



# Rulemaking: Regulatory Framework for Fusion Systems

NRC Public Meeting  
November 9, 2023

## Agenda

Time	Topic	Speaker
1:00 pm	Welcome & Meeting Logistics	Dennis Andrukat
	Opening Remarks	Adelaide Giantelli
	NRC Presentation – Specific Topics	Duncan White Duane White Cindy Rosales-Cooper Christianne Ridge Diego Saenz
2:00 pm	<i>BREAK</i>	<i>All</i>
2:10 pm	Questions & Answer Session / Public Feedback	All
3:50 pm	Closing Remarks & Adjourn	Dennis Andrukat

*Topic times are estimated and, depending on the participation level, the meeting could adjourn earlier than scheduled. If there are concerns with a potential early meeting adjournment, please inform the point of contact for this meeting.*



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Adelaide Giantelli, Branch Chief

State Agreement and Liaison Programs  
Branch

Division of Materials Safety, Security,  
State, and Tribal Programs

Office of Nuclear Material Safety and  
Safeguards

US NRC

# Opening Remarks



# Overview & Introduction

Duncan White

Division of Materials Safety, Security, State, and Tribal Programs

Office of Nuclear Material Safety and Safeguards

US NRC



# Commission Direction

## Fusion Systems

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On April 13, 2023, the Commission issued SRM-SECY-23-0001 “Options for Licensing and Regulating Fusion Energy Systems” (ML23103A449) directing the staff to implement a byproduct material approach to fusion energy system regulation.



BYPRODUCT MATERIAL  
FRAMEWORK



NUREG-1556 GUIDANCE



# Public Meetings

## **Today's (November 9, 2023) Public Meeting:**

[ML23258A180](#) Presentation

[ML23258A182](#) Meeting Summary\*

## **Previous Public Meeting: November 1, 2023**

[ML23258A171](#) Presentation

[ML23258A172](#) Handout: Preliminary Draft Guidance

[ML23258A169](#) Meeting Summary\*

## **Previous Public Meeting: October 11, 2023:**

[ML23258A147](#) Presentation

[ML23258A145](#) Handout: Preliminary Proposed Rule  
Language – October 2023

[ML23258A146](#) Meeting Summary

\* These documents will be made public once finalized



# Today's SPECIFIC TOPICS

1. Material Security
2. Emergency Preparedness
3. Waste Management
4. Facilities and Equipment
5. Tritium Bioassay



Specific Topic:

# Material Security

Duane White

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# Material Security



Current security requirements in 10 CFR Part 20 and 10 CFR Part 37 are adequate for near-term designs of fusion systems.



10 CFR Part 20 requires:

10 CFR 20.1801 – Secure licensed materials in controlled or unrestricted areas from unauthorized removal or access

10 CFR 20.1802 – Control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage.



10 CFR Part 37 requires additional security measures if you possess an aggregated Category 1 or Category 2 quantity of radioactive material as listed in Appendix A of 10 CFR Part 37.

# Material Security

- If license application presents new elements (e.g., new activated product(s)) that do not fall under current requirements but could be considered a significant public health and safety or common defense and security concern, then existing regulations under 10 CFR Part 30 provide the authority to impose requirements on a case-by-case basis.
- Applicants are encouraged to engage in pre-application discussions with the regulator if they expect their application would contain new elements or activated products.
- Additional requirements, as necessary, would be issued by using license conditions or orders.



Specific Topic:

# Emergency Preparedness

Cindy Rosales-Cooper

Division of Preparedness and Response

Office of Nuclear Security and Incident Response

US NRC





# Emergency Preparedness



Fusion facilities will be required to have emergency response capabilities, commensurate to the radiological hazard.

The emergency preparedness (EP) and response terminology in Part 30 may benefit from consistent terminology used by NRC utilization facility licensees, Federal counterparts such as the Federal Emergency Management Agency and the Department of Energy, as well as State and local offsite response organizations.



Part 30 can accommodate a graded approach to EP to account for variation in fusion system designs.



We are considering limited changes to Part 30 EP requirements to address the above and any potential unique risks with fusion systems.

# Emergency Preparedness

## Specific Questions

Question #1:

### **§ 30.4 Definitions**

Fusion facilities may benefit from an update to the emergency classification definitions in Part 30 to include general emergency, unusual event, and other changes, consistent with a performance based, technology neutral approach. What are the benefits or consequences of this approach to fusion systems and materials licensees under Part 30?

