

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, D.C. 20555-0001

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**NRC REGULATORY ISSUE SUMMARY 2013-04
CONTENT SPECIFICATION AND SHIELDING EVALUATIONS FOR
TYPE B TRANSPORTATION PACKAGES**

ADDRESSEES

All applicants for new, revised and renewed transportation package certificates of compliance (CoC) under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 71, "Packaging and Transportation of Radioactive Material."

INTENT

This regulatory issue summary (RIS) clarifies the U.S. Nuclear Regulatory Commission's (NRC's) use of staff guidance in NUREG-1609, "Standard Review Plan for Transport Packages for Radioactive Material," for the review of content specifications and shielding evaluations included in the CoC and safety analysis reports (SARs) for Type B transportation packages under 10 CFR Part 71. This RIS requires no specific action or response. To improve efficiency and predictability, the NRC recommends that the addressees consider the issues outlined in this RIS in future certificate actions.

BACKGROUND INFORMATION

In 1996, the NRC amended 10 CFR Part 71 to conform NRC regulations to those of the International Atomic Energy Agency (IAEA) (60 FR 50248). The U.S. Department of Transportation (DOT) correspondingly issued an amendment to Title 49 of the *Code of Federal Regulations* (49 CFR), "Transportation," which then brought all U.S. regulations into general accord with the IAEA's Safety Series No. 6, "Regulations for the Safe Transport of Radioactive Material," 1985 Edition. As part of this amendment, the definition of low specific activity (LSA) material became more explicit, and a quantity limit of radioactive material for shipment of LSA material was added. The updated regulations required that packages containing LSA material exceeding this limit would be subject to NRC Type B package regulations. Before this update, there was no quantity limit on LSA material within DOT regulations in 49 CFR 173, "Shippers—General Requirements for Shipments and Packagings." This material could be shipped under self-certified package designs as either a Type A package or a "strong, tight, package." The 1996 revision added consistency to NRC and DOT regulations.

LSA material is radioactive material that, by its definition, has a low activity per unit mass (specific activity) throughout the content volume. LSA material includes low-level radioactive waste, which is composed mainly of alpha and beta emitters; therefore, no substantial shielding is needed for such material. Because of the inherent properties of LSA material, it qualifies for

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less restrictive packaging requirements. However, for some former LSA packages that were converted to Type B packages, and other Type B packages containing material similar to that of LSA, certificate applications did not contain a shielding analysis that estimated maximum external dose rates based on allowable contents during normal conditions of transport (NCT). Instead, pre-shipment dose rate measurements were accepted as a way to demonstrate compliance with normal NCT dose rates in 10 CFR 71.47, "External Radiation Standards for All Packages," with analysis demonstrating compliance with hypothetical accident condition (HAC) dose rates in 10 CFR 71.51(a)(2). The NRC staff considered the nature of LSA material in finding reasonable assurance that NCT dose rate limits would not be exceeded. This is in addition to the practicality of limiting specific radionuclide contents with individual activity limits.

Since the maximum quantity allowed in these packages was limited by the pre-shipment dose rate measurements, the NRC staff also previously found it acceptable for these Type B packages containing material similar to that of LSA to have maximum content limits specified only in terms of multiples of A_2 .¹ This practice primarily addresses appropriate structural categorization of a package, as described below.

In deriving the A_1 and A_2 values, radionuclides are normalized based on radiological hazard in transport. A_1 and A_2 values take into account how the human body absorbs each radionuclide. A_1 and A_2 are derived so there is reasonable assurance that a person exposed within the vicinity of a transportation accident will not exceed the annual dose limit for radiation workers.² In 10 CFR 71.14, "Exemption for Low-Level Materials," it is required, with some exceptions, that material quantity above these limits be shipped in an NRC-regulated Type B package (versus a Type A package) and meet the requirements in 10 CFR Part 71. An NRC Type B package has specific requirements for shielding and survivability of the package during and after an accident that are different from a Type A package. The limit above which LSA material has to be shipped in a Type B package can be found in 10 CFR 71.14(b)(3)(i) and is based on an external dose rate measurement from the unshielded source at a specific distance.

Multiples of A_1 and A_2 values are used for categorizing and classifying packages within the regulations and regulatory documents such as 10 CFR 71.61, "Special Requirements for Type B Packages Containing More Than $10^5 A_2$," and 10 CFR 71.73(c)(2) HAC requirements for a dynamic crush test, structural categorization for fabrication and inspection of packages and the definition of LSA in 10 CFR 71.4. Some non-NRC-regulated uses include limits in TS-R-1 for shipping Type B packages by air, limits for excepted packages and limited quantities in 49 CFR 173.425, and highway route controlled quantities in 49 CFR 173.403.

SUMMARY OF ISSUE

For Type B packages that were once only used to ship LSA material (or material that was considered LSA prior to regulatory changes in 1996), applicants are now requesting approval for additional contents. Some applications define maximum allowable contents in terms of A_2 quantities independent of radionuclide types and have not included a shielding evaluation in the

¹ A_2 , as defined in 10 CFR 71.4, "Definitions," is an activity limit corresponding to the maximum activity of radioactive material for normal form material, other than LSA, and surface contaminated object material, permitted in a Type A package. The corresponding value for special form material is A_1 . These values are either listed in Table A-1 of 10 CFR Part 71, Appendix A, "Determination of A_1 and A_2 ," or may be derived in accordance with the procedures prescribed in Appendix A of 10 CFR Part 71.

