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WESTINGHOUSE SAVANNAH RIVER COMPANY
INTEROFFICE MEMORANDUM

January 6, 2004 OBU-NMM-2003-00494

TO: O. K. MORRELL, 704-26L
P. I. HUDSON, 705-3C

FROM: B. L. WESTOVER, 704-K BLWestover

CLASSIFICATION OF THE PADUCAH CASK WASTE STREAM AS LOW-LEVEL WASTE FOR DISPOSAL

Attached is the subject "white paper" that describes the classification of the PADUCAH Cask waste stream. After a comparison with DOE Order 435.1 "Radioactive Waste Management" requirements and guidance as well as referenced statutes and requirements, the paper confirms that the PADUCAH Cask waste stream is low-level waste.

The PADUCAH Cask waste stream consists of the cask itself that contains depleted uranium metal, and cobalt slugs, cobalt slabs, thulium slugs, and curium sampler slugs. All of the items in this waste stream result from the management of the Spent Fuel Program. With the exception of the cask itself, all other items are currently stored in the L Area Disassembly Basin. The slugs and slabs were irradiated as targets in the reactors for experimental purposes. The cask was used in the past for shipment of fuel to the Savannah River Site. The Spent Fuel Project is contractually committed to disposition these items as waste.

blw

Att.

c: W. T. Goldston, 705-3C
J. M. Simmons, 704-S
W. S. J. Kelly, 705-3C
R. J. Martini, 707-C
J. W. Paveglio, 705-3C
T. J. Spieker, 707-C
D. C. Wood, 704-26L
L. T. Reid, 705-3C
D. E. Hintze, 704-S
J. L. O'Connor, 704-K
D. M. Dimmick, 704-K
D. F. Sink, 724-15E
E. L. Wilhite, 773-43A
S. L. White, 707-C
H. S. Pope, 704-S
H. M. Crapse, 704-S
G. W. Yaffee, 704-K
R. S. Osteen, 105-L
K. Tempel, 724-15E
F. B. Williams, 730-1B
D. M. Koehne, 707-C

Classification of the PADUCAH Cask Waste Stream

as Low-Level Waste for Disposal

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Author: Betsy S Westover — 12/17/03
B. L. Westover
NMM, Lead Waste Management Engineer
Date

Reviewer: L T Reid — 12/17/03
L. T. Reid
Manager, SW&I Generator Services
Date

Reviewer: W T Goldston — 12/17/03
W. T. Goldston
Solid Waste & Infrastructure
Date

Purpose

The purpose of this document is to describe a waste stream from the Spent Fuel Project that due to worker safety concerns and technological reasons (availability of facilities including equipment) can be safely packaged as low-level waste consistent with DOE Order 435.1 requirements and guidance. This Spent Fuel waste stream consists of: a PADUCAH cask that contains depleted uranium metal, and cobalt slugs, cobalt slabs, curium sampler slugs, and thulium slugs.

Description of Waste Stream

PADUCAH Waste Cask

The PADUCAH cask has been excessed and is radioactive waste. The PADUCAH cask consists of depleted uranium metal laminate clad with stainless steel. The overall cask dimensions are 36-inches diameter by 84.5-inches high. The cask consists of two (2) concentric stainless steel shells separated by 5.75-inches of laminated depleted uranium (DU). The bottom of the cask and the cover also contain DU. The inner shell is 0.25-inches thick and has a cavity of 50.75-inches long by 17-inches inner diameter. Its volume capacity is about 11, 520 in^3. The outer shell is 0.5-inches thick, 80-inches high, with a 30-inch outer diameter. There are heat transfer fins of size 3-inch by 3/16-inch on the cask outer shell. The PADUCAH cask was used in the past to ship fuel from Idaho to SRS.

