[7590-01-P]

NUCLEAR REGULATORY COMMISSION

10 CFR Parts 20, 30, 37, 50, 51, 72, 110, 150, 170, and 171

[NRC-2023-0071]

RIN 3150-AL00

Regulatory Framework for Fusion Machines

AGENCY: Nuclear Regulatory Commission.

ACTION: Proposed rule; guidance; and request for comment.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is proposing to amend its regulations to augment the existing byproduct material framework to be inclusive of fusion machines. The NRC is proposing requirements that are technology-inclusive to accommodate the wide variety of anticipated fusion machine designs across the National Materials Program. The NRC is also issuing for comment draft guidance for the implementation of this proposed rule, entitled NUREG-1556, Volume 22, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Fusion Machine Licenses." The NRC will conduct at least one public meeting to promote full understanding of the proposed rule and to facilitate public comments. We seek comment on all aspects of this proposed rule.

DATES: Submit comments by May 27, 2026. Comments received after this date will be considered if it is practical to do so, but the Commission is able to ensure consideration of only comments received before this date.

ADDRESSES: You may submit comments by any of the following methods (unless this document describes a different method for submitting comments on a specific subject). The NRC encourages electronic comment submission through the **Federal rulemaking website** (please choose only one of the ways listed):

- **Federal Rulemaking website:** Electronically at https://www.regulations.gov. Follow the “Submit a comment” instructions. If you are reading this document on federalregister.gov, you may use the green “SUBMIT A PUBLIC COMMENT” button beneath this rulemaking’s title to submit a comment to the regulations.gov docket. Address questions about NRC dockets to Helen Chang; telephone: 301-415-3228; email: Helen.Chang@nrc.gov. For technical questions contact the individuals listed in the FOR FURTHER INFORMATION CONTACT section of this document.

- **Email comments to:** Rulemaking.Comments@nrc.gov. If you do not receive an automatic email reply confirming receipt, then contact us at 301-415-1677.

- **Fax comments to:** Secretary, U.S. Nuclear Regulatory Commission at 301-415-1101.

- **Mail comments to:** Secretary, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, ATTN: Rulemakings and Adjudications Staff. Mailed comments must be received by the close of the comment period.

- **Hand deliver comments to:** 11555 Rockville Pike, Rockville, Maryland 20852, between 7:30 a.m. and 4:15 p.m. eastern time, Federal workdays; telephone: 301-415-1677.

Do not include any personally identifiable information (such as name, address, or other contact information) or confidential business information that you do not want publicly disclosed. All comments are public records; they are publicly displayed exactly

as received, and will not be deleted, modified, or redacted. Comments may be submitted anonymously.

Follow the search instructions on https://www.regulations.gov to view public comments.

You can read a plain language description of this proposed rule at https://www.regulations.gov/docket/NRC-2023-0071. For additional direction on obtaining information and submitting comments, see “Obtaining Information and Submitting Comments” in the SUPPLEMENTARY INFORMATION section of this document.

FOR FURTHER INFORMATION CONTACT: Dennis Andrukat, Office of Nuclear Material Safety and Safeguards, telephone: 301-415-3561, email: Dennis.Andrukat@nrc.gov, and Ed Harvey, Office of Nuclear Material Safety and Safeguards, telephone: 301-415-1897, email: Edward.Harvey@nrc.gov. Both are staff of the U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

SUPPLEMENTARY INFORMATION:

EXECUTIVE SUMMARY:

The U.S. Nuclear Regulatory Commission (NRC) is proposing the revision of its byproduct material framework at part 30 of title 10 the *Code of Federal Regulations* (10 CFR), “Rules of General Applicability to Domestic Licensing of Byproduct Material,” for the licensing and oversight of the possession, use, and production of byproduct material associated with fusion machines. The proposed amendments to 10 CFR part 30 are primarily focused on definitions and the content of an application. Proposed

amendments to 10 CFR part 20, “Standards for Protection Against Radiation,” are focused on definitions and establishing a waste disposal site intruder assessment requirement, and proposed amendments to 10 CFR part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions,” are focused on a requirement to submit an environmental report. In addition, the draft proposed rule includes changes to the definition of byproduct material in several other parts of the regulations (10 CFR parts 37, 50, 72, 110, 150, 170, and 171) as required by section 205 of the ADVANCE Act.[1]

This rulemaking is separate from NRC’s comprehensive review and reform of its regulations, including those governing transportation, in accordance with Executive Order (E.O.) 14300, “Ordering the Reform of the Nuclear Regulatory Commission” (90 FR 22587; May 29, 2025). The rulemakings associated with that effort will comprehensively reexamine NRC requirements, including those in 10 CFR part 30. While there could be additional revisions to 10 CFR part 30 as a result of these future rulemakings, the NRC is moving forward with publication of this proposed rule at this time because it is a deregulatory action of high interest for stakeholders that was in progress before the issuance of E.O. 14300. In this rule, the NRC is proposing to augment the existing byproduct material framework in 10 CFR part 30 to be inclusive of fusion machines. The NRC is proposing requirements that are technology-inclusive to accommodate the wide variety of anticipated fusion machine designs across the National Materials Program.

A. Description of the Regulatory Action

[1] The Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy (ADVANCE) Act of 2024 was signed into law on July 9, 2024; Public Law No: 118-67 (https://www.congress.gov/118/plaws/publ67/PLAW-118publ67.pdf).

This proposed rule includes regulatory requirements for the possession, use, and production of byproduct material associated with near-term fusion machines that are consistent with existing requirements, to the extent practicable. The technology-inclusive and risk-informed focus of this rulemaking will ensure applicability for the wide variety of anticipated fusion machine designs while also accounting for the differing quantities of radioactive material that may be used and produced by these machines. In the context of this proposed rulemaking, the focus of licensing and oversight would be on possession, use, and production of radioactive materials associated with fusion machines, as well as activation products.

B. Major Provisions

The major provisions of this proposed rule include—

- Development of a regulatory framework for licensing the possession, use, and production of byproduct material associated with fusion machines under the existing 10 CFR part 30 byproduct material framework. This framework would provide a systematic, risk-informed, performance-based approach to the licensing and oversight of byproduct material associated with fusion machines and their associated radiological hazards.

- Establishment of new proposed definitions, adopted from the Atomic Energy Act (AEA) of 1954, as amended by the ADVANCE Act of 2024, to establish the scope of regulatory requirements for the possession, use, and production of byproduct material associated with fusion machines and technology-inclusive content-of-application requirements supportive of a performance-based approach to regulation.

- Other targeted changes to current regulations that would ensure the applicability of current domestic licensing practices, and other updates necessary for the safe and secure use of radioactive materials associated with fusion machines.

Concurrent with this proposed rule, the NRC is issuing draft NUREG-1556, Volume 22, “Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Fusion Machine Licenses.”

C. Costs and Benefits

The NRC has prepared a regulatory analysis to determine the expected quantitative costs and benefits of this proposed rule, as well as qualitative factors considered in the NRC's rulemaking decision. The quantitative analyses evaluated four attributes: industry operation, NRC implementation, NRC operation, and other government entities. Qualitative analyses were necessary to assess the attributes of regulatory efficiency and increased public confidence along with augmenting the assessments of the attributes that were quantitatively assessed because monetizing the full impact of each attribute is not possible or practical. Fully monetizing the impact of each attribute would require estimation of factors such as the frequency of security-related events and the consequences of such events.

The analysis concluded that this proposed rule would result in net averted costs to the industry that exceed the net costs to Agreement States and the NRC. The proposed rule would result in total net benefit of approximately $1.38 million, and greater than a 99-percent chance that there would collectively be a positive net benefit. The total cost of the proposed rule reflects the cost impact on fusion machine applicants, the NRC, and Agreement States.

Fusion machine applicants’ benefits stem from clarified regulations resulting in lower costs. NRC costs to implement this proposed rule include future rulemaking costs incurred at the final rule phase and costs for the preparation and issuance of final guidance. The benefits to the NRC are avoided cost associated with the application reviews and the oversight of the possession, use, and production of byproduct material

associated with fusion machines. The costs to Agreement States are the costs of revising their regulations to be compatible with the proposed rule. The benefits for Agreement States would be reduced efforts in licensing due to improvements in clarity. The regulatory analysis concludes that this proposed rule would result in a total estimated implementation cost of $858,000 at a 7-percent discount rate and $1.26 million at a 3-percent discount rate.

The regulatory analysis results show that this rulemaking is justified because the total estimated quantified benefits, estimated to be $2.24 million at a 7 percent discount rate or $4.50 million at a 3 percent discount rate, exceed the estimated costs of the rule. The regulatory analysis also considered the following qualitative considerations and associated benefits: regulatory efficiency and increased public confidence. Benefits not monetized include reduced need for exemptions and license conditions, and more timely completion of licensing and oversight. Based on the assessment of the costs and benefits of this proposed rule, including those benefits that are unquantified, the NRC has concluded that the proposed rule provisions would be justified to protect public health and safety and security. For more information, please see the regulatory analysis (ADAMS Accession No. ML25168A339).

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I. Obtaining Information and Submitting Comments

A. Obtaining Information

Please refer to Docket ID NRC-2023-0071 when contacting the NRC about the availability of information for this action. You may obtain publicly available information related to this action by any of the following methods:

- **Federal Rulemaking Website:** Go to https://www.regulations.gov and search for Docket ID NRC-2023-0071.
- **NRC's Agencywide Documents Access and Management System (ADAMS):** You may obtain publicly available documents online in the ADAMS Public Documents collection at https://www.nrc.gov/reading-rm/adams.html. To begin the search, select "Begin ADAMS Public Search." For problems with ADAMS, please contact the NRC's Public Document Room (PDR) reference staff at 1-800-397-4209, at 301-415-4737, or by email to PDR.Resource@nrc.gov. For the convenience of the reader, instructions about obtaining materials referenced in this document are provided in the "Availability of Documents" section.
- **NRC's PDR**: The PDR, where you may examine and order copies of public

documents, is open by appointment. To make an appointment to visit the PDR, please send an email to PDR.Resource@nrc.gov or call 1-800-397-4209 or 301-415-4737, between 8 a.m. and 4 p.m. eastern time, Monday through Friday, except Federal holidays.

B. Submitting Comments

The NRC encourages electronic comment submission through the **Federal rulemaking website** (https://www.regulations.gov). Please include Docket ID NRC-2023-0071 in your comment submission.

The NRC cautions you not to include identifying or contact information that you do not want to be publicly disclosed in your comment submission. The NRC will post all comment submissions at https://www.regulations.gov as well as enter the comment submissions into ADAMS. The NRC does not routinely edit comment submissions to remove identifying or contact information.

If you are requesting or aggregating comments from other persons for submission to the NRC, then you should inform those persons not to include identifying or contact information that they do not want to be publicly disclosed in their comment submission. Your request should state that the NRC does not routinely edit comment submissions to remove such information before making the comment submissions available to the public or entering the comment into ADAMS.

II. Background

A. Introduction

In anticipation of future applications for licenses authorizing the possession, use, and production of byproduct material associated with fusion machines[2], the Commission stated in 2009 that "the NRC has regulatory jurisdiction over commercial fusion energy devices whenever such devices are of significance to the common defense and security, or could affect the health and safety of the public."[3] However, the Commission directed the NRC staff to wait until the commercial deployment of fusion technology became more predictable before expending significant resources to develop a regulatory framework.

Since 2009, commercial companies worldwide have continued development of fusion technologies using a variety of designs and fuel cycles.[4] Design proof of concept, including exceeding scientific break-even (i.e., Q>1)[5] and net power production, is now targeted for some commercial fusion machine concepts as soon as the mid-to-late 2020s, with commercial deployment projected to follow in the late 2020s and early 2030s.

In 2019, the Nuclear Energy Innovation and Modernization Act (NEIMA) required the NRC to develop the regulatory infrastructure to support the development and commercialization of advanced nuclear reactors, including both nuclear fission reactors and fusion machines.[6] Section 103 of NEIMA requires the NRC to complete a

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[2] With the passage of the ADVANCE Act of 2024, section 11 of the Atomic Energy Act of 1954 (AEA) was amended to add "fusion machine" to describe the fusion process and its resultant products. The ADVANCE Act also amended the AEA definition of byproduct material to expressly include radioactive material generated by a fusion machine. With the amendment of the AEA, NRC staff will now use the term fusion machine instead of previous terms used to describe the fusion process and its resultant products such as fusion reactor, fusion energy systems, or fusion systems. Those previous terms will be used if quoted from other documents.

[3] See Staff Requirements Memorandum (SRM)-SECY-09-0064, "Staff Requirements—SECY-09-0064—Regulation of Fusion-Based Power Generation Devices," dated July 16, 2009 (ADAMS Accession No. ML092230198).

[4] See the Fusion Industry Association's report "The Global Fusion Industry in 2023" (https://www.fusionindustryassociation.org/fusion-industry-report-archive/).

[5] Q denotes the ratio of the energy of the fusion products to the energy used to heat the plasma. Q=1 would denote the fusion breakeven point where equal amounts of energy were used and produced by the fusion machine. Q > 1 denotes the fusion machine generated more energy than it used to heat the plasma, while Q < 1 denotes the fusion machine generated less energy than it used to heat the plasma.

[6] The ADVANCE Act of 2024 amended NEIMA to replace "fusion reactor" with "fusion machine."

rulemaking to establish a technology-inclusive regulatory framework for optional use by commercial advanced nuclear reactor applicants by December 31, 2027.

In response to NEIMA and due to the continued development of fusion technologies, the Commission in 2020 directed the NRC staff to "consider the appropriate treatment of fusion reactor designs in our regulatory structure by developing options for Commission consideration on licensing and regulating fusion energy systems."[7] In its November 2, 2020, response to this Commission direction, the NRC staff stated that it would assess the potential risks posed by fusion technologies and explore regulatory approaches separate from the ongoing rulemaking for advanced nuclear fission reactors that would create 10 CFR part 53, "Risk-Informed, Technology-Inclusive Regulatory Frameworks for Commercial Nuclear Plants."

The NRC staff developed an options paper[8] that included three potential approaches for the regulation of fusion machines: (1) a utilization facility approach, (2) a byproduct material approach, and (3) a hybrid approach. The utilization facility approach would use the part 53 framework and apply the requirements for fission facilities to fusion machines. The byproduct material approach would use the existing 10 CFR part 30 framework, along with a limited-scope rulemaking proposed by the NRC staff. The hybrid approach would have the NRC first regulate fusion machines under the part 30 framework but later develop decision criteria to identify whether a fusion machine design should be regulated under a part 53 framework. The NRC would develop the criteria during a future limited-scope rulemaking.

