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Accession #: D196012375

Document #: SD-SNF-HC-010

Title/Desc:

HAZARD CATEGORIZATION OF 105KE BASIN DEBRIS
REMOVAL PROJECT

Pages: 11

stx#19

JAN 25 1996

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT

701976

2. To: (Receiving Organization)

K Basins Projects

3. From: (Originating Organization)

K Basins Standards and Requirements

5. Proj./Prog./Dept./Div.:
K Basin Debris Removal

6. Cog. Engr.:
R. H. Meichle

8. Originator Remarks:

For Release

4. Related EDT No.:

140734

7. Purchase Order No.:

9. Equip./Component No.:

10. System/Bldg./Facility:

105KE

12. Major Assem. Dwg. No.:

13. Permit/Permit Application No.:

14. Required Response Date:

11. Receiver Remarks:

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-SNF-HC-010	-	0	Hazard Categorization 105-KE Basin Removal Project DEBRIS	S			

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, O, D OR N/A (See WHC-CM-3-5, Sec. 12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

(G)	(H)	17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)	(G)	(H)
Reason	Disp.	(J) Name (K) Signature (L) Date (M) MSIN	Reason	Disp.
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Hazard Categorization of 105-KE Basin Debris Removal Project

RH Meichle

Westinghouse Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: 701976 UC: 500
Org Code: 2A100 Charge Code: 1d006
B&R Code: EW3135040 Total Pages: 8

Key Words: Hazard Categorization, Debris Removal, Canister Cleaning,
105KE Basin

Abstract: This supporting document provides the hazard categorization
for 105-KE Basin Debris Removal Project activities planned in the K east
Basin. All activities are categorized as less than Hazard Category 3.

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HAZARD CATEGORIZATION OF 105-KE BASIN DEBRIS REMOVAL PROJECT

1.0 PURPOSE AND SCOPE

The purpose of this document is to provide a hazard categorization of the activities associated with the KE Basin Debris Removal Project. Hazard Categorization utilizes the method provided by DOE Standard DOE-STD-1027-92 (Reference 1). The Project is to remove empty canisters, old fuel handling tools and equipment, and miscellaneous articles dropped into the basin. No removal of spent fuel, neutron activated material, or sludge other than incidental quantities is to be made by the Project. However, sludge moving in the basin is addressed. The Process Description upon which this categorization is based is contained in WHC-SD-SNF-SP-003 Rev 0 (Reference 2).

2.0 SUMMARY

All activities associated with the KE Basin Debris Removal are less than Hazard Category 3.

No significant nonradioactive risks were identified.

3.0 DESCRIPTION OF SIGNIFICANT ACTIVITIES

The scope of the debris removal activities which impact hazard categorization are:

- Pumping of sludge.
- Removal of debris from KE Basin access/egress paths.
- Eventual removal of all debris from basin.
- Sizing and Packaging of debris for disposition.
- Shipment of debris for disposal.

New system/equipment of importance are:

- High Pressure Water Jet System. A high pressure (up to 15,000 psi at nozzle with flow rates up to 15 gpm) water jet system to remove most of surface oxidation and contaminations.
- Drip Dry/Bag Out Enclosures. An enclosure with High Efficiency Particulate Filter (HEPA) with drying racks and bag-out port to limit airborne contamination of building atmosphere.
- Vacuum System to Relocate Sludge. A system to move and collect sludge with use of vacuum pumps.
- Water Clarity Equipment (filters).

4.0 HAZARD CATEGORIZATION

The methodology of DOE Standard DOE-STD-1027-92 (Reference 1) is utilized for this hazard categorization. This methodology establishes the hazard categorization based upon the potential airborne release from the inventory of radioactive materials including form as processed.

The form of material when handled under water is considered to include the effect of the water on the release path for the radioactive material. For such handling, the amount of radioactive material being handled or that can be impacted by the handling is compared the Threshold values of reference 1 which are multiplied by the conservatively assumed decontamination factor (DF) for water of 10^4 (Reference 3). For radioactive material out of the basin the Threshold value of reference 2 are used unaltered. Source terms were taken from Reference 4.

