Analysis of Public Comments on Draft Regulatory Issue Summary 2015-02, "Reporting of H-3, C-14, Tc-99, and I-129 on the Uniform Waste Manifest"

A notice of opportunity for public comment on the Draft Regulatory Issue Summary (RIS) 2015-02, "Reporting of H-3, C-14, Tc-99, and I-129 on the Uniform Waste Manifest" was published on June 2, 2014 in the *Federal Register* (79 FR 31348) with a 30-day comment period ending on July 2, 2014. Below is the list of entities that commented on the draft RIS, as well as the Agencywide Documents Access and Management System (ADAMS) accession numbers for their comments. To access ADAMS, go to http://www.nrc.gov/reading-rm/adams.html.

Author	Date	Organization	ADAMS ML #
C.C. Miller	June 12, 2014	N/A	ML14170A018
J. Harris	July 2, 2014	WMG, Inc.	ML14190A007
T.M. Kalinowski	July 2, 2014	American Society of Mechanical Engineers (ASME)	ML14191A015
M.R. Fuller	August 5, 2014	N/A	ML14220A365
M. Welling	July 14, 2014	Organization of Agreement States (OAS)	ML14283A630

NRC staff reviewed and considered each of the comments received. Some of the comments were similar to other comments. Comments were summarized and similar comments were combined and given a single response.

Public Comments

Comment: One commenter supported the option to use indirect methods to determine the activity of H-3, C-14, Tc-99 and I-129 and agreed that the use of LLD-based values may result in an overestimation of activity for these nuclides.

Response: *NRC staff appreciates the support for the use of indirect methods and agreement that the use of LLD-based values could lead to overestimation on the radionuclide activities. As stated in the RIS, overestimation of radionuclide activities of disposal site inventory could lead to premature loss of disposal system capacity.*

Comment: Three commenters noted that Tc-99 and I-129 are not generally present in light water reactor waste streams in sufficient concentrations to be detected by standard analytical methods at commercial radio-chemical laboratories.

One of these commenters stated that in the great majority of instances these two nuclides have been reported as being present at the LLD values and this has caused gross overestimations of the activity of these nuclides in the operating burial facilities in the US.

A commenter stated that in today's economic climate non-standard analytical methods are not likely to be justified by most licensees and that one potential answer to the issue is using generic scaling factors to more precisely estimate the amount of these two hard-to-detect nuclides.

Response: *NRC staff largely agrees with these comments. Although staff has heard from stakeholders that Tc-99 and I-129 are not generally present in light water reactor waste streams in sufficient concentrations to be detected by normal counting techniques, staff has not been able to independently verify this. As part of developing this RIS, staff obtained a copy of the Department of Energy's (DOE) Manifest Information Management System (MIMS). The MIMS system is a database used to monitor the management of commercial low-level radioactive waste in the U.S. Staff learned from discussions with the DOE that the DOE does not receive the actual manifests to populate the MIMS database; they receive a database from the participating disposal facilities. Furthermore, DOE could not definitively state whether the Tc-99 and I-129 values reported in the MIMS database were LLD-based values or real values. Staff agrees using LLD-based values to report the activities of Tc-99 and I-129 could lead to gross overestimations in operating burial facilities; however, NRC staff has also learned, through public meetings with stakeholders, that some of the operating disposal facilities do not account for radionuclide LLD-values in their site inventories. Therefore, overestimation of site inventory is a concern only if the disposal site uses LLD-based manifest values in their site inventories. NRC has not received information demonstrating gross overestimation of H-3, C-14, Tc-99 and I-129 in the operating disposal site inventories. As stated in a comment response below, any person may voluntarily submit research and documentation to the NRC for review.*

The study documented in NUREG/CR-6567, "Low-Level Radioactive Waste Classification, Characterization, and Assessment: Waste Streams and Neutron-Activated Metals" determined through the use of more sensitive mass spectrometric analyses of Tc-99 and I-129, that the "concentrations of these radionuclides and their associated scaling factors in LLW have been shown to be two to four orders of magnitude lower than the corresponding values in the nuclear power industry data bases. This difference is primarily due to the fact that the concentrations of these radionuclides reported in the industry data base are mostly lower limits of detection of the radiometric measurement methods used for their determination by service analytical laboratories".

