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Oxidative stress causes a wide range of health problems:

Ionizing radiation causes oxidative stress — and so do the chemicals Idaho National Laboratory workers were exposed to.

If you've been reading our newsletters, you know that strong and diverse human epidemiology shows elevated levels of cancers in radiation workers and other people exposed to ionizing radiation and at levels far below annual radiation protection limits. But let's talk about what chronic exposure to relatively low levels of ionizing radiation does at the cellular level: ionizing radiation causes oxidative stress. It is important to understand this because of the role that chronic oxidative stress plays in the progression of degenerative diseases. Ionizing radiation does not just cause cancer; it does not just cause DNA damage and genetic effects — ionizing radiation also causes many other diseases from heart disease to neurological diseases.

In addition to normal living that causes free radicals, ionizing radiation can vastly increase free radicals as can toxic chemicals. And workers at the Idaho National Laboratory since 1949 have been exposed to both ionizing radiation and various chemicals such as carbon tetrachloride and other chemical solvents and various other chemicals.

Chemicals were disposed of into the Snake River Plain aquifer starting in the early 1950s but were not monitored until the late 1980s. Workers were drinking a soup of radiological and chemical contaminants at various facilities. Worker monitoring of airborne chemical releases has been and remains deficient. See this detailed 2014 Hanford Tank Vapor report [1] for an idea of the issues involved with inadequate protection of workers at Department of Energy facilities, historically and continuing. Many of the Hanford issues apply to the INL especially where chemical separations of nuclear fuels was conducted.

The adverse health effects from receiving both radiological and chemical exposures have never been taken into account in compensation decisions for energy employee illness compensation. [2] Workers typically have few or no advocates to pressure DOE contractors to

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[1] Hanford Tank Vapor Assessment Report, SRNL-RP-2014-00791, Oct 30, 2014. http://srnl.doe.gov/news/releases/nr14_srnl-advisory-hanford-vapors-report.pdf

[2] 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

provide adequate worker protections. Workers who oppose shortcutting worker protections tend to find themselves no longer employed by DOE contractors. In Idaho, if a crafts union leader began to press for more health protections, they or their organizations risked having fewer work opportunities for DOE contracts.

Recent epidemiology of thousands of radiation workers found elevated cancer risk occurring at an average 200 mrem/yr. [3] An INL-specific study found radiation and nonradiation workers at the site had higher risk of certain cancers. [4] The US Nuclear Regulatory Commission and the Department of Energy maintain that their 5 rem/yr worker exposure limit is protective despite compelling scientific evidence to the contrary. [5]

Free radicals use up your body's stores of antioxidants and antioxidant enzyme systems. Couple this, say, with impaired thyroid function from breathing iodine-131 or ingesting it in milk, or ingesting iodine-129 in water and your body will have even greater difficulty. Add to this hexavalent chromium, another oxidizer, in your drinking water at the Test Reactor Area, INTEC, or Central Facilities. Or add carbon tetrachloride in your drinking water (or other chemical solvents) at the Radioactive Waste Management Complex, Test Area North, or other facilities. Workers were not told of the contaminated drinking water. [6]

Often when a worker with radiation and chemical exposures from the INL goes for medical help, their physician may have no reason to suspect ionizing radiation, heavy metal poisoning, or chemical toxins that the person may have been exposed to. Even if exposures are known, most doctors still may have no clue about how to take the exposure into consideration. Often the prescribed medications further tax the body's ability to detoxify toxins.

Basically, workers need to learn as much as they can about the cellular effects and decide for themselves whether they wish to devise strategies for enhancing their diet and nutritional support to improve their health. It is not too late for some people and both the quality of life and length of life may be improved.

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

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

[5] "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.

[6] Environmental Defense Institute report by Tami Thatcher, *The Hidden Truth About INL Drinking Water*, June 2015, http://environmental-defense-institute.org/publications/INLdrinkwaterR1.pdf

For a scientific discussion of radiation and its generation of reactive oxygen species, read this 2012 publication "Ionizing radiation-induced metabolic oxidative stress and prolonged cell injury." [7] For a discussion about what to do to help your body cope with excessive free radicals, I suggest you read this book: "Fukushima Meltdown & Modern Radiation: Protecting Ourselves and Our Future Generations" by John W. Apsley, II. [8]

I have prepared a report to introduce readers to some basics about the radiation levels, radionuclides in water and air, and chemicals in the drinking water at the INL and introduce readers to some of the research connecting how they might improve their ability to mop up the excess free radicals. The report is available on our website and is called "Radiological and Chemical Exposures That Workers at the INL May Not Have Known About." [9]

Please note that this article is for information and education only. It is not intended to provide medical diagnosis or medical advice and is not a substitute for seeking medical help.