4.1 Underwater Activities

The maximum amount of fuel or sludge that the underwater activities present a hazard to is used to compare to the Categorization thresholds. These thresholds have been increased by the DF of 10^4 . The amount of radioactive material that can be at risk and still be less than Category 3 must be less than the amount of fuel in 18.5 canisters (13,400 lbs) per Table 1, or less than 5.92 E+05 pounds of sludge (Weasel pit) per Table 2. Table 3 shows the amount of KE Sand Filter Backwash Pit sludge for Category 3 threshold as 169 lbs. The amount of basin water to exceed Category 3 threshold values is 225,000 gallons per Table 4.

A review of Reference 2 indicates that all activities will involve and/or impact less than threshold quantities of radioactive material as discussed below.

- Impact on stored fuel - No large or heavy loads that could impact 18 canisters of fuel are to be used.
- Sludge pumping - The amount of sludge pumped at any one time will be less than the 5.95 E+05 pounds and there is not a large enough energy source to produce significant airborne radioactive material releases. Used filters will be stored underwater in canisters for later removal and the release potential is less than prior to processing. Sludge pumping is an activity that has been performed several times in the past.
- High pressure water jet operations - These operations are performed on single components under water and are localized so the amount of fuel and sludge that can be affected is small. Even if a canister loaded with fuel mistakenly selected rather than an empty canister only one canister is affected. The debris will only have surface contamination so that large quantities of radioactive material will not be present when cleaning and the maximum amount of radioactive material will be bounded by the amount in one canister.

- The High pressure water jet or water clarity equipment leaks - Such equipment would have to run for 24 hours at 150 gpm to remove 225,000 gallons from the pool. Since activities are only performed when the basin is manned this is judged to be an incredible scenario.
- Water clarity filter media - Spent filters will be stored underwater in canisters for later removal. The amount of radioactive material in such canisters will be less than for canisters with fuel. At no time will even 18 canisters with filters have the potential for release. Therefore this activity does not lead to inventories in excess of Category 3 threshold with water DF.

4.2 Debris Removal from Pool

The amount of material considered that presents a hazard is based on anticipated upper bounds of residual radioactive material assuming nominal operation of cleaning, drying, and inspection process. Therefore, removal of canisters or other debris with fuel elements or pieces of fuel or even visible quantities of radioactive material or sludge is not considered for the purposes of hazard categorization of the activity. Removal from the pool of a canister containing a fuel assembly was addressed by the Preliminary Hazard Assessment (Reference 6) and was identified as an extremely unlikely event and shown to have acceptable public and onsite dose consequences by the safety analysis. Evaluation of the storage boxes will be based on the conservative assumption that the inventory is equal to the threshold for TRU (100 nanocuries per gram). The Category 3 threshold quantities of radioactive material in various forms out of the pool is 1.3 pounds of uranium metal, 1.5 pounds of uranium oxide, 59.2 pounds of weasel pit sludge, or 169 pounds of sandfilter backwash pit sludge.

- Lifting of debris out of the pool - Uranium metal or oxide by themselves are not expected to be the form of material that would be a contaminant on the canisters or debris and, if it were, the cleaning process would be effective in removing the bulk of such a contaminant such that Cat 3 threshold values would not be exceeded by a single removal action. Contaminants are assumed to be similar to sludge and 59.2 pounds would be noticeable, and in fact Kg quantities would not be expected to be present after cleaning. Therefore, single canister removal would not result in removal from the basin of a Category 3 inventory of radioactive material.
- Debris removal from pool and placement in burial boxes - Reference 1 estimates that burial boxes will contain 18 empty canisters. Based on a weight of approximately 31.25 lbs per canister the TRU contamination would have to be 20 times over the TRU limit of 100 nanocuries per gram to exceed the Category 3 threshold (See Table 5). This provides sufficient margin to consider the radioactive material inventory of a box to be less than Category 3. This also allows for storage of several boxes subject to a single release event.

- Drip Dry/Bag Out Enclosures HEPA - An enclosure with High Efficiency Particulate Filter (HEPA) with drying racks and bag-out port to limit airborne contamination of building atmosphere will collect contamination. However, only a fraction of the radioactive material inventory that is removed from the pool will become airborne and be adsorbed by the filter or on the surface of the enclosure. Assuming that the airborne release that is absorbed by the filter is uranium oxide, and assuming that the filter media absorbs the Category 3 threshold amount of 1.5 pounds, the total amount of uranium oxide removed from the pool would have to have been 1500 pounds. This calculation used the 10^{-3} fraction from DOE-STD-1027-92 for solid/powders/liquids. Since the bulk of the material removed from the pool is assumed to be sludge, the sludge equivalent of 1500 pounds of Oxide would be 59,200 pounds. This is considered incredible since this amount of sludge would essentially be equal to the weight of the 1800 canisters being removed. Therefore the filter loading will never exceed Category 3 threshold amounts.