B. Rulemaking Activity

[7] SRM-SECY-20-0032, "Staff Requirements—SECY-20-0032—Rulemaking Plan on 'Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors (RIN-3150-AK31; NRC-2019-0062),'" dated October 2, 2020 (ADAMS Accession No. ML20276A293).

[8] SECY-23-0001, "Options for Licensing and Regulating Fusion Energy Systems," dated January 3, 2023 (ADAMS Accession No. ML22273A178).

The Commission directed the NRC staff to proceed with a rulemaking on fusion machines in "Staff Requirements – SECY-23-0001 – Options for Licensing and Regulating Fusion Energy Systems," dated April 13, 2023.[9] The Commission chose the byproduct material approach (Option 2) using the existing 10 CFR part 30 framework. The Commission further stated that this rulemaking should—

- Take into account the existence of fusion machines that already have been licensed and are being regulated by the Agreement States, as well as those that may be licensed prior to the completion of the rulemaking;
- Develop a new volume of NUREG-1556, "Consolidated Guidance About Materials Licenses," dedicated to fusion machines, so as to provide consistent guidance across the National Materials Program;
- Evaluate whether controls-by-design approaches, export controls, or other controls are necessary for near-term fusion machines; and
- If in the future, the NRC staff, in consultation with the Agreement States, determines that an anticipated fusion design presents hazards sufficiently beyond those of near-term fusion technologies, the NRC staff should notify the Commission and make recommendations for taking appropriate action as needed.

On July 9, 2024, the ADVANCE Act of 2024[10] was signed into law. Section 205 of the ADVANCE Act amended section 11 of the AEA to add the definition of "fusion machine" and amended the definition of "byproduct material" to include fusion machine generated radioactive material in section 11e.(3)(B). The ADVANCE Act thus establishes that, for the purposes of the AEA's definition of byproduct material, fusion

[9] SRM-SECY-23-0001, "Staff Requirements—SECY-23-0001—Options for Licensing and Regulating Fusion Energy Systems," dated April 13, 2023 (ADAMS Accession No. ML23103A449).

[10] The Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy (ADVANCE) Act of 2024 was signed into law on July 9, 2024; Public Law No: 118-67 (https://www.congress.gov/118/plaws/publ67/PLAW-118publ67.pdf).

machines are a subset of particle accelerators. In addition, the AEA's amended definition creates two criteria for determining whether radioactive material produced through use of a particle accelerator is byproduct material under AEA section 11e.(3)(B): one set of criteria for fusion machines, and another set for particle accelerators that are not fusion machines.[11] These changes are included in this rulemaking.

The ADVANCE Act also amended section 103 of NEIMA to delete "fusion reactor" and replace it with "fusion machine." Finally, subsection 205(c) of the ADVANCE Act requires the NRC to submit a report to Congress, by July 9, 2025, on design-specific licensing frameworks for "mass-manufactured fusion machines"; and provide an estimated timeframe for the NRC to issue regulations or guidance for licensing mass-manufactured fusion machines. This report is being prepared separately from this rulemaking.

C. What is fusion? How is it different from fission as seen in nuclear reactors?

Fusion machines are distinctly different from fission reactors. Fusion is a process in which two or more atomic nuclei are combined to form a heavier element, releasing energy along with charged particles and neutrons. In addition to heat, particles, and electromagnetic radiation, fusion machines can produce tritium, neutrons, and neutron activation products that need to be properly contained to protect public health and safety. The generation of net energy from fusion requires creating conditions, such as in a plasma,[12] that confines the particles and energy for long enough time at high enough density and temperature so that the energy produced by the fusion reactions exceeds

[11] Under AEA section 11e.(3)(B)(i), byproduct material is any material that has been made radioactive by use of a particle accelerator, including by use of a fusion machine. Under AEA section 11e.(3)(B)(ii), byproduct material is any material that if made radioactive by use of a particle accelerator that is not a fusion machine, is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity (42 U.S.C. 2011 et seq.).

[12] A plasma is a state of matter consisting of positive ions and free electrons with a small overall electrical charge that is dominated by electric and magnetic interactions.

the energy used to create and maintain the conditions. Fusion reactions require active control to sustain these specific conditions, such as maintaining confinement of the plasma at fusion conditions, otherwise fusion reactions will cease along with the production of radiation and radioactive material. There can be long-term generation of decay heat in the structures due to the decay of radionuclides made radioactive by neutrons from the fusion reactions, but the level of decay heat generated is not expected to require engineered emergency heat removal systems.

Fission, as seen in nuclear reactors, is the splitting of a heavy atom (usually enriched uranium-235), which releases energy (usually in the form of heat) that can be used to produce electricity. Fission may be spontaneous but is usually caused by the nucleus of an atom becoming unstable after capturing or absorbing a neutron. During fission, the heavy nucleus splits into roughly equal parts, producing radionuclides of at least two lighter elements that can be radioactive. There must be enough neutrons being released from fissions to maintain a self-sustaining fission reaction rate, namely criticality. Unlike fusion reactions, self-sustaining fission reactions require active control to maintain criticality and, when necessary, to cease the fission reactions (i.e., reach a sub-critical condition). Fission reactors also generate long-term decay heat at a high enough level that they need engineered emergency heat removal systems to ensure that the decay heat is removed from the system.

D. What is byproduct material, and why are the regulations for byproduct material a good fit for fusion machines?

Byproduct material is regulated under the framework presented in 10 CFR part 30. Byproduct material is currently defined in 10 CFR part 30 as (1) any radioactive material (except special nuclear material) produced or made radioactive by exposure to the radiation incident to the process of producing or using special nuclear material (this

includes most of the available inventory of the radionuclide hydrogen-3 also known as tritium); (2) any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or (3) any material that has been made radioactive by use of a particle accelerator and is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity. In addition, the NRC, in consultation with the Environmental Protection Agency (EPA), Department of Energy (DOE), Department of Homeland Security (DHS), and others, can designate as byproduct material any source of naturally occurring radioactive material, other than source material, that the NRC determines would pose a threat to public health and safety or the common defense and security of the United States and has been extracted or converted after extraction for use in a commercial, medical, or research activity.

The NRC currently uses an approach to licensing byproduct material that regulates the potential hazards from a wide spectrum of technologies, from lower risk portable nuclear gauges to higher risk panoramic irradiators and commercial manufacturers of radioactive sources or devices. Byproduct material regulations provide a comprehensive list of technical and regulatory areas that must be addressed in the licensing processes. NUREG-1556, “Consolidated Guidance About Materials Licenses,” provides guidance on meeting those requirements. For larger quantities of byproduct material, such as those that may be present at commercial fusion machine sites, NRC regulations, such as 10 CFR parts 20 and 30, include specific programmatic requirements, such as those related to financial assurance, emergency planning, waste management, and decommissioning.

The types of radioactive materials and hazards associated with a near-term fusion machine are more aligned with those of a byproduct material license holder than those of a nuclear power plant. For example, key areas of focus for protecting public

health and safety for byproduct material license holders are confinement of radioactive materials, shielding to protect people from radiation hazards, consideration of potential supporting systems for breeding tritium, and the accountability of tritium or other radionuclides at the site. Potential radiological hazards posed by fusion machines include the following:

- Significant quantities of tritium may be located on the site, including within the vacuum vessel, in processing, in storage, and permeated into structural materials.[13]
- During operation, fusion machines represent a large radiation source, including high-energy neutrons and gamma radiation, that requires shielding and containment of activated components.
- Neutron bombardment will activate components, with quantities of activation products increasing over time.
- Energetic plasma-surface interactions with the vacuum vessel interior wall may generate dust containing tritium and activation products.
- Fusion also can directly generate radioactive materials; for example, about 50 percent of the time, when two deuterium atoms are fused together (D–D fusion), the fusion reaction generates a tritium atom (the other direct products are not radioactive).

Fusion machines may use byproduct material as fuel or may produce byproduct material, such as through exposure of nonradioactive material to neutron radiation or from the fusion reactions. The byproduct material framework provides a flexible approach to regulate the anticipated diversity of fusion designs, fuels, and quantities of radioactive materials produced by a fusion machine.

[13] The maximum inventory of tritium at the International Thermonuclear Experimental Reactor (ITER) is expected to be 4,000 grams (about 40 million curies). Commercial companies pursuing fusion machines for deployment in the United States have communicated to the NRC that tritium inventories for their designs are expected to be significantly less (about 5 to 10 million curies).

E. Why is the NRC undergoing rulemaking to address fusion machines?

Besides incorporating the statutory changes to the AEA and the NEIMA requirement for the NRC to establish fusion machine (advanced reactor) regulations by December 31, 2027, the NRC also endeavored to provide centralized, predictable, dedicated fusion machine regulations and guidance. Rulemaking would allow for the timely alignment of the licensing and regulation of the possession, use, and production of byproduct material associated with fusion machines across the NRC and the Agreement States, as part of the National Materials Program, to provide near-term regulatory predictability for fusion developers, regulators, and the public. In addition, the participation of the public in the Administrative Procedure Act rulemaking process enables all stakeholders (e.g., regulators, industry, and the public) to interact, provide feedback, and gain an understanding of the risks, costs, cost savings, and benefits of this new technology.

In this proposed rule, the NRC proposes definitions to establish the scope of regulatory requirements for the possession, use, and production of byproduct material associated with fusion machines and technology-inclusive content-of-application requirements supportive of a performance-based approach to regulation. Other targeted changes to current regulations and guidance would ensure the applicability of current domestic licensing practices, and other updates necessary for the safe and secure use of radioactive materials used in a fusion machine.

III. Discussion

A. General Scope

The NRC is undertaking a limited-scope rulemaking to license and regulate the possession, use, and production of byproduct material associated with fusion machines.

The proposed changes would amend 10 CFR parts 20, 30, 37, 50, 51, 72, 110, 150, 170, and 171, include changes to definitions, content-of-application requirements, recordkeeping and inspection requirements, intruder assessment requirements for waste disposal sites, and environmental report submission requirements. This proposed rule is focused on fusion machines for both commercial and research and development purposes that are currently contemplated for deployment in the near term. At the time of this rule, there are 29 fusion companies[14] based in the United States, including several that are constructing proof-of-concept facilities. The phrase “near-term” for fusion machines was described in SECY-23-0001 and is not used to refer to a particular timeframe; rather, it encompasses certain characteristics associated with all the known approaches to fusion currently being researched or under development. As described in SECY-23-0001, these include—

- No fissile material is present, and criticality (a self-sustaining neutron chain reaction) is not possible.
- Energy and radioactive material production from fusion reactions cease without any intervention in off-normal events or accident scenarios.
- Active post shutdown cooling of the fusion machine’s structures containing radioactive material is not necessary to prevent a loss of radiological confinement (i.e., vessel breach).[15]
- Radionuclides present in the fusion machine, in processing or storage, or in activated materials, in any significant mobilizable amount are expected to result in low

[14] See Fusion Industry Association’s report on “Global Fusion Industry Report,” dated July 22, 2025.
[15] See EURFUBRU XII-217/95, Safety and Environmental Assessment of Fusion Power (SEAFP): Report of the SEAFP Project, European Commission DG XII, Fusion Programme, issued June 1995 (https://www.researchgate.net/publication/303252621_Safety_and_Environmental_Assessment_of_Fusion_Power_SEAFP_Final_Report_of_the_SEAFP_Project).

doses to workers and member of the public during credible accident scenarios (e.g., less than 1 rem (10 millisievert (mSv)) effective dose equivalent to a person offsite).

- Active engineered features (e.g., plasma confinement mechanisms, vacuum maintaining systems, fuel injection, external heating) are needed to achieve sustained fusion reaction.

The NRC considered these characteristics and the level of risk associated with the scientific and technical approaches to fusion known to the NRC at the time of this rulemaking.[16] The proposed rule, while technology inclusive, is not intended to address speculative fusion technologies significantly different from those being researched, developed, piloted, and deployed today (for example, today's design types include tokamak, stellarator, z-pinch, field reverse, and configurations with fuels that include deuterium-tritium, deuterium-helium-3, and proton-boron-11). The NRC will continue to monitor the development of fusion technology as it advances towards commercialization.

The proposed rule would add new requirements and modify some existing requirements to license and oversee the possession, use, and production of byproduct material associated with fusion machines under the 10 CFR part 30 byproduct material framework. Agreement States are currently using requirements compatible with 10 CFR part 30 and have safely regulated laboratory-scale fusion research and development systems for over 25 years. The 10 CFR part 30 requirements include safety, security, emergency preparedness, and radiation protection for workers and the public. Each applicant would need to provide specific design information and proposed radiological materials that will be used or generated (quantity and form), which would further shape

[16] See e.g., the National Academies of Science report, "Bringing Fusion to the US Grid," issued in 2021 (https://doi.org/10.17226/25991); UKAEA-RE(21)01, "Technology Report—Safety and Waste Aspects for Fusion Power Plants," issued September 2021 (https://scientific-publications.ukaea.uk/wp-content/uploads/UKAEA-RE2101-Fusion-Technology-Report-Issue-1.pdf); and the Fusion Industry Association's report, "The Global Fusion Industry in 2023," (https://www.fusionindustryassociation.org/fusion-industry-report-archive/).

the NRC's understanding of potential hazards that can impact safety, security, and emergency preparedness. This information may result in the need for specific license conditions. This proposed rulemaking does not amend 10 CFR parts 170 and 171 to add new initial application of annual fee categories for fusion machines. New fees for the possession, use, and production of byproduct material associated with fusion machines will be proposed in the annual fee rule following publication of the final rule for this rulemaking. The NRC uses annual fee rules to make changes to the NRC's fees; therefore, the NRC is not proposing any fee-related amendments for the possession, use, and production of byproduct material associated with fusion machines in this proposed rule.

Informed by stakeholder interactions during the development of this proposed rule, the NRC has concluded that the current requirements for key topics such as emergency preparedness, physical security, radiation protection, and waste disposal (except for a small adjustment to 10 CFR part 20) are adequate for near-term designs. The fusion industry is emerging rapidly, and designs are both diverse and evolving. The NRC, in consultation with the Agreement States, will continue to evaluate the hazards presented by near-term fusion designs as they are developed for deployment. Additionally, the NRC has coordinated with DOE on topics such as tritium handling, training, international cooperation, and public outreach and the NRC will continue to collaborate with Federal partners, as needed.