² The derivation of the A_1 and A_2 values are based on the Q system approach, which is described in Appendix I to the IAEA Guidance Document TS-G-1.1, which is the companion document to IAEA transportation regulations in TS-R-1.

SAR or application that corresponds to the maximum allowable contents, since these packages historically demonstrated compliance with the NCT dose rate regulations in 10 CFR 71.47 through pre-shipment dose rate measurements as required by 10 CFR 71.87(j).

To make positive findings on a package's compliance with the regulations (discussed further below), and therefore approve a revised CoC, the NRC needs sufficient details on content descriptions and a corresponding shielding evaluation that represents or bounds all contents. The NRC staff will only accept pre-shipment dose rate measurements as an evaluation method under special circumstances, as described later in this RIS. For each affected package, the NRC staff will review any future certificate amendment applications, including the next certificate renewal application, using the guidance in NUREG-1609. Specifically, the NRC staff will review the specification of contents using Section 1.5.2.3 of that guidance and will look for a shielding evaluation corresponding to these contents in accordance with Section 5.5 of the guidance.

Content Specification

In accordance with 10 CFR 71.33(b), the description of the contents should be complete with respect to the chemical and physical form of the material, as well as its radioactive content (radionuclides and quantity). The Division of Spent Fuel Storage and Transportation's Interim Staff Guidance-20 (SFST-ISG-20), "Transportation Package Design Changes Authorized Under 10 CFR Part 71 Without Prior NRC Approval," states that the content description must be consistent with the assumptions made about the contents in the package evaluation (e.g., in the containment, shielding, and criticality evaluations). These features must be described in sufficient detail to provide a basis for evaluating the package.

It may not be sufficient or practical to specify maximum allowable contents for multiple radionuclides only in multiples of A_2 within a CoC for the following reasons:

- Content with a given A_2 value can be any individual or combination of a variety of radioactive isotopes. Using A_2 as a unit to define the quantity limit of the content does not provide a unique description of the contents.
- The A_2 value does not describe the nature of the source (i.e., neutron or gamma) or the energy spectra of the content, and the A_2 value is independent of the shielding performance for the specific source.
- The A_2 value can be modified when regulations are updated independent of the package approval.
- Thermal evaluations rely upon knowing the decay heat of the source, which is difficult to verify by direct measurement. It is typically calculated based on the individual radionuclides allowed in the maximum source specification.

It is still appropriate to use A_2 values to provide appropriate structural categorization of the package and to limit the leak rate. For example, in 10 CFR 71.51, "Additional Requirements for Type B Packages," leak rate testing sensitivity requirements can be calculated in accordance with ANSI N14.5, "Radioactive Materials—Leakage Tests on Packages for Shipment," in which the A_2 value is specified to evaluate the leakage rate. Also in NUREG-1609, and Regulatory Guide 7.11, "Fracture Toughness Criteria of Base Material for Ferritic Steel Shipping Cask Containment Vessels with a Maximum Wall Thickness of 4 Inches (0.1 m)," structural categories

for fabrication and inspection of packages are specified. Therefore, the CoCs may retain maximum content values specified in multiples of A_2 in addition to ones corresponding to the shielding evaluation (and thermal, criticality, etc.).

Package Evaluation

In accordance with 10 CFR 71.31(a)(2) and 10 CFR 71.35(a), the package design must include an evaluation that demonstrates the package satisfies the dose rate limits in 10 CFR 71.47 for NCT and 71.51(a)(2) for HAC. SFST-ISG-20 states that the evaluation may be based on a representative loading to allow flexibility in the contents that can be loaded for Type B packages in which exact contents are not known. The applicant should provide information in the SAR or application that demonstrates the evaluation is representative or bounding for all allowable contents.

The NRC staff typically will not accept pre-shipment measurements as an appropriate 10 CFR 71.35(a) evaluation method for determining compliance with NCT dose rates in 10 CFR 71.47. The pre-shipment dose rate measurements fulfill the requirements in 10 CFR 71.87(j). Pre-shipment measurements only indicate that a particular shipment can be transported because it meets the NCT dose rate limits. This helps to ensure that the package was loaded properly and the cask's shielding is functional.

A package that relies completely on pre-shipment dose measurements to determine if a package meets its regulatory dose rate limits may not address the possibility of contents shifting or settling during transport, which could potentially result in an increase in package radiation levels. In addition, measurement procedures, instrument accuracy, efficiency, and calibration can vary widely. Calculating the estimated dose rates provides reasonable assurance against natural uncertainties associated with measurements, especially for packages with small margins to the limit.

