

Statutory Language and Regulatory History of Commercial Transuranic Waste Disposal

BACKGROUND:

Transuranic (TRU) waste comes from both commercial and governmental sources. TRU waste is a byproduct of nuclear research and power production and is primarily produced from recycling spent fuel or using plutonium to fabricate nuclear weapons. The waste consists of rags, tools, and laboratory equipment contaminated with radioactive materials, organic residues, and inorganic residues. The Atomic Energy Act of 1954 (AEA), as amended, defines TRU waste as: “material contaminated with elements that have an atomic number greater than 92, including neptunium, plutonium, americium, and curium, and that are in concentrations greater than 10 nanocuries per gram [nCi/gm], or in such other concentrations as the [U.S. Nuclear Regulatory Commission (NRC)] may prescribe to protect the public health and safety.” The NRC Glossary¹ defines TRU waste as: “material contaminated with transuranic elements – artificially made, radioactive elements, such as neptunium, plutonium, americium, and others – that have atomic numbers higher than uranium in the periodic table of elements.” This definition, while of no legal significance, does not have a concentration limit and is therefore inconsistent with the AEA definition.

Some TRU waste emits high levels of penetrating radiation and requires protective shielding. However, most TRU waste does not emit high levels of penetrating radiation, instead posing a danger when small particles of it are inhaled or ingested. The radiation from the particles is damaging to lung tissue and internal organs. As long as that type of TRU waste remains enclosed and contained, it can be managed safely.

Most of TRU waste radioactive elements are long-lived (i.e., they stay radioactive for a long time). For example, half of the original amount of plutonium-239 in the waste will remain harmful after 24,000 years. Disposal must be carefully planned so that the TRU waste poses no undue threat to public health or the environment for years to come.

This enclosure is focused on the statutory language and regulatory framework for commercial TRU waste disposal, but includes some information on defense TRU because the U.S. Atomic Energy Commission (AEC), the predecessor agency to NRC, previously regulated both commercial and defense TRU waste.

STATUTORY LANGUAGE AND REGULATORY BACKGROUND:

Prior to 1970, TRU waste was disposed of similarly to low-level radioactive waste (LLRW) (i.e., pits and trenches covered with soil) at either near-surface disposal facilities operated by the AEC or at commercial disposal sites. TRU waste generated as a result of AEC contracts with private contractors (i.e., commercial TRU) was sent to commercial disposal facilities.² Also, commercial TRU waste from mixed-oxide fuel fabricators and source manufacturers was sent to commercial disposal facilities.³

¹ NRC Glossary: <http://www.nrc.gov/reading-rm/basic-ref/glossary.html>.

² NRC, NUREG-0782, “Draft Environmental Impact Statement on 10 CFR Part 61 Licensing Requirements for Land Disposal of Radioactive Waste,” (Volume 2), (September 1981).

³ NRC, NUREG-0782, “Draft Environmental Impact Statement on 10 CFR Part 61 Licensing Requirements for Land Disposal of Radioactive Waste,” (Volume 2), (September 1981).

In terms of long-life and radiotoxicity, TRU elements are comparable to radium. In 1974, the AEC proposed to modify Title 10 of the *Code of Federal Regulations* (CFR) Part 20 to prohibit the disposal of commercially generated TRU radionuclides in soil by shallow land disposal.⁴ After reviewing the proposed rule and comments received, staff initiated development of regulations that would govern the classification of all radioactive waste, not just commercial radioactive waste contaminated with TRU radionuclides.

On March 13, 1978, President Jimmy Carter established an Interagency Review Group (IRG) on Nuclear Waste Management to formulate recommendations for the establishment of an administrative policy with respect to long-term management of nuclear wastes (including TRU waste) and supporting programs to implement the policy. In 1979, the IRG identified in its final report that: (1) TRU waste results predominantly from spent fuel reprocessing, fabrication of plutonium to produce nuclear weapons, and, if it should occur, plutonium fuel fabrication for recycle to nuclear reactors; (2) TRU waste was currently defined as waste containing more than 10 nCi of transuranic activity per gram of material; and (3) TRU waste would be disposed in a similar manner to that used for high-level radioactive waste (HLRW) disposal.⁵

In October 1980, Congress passed the West Valley Demonstration Project Act (WVDPA), which authorizes the U.S. Department of Energy (DOE) to carry out a high-level liquid nuclear waste management demonstration project at the Western New York Service Center in West Valley, New York. The WVDPA was the first statute that defined TRU waste and it defined TRU waste as: “material contaminated with elements which have atomic number greater than 92, including neptunium, plutonium, americium, and curium, and which are in concentrations greater than 10 [nCi/gm], or in such other concentrations as the [NRC] may prescribe to protect the public health and safety.”

