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NuScale Small Modular Reactor (SMR) Funding Uncertain

The Idaho Falls Post Register reported in June that additional federal support for Small Modular Reactor (SMR) funding is uncertain. [1] Proposed budget cuts could cut funding support for licensing support for the NuScale's design. The first NuScale reactor is slated to be built at the Idaho National Laboratory and to begin operation by 2026.

The Department of Energy has given NuScale $217 million dollars and $160 has been spent. The Post Register reported that "More than $600 million has been spent designing the reactor, which may take another $400 million to deploy," according to NuScale Chief Commercial Officer Tom Mundy.

NuScale's plant design includes up to 12 modular reactors in a common pool. Each module provides roughly 50 megawatts. This allows modules to be added later, reducing upfront costs. And because nuclear plants tend to operate at a steady power rather than be load-following, having several lower power modules gives more flexibility.

NuScale has a partnership with Utah Associated Municipal Power. Former INL Director John Grossenbacher was quoted by the Post Register in saying that without additional federal support, the NuScale project will be difficult to complete. Grossenbacher also noted that the high temperature gas-cooled reactor project that INL promoted during his tenure at INL wasn't built because it didn't receive enough federal support and failed to find industry partners.

The US Nuclear Regulatory Commission is reviewing the NuScale design, but the public does not have access to safety study results of the review with respect to accident severity and likelihood.

Small Modular Reactors (SMRs) Seek to Shrink Emergency Planning Zones

The US Nuclear Regulatory Commission is reviewing emergency planning zones for Small Modular Reactors and other technologies such as non-light-water reactors and medical isotope production facilities. [2]

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[1] Kevin Trevellyan, reporter, *The Idaho Falls Post Register*, "SMR funding uncertain, Federal support could be vital," June 22, 2017. As corrected in online version.

[2] US Nuclear Regulatory Commission rulemaking, Emergency Preparedness Rulemaking with Regard to Small Modular Reactors and Other New Technologies (RIN: 3150-AJ68; NRC Docket ID: NRC-2015-0225) . See https://www.nrc.gov/reactors/new-reactors/regs-guides-comm/ep-smr-other.html or

The Small Modular Reactor industry has indicated that reduction of the emergency planning zones (EPZs) will be a key factor in the business case for SMR feasibility and development, according the NRC website. Apparently they want to build SMRs at closed fossil power stations in relatively populated areas and find the nuclear plant emergency planning to be problematic.

The current regulations for Emergency Planning Zones are based on studies performed decades ago for a large pressurized-water reactor or boiling-water reactor. NUREG-0396 recommends a 10-mile radius plume exposure pathway (16 kilometers) and a 50-mile radius ingestion exposure pathway (80 kilometers) to reduce radiation doses to nearby populations. Protective Action Guidelines are 1 to 5 rem (10 to 50 mSv) total effective dose equivalent under unfavorable atmospheric conditions. Preplanned protective actions are identified in the 10-mile and 50-mile EPZ areas.

The NRC website states that "Preapplication information and SMR design concepts provided by NuScale, mPower™, and Westinghouse indicate that these SMRs could have lower offsite dose consequences in the unlikely event of an accident, although this has not yet been verified."

The NRC staff's intent is to develop a technology-neutral, dose-based, consequence-oriented emergency preparedness framework for small modular reactor (SMR) sites that takes into account the various designs, modularity and collocation, as well as the size of the emergency planning zone (EPZ), with the expectation that an applicant will provide a well-justified technical basis for NRC's review and consideration.

The NRC typically dismisses spent fuel storage pool accident issues and excludes accidents caused by sabotage. Natural hazard phenomena that can pose severe accidents have often been downplayed by the NRC in order to delay or avoid needed upgrades to facilities. The NRC softens requirements if the industry finds meeting the requirements too expensive. The NRC has tended to dismiss the accidents involving spent nuclear fuel pools by arguing that the accident likelihood is low despite the vulnerability to sabotage. The NRC also continues to use radiation health models that underestimate the actual health harm to humans from radiation exposure. [3]

In my view, customizing emergency planning zones commensurate with actual hazards posed by the facility should not be only in the direction of EPZ reduction. The NRC must also act to increase EPZs when new information informs us that existing EPZs are too small. Traffic constraints or the presence of hospitals which cannot be evacuated quickly should also be taken into consideration.

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see the docket at Regulations.gov at https://www.regulations.gov/docket?D=NRC-2015-0225

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

Air-borne plume exposure is the only release type addressed by the current emergency planning, not groundwater contamination. Bas-mat melt through and contamination of groundwater was an afterthought in the evolution of NRC accident modeling. Bas-mat melt through is the melting of reactor fuel and the molten fuel leaving the normal core region of the reactor, actually escaping the reactor vessel and melting through the concrete containment below the vessel. Even if cooling water injection is sustained, radioactively contaminated water can enter groundwater below the damaged nuclear plant. The Department of Energy continues to ignore groundwater contamination resulting from accidents at its nuclear facilities. After all, why should the Department of Energy worry about accident releases that contaminate groundwater when for years the agency ignored deliberate contamination of groundwater from nuclear waste burial, disposal wells, percolation ponds, and leakage of piping and tanks containing radioactive materials.

While the NRC maintains that existing EPZs protect the public, in highly populated areas it is known that evacuations cannot take place quickly enough to protect people. And as with the 1979 Three-Mile-Island accident, the 1986 Chernobyl accident, and the 2011 Fukushima accident, the unpredictability of the radiological releases and weather patterns spreading the releases resulted in belated evacuations and movement of people into more highly contaminated areas. The NRC marches on as though existing emergency planning is adequate, despite evidence to the contrary. The truth about the lives shortened by the Three Mile Island Unit 2 accident matters. [4]

When emergency planning zones are relaxed and larger populations are near to SMRs, more people will be exposed to the routine air and groundwater emissions from these plants. The NRC cancelled the only adequately designed epidemiology study slated in the US claiming that the $8 million cost was too high. [5] But existing epidemiology from countries other than US already prove that it is not safe to live within a few miles of nuclear plants, despite the lack of understanding exactly which radionuclides are causing the increase in childhood cancers within 3 miles of the facilities. [6] [7]

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[4] Steve Wing, David Richardson, Donna Armstrong, and Douglas Crawford-Brown, A Reevaluation of Cancer Incidence Near the Three Mile Island Nuclear Plant: The Collision of Evidence and Assumptions, Volume 105, Number 1, January 1997, Environmental Health Perspective

[5] See cancer risk study at nap.edu. The framework for the study was reported in "Analysis of Cancer Risks in Populations Near Nuclear Facilities; Phase I (2012).

