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Retention: Permanent

SPECIAL ANALYSIS:

Radionuclide Screening Analysis for E Area

Prepared by:

James R. Cook
Elmer L. Wilhite

June 1, 2004

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

Prepared for the U.S. Department of Energy Under
Contract Number DE-AC09-96SR18500

SRS savannah river site ™

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Summary

It was recently discovered that waste being disposed of onsite contained radionuclides that had not been analyzed by the Performance Assessment (PA). These radionuclides had been eliminated from the PA in an earlier screening evaluation because they were not expected to be contained in SRS-generated waste or that received from offsite generators.. This Special Analysis (SA) is being prepared to establish the screening criteria and level of evaluation for all radionuclides potentially significant to a Low Level Waste PA or Composite Analysis (CA).

The screening methodology recommended by the National Council on Radiological Protection and Measurements (NCRP) has been used to identify those radionuclides that require detailed analysis to derive disposal limits. Of the approximately 2800 radionuclides, a total of 826 were considered by the NCRP to be potentially significant. Approximately 686 radionuclides were eliminated from this analysis due to their short half-life or other properties. Approximately 40 of the 140 remaining radionuclides have been analyzed in the existing PA and waste acceptance criteria established. This SA develops the screening criteria and establishes trigger values to be used to determine the level of analysis required for those radionuclides not analyzed in PA.

The results of the SA identified 20 radionuclides that will require more detailed groundwater and intruder analysis. This analysis will be documented in a SA for trench disposal.

Background

Department of Energy (DOE) requirements for disposal of low-level radioactive waste (LLW) include the preparation of a radiological PA[1]. The PA for the E-Area Vault Disposal Facility[2] was revised in January, 2000.

The PA process involves a series of iterative steps to consider the potential impacts of specific radionuclides and waste forms on the environment and the public. Initially, very conservative (i.e., pessimistic) assumptions are made to construct simple models of radionuclide impact from disposed LLW. Screening calculations utilize the most conservative assumptions and are intended to reduce a broad set of radionuclides, pathways, etc. to a relatively small set. The purpose of the highly simplified calculations is to determine which radionuclides, environmental transport pathways, and exposure scenarios must be analyzed in more detail. Multi-dimensional numeric models are used to simulate the transport of each radionuclide of concern from the waste disposal unit to a point of assessment. From the results of these calculations, conditions are established on the disposal facility to ensure that future impacts can reasonably be expected to be acceptable. The conditions include Waste Acceptance Criteria (WAC), disposal unit design parameters, waste packaging, and waste emplacement (e.g., grouting around waste packages).

Following the screening calculation, additional radionuclides were removed from the PA analysis if they were not included in the normal SRS production waste isotopic distribution. This process was not well documented, and as a result there have been cases of non-production waste (e.g., sources) being disposed of with radionuclides that were not screened out and were not analyzed in the PA. This was the subject of a Unreviewed Disposal Question Screening.[3] The purpose of this SA is to document the screening methodology and to provide a set of very conservative

Trigger Values that can be used in lieu of PA inventory limits for those radionuclides that have not been analyzed in the PA or a subsequent SA.

Discussion

Performance Objectives

The specific performance criteria for solid waste disposal are contained in USDOE Order 435.1[1]:

Low-level waste disposal facilities shall be sited, designed, operated, maintained, and closed so that a reasonable expectation exists that the following performance objectives will be met for waste disposed of after September 26, 1988:

- Dose to representative members of the public shall not exceed 25 mrem per year total Effective Dose Equivalent (EDE) from all exposure pathways, excluding the dose from radon and its progeny in air.
- Dose to representative members of the public via the air pathway shall not exceed 10 mrem per year total EDE, excluding the dose from radon and its progeny.
- Release of radon shall be less than an average flux of 20 pCi/m^2/s at the surface of the disposal facility. Alternatively, a limit of 0.5 pCi/L of air may be applied at the boundary of the facility.

USDOE Order 435.1 provides a performance measure pertinent to impacts to hypothetical persons who are assumed to inadvertently intrude into the E-Area Low Level Waste Facility. The calculated annual total EDE to such individuals cannot exceed 100 mrem for chronic exposure scenarios. For acute exposure scenarios, calculated doses are not to exceed 500 mrem total EDE. Institutional controls are assumed to be effective in deterring intrusion for at least 100 years following closure of the facility. Passive controls, in the form of engineered barriers or features of the site, can be claimed as further deterrents to intrusion.

USDOE Order 435.1 also provides a performance measure pertinent to impacts to water resources. This performance measure has been interpreted at SRS to require the groundwater, outside a 100-m buffer zone surrounding the disposed waste, to not exceed Maximum Contaminant Levels established in the Safe Drinking Water Act[4].

Radionuclide Screening

The NCRP study considered 826 radionuclides that were selected from among the approximately 2,800 radioactive isotopes. The 826 were selected on the basis of their half life being long enough to be potentially significant to radiological protection of the public. Screening factors were developed for these 826 radionuclides by considering half life, transport properties and radiotoxicity. These factors have been used to screen these radionuclides for the groundwater pathway and for inadvertent intrusion into the waste. A few modifications of the parameters used by the NCRP were made to better represent the conditions at SRS. These are described in the following paragraphs.

Table 1 shows the differences in parameters between the NCRP methodology and the SRS implementation. For the groundwater pathway, the NCRP assumed that waste packaging would delay intrusion of water into the waste by 2 years. We chose to take no credit for packaging. The NCRP assumed that water would infiltrate the waste at a rate of 0.18 meters per year; we chose to use the infiltration rate through a closure cap of 0.04 meters per year[2]. The waste thickness was assumed to be 0.5 meters in the NCRP work. We used a value of 0.75 meters, which represents the waste thickness in an Engineered Trench after stabilization of the trench by dynamic compaction. The NCRP assumed that radionuclides leached from the waste would be contained in an annual volume of 91 cubic meters per year; we used the area of the Intermediate Level Vault footprint (15 m x 75 m) times the annual infiltration to estimate the actual dilution volume (44 m^3/year). The Intermediate Level Vault footprint was used because it is the smallest E-Area disposal unit, which makes it the most conservative choice. Using the thinnest waste layer and the smallest footprint of all of the disposal units in E Area means that this screening is conservative for all of the disposal units. The NCRP used distribution coefficients (K_d) taken from a general reference work; we used the values from the following sources in the following order, 1) the EAV PA Revision 1, the primary PA reference for literature values (Reference 6), and 3) the NCRP values. The NCRP used a water consumption rate of 800 L/yr. We used the PA value of 730 L/year. For the intruder calculations, the NCRP assumed that institutional control would last only 10 years; we used the DOE default value of 100 years.

