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SL-1 Accident 60 Years Ago, and the Department of Energy Continues Denial of Accident Causes and Consequences

The January 3, 1961 accident at the Stationary Low-Power Reactor (SL-1) nuclear reactor at what is now called the Idaho National Laboratory killed three crewmen. Many early responders would die of cancer within about decade. And many cleanup workers would also suffer health impacts, cancer and reduced life spans. [1]

The Department of Energy has continued to keep the record unclear, promoting the idea that the accident was due to a deliberate act. The lift required bending and lifting an 80-lb drive mechanism, but the rod drive was likely stuck due to material swelling from reactor operations. The rod was jerked, accidently over-lifted and there was no time for correction before the core had overheated and caused fuel to vaporize and a steam explosion with water hammer that lifted the reactor vessel 9 feet.

The rod was accidently overlifted during an outage to reconnect the rod drives, yet there are people that continue to insinuate that it was an intentional act. They typically are insinuating that the crewman with marital problems and money problems and who had missed the bus and had to drive out to the site was the man who caused the accident. Yet, that crewman's hands were undamaged and the autopsy found that he could not have lifted the rod. [2] The crewman who lifted the rod was happily married for one year and expecting a child. There has never been any evidence or reason to believe that the rod was intentionally overlifted.

A review board has long ago written a report that found that the design of the SL-1 reactor was unsafe with far too much reactivity associated with the center control rod; had used poor materials and fabrication techniques; and was operated with extremely poor safety oversight by the Atomic Energy Commission (AEC), the agency that would become the Department of Energy. Importantly, that review board found no fault with the crew. [3]

In the transmittal letter of the board review report, the letter states:

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[1] Environmental Defense Institute, Citizens Guide to the Idaho National Laboratory, 2021. http://environmental-defense-institute.org/publications/EDIguide2021.pdf

[2] C. C. Lushbaugh et al., Los Alamos Scientific Laboratory of the University of California, *The SL-1 Reactor Accident Autopsy Procedures and Results*, LAMS-2550, May 1961. https://inldigitallibrary.inl.gov/PRR/163773.pdf

[3] Joint Committee on Atomic Energy, *SL-1 Accident Atomic Energy Commission Investigation Board Report*, U.S. Government Printing Office, Washington, June 1961. available at INLDigitalLibrary.inl.gov

> "Although we cannot assign the cause or the responsibility for the explosion to any known or unknown act or condition preceding the incident, it is the judgment of the Board that, before the incident occurred, the condition of the reactor core and the reactor control system had deteriorated to such an extent that a prudent operator would not have allow operation of the reactor to continue without a thorough analysis and review, and subsequent appropriate corrective action, with respect to the possible consequences or hazards resulting from the known deficiencies." [*Please note that that the term operator means the AEC and/or Combustion Engineering management, not a crewman.*]

The board's report also states in the front pages Section 2. "Responsibility for the incident"

> "…(**We specifically absolve the military cadre, as such from any responsibility. [Emphasis added]** Individuals of the cadre had responsibility, with the limited role played by the cadre, insofar as they acted functionally as a part of the contractor's organization. There is no evidence, however, to show whether actions by individuals of the cadre were or were not related to the cause of the incident.)…"

Fast forward 60 years and the Department of Defense issued an Environmental Impact Statement on its mobile microreactor for Project Pele this year which discussed the SL-1 accident. The EIS noted only that the accident taught the lesson of the importance of adequate emergency response planning. The Project Pele EIS documents the lessons-not-learned by the Department of Energy and the Department of Defense from the SL-1 accident including the main causes of the SL-1 accident: poor design and poor safety oversight of the reactor's operations. This not only shows a mindset that neglects essential safety lessons from the SL-1 accident, it is particularly disturbing for the military's proposed mobile microreactor that won't have adequate staffing or training and is being rushed through the design process for an end goal that the reactor is unsuited for. [4]

I wrote the first report about the causes of the SL-1 accident in 2015 and updated it in 2019. [5] I have also written a report about the consequences of the SL-1 accident, and why the radiological release from the SL-1 accident probably dwarfs other past INL radiological releases. [6]

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[4] See the Environmental Defense Institute website for newsletters for November and December 2021 regarding the Department of Defense's Proposed Mobile Microreactors (Project Pele) and public comment on Project Pele including SL-1 lessons not learned at http://environmental-defense-institute.org/publications/Pele2021commentdraftEIS.pdf and the recording of the public hearings available at https://www.mobilemicroreactoreis.com

[5] Tami Thatcher, Environmental Defense Institute Special Report, *The Truth About the SL-1 Accident, Understanding the Reactor Excursion and Safety Problems at SL-1*, January 8, 2015, updated September 1, 2019. http://environmental-defense-institute.org/publications/sl-1accident.pdf

[6] Tami Thatcher, Environmental Defense Institute Special Report, *The SL-1 Accident Consequences*, September 1, 2019. http://environmental-defense-institute.org/publications/sl-1consequences.pdf

My two stand-alone reports on SL-1 about the causes and the consequences, are at the "Nuclear Accident History at INL" webpage at Environmental Defense Institute website at http://environmental-defense-institute.org/inlrisk.html

The AEC claimed that only iodine-131 was released by the accident. Iodine-131has a short 8-day radioactivity half-life. But a whole host of radionuclides went airborne and smoked regions of Idaho with cesium-137, strontium-90, and uranium-235, plutonium-238 and many other short and long-lived radionuclides, and I make the case that the radiological release was larger than admitted because the release fractions corresponding to the AEC's asserted total release are far too small in comparison to what are considered reasonable estimates of release fractions for other reactors.

