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North Korea, One More Time

This editorial by Robert Alvarez appeared in *The Washington Spector* March 18, 2019, see https://washingtonspectator.org/alvarez-north-korea/

On the eve of Trump's first meeting with Kim Jong-un in May 2018, the nuclear policy veteran Robert Alvarez wrote with skepticism in The Spectator *about the prospects for meaningful achievements from the summit process.*

A former senior policy advisor to the Secretary of the Energy Department who led DOE teams to secure weapons material at North Korea's nuclear site, Alvarez reported that North Korea wanted to be recognized and treated as a nuclear weapons state with potential long-range missiles. He noted Kim was willing to discuss nuclear arms control on a step-by-step basis, and that denuclearization, in the eyes of North Korea, meant "a process in which North Korea will no longer be a U.S. nuclear target and the United States will reduce its military presence in the region over a period of several years."

Following the collapse of the Second Summit in late February of this year, we asked Alvarez for comment on the administration's overture to North Korea, as well as the recently reported attempts by the Saudis to acquire weapons-capable nuclear technology, and the apparent role of Jared Kushner, the President's son-in-law, in those transactions.

A lot has already been said about the Hanoi meeting flop. My *Spectator* piece last year pretty much foretold what the future held. Trump, staffed by Bolton (his "polarizing new national security advisor") and Secretary of State Pompeo, pushed for the same "all or nothing" deal as G.W. Bush, with the same predictable result.

This time around, Trump was obviously fixated on Michael Cohen's testimony, staying up all night watching the House Government Oversight hearing, and he probably wanted to get out of Hanoi as soon as possible. He said as much by blaming the hearing as a big factor in the failed summit.

The big difference from the past is that Trump removed regime change from the table and deflated the nuclear brinksmanship threat, which overall are positive developments. The big questions are: will Bolton walk Trump back, ending further summits? And will Trump's love affair with Kim end badly?

Less than a week after the collapsed talks, reports of the restarting of a missile testing site the North Koreans had previously promised to dismantle do not bode well. Given Bolton and Pompeo's bellicose proclivities—and despite Trump's assertions to the contrary—resumption of joint U.S./South Korean military exercises may still be in the cards, delivering a blow to newly kindled hopes for an end to the nearly 70-year Korean War.

With respect to the Saudis' nuclear ambitions, the push for Westinghouse and U.S. nuclear business is largely mythological. The U.S. lost domestic ownership of two of its remaining reactor vendors (G.E. & Westinghouse) to Japanese companies several years ago. Westinghouse remains in business by maintaining and fueling existing reactors. It's vaunted new AP-1000 reactor business is in trouble because of cost overruns, delays, and technological problems. China, considered the world's biggest market for nuclear power, is getting cold feet after it just started up an AP-1000 after a large delay and major cost inflation. Two out of 4 AP-1000 reactors in the U.S. were cancelled for the same reasons.

After bringing its parent company, Toshiba, to the brink of collapse, Westinghouse filed for bankruptcy, and was purchased in early 2018 by Brookfield Business Partners, a Canadian asset management firm. Brookfield's parent company has been implicated in the bail out of Jared Kushner's white elephant at 666 Fifth Avenue in New York City, with funds provided by Qatar. Brookfield has also downsized Westinghouse in Pittsburgh to focus on existing reactors.

The Trump administration is still pushing for a deal with the Saudis, which requires Congressional approval. The Saudis want the U.S. to support their quest for uranium enrichment and chemical recovery of plutonium from used reactor fuel (reprocessing), the key technologies for nuclear weapons production. Such an arrangement would go against long-standing U.S. policy and growing congressional opposition.

The other competitors for Saudi business, (French, Russian, and the South Koreans) have their own problems. France is backing out of its domestic nuclear business, and its efforts to commercialize its reactor industry have failed. South Korea, which sold a reactor to the UAE, is facing serious issues that have stalled the new reactor start-up. South Korea has a long-standing agreement with the U.S. to not enrich or reprocess.

Russia's business model, going back to the Soviet era, involves providing a guaranteed supply of fuel and taking back used spent nuclear fuel to Russia, steps that discourage uranium enrichment and reprocessing. It's difficult to believe that Russia will go along with Saudis' quest for weapons technologies, given its reactor deals with Iran, and the heavy lifting it has done in support of the Iran nuclear agreement.

The people who stand to profit from this deal are the middlemen (former generals and lobbying consortia) who are looking to get rich regardless if a single uranium atom is split by the Saudis.

Nuclear Power Plant Construction, Unexpected Repairs and Decommissioning Costs Continue to Climb

The Department of Energy has given another loan guarantee of $3.7 billion to the two Georgia nuclear plants still under construction. [1] This brings the total loan guarantees promised by the Department of Energy for the AP1000 nuclear construction to $12 billion. [2]

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[1] James Osborne, Houston Chronicle, "Perry extends another $3.7 billion loan guarantee for Georgia nuclear plant," March 22, 2019. https://www.houstonchronicle.com/business/energy/article/Perry-extends-another-3-7-billion-loan-guarantee-13708658.php

[2] World Nuclear News, "Perry: Vogtle project is 'critically important'", March 22, 2019 at http://www.world-nuclear-news.org/Articles/Perry-Vogtle-project-is-critically-important and "Vogtle receives final loan

The construction cost estimates for the two Georgia nuclear plants have doubled to about $28 billion according to Tax Payers for Common Sense. [3] Rates have not kept up with the rising construction costs, but in 2018 electricity rates for Georgia Power's Vogtle's energy were projected to be 13 cents/kWh, while a combined cycle natural gas plant's generation is 4 cents/kWh. [4]

Cost estimates for the decommissioning of PG&E's Diablo Canyon nuclear plants are increasing by $1.6 billion, to be paid by ratepayers. [5] Diablo Canyon is California's only remaining nuclear power plant. Other cost estimates for nuclear plant decommissioning are topping $900 million. [6] Southern California Edison residential electricity ratepayers pay 16.07 cent/kWh to cover expected decommissioning costs.