The Screening Factors for the groundwater pathway was calculated using equation 8.21 from the NCRP Report and considering only parent radionuclides:

$$SF_{GW} = \lambda_L A_0 \frac{U_{DW}}{V} X_0 DF_{ing}$$

where

λ_L = leach rate of the parent nuclide, y^{-1}

$A_0 = e^{-(\lambda_0^r R T_{travel})}$ = decay during transport

R = Retardation Factor

U_{DW} = consumption of drinking water, L y^{-1}

V = dilution volume, L y^{-1}

$X_0 = \frac{\left[1 - e^{-(\lambda_L + \lambda_0^r)T_{av}}\right] e^{-t_{delay}\lambda_0^r}}{T_{av}(\lambda_L + \lambda_0^r)}$ = the average yearly fraction of the initial inventory of the parent radionuclide remaining from time t_{delay} to $t_{delay} + T_{av}$

where

λ_L = leach rate (y^{-1})

λ_0^r = radiological decay constant of parent (y^{-1})

T_{av} = averaging time, taken to be 1 y
t_{delay} = delay time for release (y)

The Screening Factors for the intruder scenarios were calculated by using equation 8.22 from the NCRP Report, but omitting the contribution from groundwater, since that is accounted for separately:

$$SF_{gw} = SF_{gnd} + SF_{inhal} + SF_{soil} + SF_{veg}$$

where

SF_{gnd} = screening factor from direct irradiation (Sv Bq^{-1})
SF_{inhal} = screening factor from inhalation of contaminated soil (Sv Bq^{-1})
SF_{soil} = screening factor from ingestion of contaminated soil (Sv Bq^{-1})
SF_{veg} = screening factor from ingestion of vegetables grown in the contaminated soil (Sv Bq^{-1})

The resulting screening factors were multiplied by:

$$e^{-\lambda_0^r (90)}$$

to account for the 100 year institutional control period used in DOE Order 435.1 rather than the 10 year period assumed by the NCRP.

Tables 2 and 3 present the results of the screening calculations for the groundwater and the intruder, respectively. In each case, it was assumed that the disposed waste would contain ten million curies of each radionuclide. Therefore, all radionuclides listed in Table 2 and 3 represent those cases where ten million curies resulted in exceeding 1% of the Performance Objective, i.e., the values in Column 2 exceed either 0.04 mrem/year or 1 mrem/year and all values in Column 3 are less than 10 million curies. The screening criterion employed for eliminating a radionuclide from further consideration was one percent of the relevant performance objective. For the intruder, the performance objective is 100 mrem/year; thus, the screening criterion was 1 mrem/year. For the groundwater pathway, the performance objective is to: "Protect ground water resources, consistent with Federal, State and local requirements". For this work, the performance objective is interpreted to mean that concentrations of radionuclides in groundwater may not exceed that which would give a calculated dose of 4 mrem/year, assuming a person drank 2 liters of groundwater per day for a year (730 L/year.). Thus, the groundwater screening criterion was 0.04 mrem/year. After applying the screening methodology, 72 radionuclides remained for the groundwater pathway and 109 remained due to intruder considerations.

The above methodology did not include the effects of any potentially significant progeny from radioactive decay. The NCRP report gives a table (Table 3.1 in Volume II) listing those radionuclides that do have radiologically significant daughters. Trigger values were calculated using the unaltered NCRP methodology to include the effects of progeny ingrowth. The results for both groundwater and intruder screening are given in Table 4.

The NCRP nomenclature methodology for differentiating isotopes of the same element having the same atomic mass, but different half lives is used in Table 2 and 3. This method uses lower case letters (e.g., a, b) as identifiers.

Implementation of the Screening Results

Table 5 gives the lowest Trigger Value for each radionuclide from Tables 2, 3, and 4. The radionuclides listed in Table 5 are those that should be considered for detailed performance assessment analysis, based on half life, dose conversion factor, and in the case of the groundwater pathway, transport properties. A number of the radionuclides are not included in the routine SRS waste streams, and therefore may not be included as part of a rigorous PA analysis based on professional judgement. For each radionuclide in Table 5 a Trigger Value is given. This is the curie quantity that would give a dose of 1/100th of the limiting screening criteria. If a radionuclide has not been analyzed in the current PA and that radionuclide is proposed for disposal, then as long as the total quantity of each radionuclide in a disposal location remains below its Trigger Value, it can be considered to be in compliance with the PA with no further analysis. If the curie quantity in a disposal unit exceeds the Trigger Value and that radionuclide has not been analyzed in the current PA, a UDQE should be conducted to determine if a disposal location specific limit is needed.

There are a few cases where radionuclides that have not been analyzed in the PA have been emplaced in disposal locations in the E Area LLWF.[3] These are shown in Table 6. Three of these radionuclides were analyzed in the PA for slit trench locations, Am-242m, Cm-243 and U-233. In these cases the trench limits are 6 to 8 orders of magnitude higher than the trigger values – 8.1E+02 Ci vs 7.9E-06 for Am-242m, 1.8E+04 Ci vs 4.6E-04 Ci for Cm-243 and 1.9E+00 Ci vs 9.8E-07 Ci for U-233. With this as an indication of the degree of conservatism embodied in the screening methodology, and considering the relatively small inventories involved, there is very little risk in continuing operations and leaving the waste packages in the disposal locations awaiting a PA or SA analysis.

A new trench Special Analysis is being prepared which will calculate trench disposal limits for all of the radionuclides in Table 6. A UDQE will be prepared using this analysis to compare the disposed inventories in other disposal locations with the limits for trench disposal. Since trench disposal limits are generally the lowest of the disposal locations used at SRS, comparing the quantities disposed at other locations to trench limits will provide a means to quantify the impact of the as-of now unanalyzed disposals.

A new Intermediate Level Vault Special Analysis is being prepared which will include those unanalyzed radionuclides in Table 6 associated with this disposal location.

The radionuclides in Table 6 will be considered in the next revision of the CA. It is highly unlikely that including these radionuclides will change the conclusion of the CA.

References

1. *Radioactive Waste Management*, Order 435.1, U. S. Department of Energy, July 9, 1999.

2. Martin Marietta Energy Systems, Inc., EG&G Idaho, Inc., and Westinghouse Savannah River Company, **Radiological Performance Assessment for the E-Area Vaults Disposal Facility, Revision 1**, WSRC-RP-94-218, Westinghouse Savannah River Company, Aiken, SC, January 31, 2000.

