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WHC-SD-SNF-HC-001, K Basins Fuel Encapsulation and Storage Hazard Categorization, L11EP		ECN No. N/A

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Hazard Categorization, K-Basins, fuel encapsulation, etc.	Name: D. R. Porten Dan Porten Signature Organization/Charge Code 8D143/L11EP

7. Abstract

This document establishes the initial hazard categorization for K-Basin fuel encapsulation and storage in the 100 K Area of the Hanford site.

The Hazard Categorization for K-Basins addresses the potential for release of radioactive and non-radioactive hazardous material located in the K-Basins and their supporting facilities. The Hazard Categorization covers the hazards associated with normal K-Basin fuel storage and handling operations, fuel encapsulation, sludge encapsulation, and canister clean-up and disposal.

The criteria categorizes a facility based on total curies per radionuclide located in the facility. Tables 5-3 and 5-4 display the results in section 5.0.

In accordance with DOE-STD-1027 and the analysis provided in section 5.0, the K East Basin fuel encapsulation and storage activity and the K West Basin storage are classified as a "Category 2" Facility.

8. RELEASE STAMP

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MASTER

K-BASINS FUEL ENCAPSULATION AND STORAGE HAZARD CATEGORIZATION

WESTINGHOUSE HANFORD COMPANY

DECEMBER 1994

For the U.S. Department of Energy
Contract DE-AC06-87RL10930

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CONTENTS

TABLES

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K-BASIN FUEL ENCAPSULATION AND STORAGE HAZARD CATEGORIZATION

1.0 INTRODUCTION

This document establishes the initial hazard categorization for K-Basin fuel encapsulation and storage in the 100 K Area of the Hanford site.

The Hazard Categorization for K-Basins addresses the potential for release of radioactive and non-radioactive hazardous material located in the K-Basins and their supporting facilities. The Hazard Categorization covers the hazards associated with normal K-Basin fuel storage and handling operations, fuel encapsulation, sludge encapsulation, and canister clean-up and disposal.

2.0 METHODOLOGY

The facility hazard categorization was developed using the uniform methodology under the DOE-STD-1027-92, *DOE Standard: Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, (DOE 1992). WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*, is currently being revised to include the requirements and guidance of the DOE technical standards into Westinghouse Hanford Company procedures. The criteria categorizes a facility based on total curies per radionuclide located in the facility. Tables 5-3 and 5-4 display the results in section 5.0.

3.0 RESULTS AND CONCLUSIONS

In accordance with DOE-STD-1027 and the analysis provided in section 5.0, the K East Basin fuel encapsulation and storage activity and the K West Basin storage are classified as a "Category 2" Facility.

4.0 FACILITY DESCRIPTION

The K Basins, two rectangular concrete fuel basins adjacent to the K East and K West Reactors, were built in 1951 to temporarily store irradiated fuel prior to reprocessing at PUREX. About 125 feet long and 67 feet wide, the two fuel basins together are about half the size of a football field. Each basin is 21 feet deep and divided into three sections. They sit a few hundred yards apart, about a quarter mile from the Columbia River.

The K reactors were shut down in 1970 and 1971 and the stored fuel was shipped to the 200-E Area for processing. The storage basins were then unused, but kept filled with water, until 1975 when the K East basin began accepting fuel from N Reactor. N Reactor at this time was operating in an electrical power generation mode. In order to accept the N Reactor fuel, the Basins were modified to provide for storage and handling of the N Reactor fuel. Each modification included a recirculating system for the fuel basin coolant with in-line filters, an ion exchange system, a sand filter system, and instrumentation to monitor radiation levels, heat generation rate, and fuel basin coolant level. Storage racks for the N Reactor fuel canisters were installed on the floor of the fuel basins.

