Environmental Defense Institute

News on Environmental Health and Safety Issues

May 2022 **Volume 33** **Number 5**

Department of Energy Citizens Advisory Board Meeting Update on IWTU's Simulant Confirmatory Runs: De-fluidization Event, Excessive Carbonate Bypass and Numerous Operational and Equipment Problems

The Integrated Waste Treatment Unit (IWTU) now operated by the Idaho Environmental Coalition for the Department of Energy experienced a rapid automatic shutdown on February 23 during a confirmatory test run of non-radioactive simulant. The rapid shutdown was apparently due to an error during maintenance activity. The simulated waste feed flow was restored about 24 hours later. Process differential temperature increases were observed. Excessive carbonate bypass was suspected and a series of Process Gas Filter (PGF) "blowbacks" were performed. Then very high process differential temperatures in the Carbon Reduction Reformer (CRR) were observed. The IWTU was then manually shutdown for inspection.

The problems were encountered during what was to be a confirmatory test run using non-radioactive simulant to prove that the IWTU was ready to begin treating roughly 900,000 gallons of liquid radioactive sodium-bearing waste resulting mainly from spent fuel reprocessing. This waste, stored in tanks over the Snake River Plain aquifer, was to have been treated to solidify the liquid by the IWTU facility ten years ago. "Newly generated waste" although not discussed at CAB meetings continues to be added to the liquid waste to be treated. The original estimate of 700 canisters of the treated IWTU waste has grown to about 1200 canisters.

The Department of Energy gave a presentation on the IWTU problems to the Idaho Cleanup Project's Citizens Advisory Board during the April 26 meeting held at Fort Hall. [1]

The Department of Energy states in its presentation that the suspected cause of the high differential temperatures was excess carbonate bypass. Other problems found following inspection include:

- Loose hold-down hardware
- Broken elements in filter bundles
- Required tie-down hardware preload and/or surface seal on PGF not developed or maintained

[1] Idaho Cleanup Project Citizens Advisory Board https://www.energy.gov/em/icpcab/idaho-cleanup-project-citizens-advisory-board-icp-cab 2022 meeting agenda and presentations.

- Potential interference between sub tube sheet and main tube sheet on PGF
- Shallow cracks in the CRR refractory
- Eroded CRR piping penetration
- Lack of appropriate high differential temperature alarm setting
- Procedure changes needed to direct earlier controlled shutdown
- The need to reduce the impact of potential CRR bed agglomerations.

Years ago, the problem of agglomerations, of sticky plugging up of material in the IWTU was a problem that led some people to believe the design concept was unworkable.

The safety implications of these plug-ups for the release of radiological material from the IWTU from a large accident are not discussed. And if the IWTU begins treating radioactive liquid, repairs and inspections will involve radioactive exposure to personnel. The nitric acid flush-outs of the equipment will also create more waste that must be stored and treated. Frequent shutdowns could mean never making much progress on reducing the volume of liquid radioactive waste.

Idaho Environmental Coalition (IEC) assumed the Idaho Cleanup Project on January 1, 2022 following a 3-month transition from exiting Fluor Idaho. Fluor Idaho was successful at creating an air of invincibility and Fluor Idaho's exit included development of a promotional video that highlighted its work on IWTU redesign, repairs and simulant testing from 2016 through 2021.

The testing of the process for the IWTU in miniature scale at the Hazen facility in Colorado has been conducted with improper installation of equipment and various problems, according to DOE RCRA permitting documents on the DEQ website. For some reason, the testing at the Hazen facility has not prevented the numerous IWTU problems.

Ten years of re-design, repair and repeated simulant testing of the IWTU facility appears to be an endless cycle, despite the ever-optimistic suggestion by Department of Energy that the IWTU will soon be treating the liquid radioactive waste.

Last December in IWTU permitting by the Idaho Department of Environmental Quality, I commented on the ramifications of the proposed changes to the IWTU suggested that certain aspects of the process gas filter (PGF) are likely to result in more frequent flowing of radioactively laden dry materials (that I call 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 appeared to be increased. And the storage of the flushed material will be allowed in a nearby tank and also, without adequate description, the flushed nitric acid and radioactive waste will be

allowed to be stored at the nearby NWCF, the facility repurposed from calcining. See early EDI comment submittals in November at the Environmental Defense Institute home page. [2] [3]

The Idaho Department of Environmental Quality, however, responded to comments [4] and automatically gave its approval of the revised IWTU design which accepted greater likelihood of what will be radioactive sticky sand flowing where it isn't wanted in the IWTU. The Idaho DEQ emphasized in its response that they do not regulate the radioactive portion of the liquid waste. The Idaho DEQ does not seem concerned about the ability to reduce and to monitor radionuclide emissions from the IWTU or indefensible estimates of radionuclide releases under the Federal law limiting radionuclide airborne emissions from Department of Energy facilities under NESHAPS.

The IWTU will be releasing radionuclides and volatile organic compounds out the stack at the Idaho National Laboratory's Idaho Nuclear Technology and Engineering Center (INTEC), in addition to emissions like a coal plant such as oxides of nitrogen (NO_x) and sulfur dioxide (SO_2) because it burns powdered coal to generate heat for the process. The most recent air permit for the IWTU is on the Idaho DEQ website. [5]

The Department of Energy is continuing to pay $6000 a day in fines for not meeting previously agreed to schedules to close the storage tanks by 2018 as agreed to under the schedule negotiated with the Idaho Department of Environmental Quality under the Hazardous Waste Management Act. The fines collected by 2018 were $3.6 million and have continued to pile up. The fines can be used to fund environmental projects in the state. [6] Remediation of Department of Energy radiological contamination, however, cannot be funded by the fines collected by the State of Idaho.

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[2] 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), November 11, 2021, by Tami Thatcher at http://www.environmental-defense-institute.org/publications/CommentIWTU2021.pdf

[3] 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), November 11, 2021, by Chuck Broscious, Environmental Defense Institute, at http://www.environmental-defense-institute.org/publications/EDIComIWTU2021.pdf

[4] Idaho Department of Environmental Quality letter to Tami Thatcher, Subject: Response to Comments and Final Decision for Class 3 Modification Request for the Hazardous Waste Partial Permit for the INTEC Liquid Waste Management System on the Idaho National Laboratory (INL) (EPA ID No. ID4890008952), February 14, 2022.

