cc: JGorn OCA

109.2/TCJ/84/07/20/1

SEP 10 1984

WM Record File 109.2

WM Project 1
Docket No.
PDR ✓
LPDR

Distribution:

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Mr. William Bennett
Acting Associate Director
Office of Geologic Repository Deployment
Office of Civilian Radioactive
Waste Management
Department of Energy
Washington, DC 20554

Dear Mr. Bennett:

At the Performance Assessment National Review Group (PANRG) meeting held in Gaithersburg on July 9 to July 12, 1984, it came to our attention that there was confusion over the requirements for release of radionuclides from the engineered barrier system. At the meeting we indicated we would clarify our position.

The rule, 10 CFR Part 60, states:

(§60.113(a)(1)(ii)(B))

> The release rate of any radionuclide from the engineered barrier system following the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure, or such other fraction of the inventory as may be approved or specified by the Commission; provided, that this requirement does not apply to any radionuclide which is released at a rate less than 0.1% of the calculated total release rate limit. The calculated total release rate limit shall be taken to be one part in 100,000 per year of the inventory of radioactive waste, originally emplaced in the underground facility, that remains after 1,000 years of radioactive decay.

The confusion at the PANRG meeting related to the method of computing the 0.1 percent of the total release rate for the exempted radionuclides. We have attached an example calculation which clarifies our intent.

If you have any questions, please contact Mr. Lake H. Barrett, at (FTS) 427-4173 or myself at (FTS) 427-4069.

Sincerely,

Original Signed by
Robert E. Browning

Robert E. Browning, Director
Division of Waste Management

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PDR WASTE
WM-1 PDR

Enclosure
As stated
(*See previous concurrence)

OFC	:WMEG*	:WMEG*	:WMRP*	:WMRP*	:WM	:WMEG*	: WM
NAME	:TJohnson:gh	:LBarrett	:MLogsdon	:HMiller	:REBrowning	:JTGreeves	: MJBell
DATE	:08/ /84	:08/ /84	:08/ /84	:08/ /84	:08/ /84	:08/6/84	: 08/20/84

SEP 10 1984

CALCULATION OF I-129 RELEASE RATE

PURPOSE

The purpose of this calculation is to determine the required I-129 release in accordance with the 10 CFR Part 60 engineered barrier system requirements for the Nevada Nuclear Waste Storage Investigations (NNWSI).

REFERENCES

1. 10 CFR Part 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories."

CALCULATION

The rule, 10 CFR Part 60 (Ref. 1), states release rate requirements for the engineered barrier system for a high-level waste repository. These release rate requirements are given below (§ 60.113(a)(1)(ii)(B)).

> The release rate of any radionuclide from the engineered barrier system following the containment period should not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1000 years following permanent closure, or such other fraction of the inventory as may be approved or specified by the Commission; provided, that this requirement does not apply to any radionuclide which is released at a rate less than 0.1% of the calculated total release rate limit. The calculated total release rate limit shall be taken to be one part in 100,000 per year of the inventory of radioactive waste, originally emplaced in the underground facility, that remains after 1000 years of radioactive decay.

This requirement allows radionuclides which have very low inventories to be exempt from the 1 part in 100,000 annual release rates.

I-129 is a nuclide which will have a low curie inventory at 1000 years relative to the total inventory in the repository. This calculation will determine if the I-129 inventory in spent fuel will allow it to be exempted from the 10 CFR Part 60 individual radionuclide release rate requirement of 1 part in 100,000.

Table 1 provides a nuclide inventory for spent fuel for the NNWSI repository project. The total inventory at 1000 years is computed from the data in Table 1 and is 17.6×10^5 uCi/kg U. This value is based on a 33 MWd/kg U burnup. The I-129 inventory at 1000 years is given as 32 uCi/kg U.

