Public Comment Regarding Application to the U.S. Nuclear Regulatory Commission on the "Holtec International HI-STORE Consolidated Interim Storage Facility Project," Docket NRC-2018-0052-0058

Comment submittal by Tami Thatcher on behalf of Environmental Defense Institute, Troy, Idaho, http://www.environmental-defense-institute.org/ July 30, 2018.

Summary

The Holtec draft Environmental Impact Statement is lacking basic information necessary in order for protection of human health and the environment. An adequate Environmental Impact Statement for the proposed Holtec consolidated storage facility in New Mexico must include the following:

- Include valid and conservative characterization of the **radiological consequences** of through-wall cracked canisters. The spent nuclear fuel is stored in canisters are described as "below ground" but in reality, are open to the environment to allow air circulation to cool the spent fuel in the canisters. Radionuclides released from a canister stored in the Holtec facility will be released directly to the environment.
- Include valid estimates of the number of through-wall cracked canisters likely to occur at the Holtec facility for the up-to-10,000 canister (or 100,000 metric tons heavy metal) facility
- Avoid reliance on optimistic conjecture stating that previously unsolved problems will be solved, such as the rather intractable problem of how to develop effective methods for canister inspections, especially in the face of years of failure to do so
- Include valid estimates of the increased risk of canister and other failures resulting from inadequate quality assurance practices that are already apparent
- Include conservative estimates of the number of rejected canisters that will not be accepted by the Holtec facility, that must stay behind at the stranded spent fuel sites (and therefore prevent the stated goal of these returning to green-field status)
- Acknowledge the impacts of high burn-up spent nuclear fuel and the complications of transportation and storage this may cause, both at the proposed Holtec facility and the implications for stranded fuel sites
- Acknowledge infrastructure costs as well as accident risks of spent fuel transportation to New Mexico in the light of recent years of increased rail accidents, especially involving more severe fires than previously thought likely, cask and canister quality problems and deteriorating roads and bridges.
- Acknowledge the scientifically supported human health radiological impacts to workers and the public that are higher than the currently accepted industry radiological health impacts
- Acknowledge that the service life of the proposed facility is perhaps forty years and that the radiotoxicity of the spent nuclear fuel is more than a million years and that there is a very high likelihood that no permanent spent nuclear fuel storage facility will be opened and remain open before the service life of the Holtec facility has elapsed, making its

operation intractable. And the risk that even if a permanent repository is opened, that it may not be able to accept all the spent nuclear fuel that has accumulated. Shipments to a repository can also be halted should a major transportation incident or problem with the repository arise. The EIS must explain what will happen to canisters stranded in New Mexico will mean regarding spread of radionuclides to the environment in New Mexico as canisters fail.

- An honest EIS must include the creation of a repository in New Mexico for the spent fuel rather than pretend that the spent fuel shipped to New Mexico will soon leave for a repository in another state.
- Acknowledge the imperative need to phase out nuclear energy in light of the peril facing communities near stranded fuel sites and Holtec's proposed facility in New Mexico. Citizens in other countries have the sanity to phase out nuclear power plants.

Background about the Proposed Holtec Facility for Dry Storage of Spent Nuclear Fuel in New Mexico

Holtec proposes an up-to-10,000 canister storage facility (or 100,000 metric tons heavy metal) for spent nuclear fuel and greater-than-class C nuclear waste in New Mexico, [1] some 38 miles from where another facility is proposed to be operated by Waste Control Specialists, in Andrews, Texas.

The dry storage of spent nuclear fuel will be in canisters placed vertically somewhat below grade and must maintain open vents to allow the air flow necessary to cool the canisters. It is important to understand that when the storage is described as "below ground" that the stored canisters are and must be in contact with circulating air. Any breach of a canister in the Holtec facility will result in a direct release of radionuclides to the environment to blow in the wind and that is a permanent release to the environment. Inadequacy of the monitoring to identify the magnitude of the releases from canister failure coupled with failure to conduct epidemiology may hide the truth but it does not reduce the actual harm to people living nearby.

The desire to move spent nuclear fuel away from now closed nuclear reactor sites is understandable; but none of the safety problems with dry fuel storage are solved by moving spent fuel canisters, some already compromised, to consolidated storage in New Mexico in conjunction with leaving the rejected canisters at the stranded fuel sites. The vulnerability of canisters stored near saltwater is not solved by moving the canisters after years of exposure to chloride.