[5] 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.

[6] *Exchange Monitor*, "DNFSB Cites Concerns With IWTU Safety Basis," April 24, 2018. https://www.exchangemonitor.com/dnfsb-cites-concerns-iwtu-safety-basis/

The Idaho Environmental Coalition issued a press release about IWTU testing recommencing in February, yet when the testing was terminated early due to problems, information was withheld.

Are Department of Energy Citizens Advisory Board Meeting Presentations Designed to Gloss Over the Facts?

The Department of Energy held an Idaho Cleanup Project's Citizens Advisory Board meeting on April 26 at Fort Hall. [7] A highlight of the meeting was the presentation by the Shoshone-Bannock Tribes on Cultural repatriation of artifacts, "Repatriation: Return My History, Return My Ancestors." The Shoshone-Bannock Tribes' Cultural Resource/Heritage Tribal Office (HeTO) seeks the preservation, protection, and monitoring of the Shoshone and Bannock people's original ancestral territory and seeks to ensure that DOE is complying with all federal cultural resource laws and regulations, DOE Orders, DOE/INL Cultural Resource Management Plan and National Environmental Policy Act (NEPA) regulations.

The meeting included a status of the recent problems encountered during recent testing that had been intended to be confirmatory runs using non-radioactive simulant at the Integrated Waste Treatment Unit, discussed in the previous article.

The meeting also included a presentation on the Idaho Cleanup Project End State Contract with the new cleanup contractor Idaho Environmental Coalition (IEC), LLC. The contract type is of "Indefinite Delivery/Indefinite Quantity (IDIQ) End State. Does that sound comforting? The work to be done must be negotiated on the fly and awarded via a Task Order which is also covered under the master contract. The hope is that this approach will provide a "More realistic and reliable pricing when scope is real-time/requirements are known; Flexibility in the incentive structure with balanced risk/reward; and Goal to reduce the EM footprint and financial liabilities." Well, that is the hope of IEC and DOE's Environmental Management (EM) leaders.

However, for me a "low-light" of the meeting was the absence of discussion of recent cleanup project problems. The day before the meeting, I found that the cleanup project's Advanced Mixed Waste Treatment Project (AMWTP) had problems that led to a Stand Down in March. [8] There was no mention at the April 26 CAB meeting of the Stand Down at the Advanced Mixed Waste Treatment Project (AMWTP) which had stopped all waste handling and processing work so that operations management could review whether current procedures were adequate. Maintenance activities were also discontinued on March 7, 2022 due to misunderstandings of maintenance procedures among supervisory and craft personnel at AMWTP, according to the Defense Nuclear Facilities Safety Board memo.

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[7] Idaho Cleanup Project Citizens Advisory Board https://www.energy.gov/em/icpcab/idaho-cleanup-project-citizens-advisory-board-icp-cab 2022 meeting agenda and presentations.

[8] Defense Nuclear Facilities Safety Board memo from Erin A. McCullough to Christopher J. Roscetti, Subject: Idaho National Laboratory (INL) Report for March 2022, April 1, 2022. See dnfsb.org.

Also prior to the CAB meeting, I read that the Idaho Cleanup Project had sent waste to the Waste Isolation Pilot Plant (WIPP) in New Mexico that required an evacuation upon finding radioactive liquid in the bottom of a TRUPACT-II. [9] TRUPACT-II containers are used to ship contact-handled drums of transuranic waste to WIPP. The leaking drum caused the evacuation of the WIPP CH-Bay and activation of the emergency center at WIPP. The problem transuranic waste came from the Idaho National Laboratory and shipments from the INL were paused. In the past, CAB meetings have included the discussion of safety incidents at the Idaho Cleanup Project, even if not included on previously prepared slide presentations. With the prohibited liquid found April 9, there was plenty of time to prepare to discuss the event at the April 26 CAB meeting.

As of April 27, the Idaho Environmental Coalition had not issued any press releases about IWTU testing problems in February, the 'stand down' at AMWTP in March and April, or the shipment of prohibited liquid in at least one transuranic waste drum the WIPP. The old saying "no news is good news" does not apply here, as the IEC and the Department of Energy avoid discussing the problems occurring at the Idaho Cleanup Project.

At the April 26 CAB meeting, I provided public comment and I submitted the following questions:

Based on DNFSB communications, why wasn't the AMWTP sending prohibited liquid in waste to WIPP (April 7, 2022) discussed at the April 26 CAB meeting?

Regarding IWTU, in my comments to the Idaho Department of Environmental Quality on the permit for IWTU, I expressed concern about IWTU's design problems for sticky radioactive sand carryover. This problem is now worse and the problems show grossly inadequate design processes and the CAB is not adequately informed of why the design is so unworkable. Why have the number of canisters required increased so much? Running radioactive material and having frequent shutdowns will require extensive rinse outs. It is not clear that it can treat the rinse out waste and potentially new waste streams. This needs to be discussed to CAB. Why is so much 'newly generated waste' being added to IWTU waste to be treated? And what will DOE do with newly generated waste when IWTU is not available? Preparation of shipping the treated sodium-bearing waste out of Idaho for disposal is missing from the End State Contract. Is that because there is no disposal path for the waste and the hoped-for disposal at WIPP is problematic because WIPP is already over committed especially with DOE's surplus plutonium being slated for WIPP? DOE should keep CAB informed of lack of progress on finding a disposal facility.

Regarding IWTU, given the delays in treating the liquid sodium-bearing waste, at what point should new underground tanks be built? DOE should make a commitment to replace IWTU tanks in 2 years if the schedule keeps slipping.

