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Development of guidance on applications of regulatory requirements for low specific activity materials and surface contaminated objects

Ronald B. Pope
Transportation Technologies Group
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, Tennessee 37831-6495, USA

Earl P. Easton and Susan F. Shankman
Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Mail Stop 06G22
Washington, D.C. 20555, USA

Richard W. Boyle
Research and Special Programs Administration
U.S. Department of Transportation
400 Seventh Street SW
Washington, D.C. 20590, USA

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Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831-6495
managed by
LOCKHEED MARTIN ENERGY RESEARCH CORP.
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ABSTRACT

In 1985, the International Atomic Energy Agency issued revised regulations for the safe transport of radioactive material. Significant among the changes were major revisions to requirements for Low Specific Activity (LSA) material and Surface Contaminated Objects (SCOs). In preparation for the adoption of these requirements into regulations in the United States, it became apparent that guidance on how to apply these requirements, clarifying technical uncertainties and ensuring proper implementation, would be needed both by the regulators and those regulated. Thus, the U.S. Department of Transportation and the U.S. Nuclear Regulatory Commission, with the assistance of staff from Oak Ridge National Laboratory, are preparing regulatory guidance for LSA material and SCO transport. The guidance will present examples of acceptable methods for demonstrating compliance with the revised rules. Ideas being investigated for inclusion in the pending guidance are discussed in this paper. Under current plans, the guidance will be issued for public comment prior to final issuance of the guidance in 1997.

INTRODUCTION

The U.S. Department of Transportation (DOT) [1] and the U.S. Nuclear Regulatory Commission (NRC) [2] regulations for transportation of radioactive materials, revised for compatibility with the 1985 version of the International Atomic Energy Agency (IAEA) [3] regulations, became effective 1 April 1996. The revisions changed the regulatory framework under which Low Specific Activity (LSA) material and Surface Contaminated Objects (SCOs) are characterized, classified, categorized, packaged, and transported. The large majority, by volume, of low-level radioactive waste (LLW) which is shipped in the United States as a result of NRC-licensed activities, is shipped either as LSA material or SCOs. In addition, radioactive ores and most plant maintenance and outage equipment have typically been categorized as LSA material or SCOs.

Under the previous regulations, a single broad category, LSA material, encompassed materials satisfying specific activity limits. The old LSA material category included specifications for SCOs. In contrast, under the revised rules, the scheme for shipping these materials has been refined such that:

(1) whereas SCOs were formerly a subcategory of LSA, they are now defined as their own category;

(2) LSA materials are further divided into three subcategories (LSA-I, LSA-II, and LSA-III), and SCOs are further divided into two subcategories (SCO-I and SCO-II);

(3) SCO definitions distinguish between fixed and non-fixed (i.e., removable) contamination on accessible surfaces but combines them for inaccessible surfaces;

(4) the LSA material subcategory definitions in the revised regulations make distinctions between the terms (a) *essentially uniformly distributed* and *(b) distributed throughout*;

(5) specific activity limits for LSA material have been tied to each nuclide's A_2 value, and have increased substantially for most nuclides (the A_2 quantity is the amount of normal form radioactive material which can be transported in a non-accident resistant, Type A package — see, for example 49 CFR 173.433);

(6) NRC certification of the package design for shipment of LSA material and SCOs in the United States is no longer required, unless the dose rate from the unshielded material exceeds 10 mSv/h (1 rem/h) at 3 m (9.9 ft); and

(7) a new set of packages, industrial packages (IPs), has been authorized for use with LSA material and SCOs.

Although the new regulations for LSA material and SCOs [1, 2, and 3] are more prescriptive than were the previous regulations, DOT and NRC personnel have not observed a major economic or practical impact of the revised rules on the shipment of waste as LSA material or SCOs. Specifically, experience shows that such activities, which have taken place in the past, have continued to take place in a safe manner under the new rules. However, because of the more prescriptive nature of the new rules, many questions are being asked and it was determined that guidance on the new LSA material and SCO requirements would benefit both the regulated and the regulators.

