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After Ten Years of Study, Existing INL Test Reactor Found Not Able to Support Fast Reactor Fuel Research

A recent report posted by the Department of Energy has concluded that neither the Idaho National Laboratory's Advanced Test Reactor (ATR) or the Oak Ridge National Laboratory High Flux Isotope Reactor (HFIR) are capable of providing materials testing needed to support fast reactor fuel research. [1] While the Department of Energy believes there is a need for irradiation testing in a fast neutron spectrum, the highest value of fast neutron flux among US irradiation reactors is provided by HFIR at approximately 6 displacements per atom (dpa) per year of irradiation. The desired dpa is about 100 per year to study the damage resistance of the fuel.

The Department of Energy announced at the Idaho Leadership in Nuclear Energy (LINE) meeting held in Fort Hall in April that DOE has a three-year research and development process underway to study the cost and capabilities of building a new U.S. materials testing reactor suitable for fast neutron fuels. [2] A fast neutron materials test reactor is available in Russia.

According to an INL Fuel Cycle Technology's report in 2015, [3] in 2005 a research agreement between DOE and France's CEA was signed to jointly conduct the FUTURIX irradiation experiments in the PHENIX reactor in France. Four pins in the FUTURIX-FTA fuel experiment were returned to the U.S. The shipment arrived in South Carolina on July 22 and was received at INL on July 24, 2014. Post irradiation examination of this experiment was to be conducted to compare to identical fuels irradiated in ATR in the AFC-1 test series. Results of the AFC-1 and FUTURIX-FTA experiments were apparently used to evaluate and identify any differences caused by the difference in neutron spectra between PHENIX (a typical fast reactor) and ATR (using a cadmium-lined basket to simulate fast reactor neutron spectrum in a thermal reactor).

While the U.S. national capability exists for irradiation testing in a thermal neutron spectrum, or a "slow neutron" spectrum, irradiation testing in a fast neutron spectrum is extremely limited.

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[1] Nuclear Energy Advisory Committee, Assessment of Mission and Requirements for a New U.S. Test Reactor, Draft Report, December 2016. https://www.energy.gov/sites/prod/files/2017/01/f34/Draft%20Report%2012-22-16.pdf

[2] Kevin Trevellyan, Reporter, *The Idaho Falls Post Register*, "DOE studying new fast reactor," April 22, 2017.

[3] 2014 Fuel Cycle Technologies Yearly Achievements Report, January 2015. https://inldigitallibrary.inl.gov/sites/STI/STI/6531179.pdf

An INL webpage stated how important the fuel pin studies were and the high hopes that the Advanced Test Reactor would be suitable for fast neutron flux reactor research. [4]

"Researchers hope the conditions experienced by these fuels in the French fast reactor will line up with the conditions created for the identical fuels tested in ATR. This would signify that the ATR experiments accurately recreate fast reactor fuel behavior. If so, INL researchers can continue to use their ATR experiments to study new fuels and advance the goals of the Transmutation Fuels program."

The program started in 2005 was discussed in a 2007 conference paper [5] for the study of fast neutron reactor fuels irradiation testing. Now in 2017, we have the answer.

Fast reactor research is not affordable enough or timely enough to be relevant to climate change. But that matters little to promoters seeking projects for the INL.

Cleanup Hype Continues at the INL as Contamination in the Aquifer Migrates Downgradient

Citizens are repeatedly told that the cleanup at the Idaho National Laboratory is successful. Fluor Idaho's Fred Hughes says it is 98.5 percent successful based on completing a number of tasks, most of which the Department of Energy had long promised to do like remove Rocky Flats above-ground stored transuranic waste. [6] Yet, the vast majority of these completed tasks are simply to investigate contamination, make cleanup plans and remove contaminated and unusable buildings. [7]

What remains to be done? And, literally, what contamination will remain in Idaho forever? This is rarely written about for citizen consumption.

On a cost plus fee contract, Fluor won't even provide a schedule for beginning to treat the liquid waste with the Integrated Waste Treatment Unit. [8] And no one knows if or when spent nuclear fuel will ever leave Idaho.