Energy Employee Illness Compensation radiation cohort expanded, now includes 1963 to 1974.

Finally, the radiation cohort for the Chemical Processing Plant (CPP), now called INTEC, has been approved for 1963 to 1970, which is effectively 1963 to 1974 for CPP workers because of the broadly defined INL cohort for 1970 to 1974. **Having an approved cohort means that radiation dose reconstruction will not be required for a worker to qualify for compensation, alleviating the problem of inadequate records of radiation dose.** Certain conditions such as having a qualifying illness, any of 23 specified cancers, and certain conditions such as length of employment and having an assigned radiation film badge or radiation TLD dosimeter badge will still apply.

Two other special exposure cohorts (SECs) made it through the gauntlet at the Idaho National Laboratory last year. The approved SECs are for the INL between 1970 and 1974, and ANL-W workers for 1951 to 1957. [10] But there are many other years of operation and facilities at the INL that should qualify for an SEC, to make it easier for radiation workers to obtain compensation for radiation-induced illness.

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[7] Edouard I. Azzam et al., *Cancer Letter*, "Ionizing radiation-induced metabolic oxidative stress and prolonged cell injury" 2012 December. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3980444/

[8] John W. Apsley, II, MD(E), ND, DC, "Fukushima Meltdown & Modern Radiation: Protecting Ourselves and Our Future Generations," Temet Nosce Publications, 2011. ISBN 978-0-945704-97-2

[9] See Environmental Defense Institute report "Radiological and Chemical Exposures at INL that Workers May Not Have Known About – How health is harmed by uranium, plutonium, and other radiological and chemical exposures," March 2017. http://www.environmental-defense-institute.org/publications/Radchemreport.pdf

[10] 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

NIOSH has both combined and separated INL and ANL-W statistics and petitions, causing confusion. NIOSH has two petitions it is still reviewing. One is for INL, petition 219. The other is for ANL-W, petition 224. [11] [12] ANL-W is currently called the Materials and Fuels Complex, MFC but NIOSH uses the historical name.

The reason for including all of INL between 1970 and 1974 (but excluding ANL-W workers in this time frame), centers around work conducted at the spent fuel reprocessing plant call the Chem Plant, now called INTEC. Radiation badges for workers who worked at various INL locations do not necessarily reflect the fact that they may have also worked at the Chem plant. For this reason, the 1970 – 1974 SEC includes all INL workers with a radiation badge.

Argonne National Laboratory – West (ANL-W) was under Department of Energy, Chicago Office until 2005 when it was combined with other INL operations under the DOE Idaho Operations Office. The National Institute of Occupational Safety and Health (NIOSH) then subsequently combined INL and ANL-W in some ways but treats them separately in other ways. INL and ANL-W SEC investigations continue, but the track record for NIOSH at INL and other DOE sites gives reason for pessimism for timely resolution.

While there are time limits for some aspects of the SEC investigations, the Advisory Board for NIOSH radiation dose reconstruction does not adhere to time limits. In the case of DOE's Savannah River Site, SEC investigations have proceeded for over eight years without a decision. This leaves former radiation workers to die without compensation. And with long enough delay, their qualifying survivors may also die without compensation.

NIOSH uses a guise of technical jargon to argue that it is using a rational and technically-justified approach to deny claims while it is actually perpetuating DOE's coverup of radiation worker harm. **Listening to former workers testify is heartbreaking not only because compensation is denied but because these workers know that their claims are being wrongfully denied as NIOSH radiation dose reconstructions churns out the "no" answer based on inadequate worker radiation exposure records. Compensation can be awarded to survivors of the worker if the worker dies.** [13] [14]

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[11] See NIOSH home page for INL at http://www.cdc.gov/niosh/ocas/ineel.html#techdoc and petition at http://www.cdc.gov/niosh/ocas/ineel.html#pet219 and NIOSH/ORAU: Response to Observations presented in "Evaluation of Internal Monitoring for Fission and Activation Products among INL Claimants (1949-1970), SCA-SEC-2015-0074-E2, Revision 0" [112 KB (6 pages)] February 25, 2016