Unexpected nuclear plant repairs or botched repairs can cost millions more than expected or can even result in making continued operation economically unviable, such as the botched steam generator replacements at the now-closed San Onofre nuclear plant that has cost ratepayers over a billion dollars. [7] The San Onofre plant modified the existing steam generator design which resulted in heat exchanger tube vibrations that were cracking the tubes within a short time of installation. Proper design reviews hadn't conducted because of the inappropriate characterization of the changes that were made in order to avoid a license change under the U.S. Nuclear Regulatory Commission. The "short cut" resulted not only in an unsafe design but in the economic failure of the plant because of the very expensive and failed design change.

Fees for the costs of disposing of the nuclear waste have been 0.1 cent/kWh. But while these fees have currently been suspended, no one knows what it will ultimately cost ratepayers and taxpayers to store and dispose of spent nuclear fuel for the hundreds of thousands of years that the waste is a hazard to human health and the environment.

The costs of nuclear plants that are presented to the public also don't include the costs of an accident, the environmental cost of mining, or cost of a plethora of nuclear subsidies paid by tax payers.

guarantees," June 25, 2015 at http://www.world-nuclear-news.org/NN-Vogtle-receives-final-loan-guarantees-2506157.html

[3] Tax Payers for Common Sense https://www.taxpayer.net/in-the-news/vogtle-loan-guarantees-praised-criticized/ and https://www.taxpayer.net/energy-natural-resources/doe-loan-guarantee-program-vogtle-reactors-3-4-2/

[4] Mary Landers, Savannah Morning News, "Georgia Power ratepayers not protected in new Plant Vogtle owners' deal," October 6, 2018. https://www.savannahnow.com/news/20181006/georgia-power-ratepayers-not-protected-in-new-plant-vogtle-owners-deal

[5] Kaytlyn Leslie, *The Tribune*, "PG&E needs $1.6 billion more to decommission Diablo Canyon – and it'll come from your bill," December 13, 2018. https://www.sanluisobispo.com/news/local/environment/article223058625.html

[6] Jared Stonesifer, *The Times*, "Cost to close plants tops $900M," March 20, 2019. https://www.timesonline.com/news/20190320/firstenergy-cost-to-close-plants-tops-900m

[7] San Onofre Safety, Cost of Nuclear Power at https://sanonofresafety.org/cost-of-nuclear-power/

US Ecology Idaho Resumes Limited Operations, Public Still Not Told What Caused Explosion Last November

The Idaho Department of Environmental Quality has allowed the US Ecology Idaho's hazardous chemical and radioactive waste dump to resume operations. [8] The Idaho DEQ has not disclosed what caused the explosion last November 16, 2018 at the disposal facility near Grand View, Idaho that killed a man — nor has the agency disclosed what waste was being treated or what processing was taking place.

The US Ecology Idaho disposal facility is not regulated by the U.S. Nuclear Regulatory Commission as a low-level radioactive waste dump. The facility has long accepted radioactive waste from uranium processing operations such as the Formerly Utilized Sites Remedial Action Program (FUSRAP) initiated in 1974 and Naturally Occurring Radioactive Materials (NORM), so that one would expect uranium and thorium and their radioactive decay progeny. But the disposal facility has also long accepted virtually every other fission product including cesium-137, strontium-90, and long-lived and highly mobile technetium-99, and has accepted transuranic radionuclides but excluded "special nuclear material." [9] Then sometime after 2009, the facility began accepting "Special Nuclear Material" including plutonium, all without the Idaho DEQ monitoring for plutonium.

The benign sounding "low-activity radioactive waste" accepted for disposal allows all radioactive materials including long-lived fission products, activation products, transuranic radionuclides and special nuclear material as long as estimated concentrations are low enough. While there are limits on how much radioactivity an individual shipment may contain, there is evidence of radioactivity leaching from the dump into the Snake River and evidence of elevated radionuclides in the air that the Idaho Department of Environmental Quality is actively ignoring.

While US Ecology denies that radiological materials were being treated when the explosion occurred, as I wrote last month, the federal Environmental Protection Agency's radiological air monitor, RadNet, in Boise went down the day of the explosion and for two weeks following the accident, so there are no radiological monitoring data currently publicly available, other than radon measurements. [10] [11]

Video footage of the explosion taken several miles from the explosion has been posted by 7KTVB news and shows the impressive height of the explosion, perhaps hundreds of feet in the

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[8] Nicole Blanchard, *Idaho Statesman*, "Idaho hazardous waste facility to resume limited operations following fatal explosion," February 11, 2019. The article states that landfill operations resumed February 7. https://www.idahostatesman.com/news/local/environment/article226110905.html

[9] U.S. Nuclear Regulatory Commission ADAMS document database at https://adams.nrc.gov/wba/ and use "Content Search" to find ML60390191 from 2005 which shows that at that time "Special Nuclear Material" was prohibited at the US Ecology Idaho disposal facility. "Special Nuclear Material" includes fissile materials of uranium-235 and plutonium. But in 2009, actions were taken to accept "Special Nuclear Material" for disposal, see ML111441101.

[10] Environmental Protection Agency RadNet at https://www.epa.gov/radnet/near-real-time-and-laboratory-data-state and choose the state, https://www.epa.gov/radnet/radnet-air-data-boise-id or https://iaspub.epa.gov/enviro2/erams_query_v2.simple_query

[11] Environmental Defense Institute March 2019 newsletter article by Tami Thatcher "Serious Flaws in the Radiological Monitoring in the Boise Area and the US Ecology Idaho Disposal and Transfer Facilities," and "Two Explosions at Idaho DEQ RCRA-Permitted Facilities in Idaho in 2018 Suggest Idaho DEQ Doing a Bang-Up Job of RCRA Permitting at http://environmental-defense-institute.org/publications/News.19.March.pdf

air. [12] Magnesium oxide was used as an additive in the mixing bins in the building that exploded. Two of the waste mixing bins are 17 ft by 60 ft and are 8 ft deep.

