Important Long-Lived Contaminants at INL's RWMC Not Remediated

Last November, the Department of Energy announced the third site-wide five-year review of cleanup at the Idaho site. The review will determine if the remedies are working as designed and remain protective of human health and the environment. The public will be notified when the review is complete. It is providing the appearance of transparency—without really being transparent. There is no public comment opportunity. And the five-year review won't be released to the public until it is finished. [1]

Details of waste monitoring at the INL can be found online at the Administrative Record at www.ar.inel.gov. Increasing contaminant detections are downplayed at Radioactive Waste Management Complex (RWMC) at the Idaho National Laboratory (INL) as the progress removing an important but small portion of the waste is emphasized.[2]

Of the 97 acres of subsurface disposal area that began accepting waste in 1952 and continues to accept waste, only about 6 acres of "targeted waste" will be retrieved. An estimated initial inventory is provided in Table 1. The most mobile contaminants, such as technetium-99, iodine-129, and chlorine-36 are from INL wastes and remain poised to contaminate the aquifer because "targeted waste" includes only a portion of Rocky Flats waste and not INL wastes.

The retrieval of shallowly buried "targeted waste" mainly from Rocky Flats plutonium weapons manufacturing posed an obviously excessive soil surface and chemical risk. But that should not be an excuse to ignore vast amounts of remaining waste that will trickle out long-lived contaminants.

The three agencies that signed on to the limited removal of waste are the federal EPA, Idaho Department of Environmental Quality, and the Department of Energy. The Department of Energy has to pay for the remediation and largely retains the driver's seat for both spending and "spin." The message is clear: if you support nuclear research, don't worry about aquifer contamination.

Cleanup is described in acres and volume—deliberately avoiding radionuclide and curie descriptions. The targeted waste is from Rocky Flats; however, not all Rocky Flats waste will be removed. Uranium and nitrate waste from Rocky Flats piled on Pad A, an asphalt pad and sprinkled with top soil is not planned to be retrieved. It contains half of the nitrates at RWMC. And INL waste has continued to add waste to RWMC.

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[1] More information about the INL cleanup five-year review at https://idahocleanupproject.com, EPA's website http://www.epa.gov/superfund/fiveyearreview/, http://www2.epa.gov/fedfac/five-year-review-federal-facility-cleanups, or contact DOE at badrovn@id.doe.gov.

[2] Department of Energy, *Operable Unit 7-13/14 Five-Year Monitoring Report for Fiscal Years 2010-2014*, DOE/ID-11507, August 2014.

Table 1. Radionuclide and chemical contaminants at RWMC for 1000 year and 10,000 year groundwater ingestion peak risk estimates and groundwater concentrations, unremediated.

Radionuclide (half life)	Inventory	Source[a]	Peak Risk	Calendar Year	Peak Aquifer Concentration (Percent of MCL)	Maximum Contaminant Level
Am-241 (432 yr)	243,000 Ci	RFP	3E-3[b]	3010	6.8E-8 (< 1 percent)	15 pCi/L
C-14 (5,730 yr)	731 Ci	INL	1E-5	2133	186 **9.3 percent**	2000 pCi/L
Cl-36 (301,000 yr)	1.66 Ci	INL	2E-6	2395	21.2 3 percent	700 pCi/L
I-129 (17,000,000 yr)	0.188 Ci	INL	4E-5	2111	13.1 **1310 percent**	1 pCi/L
Tc-99 (2213,000 yr)	42.3 Ci	INL	3E-4	2111	2710 **301 percent**	900 pCi/L
Np-237 (2,144,000 yr)	0.141 Ci	INL	1E-4	12000	86.8 **579 percent**	15 pCi/L[c]
U-238 (4,470,000,000 yr)	148 Ci	RFP[f]	9E-5	12000	47.1 **472 percent**	1.01E1 pCi/L[d]
Total Uranium[c]			NA	12000	1.44E-1mg/L **480 percent**	3.00E-2 mg/L[e]
Carbon Tetrachloride	7.9E8 g	RFP	5E-4	2133	3.07E-1 mg/L **6140 percent**	5.0E-3 mg/L
1,4-Dioxane	1.87E6 g 4.24E4 g	RFP INL	2E-5	2111	1.69E-01 mg/L **5633 percent**	3E-3 mg/L
Methylene chloride	1.41E7 g	RFP	5E6	2245	5.85E-2 mg/L **1170 percent**	5E-3 mg/L
Nitrate	4.06E8 g 4.97E7 g	RFP INL	(Hazard index 1)	2094	66.7 mg/L **667 percent**	10 mg/L
Tetrachloroethylene	9.87E7 g	RFP	7E-7	2145	6.64E-2 mg/L **1328 percent**	5.0E-3 mg/L
Trichloroethylene	8.92E7 g	RFP	9E-4	2130	3.8E-2 mg/L **760 percent**	5.0E-3 mg/L

Sources: DOE/ID-11241 sections 4 and 7.

a. Rocky Flats Plant (RFP); Idaho National Laboratory (INL)

b. The peak risk for Americium-241 is due to external exposure, soil ingestion, inhalation and crop ingestion. The risk for the other contaminants is primarily groundwater pathways.

c. The limit is 15 pCi/L for total alpha (40 CFR 141).

d. The limit is 3.0E-2 mg/L (30 microgram/L) for total uranium. To compare concentrations of uranium isotopes, 3E-2 mg/L is converted to the equivalent activity for each isotope.

e. Total uranium is presented for comparison to the maximum contaminant limit.

f. Table 4-4 of the RI/BRA shows that most of the U-238 waste is from Rocky Flats. Of this, 24.9 curies of U-238 was placed on pad A which is not currently planned to be removed.