3. USQ-SWE-2003-0029, Sequence Number 3427, March 26, 2004.

4. Safe Drinking Water Act, 40 CFR 141.

5. National Council on Radiation Protection and Measurements, **Screening Models for Releases of Radionuclides to Atmosphere, Surface Water, and Ground**, NCRP Report No. 123, Volumes I and II, January, 1996.

6. Sheppard, M. I., and D. H. Thibault. 1990. **Default Soil solid/Liquid Partition Coefficients, Kds, for Four Major Soil Types: A Compendium.** Health Physics, 59:471-482.

Table 1. Parameter differences between NCRP and SRS screening models

Groundwater Pathway				
Parameter	NCRP Value	SRS Value	Justification	Effect on Conservatism[1]
Release delay time	2 years	0 years	No credit for packaging	+
Infiltration rate	0.18 m/year	0.04 m/year	Closure cap infiltration rate	+
Waste thickness	0.5 m	0.75 m	Final ET waste thickness	-
Volume of dilution water	91 m^3/year, average annual consumption	44 m^3/year	Actual dilution water for ILV footprint (smallest E-Area unit)	+
Water consumption rate	800 L/year	730 L/year	2 L per day used in regulations	-
K_ds	From Kennedy and Strenge, 1992	1)From EAV PA 2) Reference 6 3) From NCRP	1)Values used in PA Revision for soil 2)Values from PA primary reference 3)NCRP default	+/-[2]

Intruder Pathways				
Institutional Control period	10 years	100 years	DOE commitment	-

[1] + = SRS value is more conservative than NCRP value

\- = SRS value less conservative than NCRP value, but represents SRS conditions

[2] Conservatism depends upon K_d value differences for specific radionuclides

Table 2. Results of Groundwater Screening

Radionuclide	mrem per 1E7 Ci	Trigger Value Ci to give 0.04 mrem	Has Radionuclide Been Analyzed In a PA or SA? LAW	ILV	Slit	Ash	CIG	NR
Ag-108m	2.90E+03	1.40E+02	N	N	N	N	N	N
Al-26	4.60E+11	8.80E-07	N	N	N	N	N	N
Am-243	7.50E+07	5.40E-03	Y	Y	Y	Y	Y	Y
Be-10	1.50E+08	2.60E-03	N	N	N	N	N	N
Bi-210m	3.20E+09	1.20E-04	N	N	N	N	N	N
Bk-247	3.40E-01	1.20E+06	N	N	N	N	N	N
C-14	5.40E+09	7.40E-05	Y	Y	Y	Y	Y	Y
Ca-41	1.10E+09	3.70E-04	N	N	N	N	N	N
Cd-113	6.6E+09	6.10E-05	N	N	N	N	N	N
Cf-249	3.40E-01	1.20E+06	Y	Y	Y	Y	Y	Y
Cf-251	1.60E+06	2.50E-01	N	N	N	N	N	N
Cl-36	9.30E+09	4.30E-05	N	N	N	N	N	N
Cm-245	9.10E+05	4.40E-01	Y	Y	Y	Y	Y	Y
Cm-246	1.40E+03	2.90E+02	Y	Y	Y	Y	Y	Y
Cm-247	2.90E+09	1.40E-04	Y	Y	Y	Y	Y	Y
Cm-248	9.40E+09	4.20E-05	Y	Y	Y	Y	Y	Y
Cm-250	2.90E+06	1.40E-01	N	N	N	N	N	N
Cs-135	1.20E+08	3.20E-03	Y	Y	Y	Y	Y	Y
Fe-60	3.60E+09	1.10E-04	N	N	N	N	N	N
Gd-152	2.30E+09	1.70E-04	N	N	N	N	N	N
H-3	1.20E+09	3.20E-04	Y	Y	Y	Y	Y	Y
Hf-182	6.20E+08	6.50E-04	N	N	N	N	N	N
Hg-194	1.7E+10	2.4E-05	N	N	N	N	N	N
Ho-166m	6.10E+06	6.60E-02	N	N	N	N	N	N
I-129	3.20E+12	1.20E-07	Y	Y	Y	Y	Y	Y
In-115	1.80E+09	2.30E-04	N	N	N	N	N	N
Ir-192m	1.10E+05	3.60E+00	N	N	N	N	N	N
K-40	7.0E+09	5.7E-05	N	N	N	N	N	N
La-137	1.60E+06	2.50E-01	N	N	N	N	N	N
La-138	2.70E+07	1.50E-02	N	N	N	N	N	N
Lu-176	5.10E+08	7.90E-04	N	N	N	N	N	N
Mn-53	1.30E+07	3.00E-02	N	N	N	N	N	N
Mo-93	4.70E+08	8.50E-04	N	N	N	N	N	N
Nb-94	2.50E+08	1.60E-03	Y	N	N	Y	N	Y
Ni-59	3.20E+06	1.30E-01	Y	Y	Y	Y	Y	Y
Np-236a	9.60E+11	4.20E-07	N	N	N	N	N	N
Np-237	2.60E+12	1.50E-07	Y	Y	Y	Y	Y	Y
Pa-231	4.10E+10	9.70E-06	N	N	N	N	N	N

