NRC-2018-0155

SUNSI Review Complete
Template = ADM-013
E-RIDS=ADM-03
ADD= Lloyd Desotell,

COMMENT (1)
PUBLICATION DATE:
12/21/2018
CITATION # 83 FR 65759

PUBLIC SUBMISSION

As of: 1/3/19 11:04 AM
Received: December 31, 2018
Status: Pending_Post
Tracking No. 1k2-97f6-ry7e
Comments Due: December 31, 2018
Submission Type: Web

Docket: NRC-2018-0155
Instructions for Completing NRC's Uniform Low-Level Radioactive Waste Manifest

Comment On: NRC-2018-0155-0001
Instructions for Completing NRC's Uniform Low-Level Radioactive Waste Manifest (NUREG/BR-0204, Rev.3)

Document: NRC-2018-0155-DRAFT-0003
Comment on FR Doc # 2018-23694

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General Comment

See attached file

Attachments

Docket NRC-2018-0155 Comments Glen Vickers Exelon Generation

Comments for NRC-2018-0155, NUREG/BR-0204 Instructions for Completing the US Nuclear Commission's Uniform Low-Level Radioactive Waste Manifest

The following comments are being provided for the NRC request for comments on the draft NUREG. Comments are provided by Glen Vickers, Exelon Generation. The NRC had three specific questions for comment.

Question
Do the proposed revised Uniform Low-Level Radioactive Waste Manifest Forms 540, 541, and 542 request all of the information that is needed for the transport and disposal of low-level radioactive waste to be safely managed? Is there any additional information that should be collected?

Response
No comment.

Question
Is any additional guidance or clarification needed in the instructions for filling out the Uniform Low-Level Radioactive Waste Manifest Forms in NUREG/BR–0204?

Response
There are several sections where clarification is requested or where conflicts with regulation or other regulatory standards are noted.

Form 540, Shipping Paper

Box 2. Is this an "Exclusive Use Shipment?
This section has overly detailed regulatory references such that if there are any minor changes to numbering of the supporting regulation then this NUREG will require revision. The current version keeps references at the section level (e.g. 49CFR173.410) such that minor changes in numbering or content within that section will not require a change to this NUREG. Also being overly specific is an error trap for those only looking at the specific reference and missing supporting logic for the implementation or exception for that step. The overall section may have other applicable requirements or exception statements which need to be considered. Overly specific references are throughout the document and recommend use of the current logic of only referring down to the section level throughout the NUREG like the current revision.

Box 8. Manifest Number
This section is overly specific and specifies at least four number or letters, or both for the manifest number. Typical manifest numbers may include spaces or special characters (e.g. LW 18-023) and would not be compliant with this requirement. Recommend the logic be made more tolerant to prevent unnecessary administrative non-compliances.

Box 11. US DOT Description (Including UN ID Number, Proper Shipping Name, Hazard Class and Any Additional Information)

Some, but not all additional description requirements were added to this section. This is an error trap. Recommend keeping with the current logic and referencing the correct regulatory sections (e.g. 172.101, 172.202, and 172.203) to ensure a thorough review of all requirements or exceptions by the shipper.

Box 14. Physical and Chemical Form

This section adds the declaration of "special form" if applicable. The special form certification for an item has no relation to the physical and chemical form. It creates a confusing conflict as the special form term is already part of the proper shipping name. This would also create a conflict with the shipping paper requirements in 49CFR172. Recommend no changes to this section. The following figure shows the proper shipping name which already includes "special form" from 172.101.

Radioactive material, Type A package, special form *non fissile or fissile-excepted*	7	UN3332

Box 15. Individual Radionuclides

This section says include the radionuclides specified by 173.433(g) and applicable WAC. The 540 form is the shipping paper for transport and emergency response and the proposed additional requirement does not exist in 49 CFR. Note 2 of the draft also recognizes the difference between the 540 transport form and 541 disposal form and their slightly different purposes. Additionally WAC requirements will vary by disposal location and be unnecessarily complicated for shippers and shipping software programmers. Recommend no change to the current logic to permit users to list all radionuclides or the minimum specified by 173.433(g), otherwise this would create a conflict with 49CFR.

Form 541, Container and Waste Description

Box 1. Manifest Totals

These comments also apply to box 16 for the activity listing of each radionuclide and box 17 for waste classification.

Use of LLD Values
The current NUREG clearly separates LLD values from measured activity values or indirectly scaled activity values derived from actual measurements. The proposed language would convert LLD values to activity to be added to the directly measured and indirectly scaled activity. This conflicts with 10CFR61 and further clarification in NRC Waste Class and Form BTP 1983. NRC IN 86-20 further discusses issues with waste classification, indirectly scaled measurements, and potential sources of error and at no point suggests the use of LLD values as real values.

