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CA APPROVED FISSILE EXCEPTIONS ONE REGULATOR'S VIEW

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Disclaimer

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This paper is the personal view of the author & does not represent UK Competent Authority policy.

Requirement

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A replacement is needed for the 5g in 10 litre fissile exception to:

- Ensure safety without package accumulation control
- Be like the 5g in 10 litre exception but tougher.

Fissile Exception Requirements

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- Ensure safety by the presence of large amounts of non-fissile material.
- Likely to be based on a fissile/non-fissile mass ratio.
- Same levels of safety as fissile package designs.
- Must remain safe under accident conditions.

Why not in TS-R-1 ?

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- Avoids overloading TS-R-1 with a large number of exceptions of interest to only a few countries.
- Difficulties in obtaining international agreement on specific exceptions.
- Intended to facilitate waste transport international movements not likely to occur frequently.

CA Approved Exceptions Process

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- User applies for material to be fissile excepted.
- CA assesses application.
- If satisfied CA produces fissile exception certificate.
- User transports material using non-fissile UN number.
- Shipment documentation refers to certificate.
- Multilateral Approval for International shipments

Application Requirements

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A application for fissile exception must provide a:

- specification of the fissile disposition.
- justification that material is safe.
- justification that accidents won’t compromise safety.

The Devil is in the detail !

Mixing (1)

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Waste comes in many varieties:

1. Deliberately prepared homogeneous fissile / non fissile mixtures (eg vitrified residue).
2. Compacted or grouted items where some effort has made to immobilise RAM
3. Contaminated soil or a sludge where the fissile nuclides are spread (but not deliberately) among a uniform non-fissile material
4. Discrete Items some of which are contaminated with fissile nuclides.

Mixing (2)

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- Specification must be tight enough to ensure safety but not so as to make it impractical to use & verify.
- No mixing requirements at all could permit unsafe situation to arise.
- Randomly distributed fissile nuclides with deliberate action only to increase homogeneity.

Survivability (1)

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- Accident conditions must assume package undergoes IAEA tests.
- Can’t claim credit for packaging.
- Difficult to define a representative sample of material (cf package test requirements)
- Other external influences (eg vibration) need to be considered as well as IAEA tests

Survivability (2)

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Possible requirements for non-fissile materials must be:

- Solid (could affect sludges)
- Insoluble – water MUST be considered
- Non-flammable
- Present only as fixed contamination ?

US Exception – A Case Study (1)

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CFR

1g fissile nuclides “comingled” with at least 2000g solid non-fissile material.

Any 360kg must contain no more than 180g fissile nuclides.

Proposed TS-R-1 Wording

“essentially uniformly distributed” among a non-fissile “solid compact binding agent”.

“relatively inseparable” from the non-fissile material by “leaching, burning or mechanical impact”.

US Exception – A Case Study (2)

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- Specification of extent of fissile/non-fissile mixing not agreed
- Ability of above to survive an accident not agreed
- US scheme not adopted
- CFR exception to be the first CA approved fissile exception ?

Beyond CFR

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Further credit might be taken for:

- particular neutron absorbing non-fissile materials.
- maximum uranium enrichment.
- better knowledge of how the fissile isotopes are distributed.
- higher level of confidence in accident conditions.
- Very basic packaging standards.
- A limit on the mass of fissile nuclides per individual package.

Criticality Philosophy (1)

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TS-R-1 requires that unless the fissile disposition is known (eg drawing) the worst case is assumed “consistent with known conditions”

For fissile waste packages this usually means:

1. Optimum moderation, geometry & location
2. Nothing else !

Known properties of the waste (ie lots of non-fissile, not very much fissile) are not usually claimed.

Criticality Philosophy (2)

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- CAs must be pragmatic & accept cases that are not based on precise specification or test results.
- Contrived deliberate arrangements may always be able to “break” an exception.
- CA exceptions are for materials where criticality could only be achieved under laboratory conditions.

Current Exceptions

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TS-R-1 has 2 exceptions covering unlimited amounts of fissile material

- Is “will not form a lattice” sufficient specification for the 1% enrichment exception in 417(b) ?
- Could a fire cause chemical changes to the uranyl nitrate in the 2% enrichment exception in 417(c) ?

Would these be accepted as CA approved exceptions ?

Exception vs Design Approval

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Fissile Exceptions

- Need only be made once.
- Shipped as non-fissile.

Fissile Package Designs

- Can take credit for specific packages, mass & accumulation control.

Conclusions

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- A replacement to the 5g per 10 litre exception is needed to avoid overregulation of waste.
- The CA approval route provides a way for each country to find its own solution.
- A “general” mass ratio exception similar to that in use in the USA could be a first candidate.
- Pragmatism in assessing an application is essential to avoid reverting to totally deterministic ways.