JOINT NRC-DOT DRAFT GUIDANCE

To address questions regarding the proper and consistent implementation of the new LSA material and SCO requirements, and at the request of industry in the United States, NRC and DOT will be issuing, in the near future, joint guidance on the packaging and transport of LSA material and SCOs. The remainder of this paper describes some of the questions and the corresponding guidance under development. In addition, separate and complementary guidance is being developed for large contaminated and/or activated objects and pieces of equipment; this activity is discussed in a companion paper at this conference.

This paper presents initial thoughts on the content of the joint guidance being considered for publication by NRC and DOT. Current plans are to issue the joint guidance in draft form for public comment in 1997. As a result of the public comments, peer review, and internal discussions, the content of both the draft and final guidance documents may be significantly different from that presented in this paper. This paper is being presented to enhance public involvement in the early stages of the guidance development.

The questions on the revised regulations can be grouped into four general categories:

(1) definitions and categorization of SCOs,

(2) compliance with SCO surface-contamination limits,

(3) determination of the dose rate 3 m (9.9 ft) from the unshielded material, and

(4) determination of distribution of activity in LSA material.

The third category applies to both LSA material and SCOs.

DEFINITIONS AND CATEGORIZATION FOR SCOs

Many materials that were previously shipped as LSA material must now be categorized and shipped using the LSA-I, LSA-II, or LSA-III subcategories. For example, process wastes (e.g., resins, filter media) and dry active wastes (absorbent materials; "bags, tags, and rags; etc.") should be categorized as LSA-II. However, some objects which are not themselves radioactive, but have radioactive materials distributed on their surfaces (e.g., certain equipment used during a utility outage), although formerly categorized as LSA material must now be classified as SCO to comply with the revised regulations. There could be, however, some practical exceptions to this. These exceptions may be addressed in the guidance (e.g., collections of small SCOs such as sample containers could be combined with LSA material and shipped as LSA material).

Under the previous regulations, SCO was a subset of LSA material, although (a) the area on the surface of the object allowed for averaging the contamination was greater and (b) the surface contamination limits did not distinguish between fixed and non-fixed (removable) contamination, or accessible and inaccessible surfaces. SCO is no longer a subset of LSA material, and under the current rules, if the definition of SCO is complied with, nonradioactive, contaminated objects should be categorized as SCOs.

Definition for *Contamination*. Objects that are radioactive (e.g., activated objects), for which the average activation is less than 70 Bq/g (2 nCi/g), can be categorized as SCO because the activation is less than the hazardous materials definition of Class 7 (radioactive) material, according to paragraph 139 of Ref. 3 and 49 CFR Part 173.403 [1]. However, if an object is activated to an average level in excess of 70 Bq/g (2 nCi/g), the object itself is classed as radioactive material, and—based upon the definition of SCO—the object may not be categorized as an SCO. It may, however, be categorized as LSA material insofar as the requirements specified in the LSA material definitions are satisfied. In this latter case, it is noteworthy that since the current regulations do not place limits on surface contamination levels for LSA material, there is no requirement to comply with the SCO surface contamination limits for an object which is activated above the 70 Bq/g (2 nCi/g) limit.

The IAEA regulations [3] define *contamination* as "the presence of a radioactive substance on a surface in excess of 0.4 Bq/cm^2 (10^{-5} μCi/cm^2) for beta and gamma emitters and low-toxicity alpha emitters or 0.04 Bq/cm^2 (10^{-6} μCi/cm^2) for all other alpha emitters." However, a comparable definition was not adopted into the U.S. domestic regulatory revisions [1, 2]. This lower limit of contamination serves a comparable function to the limit of 70 Bq/g (2 nCi/g) in the definition of radioactive material, in that materials less than these limits are below the scope of the hazardous material regulations.

Since the radioactive material definition of 70 Bq/g (2 nCi/g) is based on an activity per unit mass, it is not readily applicable to SCOs or to whether or not a slightly contaminated object is subject to regulation. Nonradioactive material (objects) with surfaces contaminated to levels less than the values in the IAEA definition of contamination should be exempted from hazardous materials regulations. Furthermore, dividing the activity in the contamination by the mass of the object (to determine whether the object as a whole should or should not be defined as radioactive material) is not appropriate for these objects. It opens the possibility for a massive object with significant amounts of contamination on its surfaces to fall below the regulatory threshold of radioactive material. This would not be consistent with the intent of the regulatory exemption limit, and is a situation which should therefore be avoided.