The hazardous waste permit for the US Ecology Idaho (site B) facility near Grand View, Idaho discusses the use of "lime" to mix with hazardous wastes. In its permit, lime is defined as "containing oxides and/or hydroxides of calcium and/or magnesium." [13]

While the human body uses both magnesium and calcium and these materials are often thought of as safe, a review of the chemical compatibility for calcium carbonate and for magnesium reveals that calcium carbonate, for example, is incompatible with "acids, fluorine, magnesium with hydrogen." [14] [15]

Calcium is a strong oxidizer and magnesium is a strong reducing agent, and they should never be mixed together, according to EPA-600/2-80-076, the chemical compatibility method described in the permit for the facility. Magnesium is used in fireworks. But the way the US Ecology Idaho's permit is worded, you would never guess that these materials would be highly incompatible. Interestingly, shipments of waste with calcium, fluoride and radionuclides had arrived at the facility near the time of the explosion. [16]

The hazardous waste permit for the facility requires conducting chemical compatibility analyses. [17] But the permit doesn't require much in the way of sampling of the materials to verify waste constituents. Nor does the permit have any documented chemical compatibility analyses, not even for the mixing bins used to "neutralize" some materials. Apparently, it is just assumed that chemical compatibility analyses are conducted.

The permit states that "USEI takes precautions to prevent the accident ignition or reaction of ignitable or reactive waste per the requirements of IDAPA 58.01.05.008 (40 CFR 264.17).

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[12] Video footage caught by passerby of the explosion at the Grand View US Ecology Idaho facility, posted on 7KTVB.com news, November 2018. https://www.ktvb.com/video/news/local/grand-view-man-killed-in-explosion-at-us-ecology-site/277-8336847

[13] US Ecology Idaho Inc. Site B facility located in Owyhee county near Grand View, Idaho (USEI), EPA Facility Identification Number: IDD073114654. The permit describes four mixing bins in the building that exploded, each having 120 cubic yard capacity. http://www.deq.idaho.gov/media/1117319/us-ecology-site-b-grand-view-permit.pdf The RCRA mixing bins are each 17 ft by 60 ft and are 8 ft deep. http://www.deq.idaho.gov/media/60178905/us-ecology-site-b-grand-view-att14a.pdf The permit's waste analysis plan uses the term lime several times. In one instance, lime is defined as follows: "lime (i.e., containing oxides and /or hydroxides of calcium and/or magnesium [ )]." http://www.deq.idaho.gov/media/60178892/us-ecology-site-b-grand-view-att2.pdf

[14] This chemical database posted on the U.S. Department of Agriculture website provides a convenient Chemical Inventory List with Material Safety Data Sheets (MSDSs) as of August 2009. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052293.pdf

[15] This chemical MSDS for magnesium oxide says it can absorb carbon dioxide and water from air. It says it is incompatible with acids, interhalogens, phosphorus pentachloride, and chlorine trifluoride. The MSDS for calcium carbonate, also called limestone, is incompatible with "acids, fluorine, magnesium with hydrogen." https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052293.pdf

[16] U.S. Nuclear Regulatory Commission ADAMS document database at https://adams.nrc.gov/wba/ and use "Content Search" to find ML110420143 and ML18198A177. See interesting documents of the US Ecology site B also in ML13280A368 and ML18156A125.

[17] The US Ecology Idaho facility at Grand View, permit attachment 2 describes the requirement to conduct chemical compatibility of the waste streams. It generally uses EPA-600/2-80-076 (see https://www.epa.gov/sites/production/files/2016-03/documents/compat-haz-waste.pdf) But the permit has no specific evaluations discussing chemical compatibility and the mixing bins that frequently used magnesium oxide to mix with waste. http://www.deq.idaho.gov/media/60178892/us-ecology-site-b-grand-view-att2.pdf

Furthermore, the permit states that "Any time USEI treats, stores, or disposes of ignitable or reactive wastes, or mixes reactive incompatible wastes, USIE will take precautions to prevent reactions which: generate extreme heat or pressure, fire or explosions, or violent reactions; …. "

This waste facility that is NOT a U.S. Nuclear Regulatory (NRC) licensed "low level radioactive waste" disposal facility accepts such high concentrations of uranium and "special nuclear material" such as plutonium, that it is required to have criticality analyses for disposal of some of the radiological material it accepts. [18] With the EPA RadNet data "disappeared" and no meaningful data have been provided by the Idaho DEQ near the time of the explosion, I haven't found evidence to prove that a nuclear criticality didn't occur.

The current radiological monitoring at the US Ecology Idaho disposal facility isn't adequate to begin with, there remains unexplained cessation of monitoring data for an established EPA program, and no DEQ or the facility radiological monitoring data from last November have been made available to the public. Nonetheless, the facility has resumed operations.

DNFSB Continues to Review the Integrated Waste Treatment Unit, As Design Modifications and Testing Continue

By Tami Thatcher and Chuck Broscious

The Defense Nuclear Facilities Safety Board continues to review the Integrated Waste Treatment Unit (IWTU) that was slated to complete its mission in 2012. Another round of design modifications has required a permit modification from the Department of Energy's cleanup contractor, Fluor Idaho, to the Idaho Department of Environmental Quality. [19] There is expected to be another round of design modifications in a future permit modification request.

The February 2019 round of design changes to the IWTU includes:

1. Replace Denitration Mineralization Reformer (DMR) Ring Header. Replace damaged ring header and fluidizing gas rails with Double Plenum design to allow better distribution of fluidizing gas. [Class 3 – 40 CFR 270.42(d)(2)(iii)]

2. Carbon Reduction Reformer (CRR) Nozzle N3 Modification. Allow the removal of damaged refractory and repair/replacement of the refractory in the CRR. [Class 2 – 40 CFR 270.42 Appendix I, G.2.]

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[18] The U.S. Nuclear Regulatory Commission posts on its ADAMS database the reports of its licensees that dispose of radioactive waste at the US Ecology Idaho facility near Grand View, Idaho. One example is ML13280A368. The criticality assessment describes mixing water, clay, and various chemical reagents to reduce the uranium concentrations through dilution. The analysis considered nuclear criticality but did not consider chemical incompatibility.

