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Secretary
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
ATTN: Rulemaking and Adjudications Staff

Subject: Docket ID NRC-2011-0012; NRC-2015-0003 "Low-Level Radioactive Waste Disposal"

Dear Madam Secretary:

The Electric Power Research Institute (EPRI) is an independent non-profit organization that conducts scientific research and development relating to the generation, delivery and use of electricity for the benefit of the public. We thank the Nuclear Regulatory Commission (NRC) for allowing EPRI to provide comment on the proposed rulemaking on Low-Level Radioactive Waste Disposal (Site-Specific Analysis Rulemaking).

The purpose of this letter is to provide comments to the NRC regarding the proposed revisions to 10CFR61 and 10CFR20 related to low-level radioactive waste (LLRW) disposal as presented for public comment on March 26, 2015. These comments are based on EPRI's technical research in the area of LLRW and comments previously submitted to the NRC on this topic.

EPRI Report 1021098, "Options for Improved Low Level Waste Disposal Using 10CFR61.58," recommended a number of changes to the regulatory requirements based on our research. All have been incorporated in the proposed rule in one form or another. The recommendations are summarized as follows:

- The risk from radionuclides typically present in nuclear power plant waste is primarily driven by relatively short half-life radionuclides. Longer lived radionuclides, such as the transuranic isotopes, dominate the risk after 500 years and are initially limited by concentration to ensure safety. EPRI research results indicated that after 1,000 years, LLRW generated during the course of the normal operation of a nuclear plant poses little risk to the public. The proposed rule recognizes the general nature of LLRW and limits the time period for the performance assessment for compliance to 1,000 years.
- The concentration limits tabulated in 10 CFR 61.55 are based upon International Council on Radiation Protection (ICRP) 2 dose conversion factors. These dose conversion factors have been updated in more recent ICRP publications. The proposed rule recognizes this fact and permits the use of more up-to-date dose assessment methods.

- The concentration limits tabulated in 10 CFR 61.55 were based on a set of generic site assessment models and conservative assumptions intended to make the limits generally applicable. Current LLRW disposal site development is occurring in dry climate areas where many of these assumptions are overly limiting with respect to radionuclide transport and projected doses. The use of site-specific performance assessments could result in different concentration limits while maintaining safety factors. The proposed rule recognizes this and establishes guidance to perform these kinds of analyses and establish site-specific criteria for LLRW disposal.

These proposed revisions enable a more technically accurate and risk-based approach to LLRW disposal. EPRI offers the following additional comments for consideration by the Nuclear Regulatory Commission:

1. **Protective Assurance Period:** Long time frames of analysis (greater than 1,000 years for the protective assurance period) have high levels of uncertainty that make the results of such analyses difficult to quantify and open to a high degree of interpretation. There are few points of comparison with past human activity to benchmark such analyses against. The need for analysis beyond 1,000 years should be more clearly limited to specific waste streams that are dominated by long-lived radionuclides. The typical LLRW streams that have already been evaluated and are not dominated by these long-lived radionuclides should not be subject to this new requirement.

2. **Institutional Control Period and Inadvertent Intrusion:** The scientific or technical basis for the 100-year active institutional control period and timing of inadvertent intrusion is unclear. An active institutional control period of 300 years is more probable, provides a more accurate assessment of the risk to an inadvertent intruder, and would better align with U.S. and international practices.

