



Public Meeting:

Issues Paper on Revisions to Transportation Safety Requirements and Harmonization with IAEA Transportation Requirements

December 5, 2016

Division of Spent Fuel Management
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Slide #1

Overall Agenda



Day 1

- Background information
- Issues paper and request for public comment overview
- Fissile materials
- Reduced external pressure design requirement for transportation packages
- Solar insolation
- Adequate space for liquid expansion clarification
- Quality assurance program clarification
- Fissile clarifications
- U.S. Department of Transportation items
- Additional time for clarifying questions

Day 2

- Type C package
- Low Specific Activity (LSA)-III leaching test
- Provisions for large solid contaminated objects (Surface Contaminated Object (SCO-III))
- Replace radiation level with dose equivalent rate
- UF₆ packages
- Transitional arrangements
- Aging
- U.S. Department of Transportation items
- Additional time for clarifying questions



Morning 12/5/16 Agenda



- 9:00 – 10:00am
 - Opening and introductions
 - Background information
 - Issues paper and request for public comment overview
- 9:40 – 10:00am – BREAK
- 10:00 – 12:00pm
 - Fissile materials
- 12:00 – 1pm LUNCH

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Background and History of the Harmonization of 10 CFR Part 71

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Public Meeting

December 5, 2016



Outline



- International Atomic Energy Agency (IAEA) regulations
- Department of Transportation (DOT)
- Potential rulemaking
- Rulemaking process



IAEA Regulations

- Revises regulations to reflect scientific and technical advances and the knowledge gained through operational experience
 - Latest edition was in 2012 (SSR-6)
 - Being revised, expected issuance in 2018 (DS495)
- Adopted for use in many countries
- Continued harmonization supports safe, effective, and efficient international shipment of radioactive materials

DOT



- MOU with the DOT to co-regulate transportation of radioactive materials in the United States
 - 44 FR 38690, July 2, 1979
- NRC coordinates revisions of 10 CFR Part 71 with the DOT to maintain appropriate compatibility with the IAEA and DOT regulations

Potential Rulemaking



- Evaluating pursuing rulemaking for 10 CFR Part 71
 - Last update: June 12, 2015, 80 FR 33988
 - Harmonized to the 2009 edition of the IAEA regulations
 - Last major update: Jan 26, 2004, 69 FR 3698
- Need to consider:
 - Harmonization with the 2012 IAEA regulations
 - Harmonization with the draft revision of the IAEA regulations, DS495
 - Harmonization/coordination with DOT
 - Other clarifications

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Rulemaking Process



- 7/28/16 - Rulemaking plan (ML16158A162)
- 8/19/16 - SRM-S16-0093
- 11/18/16 - Issues paper (ML16299A298)
- 12/5-12/6/16 - public meeting
- Regulatory Basis
- Proposed Rule
- Final Rule



DOT and IAEA Rulemakings

Michael Conroy

U.S. Department of Transportation

Pipeline and Hazardous Materials Safety Administration

December 5, 2016



U.S. Department of Transportation
**Pipeline and Hazardous Materials
Safety Administration**

"To protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives."



DOT and NRC Roles

- DOT has primary regulatory and enforcement authority for transport of hazardous materials (including radioactive)
- DOT/PHMSA/Office of Hazardous Materials Safety regulates the safe transport of hazardous materials by all modes
- DOT/NRC Memorandum of Understanding (MOU), NRC:
 - Certifies Type B and fissile material package designs for domestic shipments
 - Provides technical support to DOT for approval of import/export packages
 - Works with DOT for regulatory consistency



