Environmental Defense Institute

News on Environmental Health and Safety Issues

October 2019 **Volume 30 Number 10**

Idaho National Laboratory Pushing for Test Range Expansions, With Planned Long-lived Radionuclide Releases

It's like the good old 1950s once again, as the Department of Energy is pressing for acceptance of the intentional release of long-lived radionuclides to the soil and skies of Idaho.

The Department of Energy wants us all to pretend that these radionuclides will stay in the soil at the Idaho National Laboratory and won't be inhaled and ingested by human beings and other life, over the next millennia. It is lunacy that is murderous, disease-creating and birth-defect-creating.

Historical soil monitoring showed that radionuclides unearthed by flooding at the Radioactive Waste Management Complex blew miles away to the farming community of Howe, Idaho, many miles north of the RWMC. The 1998 report, EML-599, study found that transuranic waste from RWMC has blown miles from RWMC. [1] [2]

Just east of Osgood farming community and south of the Mud Lake and Terreton farming communities, the Department of Energy want to radiologically contaminate…well, add to the existing radiological contamination….so that more and more and more people can be diseased, disabled and sent to an early grave.

Read more about the proposed expansion of the Idaho National Laboratory's National Security Test Range and Radiological Response Training that may use unmanned aerial systems and additional explosive material and radioisotopes for testing and training. The draft environmental assessment is online and public comments will be accepted until October 12.

The Department of Energy didn't face up to past harm to Idaho citizens because it avoided conducting epidemiology of our citizens. And with so many parts of the U.S. radiologically contaminated, the harm becomes masked even if a serious attempt at epidemiology is attempted.

The document, entitled the *Draft Environmental Assessment for Expanding Capabilities at the National Security Test Range and the Radiological Response Training Range at Idaho National Laboratory* (DOE/EA-2063) was prepared in accordance with the National

---

[1] T. M. Beasley et. al, Environmental Measurements Laboratory, *Heavy Element Radionuclides (Pu, Np, U) and Cs-137 in Soils Collected From the Idaho National Engineering and Environmental Laboratory and Other Sites in Idaho, Montana, and Wyoming*, EML-599, October 1998.

[2] See EML-599, page 37 and Figure 14 on page 46 describing the way SDA windblown radionuclides could be distinguished from global weapons testing fallout, Nevada Test Site fallout and stack releases from INTEC. See page 45 describing how elevated Americium-241 to 239+240 Plutonium ratios observed near the SDA differ from weapons testing.

Environmental Policy Act and is posted for public review at https://www.id.energy.gov/insideNEID/PDF/NSRR%20Draft%20EA.pdf.

The 30-day public comment period on the draft environmental assessment will conclude on October 12, 2019. Comments can be submitted by mail to Vic Pearson, 1955 Fremont Ave., 83415-1170 or by email to nsrrea@id.doe.gov.

GAO Issues Report Discussing High-Level Waste Challenges for the Idaho National Laboratory

The U.S. Government Accountability Office issued a report in September about the High-Level Waste management and disposal challenges at the Idaho National Laboratory. [3] The report describes how decades of Department of Energy defense activities at the Idaho National Laboratory produced radioactive waste managed as High-Level Waste: liquid sodium-bearing waste (SBW) and granular, highly soluble calcine waste. The Department of Energy has long denied that the SBW is High-Level Waste and has recently set in motion actions to change the calcine from high-level waste to low-level waste to allow the waste to be disposed of in Idaho.

The report describes the cost overruns for the Integrated Waste Treatment Unit (IWTU) for treating the 900,000 gallons of radioactive liquid SBW, revealing that total project construction and reengineering expenditures have reached nearly $1 billon as of February 2019. The SBW was to have finished treatment in 2012, but treatment of the radioactive SBW has not yet commenced.

The 1995 Idaho Settlement Agreement between the State of Idaho and the Department of Energy required DOE to remove the SBW and the calcine from the state by a target date of 2035. But DOE has suspended its plans to treat or package the calcine.

In 2009, the DOE had formally identified hot isostatic pressing as the preferred treatment technology for preparing the calcine waste for land disposal outside of Idaho. I remember attending the National Environmental Policy Act (NEPA) meeting for this decision, which DOE now says is unsafe, overly expensive and of high technological risk to implement. Despite this, the DOE has no plan to issue a new Record of Decision or amend the 2010 Record of Decision selecting another treatment option for the calcine waste.

While the Department of Energy is hoping that its new interpretation of High-Level Waste to re-classify High-Level Waste to Low-Level Waste does not result in extended litigation, the GAO isn't so sure, and the GAO continues to believe that there is significant risk for extended litigation if the DOE reclassifies waste it has been managing as High-Level Waste, such as the sodium-bearing waste at the INL that is currently managed as HLW.

---

[3] US Government Accountability Office (GAO), *Report to the Subcommittee on Strategic Forces, Committee on Armed Services, U.S. Senate, Nuclear Waste Cleanup – DOE Faces Project Management and Disposal Challenges with High-Level Waste at Idaho National Laboratory*, GAO-19-494, September 2019. https://www.gao.gov/assets/710/701252.pdf

All the DOE has to do is say they conducted a Performance Assessment to decide deep geologic disposal was not necessary. The technical issues come down to completely vague and highly flexible waste Performance Assessments which are not accurate or conservative. The Performance Assessments can attain any answer desired by altering the assumptions made and the use of highly speculative and unvalidated modeling of waste migration over millennia. This means that groundwater and citizens health is not protected by such contrived Performance Assessments which are the basis for re-classifying the waste.

See High Level Waste comment submittals regarding the Department of Energy's HLW Reclassification efforts by Tami Thatcher and by Chuck Broscious on the Environmental Defense Institute website. [4] [5]

NRC Extends Idaho National Laboratory's License to Store Three Mile Island Spent Nuclear Fuel

The US Nuclear Regulatory Commission is about to extend the license for another 20 years for storing commercial spent nuclear fuel debris at the Idaho National Laboratory that came from the Three Mile Island commercial nuclear power plant (TMI Unit 2) that had a partial meltdown in 1979. [6]

The TMI fuel and debris is stored in an above ground dry cask storage system called NUHOMS-12T, which has 29 vented shielded carbon steel canisters in horizontal concrete storage vaults. The photo in the September 17, 2019 otherwise quite good Post Register news article is of an unrelated underground high-level radioactive waste storage area called the Radioactive Scrap and Waste Facility at the Idaho National Laboratory's Materials and Fuels Complex that was formerly the Argonne National Laboratory-West (ANL-W).

