UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF NEW REACTORS
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, DC 20555

February 18, 2015

NRC REGULATORY ISSUE SUMMARY 2015-02
REPORTING OF H-3, C-14, Tc-99, and I-129 ON THE
UNIFORM WASTE MANIFEST

ADDRESSEES

All licensees, certificate holders, and applicants for a fuel cycle facility licensed under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 40, "Domestic Licensing of Source Material," 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," or 10 CFR Part 76, "Certification of Gaseous Diffusion Plants."

All operating reactor facilities; all decommissioning reactor facilities; all holders of and applicants for a power reactor combined license under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants"; all holders of an operating license for a non-power reactor (research reactor, test reactor, or critical assembly) under 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," except those who have permanently ceased operations; all independent spent fuel storage installation specific licensees; and all Radiation Control Program Directors and State Liaison Officers.

INTENT

The U.S. Nuclear Regulatory Commission (NRC) is issuing this regulatory issue summary (RIS) to inform addressees of the option to use indirect methods to determine the activity of tritium (H-3), carbon-14 (C-14), technetium-99 (Tc-99), and iodine-129 (I-129) reported on the uniform waste manifest when the radionuclide is present at a concentration less than the lower limit of detection (LLD). The reason for noting this option is because accurately reporting the activities of these radionuclides is important for better decisionmaking regarding the disposal of low-level radioactive waste (LLRW). Overestimation of disposal site inventory could lead to premature loss of disposal system capacity, whereas underestimation of inventory could lead to public health and safety concerns.

Licensees may voluntarily begin using the methods described in this RIS. Neither a specific action nor any written response is required. The NRC is providing this RIS to the Agreement States for their information and for distribution to their licensees as appropriate.

BACKGROUND

Appendix G of 10 CFR Part 20, "Requirements for Transfers of Low-Level Radioactive Waste Intended for Disposal at Licensed Land Disposal Facilities and Manifests," requires that an NRC uniform manifest (i.e., NRC Forms 540, 541, and, if necessary, 542) be prepared for waste

intended for ultimate disposal at a licensed LLRW land disposal facility, and states that the activity of each of the radionuclides H-3, C-14, Tc-99, and I-129 contained in the shipment must be reported on the uniform manifest. These radionuclides were identified as being of particular concern for the groundwater pathway dose in the analysis performed for NUREG-0782, "Draft Environmental Impact Statement on 10 CFR Part 61 Licensing Requirements for Land Disposal of Radioactive Waste," published in September 1981. The concentration values provided in the 10 CFR Part 61 waste classification tables are based on intruder protection, and the potential groundwater pathway dose was not considered in the development of these tables. Instead, the NRC staff decided that the groundwater pathway for each disposal facility should be analyzed on a case-by-case basis because the groundwater pathway impacts are site-specific and are a function of the total inventory of radionuclides at a disposal site. The quantities of the four radionuclides believed to be especially important to the groundwater pathway (i.e., H-3, C-14, Tc-99, and I-129) were required to be reported on the uniform manifest. According to NUREG/BR-0204, Revision 2, "Instructions for Completing NRC's Uniform Low-Level Radioactive Waste Manifest," if these four radionuclides are present in the waste in quantities less than the LLD, they must be reported as being present at the LLD value on the uniform manifest. Because these radionuclides are difficult to measure, the LLD values are potentially much higher than the actual concentrations in the waste. Research indicates that the use of the LLD values may result in a significant over-estimation of the inventory of these four radionuclides in disposal facilities (*See* NUREG/CR-6567, "Low-Level Radioactive Waste Classification, Characterization, and Assessment: Waste Streams and Neutron-Activated Metals").

The uniform manifests are often the best source of inventory information for performance assessments, though the disposal sites are not required to use the uniform manifest information. Because the inventory of radionuclides is a key parameter in the determination of the projected dose from the groundwater pathway in a performance assessment, the reporting of more accurate information for risk-significant radionuclides on the uniform manifests may result in a more reliable performance assessment and lead to better decisionmaking regarding the disposal of LLRW. Overestimation of inventory could lead to premature loss of disposal system capacity (e.g., closure of disposal sites), whereas underestimation of inventory could lead to public health and safety concerns.

SUMMARY OF ISSUE

Licensees may be able to generate and report more accurate uniform manifest numbers for wastes that have radionuclide concentrations less than the LLD by using indirect methods. It is expected that the use of indirect methods will be most appropriate for licensees with well-characterized and consistent waste streams (e.g., nuclear power plants). Regulations in 10 CFR 61.55(a)(8) allow for the use of indirect methods to determine the concentrations of radionuclides in waste for the purpose of waste classification *if there is reasonable assurance that the indirect methods can be correlated with actual measurements*. However, the instructions for completing the uniform manifest (NUREG/BR-0204) do not include this option for reporting the inventory of H-3, C-14, Tc-99, and I-129.