[9] Maire O'Neill, *Los Alamos Reporter*, "Discovery of Radioactive Liquid in TRUPACT-II Container At WIPP Causes Evacuation of Contact-Handled Waste Bay," April 11, 2022. https://losalamosreporter.com/2022/04/11/discovery-of-radioactive-liquid-in-trupact-ii-container-at-wipp-causes-evacuation-of-contact-handling-bay/

Regarding the Radioactive Waste Management Complex, waste exhumation has ceased, leaving over 90 percent of the americium-241 remaining buried. About 100 percent of the rest of the waste is remaining buried. Why had DOE kept the studies of the remaining buried waste out of sight? Has DOE updated those studies? Also, the very thick soil cover planned for RWMC will cause heating up of the waste that may result in smoldering waste.

Regarding the Mackay dam, the 100-year-old Mackay dam design was changed during construction and never properly documented. The dam is poorly maintained. Communities have sought help obtaining funding for maintenance of the dam. Very importantly, a Mackay dam failure could cause flooding of spent nuclear fuel and soluble calcine stored and vulnerable at INL's INTEC. The CAB should be informed of the status of Mackay Dam problems and funding issues.

Department of Energy Celebrates Leaving Most of the Radioactive Waste at RWMC Buried

The buried waste exhumation of "targeted" waste at the Idaho National Laboratory's Radioactive Waste Management Complex (RWMC) has ceased. Celebrations were held and Governor Brad Little was quoted as saying "…we got it done." [10]

Governor Little should have been asking why most, nearly all, of the buried waste is remaining buried, as more radioactive waste continues to be buried at the INL.

Records of the buried waste are unreliable, but something like 10,300 cubic meters of targeted waste has been exhumed of the over 125,000 cubic meters of transuranic waste buried. [11] None of the non-transuranic waste was exhumed and as "targeted" waste was being exhumed, more radioactive waste was being buried. Targeted waste was limited to a portion of the waste in 5.69 acres of the 35 acres that waste was buried in the 97-acre RWMC disposal area.

Maybe Gov. Little just doesn't know that over 90 percent of the americium-241, the radionuclide deemed the highest risk to the aquifer will remain buried at RWMC. After all, the Department of Energy has kept very mum about the vast amounts of long-lived radionuclides that will remain buried at the RWMC over the Snake River Plain aquifer.

Since 1952, radioactive waste from INL operations and from around the country was shallowly buried over the Snake River Plain aquifer at the RWMC. Remaining buried over the aquifer are decades of cold war weapons waste, naval facilities waste and other radioactive waste.

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[10] Jakob Thorington, *The Idaho Falls Post Register*, "INL contractor celebrates completion of 16-year cleanup project," April 1, 2022.

[11] Raymond L. Murray, Understanding Radioactive Waste, Fourth Edition, Battelle Press,1994. Page 63. This table shows 64,800 cubic meters of (above ground) stored transuranic waste at the Idaho National Laboratory. This waste is also being shipped to the Waste Isolation Pilot Plant (WIPP) in New Mexico.

The State of Idaho Governor Cecil Andrus was told repeatedly by the Department of Energy that the Rocky Flats waste being buried there, was simply being "stored." It was only temporary.

By the early 1970s, the State of Idaho's concern over the aquifer led to the Department of Energy to dangerously stack barrels of radioactive waste above ground rather than bury them. Those above-ground barrels of radioactive waste posed many risks to Idaho. And the barrels of uranium and nitrate laden waste stacked above ground are simply staying put.

Chemicals from Rocky Flats waste were detected in the aquifer, above drinking water standards which made it an Environmental Protection Agency Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) problem, not just a 1995 Idaho Settlement Agreement issue. [12] [13] [14] [15] [16] Unfortunately, while Idaho won the "all means all" court case when DOE refused to exhume any waste, in 2008 Idaho shortsightedly signed on to allow DOE to remove only a fraction of the buried waste, only the "targeted" waste by exhumation at RWMC.

No matter the longevity of the radioactive waste, for a landfill such as the RWMC, the EPA limits its concern to 10,000 years. Modeling assumptions were chosen so that the leaching of radioactive waste into the aquifer was assumed to largely be delayed beyond 10,000 years. In CERCLA cleanup meetings, the public was not told of the increases of radionuclides in the aquifer from RWMC after 10,000 years for this toxic waste that spans millennia.

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[12] 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/

[13] 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. See https://www.inl.gov/about-inl/general-information/doe-public-reading-room/

[14] Idaho National Laboratory, "Explanation of Significant Differences Between Models Used to Assess Groundwater Impacts for the Disposal of Greater-Than-Class C Low-Level Radioactive Waste and Greater-Than-Class-C-Like Waste Environmental Impact Statement (DOE/EIS-0375D) and the Environmental Assessment for the INL Remote-Handled Low-Level Waste Disposal Project (INL/EXT-10-19168)," INL/EXT-11-23102, August 2011. http://www.inl.gov/technicalpublications/documents/5144355.pdf and a report prepared for the US Department of Energy, DOE Idaho Operations Office, "Preliminary Review of Models, Assumptions, and Key Data Used in Performance Assessments and Composite Analysis at the Idaho National Laboratory," INL/EXT-09-16417, July 2009. See p. 11, Tables 3 and 4 for sorption coefficients.

[15] See that the publicly available administrative record for RWMC cleanup does not contain the assessment of radionuclide migration and radioactive doses after 10,000 years. The pre-10,000-year contaminant migration is artificially suppressed for the first 10,000 years and then rapidly escalates and stays elevated for hundreds of thousands of years. See the Administrative Record at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documents for documents associated with this cleanup action, including "Record of Decision" documents and EPA mandated Five-year Reviews at http://ar.inel.gov or http://ar.icp.doe.gov

[16] Tami Thatcher, "Important Long-Lived Contaminants at INL's RWMC Not Remediated," at http://www.environmental-defense-institute.org/publications/RWMCunrem.pdf

Gov. Little should be asking why radioactive waste has continued to be shallowly buried over the aquifer at the INL. And he should be asking why airborne radioactive emissions have increased far above the levels of the 1990s.

Gov. Little also ought to be asking how spent nuclear fuel at INL will be road-ready to leave the state, in compliance with the Idaho Settlement Agreement, when there is no spent fuel repackaging facility. Gov. Little should be asking what will happen to the spent nuclear fuel at the INL when the Department of Energy does not even have a program for obtaining a disposal facility.