Table 2. Results of Groundwater Screening

Radionuclide	mrem per 1E7 Ci	Trigger Value Ci to give 0.04 mrem	Has Radionuclide Been Analyzed In a PA or SA? LAW	ILV	Slit	Ash	CIG	NR
Pb-202	6.90E+08	5.80E-04	N	N	N	N	N	N
Pb-205	2.70E+07	1.50E-02	N	N	N	N	N	N
Pd-107	2.20E+07	1.80E-02	Y	N	Y	Y	Y	N
Pt-193	8.50E-02	4.70E+06	N	N	N	N	N	N
Pu-239	3.20E+10	1.20E-05	Y	Y	Y	Y	Y	Y
Pu-240	1.80E+10	2.20E-05	Y	Y	Y	Y	Y	Y
Pu-242	3.70E+10	1.10E-05	Y	Y	Y	Y	Y	Y
Pu-244	3.80E+12	1.10E-07	Y	Y	Y	Y	Y	Y
Ra-226	4.30E+07	9.40E-03	N	N	N	N	N	N
Rb-87	5.00E+08	8.00E-04	Y	N	Y	Y	Y	N
Re-186m	3.80E+09	1.0E-04	N	N	N	N	N	N
Re-187	9.0E+06	4.4E-02	N	N	N	N	N	N
Se-79	2.10E+08	1.90E-03	Y	Y	Y	Y	Y	Y
Si-32	1.30E+08	3.00E-03	N	N	N	N	N	N
Sm-146	3.0E+09	1.30E-04	N	N	N	N	N	N
Sm-147	2.7E+09	1.5E-04	N	N	N	N	N	N
Sn-126	1.00E+09	3.80E-04	Y	Y	Y	Y	Y	Y
Sr-90	1.50E+08	2.70E-03	Y	Y	Y	Y	Y	Y
Ta-180	1.10E+08	3.50E-03	N	N	N	N	N	N
Tc-97	2.70E+09	1.50E-04	N	N	N	N	N	N
Tc-98	6.80E+10	5.90E-06	N	N	N	N	N	N
Tc-99	2.50E+10	1.60E-05	Y	Y	Y	Y	Y	Y
Te-123	9.80E+07	4.1E-03	N	N	N	N	N	N
Th-229	1.70E+06	2.40E-01	N	N	N	N	N	N
Th-230	2.50E+08	1.60E-03	N	N	N	N	N	N
Th-232	2.50E+09	1.60E-04	Y	Y	Y	Y	Y	Y
Ti-44	6.70E+11	6.00E-07	N	N	N	N	N	N
U-233	7.00E+08	5.70E-04	Y	Y	Y	Y	Y	N
U-234	7.10E+08	5.60E-04	Y	Y	Y	Y	Y	Y
U-235	7.30E+08	5.50E-04	Y	Y	Y	Y	Y	Y
U-236	7.10E+08	5.60E-04	Y	Y	Y	Y	Y	Y
U-238	6.90E+08	5.80E-04	Y	Y	Y	Y	Y	Y
V-49	3.50E+07	1.10E-02	N	N	N	N	N	N
Zr-93	1.10E+07	3.70E-02	Y	Y	Y	Y	Y	Y

Table 3. Results of Intruder Screening

Radionuclide	mrem/1E7 Ci mrem per 1E7 Ci	Trigger Value Ci to give 1 mrem	Has Radionuclide Been Analyzed In a PA or SA? LAW	ILV	Slit	Ash	CIG	NR
Ac-227	1.2E+11	8.2E-05	N	N	N	N	N	N
Ag-108m	3.6E+11	2.8E-05	N	N	N	N	N	N
Al-26	8.6E+11	1.2E-05	N	N	N	N	N	N
Am-241	2.5E+11	4.0E-05	Y	Y	Y	Y	Y	Y
Am-242m	1.3E+12	7.9E-06	N	Y	Y	N	Y	Y
Am-243	3.8E+11	2.6E-05	Y	Y	Y	Y	Y	Y
Ba-133	2.2E+08	4.5E-02	N	N	N	N	N	N
Be-10	1.6E+09	6.4E-03	N	N	N	N	N	N
Bi-207	9.0E+10	1.1E-04	N	N	N	N	N	N
Bi-210m	4.1E+11	2.4E-05	N	N	N	N	N	N
C-14	5.9E+11	1.7E-05	Y	Y	Y	Y	Y	Y
Ca-41	2.2E+10	4.6E-04	N	N	N	N	N	N
Cd-113	2.0E+12	4.9E-06	N	N	N	N	N	N
Cd-113m	1.1E+10	8.9E-04	N	N	Y	N	Y	N
Cf-249	3.9E+11	2.6E-05	Y	Y	Y	Y	Y	Y
Cf-250	6.7E+08	1.5E-02	Y	N	Y	Y	Y	N
Cf-251	3.7E+11	2.7E-05	Y	Y	Y	Y	Y	Y
Cl-36	2.6E+12	3.9E-06	N	N	N	N	N	N
Cm-243	2.2E+10	4.6E-04	N	N	Y	N	Y	Y
Cm-244	4.0E+09	2.5E-03	Y	Y	Y	Y	Y	Y
Cm-245	6.1E+11	1.6E-05	Y	Y	Y	Y	Y	Y
Cm-246	2.9E+11	3.5E-05	Y	Y	Y	Y	Y	Y
Cm-247	5.3E+11	1.9E-05	Y	Y	Y	Y	Y	Y
Cm-248	1.1E+12	9.4E-06	Y	Y	Y	Y	Y	Y
Cm-250	6.8E+12	1.5E-06	N	N	N	N	N	N
Co-60	1.8E+06	5.7E+00	Y	Y	Y	Y	Y	Y
Cs-135	6.3E+10	1.6E-04	Y	Y	Y	Y	Y	Y
Cs-137	6.6E+10	1.5E-04	Y	Y	Y	Y	Y	Y
Eu-150b	7.9E+10	1.3E-04	N	N	N	N	N	N
Eu-152	2.4E+09	4.1E-03	Y	N	N	Y	Y	N
Eu-154	1.5E+08	6.9E-02	Y	Y	Y	Y	Y	Y
Eu-155	2.4E+04	4.2E+02	N	N	N	N	N	N
Fe-60	9.6E+11	1.0E-05	N	N	N	N	N	N
Gd-148	3.2E+10	3.1E-04	N	N	N	N	N	N
Gd-152	5.1E+10	2.0E-04	N	N	N	N	N	N
H-3	6.7E+07	1.5E-01	Y	Y	Y	Y	Y	Y
Hf-178m	9.5E+10	1.1E-04	N	N	N	N	N	N
Hf-182	5.6E+11	1.8E-05	N	N	N	N	N	N
Hg-194	2.3E+12	4.3E-06	N	N	N	N	N	N
Ho-166m	5.6E+11	1.8E-05	N	N	N	N	N	N

