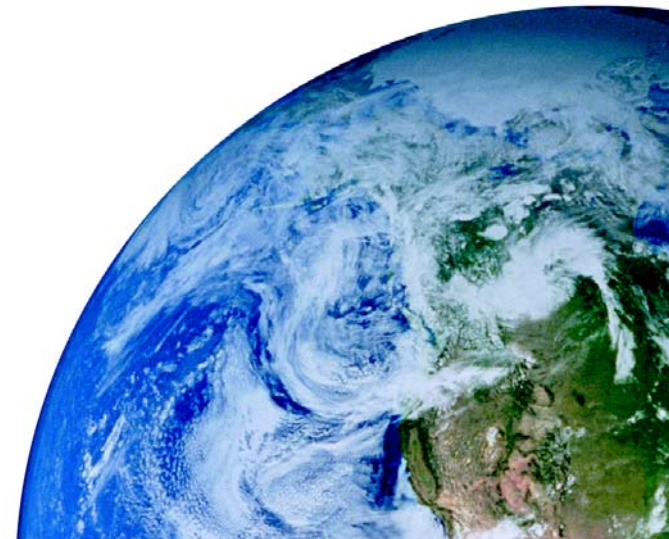


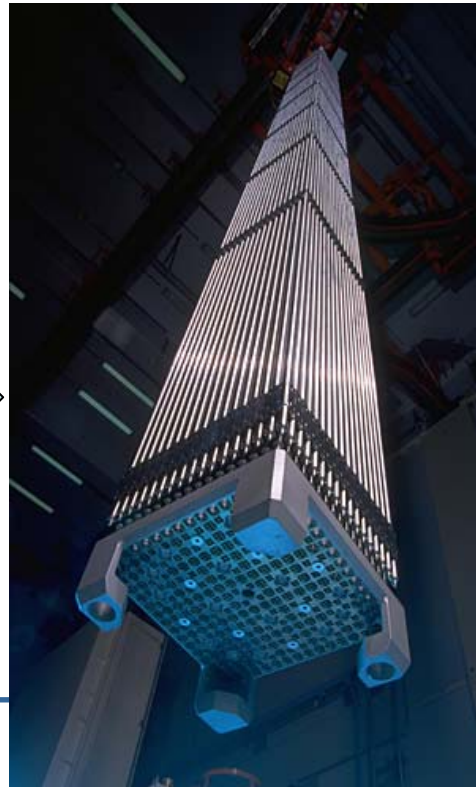
Radioactive waste and fissile exceptions

Bruno Desnoyers



Introduction

- Fissile material: mainly in nuclear fuel industry;
- Waste from these facilities contains fissile material
- Radioactive waste needs to be transported to waste disposal



Introduction

- IAEA Regulations have contained exceptions for decades
- No significant change in their definition
- Stability allows Industry to accommodate its practices
- Advantages in using fissile exceptions :
 - Communication : no hazard sign when no danger
 - Decrease in cost : avoidance of unnecessary justifications, precautions and operations
- IAEA decision to review and revise fissile exception criteria and principles
 - To increase safety and practicability
 - Taking into account industry needs
- Participation of WNTI to the review of the fissile exceptions