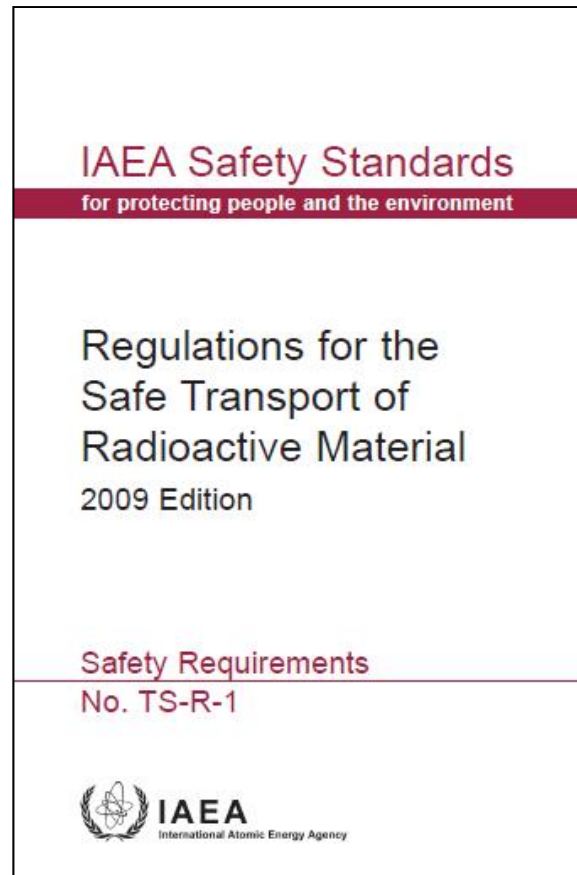
International Regulations

- DOT is the official U. S. representative (the U. S. Competent Authority) before the International Atomic Energy Agency (IAEA) with respect to the safe transport of radioactive material
- The IAEA, by convening the Competent Authorities of its member states, periodically updates its “model” regulations
- Individual members states (such as the U. S.) then adopt all or part of the IAEA regulations in their national regulations
- In addition, the 2 major international modal organizations, ICAO (International Civil Aviation Organization) and IMO (International Maritime Organization) generally adopt the IAEA regulations with almost no changes to regulate international air and ocean transport



HM-250 Harmonized with 2009 Version of the IAEA Regulations

Slide #13

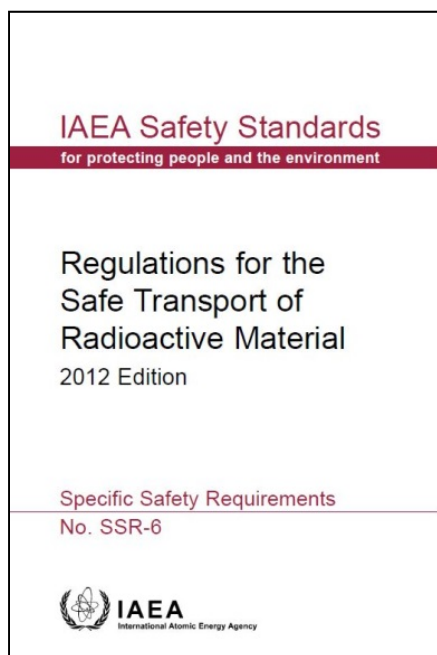


U.S. Department of Transportation
Pipeline and Hazardous Materials
Safety Administration

To Protect People and the Environment From the Risks of
Hazardous Materials Transportation



Current IAEA Regulations



- 2012 Edition of Regulations for the Safe Transport of Radioactive Material (SSR-6)
 - Adopted by DOT for international shipments
 - Changes not yet harmonized in domestic regulations
 - Fissile material excepted changes most significant change



Draft Updated IAEA Regulations

- Regulations for the Safe Transport of Radioactive Material 20xx Edition, Draft Revised Specific Safety Requirements, DS495, Revision of SSR-6, 2012 Edition
- Comments by IAEA Member States from 120-day review were due 21 November 2016
- “The principal topic that justified a new edition of the IAEA Transport Regulations is the new category of Surface Contaminated Objects (SCO-III). Special consideration is given to the transport after long storage, clarification and harmonization of the regulations.”