Table 3. Results of Intruder Screening

Radionuclide	mrem/1E7 Ci mrem per 1E7 Ci	Trigger Value Ci to give 1 mrem	Has Radionuclide Been Analyzed In a PA or SA? LAW	ILV	Slit	Ash	CIG	NR
I-129	4.0E+11	2.5E-05	Y	Y	Y	Y	Y	Y
In-115	2.3E+10	4.3E-04	N	N	N	N	N	N
Ir-192m	2.9E+11	3.4E-05	N	N	N	N	N	N
K-40	3.0E+11	3.4E-05	N	N	N	N	N	N
Kr-81	3.0E+09	3.4E-03	N	N	N	N	N	N
Kr-85	6.9E+05	1.5E+01	N	N	N	N	N	N
La-137	9.7E+09	1.0E-03	N	N	N	N	N	N
La-138	4.5E+11	2.2E-05	N	N	N	N	N	N
Lu-176	1.9E+11	5.4E-05	N	N	N	N	N	N
Mn-53	1.6E+09	6.2E-03	N	N	N	N	N	N
Mo-93	6.6E+09	1.5E-03	N	N	N	N	Y	Y
Na-22	1.9E+00	5.3E+06	N	N	N	N	N	N
Nb-93m	4.4E+06	2.3E+00	N	N	N	N	N	N
Nb-94	5.9E+11	1.7E-05	Y	N	N	Y	Y	Y
Ni-59	6.9E+08	1.4E-02	Y	Y	Y	Y	Y	Y
Ni-63	7.7E+08	1.3E-02	Y	Y	Y	Y	Y	Y
Np-236a	5.9E+15	1.7E-09	N	N	N	N	N	N
Np-237	2.4E+12	4.2E-06	Y	Y	Y	Y	Y	Y
Os-194	5.2E+05	1.9E+01	N	N	N	N	N	N
Pa-231	5.7E+12	1.8E-06	N	N	N	N	N	N
Pb-202	2.1E+11	4.8E-05	N	N	N	N	N	N
Pb-205	5.8E+08	1.7E-02	N	N	N	N	N	N
Pb-210	3.6E+10	2.8E-04	N	N	N	N	N	N
Pd-107	9.8E+08	1.0E-02	Y	N	Y	Y	Y	N
Pm-145	2.0E+08	5.0E-02	N	N	N	N	N	N
Pm-146	1.1E+06	9.2E+00	N	N	N	N	N	N
Pt-193	2.2E+08	4.6E-02	N	N	N	N	N	N
Pu-236	1.4E+01	7.1E+05	N	N	N	N	N	N
Pu-238	1.1E+11	9.0E-05	Y	Y	Y	Y	Y	Y
Pu-239	2.7E+11	3.7E-05	Y	Y	Y	Y	Y	Y
Pu-240	2.7E+11	3.7E-05	Y	Y	Y	Y	Y	Y
Pu-241	1.2E+08	8.4E-02	Y	Y	Y	Y	Y	Y
Pu-242	2.6E+11	3.9E-05	Y	Y	Y	Y	Y	Y
Pu-244	1.1E+12	9.4E-06	Y	Y	Y	Y	Y	Y
Ra-226	2.7E+12	3.7E-06	N	N	N	N	N	N
Ra-228	2.1E+07	4.8E-01	N	N	N	N	N	N
Rb-87	4.1E+10	2.4E-04	Y	N	Y	Y	Y	N
Re-186m	1.2E+11	8.3E-05	N	N	N	N	N	N
Re-187	1.4E+08	7.1E-02	N	N	N	N	N	N
Rh-101	4.6E+01	2.2E+05	N	N	N	N	N	N
Rh-102	3.6E+01	2.8E+05	N	N	N	N	N	N

Table 3. Results of Intruder Screening

Radionuclide	mrem/1E7 Ci mrem per 1E7 Ci	Trigger Value Ci to give 1 mrem	Has Radionuclide Been Analyzed In a PA or SA? LAW	ILV	Slit	Ash	CIG	NR
Sb-125	1.8E+00	5.6E+06	N	N	N	N	N	N
Se-79	2.6E+10	3.9E-04	Y	Y	Y	Y	Y	Y
Si-32	3.6E+11	2.8E-05	N	N	N	N	N	N
Sm-146	3.2E+10	3.1E-04	N	N	N	N	N	N
Sm-147	2.9E+10	3.5E-04	N	N	N	N	N	N
Sm-151	3.6E+07	2.8E-01	Y	N	Y	Y	Y	Y
Sn-121m	1.2E+10	8.4E-04	N	N	Y	N	Y	N
Sn-126	1.1E+12	9.1E-06	Y	Y	Y	Y	Y	Y
Sr-90	1.4E+11	7.1E-05	Y	Y	Y	Y	Y	Y
Ta-180	2.1E+11	4.7E-05	N	N	N	N	N	N
Tb-157	1.1E+09	8.9E-03	N	N	N	N	N	N
Tb-158	1.9E+11	5.2E-05	N	N	N	N	N	N
Tc-97	4.2E+10	2.4E-04	N	N	N	N	N	N
Tc-98	1.4E+12	7.1E-06	N	N	N	N	N	N
Tc-99	3.7E+11	2.7E-05	Y	Y	Y	Y	Y	Y
Te-123	1.2E+10	8.0E-04	N	N	N	N	N	N
Th-229	1.2E+12	8.6E-06	N	N	N	N	N	N
Th-230	1.6E+12	6.4E-06	N	N	N	N	N	N
Th-232	3.6E+12	2.7E-06	Y	Y	Y	Y	Y	Y
Ti-44	1.9E+11	5.3E-05	N	N	N	N	N	N
Tl-204	2.8E+02	3.6E+04	N	N	N	N	N	N
U-232	5.3E+11	1.9E-05	Y	Y	Y	Y	Y	Y
U-233	1.6E+11	6.4E-05	Y	Y	Y	Y	Y	N
U-234	5.8E+10	1.7E-04	Y	Y	Y	Y	Y	Y
U-235	2.4E+11	4.2E-05	Y	Y	Y	Y	Y	Y
U-236	4.8E+10	2.1E-04	Y	Y	Y	Y	Y	Y
U-238	1.4E+12	7.3E-06	Y	Y	Y	Y	Y	Y
Zr-93	8.9E+08	1.1E-02	Y	Y	Y	Y	Y	Y