The Idaho Line Commission is told not to worry about radioactive calcine stored in seismically fragile bins above the aquifer.[9] [10] The laundry detergent-like waste is highly soluble

[4] Idaho National Laboratory website: https://www.inl.gov/article/futurix/
[5] B.A. Hilton et al., Global 2007, "U.S. Plans for the Next Fast Reactor Transmutation Fuels Irradiation Test," September 2007. https://inldigitallibrary.inl.gov/sites/STI/STI/3881526.pdf
[6] Fred Hughes, Guest columnist, *The Idaho Falls Post Register*, "Remaining challenges solvable," April 1, 2017. (an auspicious date) Hughes is Fluor Idaho's program manager for cleanup at the Idaho National Laboratory.
[7] Idaho National Engineering Laboratory ("INEL") Federal Facility Agreement and Consent Order, December 9, 1991. https://energy.gov/sites/prod/files/em/2001_Agreements/INEEL_FFA_CO_12-9-91.pdf
[8] Idaho National Laboratory Citizens Advisory Board February 23, 2017 meeting. Integrated Waste Treatment Unit Status presentation by Jack Zimmerman. See www.inlcab.energy.gov
[9] Bryan Clark, reporter, *The Idaho Falls Post Register*, "Another look at '95 Settlement Agreement – Grossenbacher: Second look could improve environmental protection," April 25, 2017.

and also vulnerable to flooding events. The calcine will forever contaminate Idaho as it leaches to the aquifer or blows in the wind if there's a mishap.

If a citizen gets arrested, they will have their mugshot in the paper and a description of their misdeeds. The paper doesn't instead list only the good things this person has done while on parole.

On the other hand, if the Department of Energy poisons air, land and the aquifer for decades while claiming to be watchful stewards, then any steps toward progress are the main message given to the public. The public really doesn't know the decades of misdeeds. Neither is the public informed of recent mistakes by INL contractors as protecting their reputation is more important than informing citizens. [11]

The latest aquifer monitoring report by the US Geological Survey "bright spots" areas where aquifer contamination is decreasing. But the USGS report monitoring from 2012 to 2015 tends to avoid giving bad news. [12] Increasing contamination in wells downgradient of major contamination sites isn't highlighted. . .neither is the lack of aquifer improvement at Test Area North despite decades of treatment. In the patchwork of INL aquifer monitoring, grasping the big picture is a challenge and when grasped, [13] the outlook is not nearly as optimistic as AP headlines suggest. [14]

The Idaho Department of Environmental Quality does its part for concealing INL contamination by removing from its website environmental monitoring prior to 2010. [15] [16]

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[10] Calcined Solids Storage Comment Submittal (Docket No. 10W-1604), by Chuck Broscious and Tami Thatcher, July 11, 2016. http://www.environmental-defense-institute.org/publications/EDICalcineComments.pdf

[11] DOE-ID Operations Summaries, http://www.id.doe.gov/NEWS/OperationsSummarys.htm retrieved April 26, 2017, no report of events since August 2016.

[12] Roy C. Bartholomay et al., US Geological Survey, An *Update of Hydrologic Conditions and Distribution of Selected Constituents in Water, Eastern Snake River Plain Aquifer and Perched Groundwater Zones, Idaho National Laboratory, Idaho, Emphasis 2012-15*, Report 2017-5021, DOE/ID-22242.

[13] 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

[14] Keith Ridler, AP, *The Idaho Falls Post Register*, "Nuke Site Cleanup Efforts Paying Off for Idaho Aquifer," April 13, 2017.

[15] Fred Hughes, Guest columnist, *The Idaho Falls Post Register*, "Remaining challenges solvable," April 1, 2017. (an auspicious date) Hughes is Fluor Idaho's program manager for cleanup at the Idaho National Laboratory.