Instead, Gov. Little sees that cleanup of a tiny fraction of the buried waste along with the continued burial of long-lived radioactive waste over the aquifer at the INL [17] as reason to celebrate and to have "confidence in what takes place out here at the lab."

The Idaho Department of Environmental Quality, under Gov. Little's leadership, is actively ignoring increased radiological emissions from the INL. But Gov. Little isn't just working to allow unfettered expanding radiological contamination of southeast Idaho. He also supports virtually unmonitored and unregulated radioactive waste disposal at the US Ecology Idaho site, which is not a licensed radioactive waste facility, at Grand View in southwest Idaho. [18]

Targeted omissions are typical of the Department of Energy when it comes to discussing radioactive waste. The Governor of Idaho needs to do more than make Idaho a growing radioactive wasteland. Elevated rates of thyroid cancer incidence are common to every county surrounding the INL compared to the rest of the state and the country. [19] And it should come as no surprise that Idaho rates a grade "F" for tracking and prevention of birth defects because elevated rates of birth defects can be expected with increasing environmental radiological contamination. [20]

For other newsletter articles on INL's buried waste exhumation, see the Environmental Defense Institute newsletters from January and February 2022.

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[17] US Department of Energy, "Environmental Assessment for the Replacement Capability for Disposal of Remote-Handled Low-Level Radioactive Waste Generated at the Department of Energy's Idaho Site," Final, DOE/EA-1793, December 2011. http://energy.gov/sites/prod/files/EA-1793-FEA-2011.pdf

[18] See the February 2022 Environmental Defense Institute newsletter for more information about the US Ecology Idaho, Grand View disposal facility in southwest Idaho.

[19] See the July 2020 Environmental Defense Institute newsletter for more information about the elevated rates of thyroid cancer in the countries surrounding the Idaho National Laboratory. "Counties near the INL have double the thyroid cancer incidence while other counties in Idaho did not approach these high thyroid cancer incidence rates. The counties near the INL listed in the table [in the newsletter for 2017] are Butte, Bonneville, Madison, Jefferson, Bingham and Fremont counties, which ranged from 42.8 per 100,000 for Butte to 27.9 per 100,000 for Fremont. These cancer incidence rates are double, or more, the US and the Idaho state average for incidence of thyroid cancer which are 15.7 per 100,000 and 14.2 per 100,000." Bonneville country's thyroid cancer incidence rate in 2017 was 30.9 per 100,000.

[20] Trust for America's Health, *Birth Defects Tracking and Prevention; Too Many States Are Not Making the Grade*, 2002. https://collections.nlm.nih.gov/catalog/nlm:nlmuid-101143813-pdf

See the longevity of the radioactive waste remaining buried at the Radioactive Waste Management Complex in the figure below from the DOE's composite studies. [21]

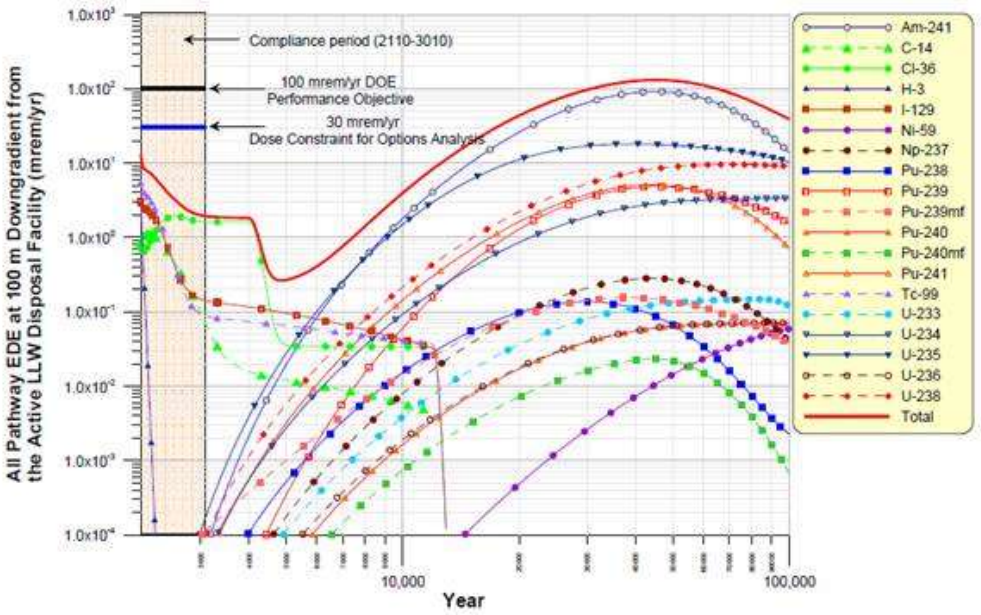

Figure 4-2. All-pathways effective dose equivalent 100 m downgradient from the Radioactive Waste Management Complex boundary from year 2110 to year 100,000 with cover infiltration rate equal to 1 cm/year.

Figure 1. Radionuclides leaching from RWMC for over 100,000 years as U.S. EPA focused on the first 1000 years.

[21] 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. See https://www.inl.gov/about-inl/general-information/doe-public-reading-room/

Independent Report finds NuScale Small Modular Reactors Too Expensive and Will Take Too Long to Deploy

An independent report by the Institute for Energy Economics and Financial Analysis carefully examined the claims made by NuScale on the small modular reactor's projected costs. [22] They examined other construction cost estimates for NuScale and the nuclear industry's construction costs in the U.S. and the world.

There will soon come the point when rate payers in UAMPS communities, including Idaho Falls, will face decades of high electricity costs from the con job NuScale accomplished with its optimistic claims.

Even without accounting for the cost of spent nuclear fuel storage and disposal, and without accounting for repair costs and without accounting for the increased financing costs for extending the time to construct the facility, the NuScale claims on reactor cost are unrealistically low and NuScale remains committed to a lack of transparency concerning how they arrive at their cost estimate.

The report found that the NuScale small modular reactor project is a first-of-a-kind, untested and unproven at commercial scale. NuScale had claimed it would keep construction costs low by fabricating the reactor modules at a single location. A similar claim by the Vogtle AP1000 (Westinghouse) reactors in Georgia was made, but cost and schedule overruns occurred there.