Because of these problems, DOT staff is currently considering adding the definition of *contamination* to 49 CFR Part 173.

Definitions for *accessible surfaces* and *inaccessible surfaces, and fixed contamination* and *non-fixed contamination*. It appears that some consignors (i.e., shippers; also commonly known as licensees in the United States) have had difficulty in properly interpreting or implementing the new regulations for categorizing SCOs. For example, health physicists (or other certifying officials) have indicated hesitation in signing certification statements for SCO shipments because of concerns that the receiver of the shipment (i.e., the consignee) or a regulatory inspector may find fault with the consignor's determination and stipulate that a violation has occurred, despite the consignor's conscientious efforts to meet the intent of the regulation.

Additionally, there have been questions regarding categorization as SCO-I as compared with SCO-II, since some have questioned whether it is permitted, or conservative, to default to SCO-II. Another question relates to categorizing collections of small contaminated objects. Finally, there has been some confusion in defining *inaccessible* (as compared with *accessible*) surfaces and *fixed* (as compared with *non-fixed*) *contamination*.

Although SCOs were categorized as a subset of LSA material under previous regulations, it is necessary that such objects be categorized as SCOs, when appropriate, under the current regulations. Presumably, the hesitation to categorize objects as SCO arises because contamination level measurements taken at the point of origin may be obtained using methods, or locations, which will be different from those taken at the point of destination, thus resulting in different results being obtained. It should be recognized that, although it is necessary to carry out surface-contamination measurements after a package is received (see 10 CFR Part 20.1906 [4]), there are no requirements imposed by the regulations on the consignee to verify that the shipper accurately categorized the radioactive material before its shipment.

Also, it is noted that, in the United States, regulations continue to allow [in 49 CFR Part 173.427(b)(3)] [1] the use of the previously defined strong, tight packages for SCO if:

(a) the shipment is domestic only (i.e., within the United States),

(b) it is transported under exclusive-use, and

(c) the total quantity of radioactivity in the package does not exceed 1 A_2.

Such shipments are exempted from the DOT general marking and labeling requirements by 49 CFR Part 173.427(a)(6)(vi) [1].

In addition, consideration is being given in the development of the guidance to acknowledging that measurements are not the only means of demonstrating compliance with the contamination limits; reasoned arguments, reference to previous shipment, and calculations can also be used if justified.

Furthermore, it is always permitted to categorize and ship an object as an SCO-II, even if later, detailed characterization demonstrates the object actually had met the lower contamination limits of an SCO-I. In the United States, SCO-I and SCO-II have equivalent packaging requirements for domestic transport as specified in 49 CFR 173.427(b)(2) through (b)(5) [1]. Thus, since SCO-I is less of a contamination hazard than is SCO-II, categorization of a potential SCO-I as SCO-II is a conservative approach. Such an action would not be deemed as an unsatisfactory approach by the shipper, nor would it be viewed as a noncompliance.

Although used in the definition of SCOs, the terms *accessible surfaces* and *inaccessible surfaces* are not defined in the regulations, either internationally [3] or in the United States [1, 2]. Thus, NRC and DOT are proposing to define *inaccessible surfaces* as "surfaces which cannot be readily smeared by hand using standard or wiping techniques." The phrasing, "by hand" is not meant to discourage use of as low as is reasonably achievable (ALARA) tools such as telescopic sampling instruments. The phrasing, "standard wiping techniques," is intended to imply practices similar to those used for complying with package contamination limits in 49 CFR Part 173.433. For example, the bottom or top of an object would be accessible, but surfaces which must be reached by probing small openings would be inaccessible.

