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MAY 1 1 2005

Ms. Elizabeth Cotsworth, Director
Office of Radiation and Indoor Air
U. S. Environmental Protection Agency
Ariel Rios Building, 6601J
1200 Pennsylvania Ave., N.W.
Washington, DC 20460

COPY

Subject: Hanford Tank and K-Basin Wastes

Dear Ms. Cotsworth:

In a telephone conversation in early April 2005 Environmental Protection Agency (EPA) staff asked some additional questions concerning the Hanford Tank and K-Basin transuranic (TRU) waste inventories included in the Waste Isolation Pilot Plant (WIPP) Compliance Recertification Application (CRA). These questions were based on their review of information previously provided in my letter dated March 18, 2005 in responding to your December 17, 2004 letter concerning this subject. Some of these informal verbal questions were addressed in a teleconference between Department of Energy (DOE) staff, EPA staff and Hanford site personnel on April 13, 2005. Three questions remain to be answered from this exchange as listed below. For your convenience, a brief answer is provided and additional responsive information is enclosed with this response, as indicated.

1) It is stated that the mechanical removal of cladding creates waste that is not high level waste. How does DOE make the connection that chemical removal of cladding is also not high level waste?

Brief Answer: The NRC has not distinguished between chemical and mechanical means to separate radioactive hulls (i.e., cladding) from irradiated reactor fuel. Further, the NRC, denying a petition for rulemaking by the States of Washington and Oregon, stated that

> "the [AEC] specifically noted that the term HLW [high-level waste] did not include 'incidental' waste resulting from reprocessing plant operations, such as ion exchange beds, sludges, and contaminated laboratory items such as clothing, tools, and equipment. Neither were radioactive hulls and other irradiated and contaminated fuel structural hardware encompassed by the Appendix F definition."

See 58 FR 12342 (March 4, 1993). Thus, the Department has concluded that radioactive cladding is excluded from the definition of high-level waste.

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2) Does the K-Basin sludge contain chunks of spent nuclear fuel, or has all of the residue been dissolved?

Brief Answer: K-Basin sludge designated for disposal at WIPP and included in the CRA TRU waste inventory contains no "chunks" of spent nuclear fuel. Wastes generated from spent fuel cleaning activities are distinguishable from other K-Basin wastes. Cleaning activities associated with the removal of N-Reactor fuel from the K-Basin involved a sequence of washing, straining and collection through a system that included Knock-Out Pots and Settler Tanks. These are closed systems which did not mingle with sludge in other locations of the K-Basins. Because these treatment systems are closed, materials derived from these systems contain very little sand, dirt, silt or other foreign, material making them distinguishable from other K-Basin wastes.

3) Why is the knock out pot sludge so similar to N – reactor fuel?

Brief Answer: See brief answer to question 2, above. Large chunks of spent N-Reactor fuel and corrosion products were removed and packaged into multi-canister overpacks and managed as spent nuclear fuel scrap or debris. The resulting wastes were washed through a piping system, using the same water used to wash the spent fuel, to a series of strainers and collection containers; the Knock-Out-Pots and Settler Tanks. Wastes leaving the Knock-Out-Pots contained particulate matter less than 500 microns in size. This waste was sent to the Settler Tanks to allow particulate matter to settle further. Materials collected from this process will be managed as either debris or spent fuel.

In response to question 1, enclosure 1 and its attachments provide additional historical regulatory information regarding the Department's assertion that cladding hulls from the Hanford tank wastes are not high-level waste. In response to questions 2 and 3, enclosure 2 provides addition technical information regarding the various Hanford K-Basin wastes, their generation, and their relation to N-Reactor spent fuel.

EPA transmitted on April 22, 2005 via e-mail an additional question regarding "high-level liquid radioactive waste". As noted the solid wastes resulting from the treatment of such wastes are prohibited from disposal at WIPP by the WIPP Land Withdrawal Act, however 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 provided in enclosure 3.

The above enclosures are being provided both in hard copy and in the attached compact disc (enclosure 4). If you have any additional questions regarding this issue, please contact me at (505) 234-7457.

Sincerely,

Russell Patterson
Certification Compliance Manager

Enclosures

cc: w/enclosure

S. White, EPA	*ED
C. Byrum, EPA	ED
T. Peake, EPA	ED
R. Lee, EPA	ED
D. Bartus, EPA Region X	ED

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CBFO M&RC	

*ED denotes Electronic Distribution
CBFO:AMO:RLP:LR:05-0268:UFC:5822

Additional Information on Hanford Tank Wastes

Introduction

The U. S. Nuclear Regulatory Commission (NRC) and its predecessor, the U. S. Atomic Energy Commission (AEC) have long established that radioactive hulls and other irradiated and contaminated fuel structural hardware are not encompassed in the definition of high-level waste.