[15] Idaho National Engineering Laboratory ("INEL") Federal Facility Agreement and Consent Order, December 9, 1991. https://energy.gov/sites/prod/files/em/2001_Agreements/INEEL_FFA_CO_12-9-91.pdf

[15] Idaho National Laboratory Citizens Advisory Board February 23, 2017 meeting. Integrated Waste Treatment Unit Status presentation by Jack Zimmerman. See www.inlcab.energy.gov

[15] Bryan Clark, reporter, *The Idaho Falls Post Register*, "Another look at '95 Settlement Agreement – Grossenbacher: Second look could improve environmental protection," April 25, 2017.

[15] Calcined Solids Storage Comment Submittal (Docket No. 10W-1604), by Chuck Broscious and Tami Thatcher, July 11, 2016. http://www.environmental-defense-institute.org/publications/EDICalcineComments.pdf

[15] DOE-ID Operations Summaries, http://www.id.doe.gov/NEWS/OperationsSummarys.htm retrieved April 26, 2017, no report of events since August 2016.

Many challenges remain and the cleanup work is difficult and results in continuing Energy Worker illness claims despite radiation protection programs that supposedly protect workers. [17]

Despite the often repeated hype that "the buried waste is being removed," the vast majority of buried waste at INL is staying buried in Idaho and more radioactive waste is being buried. [18] [19]

The number of "forever contamination" sites at INL continues to grow. [20] [21] These are places too contaminated to remediate that will never be safe for unlimited human use. [22]

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[15] Roy C. Bartholomay et al., US Geological Survey, An *Update of Hydrologic Conditions and Distribution of Selected Constituents in Water, Eastern Snake River Plain Aquifer and Perched Groundwater Zones, Idaho National Laboratory, Idaho, Emphasis 2012-15*, Report 2017-5021, DOE/ID-22242.

[15] 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

[15] Keith Ridler, AP, *The Idaho Falls Post Register*, "Nuke Site Cleanup Efforts Paying Off for Idaho Aquifer," April 13, 2017.

[15] See the Idaho Department of Environmental Quality Oversight Monitoring page where the monitoring for two decades prior to 2010 has been removed at https://www.deq.idaho.gov/inl-oversight/monitoring/reports/

[16] USGS report 2017-5021 omits stating the amount of americium-241 buried at INL's RWMC. See ar.icp.doe.gov (formerly ar.inel.gov) or DOE-ID Public Reading room 2013 "RPT-1267" which estimates that 2.15 million curies of Am-241 are buried at RWMC. Also see the September 2015 EDI newsletter. The amount of Am-241 removed by buried waste removal is expected to be minimal and undiscernable because the actual amount removed cannot be known by drum survey. Note that the 2014 underground accident at WIPP was initially thought to have involved multiple drums because of the large release. The investigators found, however, that only one partial drum was involved and so the drum contents of transuranic material were many times higher than expected.

[17] See September 2016 and other EDI newsletters regarding National Institute for Occupational Safety and Health (NIOSH) that oversees radiation dose reconstruction for the Energy Employee Occupational Illness Compensation Act (EEOICPA).

[18] 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. Available at INL's DOE-ID Public Reading room electronic collection. (Newly released because of Environmental Defense Institute's Freedom of Information Act request.) See https://www.inl.gov/about-inl/general-information/doe-public-reading-room/

[19] See the CERCLA administrative record at www.ar.icp.doe.gov (previously at ar.inel.gov) and see also Parsons, Alva M., James M. McCarthy, M. Kay Adler Flitton, Renee Y. Bowser, and Dale A. Cresap, Annual Performance Assessment and Composite Analysis Review for the Active Low-Level Waste Disposal Facility at the RWMC FY 2013, RPT-1267, 2014, Idaho CleanupProject. And see Prepared for Department of Energy Idaho Operations Office, Phase 1 Interim Remedial Action Report for Operable Unit 7-13/14 Targeted Waste Retrievals, DOE/ID-11396, Revision 3, October 2014 https://ar.inl.gov/images/pdf/201411/20141103009 60BRU.pdf

[20] INL Waste Area Group Institutional Controls Report. Dated February 16, 2016. https://cleanup.icp.doe.gov/ics/ic_report.pdf from the EPA page: https://cleanup.icp.doe.gov/ics/