Similarly, the terms *fixed contamination* and *non-fixed contamination* are used in the definition of SCOs, but are not defined in the regulations. Thus, NRC and DOT are proposing to define *non-fixed* (removable) *contamination* as that contamination which would be identified as removable if a surface were smeared using standard wiping techniques (i.e., applying moderate finger pressure on an absorbent material against a surface to be checked and accounting for a removal efficiency). *Fixed contamination* would be defined as that contamination which exists on a surface and which cannot be easily removed using the standard techniques noted above (i.e., that remains in situ and which cannot provide hazards from ingestion, inhalation, or transfer). In most instances, fixed contamination will have to be inferred from direct readings of radiation monitors, contamination monitors measuring the non-fixed contamination, and knowledge of probable gamma radiation emanating from the surface of the package. This approach is consistent with the method described in appendix II of the IAEA's guidance document [5] for measuring fixed and non-fixed contamination.

COMPLIANCE WITH SCO CONTAMINATION LIMITS

As mentioned above, some nonradioactive objects which are themselves not radioactive, but have radioactive materials distributed on their surfaces, are now categorized as SCO. However, the regulations do not require measurement of contamination or radiation levels as the only means of compliance; calculations, references to other determinations, or reasoned arguments can also be acceptable.

Although preshipment analyses (or determinations) are required to demonstrate compliance with the applicable SCO definition, the level of detail in these analyses is expected to be proportional to the potential hazard that the material represents. In applying this philosophy, it is recognized that the potential hazard is based on both

(a) the quantity (i.e., activity) and

(b) the radiotoxicity (as indicated by the A_2 value, where a low A_2 value indicates a high radiotoxicity)

of the Class 7 (radioactive) material to be shipped and that the approach taken must be consistent with requirements to maintain occupational exposures ALARA as specified, for example, in Refs. 4 and 6. Thus, a method is needed for excluding from the categorization of an object those radionuclides whose radiotoxicity combined with the quantity present indicate they are radiologically insignificant (i.e., a method for excluding from consideration, low-hazard quantities).

To assist consignors in defining which radionuclides can be excluded from being listed on shipping papers and labels, the United States has introduced into its regulations a "95 % sum of fractions" rule. This rule accounts for both the quantity and radiotoxicity of a mixtures of radionuclides. It could also be applied to defining those radionuclides, on a given object, which truly pose a hazard during the packaging and transport of that object. Thus, as a result, consideration is being given by the regulators in the United States to indicating that, if the total activity on an object is less than 1 A_2, the first step in characterizing an object in any shipment could be the determination of the radionuclides constituting the A_2 fraction of Class 7 (radioactive) material in the package using the "95 % sum of fractions" method described by DOT in 49 CFR Part 173.433(f) [1].

Specifically, the 95 % sum of fractions rule states that

$$\sum_{i=1}^{n} a_{(i)} / A_{(i)} \geq 0.95 \sum_{i=1}^{n+m} a_{(i)} / A_{(i)},$$

where

a_i is the activity of radionuclide i in the mixture;

A_i is the A_2 value, as appropriate, for radionuclide i;

m represents the radionuclides that do not need to be considered in the determination;

n represents the radionuclides of significance which must be considered in the determination; and

n + m represents all the radionuclides present in the mixture.

Note that the identity of the nuclides representing at least 95% of the total A_2 fraction (i.e., the listing of the "most restrictive nuclides," according to paragraph 442 of Ref. 3) in the package is required to be entered on the shipping papers and on labels, pursuant to 49 CFR Part 173.433 and 49 CFR Part 172.203 [1]. Since this identification is required for all radioactive material shipments, is independent of categorization, and was also required (in a slightly different form) under the previous U.S. regulations, this determination of the nuclides is not construed to cause additional doses to personnel.

In practice, it is anticipated that almost all SCO packages will contain less than 1 A_2 quantity and, therefore, can be qualified for shipment, domestically, in strong, tight packages pursuant to 49 CFR Part 173.427(b)(3) [1]. One concept being considered for guidance is that a reasoned argument could be used to categorize the great majority of these candidate SCOs, without the need for detailed, quantitative measurement of fixed contamination on accessible surfaces or total (fixed plus non-fixed) contamination on inaccessible surfaces. The objects categorized using this reasoned argument approach would be shipped as "Radioactive material, SCO."