Future Rulemaking

- DOT will monitor NRC progress on rulemaking
- Intend to issue Notice of Proposed Rulemakings at same time
- Objective to finalize and implement regulation updates at same time as NRC





Overview of the Issues Paper

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DSFM/Inspection and Operations Branch

Public Meeting

December 5, 2016

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Harmonization Approach



- Contracted ORNL/TM-2014/658 – “Comparison of the International and United States Domestic Radioactive Material Transport Regulations”
 - Determined the areas of possible rulemaking
 - Limited to the Part 71 regulations circa 2014
- Compared the Part 71 regulations published in 2015 to the ORNL identified gaps
- Compared Part 71 to the draft revision of the IAEA regulations, DS495

Issues Paper



- Issued on November 18, 2016 (ML16299A298)
- 10 issues: harmonization with IAEA
- 4 issues: harmonization with DOT or clarifications
- Facilitate stakeholder input and feedback on these items

Day 1 List

- International fissile exceptions
- Reduced external pressure design requirement for transportation packages
- Solar insolation
- Adequate space for liquid expansion clarification
- Quality assurance program clarification
- Fissile clarifications

Day 2 List

- Type C Packaging
- Low Specific Activity (LSA)-III leaching test
- Provisions for large solid contaminated objects (Surface Contaminated Object (SCO-III))
- Replace radiation level with dose equivalent rate
- UF₆ packages
- Transitional arrangements
- Aging

Public Comment Period



- Issues paper (ML16299A298)
- FRN (81 FR 83171): 60 day period
 - November 21, 2016 through January 20, 2017
- Electronically on Federal Rulemaking Website:
<http://www.regulations.gov>, **Docket ID NRC-2016-0179**
- Mail comments to: Cindy Bladey, Chief, Rules, Announcements, and Directives Branch (RADB), Division of Administrative Services, Office of Administration, Mail Stop: OWFN-12-H08, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001



NRC Next Steps



- 60 day comment period ends on January 20, 2017
- Determine scope of rulemaking
- Develop regulatory basis

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Questions/Comments



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A decorative blue graphic at the bottom of the slide. It features a stylized atomic symbol with three orbiting electrons in blue, orange, and green. The text "NMSS" is written in a large, bold, serif font. Below this, in a smaller, sans-serif font, are the words "Division of Spent Fuel Management".

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References



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- 44 FR 38690, July 2, 1979. “Transportation of Radioactive Materials; Memorandum of Understanding.” *Federal Register*, U.S. Department of Transportation and U.S. Nuclear Regulatory Commission, Washington, DC.
- 48 FR 35600, August 5, 1983. “Rule to Achieve Compatibility with the Transport Regulations of the International Atomic Energy Agency (IAEA).” *Federal Register*, U.S. Nuclear Regulatory Commission, Washington, DC.
- 49 CFR. *Code of Federal Regulations*, Title 49, Energy, “Transportation,” Washington, DC.
- 60 FR 50248, September 28, 1995. “Compatibility with the International Atomic Energy Agency (IAEA).” *Federal Register*, U.S. Nuclear Regulatory Commission, Washington, DC.
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- 80 FR 33988, June 12, 2015. "Revisions to the Transportation Safety Requirements and Harmonization with International Atomic Energy Agency Transportation Requirements." *Federal Register*, U.S. Nuclear Regulatory Commission, Washington, DC.
- 81 FR 62972, September 13, 2016. "Hazardous Materials: International Relations for the Safe Transport of Radioactive Material (SSR-6); Draft Revision Available for Comment." *Federal Register*, U.S. Department of Transportation, Washington, DC.
- American Nuclear Society. 2014. "Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors," ANSI/ANS 8.1 (2014).

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- International Atomic Energy Agency. 1973. Safety Series No.37: "Advisory Material for the Application of the IAEA Transport Regulations."
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- International Atomic Energy Agency. 2012. Specific Safety Requirements No. SSR-6: "Regulations for the Safe Transport of Radioactive Material 2012 Edition."
- International Atomic Energy Agency. June 2015. Information Paper (#10) TRANSSC 30, agenda item 4.1: "Review of LSA-II / LSA-III concept – deletion of the LSA-III leaching test."