[6] See our October 2015 newsletter. Serious epidemiology studies have been conducted in Europe — not like the flawed 1990 study performed in the US that did not and could not possibly detect elevated cancer risk. Studies conducted in Europe have reported increased rates of childhood leukemia around nuclear facilities. In 1992, the German Childhood Cancer Registry found a statistically significant increased incidence rate for leukemias among children below five years of age within the 5-km-zone around nuclear sites. A second study was published in 1997, and again found increased childhood leukemias near nuclear plants.

The third study was initiated, funded and published by the Federal Office for Radiation Protection on behalf of the Federal Ministry for the Environment and conducted by the German Childhood Cancer Registry on childhood cancer near nuclear installations. The study is known by its German acronym KiKK (Kinderkrebs in der Umgebung von Kernkraftwerken). The KiKK study on Childhood Cancer in the Vicinity of Nuclear Power Plants, completed in 2007 is scientifically rigorous and statistically sound and its peer reviewed results show

Idaho National Laboratory's Spent Nuclear Fuel and High Level Waste Slated for a Defense Repository That Doesn't Exit

Even if the Yucca Mountain Spent Nuclear Fuel (SNF) repository development receives modest levels of funding, the high level waste in Idaho that includes Navy and other Department of Energy spent nuclear fuel along with calcine, the Department of Energy has said Yucca Mountain would only receive commercial nuclear SNF.

A defense-only repository has not been identified but DOE continues to extol the virtues of salt repositories. The DOE has conducted research on the storage of vitrified Hanford waste and on Navy spent nuclear fuel in salt medium. It doesn't seem to matter that the DOE promised the State of New Mexico that it would not dispose of High Level Waste or spent nuclear fuel at the Waste Isolation Pilot Plant (WIPP) in New Mexico that currently accepts transuranic defense waste from the DOE.

Spent nuclear fuel across the DOE Complex includes 2,130 metric tons heavy metal (MTHM) at Hanford from plutonium production and research; 30 MTHM at Savannah River Site, 15 MTHM at Fort St. Vrain; and over 300 MTHM at the Idaho National Laboratory with 265 MTHM at INTEC plus 28 MTHM belonging to the Navy. [8] Navy and foreign research reactor shipments continue to increase the SNF at the INL. The INL manages over 250 different types of non-Naval SNF. [9] The SNF at the INL is from reactors that operated on the site and SNF shipped to the INL from the navy, from DOE research reactors, from university test reactors and several commercial nuclear reactors including Peach Bottom (3 MTHM), Shippingport reactor (8.7 MTHM PWR and 39 MTHM U-233 with thorium in Zr cladding) and damaged fuel from the Three-Mile-Island Unit II accident (87.5 MTHM). The varieties of SNF span low, medium and high enrichment types and included "disrupted" fuels that have been damaged.

Typical commercial nuclear power plant SNF is less than 5 percent enriched. Navy and DOE research fuel can be over 93 percent enriched in Uranium-235 and thus may have higher burnup in a reactor and would thus contain higher amounts of fission products in the used fuel. For this reason, the usage of Metric Tons Heavy Metal that pertains to the initial fuel design may rather weakly correlate to the levels of fission products and long-term toxicity of the fuel. The fuel may

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significantly elevated cancer risk for children under five years of age living within 5 km of a nuclear power plant. The study looked at childhood leukemia and cancer near nuclear plants from 1980 to 2003.
The German Federal Office for Radiation Protection formally confirmed these findings, stating that 'in the vicinity of nuclear power plants, an increased risk of 60 per cent was observed for all types of childhood cancer, and for childhood leukaemia the risk doubled equaling a risk increase of approximately 100 per cent'.

[7] See Environmental Defense Institute's April 2009, May 2010, and January 2014 newsletters for more about the harm from the 1979 Three Mile Island Unit 2 accident at www.environmental-defense-institute.org

[8] US Nuclear Waste Technical Review Board, DOE-Managed Spent Nuclear Fuel, Table 1, Navy data as of 2013, online publication dated March 2016. www.nwtrb.gov/facts/DOE_SNF.pdf

[9] T.J. Hill, Idaho National Laboratory and D. L. Fillmore, Idaho Closure Project, *NATO Advanced Research Workshop, Safety-Related Issues of Spent Nuclear Fuel Storage*, "Managing Spent Nuclear Fuel at the Idaho National Laboratory," September 2005.

be fully spent such that it can no longer sustain a nuclear reaction as designed, or SNF owned by the DOE may be unused, partially spent, or severely damaged. [10] The cladding material, the enrichment level and the fuel burnup, as well as any damage to the fuel all affect the timing and amount of radionuclides that migrate from the repository into watersheds over thousands of years.

Beyond the SNF that the Idaho Settlement Agreement [11] requires be repackaged using a facility that has not been built in order to be shipped out of Idaho by 2035, the High Level Waste (HLW) at the INL includes the calcine and the remaining to be treated liquid sodium-bearing waste. Both the calcine and the SBW will require another expensive round of processing into canisters that can be shipped out of the state and meet disposal requirements for the yet-to-be-named defense repository. Liquid HLW at Hanford, (210,000 m^3) and at Savannah River Site (140,000 m^3) require vitrification before these can be disposed of. [12] The vitrification plant at Hanford is decades behind original schedules and billions over original cost estimates. [13]

Idaho National Laboratory Citizens Advisory Board Briefed on IWTU and Calcine Retrieval Status

The June 22 Idaho National Laboratory Citizens Advisory Board (or INL CAB) was briefed in the status of the Integrated Waste Treatment Unit. The IWTU missed the 2012 milestone for treating about 900,000 gallons of liquid radioactive waste stored in three tanks at INL's INTEC facility. The intent is to treat the liquid waste into a dry solid granular carbonate product. Progress has been made in reducing scale build up by about half of the prior runs using non-radioactive material called "simulant." A manway was cut into the vessel of the Denitration Mineralization Reformer (DMR) in order to replace the damaged ring header. Computer modeling is being used as well as bench-scale and pilot plant testing in Hazen, Colorado to understand why there are areas of insufficient fluidization in the DMR. Uneven temperatures — temperature excursions as well as lowered temperatures — within the fluidized bed in the DMR point to inadequate fluidization in the lower region of the DMR.

[10] MTHM: Metric Tons Heavy Metal prior to use in a reactor and not including metal endcaps or cladding. Note that 1000 kilograms is equivalent to 1 metric ton.