The K East Basin was modified under Project-H-501 and placed in service in June 1975. These modifications were basically the same as those made under Project H-508 at K West which began service in February 1981. The only significant differences between the two as modified and used are:

The K West Basin was coated with a pliable epoxy sealant,

Only encapsulated canisters of fuel elements are stored in K West Basin,

The K East Basin storage racks contain open canisters of fuel elements,

The PUREX plant was shut down in 1972 after all of Hanford's Single Pass Reactor fuel inventory had been reprocessed. N Reactor kept running until 1987, discharging irradiated fuel, much of which was stored in the K Basins. PUREX resumed operation in 1983, but the plant was permanently closed in 1989 before all the irradiated fuel stored at the K Basins could be reprocessed.

A fuel segregation program in the K East Basin was initiated in 1982 which provided the capability to segregate N Reactor fuel by Pu-240 content into weapons, low-blend, high-blend, and remains stock. This activity took place in the K East Basin discharge-pickup chute area. The fuel segregation, which resulted in the removal of weapons grade Plutonium from the KE Basin and subsequent processing in the PUREX plant, was completed in 1984 and the equipment was removed.

Today, N Reactor irradiated fuel elements contained in canisters, some dating back to 1975, are stored upright in metal racks beneath 16 feet of water that acts as a radiation shield. There are 3,668 unencapsulated canisters in the East Basin and approximately 3800 encapsulated canisters in K West Basin.

5.0 RADIOLOGICAL HAZARD CATEGORY ANALYSIS

According to DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, a facility is categorized based on the radiological inventory. There are two conditions that must be evaluated to determine a facilities hazard category: 1) the radionuclide quantities in the facility's inventory are less than threshold quantities as mandated in Attachment 1 of DOE-STD-1027-92, and

2) the sum of the ratios of the quantity of each material to the Category threshold quantities does not exceed one.

The inventories of the two basins, K East, and K West, will each be treated separately in this hazard category analysis. The basin inventories were segmented because there are significant differences between the two, i.e. K West has encapsulated canisters while K East has unencapsulated canisters and sludge in the basin, that may affect later analyses.

5.1 RADIOLOGICAL INVENTORY FOR HAZARD CATEGORY ANALYSIS

Irradiated fuel in the two basins is primarily the product of the N Reactor electrical power generation mode of operation which resulted in ^{240}Pu concentrations of about 12% in the irradiated fuel. Wittekind 1994 contains a tabulation of fuel in the K basins by the weight percents of ^{240}Pu and the associated quantities. A weighting of these values for both K East and K West yields 12% ^{240}Pu as the most representive value. This is the case for both basins, despite the fact that the segregation program only affected the K East Basin where 6% ^{240}Pu was preferentially removed.

The isotopic distribution and associated curie amounts per 1 metric ton of 12% ^{240}Pu irradiated fuel is given in Appendix A and is included in the following two tables where the radiological inventory for each basin is determined. These distributions were obtained from Hendengren 1993a, Hendengren 1993b, and Hendengren 1993c.

Appendix B contains inventories of the fuel in the two basins (Conn 1990). From those inventories, it can be seen that the irradiated fuel had a mixture of initial enrichments ranging from 0.71% to 1.25% ^{235}U. Based on the data from Wittekind 1994, it is assumed in this analysis that the composition of the radionuclides in the irradiated fuel is independent of the initial enrichments, therefore the radionuclides evaluated in this hazard categorization are those that would be present in fuel with 12% ^{240}Pu concentration.

From Appendix B which contains inventories of the fuel in the two basins, the tables for the K East Basin indicate there is a total of 2,534,357.9 lbs (2,515,049.0 lbs + 19,308.9 lbs) of irradiated fuel, and in the K West Basin there is a total of 2,112,377.0 lbs (1,395,012.0 lbs + 2,477.0 lbs + 714,888.0 lbs).

