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INL plays hide the ball

If the Idaho National Laboratory really wanted an informed conversation, it wouldn't make information about waste disposal and other issues to difficult to attain, writes Tami Thatcher. Printed in the Idaho Falls Post Register March 20, 2015.

I agree that a meaningful conversation requires an informed public—that understands the risks, benefits and issues at hand.

Dollars have been spent on clean up at the Idaho National Laboratory, but has it ensured protection of the Eastern Snake River Plain Aquifer? The largest reduction in polluting came from ceasing spent fuel reprocessing at the Idaho Nuclear Technology and Engineering Center (INTEC).

But while high volumes of radioactively contaminated waste water were poured into our aquifer beginning in 1952, monitoring lagged the polluting by years. When significant quantities of long-lived and mobile radionuclides from reprocessing were found including technetium-99, the 1998 US Geological Survey report analyzing these contaminants was hidden away in a closed-access journal. [1] [2]

INL's website mischaracterizes solid waste at INL as "trash, tools and clothes" and emphasizes that the most egregious chemical and radiological wastes were dumped "in compliance with laws at that time." [3] [4] [5]

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[1] T. M. Beasley, P. R. Dixon, and L. J. Mann, ^{99}Tc, ^{236}U, and ^{237}Np in the Snake River Plain Aquifer at the Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, Environ. Sci. Technol., 1998, 32, 8375-3881.

[2] US Geological Survey website link: http://id.water.usgs.gov/projects/INL and INL bibliography at http://id.water.usgs.gov/INL/Pubs/INL_Bibliography.pdf . Select individual wells at the USGS mapper at http://maps.waterdata.usgs.gov/mapper/index.html

[3] Video: Understanding radioactive waste and research materials at INL **https://www.inl.gov/article/cleanup/**

[4] CERCLA documents for RWMC cleanup include over inventory estimates for RWMC at the Administrative Record (ar.inel.gov). Many cleanup and other INL documents are available at osti.gov/scitech or the INL Technical Library (https://www.inl.gov/about-inl/general-information/research-library/).

[5] CERCLA stands for Comprehensive Environmental Response Compensation and Liability Act, an environmental law enacted in 1980 authorizing the US Environmental Protection Agency to create a list of polluted locations

Waste that remains buried at the Radioactive Waste Management Complex (RWMC) and will be placed in the new replacement facility will include large quantities of long-lived and mobile radionuclides from reactor operations, accidents and experiments that will **[the Post Register said "could"]** contaminate the aquifer.

Descriptions of cleanup progress are limited to discussions of the waste "targeted for retrieval." Of the roughly 6 acres of targeted waste, the remaining 91 acres of waste is not mentioned.

Obtaining the Department of Energy performance assessments that describe the remaining RWMC wastes that will migrate to the aquifer for thousands of years requires a Freedom of Information Act request. [6]

Will INL explain Pad A during a tour of RWMC? This waste was placed on an asphalt pad in the 1970s when burial of weapons waste[7] was forbidden. Soil was sprinkled on top of the mound but grass has refused to grow. Will the tour leaders explain why a cap over RWMC waste and Pad A will be satisfactory despite other studies that find soil caps cannot be maintained over the thousands of years they are needed?

At least INL is not pretending that the pyroprocessing research will help solve "used" fuel storage issues. The research for detecting the use of pyroprocessing to attain weapons material naturally follows INL's sharing of this technology with foreign countries. Pyroprocessed waste remains inside INL facilities or "temporarily" in cans buried in soil at the Radioactive Scrap and Waste facility. [8] [9] [10] [11]

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requiring a long-term response to cleanup hazardous material contaminations. These locations are known as "Superfund" sites.

[6] **RWMC Performance Assessment documents that require FOIA:** U.S. Department of Energy, 2008. Composite Analysis for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site. DOE/NE-ID-11244. Idaho National Laboratory, Idaho Falls, ID and U.S. Department of Energy, 2007. Performance Assessment for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site. DOE/NE-ID-11243. Idaho National Laboratory, Idaho Falls, ID.

[7] Much of Rocky Flats weapons waste was plutonium waste or transuranic, known as "TRU." Transuranic refers to isotopes above uranium in the periodic table of elements. But, non-TRU waste, depleted or enriched uranium, which was placed on Pad A, is also a toxic radionuclide. While historically ignored in regulatory waste matters because viewed as a resource not a waste, waste disposal of uranium is an increasing problem. Processed uranium is in a soluble form, posing a greater migration threat.