[19] The Department of Energy's cleanup contractor, Fluor Idaho, has submitted a Class 3 Permit Modification request for the IWTU, EPA ID No. ID4890008952. "Class 3 Permit Modification Request Including a Request for Temporary Authorization for the Volume 14 HWMA/RCRA Storage and Treatment Permit for the Liquid Waste Management System at the Idaho Nuclear Technology and Engineering Center." The February 2019 permit request can be found at https://inldigitallibrary.inl.gov document ID4890008952 at https://inldigitallibrary.inl.gov/PRR/168374.pdf#search=ID4890008952%20%2A%202019

3. CRR refractory repair/replacement. Replace damaged castable refractory with hard faced refractory brick and castable refractory suitable for continued operation. [Class 2 – 40 CFR 270.42, Appendix I, G.2]

4. Lower maximum feed. Allow better control for treatment of wastes. [Class 2 – 40 CFR 270.42, Appendix I, L.4.]

5. Modify Offgas blower over-pressurization protection. Prevent accumulation of off-gas and condensation for stand-by blower. [Class 1 – 40 CFR 270.42, Appendix I, A.3]

6. Changes to the auger/grinder. Allow for continuous product transfer and removal of cementous material. [Class 1 – 40 CFR 270.42, Appendix I, A.3]

7. Replacement of DMR bed 3-point thermocouples with 6-point thermocouples. Allows for additional temperature data monitoring in the DMR. [Class 1 – 40 CFR 270.42 Appendix I, A.3]

8. Addition of DMR nitrogen neck purge. Allow increased fluidization. [Class 2 - 40 CFR 270.42, Appendix I, L.4]

9. DMR drain line purge. Allow increased fluidization. [Class 2 – 40 CFR 270.42, Appendix I, L.4]

10. CRR Nozzle N2 drain enhancement. Allow for effective bed removal in the vessel during radiological operations. [Class 1 – 40 CFR 270.42 Appendix I, A.3].

11.Sample System Part Modifications. Allow increased functionality of the sample system. [Class 1 – 40 CFR 270.42, Appendix I, A.3]

12. Addition of Carbon Dioxide to the Fluidizing Gas. Reduces the buildup of wall scale and cementous product deposits in the DMR. [Class 2 – 40 CFR 270.42, Appendix I, L.4.

After additional non-radioactive "simulant" testing is completed, initial IWTU emissions testing will be conducted using the sodium-bearing liquid waste. The liquid waste will require some preparation before being pumped to the IWTU. And stratification of the waste could mean that deeper layers of the waste could contain more transuranic radionuclides, not represented by initial emission testing. The current plans will assume that initial emissions will be representative for all operations as minimal radiological emissions monitoring appears to be planned when the unit is operational.

The future initial emissions testing and data are slated to require another RCRA hazardous waste treatment permit modification, with public meetings and comment period.

To get an idea of the safety issues involved with operating the IWTU, we provide a description written by the Defense Nuclear Facility Safety Board (DNFSB) in 2007 and more recent DNFSB reviews.

Back in January 24, 2007, the DNFSB wrote a letter [20] describing that "The Integrated Waste Treatment Unit (IWTU) will convert approximately 900,000 gallons of acidic, liquid sodium bearing waste to a solid carbonate or mineralized product for permanent disposal at the Waste Isolation Pilot Plant or an off-site geologic repository. The sodium bearing waste is currently stored in three tanks at the Idaho Nuclear Technology and Engineering Center (INTEC) and will

[20] Defense Nuclear Facilities Safety Board letter to the Department of Energy, January 24, 2007 at https://www.dnfsb.gov/sites/default/files/document/509/ltr_2007124_2127.pdf

be treated using steam reforming technology. The IWTU will also stabilize liquid wastes generated from continued cleanup of the INTEC area. Portions of the facility's structure may have a future mission to support the recovery of High-Level-Waste Calcine for off-site disposal, and are thus being designed to more rigorous structural requirements."

"The safety strategy relies on confinement of hazardous materials, radiation shielding, and accident prevention during steam reforming and waste product handling operations. **Significant hazards include mercury release from a charcoal adsorber bed fire, hydrogen deflagration in process equipment, and confinement boundary failure resulting in release during a seismic event. Engineered and administrative controls will prevent and mitigate worker consequences from these and other events identified in safety basis document. Controls credited as safety significant for the IWTU include the following:**

- rapid shutdown system (including its uninterruptible power supply;
- off-gas cooling system;
- radiation shielding (process cell, carbon reduction reformer cell, packaging station cell, storage vaults, vault loading area, 72B transport cask and adapter, and remote-handled transuranic (RH-TRU) waste canister transfer bell); and
- confinement (storage vaults, process cell, carbon reduction reformer cell, packaging station cell, RH-TRU canister, and denitration and mineralization reformer and carbon reduction reformer in-cell carbon addition lines).

"To provide additional worker protection, all components providing primary confinement of the waste during operations with the exception of the RH-TRU canister are credited as defense-in-depth. The building ventilation system is also credited as defense-in-depth, and a Technical Safety Requirement level control will require cessation of steam reforming operations if the system becomes inoperable."

"A one-tenth scale pilot plant was constructed at Hazen Research, Inc. to demonstrate integrated operation of the IWTU process, confirm process chemistry and mass and energy balance calculations, and demonstrate acceptability of the waste product and off-gas emissions. The first stage of testing produced a carbonate waste form. Valuable lessons learned were derived from this effort including, among others, the acceptability of sintered metal in the high temperature process gas filter and the control set to prevent and mitigate a charcoal adsorber bed fire. Testing for the mineralized waste form was completed at the end of 2006."

But despite the testing at the Hazen facility completed in 2006, the IWTU was plagued with problems, including a serious overpressurization during testing on June 16, 2012. [21]

Additional testing at the Hazen facility had to be conducted beginning in 2016 after Fluor took over the cleanup contract because of the many malfunctions and clogging up of the IWTU during "simulant" runs.