The NRC, and the Atomic Energy Commission before it, has experience licensing new and rapidly evolving technologies. The NRC has authority under § 30.32(b) to require additional information as necessary to evaluate an application, and under § 30.34(e) to impose any license conditions, orders, or other requirements needed to ensure that fusion machines will be operated safely and securely. As stated in

§ 30.33(b), the NRC will only grant a license upon a determination that the application meets the requirements of the Atomic Energy Act of 1954, as amended, which includes protection of the public health and safety and promotion of the common defense and security. In the proposed rule, the NRC is specifying the basic regulatory requirements that applicants must meet (e.g., dose limits) and providing licensing guidance that asks for basic information to ensure a common understanding of the machine such that it will provide adequate public health and safety (such as meeting dose limits and training of radiation safety staff and users). This performance-based approach provides safety and security while providing the applicant or licensee the necessary flexibility to design and innovate its fusion machine design. This paragraph in this proposed rule is intended to explain how the licensing and oversight provisions allow for the use of flexible, technology appropriate safety measures even though these measures are not prescribed in the regulations.

If the NRC receives an application for the possession, use, and production of byproduct material associated with a near-term fusion machine that includes safety and security elements that were not anticipated, the proposed and existing regulations under 10 CFR part 30 afford the NRC adequate authority to impose requirements to carry out that responsibility on a case-by-case basis. In addition, the NRC will continue to work with the Agreement States to ensure that the States have licensing and inspection programs for fusion machines that are compatible and provide consistency across the National Materials Program.

For waste disposal, new proposed rule language would allow fusion-machine-produced byproduct material that was not considered during the development of the existing 10 CFR part 61, “Licensing Requirements for Land Disposal of Radioactive Waste” (47 FR 57463; December 27, 1982), to be disposed at low-level radioactive

waste (LLW) disposal facilities. This disposal path for materials used or generated in a fusion machine provides safe disposal at existing LLW disposal facilities.

For emergency preparedness, the NRC would continue to require applicants to determine if the maximum dose to a person offsite could exceed 1 rem (10 mSv), and if so, to provide an emergency plan for offsite protection of the public. The basis for the offsite dose evaluation and the subsequent emergency plan (if needed) would consider the unique characteristics of the radionuclides generated or used by the fusion machine, such as dispersion and radiochemistry. Separately, an onsite emergency plan, or emergency procedures, would be needed based on the potential events and radiological hazards within the site boundary of each fusion machine.

For physical security, the quantities or forms of radioactive material associated with the fusion machine possessed by a licensee may warrant additional protection beyond that required by 10 CFR part 20, and those radionuclides may not be listed in appendix A to 10 CFR part 37, “Physical protection of category 1 and category 2 quantities of radioactive material.” In such cases, the NRC would determine on a case-by-case basis if other additional security requirements are warranted (e.g., based on the use of structural materials that create new radionuclides of concern through activation).

For radiation protection, the existing 10 CFR part 20 radiation safety requirements apply to all licensees currently regulated by the NRC. Licensees that possess fusion machines would be required to meet these 10 CFR part 20 radiation safety requirements, some of which may or may not apply depending on a licensee’s specific radioactive materials and their quantities. Therefore, this proposed rule would require applicants to describe what radionuclides and quantities will be used and produced in their specific fusion designs, which would allow regulators to evaluate how these requirements apply to a fusion machine before a license can be issued.

B. Specific Technical Topics

This proposed rule would revise requirements in several technical areas. The NRC also considered certain additional technical areas (e.g., export controls, emergency preparedness) to determine if revisions were needed but, as described above, ultimately concluded no new or amended requirements were necessary beyond those described below.

1. Defining Fusion Machines and Particle Accelerators

This proposed rule would add a new definition for "fusion machine" in §§ 20.1003 and 30.4 of this chapter; revise the definition of "particle accelerator" in §§ 20.1003, 30.4, and 110.2 of this chapter; and revise the definition of "byproduct material" in §§ 20.1003, 30.4, 37.5, 50.2, 72.3, 110.2, 150.3, 170.3, and 171.5 of this chapter. The NRC has been evaluating the linkage between fusion devices and particle accelerators for several years, and these definitions have been a topic of extensive discussion with stakeholders. Congress clarified this issue with the passage of the ADVANCE Act of 2024. The ADVANCE Act clarified this linkage by clearly defining all fusion-machine-produced radioactive material as falling within the AEA's existing definition for byproduct material. Specifically, the term "fusion machine" was added to section 11 of the AEA and "byproduct material" was amended in section 11e.(3)(B) to include any material that (i) has been made radioactive by use of a particle accelerator, including by use of a fusion machine; and (ii) if made radioactive by use of a particle accelerator that is not a fusion machine, is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity.[17] As explained above, the AEA's amended definition creates two criteria for determining whether

[17] The term "particle accelerator" is not defined in the AEA. The NRC's proposed regulatory definitions would define fusion machines as a subset of particle accelerators. The new requirements would apply to fusion machine applicants and licensees.

radioactive material produced through use of a particle accelerator is byproduct material under AEA section 11e.(3)(B): one set of criteria for fusion machines, and another set for particle accelerators that are not fusion machines.

The ADVANCE Act also amended NEIMA to change “fusion reactor” to “fusion machine” and points to the fusion machine definition under the ADVANCE Act. The definition of fusion machine in the ADVANCE Act and proposed for this rulemaking does not define fusion but focuses on what broadly is the role of the “machine,” i.e., transforming atomic nuclei using fusion processes and capturing and using the resultant products from those processes. Given the diversity of fusion processes and designs currently under consideration, the new definition provides the flexibility to be incorporated into NRC’s part 30 framework in a technology-inclusive manner. The proposed regulatory framework would provide a risk-informed approach to protecting workers, the public, and the environment from the possession, use, and production of byproduct material associated with fusion machines.

The NRC’s existing regulations and guidance (i.e., NUREG-1556, Volume 21, “Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Possession Licenses for Production of Radioactive Material Using an Accelerator”) provide for the licensing of particle accelerators. Consistent with the distinction in the AEA between byproduct material produced by fusion machines and other particle accelerators, the NRC’s proposed definitions would consider fusion machines as a subset of particle accelerators. This approach would affirmatively establish that existing guidance for particle accelerators would not apply to fusion machines.

In addition, the NRC would revise the part 110.2 definition for “byproduct material” to replace the reference to 10 CFR 20.1003 with the language found in 10 CFR 20.1003. This change would be consistent with the definition language found in the other byproduct material definitions in this chapter.

2. Specific Requirements for Fusion Machines

This proposed rule would add new §§ 30.32(k), 30.33(a)(6), and 51.60(b)(1)(viii) of this chapter. This proposed rule would also amend existing regulations in §§ 20.2008, 30.51(a) introductory text, 30.51(a)(1), and 30.52(a) of this chapter. The proposed new sections §§ 30.32(k) and 30.33(a)(6) are specific to the license application requirements for the possession, use, and production of byproduct material associated with fusion machines. The proposed new paragraph § 51.60(b)(1)(viii) is specific to the submission of an environmental report for the possession, use, and production of byproduct material associated with fusion machines. The proposed new language in paragraph § 20.2008(a) is specific to the disposal requirements for waste from a fusion machine. The remaining proposed changes amending the existing regulations in §§ 30.51(a) introductory text, 30.51(a)(1), and 30.52(a) of this chapter are conforming changes to existing byproduct material requirements to address specific attributes of fusion machines.

This proposed rule would add technology-inclusive, content-of-application requirements supportive of a performance-based approach to regulating the possession, use, and production of byproduct material associated with fusion machines. The content-of-application section would provide the requirements for the licensing of byproduct material associated with a fusion machine which would be supplemented by the current general regulatory requirements and the terms and conditions of licenses already contained in §§ 30.32, 30.33, and 30.34. In addition to the contents of application, other conforming changes would be added specific to fusion machines.

The proposed contents of application section in § 30.32(k) would require that an applicant for a license to possess, use, and produce byproduct material associated with a fusion machine provide several items:

(1) a general description of the fusion machine;

(2) a summary of operating and emergency procedures related to radiation safety;

(3) a description of the radiation safety organizational structure;

(4) a description of the training program for fusions machines and radiation protection;

(5) a description of inspection and maintenance programs; and

(6) a description of the methodology for maintaining a radioactive material inventory.

In the summary of the procedures important to radiation protection, the applicant must provide descriptions of (1) the radiation protection measures to be employed for byproduct material, including all interlocks, access control systems, shielding, and radiation monitors; (2) the byproduct material handling systems procedures and inventory control procedures; and (3) description of any other components or systems used to control radiation and radioactive material.

The proposed contents of application for the possession, use, and production of byproduct material associated with fusion machines also would give an applicant an alternative to providing a description of the fusion machine and operational programs relative to radiation safety as proposed in § 30.32(k)(2)(i)–(iii). The alternative pathway, proposed in § 30.32(k)(2)(iv), would require the applicant to provide a description of any aspects of the fusion machine relevant to radiation safety that differ from the information listed in paragraphs (k)(2)(i) through (iii), an explanation for how those aspects of the application ensure the fusion machine can be operated safely, and any other information requested by the NRC during preapplication communications to enable the NRC to evaluate whether the applicant can safely possess, use, and produce byproduct material associated with a fusion machine. This technology-inclusive approach to licensing recognizes the diversity of fusion machine designs currently being considered and

possible in the future while helping to provide early awareness of some information the applicant would need to provide to allow the NRC to determine whether byproduct material associated with a fusion machine can be possessed, used, and produced safely.

A new, proposed paragraph would be added to § 30.33(a)(6) to specifically provide the general requirement for approving an application to license the possession, use, and production of byproduct material associated with a fusion machine.

A new, proposed paragraph would be added to § 51.60(b)(1)(viii) to require that an environmental report be prepared for the construction and operation of a fusion machine unless a categorical exclusion applies.[18] The NRC expects that scope of the environmental report would be discussed during any voluntary preapplication discussions described in § 30.32(k)(2)(iv)(B).

Radioactive material as defined in paragraphs (3) and (4) of the definition of byproduct material in § 20.1003 is not LLW.[19] Given that fusion machines produce radioactive material that meets paragraph (3) of the definition of byproduct material, the NRC is proposing to include new language in paragraph (a) to § 20.2008 that would allow certain licensed waste from fusion machines to be disposed in a LLW disposal facility. The addition would not affect the ability of waste to be disposed of under

[18] Based on case-specific circumstances, a categorical exclusion may apply. Categorical exclusions are established by rule in § 51.22 for categories of actions that the Commission has found do not individually or cumulatively have a significant effect on the human environment. Even if a categorical exclusion would otherwise apply, the NRC may determine that special circumstances are present that warrant the preparation of an environmental document.

[19] Some radioactive material, added to the AEA definition of byproduct material by Section 651(e) of the Energy Policy Act of 2005 and ADVANCE Act of 2024, has special status relating to its disposal at LLW disposal facilities. These 11e.(3) and (4) byproduct materials include certain discrete sources of radium 226 (11e.(3)(A)), radioactive material resulting from operation of an accelerator or a fusion machine (11e.(3)(B)), and certain other discrete source[s] of naturally occurring radioactive material, other than source material (11e.(4)). As described in AEA sections 81b. and c., 11e.(3) and (4) byproduct materials intended for disposal are not considered LLW under the Low-Level Radioactive Waste Policy Act but may nevertheless be disposed of at near surface LLW disposal facilities. Under NRC regulations, licensed material that contains LLW must be disposed of in accordance with the requirements for LLW. Thus, licensed material that contains a mix of LLW and 11e.(3) and (4) byproduct material must be disposed of as LLW. In addition, AEA section 81c. provides that 11e.(3) and (4) byproduct material may be disposed of at hazardous waste facilities.

§ 20.2002 (e.g., in a hazardous waste facility) if it met any other applicable State and Federal requirements. The NRC is not proposing any changes to § 20.2006 or appendix G to 10 CFR part 20 because those requirements are sufficiently general to apply to fusion machine generated waste without modification. The NRC would add § 20.2008 to the list of approved information collections in § 20.1009.[20]

The NRC is proposing to amend §§ 30.51(a) and 30.52(a) to include requirements for recordkeeping and to allow inspection of the *production* of byproduct material. Maintaining records of the total quantity of byproduct material possessed by the licensee is important, including that material produced and used by the fusion machine, for purposes of material control and accountability, maintaining adequate financial assurance, and evaluation of offsite doses from routine and accidental releases. The NRC recognizes that calculating the total quantity of byproduct material may be complex and the uncertainties in those calculations for fusion machines have yet to be determined. The draft NUREG-1556 acknowledges the complexity of accountability and provides flexibility for licensees to use computational methods for this purpose. Additionally, the NRC is supportive of receiving feedback from industry and academia on proposals for byproduct material accountability.

3. Decommissioning and Financial Assurance

It is expected that some licensees that possess, use, and produce byproduct material associated with a fusion machine would need to meet the existing requirements for financial assurance or a decommissioning funding plan as described in § 30.35. The NRC is not proposing changes to these requirements for decommissioning and financial

[20] Concurrent with the development of this rulemaking, the NRC staff proposed to the Commission, a revision of 10 CFR part 61 in a separate rulemaking activity. See SECY-24-0045, "Proposed Rule: Integrated Low Level Radioactive Waste Disposal," dated May 29, 2024 (ADAMS Accession No. ML23242A249). The draft proposed part 61 rule, if approved by the Commission, would not conflict with the fusion machine rule's proposed changes to § 20.2008. Similarly, the draft proposed changes to 10 CFR part 61 would not change the requirements for disposal of fusion machine waste.

assurance because the existing regulations already provide the needed flexibility based on the quantity of radioactive material remaining at the facility at the end of life. The current regulations already offer fusion machine applicants a clear pathway to determine the appropriate level of financial assurance for decommissioning their facility and to fund that decommissioning using a financial instrument that aligns with their business model and needs.. For the same reasons, the NRC is not proposing revisions to NUREG-1757, Volumes 1-3, “Consolidated Decommissioning Guidance.”