[11] See more about Idaho's Settlement Agreement at https://www.deq.idaho.gov/inl-oversight/oversight-agreements/1995-settlement-agreement.aspx Section D(1)(e) stipulates that naval fuel be among the early shipments to the first permanent repository or interim storage facility.

[12] US Nuclear Waste Technical Review Board, Spent Nuclear Fuel and High Level Waste in the United States, March 2016. http://www.nwtrb.gov/facts/Overview_SNF_HLW.pdf

[13] Annette Cary, Tri-City Herald, "Hanford vit plant cost estimate jumps $4.5 billion," December 16, 2016. http://www.tri-cityherald.com/news/local/hanford/article121354623.html The 2006 $12.6 billion estimate has jumped to $16.8 billion. A court-set deadline for operation is 2036.

Bottom line: Cleanup contractor Fluor is not giving any schedule for beginning to treat the radioactive liquid sodium bearing waste with the IWTU. Treatment of the waste appears to me to be years away and it is not clear that the IWTU will ever operate.

The High Level Waste Calcine retrieval project at the INL is a small step in the right direction. In order to ship the calcine out of state, it needs a repository to ship to. It needs to be packaged into canisters for shipping and disposal. But before that, methods need to be developed to retrieve the calcine from the various vintages of storage units called "bin sets." The current project is developing the ways to remove the dry powdery calcine from the oldest bin set. The calcine from bin set 1 will be moved to newest bin set 6. The estimated cost is $50 million and is expected to be completed in 2022. [14]

Calcine retrieval must be performed regardless of the choice of repository or choice of canister packaging method such as Hot Isostatic Press (HIP) (see our June 2017 newsletter). The Department of Energy had formally announced in 2009 the decision to use HIP as the method of repackaging the calcine for shipping and disposal. [15] The 2009 decision was actually amending previous decisions. Now it appears that the 2009 decision may be changed again because the Department of Energy recently issued a report by an independent review panel describing the possible treatment options for the calcine. [16]

The calcine retrieval requires careful engineering and the INL CAB and DOE-ID both agree that this project needs to continue uninterrupted. [17] Environmental Defense Institute has previously submitted comments to the Idaho Department of Environmental Quality about the calcine. [18] [19] More background on the calcine can be found in other reports listed here. [20]

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[14] Kevin Trevellyan, reporter, *The Idaho Falls Post Register*, "Calcine retrieval continues – Estimated $50M project expected to finish in 2022," June 27, 2017.

[15] Department of Energy Press Release, Amended Record of Decision: Idaho high-Level Waste Facilities Disposition Final Environmental Impact Statement REVISED BY STATE 12/21/09. http://www.id.doe.gov/NEWS/PressReleases/PR100104-HIP/Calcine%20ROD%20final_SIGNED_PDF.pdf In 2009 DOE had decided to select hot isostatic pressing (HIP) to treat the calcine.

[16] US DOE-EM, "Independent Analysis of Alternatives for Disposition of the Idaho Calcined High-Level Waste Inventory, Volume 1 – Summary Report," April 2016. https://energy.gov/sites/prod/files/2016/05/f31/Volume%201%20Calcine%20AoA%20Final%2004-19-16%20w_signatures.pdf

[17] See the Idaho National Laboratory Citizens Advisory Board meeting presentations for June 22, 2017, for the Idaho Cleanup Project at www.inlcab.energy.gov

[18] Chuck Broscious and David B. McCoy, "Preliminary Comments on Calcined Solids Storage Facility," Submitted to Idaho Department of Environmental Quality, May 9, 2017. http://www.environmental-defense-institute.org/publications/EDI-CSSF-Permit-S.pdf and pictures at http://www.environmental-defense-institute.org/publications/EDI-CSSF-Attach.pdf

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

[20] J. V. Crum and J. D. Vienna, Pacific Northwest National Laboratory and D. K. Peeler and I. A. Reamer, Savannah River Technology Center, for the US Department of Energy, "Formulation Effects for Direct Vitrification of INEEL Blend Calcine Waste Simulate: Fiscal year 2000. http://www.pnl.gov/main/publications/external/technical_reports/PNNL-13483.pdf

Over 900 TRU Waste Shipments Ready to Ship to WIPP But WIPP Only Accepting 61 Shipments Through January 2018

Idaho National Laboratory Citizens Advisory Board Chair Keith Branter provided a communication in June that is available on the INL CAB website. He states that transuranic waste shipments to the Waste Isolation Pilot Plant (WIPP) in New Mexico through January 2018 are expected to be 61 shipments from Idaho. The problem is that INL has over 900 TRU waste shipments ready to go the WIPP. At the current rate, it will take over 14 years to complete this milestone. This will result in missing two Idaho Settlement Agreement milestones, one for progress in shipping and one for completion of TRU waste shipping. [21] The Idaho Settlement Agreement milestone for completing TRU shipments is 2018.

"We need to be at about 25 shipments per week, not two," Jim Malmo, US Department of energy Idaho Assistant Manager said at the June INL Citizens Advisory Board meeting. Each 4-cubic-meter shipment includes 20 55-gallon drums. There are 234 shipments ready to leave Idaho. There are, in total, 1,000 shipments packed, but their status is uncertain pending new waste acceptance criteria being developed by WIPP officials because of the 2014 incidents. [22]

According to the Department of Energy, TRU waste emplacement rates and therefore shipping rates are expected to increase once the contaminated portions of the underground mine are full and the new uncontaminated Panel 8 is open in 2020 or later and a new permanent ventilation system is on-line (2021 or later). [23]

WIPP plans to accept 128 TRU waste shipments from the Idaho National Laboratory, Los Alamos, Oak Ridge, Savannah River and Waste Control Specialists between April 2017 and January 2018. [24] This means that the Idaho Settlement Agreement 2018 milestone will not be met.

[21] See the Idaho National Laboratory Citizens Advisory Board letter for June 2017, for the Idaho Cleanup Project at www.inlcab.energy.gov

[22] Kevin Trevellyan, reporter, *The Idaho Falls Post Register*, "WIPP continues to receive shipments – Settlement agreement's 2018 deadline looming," June 27, 2017.