In response to the complex LLRW disposal issue, Congress passed the Low-Level Radioactive Waste Policy Act of 1980 (1980 Act), which defined LLRW as: “radioactive waste not classified as [HLRW], [TRU] waste, spent nuclear fuel, or byproduct material as defined in section 11e.(2) of the Atomic Energy Act of 1954.” Therefore, according to the 1980 Act, the definition of LLRW specifically provided that TRU waste was not LLRW.

The NRC’s licensing requirements for the disposal of HLRW in a non-site specific geologic repository reside in 10 CFR Part 60, “Disposal of High-Level Radioactive Wastes in Geologic Repositories.” In July 1981, the proposed rule to amend Part 60 included the following definition of TRU waste: “radioactive waste containing alpha emitting transuranic elements, with radioactive half-lives greater than five years, in excess of 10 [nCi/gm].”⁶ The final rule was issued in June 1983, and noted

⁴ See “Transuranic Waste Disposal: Proposed Standards for Protection Against Radiation,” 39 FRN 32921 (September 12, 1974).

⁵ The final IRG report can be found at: http://curie.ornl.gov/system/files/documents/SEA/Interagency_Review_Group_Report_MOL.19980625.0169.pdf.

⁶ See “Disposal of High-Level Radioactive Wastes in Geologic Repositories,” 46 FR 35280 (July 8, 1981).

the proposed rule included a definition of [TRU] waste and performance objectives that would apply to the disposal of [TRU] [waste] in a licensed geologic repository. This was widely misconstrued [by the public] as a requirement that radioactive material conforming to this definition of TRU waste must be disposed of in that manner [(i.e., in a geologic repository)]. This was not the intention, nor in fact did the rule so specify. Rather, the Commission was merely indicating what performance objectives would apply if TRU [waste] were disposed of in a licensed geologic repository. Some commenters also took exception to the definition of TRU [waste] in the proposed rule.... For the time being, the Commission has concluded that the matter is best handled by eliminating all references to TRU [waste in the final rule]. The remaining performance objectives provide adequate guidance to deal with TRU [waste]-related issues that may arise.⁷

Thus, the definition of TRU waste is not in the final Part 60 rule.

In September 1981, NRC issued NUREG-0782, "Draft Environmental Impact Statement [EIS] on 10 CFR Part 61 Licensing Requirements for Land Disposal of Radioactive Waste." In that draft EIS, 13 of the 36 waste streams evaluated contained TRU isotopes. Those waste streams included sealed sources and both pressurized water reactor/boiling water reactor ion exchange resins and filter sludges. The proposed rule⁸ noted

for most of the alpha emitting [TRU] nuclides, the maximum allowable concentrations were calculated to be in the range of 10 [nCi/gm] currently imposed by disposal facilities. These calculations were conservatively based, in that they did not allow credit for dilution by other wastes. If this factor were changed, [then] the values would increase somewhat. A decision was made not to recalculate in order to come up with higher values. This decision is based on two factors. First, in the spirit of the ALARA (as Low as Reasonably Achievable) concept, the lower value of 10 nCi/g[m] has been demonstrated as an achievable concentration to control the disposal of [TRU] nuclides.... The last commercial site imposed the 10 nCi/g[m] restriction in 1981. Thus, there is no need to increase the limit from the standpoint of achievability. Second, there is a tendency toward a more conservative assessment of the hazard of certain [TRU] nuclides (Ref. ICRP 30) and it does not seem prudent at this time to use the higher calculated values.... At present, wastes containing [TRU] nuclides are not being generated in significant volumes.

As such, Table 1 in the proposed 10 CFR Part 61 rule for alpha emitting [TRU] isotopes had a limit of 10 nCi/gm for Class C.

Subsequently, at an Alpha-Contaminated Waste Management Workshop held in 1982, DOE, U.S. Environmental Protection Agency (EPA), NRC, and private sector experts met to define radioactive wastes based on radiological hazards to the environment, public, and the worker.

⁷ See "Disposal of High-Level Radioactive Wastes in Geologic Repositories Technical Criteria," 48 FR 28194 (June 21, 1983).

⁸ See "Licensing Requirements for Land Disposal of Radioactive Waste," 46 FR 38081 (July 24, 1981).