[21] Tami Thatcher, *The Forever Contamination Sites at the Idaho National Laboratory*, April 2016, http://environmental-defense-institute.org/publications/EarthDayINLreport.pdf

[22] Note this Time Labs website that "has mapped 1,317 so-called Superfund sites—the most toxic locations in the U.S., as tracked by the federal government. They're scattered across the country. . ." see an interactive map to find a superfund site near you at www.time.com/toxic-map

Is it time to renegotiate the 1995 Idaho Settlement Agreement? [23] With Idaho's unquestioning support for all things nuclear and propensity to conceal rather than disclose INL problems, those citizens living within 50 miles of the wind pattern or downgradient from the aquifer underneath the INL should be concerned.

Battery Research Could Transform Clean Power

The Idaho Falls Post Register reported that battery researchers at the Idaho National Laboratory recently obtained a pair of fireproof chemical storage units to allow batteries to be tested in extreme temperature conditions. Eight employees work on battery research at the INL. [24] The researchers at INL also have a table that shakes and vibrates to test electric car batteries. The INL has tested roughly 700 batteries annually, and about 50 to 70 are car batteries tested in the Nondestructive Battery Evaluation Laboratory.

TIME reports that research in San Diego could solve a key problem for wind and solar power. Developers hope that batteries will store excess energy, allowing power providers to rely less on fossil fuels at a backup. San Diego's program operated by San Diego Gas & Electric already gets more than one-third of the electricity it provides from renewable sources like wind and solar. The batteries they are testing store enough electricity to power 20,000 homes for four hours. [25]

Improvements in battery technology are happening. But will nuclear reactors go the way of the dinosaur before we waste more money researching them?

Top Ten Reasons Why We Don't Need Nuclear Energy

As Pete Lyons and John Kotek co-wrote an editorial recently headlined "Nuclear Energy Needed More Than Ever," [26] who needs a comics page in the Idaho Falls Post Register?

I submit these top ten reasons describing why they are wrong.

1. **The costs of renewable energy continue to drop.** And I expect batteries are going to solve the issue of how to provide energy when the sun doesn't shine and the wind doesn't blow.

[23] See the Idaho Settlement Agreement at https://www.deq.idaho.gov/inl-oversight/oversight-agreements/1995-settlement-agreement.aspx

[24] Kevin Trevellyan, Reporter, *The Idaho Falls Post Register*, "INL boosts battery testing methods," April 18, 2017.

[25] Justin Worland, *TIME*, "Better Batteries – A Simple Solution That Could Transform Clean Power," p. 29, April 10, 2017.

[26] Pete Lyons and John Kotek, guest columnists, *The Idaho Falls Post Register*, "Nuclear energy needed more than ever," April 14, 2017.

2. **The costs of nuclear energy continue to climb.** This includes construction costs, maintenance costs, decommissioning costs and spent nuclear fuel storage and disposal costs. Nuclear construction costs have continued to climb despite promises to the contrary. Large cost overruns for construction of new reactors in the U.S. and around the world continue to climb — we don't even know yet how high the construction costs will be before these plants begin operating. None of the four U.S. AP1000 units under construction in the US or outside the US have started up. None of the new AREVA reactors have completed construction. And as nuclear owners sue equipment suppliers over defects, don't expect procurement to get easier. San Onofre sued Mitsubishi Heavy Industries for the botched new Steam Generators. [27] The costs of forever care for spent nuclear fuel and of accidents are also unknown and perhaps unknowable.

3. **Lyons and Kotek are off their rockers to be red, white, and blue washing the need for nuclear energy** because, for example, the Chinese investment in Bill Gates Terra Power [28] and the technology transfer of the Westinghouse AP1000 advanced light water reactors to China, [29] and the selling or partnering of U.S. nuclear businesses to Japan.

4. **The nuclear energy giants have huge financial problems**: France's AREVA has been bailed out by France's government-owned utility EDF. [30] The nuclear divisions of the old US giants General Electric and Westinghouse have partnered, becoming GE Hitachi and Toshiba's Westinghouse. [31] [32] The hopes for small modular nuclear reactor promoter, NuScale, remain more logical than a push for fast reactors but the rub is that industry doesn't need a federal laboratory to assist in building a large or small light water reactor. But if the fast neutron reactor promoters are right, isn't NuScale, a light water reactor small modular reactor design already obsolete?