[12] See NIOSH home page for ANL-W at http://www.cdc.gov/niosh/ocas/anlw.html#sec and see the proposed 1951-1957 cohort at: http://www.cdc.gov/niosh/ocas/pdfs/abrwh/pres/2016/dc-anlwer-032316.pdf

[13] Employee radiation dose records, when containing excessive radiation doses have tended to be destroyed at DOE contractor facilities. See NIOSH public comment regarding the Idaho National Laboratory regarding the radiation dose records for the 1961 Stationary Low-Power 1 reactor accident firemen that could not be found years later, the 2011 ZPPR accident, various radiation exposure records at Rocky Flats that witnesses have given statements were destroyed, and others.

Attempts to restart Yucca Mountain begin — Last year's consent-based siting efforts all but forgotten

No matter that the mountain of Nuclear Regulatory Commission legal hearings brought by Nevada alone could cost more than $1.6 billion dollars, President Trump is attempting to restart the licensing process for a spent nuclear fuel repository at Nevada's Yucca Mountain. A proposed budget reserves $120 million to restart licensing activities.

Nevada is adding dozens more reasons to a list of 218 already accepted by the NRC about why transporting, storing and monitoring the most radioactive material in the US cannot be done safely at Yucca Mountain. A Nevada delegation is sponsoring a bill, the Nuclear Waste Informed Consent Act, to prohibit the federal government from putting a repository in a state that doesn't want it. [15]

"The Trump administration's attempt to revive Yucca Mountain is naïve and a waste of taxpayer dollars," said Sen. Catherine Cortez Masto (D-Nev) who successfully fought off the Energy Department for years when she was the state's attorney general. "It's a non-starter." [16]

Last year's consent-based siting meetings seem to be forgotten. At least they aren't pushing right now for a temporary storage site, which was part of the proposed strategy last year. [17]

John Kotek had led the series of meetings last year as acting assistant secretary for the Office of Nuclear Energy, Department of Energy. Kotek became well-known and well-liked in Idaho Falls as he had worked for the DOE-Idaho Operations office from 2003 to 2006. Kotek served on the Blue Ribbon Commission on America's Nuclear Future from 2010 to 2012 which had proposed the vague but likeable idea of consent-based siting of nuclear waste.

But all the acting that went on by the Department of Energy did not resulted in support for short-sighted temporary storage or much hope that a consent-based approach would find a permanent repository any time soon. It appeared doomed last year because of the way the final reports of the consent-based meetings were quietly dispatched. As of January 2017, John Kotek is no longer at the Department of Energy and he joined Nuclear Energy Institute.

Nevada's Nye County Commission Chairman Dan Schinhofen told the Associated Press that "It is important to note that nine of 17 Nevada counties **have asked for the science to be heard**

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

[15] Ken Ritter, AP, *The Idaho Falls Post Register*, "Nevadans in Congress united against nuke dump funding," March 18, 2017.

[16] Ralph Vartabedian, *Los Angeles Times*, "Decades-old war over Yucca Mountain nuclear dump resumes under Trump budget plan," March 29, 2017.

[17] Read our Environmental Defense Institute newsletters about consent-based siting of nuclear waste in the 2016 newsletters from July to October at http://www.environmental-defense-institute.org/edipubs.html , and our July 2016 consent-based comments at http://www.environmental-defense-institute.org/publications/EDIXConsentFinal.pdf

and that has been Nye County's position for years." He continued, "If science proves it's not safe, no one wants it. But if it is safe, who would say no to a multibillion dollar multi-generational public works project?"

Here's the rub. Science in the nuclear geosciences world is bought and paid for, just like in the pharmaceutical world. People know how often new drugs are introduced as safe and then pulled from the shelves after a few short years when it has become obvious that the new drug is causing more harm than good. Drug safety studies can be gamed in various ways such as by terminating those studies yielding unfavorable results.

The estimation of the migration of radioactive contaminants over thousands of years is fraught with uncertainties and only the most compliant geoscientists are invited to participate. The modeling approach could be done in a conservative manner in order to be more likely to be protective, but that isn't how it's done. Rather than protect water sheds with a high level of confidence, the contamination levels are likely to exceed advertised levels and more many years. Oddly, the even the scientists basically admit that their models are simply unable to predict what will happen over millennia, so they admit they just don't care what happens after they retire and die. After all, they are getting paid handsomely to act like burying the waste is being done scientifically — when it is really just a sham to convince the public that there's very little chance of harm.