NuScale has abandoned the claim of having a single factory and the fabrication and construction process is not going to benefit from the previously claimed single NuScale factory. NuScale is claiming it will be able to construct the facility in 36 months, despite the rest of the nuclear industry not achieving construction completion in 100 months and still are not completed.

The NuScale facility was designed for twelve modules but now only six are slated to be built, yet many of the costs for construction are not reduced by the reduced number of reactor modules. NuScale claims it will achieve a higher operating capacity than the rest of the nuclear industry, yet this, as are many other claims by NuScale, is purely speculative.

NuScale is putting electricity rate payers on the hook for all of the cost overruns, as soon as the licensing is completed. Nothing about NuScale's contract with Utah Associated Municipal Power Systems (UAMPS) will protect UAMPS or its rate payers for the cost overruns far beyond NuScale's optimistic claims.

The only good news is that the rest of the world doesn't believe what the nuclear boosters have been claiming *which is that nuclear plants are required for base-load electricity*. We all

[22] David Schlissel and Dennis Wamsted, Institute for Energy Economics and Financial Analysis, *NuScale's Small Modular Reactor – Risks of Rising Costs, Likely Delays, and Increasing Competition Cast Doubt on Long-Running Development Effort*, February 2022. See BeyondNuclear.org at https://beyondnuclearinternational.org/2022/04/17/nuscale-not-new-not-needed/

know that the solar and wind are intermittent. But the technology for battery storage continues improving as is the ability to distribute power. While current lithium-ion batteries store power for 3 to 6 hours, new designs using iron and salt are providing 12 hours of storage and have a longer life before needing replacement. The IEEFA report expects that thousands of megawatts of new solar and wind, and battery storage are going to added within the next decade.

NuScale will cost too much and will follow the transformation of the Western Grid. The most optimistic schedule for NuScale would have it online by 2029 and realistically, it may take many years longer to come fully online and it will have cost far more than other alternatives.

NuScale will not be paying for the increased financing costs or the construction cost overruns. The excessive cost to people living in these small cities may be significant. Those people are going to wonder why the newspapers and their elected representatives did not inform citizens of the highly speculative and unexamined claims made by NuScale.

Can Ionizing Radiation cause Down Syndrome? The Answer is Yes.

Idaho Governor Brad Little signed the Down Syndrome Diagnosis Information Act into law on March 21. The law will require the state Department of Health and Welfare to develop an "up-to-date, evidence-based support sheet about Down syndrome that has been reviewed by medical experts and the Idaho Down Syndrome Council. [23]

This law is to help provide information about Down Syndrome, but apparently not potential causes of it and not the tracking of cases in Idaho.

In 2002, Idaho earned the grade of "F" on the tracking of birth defects and as far as I can tell, nothing has changed. Idaho has no program for tracking the increases in rates of birth defects. [24]

When state-wide rates in birth defects are averaged and averaged over several years, the ability to detect elevated rates in affected communities is lost. And I suspect this is no accident. Radiological polluters do not want the adverse effects of their pollution tracked.

Similarly, when elevated radiological releases occur from the Idaho National Laboratory, the Department of Energy works hard to avoid saying when the releases occurred. They prefer to simply state what the annual releases were, and to shut off radiation air monitors if the releases are rather high. I have noticed that extended outages of airborne radiation monitors in Idaho Falls tend to coincide with elevated airborne radiological releases from the INL.

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[23] John Miller, *The Idaho Falls Post Register*, "Blackfoot family celebrates signing of Down syndrome bill," March 29, 2022.

[24] Trust for America's Health, *Birth Defects Tracking and Prevention; Too Many States Are Not Making the Grade*, 2002. https://collections.nlm.nih.gov/catalog/nlm:nlmuid-101143813-pdf

It is well documented that congenital malformations increased after the 1986 Chernobyl reactor accident. [25] [26] [27] [28] [29] [30] Down Syndrome in a common congenital malformation and is a trisomy of the chromosome 21. It is one of the most common chromosome number anomalies. An increased number of cases of Down Syndrome was observed across Europe 9 months after Chernobyl far from the site of the disaster. [31] [32]

While elevated rates of birth defects have been observed to occur 8 to 9 months after the Chernobyl radiation plume passage occurred, closer to the site of the Chernobyl accident, significantly elevated rates of microcephaly, neural tube defects, and microphthalmia were observed in selected regions of Ukraine more than fourteen years after the Chernobyl accident. [33]

Even in areas of natural radiation from thorium, the rate of Down Syndrome has been found to be elevated. [34] [35] [36] But in the same manner that the correct findings of Dr. Alice Stewart in 1956 that found that small doses of medical routine diagnostic radiation delivered to a fetus in utero provoked a 50 percent increase in childhood cancer and leukemia, [37] in 1992 nuclear

[25] Tom Pacific, *The Medicine Correspondence Blog*, "Authors' reply: Letter to the Editor by Noboru Takamura et al.: Increases in perinatal mortality in prefectures contaminated by the Fukushima nuclear power plant accident," January 12, 2017. https://journals.lww.com/md-journal/Blog/MedicineCorrespondenceBlog/pages/post.aspx?PostID=49

[26] G. I. Lazjuk et al., Stem Cells, "Changes in registered congenital anomalies in the Republic of Belarus after the Chernobyl accident, 1997.

[27] V. Zieglowski et al., Mund Kiefer Gesichtschir, [Facial cleft birth rate in former East Germany before and after the reactor accident in Chernobyl], 1999.

[28] H. Scherb et al., *Environmental Science and Pollution Research*, Special Issue, "Congenital Malformation and Stillbirth in Germany and Europe Before and After the Chernobyl Nuclear Power Plant Accident," 2003.

[29] H. Scherb et al., *Mund Kiefer Gesichtschir*, [Cleft lip and cleft palate birth rate in Bavaria before and after the Chernobyl nuclear power plant accident], 2004.

[30] W. Wertelecki, Pediatrics, "Malformations in a Chornobyl-Impacted Region, 2010.