5. **Fast reactors are NOT affordable, timely, safe, or going to make a dent in solving spent nuclear fuel storage problems.** Fast reactors have been plagued by a high number

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[27] Ivan Penn, reporter, Los Angeles Times, "Edison awarded $125 million for San Onofre's faulty steam generators," March 13, 2017. Southern Cal. Edison had sought $7.6 billion.

[28] World Nuclear News, "Fast Neutron Reactors," March 2017. Terra Power promoted the Traveling Wave Reactor design in 2008 until finding it unworkable and now promotes the Standing Wave Reactor design, first the TWR-P, 600 MWe prototype, then the TWR-C that would be 1150 MWe. http://www.world-nuclear.org/information-library/current-and-future-generation/fast-neutron-reactors.aspx

[29] Rod Adams, Atomic Insights website, "Westinghouse Sold AP1000 Technology Developed With American Taxpayer Assistance to China More Than Three Years Ago," November 26, 2010. Technology transfer was an integral part of the sale of the AP1000 to China.

[30] World Nuclear News, Nuclear Power in France, April 12, 2017. Areva lost 2 billion Euros in 2015, half due to nuclear construction of Olkiluoto 3 in Finland and half related to market conditions.

[31] Adam Vaughan, Reporter, The Guardian, "[Toshiba's] Westinghouse bankruptcy move casts shadow over world nuclear industry," March 29, 2017. https://www.theguardian.com/business/2017/mar/29/toshiba-nuclear-westinghouse-bankruptcy-us-uk#img-1

[32] Tom Hals, Makiko Yamazoki, and Tim Kelly, Reuters, "Huge nuclear cost overruns push Toshiba's Westinghouse into bankruptcy," March 30, 2017. http://www.reuters.com/article/us-toshiba-accounting-board-idUSKBN17006K

of equipment malfunctions, and more time spent fixing than operating them. See the low fraction of time spent operating of France's Phenix and Superphenix, Japan's Monju, and U.S. fast reactors: Fermi I in Michigan, Southeast Experimental Fast Oxide Reactor in Arkansas, and the Fast Flux Test Facility at Hanford. The Idaho National Laboratory's EBR-II (20 MWe) led to GE Hitachi's larger PRISM design, which so far, no one has wanted to build. [33]

6. **We face spent fuel disposal conflicts with no end in sight**. As Yucca Mountain may be contested for decades and John Kotek's attempted consent-based siting for interim storage of spent nuclear fuel is dead. The problems of storing and disposing of spent nuclear fuel will span generations, be costly, and may only be solved partially. The Blue Ribbon Commission report concluded that fast reactors would not solve the disposal problem. [34] The cost to human life and the environment are and will be enormous despite the pretending by nuclear promoters that SNF disposal is not really a problem. The fact is that burying to radioactive material does not prevent the radionuclides from migrating into water sheds over time.

7. **Our crumbling railway and highway infrastructure means that the risk of an accident involving shipping of spent nuclear fuel is far greater** than the Department of Energy and the Nuclear Regulatory Commission have acknowledged. The transportation casks are not designed to withstand what have become common train accidents involving oil tanker fires in the U.S. [35] [36] [37]

8. **The US Nuclear Regulatory Commission has failed the American people by failing to conduct epidemiology near U.S. nuclear plants as it committed to do.** And don't try to say the older U.S. study it has relied on is relevant—it was inconclusive by design. The framework for the new adequately designed study was reported in "Analysis of Cancer Risks in Populations Near Nuclear Facilities; Phase I (2012). [38] After 5 years in planning

[33] GE Hitachi website, "PRISM: Waste not, want not," February 6, 2017. PRISM is a pool-type, metal-fueled small modular sodium fast reactor, 311 MWe. The EBR-II which began operating in 1964 at what is now the Idaho National Laboratory's Materials and Fuels Complex provided the basis for the current PRISM conceptual design.