In the September 2019 newsletter I compare the SL-1 fuel release fractions to the Three Mile Island accident. http://environmental-defense-institute.org/publications/News.19.Sept.pdf

In the December 2019 newsletter I compare the SL-1 accident to the Chernobyl accident. http://environmental-defense-institute.org/publications/News.19.Dec.pdf

The poor safety analysis for the SL-1 and the lack of any safety analysis for shutdown conditions when the accident occurred also contributed to the SL-1 accident. There had been no requirement to prevent the water temperature in the vessel from falling so far below saturation temperature that January evening. The accident was later estimated to be 10 times worse because of the reduced heat removal by the water in the vessel due to the low fuel coolant temperature at the time of the rod withdrawal (see the November 1962 Atomic Energy Commission report IDO-19313, page 151).

A reactor prompt critical condition causing an explosion was deemed impossible and not included in the safety analysis for the SL-1.

In addition to control rod sticking, material swelling in the SL-1 nuclear reactor had gotten so bad that fuel elements were too difficult to remove and so fuel element inspections had simply ceased by August 1960. Jerking the stuck center rod free caused the accident despite the AEC's dismissal that rod sticking had played in the accident and this decision to exclude rod sticking as the cause of the accident was made before many of the Idaho Operations Office reports and investigations had been completed. The center rod's history of sticking, particularly during shutdown, was omitted from various AEC reports but is documented. There were numerous reasons why the center rod could have been stuck and when forcefully lifted would have caused lifting the rod farther than intended. The center rod had stuck many times during shutdown and at the same position as when the accident occurred. The material swelling in the core and rod sticking had greatly increased during the last weeks of SL-1 operation.

The amount of the over lift is incorrectly described in the Department of Energy's popular and readily available *Proving the Principle.* [7] Some early reports were written based on the position of components that had been moved by the force of the accident, not by the lifting of the rod. The publication *Proving the Principle* contains many inaccurate and biased statements to insinuate that a crewman deliberately caused the accident and is the only reference cited by the Project Pele draft EIS. Many text books incorrectly attribute the cause of the SL-1 accident to a deliberate act by a crewman because of the propaganda which sought to avoid putting the blame on the SL-1 accident where it belonged: on the Department of Energy (then called the Atomic Energy Commission). [8]

Despite being strongly discouraged from doing so by the military, all of the wives of the three crewmen, by the way, did later sue and achieve monetary settlements from the government for their husband's deaths for the negligent way the SL-1 was being managed.

None of the SL-1 crewmen were at fault but a crewman continues to be wrongfully accused of deliberately causing the accident that was caused by designers and all levels of reactor management for the SL-1. The AEC (now called the Department of Energy) granted operation outside its specified safety limits with by verbal agreement, without the necessary evaluation. The AEC withheld needed funding for staffing, drawing changes, proper engineering, and proper oversight of the reactor. The AEC managers caused the facility to be operated unsafely in multiple ways and caused the SL-1 accident.

CERCLA cleanup investigations that commenced at the INL in 1995 found not only the special SL-1 burial grounds but also the buildings adjacent to where the SL-1 reactor had been, were radiologically contaminated. [9] The buildings had housed workers since 1961, and the contamination was not due to iodine-131. The reasons why the extensive radiological contamination was not detected by the Department of Energy for decades were never explained.

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[7] Susan Stacy, "Proving the Principle – A History of the Idaho National Engineering and Environmental laboratory, 1949-1999," Washington, D.D.: US Department of Energy. p. 148. http://www.inl.gov/publications/ and http://www.inl.gov/proving-the-principle/introduction.pdf

[8] Although not a text book for nuclear engineering, the book by Howard G. Wilshire et al., The American West at Risk" includes in a footnote information typical of prevalent misinformation from Atomic Energy Commission. It describes the SL-1 accident as an "apparent sabotage" and says an AEC memo stated that "the …accident is now known to have been initiated on purpose by one of the operators," suspicious of an affair between his wife and a shift partner."

[9] See the Idaho Environmental Coalition, LLC (IEC) that will take over the Idaho Cleanup Project on January 1, 2022 for the new location of the Administrative Record and Information Repository for Idaho National Laboratory CERCLA cleanup records at http://www.idaho-environmental.com/ARIR/

IWTU Permit Modification Granted by Idaho DEQ

The public comment period for the Integrated Waste Treatment Unit (IWTU) RCRA hazardous waste permit modification closed December 20 after a virtual public hearing held that evening. [10]

Fluor Idaho will be exiting as the Idaho Environmental Coalition takes over the Idaho Cleanup Project January 1, 2022. The Idaho Environmental Coalition includes Jacobs, North Wind, Portage, Navarro Research and Engineering, Oak Ridge Technologies and Spectra Tech. [11]

I could not find any information on whether or not test runs are being conducted at the Integrated Waste Treatment Unit (IWTU) this fall as planned.