NRC staff is aware non-standard analytical methods such as mass spectrometry used to identify Tc-99 an I-129 activities can be costly.

The NRC staff revised the RIS to clarify that generic information can be used as the basis for scaling factors. As stated in the RIS, "an assessment should be

performed periodically to evaluate whether there have been any changes in the system that might cause the generic information to no longer be applicable (e.g., changes to coolant chemistry).”

Comment: One commenter expressed concern that there previously may have been software errors that led to the underestimation of the inventory of significant radionuclides. This commenter noted that any error in reporting of amounts of radioactive material is important to the waste burial ground dose calculation and burial ground capacity. This commenter suggested that allowing for indirect calculation methods from this point forward would not be useful if the historic waste burial loading values are underestimated.

Response: *As is described in the RIS, the NRC staff agrees that the use of more accurate inventory information could improve the usefulness of performance assessment results. The underestimation of risk-significant radionuclides is particularly problematic because this could lead to an underestimation of the projected dose. It is the expectation of the NRC staff that disposal sites will use a defensible inventory in their performance assessments. The disposal sites are not required by the NRC to use the inventory information from the uniform waste manifest in their performance assessments. The NRC staff recognizes that while the inventory information reported on the uniform waste manifest is often the best source of information, in some cases other sources of information may be better or may be needed to supplement the uniform waste manifest information.*

Comment: One commenter stated that they felt that there are opportunities for NRC to specifically endorse indirect methods that incorporate process knowledge for the quantification of H-3, C-14, Tc-99 and I-129 in waste packages that are more precise than the application of independent-lab-reported LLD concentrations scaled to readily detectable nuclides.

Response: *Any person may voluntarily submit research and documentation supporting a proposed indirect methodology to the NRC for review through the Topical Report (TR) Program. If approved, the methodology would be available for use by all licensees. For example, the NRC, back in 1995, issued a technical evaluation report (TER) for its review and approval of a topical report for a computer program for use within waste management programs at nuclear power plants for providing more accurate estimates of the actual quantities of I-129 and Tc-99 in LLW shipped to disposal facilities. NRC staff can also review and endorse industry methodologies by issuing a RIS.*

Comment: Three commenters discussed the use of generic scaling factors to quantify hard-to-detect radionuclides. One of these commenters suggested that the nuclear industry should adopt methods to allow for more precise estimation of the nuclides. This commenter stated that the Electric Power Research Institute

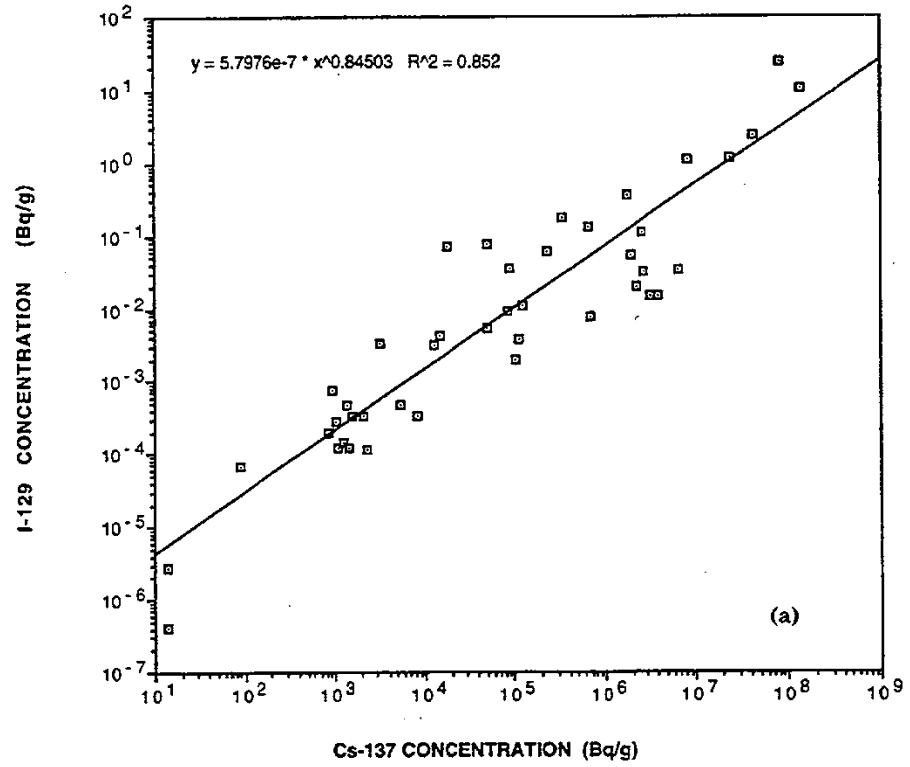
(EPRI) has amassed a large amount of data from the operating nuclear facilities in the US and has been able to make some correlations that will provide some basis for potential generic scaling factors for Tc-99 and I-129. The commenter believes that the use of this information is a potential resolution to the issue of overestimation.