The reasoned argument would be based (a) on the non-fixed (removable) contamination on accessible surfaces, (b) on the total quantity of activity in the package, and (c) on the fact that the contents of the package would otherwise meet the LSA-II material specific activity and distribution requirements. The applicability would be limited to shipments of SCO-I or SCO-II made domestically, under exclusive-use transport, in strong, tight packages pursuant to 49 CFR Part 173.427(b)(3) [1], with total activity in quantities less than 1 A_2 per package.

The basis for allowing this argument is that, for exclusive-use shipments of radioactive materials in quantities less than A_2 per package, the minimum packaging requirements for solid LSA material and for SCOs are identical (i.e., strong, tight packages for domestic shipments within the United States, or IP-1 packages for international shipments). Furthermore, there are no other requirements (e.g., emergency response requirements) in the regulations which would increase safety if an object were categorized as SCO as opposed to LSA material. Therefore, incurring additional dose during categorization in order to further demonstrate satisfaction of the conditions in the SCO definition would not be expected to provide any additional safety for such a shipment and would not be consistent with ALARA requirements.

The second part of the guidance in this area would be that, for packages containing SCOs with greater than 1 A_2 quantity, a more quantitative analysis is expected than for packages with less than 1 A_2 quantity. The justification of this expectation is that for quantities greater than 1 A_2, in the United States the packaging requirements for LSA material and SCOs are different in some cases, and for quantities of normal form radioactive material exceeding 1 A_2, the non-LSA material or SCO would otherwise require accident-resistant (i.e., Type B) packaging for transport. For these larger quantities, strict, quantitative compliance with the definition of SCO is much more important, because the special properties of the SCO serves as the justification for using the non-accident-resistant package.

UNSHIELDED DOSE RATE LIMIT

Certification of package designs by the NRC for both LSA material and SCOs is now required only when the dose rate at 3 m (9.9 ft) from the unshielded LSA material or SCO exceeds 10 mSv/h (1 rem/h). In excess of this, a Type B (accident resistant) package is required, except that—within the United States—previously approved NRC Type A-LSA packages are also authorized until April 1999 [2]. In any event, if the dose rate at 3 m (9.9 ft) exceeds 10 mSv/h (1 rem/h), the material or object could not be categorized for shipment as "Radioactive material, LSA," or "Radioactive material, SCO"; rather it would need to be categorized as "Radioactive material, n.o.s."

Under the previous U.S. regulations, if the contents of a package was LSA material in greater than 1 A_2 quantity, then the material was required to be shipped in an NRC-certified package. Such a package was required to meet the Type A (non-accident) standards. Generally, there was no specific upper limit to the activity of LSA material which could be placed in a Type A package (a practical limit existed due to vehicle dose rates). The effect of the new regulations is to limit the contents allowed in non-accident-resistant packages for LSA material and SCO to effectively several multiples of the A_2 limit.

It is believed that, in the great majority of candidate LSA material or SCO shipments, the unshielded dose rate will be much lower than the regulatory limit. Therefore, consignors would be expected to be able to use simple, reasoned arguments for demonstrating compliance with the requirement. It is also assumed that the 3 m (9.9 ft) unshielded dose rate will generally not be an issue for SCOs, other than for very large objects (e.g., discarded steam generators), because the surface contamination on smaller objects should not present practical cases in which dose rates could reach such values.

NRC and DOT are considering a position in which the required limit of 10 mSv/h (1 rem/h) at 3 m (9.9 ft) dose rate from the unshielded LSA material and SCO would only be of relevant concern when the package contents exceed a total quantity of 2 A_1. Analyses during development of the NRC and DOT rulemaking activities, which resulted in the adoption of the 1985 edition of the IAEA regulations, demonstrated it is unlikely that a package of LSA material with a total radioactivity of 2 A_1 or less would approach the 10 mSv/h (1 rem/h) dose rate limit at 3 m (9.9 ft) from the unshielded LSA material or SCO. NRC and DOT staff therefore believe that taking this position in the forthcoming guidance would essentially eliminate the need to carry out dose rate measurements on a large number of LSA material and SCO shipments, provided the contents are known to include a quantity of activity less than 2 A_1. This position would result in reduced personnel exposure while retaining an equivalent level of transport safety.