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[21] Environmental Defense Institute August 2012 newsletter article by Chuck Broscious "INL's Highly Radioactive Liquid Waste Treatment Plant Having Major Startup Problems," at http://environmental-defense-institute.org/publications/News.12.Aug.Final..pdf

The Department of Energy's own inspector general found that the DOE had prematurely declared the IWTU to have completed construction and DOE had used faulty rationale to accept the results of the early tests at the Hazen facility. [22] The series of tests and repairs since missing the 2012 Idaho Settlement Agreement milestone resulted in costs termed operational costs exceeding $181 million in 2016, yet the facility had yet to process any waste. Redesign of the IWTU has cost as much as $50 million a month and been ongoing since 2016.

The DNFSB has noted the need to perform "Validation that the radionuclide assumptions in the safety basis are accurate, either through completion of sampling or through batch feed sampling requirements."

In addition, the DNFSB Board "encourages the IWTU project to consider incorporating limited, post-seismic monitoring capability into the IWTU control system as defense-in-depth assurance of safe shutdown. Currently, no seismically qualified system exists to verify safe shutdown following an earthquake."

Not only was the IWTU not designed for safety shutdown following a seismic event as recommended by the DNFSB in 2007, **it hasn't even been designed to assure safe configuration following an expected loss of electrical power event like the one that occurred February 20, 2019 which left workers scrambling to determine plant equipment status following power loss.**

The DNFSB wrote on August 3, 2018 that "After completion of the simulant runs, Fluor Idaho managers plan to conduct a facility outage, nominally scheduled to last six months, to perform required maintenance. Longer term plans include a readiness assessment prior to the start of radioactive, sodium-bearing liquid waste processing. Based on a projected efficiency rate of 30%, **processing the sodium-bearing waste could last as long as seven years**." With the IWTU not expected to begin operations before 2020, this would mean that it won't complete processing before 2026.

The DNFSB also wrote in 2018 about the inadequate fire hazards mitigations — that were justified based on the "short expected operational life" of the IWTU, that was originally to be less the two years. The DNFSB wrote that "IWTU's fire hazard analysis relies on the implementation of site-wide safety management programs to screen out hazards during the unmitigated analysis. This is inconsistent with the Department of Energy's documented requirements. Consequently, IWTU's safety basis does not analyze several possible accident events, such as a carbon dust fire in the additive storage room. A carbon dust fire could spread to the adjacent mechanical equipment area, potentially damaging the safety significant components

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[22] Department of Energy's Inspector General 2016 report: "Management of the Startup of the Sodium-Bearing Waste Treatment Facility" at http://energy.gov/ig/downloads/audit-report-doe-oig-16-09 Read about the faulty rationale to accept the results of two small scale tests: "The testing at Hazen Research Inc., which was used to help form the basis for the testing at the SBWTF [IWTU], was only a one-tenth scale prototype facility, and the testing consisted of only two test runs, one of which was unsuccessful. In addition, there were significant differences between the two facilities. For example, the primary system that transforms the waste at Hazen did not have the same internal components due to scale limitations. Also, the safety standards used during the pilot plant testing were much less stringent than those used at the SBWTF during operations, primarily because Hazen is a nonradiological, nonnuclear facility. While these differences were not considered significant during testing, Idaho officials told us they subsequently realized that the differences were significant enough that full scale or even half-scale pilot testing should have been conducted prior to startup."

in that space. IWTU has implemented safety management programs and non-credited safety controls that are intended to address these potential hazards within the short expected operational life of the facility but has not sufficiently documented the hazards and the controls in the safety basis. Such documentation should be completed regardless of the expected operational life of a facility."

The Department of Energy continues to set the trap for serious safety problems and accidents at the IWTU, as well as for unmonitored and potentially excessive emissions, both chemical and radionuclide, should it ever operate.

The Department of Energy also formally made the "assumption" that offsite disposal for the treated sodium-bearing waste would be found but this is no closer to reality than it was 20 years ago. See some of DOE's formal *ass*umptions for the IWTU project in this 2011 document. [23]

The Department of Energy abandoned the calcine units that burned kerosene that operated at 500 Celsius (932 Fahrenheit) because they could not meet federal clean air Maximum Achievable Control Technology (MACT) standards, but then decided not to meet those requirements with the IWTU even though it will burn coal and operate at temperatures near 1000 Celsius (1832 Fahrenheit). [24] [25] Excuses have been verbalized such as: "it isn't an incinerator and has no open flame." There are claims that the IWTU will meet MACT standards, so why not *require* the IWTU to meet MACT standards?

The Idaho DEQ addresses radionuclide emissions via Permit to Construct licenses which the Idaho DEQ does not make public and does not enforce, based on DEQ's failure to investigate the unplanned disposal of radionuclides at the Advanced Test Reactor Complex radioactive waste pond. Radionuclide emissions via federal National Emission Standards for Hazardous Air Pollutants (NESHAPS) [26] means unmonitored guessimated and not-publicly-available rationale for radionuclide estimates are used to make estimated radiological dose estimates all while ignoring the buildup of long-lived radionuclides in the air, soil and water.

U.S. NRC Agreed Radionuclide Separations Were Not Needed at the Integrated Waste Treatment Unit, But Did Not Approve Waste Reclassification of Sodium-Bearing Waste

At the February 21, 2019 Idaho Cleanup Project Citizens Advisory Board meeting, the Department of Energy made statements to the effect of saying that the U.S. Nuclear Regulatory Commission (NRC) had approved of the Department of Energy's waste reclassification of the liquid sodium-bearing waste that is to be processed by the Integrated Waste Treatment Unit (IWTU).