[34] Blue Ribbon Commission of America's Nuclear Future. 2012. (It uses 2010 estimates for spent fuel quantities) www.brc.gov

[35] Matthew Brown, AP, *The Idaho Falls Post Register*, "Thousands of detects found on oil train routes," April 8, 2017.

[36] Bismarck, N.D. AP, *The Idaho Falls Post Register*, "Train hauling crude from N.D. oil patch derails, catches fire," May 7, 2015. "It's the fifth fiery accident since February involving that type of tank car. . ." Oil carrying train fires can burn hotter and longer than spent nuclear fuel casks are designed to withstand..

[37] Philadelphia, AP, *The Idaho Falls Post Register*, "Train in deadly wreck going over 100 mph – The speed limit at the derailment site is 50 mph," May 14, 2015. The error of a single engineer driving the train can result in derailment.

[38] See cancer risk study at nap.edu.

for the new study, the NRC has now decided it would take too long and cost too much, excuses that don't ring true.

9. **Cancer risk and genetic health harm from radiation are underestimated.** The study of harm to human health and genetic harm continues to find that the "gold standard" of radiation health studies, the study of survivors of the U.S. atomic bombing of Japan, underestimates the cancer risk and genetic risk. The so-called Life Span study has ignored many health risks of radiation induced oxidative damage and never should have been used to extrapolate to internally committed radionuclides. [39]

10. **Children and the unborn child are harmed by radiation far more than the U.S. regulatory standards acknowledge** [40] and therefore, the transportation of radioactive materials including spent nuclear fuel, the routine emissions from nuclear plants, the releases due to accidents, and the releases from licensed disposal are not adequately protective of human health and the environment.

Attention Rad Waste Shippers: Idaho has Glow in the Dark Specials for Your Radioactive Waste Dumping Needs at Idaho's Grand View in Southwest Idaho

The State of Idaho has been quietly allowing radioactive waste at the Grand View US Ecology Idaho disposal site. [41] Grand View is about 40 miles south of Boise.

As the Nuclear Regulatory Commission (NRC) reviews the plan to ship radioactive waste water from the Entergy Nuclear Operations' Vermont Yankee Nuclear Power Station in Vernon, Vt, Idaho Department of Environmental Quality says Grand View has accepted such shipments in the past.

The Vermont company planning to ship waste said that the radiation levels of the wastewater are slightly about radiation background levels in Idaho. If that is the case, why don't they keep

[39] See Environmental Defense Institute's February and April 2017 newsletters.

[40] "Health Risks from Exposure to Low Levels of Ionizing Radiation BEIR VII – Phase 2, The National Academies Press, 2006, http://www.nap.edu/catalog.php?record_id=11340 The BEIR VII report reaffirmed the conclusion of the prior report that every exposure to radiation produces a corresponding increase in cancer risk. The BEIR VII report found increased sensitivity to radiation in children and women. Cancer risk incidence figures for solid tumors for women ar eabout double those for men. And the same radiation in the first year of life for boys produces three to four times the cancer risk as exposure between the ages of 20 and 50. Female infants have almost double the risk as male infants.

[41] Keith Ridler, AP, *The Idaho Falls Post Register*, "Vermont radioactive waste could be sent to Idaho – The waste water would be trucked to Idaho's site near Grand View in Southwest Idaho," April 8, 2017.

the radioactive water in Vermont? The gamma shine from the disposed of materials is only one aspect. What also matters is the potential for migration of the waste into ground water and that depends on how long-lived the radionuclides are, as well as soil, precipitation and groundwater depth.

The low rainfall, engineered features such as liners, a cover and a monitoring system are said to "limit the release of any stored radioactive material into the environment."

But the radioactive half life of the materials being accepted by facility at Grand View are well beyond many thousands of years. Some radioisotopes do not decay to stable isotopes but decay to other radioisotopes that decay into other radioisotopes. For example, americium-241 has a 432 year half life — but its decay progeny will be radioactive beyond thousands of years. The non-radiological hazardous wastes are also forever wastes.