Regulation 10CFR61(a)(8) discusses actual waste concentrations and indirectly scaled values from other measured values for waste classification, but LLD values which are not measured values are not part of the activity for the waste. The NRC Waste Class and Form BTP 1983 page 8, states, “If the radionuclide is determined through material accountability, direct measurement, inference through direct measurement, or gross radioactivity measurement, this quantity should be reported as determined…Radionuclides <LLD values are recorded separately in parenthesis”. Converting inflated LLD values to real values has no technical basis and would improperly inflate waste class and other regulatory fractions. This constitutes a conflict with 10CFR61. Radionuclides which are <LLD are not measured and not included in waste classification or other supporting regulatory fractions.

The radionuclides of interest are H-3, C-14, Tc-99, and I-129. The H-3 activity may be determined by the direct measurement of H-3 in waste or scaled in from measurements of H-3 concentration in the applicable water stream and the estimation of moisture content in waste. The C-14 activity is determined by vendor analysis of annual 10CFR61 samples. Scaling factors are determined by calculating the geometric mean value of measured values and applying a factor of 10 to those data points used to calculate the scaling factor. There are cases where LLD values are scaled in due to an absence of measured values (e.g. Tc-99, I-129), but these are manifested as LLD values and do not affect activity totals, waste classification, or other regulatory fractions. The radionuclides Tc-99 and I-129 are always LLD values as determined by vendor 10CFR61 waste stream analysis. The NRC specifies a sensitivity of <0.01 times 10CFR61 Table 1 or Table 2, column 1 for the analysis of radionuclides and neither Tc-99 nor I-129 ever yield measured values.

The proposed language would have shippers convert LLD values for something which cannot be measured to activity measurements and meet the reasonable assurance requirement for accuracy within a factor of 10. Neither shippers, nor regulators have any basis for attempting to convert LLD values to real activity values. The LLD values are not representative of the quantities in the waste, but are driven by the background radiation levels of the vendor laboratory. The background in a vendor laboratory clearly has no relation to the conditions at any plant which makes it impossible for a shipper to convert an LLD value to a real value and meet the reasonable assurance requirements of 10CFR61.

Attempting to convert LLD values to real values has other adverse consequences. Both site gamma isotopic analyses and vendor 10CFR61 analyses have an additional 30 or more radionuclides which are LLD values. Adding these gamma emitting LLD values as real values would reduce the fractional abundance of base scaling radionuclides such as Co-60 or Cs-137 and under-report 10CFR61 difficult-to-measure radionuclides (e.g. H-3, C-14, Fe-55, Ni-59, Ni-63, Sr-89, Sr-90, Nb-94, Am-241, Pu-238, Pu-239, Pu-241, Cm-242, Cm-244) when performing dose-to-curie activity calculations. Conversely, adding a restrictive radionuclide LLD to the mix as real such as Nb-94 would improperly inflate the waste class fraction and over-characterize the waste. The list of LLD nuclides is also virtually infinite as it consists of all the radionuclides in a counting system library. There is no proposed logic for what cutoff shippers would use for the infinite list of LLD values associated with a waste package. Since an LLD value is greater than the actual concentrations in the waste, over-estimation of that radionuclide will occur every time if LLD values were considered real values. As the intensity of a waste stream may vary by an order of magnitude or so, the inflated vendor LLD value would be further scaled up to an even greater value. Fundamentally, all reasonable assurance for waste classification and supporting regulatory fractions are lost if LLD values are converted to real values.

The current NUREG clearly separates determined values from LLD values and LLD values have no impact upon shipment activity, waste classification, or other regulatory fractions. It is recommended that no change be made to the current logic.

From a broader perspective, the NUREG is a brochure for the completion of a form and not the vehicle to userp regulation and other regulatory guidance. It is understood that there is interest in this topic by the NRC and burial sites, but this is not the mechanism to solve this issue and it is clear that there are many unforeseen consequences which need further analysis.

Use of Indirect Measurements

The current NUREG does not try to differentiate between direct measurements and indirectly scaled activity based upon measurements because they are considered to be “determined” or “real” activity values. This once again conflicts with 10CFR61 and NRC Waste Class and Form BTP 1983. Additionally, most of the radionuclides on a shipping paper are determined indirectly from measurements (e.g. H-3, C-14, Fe-55, Ni-59, Ni-63, Sr-89, Sr-90, Nb-94, Am-241, Pu-238, Pu-239, Pu-241, Cm-242, Cm-244). There should be no action to attempt to differentiate values which are already considered to be “determined” values.