The Idaho Settlement Agreement milestone to finish treating the radioactive liquid sodium-bearing waste was in 2012. The cost estimate for the IWTU has grown from $570 million to more than $1 billion. [12]

Under hazardous waste regulations implemented by the State of Idaho, the Department of Energy has been fined $6000 per day beginning October 1, 2016 for DOE's failure to empty the tanks as agreed to in the phased compliance schedule due to DOE's noncompliance with Environmental Protection Agency requirements for not having adequate secondary containment for the tanks the sodium-bearing waste is stored in. [13]

The recent schedule for beginning to treat the radioactive liquid sodium-bearing high-level waste resulting from nuclear fuel reprocessing at the Idaho National Laboratory documented in the INL Site Treatment Plan stated that the sodium-bearing waste treatment was to have filled 100 canisters by the fourth quarter of 2021. [14] However, the Department of Energy has communicated to the Idaho DEQ that twelve months of schedule slip have occurred due to COVID-19 impacts (in June 28, 2021 communication from the Department of Energy to the Idaho Department of Environmental Quality).

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[10] Idaho Department of Environmental Quality, Public Comment Opportunities page https://www.deq.idaho.gov/public-information/public-comment-opportunities/ with the recent notice for the IWTU at https://www.deq.idaho.gov/deq-announces-notice-of-public-hearing-on-the-intent-to-approve-a-draft-hazardous-waste-treatment-storage-and-disposal-permit-modification-for-the-idaho-nuclear-technology-and-engineering-center-liq/

[11] Wayne Barber, *Exchange Monitor – Weapons Complex Monitor*, "Jacobs Bosses Cheer Idaho Cleanup Contract, Earnings Dip," August 6, 2021. https://www.exchangemonitor.com/jacobs-bosses-cheer-idaho-cleanup-contract-earnings-dip/?printmode=1

[12] *Exchange Monitor – Weapons Complex Monitor*, "Idaho Waste Treatment Unit Could Start Operation This Fall," March 9, 2021. https://www.exchangemonitor.com/idaho-waste-treatment-unit-start-operation-fall/

[13] Idaho Department of Environmental Quality, webpage "INL Regulatory Information" at https://www.deq.idaho.gov/idaho-national-laboratory-oversight/inl-oversight-program/inl-regulatory-information/

[14] Idaho National Laboratory Site Treatment Plan, INL-STP, Revision 41, November 2020. See https://www.deq.idaho.gov/idaho-national-laboratory-oversight/inl-oversight-program/inl-regulatory-information/

The ramifications of the proposed changes to the IWTU suggest that certain aspects of the process gas filter (PGF) are likely to result in more frequent flowing of radioactively laden dry materials (I'll call it sticky radioactive sand) to flow beyond the PGF into portions of the process not designed to receive this material. The need for nitric acid flushes appears to be increased. And the storage of the flushed material will be allowed in a nearby tank and also, the flushed nitric acid and radioactive waste will be allowed to be stored at the nearby NWCF, the facility repurposed from calcining. Any complications and the ultimate fate of the waste from flushing out the plugged-up system has not been adequately discussed.

The estimated number of canisters of treated dry sodium-bearing waste has increased from roughly 700 canisters to 1200 canisters and more storage at INL for the treated sodium-bearing waste canisters will be needed. It remains unstated whether this is due to addition of newly generated liquid radioactive waste or some other reason.

The Department of Environmental Quality air quality permit for the IWTU (and the rest of the Idaho National Laboratory) was revised and the new permit number P-2020.0045 was issued on January 29, 2021. The most recent air permit for the IWTU is on the Idaho DEQ website. [15]

Although the process used by the IWTU is called "steam reforming," the IWTU burns coal to heat the process. The liquid sodium-bearing high-level waste it will treat contains mercury, nitrates and other hazardous chemicals and a host of radionuclides. Many of the radionuclides are long-lived, decay through many radioactive decay progenies and are strongly retained in the body, such as plutonium. Although there are monitoring provisions, HEPA filters, and mercury adsorbers, the IWTU will be releasing mercury, nitrogen oxides (NOx), sulfur dioxide (SO_2) and radionuclides to the skies of southeast Idaho. All iodine-129 in the sodium-bearing waste would be released because no filters will prevent its release. [16]

The estimated radionuclide releases from the IWTU and the rest of the Idaho National Laboratory are to be reported to the Environmental Protection Agency in accordance with 40 CFR 61 National Emissions Standards for Hazardous Air Pollutants (NESHAP), Subpart H (National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities), which is to limit radionuclide emissions such that an effective dose equivalent (whole body) dose does not exceed 10 millirem per year (mrem/yr), as estimated using EPA-approved methods. The annual NESHAP report of radiological air emissions from the INL is created by the Department of Energy and given to the Region 10 EPA and a copy provided to the Idaho Department of Environmental Quality. But this didn't mean that the EPA or the Idaho DEQ noticed glaring underreporting of radionuclides from 1993 to 2000, when the DOE ignored the airborne effluents from its now-lined radioactive waste evaporation pond at the

[15] Idaho Department of Environmental Quality air permit which includes the Integrated Waste Treatment Unit, Transmittal letter dated January 29, 2021, Idaho DEQ to U.S. Department of Energy, Facility ID No. 023-00001, US Dept of Energy – INL, Scoville Final Permit Letter (Document file name us-dept-of-energy-inl-023-idaho-falls-permit-0121-1) at the www.idaho.deq.gov website.

[16] Idaho Cleanup Project, CH2M-WG Idaho, LLC, *Mass and Energy Balance for Sodium Bearing Waste Integrated Waste Treatment Unit – Modified to Support Emissions Permitting*, EDF-6495, February 18, 2009.

ATR Complex. Those annual reports apparently did not include these emissions in the estimated radiation dose to the public. Also, neither the State nor the EPA would address the long-standing radioactively-laden resin bead releases to the ATR Complex pond that were not largely unreported until the contractor reported noticing high levels of soil contamination near the pond in 2016.