4. *Emergency Preparedness*

For an application to possess, use, and produce byproduct material associated with a fusion machine submitted to the NRC, the proposed rule would require the applicant under § 30.32(k)(2) to submit a summary of the radiation safety aspects of the written operating and emergency procedures. Onsite emergency procedures are needed to handle events ranging from a minor spill to a larger incident that could require intervention by outside emergency response personnel. The NRC is issuing draft guidance, Volume 22 of NUREG-1556, “Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Possession Licenses for Fusion Machines,” for public comment with this proposed rule that includes guidance on developing emergency procedures for fusion machines. This draft guidance is similar to the emergency procedure guidance available in other volumes of NUREG-1556 for similar types of 10 CFR part 30 licenses. This draft guidance describes what an applicant should consider regarding response capabilities for protecting onsite personnel, as well as coordination with fire, medical, and local law enforcement agencies, as needed, for an incident at a fusion machine facility.

Potential unsealed sources of radioactive material for fusion machines include tritium for fuel and materials made radioactive by exposure to neutrons from the fusion

reactions (activated materials). Activated materials may contribute to offsite doses during an accidental offsite release of radioactive material.

In accordance with the requirements of § 30.32(i), each application to possess radioactive materials in unsealed form in excess of quantities in § 30.72, “Schedule C—Quantities of radioactive materials requiring consideration of the need for an emergency plan for responding to a release,” must contain either an evaluation showing that the maximum dose to a person offsite due to a release of radioactive materials would not exceed 1 rem (10 mSv) effective dose equivalent or 5 rem (50 mSv) to the thyroid, or the application must contain an emergency plan for responding to the release of radioactive material. Draft Volume 22 of NUREG-1556 includes program-specific guidance for how applicants to possess, use, and produce byproduct material associated with a fusion machine can meet the requirements for the dose evaluation to demonstrate that an offsite emergency plan is not needed, and guidance for applicants for the contents of an emergency plan when one may be needed.

5. Environmental Review

Under the proposed § 51.60(b)(1)(viii) the applicant would be required to include an environmental report unless a categorical exclusion applies. Requiring an applicant to develop an environmental report would enable the NRC to fully assess the environmental impacts of these novel and evolving fusion machine designs.

The NRC would review the environmental report with each application pursuant to the regulation in 10 CFR part 51. The NRC can prepare an environmental assessment (EA) under § 51.21 if the NRC expects the findings to not be significant and could reach a finding of no significant impact (FONSI). If an EA cannot reach a FONSI, an environmental impact statement (EIS) under § 51.20 would be prepared. An EIS would

not be prepared by default, as is done in other portions of the NRC's regulatory process, but only if the circumstances warrant or the Commission so directs.[21]

Although 10 CFR part 51 is not required as a matter of compatibility for Agreement States, several Agreement States have State environmental requirements that are similar to the requirements in the National Environmental Policy Act (NEPA). A fusion machine licensed in an Agreement State would be required to comply with the State's applicable environmental requirements.

An applicant for a license to possess, use, and produce byproduct material associated with a fusion machine may apply the guidance in NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs," in preparing their environmental-related submittals to the NRC whether to support an EIS, EA, or a categorical exclusion. Under § 51.40, a prospective applicant to possess, use, and produce byproduct material associated with a fusion machine is encouraged to confer with the NRC staff to discuss the guidance in NUREG-1748 as early as possible in its planning process before submitting environmental information or filing an environmental report.

6. Export Controls

This rule does not propose any changes to export controls related to fusion machines because a comprehensive export control framework for fusion machines currently exists, and this framework is consistent with international policy, obligations, and commitments, as well as U.S. law and regulations. Different U.S. Government departments and agencies have export control jurisdiction over nuclear-related technology, equipment, and materials depending on the commodity to be exported.

[21] The Commission could determine, under § 51.20(b)(14), that a particular licensing action is a major Commission action significantly affecting the quality of the human environment and instruct staff to prepare an EIS.

Generally, the NRC controls the export of equipment, components, and material that require the application of safeguards by the International Atomic Energy Agency (IAEA). Nuclear-related items that do not require IAEA safeguards are generally controlled by the Department of Commerce (DOC). Since fusion machines do not use or produce nuclear material, they do not require the application of IAEA safeguards. Accordingly, the DOC, rather than the NRC, currently controls the export of fusion machines. There is precedent for DOC export control over fusion machines as well. As a participant in the International Thermonuclear Experimental Reactor (ITER) fusion project in France, the United States has already exported fusion equipment and components to the ITER facility under DOC export authority.

This export control framework is also consistent with international frameworks and commitments. As a member of the Nuclear Suppliers Group (NSG), the United States has made a commitment to implement the NSG's export control guidelines. Part 1 of the NSG Guidelines (INFCIRC/254/Part 1) contains a list of items that should be controlled for export because they would require IAEA safeguards, and it explicitly excludes "fusion reactors" from the scope of control. The United States also has adopted the "Model Protocol Additional to the Agreement(s) Between State(s) and the International Atomic Energy Agency for the Application of Safeguards" (INFCIRC/540 (Corrected)), known as the Additional Protocol (AP). Annex II of the AP contains a list of equipment and non-nuclear material that must be reported when exported or imported. This list likewise excludes fusion machines from its scope, since they would not be subject to IAEA safeguards.

The NRC's export control authority is not limited by the NSG Guidelines or the AP. If the NRC were to exert export control over fusion machines, its authority would stem from section 109b of the AEA. However, because section 109b requires that IAEA safeguards be applied to the exported item, exerting NRC export control authority over

fusion machines under section 109b would not be consistent with the established international export control and IAEA safeguards framework.

Consideration was also given to export control of non-nuclear materials that could be used or produced by fusion machines. Tritium, which could have end uses related to nuclear weaponization, could reasonably be used and produced in significant quantities by a fusion machine. While tritium is not subject to IAEA safeguards, the NRC controls tritium and other byproduct material for export under its AEA section 82 authority rather than its AEA section 109b authority. Further, the DOC controls export of lithium-6 as well as lithium target assemblies, which could be used to produce tritium. The DOC also controls export of tritium production, recovery, extraction, and handling equipment. Additionally, export of deuterium for nuclear end use is controlled by the NRC, and deuterium for non-nuclear end use is controlled by DOC. In the event that the neutrons produced from a fusion machine are used to irradiate a subcritical assembly or blanket of nuclear material, then such use or production of nuclear material would automatically trigger IAEA safeguards, and the NRC would then control such nuclear material for export.

In summary, the U.S. Government's existing, comprehensive export control framework for fusion machines is consistent with, and based upon, international export control frameworks. If the United States, in conjunction with the international export control community, as well as the IAEA, determine that fusion machines may warrant additional export controls and safeguards, then the U.S. Government can evaluate and adjust its national framework at that time, including whether the NRC should exert export authority over fusion machines.

7. Physical Security and Accountability of Licensed Material

In accordance with § 20.1801 and § 20.1802, licensees must ensure the security and accountability of licensed material. Therefore, all byproduct material that is used,

produced, and stored as part of fusion machine activities must be protected. In addition to the security requirements in 10 CFR part 20, 10 CFR part 37 requires additional security measures for specific types of byproduct material considered to be risk significant and meet the category 1 and category 2 quantity thresholds identified in appendix A to 10 CFR part 37.

Tritium used, produced, and stored as part of fusion machine activities is not considered a risk-significant radionuclide. However, there could be activation products not listed in appendix A to 10 CFR part 37 that are produced from fusion machines that require implementation of additional security measures, beyond those required by 10 CFR part 20. Currently, not enough information is available to determine the activation products that may be produced by near-term fusion machines. For radionuclides not listed in table 1 of appendix A to 10 CFR part 37, the NRC will determine on a case-by-case basis whether additional security requirements are warranted (e.g., based on the use of structural materials that create new radionuclides of concern through activation). The NRC would address the issue through license conditions or orders.

Guidance regarding security measures that can be used to protect byproduct material that will be produced, used, and stored as part of fusion machine activities is provided in draft Volume 22 of NUREG-1556.

8. Waste Management

The NRC's regulations governing waste management requirements under 10 CFR part 20 are proposed to be amended to apply specifically to fusion machine facilities and their expected associated radioactive waste. The scope of this discussion includes aspects of 10 CFR part 20 and 10 CFR part 61 related to the handling and disposal of radioactive waste generated by fusion machines. The NRC determined that fusion machine waste is adequately addressed by the existing regulations related to land

disposal of radioactive waste (i.e., 10 CFR part 61) with a proposed change to 10 CFR part 20.

The Energy Policy Act of 2005 adopted on August 8, 2005, expanded NRC jurisdiction to include certain materials made radioactive by a particle accelerator. The NRC's 2007 final rule made conforming changes to § 20.2008(a), providing disposal requirements for byproduct material as defined in sections 11e.(3) and (4) of the AEA. Further, the definition of waste in § 61.2, which excludes material produced by an accelerator, does not prevent disposal of accelerator-produced waste with LLW. The ADVANCE Act of 2024 amended section 11e.(3) of the AEA to ensure all radioactive material generated by fusion machines is defined as byproduct material. Therefore, the NRC determined that the existing NRC regulations under 10 CFR part 61 for land disposal of radioactive waste could apply to waste generated by fusion machines.

Similarly, § 20.2008(b) states that accelerator waste can be disposed of at a Federal or State solid or hazardous waste disposal facility authorized to dispose of such material. In general, the NRC evaluates whether NRC-licensed material can be sent to a solid or hazardous waste disposal facility for disposal on a case-by-case basis under § 20.2002, "Method for obtaining approval of proposed disposal procedures." For either disposal with LLW or disposal under § 20.2002, existing NRC regulations allow NRC-licensed, accelerator-produced material to be sent for disposal with other types of waste if additional applicable requirements are met. Those requirements may include approvals from State and other Federal agencies.

Several stakeholders have expressed concern that the § 61.55 waste classification tables may fail to address risk-significant radionuclides in fusion machine waste because those tables were based on expected waste streams in the early 1980s. The Advisory Committee on Reactor Safety (ACRS) proposed, in its letter dated October 21, 2022, that the NRC consider revising the § 61.55 waste classification tables to

address radionuclides generated by fusion machines. Based on stakeholder feedback, the NRC understands that fusion machines could create significant inventories of activation products[22] that are not included in the waste classification tables (e.g., see SECY-23-0001). However, this rule does not propose to revise those tables because sufficient information is not yet available to determine which radionuclides will drive the risk significance of fusion machine generated waste. As described by the ACRS, the activation products formed by fusion machines will depend on the structural materials used in the systems and their impurities. Because many of those materials have not yet been selected or developed, the identity, quantities, and concentrations of the potential activation products in those materials are not yet known. In a staff requirements memorandum (SRM) responding to the NRC staff's plan to revise 10 CFR part 61 (SRM-SECY-08-0147), the Commission directed the NRC staff to consider changing the waste classification tables after the completion of the integrated low-level radioactive waste disposal rulemaking for 10 CFR part 61. The NRC staff plans to consider the radionuclides in fusion machine waste during that process. In addition, the NRC is proposing a change to 10 CFR part 20 that would address issues related to the § 61.55 waste classification tables with a requirement for site-specific analyses in some circumstances, as described below.

A key safety concern associated with land disposal of waste from fusion machines is the protection of individuals who might inadvertently intrude into LLW. This protection is typically demonstrated by compliance with technical requirements that are based in part on LLW classification. Therefore, to ensure intruder protection at this time, the NRC proposes to require that licensees with novel wastes or radionuclide

[22] Many stakeholders, including the ACRS, expect fusion machines to generate significant quantities of tritium-contaminated waste in addition to activation products. Class A tritium is addressed in the existing § 61.55 waste classification tables. The NRC addresses tritium disposed with Class B waste in guidance accompanying the proposed rule. There is no concentration limit for tritium in Class C waste because the calculated value exceeds the specific activity of tritium.

concentrations from fusion machines use disposal sites that have completed a site-specific intrusion assessment for such waste material. The NRC proposes to allow disposal of novel waste types without a site-specific intrusion assessment for waste with physical, chemical, and radiological characteristics that can be shown to be consistent with an appropriate waste classification description in § 61.7, “Concepts.”

Specifically, the NRC proposes to amend § 20.2008 to add new language to paragraph (a). The new text would require that fusion machine waste that would be disposed of as low-level waste under 10 CFR part 61 either be accompanied by an analysis showing the waste is manifested and labeled for disposal consistent with the description of the applicable waste class in § 61.7 or be disposed of at a disposal site that has completed a site-specific intrusion assessment. Draft NUREG-1556, Volume 22, includes guidance on waste types and radionuclide concentrations the NRC staff has previously analyzed under the waste classification descriptions in § 61.7. If a site-specific intrusion assessment will be relied on, the assessment should demonstrate the projected dose to an individual who inadvertently intrudes into the waste at the facility will not exceed 0.5 rem (5 mSv) per year. That dose limit is consistent with the dose limit used to develop the LLW classification tables in 10 CFR part 61, which the NRC selected based on safety, costs, disposal efficiency, and the potential for increased disposal of waste containing long-lived radionuclides that could increase the hazard for long time periods (see NUREG-0945).

9. Reporting and Recordkeeping

The NRC is proposing to amend its regulations governing the reporting and recordkeeping requirements under § 30.51 to cover licensees authorized for the possession, use, and production of byproduct material associated with fusion machines by adding “production of” tritium and activation products for the necessary reports, analyses, submittals, inspection documentation, and other required documentation for a

fusion machine. The draft guidance in NUREG-1556, Volume 22, provides additional discussion on accountability, including inventory, production, use, decay, and consumption of radioactive material. The draft guidance emphasizes the importance of confirming the accuracy and reliability of the facility's accounting records, particularly for the detection of any unmeasured material losses or diversion or theft of radioactive materials. Licensees are already required to have records for what they possess including what they produce and therefore it is not expected to change the record retention at other stakeholder facilities.

C. Implementation Guidance

The NRC has developed a new draft volume under the NUREG-1556 series to address possession, use, and production of byproduct material in a fusion machine. NUREG-1556, Volume 22, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Possession Licenses for Fusion Machines," would provide guidance on preparing a license application for the radioactive byproduct materials associated with the use of a fusion machine. This draft guidance document also includes criteria the NRC would use in evaluating license applications for the possession, use, and production of byproduct material associated with fusion machines.