[31] K. Sperling et al., *Genetic Epidemiology*, "Evidence for an increase in trisomy 21 (Down syndrome) in Europe after the Chernobyl reactor accident, 2012. https://www.unboundmedicine.com/medline/citation/22162022/Evidence_for_an_increase_in_trisomy_21__Down_syndrome__in_Europe_after_the_Chernobyl_reactor_accident_

[32] I. Zatsepin et al., *Reproductive Toxicol.*, "Down syndrome time-clustering in January 1987 in Belarus: link with the Chernobyl accident?" 2007.

[33] W. Wertelecki et al., *European Journal of Medical Genetics*, "Chornobyl 30 Years Later: Radiation, Pregnancies, and Developmental Anomalies in Rivne, Ukraine," 2017. (See also https://ncjs.us/twin-impacts-of-the-chernobyl-disaster-birth-defects-and-mental-health/)

[34] N. Kochupillai et al., *Nature* **262,** 60–61, "Down's syndrome and related abnormalities in an area of high background radiation in coastal Kerala," 1976. https://doi.org/10.1038/262060a0 or https://www.nature.com/articles/262060a0#citeas

[35] G. Jaikrishan et al., *Journal of Community Genetics*, "Study of stillbirth and major congenital anomaly among newborns in the high-level natural radiation areas of Kerala, India," August 2012. https://link.springer.com/article/10.1007/s12687-012-0113-1

[36] T. S. Krishnan et al., *Economic & Political Weekly*, "Understanding the Debate – Impact of Natural Background Radiation on Health," September 12, 2020. https://www.epw.in/journal/2020/37/insight/impact-natural-background-radiation-health.html

[37] John W. Gofman, M.D., PhD., *Radiation and Human Health*, Sierra Club Books, ISBN 0-87 156-275-8, 1981.

boosters were still dismissing the findings and describing them as controversial, see the text book by H. Cember. [38]

No matter how compelling the evidence, nuclear boosters will manage to dismiss and deflect unwanted results of radiation harm, sometimes for decades beyond when the truth was presented. Their effort is made entirely on behalf of the nuclear industry, and their false arguments are unfortunately pretty effective. Radiation health harm, continues to be found to occur at very low radiation dose levels to the detriment of human health, especially the health of children, who cannot speak up for themselves.

The Problem of Highly Uncertain Radiation Doses from Plutonium and Other Actinides Has Not Been Solved

Despite decades of study and millions of dollars spent, the ability to assess actinide intakes remains wildly inaccurate. Actinides are radionuclides such as plutonium, americium, curium and other alpha emitters.

When radiation workers at Department of Energy facilities are told their radiation dose from the inhalation of plutonium, for example, the radiation dose is provided to them with an air of confidence despite the wildly high uncertainty in the actual dose.

The internal dosimetrists who work at Department of Energy facilities are employed by DOE contractors. And these DOE contractors put pressure on dosimetrists to achieve the lowest radiation dose estimate that the dosimetrist can come up with.

An actual case documented in 1992 for a plutonium-238 inhalation evaluated the urine bioassay from the worker. [39] The initial radiation dose for effective whole body was 1.5 rem, then 3.7 rem and then was revised again to 16 rem following 407 days of bioassay.

The worker had been chelated and modeling assumptions regarding the effect of the chelation evolved but there is no way of validating the modeling. The solubility and the particle size were unknown. For the final 16 rem committed dose over 50 years, the dose during the first year was estimated as 0.5 rem.

The activity in disintegrations per minute (dpm) of the urine excreted early on was exceedingly high, over 100 dpm. The activity (dpm) in urine remained above about 0.3 dpm per day after 500 days. The urine activity reflects the level in the blood. Very high levels of plutonium-238 in urine were detected in the first few hours or days and this was followed by lowered but sustained levels even after 500 days. This high dose initially followed by chronic dose is typical of plutonium and americium inhalations.

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[38] Herman Cember, *Introduction to Health Physics*, 2nd Ed., McGraw-Hill, Inc., 1992. ISBN 0-070105256-9

[39] La Bone et al., Westinghouse Savannah River Company, Evaluation of Savannah River Site Internal Dosimetry Registry Case 664(U), ESH-HPT-920178, 1992. See osti.gov 45323 for 1993 Radiation Protection Workshop Proceedings, Las Vegas, Nevada, April 13-15, CONF-9304128, 1993.

No blood test results were reported. The levels of radioactivity detected in the urine did not match what was expected by the modeling. Models were adjusted but the adjustments were speculative because the characteristics of the inhaled plutonium-238 were never determined. The particle size was unknown, the solubility, the fraction of material that was highly soluble and the fraction that was less soluble were unknown, as was the actual intake.

The conference article written about this plutonium-238 inhalation at the Department of Energy Savannah River Site expresses the concern about the problems associated with evaluating an intake of plutonium and the uncertain results. It also shows the mind set of dosimetrists to endeavor to keep the doses under DOE prescribed limits.

Many health implications are not addressed for workers who inhale actinides. The worker who inhaled the plutonium-238 in 1991 had initially very high urine excretion which indicate a high level in the blood as well as absorption to bone whenever levels in the blood are elevated. The radiation dose in rem does provide a tool for estimating cancer and leukemia risk, yet the effect on the blood and bone marrow as the subsequent effects on the immune system were and continue to be ignored.

A Department of Energy Standard [40] does provide some explanation of the variables that affect the dose from a plutonium (or other actinide) inhalation. To understand the inhalation dose, there are many variables that need to be known. These include

- the composition of radionuclides inhaled (or the isotopic composition)
- the decay or of the ingrowth of radionuclides since the material was processed
- the solubility of the material is needed as well as the fraction of material that is soluble and the fraction of material that is insoluble
- the particle size (or distribution of particle sizes) also affects the way the material behaves in the lungs and the way the material is distributed in the body
- the surface area of the material particles
- the chemical form of the material is also needed.
- materials long exposed to air may have oxidized, while those recently unpackaged may not have oxidized.

There are standard assumptions that are made and when working with a commonly monitored and encountered form of the material, many of these properties may be adequately known. But for materials less commonly encountered, many of these properties are not known. Not only that, it seems that the DOE contractors avoid determining any of these properties, especially if it is likely to increase the estimated radiation dose.