4.3 Nonradioactive Hazards

The major nonradioactive hazard is from the high pressure water. Implementation of Water Jet Association recommended practices (Reference 5) provides adequate control of this hazard.

5.0 REFERENCES

1. DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance With DOE Order 5480.23, Nuclear Safety Analysis Reports", December 1992.
2. WHC-SD-SNF-SP-003, Rev. 0, "Process Description K Basin Debris Removal", J. B. Crystal, August 9, 1995.
3. WHC-SD-SNF-SARR-001, Rev 0, "Review of the Consequences of Uranium Hydride Formation in N-Reactor Fuel Elements Stored in the K Basins," Weber, J. W., 1994
4. WHC-SD-SNF-RA-001, Rev. 0, "K Basin Safety Analysis," Porten, D. R., and R. D. Crowe, 1994.
5. "Recommended Practices for the Use of Manually Operated High Pressure Water Jetting Equipment" prepared by Water Jet Technology Association, 1994.
6. WHC-SD-SNF-PHA-001, Rev. 0, Preliminary Hazards Analysis of K Basins Fuel Encapsulation and Storage, Strickland, G. C., 1994.

TABLE 1 CATEGORY 3 THRESHOLD QUANTITIES OF URANIUM AND URANIUM OXIDE IN AND OUT OF THE POOL					
RADIONUCLIDE i IN URANIUM	CURIES/MTU URANIUM	CAT 3 THRESHOLD Ci	CAT 3 THRESHOLD WITH WATER DF of 10E+04 Ci	B(i)/D(i)	B(i)/C(i)
	B(i)	C(i)	D(i)		
Y-90*	5.80E+03	2.10E+02	2.10E+06	2.76E-03	2.76E+01
Sr-90	5.80E+03	1.60E+01	1.60E+05	3.63E-02	3.63E+02
Ru-106	5.20E+01	1.00E+02	1.00E+06	5.20E-05	5.20E-01
Sb-125*	1.20E+02	2.10E+02	2.10E+06	5.71E-05	5.71E-01
Te-125M*	3.00E+01	2.10E+02	2.10E+06	1.43E-05	1.43E-01
Pr-144M*	3.30E-01	2.10E+02	2.10E+06	1.57E-07	1.57E-03
Pr-144*	2.80E+01	2.10E+02	2.10E+06	1.33E-05	1.33E-01
Ce-144	2.80E+01	1.00E+02	1.00E+06	2.80E-05	2.80E-01
Cs-134	1.30E+02	4.20E+01	4.20E+05	3.10E-04	3.10E+00
Cs-137	7.30E+03	6.00E+01	6.00E+05	1.22E-02	1.22E+02
Pm-147	2.00E+03	1.00E+03	1.00E+07	2.00E-04	2.00E+00
Eu-154	8.80E+01	2.00E+02	2.00E+06	4.40E-05	4.40E-01
U-235	2.68E-02	4.20E+00	4.20E+04	6.38E-07	6.38E-03
U-238	3.29E-01	4.20E+00	4.20E+04	7.83E-06	7.83E-02
Pu-236*	2.20E-04	5.20E-01	5.20E+03	4.23E-08	4.23E-04
Pu-238	4.80E+01	6.20E-01	6.20E+03	7.74E-03	7.74E+01
Pu-239	1.10E+02	5.20E-01	5.20E+03	2.12E-02	2.12E+02
Pu-240*	5.80E+01	5.20E-01	5.20E+03	1.12E-02	1.12E+02
Pu-241	4.40E+03	3.20E+01	3.20E+05	1.38E-02	1.38E+02
Pu-242*	2.10E+02	5.20E-01	5.20E+03	4.04E-02	4.04E+02
Am-241	9.30E+01	5.20E-01	5.20E+03	1.79E-02	1.79E+02
Cm-244*	4.60E+00	5.20E-01	5.20E+03	8.85E-04	8.85E+00
			Totals	1.65E-01	1.65E+03
Metric tons to exceed Category 3 Threshold				6.07E+00	6.07E-04
KGS METAL FUEL TO EXCEED CATEGORY 3 THRESHOLD				6.07E+03	6.07E+00
POUNDS METAL FUEL TO EXCEED CATEGORY 3 THRESHOLD				1.34E+04	1.34E+00
KGS OXIDE FUEL TO EXCEED CATEGORY 3 THRESHOLD				6.88E+03	6.88E+00
POUNDS OXIDE FUEL TO EXCEED CATEGORY 3 THRESHOLD				1.52E+03	1.52E+00
NO. CANISTERS TO EXCEED CATEGORY 3 THRESHOLD				1.85E+01	1.85E-03