Table 4. Radionuclides with Significant Daughters

	GW Trigger	Intruder Trigger	Has Radionuclide Been Analyzed In a PA or SA?											
			LAW		ILT		Slit		Ash		CIG		NR	
Radionuclide	Ci	Ci	GW	Int	GW	Int	GW	Int	GW	Int	GW	Int	GW	Int
Ac-227	1.3E-06	4.7E-06	N	N	N	N	N	N	N	N	N	N	N	N
Am-237	6.4E+07	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Am-241	1.8E-05	3.5E-05	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Am-243	1.8E-05	2.6E-05	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bi-210	6.8E-03	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Bk-249	3.7E-06	No Trigger	N	N	N	N	Y	Y	N	N	Y	Y	N	N
Cf-249	4.0E-06	2.2E-05	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cf-252	3.1E-05	No Trigger	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N
Cm-241	1.9E-01	1.6E-01	N	N	N	N	N	N	N	N	N	N	N	N
Cm-242	9.0E-03	8.5E-03	N	N	N	N	Y	Y	N	N	Y	Y	N	N
Cm-244	9.8E-05	9.3E-05	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Cm-245	2.1E-05	1.6E-05	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cm-248	9.8E-06	9.3E-06	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Es-253	5.4E-05	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Ge-68	1.6E-04	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Hf-172	5.7E-06	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
I-123	3.9E+03	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Ir-192m	2.3E-04	2.5E-05	N	N	N	N	N	N	N	N	N	N	N	N
La-141	5.4E+07	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Nb-95m	1.4E+05	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Nd-147	5.4E-01	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Ni-57	1.2E+01	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Pa-230	1.9E-02	8.4E-02	N	N	N	N	N	N	N	N	N	N	N	N
Pa-231	7.2E-07	1.7E-06	N	N	N	N	N	N	N	N	N	N	N	N
Pb-210	2.0E-06	1.7E-05	N	N	N	N	N	N	N	N	N	N	N	N
Pu-236	1.3E-04	1.9E-04	N	N	N	N	N	N	N	N	N	N	N	N
Pu-237	8.3E+01	7.0E+01	N	N	N	N	N	N	N	N	N	N	N	N
Pu-238	6.4E-06	4.4E-05	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Pu-239	5.4E-06	3.6E-05	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Pu-240	5.4E-06	3.6E-05	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Pu-241	1.8E-04	1.2E-03	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Pu-242	5.7E-06	3.8E-05	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ra-225	1.8E+11	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Ra-226	2.4E-06	3.6E-06	N	N	N	N	N	N	N	N	N	N	N	N
Ra-228	2.0E-05	9.2E-06	N	N	N	N	N	N	N	N	N	N	N	N
Ru-97	1.4E+06	5.3E+04	N	N	N	N	N	N	N	N	N	N	N	N
Sb-125	3.0E-03	7.8E-04	N	N	N	N	N	N	N	N	N	N	N	N
Se-73	1.5E+03	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Si-32	2.0E-06	2.5E-05	N	N	N	N	N	N	N	N	N	N	N	N
Sn-121m	9.8E-04	2.7E-04	N	N	N	N	N	Y	N	N	N	Y	N	N
Sn-127	5.4E+02	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Sr-85m	2.4E+03	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Sr-91	8.3E+01	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N

Table 4. Radionuclides with Significant Daughters

Radionuclide	GW Trigger Ci	Intruder Trigger Ci	Has Radionuclide Been Analyzed In a PA or SA? LAW GW	LAW Int	ILT GW	ILT Int	Slit GW	Slit Int	Ash GW	Ash Int	CIG GW	CIG Int	NR GW	NR Int
Th-228	5.1E-03	3.8E-04	N	N	N	N	N	N	N	N	N	Y	N	N
Th-232	2.3E-05	2.7E-06	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
U-230	3.5E-05	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
U-232	3.3E-07	7.9E-06	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
U-233	9.8E-07	6.8E-05	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
U-234	2.6E-06	1.7E-04	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
U-235	7.7E-07	4.5E-05	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
U-238	7.7E-08	9.0E-06	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
W-188	5.7E-01	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Y-91m	1.2E+04	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N
Zr-93	6.4E-03	1.1E-02	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Zr-95	1.2E+01	No Trigger	N	N	N	N	N	N	N	N	N	N	N	N

Table 5. Limiting Trigger Values

Radionuclide	Trigger Value Ci	LAW	ILV	SLIT	ASH	CIG	NR
		Has Radionuclide Been Analyzed In a PA or SA?					
Ac-227	1.3E-06	N	N	N	N	N	N
Ag-108m	2.8E-05	N	N	N	N	N	N
Al-26	8.8E-07	N	N	N	N	N	N
Am-237	6.4E+07	N	N	N	N	N	N
Am-241	1.8E-05	Y	Y	Y	Y	Y	Y
Am-242m	7.9E-06	N	Y	Y	N	Y	Y
Am-243	1.8E-05	Y	Y	Y	Y	Y	Y
Ba-133	4.5E-02	N	N	N	N	N	N
Be-10	2.6E-03	N	N	N	N	N	N
Bi-207	1.1E-04	N	N	N	N	N	N
Bi-210	6.8E-03	N	N	N	N	N	N
Bi-210m	2.4E-05	N	N	N	N	N	N
Bk-247	1.2E+06	N	N	N	N	N	N
Bk-249	3.7E-06	N	N	Y	N	Y	N
C-14	1.7E-05	Y	Y	Y	Y	Y	Y
Ca-41	3.7E-04	N	N	N	N	N	N
Cd-113	4.9E-06	N	N	N	N	N	N
Cd-113m	8.9E-04	N	N	Y	N	N	N
Cf-249	4.0E-06	Y	Y	Y	Y	Y	Y
Cf-250	1.5E-02	Y	N	Y	Y	Y	N
Cf-251	2.7E-05	Y	Y	Y	Y	Y	N
Cf-252	3.1E-05	Y	Y	Y	Y	Y	N
Cl-36	3.9E-06	N	N	N	N	N	N
Cm-241	1.6E-01	N	N	N	N	N	N
Cm-242	8.5E-03	N	N	Y	N	Y	N
Cm-243	4.6E-04	N	N	Y	N	Y	Y
Cm-244	9.3E-05	Y	Y	Y	Y	Y	Y
Cm-245	1.6E-05	Y	Y	Y	Y	Y	Y
Cm-246	3.5E-05	Y	Y	Y	Y	Y	Y
Cm-247	1.9E-05	Y	Y	Y	Y	Y	Y
Cm-248	9.3E-06	Y	Y	Y	Y	Y	Y
Cm-250	1.5E-06	N	N	N	N	N	N
Co-60	5.7E+00	Y	Y	Y	Y	Y	Y
Cs-135	1.6E-04	Y	Y	Y	Y	Y	Y
Cs-137	1.5E-04	Y	Y	Y	Y	Y	Y
Es-253	5.4E-05	N	N	N	N	N	N
Eu-150b	1.3E-04	N	N	N	N	N	N
Eu-152	4.1E-03	Y	N	N	Y	Y	N