[8] R. Einhorn, "US –ROK Civil Nuclear Cooperation Agreement: overcoming the Impasse, October 11, 2013. http://www.brookings.edu/research/speeches/2013/10/us-south-korea-civil-nuclear-cooperation-agreement-einhorn

[9] http://belfercenter.ksg.harvard.edu/publication/22979/safeguards_for_pyroprocessing_plants.html

[10] Blue Ribbon Commission of America's Nuclear Future. 2012. (2010 estimates quoted) www.brc.gov

[11] A. Makhijani and L Ledwidge, "Reprocessing: Mythology versus Reality," Science for Democratic Action, February 2012. http://ieer.org/wp/wp-content/uploads/2012/02/16-2.pdf

While "research quantities" of "used" fuel that INL describes as "would fill a bread box" are discussed, transportation accident consequences for these million curie shipments are not. Now common are train accidents with fire duration and intensity exceeding cask design limits. [12] [13]

Government-sponsored spin may impress local officials. But if DOE and INL are truly interested in accurate public discourse, its operations summaries would not be 6 months behind [14]and it would not require a Freedom of Information request to obtain documents describing its current waste disposal, its technical basis for radiological monitoring, its nuclear facility protective action distances, or its historical radiological releases. [15]

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An Alarming Change in the Status of Technetium-99 in the Vadose Zone and Aquifer at INL

Technetium-99, with half life 213,000 years, is a long lived carcinogenic radionuclide created by nuclear fission from nuclear reactors or nuclear weapons testing. Nuclear fuel debris buried underground at INL's Radioactive Waste Management Complex (RWMC) and waste from nuclear fuel reprocessing at INL's Idaho Nuclear Technology Center (INTEC) have released Tc-99 into the ground. Technetium-99 contamination from INTEC operations of Tc-99 has been detected in the aquifer since 1998. So, why have you read so little about this?

Despite the Cleanup News at RWMC, Vadose Zone Tc-99 Levels Are Increasing

Examine recent USGS reports for selected contaminants like USGS 2013-5214 for 2009 through 2011, or USGS 2015-5003 and you'll find various radionuclides included—but sweetly and oh so neatly, Tc-99 is completely absent from the reports.[16] You must search the CERCLA cleanup studies to find information about Tc-99 monitoring.

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[12] US NRC, Office of Nuclear Material Safety and Safeguards, *Spent Fuel Transportation Risk Assessment*, NUREG-2125, January 2014. *http://pbadupws.nrc.gov/docs/ML1403/ML14031A323.pdf*

[13] High Burnup Dry Storage Cask Research and Development Project, Contract No.: DE-NE-0000593. http://www.osti.gov/scitech/servlets/purl/1133392

[14] See DOE-ID operating summaries at: http://www.id.doe.gov/news/OperationsSummarys.htm

[15] See DOE's Human Radiation Experiment document roadmap at https://ehss.energy.gov/ohre/roadmap/roadmap/part2.html#Idaho1

[16] US Geologic Survey, *An Update of Hydrologic Conditions and Distribution of Selected Constituents in Water, Eastern Snake River Plan Aquifer and Perched Groundwater Zones, Idaho National Laboratory, Idaho, Emphasis 2009-11*, Report 2013-5214 (DOE/ID-22226), 2013 or *Water-quality characteristics and trends for selected wells possibly influenced by wastewater disposal at the Idaho National Laboratory, Idaho, 1981–2012*, Report 2015–5003 (DOE/ID-22233), 2015.

Technetium-99 has not been found in the aquifer below RWMC where chemical contaminants (prominently carbon tetrachloride, uranium, cesium-137, and others continue to be the largest aquifer contaminants. And success stories of RWMC cleanup are prominent, with successful retrieval of "targeted" waste continuing, even though shipments to WIPP have been interrupted due to the accidents last February 2014. Restart efforts are expected to take several years at WIPP, the New Mexico salt mine for underground disposal of defense-generated wastes.[17]

In 2006, here's what you might have read about Tc-99 at RWMC above the aquifer: [18]

"Technetium-99 is consistently detected at depths of 27 m (88 ft) in two locations. . .at the western end of the [subsurface disposal area]. The concentration associated with Well D06 is increasing. Historically, Tc-99 has not been a priority analyte for vadose zone monitoring; therefore, data are sparse." (No concentration level is given.)