Fictitious Case Against More Complete Cleanup

Aside from ten times the cost of the limited 6-acre "targeted waste" retrieval compared to full retrieval which is a legitimate case, one widely touted argument against more meaningful cleanup at RWMC was saying that the increased worker cancer risk did not justify the marginal improvement in human health risk to future residents. They imply that a monitored radiation worker is the type of worker exposed to the increased health risk for each additional acre of retrieval.

But, using a monitored radiation worker and a reasonable analysis would not have provided an argument against more extensive or full cleanup. So, they concocted a misleading and incongruent argument to say that performing more years of cleanup at RWMC would increase worker cancer risk per acre.

This argument was based on an exaggerated unmonitored radiation dose to an assumed state employee frequently involved with the shipments. The problem of an unmonitored person near the shipments who was classed as a "member of the public" in the original analysis but converted to "worker" for appearances should have highlighted an area of concern for increased radiation protection for work associated with shipments rather than be used to nix more extensive cleanup.

There is a problem with comparing a single grossly conservative unmonitored worker who receives over 48 rem and apparently has no comprehension of the radiation fields he is exposed to—to the highly uncertain estimated public health dose from contaminant migration to groundwater. The appearance of a rather flat-lined public all-pathways risk doesn't convey the fact that 5 in 1000 cancer risk is significantly more than 1 in 10,000 or zero. [3] [4] [5]

Total population dose is ignored. The contaminants are predicted to trickle out for hundreds and thousands of years. But it is very unattractive for the nuclear industry to attempt to estimate the populations of people over millennia and admit the vast numbers of people including children and elderly that can be exposed. So, they are focusing on a single individual dose.

If a monitored DOE radiation worker were used, as is implied, life time dose limits would limit the risk, although I believe the true risk is higher than recognized. The career dose of a worker assumed to get the maximum allowable dose would not change—the worker would likely continue to perform radiation work but at a different facility. It would not reduce a worker's hypothetical lifetime dose to limit RWMC operations to only 6 years rather than the

[3] N. M. Wheldon et al., *Short-Term Risk Assessment for the Operable Unit 7-13/14Feasibility Study*, RPT-188, April 2006, p. 2-6 to 2-8. https://ar.inl.gov/images/pdf/200604/2006041200257TUA.pdf

[4] US DOE, US EPA, Idaho DEQ, *Record of Decision for Radioactive Waste Management Complex Operable Unit 7-13/14,* DOE/ID-11359, September 2008. p. 41 https://ar.inl.gov/images/pdf/200810/2008100100495TUA.pdf

[5] U.S. Department of Energy, K. J. Holdren, "Feasibility Study for Operable Unit 7-13/14," DOE/ID-11268, May 2007. https://ar.inl.gov/images/pdf/200706/2007061400254TUA.pdf

25 years for a full cleanup of RWMC. The argument put forth goes beyond highly misleading; it is utter fiction posing as reason and logic.

Disconnects in Contaminant Monitoring

Increasing trends are being downplayed even though not predicted. Once contaminants are in the vadose zone and aquifer, there basically is no means of remediation.

Monitoring the migration of contaminants continues in the soil or vadose zone, in soil core samples, in soil lysimeters and perched and aquifer water. But past monitoring has proven inadequate from inability to monitor volatile contaminants such as carbon-14 to simply not monitoring important contaminants such as technetium-99. There seems a complete disconnect with lack of concern about monitoring long-lived radionuclides.

Waste Area Capping Magical Only at RWMC

At RWMC it has been accepted that an engineered contoured cap over the waste will be protective despite the conclusion by the replacement facility for RWMC, the Replacement Remote-Handled Low-Level Waste Facility that a cap cannot be maintained and is detrimental. An engineered cap sounds good but others conclude that engineered caps will not hold up over the thousands of years they need to limit water infiltration without frequent maintenance.

Low Curie Levels of Long-Lived Isotopes Obscures Their Risk

Curie inventory can be a misleading indicator of repository risk because the highest curie contaminants tend to have shorter a half life. Lower curie contaminants may have a very long half life, and dominate ingestion risk. Uranium involves decay chains that introduce new radiological contaminants over time, increasing rather than decreasing radioactive contamination. The mobility of the contaminant with water infiltration is also an important characteristic that isn't presented in CERCLA reports of risk results.

Of the 1.5 million curies buried at RWMC, only 243,800 curies were calculated to be the dominant contributors and exceed maximum contaminant levels, by wide margins. Most of those curies were from the shallow burial of Americium-241 resulting in external exposure, soil ingestion, inhalation, and crop ingestion which are likely largely involved in remediation efforts. The remaining dominant health contributors at RWMC were less than 923 curies. Most of these curies are remaining at RWMC where they will slowly leach into the aquifer; they are INL wastes and not destined for WIPP.

A comparison of the waste that will remain buried at RWMC is provided in Table 2. So, it would appear that resident doses near RWMC even after CERCLA remediation are going to significantly exceed the Replacement RH-LLW waste facility, not withstanding additional chemical contamination at RWMC.

Table 2. Assumed remaining RWMC inventory comparison to the added INL Replacement Remote-Handled Low-level Waste Facility.

Radionuclide (half life)	**RWMC Inventory (curies)**	**Replacement RH-LLW Inventory (curies)**	**Percent of RH-LLW Inventory**
Carbon-14 (5730 year)	731	432	169
Chlorine-36 (301,000 year)	1.66	260	< 1 percent
Iodine-129 (17,000,000 year)	0.188	0.133	141
Technetium-99 (213,000 year)	42.3	16.7	253
Neptunium-237 (2,144,000 year)	0.141	0.003	4700
Uranium-238 (4,470,000,000 year)	148	16.2	913

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