

DOE Response to EPA Question Regarding "High-Level Liquid Radioactive Waste"

Subsequent to the April 13, 2005 teleconference EPA transmitted on April 22, 2005 via e-mail an additional question regarding "high-level liquid radioactive waste". As stated in the body of the letter the solid wastes resulting from the treatment of such wastes are prohibited from disposal at WIPP by the WIPP Land Withdrawal Act. As described in more detail below the wastes from the plutonium decontamination cycles in the Bismuth Phosphate process are not HLW because these wastes originated from plutonium processing activities and are not aqueous waste from the reprocessing of irradiated reactor fuel or subsequent extraction cycles. The complete EPA question and the DOE response are as follows:

Question: The current 10 CFR Part 50 has no Appendix D, but in answer to our question about that DOE noted that the contents of D had been moved to Appendix F. Appendix F does deal with the same general topic of spent fuel reprocessing facilities, but does not contain the same wording about the hulls as the 1969 Appendix D (which begs the question - why was it removed?). I don't think the removal in Appendix F of the old Appendix D language about the hulls is of any consequence, but what did catch my eye was the wording in the second paragraph of Appendix F defining High Level Waste:

For the purpose of this statement of policy, "high-level liquid radioactive wastes" means those aqueous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuels.

This is different from the definition that we have used to date, which is from the definitions in the Nuclear Waste Policy Act:

The term "high-level radioactive waste" means—

(A) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and

(B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation.

The definition of HLW in 10 CFR Part 50 Appendix F looks like it could be argued that it includes the waste from the first and second decon cycle of the Bismuth Phosphate Process.

Part B of the NWPA definition seems to say that if the NRC defines something to be HLW in a rule, then that material is HLW. Here's the link to the 10 CFR reference:

<http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appf.html>

Response: 10 CFR 50 Appendix F refers to HLW as being "... those aqueous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuels". Comparison of the Bismuth Phosphate process with this HLW definition results in a similar understanding of waste streams as from the applicable definition of HLW in the Nuclear Waste Policy Act.

In the Bismuth Phosphate process, the cladding (or coating) hulls are first removed and separated from the irradiated reactor fuel (the waste from this step is not HLW as discussed above). The fuel is then dissolved into its constituent parts consisting of uranium, transuranic elements (e.g. plutonium) and fission products. The plutonium is then co-precipitated with bismuth, centrifuged and washed three times to separate the plutonium bearing solids from the aqueous solution that contained virtually 100% of the uranium and 90% of all fission products (and nearly 100% of the fission products with long half-lives). This aqueous solution and the wash solutions were combined and designated as 'metal waste'. Based on the 10 CFR 50 Appendix F definition, metal waste¹ meets the definition of HLW as "... those aqueous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent". The term "equivalent" being the operative definition for the Bismuth Phosphate process, as the Bismuth Phosphate process is not a solvent extraction system.

Irradiated reactor fuel constituent elements (i.e. uranium, fission products, plutonium, and other actinides) are present only in the fuel dissolution and plutonium separation steps discussed above. The plutonium solids are not aqueous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuels. The plutonium solids are special nuclear material product. The plutonium solids were subsequently processed through two decontamination cycles to purify the plutonium solid product. The decontamination cycles entailed dissolving the plutonium solids and re-precipitated as solids several times to separate the contaminants of cerium, zirconium and niobium as well as trace amounts of other fission products and chemical contaminants. The resulting plutonium product was then transferred to a separate, contact operated / maintained building (224 Concentration Building) where additional processing was conducted to separate bismuth and trace amounts of short-lived fission products from the plutonium.

The wastes from the plutonium decontamination cycles (designated as 1C and 2C wastes) and the 224 Concentration Building wastes are not HLW because these wastes originated from plutonium processing activities and are not aqueous wastes from reprocessing of irradiated reactor fuel. The plutonium decontamination cycles are not "... subsequent extraction cycles, or equivalent..." and therefore the wastes from the plutonium decontamination cycles are not "... concentrated wastes from subsequent extraction cycles, or equivalent". Therefore, these wastes do not meet the definition of HLW stated in 10 CFR 50 Appendix F.

¹ The metal waste was temporarily stored in underground tanks and was eventually removed from these storage tanks. Metal waste was processed in a separate building (221-U Plant) to extract fission products and other impurities from uranium. The 221-U Plant employed a solvent extraction process that was a "... subsequent extraction cycle", as defined in 10 CFR 50 Appendix F. The fission products and other impurities extracted from the uranium were contained in a concentrated aqueous waste and therefore meet the definition of HLW stated in 10 CFR 50 Appendix F. The uranium product was transported to another location in the United States for nuclear fuel fabrication.