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- U.S. Nuclear Regulatory Commission. 1998. "Assessment and Recommendations for Fissile-Material Packaging Exemptions and General Licenses within 10 CFR Part 71," NUREG/CR-5342, Washington, DC.



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- U.S. Nuclear Regulatory Commission. 1998. "Categorizing and Transporting Low Specific Activity Materials and Surface Contaminated Objects." NUREG-1608/RAMREG-003, Washington, DC.
- U.S. Nuclear Regulatory Commission. 2016. SRM-16-0093: "Rulemaking Plan for Revisions to Transportation Safety Requirements and Harmonization with International Atomic Energy Agency Transportation Requirements," Washington, DC.
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BREAK



Issue 1

Fissile Material

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Public Meeting

December 5, 2016

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Fissile Material

Topics



- Background
- New Fissile Exceptions in IAEA SSR-6, p417
- Competent Authority-Approved Fissile Exception, SSR-6 p417(f)
- CSI-Controlled Fissile Material Packages, SSR-6 p674
- Plutonium Shipments in Type A Packages, SSR-6 p675



Fissile Material

Background

Fissile material is material capable of sustaining a nuclear fission chain reaction

- 10 CFR Part 71 defines fissile material as these nuclides: ^{233}U , ^{235}U , ^{239}Pu , and ^{241}Pu
- Other U and Pu nuclides (e.g., ^{238}U , ^{240}Pu) act as neutron absorbers, and are physically inseparable

Fissile Material

Background

Packaging requirements for packages certified by the NRC to transport fissile material (Type AF or B(U)F / B(M)F):

- 10 CFR 71.55 – General requirements
 - Subcritical with water in-leakage
 - Subcritical under all normal and accident conditions
- 10 CFR 71.59 – Standards for package arrays
 - “Criticality Safety Index” (CSI) applied to packages to limit accumulation on a conveyance
 - CSI based on consideration of subcritical arrays of packages under normal or hypothetical accident conditions (whichever is limiting)

Fissile Material

Background



Provisions for fissile material shipment in packages *not* certified by NRC (i.e., self-certified by licensee):

- 10 CFR 71.15 (also 49 CFR 173.453) – exemption from classification as fissile material
- 10 CFR 71.22 – general license – fissile material
- 10 CFR 71.23 – general license – plutonium-beryllium special form material

Fissile Material

Background



Fissile material exemptions and general licenses facilitate safe transport of low-risk (small quantities or concentrations) fissile material

- Fissile material exemptions and general licenses established to ensure safety under normal conditions of transport and hypothetical accident conditions
- Calculations to determine limits assume worst-case geometric reconfiguration, moderation by fresh water, and pure materials (existing minimum critical mass/concentration values where appropriate)
- Exempt material is relieved of the fissile material packaging requirements and criticality safety assessments required for NRC-approved packages

Fissile Material

Background



Major revision to requirements in 2004, based largely on NUREG/CR-5342, *Assessment and Recommendations for Fissile-Material Packaging Exemptions and General Licenses within 10 CFR Part 71*:

- Provide nonfissile-to-fissile mass ratio approach for some exemptions
- Limit low-absorption moderators (beryllium, graphite, deuterium)
- Consolidate general licenses and provide mass limits with safety equivalent to that provided by certified packages

Fissile Material

Background

Exemptions in 10 CFR 71.15:

- 10 CFR 71.15(a) – less than 2 grams per package
 - “De minimus” per package limit; no restriction on accumulation
 - Impractical to accumulate number of packages required for criticality
- 10 CFR 71.15(b) – less than 15 grams per package
 - Must have 200 grams non-fissile for 1 gram fissile (not including packaging)
 - Pb, Be, graphite, ^2H can be present, but not included in non-fissile mass
- 10 CFR 71.15(c) – low concentrations of solid fissile material
 - Commingled with solid non-fissile material – 2000:1 mass ratio
 - ≤ 180 grams distributed in 360 kg of contiguous non-fissile material
 - Intended for shipment of large quantities of bulk materials (e.g., railcar of contaminated soil)