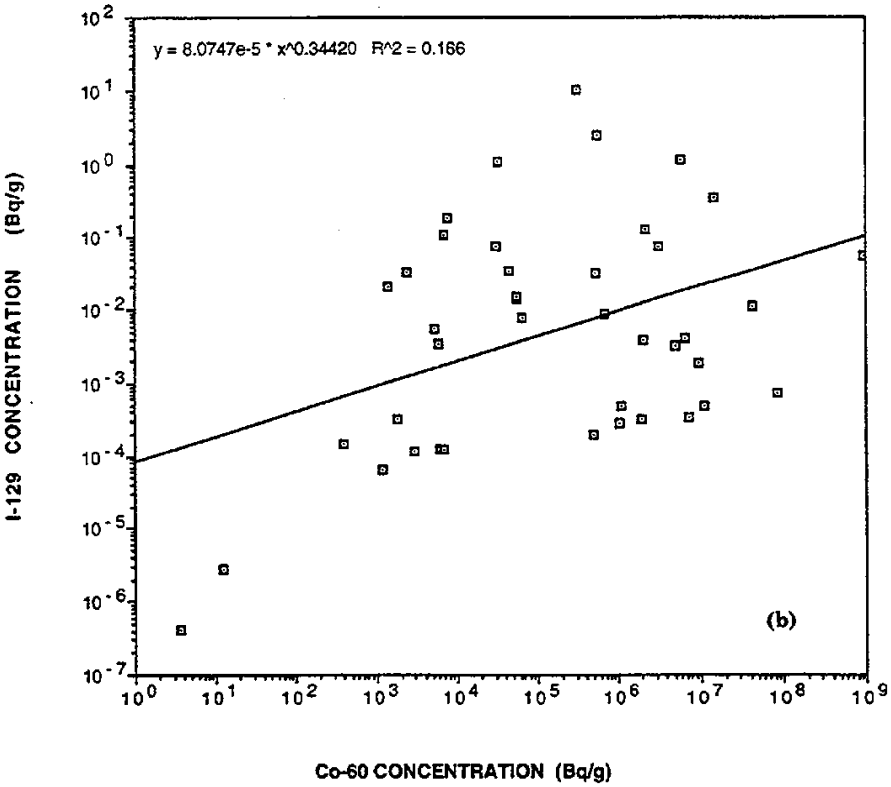
The other two commenters suggested that the RIS should be edited to specifically allow for the use of scaling factors developed by EPRI based on samples analyzed using mass spectrometry (MS). These commenters indicated that the industry scaling factors had been derived using the dispersion method, and both suggested that this was the appropriate statistical method for evaluating a data set with a large variation. Additionally, the commenters noted that the use of generic scaling factors should be evaluated for change when a large fuel defect is present.

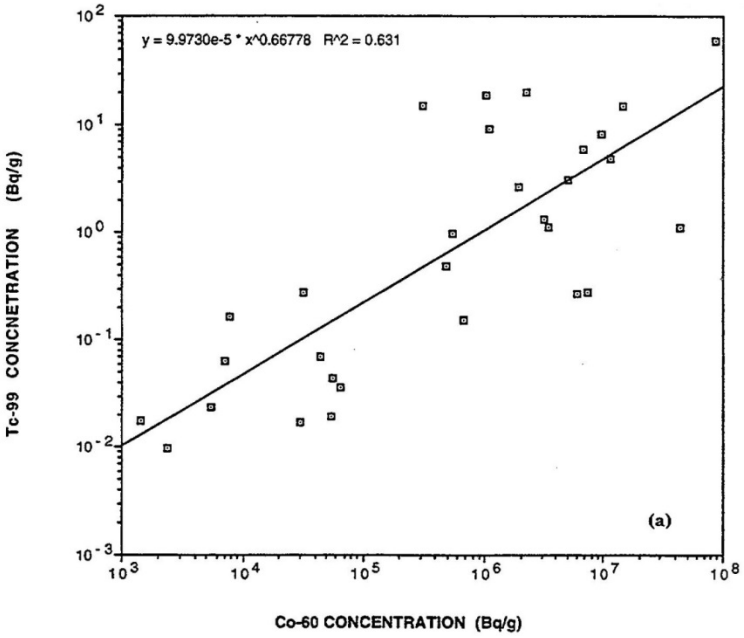
Response: *The NRC staff agrees that the development of methods that allow for more precise estimation of the hard-to-detect nuclides would be useful. The development of such methods would result in more accurate reporting of these nuclides, and, consequently, more useful performance assessment results.*