[23] See the Idaho National Laboratory Citizens Advisory Board WIPP Update presentation from June 6, 2017 National Transportation Stakeholders Forum presentation which was also given at the June 22, 2017 INL CAB meeting. See www.inlcab.energy.gov

[24] See the Idaho National Laboratory Citizens Advisory Board June 2017 WIPP Update presentation www.inlcab.energy.gov

Idaho National Laboratory Cleanup Status as of June 2017

The cleanup work remaining at the Idaho National Laboratory includes the treatment of liquid sodium-bearing waste, the retrieval high level waste calcine and both the treated sodium-bearing waste and the calcine will require treatment and packaging into canisters for transportation and disposal in a geologic repository. Work continues to store spent nuclear fuel and to transfer spent nuclear fuel in pools to dry storage. A facility must be built to repackage the fuel for shipment out of the state. Both the spent nuclear fuel and the sodium-bearing waste and calcine are to be road ready to ship out of the state by December 31, 2035. [25]

The transuranic waste being shipped out of Idaho is from waste stored above ground at the Transuranic Storage Area and the ground in canisters at the Radioactive Scrap and Waste Facility at the Materials and Fuels Complex, as well as the limited amounts of transuranic waste being exhumed from the Radioactive Waste Management Complex burial ground in "targeted" chemically-laden waste. The exhumations are conducted in temporary structures called Accelerated Retrieval Projects I through IX.

In addition, the EPA and the State of Idaho are overseeing the Department of Energy CERCLA [26] cleanup of contaminated sites at the Idaho National Laboratory. The investigations of contamination at the INL began in 1989 and there are ten waste area groups (WAGs). There are records of decision for the remediation in these WAGs. The contamination that is not safe for unrestricted use is put under institutional controls. In some cases, due to the radioactive decay of the contamination, for example, the institutional controls may be lifted in 100 or 500 years. But in dozens of areas, the radioactive decay will not render the area safe after more than hundreds of thousands of years. In these cases, the institutional controls are said to continue "indefinitely." I call these sites forever contamination sites. [27]

Table 1 below shows the major cleanup work in progress and yet to be completed.

[25] See the Idaho National Laboratory Citizens Advisory meeting presentations from the June 22, 2017 at www.inlcab.energy.gov And see the Idaho Department of Environmental Quality INL Settlement Agreement Oversight summary at http://www.deq.idaho.gov/inl-oversight/oversight-agreements/cleanup-progress-at-inl/

[26] Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986.

[27] See the list of "forever contamination" sites at INL Waste Area Group Institutional Controls Report. Dated February 16, 2016: https://cleanup.icp.doe.gov/ics/ic_report.pdf and from the EPA page: https://cleanup.icp.doe.gov/ics/

Table 1. June 2017 INL cleanup status.

DOE's To Do List	Milestone Date	Status	Comments
High Level Waste			
Treat liquid sodium bearing waste, 900,000 gallons of waste in underground tanks. Then treat and package for transportation and disposal.	Treat by 12/31/12 (missed)	In 2017, the 2015 status is roughly the same: Re-design and testing of IWTU ongoing and remains at high risk of failure	Tank liquid would not be remediable if the tanks leak. As of June 2017, new cleanup contractor Fluor has offered no schedule for beginning to treat the radioactive sodium-bearing liquid waste. State waste management under state Resource Recovery and Conservation Act (RCRA) enforcement also applies and fines are being levied by the state to DOE for failure to empty the sodium-bearing tanks.
Retrieve and package high level waste calcine for transportation and disposal	Ready to ship by12/31/2035	In 2015, it appeared that DOE was pushing to delay calcine waste treatment. In 2017, DOE is proceeding with calcine retrieval research and plans to move calcine from bin set 1 to bin set 7.	Calcine treatment is held up by the tardy IWTU because it will use the same building. Calcine bin sets are vulnerable to flooding and seismic hazards and pose a huge radiological hazard in the event of an accident. The decision to use Hot Isostatic Press (HIP) is being revisited. In 2016, DOE's hopes to dispose of calcine in deep bore holes in North or South Dakota are dashed by refusal of these states to allow research. There is no named defense repository for the calcine high level waste.
Transuranic Waste			
Complete removal of targeted buried waste, exhuming portions of 5.69 acres of the 97 acre burial ground	TRU waste to be removed from the state by 2018 2017 buried waste exhumation 2017 budget is $ 21.6 million.	Continuing but must be stored above ground at INL, at greater release risk, because shipments to WIPP are backlogged. The Accelerated Retrieval Projects (ARPs) I through VII are completed.	The amount of buried radioactive waste that will leach into the aquifer will be 100 mrem/yr for millennia (or 30 mrem/yr if the soil cap works perfectly for millennia). The "targeted waste" will remove less than 10 percent of the buried TRU waste and none of the other long-lived and mobile contaminants poised to pollute the aquifer. The soil cap installation isn't due until 9/30/2027 to meet the Federal Facility Agreement and Compliance Order

DOE's To Do List	Milestone Date	Status	Comments
		ARP VIII: 1.33 acres out of 1.72 acres exhumed as of 6/1/2017. ARP IX: construction of enclosure in progress.	
Continue Shipping TRU waste to WIPP and status of above-ground stored waste from Rocky Flats	Ship at least 2000 cubic meters/yr through 2018.	Shipments stopped in 2014 because of WIPP accidents. Shipments resumed in April 2017 but only a limited rate of shipments is allowed.	WIPP resumed accepting shipments in April 2017 but at a limited rate due to the contaminated underground mine and limited ventilation system. Remote-handled TRU waste shipments remain on hold until WIPP accepts them.
Spent Nuclear Fuel			
Spent Nuclear Fuel transfer from wet to dry storage Total Navy and DOE fuel limit of 55 metric tons heavy metal (MTHM)	Move spent nuclear fuel from pools to dry storage by 12/31/2023. Remove spent nuclear fuel 1/1/2035	The 1995 Idaho Settlement Agreement stops shipments (except from the Navy) when milestones are not met. Continue EBR-II and ATR SNF out of wet storage.	No one is discussing when the facility for dry storage handling (also called a transshipment facility) will be built at INL.[28] If there is no repository, spent nuclear fuel will require re-packaging until a repository is available. According to IDEQ website, 21.52 MTHM Navy and 27.73 MTHM DOE SNF (totaling 49.25 MTHM) have been received of the total allowed 55 MTHM. Fuel received from Oak Ridge must balance aluminum clad (ATR) fuel shipped to Oak Ridge.
CERCLA Cleanup			
Idaho CERCLA Disposal Facility		Continues as needed.	The ICDF burial facility at INL continues to bury waste and expansion is expected.
INL Decontamination and Decommissioning			Decreased funding of D&D has slowed the filling of the Idaho CERCLA Disposal Facility. Resumed D&D will require expansion of the ICDF burial ground at INL.
INTEC Liquid	WAG 3 Record		Tank farm closure delayed because of