Fissile Material

Background

Exemptions in 10 CFR 71.15, cont'd:

- 10 CFR 71.15(d) – uranium enriched to less than 1%
 - Pu, ^{233}U <1% of ^{235}U mass; Be, graphite, ^2H < 5% of ^{235}U mass
 - Essentially homogeneous with no lattice arrangement
- 10 CFR 71.15(e) – uranyl nitrate solutions with enrichment <2%
 - Pu, ^{233}U <0.002% of total U mass, with N/U >2
 - Must be in Type A package
- 10 CFR 71.15(f) – up to 1 kg Pu, with <20% fissile
 - Parasitic absorption in non-fissile nuclides of Pu
 - Most likely in Type B package, as low quantities of most Pu nuclides will exceed Type A quantities

Fissile Material

Background

Fissile Material General License in 10 CFR 71.22:

- Fissile material in a Type A package, with a CSI determined by the equation:

$$CSI = 10 \left[\frac{\text{Grams of } ^{235}\text{U}}{X} + \frac{\text{Grams of } ^{233}\text{U}}{Y} + \frac{\text{Grams of Pu}}{Z} \right]$$

- Denominators determined from Tables 71-1 or 71-2
- Table 71-1 (lower values) if Pu or ^{233}U present, if ^{235}U enrichment is unknown or >24%, or if mixed with substances with H_2 density greater than water
- Table 72-2 (higher values) otherwise
 - Limits as a function of ^{235}U enrichment from 0.92% up to 24%
 - Limits range from 60 to 1,800 grams ^{235}U

Fissile Material

Background

General License in 10 CFR 71.23 for Pu-Be special form sources:

- Pu-Be sources meeting special form requirements of 10 CFR 71.75, with a CSI determined by the equation:

$$CSI = 10 \left[\frac{\text{Grams of } ^{239}\text{Pu} + \text{Grams of } ^{241}\text{Pu}}{24} \right]$$

- Up to 1 kg Pu, with less than 240 grams ^{239}Pu and ^{241}Pu
 - Must be in a Type A package
 - No more than a Type A quantity

Fissile Material

Background

Type A Limits – anything greater must be in Type B package:

Nuclide	A ₂ (Curies)	A ₂ (Grams)
²³³ U	0.16	16.5
²³⁵ U	Unlimited	Unlimited
²³⁹ Pu	0.027	0.435
²⁴¹ Pu	1.6	0.016

Nuclide	A ₁ (Curies)	A ₁ (Grams)
²³⁹ Pu	270	4350
²⁴¹ Pu	1100	11

Fissile Material

Background



- IAEA updated fissile exception language in SSR-6 in 2012
 - IAEA prefers “exception” term – effectively the same as “exemptions” used in 10 CFR 71
- IAEA also updated language for CSI-controlled packages that do not require criticality analysis (similar to Part 71 general licenses)
- Following slides evaluate differences between SSR-6 and 10 CFR 71 exemption and general license language, provide factors for consideration, and proposed actions related to each difference.

Fissile Material Issues



- Issue 1a - New Fissile Exceptions, IAEA SSR-6 p417
- Issue 1b - Competent Authority-Approved Fissile Exception, SSR-6 p417(f)
- Issue 1c - CSI-Controlled Fissile Material Packages, SSR-6 p674
- Issue 1d - Plutonium Shipments in Type A Packages, SSR-6 p675

Issue 1a

Fissile Material Issues

IAEA revised fissile exceptions in paragraph 417 of SSR-6 to add three new provisions:

- p417(c) – uranium with enrichment up to 5.0%, up to 3.5 grams ^{235}U per package, up to 45 grams ^{235}U per consignment
- p417(d) – up to 2.0 grams fissile nuclides per package, up to 15 grams per consignment
- p417(e) – up to 45 grams fissile nuclides, packaged or unpackaged, shipped exclusive use

Issue 1a

Fissile Material Issues

p417(c) limit of 3.5 grams ^{235}U is comparable to 10 CFR 71.15(a) limit of 2 grams fissile material (i.e., pure ^{235}U)