In other words, inaccurate reporting to the EPA in Department of Energy NESHAP reports is to be expected and the releases from ponds, waste barrel explosions, plowing of highly radioactively laden soils, and soil resuspension in general — all result in under-reporting of the radionuclide inhalation doses under the EPA NESHAP regulations. Meeting EPA regulations for monitoring of radionuclides is not likely to insure that the radionuclide releases are accurately reported.

See updated EDI comment submittals from December at the Environmental Defense Institute home page. [17] [18]

Idaho Department of Environmental Quality Continues Acquiescing to Department of Energy Requests

Nuclear fuel reprocessing for naval and government reactors was conducted at the INL (formerly the National Nuclear Testing Station) beginning in 1953 until 1991. Highly radioactive liquid wastes were then solidified into a powdery waste form by calcining with a fluidized bed. Calcining began in 1963 to 1981 in the Waste Calcining Facility (WCF). The New Waste Calcining Facility (NWCF) then operated from 1982 through May 2000. Calcining produced about 12.2 million pounds of powdery, highly soluble radioactive calcine material that is stored partially below grade in various vintages of calcine storage "bin sets."

The calciner had operated for years without a state permit for its stack emissions. In 1991 the Idaho Department of Environmental Quality issued a RCRA Part B Notice of Deficiency on the Department of Energy's submitted RCRA Part B application. The issues involved the lack of emission monitoring of radionuclide and chemical emissions and limited waste stream characterization. [19]

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[17] Public Comment Submittal to the Idaho Department of Environmental Quality regarding its Notice of Intent to Approve a Draft Hazardous Waste Treatment, Storage, and Disposal Permit Modification for the INTEC Liquid Waste Management System Partial Permit at the Idaho National Laboratory (Changes to the IWTU), December 20, 2021, by Tami Thatcher at http://www.environmental-defense-institute.org/publications/CommentIWTU2021Dec20.pdf

[18] Public Comment Submittal to the Idaho Department of Environmental Quality regarding its Notice of Intent to Approve a Draft Hazardous Waste Treatment, Storage, and Disposal Permit Modification for the INTEC Liquid Waste Management System Partial Permit at the Idaho National Laboratory (Changes to the IWTU), December 20, 2021, by Chuck Broscious, Environmental Defense Institute, at http://www.environmental-defense-institute.org/publications/EDIComIWTU2021Dec20.pdf

[19] Office of Inspector General, United States Environmental Protection Agency, "Evaluation Report: Review of EPA's Response to Petition Seeking Withdrawal of Authorization for Idaho's Hazardous Waste Program," Report No. 2004-P-00006, February 5, 2004.

The Idaho DEQ issues were never resolved and the Department of Energy restarted the calciner in 1997 and ran until 2000. The Idaho DEQ admits that they met with the DOE at least quarterly to discuss compliance issues but the Idaho DEQ did not require the DOE to resolve the calcine radiological air release issues.

The Department of Energy ceased calcining in 2000 because the remaining liquid waste chemistry required either significant modification of the existing calciner or building a new facility. The Department of Energy chose to build a new facility, the Integrated Waste Treatment Unit (IWTU). [20] The IWTU has continued to be modified and tested since it was constructed in 2012. The IWTU has not treated any radioactive waste yet.

In the calcine operations until mid-2000, if I read between the lines, it would appear that the DOE and Idaho DEQ understood that the iodine-129 emissions from calcining could not met federal limits. So, it appears to me that that the Idaho DEQ agreed to ignore the monitoring and emissions characterization issues. **The extent to which the Idaho DEQ is an enabler of Department of Energy polluting appears to have not diminished with time.**

Prior to 1992, the Department of Energy had strenuously fought against hazard chemical waste laws applicability to "mixed waste," which is both chemically and radiologically contaminated waste. The DOE maintained that only DOE could regulate radiological materials even if the materials contained chemical waste. While DOE lost this battle, the DOE has successfully influenced state agencies and weakened regulation by the Idaho DEQ.

When Cecil Andrus was the Governor of Idaho, the Idaho Department of Environmental Quality created stronger monitoring of the Idaho National Laboratory. Since then, air and water protections have consistently been weakened by the Idaho DEQ at the request of the Department of Energy.

In the late 1980s, Governor Andrus requested the Department of Energy to explain what the radiological releases had been. The Department of Energy didn't actually know and had to estimate the annual radiological releases. The guesstimates were issued a report called the *INEL Historical Dose Evaluation* [21] which estimated the radiological airborne releases from 1952 to 1989. The report has underestimated the releases, omitted certain radionuclides important to human health, and underestimated the harm from airborne releases. The report also ignored the aquifer contamination based on deceptive and spotty monitoring by the USGS that was intended to not show how rapidly radionuclide waste in the aquifer and chemical waste had been transported to south of the INL.

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[20] Nick Soelberg, Idaho National Laboratory, *The 10th International Conference on Environmental Remediation and Radioactive Waste Management*, "Advanced Off-Gas Control System Design For Radioactive And Mixed Waste Treatment," INL/CON-05-00568, September 2005.

[21] US Department of Energy Idaho Operations Office, "Idaho National Engineering Laboratory Historical Dose Evaluation," DOE/ID-12119, August 1991. Volumes 1 and 2 can be found at https://www.iaea.org/inis/inis-collection/index.html

In 1985, the Department of Energy began to comply with new Environmental Protection Agency (EPA) regulations for airborne radionuclides from DOE facilities and submitted its first annual report for airborne radionuclide emissions under 40 CFR 61, Subpart H, [22] known as "NESHAPs."