Converting lbs to Metric Tons (MT) for K East yields:

$$2{,}534{,}357.9 \text{ lbs} \times 0.4536 \frac{\text{kg}}{\text{lb}} \times \frac{1 \text{ MT}}{1000 \text{ kg}} = 1{,}149.6 \text{ MT}$$

And likewise for K West:

$$2{,}112{,}377.0 \text{ lbs} \times 0.4536 \frac{\text{kg}}{\text{lb}} \times \frac{1 \text{ MT}}{1000 \text{ kg}} = 958.2 \text{ MT}$$

Not included in the above values is the amount of Single Pass Reactor (SPR) fuel in the basins. From Bergsman 1993, it has been determined that

there are 3.37 MTU of the SPR fuel at Hanford. The majority is 2.87 MTU of highly depleted uranium contained in 779 fuel elements stored at PUREX. The remaining 0.50 MTU of the SPR fuel is natural or enriched uranium contained in 185 fuel elements; 0.40 MTU in 138 elements within the KE Basin and 0.10 MTU in 47 fuel elements within the KW Basin. Most of this fuel is residual material from the 105-KE and the 105-KW Reactors, but also includes fuel from the clean out of the 105-C and 105-D Storage Basins. With the addition of this fuel, the amount of irradiated fuel in K East Basin is 1,150.0 MTU and 958.3 MTU in K West Basin.

The inventory in curies for each isotope is then determined by multiplying the value for Curies/MT by the MT's in the basin.

As an example, for Pu-236 in the K East Basin:

2.2 E-04 Ci/MT x 1.15 E+03 MT = 2.5 E-01 Ci

Sludge consisting of corrosion products from damaged fuel is present in the K East Basin. The sludge activity was originally part of the fuel inventory and has not been separated from it. No further accounting for the sludge activity is required in this analysis. In addition, according to the data supplied in Appendix C (Morton 1991), the sludge curie content is orders of magnitude less than that of the fuel inventory and its subtraction or addition would not affect the analysis.

Table 5-1. Radiological Inventory Distribution for K East Basin.

Radionuclide	Isotopic Content[1] (Curies per Metric Ton)	Inventory[2] (Curies)
Pu-236	2.2 E-04	2.5 E-01
Pu-238	4.8 E+01	5.5 E+04
Pu-239	1.1 E+02	1.3 E+05
Pu-240	5.8 E+01	6.7 E+04
Pu-241	4.4 E+03	5.1 E+06
Pu-242	2.1 E-02	2.4 E+01
Am-241	9.3 E+01	1.1 E+05
Cm-244	4.6 E+00	5.3 E+03
Eu-154	8.8 E+01	1.0 E+05
Cs-134	1.3 E+02	1.5 E+05
Cs-137	7.3 E+03	8.4 E+06
Ce-144	2.8 E+01	3.2 E+04
Pr-144	2.8 E+01	3.2 E+04
Pr-144M	3.3 E-01	3.8 E+02
Pm-147	2.0 E+03	2.3 E+06
Sb-125	1.2 E+02	1.4 E+05
Te-125M	3.0 E+01	3.4 E+04
Ru-106	5.2 E+01	6.0 E+04
Sr-90	5.8 E+03	6.7 E+06
Y -90	5.8 E+03	6.7 E+06

[1]See Appendix A for inventory basis
[2]Curies = Ci/MT x 1.15 E+3 MT

Table 5-2. Radiological Inventory Distribution for K West Basin.

Radionuclide	Isotopic Content[1] (Curies per Metric Ton)	Inventory[2] (Curies)
Pu-236	2.2 E-04	2.0 E-01
Pu-238	4.8 E+01	4.6 E+04
Pu-239	1.1 E+02	1.0 E+05
Pu-240	5.8 E+01	5.6 E+04
Pu-241	4.4 E+03	4.2 E+06
Pu-242	2.1 E-02	2.0 E+01
Am-241	9.3 E+01	8.9 E+04
Cm-244	4.6 E+00	4.4 E+03
Eu-154	8.8 E+01	8.4 E+04
Cs-134	1.3 E+02	1.2 E+05
Cs-137	7.3 E+03	7.0 E+06
Ce-144	2.8 E+01	2.7 E+04
Pr-144	2.8 E+01	2.7 E+04
Pr-144M	3.3 E-01	3.2 E+02
Pm-147	2.0 E+03	1.9 E+06
Sb-125	1.2 E+02	1.1 E+05
Te-125M	3.0 E+01	2.9 E+04
Ru-106	5.2 E+01	5.0 E+04
Sr-90	5.8 E+03	5.6 E+06
Y -90	5.8 E+03	5.6 E+06