NUREG-1556, Volume 22, would provide guidance related to each of the topics an applicant should address in its materials license application. These topics would include radioactive material that will be used and produced and its purpose; information on individuals responsible for the radiation safety program; training for individuals that will handle radioactive material; description of the facilities and equipment used; and the radiation safety program. This guidance document would be applied to a wide variety of near-term fusion machine design applications and would contain information about how licensees may choose to implement their programs to meet NRC regulatory

requirements. The information in this guidance document would not be intended to impose any conditions beyond those required by regulations nor will all items discussed in this guidance document apply to every applicant.

There are some unique aspects of handling radioactive materials involved in or produced by a fusion machine that are discussed in this draft guidance document. For example, there is draft guidance on training and experience for individuals who will handle radioactive material during the maintenance and repair of the fusion machine, draft guidance on security and emergency procedures, and draft guidance on facility design and type of equipment needed to store and handle large quantities and activities of radioactive materials.

On March 7, 2024, the NRC staff issued a preliminary draft of this guidance document and discussed it during a March 18, 2024, public meeting. Information on how to access the meeting summary, preliminary draft guidance document, and the draft guidance are available in the NRC's Agencywide Documents Access and Management System (ADAMS), as provided in the “Availability of Documents” section of this document.

IV. Specific Requests for Comment

The NRC is seeking advice and recommendations from the public on this proposed rule. We seek comment on all aspects of this proposed rule. NRC requests comment on the assumptions regarding the costs, benefits, and cost savings of this rule. NRC acknowledges that other ongoing rulemaking efforts may impact similar regulated entities and solicits comments on the cumulative regulatory burden of rules affecting these entities. We solicit comments on potential impacts, if any, on U.S. manufacturing and supply chains including the production of advanced nuclear fuel, the current

commercial nuclear reactor fleet; national security, critical infrastructure for national defense, nuclear energy dominance, and American competitiveness abroad. We are particularly interested in comments and supporting rationale from the public on the following:

(1) Section 30.55(c) requires licensees who are authorized to possess tritium to report to the NRC any incident in which an attempt has been made or is believed to have been made to commit a theft or unlawful diversion of more than 10 curies of such material at any one time or more than 100 curies of such material in any one calendar year. This requirement was originally promulgated by the Atomic Energy Commission (AEC) in the early 1970s as part of a set of requirements that in the interest of national security, provide the AEC information within reasonable limits and on a current basis as to the flow of tritium into, out of, and within the country, and inventory quantities at various locations (36 FR 16593, August 24, 1971).

In addition to the reporting requirement in § 30.55(c), § 20.2201 requires reports when it becomes known to a licensee that certain quantities of tritium (and other materials listed in appendix C to 10 CFR part 20) have been lost or stolen or are otherwise missing. Under § 20.2201, licensees must immediately report an occurrence of lost, stolen, or missing tritium in aggregate quantities equal to or greater than 1 curie after it becomes known to the licensee and if it appears to the licensee that an exposure to persons in unrestricted areas could occur. Licensees are also required to report if more than 10 millicuries of tritium are still missing within 30 days after an occurrence of lost, stolen, or missing quantities of tritium greater than 10 millicuries becomes known to the licensee. These reporting requirements apply only when a licensee believes or has knowledge that a theft or attempted theft has occurred or that tritium is missing.

Based on information provided by fusion industry stakeholders, including fusion machine developers and the DOE, the quantities of tritium used and produced at near-

term commercial fusion machines could exceed 100 grams, which is approximately 1 million curies. Accurately accounting for the location of all tritium in a fusion machine will be difficult due to various factors including absorption of tritium into components, tritium produced in the breeder blankets, losses of tritium during the fusion reaction, and the difficulty in measuring tritium inside the components of a fusion machine.

The NRC recognizes that due to the physical and chemical properties of tritium, there can be difficulties in tracking its location within a fusion machine, and licensees may not be able to rely on tritium inventory monitoring to discover all losses. One Agreement State has issued an exemption to its licensee regarding the State's equivalent of § 20.2201 to raise the tritium threshold due to a licensee's inability to account for tritium at the millicurie and low curie levels.

Specific request for comment: Should the NRC revise § 30.55(c) and § 20.2201 to change the reporting threshold to a higher activity for tritium? If so, what should be the new reporting threshold for tritium? Please provide the basis for your response.

(2) The NRC staff proposes to amend paragraph (a) of 10 CFR 20.2008, "Disposal of certain byproduct material," to require either (1) an analysis showing that the waste is manifested and labeled for disposal consistent with the description of the applicable waste classification in § 61.7, "Concepts," based on the physical, chemical, and radiological characteristics of the waste, or (2) that the waste be disposed of in a facility that has completed a site-specific intrusion assessment. The NRC's view is these revisions would allow safe disposal of novel waste types from fusion machines.

Specific request for comment: The NRC is particularly interested in feedback on this proposed approach to amend 10 CFR 20.2008 to provide options for safe waste disposal. Does this approach comprehensively address potential waste generated by fusion machines? Are there other approaches the NRC should consider? If yes, please provide the basis for your response.

(3) In addition, the NRC is interested in the need to develop more specific guidance to address disposal of large volumes of low-activity fusion waste.

Specific request for comment: What would the benefits be of expanding existing guidance for alternative disposal under 10 CFR 20.2002, “Method for obtaining approval of proposed disposal procedures,” to specifically address fusion machine waste? Should the NRC develop guidance focused on reusing or recycling low-activity fusion machine waste? Are there alternative approaches the NRC should consider? Please provide the basis for your response.

(4) This rule does not propose any changes to export controls related to fusion machines because a comprehensive export control framework for fusion machines currently exists, and this framework is consistent with international policy, obligations, and commitments, as well as U.S. law and regulations. However, the NRC is interested in ensuring that the proposed rule provides clarity on the export controls.

Specific request for comment: Should the NRC propose export controls related to fusion machines? Please provide the basis for your response.

(5) The NRC is interested in ensuring that the proposed rule provides clarity on the licensing process for both the applicants and Agreement States.

Specific request for comment: Does the proposed rule provide adequate clarity on the licensing process, including designated Compatibility Categories, and if not, where is additional clarity needed? Please provide the basis for your response.

(6) Lastly, the NRC is interested in the unintended consequences or impacts of changes to the “particle accelerator” definition. Some Agreement States have definitions for particle accelerators that are different from the NRC definition. Agreement States that have licensed existing fusion machines have done so under their particle accelerator regulatory frameworks. The NRC is also interested in the unintended consequences or impacts of the proposed compatibility designations for “byproduct material” and “fusion

machine" definitions. The NRC is proposing a compatibility designation of "B" for the "fusion machine" definition and paragraph 3(ii)(A) of the "byproduct material" definition. Currently, the definition for "byproduct material" and "particle accelerator" are compatibility designation health and safety (H&S).

Specific request for comment: Are there unintended consequences or impacts not considered by the NRC by including fusion machines in the definition of "particle accelerator"? Are there unintended consequences or impacts not considered by the NRC with respect to the proposed compatibility designations of the "fusion machine" and paragraph 3(ii)(A) of the "byproduct material" definitions? Please provide a basis for your response.

V. Section-by-Section Analysis

The following paragraphs describe the specific changes proposed by this rulemaking.

Section 20.1003 Definitions

This proposed rule adds a definition for *Fusion machine*. This proposed rule also revises the definitions for *Byproduct material* and *Particle accelerator*.

Section 20.1009 Information collection requirements: OMB approval

In § 20.1009, this proposed rule revises paragraph (b) to add § 20.2008 to the list of approved information collection requirements contained in 10 CFR part 20.

Section 20.2008 Disposal of certain byproduct material

This proposed rule adds new requirements to paragraph (a) for disposal of certain fusion machine waste under the regulations of part 61 of this chapter.

Section 30.4 Definitions

This proposed rule adds a definition for *Fusion machine*. This proposed rule also revises the definitions for *Byproduct material* and *Particle accelerator*.

Section 30.32 Application for specific licenses

This proposed rule adds new paragraph (k), which describes required content specific to a license application for a possession, use, and production of byproduct material associated with a fusion machine. This new section is not intended to address the licensing of a standard fusion machine design or the approval of mass production of fusion machines.

Section 30.33 General requirements for issuance of specific licenses

This proposed rule adds new paragraph (a)(6) for the issuance of a license to possess, use, and produce byproduct material associated with a fusion machine when all requirements for the license in 10 CFR part 30 are met.

Section 30.51 Records

This proposed rule amends paragraphs (a) and (a)(1) to include the production of byproduct material.

Section 30.52 Inspections

This proposed rule amends paragraph (a) to include the production of byproduct material.

Section 37.5 Definitions

This proposed rule revises the definition for *Byproduct material*.

Section 50.2 Definitions

This proposed rule revises the definition for *Byproduct material*.

Section 51.60 Environmental report—materials licenses

This proposed rule adds new paragraph (b)(1)(viii) to require that an environmental report be prepared for the construction and operation of a fusion machine.

Section 72.3 Definitions

This proposed rule revises the definition for *Byproduct material*.

Section 110.2 Definitions

This proposed rule revises the definitions for *Byproduct material* and *Particle accelerator*.

Section 150.3 Definitions

This proposed rule revises the definition for *Byproduct material*.

Section 170.3 Definitions

This proposed rule revises the definition for *Byproduct material*.

Section 171.5 Definitions

This proposed rule revises the definition for *Byproduct material*.

VI. Regulatory Flexibility Certification

As required by the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission certifies that this rule, if adopted, will not have a significant economic impact on a substantial number of small entities.

The structure of the industries that would form to use the emerging fusions machine technologies is uncertain. The most significant potential sector that could use fusion machines is the electric power sector. Among electric utilities that might operate a fusion machine, 90 percent have revenues between $7.8 million and $1.2 billion (EIA, 2022). Thus, for 95 percent of electric utilities, the cost impact of the proposed rule would be a benefit of less than 0.6 percent. Note that larger utilities would be more likely to have an economy of scale that could benefit from fusion machines in their power supply mix. An electric utility that might be classified as a small entity would be less likely to be able to afford to invest in fusion technology. Therefore, the NRC estimates that the proposed rulemaking will not have a significant economic impact on a substantial number of small entities.

As for any entity building or operating fusion machines, the proposed rule reduces the regulatory impact of obtaining the materials licenses required for fusion machines, for small entities also, by clarifying the application of existing requirements to fusion machines. This clarity might be more useful to small entities to the extent that the smaller organizations have fewer resources available for interpreting less clear regulatory language.

NRC requests all comments from potentially impacted small entities. Any small entity subject to this regulation that determines, because of its size, it is likely to bear a

disproportionate adverse economic impact should notify the Commission of this opinion in a comment that indicates—

(a) The licensee's size and how the proposed regulation would impose a significant economic burden on the licensee as compared to the economic burden on a larger licensee;

(b) How the proposed regulations could be modified to take into account the licensee's differing needs or capabilities;

(c) The benefits that would accrue or the detriments that would be avoided if the proposed regulations were modified as suggested by the licensee;

(d) How the proposed regulation, as modified, would more closely equalize the impact of NRC regulations or create more equal access to the benefits of Federal programs as opposed to providing special advantages to any individual or group; and

(e) How the proposed regulation, as modified, would still adequately protect public health and safety.

Comments should be submitted as indicated under the ADDRESSES caption of this document.

VII. Regulatory Analysis

The NRC has prepared a draft regulatory analysis on this proposed regulation. The analysis examines the costs and benefits of the alternatives considered by the NRC. The NRC requests public comment on all aspects of the draft regulatory analysis. The regulatory analysis is available as indicated in the "Availability of Documents" section of this document. Comments on the draft analysis may be submitted to the NRC as indicated under the ADDRESSES caption of this document.

VIII. Cumulative Effects of Regulation

The NRC seeks to minimize any potential negative consequences resulting from the cumulative effects of regulation (CER). The CER refers to the challenges that licensees, or other impacted entities such as State partners, may face while implementing new regulatory positions, programs, or requirements (e.g., rules, generic letters, backfits, inspections). The CER is an organizational effectiveness challenge that may result from a licensee or impacted entity implementing a number of complex regulatory actions, programs, or requirements with limited available resources.

The NRC is following its CER process by engaging with external stakeholders throughout this proposed rule and related regulatory activities. Opportunity for public comment is provided to the public at this proposed rule stage.

To better understand the potential CER implications incurred due to this proposed rule, the NRC is requesting comment on the following questions. Responding to these questions is voluntary, and the NRC will respond to any comments received in the final rule.

1. In light of any current or projected CER challenges, would the proposed effective date of 30 days after the date of publication of a final rule provide sufficient time to implement the new, proposed requirements? Please provide a rationale for your response.

2. If CER challenges currently exist or are expected, what should be done to address them? For example, if more time is required for implementation of the new requirements, what period of time is sufficient? Please provide a rationale for your response.

3. What other (NRC or other agency) regulatory actions (e.g., orders, generic communications, license amendment requests, inspection findings of a generic nature)

influence the implementation of this proposed rule's requirements? Please provide a rationale for your response.

4. What are the unintended consequences, and how should they be addressed? Does this proposed rule create conditions that would be contrary to this proposed rule's purpose and objectives? Please provide a rationale for your response.

5. Please comment on the NRC's cost and benefit estimates in the regulatory analysis that supports this proposed rule.

IX. Plain Writing

The Plain Writing Act of 2010 (Pub. L. 111-274) requires Federal agencies to write documents in a clear, concise, and well-organized manner. The NRC has written this document to be consistent with the Plain Writing Act as well as the Presidential Memorandum, "Plain Language in Government Writing," published June 10, 1998 (63 FR 31885). The NRC requests comment on this document with respect to the clarity and effectiveness of the language used.

X. Environmental Assessment and Proposed Finding of No Significant Environmental Impact

The Commission has determined under the National Environmental Policy Act of 1969, as amended, and the Commission's regulations in Subpart A of 10 CFR part 51, that this rule, if adopted, would not be a major Federal action significantly affecting the quality of the human environment, and an EIS is not required. The implementation of the proposed rule requirements would not have a significant impact on the environment. The proposed rule would either have requirements that are administrative in application or

matters of procedure. The proposed rule would provide clarity on licensing and regulating the possession, use, and production of byproduct material associated with fusion machines but would not materially change any requirements and would not result in any new or different environmental impacts.

The determination of this draft EA is that there would be no significant effect on the quality of the human environment from this action. Public stakeholders should note, however, that comments on any aspect of this draft EA may be submitted to the NRC as indicated under the ADDRESSES caption. The draft EA is available as indicated under the “Availability of Documents” section of this document.