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[23] Department of Energy, Idaho Closure Project, "Integrated Waste Treatment Unit GFSI Risk Management Plan," DOE/ID-11270, June 21, 2007, OSTI identifier 909857, at https://www.osti.gov/biblio/909857

[24] Code of Federal Regulations (CFR), National Emission Standards for Hazardous Air Pollutants, Maximum Achievable Control Technology (MACT) Standards for Major Sources 40 CFR 63.40 through 63.44

[25] Environmental Defense Institute and Keep Yellowstone Nuclear Free letter to U.S. Environmental Protection Agency, March 13, 2007 at http://www.environmental-defense-institute.org/publications/EDI.Pet.%20EPA%20IG.Fin3.13.07.pdf

[26] https://www.epa.gov/compliance/national-emission-standards-hazardous-air-pollutants-compliance-monitoring

I think it important to understand that the NRC only agreed that additional separation of radionuclides was not needed. The NRC review focused on the first criterion under the 1999 version of DOE Order 435.1, *that the waste must be processed or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical*. [27]

The other two criteria in DOE Order 435.1 regarding Waste Incidental to Reprocessing (WIR) pertain to waste classification and disposition requirements. The NRC did not explicitly evaluate these criteria. According to the DOE's response to the question on the matter of the extent of NRC approval of DOE's reclassification of sodium-bearing waste, the DOE stated:

> "The NRC did not explicitly evaluate these criteria—regarding classification of SBW as transuranic waste and disposal at the Waste Isolation Pilot Plant (WIPP)—because they determined that doing so would be inappropriate and outside NRC's jurisdiction given that NRC's WIR guidance does not include a TRU disposal option and the WIPP's long-term performance is regulated by the Environmental Protection Agency.
>
> At this time, DOE has not made a decision related to the final classification and disposition of the SBW." [28]

The DOE is also refusing to acknowledge to the public and to the ICP CAB — to a degree I consider unethical — the serious cloud over the legality of its proposal to reclassify the bulk of its HLW. The court found that DOE's vague approach using its DOE Order and Manual 435.1 to allow unspecified "alternate requirements" would be unacceptable because it would allow DOE to reclassify waste on whim. For example, the DOE could allow cost savings to be the overriding waste classification criteria, not safety of human health and the environment. The court dismissed the case as unripe because the DOE had not yet reclassified its HLW.

See our March 2019 newsletter [29] and see details of the legal challenges to DOE's HLW reclassification in the State of Idaho's HLW comment submittal, [30] the National Resources Defense Council (NRDC) comment submittal,[31] and also the book *Fuel Cycle to Nowhere*. [32]

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[27] U.S. Nuclear Regulatory Commission, "U.S. Nuclear Regulatory Commission Review of the Idaho National Engineering and Environmental Laboratory Draft Waste Incidental to Reprocessing Determination for Sodium-Bearing Waste, August 2, 2002, at ADAMS document database at https://adams.nrc.gov/wba/ ML022170255.

[28] Idaho Cleanup Project Citizens Advisory Board (ICP CAB), see recently answered questions at https://www.energy.gov/em/icpcab/recently-asked-questions

[29] Environmental Defense Institute March 2019 newsletter article by Tami Thatcher "ICP Citizens Advisory Board Wrestles with DOE's Proposed HLW Interpretation, Focuses on Unanswered Questions about INL's High-Level Waste" at http://environmental-defense-institute.org/publications/News.19.March.pdf

[30] John H. Tippets, Director, Idaho Department of Environmental Quality, Letter to Anne White, Assistant Secretary, Office of Environmental Management, U.S. Department of Energy, Subject: State of Idaho Comments on U.S. Department of Energy Interpretation of High Level Radioactive Waste (83 FR 50909), January 9, 2019. See it on our website at http://www.environmental-defense-institute.org/publications/IDEQHLW.pdf

[31] The Natural Resources Defense Council (NDRC), "NRDC et al. Comments on Energy Department's Request for Public Comment on the Interpretation of High-Level Radioactive Waste," January 9, 2019. https://static1.squarespace.com/static/568adf4125981deb769d96b2/t/5c36635670a6add06a0aa079/1547068277020/NRDC+et+al.+Full+Comments+DOE+HLW+9+Jan+2019.pdf

[32] Richard Burleson Stewart and Jane Bloom Stewart, *Fuel Cycle to Nowhere – U.S. Law and Policy on Nuclear Waste*, Vanderbilt University Press, 2011, ISBN 978-0-8265-1774-6.

Degraded Spent Nuclear Fuel Storage Facility Requires Movement of Spent Fuel at Idaho National Laboratory

The Department of Energy has found water in the Underground Fuel Storage Facility (UFSF), CPP-749, located at the Idaho Nuclear Technology and Engineering Center (INTEC) within the Idaho National Laboratory (INL), in its first generation of vaults placed in operation in 1971.

The Department of Energy stated that "despite the careful engineering" small amounts of water have been observed in the first-generation vaults. It is not known whether the water gained access through seepage or occurred from condensation. The spent fuel is containerized, but water can pose the risk of hydrogen generation and structural degradation. The fuel in the first-generation vaults will be transferred to the second-generation vaults, placed in operation in 1984. [33]

The problem had resulted in five fuel transfers out of the CPP-749 "dry" wells in 1997. But the transfers were put on hold after the spent fuel packaging facility was cancelled. Without a spent fuel packaging facility, there will be no spent fuel leaving the Idaho National Laboratory, other than naval fuel. The Department of Energy stores about 270 MTHM of research and commercial SNF that is not naval SNF.

The underground SNF vaults at CPP-749 store about 78.4 Metric Tons Heavy Metal (MTHM). The spent nuclear fuel stored at CPP-749 includes SNF from Peach Bottom Unit 1 Core 1, Shippingport Light Water Breeder Reactor, and Fermi-1 blanket SNF. The facility consists of 218 underground vaults. The first generation of storage vaults consists of 61 steel-lined, below-grade, individual vaults that were built for Peach Bottom Unit 1 SNF. The Peach Bottom Unit 1 Core 1 spent nuclear fuel is 70 to 93 percent enriched in uranium-235, and is a thorium/uranium carbide in graphite matrix.

The Department of Energy documented problems at CPP-749 in 2010 stating that "Accelerated corrosion of stored fuels occurred as a result of moisture intrusion" according to the U.S. Nuclear Waste Technical Review Board December 2017 report, *Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel*. [34]

More recent examination and the extent of material degradation has not been described at Idaho Cleanup Project Citizens Advisory Board meetings, but there seems to be increased concern over the fuel storage facility — enough for the Department of Energy to resume moving the fuel that it left in a degraded condition since 1997 — and apparently an avoidance of any kind of press release to describe the degradation.