[1]See Appendix A for inventory basis
[2]Curies = Ci/MT x 9.58 E+2 MT

5.2 RADIOLOGICAL HAZARD CATEGORY ANALYSIS

The facility hazard category for K East Basin was calculated (see Table 5-3) using the radiological inventory identified in Table 5-1.

Table 5-3. Hazard Category Determination for K East Basin.

Radionuclide	Inventory (Curies)	Category 2 Threshold (Curies)	Ratio of Facility Inventory/Category 2 Criteria
Pu-236	2.5 E-01	5.5 E+01	4.5 E-03
Pu-238	5.5 E+04	6.2 E+01	8.9 E+02
Pu-239	1.3 E+05	5.6 E+01[1]	2.3 E+03
Pu-240	6.7 E+04	5.5 E+01	1.2 E+03
Pu-241	5.1 E+06	2.9 E+03	1.8 E+03
Pu-242	2.4 E+01	5.5 E+01	4.4 E-01
Am-241	1.1 E+05	5.5 E+01	2.0 E+03
Cm-244	5.3 E+03	5.5 E+01	9.6 E+01
Eu-154	1.0 E+05	1.1 E+05	9.1 E-01
Cs-134	1.5 E+05	6.0 E+04	2.5 E+00
Cs-137	8.4 E+06	8.9 E+04	9.4 E+01
Ce-144	3.2 E+04	8.2 E+04	3.9 E-01
Pr-144	3.2 E+04	4.3 E+05	7.4 E-02
Pr-144M	3.8 E+02	4.3 E+05	8.8 E-04
Pm-147	2.3 E+06	8.4 E+05	2.7 E+00
Sb-125	1.4 E+05	4.3 E+05	3.3 E-01
Te-125M	3.4 E+04	4.3 E+05	7.9 E-02
Ru-106	6.0 E+04	6.5 E+03	9.2 E+00
Sr-90	6.7 E+06	2.2 E+04	3.0 E+02
Y -90	6.7 E+06	4.3 E+05	1.6 E+01
		Sum of the Ratios	8.7 E+03

The facility radionuclide inventory was compared to the Category 2 criteria shown in Table 5-3. The total curies exceeded Category 3 threshold curie criteria, therefore, the comparison was performed to the Category 2 threshold curie criteria. The results of this comparison indicated that the radionuclides exceeded the Category 2 threshold curie criteria. As required in DOE 1992, the sum of the ratios (facility radionuclide inventory to Category 2 threshold criteria) analysis was performed to determine if the sum of the ratios exceeded 1. As displayed in Table 5-3, the sum of the ratios (i.e., 8.7 E+03) does exceed 1, therefore, the K East Basin should be classified as a "Category 2 Facility" unless otherwise designated by the Program Secretarial Officer (PSO).

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[1]Value used following establishment that the nature of the process precludes potential for criticality. A nuclear criticality safety analysis was performed and is documented in the existing SAR (Meichle, 1993) to demonstrate the acceptability of the present fuel storage configuration for both normal operation and credible accident conditions.

The facility hazard category for K West Basin was calculated (see Table 5-4) using the radiological inventory identified in Table 5-2.

Table 5-4. Hazard Category Determination for K West Basin.