XI. Paperwork Reduction Act

This proposed rule contains new or amended collections of information subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq). This proposed rule has been submitted to the Office of Management and Budget for review and approval of the information collections.

Type of submission: Revision

The title of the information collection: Regulatory Framework for Fusion Machines

The form number if applicable: NRC Form 313

How often the collection is required or requested: Once per event, on occasion, and annually

Who will be required or asked to respond: Applicants for a license to possess, use, and produce byproduct material associated with a fusion machine, licensees that possess, use, and produce byproduct material associated with a fusion machine, and low-level waste disposal facility licensees.

An estimate of the number of annual responses: 3 (1 reporting response + 2 recordkeepers)

The estimated number of annual respondents: 3

An estimate of the total number of hours needed annually to comply with the information collection requirement or request: 607 (600 reporting + 7 recordkeeping)

Abstract: The NRC is proposing to amend its regulations to establish a regulatory framework for the possession, use, and production of byproduct material associated with fusion machines. The proposed rule includes definitions to establish the scope of regulatory requirements for fusion machines and technology-inclusive, content-of-application requirements supportive of a performance-based approach to regulation. The proposed rule includes specific requirements for submitting an application for a license to possess, use, and produce byproduct material associated with a fusion machine. Such applicants may file an application using NRC Form 313, “Applications for Materials License.” The proposed rule would add a requirement for an applicant to submit an environmental report for the construction and operation of a fusion machine unless a categorical exclusion applies. The proposed rule would require applicants or licensees to maintain records of production of tritium and activation products associated with fusion machines. The records and recordkeeping requirements would allow the NRC to

determine if the applicant has training, experience, equipment, facilities, and procedures that provide reasonable assurance of adequate protection of public health and safety and the environment. The records and recordkeeping requirements associated with receipt, transfer, production, and disposal of byproduct material would be reviewed by the NRC to determine that licensees have confined their possession and use of byproduct material to the locations, purposes, receipt, and quantities authorized in their licenses.

The proposed rule would require that radioactive waste resulting from fusion machines must either be accompanied by an analysis showing the waste is manifested and labeled for disposal consistent with the description of the applicable waste class in [10 CFR] 61.7 of this chapter, based on the physical, chemical, and radiological characteristics of the waste, or be disposed of in a disposal facility that has completed a site-specific intrusion assessment that demonstrates the projected dose to an individual who inadvertently intrudes into the waste at the facility will not exceed 0.5 rem (5 (mSv)) per year. The information requested would allow the NRC to determine whether the proposed activities can be conducted safely without harming the common defense and security or constituting an unreasonable risk to public health and safety and the environment. The NRC is proposing to amend its regulations to establish a regulatory framework for licensing the possession, use, and production of byproduct material associated with fusion machines. The NRC is also proposing new guidance for the implementation of this proposed rule, entitled NUREG-1556, Volume 22, “Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Fusion Machine Licenses.”

The NRC is seeking public comment on the potential impact of the information collections contained in this proposed rule and on the following issues:

1. Is the proposed information collection necessary for the proper performance of the functions of the NRC, including whether the information will have practical utility? Please explain your response.

2. Is the estimate of the burden of the proposed information collection accurate? Please explain your response.

3. Is there a way to enhance the quality, utility, and clarity of the information to be collected? Please explain your response.

4. How can the burden of the proposed information collection on respondents be minimized, including the use of automated collection techniques or other forms of information technology?

A copy of the Office of Management and Budget (OMB) clearance package and proposed rule are available in the “Availability of Documents” section of this document or may be viewed free of charge by contacting the NRC’s Public Document Room reference staff at 1-800-397-4209, at 301-415-4737, or by email to PDR.Resource@nrc.gov. You may obtain information and comment on submissions related to the OMB clearance package by searching on https://www.regulations.gov under Docket ID NRC-2023-0071.

You may submit comments on any aspect of these proposed information collection(s), including suggestions for reducing the burden and on the above issues, by the following methods:

- **Federal rulemaking website:** Go to https://www.regulations.gov and search for Docket ID NRC-2023-0071.

- **Mail comments to:** FOIA, Library, and Information Collections Branch, Office of the Chief Information Officer, Mail Stop: T-6 A10M, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001 or to the OMB reviewer at OMB Office of Information and Regulatory Affairs (3150-0014, 3150-0017, 3150-0021, and 3150-0120),

Attention: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street NW, Washington, DC 20503.

Submit comments by March 30, 2026. Comments received after this date will be considered if it is practical to do so, but the NRC staff is able to ensure consideration only for comments received on or before this date.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

XII. Executive Orders

Executive Order (E.O.) 12866

The Office of Information and Regulatory Affairs (OIRA) has determined that this proposed rule is a significant regulatory action under E.O. 12866, “Regulatory Planning and Review.” Accordingly, NRC submitted this proposed rule to OIRA for review. NRC is required to conduct an economic analysis in accordance with section 6(a)(3)(B) of E.O. 12866. More can be found in Section VII, of this document, “Regulatory Analysis.”

Review Under E.O.s 14154, 14192, 14215, and 14300

NRC has examined this proposed rule and has determined that it is consistent with the policies and directives outlined in E.O. 14154, “Unleashing American Energy,”

E.O. 14192, “Unleashing Prosperity Through Deregulation,” E.O. 14215 “Ensuring Accountability for All Agencies,” and E.O. 14300, “Ordering the Reform of the Nuclear Regulatory Commission.” This proposed rule is tentatively considered an E.O. 14192 deregulatory action. Details on the estimated costs of this proposed rule can be found in Section VII, of this document, “Regulatory Analysis.”

Review under E.O. 14270

Executive Order 14270, “Zero-Based Regulatory Budgeting to Unleash American Energy,” requires the NRC to insert a conditional sunset date into all new or amended NRC regulations provided the regulations are (1) promulgated under the Atomic Energy Act of 1954, as amended (AEA), the Energy Reorganization Act of 1974, as amended (ERA), and the Nuclear Waste Policy Act of 1982, as amended (NWPA); (2) not statutorily required; and (3) not part of the NRC’s permitting regime. The NRC determined that the regulatory changes proposed in this rule are for augmenting the existing byproduct material framework to be inclusive of fusion machines. Therefore, the NRC views this rulemaking to be outside the scope of Executive Order 14270 and did not insert conditional sunset dates for the regulatory changes in this proposed rule.

XIII. Coordination with NRC Agreement States

Thirty eight of the 39 Agreement States[23] have assumed authority for 11e.(3) byproduct material. Consequently, these 38 Agreement States would have oversight of byproduct material associated with fusion machines licensed in their jurisdiction.

The NRC has coordinated with the Agreement States throughout the development of this proposed rule. Agreement State representatives served on the rulemaking working group that developed this proposed rule and guidance and on the Standing Committee on Compatibility for the review of the rulemaking and the compatibility determinations. In addition, the NRC held a total of six government-to-government meetings with Agreement States during the development of this proposed rule.

The NRC also provided a preliminary draft of this proposed rule and guidance to the Agreement States for formal review. The NRC held one of the government-to-government meetings with Agreement States during this formal review. The NRC received comments on the preliminary draft of the proposed rule from four Agreement States (New Jersey, New York, Tennessee, and Wisconsin) and the Organization of Agreement States Board. Regarding the draft guidance, the NRC received comments from four Agreement States (New Jersey, New York, Tennessee, and Wisconsin) and the Organization of Agreement States Board. The NRC considered these comments in the development of the proposed rule, which covered topics such as definitions, emergency plan, security, waste management, and other more general topics.

[23] The State of Wyoming's Agreement with the NRC is limited to the oversight of byproduct material from uranium milling and certain source material. Accordingly, a fusion machine in the State of Wyoming would be regulated by the NRC.

XIV. Compatibility of Agreement State Regulations

Under the "Agreement State Program Policy Statement" approved by the Commission on October 2, 2017, and published in the *Federal Register* (82 FR 48535; October 18, 2017), NRC program elements (including regulations) required for adequacy and having a particular health and safety component are those that are designated as Categories A, B, C, D, NRC, and H&S: and those required for compatibility include those regulations and other legally binding requirements designated as Compatibility Categories A, B, C, and D. Compatibility Category A are those program elements that include basic radiation protection standards and scientific terms and definitions that are necessary to understand radiation protection concepts. An Agreement State should adopt Category A program elements in an essentially identical manner in order to provide uniformity in the regulation of agreement material on a nationwide basis. Compatibility Category B are those program elements that apply to activities that have direct and significant effects in multiple jurisdictions. Compatibility Category B pertains to a limited number of program elements that cross jurisdictional boundaries and should be addressed to ensure uniformity of regulation on a nationwide basis. The Agreement State program element should be essentially identical to that of NRC. Compatibility Category C are those program elements that do not meet the criteria of Category A or B, but the essential objectives of which an Agreement State should adopt to avoid conflict, duplication, gaps, or other conditions that would jeopardize an orderly pattern in the regulation of agreement material on a national basis. An Agreement State should adopt the essential objectives of the Category C program elements. Compatibility Category D are those program elements that do not meet any of the criteria of Category A, B, or C, above, and, thus, do not need to be adopted by Agreement States for purposes of compatibility. Compatibility Category NRC are those program elements that address

areas of regulation that cannot be relinquished to the Agreement States under the AEA, or provisions of 10 CFR. These program elements should not be adopted by the Agreement States. Category H&S program elements are not required for purposes of compatibility; however, they do have particular health and safety significance. The Agreement State should adopt the essential objectives of such program elements to maintain an adequate program.

This proposed rule is a matter of compatibility between the NRC and the Agreement States. The proposed compatibility categories are designated in the following table:

Compatibility Table

Section	Change	Subject	Compatibility	
			Existing	New
20.1003	Amend	Definitions "Byproduct material"	H&S	H&S
20.1003	Amend	Definitions "Byproduct material" paragraph 3(ii)(A)	H&S	B
20.1003	New	Definitions "Fusion machine"	-	B
20.1003	Amend	Definitions "Particle accelerator"	H&S	H&S
20.1009	Amend	Add "20.2008" to information collections list	D	D
20.2008	Amend	Disposal of certain byproduct material	B	B
30.4	Amend	Definitions "Byproduct material"	H&S	H&S
30.4	Amend	Definitions "Byproduct material" paragraph 3(ii)(A)	H&S	B
30.4	New	Definitions "Fusion machine"	-	B
30.4	Amend	Definitions	H&S	H&S

		"Particle accelerator"		
30.32(k), except (k)(2)(iv)	New	Application for specific licenses	-	C
30.32(k)(2)(iv)	New	Application for specific licenses	-	D
30.33(a)(6)	New	General requirements for issuance of specific licenses	-	D
30.51(a) introductory text	Amend	Records	C	C
30.51(a)(1)	Amend	Records	C	C
30.52(a)	Amend	Inspections	D	D
37.5	Amend	Definitions "Byproduct material"	H&S	H&S
37.5	Amend	Definitions "Byproduct material" paragraph 3(ii)(A)	H&S	B
150.3	Amend	Definitions "Byproduct material"	H&S	H&S
150.3	Amend	Definitions "Byproduct material" paragraph 3(ii)(A)	H&S	B

The Agreement States have licensed fusion research and development facilities operated by academic institutions and commercial companies using their existing authorities. Since the term "fusion machine" is a new definition, staff is proposing that the definition of fusion machine be Compatibility Category B to ensure consistency across the National Materials Programs. Accordingly, the staff is proposing that paragraph 3(ii)(A) of the definition of "Byproduct material," which refers to "fusion machine," is also Compatibility Category B. The new section on application for specific licenses is proposed to be Compatibility Category C, based on the need for Agreement States to have the flexibility to include other components that generate non-ionizing radiation or

other machine-produced radiation which the Agreement States may already regulate and would be integral parts of a fusion machine.

With the exception of paragraph 3(ii)(A) of the definition of “Byproduct material,” the amended definitions of byproduct material and particle accelerator would continue to be Category H&S. The definition of byproduct material was expanded by the Energy Policy Act of 2005 to incorporate certain discrete sources of radium-226 and certain accelerator-produced radioactive material. NRC amended its regulations in 2007 (72 FR 55864, October 1, 2007) to revise the definition of byproduct material and add the new definitions of discrete source and particle accelerator. All three of these definitions were designed as Category H&S. Particle accelerator was designated as H&S to provide the Agreement States flexibility to meet the essential objectives of the definition since several Agreement States already had regulations in place for particle accelerators and the naturally occurring and accelerator-produced radioactive material (NARM) they produced. Byproduct material was also designated as H&S to provide the Agreement States flexibility to meet the essential objectives of the definition since several Agreement States already incorporated NARM into the statutory definition or radioactive material.

XV. Availability of Guidance

The NRC is issuing new draft guidance, NUREG-1556, Volume 22, “Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Fusion Machine Licenses,” for the implementation of the proposed requirements in this rulemaking for comment. This draft guidance is available in ADAMS under Accession No. ML24092A377. You may obtain information and submit comments related to the

draft guidance by searching on https://www.regulations.gov under Docket ID NRC-2023-0071.

Draft NUREG-1556, Volume 22, provides guidance to applicants and licensees for the possession, use, and production of byproduct material associated with fusion machines concerning the contents of a licensing application necessary to comply with the licensing requirements under part 30 of this chapter. You may submit comments on this draft regulatory guidance by the methods outlined in the ADDRESSES section of this document.

XVI. Public Meeting

The NRC will conduct at least one public meeting on this proposed rule for the purpose of describing this proposed rule to the public and answering questions from the public on this proposed rule.

The NRC will publish a notice of the location, time, and agenda of the meeting(s) in the *Federal Register*, on Regulations.gov, and on the NRC's public meeting website within at least 10 calendar days before the meeting. Stakeholders should monitor the NRC's public meeting website for information about the public meeting at https://www.nrc.gov/public-involve/public-meetings/index.cfm.

XVII. Availability of Documents

The documents identified in the following table are available to interested persons through one or more of the following methods, as indicated.