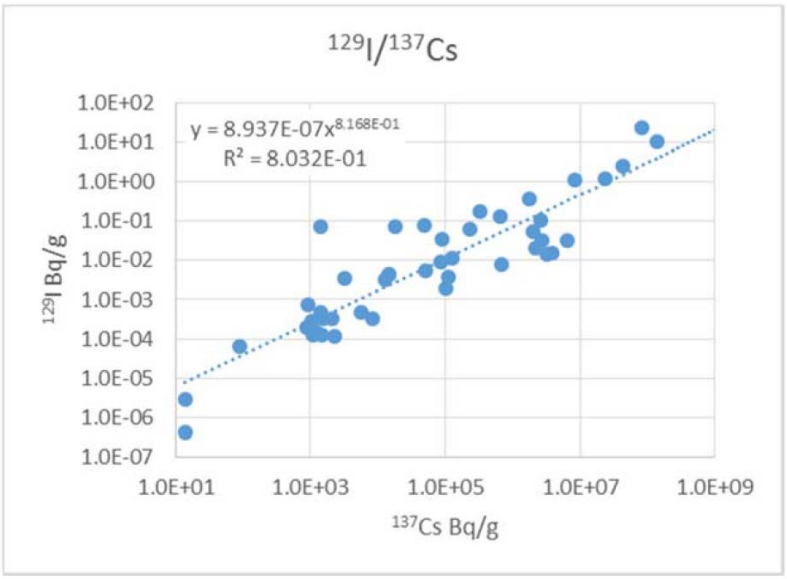
The radionuclides of true interest are H-3, C-14, Tc-99, and C-14. Indirect scaling factors to other measurements can easily be determined for H-3 and C-14. The radionuclides Tc-99 and I-129 are always <LLD, so shippers have no mechanism to calculate a scaling factor which would meet the reasonable assurance clause of 10CFR61(a)(8) and supporting regulatory guidance. The LLD value currently becomes scaled to a measurable base radionuclide such as Co-60 or Cs-137 and is reported on the manifest as an LLD value.

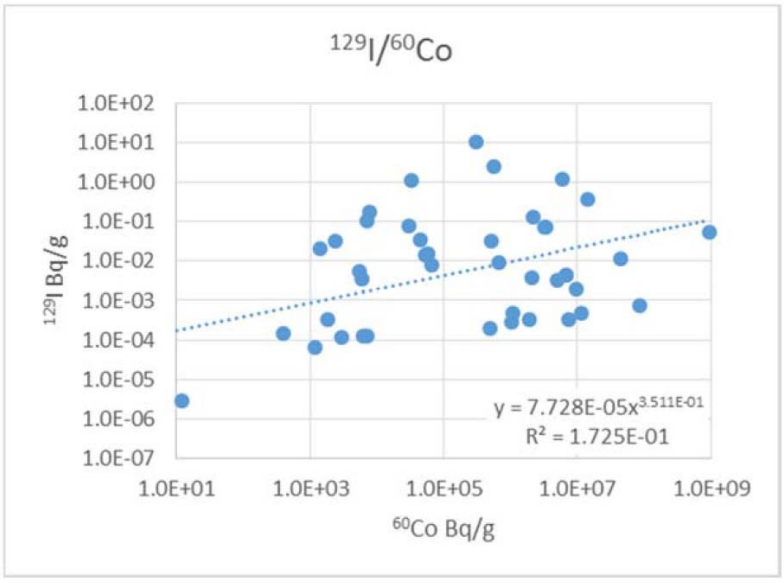
The draft NUREG points to logic from RIS-2015-02 for indirectly scaled values for H-3, C-14, Tc-99, and I-129. RIS-2015-02 was incorrect in stating that the use of indirectly scaled activity was not permitted. Regulation 10CFR61 and supporting regulatory guidance consider both directly measured values and indirectly scaled values from measurements to both be “determined” values for the purposes of reporting activity and waste classification. NRC Waste Class and Form BTP 1983 further clarifies, “If the radionuclide is determined through material accountability, direct measurement, inference through direct measurement, or gross radioactivity measurement, this quantity should be reported as determined”. The current NUREG is correct when it says report the activity and LLD values separately in parentheses, since directly measured and indirectly scaled values are the same.

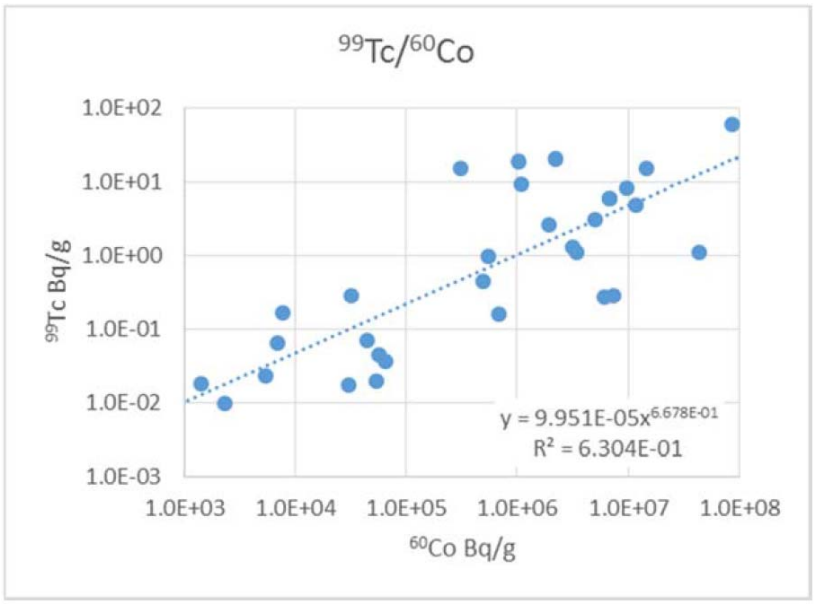
Document RIS-2012-02 references data in NUREG/CR-6567 as a potential source of scaling factors for use in determining scaled values for Tc-99 and I-129 in lieu of LLD values. The RIS also notes the typical expectation of accuracy with the reasonable assurance clause of 10CFR61. Shippers have no ability to determine if their plant radiochemistry or plant conditions are bounded by that study to meet the factor of 10 accuracy requirements of the reasonable assurance clause. This data also appears in an EPRI 2015 work suggesting this data be used as a method to scale in Tc-99 and I-129.