Documents that have been created for assessing the radiation dose in emergency situations often ignore the intake of actinides (plutonium, americium and other alpha emitters). One such

[40] Department of Energy, DOE Standard, Guide of Good Practices for Occupational Radiological Protection in Plutonium Facilities, DOE-STD-1128-2008, December 2008. (Not the latest version.)

document describes various emergency situations but leaves out an incident involving primarily actinides such as plutonium. This primer by Wolbarst provides a table of blood lymphocyte depletion kinetics but this is only for acute whole body external radiation. [41]

Although the Wolbarst article on nuclear accidents has excluded accidents involving primarily alpha emitters, the public is increasing at risk of such exposures. Accidents involving alpha emitters such as plutonium may occur at any of many DOE sites and blow in the wind to the offsite public. The transportation of plutonium-238, plutonium-239, americium-241, etc. also pose the risk of accidents involving the public. The absence of coverage of these types of events in articles like the one by Wolbarst does not mean that these severe actinide inhalation accidents cannot occur.

Another document for medical triage [42] includes consideration of acute bone marrow poisoning or hematopoietic syndrome for both external and internal radiation. But for actinides, the triage manual has provided clues but has not bounded the harm. It provides an americium-241 inhalation of 5 micrometer particle size and moderate solubility (Type M) [43] and the potential dose this might create in terms of the dose within 30 days of the intake. This, unfortunately does not bound dose, which may be far higher, because of the forms of plutonium material that might be inhaled. Neither has the damage to the immune system and the damage to an embryo or fetus been taken into account.

Promoters of nuclear reactors touting high burnup fuels rarely mention the higher plutonium and americium in their spent fuel which increases the severity of an accidental release. Nuclear reactor accidents, where monitoring is conducted, often focus on the more easily measured high gamma emitters such as cesium-137. The plutonium and americium-241 that are also present often simply are not measured and may not be mentioned.

When it comes to Inhaling Plutonium or Americium, Particle Size Matters

The typical assumption made by the Department of Energy in estimating the radiation dose from inhalation of plutonium or americium particles is that the particle size is 5 micrometers in diameter, activity median aerodynamic diameter (AMAD). At Department of Energy facilities, usually the particle size is not known. And the Department of Energy contractors are not interested in determining the particle size, or the distribution of the range of particle sizes, because smaller particle sizes will yield a higher estimated radiation dose.

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[41] Anthony B. Wolbarst, Ph.D. et al., *Radiologic*: Volume 254: Number 3, "Medical Response to a Major Radiologic Emergency: A Primer for Medical and Public Health Practitioners," March 2010.

[42] Carlos Rojas-Palma et al., *TMT Handbook – Triage, Monitoring and Treatment of people exposed to ionizing radiation following a malevolent act*, 2009. www.TMThandbook.org

[43] According to Department of Energy Standard DOE-STD-1128-2008, the biological transportability of material is now classified in terms of absorption types: F (fast), M (medium) and S (slow). Previously, these were classified in terms of material class: D (days), W (weeks) and Y (years).

For radionuclides of moderately soluble Type M material, the effective whole-body dose would be 4.4 times higher for 1 micrometer diameter particles than for 5 micrometer diameter particles, and the bone surface dose would be 2 times higher.

An Environmental Protection Agency document called the Federal Guidance Report No. 11 gives the effective whole-body dose, and the organ doses for 1 micrometer diameter particles. The Department of Energy prefers to select the 5-micrometer diameter rather than the 1 micrometer diameter particle size because the predicted doses are lower for the 5 micrometer AMAD particles.

Table 1 provides the dose conversion factors (at least those prior to 2019) for moderately soluble Type M and more insoluble Type S materials and for 1 micrometer and 5 micrometer diameter particles. The dose conversion factors for Type S material are 10 times higher for 1 micrometer (um) diameter particles than for 5 um particles, for whole body dose and for bone surface dose.

Table 1. Radiation dose conversion factors for effective whole-body and bone surface doses.

Particle Size and Solubility Type	**Effective Whole-Body Dose Conversion Factor**		**Equivalent Committed Bone Surface Dose Conversion Factor**	
1 um, Type M	***Am-241***	***Pu-239/240***	***Am-241***	***Pu-239/240***
Sv/Bq	1.20E-4	1.16E-4	2.17E-3	2.11E-3
Rem/Ci	4.44E8	4.29E8	80.3E8	78.07E8
5 um, Type M	***Am-241***	***Pu-239/240***	***Am-241***	***Pu-239/240***
Sv/Bq	2.7E-5	3.20E-5	1.10E-3	1.00E-3
Rem/Ci	1.0E8	1.2E8	40.7E8	37.0E8
1 um, Type S	***Am-241***	***Pu-239/240***	***Am-241***	***Pu-239/240***
Sv/Bq	No data	8.33E-5	No data	8.21E-4
Rem/Ci	No data	3.0E8	No data	9.08E-5
5 um, Type S	***Am-241***	***Pu-239/240***	***Am-241***	***Pu-239/240***
Sv/Bq	8.60E-6	8.37E-6	1.04E-4	9.08E-5
Rem/Ci	1.0E8	3.1E7	3.85E8	3.36E8

Table notes: Sievert/becquerel is Sv/Bq. 1 Sv equals 100 rem. 37E9 Bq equals 1.0E9 nanocuries. 1 nanocurie is 1.0E-9 curies. 1 micrometer diameter is denoted as 1 um. Type M material is moderately soluble and enters the blood stream faster while Type S material is considered more insoluble and is retained in the lungs undissolved for years.

The dose conversion factors for Type M material are higher than for Type S material. And no data has been provided for americium-241 for 1 um Type S material because the material has long been considered to behave as more like Type M material.

Nasal swabs may be taken following an inhalation of actinides. The counting of disintegrations per minute (dpm), however, may be designed to exclude the activity of uranium and thorium decay products and also leave out the americium. When the ingrowth of americium is small relative to the plutonium, this might be acceptable. However, when the ingrowth of americium is larger, the nasal swab results for only the plutonium-239 would understate the intake.