IAEA Safety Standards

for protecting people and the environment

Regulations for the
Safe Transport of
Radioactive Material
2009 Edition

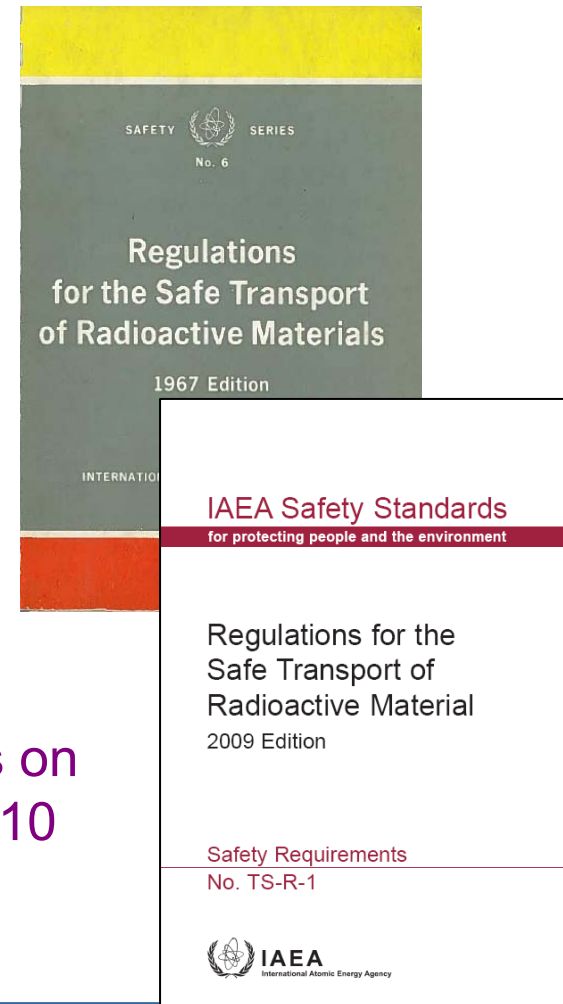
Safety Requirements

No. TS-R-1



Fissile exceptions in radioactive wastes - History

- Already existing exceptions in 1967:
 - Natural uranium, depleted uranium, possibly irradiated in thermal reactors
 - Uranium enriched to 1% in U-235
 - 15 g of fissile nuclides per package
- Main changes since 1967:
 - 5 g in 10 liters
 - 10 cm minimum dimension of packages
 - Conditions on Pu and U-233 for U-235 $\leq 1\%$
 - Mass limit per consignments and restrictions on Be and D for “15 g per package” and “5 g in 10 liters”



Safety and operational issues generated by the current exceptions



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- Increase of knowledge and techniques for criticality safety assessment
 - More situations explored
 - Identification of potentially unsafe situations
- Remarks made to the existing system
 - Minimum critical masses: not correct
 - Sub-criticality demonstrations: questionable
 - Operational constraints: undue
- Review of the fissile exceptions with WNTI participation
 - From 2004 to 2009
 - Review of principles and criteria
 - Increasing safety and taking care of industry needs

The need for shipment of wastes containing fissile material



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- Any industrial process produces waste : it is also the case for nuclear industry where fissile material is handle
 - National policies concerning radioactive waste impact:
 - Radioactive waste repository sites \neq from nuclear industry sites
 - Fissile nuclides are long life radio-nuclides
 - No possibility to wait the decrease of their activity
- => Transport of waste containing fissile nuclides is and will remain necessary as long the nuclear fuel industry will exist**