The Idaho DEQ had required air permits for liquid radioactive waste pond at the Test Reactor Area (now called the ATR Complex) since 1993. **But recently at DOE's request, the Idaho DEQ accepted an exemption on the air permit.** The Idaho DEQ issued the decision on May 29, 2020 that an air permit for the evaporation pond would no longer be needed. [23]

The State of Idaho public drinking water monitoring program that began in the late 1980s was still not mature in the early 1990s. Initially the state program required both chemical and radiological monitoring of drinking water at the INL. But at the request of the Department of Energy, the state ceased collecting radionuclide drinking water data (tritium, gross alpha, and gross beta) from the INL drinking water wells. The legal basis is that the INL drinking water wells are *non-transient non-community* wells – no one lives there. But this loop hole was intended to hold down costs for monitoring campgrounds, for example, should not be used as an excuse to withhold from public view the contamination levels of chronically radiologically contaminated nuclear sites.

The original State of Idaho Department of Environmental Quality program under EPA regulations 40 CFR 141 for drinking water monitoring at the INL included sending samples to multiple labs to keep the sample results honest but that was discontinued at DOE's request. Reporting when the samples are taken, what lab evaluates them, what radionuclides were evaluated or the radiological results — is no longer provided on State of Idaho public drinking water databases.

The Idaho National Laboratory's production wells used for drinking water by people working at the site have a long history of radiological contamination that the Department of Energy and the US Geological Survey largely ignored. The Central Facilities Area (CFA) wells were downgradient from both the fuel reprocessing injection disposal well at INTEC and the test reactor area now called the ATR Complex. The levels of tritium were astronomical, far exceeding 20,000 picocuries/liter (pCi/L). And there were a host of other radionuclides in the CFA tap water as well, including iodine-129. Use of groundwater for lawn irrigation at CFA with sprinklers releases tritium and other radionuclides to the air.

Although the U.S. Geological Survey had conducted groundwater monitoring at the INL since its inception in 1949, it was not until 1987, that for the first time, the USGS monitored

[22] See 40 CFR [Code of Federal Regulations] Part 61, Subpart H – National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities at https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-61/subpart-H

[23] Idaho Department of Environmental Quality air permit Transmittal letter dated May 29, 2020, Idaho DEQ to U.S. Department of Energy, Facility ID No. 023-00001, U.S. Department of Energy – Idaho Operations Office Permit to Construct Termination, PTC No. 023-00001. (Document file name us-dept0of-energy-inl-023-permit-termination-0520) at the www.idaho.deq.gov website.

some INL wells for purgeable organics and detected a host of chemicals in various wells. At some facilities, the USGS found that permission levels of chemical contaminants in the INL's drinking water wells were exceeded.

In 1988, EPA regulations for hazardous chemical waste under EPA's 1976 Resource Conservation and Recovery Act (RCRA) and regulations for contaminated areas under EPA's 1980 Comprehensive Environmental Response, Compensation, and liability Act (CERCLA) began to be addressed at the INL. The 1987 Superfund Amendments and Reauthorization Act (SARA) amendments to CERCLA applied the hazardous substance requirements to the DOE and other federal facilities. The 1992 Federal Facility Compliance Act (FFCA) subjected DOE to state and local enforcement of hazardous waste regulations and enforcement actions. [24]

The Department of Energy had estimated that it had about 65,000 cubic meters of above ground "stored" transuranic waste. The 1995 Idaho Settlement Agreement [25] promised to remove all the transuranic waste "stored" in Idaho, about 65,000 cubic meters. The State of Idaho thought that all of the buried and above-ground stored transuranic waste would be leaving the state. But the Department of Energy had no intention of exhuming any more transuranic waste that it had buried. A lawsuit brought by the State of Idaho found that "all means all." But while the Department of Energy agreed to exhume further buried transuranic waste, in 2008 the State of Idaho allowed DOE to limit the exhumation to a small fraction of the buried transuranic waste, the most chemically-laden "targeted waste" which was already contaminating the Snake River Plain Aquifer with carbon tetrachloride. Of the 97-acre burial ground, waste was buried in 35 acres. Only the partial contents of less than 6 acres was deemed "targeted waste." Any radioactive waste not deemed "targeted waste" is not exhumed or is returned to the pit. Of the americium-241 estimated to be buried at the RWMC, most of it is not being exhumed.

Beginning in the Department of Energy's 1988 annual environmental surveillance report, compliance programs for EPA RCRA and CERCLA regulations are discussed. See a summary of the timing of when various radionuclide limits and EPA regulations enter the DOE's annual environmental surveillance reports in Table 1.

In 1988, however, the Department of Energy was still saying 500 mrem/yr was an acceptable dose to the public. It was not until 1989 that the Department of Energy would emphasize a lower 100 mrem/yr dose to the public from all pathways. In 1989, for airborne dose, the EPA would still allow 25 mrem/yr whole body effective dose with a limit on organ dose of 75 mrem/yr; but in 1990, the EPA lowered its airborne limit to 10 mrem/yr and eliminated the organ dose limit.

This conveniently allows the Department of Energy to overdose various parts of your body and your developing embryo/fetus, but both the DOE and the EPA focus on cancer fatalities and not birth defects or infant mortality. The EPA cleanup standards say they address cancer

[24] Richard Burleson Stewart and Jane Bloom Stewart, *Fuel Cycle to Nowhere – U.S. Law and Policy on Nuclear Waste*, Vanderbilt University Press, 2011.