"Few radionuclides are detected in core samples. Most are detected only sporadically and have no associated temporal or spatial trends; however, some radionuclides are consistently detected in RWMC core samples. In order of detection frequency from highest to lowest, these radionuclides are Tc-99, Am-241, Pu-239/240, Sr-90, and Pu-238."

"Detections of Tc-99 in the I-series wells in 1999 were not corroborated by detections in the 2003 core sampling campaign. Some evidence supports the conclusion that Tc-99 is present, while some evidence is to the contrary. However, lysimeter data imply Tc-99 transport may be occurring."

So, they are saying, gee, we just don't see any trends and the detections are sporadic. The meta-message seems to be we're not really sure that Tc-99 transport is occurring so there doesn't appear to be anything to worry about.

But along comes the 5 year monitoring report for reporting in 2010 to 2014. [19] This report documents detections of concentrations of 15,700 pico curies per liter (pCi/L), well above the derived maximum contaminant level (MCL) of 900 pCi/L. This same location has also yielded concentrations of nitrate, tritium, and total uranium that exceeded respective MCLs. "Tc-99 continues a generally upward trend." [20]

[17] Read more at wipp.energy.gov or http://www.abqjournal.com/540901/news/flynn-wipp-leak-fines-have-national-implications.html

[18] J. Holdren et al., Idaho Cleanup Project, Department of Energy, *Remedial Investigation and Baseline Risk Assessment for Operable Unit 7 13/14*, DOE/ID-11241, May 2006. http://ar.inel.gov

[19] Department of Energy, "Operable Unit 7-13/14 Five-Year Monitoring Report for Fiscal Years 2010-2014, DOE/ID-11507, August 2014. p. 31-32, at Zone 1, R2004. https://ar.inl.gov/images/pdf/201409/2014091800949BRU.pdf

[20] DOE/ID-11507, August 2014. p. 31-32, at Zone 1, R2004. https://ar.inl.gov/images/pdf/201409/2014091800949BRU.pdf

Technetium-99 is highly soluble and mobile in soil. Contamination in the vadose zone above the aquifer will continue downward to the aquifer. RWMC has an estimated 42.3 curies of Tc-99. [21]

But cleanup is happening at RWMC, so aren't the levels of Tc-99 going to be reduced? No—they may argue that once an engineered cap is installed the leaching will slow. But, the Tc-99 is mainly from INL operations and not from Rocky Flats. Only the chemical waste and the transuranic waste from Rocky Flats is targeted for retrieval and shipment to the WIPP.

Over 16 curies of technetium-99 to be disposed of at the proposed Replacement RH-LLW facility to replace RWMC roughly matches estimates of what INTEC released to the aquifer from injection well practices.[22] And, the RWMC technetium-99 waste is supposedly stored in metal canisters.[23]

Technetium-99 at INTEC

As part of ongoing CERCLA (Superfund site) activities at INTEC, in May 2003 Tc-99 was found **in the aquifer** at concentrations between 2,000 and 3,000 pCi/L. This was the first time Tc-99 concentrations exceeded the derived maximum contaminant level of 900 pCi/L. [24] Elevated Tc-99 in groundwater at monitor well ICPP-MON-A-230 is thought to be from historical liquid waste releases (leakage) at the INTEC tank farm. As the contamination disperses and spreads in the aquifer, the detected levels are expected to decrease as the contaminant disperses in the aquifer.

The former INTEC injection well, used from the 1953 until 1986 and plugged in 1989, likely constituted an earlier source of Tc-99 to the aquifer, but the resulting groundwater Tc-99 concentrations did not exceed the MCL. The injection well flushed high volumes of water, creating a more dilute Tc-99 plume that extends south and down gradient of INTEC.

The report of detections of Tc-99 at INTEC in 2003 cites a USGS report of Tc-99 detection in the aquifer. [25] This came as quite a surprise to me, as I had been searching for USGS reports for aquifer contamination using the UGSG bibliography for INL but found none. This 1998 report for Tc-99 and other contaminants at INL was only printed in a journal. It is not in the INL bibliography, nor is any report of Tc-99 included in the bibliography nor is it included as a "selected" radionuclide in reports I have reviewed.