[28] This September 2004 Idaho Department of Environmental Quality newsletter discusses a transshipment facility design that is expected to take two years to construct and three years to operate to transfer remaining INL spent nuclear fuel from wet to dry storage. http://deq.idaho.gov/media/552776-newsletter_0904.pdf

DOE's To Do List	Milestone Date	Status	Comments
Waste Treatment Facility (Tank Farm Closure)	of Decision		failure to treat liquid sodium-bearing waste. A low-permeability pavement cover to prevent water infiltration into the soils driving contaminants into the aquifer is planned, but is a temporary measure.
Subsurface vapor extraction under CERCLA	At RWMC and at Test Area North, vapor extraction continues		The subsurface vapor extraction has removed volatile organic compounds but extraction becomes less effective as the concentrations decrease. The levels of aquifer contamination remain elevated.
CERCLA WAG 10 and WAG 1 TAN Groundwater		New waste sites continue to be found. In situ Bioremediation injections are continuing.	Aquifer remediation at TAN is not progressing well and the contaminant plume continues to spread.
Advanced Mixed Waste Treatment Project (AMWTP)	INL CAB has voiced the desire for DOE to find new missions for the AMWTP	Above-ground stored TRU waste and exhumed targeted waste continues to be treated at AMWTP.	Despite the argument that worker radiation doses risk versus benefit were the reason to limit RWMC buried waste exhumation, new missions are being sought to the Advanced Mixed Waste Treatment Project.
In situ grouting at RWMC under CERCLA	CERCLA record of decision	In situ grouting has been completed.	In the Record of Decision (DOE/ID-11359) it was considered prudent to perform in situ grouting because of the long wait before the soil cap would be installed. There was no assurance of effectiveness of the grouting. It was described as reducing mobility of contaminants in the short term. There was no estimate of how much it would reduce the mobility. Despite this, presenters often incorrectly describe the grouting as a fully effective prevention of mobile radionuclide migration from the buried waste.
Install CERCLA Soil Cap on RWMC	WAG 7 Record of Decision	Contractor selected for designing soil cap in 2017. Questions as to how	The soil cap is being acknowledged by the DOE as requiring inspection and maintenance forever.

DOE's To Do List	Milestone Date	Status	Comments
		to address the 20 ft high stack of buried above ground waste at Pad A continue.	
CERCLA Institutional Controls	Inspect and monitor into perpetuity	Dozens of "forever contamination" sites officially termed unfit for unrestricted access for an "indefinite" period at the INL when CERCLA remediation is complete.	See the list of "forever contamination" sites at INL Waste Area Group Institutional Controls Report.

A Timeline for the Burial Ground for the Radioactive Waste Management Complex

Idaho National Laboratory Citizens Advisory Board Chair Keith Branter provided a communication in June that is available on the INL CAB website that included a timeline of events at the Idaho lab's burial ground, the Radioactive Waste Management Complex (RWMC).

Highlights of the timeline are given here, with additions of events not included in the INL CAB communication.

RWMC Timeline Highlights:

1952 - Thirteen acres at RWMC were established for shallow burial of site-generated radioactive wastes.

1954 - Waste is being buried from Rocky Flats weapons plant and other off-site generators. Waste is buried in shallow pits, trenches and soil vaults.

1957 - Burial ground is expanded to about 87 acres.

1962 – Dikes and ditches constructed around the burial ground and a diversion dike for the Big Lost River to the spreading area following flooding of the SDA.

1965 – Big Lost River flooding

1969 – Constructed extensive dike system to protect burial ground from runoff, again, following flooding at the SDA. The flooding events in 1962 and 1969 remobilized shallowly buried transuranic waste allowing it to blow in the wind but this is not recognized until 1998.

1970 - Burial ground is expanded to 97 acres and added above-ground Transuranic Storage Area

1972 – 1978 - Despite ban on burial of Rocky Flats transuranic waste at the burial ground, on a 2.3 acre asphalt pad called Pad A Rocky Flats uranium-ladden waste in barrels is stacked 19.7 ft for barrels stacked 11 high on their side and 20.7 ft for 4 x 4 x 7 ft wooden boxes. Later Pad A would be covered with about 4 feet of soil. Pad A contains about 18,000 barrels and about 2000 large wooden boxes containing uranium, nitrates and beryllium. (See DOE/ID-11541 report cited below.)

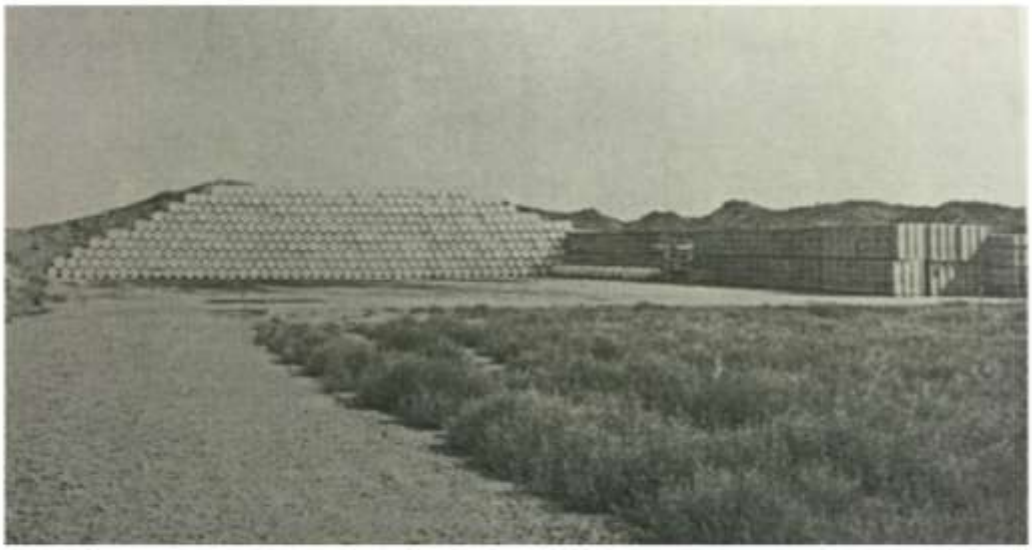


Figure 1-10. Pad A in 1973 showing stacked white 55-gal drums to the north (left) and stacked plywood boxes to the east (right) (Hiaring, Horton, and Schlafman 1992).

1974-78 – Began Initial Transuranic Drum Retrieval (IDR) program removing 20,262 drums of waste from pits 11 and 12.

1979 – Initiated removal of basalt in subsurface disposal area (SDA) pits to increase disposal space.