According to the U.S. Nuclear Waste Technical Review Board December 2017 report, [7] Three Mile Island spent fuel debris is stored at the Idaho National Laboratory's Idaho Nuclear Technology and Engineering Center (INTEC) at the CPP-1774 above ground storage facility. The canisters are vented to prevent hydrogen accumulation. DOE had to repair concrete spent

---

[4] Environmental Defense Institute newsletter articles: If You Care About Human Health and the Environment, You Will Oppose Allowing DOE's HLW Reclassification, http://www.environmental-defense-institute.org/publications/News.19.Jan.pdf and Idaho Leaders and the Department of Energy Not Being Transparent About High-Level Waste Reclassification, Idaho Department of Environmental Quality Concerns About DOE's Proposed HLW Reclassification, and State of Washington Opposes DOE's Proposed HLW Reclassification, http://environmental-defense-institute.org/publications/News.19.Feb.pdf

[5] High-level Waste Reclassification comment submittals at http://www.environmental-defense-institute.org/index.html (http://www.environmental-defense-institute.org/publications/CommentDOEHLW.pdf and http://www.environmental-defense-institute.org/publications/EDIComHLW6.pdf)

[6] Keith Ridler, Associated Press, *Idaho Falls Post Register*, "Agency could keep Three Mile Island nuclear debris in Idaho," September 17, 2019.

[7] U.S. Nuclear Waste Technical Review Board, *Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel – Report to the United States Congress and the Secretary of Energy*, December 2017. http://www.nwtrb.gov/our-work/reports/management-and-disposal-of-u.s.-department-of-energy-spent-nuclear-fuel-(december-2017)" See p. 84 for discussion of CPP-749.

nuclear fuel storage module structures in 2011 (see Environmental Defense Institute June 2011 newsletter article, "Three Mile Island Storage Modules at DOE Idaho Facility are Cracking." The concrete structure provides shielding but not confinement of radionuclides. The degradation of the concrete, however, shows poor quality design and construction and didn't hold up for even half of the specified 50-year design life.

The average thermal output is 29 watts. The TMI Unit 2 fuel debris was zirconium-clad fuel with about 3 percent uranium-235 enrichment. There are 81.6 metric tons heavy metal (MTHM) of the TMI-2 fuel debris.

NRC documents can be found at the NRC.gov ADAMS database. [8] [9] Errors are now acknowledged that previously estimated, and relatively simple computations, were wrong and underestimated radiological doses for occupational exposure as 3 mrem/hr when the estimates were later found to be 55 mrem/hr. For the evaluation of a complete radioactive particulate release, the total dose at the INL site boundary was calculated and not disclosed to the public. The site boundary means that the release passes over a public highway and also effects various INL facilities where people work. The entire exercise is typical of the NRC which means exclusions, excuses, errors and a lack of transparency of the realities of the risk workers and the public face from the continued storage of spent nuclear fuel at the Idaho National Laboratory.

The canisters were estimated to have a 50-year life, so the canisters will be at the end of their expected life when this NRC license expires. There is no spent nuclear fuel repository available for spent nuclear fuel generated in the US as Yucca Mountain licensing efforts have stalled.

Care About Climate Change? Ditch Slow to Build, Expensive, Forever Polluting Nuclear Energy

Folks who care about climate change and who assess nuclear energy objectively, conclude the nuclear energy siphons money away from needed solutions. An article in *Reuters* [10] describes a new report that has concluded was has long been known: nuclear energy is too slow and too expensive to save the climate. [11]

The World Nuclear Industry Status Report for 2019 describes the status of nuclear operation and construction worldwide. It describes that over the past two years, Westinghouse and France's AREVA went bankrupt. The report details the construction cost overruns in the US,

[8] Safety Evaluation Report for the Three Mile Island Unit 2 Independent Spent Fuel Storage Installation, Specific License No. SNM-2508 Renewal, Docket No. 72-20, September 2019. ML19259A013.pdf.

[9] TMI-2 Independent Spent Fuel Storage Installation Application for 10 CFR 72 Specific License Renewal (redacted), ML19150A336, May 30, 2019. See NRC Adams database.

[10] Marton Dunai and Geert De Clercq, Reuters, "Nuclear energy too slow, too expensive to save climate: report." September 23, 2019. https://www.reuters.com/article/us-energy-nuclearpower/nuclear-energy-too-slow-too-expensive-to-save-climate-report-idUSKBN1W909J

[11] Mycle Schneider et al., *The World Nuclear Industry Status Report 2019*, A Mycle Schneider Consulting Project, Paris Budapest, A World Nuclear Industry Report (WNISR), September 2019. https://www.worldnuclearreport.org/IMG/pdf/wnisr2019-lr.pdf

Finland and other countries. And it points out the while nuclear energy costs continue to climb; wind and solar costs continue to fall. The report points out that of 33 reactors built in Japan, only 9 are operating and 24 reactors are in long-term outage.

The report gives an overview efforts to license small modular reactors, including the NuScale small module reactor project proposed for the INL. The report concludes that even with massive government funding for NuScale small modular reactor project and advantageous financing, it is unlikely that small modular reactors will play any significant role in the future electricity sector.

Idaho Department of Environmental Quality Approves of Fluor Idaho and DOE Chemical Compatibility Evaluations for Waste Disposal That are a Sham

After the organic kitty litter debacle at the Waste Isolation Pilot Plant (WIPP) in New Mexico caused extensive radiological contamination of the underground salt mine for disposal of transuranic waste in 2014, the Department of Energy published new requirements.

Because the 2014 exothermic reaction at WIPP involved nitrates which is an oxidizing chemical, the focus was on assessment of oxidizing chemicals including nitric acid, mercuric nitrate, lead nitrate, vanadium pentoxide, sodium nitrate and potassium nitrate.

But, the new requirements for waste characterization for WIPP disposal included emphasis on Chemical Compatibility Evaluations based on the 1980 EPA method EPA-600/2-80-076, "A Method for Determining the Compatibility of Hazardous Waste." [12] But this requirement is nothing new; chemical compatibility evaluations have long been a requirement in state-approved Resource Conservation and Recovery Act (RCRA) hazardous waste permits.

The Idaho Department of Environmental Quality grants hazardous waste RCRA permits to the Advanced Mixed Waste Treatment Project and other facilities at the Idaho Cleanup Project and Idaho National Laboratory. Federal and state hazardous waste laws require chemical compatibility evaluations to prevent potential adverse chemical reactions such as the generation of heat, fire, explosion, or toxic fumes.