Likewise, although the effects of ionizing radiation have been studied for decades, the science has long been subject to bias. The Department of Energy was suppressing human epidemiology that showed elevated cases of leukemia resulting from Nevada weapons testing fallout. No data have been kept on the rate of birth defects of radiation workers despite long known cases of elevated levels of birth defects, "Hanford babies," for example. Non-cancerous effects are often not studied except in countries outside the US. **The US nuclear industry actively avoids the truth about their currently accepted radiation health models which focus on cancer risk to adults and are shown again and again to underestimate the true health harm, particularly to children and to the unborn developing child.**

Trump declares war on EPA and the environment and embraces more spending on nuclear weapons

Trump doesn't' just want to save coal. He doesn't just want to promote fossil fuels. Trump wants to gut the Environmental Protection Agency, cutting 31 percent of its budget. And Trump is trying to throw out Obama's Clean Power Plan.

If US President Donald Trump gets his way, clean energy research and development is out. Big money for new nuclear weapons is in. Opposition is mounting, so it will be interesting to watch what happens.

Pretending to protect the environment, is unfortunately, a lot of what the EPA and state department of environmental quality do best. Example: the EPA is "studying" the potential health harm of hexavalent chromium, still, and has no date for completing this study. Meanwhile, children and adults in Idaho have died from cancer from drinking hexavalent chromium from the Idaho National Laboratory's historical operations at levels in drinking water that the EPA deemed safe. We need a stronger EPA to interpret and enforce environmental protections, not the opposite. People seem to forget that environmental protections protect human health and human life along with protecting the environment.

The State of Idaho is increasingly not the model to follow if you care about healthy people and healthy environment. Based on a poorly understood bill that won last fall, the Idaho legislature can now remove any and all regulations put forth by state agencies and do so because they deem that it might cause a rich constituent a few bucks. No one seems to understand that it will allow rich polluters to pollute and people will suffer when it is their child who suffers disease as a result. But the parents likely won't know that their child died from environmental toxins—so they will continue voting against the environment in order to save a few industry bigwigs a few bucks.

Nuclear regulatory commission accepts NuScale Application

The Nuclear Regulatory Commission (NRC) has accepted the NuScale Power's small modular nuclear reactor design application Wednesday March 15, 2017. The application was submitted late December. The 12,000-page document required several hundred million dollars to develop. More than $500 million came from the Department of Energy. The project is being promoted by the Utah Associated Municipal Power Systems Carbon Free Power Project.

The group includes Idaho Falls Power and other municipal power organizations in California, New Mexico, Oregon, Utah and Wyoming. Each of the 12 modules would produce about 50 megawatts. [18]

[18] Kevin Trevellyan, Reporter, *The Idaho Falls Post Register*, "Regulatory commission accepts SMR application – Review process expected to take 40 months to complete," March 16, 2017.

Will AP1000 or EPR reactors begin operating this year?

There are eight Westinghouse AP1000 reactors under construction, but so far, none have begun operating. Four of the AP1000 reactors are under construction in China, and one of these units, Sanmen unit 1 is expected to begin operating this fall.

Four of the AP1000 reactors are under construction in the US: 2 units at Georgia's Vogtle station and 2 units at South Carolina's V.C. Summer station. Construction of the plants is over budget and behind schedule, despite claims that the AP1000 plant's modular construction would control costs.

Westinghouse is mostly owned by Toshiba Corporation and the US Westinghouse group of Toshiba Corporation has filed for Chapter 11 protection from creditors March 29, 2017 because of inability to construct the four US plants within the promised schedule and cost. The plants are projected to begin operating by 2020. Westinghouse has written down $6.1 billion dollars for cost overruns during construction that began in 2012 at the US plants. In 2015, Westinghouse contracted with construction giant Fluor to help continue construction of the plants. [19] [20]

In a similar plight, former giant Areva, has several nuclear plants under construction but none yet to operate, resulting in crushing cost overruns and schedule over runs. An Areva nuclear design, the EPR is being built in Finland, China and France. None of the first-of-a-kind reactors is yet running. Areva was financially bailed out by its home country, France. [21] [22] [23]

Aging Mackay Dam is Awaiting High Runoff

The Mackay Dam is facing high spring runoff because of record snowfall in the valley's two major drainages. Snow depth is high, double the normal snow depths in the Copper Basin north of Mackey in the Big Lost River Drainage and Dry Fork in the Antelope Creek Drainage west of Moore. Peak runoff is expected to be early: the last week in May for the Antelope Drainage and