Discussion

As communicated in the March 18, 2005 letter from the Department of Energy to the U. S. Environmental Protection Agency addressing the Hanford Tank and K Basin Wastes (CBFO:AMO:RP:KJB:05-0217:UFC5486), the Department has applied this policy in determining the cladding removal waste stored in two tanks (designated as tanks 241-AW-103 and 241-AW-105) at the Hanford Site are not high-level waste. The Department's March 18, 2005 letter stated "… This determination continues the position established by the Atomic Energy Commission in 1969 that cladding hulls (removed from spent fuel by mechanical rather than chemical means) are not HLW." The Department did not mean to communicate the NRC has drawn a distinction between processes that use chemical versus mechanical means to separate radioactive hulls from irradiated reactor fuel, since it is evident that the NRC never created such a distinction. Instead, the Department was communicating that a chemical process was used at the Hanford Site as opposed to a mechanical process used by some commercial reprocessing facilities to separate the radioactive hulls from irradiated reactor fuel. Radioactive hulls are the material encasing the irradiated reactor fuel and are sometimes referred to as cladding or coating materials. Applicable excerpts, from NRC and AEC policy statements regarding radioactive hulls and other irradiated and contaminated fuel structural hardware as not being encompassed in the high-level waste definition, are cited below.

This long standing policy was first discussed in the June 3, 1969 federal register in a proposed rule making[1]. In this proposed rule making, the AEC proposed adding an Appendix D to Title 10 Part 50 of the code of federal regulation (CFR) in which the AEC stated:

> *"1. Public health and safety considerations relating to commercial fuel reprocessing plants do not require that such facilities be located on land owned and controlled by the Federal Government. Such plants, including the facilities for the temporary storage of high-level liquid radioactive wastes, may be located on privately owned property. (For the purpose of this statement of policy, "high-level liquid radioactive waste" means those aqueous wastes resulting from the operation of the first cycle solvent*

[1] AEC, 1969, Siting of Commercial Fuel Reprocessing Plants and Related Waste Management Facilities; Statement of Proposed Policy, 10 CFR Part 50, 'Licensing of Production and Utilization Facilities', 34 FR 8712, Atomic Energy Commission, Washington, D.C., June 3, 1969.

extraction system and the concentrated wastes from subsequent extraction cycles in a facility for reprocessing irradiated reactor fuels.) …

6. Radioactive hulls and other irradiated and contaminated fuel structural hardware may be disposed of by one of the following methods:

(a) Disposal in the same manner as high-level wastes; or
(b) *Disposal at a licensed waste burial facility located on land owned by the Federal Government or by a State government as required by § 20.302 of this chapter."* (at present 10 CFR 20.2002)

After public comment, the AEC adopted this proposed statement of policy[2] in November of 1970:

"The text of the statement of policy set out below is the same as that published for comment on June 3, 1969, except for minor editorial changes and (1) the redesignation of the appendix as Appendix F of 10 CFR Part 50; (2) the revision of the definition of "high-level liquid radioactive wastes" in paragraph 1 of the appendix to clarify its application to fuel reprocessing systems other than solvent extraction; (3) the revision of paragraph 2 of the appendix to include a specification of AEC-approved solid waste form; (4) the inclusion of a statement in paragraph 4 of the appendix to indicate that the decontamination to be required upon decommissioning will be the subject of criteria which the Commission will develop in consultation with competent groups; (5) the deletion of the previously proposed paragraphs 6 and 7 of the appendix dealing with ultimate disposal of miscellaneous solid wastes generated at fuel reprocessing facilities in view of current AEC studies which the Commission anticipates may result in proposed amendments to its regulations identifying certain radioactive materials deemed unsuitable for disposal onsite or at licensed, privately owned land burial facilities; and …"

The decision by the AEC in 1970 to delete paragraphs 6 and 7 from the appendix did not mean the Commission had modified its policy regarding radioactive hulls and other irradiated and contaminated fuel structural hardware being excluded from the definition of high-level waste. In announcing the decision to adopt this appendix, the AEC stated[3]:

"The proposed policy statement, as previously published, also included provisions designated as paragraphs 6 and 7 of the policy, which related to the disposal of radioactive hulls and other solid wastes resulting from