DOCUMENT	ADAMS ACCESSION NO. / WEB LINK / *FEDERAL REGISTER* CITATION

SECY-24-0085, Proposed Rule—Regulatory Framework for Fusion Machines, December 11, 2024	ML24019A064
Draft Environmental Assessment, February 2026	ML25168A335
Draft Regulatory Analysis, February 2026	ML25168A339
Draft NUREG-1556, Volume 22, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Possession Licenses for Fusion Machines," February 2026	ML24092A377
Office of Management and Budget (OMB) Supporting Statement, Proposed Rule—Form 313, February 2026	ML24183A213
OMB Supporting Statement, Proposed Rule—10 CFR part 20, February 2026	ML24019A080
OMB Supporting Statement, Proposed Rule—10 CFR part 30, February 2026	ML24019A081
OMB Supporting Statement, Proposed Rule—10 CFR part 51, February 2026	ML24019A082
SECY-24-0045, "Proposed Rule: Integrated Low Level Radioactive Waste Disposal," May 29, 2024	ML23242A249
SRM-SECY-23-0001, "Staff Requirements—SECY-23-0001—Options for Licensing and Regulating Fusion Energy Systems," April 13, 2023	ML23103A449
SECY-23-0001, "Options for Licensing and Regulating Fusion Energy Systems," January 3, 2023 [Rulemaking Plan]	ML22273A163 (paper) ML22273A178 (package)
SRM-SECY-20-0032, "Staff Requirements—SECY-20-0032—Rulemaking Plan on 'Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors (RIN-3150-AK31; NRC-2019-0062),'" October 2, 2020	ML20276A293
SRM-SECY-09-0064, "Staff Requirements—SECY-09-0064—Regulation of Fusion-Based Power Generation Devices," July 16, 2009	ML092230198
SRM-SECY-08-0147, "Staff Requirements—SECY-08-0147—Response to Commission Order CLI-05-20 Regarding Depleted Uranium," March 18, 2009	ML090770988
Preliminary Proposed Rule Language, "Fusion Systems Proposed Rule," October 11, 2023	ML23258A145
Preliminary Draft NUREG-1556, Volume 22, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Possession Licenses for Fusion Systems," March 7, 2024	ML24067A227

NUREG-0945, “Final Environmental Impact Statement on 10 CFR Part 61 Licensing Requirements for Land Disposal of Radioactive Waste,” November 1982	https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0945/index.html
NUREG-1556, Volumes 1-21, “Consolidated Guidance About Materials Licenses”	https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1556/index.html
NUREG-1748, “Environmental Review Guidance for Licensing Actions Associated with NMSS Programs,” August 2003	ML032450279
NUREG-1757, Volumes 1-3, “Consolidated Decommissioning Guidance”	https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1757/index.html
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November 1, 2023, Public Meeting Summary—Fusion System Proposed Rule	ML23258A169
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ACRS Letter—Draft SECY White Paper on Licensing and Regulating Fusion Energy Systems October 5-7, 2022, Full Committee, October 21, 2022	ML22290A177
Executive Order 12866, “Regulatory Planning and Review,” October 4, 1993	58 FR 51735
Executive Order 14154, “Unleashing American Energy,” January 29, 2025	90 FR 8353
Executive Order 14192, “Unleashing Prosperity Through Deregulation,” February 6, 2025	90 FR 9065
Executive Order 14215, “Ensuring Accountability for All Agencies,” February 24, 2025	90 FR 10447
Executive Order 14270, “Zero-Based Regulatory Budgeting to Unleash American Energy,” April 15, 2025	90 FR 15643

Executive Order 14300, “Ordering the Reform of the Nuclear Regulatory Commission,” May 29, 2025	90 FR 22587
Final Rule, Requirements for Expanded Definition of Byproduct Material, October 1, 2007	72 FR 55864
Final Rule, Licensing Requirements for Land Disposal of Radioactive Waste, December 27, 1982	47 FR 57466
Proposed Rule, Reporting and Control Requirement for Tritium, August 24, 1971 [issued by the Atomic Energy Commission]	36 FR 16593
Presidential Memorandum, “Plain Language in Government Writing,” June 10, 1998	63 FR 31885
Agreement State Program Policy Statement, October 18, 2017	82 FR 48535
Atomic Energy Act of 1954, as amended	https://www.nrc.gov/about-nrc/governing-laws.html
Nuclear Energy Innovation and Modernization Act (NEIMA; Public Law 115 439)	https://www.govinfo.gov/app/details/PLAW-115publ439
Energy Policy Act of 2005, Public Law 109-58)	https://www.congress.gov/109/plaws/publ58/PLAW-109publ58.pdf
Low-Level Radioactive Waste Policy Act	https://www.nrc.gov/about-nrc/governing-laws.html
Low-Level Radioactive Waste Policy Amendments Act of 1985	https://www.nrc.gov/about-nrc/governing-laws.html
Public Law (Pub. L.) 118-67, Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy of 2024 (ADVANCE Act of 2024)	https://www.congress.gov/118/plaws/publ67/PLAW-118publ67.pdf
EURFUBRU XII-217/95, “Safety and Environmental Assessment of Fusion Power (SEAFP): Report of the SEAFP Project, European Commission DG XII, Fusion Programme,” June 1995	https://www.researchgate.net/publication/303252621_Safety_and_Environmental_Assessment_of_Fusion_Power_SEAFP_Final_Report_of_the_SEAFP_Project
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IAEA INFCIRC/540 (Corrected), “Model Protocol Additional to the Agreement(s) Between State(s) and the International Atomic Energy Agency for the Application of Safeguards,” also known as the Additional Protocol (AP), September 1997	https://www.iaea.org/topics/additional-protocol
Fusion Industry Association’s Report, “The Global Fusion Industry in 2023,” July 2023	https://www.fusionindustryassociation.org/fusion-industry-report-archive/
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UKAEA-RE(21)01, “Technology Report—Safety and Waste Aspects for Fusion Power Plants,” September 2021	https://scientific-publications.ukaea.uk/wp-content/uploads/UKAEA-RE2101-Fusion-Technology-Report-Issue-1.pdf
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The NRC may post materials related to this document, including public comments, on the Federal rulemaking website at https://www.regulations.gov under Docket ID NRC-2023-0071. In addition, the Federal rulemaking website allows members of the public to receive alerts when changes or additions occur in a docket folder. To subscribe: 1) navigate to the docket folder (NRC-2023-0071); 2) click the “Subscribe” button; and 3) enter an email address and click on the “Subscribe” button.

List of Subjects

10 CFR part 20

Byproduct material, Criminal penalties, Fusion, Hazardous waste, Licensed material, Nuclear energy, Nuclear materials, Nuclear power plants and reactors, Occupational safety and health, Packaging and containers, Penalties, Radiation protection, Reporting and recordkeeping requirements, Source material, Special nuclear material, Waste treatment and disposal.

10 CFR part 30

Byproduct material, Criminal penalties, Government contracts, Fusion, Intergovernmental relations, Isotopes, Nuclear energy, Nuclear materials, Penalties, Radiation protection, Reporting and recordkeeping requirements, Whistleblowing.

10 CFR part 37

Byproduct material, Criminal penalties, Exports, Hazardous materials transportation, Imports, Licensed material, Nuclear materials, Penalties, Radioactive materials, Reporting and recordkeeping requirements, Security measures.

10 CFR part 50

Administrative practice and procedure, Antitrust, Backfitting, Classified information, Criminal penalties, Education, Emergency planning, Fire prevention, Fire protection, Intergovernmental relations, Nuclear power plants and reactors, Penalties, Radiation protection, Reactor siting criteria, Reporting and recordkeeping requirements, Whistleblowing.

10 CFR part 51

Administrative practice and procedure, Environmental impact statements, Hazardous waste, Nuclear energy, Nuclear materials, Nuclear power plants and reactors, Reporting and recordkeeping requirements.

10 CFR part 72

Administrative practice and procedure, Hazardous waste, Indians, Intergovernmental relations, Nuclear energy, Penalties, Radiation protection, Reporting and recordkeeping requirements, Security measures, Spent fuel, Whistleblowing.

10 CFR part 110

Administrative practice and procedure, Classified information, Criminal penalties, Exports, Imports, Intergovernmental relations, Nuclear energy, Nuclear materials, Nuclear power plants and reactors, Penalties, Reporting and recordkeeping requirements, Scientific equipment.

10 CFR part 150

Criminal penalties, Hazardous materials transportation, Intergovernmental relations, Nuclear energy, Nuclear materials, Penalties, Reporting and recordkeeping requirements, Security measures, Source material, Special nuclear material.

10 CFR part 170

Byproduct material, Import and export licenses, Intergovernmental relations, Nonpayment penalties, Nuclear energy, Nuclear materials, Nuclear power plants and reactors, Source material, Special nuclear material.

10 CFR part 171

Annual charges, Approvals, Byproduct material, Holders of certificates, Intergovernmental relations, Nonpayment penalties, Nuclear materials, Nuclear power plants and reactors, Registrations, Source material, Special nuclear material.

For the reasons set out in the preamble and under the authority of the Atomic Energy Act of 1954, as amended; the Energy Reorganization Act of 1974, as amended; and 5 U.S.C. 552 and 553, the NRC is proposing to amend 10 CFR parts 20, 30, 37, 50, 51, 72, 110, 150, 170, and 171.

PART 20—STANDARDS FOR PROTECTION AGAINST RADIATION

1. The authority citation for part 20 continues to read as follows:

Authority: Atomic Energy Act of 1954, secs. 11, 53, 63, 65, 81, 103, 104, 161, 170H, 182, 186, 223, 234, 274, 1701 (42 U.S.C. 2014, 2073, 2093, 2095, 2111, 2133, 2134, 2201, 2210h, 2232, 2236, 2273, 2282, 2021, 2297f); Energy Reorganization Act of 1974, secs. 201, 202 (42 U.S.C. 5841, 5842); Low-Level Radioactive Waste Policy Amendments Act of 1985, sec. 2 (42 U.S.C. 2021b); 44 U.S.C. 3504 note.

2. In § 20.1003:

a. Revise the definition for *Byproduct material*;

b. Add in alphabetical order the definition for *Fusion machine*; and

c. Revise the definition for *Particle accelerator*.

The revisions and addition read as follows:

§ 20.1003 Definitions.

* * * * *

Byproduct material means—

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material;

(2) The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute “byproduct material” within this definition;

(3)

(i) Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or

(ii) Any material that—

(A) Has been made radioactive by use of a particle accelerator, including by use of a fusion machine; and

(B) If made radioactive by use of a particle accelerator that is not a fusion machine, is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; and

(4) Any discrete source of naturally occurring radioactive material, other than source material, that—

(i) The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and

(ii) Before, on, or after August 8, 2005, is extracted or converted after extraction for use in a commercial, medical, or research activity.

* * * * *

Fusion machine means a machine that is capable of—(1) transforming atomic nuclei, through fusion processes, into different elements, isotopes, or other particles; and (2) directly capturing and using the resultant products, including particles, heat, or other electromagnetic radiation.

* * * * *

Particle accelerator (or accelerator) means any machine capable of accelerating electrons, protons, deuterons, or other charged particles in a vacuum, and of discharging the resultant particulate or other radiation into a medium at energies usually in excess of

1 megaelectron volt, including fusion machines. For the purposes of this definition, “accelerator” is an equivalent term.

* * * * *

§ 20.1009 [Amended]

3. In § 20.1009, in paragraph (b), add the citation “20.2008,” after the citation “20.2006,”.

4. In § 20.2008, revise paragraph (a) to read as follows:

§ 20.2008 Disposal of certain byproduct material.

(a) Licensed material as defined in paragraphs (3) and (4) of the definition of Byproduct material set forth in § 20.1003 may be disposed of in accordance with part 61 of this chapter, even though it is not defined as low-level radioactive waste. Therefore, any licensed byproduct material being disposed of at a facility, or transferred for ultimate disposal at a facility licensed under part 61 of this chapter, must meet the requirements of § 20.2006. In addition, waste resulting from fusion machines must either be accompanied by an analysis showing the waste is manifested and labeled for disposal consistent with the description of the applicable waste class in § 61.7 of this chapter, based on the physical, chemical, and radiological characteristics of the waste, or be disposed of in a disposal facility that has completed a site-specific intrusion assessment that demonstrates the projected dose to an individual who inadvertently intrudes into the waste at the facility will not exceed 0.5 rem (5 mSv) per year.

PART 30—RULES OF GENERAL APPLICABILITY TO DOMESTIC LICENSING OF BYPRODUCT MATERIAL

5. The authority citation for part 30 continues to read as follows:

Authority: Atomic Energy Act of 1954, secs. 11, 81, 161, 181, 182, 183, 184, 186, 187, 223, 234, 274 (42 U.S.C. 2014, 2111, 2201, 2231, 2232, 2233, 2234, 2236, 2237, 2273, 2282, 2021); Energy Reorganization Act of 1974, secs. 201, 202, 206, 211 (42 U.S.C. 5841, 5842, 5846, 5851); 44 U.S.C. 3504 note.

6. In § 30.4:

a. Revise the definition for *Byproduct material*;

b. Add in alphabetical order the definition for *Fusion machine*; and

c. Revise the definition for *Particle accelerator*.

The revision and addition read as follows:

§ 30.4 Definitions.

* * * * *

Byproduct material means—

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material;

(2)

(i) Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or

(ii) Any material that—

(A) Has been made radioactive by use of a particle accelerator, including by use of a fusion machine; and

(B) If made radioactive by use of a particle accelerator that is not a fusion machine, is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; and

(3) Any discrete source of naturally occurring radioactive material, other than source material, that—

(i) The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and

(ii) Before, on, or after August 8, 2005, is extracted or converted after extraction for use in a commercial, medical, or research activity.

* * * * *

Fusion machine means a machine that is capable of—(1) transforming atomic nuclei, through fusion processes, into different elements, isotopes, or other particles; and (2) directly capturing and using the resultant products, including particles, heat, or other electromagnetic radiation.

* * * * *

Particle accelerator (or accelerator) means any machine capable of accelerating electrons, protons, deuterons, or other charged particles in a vacuum, and of discharging the resultant particulate or other radiation into a medium at energies usually in excess of 1 megaelectron volt, including fusion machines. For the purposes of this definition, “accelerator” is an equivalent term.

* * * * *

7. Amend § 30.32 by adding new paragraph (k) to read as follows:

§ 30.32 Application for specific licenses.

* * * * *

(k) An application for a specific license filed under this part for possession, use, and production of byproduct material associated with a fusion machine must include the following information:

(1) A general description of the fusion machine.