# Emergency Preparedness

## Specific Questions

Question #2:

### **§ 30.32 Application for specific licenses**

10 CFR 30.32 (i)(1) has emergency plan requirements based on Schedule C quantities for existing materials facilities and technologies. What would be the benefits or consequences of requiring all fusion system applicants to submit a maximum dose evaluation and specific emergency response plan for the expected quantities that will be present and generated at the facility instead of applying the quantities in §30.72 “Schedule C-Quantities of Radioactive Materials Requiring Consideration of the Need for an Emergency Plan for Responding to a Release”?



# Emergency Preparedness

## Specific Questions

Question #3:

### **§ 30.32 Application for specific licenses**

The staff is considering whether to clearly specify, in the preliminary proposed 10 CFR 30.32(k)(2), the requirement for response capabilities for protecting onsite personnel, as well as coordination with fire, medical, and local law enforcement agencies, as needed, during an emergency as intended in NUREG-1140. What would be the benefits or consequences of doing so?



Specific Topic:

# Waste Management

Christianne Ridge

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US NRC



# Waste Management Key Issues

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- Waste characteristics
  - Fusion systems could generate waste with different physical forms or radionuclide contents than NRC considered during the development of low-level waste (LLW) regulations
  - Safety analyses for LLW disposal facilities consider radionuclide concentrations and inventories
  - Safety goals of the LLW classification tables can be accomplished in a risk-informed way with a site-specific intrusion assessment for wastes that differ significantly from waste characteristics NRC considered during the development of the classification tables
- Waste volumes
  - Waste volumes are considered in the environmental review for this rulemaking
  - Staff is considering whether applications should include an assessment of the disposal pathway as part of the decommissioning funding plan

# Preliminary Proposed Rule Language

## Additional Changes to Part 20

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### **New § 20.2008(c)**

Waste resulting from fusion systems that differs significantly from the waste types and radionuclide concentrations considered during the development of 10 CFR Part 61 must 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 be less than 5 millisievert (mSv) per year.

### **Notes:**

- Blue text is being considered by NRC staff since the October 11, 2023 public meeting
- Guidance for determining if waste triggers the need for an inadvertent intrusion assessment will be provided in the proposed Volume 22 of NUREG-1556
- Guidance for conducting an inadvertent intrusion assessment is currently available in Draft NUREG-2175, "Guidance for Conducting Technical Analyses for 10 CFR Part 61"



# Preliminary Proposed Rule Language

## Additional Changes to Part 20 (continued)

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- Proposed rule change allows waste from fusion systems to be disposed at existing LLW disposal sites
- Proposed change uses a risk-informed approach based on site-specific intrusion assessment at LLW disposal facility to allow disposal of novel waste streams
  - Does not require changes to Part 61
  - Does not require changes to other sections and appendices in Part 20
  - Consistent with LLW rulemaking currently underway

# Contents of Application Item 11: Waste Management



- Application should include procedures for waste minimization, waste characterization, waste handling, safe and secure storage, and waste disposal
- Potential waste disposal methods include
  - Transfer to LLW disposal facility
  - Decay-in-storage (half-life < 120 days)
  - Effluent releases under 10 CFR 20.1302(b)(2)
  - Other methods authorized under § 20.2002 – § 20.2005
- For wastes to be transferred to a LLW disposal facility (e.g., tritium contaminated waste, activated components), applicant should demonstrate whether a site-specific intrusion analysis is needed
  - Proposed guidance in NUREG-1556 Volume 22 considers physical, chemical, and radiological characteristics



Specific Topic:

# Facilities and Equipment

Diego Saenz

State of Wisconsin

# Facilities and Equipment



**Regulations:** 10 CFR 2.390, 10 CFR 20.1101(b), 10 CFR 20.1301, 10 CFR 20.1406, 10 CFR 30.33(a)(2), 10 CFR 30.35(g), 10 CFR 30.36.



**Criteria:** Facilities and equipment must be adequate to protect health and minimize danger to life or property. Under 10 CFR 20.1101(b) and 10 CFR 20.1406, the licensee must keep exposures to workers and the public ALARA and minimize the introduction of residual radioactivity into the site.