[2] AEC, 1970, Siting of Commercial Fuel Reprocessing Plants and Related Waste Management Facilities, 10 CFR Part 50, 'Licensing of Production and Utilization Facilities', 35 FR 17530, Atomic Energy Commission, Washington, D.C., November 14, 1970.
[3] Ibid 2, 35 FR 175332

operation of fuel reprocessing plants. Since publication of the proposed policy, the Commission has undertaken studies in connection with the ultimate disposal of wastes contaminated with plutonium or other transuranium nuclides. The Commission anticipates that these studies may result in amendments to its regulations identifying certain radioactive materials deemed unsuitable for disposal at licensed, privately operated land burial facilities."

As evident from this statement, the Commission was contemplating revising its regulations for disposal of wastes contaminated with plutonium or other transuranium nuclides, such as radioactive hulls, in land burial facilities.

Further evidence that the NRC has not modified its policy regarding radioactive hulls is found in the *Advanced Notice of Proposed Rulemaking; 10 CFR Part 60, Definition of High-Level Radioactive Waste*[4], in which the Commission stated:

"As used in Appendix F, "high-level waste" thus refers to the highly concentrated (and hazardous) waste containing virtually all the fission products and transuranic elements (except plutonium) present in irradiated reactor fuel. The term does not include incidental wastes resulting from reprocessing plant operations such as ion exchange beds, sludges, and contaminated laboratory items, clothing, tools and equipment. Neither are radioactive hulls and other irradiated and contaminated fuel structural hardware within the Appendix F definition.[1]*"*

> [1] *See 34 FR 8712, June 3, 1969 (notice of proposed rulemaking), 35 FR 17530 at 17532, November 14, 1970 (final rule)*.

The NRC has further reaffirmed its policy regarding the exclusion of radioactive hulls from the definition of high-level waste in denying a petition by the States of Washington and Oregon to revise the definition of high-level waste[5]. In addressing the classification of DOE reprocessing wastes at the Hanford and other sites, the Commission stated:

"*At Hanford and other sites, questions have arisen regarding the classification of reprocessing wastes for which DOE must provide disposal. In the longstanding view of the Commission, these questions must be resolved by examining the source of the wastes in question. The reason for this is that when Congress assigned to NRC the licensing authority over certain DOE facilities for "high-level radioactive wastes," the Congress was referring to those materials encompassed within the meaning of the term "high-level radioactive waste" in Appendix F of 10*

[4] NRC, 1987, Advanced Notice of Proposed Rulemaking; 10 CFR Part 60, 'Definition of High-Level Radioactive Waste', 52 FR 5992, U.S. Nuclear Regulatory Commission, Washington, DC, February 27, 1987.

[5] NRC, 1993, Denial of petition for rulemaking; 10 CFR Part 60, 'States of Washington and Oregon: Denial of Petition for Rulemaking', 58 FR 12342, U.S. Nuclear Regulatory Commission, Washington, DC, March 4, 1993.

CFR Part 50. (For a full statement of this position, see the discussion presented in the Commission's advanced notice of proposed rulemaking, "Definition of High-Level Radioactive Waste" (52 FR 5993, February 27, 1987).) Accordingly, any facility to be used for the disposal of "those aqueous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent …" as HLW is defined in Appendix F to Part 50, must be licensed by the NRC. Most of the wastes storage tanks at Savannah River (South Carolina), West Valley (New York) and Hanford contain wastes that meet this definition, and the facilities to be used for disposal of these wastes are, therefore, potentially subject to NRC licensing jurisdiction.

However, when the Appendix F definition was promulgated, the Atomic Energy Commission specifically noted that the term HLW did not include "incidental" waste resulting from reprocessing plant operations, such as ion exchange beds, sludges, and contaminated laboratory items such as clothing, tools and equipment. Neither were radioactive hulls and other irradiated and contaminated fuel structural hardware encompassed by the Appendix F definition."

<u>Conclusion</u>

The above body of information testifies to the NRC (and its predecessor AEC) having established over the past 36 years a policy that excludes radioactive hulls (i.e. cladding) from the definition of high-level waste. The NRC (and its predecessor AEC) did not define the process used to separate radioactive hulls from irradiated reactor fuel. As stated earlier, the Department has applied this policy in determining the cladding removal waste stored in two tanks (designated as tanks 241-AW-103 and 241-AW-105) at the Hanford Site are not high-level waste.