The concept of filling a consolidated storage site when there is no licensed and operating spent fuel repository has long been known to be fool hardy. The nuclear waste, once in New Mexico, is likely to never leave the state. It may force New Mexico to open a repository.

[1] See Docket NRC-2018-0052 at https://www.regulations.gov/document?D=NRC-2018-0052-0058

Vague promises to develop meaningful inspection techniques for canisters sometime in the future is unacceptable. The NRC must create and enforce regulations that protect communities by requiring the design, inspection and contingency methods to keep canisters from leaking and to ensure the containment of any that do.

Canister Leakage is Certain, But Radiological Consequences Not Yet Characterized

The Holtec study of dry storage risks omitted accidents involving canister leakage from chloride-induced stress corrosion cracking. [2] Furthermore, the NRC has not published analyses characterizing the **radiological consequences** of a through-wall crack in a canister or other degradation accident scenarios. A 2017 EPRI report stated that "The potential consequences associated with unmitigated [chloride-induced stress corrosion cracking] CISCC of canisters have not been specifically analyzed. The CISCC degradation scenario could include through-wall cracking, followed by loss of inert backfill overpressure, air ingress, and reduced heat removal capacity." [3]

The NRC has yet to complete a study of the radiological consequences of a through-wall crack in a canister. Still unknown are what the rate of leakage of radionuclides will be, which radionuclides will be released (gaseous and volatiles initially and the rest as the fuel fails?), what will the total radionuclide release be, what role the condition of the spent fuel initially will play, what will happen to the fuel condition following the leak, and the vulnerability of hydrogen explosion.

How Many Canisters Will Leak at the Holtec Facility?

There has been acknowledgement by the NRC that canisters will leak. There just has not been an estimate of how many canisters will leak. How can a valid EIS be prepared without estimating the number of canisters expected to leak over the facility life?

At the June 13 meeting of the U.S. Nuclear Waste Technical Review Board held in Idaho Falls, NRC's Darrel Dun stated that only a limited number of canisters would have problems. [4] He also stated that the canisters can be inspected, but he admitted that the canisters in dry storage less than 20 years and prior to re-licensing had not been inspected at San Onofre, but that the NRC *was now studying ways that inspections could be performed*. It is supposed to be reassuring that the NRC is now trying to find ways to inspect the spent fuel dry storage canisters for cracks.

---

[2] This "Pilot" analysis left out aging and sabotage and wrongly assumed there was no corrosion mechanism to break a canister. A. Malliakos, NRC Project Manager, "A Pilot Probabilistic Risk Assessment of a Dry Cask Storage System at a Nuclear Power Plant," NUREG-1864, Published March 2007. https://www.nrc.gov/docs/ML0713/ML071340012.pdf But that's OK – it was only a Pilot study…

[3] Electric Power Research Institute (EPRI), *Dry Cask Storage Welded Stainless Steel Canister Breach Consequence Analysis Scoping Study*, November 2017, 3002008192 on www.epri.com, Publicly Available. It states that the amount of radioactive gas that may escape a spent fuel canister with a though wall crack has been previously guessed to be from less than 1 percent per year to 60 percent per year.

[4] Darrell Dunn, U.S. Nuclear Regulatory Commission presentation to the Nuclear Waste Technical Review Board (NWTRB) meeting held in Idaho Falls on June 13, 2018. "NRC Perspective on a National Program to Transport Spent Nuclear Fuel and Radioactive Materials,"

Inability to Perform Adequate Inspection of Canisters Assures Canister Failure

An adequate Environmental Impact Statement for interim spent nuclear fuel storage at a proposed Holtec facility in New Mexico must not ignore the realities of imminent — perhaps within two decades — fuel storage canister failure due to chloride-induced stress corrosion cracking or other canister vulnerabilities.

The proposed new Holtec facility in New Mexico is not providing any means for replacing a faulty canister. In fact, they don't even have the technology in place to detect crack development. Despite the claim that they are trying to develop canister inspection methods, the reality is that we may only learn of a through-wall cracked canister because it is leaking radionuclides into the atmosphere. Despite this, the trend in the U.S. nuclear industry is to reduce air monitoring around canisters to only once a quarter and only at the air inlet and not the air outlet of the dry storage units.