Cobalt Slugs & Slabs

The cobalt slugs and slabs were irradiated to produce Co-60 for use by vendors and the United States military. As manufactured, these slugs consisted of cobalt wafers encased in aluminum averaging about 8" in length and 0.862" diameter. The cobalt slabs are rectangular in shape, encased in stainless steel and measure about 13" long, 0.15" thick and 0.8" wide. The cobalt slugs and slabs were placed in both control rod positions and one-inch diameter positions in the reactor. There are approximately 850 slugs and slabs located in the L Disassembly Basin, with a total activity of approximately 126,780 Ci. The maximum radiation dose is approximately 60 R/hr per piece.

Thulium Slugs

In the mid-1970s the thulium slugs were also irradiated in control rod positions in the reactor and are of similar size and shape as the cobalt slugs. There are approximately nine thulium slugs located in the L Disassembly Basin. As Thulium-170 has a half-life of 128.6 days, the total activity is considered to be 0 Ci.

Curium Sampler Slugs

The curium sampler slugs were irradiated in the 105-C reactor in the 1960s/1970s in thimble positions. As manufactured, these slugs were solid cylinders about 14" long and

0.94" in diameter. The fissile material in each slug is in a central cylindrical Pu-Al pin measuring about 8" in length and 1/8" in diameter. Each pin contained approximately 100 mg of Pu-239 before irradiation. Each slug also contained a small piece of cobalt wire. These slugs were part of a larger campaign to produce kilogram quantities of curium-244 (Cm-244) from Pu-239. The slugs were not designed to make production quantities of Cm-244 but instead were to provide test irradiation samples that could be analyzed to monitor the progress of Pu burnup in the initial stages of Cm-244 production. There are approximately 18 curium sampler slugs in the L Disassembly Basin with a total activity of approximately 2.19 Ci, of which 3.62E-05 Ci come from Co-60. The maximum radiation dose is approximately 3 R/hr per piece. The concentration of Pu-239 is 2.21E+00 nCi/g for the entire waste stream and 4070 nCi/g for the slugs themselves. This is the only known remaining inventory of curium slugs at SRS.

Spent Nuclear Fuel Determination

DOE Order 435.1 Guidance, Section IV.A, on page IV-3, defines Spent Nuclear Fuel (SNF) as "...fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing." None of the items in this waste stream are considered to be DOE-managed SNF. SNF refers to the spent fuel rods and assemblies as they are managed upon removal from a reactor. All of the items, with the exclusion of the cask itself, were irradiated as targets in the reactor for experimental purposes and not as fuel. Therefore, the SNF exclusion from low-level waste does not apply.

Discussion

The materials described above have been determined to be waste. These waste materials include the cobalt slugs and slabs, curium sampler slugs, thulium slugs, and the PUDUCAH shipping cask. After evaluation it was determined that use of existing facilities and equipment in L Disassembly Basin would provide the required worker protection if the highly radioactive waste items were packaged inside of the waste cask. This can be accomplished with existing facilities (the L-Basin and its equipment) by loading the waste items into the waste cask under water in the L Area Disassembly Basin. As mentioned before, the slugs are currently located in the L Area Basin and the waste cask is nearby. The cask would be loaded under water, closed, then brought out of the basin for draining, prepared for shipment, and the waste package would be characterized.

Through utilization of existing facilities and the waste cask, worker protection can be achieved in a cost-effective manner. The waste PADUCAH cask contains depleted uranium that will provide the necessary packaging and radiation attenuation to allow workers to prepare and transfer the waste to disposal. The slugs that will be loaded into the waste cask exhibit a maximum dose of approximately 60 R/hr per piece so radiation attenuation is necessary to protect worker safety.