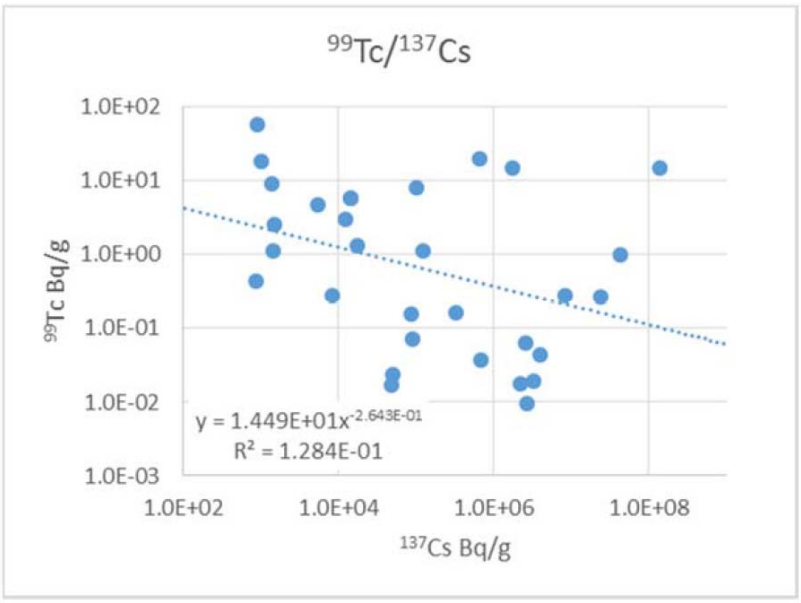
Some sites previously used the Tc-99 and I-129 scaling factors from the data noted in NUREG/CR-6567, but were forced to stop when NRC Inspectors asked shippers to demonstrate their plant radiochemistry and conditions were bounded by that study to meet the reasonable assurance requirements of 10CFR61. Those sites were forced to go back to using the vendor LLD values that the NRC said were undesirable. The NRC has the opportunity to resolve this entire issue with no revisions to NUREG/BR-0204 by simply endorsing the scaling factors for Tc-99 and I-129 in NUREG/CR-6567 as best-available technology and permit shippers to use without further regulatory scrutiny. Otherwise, shippers will be forced to continue to use vendor LLD values as that is the only value available that is provided by a credible source such as a vendor radiochemistry laboratory.

The following figures are from NUREG/CR-6567 and reproduced in the EPRI 2015 work. It is clear there is significant scatter in the data. A factor of 10 is typically applied when comparing an individual data point to the geometric mean of the population when determining if a data point is an outlier and not included in the calculation of a scaling factor. The figures show there are quite a few points that would be outside a factor of 10 of the geometric mean such that there is less certainty of the scaling factor as compared to many other radionuclides with better radiochemical fit.



