Public Meeting to Discuss Potential Options for Physical Protection Requirements for Spent Nuclear Fuel (SNF) and the "Self-Protection" Threshold

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

What are the proposed issues to be considered in the Commission paper?

A. Security for Category II quantities of SNM

B. Security for spent nuclear fuel (use and storage / transportation)

C. Security for ANM

D. Security for Categories I and III quantities of SNM

What is the purpose of today's meeting?

- Engage stakeholders regarding potential revised physical protection requirements for spent nuclear fuel (SNF) and the "self-protection" threshold
- This is the last of three public meetings to discuss various aspects of potential enhanced security of special nuclear material (SNM)
- This is a Comment-Gathering meeting
  - Attendees will have the opportunity to ask questions and/or make comments about the issues discussed; however, the NRC will not provide written responses to comments or questions raised
  - Later opportunity for stakeholder review if Commission directs rulemaking
  - Comments/questions must involve only publicly-available information

What do we mean by SNM, Strategic Special Nuclear Material (SSNM) and SNF?

- SNM = plutonium (Pu), uranium (U)-233, or uranium enriched in the isotopes U-233 or U-235
- SSNM = U-235 contained in uranium enriched to >=20% in the U-235 isotope (High Enriched Uranium), U-233 or Pu
  - A Category I quantity of Pu or U-233 is 2 kilograms (kg) or more
- SNF consists of the residual original SNM, fission products, and SSNM.
  - A single pressurized water power reactor SNF assembly could contain 4 – 5 kg of Pu, at a nominal burnup
  - The total external radiation level of an SNF assembly decreases over time due to fission product decay

Why is SNF attractive to an adversary?

- The attractiveness of SNF changes over time because of the contained SSNM and fission product activity.
  - Following discharge from a reactor, SNF presents a risk of radiological sabotage due to the fission products.
  - After a period of decay, SNF additionally presents a risk of theft or diversion for construction of an improvised nuclear device (IND), due to the contained SSNM.
- The regulations in 10 CFR Part 73 differentiate these two risks with separate sets of physical protection requirements.
  - These more rigorous requirements for protecting SSNM currently do not credit certain mitigating factors.

Exemption in 10 CFR 73.6(b)

- 10 CFR 73.6(b) provides an exemption to certain security regulations for SNM that is not readily separable and has a total external radiation level exceeding 1 gray (Gy) [100 rad] per hour at 1 meter (m) [3.3 ft].
  - Both the non-separability and radiation level conditions must be present.
- For material that no longer exceeds this threshold, the provisions of 10 CFR 73.20 apply, depending on the mass of SNM.
  - 10 CFR 73.20 applies to Category I quantities of SSNM.
  - Applies to both entities possessing SSNM and transporting SSNM.
- One or more SNF assemblies, when loaded in a cask, can contain a Category I quantity of SSNM. Consequently, this exemption is important to determining which security regulations apply.

Why focus on the exemption in 10 CFR 73.6(b)?

- Oak Ridge National Laboratory (ORNL) analysis of data in a DOE database indicates that there are SNF assemblies currently in storage at NRC-licensed facilities that may no longer exceed the radiation level threshold. Accordingly, and because some of those SNF assemblies may contain a Category I quantity of SSNM, additional analysis is needed.
- Results of a separate ORNL study lead the staff to conclude that the current external radiation level threshold in 10 CFR 73.6(b), if applied to an adversary who is willing to die in attempting a malevolent act involving SNF, is too low to incapacitate the adversary soon enough to prevent the act.