The basis for any indirect methods used should be justified by the licensee. As part of this basis (and as indicated by the guidance provided in the references found in Enclosure 2 of this RIS), the licensee should determine the range of conditions under which the indirect method is appropriate and the situations that could lead to a change in the correlation or cause the indirect method to no longer be appropriate. This is particularly important when the indirect method is based on an empirical relationship that does not have a physical basis. For example, indirect

methods involving the correlation of radionuclides with different production mechanisms (e.g., activation products versus fission products) or different transport properties (e.g., H-3 and C-14 versus cobalt-60 (Co-60) or cesium-137 (Cs-137)) would not be expected to correlate well over a range of conditions.

One type of indirect method is the use of scaling factors. Scaling factors are used to calculate the activity of a difficult-to-measure radionuclide from that of an easy-to-measure radionuclide that has been shown to be correlated. The NRC previously published guidance on the use of scaling factors to determine radionuclide concentrations in waste for the purpose of waste classification in the 1983 Branch Technical Position (BTP) on Waste Classification, as well as in Information Notice 86-20, "Low Level Radioactive Waste Scaling Factors, 10 CFR Part 61." The NRC staff believes that the use of scaling factors as described in these guidance documents for waste classification purposes is also suitable for the purpose of reporting of difficult-to-measure radionuclides on the uniform manifest. This guidance is summarized and clarified in Enclosure 1, which states that a reasonable target for determining inferred radionuclide concentrations is that the concentrations are accurate to within a factor of 10.

The scaling factors should be periodically assessed to confirm that the values used remain appropriate. Direct analytical measurement of samples that are representative of the waste stream using techniques that are sensitive enough to quantify these radionuclides is the best method to confirm that the scaling factors remain appropriate. However, if enough data has previously been collected to demonstrate that the scaling factors are relatively constant in a particular system or waste stream, then an evaluation of whether the current conditions remain comparable to the conditions under which the scaling factors were determined would be sufficient. This assessment should include an evaluation of which parameters could affect the relative ratios of radionuclides and confirmation that these parameters have not significantly changed. A confirmatory assessment should also be performed whenever there is reason to believe that facility or process changes may have significantly altered the previously determined correlations. Additionally, the waste stream should continue to be periodically sampled to confirm that the concentrations of the radionuclides remain below the LLD. If the concentrations are above the LLD, the measured concentrations should be used to derive the radionuclide activities on the manifest.

Other indirect methods, such as the use of material accountability or computer codes that predict the activity of radionuclides, can also be used to determine the reported activity of H-3, C-14, Tc-99, and I-129 on the uniform manifest if there is reasonable assurance that the results obtained using these methods are correlated with actual measurements. As with the use of scaling factors, periodic assessment should be performed to confirm that the method remains appropriate and that it is accurately determining the concentrations to within a factor of 10.

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. The 1983 BTP on Waste Classification states that the lower limit of detection of a measurement technique for direct measurement of a particular radionuclide should be no more than 0.01 times the concentration for that radionuclide listed in Table 1 of Section 61.55, and 0.01 times the smallest concentration for that radionuclide listed in Table 2 of Section 61.55. Although not required, licensees can take additional steps, such as using improved analytical techniques (e.g., mass spectrometry, increased count times), to achieve a lower detection limit.

This RIS does not require licensees to make any changes to how they report the activity of H-3, C-14, Tc-99, and I-129 on the uniform manifest, and licensees continue to have the option to

report LLD-based activity values. As described in NUREG/BR-0204, LLD-based values reported on the uniform manifest should continue to be put in parentheses. The staff plans to update NUREG/BR-0204 in the near future to reflect the permissible use of indirect methods (e.g., scaling factors) for the purpose of reporting of difficult-to-measure radionuclides on the uniform manifest as described in this RIS.

BACKFIT DISCUSSION

This RIS discusses additional ways by which licensees may satisfy the existing regulatory requirements in 10 CFR Part 20, Appendix G. This RIS requires no action or written response beyond that already required by the regulations. As this RIS does not require any action, the RIS does not represent backfitting as defined in 10 CFR 50.109(a)(1), and is not otherwise inconsistent with any issue finality provision in 10 CFR Part 52. Therefore, the NRC did not prepare a backfit analysis for this RIS or further address the issue finality criteria in Part 52.

FEDERAL REGISTER NOTIFICATION

A notice of opportunity for public comment on this RIS was published in the *Federal Register* (79 FR 31348) on June 2, 2014. Comments were received from the American Society of Mechanical Engineers, WMG, Inc., and from two individuals. The staff considered all comments that were received. The staff's evaluation of the comments is publicly available through NRC's Agencywide Documents Access and Management System (ADAMS), under Accession No. ML14289A361.

CONGRESSIONAL REVIEW ACT

The NRC has determined this RIS is a rule as designated by the Congressional Review Act (5 U.S.C. §§ 801-808). However, the Office of Management and Budget (OMB) has determined this RIS is not a major rule as designated by the Congressional Review Act.