What kind of radioactive waste is U.S. Ecology Idaho, Inc. (USEI) accepting? They like to call it "low-activity radioactive waste. Oh, just a little uranium, enriched uranium, technetium-99, and various radionuclides associated with nuclear fuel manufacturing and reprocessing. Wait a minute — that sounds like they accept pretty much any radioisotope on the planet, and they are trying to give the impression that those long-lived alpha emitters pose little hazard. Hum, I wonder how much the workers understand how damaging alpha emitters are to their health and genetics. [42]

Who has been sending radioactive waste to the Idaho low-cost provider? Westinghouse sent 30,000 cubic yards of low-activity radionuclide materials from nuclear fuel manufacturing and reprocessing. Hematite Decommissioning Project (HDP) sent enriched uranium and other low-activity materials from nuclear fuel manufacturing. Pacific Gas and Electric Humboldt Bay near Eureka, CA sent "low-activity decommissioning waste." [43] And the U.S. Air Force sent "radon dust" from aircraft instruments. [44]

Just how much radioactive waste is going to be allowed into Idaho? Is USEI as licensed low-level radioactive waste facility? I'll keep looking for answers.

A general description online tells us only that USEI is a RCRA Subtitle C hazardous waste disposal facility permitted by the Idaho Department of Environmental Quality (IDEQ) to receive

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[42] Inge Schmitz-Feuerhake, Christopher Busby, and Sebastian Pfugbeil, *Environmental Health and Toxicology*, "Genetic radiation risks: a neglected topic in the low dose debate," Published January 20, 2016. http://doi.org/10.5620/eht.e2016001 and http://www.theecologist.org/News/news_analysis/2987395/its_not_just_cancer_radiation_genomic_instability_and_heritable_genetic_damage.html The report found that the risk of congenital malformations (CM) may result in 50 percent excess risk at doses as low as 1 mSv (or 100 mrem). That would be 1.5 cases of CM when 1 case is expected.

[43] May Marcinek, *Wastetrak*, "Westinghouse to Use US Ecology Idaho," February 1, 2012. https://www.wastetrak.com/newstrak/article.asp?ID=1876

[44] Katharine Meiszkowski and Matt Smith, California Watch, "Air Force ships Calif. radioactive waste to Idaho Landfill," November 9, 2012.

low activities of radioactive waste under the terms of its radioactive materials Waste Acceptance Criteria. It is located near Grand View, Idaho in the Owyhee Desert of southwestern Idaho. Low activity radioactive material is disposed of in an U.S. EPA standard triple-lined, engineered disposal cell. Thick natural clay deposits, low precipitation rate, deep, non-potable groundwater, and lack of any up-gradient drainage area provide superior environmental protection over other available options. In addition to the natural environmental protections provided by geology and climate, a number of engineered features are also present to enhance confinement of contaminants over the long term including engineered covers, multiple earthen and synthetic liners and leachate monitoring/collection systems. In addition, USEI has a comprehensive radiological protection program including personnel training in the safe handling of radioactive materials, dosimetry, environmental monitoring, a medical surveillance program, and an approved radioactive materials model.

A 2013 Idaho Department of Environmental Quality monitoring report states that a person standing at the fence for 1000 hours per year at the USEI Grand View facility would receive an extra 9.15 millirem (mrem) annually from external and internal radiation combined. The limit to the public is 100 mrem/yr. [45] But I have to wonder what dose a worker inside the facility working about 2000 hours per year is getting. Nuclear industry radiation workers receiving only about 400 mrem/yr have been found to have increased cancer risk. [46]

USEI's radiological program and waste acceptance is regulated by the State of Idaho through authority found in Idaho statute and related regulations. This is supposed to assure Idahoans of adequate protection of human health and the environment. Well, good luck with that, in light of epidemiology of INL workers [47] and past and ongoing Department of Energy worker illness compensation claims from INL exposed workers.

