UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 29, 2023

MEMORANDUM TO: Michelle W. Hayes, Chief
Licensing and Regulatory Infrastructure Branch
Division of New and Renewed Licenses
Office of Nuclear Reactor Regulation

FROM: Victoria V. Huckabay, Senior Project Manager **/RA/**
Licensing and Regulatory Infrastructure Branch
Division of New and Renewed Licenses
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF THE NOVEMBER 15, 2023, PARTIALLY CLOSED MEETING WITH SHINE TECHNOLOGIES, LLC, TO DISCUSS THE PRE-APPLICATION ENGAGEMENTS FOR THE LICENSING OF A USED NUCLEAR FUEL RECYCLING PILOT FACILITY

Meeting Information:

Applicant: SHINE Technologies, LLC (SHINE)

Docket No.:99902115

Meeting Title: Meeting to Discuss the Pre-Application Engagements with SHINE Technologies, LLC, for the Licensing of a Used Nuclear Fuel Recycling Pilot Facility

Meeting Date: November 15, 2023

Meeting Type: Partially Closed

Public Meeting Notice Agencywide Documents Access and Management System (ADAMS) Accession No.: ML23304A306

Meeting Attendees: See Enclosure 1 for a list of the meeting attendees.

Enclosure 2 to this letter contains Proprietary Information. When separated from Enclosure 2, this letter is DECONTROLLED.

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Meeting Summary:

The U.S. Nuclear Regulatory Commission (NRC) staff conducted the meeting in accordance with NRC Management Directive 3.5, "Attendance at NRC Staff-Sponsored Meetings" (ML21180A271). During the meeting, SHINE provided an overview of planned pre-application activities that support the licensing of a proposed pilot facility for the recycling of used nuclear fuel.

During the open portion of the meeting, SHINE provided an overview their company and discussed a four-phase approach to the use of fusion technology in various commercial applications, including recycling of nuclear waste (ADAMS Accession No. ML23305A178). The presenters discussed the primary goal of building the recycling pilot facility as a demonstration facility while leveraging existing technologies and collaborating with experienced international partners.

SHINE also provided an overview of their recycling technology, describing the process steps, the product streams, and waste streams. They explained that the goal of recycling is to minimize the mass, volume, and toxicity of nuclear waste and they expect approximately 95 percent of the reprocessing facility's waste stream to be suitable for near-surface disposal. In response to the NRC staff's question regarding the facility's in-process inventory, SHINE clarified that the expected inventory of approximately one metric ton of initial heavy metal (MTiHM) would equate to the processing of approximately one to two fuel assemblies per day.

SHINE stated that they are reviewing all regulations in Title 10, Chapter I of the *Code of Federal Regulations* (10 CFR) to identify those requirements that are applicable to the proposed pilot facility, applicable in part, not applicable, or would require an exemption. While SHINE has not yet identified any requirements that would require an exemption, they anticipate that some exemptions would be needed (for example, with regard to the monitoring requirements in heavily shielded areas found in 10 CFR 70.24, "Criticality accident requirements.")

The NRC staff asked about SHINE's plans for pre-application engagements on the topics of material control and accounting (MC&A), safeguards, and material security. SHINE stated that with the exception of MC&A which they plan to discuss further during the pre-application engagements for a future construction permit application, the remaining topics will be addressed in more detail during the application process for an operating license.

The NRC staff asked if SHINE has considered all gaps from the gap analysis in SECY-09-0082, "Update on Reprocessing Regulatory Framework – Summary of Gap Analysis," and how these gaps may need to be addressed by SHINE during the licensing process. SHINE stated that they understand that all gaps would need to be addressed and are considering them in their licensing strategy.

The NRC staff asked about SHINE's plans to have an interaction with the NRC staff regarding the applicability of regulations and the need for exemptions. SHINE stated that they are planning on engaging with the NRC staff on this topic, either as a standalone interaction or as a part of the regulatory analysis discussion.

In response to the NRC staff's question regarding whether SHINE has considered including topics on security and material attractiveness in the pre-application engagement process,

SHINE stated that they are aware of the security requirements that have impacts in the physical, information, and personnel security areas (such as the requirements in 10 CFR Part 73, “Physical Protection of Plants and Materials,” Part 95, “Facility Security Clearance and Safeguarding of National Security Information and Restricted Data,” Part 25, “Access Authorization,” and Part 11, “Criteria and Procedures for Determining Eligibility for Access to or Control Over Special Nuclear Material,” that include Category I strategic special nuclear material security requirements and classified information requirements) and are planning on engaging with the NRC staff regarding these topics.