Acceptable knowledge documentation for each waste stream are supposed to identify the chemical processes used in creating the waste and to identify what chemicals are or could be in the waste. The problem is that for a waste stream, the so-called "Acceptable Knowledge" documentation for the waste streams is not necessarily adequate. For waste that came to Idaho from the Rocky Flats plant in Colorado, there were so many different processes conducted there and also the fact that Rocky Flats accepted waste from other operations at various laboratories around the country, that it isn't always easy to know which processes were associated with a specific drum if labeling of the drum isn't available.

[12] Alison Moon et al., *U.S. Department of Energy Implementation of Chemical Evaluation Requirements for Transuranic Waste Disposal at the Waste Isolation Pilot Plant*, DOE-EM-4.21-01, July 2017. https://www.osti.gov/servlets/purl/1373361

RCRA hazardous waste laws do not include radionuclides which are present in the waste. Radionuclides are regulated under the Atomic Energy Act rather than the RCRA hazardous waste laws. But despite that, a chemical compatibility evaluation has to include all of the waste constituents, even radionuclides regulated under the Atomic Energy Act. Radionuclides present in less than one percent by weight have typically been called "trace" amounts and were assumed to be negligible. [13] The 1990 version of the safety analysis report for WIPP described the radionuclide inventory in a drum as having an average of 10 grams of uranium-238 compared with an average 14 grams per drum of plutonium-239. The waste drums have varying weights ranging from perhaps about 300 lbs to almost 600 lbs. But one of the four drums that blew off it lid April 2018 had less than 1 percent by weight of the unreacted depleted uranium, confirming the inadequacy of the 1 percent by mass guide.

The July 5, 2016 version of the WIPP Waste Acceptance Criteria allows radioactive pyrophoric materials when less than 1 percent by weight in a container. It required radioactive pyrophorics in concentrations above 1 percent by weight as well as all nonradioactive pyrophorics to be reacted or oxidized. But there are no criteria for how this is to be accomplished.

For the April 2018 four-drum overpressurizations, it seems that the packaging of the unreacted uranium in the drums that exploded was intended to distribute the uranium in amounts approximately less than one percent by weight of the container's waste. Still, because of the deliberate denial of the excessive beryllium and the lack of chemical compatibility evaluation for either beryllium or beryllium carbide, the waste was dangerously incompatible with the pyrophoric uranium that was now combined with oxygen and also combined with the humid moisture-laden air of a rainy day on the day the drums that overpressurized were repackaged in April 2018.

The four drums that overpressurized, overcame the drum vent capacity, blew their lids off, smoldered at elevated temperatures and spewed chemical and radiological waste creating dangerous inhalation of chemical vapors, metal fumes, smoke and radionuclides last April 2018 — which Fluor Idaho and the Department of Energy emphasize did not "explode" — were found to have many waste constituents that have not been identified as being present or being present in greater than one percent by weight in the drums. [14] Nitrates were found present, excessive beryllium in a methane-generating form of beryllium carbide, and others — yet, inexplicably and inexcusably, no corrective actions were discussed regarding the many ways that the waste characterization had been inadequate, which caused the four drums to eject their waste contents

[13] Matthew Silva, Environmental Evaluation Group, *An Assessment of the Flammability and Explosion Potential of Transuranic Waste*, ML031910324 EEG-48, June 1991. https://www.nrc.gov/docs/ML0319/ML031910324.pdf This report includes a discussion of the allowance of up to 1 percent by weight of pyrophoric radionuclides in a container and how this is not necessarily safe.

[14] Rod E. Arbon et al., Idaho Cleanup Project Core, Prepared for DOE EM, *Technical Analysis of Drum Lid Ejections – ARP V*, RPT-1662, December 2018. https://www.dnfsb.gov/sites/default/files/meeting/RPT-1662%20ARP%20V%20Technical%20Analysis.pdf

April 2018. And the Idaho Department of Environmental Quality has no problem with this — or just isn't paying attention.

The 1980 EPA chemical compatibility method is typically applied with the assumption that when the waste constituent is in "trace" amounts, less than one percent by weight, it can be ignored. The four-drum breach event in April 2018 resulted in extensive sampling of the dispersed waste and the waste remaining in the drums. The beryllium assumed to be less than 1 percent by weight ranged from 10 to 30 percent by weight in analyzed drums, including analysis of one drum that had not breached. One of the drums that breached contained depleted uranium in non-roaster oxide form in less than 1 percent by weight, suggesting that the 1 percent by weight assumption is not valid. Previously unidentified in Acceptable Knowledge (AK) documents but found in the debris waste were nitrates, an oxidizer.

The Idaho Department of Environmental Quality fails repeatedly to question the Department of Energy's sham chemical compatibility evaluations, all while excusing the lack of adequate waste characterization via Acceptable Knowledge or by waste sampling. **The Idaho Department of Environmental Quality simultaneously pretends to require chemical compatibility evaluation and accepts the excuse that one isn't needed if you don't know what is in the waste!**

At the August 28 public meeting by Fluor Idaho to support the Partial Modification Request (PMR) for treating pyrophoric materials at the treatment facility and supercompacting pyrophoric materials, when I asked Fluor Idaho what their definition of "pyrophoric" was, as it pertained to the AMWTP RCRA permit, they didn't have one. [15] After the four drums breached because of treating unreacted pyrophoric uranium in a facility that prohibited treatment of pyrophoric radionuclides, and Fluor's event cause report [16] stated that failure to have a working definition pyrophoric material contributed to the accident, the Idaho Department of Environmental Quality did not require that any working definition of "pyrophoric" be identified.

The Idaho Department of Environmental Quality, having already approved the permit modification, apparently didn't care about the lack of a working definition for pyrophoric material or many of the other unaddressed issues that caused the April 2018 four-drum accident. My partial comments on the permit modification were sent to the Idaho DEQ August 29. [17]

---

[15] Fluor Idaho, Letter dated July 25, 2019, Notification of a Class 2 Permit Modification Request and Request for Temporary Authorization from the Advanced Mixed Waste Treatment Project Hazardous Waste Management Act/Resource Conservation and Recovery Act Permit Located on the Idaho National Laboratory, EPA ID No. ID4890008952. Public comment period July 25 to September 23, 2019. Public meeting held August 28, 2019 in Idaho Falls.