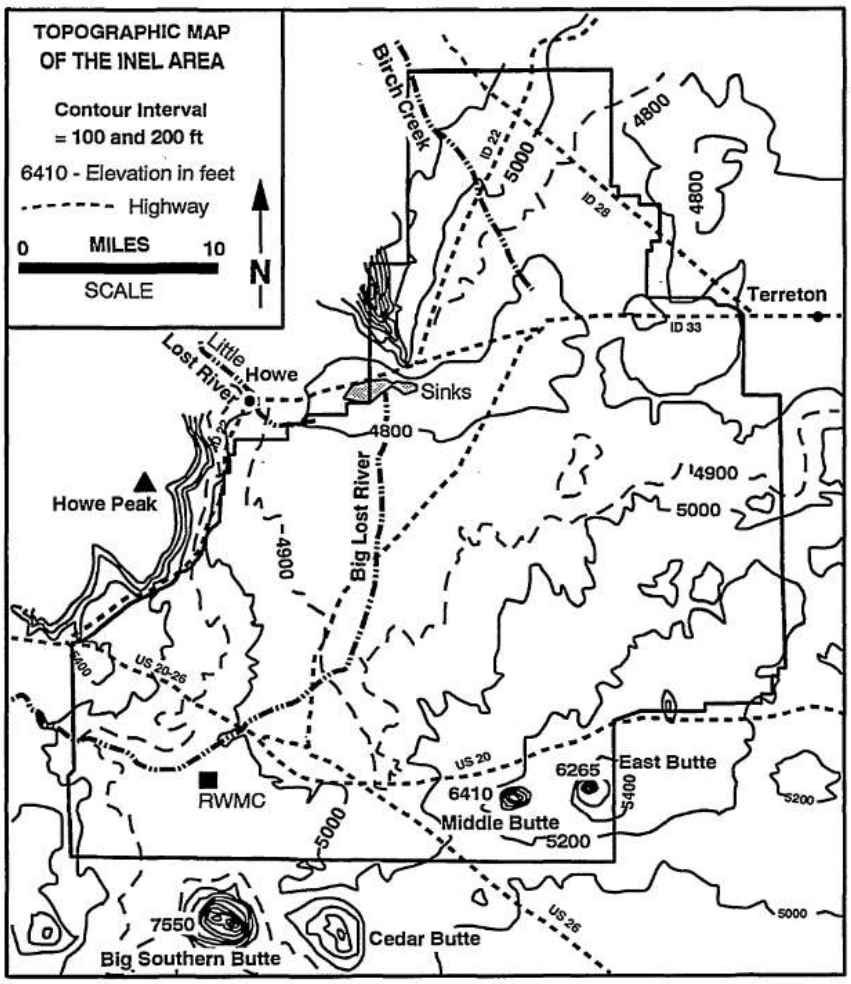
1982 – Upgraded flood controls after RWMC flooded by rapid snowmelt.

1988 – Postponed the opening of WIPP in New Mexico; as a result Idaho Governor Cecil Andrus ordered Idaho State police to stop any railcars bringing nuclear waste to the Idaho site.

1989 – EPA CERCLA comes to the Department of Energy Idaho National Engineering Laboratory site and investigations commence.

1994 - EPA CERCLA Record of Decision at the RWMC. [29]

1995 – Signed the Idaho Settlement Agreement which stated that all transuranic waste would be shipped out of Idaho; CERCLA remedial investigation and feasibility study for the SDA at RWMC commences. An INEL study focuses on 10,000 years of geologic stability in the absence of information that the migration of long-lived radionuclides will continue for millennia. [30]



1995 – Soil covering of Pad A reported to have caused a dump truck and a grader to sink to the axles (see page 1-16 of DOE/ID-11541 report cited below).

[29] EPA/ROD/R10-94/073 "EPA Superfund Record of Decision: Radioactive Waste Management Complex, Idaho Falls, ID 1/27/1994" January 1994.

[30] W. R. Hackett, et.. al, Lockheed Martin Idaho Technology and University of Idaho, Soil Science Division for the US Department of Energy-EM, "Geological Processes in the RWMC Area, INEL; Implications for Long Term Stability and Soil Erosion at the Radioactive Waste Management Complex," INEL-95-0519, September 1995. http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/27/032/27032374.pdf This report acknowledges that beyond 10,000 years, the prediction of geologic stability is very uncertain.

1998 – EML-599 study finds that transuranic waste from RWMC has blown miles from RWMC. [31] [32]

1999 – First truckload of transuranic waste sent to WIPP.

2000 – The Energy Employee Occupational Illness Compensation Program Act (EEOICPA) is passed. [33] The National Institute of Occupational Safety and Health (NIOSH) performs dose reconstruction to determine eligibility for compensation and roughly two-thirds of the INL worker illness compensation claims have been denied. [34]

2004 – US Court of Appeals rules [35] that the 10,000 year cutoff date for estimating consequences of waste migration from Yucca Mountain licensing is not consistent with recommendations of the National Academy of Sciences. The court noted that at massive levels, radiation exposure can cause sudden death. At lower doses, radiation can have devastating health effects, including increased cancer risks and serious birth defects such as mental retardation, eye malformation, and small brain or head size. Radioactive waste and its harmful consequences persist for times spans seemingly beyond human comprehension. The half life of iodine-129 is 17 million years, and of neptunium-237 is 2 million years.

Despite this 2004 ruling, the EPA, the State of Idaho and the Department of Energy continue to use 10,000 years as the time after which, they could disregard what happens to future earth inhabitants. The public was not told of the radiation doses from RWMC waste migration after 10,000 years, the time when the radiation ingestion doses start to ramp up and stay elevated for millennia, and that is with perfect soil cap performance.

2008 – Idaho wins the court battle of the question of whether "all means all" because the Department of Energy maintained that they never intended to exhume any of the buried transuranic waste; Then Idaho capitulates agreeing that only "targeted" chemically laden transuranic waste will be exhumed, roughly 6 of the 97 acres, and probably less than 10 percent of the buried transuranic waste. Uncertainty concerning how much was buried and inability to

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

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

[33] 42 USC 7384, The Act--Energy Employees Occupational Illness Compensation Program Act of 2000 (EEOICPA), as Amended and see the website for the Center for Disease Control, National Institute of Occupational Safety and Health, Division of Compensation Analysis and Support at http://www.cdc.gov/niosh/ocas/ and U.S. Department of Labor, Office of Workers' Compensation Programs, EEIOCPA Program Statistics, http://www.dol.gov/owcp/energy/regs/compliance/weeklystats.htm

[34] See the NIOSH Radiation Dose Reconstruction Program at http://www.cdc.gov/niosh/ocas. See the Idaho National Laboratory status at http://www.cdc.gov/niosh/ocas/ineel.html and see the portion of INL formerly ANL-W at http://www.cdc.gov/niosh/ocas/anlw.html

[35] US Court of Appeals July 9, 2004 court opinion at http://www.yuccamountain.org/pdf/opinion04.pdf

estimate how much is being exhumed mean we can't know for certain how much TRU waste has been exhumed.