The NRC staff pointed out that there is limited engineering scale experience of the processes proposed by SHINE. The NRC staff asked if SHINE has plans to test the technology and equipment in order to increase their confidence in the performance of the design and the nature of the spectrum of product and waste streams. The NRC staff also inquired about the maturity of SHINE’s voloxidation technology. SHINE responded that while they are still assessing the research and development activities that will need to be completed in order to demonstrate the technologies, they are partnering with national laboratories and members of the recycling industries to identify the best path forward. SHINE further stated that additional research and development efforts will be needed to support the voloxidation technology.

In response to the NRC staff’s question regarding whether SHINE has considered using ORNL/TM-2020/1478, “Proposed Guidance for Preparing and Reviewing a Molten Salt Non-Power Reactor Application,” (ADAMS Accession No. ML20219A771) to inform off-gas management, SHINE stated that they not yet closely reviewed the document or considered its applicability.

The NRC staff noted that SHINE’s presentation proposed to conduct an Integrated Safety Analysis (ISA)-like evaluation. The NRC staff asked whether SHINE proposes to meet the performance requirements of Subpart H, “Additional Requirements for Certain Licensees Authorized to Possess a Critical Mass of Special Nuclear Material,” to 10 CFR Part 70, “Domestic Licensing of Special Nuclear Material,” and if so, what will be the regulatory basis for doing so. The NRC staff further asked SHINE to clarify whether an ISA-like evaluation would be committed to via proposed license conditions and maintained as a living document as required by a license condition; whether descriptions of any updates would be submitted to the NRC on an annual basis; and whether an ISA summary-like document would be submitted for the NRC staff’s review as a non-license application document. SHINE stated that an ISA-like evaluation will be handled similar to how it was done for the SHINE Medical Isotopes facility application, which included maintaining an internal (licensing basis) document, with a methodology description provided in the accident analysis. SHINE added that appropriate change control provisions for the accident analysis are already included in 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” so a license condition to require this analysis to be maintained as a living document will not be needed.

The NRC staff pointed out that there were some inconsistencies in the references for Quality Assurance (QA) cited in the SHINE Regulatory Engagement Plan. Specifically, for fuel reprocessing and power reactors, the regulations in Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” of 10 CFR Part 50 would apply and vendors can establish a QA Program that meets American Society of Mechanical Engineers (ASME) NQA-1; however, for non-power reactors, the guidance in NUREG-1537, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors,” refers to

a different standard, American National Standards Institute (ANSI)-15.8, “Quality Assurance program Requirements for Research Reactors.” The NRC staff asked SHINE to clarify how the QA requirements will be addressed for the proposed used nuclear fuel recycling pilot facility. SHINE stated that they had determined that the requirements of Appendix B to 10 CFR Part 50 apply and they are developing a Quality Assurance Program Description that is compliant with the requirements in Appendix B and NQA-1.

The NRC staff asked if SHINE can present an overview of the technology status for the various steps in a future meeting. The NRC staff elaborated that the areas of interest include the status of technology development (lab scale, engineering scale, pilot scale) for each technology step (e.g., separation, waste treatment, off-gas treatment, etc.), how much and what type of material has been processed, a discussion of experience with the technology, and the challenges associated with its development. SHINE stated that they can provide this information in a future engagement, possibly as a more detailed process overview discussion.

The NRC staff asked if SHINE plans to consider the 78 areas where general design criteria for reprocessing may be needed, as listed in Table 2.5 of the draft regulatory basis document for reprocessing (Enclosure 1 to SECY-11-0163, “Reprocessing Rulemaking: Draft Regulatory Basis and Path Forward,” ADAMS Accession No. ML112081702). SHINE stated that they plan to address these areas in the identification and proposed application of the principal design criteria for the reprocessing facility.

The NRC staff asked SHINE about their plans to have pre-application meetings on the expected Environmental Report to be submitted, including a discussion of the best NUREG guidance to be applied in an environmental review of the application for fuel recycling facility. SHINE stated that they plan to have engagements with the NRC staff on the environmental review topic, including the use of guidance. SHINE further stated that the scope of environmental review will depend on the site selection.

The NRC staff pointed to a statement in SHINE’s presentation that indicates that “very high consequence” events are not expected for its pilot fuel recycling facility. The NRC staff asked SHINE to clarify if this statement was in reference to the same very high consequence accident described in the NRC’s draft regulatory basis document and if so, whether SHINE’s assessment is based on consequences from unmitigated/uncontrolled events/accidents (i.e., without the application of structures, systems, and components important to safety, such as a completely unfiltered release). SHINE confirmed that that the reference was made to the same events described in the draft regulatory basis and that it is based on unmitigated consequences (i.e., not crediting the controls).