If the radioactive content of a package exceeds a total quantity of 2 A_1, it is anticipated that the guidance will specify that consignors should base dose rate determinations on measured dose rates from the package's surfaces combined with prior knowledge about the package and its contents through routine sampling (e.g., for process wastes), or through specific sampling of the contents (e.g., for activated hardware/components). With this information, a back-calculation can then be performed which effectively removes the effects of *all* packaging, including liners, from the determination. It is expected that consignors may develop or purchase systematic procedures or programs which relate measured dose rates, frequently used package types, and waste stream information to the unshielded dose rate at 3 m (9.9 ft). Adherence to ALARA practices is still possible for these determinations. It is recognized that back-calculations from measurements, for example, may mask "hot spots" within LLW. Methods for addressing this technically difficult issue are being investigated.

The U.S. regulations, at 10 CFR Part 71.52 [2], allow that previously certified NRC packages for LSA materials may continue to be used for LSA and SCO shipments until April 1, 1999. NRC certified packages for LSA materials are listed in the Directory of Certificates of Compliance for Radioactive Materials Packages, NUREG-0383 [7]. The authorized contents specified on these certificates are based on the LSA definitions from the previous rules. NRC has revised all certificates for these packages to

(1) show an expiration date of April 1, 1999 and

(2) to limit the specific activity allowed to correspond to that of the old rules (i.e., basically 0.1 μCi/g for nuclides with an $A_2 \leq 0.05$ Ci, 5 μCi/g for nuclides with $0.05 < A_2 \leq 1$ Ci, or 0.3 mCi/g for nuclides with an $A_2 > 1$ Ci).

NRC licensees (consignors) must (a) have a copy and (b) ship in compliance with the revised Certificate of Compliance when using these packagings.

DISTRIBUTION OF ACTIVITY IN LSA MATERIAL

The subcategories, LSA-I, LSA-II and LSA-III, and SCO-I and SCO-II, are based primarily on the origin of the material and the concentration, distribution, and/or surface-contamination levels of radioactivity. Generally, the categorization determines the packaging requirements for nondomestic shipments (i.e., IPs). For domestic shipments containing radioactive material in excess of 1 A_2 value but having an unshielded dose rate less than 10 mSv/hr (1 rem/hr) at 3 m (9.9 ft), consignors may choose to use either the appropriate IP or the more robust DOT Specification 7A Type A package. The practical experience has been that the IPs are not yet widely available, and consignors are currently tending to use DOT Specification 7A Type A packages.

The LSA material definitions in the revised regulations employ two terms describing the distribution of radioactivity in LSA material, *essentially uniformly distributed* and *distributed throughout.** *Essentially uniformly distributed* is intended to be more restrictive than *distributed throughout*. However, neither of these terms are specifically defined in either the international [3] or the U.S. domestic [1, 2] regulations.

The terms, *essentially uniformly distributed* and *distributed throughout*, are both intended to disallow categorization of material as LSA in a situation during which a small volume of very high radioactivity (such as a sealed source) is placed within a large quantity of nonradioactive or slightly radioactive material, thereby reducing the average concentration to within specified limits. If, in such a case, the packaging were destroyed during transport and the highly radioactive portion were separated from the nonradioactive or slightly radioactive portion, it could cause substantial radiation exposure, either from direct radiation or through a pathway (e.g., inhalation or ingestion). The IAEA models justifying the less restrictive rules applied to LSA shipments (as compared to other radioactive materials shipments) assume uniform distribution of any LSA material released from the package.

* It is noted that misprints of these terms in the United States appeared in both the DOT and NRC final rule *Federal Register* notices [1, 2] and the most recent bound Code of Federal Regulations (CFR) volumes. This tended to confuse the issue in the United States. NRC and DOT have since issued corrections notices (61 FR 28723 and 61 FR 20747) which clarify these and other misprints in the original notices.