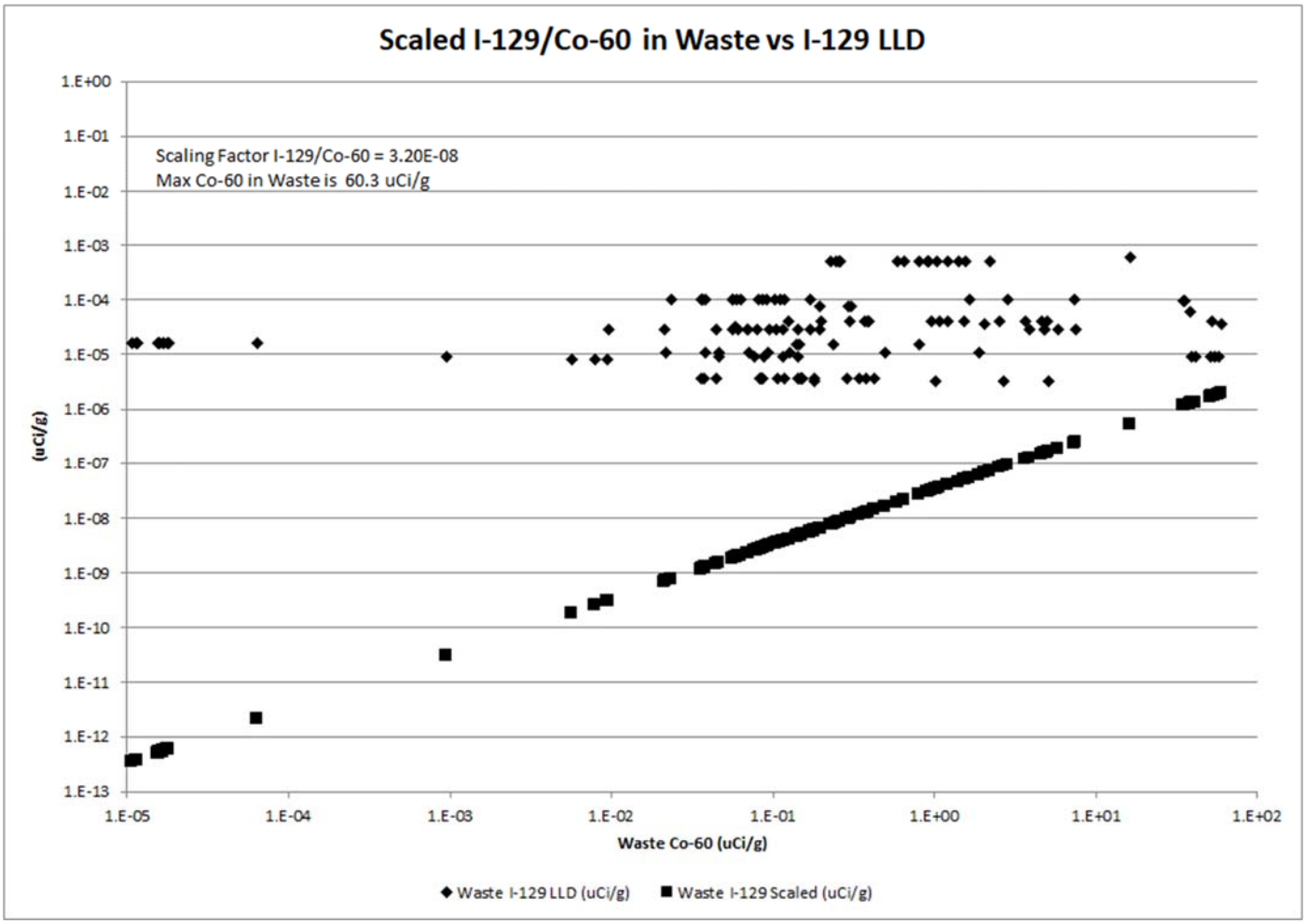


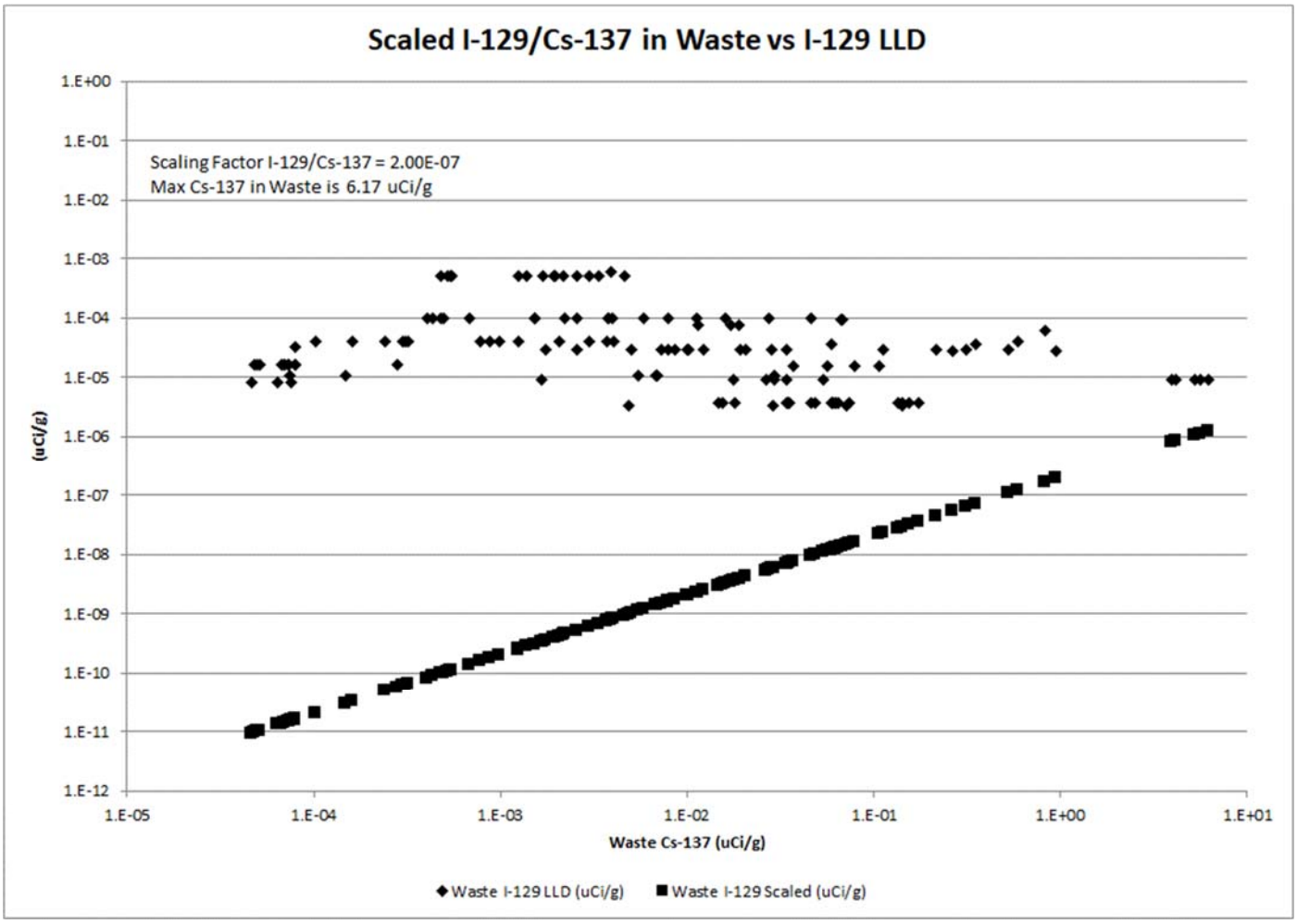


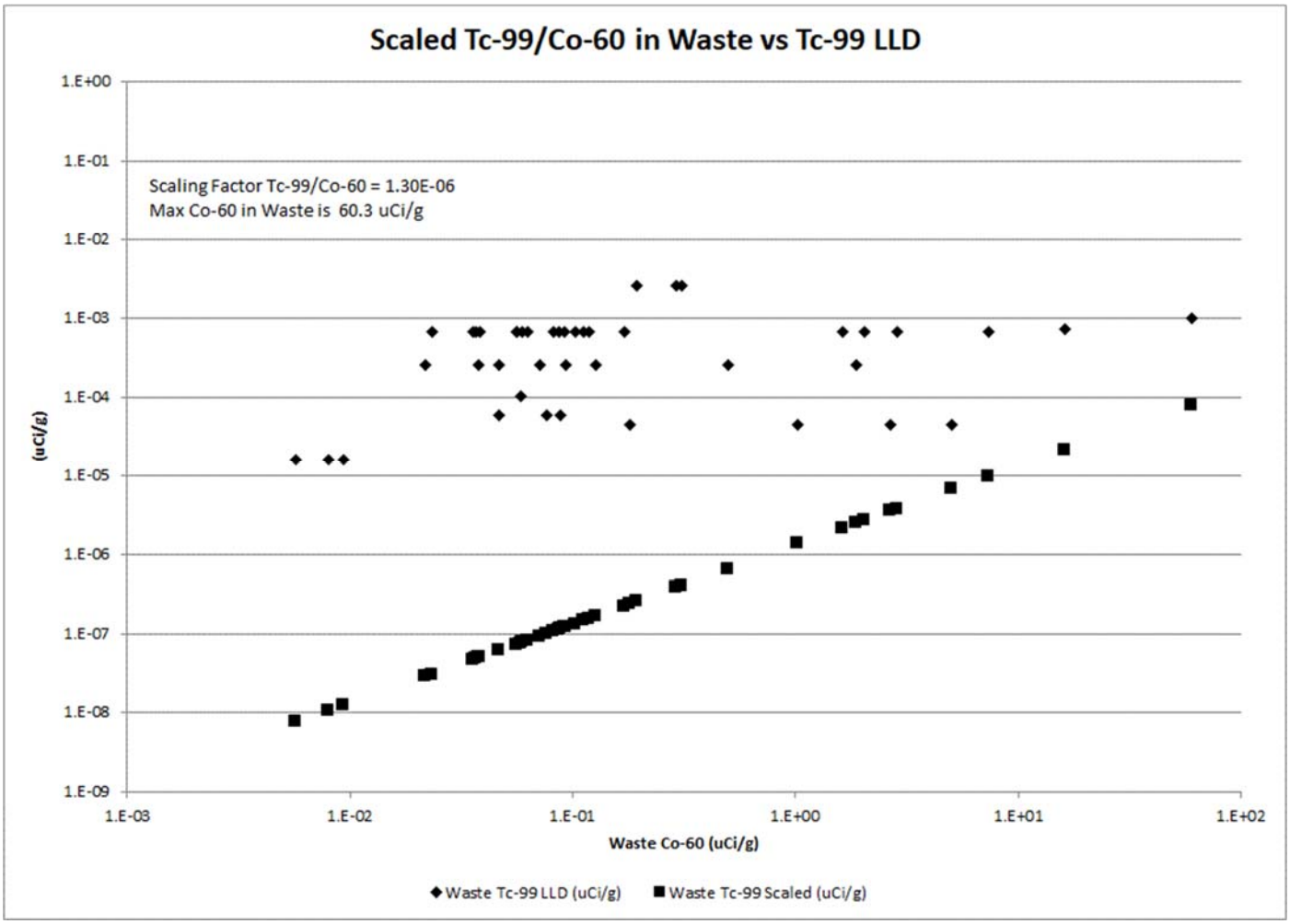


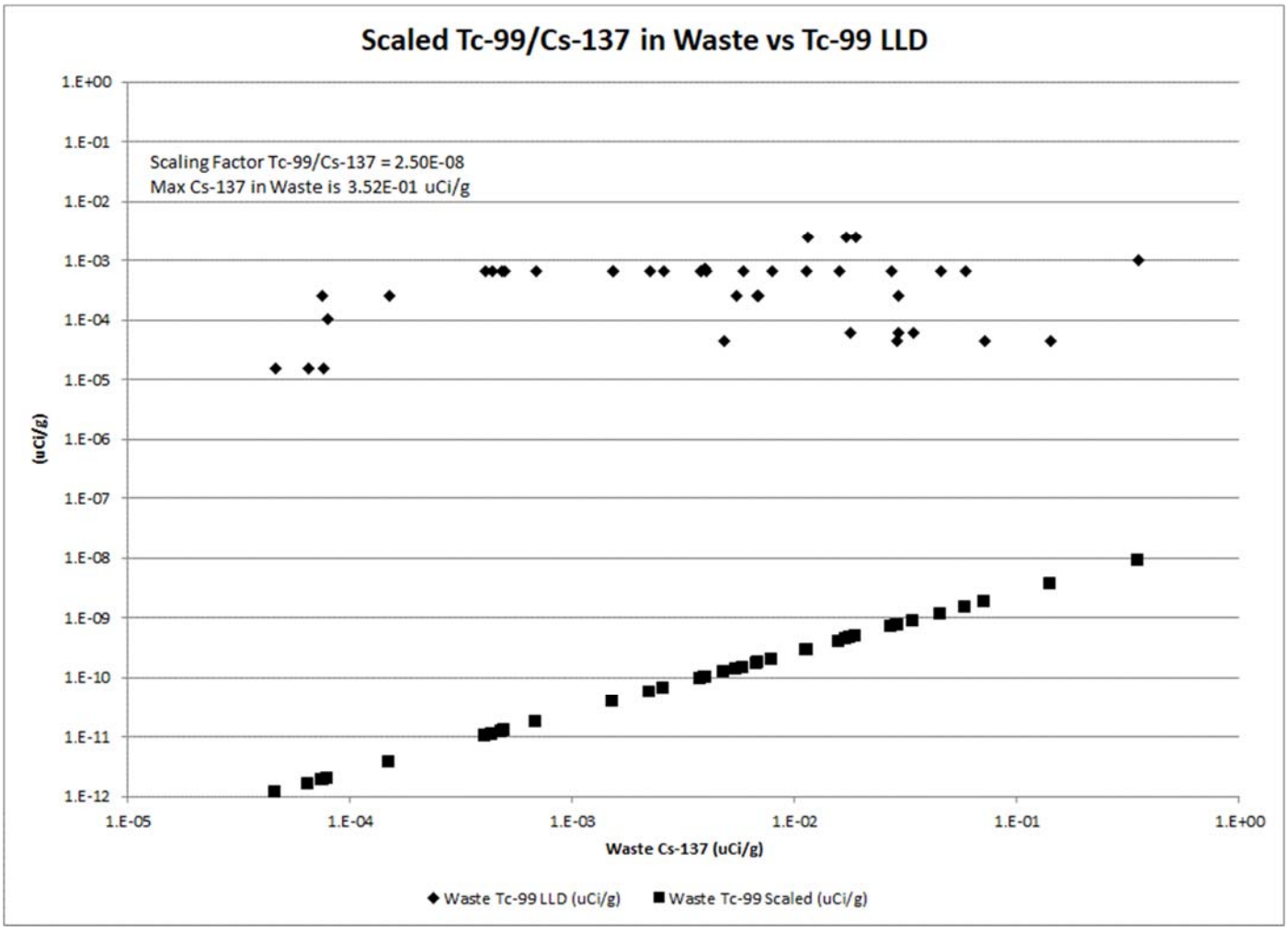
As previously noted, a shipper would not be able to articulate how their radiochemistry and plant conditions would bound them within this high-scatter data environment within a factor of 10 for a specific waste container. This why the NRC would need to endorse the use of the scaling factors from NUREG/CR-6567 and/or the EPRI 2015 work as best available technology and relieve shippers of the reasonable assurance clause. Otherwise shippers will continue using vendor LLD values.