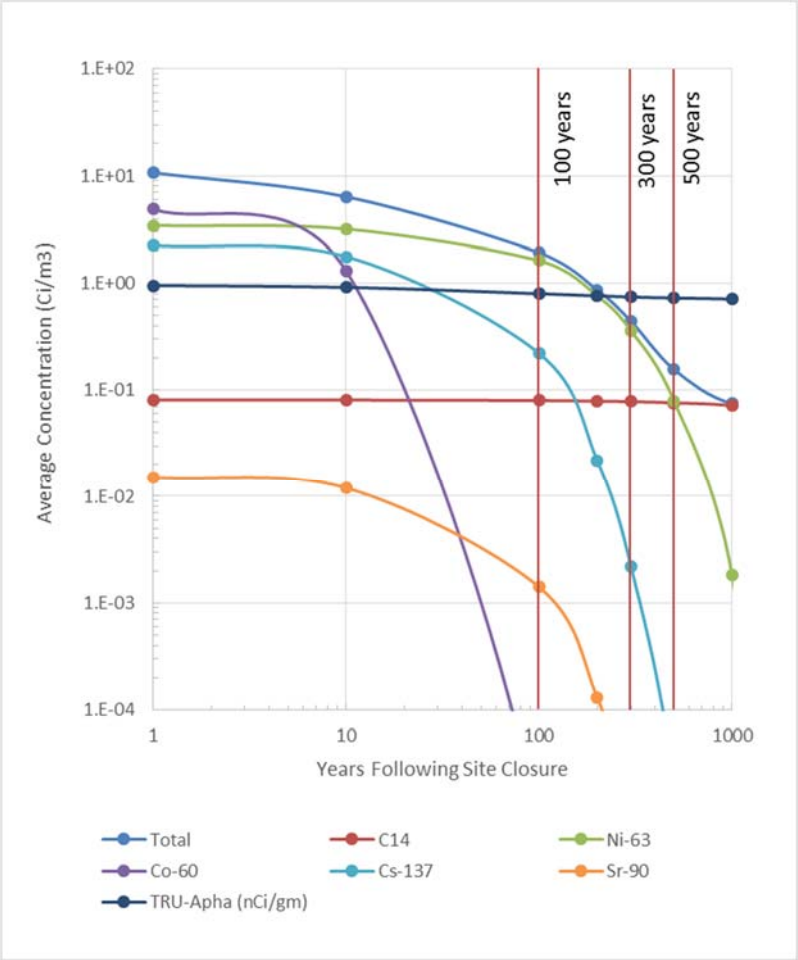
   A recent expert elicitation study conducted on behalf of the Nevada National Security Site (NNSS) and the Department of Energy (DOE)[1] concluded that the greatest probability of inadvertent human intrusion into disposal sites would occur some time after the loss of active institutional controls. The NRC's deterministic assumption that inadvertent human intrusion into disposal sites occur immediately after the loss of institutional controls is therefore a reasonable, simplified and conservative approach. However, the timeframe of the loss of institutional control and inadvertent intrusion should be re-evaluated to reflect DOE and international study results.

[1] **Black, P., et. al.** *DOE/NV-593-Vol. 1, Assessing the Probability of Inadvertant Human Intrusion at the Nevada Test Site Radioactive Waste Management Sites.* Oak Ridge : USDOE, 2001.