Criteria for wastes disposal and fissile exceptions for transport

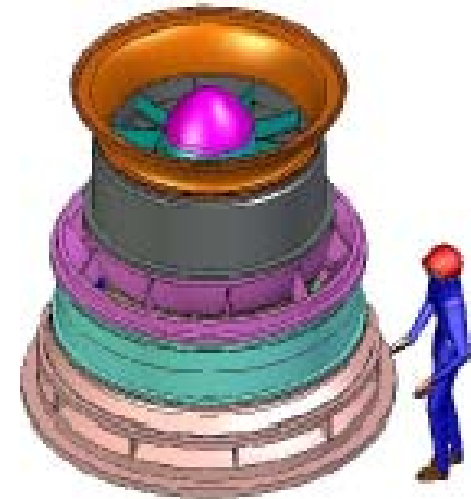


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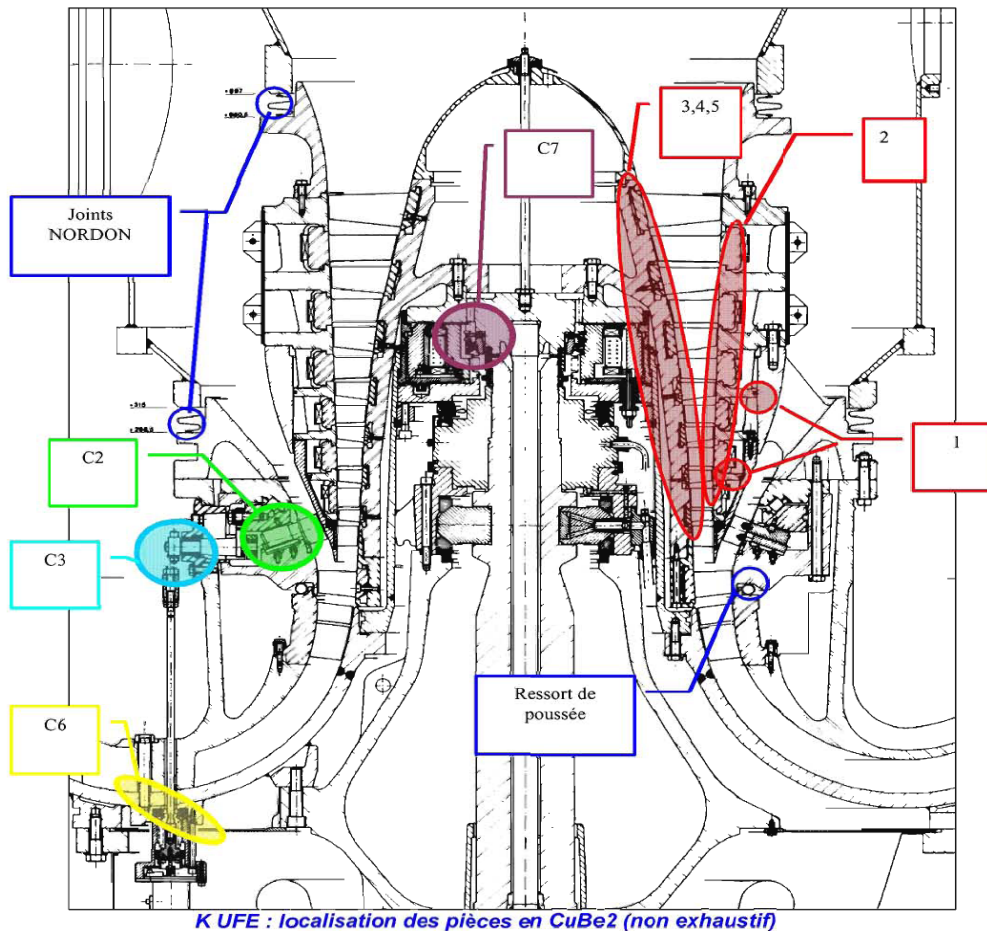
- National policies concerning radioactive waste impact:
 - High Level Waste: with its containment shall be safe in the repository for very long term, and sub-critical
 - Low Level Waste and short lived radioactive waste: shall be safe without need of supervision of the waste after a short period of time (≈ 300 years)
 - U-235 is considered as LLW; shall be sub-critical in the LLW sites when complying with LLW sites criteria
- \Rightarrow it is in the interest of the industry and the Regulators to find solutions to harmonize criteria for transport and for storage**

Relaxation of beryllium restriction on fissile exceptions

- Cu-Be alloys may contain up to 4% in mass of Be
- Components made of that material are used in enrichment technology
- Compressors in Georges Besse enrichment plant in France contain up to 15 kg of CuBe
 - ⇒ shall be fissile material because of the presence of Be in excess of the current criteria
 - ⇒ it was possible to demonstrate that Cu-Be alloys are not more reflective or reactive than carbon steel
 - ⇒ Be in Cu-Be alloys may be neglected