RELATED GENERIC COMMUNICATIONS

Information Notice 86-20, "Low-Level Radioactive Waste Scaling Factors, 10 CFR Part 61"

PAPERWORK REDUCTION ACT STATEMENT

This RIS does not contain new or amended information collection requirements that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). Existing requirements were approved by the Office of Management and Budget, approval numbers 3150-0014 and 3150-0135.

PUBLIC PROTECTION NOTIFICATION

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

CONTACT

This RIS requires no specific action or written response. If you have any questions about this summary, please contact one of the technical contacts listed below.

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Enclosures:
1. Additional Information on the Use of Scaling Factors
2. References

Note: NRC generic communications may be found on the NRC public Web site, http://www.nrc.gov, under “NRC Library” > “Document Collections.”

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ADAMS Accession No.: ML14272A217 ***via e-mail**

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THE USE OF SCALING FACTORS

The U.S. Nuclear Regulatory Commission (NRC) previously published guidance on the use of scaling factors in the 1983 Branch Technical Position (BTP) on Waste Classification and Information Notice (IN) 86-20. The NRC staff believes that the use of indirect methods (e.g., scaling factors) as described in these guidance documents for waste classification purposes is also suitable for the purpose of reporting of difficult-to-measure radionuclides on the uniform manifest. In this previous guidance, the NRC staff stated that a reasonable target for determining inferred radionuclide concentrations is that the concentrations are accurate to within a factor of 10 when compared to direct measurements.

As described in the BTP and IN 86-20, scaling factors should be developed on a facility and waste stream specific basis. If a site has multiple units, separate scaling factors may need to be developed for the waste streams from each unit. Generic information can be used as a basis for these scaling factors provided there is sufficient data demonstrating that these scaling factors are expected to be accurate to within a factor of 10. The use of generic information may be the most appropriate for similar waste streams (e.g., similar resins performing the same function from the same type of power plant). If generic information from other sites is used in the development of the scaling factors, it is important to consider whether the information is applicable to the specific facility and waste streams and to understand the range of conditions under which the information is applicable. For example, if a power reactor has a higher amount of fuel failure than usual, generic information may not be applicable. Additionally, if generic information is used as the basis for scaling factors, 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).

The scaling factors should be periodically assessed to confirm that the values used remain appropriate. Direct analytical measurement of samples that are representative of the waste stream using techniques that are sensitive enough to quantify these radionuclides is the best method to confirm that the scaling factors remain appropriate. More rigorous analytical techniques, such as using an increased counting time or mass spectrometry, may be needed for these measurements to verify values that are lower than the lower limit of detection (LLD) typically achieved. The guidance in the BTP suggests that the confirmatory analysis should be performed on at least a biannual basis for Class A waste and annually for Class B and C waste; however, the BTP goes on to state that “these frequencies may be raised or lowered based upon consideration of particular facility, waste stream, or radionuclide characteristics.” Therefore, licensees can change the sampling frequencies (e.g., per fuel cycle) based on information such as trend analysis or historical data. A confirmatory analysis should also be performed whenever there is reason to believe that facility or process changes may have significantly altered the previously determined correlations (e.g., increased fuel failure, crud burst, change in reactor coolant chemistry).

IN 86-20 discusses problems observed in the determination of low-level waste scaling factors during the 1980s and provides guidance on how to avoid these problems and the inappropriate use of scaling factors. Inspections at the time found that licensees were using scaling factors derived from a mix of generic and facility-specific data that differed significantly from actual measured values, with differences as high as a factor of 10,000 being observed.

The inspections also found that the same scaling factors were often used for all of the waste streams despite significant differences in radionuclides in the different waste streams. When discrepancies (i.e., differences greater than a factor of 10) are observed between the calculated and measured concentration values, either the scaling factors need to be adjusted, or the waste stream needs to be resampled if there is some question as to the validity of the sample analysis causing the discrepancy. It may also be useful to perform a trend analysis comparing the predicted and actual concentration values to ensure that the scaling factors are not consistently under- or over-predicting the inventories in the waste stream.

References

1. Title 10 of the *Code of Federal Regulations* (10 CFR) Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste" (http://www.nrc.gov/reading-rm/doc-collections/cfr/part061/)

2. 10 CFR Part 20, Appendix G, "Requirements for Transfers of Low-Level Radioactive Waste (LLRW) Intended for Disposal at Licensed Land Disposal Facilities and Manifests," (http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/)

3. Information Notice 86-20, "Low Level Radioactive Waste Scaling Factors, 10 CFR Part 61," (Agencywide Documents Access and Management System (ADAMS) Accession No. ML103420436)

4. NUREG/CR-6567, "Low-Level Radioactive Waste Classification, Characterization, and Assessment: Waste Streams and Neutron-Activated Metals" (ADAMS Accession No. ML003752437)

5. 1983 Branch Technical Position on Radioactive Waste Classification (ADAMS Accession No. ML033630755)

6. NUREG/BR-0204, Rev 2, "Instructions for Completing NRC's Uniform Low-Level Radioactive Waste Manifest," (ADAMS Accession No. ML07187017