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Bases for the General Licenses for Fissile Material and Exemptions from Classification as Fissile Material in 10 CFR Part 71, "Packaging and Transportation of Radioactive Material"

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Presented at the
16th International Symposium on the Packaging and Transport of Radioactive Materials

October 3-8, 2010

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- Background
- Assessment and recommendations for 2004 rule-making
- Fissile exemptions in 10 CFR 71.15
- General license in 10 CFR 71.22
- Comparison to TS-R-1 proposed revisions

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Background

- Several instances of potentially unsafe shipments allowed by previous versions of fissile exemptions:
  - former §71.53(a), which allowed up to 15g/package w/o accumulation control
  - Exempt amounts of material shipped with special moderators (Be, C, D_2O)
- Part 71 revision in 1997 added consignment limits and special moderator restrictions

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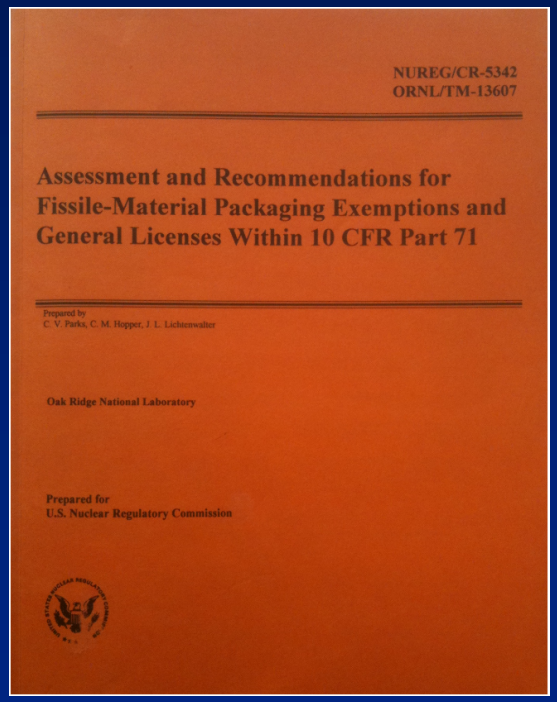
NUREG/CR-5342

Goals:

- document perceived deficiencies in the technical or licensing bases for subcriticality in transportation,
- identify confusing or contradictory language in the regulatory text,
- identify aspects of transportation or licensing that could mitigate, justify, or provide a historical basis for identified deficiencies, and
- develop recommendations for revising the regulations to minimize impacts on licensees while maintaining safe practices and correcting identified deficiencies.



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Recommendations for Fissile Exemptions:

- Replace mass-limited and volumetric concentration-limited exemptions with exemptions based of a ratio of fissile to non-fissile mass
- Provide a low-mass “de-minimis” value of fissile material, below which no package or accumulation requirements are necessary
- Provide less restrictive limits for special moderators based on more realistic transportation scenarios

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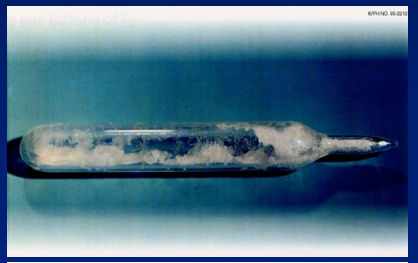
Recommendations for General License:

- Consolidation of previous “limited quantity” and “controlled shipment” requirements into single, clearly defined exemption
- Separate CSI determination for 1) mixtures of ^{235}U, ^{233}U, and Pu, or 2) uranium of known enrichment
- Type A packaging
- Single, 500g limit on special moderators

Fissile exemptions in §71.15

§71.15(a) - *Individual package containing 2 grams or less fissile material.*

- Intended for shipment of small samples of fissile material without packaging requirements or accumulation control
  * up to 2g ^{235}U
  * up to radionuclide exemption values for other nuclides (^{233}U, ^{239}Pu, or ^{241}Pu - Type A if greater than exemption value, Type B if greater than A_1/A_2 values)



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Fissile exemptions in §71.15

§71.15(b) - Individual or bulk packaging containing 15 grams or less of fissile material provided the package has at least 200 grams of solid nonfissile material for every gram of fissile material. Lead, beryllium, graphite, and hydrogenous material enriched in deuterium may be present in the package but must not be included in determining the required mass for solid nonfissile material.

- Replaces previous 15 gram per package exemption
- Removes overly restrictive limitations on special moderators
- Provides flexibility to shippers with larger amounts of dilute fissile material
- Mitigates criticality safety concerns by the presence of solid, non-fissile mass in the package together with the fissile mass limit per package

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Fissile exemptions in §71.15

§71.15(c) - (1) Low concentrations of solid fissile material commingled with solid nonfissile material, provided that:

(i) There is at least 2000 grams of solid nonfissile material for every gram of fissile material, and

(ii) There is no more than 180 grams of fissile material distributed within 360 kg of contiguous nonfissile material.

(2) Lead, beryllium, graphite, and hydrogenous material enriched in deuterium may be present in the package but must not be included in determining the required mass of solid nonfissile material.

- Accommodates large volumes of well-mixed, very dilute, fissile material (e.g., contaminated soil shipped in a rail car
- Distributes material such that large, heterogeneous lumps of fissile material are not present

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Fissile exemptions in §71.15

§71.15(d) – <1% enriched uranium: changed to restrict special moderators and remove heterogeneity requirement

§71.15(e) – <2% enriched uranyl nitrate: changed to require Type A packaging

§71.15(f) – <1kg plutonium, with <20% by mass fissile nuclides: mostly unchanged

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Fissile material general license in §71.22

- Packages must contain less than:
  - A_1 quantity for special form radioactive material
  - A_2 quantity for normal radioactive material
  - Less than 500 grams beryllium, graphite, or hydrogenous material enriched in deuterium
- Default A_1 and A_2 values listed in Table A-1
- A_1 and A_2 values may be calculated

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

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Fissile material general license in §71.22

- Packages must be labeled with the CSI
- CSI must be less than 10, where:

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

- Use Table 71-1 for mixtures of all three
- Use Table 71-2 for ECGU or recycled uranium of known enrichment ≤ 24 wt.% that does not contain ^{233}U, Pu greater than 1.0% of the mass of ^{235}U, or substances that have a moderating effectiveness greater than that of H_2O

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Fissile material exceptions in TS-R-1

- Uses similar fissile to non-fissile mass ratio
- *de minimis* fissile exemption changes
  - 0.25 grams or less
  - 10 cm package with up to 2 grams ^{235}U with a consignment limit of 45 grams
  - 10 cm package with up to 0.5 grams Pu with a consignment limit of 15 grams
- Criticality Safety consignment control not based on CSI
- Conveyance limits set at 45 grams for exclusive use

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Summary and Conclusions

- Revised exemptions and general license have been in use for 6 years
- Provide flexibility for shippers of small quantities or concentrations of fissile material
- Pragmatic and reasoned basis for safety commensurate with the potential risk
- For future revisions of the fissile exemptions and general license NRC will consider similar language in IAEA TS-R-1, as well as experience and insight gained by industry in using these regulations

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Questions?