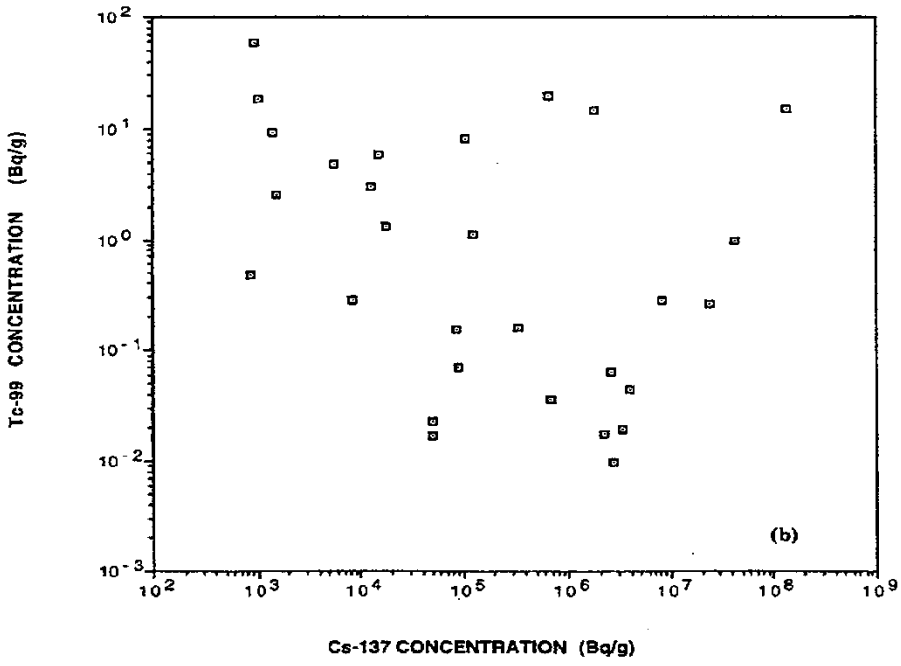
EPRI has not submitted data to the NRC for review. As described above, any person may voluntarily submit information providing a basis for use of a particular indirect method, such as the use of particular generic scaling factors, to the NRC staff for review.

The MS analyses performed by PNNL referred to in these comments are documented in NUREG/CR-6567. In the research documented in this report, a variety of low level waste samples were obtained from commercial nuclear power reactors. The activities of Tc-99 and I-129 in these samples were measured using the highly sensitive MS methods. The sample results are listed in Table 7.8 of NUREG/CR-6567 and include 45 samples from both BWR and PWR plants. The types of waste sampled include resin, dry active waste, filters, charcoal, soil, lubricating oil, and reactor coolant. As is shown in Table 7.8, the ratios of I-129 and Tc-99 to Co-60 and Cs-137 were calculated for each sample. Geometric means of these ratios were also calculated for each radionuclide pair. Scatter plots of the concentrations of I-129 and Tc-99 versus Co-60 and Cs-137 from NUREG/CR-6567 are reproduced below.


y = 5.7976e-7 * x^0.84503 R^2 = 0.852
I-129 CONCENTRATION (Bq/g)
Cs-137 CONCENTRATION (Bq/g)
(a)


y = 8.0747e-5 * x^0.34420 R^2 = 0.166
I-129 CONCENTRATION (Bq/g)
Co-60 CONCENTRATION (Bq/g)
(b)


y = 9.9730e-5 * x^0.66778 R^2 = 0.631
Tc-99 CONCNETRATION (Bq/g)
Co-60 CONCENTRATION (Bq/g)
(a)