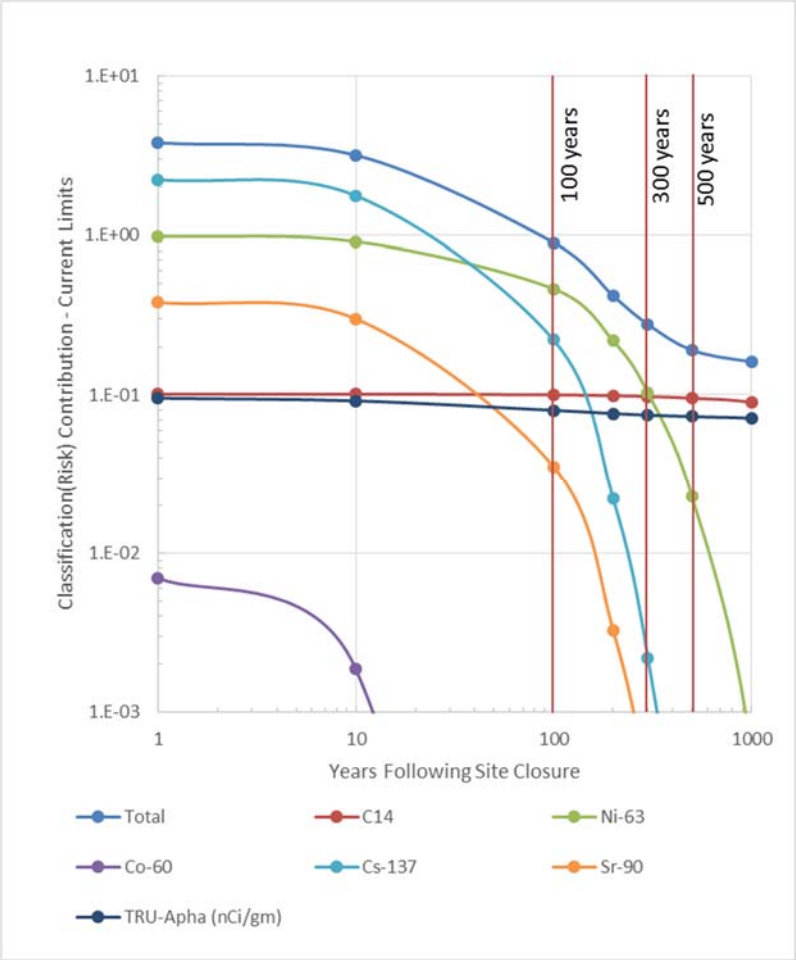
The NNSS, the International Atomic Energy Agency (IAEA), and Washington Department of Public Health consider active institutional controls to be effective for several hundred years after disposal site closure. The IAEA "Safety Assessment for Near Surface Disposal of Radioactive Waste"[2] state that active institutional controls "are generally considered to have an effectiveness of up to a few hundred years." The Washington Department of Public Health stated that the Richland site's "'institutional control period' could last for several centuries."[3] The NNSS study concluded that the 50$^{th}$ percentile for intrusion occurred at greater than 300 years after site closure and that the probability of intrusion at 100 years after site closure at the less than the 20th percentile. Based on these studies, a sound technical basis exists to place the time for inadvertent intrusion at 300 years after site closure.

EPRI research indicates that the majority of activity in LLRW from nuclear utilities consists of radioisotopes that will decay to minimal levels within 300 years. This recognition was fundamental to the original framing of 10 CFR 61, which concentrated primarily on non-fuel waste generated from power plant operations (EPRI, 2010). A graph of average concentrations of primary radionuclides from nuclear utilities is shown below.

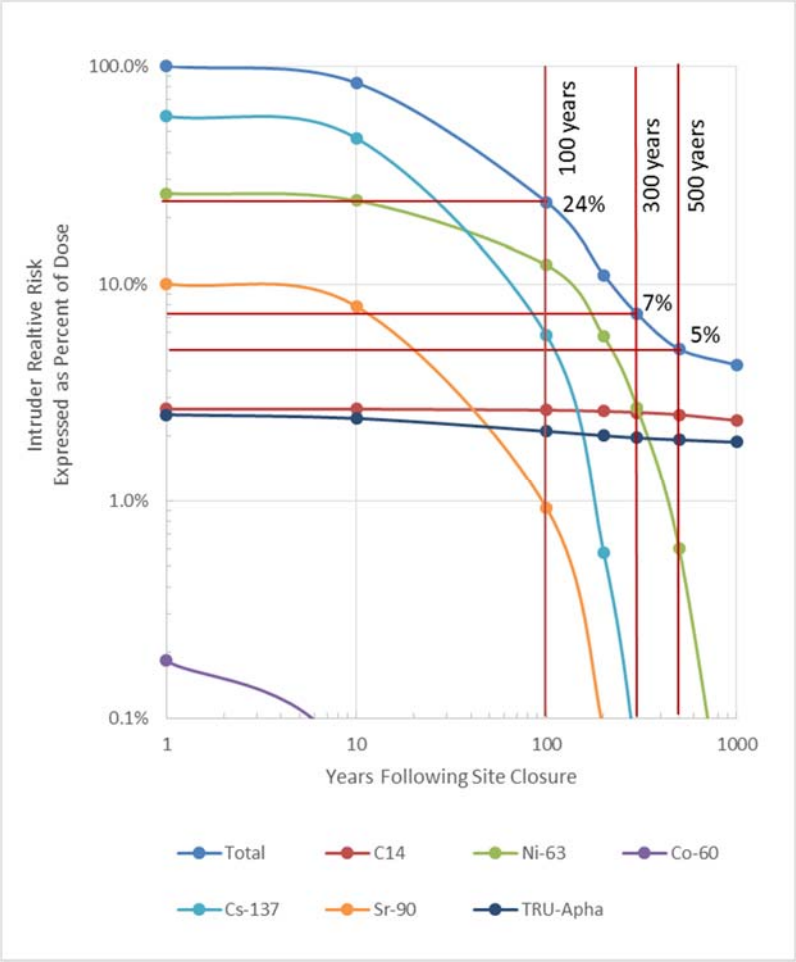
[2] **IAEA.** *WS-G-1.1, Safety Assessment for Near Surface Disposal of Radioactive Waste.* Vienna : IAEA, 1999.
[3] **Thatcher, Andrew H.** *Radiological Risk Assessment: Low Level Radioactive Waste Disposal Site Richland, Washington.* Washington Department of Health, Office of Radiation Protection. October 2003.