[16] Idaho Cleanup Project Core, *Formal Cause Analysis for the ARP V (WFM-1617) Drum Event at the RWMC,* October 2018. https://fluor-idaho.com/Portals/0/Documents/04_%20Community/8283498_RPT-1659.pdf

[17] Comment submittal to Idaho Department of Environmental Quality regarding Permit Modification Request (PMR) and Request for Temporary Authorization for the AMWTP, August 29, 2019 at http://environmental-defense-institute.org/publications/CommentIDEQAMWTPpmr1.pdf

The Idaho Department of Environmental Quality actually granted the RCRA permit change for an Permit Modification Request for the AMWTP before the public comment period for the change had hardly begun. These Idaho DEQ folks have approved of the same inadequate permit supporting documents (see Table 1) being used in the RCRA permit for the AMWTP that were contributing causes to the April 2018 four-drum accident at the Radioactive Waste Management Complex also run by Fluor Idaho for the Department of Energy.

Table 1. PMR shared supporting documents with waste that overpressurized, breached containers, ejected waste, and smoldered at elevated temperatures at ARP V.

Accelerated Retrieval Project ARP V	Advanced Mixed Waste Treatment Project	AMWTP July 2019 Permit Modification Request
RPT-TRUW-05, Revision 41, 2016, "Waste Matrix Code Reference Manual"	RPT-TRUW-05, Revision 41, 2016, "Waste Matrix Code Reference Manual"	RPT-TRUW-05, Rev. 43 referenced in PMR. Rev. 45 provided August 13.
RPT-TRUW-12, Rev. 24, 2014, "AMWTP Waste Stream Designations" and Appendix A "Chemical Constituents and HWNs Identified in TRU Waste"	RPT-TRUW-12, Rev. 24, 2014, "AMWTP Waste Stream Designations" and Appendix A "Chemical Constituents and HWNs Identified in TRU Waste"	RPT-TRUW-12 not referenced in PMR and no indication that this document has changed.
RPT-ESH-014, Rev. 9, 2015 "Chemical Compatibility Evaluation of Wastes for the Advanced Mixed Waste Treatment Project"	RPT-ESH-014, Rev. 9, 2015 "Chemical Compatibility Evaluation of Wastes for the Advanced Mixed Waste Treatment Project"	RPT-ESH-014 cited but no revision identified. Rev. 9 provided August 13.

The Idaho Department of Environmental Quality has granted to Fluor Idaho numerous hazardous waste permit renewals or modifications since the April 2018 four-drum breaches without ensuring that all causes of that event have been addressed and without concern over the Defense Nuclear Facilities Safety Board's documented concerns about Fluor's inadequate investigation of longstanding explosive gas buildup in waste drums. [18] [19] Idaho DEQ has stated that no harm came from the four-drum breaches because the Department of Energy does not admit that any workers were harmed and says that there was no environmental release. I suspect both claims are false. See my August newsletter article on Respiratory Protection Basics that points out that Fluor's cause report [20] states that the emergency responders' nasal smears were lost. Nasal smears are used to determine whether lung counts were needed to estimate

[18] Defense Nuclear Facilities Safety Board, Letter to Secretary of Energy, March 12, 2019 with attached staff report "Idaho Waste Drums with Elevated Methane Concentrations," dated December 10, 2018 See dnfsb.org or https://ehss.energy.gov/deprep/2019/FB19M12A.PDF

[19] Defense Nuclear Facilities Safety Board public hearing and related documents at https://www.dnfsb.gov/public-hearings-meetings/public-hearing-safety-management-waste-storage-and-processing-defense

[20] Idaho Cleanup Project Core, *Formal Cause Analysis for the ARP V (WFM-1617) Drum Event at the RWMC*, October 2018. https://fluor-idaho.com/Portals/0/Documents/04_%20Community/8283498_RPT-1659.pdf

radiological material inhalation. There was no chemical vapor or fume monitoring and at least one responder was wearing inadequate respiratory protection because Fluor Idaho had no radiological control technical support or any other technical support staff qualified to wear self-contained breathing apparatus that is worn by fire department responders.

Also see my July newsletter article "Elevated Levels of Plutonium and Americium Detected in the Second Quarter of 2018, Several Potential INL Sources" that discusses 2018 second quarter radiological air monitoring that found elevated and unusual levels of plutonium and americium that appeared to be from the Radioactive Waste Management Complex. [21]

The Idaho DEQ states that the permits are adequate and DEQ has not taken any enforcement action against Fluor Idaho or the Department of Energy for the four-drum breaches that resulted from ignoring the hazardous waste permit that prohibited treatment of pyrophoric material and deliberately ignoring signs that they were applying the wrong Acceptable Knowledge for the material in the drums.

Even if they had not ignored the fact that the waste contained prohibited pyrophoric material and hadn't ignored the fact that the waste came from Building 444 at Rocky Flats — even if they had applied the correct Acceptable Knowledge to the waste, the Acceptable Knowledge was still inadequate.

But no matter. I noticed that along with repeated excuses by the Department of Energy about how long ago the waste had been exhumed from burial and how little was known about what was in the waste drums, that the DOE did not want to call the waste that breached the drums transuranic waste. Yet, in the RCRA permit, Fluor Idaho and the DOE have stated that their knowledge of the waste is adequate and therefore minimal waste sampling is needed.

Pyrophoric uranium in small fines behaves similarly to magnesium metal and can be pyrotechnic. [22] Remember the mixing of waste with magnesium powder that caused a detonation in 2018 at the Idaho State Approved RCRA-permitted hazardous waste and radionuclide dump at the US Ecology Grandview facility? That lack of either adequate waste characterization or of inadequate chemical compatibility evaluation killed one worker and injured several others.

With the deliberate lack of clarity on whether the waste was destined for WIPP or low-level radioactive waste disposal at Clive, Utah, the DOE continued to emphasize that additional characterization processes were going to be conducted before shipping the waste. But that was just another smoke screen. Analysis of the waste material in the drum by conducting chemical

[21] INL Environmental Surveillance, Education and Research Program, Managed by Veolia Nuclear Solutions – Federal Services, www.idahoeser.com, Second Quarter 2018 INL Quarterly Site Environmental Report, VNS-ID-ESER-SURV-058, http://www.idahoeser.com/Quarterlies/2018Q2/air.html

[22] Carl T. Olofson et al., Metals and Ceramics Information Center, Battelle Columbus Laboratories, Columbus, Ohio, U.S. Department of Commerce, *Processing and Applications of Depleted Uranium Alloy Products*, AD-A033 938, MCIC-76-28, September 1976. https://apps.dtic.mil/dtic/tr/fulltext/u2/a033938.pdf "Depleted uranium alloys can be shaped into parts by conventional metal processing. The main problem is reactivity with the atmosphere. Uranium is about as pyrophoric as magnesium."

analysis of the waste is conducted only for a very small number of drums. And based on the permit modification meeting I attended, the policy for justifying this small number of sampled drums was not reviewed or modified after the April 2018 four-drum event.