TABLE 2 CATEGORY 3 THRESHOLD QUANTITIES OF SLUDGE (WEASEL PIT)			
RADIONUCLIDE i IN SLUDGE	SLUDGE MICRO-CURIES PER GRAM B(i)	CAT 3 THRESHOLD Curies C(i)	$B(i)*1E-06/C(i)$
Y-90*	88.1	2.10E+02	4.20E-07
Sr-90	88.1	1.60E+01	5.51E-06
Cs-137	42.8	6.00E+01	7.13E-07
Pu-238	1.2	6.20E-01	1.94E-06
Pu-239	6.8	5.20E-01	1.31E-05
Am-241	8.1	5.20E-01	1.56E-05
		Total	3.72E-05
Grams of sludge to exceed Cat 3 Threshold			2.69E+04
Kilograms of sludge to exceed Cat 3 Threshold			2.68E+01
Pounds of sludge to exceed Cat 3 Threshold			5.92E+01
Pounds of sludge to exceed Cat 3 Threshold with DF of 1.0E+04			5.922E+05

TABLE 3 CATEGORY 3 THRESHOLD QUANTITIES OF SLUDGE (KE SFBWP)			
RADIONUCLIDE i IN SLUDGE	SLUDGE MICRO-CURIES PER GRAM (B _i)	CAT 3 THRESHOLD CURIES (C _i)	$(B_i)*1E-06/(C_i)$
Y-90*	5.40E+01	2.10E+02	2.57E-07
Sr-90	5.40E+01	1.60E+01	3.38E-06
Cs-137	4.88E+01	6.00E+01	8.13E-07
Pu-238	3.90E-01	6.20E-01	6.29E-07
Pu-239	2.25E+00	5.20E-01	4.33E-06
Am-241	1.89E+00	5.20E-01	3.63E-06
		Total	1.30E-05
Grams of sludge to exceed Cat 3 Threshold			7.67E+04
Kilograms of sludge to exceed Cat 3 Threshold			7.67E+01
Pounds of sludge to exceed Cat 3 Threshold			1.69E+02
Pounds of sludge to exceed Cat 3 Threshold with DF of 1.0E+04			1.69E+05

TABLE 4 CATEGORY 3 THRESHOLD QUANTITIES OF KE BASIN WATER			
RADIONUCLIDE (i)	WATER MICRO-CURIES PER LITER B(i)	CAT 3 THRESHOLD CURIES C(i)	$B(i)*1E-06/C(i)$
H-3	3.40E+00	1.00E+03	3.40E-09
Y-90*	2.50E+00	2.10E+02	1.19E-08
Sr-90	2.50E+00	1.60E+01	1.56E-07
Cs-137	6.10E+00	6.00E+01	1.02E-07
Pu-238	6.90E-02	6.20E-01	1.11E-07
Pu-239	3.30E-01	5.20E-01	6.35E-07
Am-241	7.00E-03	5.20E-01	1.35E-08
		TOTALS	1.03E-06
CATEGORY 3 THRESHOLD LITERS			9.68E+05
CATEGORY 3 THRESHOLD GALLONS			2.56E+05
GPM FOR 24 HOURS TO REACH CATEGORY 3 THRESHOLD			1.78E+02

TABLE 5 CATEGORY 3 QUANTITIES OF TRU		
CURIES TRU PER GRAM (1) B	CAT 3 THRESHOLD CURIES(2) C	RATIO B/C
1.00E-07	5.20E-01	1.92E-07
GRAMS TRU TO EXCEED CATEGORY 3 THRESHOLD		5.20E+06
LBS TRU TO EXCEED CATEGORY 3 THRESHOLD		1.15E+04
(1) MINIMUM VALUE FOR TRU		
(2) MINIMUM THRESHOLD VALUE USED		

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Standards and Requirements	Date 01/25/96
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