- Additional ^{238}U associated with 5.0 weight % enriched uranium provides significant neutron absorption
- Comparison of mass limits for ^{235}U calculated for general license in 10 CFR 71.22:
 - 60 grams for pure ^{235}U , vs. 108 grams for 5.0% enriched ^{235}U , leads to a ratio of 1.8 (108/60)
 - 3.6 grams of 5.0% enriched ^{235}U results in similar criticality safety to 2.0 grams pure ^{235}U
- Consignment limit does not prevent physical accumulation

Issue 1a

Fissile Material Issues



p417(d) limit of 2.0 grams fissile nuclides similar to
10 CFR 71.15(a) limit

- Consignment limit of 15 grams in p417(d) to control accumulation
 - Consignment limits are an administrative control; consignments may still physically accumulate on conveyances
- Not credible to accumulate enough packages, with 2.0 grams per package, to cause criticality concern:
 - More than 80,000 Type A packages under normal conditions of transport
 - More than 250 Type A packages (based on limiting minimum critical mass for ^{233}U) would have to completely fail under hypothetical accident conditions
 - Material would have to consolidate and reconfigure into favorable geometry, and be optimally moderated

Issue 1a

Fissile Material Issues

p417(e) limit of 45 grams of fissile material, packaged or unpackaged, is conservative

- Less than one tenth of the minimum critical mass of ^{235}U
- “Exclusive Use” requirement not consistent with intent of NRC fissile exemption requirements:
 - Safe without accumulation control
 - If incorporated, may be separate from fissile exemptions
- Higher mass value could be justified, considering conservatism inherent in exclusive use restriction:
 - 140 grams could be justified, as this represents less than one fifth of the ^{235}U minimum critical mass under optimum conditions
 - Could provide more flexibility for shipping large contaminated items or small fissile masses

Issue 1a

Factors for Consideration



- Would adopting the fissile exceptions from SSR-6 paragraphs 417(c) and 417(e) as exemptions under 10 CFR Part 71, without the accompanying consignment limits and potentially with a higher mass limit than provided in p417(e), provide options that would be useful to fissile material licensees?
- Would declining to adopt these provisions negatively impact international shipping of small quantities of fissile material?

Issue 1a

Proposed Actions



- Incorporate paragraph 417(c), without the associated consignment limit, as an additional fissile exemption under 10 CFR 71.15
- Incorporate paragraph 417(e) as a provision separate from 10 CFR 71.15, with a corresponding increased fissile material mass limit of 140 grams
- Do not incorporate the consignment limit associated with paragraph 417(d)

Issue 1b

Fissile Material Issues



Competent Authority-Approved Fissile Exception, SSR-6 Paragraph 417(f)

- Allows competent authority to approve fissile exceptions other than those found in the rest of paragraph 417
 - Demonstration of subcriticality similar to that for approved packages
 - Multilateral approval for international shipments
 - Competent authority issues a certificate per paragraph 802
- This provision recognizes that some countries may want to approve exceptions for different fissile materials, similar to the U.S. in 2004

Issue 1b

Fissile Material Issues



- No mechanism in the domestic transportation regulations for issuing a “certificate” for fissile exempt material
- May be of use to domestic licensees to have process for approving fissile exemptions other than what is available in 10 CFR 71.15

Issue 1b

Factors for Consideration



- Would it be useful for licensees to have a mechanism in the NRC's regulations for facilitating multilateral approval of existing fissile exemptions in 10 CFR 71.15, for international shipping?
- Is there value to licensees in having a process in the regulations for approving exemptions for fissile material beyond what is in 10 CFR 71.15 for domestic shipment?
- Would declining to adopt these provisions negatively impact international shipping of fissile exempt material?