The approach being considered by NRC and DOT in order to evaluate the distribution of activity within a package is to allow the use of qualitative evaluation techniques if the material is LSA in less than 1 A_2 quantity. However, for LSA materials containing radioactivity exceeding a quantity of 1 A_2, but having a dose rate less than 10 mSv/h (1 rem/h) at 3 m (9.9 ft) from the unshielded surface, more rigorous, quantitative techniques of demonstrating compliance with this requirement would be expected. For LSA material with unshielded dose rates exceeding the 3 m (9.9 ft) limit, the distribution of activity is not viewed as a practical issue since NRC-approved, accident-resistant (i.e., Type B) package designs will be required for these materials.

For LSA material containing less than 1 A_2 quantity of radioactivity, NRC and DOT are proposing to allow consignors to assume that the activity is reasonably distributed throughout the material such that a large amount of nonradioactive or slightly radioactive material has not been considered with the radioactive material presenting the hazard. For example, collections of dry, activated LLW could meet this assumption. In these cases, further, more quantitative, assessments would not be expected by consignors when demonstrating compliance with the distribution of the nuclides in the LSA material.

For LSA material exceeding 1 A_2 quantity, but less than 10 mSv/h (1 rem/h) at 3 m (9.9 ft) from the unshielded material, a more quantitative determination of the distribution of activity would be expected. This determination can be made through reasoned argument, reference, calculation, or measurement. In this case, NRC and DOT may recommend use of a procedure similar to the advisory material in IAEA Safety Series No 37 [5]. A method for assessing the average activity will be described, which involves dividing the volume occupied by the material into equal portions, and then assessing and comparing the activity in each of these portions. The guidance being considered is that:

- To satisfy the *distributed throughout* requirement, five equal portions would be used if the source volume ranges between 0.2 and 1 m^3, whereas 10 equal portions would be used for greater volumes. Activity differences between portions should not vary by more than a factor of 10.

- To satisfy the *essentially uniformly distributed* requirement, 10 or more equal portions would be used, each with a maximum volume not to exceed 0.1 m^3. Activity differences between portions should not vary by more than a factor of 3.

- For smaller (i.e., than 0.2 m^3) LSA materials, these methods should not be applied.

CONCLUSION

In addition to the guidance issues discussed previously, it is anticipated that several other related LSA material and SCO issues in the regulations will be clarified in the guidance. Briefly, a sample of additional issues that NRC and DOT staff plan to address in the joint guidance includes:

- procedures to be followed rules for mixing LSA material and SCOs in a single package;
- appropriate methods for determining fixed contamination and non-fixed contamination on surfaces;
- the appropriate use of grout and binding agents;
- acceptable methods for converting accessible surfaces to inaccessible surfaces on SCOs;
- defining combustible solids for application of the conveyance limit for LSA materials; and
- substitution of leach testing for disposal (10 CFR Part 61) for the LSA-III leach testing-requirement.

In addition, as noted earlier, complementary guidance is being developed to address issues related to the impact of the revised regulations on the packaging and shipment of large components, such as discarded hardware (e.g., steam generators) and outage equipment. A companion paper on applying LSA material and SCO requirements to large components is provided in this conference.

This paper presents the U.S. regulatory staff's initial thoughts on issues that have been raised on the revised regulations. Current plans are to issue joint guidance, in draft form, for public comment in 1997. Interested parties will be encouraged to provide feedback, especially on the practical aspects of applying what is presented. This feedback should include insights into additional "real world" problems, questions, examples, and experiences in implementing the revised regulations. These efforts, when completed, should provide the U.S. regulatory agencies an opportunity for collaboration with personnel from other countries and the IAEA to develop guidance on these issues which can be accepted worldwide.

It is noted that DOT and NRC personnel have not, to date, observed a major economic or technical impact of the revised rules on the shipment of waste as LSA material or SCOs. Transport activities that have taken place in the past have continued to take place in a safe manner; however, significant questions regarding the new requirements and how they can be applied to certain materials have arisen. It is hoped that with the assistance of interested parties, effective guidance to address those questions will be provided.

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