Tc-99 CONCENTRATION (Bq/g)
Cs-137 CONCENTRATION (Bq/g)
(b)

The figures above revealed a degree of I-129 and Cs-137 correlation and a degree of Tc-99 and Co-60 correlation, but correlations between I-129/Co-60 and Tc-99/Cs-137 were not observed. The lack of correlation may be due to differences in the production mechanism of these radionuclides (i.e., I-129 and Cs-137 are fission products while Co-60 is an activation product and Tc-99 is both a fission and an activation product). The NRC staff believes that the lack of correlation may also be due to the fact that many waste types and plant types are included in this data set. A better correlation may be seen for data sets that include similar waste streams from similar plant types. The research in NUREG/CR-6567 is therefore not adequate on its own to support a generic scaling factor. More research is needed to understand the correlations between these radionuclides in different waste streams and the range of conditions under which the correlations are applicable. Additionally, this study only included 45 samples that were taken between 1988 and 1996; more sample data, including more recent samples, are needed to supplement the research in the NUREG/CR.

NRC staff has not seen information that demonstrates that these correlations are improved when a particular statistical method is used. If such information exists, any person may voluntarily submit this information to the NRC for its review.

NRC staff agrees with the commenters that fuel defects could lead to changes in the relative ratios of radionuclides, which could then lead to the use of generic scaling factors not being appropriate. Fuel defects are not the only condition that could cause a significant change in the relative ratio of the radionuclides present. For example, changes in the chemistry of the reactor cooling system water could lead to changes in the transport of the radionuclides in the system, which could lead to changes in the relative ratios of the radionuclides present in different parts of the system. Additionally, crud bursts could lead to changes in the relative ratios of the radionuclides.

Comment: A commenter noted that careful consideration should be exercised when correlating H-3, C-14, Tc-99 and I-129 to nuclides with differing production mechanisms (e.g., Co-60, Cs-137). The commenter also noted that while the data can be correlated to most normal operating conditions for light water reactor sites, each licensee must review the data as presented and determine what operating conditions it could apply to and under what conditions the correlations would not be justified.

Response: *The NRC staff agrees that if generic information is used in the quantification of H-3, C-14, Tc-99 and I-129 it is important for licensees to determine what operating conditions the correlations apply to in order to ensure that the use of the correlations is justified. As is noted in the comment, this is particularly important when the correlations involve radionuclides that have different production mechanisms.*

Comment: Two commenters suggested changing the language in the RIS that states “As with the use of scaling factors, periodic sampling should be performed to confirm the method remains appropriate and that it is accurately determining”. One commenter suggested changing this language to "Similar to the use of Scaling Factors, an evaluation of the inputs to computer codes for determination of Tc-99 and I-129 concentrations should be conducted upon condition of a large fuel defect where Cs-137, Sr-89/90 and Pu-241 (TRU) concentrations all increase above historical plant conditions”. The other commenter suggested changing this language to “Similarly to the use of Industry scaling factors for Tc-99 and I-129, periodic assessment should be performed”.

Response: *The NRC staff revised this sentence from “periodic sampling should be performed” to “periodic assessment should be performed”. As is noted in the RIS, the best method of assessment is the direct analytical measurement of samples using analytical techniques that are sensitive enough to quantify the hard-to-detect radionuclides. However, if the system is well understood and sufficient evidence has been collected to demonstrate that the scaling factors are relatively constant in the waste stream, then an assessment of whether the current conditions remain comparable to the conditions under which the scaling factors were determined may be sufficient.*

As is noted above, conditions other than large fuel defects may cause changes in the ratios of Tc-99 and Cs-137 and gamma emitters.

Comment: One commenter suggested that the LLD or MDA must be used to calculate the amount (i.e., activity) of individual radionuclides on the manifest, and then the individual radionuclide activities on each manifest must be summed to indicate the total activity of the radionuclide present in the landfill unless the generator has solid evidence that the radionuclide is present in lesser quantities. This commenter also stated that the MDA or LLD value reported has been obtained by the licensee from its third party laboratory analysis and, often, there has never been a definitive result obtained. This commenter expressed concern that there may not be any supporting underlying data available to support the use of indirect methods.