Radio-assay for radionuclide estimation, radiography for seeing solid metal objects, and visual exam for the waste that breached their containers within hours of repackaging had already been conducted before the four waste drums were breached. Additional radio-assay would have been conducted on the repackaged drums had they not breached their containers. But there are problems with accurately estimating alpha emitters in the drums especially if the radionuclides are not evenly distributed in the waste. The underestimation of radionuclides in the drum at WIPP that exploded despite radio-assay has not been adequately addressed. We would not accurately know what was in the four drums that breached in Idaho in April 2018 without the analysis conducted after the accident, particularly because of the extensive undocumented waste co-mingling that mixed waste from various drums together during repackaging.

After the four waste drums were breached in 2018, thermal imaging for temperature rises was conducted at the Idaho Cleanup Project and at the radioactive waste facility at Clive, Utah. The unreacted pyrophoric depleted uranium metal, now in vented drums rather than sealed drums, allowing the uranium to oxidize and generate heat while doing so, was not in a form safe to ship to Clive, Utah or WIPP or to be stored in Idaho.

The Idaho Department of Environmental Quality (DEQ) rubber-stamped renewal of the hazardous waste RCRA permit for the Advanced Mixed Waste Treatment Project (AWMTP) operated by the Department of Energy at the Idaho National Laboratory by its contractor Fluor Idaho, LLC. On April 18, the DEQ issued its response to public comment on the permit, stating:

> *Any person who filed comments on the draft permit may petition DEQ's Director, within 30 calendar days of this decision, to review any condition of the final permit. Petitions must include reasons supporting the review and demonstrate that any issues being raised were raised during the comment period. To the extent required by these regulations, and when appropriate, such Petitions must also show that the condition in question is based on: (1) A finding of fact or conclusion of law that is clearly erroneous, or (2) was an exercise of discretion or an important policy consideration that the Director should review in accordance with IDAPA 58.01.05.013 [40 CFR Section 124.19(a)].*

Because I had provided public comment, I was able to submit a Petition. After doing so, I was contacted by the Idaho DEQ and informed that the information provided above was incorrect and that the Petition needed to be processed according to a different law, the Rules of Administrative Procedure before the Board of Environmental Quality, IDAPA 58.01.23, as referenced in IDAPA 58.01.05.996. [23]

[23] https://adminrules.idaho.gov/rules/current/58/580123.pdf 58.01.23 – Rules of Administrative Procedure Before the Board of Environmental Quality and https://adminrules.idaho.gov/rules/current/58/580105.pdf. 58.01.05 –

The Petition I submitted is available on the Environmental Defense Institute's website. [24]

But, the Idaho Department of Environmental Quality is not about to review the causes of the April 2018 drum breaches, despite my petition asking them to. I naively thought that the laws for petitioning the Idaho DEQ cited in permitting communications were correct, and that communicating to the Idaho DEQ some of the many problems in the AWMTP RCRA permit that they had granted would have some effect. Evidence of the Idaho DEQ doubling down on stupid decisions came when DEQ granted the AMWTP's Permit Modification request before the public comment period had hardly started. The process for petitioning the Idaho DEQ is designed to help businesses wanting to make a profit — not to help citizens communicate concerns to the DEQ. The Idaho DEQ and those they hire say no harm came of the accident and worrying about any future harm is speculative.

A Look at Spent Nuclear Fuel and Irradiated Target Material Chemical Separations Processes

Organic solvents can be carcinogens, reproductive hazards, and neurotoxins, according to the Center for Disease Control (CDC). [25] Carcinogenic organic solvents include benzene, carbon tetrachloride and trichloroethylene. Organic solvents recognized as reproductive hazards include 2-thoxyethanol, 2-methoxyethanol, and methyl chloride.

The minor transuranic elements americium and curium have been chemically separated from spent fuel or irradiated targets by using the chemical bis(2-ethylhexyl) phosphoric acid (HDEHP) extractant with 2-ethyl(hexyl)phosphoric acid mono-2-ethylhexyl ester (HEH). [26] Other solvents associated with actinide extraction include n-Dodecane, nitrobenzene, and 1,2-Dichloroethane. [27] Other organic solvents include alcohols, ethyl ether, hexane, tetrachloroethane, toluene and xylene.

Many of these chemicals have been found in the Snake River Plain aquifer downgradient from various Idaho National Laboratory facilities. See our Environmental Defense Institute

---

Rules and Standards for Hazardous Waste. 996. Administrative appeals of agency actions shall be governed by IDAPA 58.01.23, "Rules of Administrative Procedure Before the Board of Environmental Quality."

[24] Tami Thatcher, *Petition of Idaho Department of Environmental Quality for Review of HWMA/RCRA Hazardous Waste Treatment and Storage Permit Renewal for the AMWTP*, Case Docket No. 0105-19-01, May 2019. http://www.environmental-defense-institute.org/publications/IDEQpetition.pdf and corrected coversheet at http://www.environmental-defense-institute.org/publications/NoticePetitionAMWTP.pdf

[25] Center for Disease Control, The National Institute for Occupational Safety and Health (NIOSH), Organic Solvents web page https://www.cdc.gov/niosh/topics/organsolv/default.html . Accessed September 29, 2019.

[26] U.S. Department of Energy, Office of Nuclear Energy, *Material Recovery and Waste Form Development FY-15 Accomplishments Report*, FCRD-MRWFD-2016-000001, INL/EXT-15-37053, November 2, 2015. https://inldigitallibrary.inl.gov/sites/sti/sti/6748414.pdf

[27] L. W. Gray et al., *Separation of Plutonium from Irradiated Fuels and Targets*, LLNL-TR-677668, September 30, 2015. https://e-reports-ext.llnl.gov/pdf/799624.pdf This report discusses various spent nuclear fuel separation processes.

special report on the contamination at Kimama [28] for a detailed look at the radionuclides and other constituents found in the deep Kimama borehole in the Snake River Plain Aquifer and the contaminants that were prominent in historical waste water from the Idaho National Laboratory, originally called the National Reactor Testing Station.

Figure 1 below shows some of the wells south of the INL that existed by the 1960s, although many of them are no longer actively monitored by the USGS.