Issue 1b

Proposed Actions



- Not to adopt SSR-6 paragraph 417(f), absent stakeholder feedback that multilateral approval of existing NRC exemptions for fissile material is necessary
- Not to incorporate a process in the NRC's regulations for approving exemptions for fissile material beyond what is in 10 CFR 71.15 for domestic shipment, unless there is significant stakeholder feedback that this would be useful

Issue 1c

Fissile Material Issues



IAEA added provisions in paragraph 674 similar to general licenses in 10 CFR 71.22 and 10 CFR 71.23, for CSI-Controlled fissile material

- p674(a): fissile material mass limits and a CSI determination for packages with a minimum external dimension of 10 cm; do not have to withstand normal conditions of transport
- p674(b): fissile material mass limits, with a lower CSI, for packages which maintain a minimum external dimension of 30 cm after normal conditions of transport
- p674(c): same CSI determination as in 674(b), for packages which maintain a minimum external dimension of 10 cm after normal conditions of transport; limit of 15 grams fissile material per package.

Issue 1c

Fissile Material Issues

- The mass values in Tables 71-1 and 71-2 of 10 CFR 71.22, and for plutonium in 10 CFR 71.23, are supported by assessments performed in NUREG/CR-5342
- Mass limits in the 10 CFR Part 71 fissile material general licenses are generally higher
- Table 71-1 of 10 CFR 71.22 provides mass limits for fissile materials mixed with substances having an average hydrogen density less than or equal to water
- Lower mass limits if the fissile material is mixed with substances having an average hydrogen density greater than water (e.g., polyethylene, hydrocarbon oils)

Issue 1c

Factors for Consideration



- Are the existing mass limits for the fissile material general licenses in 10 CFR 71.22 and 71.23 appropriate for providing criticality safety of these types of shipments?
- Would declining to adopt these provisions negatively impact international shipping of small quantities of fissile material?

Issue 1c

Proposed Actions



Not to adopt the changes in IAEA SSR-6
paragraph 674

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Issue 1d

Fissile Material Issues



Plutonium Shipments in Type A Packages, SSR-6 Paragraph 675

- Provision for shipping plutonium in a non-fissile package, labeled with a CSI for accumulation control
- Up to 1000 grams plutonium, where up to 20% by mass may be fissile (^{239}Pu or ^{241}Pu)
- NRC regulations include this provision currently as a fissile exemption in 10 CFR 71.15(f), without a CSI for accumulation control
 - Sufficient non-fissile plutonium to provide parasitic neutron absorption to limit criticality
 - Plutonium greater than 0.435 grams must be in a Type B package, which limits releases and provides package mass for further neutron absorption.

Issue 1d

Factors for Consideration



- Do licensees still use this exemption, and would the change to require a CSI be burdensome (i.e., prevent currently authorized shipments)?
- Is this material often shipped internationally, such that there would be an incentive to adopt the IAEA CSI limitation in NRC regulations for consistency?

Issue 1d

Proposed Actions



Not to adopt the changes in IAEA SSR-6
paragraph 675

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Public Comment Period



- Issues paper (ML16299A298)
- FRN (81 FR 83171): 60 day period
 - November 21, 2016 through January 20, 2017
- Electronically on Federal Rulemaking Website:
<http://www.regulations.gov>, **Docket ID NRC-2016-0179**
- Mail comments to: Cindy Bladey, Chief, Rules, Announcements, and Directives Branch (RADB), Division of Administrative Services, Office of Administration, Mail Stop: OWFN-12-H08, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001



Abbreviations

- CFR – *Code of Federal Regulations*
- CSI – Criticality Safety Index
- DOT – U.S. Department of Transportation
- DSFM – Division of Spent Fuel Management
- HAC – Hypothetical Accident Conditions
- IAEA – International Atomic Energy Agency
- IP – Industrial Package
- LSA – Low Specific Activity
- MOU – Memorandum of Understanding
- NRC – Nuclear Regulatory Commission
- ORNL – Oak Ridge National Lab
- QAP – Quality Assurance Program
- RADB – Rules, Announcements and Directives Branch
- RG – Regulatory Guide
- SCO – Surface Contaminated Object
- SOC – Statement of Consideration
- SRM – Staff Requirements Memorandum
- TI – Transport Index