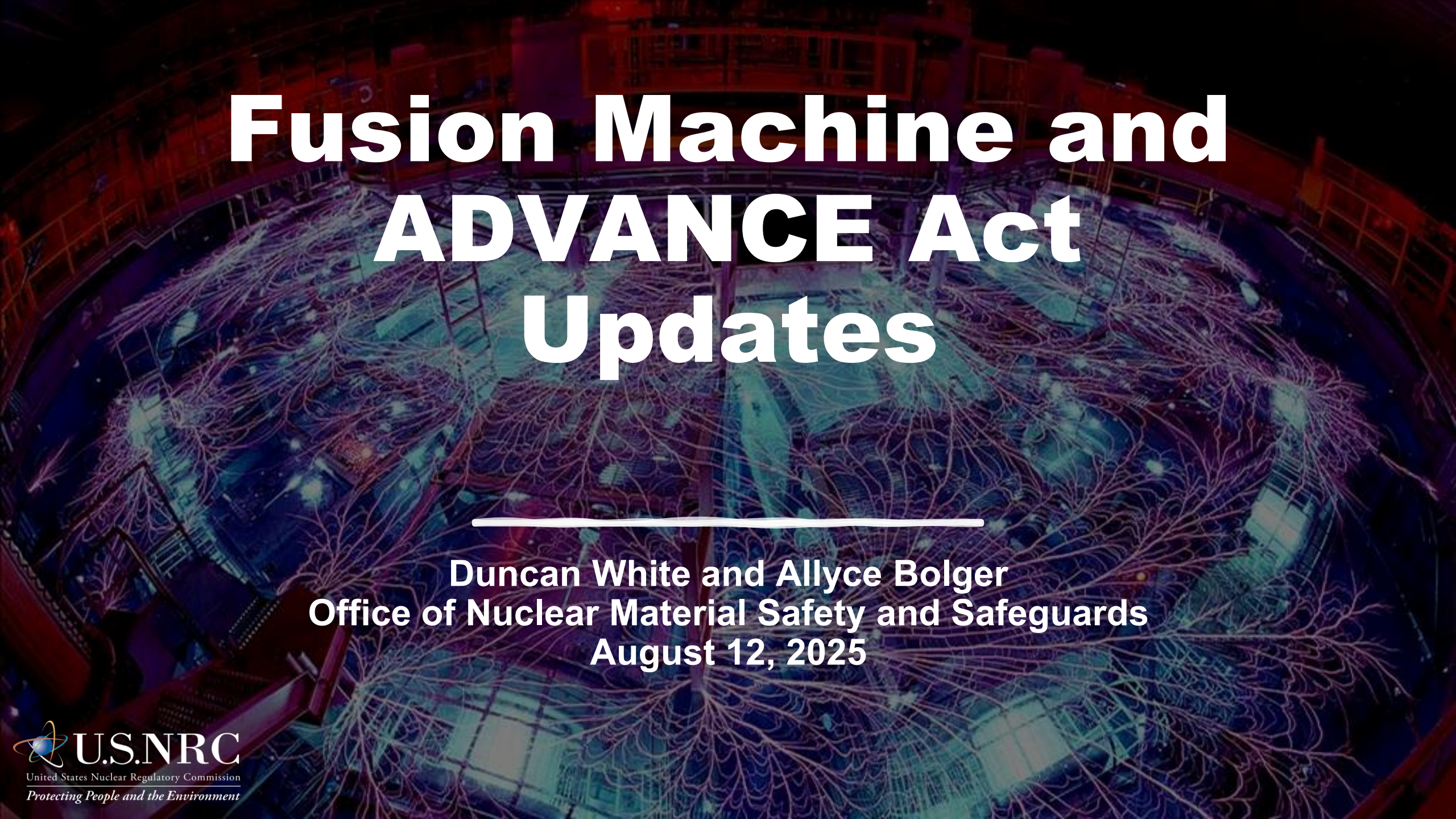

Fusion Machine and ADVANCE Act Updates

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Office of Nuclear Material Safety and Safeguards
August 12, 2025

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

The Journey Continues….

July 16, 2009	Jan. 14, 2019	Oct. 2, 2020	Jan. 3, 2023	Apr. 13, 2023	July 9, 2024	Dec. 11, 2024
SRM-SECY-09-0064 “Regulation of Fusion-Based Power Generation Devices”; addresses NRC regulatory jurisdiction over commercial fusion energy devices	The **Nuclear Energy Innovation and Modernization Act** (**NEIMA**); signed into law	Commission Issued SRM-SECY-20-0032, “Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors” which directed staff to develop options for fusion regulation	NRC staff submitted SECY-23-0001, “Options for Licensing and Regulating Fusion Energy Systems”	Commission issued SRM-SECY-23-0001 “Options for Licensing and Regulating Fusion Energy Systems”	**The Accelerating Deployment of Versatile, Advance Nuclear for Clean Energy (ADVANCE) Act** was signed into law on July 9, 2024, clarifying fusion-produced radioactive material is byproduct material	NRC staff submitted the Fusion Machine proposed rule to the Commission, SECY-24-0085, “Proposed Rule: Regulatory Framework for Fusion Machines (3150-AL00; NRC-2023-0071)”