They recommended that the value for TRU waste be changed from 10 nCi/gm to 100 nCi/gm. The workshop included a presentation by Paul Lohaus (NRC) that provided an overview of the draft proposed 10 CFR Part 61 rule and how NRC was addressing the disposal of TRU waste through those regulatory efforts. From the workshop proceedings, Mr. Lohaus presented a speech that included the following passage:

The first point I'd like to emphasize is that we are not now planning to develop a separate regulation for TRU waste. Rather, through our existing regulations development efforts, we are addressing the disposal of waste containing TRU radionuclides. Considering today's commercial wastes, we do not really see the need for a separate TRU waste regulation. With few exceptions, most commercial waste (particularly reactor waste) contains TRU nuclides as a trace contaminant. This is opposed to some DOE wastes, which predominantly contain TRU nuclides. Some commercial TRU wastes, for example those from the decommissioning of plutonium fuel fabrication plants, will have high amounts of TRU nuclides, but those wastes are limited in number and should be generated over a relatively short timeframe.

After the workshop, in December 1982, NRC promulgated the licensing requirements for the land disposal of LLRW in 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste."⁹ That regulation defines LLRW as: "radioactive waste not classified as [HLRW], [TRU] waste, spent nuclear fuel, or byproduct material as defined in paragraphs (2), (3), and (4) of the definition of *Byproduct material* set forth in §20.1003 of this chapter." Based on the current definition of LLRW in 10 CFR Part 61, TRU waste is not LLRW. The statements of consideration for the final rule stated "for a number of radionuclides, the maximum allowable concentrations in Class C waste have been increased by a factor of ten. This came in response to a number of comments received on the proposed rule and the draft [EIS] that pointed out where unnecessary conservative assumptions had been incorporated into the calculations for intruder protection.... To the extent practicable, the numerous footnotes found in the proposed Table 1 were eliminated and incorporated into the text part of the section on waste classification."¹⁰ As such, Table 1 in the final 10 CFR Part 61 rule for alpha emitting TRU nuclides with half-lives greater than 5 years has a limit of 100 nCi/gm for Class C.

The 1982 workshop recommendation of 100 nCi/gm for TRU waste was adopted in DOE Order 5820.1 (Radioactive Waste Management)-1982, which was also adopted in subsequent revisions to that order (i.e., 5820.2-1984, and 5820.2A-1988). In 1999, DOE issued DOE Order and Manual 435.1 (Radioactive Waste Management), which updated the information and superseded DOE Order 5820.2A and included the 1982 workshop recommendation of 100 nCi/gm for TRU waste. In 2001, Change 1 of DOE Manual 435.1 defines TRU waste as: "radioactive waste containing more than 100 [nCi] (3,700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) [HLRW]; (2) waste that the Secretary of Energy has determined, with the concurrence of the [EPA Administrator], does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; or (3) waste that the [NRC] has approved for disposal on a case-by-case

⁹ See "Licensing Requirements for Land Disposal of Radioactive Waste," 47 FR 57446 (December 27, 1982).

¹⁰ *Id.* at 57456.

basis in accordance with 10 CFR Part 61. [Source: *WIPP Land Withdrawal Act of 1992*, as amended].”¹¹

In 1985, Congress passed the Low-Level Radioactive Waste Policy Amendments Act (Amendments Act): “(A) IN GENERAL – The term [LLRW] means radioactive material that: (i) is not [HLRW], spent nuclear fuel, or byproduct material (as defined in section 11e.(2) of the Atomic Energy Act of 1954 (42 USC 2014(e)(2)); and (ii) the [NRC], consistent with existing law and in accordance with paragraph (A), classifies as [LLRW].” Thus, TRU waste is considered LLRW under the Amendments Act.

According to the “Low-Level Waste Handbook” by Holmes Brown, the principle reason for the change to the original 1980 Act definition for LLRW was “to make some entity responsible” for disposal of Greater-Than Class C (GTCC) waste that contained TRU waste. According to section (A)(i) of the Amendments Act, TRU waste is LLRW. Based on (A)(ii) of the Amendments Act, the NRC can set the definition of LLRW. Consistent with (A)(ii) of the Amendments Act and because the 10 CFR Part 61 definition of LLRW excludes TRU, TRU is not LLRW.

The NRC developed a plan and schedule for implementation of NRC’s Amendments Act responsibilities in NUREG-1213, “Plans and Schedules for Implementation of U.S. Nuclear Regulatory Commission Responsibilities under the Low-Level Radioactive Waste Policy Amendments Act of 1985 (P.L. 99-240)” (ADAMS Accession No.: ML15153A197). However, an action to revise 10 CFR Part 61 definition of LLRW to be consistent with the definition of LLRW in the Amendments Act was not included in that plan.