Additional Information on K-Basins Knock-Out Pot Sludge

Source of Knock-Out Pot Sludge

The preparation activities for removal of N-Reactor fuel from the K-Basins included "cleaning" of the fuel elements. During these cleaning activities, the fuel and fuel storage canisters were placed into a primary cleaning machine that removed the sludge from the surface of the fuel elements. Removing the sludge from the fuel elements depended upon the sliding action of the fuel elements against one another and the release of the solid particles by the rinsing action of a water jet. The cleaning actions dislodged corrosion products, corroded uranium metal pieces, zirconium cladding, and loosely adhered materials from the surface of the fuel elements stored in the K-Basins. The removed materials were carried along in a piping system by the water used for washing the fuel. Larger pieces of material were then passed through a series of strainers and collection containers called Knock-Out Pots (KOP) and Settler Tanks.

After cleaning, the intact fuel elements were re-packed into multi canister overpacks. Damaged fuel and fuel pieces that had separated from the elements but were larger than ¼ inch were collected in special baskets, packed into multi canister overpacks and managed as spent nuclear fuel scrap/debris.

The Knock-Out Pot strainers limited the material passing through into the Knock-Out Pots to ¼ inch or less. This material that passed through the strainer then settled out in the Knock-Out Pots. Velocity of the water limited the material collected in the Knock-Out Pots to the ¼ inch maximum down to about 500 micron size. The Knock-Out Pots included an internal 500 micron filter at its outlet port assuring >500 micron particles were captured. The remaining material, less than about 500 microns, was carried along with the water to the Settler Tanks where the velocity of the water was much slower, allowing the particles to settle out. The material collected in the strainers upstream of the Knock-Out Pots was placed into temporary containers to be part of the spent fuel packaging activity. This larger than ¼ inch material will be managed as either spent nuclear fuel scrap or debris.

Knock-Out pot sludge is different from sludge formed in other parts of the K-Basin. Because this part of the N-Reactor spent fuel packing system was essentially a closed system, the sludge contained in the Knock-Out Pots and the Settler Tanks did not mingle with the sludge in other locations of the K-Basins. Thus, there is little sand, dirt, silt, and other foreign material in the sludge collected in these two locations.

Material Characteristics

The following is a review of five characteristics measured in N-Reactor spent fuel as compared to these same characteristics attributed to the KOP sludge.

Physical Characteristics

Knock-Out Pot Sludge- The KOP sludge is generated in a stream containing small particles, less than ¼ inch, without specific shape or form. The physical make-up of the sludge is not uniform, as a sample may contain mostly uranium or mostly corrosion products, or mostly cladding hydrides, etc. The cleaning action used in the fuel packaging preparation produced random size, configuration, and quantities of particles. The density of this sludge is about 10.5 grams per cubic centimeter.

N-Reactor spent fuel- The fuel elements are a precise mixture of metallic uranium and Zircaloy-2 cladding in a specific configuration, readily identifiable and retrievable for handling and packaging operations. The spent fuel elements are right cylinders, 26 inches long and 2.4 inches in diameter. The density of the spent fuel elements is 16.5 grams per cubic centimeter. At N-Reactor Basin, suspect fuel pieces discovered during deactivation were classified as spent fuel when greater than or equal to 0.25 inches, based on fissionable material content and retrievability. The fissionable material criterion was defined as 0.5 grams of ^{239}Pu, which was based on an approved safeguards plan for the N-Reactor fuel. In general, 0.5 gram of ^{239}Pu fissionable material would be an approximately 0.5 inch long piece of the outer fuel element, (2.4 inch outer diameter). As a point of comparison with other Hanford spent fuel recovery efforts, material discovered at Hanford's F-Reactor Basin was classified as spent fuel when the material was found to be pieces greater than or equal to a 1-inch long by 1 ½ inch diameter and containing less than 0.5 grams of ^{239}Pu fissionable material. This definition of SNF was based on nuclear material control requirements established in DOE O 474.1-1A, Manual for Control and Accountability of Nuclear Materials and recognizes both the attractiveness and feasibility of retrieving the material.

Chemical Characteristics[1]

Chemical Characteristics	Knock-Out Pot Sludge	KOP Sludge as %	N-Reactor Spent Fuel
Uranium, grams per cm^3	9.4	60	15.6
Metallic Uranium, grams per cm^3	9.4	60	15.6
Chemical Reactivity	High[2]	--	Low
Volume Expansion Potential, Final volume to initial volume	7.5	56	13.3

[1]The Knock-Out Pot sludge has not been sampled. All values reported are from the Spent Nuclear Fuel Project Data book, Volume 2, Sludge, HNF-SD-SNF-TI-015, Revision 12, 2004 that contains data taken from all of the sampling activities. Nominal Knock-Out Pot sludge values used in the data book, and reported here, are those used for safety analyses.