2008 – The Record of Decision for RWMC (WAG 7) is signed. [36]

2008 – State, EPA and DOE give the public information about remediation of the RWMC in terms of 100, 1000 and 10,000 year time periods. At no time is the public informed that the modeling coefficients have delayed the estimated migration of the radioactive waste to the aquifer beyond 10,000 years. And that the migration of these wastes will continue essentially forever, beyond hundreds of thousands of years. The ingestion doses will exceed 100 milli-rem per year without a soil cap, or will exceed 30 mrem/yr with perfect soil cap performance, forever. The studies assume steady infiltration of water and assume geologic stability forever.

2008 – Construction of Accelerated Retrieval Project (ARP) commences. The ARPs involve separate enclosures over the SDA for exhumation work of "targeted" chemically laden transuranic waste.

2012 – Agencies agree that Pad A needs additional study to lower its profile if feasible and to address subsidence. (See the March 2017 DOE/ID-11541 report cited below.)

2015 – Environmental Defense Institute obtains by Freedom of Information Act the RWMC burial ground with remediation radiological ingestion doses. [37] [38]

In the short term, less than 1000 years, the ingestion dose from drinking water near RWMC due to migration of radionuclides buried at RWMC to the aquifer is primary due to carbon-14, chlorine-36, iodine-129, and technetium-99. In the longer term, americium-241 is the predominant contributor to dose as well as various uranium and plutonium isotopes. The figure does not show the chemical contamination at RWMC which already exceeds federal MCL

[36] Idaho Cleanup Project, Idaho National Laboratory, " Record of Decision – Radioactive Waste Management Complex Operable Unit 7-12/14, DOE/ID-11359, September 2008. https://ar.icp.doe.gov/images/pdf/200810/2008100100495TUA.pdf

[37] U.S. Department of Energy, 2008. Composite Analysis for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site. DOE/NE-ID-11244. Idaho National Laboratory, Idaho Falls, ID and U.S. Department of Energy, 2007. Performance Assessment for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site. DOE/NE-ID-11243. Idaho National Laboratory, Idaho Falls, ID. Available at INL's DOE-ID Public Reading room electronic collection. (Newly released because of Environmental Defense Institute's Freedom of Information Act request.) See https://www.inl.gov/about-inl/general-information/doe-public-reading-room/

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

drinking water standards.

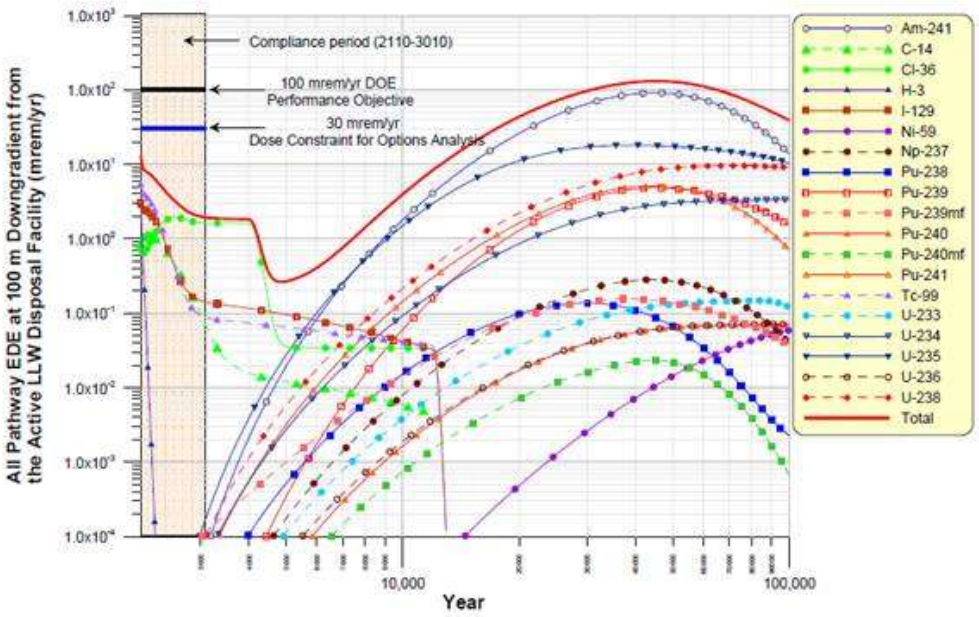

Figure 4-2. All-pathways effective dose equivalent 100 m downgradient from the Radioactive Waste Management Complex boundary from year 2110 to year 100,000 with cover infiltration rate equal to 1 cm/year.

2015 – NIOSH informally admits that Energy Employee radiation illness claims are being received by RWMC workers, including workers from recent decades since the 1990s.

2017 – The Energy Employee compensation program investigations have collected data and interviews concerning the burial ground at RWMC and finds that worker radiological protection programs were weak. If radiation exposures cannot adequately be estimated, a formal special exposure cohort for RWMC workers may need to be designated. Details regarding the May 1, 2017 SC&A contractor review of the INL's burial ground can be found on the NIOSH website. [39]

2017 – In March, a study of Pad A at RWMC documents the recognition that lowering the profile of Pad A would simplify soil cap construction and reduce construction costs. The study punts by saying the final decision will depend on the analysis of the soil cap. [40]

2017 – A contractor is selected to design the soil cap for the SDA at RWMC, Daniel B. Stephens and Associates, and it will be a two year effort that began in February. At the June INL CAB meeting, DOE acknowledges that the soil cap design must last into perpetuity and will

[39] See 2017 SC&A burial ground review at https://www.cdc.gov/niosh/ocas/pdfs/abrwh/scarpts/inlburgnd-r0.pdf
[40] DOE-ID, "Operable Unit 7-13/14 Phase 3 Pad A Focused Feasibility Study," DOE/ID-11541, March 2017. See https://ar.icp.doe.gov

require ongoing inspection and maintenance, forever. The presentation to the INL CAB avoids discussing design and construction costs, soil cap height, soil volume or the fact that decisions about what to do with Pad A have not been made. No time is allowed at the meeting for questions to the presenters. There is no discussion of the study of Pad A issued in March or the associated costs of the Pad A.