[21] ibid. RI/BRA DOE/ID-11241Table 4-2.
[22] Environmental Defense Institute report: Unwarranted Confidence in DOE's Low Level Waste Facility's Performance Assessment.
[23] ibid. RI/BRA DOE/ID-11241. p 7-44.
[24] Idaho Completion Project, Bechtel BWXT Idaho LLC, "Evaluation of Tc-99 in Groundwater at INTEC: Summary of Phase 1 Results," ICP/EXT-04-00244, September 2004. p. 2-2.
[25] ibid. ICP/EXT-04-00244. p. 2-2, 5-1.

In this 1998 journal article by T. M Beasley,[26] Tc-99 was found in groundwater over a large area extending south from the INTEC to the area of the Big Southern Butte. The plume was similar in size and shape to the known tritium plume south of INTEC. An estimated 15 Ci of Tc-99 was disposed of in the aquifer attributed to the former INTEC injection well which operated from 1953 to 1986. The INL and Department of Energy had made no documented measurements (or estimates) of the fuel reprocessing contaminant, Tc-99, released by INTEC.

Technetium-99 Health Summary

Technetium-99 human health risk is primarily through groundwater ingestion and irrigation of crops with contaminated groundwater. The Environmental Protection Agency (EPA) has established a Maximum Contaminant Level (MCL) of 4 millirem per year for beta particle and photon radioactivity from man-made radionuclides in drinking water. The average concentration of technetium-99 to yield 4 millirem per year is a derived value of 900 pCi/l. It is crucial to remember the additive effect of other radionuclides present in addition to technetium-99. The annual dose from all the beta emitting radionuclides combined should not exceed 4 millirem/yr.[27]

Once in the human body, Tc-99 concentrates in the thyroid gland and the gastrointestinal tract. The body, however, constantly excretes Tc-99 once it is ingested. As with any other radioactive material, there is an increased chance that cancer or other adverse health effects can result from exposure to radiation.

At radioactively contaminated sites with Tc-99 contamination, the primary routes of exposure to an individual are from the potential use of contaminated drinking water and ingestion of contaminated plants. The contamination at INTEC has been generously spread into the aquifer and spread downstream. The leaching of Tc-99 at RWMC has only just begun and will continue for thousands of years. The leaching of Tc-99 from the new Replacement Remote-Handled Low-Level Waste (RH-LLW) at INL will add to the legacy of dumping radioactive waste into the Snake River aquifer. See Table 1 for a summary of Tc-99 in or headed for the aquifer.

Table 1. Estimated inventory of technetium-99 in disposed waste, vadose, or aquifer at INL.

Location	Technetium-99, curies	INL Facility[a]	Highest measured concentration, pCi/L	Percent of 900 pCi/L Maximum Contaminant Level[b]

[26] T. M. Beasley, P. R. Dixon, and L. J. Mann, "^{99}Tc, ^{236}U, and ^{237}Np in the Snake River Plain Aquifer at the Idaho National Engineering and Environmental Laboratory," *Environmental Science & Technology*, 32:3875-3881, 1998.

[27] EPA Facts about Technetium. http://www.epa.gov/superfund/health/contaminants/radiation/pdfs/technetium.pdf

RWMC buried waste	42.3 curies	MFC, INTEC, ATRC, NRF	15,700 pCi/L (2010-2014)	1744
INTEC disposal well	15 curies	Government-owned nuclear fuel reprocessing	518 pCi/L (1994)	57
INTEC tank farm leakage	less than 4 curies	Government-owned nuclear fuel reprocessing	3000 pCi/L (2003)	333

Information source: DOE/ID-11241, ICP/EXT-04-00244

Notes:

a. Facilities: Advanced Test Reactor Complex (ATRC); Idaho Nuclear Technology Center (INTEC); Materials and Fuels Complex (MFC), formerly ANL-W; Naval Reactors Facility (NRF).

b. The maximum contaminant level in pico curies per liter (pCi/L) for technetium-99 is derived from the EPA drinking water regulation, 40 CFR 141.66, of 4-mrem/yr for a beta-emitting radionuclide. The presence of more than one radionuclide reduces the MCL for each so the total dose does not exceed 4 mrem/yr to the critical organ. Beta emitters cesium-137, iodine-129 and technetium are summed for the 4 mrem/yr limit; however, strontium-90 and tritium have their own MCL.