In order for I-129 to be exempted it must be released at a rate less than 0.1 percent of the total release rate. The total release rate will be:

$$17.6 \times 10^5 \text{ uCi/kg U/yr} \left(\frac{1}{10^5}\right) = 17.6 \text{ uCi/kg U/yr.}$$

In order for I-129 to be exempted from the 1 part in 100,000 annual release rate criteria, it must have a release rate of less than $(17.6 \text{ uCi/kg U/yr})(10^{-3}) = 0.0176$ uCi I-129/kg U/yr.

If it is assumed that all the I-129 is released in one year, it will be released at a rate of:

32 uCi/kg U/yr.

Therefore, the I-129 cannot be summarily dismissed because this maximum annual rate of release exceeds 0.0176 uCi/kg U/yr. If, however, release rate information for I-129 can be obtained which shows that the maximum annual release rate will not exceed 0.0176 uCi/kg U/yr, I-129 could be dismissed from further consideration. For this second option to occur, a release rate fraction of less than:

$$\frac{0.0176 \text{ uCi/kg U}}{32 \text{ uCi/kg U}} = 5.5 \times 10^{-4} .$$

would have to be demonstrated. This value, however, would be less restrictive than the 1 in 100,000 release value which would otherwise be required.

Calculated By [signature] 9-6-84
Checked By [signature] 9-6-84
Approved By [signature] 9/6/84

TABLE 1

SPENT FUEL RADIONUCLIDE CONTENT* IN ORDER OF DECREASING ACTIVITY AT 1000 YEARS (33 MWd/kg U PWR Fuel)

Radionuclide	μCi/kg U at Years from Discharge(10) 10 yr	1000 yr	10,000 yr	Half-Life(11) (years)
^{241}Am	1.7×10^6	9.3×10^5	10.6	458
^{240}Pu	5.3×10^5	4.8×10^5	1.9×10^5	6580
^{239}Pu	3.2×10^5	3.1×10^5	2.4×10^5	24,400
^{243}Am**	1.7×10^4	1.6×10^4	7.0×10^3	7370
^{99}Tc	1.4×10^4	1.4×10^4	1.3×10^4	2.1×10^5
^{93}Zr	3.0×10^3	3.0×10^3	3.0×10^3	1.5×10^6
^{234}U	1.2×10^3	2.0×10^3	2.0×10^3	2.5×10^5
^{242}Pu	1.9×10^3	1.9×10^3	1.8×10^3	3.8×10^5
^{14}C***	1.5×10^3	1.4×10^3	4.6×10^2	5730
^{238}Pu	2.2×10^6	1.0×10^3	--	86
^{237}Np	3.3×10^2	1.0×10^3	1.2×10^3	2.1×10^6
^{126}Sn	8.0×10^2	8.0×10^2	7.5×10^2	$\sim 10^5$
^{79}Se	4.2×10^2	4.2×10^2	3.8×10^2	6.5×10^4
^{135}Cs	3.8×10^2	3.8×10^2	3.8×10^2	3.0×10^6
^{151}Sm	3.6×10^5	2.3×10^2	--	93
^{107}Pd	1.2×10^2	1.2×10^2	1.2×10^2	7.0×10^6
^{129}I	32	32	32	1.7×10^7
^{241}Pu	8.0×10^7	21	10	13
^{230}Th	0.1	16	164	8.0×10^4
^{226}Ra****	3.3×10^{-4}	3	128	1600
^{210}Pb	4.0×10^{-5}	3	128	--

*Includes radionuclides with half-lives greater than 1 year and with activities greater than 10^{-8} of total 1000-year activity.

**^{243}Am decay followed by 2-day half-life ^{239}Np daughter product decay.

***^{14}C activity will vary depending on initial fuel nitrogen content.

****Relatively rapid (~22 year) eight-step decay chain from ^{226}Ra to stable ^{206}Pb, only ^{210}Pb in this chain has a half-life greater than 1 year.

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Robert E. Browning, Director
Division of Waste Management

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As stated

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NAME	:TJohnson:gh	:LBarrett	:MLogsdon	:HMiller	:MJBell	:REBrowning	:JTGreeves
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