2017 – About 4.47 acres of "targeted" waste of the designated 5.69 acres of the 97-acre burial ground have been exhumed.

2017 – Vacuum vapor extraction has removed 246,000 pounds of solvent vapors from beneath the SDA, releasing the solvent to the atmosphere. Aquifer levels of chemical contamination may have peaked, but continue to exceed drinking water standards.

2017 - Burial of long-lived radioactive wastes has not ceased since 1952 and continues today in 2017. A replacement for the RWMC is being constructed at the ATR Complex so that long-lived radioactive wastes will continue to be buried about the Snake River Plain aquifer for years to come.

Future – By 2028, a soil cap requiring inspection and maintenance forever will be required to be installed over the SDA.

In summary, at INL's RWMC, of the 97 acres of subsurface disposal area that began accepting waste in 1952 and continues to accept waste, only about 6 acres of "targeted waste" will be retrieved. The most mobile contaminants, such as technetium-99, iodine-129, and chlorine-36 are from INL wastes and remain poised to contaminate the aquifer — despite grouting — because "targeted waste" includes only a portion of Rocky Flats waste and not INL wastes. These contaminants will exceed federal drinking water standards even though their curie inventory seems small. Other rather low curie amounts of radionuclides like uranium, plutonium and americium will cause seriously unhealthy drinking water for hundreds of thousands of years.

Downgradient of INL, the migrating buried waste will reach 100 mrem/yr unless the soil cap performance is perfect for millennia. But that is based on contrived modeling of soil "sorbing" factors that slow the migration of the waste into the aquifer and contrived mixing that maximizes dilution. [41] [42]

[41] 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.

[42] See that the publically 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,

Investigation of Aquifer Detections of PCE in Multilevel Wells Continue, No New Data Until Fall

The status of the investigation into mysterious detection of high levels of PCE in deep multilevel wells north of RWMC was provided at the June Idaho National Laboratory Citizens Advisory Board Meeting. Detections of PCE was found in deep well levels as high as 829 micrograms/liter in September of 2016. The federal drinking water limit is 5 micrograms/liter.

Additional well samples have been collected and sent for analysis but the results are not expected before fall.

The unique design of the Westbay wells installed 10 years ago appears to plan a prominent role. The PCE detections are suspected of being from the chemical being used in construction of the well. [43]

The wells allow sampling a various depths in the aquifer. However, it turns out that water from another INL well referred to as the "fire station well" was used to fill up a portion of the well internals. Additional samples have also been collected from the fire station well. Instead of monitoring the aquifer, the wells may have been monitoring the internal tubing portions of the well instead of groundwater in the aquifer.

NIOSH Continues to Study Expanding INL/ANL-W Special Exposure Cohorts

In the May 16, 2017 Advisory Board meeting transcripts for the National Institute of Occupational Safety and Health for the Energy Employee Occupational Illness Compensation Program, [44] it looks like special exposure cohort classes will expand at the Idaho National Laboratory and ANL-W.

The chemical processing plant (CPP) now called INTEC special exposure cohort seems likely to expand and an SEC for the burial ground seems likely. Burial grounds internal monitoring problems found to have persisted years after problems first identified.

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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

[43] See the Idaho National Laboratory Citizens Advisory Board meeting presentations for June 22, 2017, for the Idaho Cleanup Project at www.inlcab.energy.gov The presentation is titled "Well MIDDLE-2051 Update" and the title of the session in the agenda was called new site information.

[44] See May 16, 2017 Advisory Board meeting transcripts at https://www.cdc.gov/niosh/ocas/pdfs/abrwh/2017/wgtr051617.pdf.

There were many different types of nuclear reactors operated and various experiments and processes conducted. The monitoring of the radionuclides released was generally limited to characterizations that do not completely describe the radionuclides present. But in order to estimate the radiation exposures, particularly from inhalation and ingestion, an understanding of the radionuclides most significant to contributing to radiation dose is needed. For this reason, NIOSH attempts to estimate the amounts of dose significant radionuclides by making assumptions.

Of numerous reactors at site in early years, the current method to estimate the radionuclides workers were exposed to is by assuming a ratio of the unmonitored dose significant radionuclides to monitored radionuclides. The hope is that the assumptions will be claimant-favorable. But recent studies are finding that the assumptions NIOSH has in place may not be claimant favorable. These studies continue to focus on reactor fuel composition rather than experiments and dissolution processes that I believe may further underestimate worker exposures.

Switzerland and South Korea Exit Nuclear Energy

BBC News reported that Switzerland has voted to exit nuclear power. [45] The country has voted to phase out nuclear power in favor of renewable energy. Switzerland has five aging nuclear plants that provide a third of the country's energy.

The Guardian reported that new South Korean President Moon Jae-in vows to end the use of nuclear power. [46] He warned of "unimaginable consequences" from a Fukushima style meltdown. Weaning South Korea off of nuclear power, however, could take decades. The country was the fifth-largest producer of nuclear energy last year, according to the World Nuclear Association, with its 25 reactors generating about a third of its electricity. This signals an end to the country's fast reactor ambitions.

On May 30, 2011, the German government announced it would exit nuclear energy by 2022. The decision came after the devastating Fukushima accident in Japan. [47]

In 2016, Taiwan voted to exit nuclear power generation by 2025. Construction had already ceased on the partially completed Lungmen project after the Fukushima accident. Taiwan's six nuclear reactors at three power plants will be shutdown by 2025. [48]

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[45] *BBC News*, "Switzerland votes to phase out nuclear power," May 21, 2017. http://www.bbc.com/news/world-europe-39994599

[46] Justin McCurry, *The Guardian*, "New South Korean President vows to end use of nuclear power," June 19, 2017. https://www.theguardian.com/world/2017/jun/19/new-south-korean-president-vows-to-end-use-of-nuclear-power

[47] *BBC News*, "German: Nuclear Power Plants to Close by 2022," May 30, 2011 http://www.bbc.com/news/world-europe-13592208

Countries choosing nuclear energy phase-outs prior to 2004 include Austria, Belgium, Italy, Netherlands, Philippines, Spain, and Sweden.

Articles are by Tami Thatcher, for July 2017. Initial posting of this newsletter was revised to include Taiwan's 2016 decision to exit from nuclear energy generation, explaining what bas-mat melting is, and providing the Emergency Zone NRC comment address at Regulations.gov for Docket NRC-2015-0225.

[48] *Enerdata*, "Taiwan will exit nuclear power generation and boost renewable by 2025," October 25, 2016.