The Nuclear Regulatory Commission has licensed dry storage facilities without adequate technical basis for design of the spent fuel canisters. The NRC expected that the canisters would be shipped to a repository by 1998. The industry has been, belatedly, studying the susceptibility of the spent nuclear fuel dry storage canisters to chloride-induced stress corrosion cracking. [5] [6] [7] [8] Neither the Holtec facility planned for New Mexico nor dry storage of spent nuclear fuel around the country have the capability to conduct effective inspections to detect canister cracking. They do not have the capability to repair a partially or fully cracked canister, and the NRC does not require or endorse any method of isolating a canister. [9]

For spent nuclear fuel storage near the ocean coast, all three criteria are met for localized corrosion to create a through-wall crack, and through-wall cracking may fail the canister with sixteen years of crack initiation. [10] I worked at a Department of Energy nuclear facility that

---

[5] Nuclear Regulatory Commission, Darrell S. Dunn, August 5, 2014 "Chloride-Induced Stress Corrosion Cracking Tests and Example Aging Management Program," August 5, 2014 https://www.nrc.gov/docs/ML1425/ML14258A082.pdf

[6] Electric Power Research Institute (EPRI), *Aging Management Guidance to Address Potential Chloride-Induced Stress Corrosion Cracking of Welded Stainless Steel Canisters*, March 2017, 3002008193 on www.epri.com, Publicly Available.

[7] Electric Power Research Institute (EPRI), *Welding and Repair Technology Center: Friction Stir Welding of Degraded Dry Cask Storage System Canisters*, August 2017, 3002010734 on www.epri.com, Publicly Available.

[8] J. Renshaw and S. Chu, Electric Power Research Institute (EPRI), Presentation: "Monitoring and Aging Management of Spent Fuel," 33rd INMM Spent Fuel Management Seminar, January 24, 2018. https://www.inmm.org/INMM/media/Documents/Presenations/Spent%20Fuel%20Seminar/2018%20Spent%20Fuel%20Seminar/1-24-18_0950-2-Renshaw-Monitoring-and-Aging-Management-of-Spent-Fuel.pdf

[9] Myron M. Kaczmarsky, Holtec, presentation to the Nuclear Waste Technical Review Board meeting in Idaho Falls on June 13, 2018, "Integrated Planning for Packaging, Transportation, and Storage of Commercial SNF at an Interim Storage Facility." They were planning on a version of H.R. 3053 to expand Yucca Mountain from 70,000 to 110,000 metric tons, give DOE full control of public land, authorize the DOE to store SNF at an NRC-licensed interim storage facility owned by a nonfederal entity.

[10] Kristina L. Banovac, NRC to Anthony Hsia, NRC, Memorandum: Summary of August 5, 2014, Public Meeting with the Nuclear Energy Institute on Chloride Induced Stress Corrosion Cracking Regulatory Issue Resolution Protocol, September 9, 2014. https://sanonofresafety.files.wordpress.com/2013/06/ml14258a081-8-5-14meetingsummary.pdf or https://www.nrc.gov/docs/ML1425/ML14258A081.pdf "Based on estimated crack

unexpectedly discovered stress corrosion cracking indoors and nowhere near an ocean in safety class stainless steel piping that occurred simply because of check valves allowing in some groundwater that had not been demineralized.

In order for stress corrosion cracking to occur, three conditions must be met: (1) a sufficiently aggressive chemical environment, (2) the metal is susceptible to SCC, and (3) sufficient tensile stress must be present. A published in 2016 found that all three conditions are present for at least some of the spent nuclear fuel dry storage sites. [11]

While other countries (Germany, France, Japan and others) had decided to use thick walled cast iron canisters that can be repaired if cracks develop, the U.S. NRC licensed thin walled stainless steel dry storage canisters knowing that there was no approved method for repairing the canister or replacing the canister. Even if a fuel pool were required to be available (and there is no requirement for a pool to remain available), it may not be known whether fuel could be safely extracted from the canister. [12] [13] [14] [15]

At dry fuel storage sites around the U.S. as well as at the facility proposed by Holtec, so far there is no way for canisters to be effectively inspected for cracking. [16] [17] Holtec has pointed to NUREG-1864 as the probabilistic risk assessment for dry cask storage despite the fact that it omits consideration of aging effects, stress corrosion cracking, sabotage, etc. Holtec has no approved provision for isolating a canister leaking radionuclides. They have no way to transport a compromised canister. The NRC also assures people that the number of compromised canisters *will be limited and the corrective actions necessary to return to normal operations will be taken*. [18] NRC has no specific estimates of the risk (likelihood or consequence) of canister cracking and has no specific plans to address isolating or repairing a cracked canister.