External Engagement

Meetings with external stakeholders

- Public meetings
- Government-to-Government
- Site visits: DOE, commercial, and international
- Professional societies (ASME, HPS)

Consultation with other regulators

- Agreement States
- Department of Energy
- Food and Drug Administration
- Federal Aviation Administration
- Department of Transportation
- International community

Proposed Rule: Regulatory Framework for Fusion Machines

- Provided to NRC Commission on December 11, 2024 (SECY-24-0085)
- Limited rulemaking
- Technology neutral and risk-informed
- Incorporates new and revised definitions from ADVANCE Act of 2024
- ADAMS Accession No. ML24019A060

Fusion Machine Licensing Guidance

NUREG-1556, Volume 22 (revised proposed draft version released on March 12, 2025 (ML24295A002))

- Applies to fusion machines for research and development or commercial deployment
- Risk-informed and technology neutral
- Leverages existing 10 CFR Part 30 requirements applicable to all licensees
- Emphasizes containing, shielding, processing, or controlling radiation and radioactive materials
- Limited to specific components where radioactive materials are present (i.e., not facility-wide)

Section 205 of the ADVANCE Act

- The Accelerating Deployment of Versatile, Advance Nuclear for Clean Energy (ADVANCE) Act was signed into law on July 9, 2024
- Adds a new definition of “fusion machine” to the Atomic Energy Act of 1954, as amended (AEA)
- Incorporates “fusion machine” into the definition of “byproduct material” in Section 11e(3)(B) of the AEA
- Made conforming changes to the Nuclear Energy Innovation and Modernization Act (NEIMA) to replace the term “fusion reactor” with “fusion machine”
- **Tasked the NRC with performing a study on mass-production of fusion machines and submitting a report to Congress on the results (Section 205 (c))**

ADVANCE Act Section 205(c) Requirements

Perform	Perform a study on performance-based, design-specific licensing frameworks for mass-manufactured fusion machines
Consult	Study to be performed in consultation with Agreement States and private fusion sector
Evaluate	Evaluate the design, manufacturing, and operations certification process for aircraft used by the Federal Aviation Administration (FAA) as a potential model for fusion machines
Develop	Develop an estimated timeline for the NRC to issue consolidated guidance or regulations for licensing mass-manufactured fusion machines, considering the results of the study and anticipated need
Submit	Submit a report to Congress by July 9, 2025

Overview of Section 205 Report

Highlights ADVANCE Act implementation as a key agency priority and notes the importance of identifying efficiencies in fusion machine licensing
Summarizes existing external and internal regulatory frameworks that could be leveraged in the development of a framework for licensing mass-manufactured fusion machines
Discusses the NRC's estimated timeline to issue guidance or regulations for the licensing of mass-manufactured fusion machines
Identifies completed, ongoing, and future actions the NRC is taking to enhance its regulatory framework for fusion machines
Discusses licensing considerations within the National Materials Program
Report sent to Congress on July 10, 2025 (ML25120A080)

External and Internal Regulatory Frameworks Reviewed

NRC certification frameworks:

- sealed sources and devices
- transportation packages
- spent fuel casks
- microreactors

Certification frameworks used outside the NRC:

- The FAA's design, manufacturing, and operations certification of aircraft
- The Food and Drug Administration's (FDA) review of radiation therapy medical devices
- The Department of Transportation's regulation of safety-related components for vehicles
- Agreement State emerging technologies

What Did We Learn?

There are several concepts in both external and internal frameworks that the NRC could adopt to efficiently develop a licensing framework for mass-manufactured fusion machines:

- Design type categories used by the FAA
- Equivalence reviews used by the FDA
- Sealed source & device certification used by the NRC
- Transport package and spent fuel cask certification used by the NRC
- Nth of a Kind (microreactors)
- Leveraging Agreement State experience in licensing emerging technologies (e.g., fusion and medical)

Indicators for Industry Readiness

Indicators that could be used to inform the process:

- Technical achievements
- Full-scale demonstration of novel components
- Mass-manufacturing of fusion machine parts
- Supply chain management
- Funding certainty
- Economic viability

Section 205 Report: Completed and Ongoing Actions

- Publication of “Vision and Strategy: Regulating Fusion Machines Across the National Materials Program”
- Continue efforts to publish final rule on fusion machines and associated consolidated licensing guidance
- Monitor the development and assess the adoption of third-party codes and standards for fusion machines
- Monitor industry milestones and technical developments for integration into future fusion machine guidance
- Continue development of a training program for fusion machines

Section 205 Report: Future Actions

- Following initial licensing, deployment, and operation of the first commercial fusion machine in the United States
  - Update or issue new guidance for commercial fusion machines
  - Incorporate any NRC and Agreement State lessons learned and best practices to better risk-inform licensing reviews
- Evaluate existing suite of health physics computer codes
  - Update SCALE and MELCOR for independent validation of an application's shielding and safety designs during licensing