[19] World Nuclear News, "Westinghouse files for US bankruptcy protection," March 29, 2017. http://www.world-nuclear-news.org/C-Westinghouse-files-for-US-bankruptcy-protection-29031702.html

[20] Aaron Larson, Power, "CB&I Out, Fluor In at Vogtle and V.C. Summer Nuclear Power Plant Construction," October 28, 2015. http://www.powermag.com/cbi-out-fluor-in-at-vogtle-and-v-c-summer-nuclear-power-plant-construction-projects/

[21] World Nuclear News, "Areva outlines restructuring plan," June 15, 2016. http://www.world-nuclear-news.org/C-Areva-outlines-restructuring-plan-1506164.html

[22] World Nuclear News, "[Finnish utility] TVO welcomes partial award in Olkiluoto EPR arbitration," November 10, 2016. http://www.world-nuclear-news.org/C-TVO-welcomes-partial-award-in-Olkiluoto-EPR-arbitration-1011164.html

[23] World Nuclear News, "China revises commissioning dates of EPRs," February 22, 2017. http://www.world-nuclear-news.org/NN-China-revises-commissioning-dates-of-EPRs-2202174.html

mid-June for the Big Lost River Drainage. [24] This could put the aging dam, with its numerous design changes, to the test. Scant documentation is available concerning the design changes, but a portion of the original outlet piping was abandoned and a new route selected that put the outlet tower under a rock cliff outcrop. The dam's spillway elevation was also raised allowing the dam to hold more water, but creating more stress on the dam. Changes in the dam's design and its construction contractors years ago don't seem to be explained.

As of March 24, 150 cubic feet per second (cfs) was flowing into the reservoir, and about 400 cfs was being released in order to lower the water stored in the reservoir, in anticipation for higher runoff that will fill the reservoir later this spring.

The Mackay Dam is located 45 miles from the Idaho National Laboratory remains inadequately inspected despite putting Mackay town residents at risk and having the potential for inundating several Idaho National Laboratory nuclear waste burial, waste storage and operating nuclear facilities with several feet of flood water, warn David McCoy and Chuck Broscious, in a letter to Idaho Governor C. L. Butch Otter. [25]

The Mackay Dam was built about a century ago, is located near the Borah earthquake fault that caused a 7.3 earthquake in 1983. In addition to seismic design vulnerability, the dam is vulnerable to heavy spring runoff resulting in overtopping failure of the dam, internal erosion, and other failures. The Mackay Dam has serious levels of underseepage, water leaking out at the base of the dam.

Estimates of 100-year flooding range from about 6200 cubic feet per second (cfs) to 24,870 cfs. The 100-year flooding reaches numerous INL facilities within hours of onset of flooding and reaches several feet above grade. [26] Nuclear facilities that are vulnerable to the flooding include liquid storage tanks and highly soluble calcine at INTEC and an operating reactor at the ATR Complex. The waste waters will accelerate the migration of radionuclides in soil over the Snake River Plain Aquifer at the contaminated INTEC tank farm, the new ponds and burial at the Idaho CERCLA Disposal Facility near INTEC, extensive in soil contamination at INTEC and TRA, and waste above and below ground at the Radioactive Waste Management Complex.

If the storage of powdered calcine at INTEC were compromised by the flood waters, there would be no remediation likely to halt the release of soluble radionuclides over the aquifer.

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[24] Dianna Troyer, Reporter, *The Idaho Falls Post Register*, "Lost River Valley expects to find high runoff," March 24, 2017.

[25] Letter to Idaho Governor C. L. Butch Otter, from David B. McCoy, Esq., Board of Directors, Environmental Defense Institute, and Chuck Broscious, President, Environmental Defense Institute, Subject: Mackay Dam: A Preventable Disaster, February 14, 2017. http://www.environmental-defense-institute.org/publications/MackayDam2017.pdf

[26] Letter to Idaho Department of Environmental Quality from David B. McCoy, Esq., Board of Directors, Environmental Defense Institute, Subject: Docket 10HW-0109 including Mackay Dam: A Disaster Waiting to Happen. January 11, 2002. http://www.environmental-defense-institute.org/publications/MackayDam2002.pdf

Radionuclides would migrate through layers of soil and reach the aquifer, then flow downgradient to communities south of the INL.

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