Table 5. Limiting Trigger Values

Radionuclide	Trigger Value Ci	Has Radionuclide Been Analyzed In a PA or SA? LAW	ILV	SLIT	ASH	CIG	NR
Eu-154	6.9E-02	Y	Y	Y	Y	Y	Y
Eu-155	4.2E+02	N	N	N	N	N	N
Fe-60	1.0E-05	N	N	N	N	N	N
Gd-148	3.1E-04	N	N	N	N	N	N
Gd-152	1.7E-04	N	N	N	N	N	N
Ge-68	1.6E-04	N	N	N	N	N	N
H-3	3.2E-04	Y	Y	Y	Y	Y	Y
Hf-172	5.7E-06	N	N	N	N	N	N
Hf-178m	1.1E-04	N	N	N	N	N	N
Hf-182	1.8E-05	N	N	N	N	N	N
Hg-194	4.3E-06	N	N	N	N	N	N
Ho-166m	1.8E-05	N	N	N	N	N	N
I-123	3.9E+03	N	N	N	N	N	N
I-129	1.2E-07	Y	Y	Y	Y	Y	Y
In-115	2.3E-04	N	N	N	N	N	N
Ir-192m	2.5E-05	N	N	N	N	N	N
K-40	3.4E-05	N	N	N	N	N	N
Kr-85	1.5E+01	N	N	N	N	N	N
La-137	1.0E-03	N	N	N	N	N	N
La-138	2.2E-05	N	N	N	N	N	N
La-141	5.4E+07	N	N	N	N	N	N
Lu-176	5.4E-05	N	N	N	N	N	N
Mn-53	6.2E-03	N	N	N	N	N	N
Mo-93	8.5E-04	N	N	N	N	Y	Y
Na-22	5.3E+06	N	N	N	N	N	N
Nb-93m	2.3E+00	N	N	N	N	N	N
Nb-94	1.7E-05	Y	N	N	Y	Y	Y
Nb-95m	1.4E+05	N	N	N	N	N	N
Nd-147	5.4E-01	N	N	N	N	N	N
Ni-57	1.2E+01	N	N	N	N	N	N
Ni-59	1.4E-02	Y	Y	Y	Y	Y	Y
Ni-63	1.3E-02	Y	Y	Y	Y	Y	Y
Np-236a	1.7E-09	N	N	N	N	N	N
Np-237	1.5E-07	Y	Y	Y	Y	Y	Y
Os-194	1.9E+01	N	N	N	N	N	N
Pa-230	1.9E-02	N	N	N	N	N	N
Pa-231	7.2E-07	N	N	N	N	N	N
Pb-202	4.8E-05	N	N	N	N	N	N

Table 5. Limiting Trigger Values

Radionuclide	Trigger Value Ci	Has Radionuclide Been Analyzed In a PA or SA? LAW	ILV	SLIT	ASH	CIG	NR
Pb-205	1.5E-02	N	N	N	N	N	N
Pb-210	2.0E-06	N	N	N	N	N	N
Pd-107	1.0E-02	Y	N	Y	Y	Y	N
Pm-145	5.0E-02	N	N	N	N	N	N
Pm-146	9.2E+00	N	N	N	N	N	N
Pt-193	4.6E-02	N	N	N	N	N	N
Pu-236	1.3E-04	N	N	N	N	N	N
Pu-237	7.0E+01	N	N	N	N	N	N
Pu-238	6.4E-06	Y	Y	Y	Y	Y	Y
Pu-239	5.4E-06	Y	Y	Y	Y	Y	Y
Pu-240	5.4E-06	Y	Y	Y	Y	Y	Y
Pu-241	1.8E-04	Y	Y	Y	Y	Y	Y
Pu-242	5.7E-06	Y	Y	Y	Y	Y	Y
Pu-244	1.1E-07	Y	Y	Y	Y	Y	Y
Ra-225	1.8E+11	N	N	N	N	N	N
Ra-226	2.4E-06	N	N	N	N	N	N
Ra-228	9.2E-06	N	N	N	N	N	N
Rb-87	2.4E-04	Y	N	Y	Y	Y	N
Re-186m	8.3E-05	N	N	N	N	N	N
Re-187	4.4E-02	N	N	N	N	N	N
Rh-101	2.2E+05	N	N	N	N	N	N
Rh-102	2.8E+05	N	N	N	N	N	N
Ru-97	5.3E+04	N	N	N	N	N	N
Sb-125	7.8E-04	N	N	N	N	N	N
Se-73	1.5E+03	N	N	N	N	N	N
Se-79	3.9E-04	Y	Y	Y	Y	Y	Y
Si-32	2.0E-06	N	N	N	N	N	N
Sm-146	1.3E-04	N	N	N	N	N	N
Sm-147	1.5E-04	N	N	N	N	N	N
Sm-151	2.8E-01	Y	N	Y	Y	Y	Y
Sn-121m	2.7E-04	N	N	Y	N	Y	N
Sn-126	9.1E-06	Y	Y	Y	Y	Y	Y
Sn-127	5.4E+02	N	N	N	N	N	N
Sr-85m	2.4E+03	N	N	N	N	N	N
Sr-90	7.1E-05	Y	Y	Y	Y	Y	Y
Sr-91	8.3E+01	N	N	N	N	N	N
Ta-180	4.7E-05	N	N	N	N	N	N
Tb-157	8.9E-03	N	N	N	N	N	N
Tb-158	5.2E-05	N	N	N	N	N	N

Table 5. Limiting Trigger Values

Radionuclide	Trigger Value Ci	LAW	ILV	SLIT	ASH	CIG	NR
		Has Radionuclide Been Analyzed In a PA or SA?					
Tc-97	1.5E-04	N	N	N	N	N	N
Tc-98	5.9E-06	N	N	N	N	N	N
Tc-99	1.6E-05	Y	Y	Y	Y	Y	Y
Te-123	8.0E-04	N	N	N	N	N	N
Th-228	3.8E-04	N	N	N	N	Y	N
Th-229	8.6E-06	N	N	N	N	N	N
Th-230	6.4E-06	N	N	N	N	N	N
Th-232	2.7E-06	Y	Y	Y	Y	Y	Y
Ti-44	6.0E-07	N	N	N	N	N	N
Tl-204	3.6E+04	N	N	N	N	N	N
U-230	3.5E-05	N	N	N	N	N	N
U-232	3.3E-07	Y	Y	Y	Y	Y	Y
U-233	9.8E-07	Y	Y	Y	Y	Y	N
U-234	2.6E-06	Y	Y	Y	Y	Y	Y
U-235	7.7E-07	Y	Y	Y	Y	Y	Y
U-236	2.1E-04	Y	Y	Y	Y	Y	Y
U-238	7.7E-08	Y	Y	Y	Y	Y	Y
V-49	1.1E-02	N	N	N	N	N	N
W-188	5.7E-01	N	N	N	N	N	N
Y-91m	1.2E+04	N	N	N	N	N	N
Zr-93	6.4E-03	Y	Y	Y	Y	Y	Y
Zr-95	1.2E+01	N	N	N	N	N	N

Table 6. Unanalyzed Radionuclides and Disposed Inventories Exceeding Trigger Values