Alpha spectrometry to evaluate the radionuclides on the nasal swab may be conducted, but won't typically be available rapidly. Once the actinides are in the blood stream, they are absorbed into bone tissue within 2 hours. The rate at which inhaled materials enter the blood stream depends on the solubility, particle size and chemical form.

Monitoring information about the relative levels of uranium and thorium and their decay progeny don't seem to be provided in accident descriptions but changes in those radioactivity levels above normal levels could be useful despite being ignored currently in actinide inhalation events.

For the plutonium and americium inhalation event that occurred November 8, 2011 at the Idaho National Laboratory's Materials and Fuels Complex, many of the needed characteristics about the inhaled material were unknown. [44] The ingrowth of americium-241 was unknown and unusually high. The solubility, particle size and chemical form of the airborne material were also unknown.

When the activity of plutonium-239 on a nasal swab is initially measured, it may include both the plutonium-239 and the plutonium-240 because some monitoring methods do not distinguish between the two radionuclides. Initial measurements of nasal swabs may exclude the activity of the americium. The rough estimate of potential uptake may be made by summing the left and right nostril swabs and dividing by 0.05.

If each nasal swabs (left and right) was 4625 dpm, multipling by 2 for each nostril equals 9250 dpm for the Pu-239/240. Dividing by 0.05 yields an estimate of the intake as 185,000 dpm Pu-239/240 which is equal to 83.3 nCi Pu-239/240. The americium-241 intake must then be derived from isotopic plate composition or filter or analysis of swab composition. For a ratio of Pu-239/240 to Am-241 of 1.5, in this case the Am-241 intake would be 55.53 nCi.

The calculated plate isotopic composition at the November 8, 2011 accident at the Idaho National Laboratory based on previous assay and subsequent decay and ingrowth is the ratio of Pu-239/240 to Am-241 of 1.5. However, analysis of the nasal swabs for several workers

[44] U.S. Department of Energy Office of Health, Safety and Security Accident Investigation Report, *Plutonium Contamination in the Zero Power Physics Reactor Facility at the Idaho National Laboratory, November 8, 2011*, January 2012.

indicated a variety of ratio values of Pu-239/240 to Am-241 ranging from 0.3 to 1.96. The lower values would predict a higher Am-241 intake. No explanation was offered for the widely varying ratios.

The intake of each radionuclide is multiplied by the dose conversion factor to estimate the radiation dose. The typical assumption is to initially assume Type M material and 5 micrometer (um) diameter particle size. However, 1 um material would yield a higher dose estimate.

The dose from both the Pu-239/240 and the Am-241, for whole-body and bone surface dose are estimated here using the dose conversion factors for Type M, 1 um material for the Am-241 and Pu-239/240. The combined americium and plutonium doses yield an estimated 60 rem effective whole-body dose and 1096 rem bone surface dose, as shown in Table 2.

Table 2. Radiation dose conversion factors for effective whole-body and bone surface doses.

Particle Size and Solubility Type	**Effective Whole-Body Dose Conversion Factor**		**Equivalent Committed Bone Surface Dose Conversion Factor**	
1 um, Type M	***Am-241***	***Pu-239/240***	***Am-241***	***Pu-239/240***
DCF	4.44E8 rem/Ci	4.29E8 rem/Ci	80.3E8 rem/Ci	78.07E8 rem/Ci
Intake	55.53 nCi 123,333 dpm	83.3 nCi 185,000 dpm	55.53 nCi	83.3 nCi
Dose, rem	24.65 rem	35.73 rem	445.9 rem	650.3 rem
Total Dose, rem	**60.38 rem Whole-body**		**1096.2 rem Bone Surface**	

Table notes: 37E9 Bq equals 1.0E9 nanocuries. 1 nanocurie is 1.0E-9 curies. 1 micrometer diameter is denoted as 1 um. Type M material is moderately soluble and enters the blood stream faster while Type S material is considered more insoluble and is retained in the lungs undissolved for years.

The fraction of the dose received rapidly, within 4 hours of the intake, could easily have been significant. The actual dose received rapidly to the blood and active bone marrow is difficult to estimate with the current lack of information for actinide blood doses and the lack of validation for current models of red bone marrow dose. Battelle Energy Alliance discontinued blood monitoring after the accident while lacking information about the intake and failure to document and evaluate the sharp drop in blood lymphocytes (and monocytes) that occurred with 4 hours of the event.

The Department of Energy's Accident Investigation report found Battelle Energy Alliance had failed to prevent the accident that occurred on November 8, 2011 despite numerous written warnings of the risk to workers from using the fume hood to examine the mixed oxide fuel plates.

The Department of Energy's annual dose limits are 5 rem effective whole-body dose and 50 rem bone surface dose for plutonium-239 and americium-241.

The coverup of the actual extent of the harm from the November 8, 2011 accident began within hours of the accident. The coverup included fraudulent nasal swab data, manipulations to lung counting evaluations, destruction of logbooks, and discontinuing blood tests despite sharp drops in blood lymphocyte counts. Furthermore, any investigation of facts that would increase the estimated dose were avoided as steps, many of them unsupportable, were taken to creatively lower the estimated dose. In addition, elevated fecal bioassay results 224 days after the accident were ignored as a worker was returned to radiation work and not told of the still elevated detections.

For additional information on how Battelle Energy Alliance arrived at a radiation dose estimate for one worker at November 8, 2011 accident at the MFC ZPPR facility, see the updated slide presentations at the Environmental Defense Institute website. [45] [46]

Articles by Tami Thatcher for May 2022 and updated May 2 for minor editing corrections.

[45] Tami Thatcher, Slide Presentation for Environmental Defense Institute, "Review of Ralph Stanton's Radiation Dose from the 2011 Plutonium Inhalation Event at the Idaho National Laboratory – Part 2," April 2022 at http://www.environmental-defense-institute.org/publications/PowerptLowDose.pdf

[46] Tami Thatcher, Slide Presentation for Environmental Defense Institute, "Review of Ralph Stanton's Radiation Dose from the 2011 Plutonium Inhalation Event at the Idaho National Laboratory – Part 1, Lung Counting," April 2022 at http://www.environmental-defense-institute.org/publications/PowerptLungCount.pdf