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[33] Idaho Cleanup Project Citizens Advisory Board (ICP CAB), see recently answered questions at https://www.energy.gov/em/icpcab/recently-asked-questions

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

And while press releases describe the transfer of Advanced Test Reactor fuel to dry storage, [35] there is no coverage of the impending failure to meet Idaho Settlement Agreement milestones to have the DOE's SNF repackaged and road ready to transfer spent nuclear fuel to permanent storage.

Radiation Emergency Guidance, Initial Estimates of Radiation Dose and Possible Symptoms Involving Bone Marrow and Blood

Radiation emergency guidance is provided by the Radiological Emergency Center/Training Site at Oak Ridge. [36] A method for providing an initial estimate of potential inhalation of radionuclides can be made based on nasal swabs. The result in disintegrations per minute (dpm) for each nostril are summed and then most guidance recommends assuming that the nasal swab result is 5 or10 percent of the inhalation, to provide a rough idea of the intake. (Hopefully, the worker is breathing mostly through the nose rather than the mouth.)

According to the Radiological Emergency Center/Training Site at Oak Ridge, [37] if the nasal swabs taken within hours of the intake sum to 1300 dpm, and the inhaled radionuclide was americium-241, the initial intake estimate would be made by dividing by 0.1 to obtain 13,000 dpm. This would correspond to a 6 nCi intake yielding a 5 rem annual dose (whole body) or a 50 rem limiting organ dose, the limit in the U.S. for a radiation worker (see Table 1.)

This estimate is not as conservative as recommended in in NCRP Report 161, which assumes the nasal swabs indicate only 5 percent of the intake, double the REACTS estimate based on nasal swabs.

In the U.S., for radiation workers, the annual limit on intake (ALI) can be used as a guide and is derived from the committed effective dose equivalent (CEDE) of 5 rem. The international annual dose limit is to not exceed 10 rem total within 5 years and no annual dose exceeding 5 rem — this is an average dose limit over 5 years of 2 rem annually. The U.S. Department of Energy maintains the 5 rem annual dose limit but states having a policy of not planning to have doses exceeding 2 rem per year. Despite this, many radiation publications give the impression that a 5 rem annual radiation dose would be benign. Radiation worker epidemiology has found elevated risk of cancer at average annual doses of 400 mrem. [38]

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[35] Ryan Suppe, The Idaho Falls Post Register, "INL, Fluor Idaho streamline spent nuclear fuel storage – The 1995 Settlement Agreement, between the state of Idaho, the U.S. Navy and U.S. Department of Energy, says that all spent nuclear fuel stored in Idaho must be transferred to dry storage," March 22, 2019.

[36] Oak Ridge Institute for Science and Education, Radiation Emergency Assistance Center/Training Site, "The Medical Aspects of Radiation Incidents, 4th Edition, July 2017 https://orise.orau.gov/reacts/documents/medical-aspects-of-radiation-incidents.pdf

[37] Oak Ridge Institute for Science and Education, Radiation Emergency Assistance Center/Training Site, "The Medical Aspects of Radiation Incidents, 4th Edition, July 2017 https://orise.orau.gov/reacts/documents/medical-aspects-of-radiation-incidents.pdf

[38] Richardson, David B., et al., "Risk of cancer from occupational exposure to ionizing radiation: retrospective cohort study of workers in France, the United Kingdom, and the United States (INWORKS), BMJ, v. 351 (October 15, 2015), at http://www.bmj.com/content/351/bmj.h5359 Richardson et al 2015 . This epidemiology study that included a cohort of over 300,000 nuclear industry workers has found clear evidence of solid cancer

Table 1. Radionuclide inhalation Allowable Limit on Intake (ALI) for selected radionuclides (based on REACTS).

Primary Emission	Radionuclide	ALI for 5 rem (solubility class)	Disintegrations per minute (dpm)
Alpha	Am-241 Pu-239	6 nCi 0.2k Bq (W)	13,000 dpm
Beta	Sr-90	4000 nCi 148 kBq (Y)	8,900,000 dpm
Gamma	Cs-137	200,000 nCi 7400kBq (D)	440,000,000 dpm

Table notes: Am-241 is americium-241; Sr-90 is strontium-90; Cs-139 is cesium-137; nCi is nanocurie or 1.0E-9 curies; kBq is kilobecquerel; 3.7E10 disintegrations per second is 1 curie; 1 disintegration per second is a becquerel. The ALI values are from Federal Guidance Report (FGR) 11. The ALI gives an indication of dose but estimate of each organ dose is still needed. The most conservative solubility class was used, with the exception that Super S Class which yields longer lung retention times and higher doses was not used.

Table 2 provides information adapted from REACTS to indicate the medical symptoms associated with radiation dose. Radiation emergency guidelines are often expressed in estimated whole-body dose for an external radiation exposure. The bone marrow dose for a whole body radiation dose of 100 rads would be 12 rads, because of the regulatory dose fraction for bone marrow of 0.12.

For inhaled or ingested radionuclides, there are many methods for estimating the radionuclide intake. But dose estimate may depend on knowledge of the radionuclides in the mixture, and the method or methods selected for conducting the dose estimate vary among Department of Energy sites. Many of the more precise methods for dose estimation are avoided at DOE sites, in favor of methods that allow more adjustment by the analysts. The precise dose at the Idaho National Laboratory has typically required many weeks and even many months before radiation workers have been told their estimated radiation doses arising from unplanned exposures. While it may appear that the more time that is taken to calculate the estimated the dose, the more confidence that there would be in the result — but that really isn't the case. Time-consuming dose estimates, not readily available during the emergency and in critical days and weeks following intakes, are not accompanied by uncertainty analyses and are actually driven downward by the desire to avoid penalties for unplanned doses to radiation workers. That was certainly the case for the 2011 plutonium and americium inhalation event of November 8, 2011 at the Zero Power Research Reactor (ZPPR).

