REGULATORY REFERENCES

Domestic Regulations

U.S. Nuclear Regulatory Commission (NRC) transportation regulations, including performance standards for packages, are in 10 CFR Part 71. Regulations that specify criticality safety requirements for fissile material packages are 10 CFR 71.55 and 71.59. In general, 10 CFR 71.55 addresses subcriticality of a single package in isolation, whereas 10 CFR 71.59 addresses criticality safety for arrays of packages that may be transported in a single conveyance. The following paragraphs in Part 71 contain, in part, the regulatory basis for criticality safety of a single package of fissile material, and are the important regulatory provisions in considering moderator exclusion:

Paragraph 71.55 (b) states:

> Except as provided in paragraph (c) ... of this section, a package used for the shipment of fissile material must be so designed and constructed and its contents so limited that it would be subcritical if water were to leak into the containment system, or liquid contents were to leak out of the containment system so that, under the following conditions, maximum reactivity of the fissile material would be attained:
>
> > (1) The most reactive credible configuration consistent with the chemical and physical form of the material;
> > (2) Moderation by water to the most reactive credible extent; and
> > (3) Close full reflection of the containment system by water on all sides, or such greater reflection of the containment system as may additionally be provided by the surrounding material of the packaging.

Paragraph 71.55(c) states:

> "The Commission may approve exceptions to the requirements of paragraph (b) of this section if the package incorporates special design features that ensure that no single packaging error would permit leakage, and if appropriate measures are taken before each shipment to ensure that the containment system does not leak."

Additionally, portions of 10 CFR 71.55 (d) and (e) address water moderation, within the containment system, under normal conditions of transport and hypothetical-accident conditions, respectively. These are:

Paragraph 71.55(d) states, in part, that a fissile material package must be designed and its contents limited such that, under normal conditions of transport, the contents would be subcritical, and that:

> "... There would be no leakage of water into the containment system unless, in the evaluation of undamaged packages under §71.59(a)(1) [criticality safety standards for arrays of fissile material packages under normal conditions of transport], it has been assumed that moderation is present to such an extent as to cause maximum reactivity consistent with the chemical and physical form of the material; ...."

Paragraph 71.55(e) states, in part, that a fissile material package must be designed and its contents limited such that, under hypothetical-accident conditions, the package would be subcritical, assuming that:

> "Water moderation occurs to the most reactive credible extent consistent with the damaged condition of the package and the chemical and physical form of the contents; ...."

International Regulations

The International Atomic Energy Agency (IAEA) develops and publishes safety regulations, for transportation of radioactive materials, that Member States may adopt. The IAEA regulations are contained in TS-R-1, "Regulations for the Safe Transport of Radioactive Material." TS-R-1 includes provisions for fissile-material packages that are similar, but not identical to, those in Part 71.

For the criticality safety of a single package, TS-R-1 (2005 Edition), Paragraph 677, states, in part:

> For a *package* in isolation it shall be assumed that water can leak into or out of all void spaces of the *package*, including those within the *containment system*. However, if the *design* incorporates special features to prevent such leakage of water into or out of certain void spaces, even as a result of error, absence of leakage may be assumed in respect of those void spaces. Special features shall include the following:
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> (a) Multiple high standard water barriers, each of which would remain watertight if the package were subject to the tests prescribed in para. 682 (b) [normal and accident conditions], a high degree of quality control in the manufacture, maintenance and repair of packagings, and tests to demonstrate the closure of each package before each shipment; ....