ <https://www.nrc.gov/reactors/new-reactors/advanced.html>

²⁸ <https://www.nrc.gov/reactors/new-reactors/advanced/how-were-executing/integrated-review-schedule.html>

²⁹ <https://www.nrc.gov/reactors/new-reactors/advanced/get-involved/meetings.html>

digital instrumentation and controls licensing framework³⁰ and proposed guidance on the contents of an application.³¹

The staff also briefed the ACRS subcommittees and the ACRS Full Committee on various topics, including the staff safety evaluation for the Kairos Power, LLC, Hermes 1 test reactor construction permit application and two Kairos topical report safety evaluations; the staff review of a General Atomics topical report; proposed guidance on content of applications; the draft white paper on micro-reactor licensing and deployment considerations; and other advanced reactor-related topics. The staff supported overview presentations made by potential applicants to the ACRS Full Committee on two designs (the TerraPower, LLC, Sodium reactor and the X-energy Xe-100 reactor) and to an ACRS subcommittee on the Westinghouse eVinci micro-reactor design.

The staff briefed the Commission on three topics: advanced reactor licensing under 10 CFR Part 50 and 10 CFR Part 52, an update on the 10 CFR Part 53 rulemaking, and a strategic programmatic overview of the new reactor business line.

Other Government Organizations

The staff continues to work productively with DOE and the U.S. Department of Defense (DOD) under various memoranda of understanding (MOUs) associated with advanced reactor deployment. In 2023, as part of its coordination on the DOD Strategic Capabilities Office's Project Pele demonstration transportable reactor, the staff reviewed a risk-informed methodology to be used in a transportation package application as an alternate approval pathway for a transportable micro-reactor. The staff expects to provide an information paper to the Commission and issue its approval of this methodology early in 2024. The staff also continued to engage with the Department of the Air Force (DAF) in support of its Eielson Air Force Base micro-reactor pilot program. The staff is working to establish an MOU for cooperation on the anticipated environmental review and supported several DAF-led community engagement meetings for this project. The DAF expects to complete its procurement process to select a commercial vendor in 2024.³²

International Collaboration

In 2023, the staff continued its mutually beneficial engagements with the international community on technical and regulatory topics for new technologies.

NRC/CNSC Work

On January 11, 2023, the staff presented to the ACRS on "CNSC-U.S. NRC Cooperation on Advanced Reactor Technologies and Small Modular Reactors" (ML23017A111), discussing the Memorandum of Cooperation signed in 2019 (ML19275D578), its goals, and the benefits of this collaboration. The CNSC and the NRC continue to collaborate and issue joint reports that cover topics that are generally applicable to advanced reactor developers and designers, as well as targeted reports addressing specific technical aspects for individual vendors or potential applicants. In 2023, this collaboration led to issuance of two joint reports concerning the GEH BWRX-300 SMR; one interim report on the safety classification of structures, systems, and

³⁰ <https://www.nrc.gov/reactors/new-reactors/advanced/modernizing/rulemaking-and-guidance/digital-instrumentation-and-control.html>

³¹ <https://www.nrc.gov/reactors/new-reactors/advanced/modernizing/rulemaking-and-guidance/advanced-reactor-content-of-application-project.html#table1>

³² <https://www.eielson.af.mil/microreactor/>

components; and one final report concerning TRISO fuel qualification. Enclosure 1 and the Joint Reports of the CNSC and the NRC website³³ contain additional information on the ongoing collaborative work between these regulatory bodies.

International Atomic Energy Agency Working Groups

In 2023, the staff continued to lead and participate in the Small Modular Reactor Regulators' Forum³⁴ at the International Atomic Energy Agency (IAEA). The Forum's Steering Committee has three working groups preparing reports in the areas of Licensing Issues; Design and Safety Analysis; and Manufacturing, Construction, Commissioning and Operations. The Forum's Phase 3 activities wrapped up in late 2023 and final reports will be issued and made public in early 2024.

The staff is also collaborating with the IAEA on its ongoing assessment of the applicability of current safety standards to advanced reactors and novel technologies. The IAEA's Nuclear Harmonization and Standardization Initiative aims to enhance international cooperation to support the effective global deployment of safe and secure new reactors, and the staff is supporting each of the three working groups in the regulatory track.