As described above, the waste slugs and slabs exhibit high radiation in the order of 60 R/hr per piece (maximum). Segregation and removal of each type of waste from the L-

Basin cannot be accomplished with existing equipment and facilities. Segregation may be able to be accomplished by removing the items and placing them in a shipping container that was designed with added shielding for worker protection. If the 18 curium sampler slugs were removed separately and packaged in a newly constructed shipping container, shielding would be required to be added to the container and controls (both engineered and administrative) would be required to reduce worker exposure to the radiation from the curium sampler slugs. The separation of these waste items would not only require development of new equipment, but due to the transuranic content of these curium sampler slugs, they would, if characterized as a separate waste package, be above 100 nCi/g TRU and thus considered remote handled TRU waste. The new shielded shipping package that would need to be developed would also be required to meet the shipping requirements for shipping remote handled TRU waste to WIPP. Currently WIPP cannot receive remote handled TRU waste for disposal. Were this waste segregated from the waste stream in L-Basin, a waste with no path to disposal would be generated and consistent with DOE 435.1 requirements; approval from the DOE-SR Manager to generate this waste would be required. However, generation of waste with no path to disposal is highly discouraged by DOE Order 435.1.

The waste cask includes waste depleted uranium. A Special Analysis (SA) is being conducted to ensure that the entire waste stream as packaged in the cask will meet the performance objectives for LLW disposal in accordance with DOE 435.1 Requirement. The Unreviewed Disposal Question (UDQ) Evaluation conducted for this waste determined that the waste depleted uranium metal would not meet performance objectives without taking credit for the containment of the uranium by the steel cask outer walls. The SA must be approved by DOE-SR before this waste can be disposed. The waste slugs containing cobalt, thulium, and curium were shown in the UDQE to be well within the performance objectives, but the SA will confirm this. Therefore, all of this waste stream including the uranium in the cask will be demonstrated to meet LLW performance objectives prior to disposal.

DOE Order 435.1 Guidance, Section III.A. indicates that worker safety should be a matter of high importance and that technological rationale should be applied when deciding how to process a waste stream. In P.III-3 the Guidance states, "It is also recognized that actions taken to process a waste stream for safety or technological reasons that are justified, may result in the waste being reclassified after processing as low-level waste." Due to the fact that (as described above) the curium sampler slugs are remote handled waste and they are located in the L-Basin with the other slugs that are highly radioactive, the technology and equipment exists in L-Basin to package these wastes into the existing waste PADUCAH cask in a manner that is protective of the workers. No other equipment or facilities currently exist to perform these tasks safely. The use of the waste PADUCAH cask will allow safe handling of the highly radioactive slugs since the waste depleted uranium in the cask will provide the necessary attenuation of the radiation to protect the workers.

DOE Order 435.1 Guidance Section III-A also requires that classification of waste be determined at "the time of waste certification, that is, each time the waste is transferred to

another person or facility." The waste stream as packaged must be certified after it is prepared to be transferred to the LLW disposal facilities. In this case, the waste stream consists of the waste cask containing depleted uranium, the cobalt slugs and slabs, thulium slugs, and the curium sampler slugs. As previously discussed, the waste stream is being processed and prepared for LLW disposal using existing technology, facilities, and equipment to prepare the waste safely (protect the workers from intense radiation), and as a result the waste stream is expected to be classified after this preparation as low-level waste. The 18 remote handled, radioactive curium sampler slugs (total activity 2.19 Ci) prepared and packaged with the other items in this waste stream (depleted uranium, cobalt, and thulium) results in a waste package that is less than 100 nCi/gm transuranic, thus it is classified as LLW. It should be noted that the depleted uranium, although providing necessary radiation attenuation to protect workers, is waste and is an inherent part of the waste stream. Therefore the mass of the depleted uranium is properly included in determining whether the waste stream is TRU or not. No shielding will be added to shield this waste stream. If shielding were required to be added, the shielding mass could not be used to classify the waste stream as TRU or not.

Conclusion

In summary, actions are being taken to process this waste stream for safety and technological reasons that result in this waste stream being classified as low-level waste after it is properly processed and packaged. The certification of the entire waste package will take place after removal of the waste from L-Basin and classification of the waste package will result in a determination that the waste stream is low-level waste in accordance with DOE 435.1.