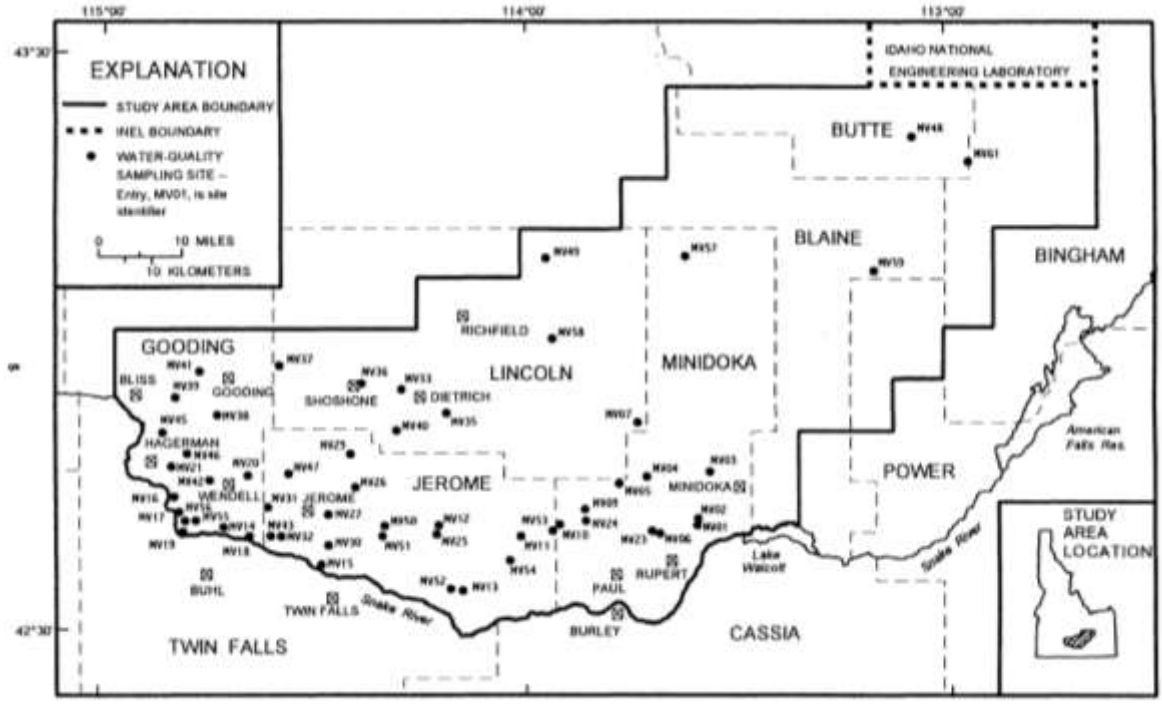

Figure 2.—Location of selected water-quality sampling sites on the eastern Snake River Plain.

Figure 1. Figure is from 97-4007 (DOE/ID-22133) from https://pubs.usgs.gov/wri/1997/4007/report.pdf

Figure 2 below shows in deeper red the portion of the Snake River Plain Aquifer having greater depth. As the aquifer flows from deeper to shallower sections, in the general southwesterly downgradient flow, the frequently unmeasured levels of higher contamination deep in the aquifer then mix with more less contaminated monitored aquifer contamination closer to ground level. This may explain why contamination levels often bump up in the regions to the south where the aquifer is more shallow, in the lighter pink areas on the figure.

[28] Thatcher, T.A., Environmental Defense Special Report, "Tritium at 800 pCi/L in the Snake River Plain Aquifer in the Magic Valley at Kimama: Why This Matter," 2017. www.environmental-defense-institute.org/publications/kimamareport.pdf

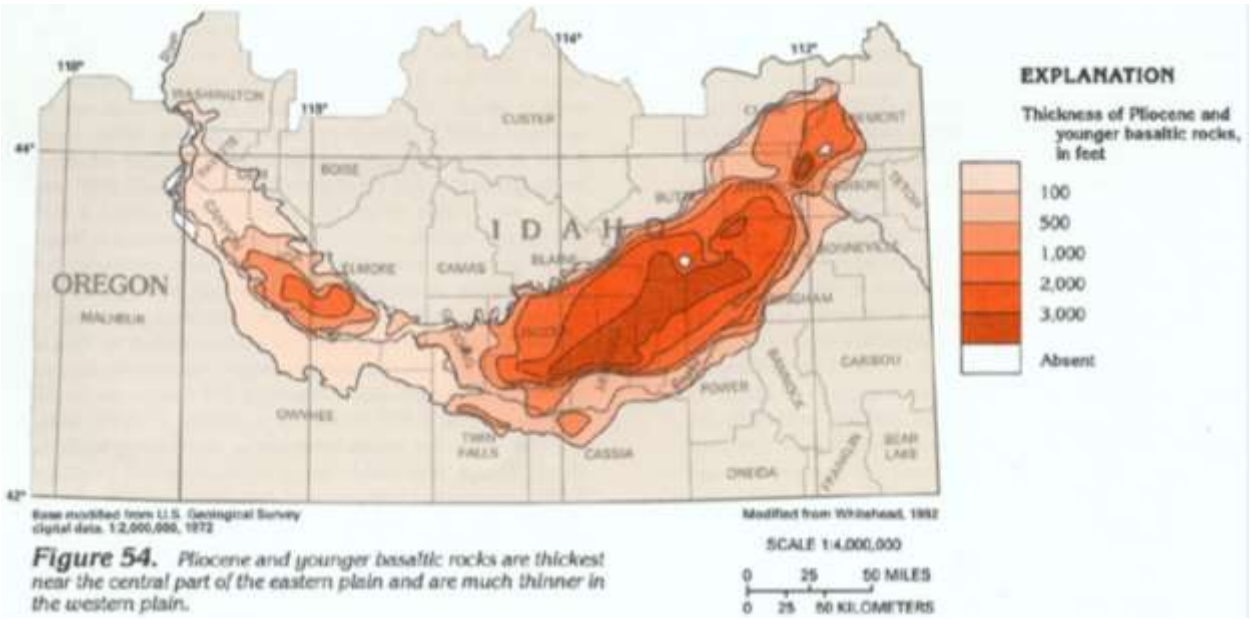

Figure 54. Pliocene and younger basaltic rocks are thickest near the central part of the eastern plain and are much thinner in the western plain.