Nuclear Energy Agency

The staff chairs the new Working Group on Policy and Licensing under the Committee on Nuclear Regulatory Activities (CNRA) at the Nuclear Energy Agency.³⁵ The group received approval on its first task to look at prelicensing engagement practices across member countries. The staff also participates in the CNRA Working Group on New Technologies (WGNT). Initial WGNT tasks pertain to the safety classification of pressure boundary components, regulatory practices to ensure appropriate qualification and through-life performance of materials in advanced reactors, and updates to a generic common position on the treatment of common cause failure caused by software within digital safety systems.

Oversight

Advanced Reactor Construction Oversight

On June 6, 2023, the staff issued SECY-23-0048, "Vision for the Nuclear Regulatory Commission's Advanced Reactors Construction Oversight Program" (ML23061A086), to communicate the plan to develop the Advanced Reactor Construction Oversight Program (ARCOP). The ARCOP framework reflects an approach that optimizes the NRC's established oversight framework to ensure the program is responsive to the evolving landscape of advanced reactor technologies. The ARCOP will address each aspect of an effective oversight program (i.e., performance monitoring, enforcement, and assessment) for advanced reactor manufacturing and construction. Three workshops were held with the inspection staff in the NRC regional offices to tabletop ARCOP proposed guidance, and the proposed guidance was also presented at two Periodic Advanced Reactor Stakeholder meetings. Further engagement with external stakeholders is planned as the framework development continues and guidance details are formulated.

³³ <https://www.nrc.gov/reactors/new-reactors/advanced/who-were-working-with/international-cooperation/nrc-cnsc-moc/joint-reports.html>

³⁴ <https://www.iaea.org/topics/small-modular-reactors/smr-regulators-forum>

³⁵ <https://www.oecd-nea.org/tools/mandates/>

Fuel Facility Oversight

In 2023, the staff assessed the need to have resident inspectors stationed at Category II fuel facilities during construction and operation activities. In January 2024, the staff issued memoranda documenting the staff's assessment and determination that resident inspectors are not needed at the TRISO-X and Centrus American Centrifuge Plant Category II fuel facilities during construction or operations (ML23355A245, ML23356A124).

CONCLUSION:

In 2023, the staff made substantial progress in enabling the deployment of advanced reactor technologies. The staff continued to enhance and maintain an agile, sustainable program for regulating advanced reactors. The staff demonstrated its ability to conduct timely reviews of advanced reactor license applications and is well positioned to review the increasing number of advanced reactor applications that the agency anticipates. The staff will continue to engage proactively with stakeholders, collaborate with other federal agencies, and pursue further opportunities to cooperate with international counterparts to fully leverage technical resources to address new and novel advanced reactor regulatory and policy topics.

The staff will keep the Commission informed of its advanced reactor activities, including the status of ongoing license application reviews, plans for reviews of future license applications, and strategies for addressing advanced reactor policy topics. The staff will seek Commission direction on its activities, where appropriate.

COORDINATION:

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

**Robert M.
Taylor**  Digitally signed by
Robert M. Taylor
Date: 2024.02.27
11:24:00 -05'00'

Robert M. Taylor, Director
Office of Nuclear Reactor Regulation

Enclosure:
SRM-M170511-4 Details of CY 2023
Advanced Reactor Program
Accomplishments

SUBJECT: ADVANCED REACTOR PROGRAM STATUS DATED: February 27, 2024

SRM-M170511-4

ADAMS Accession Nos.:
 Pkg:ML23350A002
 SECY: ML23350A003
 Enclosure: ML23350A004

***Concur via Email**

SECY-012

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NAME	WJessup	MWentzel	JSegala	MCarpentier
DATE	01/17/2024*	01/17/2024*	01/19/2024*	02/20/2024
OFFICE	NRR/DNRL	NRR/DANU/D	NRR/D	NRR/D
NAME	BSmith	MShams	AVeil (RTaylor for)	AVeil (RTaylor for)
DATE	01/17/2024*	02/16/2024*	02/21/2024 (Reviewer)	02/27/24

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