[25] See the Idaho Settlement Agreement and memorandums at https://www.deq.idaho.gov/inl-oversight/oversight-agreements/1995-settlement-agreement/ and cleanup progress at https://www.deq.idaho.gov/inl-oversight/oversight-agreements/cleanup-progress-at-inl/

incidence, but in reality, the cleanup goals are not met and organ doses and cancer incidence limits are not met at contaminated sites like the INL.

Table 1. Timing of the Department of Energy programs to address EPA laws.

Regulation	1987 DOE Annual Environmental Surveillance Report and report prior to 1987 beginning in the 1950s	1988 DOE Annual Environmental Surveillance Reports (and thereafter)
EPA NESHAPs National Emissions Standards for Hazardous Air Pollutants (NESHAP), Subpart H (National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities)(40 CFR 61, Subpart H) for reporting the release of airborne radionuclides at DOE Facilities, is established in 1985	25 mrem/yr whole body 75 mrem/yr organ	25 mrem/yr whole body 75 mrem/yr organ In 1990, the EPA airborne limits change to: 10 mrem/yr whole body (no organ dose limit)
DOE's Orders for Radiation Dose to the Public	500 mrem/yr	500 mrem/yr 100 mrem/yr would be emphasized after 1988 in DOE's "Derived Dose Concentrations" or "Derived Dose Standards" despite the 10 mrem/yr EPA limit from annual emissions
EPA RCRA and FFCA Resource Conservation and Recovery Act of 1976 (RCRA) for hazardous chemical waste. DOE-Idaho, State of Idaho and EPA sign agreement in 1991. In 1992, the Federal Facilities Compliance Act (FFCA) is enacted formally subjecting DOE and other federal facilities to RCRA.	None	Yes, included.
EPA CERCLA and SARA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund for contaminated sites. The 1987	None	Yes, included.

Regulation	1987 DOE Annual Environmental Surveillance Report and report prior to 1987 beginning in the 1950s	1988 DOE Annual Environmental Surveillance Reports (and thereafter)
Superfund Amendments and Reauthorization Act (SARA) enacted.		
EPA Safe Drinking Water Act (40 CFR 141, 142) but emphasis is placed on MCLs generally not applicable to noncommunity (transient or non-transient) wells.	First monitoring by USGS of purgeable organic compounds in groundwater at INL, and in 1987 the EPA promulgated maximum contaminant levels for drinking water. In 1987, purgeable organics MCLs added for trihalomethanes, carbon tetrachloride, 1,1,1-trichloroethane and trichloroethylene.	Not until 1992 are nontransient noncommunity wells considered to need to apply drinking water maximum contaminant levels (MCLs) for radionuclides. Monitoring and reporting of radionuclides to the state in INL's noncommunity drinking wells takes advantage of exemptions and stop being reported to the state's drinking water database as it had at program inception.

Before 1987, the Department of Energy's annual environmental monitoring reports stated that estimated background radiation doses in southeast Idaho were around 143 mrem/yr. But in 1987, the DOE would add 200 mrem/yr in inhaled radionuclides as recommended as a national average, largely from radon. [26] [27] The background radiation to a member of the public in southeast Idaho is stated as roughly 355 mrem/yr. The actual dose to people living in southeast Idaho has not been estimated. Southeast Idaho as a particular problem with radon and other uranium decay series due to extensive phosphate ore mining and processing.

In 2009, a new NCRP report was issued which recommended adding an assumed medical exposure of 300 mrem/yr to every member of the public every year and to also add 10.5 mrem for consumer products and activities and occupational exposure. [28] Does every embryo/fetus get 300 mrem/yr from medical exposure? Let's hope not, because 500 mrem to an embryo/fetus has been found to double their risk of dying of cancer or leukemia before they become an adult.

[26] National Council on Radiation Protection and Measurements, Ionizing Radiation Exposure of the Population of the United States, NCRP Report No. 93, September 1, 1987.
[27] National Council on Radiation Protection and Measurements, Ionizing Radiation Exposure of the Population of the United States and Canada from Natural Background Radiation, NCRP Report No. 94, December 30, 1987.
[28] National Council on Radiation Protection and Measurements, Ionizing Radiation Exposure of the Population of the United States, NCRP Report No. 160, 2009.

Poorly Designed and Inadequately Maintained Mackay Dam Poses Radiological Risks to the INL

There are many reasons to have concern about the Mackay Dam, even if you don't live in Mackay, Idaho. Seismic failure of the dam when the dam is full can cause serious flooding at the Idaho National Laboratory, including its Idaho Nuclear Engineering and Technology Center (INTEC) where spent nuclear fuel and high-level waste known as calcine and the liquid sodium-bearing waste are stored.

A serious flooding event at INTEC due to Mackay Dam failure is possible. For example, the powdery, soluble calcine high-level waste tanks may float and break piping attached to the storage containers called bin sets that the calcine is stored in. A release of millions of curies of powdery calcine could blow in the wind and/or leach into groundwater. There would be no realistic way to remediate its release. Spent nuclear fuel is also stored at INTEC for the Three Mile Island Unit 2 fuel debris and other spent nuclear fuel in outdoor storage could also be affected. See Environmental Defense Institute report by David B. McCoy and Chuck Broscious issued in 2018 on the Mackay Dam. [29]

Inspections of the Mackay Dam and maintenance of the dam have been inadequate for years. The most recent dam certificate on the Big Lost River Irrigation District website expired in 2019. [30]

We've recently been told that "The irrigation department has been ordered by the Idaho Department of Water Resources to make the repairs and had two years to do it. It's been at least 3 years and nothing has been done."