---

growth rates as a function of temperature and assuming the conditions necessary for stress corrosion cracking continue to be present, the shortest time that a crack could propagate and go through-wall was determined to be 16 years after crack initiation."

[11] D. G. Enos and C. R. Bryan, Sandia National Laboratories, "Final Report: Characterization of Canister Mockup Weld Residual Stresses," SAND2016-12375R, November 22, 2016. http://prod.sandia.gov/techlib/access-control.cgi/2016/1612375r.pdf

[12] See the petition Ray Lutz, Citizens' Oversight, PRM-72-8, Position White Paper by Citizens' Oversight, "A New Strategy: Storing Spent Nuclear Fuel Waste," January 2, 2018.

[13] See this power point presentation by Erica Gray: https://www.nrc.gov/public-involve/conference-symposia/dsfm/2015/dsfm-2015-erica-gray.pdf

[14] See Donna Gilmore on thin walled canister versus thick walled canisters used in other countries at https://sanonofresafety.org/

[15] More nuclear "qwap" about canisters near the coastline https://documents.coastal.ca.gov/reports/2017/10/w9a/w9a-10-2017-corresp.pdf

[16] See SanOnofreSafety.org

[17] Krishna P. Singh, Ph.D. and John Zhai, Ph.D., Holtec, "The Multipurpose Canister: A Bulwark of Safety in the Post-9/11 Age," 2003. (begins on 8th page of the link which is compiled by Dr. Fred Bidrawn, Ph.D., Revision 1 March 28, 2018.) https://publicwatchdogs.org/wp-content/uploads/2018/06/holtec-response-to-queries-on-shim.pdf

[18] Darrell Dunn, U.S. Nuclear Regulatory Commission presentation to the Nuclear Waste Technical Review Board (NWTRB) meeting held in Idaho Falls on June 13, 2018. "NRC Perspective on a National Program to Transport Spent Nuclear Fuel and Radioactive Materials,"

The risk of canister failure is not just about failure will occur following long-term neglect. The airborne release of radionuclides from the canisters within a decade or two should be expected. And the opening of a consolidated storage facility that slowly accepts some selected canisters while rejecting others that then remain a stranded fuel sites still leaves the U.S. with the wide-spread problem of spent fuel canister failure from aging mechanisms such as chloride-induced stress corrosion cracking. It is not a matter of if a canister will leak (and the NRC has acknowledged this [19]). It is a matter of how many canisters and what amount of the radionuclides in the spent fuel will be released.

Poor Quality Assurance on Casks and Canisters

Holtec's track record on cask and canister quality assurance certainly appears questionable and the NRC has enabled shoddy construction practices. [20] Where is the NRC's risk assessment of the risk of various weld and other defectives in canister and cask manufacture?

Recently, after loose pins were found in canisters by Edison at San Onofre, it was discovered that Holtec had modified the canister design without getting NRC approval for the modification that failed. Holtec did not discover the failed pins and had approved the defective canisters for use. [21] Basically, citizens cannot expect that the approved design will be used or that even simple inspections to find canister flaws will be performed. The loose pin problem indicates not just the short-cut decision that the shim design change was "like-for-like," it also indicates extremely poor fabrication and quality control in the manufacture of canisters for storage of spent fuel.