In 49 CFR 191.02, the EPA defines TRU waste as: “waste containing more than 100 [nCi] of alpha-emitting transuranic isotopes, with half-lives greater than twenty years, per gram of waste, except for: (1) [HLW]; (2) wastes that [DOE] has determined, with the concurrence of the [EPA] Administrator, do not need the degree of isolation required by this part; or (3) wastes that the [NRC] has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.” Therefore, EPA’s definition of TRU incorporates the 100 nCi/gm limit and isotopes with half-lives greater than twenty years.

In 1988, Congress passed the Price-Anderson Amendments Act, which amended the AEA by adding the definition of TRU waste to the AEA: “material contaminated with elements that have an atomic number greater than 92, including neptunium, plutonium, americium, and curium, and that are in concentrations greater than 10 [nCi/gm], or in such other concentrations as the [NRC] may prescribe to protect the public health and safety.” Therefore, the AEA uses 10 nCi/gm in the definition of TRU waste, but allows NRC to change the value as long it protects the public health and safety.

In 1992, Congress passed the Waste Isolation Pilot Plant Land Withdrawal Act (LWA), which defined defense TRU waste based on EPA’s definition in 49 CFR § 191.02. In 1996, Congress

¹¹ DOE Order and Manual 435.1-2001 are found in NRC’s Agencywide Documents Access and Management System (ADAMS) Package Accession No.: ML15022A060.

passed the Waste Isolation Pilot Plant Land Withdrawal Amendments Act, but did not change the definition of TRU waste. The DOE Waste Isolation Pilot Plant Facility, which began operation in March 1999, is a deep geologic repository for permanent disposal of defense TRU waste.

WASTE CLASSIFICATION OF TRU NUCLIDES IN LLRW

As noted above, 10 CFR Part 61 governs disposal of LLRW. LLRW disposal is regulated by either NRC or an NRC Agreement State. The waste classification system, found in 10 CFR § 61.55, categorizes waste as Class A, B, C, or GTCC.

The NRC has determined that, commercial LLRW containing TRU nuclides meeting certain criteria may be suitable for disposal in a 10 CFR Part 61 disposal facility. Based on 10 CFR § 61.55, Table 1, alpha emitting TRU nuclides with half-lives greater than 5 years and a concentration that does not exceed 10 nCi/gm are acceptable for disposal as Class A waste in a LLRW disposal facility [§61.55(a)(3)(i)]. Based on 10 CFR § 61.55, Table 1, alpha emitting transuranic nuclides with half-lives greater than 5 years and a concentration greater than 10 nCi/gm, but less than 100 nCi/gm, may be disposed of as Class C waste in a LLRW disposal facility [§61.55 (a)(3)(ii)].

NEXT STEPS:

In the February 2011 “Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste” (DOE/EIS-0375-D), DOE evaluated five alternatives for disposal of GTCC and GTCC-like waste and its potential consequences on 11 environmental resource areas including, water resources, land use, and human health. The human health section evaluated the consequences of scenarios involving disposal methods (e.g., geologic repository, near-surface disposal) and intentional destructive acts (e.g., sabotage, terrorism, and events associated with sabotage or terrorism). In the draft EIS, DOE defined TRU waste consistent with the definitions found in 49 CFR § 191.02 and the LWA. DOE has indicated that up to 87 percent of GTCC waste inventory analyzed for the draft EIS contains TRU radionuclides with concentrations greater than 100 nCi/gm. However, a more recent U.S. EPR (i.e., one of the new power reactor types that the NRC is reviewing a combined operating license for) safety analysis report included an analysis of the sources of radioactivity that are expected to be produced from fission, activation, and corrosion products that concluded that there was not expected to be any TRU radionuclides in realistic source terms for the reactor coolant system and secondary coolant system. That means that the 87 percent estimate used in the draft EIS is a conservative value and a more realistic number would likely be a lower percentage of GTCC waste would contain TRU radionuclides with concentrations greater than 100 nCi/gm.

In the future, if DOE decides to submit a license application for the disposal of its GTCC waste, then NRC will need to consider a regulatory framework for the waste with TRU nuclides above 100 nCi/gm. That review would use NUREG-1200, “Standard Review Plan for the Review of a License Application for a Low-Level Radioactive Waste Disposal Facility.” NUREG-1200 includes review of the physical security plan for the protection of the facility against potential acts of vandalism, theft, or sabotage. NRC expects that the level of security will be commensurate with the level of radiological hazards and nature of the waste.

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