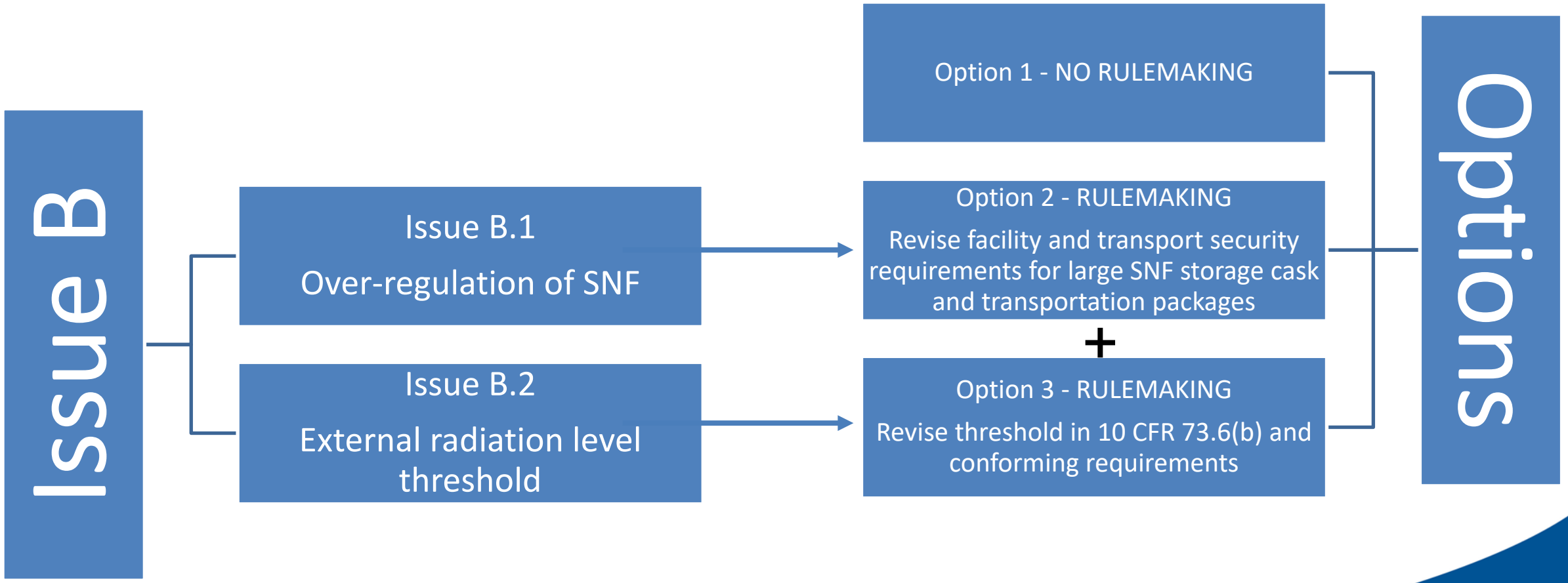
When, not if…

- As time progresses, more and more SNF assemblies will decay to a radiation level that is less than the current non-self protection threshold.
- This increase in the number of SNF assemblies falling below the exemption threshold in 10 CFR 73.6(b) informs the potential size of the challenge facing licensees and the NRC.

Activities potentially impacted by changes to physical protection requirements for SNF

Activity
Storage of SNF
Transportation of SNF
Reprocessing of SNF

What are the options the staff is considering for physical protection of SNF (Issue B)?



What would happen if there were no rulemaking for SSNM in SNF that does not exceed the exemption threshold (Option 1)?

- SSNM contained in SNF that does not meet the exemption threshold would be subject to the Category I requirements of 10 CFR 73.20 and other applicable physical protection regulations
  - Staff would conduct any necessary reviews of a license for SNF that no longer meets the exemption
  - Current security orders would remain in place and be augmented by Category I SSNM orders
  - Staff would employ a case-by-case approach in evaluating requests for exemptions and enforcement discretion
  - There would continue not to be requirements in 10 CFR 73.26 for advance notification to a Governor of an affected state or Tribal officials regarding SNF shipments

Advantages/Disadvantages of no rulemaking (Option 1)

- Advantage
  - Involves no expenditure of resources for rulemaking
- Disadvantages
  - Would not fully risk-inform the regulations to recognize the robust and resilient nature of SNF storage casks and transport packages (i.e., would not provide credit for the logistical challenges in trying to steal SSNM)
  - Would result in very significant one-time and annual costs for licensee compliance with current Category I SSNM regulations

What would happen if rulemaking proceeded for licensees possessing or transporting SSNM in SNF (Option 2)?