Response: *NRC staff agrees that the LLD value should be used to calculate the radionuclide activity in the absence of defensible documentation that the radionuclide is present in a lesser amount. However, as noted above, the study documented in NUREG/CR-6567, “Low-Level Radioactive Waste Classification, Characterization, and Assessment: Waste Streams and Neutron-Activated Metals” determined, that the concentrations of Tc-99 and I-129 and their associated scaling factors in LLW have been shown to be two to four orders of magnitude lower than the corresponding values in the nuclear power industry*

data bases. This difference is primarily due to the fact that the concentrations of these radionuclides reported in the industry data base are mostly lower limits of detection of the radiometric measurement methods used for their determination by service analytical laboratories. Although licensees may report conservative values for radionuclides on the uniform manifest, there may be benefits for disposal facilities if more accurate and less conservative numbers are used.

Comment: A commenter recommended that the RIS should be changed to eliminate the requirement to report LLD based values for Tc-99 and I-129 and to direct licensees to use an indirect method for reporting the activity instead.

Response: *Licensees were instructed to use LLD-based values for reporting the inventory for H-3, C-14, Tc-99, and I-129 in NUREG/BR-0204. RIS 2015-02 informs licensees of the option to use indirect methods to determine the activity of H-3, C-14, Tc-99, and I-129 reported on the uniform waste manifest when the radionuclide is present at a concentration less than the lower limit of detection (LLD). However, the use of LLD-based values is conservative and does not present a safety issue, so the reporting of LLD-based inventories for these radionuclides remains acceptable to the NRC staff. However, as described in the RIS, the use of indirect methods to generate more accurate inventory numbers for risk-significant radionuclides could improve the usefulness of performance assessment results for the disposal facility and lead to better decision making regarding the disposal of low level radioactive waste.*

Comment: One commenter noted that studies have shown that H-3 does not correlate well with typical gamma radionuclides in utility waste as the production, transport and removal mechanisms are very different. This commenter suggested that the use of a scaling factor is inappropriate and misleading. This commenter suggested that H-3 could be better quantified by using the reactor coolant system (RCS) concentrations and the water content of the waste.

Response: *The NRC staff agrees that the production, transport, and removal mechanisms of H-3 are very different than typical gamma radionuclides in nuclear power plant waste (e.g., Cs-137 and Co-60). The use of the RCS concentrations and the water content of the waste may be a better approach for quantifying H-3 than the use of scaling factors. As is noted in the RIS, it is acceptable to use an indirect method, such as quantification based on the RCS concentrations and the water content, provided there is reasonable assurance that the results obtained indirect methods can be correlated with actual measurements.*

Comment: One commenter stated that to the best of their knowledge in the late 1980's, a radwaste shipping program reported the MDA (LLD) concentration values for H-3, C-14, Tc-99, and I-129 in µCi/gm, and not the amount in total µCi. However, the paperwork indicated that the value shown was the amount. The commenter

suggested that the NRC go back and check on this problem because it could impact inventory accounting and lead to an underestimation of the inventory.

Response: *This comment is outside the scope of the RIS because the RIS does not address specific shipping programs or how the past or current inventory of the disposal sites is determined. NRC does not currently license any of the operating disposal facilities under 10 CFR Part 61, "Licensing Requirements for Land disposal of Radioactive Waste". The Agreement States where the disposal facilities are located license the facilities. NRC, through the Integrated Materials Performance Evaluation Program (IMPEP), periodically evaluates Agreement State programs to ensure public health and safety is adequately protected and the programs are compatible with NRC's program. The IMPEP process employs a team of NRC and Agreement State staff to assess Agreement State and NRC Regional radioactive material programs.*

Additionally, the disposal sites are not required by NRC to use the inventory information from the uniform waste manifest in their performance assessments. It is the expectation of the NRC staff that disposal sites will use a defensible inventory in their performance assessments.

Comment: One commenter noted that it should be made clear that the estimated total amount of the radionuclide should be calculated and displayed on the manifest, not the concentration.

Response: *The NRC staff agrees that the value reported for H-3, C-14, Tc-99, and I-129 in box 1 of NRC Form 541 on the uniform waste manifest should be total inventories, not concentrations. During the next revision of NUREG/BR-0204, "Instructions for Completing NRC's Uniform Low-Level Radioactive Waste Manifest", the NRC staff intends to add language to make this point more clear.*