Radionuclide	Inventory (Curies)	Category 2 Threshold (Curies)	Ratio of Facility Inventory/Category 2 Criteria
Pu-236	2.0 E-01	5.5 E+01	3.6 E-03
Pu-238	4.6 E+04	6.2 E+01	7.4 E+02
Pu-239	1.0 E+05	5.6 E+01[2]	1.8 E+03
Pu-240	5.6 E+04	5.5 E+01	1.0 E+03
Pu-241	4.2 E+06	2.9 E+03	1.4 E+03
Pu-242	2.0 E+01	5.5 E+01	3.6 E-01
Am-241	8.9 E+04	5.5 E+01	1.6 E+03
Cm-244	4.4 E+03	5.5 E+01	8.0 E+01
Eu-154	8.4 E+04	1.1 E+05	7.6 E-01
Cs-134	1.2 E+05	6.0 E+04	2.0 E+00
Cs-137	7.0 E+06	8.9 E+04	7.9 E+01
Ce-144	2.7 E+04	8.2 E+04	3.3 E-01
Pr-144	2.7 E+04	4.3 E+05	6.3 E-02
Pr-144M	3.2 E+02	4.3 E+05	7.4 E-04
Pm-147	1.9 E+06	8.4 E+05	2.3 E+00
Sb-125	1.1 E+05	4.3 E+05	2.6 E-01
Te-125M	2.9 E+04	4.3 E+05	6.7 E-02
Ru-106	5.0 E+04	6.5 E+03	7.7 E+00
Sr-90	5.6 E+06	2.2 E+04	2.5 E+02
Y -90	5.6 E+06	4.3 E+05	1.3 E+01
		Sum of the Ratios	7.0 E+03

The facility radionuclide inventory was compared to the Category 2 criteria shown in Table 5-4. The total curies exceeded Category 3 threshold curie criteria, therefore, the comparison was performed to the Category 2 threshold curie criteria. The results of this comparison indicated that the radionuclides exceeded the Category 2 threshold curie criteria. As required in DOE 1992, the sum of the ratios (facility radionuclide inventory to Category 2 threshold criteria) analysis was performed to determine if the sum of the ratios exceeded 1. As displayed in Table 5-4, the sum of the ratios (i.e., 7.0 E+03) does exceed 1, therefore, the K West Basin should be classified as a "Category 2 Facility" unless otherwise designated by the PSO.

[2]Value used following establishment that the nature of the process precludes potential for criticality. A nuclear criticality safety analysis was performed and is documented in the existing SAR (Meichle, 1993) to demonstrate the acceptability of the present fuel storage configuration for both normal operation and credible accident conditions.

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APPENDIX A

ISOTOPIC DISTRIBUTION

OF 12% ^{240}Pu

K-BASIN FUEL ELEMENTS

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12% ^{240}Pu k-Basin Fuel Elements

The isotopic distribution used in the analyses of the 12% ^{240}Pu K-Basin fuel elements (aged 10 years) was based on 1 metric ton of fuel and later applied to the appropriate isotopic release fractions. The isotopic distribution and associated curie amounts of 1 metric ton of 12% ^{240}Pu fuel aged 10 years is as follows:

PU236	2.2E-04
PU238	4.8E+01
PU239	1.1E+02
PU240	5.8E+01
PU241	4.4E+03
PU242	2.1E-02
AM241	9.3E+01
CM244	4.6E+00
EU154	8.8E+01
CS134	1.3E+02
CS137	7.3E+03
CE144	2.8E+01
PR144	2.8E+01
PR144M	3.3E-01
PM147	2.0E+03
SB125	1.2E+02
TE125M	3.0E+01
RU106	5.2E+01
SR90	5.8E+03
Y 90	5.8E+03

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APPENDIX B

K AREA FUEL BASIN INVENTORIES

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K AREA FUEL BASIN INVENTORIES