Pre-shipment measurements are, however, appropriate to verify an evaluation. The level of rigor in the measurement procedures should depend on the level at which they are relied upon to verify the evaluation (i.e., the level of uncertainty). The NRC staff may request, in response to a certificate application, that more comprehensive measurement requirements be added to the operating procedures or the CoC, if they are not present already. Examples of recent package evaluations that the staff have accepted are described below to provide examples of evaluation methods the staff has seen and the circumstances under which the staff found them acceptable.

One applicant defined a generic bounding gamma energy and corresponding emission rate that can then be translated into activity limits of the radionuclides present. The applicant evaluated several discrete gamma energies so that radionuclides with lower gamma energy can be shipped with a higher activity. In addition, the applicant provided adjustment factors for different material density to account for self-shielding and different limits for a distributed source versus a point source geometry. This method contained many areas of uncertainty. Therefore, the applicant relies upon comprehensive pre-shipment dose rate measurements for the analysis uncertainties and these were added as a condition of the CoC and the operating procedures. A limit of $3,000 A_2$ was retained in the CoC for purposes of bounding the loss or dispersal of radioactive contents (i.e., leak rate), as 10 CFR 71.51 requires.

A design evaluation method may be based on measurement. One certificate holder has several packages that are approved to ship special form source material. This material is very well defined and consists of a single radionuclide. The evaluation has a unit amount of source

material within a prototype package. The certificate holder then measures the dose rates external to the package prototype and includes the results in the CoC (or revised CoC) application or SAR to demonstrate compliance. Since this is the same source material to be shipped, the allowable content can be calculated by scaling up the dose rate measured from the unit source material. The NRC staff found this to be an appropriate use of measurement as a design evaluation method to demonstrate compliance with NCT dose rate requirements in 10 CFR 71.47. The NRC staff notes, however, that pre-shipment measurement can be used to confirm compliance with the dose rate limits for a package at the time of shipment.

In some cases, it may be impossible for applicants to evaluate shielding design for NCT based on reasonably bounding content representations. The NRC staff will accept pre-shipment measurement as an evaluation method for packages on a case-by-case basis, taking into consideration several factors:

- the radiation level of the material;
- the scope of the package's use (i.e., number of different package users, shipping locations, sources of the material);
- how well-defined the material is; and
- the inclusion of comprehensive measurement procedures.

The NRC staff has accepted pre-shipment measurement as part of a shielding evaluation for a recent application, which included an additional shielding canister that provided for higher content activity. With the exception of the increase in activity, the proposed contents' characteristics were very similar to those previously shipped. The applicant provided information about past shipments already conducted under the previously approved CoC. This information included the dose rate measurements and the fraction of CoC curie quantity limits (which were based on shielding analyses for HAC) loaded in each shipment. These measurements were taken using the same procedures that were required and explicitly specified under the amended CoC. The NRC staff reviewed these procedures and found them acceptable. The NRC staff notes that this package did have specific content limits for individual radionuclides rather than specifying contents only in terms of multiples of A_2 . The waste stream transported by the package was clearly characterized, and the applicant has a rigorous characterization scheme for each shipment's contents. The waste that can be shipped in the package has a limited number of sources and users. Considering the above, the staff found that the evaluation demonstrated that the package meets the NCT dose rate requirements.

BACKFIT DISCUSSION

This RIS is directed at applicants for new, revised and renewed transportation CoCs (the addressees of this RIS) and describes the information that the addressees should consider incorporating in their applications for new, revised and renewed CoCs. This information will assist the NRC in the regulatory process and aid the addressees in developing thorough submittals. There are no backfitting or issue finality provisions in 10 CFR Part 71; therefore, these addressees – in their status as applicants for or holders of 10 CFR Part 71 CoCs – are not protected by any backfitting or issue finality requirements.

Further, this RIS does not impose on the addressees in their status as applicants, licensees or holders of NRC regulatory approvals under 10 CFR Parts 50, 52, 70, 72, or 76 either backfitting (as defined in those parts) or actions which are inconsistent with the issue finality requirements in 10 CFR Part 52. Consequently, the NRC staff did not address the documentation requirements of the backfitting provisions or the issue finality provisions of those parts.

FEDERAL REGISTER NOTIFICATION

The staff published a notice of opportunity for public comment on this RIS in the *Federal Register* on November 13, 2012 (77 FR67678) for a 45 day comment period. The staff received a total of 3 comments. The staff considered all comments. The staff's evaluation of the comments is publicly available through the NRC's Agencywide Documents Access and Management System (ADAMS) under Accession No. ML13035A235.

CONGRESSIONAL REVIEW ACT

The NRC has determined that the RIS is a rule as designated in the Congressional Review Act (5 U.S.C. §§ 801–808). However, OMB has not found it to be a major rule as designated in the Congressional Review Act.

PAPERWORK REDUCTION ACT STATEMENT

This RIS contains and references information collection requirements that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These information collection requirements were approved by the Office of Management and Budget, approval numbers 3150-0008.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

CONTACT

Please direct any questions about this matter to the technical contact listed below.

/RA/

Mark Lombard, Director
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety and Safeguards

Technical Contact: Veronica Wilson, NMSS
301-492-3278
e-mail: veronica.wilson@nrc.gov

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