In addition, there is also some very aggressive mining in the area. The Phoenix copper/ Konnex is planning 5 open pit mines in the White Knob Range. One of them is at Navarre Creek upgrade from the Mackay reservoir. [31]They are in the permitting process with the Forrest Service to begin drilling a ton of exploration holes and hoping to use Categorical Exclusions (CEs) to avoid doing the necessary studies to determine if this will harm the Mackay Dam or cause other harm.

The Forest Service is currently accepting comments on this proposal through January 10th. Comments can be emailed to the Forest Service at comments-intermtn-salmon-challis@usda.gov. We suggest that commenters request the Forest Service to conduct evaluations of whether drilling or other activities could increase the seismicity of the area, which could compromise the vulnerable Mackay Dam and cause a nuclear catastrophe in the state.

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[29] David B. McCoy and Chuck Broscious, Environmental Defense Institute, Report: Complaint to Idaho Governor on Mackay Dam Hazards Ignored, January 2018. at http://www.environmental-defense-institute.org/publications/MackayDam2018.pdf

[30] Big Lost River Irrigation District at http://www.blrid.com/

[31] U.S. Forest Service, See Navarre Exploration Drilling, Proposed Action 61118 posted December 7, 2021. The drilling is within 10 air miles of Mackay, Idaho. https://www.fs.usda.gov/project/?project=61118

Ongoing INL Airborne Contamination – Where Does It Go?

I have compiled highlights of the DOE's annual surveillance reports on airborne radiological effluents with an emphasis on the years 1990 through 2019. See our recent report, *Airborne Radiological Releases from the Idaho National Laboratory and the Increasing Radioactive Contamination in Southeast Idaho,* for trends in DOE's reported INL radiological airborne effluent releases, the Department of Energy's estimated effective whole-body dose from the airborne releases, and the levels of radioactive contamination in air, milk, lettuce, wheat and soil from the DOE's environmental surveillance program. [32]

It becomes clear that the Department of Energy underreported its stated INL airborne releases, not only before 1989, but at least until 2001 because none of the radioactive liquids in open-air percolation ponds or lined evaporation ponds were reported as contributing to airborne effluents prior to 2001.

As noted in the previous article, the transition from percolation ponds to lined evaporation ponds at the ATR Complex, for liquid radioactive waste, occurred in 1993. But the lined ponds continued to be reported as liquid effluent and were not included in airborne effluents that are used in estimating the radiation dose to the public until 2001.

The TRA radioactive waste ponds have received enormous quantities of a variety of radionuclides and some of the radionuclides are detected 50 miles away from the INL in communities surrounding the INL, although the Department of Energy does not acknowledge the INL as the source of the contamination.

The Department of Energy's monitoring of antimony-125 (Sb-125) which was released from the Idaho National Laboratory's INTEC facility from spent nuclear fuel reprocessing and not released from nuclear weapons testing, revealed how far and wide the releases from the INTEC stack blew. Craters of the Moon is miles upwind of the INTEC stack. But the prevailing winds do reverse and often, reverse at night.

When Sb-125 releases were very high in 1986, 1987 and 1988, Sb-125 was detected onsite and detected above two standard deviations (2s) at offsite locations: Arco, Atomic City, Howe, Monteview, Mud Lake, Reno Ranch, and Craters of the Moon. The detections of radioactive Sb-125 were made by the Department of Energy's annual environmental surveillance program. The INTEC stack is near the center of the INL, roughly below the "N" in INEEL on Figure 1.

Note that many areas offsite had detections below two standard deviations (2s) and many areas were not monitored. Also, the monitoring minimum detectable concentration (MDC) specified by the program was rather high, 6 E-15 microcuries/milliliter (uCi/mL), which means lower levels would not be detected.

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[32] Special Report, Environmental Defense Institute, *Airborne Radiological Releases from the Idaho National Laboratory and the Increasing Radioactive Contamination in Southeast Idaho*, December 2021 by Tami Thatcher at http://www.environmental-defense-institute.org/publications/INLcontamination.pdf