The NRC staff inquired whether SHINE considered the applicability of the following two documents with regard to an evaluation of environmental effects from reprocessing: WASH-1248, “Environmental Survey of the Uranium Fuel Cycle” (ADAMS Accession No. ML14092A628) and Supplement 1 to WASH-1248, NUREG-0116, “Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle: A Task Force Report.” SHINE responded that they have not yet reviewed or considered these documents.

The NRC staff asked whether SHINE has considered the International Atomic Energy Agency (IAEA) Advanced Protocol and whether SHINE has reported any research and development (R&D) activities related to the development of their reprocessing technology. SHINE stated that

they are aware of the IAEA Advanced Protocol requirements and are working with the national laboratories to ensure that the R&D activities are included in this reporting cycle.

At the end of the open portion of the meeting, members of the public were invited to provide comments or ask the NRC staff questions pertaining to the scope of the meeting. One member of the public asked the NRC staff about the status of the rulemaking plan SECY paper on special nuclear material security and inquired about NRC's recommendation for physical security measures related to certain radioactive material that would be produced by the SHINE recycling facility. The NRC staff responded that the SECY paper is under the NRC staff's final review and has not yet been submitted to the Commission. With regard to the question about physical security measures, the NRC staff stated that this would be determined based on the location of material within the facility.

Enclosures:
1. List of Attendees
2. Meeting Minutes – Closed Portion (proprietary)

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DATED: December 29, 2023

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ADAMS Accession Nos.:
Package: ML23360A001
Letter: ML23360A002
Enclosure 2: ML23360A003 **NRC-001**

OFFICE	NRR/DNRL/NLIB:PM	NRR/DNRL/NLIB:LA	NRR/DNRL/NLIB:BC	NRR/DNRL/NLIB:PM
NAME	VHuckabay	CSmith for SGreen	CLauron for MHayes	VHuckabay
DATE	12/18/2023	12/28/2023	12/21/2023	12/29/2023

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PARTIALLY CLOSED MEETING WITH SHINE TECHNOLOGIES, LLC TO DISCUSS THE PRE-APPLICATION ENGAGEMENTS FOR THE LICENSING OF A USED NUCLEAR FUEL RECYCLING PILOT FACILITY

MEETING ATTENDEES

NOVEMBER 15, 2023

Name	Organization
Victoria Huckabay	NRC
Elijah Dickson	NRC
Yawar Faraz	NRC
Wendy Reed	NRC
Phil Brochman	NRC
Glenn Tuttle	NRC
Michelle Hayes	NRC
Ian Tseng	NRC
James Hammelman	NRC
Donald Palmrose	NRC
Tim Harris	NRC
Chris Markley	NRC
Rao Tammara	NRC
Jonathan Marcano Lozada	NRC
Jose Cuadrado	NRC
Nicolas Mertz	NRC
David Roth	NRC
Francheska Colon Gonzalez	NRC
Damaris Marcano	NRC
Emma Duncan	NRC
Aditya Savara	NRC
Hosung Ahn	NRC
Jim Shea	NRC
Tom Boyce	NRC
Peyton Doub	NRC
Michael Balazik	NRC
James Rubenstone	NRC
Nicole Cortes	NRC
Rosalynn Wang	NRC
Andrea Keim	NRC
Holly Cruz	NRC
Pierre Saverot	NRC
Raj Iyengar	NRC
Michelle Romano	NRC
Kayla Gamin	NRC
Mike Lee	NRC

Jason Piotter	NRC
Stephen Poy	NRC
Daneira Melendez-Colon	NRC
Samantha Lav	NRC
James Drabble	NRC
India Banks	NRC
Jesse Carlson	NRC
David Garmon	NRC
Dave McIntyre	NRC
William Rautzen	NRC
Nanette Valliere	NRC
Storm Veunephachan	NRC
Jeff Bartelme	SHINE
Alex Newell	SHINE
Tracy Radel	SHINE
Ross Radel	SHINE
Abdul Momen	SHINE
AJ Hipke	SHINE
Marek Piechowicz	SHINE
Yana Karslyan	SHINE
Christopher Chwasz	Idaho National Laboratory
Cemal Cakez	Curio
Adam Mang	Curio
Carlyn Greene	UxC, LLC
Edwin Lyman	Union of Concerned Scientists
Andrea Jennetta	SP Global
Ed Petit de Mange	Oklo
Ross Moore	Oklo
Cassandra Fike-Hanley	Oklo
Chase Li	
Melinda Graham	