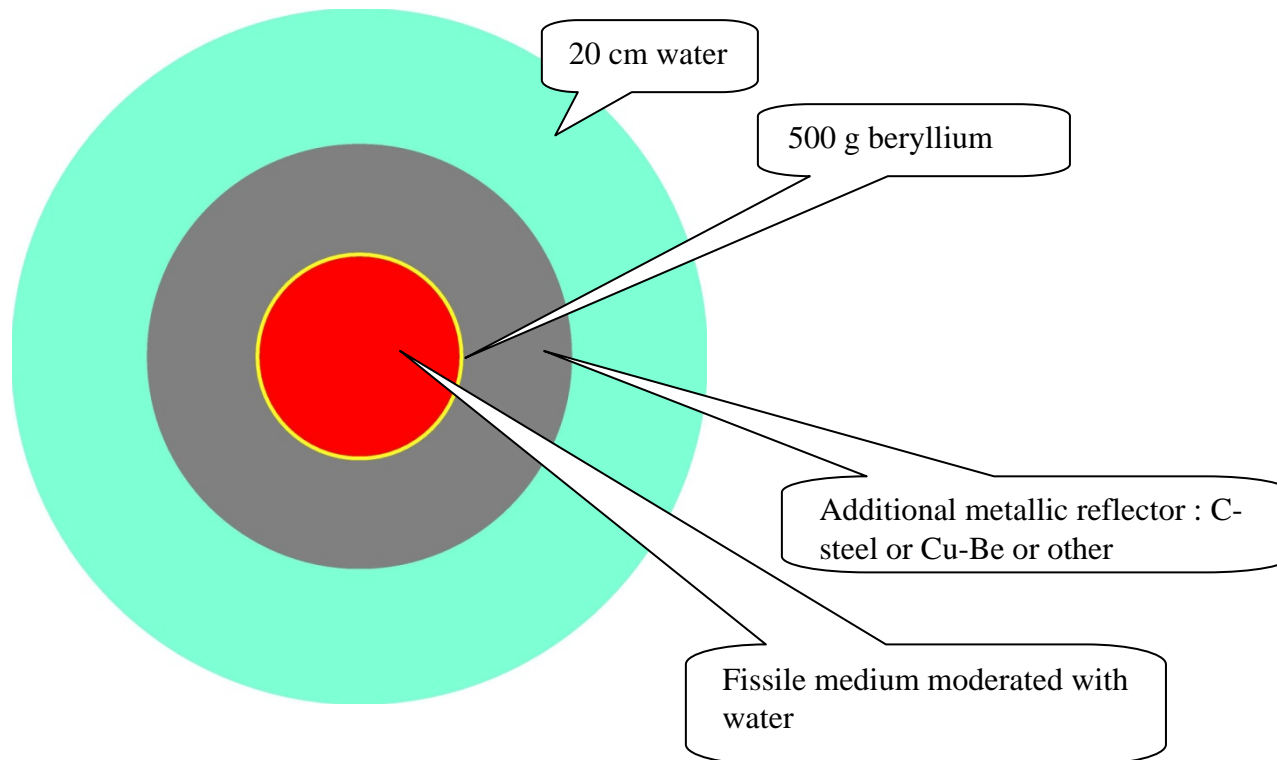
Relaxation of beryllium restriction on fissile exceptions



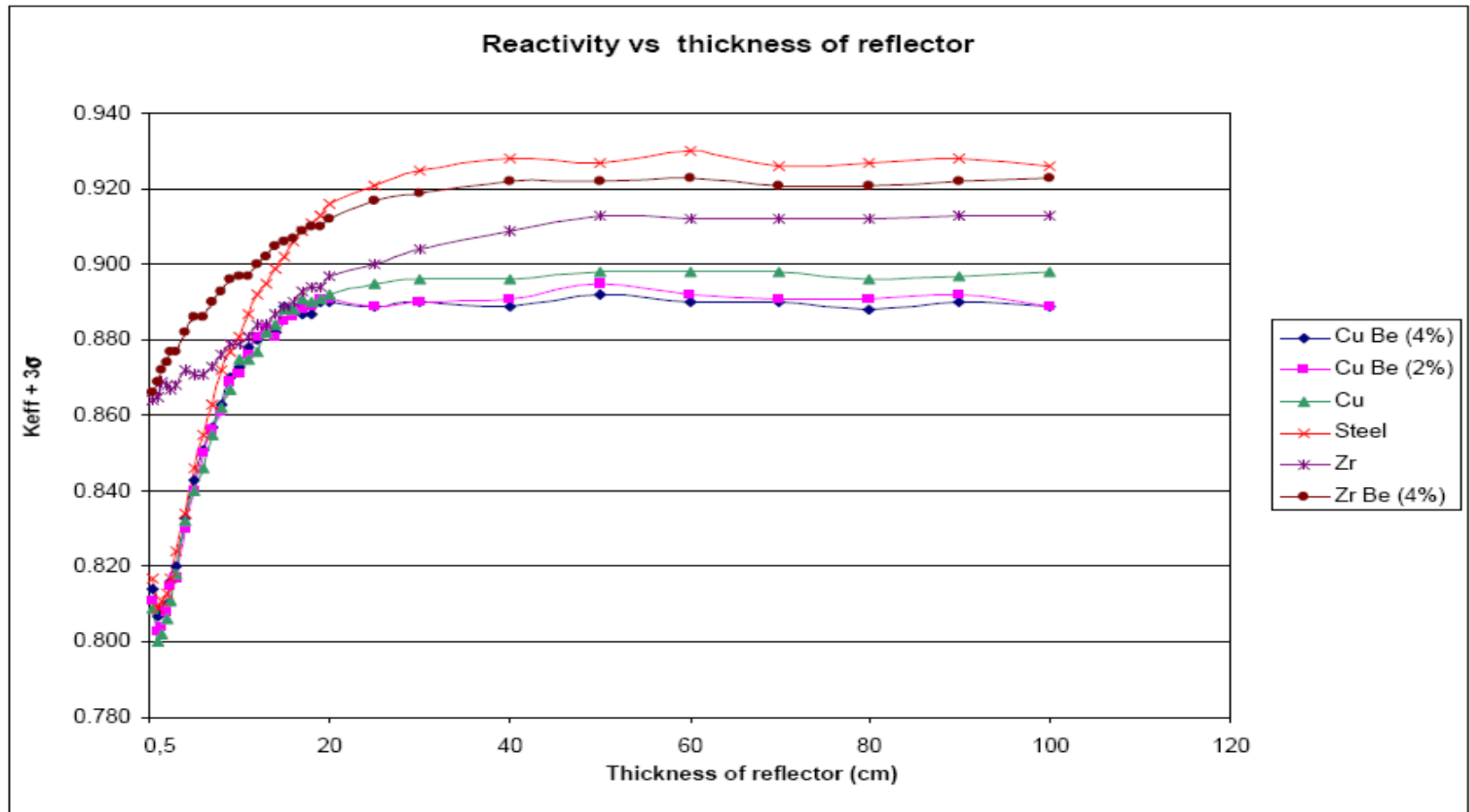
Example of localization of copper-beryllium components in a compressor