Figure 2. Snake River Plain Aquifer thickness from US Geological Survey at http://pubs.usgs.gov/ha/ha730/ch_h/jpeg/H054.jpeg

Once a contaminant is in the aquifer, it flows downgradient, generally to the south or southwest of the INL. A portion of the flow will arrive very rapidly while the rest of the contamination may continue to arrive for years. Soil may slow the migration of contaminants buried below grade in waste or in percolation ponds. Ongoing precipitation and waste water from percolation ponds/ditches flush contaminants in the soil or perched water layers into the aquifer. But once that contamination is in the aquifer, it flows downgradient, generally flowing deeper as it flows from the source of the contamination.

Along with radiological contaminants, historical operations at the INL disposed of a multitude of chemical contaminants into the aquifer. The chemical wastes were often used in nuclear fuel reprocessing or other separations processes, then disposed of via deep injection wells at Idaho Nuclear Technology and Engineering Center (INTEC), ATR Complex (formerly the Test Reactor Area), the Naval Reactors Facility (NRF), Test Area North (TAN) and other facilities. [29] Chemical contaminants have also reached the aquifer from burial of wastes at the Radioactive Waste Management Complex (RWMC). See Figure 3 for the location of various INL facilities.

[29] The Administrative Record for the Idaho National Laboratory CERCLA cleanup investigations can be found at https://ar.icp.doe.gov and it includes other facilities such as the Power Burst Reactor and its aquifer disposal well and ponds.

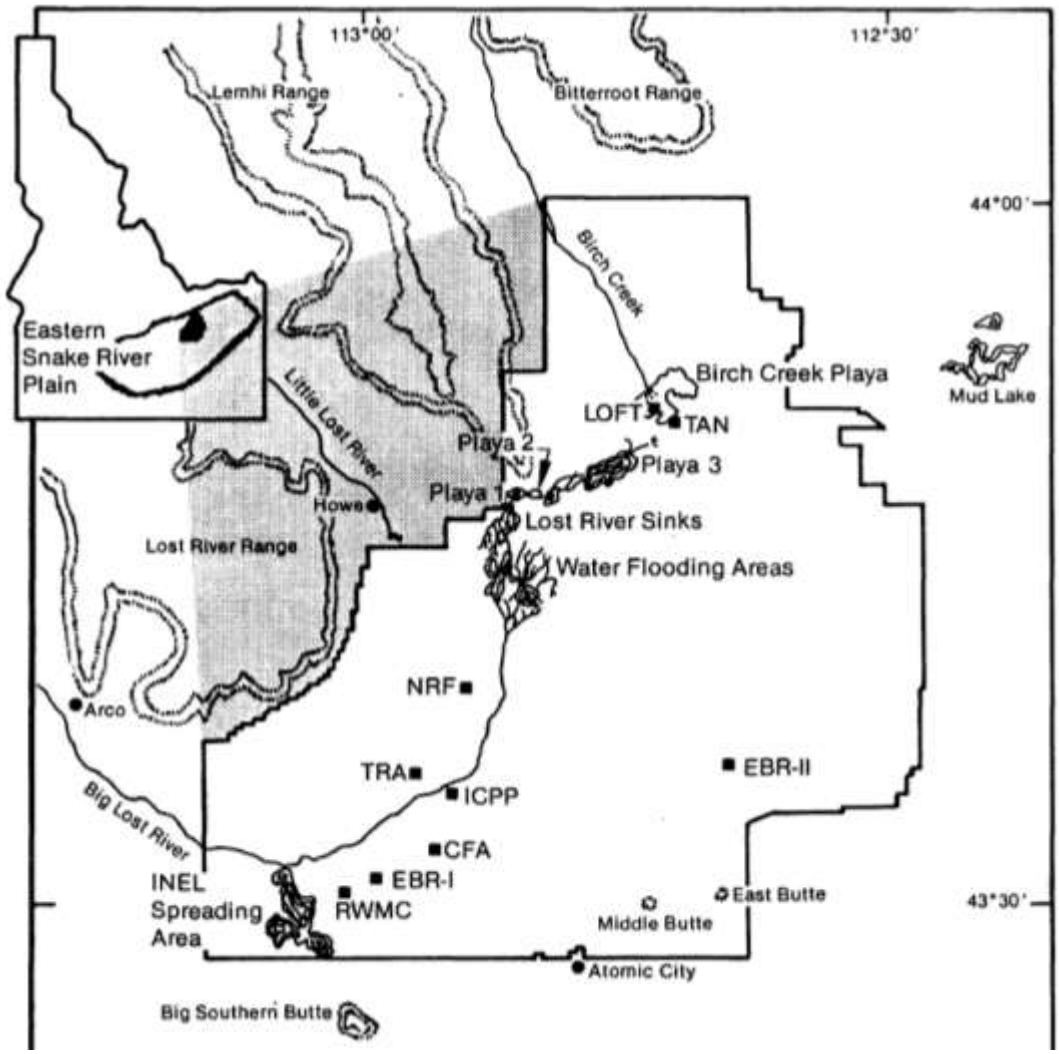

Figure 3. Idaho National Laboratory facilities.

Nuclear Fuel Cladding Materials and Chemicals From Fuel Reprocessing at INTEC – Why Were They Detected in the Snake River Plain Aquifer?

Reprocessing of Naval spent fuel and Department of Energy research reactor spent nuclear fuel including the Materials Test Reactor fuel was conducted from 1952 to 1991 at the Idaho National Laboratory (INL). [30] [31] Over 31 metric tons of spent fuel was reprocessed, mainly to

[30] U.S. Nuclear Waste Technical Review Board (NWTRB), Fact Sheet, Calcined High-Level Radioactive Waste, Revision 1, November 2017. https://www.nwtrb.gov/docs/default-source/facts-sheets/calcined_hlw.pdf?sfvrsn=12

recover uranium-235 from the highly enriched fuels, but also sometimes to recover radioactive lanthanum, neptunium, and radioactive krypton and xenon. [32] The facility formerly known as the "chemical processing plant" or CPP was renamed the Idaho Nuclear Technology and Engineering Center (INTEC).

After the spent fuels were chemically dissolved and separated, the resulting liquid waste was calcined into a powdery solid. Nitric acid was used to dissolve aluminum-containing fuels and hydrofluoric acid was used to dissolve zirconium-containing fuels. [33] Depending on the fuel type, various other chemicals were used in different stages of reprocessing. Fluorides, chlorides, phosphates and sulfates are in the calcined material in addition to the fission products, activation products, uranium, and transuranic radionuclides.