[45] January 27, 2014 letter from Idaho Department of Environmental Quality to US Ecology Idaho Inc., EPA ID No. IDD07311654 DEQ Radiation Oversight for 2013 Environmental Monitoring Report. https://www.nrc.gov/docs/ML1501/ML15014A092.pdf

[46] Richardson, David B., et al., "Risk of cancer from occupational exposure to ionizing radiation: retrospective cohort study of workers in France, the United Kingdom, and the United States (INWORKS), BMJ, v. 351 (October 15, 2015), at http://www.bmj.com/content/351/bmj.h5359 Richardson et al 2015] (And please note that studies of high leukemia risk in radiation workers and of ongoing studies to assess health effects of high and low-linear energy transfer internal radiation must also be studied in addition to this one on external radiation.)

[47] "An Epidemiology Study of Mortality and Radiation-Related Risk of Cancer Among Workers at the Idaho National Engineering and Environmental Laboratory, a U.S. Department of Energy Facility, January 2005. http://www.cdc.gov/niosh/docs/2005-131/pdfs/2005-131.pdf and http://www.cdc.gov/niosh/oerp/ineel.htm and Savannah River Site Mortality Study, 2007. http://www.cdc.gov/niosh/oerp/savannah-mortality/

LINE Commission Needs to Provide Answers

I am glad that the above-ground stored transuranic waste from Rocky Flats weapons production is finally being packaged for shipment from the Idaho National Laboratory to the recently re-opened facility for defense waste, the Waste Isolation Pilot Plant, WIPP, in New Mexico. [48] But Idaho citizens need to have a full understanding of the routine emissions and risks of cleanup as continued operations to treat waste from other states is promoted. And Idaho citizens need to understand the harm from past operations in order to learn the true costs to human health and the environment.

Idaho citizens should demand straight answers — not just swaggering confidence coupled with strategic omissions and a greasing of the facts that is typical of presentations by the Department of Energy or its contractors. Idaho citizens need straight answers to a few questions, a dirty dozen questions below.

1. Which long-lived radioisotopes and in what amounts will remain buried at the INL's Radioactive Waste Management Complex after completion of buried waste exhumation (via the Accelerated Retrieval Projects)?

2. Should the slow trickle out modeling of these contaminants be believed? And why was the true extent of future contamination of the aquifer withheld during public announcements of cleanup decisions?

3. How many curies of various long-lived radioisotopes have been buried over the aquifer since cleanup began? And how many more curies of specific isotopes are planned to be buried over the aquifer in the future?

4. Has the level of chemical contamination of the aquifer increased since cleanup began?

5. What are the risks of large airborne releases should a fire occur in above ground storage facilities of drums of transuranic waste? What are the risks to stored waste or buried waste from a Mackay dam break?

6. How many "forever" contamination sites will be left behind at INL after cleanup is considered complete and what radionuclides (and their amounts) are contained in these sites?

7. How many curies of plutonium and other radionuclides have been released to Idaho skies during cleanup? And for that matter, since INL's inception.

8. Why are wind isopleths of INL airborne contamination frequently lopped off south of the INL despite being elevated? Why has there been no lettuce sampling in Minidoka for decades?

[48] Bryan Clark, reporter, *The Idaho Falls Post Register*, "Waste shipment leaves Idaho – It's the first such shipment in three years," April 11, 2017.

9. What is the source of elevated radionuclide and chemical contamination in the aquifer south of INL?

10. If there was really no weapons proliferation risk as INL claimed when it sold the technology to S. Korea, why the urgent need to study pyroprocessing detection? And if INL can't estimate the airborne releases from various types of pyroprocessing processes, does it really know what contamination it released to Idaho skies from decades of pyroprocessing?

11. Why does human epidemiology continue to show more harm from radiation exposure than official models predict?

12. Why has the Idaho Department of Environmental Quality removed from its website several decades of tax-payer funded environmental monitoring of the INL. If they truly don't have the space on their servers, I will gladly agree to post the reports.

Idaho citizens need to study the answers to these questions. I suggest that Idaho's Leadership in Nuclear Energy (LINE) Commission promptly post the answers to these questions on the state's LINE commission website with supporting references cited.

If LINE ever provides answers, I'll be checking them.

Articles unless otherwise noted are by Tami Thatcher, for May 2017.