ADVANCE Act Section 401 Report

- Advanced Methods of Manufacturing and Construction for Nuclear Energy Projects
- Report focused on advance reactors but included fusion machines
- Brief discussion on current efforts for standards and codes
- Report sent to Congress on January 6, 2025 (ML24292A171)

NRC's Vision and Strategy: Regulating Fusion Machines Across the National Materials Program

- **Vision**
  - NRC's Principles of Good Regulation
- **Strategic Focus**
  - Regulatory Optimization
  - Technical Readiness
  - Partnership and Coordination
- **Outcomes**
  - Regulatory Preparedness
  - Prototypes, Demonstrations, and Other Single-Site Projects
  - Broader Adoption

Released on March 11, 2025
(ML25069A706)

Fusion Training for the NMP

Currently Available: November 2023 MIT fusion seminar available in Collaborative Learning Environment (CLE)

Phase I: Fusion Fundamentals (March – May 2026)

- Part 1 will provide an introduction into basic science, mathematics, and physics associated with fusion
- Part 2 will provide an overview of near-term fusion machine design approaches and their associated hazards

Phase II: Regulatory Training (July 2027)

- Changes to regulations and new guidance associated with fusion machines concurrent with final rule
- Update G-108 and G-109 inspection and licensing courses

Phase III: Formal Fusion Technology Course (TBD)

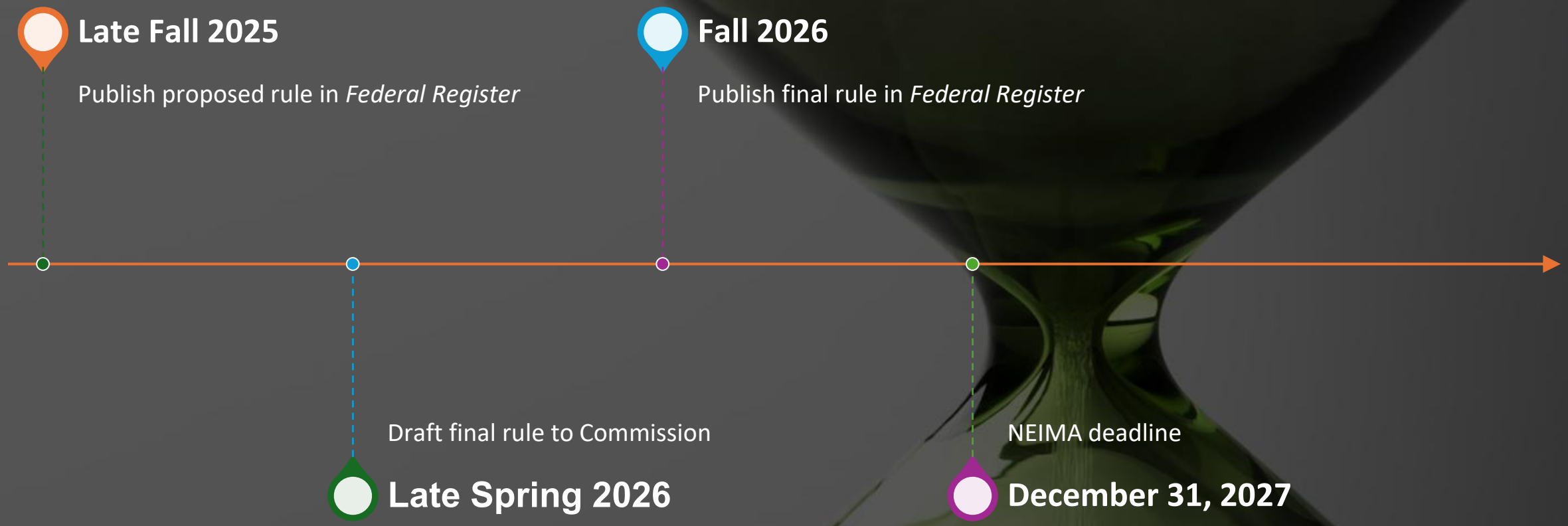
•Instructor-led fusion technology course

Standing Committee on Fusion Machine Oversight

NRC/Agreement State advisory committee for fusion regulatory program development

- Share lessons learned and best practices
- Provide technical assistance to the NMP on licensing and inspection issues
- Track readiness of commercial fusion technology development
- Provide recommendations to the NMP on regulatory issues
- Provide input to guidance for IMPEP review process
- Provide input on qualification and refresher training
- Charter: ML25183A025

Upcoming Milestones



Updated Website

https://www.nrc.gov/materials/fusion.html

- Fusion Basics
- Vision & Strategy
- Public Meeting Information
- Rulemaking
- Mass Production
- FAQs
- Fusion Activities in Agreement States
- NRC & Agreement State Partnership in Fusion
- International Activities

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