**Discussion:** Applicants must demonstrate that, together with any proposed administrative measures, their facilities and equipment provide sufficient engineered controls and barriers to protect the health and safety of the public and their employees, keep exposures to radiation and radioactive materials ALARA, and minimize the danger to life and property from the uses of the types and quantities of radioactive materials to be used.



# Typical Information Required by Applicant for Facilities and Equipment

- Building(s) and description.
- Fusion device(s) name and specifics
- A diagram and description of the locations of radiation material and radiation sources
- Methods used for determining shielding calculations, i.e. workload
- Written summary of each component and its shielding or containment
- A separate summary table including the following for each shielding/containment wall: Wall description, barrier type, control type, distance of occupied area, occupancy factor, existing shielding, calculated shielding, amount recommended.
- Equipment layout/blueprints of the area which is affected by neutron, X-ray and gamma scatter.
- A description of the areas assigned for the production, transfer, storage, preparation, shipping, security, and measurement of radioactive materials.

# Typical Information Required by Applicant for Facilities and Equipment

- A description and diagrams showing the locations of delivery lines, shielded areas and equipment (e.g., hot cells, waste), the proximity of radiation sources to unrestricted areas, and other items related to radiation safety.
- Penetrations into the fusion device and methods to prevent radiation streaming
- A description and diagram of the ventilation system, including representative equipment such as hot cells, glove boxes, or fume hoods. Pertinent airflow rates, differential pressures, filtration equipment, and monitoring systems should be described in terms of the minimum performance to be achieved. Confirm that such systems will be employed for the use or storage of radioactive materials that have the probability of becoming airborne.
- Verification that ventilation systems ensure that effluents are ALARA, are within the dose limits of 10 CFR 20.1301, and are within the ALARA constraints for air emissions under 10 CFR 20.1101(d).



Specific Topic:

# Tritium Bioassay

Duncan White

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US NRC



# Determination of Internal Exposure: Tritium Bioassay Program

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## **Criteria:** 10 CFR 20.1204

For purposes of assessing dose used to determine compliance with occupational dose equivalent limits, the licensee shall, when required under [§ 20.1502](#), take suitable and timely measurements of—

- Concentrations of radioactive materials in air in work areas; or
- Quantities of radionuclides in the body; or
- Quantities of radionuclides excreted from the body; or
- Combinations of these measurements.

## **Discussion:**

Bioassays determine the kinds, quantities or concentrations, and in some cases, the location of radioactive material in the human body. A bioassay can be made by direct measurement or by analysis and evaluation of material excreted or removed from the human body.

# Frequency of Bioassay Measurements

## Requirement for Bioassay

- 10% the annual limit on intake in 10 CFR 20

## Routine

- Baseline, periodic, and termination measurements
- Conducted to assess occupational dose and confirm appropriate engineering and administrative controls in place

## Special

- Evaluation of abnormal or inadvertent intakes



# Procedures for Bioassay Program

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- Licensees will need to develop, implement, and maintain written procedures for determination of internal exposure that meet the requirements in 10 CFR 20.1204.
- The following items should be considered in developing procedures for collecting bioassay samples:
  - the type of bioassay that must be performed (direct or indirect)
  - the number of samples or data points to be collected
  - the frequency of sampling (e.g., hourly, daily, weekly, once)
  - the size of the sample to be collected (e.g., 24-hour urine collection)
  - the ease or difficulty of sample collection
  - the need for written instructions to be provided to the sample collector, who may be the contaminated individual



# Break

A background image showing several people in a meeting room with their hands raised, indicating an interactive session. The focus is on the hands in the foreground, with people in the background slightly blurred.

# Question & Answer Session

*Please Note: the NRC is not accepting official comments during this meeting and will not provide any official responses to any feedback provided during this meeting.*

# Upcoming Events/Milestones

## Upcoming Public Meeting

- To be determined

## Proposed Rule Schedule

- Proposed rule and draft guidance to Commission by Fall 2024



# Thank You!

## Contacts

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*Presentation: ADAMS Accession No.* [ML23258A180](#)

## Public Information

NRC Public Website:

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

Docket ID: [NRC-2023-0071](#)  
([www.regulations.gov](http://www.regulations.gov))

Meeting Notice / Feedback Form:

<https://www.nrc.gov/pmns/mtg?do=details&Code=20231014>