(2) A summary of the radiation safety aspects of the written operating and emergency procedures, including, as applicable—

(i) A description with diagram(s) of the radiation protection measures to be employed for the possession, use, and production of byproduct material associated with the fusion machine, including all interlocks, access control systems, shielding, and radiation monitors;

(ii) A description of the radioactive material handling procedures and inventory control procedures; and

(iii) A description of any other components or systems used to control radiation and radioactive material.

(iv) As an alternative to paragraphs (k)(2)(i) through (iii) of this section:

(A) A description of any aspects of the fusion machine relevant to radiation safety that differ from the information listed in paragraphs (k)(2)(i) through (iii) of this section, and an explanation for how they ensure the possession, use, and production of byproduct material associated with a fusion machine can be performed safely; and

(B) Any other information requested by the NRC staff in preapplication communications to enable the NRC to evaluate whether the possession, use, and production of byproduct material associated with a fusion machine can be performed safely.

(3) A description of the applicant’s organizational structure that describes the radiation safety responsibilities, authorities, and qualifications.

(4) A description of training related to the fusion machine and radiation protection provided to personnel.

(5) A description of the plan for inspection and maintenance of the fusion machine.

(6) A description of the methodology for radioactive material inventory.

8. In § 30.33, add new paragraph (a)(6) to read as follows:

§ 30.33 General requirements for issuance of specific licenses.

(a) * * *

* * * * * *

(6) In the case of an application for possession, use, and production of byproduct material associated with a fusion machine, the application demonstrates adequate training and planning to operate and decommission the fusion machine safely.

* * * * *

9. In § 30.51, revise paragraph (a) introductory text and paragraph (a)(1) to read as follows:

§ 30.51 Records.

(a) Each person who produces or receives byproduct material pursuant to a license issued pursuant to the regulations in this part and parts 31 through 36 of this chapter shall keep records showing the production, receipt, transfer, and disposal of the byproduct material as follows:

(1) The licensee shall retain each record of production or receipt of byproduct material as long as the material is possessed and for three years following transfer or disposal of the material.

* * * * *

§ 30.52 [Amended]

10. In § 30.52, in paragraph (a), remove the phrase “is used or stored” and add in its place the phrase “is used, stored, or produced”.

PART 37—PHYSICAL PROTECTION OF CATEGORY 1 AND CATEGORY 2 QUANTITIES OF RADIOACTIVE MATERIAL

11. The authority citation for part 37 continues to read as follows:

Authority: Atomic Energy Act of 1954, secs. 11, 53, 81, 103, 104, 147, 148, 149, 161, 182, 183, 223, 234, 274 (42 U.S.C. 2014, 2073, 2111, 2133, 2134, 2167, 2168, 2169, 2201, 2232, 2233, 2273, 2282, 2021); Energy Reorganization Act of 1974, secs. 201, 202 (42 U.S.C. 5841, 5842); 44 U.S.C. 3504 note.

12. In § 37.5, revise the definition for *Byproduct material* to read as follows:

§ 37.5 Definitions.

* * * * *

Byproduct material means—

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material;

(2) The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute “byproduct material” within this definition;

(3)

(i) Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or

(ii) Any material that—

(A) Has been made radioactive by use of a particle accelerator, including by use of a fusion machine; and

(B) If made radioactive by use of a particle accelerator that is not a fusion machine, is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; and

(4) Any discrete source of naturally occurring radioactive material, other than source material, that—

(i) The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and

(ii) Before, on, or after August 8, 2005, is extracted or converted after extraction for use in a commercial, medical, or research activity.

* * * * *

PART 50—DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

13. The authority citation for part 50 is revised to read as follows:

Authority: Atomic Energy Act of 1954, secs. 11, 101, 102, 103, 104, 105, 108, 122, 147, 149, 161, 181, 182, 183, 184, 185, 186, 187, 189, 223, 234 (42 U.S.C. 2014, 2131, 2132, 2133, 2134, 2135, 2138, 2152, 2167, 2169, 2201, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2239, 2273, 2282); Energy Reorganization Act of 1974, secs. 201, 202, 206, 211 (42 U.S.C. 5841, 5842, 5846, 5851); Nuclear Waste Policy Act of 1982, sec. 306 (42 U.S.C. 10226); National Environmental Policy Act of 1969 (42 U.S.C. 4332); 44 U.S.C. 3504 note.

14. In § 50.2, revise the definition for *Byproduct material* to read as follows:

§ 50.2 Definitions.

* * * * *

Byproduct material means—

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material;

(2)

(i) Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or

(ii) Any material that—

(A) Has been made radioactive by use of a particle accelerator, including by use of a fusion machine; and

(B) If made radioactive by use of a particle accelerator that is not a fusion machine, is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; and

(3) Any discrete source of naturally occurring radioactive material, other than source material, that—

(i) The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and

(ii) Before, on, or after August 8, 2005, is extracted or converted after extraction for use in a commercial, medical, or research activity.

* * * * *

PART 51—ENVIRONMENTAL PROTECTION REGULATIONS FOR DOMESTIC LICENSING AND RELATED REGULATORY FUNCTIONS

15. The authority citation for part 51 is revised to read as follows:

Authority: Atomic Energy Act of 1954, secs. 161, 193 (42 U.S.C. 2201, 2243); Energy Reorganization Act of 1974, secs. 201, 202 (42 U.S.C. 5841, 5842); National Environmental Policy Act of 1969 (42 U.S.C. 4332, 4334, 4335); Nuclear Waste Policy Act of 1982, secs. 144(f), 121, 135, 141, 148 (42 U.S.C. 10134(f), 10141, 10155, 10161, 10168); 44 U.S.C. 3504 note.

16. Amend § 51.60 by adding new paragraph (b)(1)(viii) to read as follows:

§ 51.60 Environmental report—materials licenses.

* * * * *

(b) * * *

(1) * * *

(viii) Construction and operation of a fusion machine pursuant to part 30 of this chapter.

* * * * *

PART 72—LICENSING REQUIREMENTS FOR THE INDEPENDENT STORAGE OF SPENT NUCLEAR FUEL, HIGH-LEVEL RADIOACTIVE WASTE, AND REACTOR-RELATED GREATER THAN CLASS C WASTE

17. The authority citation for part 72 continues to read as follows:

Authority: Atomic Energy Act of 1954, secs. 51, 53, 57, 62, 63, 65, 69, 81, 161, 182, 183, 184, 186, 187, 189, 223, 234, 274 (42 U.S.C. 2071, 2073, 2077, 2092, 2093, 2095, 2099, 2111, 2201, 2210e, 2232, 2233, 2234, 2236, 2237, 2238, 2273, 2282, 2021); Energy Reorganization Act of 1974, secs. 201, 202, 206, 211 (42 U.S.C. 5841, 5842, 5846, 5851); National Environmental Policy Act of 1969 (42 U.S.C. 4332); Nuclear Waste Policy Act of 1982, secs. 117(a), 132, 133, 134, 135, 137, 141, 145(g), 148, 218(a) (42 U.S.C. 10137(a), 10152, 10153, 10154, 10155, 10157, 10161, 10165(g), 10168, 10198(a)); 44 U.S.C. 3504 note.

18. In § 72.3, revise the definition for *Byproduct material* to read as follows:

§ 72.3 Definitions.

* * * * *

Byproduct material means—

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material;

(2)

(i) Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or

(ii) Any material that—

(A) Has been made radioactive by use of a particle accelerator, including by use of a fusion machine; and

(B) If made radioactive by use of a particle accelerator that is not a fusion machine, is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; and

(3) Any discrete source of naturally occurring radioactive material, other than source material, that—

(i) The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and

(ii) Before, on, or after August 8, 2005, is extracted or converted after extraction for use in a commercial, medical, or research activity.

* * * * *

PART 110—EXPORT AND IMPORT OF NUCLEAR EQUIPMENT AND MATERIAL

19. The authority citation for part 110 continues to read as follows:

Authority: Atomic Energy Act of 1954, secs. 11, 51, 53, 54, 57, 62, 63, 64, 65, 81, 82, 103, 104, 109, 111, 121, 122, 123, 124, 126, 127, 128, 129, 133, 134, 161, 170H, 181, 182, 183, 184, 186, 187, 189, 223, 234 (42 U.S.C. 2014, 2071, 2073, 2074, 2077, 2092, 2093, 2094, 2095, 2111, 2112, 2133, 2134, 2139, 2141, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2160c, 2160d, 2201, 2210h, 2231, 2232, 2233, 2234, 2236, 2237, 2239, 2273, 2282); Energy Reorganization Act of 1974, sec. 201 (42 U.S.C. 5841); Administrative Procedure Act (5 U.S.C. 552, 553); 42 U.S.C. 2139a, 2155a; 44 U.S.C. 3504 note.

Section 110.1(b) also issued under 22 U.S.C. 2403; 22 U.S.C. 2778a; 50 App. U.S.C. 2401 et seq.

20. In § 110.2, revise the definitions for *Byproduct material* and *Particle accelerator* to read as follows:

§ 110.2 Definitions.

* * * * *

Byproduct material means—

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material;

(2) The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute “byproduct material” within this definition;

(3)

(i) Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or

(ii) Any material that—

(A) Has been made radioactive by use of a particle accelerator, including by use of a fusion machine; and

(B) If made radioactive by use of a particle accelerator that is not a fusion machine, is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; and

(4) Any discrete source of naturally occurring radioactive material, other than source material, that—

(i) The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and

(ii) Before, on, or after August 8, 2005, is extracted or converted after extraction for use in a commercial, medical, or research activity.

* * * * *

Particle accelerator (or accelerator) means any machine capable of accelerating electrons, protons, deuterons, or other charged particles in a vacuum, and of discharging the resultant particulate or other radiation into a medium at energies usually in excess of 1 megaelectron volt, including fusion machines. For the purposes of this definition, “accelerator” is an equivalent term.

* * * * *

PART 150—EXEMPTIONS AND CONTINUED REGULATORY AUTHORITY IN AGREEMENT STATES AND IN OFFSHORE WATERS UNDER SECTION 274

21. The authority citation for part 150 continues to read as follows:

Authority: Atomic Energy Act of 1954, secs. 11, 53, 81, 83, 84, 122, 161, 181, 223, 234, 274 (42 U.S.C. 2014, 2201, 2231, 2273, 2282, 2021); Energy Reorganization

Act of 1974, sec. 201 (42 U.S.C. 5841); Nuclear Waste Policy Act of 1982, secs. 135, 141 (42 U.S.C. 10155, 10161); 44 U.S.C. 3504 note.

Sections 150.3, 150.15, 150.15a, 150.31, 150.32 also issued under Atomic Energy Act secs. 11e(2), 81, 83, 84 (42 U.S.C. 2014e(2), 2111, 2113, 2114).

Section 150.14 also issued under Atomic Energy Act sec. 53 (42 U.S.C. 2073).

Section 150.15 also issued under Nuclear Waste Policy Act sec. 135 (42 U.S.C. 10155, 10161).

Section 150.17a also issued under Atomic Energy Act sec. 122 (42 U.S.C. 2152).

Section 150.30 also issued under Atomic Energy Act sec. 234 (42 U.S.C. 2282).

22. In § 150.3, revise the definition for *Byproduct material* to read as follows:

§ 150.3 Definitions.

* * * * *

Byproduct material means—

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material;

(2) The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute “byproduct material” within this definition;

(3)

(i) Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or

(ii) Any material that—

(A) Has been made radioactive by use of a particle accelerator, including by use of a fusion machine; and

(B) If made radioactive by use of a particle accelerator that is not a fusion machine, is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; and

(4) Any discrete source of naturally occurring radioactive material, other than source material, that—

(i) The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and

(ii) Before, on, or after August 8, 2005, is extracted or converted after extraction for use in a commercial, medical, or research activity.

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PART 170—FEES FOR FACILITIES, MATERIALS, IMPORT AND EXPORT LICENSES, AND OTHER REGULATORY SERVICES UNDER THE ATOMIC ENERGY ACT OF 1954, AS AMENDED

23. The authority citation for part 170 continues to read as follows:

Authority: Atomic Energy Act of 1954, secs. 11, 161(w) (42 U.S.C. 2014, 2201(w)); Energy Reorganization Act of 1974, sec. 201 (42 U.S.C. 5841); 42 U.S.C. 2215; 31 U.S.C. 901, 902, 9701; 44 U.S.C. 3504 note.

24. In § 170.3, revise the definition for *Byproduct material* to read as follows:

§ 170.3 Definitions.

* * * * *

Byproduct material means—

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material;

(2)

(i) Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or

(ii) Any material that—

(A) Has been made radioactive by use of a particle accelerator, including by use of a fusion machine; and

(B) If made radioactive by use of a particle accelerator that is not a fusion machine, is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; and

(3) Any discrete source of naturally occurring radioactive material, other than source material, that—

(i) The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and

(ii) Before, on, or after August 8, 2005, is extracted or converted after extraction for use in a commercial, medical, or research activity.

* * * * *

PART 171—ANNUAL FEES FOR REACTOR LICENSES AND FUEL CYCLE LICENSES AND MATERIALS LICENSES, INCLUDING HOLDERS OF CERTIFICATES OF COMPLIANCE, REGISTRATIONS, AND QUALITY ASSURANCE PROGRAM APPROVALS AND GOVERNMENT AGENCIES LICENSED BY THE NRC

25. The authority citation for part 171 continues to read as follows:

Authority: Atomic Energy Act of 1954, secs. 11, 161(w), 223, 234 (42 U.S.C. 2014, 2201(w), 2273, 2282); Energy Reorganization Act of 1974, sec. 201 (42 U.S.C. 5841); 42 U.S.C. 2215; 44 U.S.C. 3504 note.

26. In § 171.5, revise the definition for *Byproduct material* to read as follows:

§ 171.5 Definitions.

* * * * *

Byproduct material means—

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or using special nuclear material;

(2)

(i) Any discrete source of radium-226 that is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; or

(ii) Any material that—

(A) Has been made radioactive by use of a particle accelerator, including by use of a fusion machine; and

(B) If made radioactive by use of a particle accelerator that is not a fusion machine, is produced, extracted, or converted after extraction, before, on, or after August 8, 2005, for use for a commercial, medical, or research activity; and

(3) Any discrete source of naturally occurring radioactive material, other than source material, that—

(i) The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat

similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and

(ii) Before, on, or after August 8, 2005, is extracted or converted after extraction for use in a commercial, medical, or research activity.

* * * * *

Dated: February 24, 2026.

For the Nuclear Regulatory Commission.

/RA/

Carrie Safford,
Secretary of the Commission.