KE BASIN INITIAL ENRICHMENT - 0.71%				
GROUP	YEAR DISCHARGED	TOTAL MWD	TOTAL POUNDS	MWD/TON
1	71	140.5	484.5	579.98
2	72/73	410.3	588.0	1,395.58
3	73	774.6	864.0	1,793.06
4	74	973.8	1152.0	1,690.63
5	75	627.8	624.0	2,012.18
6	75	400.0	420.0	1,904.76
7	76	787.5	504.0	3,125.00
8	77	488.4	516.0	1,893.02
9	77	199.2	180.0	2,213.33
10	77/78	618.0	612.0	2,019.61
11	79/82	704.2	877.2	1,605.56
12	85/86	532.7	1754.4	607.27
13	87	1676.1	10732.8	312.33
		8,333.10	19,308.90	863.14

Reference:

Conn, K.R., 1990, *100K Basins Spent Fuel Heat Leads*, WHC-SD-NR-ANAL-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

KE BASIN INITIAL ENRICHMENT - 0.95%				
GROUP	YEAR DISCHARGED	TOTAL MWD	TOTAL POUNDS	MWD/TON
1	71/72	295	709	832.16
2	72	99425	134156	1,482.23
3	73	125862	138145	1,822.17
4	73	130379	124152	2,100.31
5	74	227693	208267	2,186.55
6	74/75	164098	139662	2,349.93
7	75	137621	111795	2,462.02
8	75/76	153586	133129	2,307.33
9	76	38915	29360	2,650.89
10	76/77	71094	62687	2,268.22
11	77	101570	81295	2,498.80
12	77	100650	81681	2,464.47
13	77	80032	67167	2,383.08
14	78	225091	191657	2,348.89
15	78/79	348867	306597	2,275.74
16	79/80	8815	7495	2,352.23
17	81/82	19357	15899	2,435.00
18	83/84	52935	50957	2,077.63
19	86	107089	257308	832.38
20	86/87	96626	372931	518.20
		2,290,000.00	2,515,049.00	1,821.04

Reference:

Conn, K.R., 1990, *100K Basins Spent Fuel Heat Leads*, WHC-SD-NR-ANAL-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

KW BASIN INITIAL ENRICHMENT - 0.71%				
GROUP	YEAR DISCHARGED	TOTAL MWD	TOTAL POUNDS	MWD/TON
1	80	1443	1651	1,748.03
2	82	714	826	1,728.81
		2,157.00	2,477.00	1,741.62

KW BASIN INITIAL ENRICHMENT - 0.95%				
GROUP	YEAR DISCHARGED	TOTAL MWD	TOTAL POUNDS	MWD/TON
1	72	1279	1988	832.16
2	76	30410	25636	1,482.23
3	79/80	506552	444707	1,822.17
4	81	147182	125610	2,100.31
5	82	120321	115839	2,186.55
6	83/85	677	1073	2,349.93
7	86	15	35	2,462.02
		806,436.00	714,888.00	1,821.04

Reference:

Conn, K.R., 1990, *100K Basins Spent Fuel Heat Leads*, WHC-SD-NR-ANAL-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

KW BASIN INITIAL ENRICHMENT - 1.25%				
GROUP	YEAR DISCHARGED	TOTAL MWD	TOTAL POUNDS	MWD/TON
1	72	19976	19439	2,055.25
2	72	76359	80563	1,895.63
3	73	100467	90375	2,223.34
4	73	69087	57804	2,390.39
5	74	100211	70295	2,851.16
6	74/75	137944	89049	3,098.16
7	75	34272	22988	2,981.73
8	75/76	135425	88929	3,045.69
9	76	41201	27760	2,968.37
10	77	70210	44450	3,159.06
11	77	73502	43843	3,352.96
12	77	93283	56433	3,305.97
13	77	57743	35116	3,288.70
14	78	146858	99811	2,942.72
15	78/79	231925	151580	3,060.10
16	79/80	203446	138768	2,932.17
17	81	75845	50051	3,030.71
18	82	110083	76605	2,874.04
19	82	87295	65803	2,653.22
20	86	138	320	862.50
21	87	27741	85030	652.50
		1,893,011.00	1,395,012.00	2,713.97