Radionuclides with special affinity for bone, when radioactive particles are inhaled or ingested, include strontium-90, uranium, plutonium, americium and californium. [39]

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risk increases despite the average exposure to workers being about 2 rem and the median exposure was just 410 millirem. Also see December 2015 EDI newsletter.

[39] Stephen L. Sugarman, MS, CHP, CHCM, Radiation Emergency Assistance Center/Training Center (REACTS), Oak Ridge, TN, "Early Internal and External Dose Magnitude Estimation," version July 2017 at https://orise.orau.gov/reacts/documents/rapid-internal-external-dose-magnitude-estimation.pdf

Table 2. Thresholds for Acute Radiation Syndromes (based on REACTS).

Whole Body External Radiation Dose	**Estimated Bone Marrow Dose Associated with these symptoms***	**Syndrome**	**Signs/Symptoms**
0-100 rads (0- 1 Gy)	0 – 12 rads (0 – 0.12 Gy)	NA	Generally symptomatic, potential slight drop in lymphocytes later (near 1 Gy)
> 100 rads (> 1Gy)	> 12 rads (>0.12 Gy)	Hematopoietic	Anorexia, nausea, vomiting, initial granulocytosis and lymphocytopenia
> 600 to 800 rads (> 6 to 8 Gy)	> 72 to 96 rads (> 0.72 to 0.96 Gy)	Gastrointestinal	Early severe nausea, vomiting, watery diarrhea, pancytopenia
> 2000 rads (> 20 Gy)	> 240 rads (< 2.4 Gy)	Cardiovascular/CNS	Nausea/vomiting within first hour, prostration, ataxia, confusion

Table notes: Adapted from Radiation Emergency Assistance Center/Training Center (REACTS) documents including https://orise.orau.gov/reacts/documents/rapid-internal-external-dose-magnitude-estimation.pdf . Bone marrow dose associated with a whole body dose, absent a specific organ dose, is assumed to be this fraction, (0.12) of the whole body dose. Whole body dose of 100 rads is then multiplied by 0.12 and is equal to 12 rads. 1 Gray (Gy) is equivalent to 100 rads. The > symbol means "greater than."

Because an intake of americium or plutonium can quickly be absorbed in bone marrow, there are several conditions affecting the blood, following radiation exposure, most medical radiation emergency guidance such as that of REACTS focus on **lymphocyte depletion** which can be caused by intake of actinides such as americium-241, plutonium-239, and others.

Some explanation of the medical terminology in Table 2 used by REACTS is provided below. Following a radiation exposure or intake, the drop in lymphocytes is a typical focus, although other blood cell counts may also drop.

Lymphocytes are a type of white blood cell which are also called leukocytes. There are two groups of leukocytes (white blood cells): agranulocytes that lack granules and granulocytes which have granules. Of the five types of leukocytes, two are agranulocytes: **lymphocytes and monocytes**; and three are granulocytes: **neutrophils, basophils, and eosinophils**.

Lymphocytopenia is the condition of having an abnormally low level of lymphocytes in the blood. Lymphocytes are white blood cells, typically accounting for 25 percent of the total white blood cell count.

Pancytopenia is the condition of having abnormally low levels of all three cellular components of the blood (red blood cells also called erythrocytes, white blood cells also called leukocytes, and platelets).

While initially the radiation exposure can result in a drop of leukocytes and other blood cells, that may return to normal over a few weeks, ultimately radiation exposure can cause diseases that result is abnormally high blood cell counts.

Leukemia is a broad term given to a group of malignant diseases characterized by diffuse replacement of bone marrow with proliferating leukocyte precursors, abnormal numbers and forms of immature white blood cells in circulation. Leukemia may be acute or chronic. Diagnoses are made by blood tests and bone marrow biopsies. Radiation exposure to external radiation or to intake of radionuclides into the body is a known cause of leukemia.

Granulocytosis is the condition of having an increased number of granulocytes in the peripheral blood. The neutrophil granulocyte count is increased and usually the combination of neutrophils, eosinophils and basophils are increased. It is known to occur after exposure to radiation. It is a condition that is closely related to chronic myelogenous leukemia (CML) and other bone marrow disorders. Myelogenous leukemia (also called myelocytic leukemia) is a disorder characterized by the unregulated and excessive production of leukocytes.

Hematopoietic syndrome or "bone marrow syndrome" is associated with the effects of radiation on the blood and lymph tissues and is associated with hemolysis (the breakdown of red blood cells) and destruction of the bone marrow. Hematopoietic stem cells are responsible for the production of mature blood cells in bone marrow.

Primary polycythemia vera includes elevated red blood cell counts, elevated cytosis and platelet dysfunction; other irregularities and bone marrow aspiration shows panmyelosis. Secondary polycythemia vera is often treated by addressing the underlying cause, such as heart disease, pulmonary disease, or prolonged exposure to high altitudes. In secondary polycythemia vera, the bone marrow is undamaged and there is an absence of leukocytosis (abnormally high levels of leukocytes). See more about polycythemia vera in our September 2018 newsletter article "Polycythemia Vera, Recognized for Decades as being Caused by Radiation, is a Bone Cancer Covered in Energy Worker Illness Compensation." [40]

Aplastic anemia is a deficiency of all of the formed elements of blood (erythrocytes, leukocytes, and platelets) due to failure of the cell-generating capacity of bone marrow. Neoplastic disease of bone marrow can be caused by exposure to toxic chemicals, ionizing radiation, and certain medications.

It should also be noted that many medical tests for iron in the blood do not distinguish between iron and heavy metals such as plutonium.

See more about blood cell counts in our article "Understanding Complete Blood Count Results Following Radiation Exposure" at http://environmental-defense-institute.org/publications/RadCBC.pdf

Articles by Tami Thatcher, except as noted, for April 2019.

[40] Environmental Defense Institute September 2018 newsletter article by Tami Thatcher "Polycythemia Vera, Recognized for Decades as being Caused by Radiation, is a Bone Cancer Covered in Energy Worker Illness Compensation," at http://environmental-defense-institute.org/publications/News.18.Feb.pdf