The concentration values identified above can be divided by the existing 10 CFR 61.55 concentration limits as a measure of risk. The results are shown below.




For the first 300 years disposal risk is driven almost entirely by $^{137}$Cs and $^{63}$Ni. After 500 years, only $^{14}$C and TRU continue to stand as dominant risk contributors, but at reduced levels from that observed during the first 300 years. Neither $^{14}$C nor TRU in this mixture are ever more than about 10% of the Class A limits (EPRI, 2010).




This data indicates that the relative total intruder risk at 100 years is 24% of the intruder risk at the time of site closure. However, based on the international studies referenced above, the more probable time for the failure of institutional controls is 300 years after site closure. The relative total intruder risk at 300 years is 7% of the risk at the time of site closure. As such, when 100 years is used as the time period for intrusion (coincident with the loss of active institutional controls), the risk is three times higher compared to when intrusion is more likely to occur. While the proposed rule assumption that inadvertent intrusion occurs immediately after the loss of institutional control is a reasonable and conservative approach, the time of the loss of institutional control should be re-evaluated.

3. **Blended Waste Described as Unanalyzed Waste Stream:** A motivation to amending the current regulations is to ensure that waste streams not analyzed during the development of the current regulation can be disposed of safely. Explicitly identified are depleted uranium and blended waste streams. The addition of 61.13 (e) Table A and the greater than 10,000 year performance period analysis requirement has resolved this concern for depleted uranium and the 2015 revision of the BTP has resolved this concern for other wastes.

   The NRC position in the draft rule is that "the blending of different classes of LLRW could also result in LLRW streams with concentrations that are inconsistent with the assumptions used to develop tables 1 and 2 of 10 CFR 61.55," which could pose an increased risk to an inadvertent intruder. This position is inconsistent with Revision 1 of the Concentration Averaging and Encapsulation Branch Technical Position (BTP). For development of the BTP, NRC staff analyzed several well drilling scenarios to determine under which conditions blending of waste streams would be safe (i.e. an annual exposure to inadvertent intruder of less than 5 mSv (500 mRem)). Using the results of the analysis, NRC staff placed constraints on blending waste streams to ensure that such waste streams are generated and disposed of in a manner to ensure public safety. Therefore, EPRI recommends that references to blended waste streams as not being analyzed be removed.