Reference:

Conn, K.R., 1990, *100K Basins Spent Fuel Heat Leads*, WHC-SD-NR-ANAL-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

APPENDIX C

RADIONUCLIDES IN KE BASIN SLUDGE

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K-Basin Sludge Release

The isotopic distribution of the K-Basin sludge release used in the analyses was based on 3 canisters of sludge, each weighing 723 lbs. The isotopic distribution and associated curie amounts are listed in table 1 as follows:

Table 1: RADIONUCLIDES AND AMOUNT RELEASED INVOLVING KE BASIN SLUDGE

Radionuclide	1985 Concentration (Ci/gm)	1985 Inventory (Ci)	1991 Inventory (Ci)
Mn-54	1.4E-06	5.1E-04	8.9E-06
Co-60	1.3E-05	4.7E-03	2.4E-03
Ru-106	1.7E-05	6.2E-03	2.0E-04
Cs-134	8.6E-07	3.1E-04	5.8E-05
Cs-137	6.7E-05	2.4E-02	2.1E-02
Ce-144	3.0E-05	1.1E-02	1.3E-04
Eu-154	1.0E-05	3.7E-03	2.5E-03
Eu-155	7.8E-06	2.9E-03	1.4E-03
Pu-238	6.0E-06	2.2E-03	2.1E-03
Pu-239/240	4.0E-05	1.5E-02	1.5E-02
Pu-241	6.8E-04	2.5E-01	2.0E-01
Am-241	1.53E-05	5.6E-03	7.3E-03

The amounts shown above, except for Pu-241, are based on 1985 data and decayed six years. The amount Pu-241 was estimated based on the ratio of Pu-238 in N reactor fuel and sludge then decayed six years.

Reference:

Morton, L.A., 1991, *Facility Hazard Classification for KE/KW Fuel Storage Basins*, WHC-SD-NR-HC-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

PEER REVIEW CHECKLIST

Document Reviewed: K-basin Fuel Encapsulation and Storage Hazard Categorization
Author: Ralph Crowe
Date: 30 March 1994
Scope of Review: Technical Peer Review per WHC-CM-6-32, Section WP-6.2

Yes	No	NA	
[ ]	[ ]	[X]	Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
[X]	[ ]	[ ]	Problem completely defined.
[ ]	[ ]	[X]	Accident scenarios developed in a clear and logical manner.
[X]	[ ]	[ ]	Necessary assumptions explicitly stated and supported.
[ ]	[ ]	[X]	Computer codes and data files documented.
[X]	[ ]	[ ]	Data used in calculations explicitly stated in document.
[X]	[ ]	[ ]	Data checked for consistency with original source information as applicable.
[X]	[ ]	[ ]	Mathematical derivations checked including dimensional consistency of results.
[X]	[ ]	[ ]	Models appropriate and used within range of validity or use outside range of established validity justified.
[X]	[ ]	[ ]	Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
[ ]	[ ]	[X]	Software input correct and consistent with document reviewed.
[ ]	[ ]	[X]	Software output consistent with input and with results reported in document reviewed.
[X]	[ ]	[ ]	Limits/criteria/guidelines applied to analysis results are appropriate and referenced. Limits/criteria/guidelines checked against references.
[ ]	[ ]	[X]	Safety margins consistent with good engineering practices.
[X]	[ ]	[ ]	Conclusions consistent with analytical results and applicable limits.
[X]	[ ]	[ ]	Results and conclusions address all points required in the problem statement.
[X]	[ ]	[ ]	Format consistent with appropriate NRC Regulatory Guide or other standards
[ ]	[ ]	[X]	Review calculations, comments, and/or notes are attached.
[X]	[ ]	[ ]	**Document approved.**

RALPH CROWE Ralph C — 30 March 1994
Reviewer (Printed Name and Signature) — Date