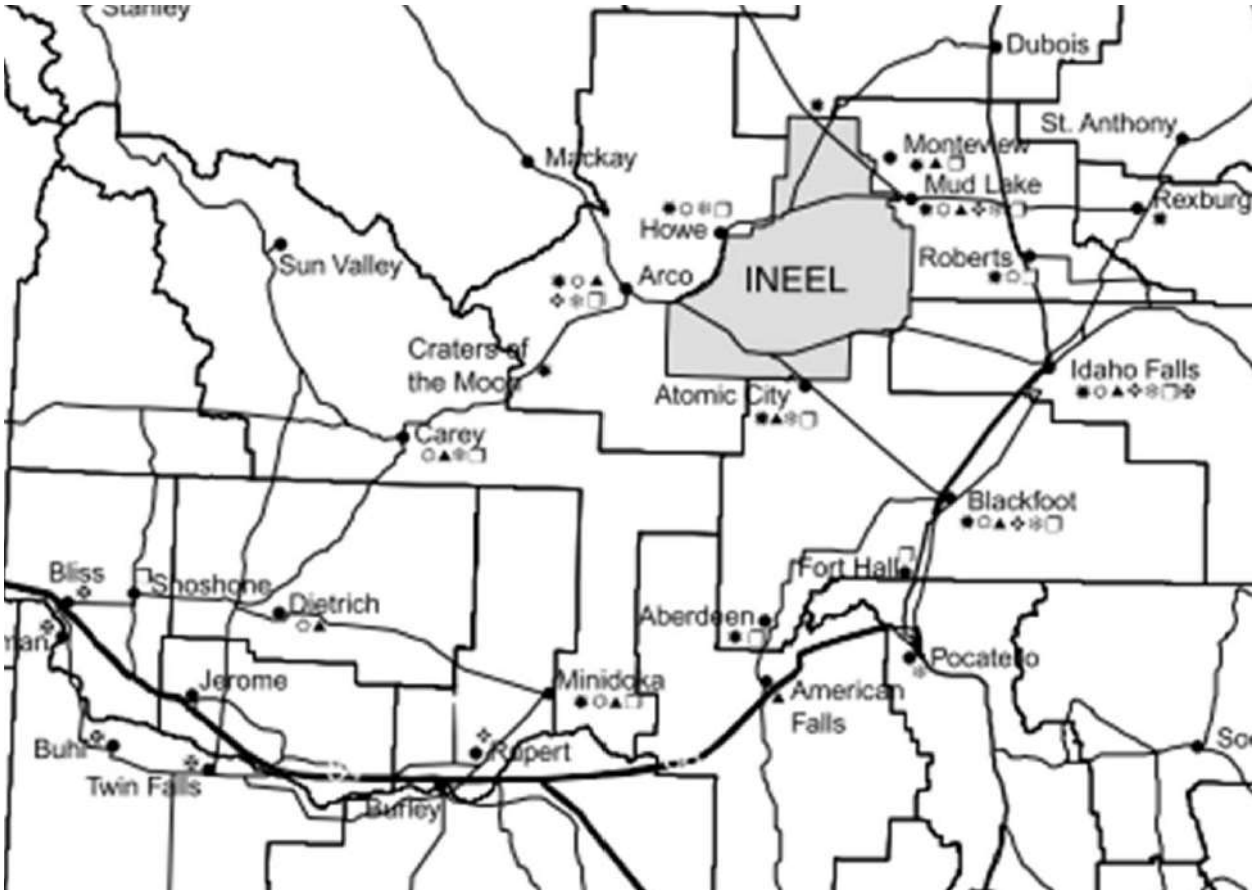

Figure 1. Communities near the Idaho National Laboratory (formerly the INEEL). **Note that the strong Sb-125 detections at the Craters of the Moon reveal ICPP stack releases reached Craters of the Moon despite being southwest of the stack. Note also that the prevailing winds would have carried Sb-125 to Dubois, but Dubois was often unmonitored.**

In 1995, radioactive scandium-46 with a 83.83-day radioactive half-life was detected in Rexburg in the third and fourth quarters of the year. There is no way this came from former nuclear weapons testing.

Also in 1995, the highest recorded detection of cerium-144 occurred and the detection was at Craters of the Moon. Cerium-144 has a 284.3-day radioactive half-life and in 1995 would not be detected from nuclear weapons testing. The detection was 11 E-15uCi/mL plus-or-minus 10 E-15uCi/mL (two standard deviations).

Zinc-65 was detected in Blackfoot and in Rexburg in 1995. This radionuclide has a 243.9-day radioactive half-life and would not have come from former nuclear weapons testing. It is

frequently released, however, at the ATR Complex evaporation pond. **The source of cerium-144, scandium-46 and zinc-65 in 1995 could have only been the Idaho National Laboratory.**

Dyes used in the ATR Complex radioactive waste evaporation pond installed in 1993 were experimented with an improving the evaporation rate, yet **the radionuclides sent to the evaporation pond were not included in radionuclide air emissions under EPA's NESHAPs, 40 CFR 61, Subpart H for DOE facilities until 2001.**

Idaho Falls also receives extensive radiological airborne contamination from INL operations.

The DOE's environmental monitoring strategy after 2003 was to raise the bar on reporting of radionuclide detections. Only detections exceeding three standard deviations (3s) would be deemed "detected." Valid results that would have been reported, 2.9 ± 1 (1s) pCi/L (for example), would no longer be considered "detected" because the result 2.9 was less than 3.0. While a result greater than 3s is a stronger detection than a 2s detection, the strategy is not dictated by statistics. Ignoring detections below 3s is not actually defensible. Nor is raising the minimum detectable concentration (MDC) in order to hide INL airborne radiological contamination, and this has also been occurring. Raising the MDC may have been necessary at times due to the high levels of a variety of radionuclides from INL airborne releases causing "interference" in radiological sample analysis. But raising the MDC to hide INL contamination has often been accompanied by avoiding disclosure of the MDC specified prior to sample analysis or achieved during the sample analysis.

See our recent report, *Airborne Radiological Releases from the Idaho National Laboratory and the Increasing Radioactive Contamination in Southeast Idaho,* for more information on the DOE's annual environmental surveillance program, including the monitoring of specific radionuclides detected in ambient air filters. [33]

Articles by Tami Thatcher for January 2022.

[33] Special Report, Environmental Defense Institute, *Airborne Radiological Releases from the Idaho National Laboratory and the Increasing Radioactive Contamination in Southeast Idaho*, December 2021 by Tami Thatcher at http://www.environmental-defense-institute.org/publications/INLcontamination.pdf