[2] Treatment is required due to the significantly larger surface area to particle mass of the KOP sludge which results in a higher level of chemical reactivity compared to N-Reactor Spent Fuel.

Fissile Characteristics

Knock-Out Pot Sludge-The fissile gram equivalent for this sludge has been conservatively assumed to be the same as that of the N-Reactor spent fuel, 9468 fissile gram equivalents per metric ton of uranium, but has not been characterized.

Radiological Characteristics [3]

Radiological Characteristics	Knock-Out Pot Sludge[4]	N-Reactor Spent Fuel[4]	KOP Sludge as % of N-Reactor SNF
Pu-238	5.04E+02	8.36E+02	72
Pu-239	9.97E+02	1.65E+03	60
Pu-240	6.48E+02	9.06E+02	71
Am-241	1.67E+03	2.77E+03	60
Cs-137	6.56E+04	1.09E+05	60

[3]All values reported are from the Spent Nuclear Fuel Project Data book, Volume 2, Sludge, HNF-SD-SNF-TI-015, Revision 12, 2004 that contains data taken from all of the sampling activities and has not been corrected for decay. Nominal Knock-Out Pot sludge values used in the data book, and reported here, are those used for safety analyses.
[4] Units are micro curies per ml

Heat Generation Characteristics

Two measures are available to evaluate the heat generation capability of irradiated material: Decay power in watts per cubic meter of material; and watts per metric ton of uranium. For the KOP Sludge, the decay power in watts per cubic meter of sludge is 690, or about 60% of the 1140 for the N-Reactor spent fuel[5].

The measurement of watts per metric ton of uranium is the same for the KOP sludge and the N-Reactor spent fuel (73)[6]. This result is not unexpected as this measurement parameter looks at an individual constituent, uranium, within the materials. The parameter does not account for the material as a whole as does the measurement of watts per cubic meter.

Although there are definite similarities evident between the KOP sludge and the N-Reactor spent fuel, an examination of the five characteristics demonstrates that the sludge exhibits characteristics that are substantially different than spent nuclear fuel.

Material Processing Overview

The KOP sludge will be removed from the KOP while still in the K-Basin. All operations will be done underwater. A criticality safe collection vessel will be placed near the KOP. The KOP lid and strainer will be removed and the accumulated material isolated from

[5,6] All values reported are from the Spent Nuclear Fuel Project Data book, Volume 2, Sludge, HNF-SD-SNF-TI-015, Revision 12, 2004 that contains data taken from all of the sampling activities. Nominal Knock-Out Pot sludge values used in the data book, and reported here, are those used for safety analyses.

the KOP sludge and managed as SNF debris. The KOP baffles (internal to the KOP) will be removed and placed into the collection vessel for cleaning by washing with a water wand. The sludge material removed in this manner will be allowed to settle in the collection vessel. The sludge within the KOP body will then be vacuumed out and discharged into the collection vessel.

The KOP sludge within the collection vessel will be transferred to the packaging facility, located in the Cold Vacuum Drying Facility (CVDF), by means of pumping a slurry, very similar to the system used for transferring the KE-Basin sludge to the KW-Basin. After transfer to the CVDF the KOP sludge will be partially dewatered and then fed forward to a corrosion vessel where the uranium metal will be oxidized to uranium oxide.

In order to reduce the potential for hydrogen gas generation caused by the reaction between uranium metal and water, the uranium metal in the KOP sludge will be oxidized through a corrosion process. Corrosion will be conducted in a moderately pressurized criticality safe corrosion vessel at 160^{o} C. It is anticipated that the corrosion time for KOP will be approximately 9-12 days per batch of sludge.

After the corrosion process, the KOP will be fed to buffer storage tanks where it is batched to a smaller assay tank where assay measurements will be taken using a BNFL Instruments IPAN ^{tm} system. The assay tank feeds to an agitated batch dosing tank to ensure homogeneity and is used to meter the correct amount of sludge into each drum.

The final process step involves the use of the BNFL Mobile Solidification System (MOSS) to grout the sludge. This system is highly automated and has steps in the process where the sludge contents are mixed with cement powders to ensure homogeneity. The grouted waste drum is then placed into interim storage awaiting final disposition.

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 waste[1] 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.

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[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.