The following figures show the application of the Tc-99 and I-129 scaling factors from the EPRI interpretation of the data in NUREG/CR-6567 with actual sample data from a Boiling Water Reactor. Both the NUREG and EPRI documents have very similar scaling factors. The calculated Tc-99 and I-129 content for the waste container was less than the vendor LLD values. At very high activity levels there will be cases where the calculated content exceeds the LLD value for the waste sample. This reveals the proposed scaling factors are not perfect under every condition, but they are the best available technology at this time.




Scaled I-129/Cs-137 in Waste vs I-129 LLD
Scaling Factor I-129/Cs-137 = 2.00E-07
Max Cs-137 in Waste is 6.17 uCi/g
(uCi/g)
1.E+00
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
1.E-08
1.E-09
1.E-10
1.E-11
1.E-12
1.E-05
1.E-04
1.E-03
1.E-02
1.E-01
1.E+00
1.E+01
Waste Cs-137 (uCi/g)
Waste I-129 LLD (uCi/g)
Waste I-129 Scaled (uCi/g)


Scaled Tc-99/Co-60 in Waste vs Tc-99 LLD
Scaling Factor Tc-99/Co-60 = 1.30E-06
Max Co-60 in Waste is 60.3 uCi/g
1.E+00
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
1.E-08
1.E-09
(uCi/g)
1.E-03
1.E-02
1.E-01
1.E+00
1.E+01
1.E+02
Waste Co-60 (uCi/g)
Waste Tc-99 LLD (uCi/g)
Waste Tc-99 Scaled (uCi/g)



It is recommended that no changes be made with the reporting of determined values (e.g. material accountability, direct measurement, inference through direct measurement, or gross radioactivity measurements) and LLD values.

It is recommended that the NRC endorse the Tc-99 and I-129 scaling factors in NUREG/CR-6567 for use by shippers without further regulatory scrutiny. This would solve everything and there would be no need to alter the current NUREG/BR-0204.

Current recommendations conflict with 10CFR61 and supporting regulatory guidance. this is also a conflict with Form 540 Box 16 package activity. Additionally neither shippers, nor regulators have no basis for converting LLD values to activity values and adherence with the reasonable assurances clauses of 10CFR61. This section also noted other undesired consequences of attempting to mix real values and LLD values.

Box 5. Container Identification Number/Generator ID Number(s)

This section is overly specific and specifies number or letters, or both. Typical container numbers also include spaces or special characters for this string (e.g. PL 14-215 FR) and would not be compliant with this requirement. Recommend the logic be made more tolerant to prevent unnecessary administrative non-compliances.

Box 13. Approximate Waste Volume(s) in Container
This section says indicate the approximate volume by discrete waste type. This is in error as the waste types on the 541 form are a mixture of blendable and discrete waste types. The current logic is more generic and says list the volume by different "waste descriptors" found on the 541 form. Recommend no change from current logic.

The CA BTP 2015 states that if a blendable waste exceeds 90% of the fill volume, then the concentration may be averaged over the entire fill volume. This means the shipper will need to enter the entire fill volume and not the actual waste volume used for classification. Recommend some recognition of this be incorporated. Currently there is an 85% phrase which has no applicability with the waste concentration averaging processes at all.

Box 16. Radiological Description
Issues were previously noted in "Box 1 Manifest Totals" with trying to differentiate measured values from indirectly scaled values from direct measurements and attempting to convert LLD values to real values.

The section states a "significant" radionuclide could be below LLD. This statement is incorrect. If a radionuclide is <LLD, then it was not measured and therefore cannot exceed 0.01 of 10CFR61 table values. Additionally the rules for a significant radionuclide are >0.01 times 10CFR61 Table 1 or Table 2 column 1 values and the required LLD values are <0.01 times the 10CFR61 Table 1 or Table 2 column 1 values. There is no overlap in the definitions and requirements.

Measured values and indirectly scaled values from measurements are already considered to be equivalent determined values, so attempting to differentiate is a conflict with 10CFR61 itself.

Recommend no change to the current practice and regulation for reporting activity determined through material accountability, direct measurement, inference through direct measurement, or gross radioactivity measurements as determined activity. Values which are <LLD are reported separately in parenthesis with no adverse impact on activity, waste classification, or supporting regulatory fractions.

Box 17. Waste Classification
This section suggests converting LLD values to real values for the purposes of waste classification. As previously noted there is no methodology for converting LLD values to inflated activity values adversely affecting waste classification and conflicts with 10CFR61

Question
NRC Form 541 has lists of container description codes (note 1), waste descriptor codes (note 2), and sorption and solidification media (note 3) that have not been updated recently. Are there any items that should be added to these lists based on new technology or changes to industry practices? Are there any items on these lists that should be deleted because they are no longer in use or for any other reason? Should the items in the lists be combined in any way?

Response
No comment.