4. **Requirement for Site Closure Site-Specific Technical Analysis:** The site-specific technical analysis is identified to include: a) a performance assessment, b) an intruder assessment, c) performance period analyses, and d) demonstration of defense-in-depth protections. The site-specific technical analysis is to be provided to the regulatory authority by all operating licensees for continued operation of the disposal sites. The proposed rule further states that the site-specific technical analysis is required at the time of site closure. The rationale behind this is to provide assurance that previously unanalyzed waste streams meet performance objectives. If all of the waste that was disposed of at a particular site was analyzed in the initial site-specific technical analysis and only disposed of in accordance with the initial-site specific technical analysis, the requirement to submit a second analysis at closure should be unnecessary. An alternative to the proposed analysis requirement at closure would be to allow sites to analyze for "new" waste streams during operation prior to accepting them for disposal. This option provides greater assurance of compliance and eliminates the potential for disposal of waste streams that may not meet performance objectives.

5. **Generator's Certification Statement:** The use of NRC Form 540 is a regulatory requirement for all waste shipments regardless of the consignee (processor, collector or

disposal site) (Part 20 Appendix G III, 6.) Form 540 includes a generator's certification statement as follows:

> *This is to certify that the herein-named materials are acceptable for disposal, are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the department of transportation and the commission.*

The words "disposal" and "classified" should be removed from the certification statements in NUREG/BR-0204, Form 540 and 10 CFR Part 20 Appendix G to account for such situations where waste is not being shipped for disposal and as a result may not be classified.

The statement could be modified to bound all waste shipments regardless of the consignee (processor, collector, or disposal facility) as follows:

> *This is to certify that the herein-named materials are acceptable for the consignee's waste acceptance criteria, are properly characterized, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the department of transportation and the commission.*

Alternatively a second Generator Certification Statement could be provided that applies to shipments not intended for disposal. In its current form, the certification statement may constitute a material false statement when used for shipments to processors or for Class B and C wastes requiring structural stability.

Furthermore, certification statements should not be tied exclusively to waste acceptance criteria for disposal sites, as proposed in the revised 10 CFR Part 20 Appendix G Section II, because certification is required for all shipped waste regardless of consignor (generator) or consignee (processor, collector or disposal facility). Not all wastes shipped are suitable for disposal in the shipped form and may require further conditioning prior to disposal.

6. **Clarification Regarding Average Concentrations:** The discussion of the performance period analysis defines average concentrations as disposal site concentrations (volume of waste, stabilizer materials, material placed with disposal units and the materials used to construct disposal units). The proposed language for 10 CRF 61.13 (e) states "… waste

that contains radionuclides with average concentrations exceeding the values listed in table A of this paragraph…". It does not, however, explicitly state that the concentrations of the waste are the disposal site concentrations. The language should state this explicitly to avoid confusion.

7. **Dose Level and Effective Dose Equivalent:** When referring to waste disposal, ICRP 103 (2007) states:

> *…[D]ose estimates should not be regarded as measures of health detriment beyond times of several hundred years into the future. Rather they represent indicators of the protection afforded by the disposal system. The commission [ICRP] has given specific guidance for disposal of long lived solid radioactive waste in publication 81 and this guidance remains valid.*

The proposed reference dose thresholds in 61.42 are not risk informed when the same numerical values are used for 0-1,000 years and 1,000 to 10,000 years given the increases in uncertainty that occur as time elapses. The dose thresholds in the proposed rule should align with the latest ICRP guidance for international consistency and in recognition of the increased uncertainty of dose projections for long time periods into the future, as follows:

- The dose values in 61.41 (a), 61.41 (b), 61.42 (a), and 61.42 (b) should state that the units are presented as effective dose equivalents (EDE) to be consistent with latest dose assessment science and terminology.
- The value in the proposed 61.41 (a) for doses to the public during the compliance period (0-1,000 years) should be changed from 0.25 mSv/a (25 mrem/a) to 0.3 mSv/a[4] (30 mrem/a) for consistency with ICRP 103 and ICRP 81.
- The value in the proposed 61.41 (b) for doses to the public during the protective assurance period (1,000 to 10,000 years) should be changed from 5 mSv/a (500 mrem/a) to 10 mSv/a (1 rem/a). This is consistent with ICRP 81 recommendations for doses below which interventions[5] are likely not justified.
- The value in the proposed 61.42 (a) for doses to the inadvertent intruder during the compliance period (0-1,000 years) should be changed from 5 mSv/a (500 mrem/a) to 10 mSv/a (1 rem/a). This is consistent with ICRP 81 recommendations for doses below which interventions are likely not justified.