Zirconium-clad naval fuels and aluminum-clad research reactor fuels were reprocessed, in addition to stainless-steel-clad research fuels. Fluorinel calcine contains cadmium and sulfate from the cadmium sulfate and cadmium nitrate that were used as neutron absorbers in the fuel dissolution process. The calcined waste also contains chromium, mercury, nickel, lead, barium, silver, arsenic and selenium, according to the Nuclear Waste Technical Review Board fact sheet.

Aluminum nitrate was added to process zirconium-clad and aluminum-clad fuels. When uranium is recovered by solvent extraction, the leftover material from the spent fuel is the aqueous raffinate containing fission products and the metal ions from the fuel. Fluoride was used in reprocessing and present in the zirconium process raffinate.

So, aluminum, nitrate, fluoride would be among the constituents flushed out of piping systems from rinsing out piping. In 1968, boron was added to the processing as a nuclear poison to aid zirconium-clad fuel reprocessing. [34] This rinsing water laden with various chemicals, metals and radionuclides was injected into the Snake River Plain Aquifer.

Although the U.S. Geological Survey monitored the aquifer and has published many reports, sampling is spotty and does not include many of the contaminants. But, in 1979 and 1980, a unique set of contaminants were sampled and recorded by the U.S. Environmental Protection Agency. This water sampling data was taken than reveals extraordinary levels of aluminum and zirconium and other constituents of spent fuel cladding such as boron, cerium, titanium and other

---

[31] International Atomic Energy Agency (IAEA), *Corrosion of Research Reactor Aluminum Clad Spent Fuel in Water*, IAEA-TECDOC-1637, 2009. https://www-pub.iaea.org/MTCD/Publications/PDF/te_1637_web.pdf Note that the Materials Test Reactor used aluminum cladding. Western fuel types typically used cladding alloys of 6061 or 1100 grade aluminum.

[32] Susan M. Stacy, Idaho Operations Office of the Department of Energy, *Proving the Principle – A History of the Idaho National Engineering and Environmental Laboratory 1949-1999*, DOE/ID-10799, 2000. See Appendix B a description of the spent fuel reprocessing runs for nuclear fuel from various reactors. Be aware that the report is useful but contains various errors. https://factsheets.inl.gov/FactSheets/PtP-appendices.pdf

[33] B. J. Newby and T. L. Hoffman, Idaho Nuclear Corporation, U.S. Atomic Energy Commission, *Blending Raffinates From Zirconium And Aluminum Processes*, IN-1114, September 1967. https://inldigitallibrary.inl.gov/PRR/163952.pdf#search=newby

[34] Brenda Pace et al., *Idaho National Laboratory Fuel Reprocessing Complex Historic American Engineering Record Report – ID-3-H*, INL/EXT-06-11969, December 2006. https://inldigitallibrary.inl.gov/sites/sti/sti/4460713.pdf

elements. [35] The EPA data does not include sample data for every contaminant, but the data provide an important glimpse into contaminants in the aquifer downgradient of the Idaho National Laboratory's INTEC facility where spent fuel reprocessing was coupled with deep well injection of waste water.

Rare earth elements (REEs) are cerium (CE), dysprosium (Dy), erbium (Er), europium (Eu), gadolinium (Gd), holmium (Ho), lanthanum (La), lutetium (Lu), neodymium (Nd), praseodymium (Pr), promethium (Pm), samarium (Sm), scandium (Sc), terbium (Tb), thulium (Tm) , ytterbium (Yb), and yttrium (Y). [36] Various rare elements and other elements, such as niobium, are used in cladding materials.

Information about expected levels and levels of concern for some of the uncommon contaminants can be found in Secondary Drinking Water Standards. [37] Information about other trace elements in ground water can be found is various sources, including a report by Donald Langmuir and others published in 2005. [38]

Levels of aluminum in drinking water are expected to be below 200 ug/L or 200 parts-per-billion (ppb). [39] In the Agency for Toxic Substances and Disease Registry guide for aluminum, aluminum concentrations in surface water are "generally below 0.1 mg/L." [40] This value of 0.1 milligram/liter (mg/L) is equivalent to 100 microgram/liter (ug/L) or 100 part-per-billion (ppb).

So, despite Department of Energy denial that waste water has left the boundary of the INL, it is interesting that the 1979 and 1980 EPA data showed aluminum concentrations found in the aquifer downgradient from the Idaho National Laboratory have exceeded 3 percent, or 30,000,000 ppb aluminum.

More about this to come in a later article.

---

[35] Carl T. Olofson et al., Metals and Ceramics Information Center, Battelle Columbus Laboratories, Columbus, Ohio, U.S. Department of Commerce, *Processing and Applications of Depleted Uranium Alloy Products*, AD-A033 938, MCIC-76-28, September 1976. https://apps.dtic.mil/dtic/tr/fulltext/u2/a033938.pdf Note in this report the search for uses of depleted uranium and the uranium alloys containing molybdenum, titanium or niobium.

[36] https://web.mit.edu/12.000/www/m2016/finalwebsite/elements/ree.html

[37] US Environmental Protection Agency, Secondary Drinking Water Standards: Guidance for Nuisance Chemicals, https://www.epa.gov/dwstandardsregulations/secondary-drinking-water-standards-guidance-nuisance-chemicals Page accessed September 28, 2019. Guidance for aluminum (0.05 to 0.2 mg/L), iron (0.3 mg/L), manganese (0.05 mg/L), fluoride (2.0 mg/L), copper (1.0 mg/L), silver (0.1 mg/L), zinc (5 mg/L) and other constituents.

[38] Donald Langmuir et al., Issue Paper on the Environmental Chemistry of Metals, 2005. https://www.semanticscholar.org/paper/ISSUE-PAPER-ON-THE-ENVIRONMENTAL-CHEMISTRY-OF-Langmuir-Chrostowski/2469b7d4bc22c8845ce3302bbab69a55f7c8b32f

[39] Daneil Krewski et al., *Journal Toxicology Environmental Health*, "Human Health Risk Assessment for Aluminium, Aluminium Oxide, and Aluminium Hydroxide," 2007. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2782734/ doi: 10.1080/10937400701597766 Aluminum in drinking water, secondary guideline, 0.2 mg/L or 200 ug/L. Water ingestion intakes are assumed to be below 200 ug/L or 200 ppb.

[40] ToxGuide TM for Aluminum, Agency for Toxic Substances and Disease Registry (ATSDR), CAS# 7429-90-5, September 2011. https://www.atsdr.cdc.gov/toxguides/toxguide-22.pdf This guide states that aluminum concentration in surface water is "generally below 0.1 mg/L."

Articles by Tami Thatcher for October 2019.