Nuclide	Lowest Trigger Value (Ci)	CIG	ET	ILV	LAWV	NR	SLIT1	SLIT2	SLIT3	SLIT4
Am-242m	7.9E-06				5.33E-03					
Ba-133	4.5E-02				6.55E-02					
Cl-36	3.9E-06		7.00E-05		7.96E-04	1.27E-02		1.06E-05		
Cm-242	8.5E-03					8.20E-01				
Cm-243	4.6E-04			7.12E-03						
Eu-152	4.1E-03		1.86E-01					8.08E-03		
K-40	3.4E-05		1.30E-04				4.28E-03	4.14E-04	6.40E-04	
Kr-85	1.5E+01			2.02E+01						
Mo-93	8.5E-04		2.08E-03							
Nb-93m	2.3E+00					4.71E+01				
Nb-94	1.7E-05		1.80E-03	1.06E-03			1.08E-03	2.26E-03	2.06E-05	1.32E-04
Pb-210	2.0E-06		9.95E-04	7.67E-01			1.94E-04	5.14E-04	8.02E-04	
Ra-226	2.4E-06	1.85E-01	1.40E-03	7.67E-01			3.37E-03	5.21E-04	8.02E-04	
Ra-228	9.2E-06		3.25E-03	1.79E-05	1.78E-03		2.63E-03	7.73E-04	1.21E-03	
Sb-125	7.8E-04	5.42E-03	9.46E-02	1.00E-01	2.33E-01	1.49E+04	4.62E-02	1.35E-01	8.73E-04	1.46E-03
Th-228	3.8E-04		5.49E-03	1.28E-04	7.44E-03		2.63E-03	7.76E-04	1.21E-03	
Th-229	8.6E-06		2.03E-04							
Th-230	6.4E-06		3.16E-03	1.82E-05	2.42E-05		4.81E-04	5.14E-04	8.02E-04	
U-233	9.8E-07					7.82E-06				
Zr-95	1.2E+01					8.86E+03				

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ATTACHMENT A

DESIGN CHECK PACKAGE

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DESIGN CHECK INSTRUCTIONS FOR SCREENING SA

Perform a design check for *Special Analysis: Screening Analysis for E-Area* following the general guidance provided in WSRC-IM-2002-00011.

Specific instructions are as follows:

Check the groundwater spreadsheet (NEW NCRP GW.xls) correctly implements equation 8.21 in NCRP Report 123, volume I, using the X factor from equation 8.19.

Spot check the Ingestion Effective Dose Factors in NEW GW NCRP.xls against Appendix A of NCRP Report 123, Volume I.

Check that the intruder spreadsheet (NCRPIntScreen.xls) correctly implements equation 8.22 in NCRP Report 123 Volume I, omitting the contribution from water, and using the Screening Factors from Table 3.2 in NCRP Report 123 volume II.

In both spreadsheets verify the conversion factor from Sv/Bq to mrem/Ci is correct.

Maurice Ades/WSRC/Srs
06/04/2004 03:05 PM To
Tom Butcher/WSRC/Srs@Srs
cc
Welford03 Goldston/WSRC/Srs@Srs, Marshall Looper/WSRC/Srs@Srs, Jim Cook/WSRC/Srs@srs, Elmer Wilhite/WSRC/Srs@Srs
bcc

Subject
PA Report, Tables 1-6 - Summary of Review Items

The summary of the Design Check review items for the Radionuclide Screening Analysis for E-Area Report, Tables 1-6 and Supporting Spreadsheets, is provided in the Attachment.

All the review items have been provided to the PA analyst (Jim Cook). Furthermore, these items have been discussed, resolved, and satisfactorily included into the revised PA Report, Tables 1 through 6. No further action is needed.

Should you have any questions on the attached review items, please contact me.

Radionuclide Screening Analysis for E-Area
Part III. Tables 1-6, and Supporting Spreadsheets

Summary of Design Check Review Items

Specific Items

1. Groundwater Spreadsheet:

   Correct the kd coefficients for all the radionuclides of the following elements:
   Ca, Cd, Cr, Fe, K, P, Re, Sm, Te, and Y.
   Also the kd coefficient for Zn-62 is in error. It should be equal to 200.

2. Table 1:

   The SRS value for the volume of dilution water should be 44 m3/yr.

3. Table 2:

   Correct the doses per 1E7 Ci and the activity trigger values for the radionuclides of the elements reported in Item #1 above.

4. Spreadsheet for Table 4:

   - The Ground screening factors for water are in error for the following radionuclides:

     Am-241 (5.9E-13)
     Pu-238 (1.7E-12)
     Pu-239 (2.0E-12)
     Pu-240 (2.0E-12)
     Pu-241 (6.1E-14)
     Pu-242 (1.9E-12)

   - The formulas for calculating the Intruder Dose (Column G) and the Intruder Trigger Values (Column H) are off by a factor of 1.0E7.

   - The threshold dose used for the intruder is incorrect and should be equal to 1 mrem (Column H) (Review Item suggested by J. Cook).

5. Table 4:

   - Correct GW Trigger for Am-241 (1.8E-5)
   - Specify units for Intruder Trigger (Ci)

6. Table 5:

   Correct the limiting trigger values for the following radionuclides:

   i. Am-241 (1.8E-5)
   ii. Ca-41 (3.7E-4)

iii. Nb-93m (2.3E0)
iv. Re-187 (4.4E-2)
v. Rh-101 (2.2E5)
vi. Sm-147 (1.5E-4)
vii. Tl-204 (3.6E4)

7. Table 6:

- Correct the trigger value for Nb-93m (2.3E0)
- Delete the Ra-226 inventory for LAWV
- Delete the Th-228 inventory for SLIT4

ATTACHMENT B

UDQ SCREENING

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CATEGORICAL EXCLUSION UNREVIEWED SAFETY QUESTION
{ USQ-SWE-2002-0097 superseded by USQ-SWE-2003-0029}

CAT X USQ #	SEQ. #	DATE	EO / QR	REFERENCE DOC'T ID	REV. #	BRIEF DESCRIPTION /JUSTIFICATION
USQ-SWE-2003-0029	3427	3/26/2004	K. L. Tempel	2004-PIR-26-0024 2004-NCR-26-0018		The Proposed Activity is the discovery that 15 isotopes have been disposed in SWMF LLW facilities that were not properly evaluated in the Performance Assessment. A UDQE and/or Special Analysis is necessary to evaluate the impact of disposal of these isotopes on the existing Performance Assessment. This activity was reviewed against Attachment 1 of the Cat X USQ. All Section 1 USQ questions were answered no. (These isotopes are included in the WITS limit checks for TSR inventory control purposes.) For the Section 2 UDQ criteria, it was determined that Criteria #4 (5th bullet) and #7 were not met.

Signature: KLT [signature] 3-26-04

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