[4] 0.3 mSv/a (30 mrem/a), in ICRP 103 and as recommended by EPRI, remains a fraction of the recommended total individual public dose limit of 1 mSv/a (100 mrem/a) in ICRP 103 and a fraction of the same required individual public dose limit of 1mSv/a (100 mrem/a) in 10CFR20.1301.

[5] Examples of interventions when used in this context could mean additional protective measures in the disposal site design, a different disposal site location, etc.

- The value in the proposed 61.42 (b) for doses to the inadvertent intruder during the protective assurance period (1,000 to 10,000 years) should be changed from 5 mSv/a (500 mrem/a) to 100 mSv/a (10 rem/a). This is consistent with ICRP 81 recommendations for doses above which interventions are almost always justified.

8. **Structural Stability and the Proposed 61.58:** All three of the U.S. disposal sites accepting waste that require structural stability (normally Classes B and C) attain that stability primarily, or entirely, through actions taken at the disposal site during waste emplacement. The shipped waste package does not necessarily provide the required structural stability. The shipped package may be a licensed component of the disposal method (for example, a polyethylene high integrity container used at the Barnwell, SC facility); it is the concrete overpack applied during the disposal process, however, that fulfills the waste stability requirement in 61.56 (b) (1). Therefore, the proposed 61.58 (a) (2) is likely not achievable as written because, in general, waste as shipped does not meet the stability requirement. The proposed 61.58 (a) (2) should be reworded to specify containers and/or conditioning required by the disposal site as a component of stability recognizing that stability requirements may be fulfilled completely by the actions of the disposal site or partially by the waste container (shipped package) then completed by activities at the disposal site.

9. **Introduction of the Term "Waste Acceptance Criteria" for Site Specific Technical Analyses:** All waste consignees (processors, collectors and disposal sites), already have some form of waste acceptance criteria (WAC) or waste acceptance guidelines (WAG). This terminology, while not currently in regulation, has existed and been used for many years. In order for a consigner to ship waste (classified or not) to a consignee, it must meet the consignee WAC or WAG (hereafter WAC will be used for simplicity).

   When the term WAC is used in the proposed rules (Parts 20 and 61) and guidance (NUREG-2175), it could be construed to have a different definition depending upon where it is used. It may refer only to sites using a site specific technical analysis in accordance with the proposed revision to 61.13 and 61.58 or it may have a more generic meaning for all consignees accepting waste.

   It would be helpful to add clarity to the regulations and guidance to refer to "waste acceptance criteria" as "site specific waste acceptance criteria," "alternative waste acceptance criteria," "61.13 waste acceptance criteria," or something similar when the term "waste acceptance criteria" is referring to a disposal site that has implemented a site specific technical analysis in accordance with the proposed revisions to 61.13 and 61.58 in lieu of a more traditional 61.55 waste classification approach.

The results of EPRI research related to this topic have been published in several publicly available technical reports:

- An Evaluation of Alternative Classification Methods for Routine Low Level Waste from the Nuclear Power Industry. EPRI, Palo Alto, CA, 2007, 1016120
- Proposed Modifications to the NRC Branch Technical Position on Concentration Averaging and Encapsulation (BTP): Technical Bases and Consequence Analysis. EPRI, Palo Alto, CA, 2008, 1016761
- Options for Improved Low Level Waste Disposal Using 10 CFR 61.58. EPRI, Palo Alto, CA, 2010. 1021098.

Thank you for consideration of this letter in finalizing the revisions to 10 CFR Part 20 and 61.

Sincerely,

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