- Provide credit for the logistical challenges of stealing a large storage cask or transport package containing SNF, removing non-self-protecting SSNM, and constructing an IND – licensees would remain under current facility or transportation security requirements
  - Potentially exempt non-self-protecting SSNM in large storage casks and transport packages (e.g., a rail-size cask/package) from 10 CFR 73.20 requirements
  - Non-power reactors unaffected (exemption in 10 CFR 73.6(e))
- Address regulatory gaps with Category I SSNM (contained in SNF) for:
  - Advance notifications to Governors and Tribes
  - Water-mode shipments in rail-size packages

Advantages of rulemaking for SSNM (Option 2)

- Would entail cost savings for licensees not having to implement additional security requirements for non-self-protecting Category I SSNM contained in SNF
- Would allow for broader engagement with stakeholder community on potential improvements to security requirements
- Would reflect a Commission determination that reduced requirements and additional considerations provide reasonable assurance of adequate protection of the common defense and security for SSNM in large storage casks or transport packages
- Would provide for advance notifications to Governors of States affected by shipments of Category I quantities of SSNM contained in SNF
- Would align with Commission's previous rulemaking regarding advance notification to Tribes for shipments of self-protecting SNF

Disadvantages of rulemaking for SSNM (Option 2)

- Requires significant financial resource expenditure for rulemaking
- Rulemaking is a lengthy process

What would happen if rulemaking proceeded to increase the external radiation level threshold for SNM (Option 3)?

- Staff would initiate a rulemaking to increase the threshold value above the current value of ≤ 1 Gy/hr at 1 m
- Staff would consider conforming changes to other 10 CFR Part 73 provisions that use the radiation threshold value
  - Non-power reactor licensees would still meet 10 CFR 73.6(e) exemption
  - Non-power reactor licensees subject to 10 CFR 73.60 may be impacted
- Staff would take into account the intent of Section 104c of the Atomic Energy Act

Advantages of rulemaking to increase the external radiation level threshold (Option 3)

- Would apply risk-informed analysis to the exemption threshold in 10 CFR 73.6(b), in consideration of the current understanding of the threat
- Would consider the analysis in the 2022 National Academies report regarding the malevolent uses of non-self-protecting SSNM

Disadvantages of rulemaking to raise the external radiation level threshold (Option 3)

- Would require expenditure of NRC staff resources to conduct rulemaking and industry resources to participate in a rulemaking
- Would require certain licensees to implement more stringent security requirements for their Category I SSNM (contained in SNF) compared to what is currently being done

Schedule

- 1/30/23 – Public meeting on Category II SNM (Issue A)
- 2/28/23 – Public meeting on Category I and III SNM and alternate nuclear material (Issues C & D)
- 4/11/23 – Public meeting on spent fuel, including 1 Gy/hr at 1 m external radiation level threshold (Issue B)
- 10/2/23 – Commission paper due

Summary

- Current options under consideration for SNF
  - No rulemaking – Status quo
  - Rulemaking to revise facility and transport security requirements for SSNM contained in large SNF storage casks and transportation packages
  - Rulemaking to revise external radiation level threshold

Summary

- All options, definitions and physical protection measures are pre-decisional and are subject to change
- Further opportunity for stakeholder review and input if Commission directs rulemaking

References

ORNL analysis of SNF assemblies

Scaglione, J.M, Jarell, J.J., Feldman, M.R., Howard, R.L., and Clarity, J.B. “Overview of Security Considerations for the Back-end of the United States Fuel Cycle,” Oak Ridge National Laboratory, Oak Ridge, TN (under Contract No. DE-AC05-00OR22725 with the U.S. Department of Energy), presented at the 2016 Annual Meeting of the Institute of Nuclear Materials Management (INMM), (excerpted with author permission).

ORNL study of radiation effects

Oak Ridge National Laboratory (ORNL) (2005), “Radiation Effects on Personnel Performance Capability and a Summary of Dose Levels for Spent Research Reactor Fuels,” ORNL/TM-2005/261, Oak Ridge, TN, December 2005, ML16069A288.

Marshall Kohen
Marshall.Kohen@nrc.gov
301-287-3689

Tim Harris
Tim.Harris@nrc.gov
301-287-3594

Phil Brochman
Phil.Brochman@nrc.gov
301-287-3691