Relaxation of beryllium restriction on fissile exceptions

- Comparison of reflectivity by Cu-Be and by carbon steel



Relaxation of beryllium restriction on fissile exceptions



New fissile exceptions and radioactive waste



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- Two kinds of exceptions:
 - Exceptions with accumulation limits: paragraph 672
 - CSI determined using formulas given in the Regulations,
 - Exempted from package design requirements and from package design approval
 - Transported as FISSILE (UN number, proper shipping name, labelling)
 - Exceptions without accumulation limits: paragraph 417
 - Transported as non-fissile

New fissile exceptions and radioactive waste



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Which are the changes for waste?

- Natural or depleted uranium : no change
- Uranium enriched up to 1% in U-235 : no change
- 15 g /package : see para.672 (a), (b) and (c)
- Various enrichment values considered for uranium : NEW
- 5 g / 10 L : **partially covered** by para.672 (a), (b) and (c) and, as last, possibility 417 (f)
- up to 45 g / consignment, packaged or unpackaged: NEW
- Possibility to consider smallest dimension of package = 30 cm instead of 10 cm : NEW
- **Smallest dimension of the package and containment of fissile nuclides shall be maintained after normal conditions of transport for some of the exceptions : NEW**

New fissile exceptions and radioactive waste

Maximum quantities per package and consignment for “limited use”

| Fissile nuclide | | U235 mass / package (g) | | U235 mass / consignment (g) | |
|------------------------|------|-------------------------|------------------|-----------------------------|------------------|
| | | 672 a) CSI=10 | 672 b) CSI=10 | 672 a) CSI=50 | 672 b) CSI=50 |
| U235 Enrichment | 1.5% | 96 | 240 | 480 | 1200 |
| | 5% | 40 | 100 | 200 | 500 |
| | 10% | 32.4 | 81 | 162 | 405 |
| | 20% | 28 | 70 | 140 | 350 |
| | 100% | 21.6 | 54 | 108 | 270 |
| Other fissile nuclides | | 14 | 35 | 70 | 175 |

Colored cells : lower quantities than previously

Under exclusive use providing shipment approval, quantities per consignment may be increased by a factor 2 (CSI=100)

Conclusion

- Except the “5 g in 10 liters” exception, the exceptions usually used for radioactive wastes have been extended or kept as they were.
- The way these exceptions have been reviewed, with the full consideration of the implication of the industry through WNTI, illustrates that combining industrial objectives and safety objectives is possible and can converge to suitable rules.