Rejected Canisters Must Stay at Stranded Fuel Sites

Holtec proposes to accept only uncompromised loaded canisters at the new facility. Yet, the canisters that have been stored above ground may already have been exposed to factors that induce canister failure such as chloride-induced stress corrosion cracking. Other canisters that will be left behind at stranded fuel sites include pressurized water reactor (PWR) canisters that pose a criticality risk if water enters the canister. [22] The stated goal of returning stranded nuclear sites back to green field status will not be met when flawed canisters are not accepted at the Holtec facility. The number of rejected canisters must be estimated and the reality that there may

[19] Darrell Dunn, U.S. Nuclear Regulatory Commission presentation to the Nuclear Waste Technical Review Board (NWTRB) meeting held in Idaho Falls on June 13, 2018. "NRC Perspective on a National Program to Transport Spent Nuclear Fuel and Radioactive Materials,"

[20] Nuclear Information and Resource Service, Summary of Oscar Shirani's Allegations of Quality Assurance Violations Against Holtec Storage/Transport Cask, July 22, 2004. https://www.nirs.org/summary-oscar-shiranis-allegations-quality-assurance-violations-holtec-storagetransport-casks/

[21] Teri Sforza, Orange County Register, The Press-Enterprise, Why the redesigned San Onofre nuclear waste containers weren't approved by the feds, April 3, 2018 and updated June 4, 2018. https://www.pe.com/2018/04/03/why-the-redesigned-san-onofre-nuclear-waste-containers-werent-approved-by-the-feds/ Holtec decided that a design change that affected heat flow and reliability of the shims inside the canister was a "like-for-like" change that didn't require NRC approval. Holtec didn't tell Edison of the change. And Holtec didn't detect that the pins had failed and were loose in the canister. Holtec also is noted in the article as having to pay fines to TVA for an issue involving bribery.

[22] See HOLTEC Draft EA at https://www.nrc.gov/waste/spent-fuel-storage/cis/hi/hi-app-docs.html And see HI-STORE [Consolidated Interim Storage] CIS Facility Environmental Report, Attachment 4 to Holtec Letter 5025021 at https://www.nrc.gov/docs/ML1802/ML18023A904.pdf

be a large number of compromised canisters that remain stranded at former nuclear reactor sites must be acknowledged.

Complications from Increasing Spent Fuel Burnup Must be Described

The complications from the increasing levels of fuel burnup must be acknowledged. Higher burnup fuels may be more brittle and more susceptible to cladding failure, as well as having more fission product and transuranic radionuclide content in the fuel. The conditions that must be met in order for transportation, storage and contingency methods to apply must be clearly stated in regard to fuel burnup status and the lack of knowledge of how the increased fuel burnup is going to adversely affect the safety of storage, transportation, and any proposed contingency planning and must be clearly stated in the EIS.

The consequences of canister failure must adequately address how much of the radionuclide inventory in a canister is released (see Table 1).

Table 1. Spent fuel canister radionuclide inventory. (Source: NUREG-1864, 50,008 MWD/MTIHM (10-yr-cooled))

Nuclide	Bq	Ci	Nuclide	Bq	Ci
Co-60	1.61E14	3133	Pu-238	3.98E15	107440
Kr-85	2.77E15	74800	Pu-239	1.87E14	5060
Y-90	3.40E16	918000	Pu-240	3.47E14	9384
Sr-90	3.40E16	918000	Pu-241	5.23E16	1414400
Ru-106	2.72E14	7888	Am-241	1.20E15	32504
Cs-134	5.13E15	138720	Am-242m	1.97E13	532
Cs-137	5.54E16	1496000	Am-243	3.07E13	816
Ce-144	5.08E13	1374	Cm-243	3.02E13	816
Pm-147	3.37E15	91120	Cm-244	5.66E15	153000
Eu-154	4.15E15	112200			

Table notes: MWD is MegaWatt Days of reactor operation; MTIHM is metric tons initial heavy metal (uranium-238 and uranium-235); Bq is becquerel and is disintegration per second; Ci is curie; 1 curie is 3.7E10 bq. This is only a partial list of radionuclides in the spent fuel.

Chloride-induced stress corrosion cracking has been studied for many decades and there is no technical reason for the U.S. NRC to have ignored it. [23] And it is a fact that the proposed Holtec CIS is near the world's purest potash deposit is in Lea County, New Mexico. Potash includes potassium chloride. The proposed consolidated interim storage facility is very near the Waste Isolation Pilot Plant (WIPP) that is underground salt mine that is the Department of Energy

[23] INCO, The International Nickel Company, Inc., "Corrosion Resistance of the Austenitic Chromium-Nickel Stainless Steels in Chemical Environments," Copyright 1963. http://www.parrinst.com/wp-content/uploads/downloads/2011/07/Parr_Stainless-Steels-Corrosion-Info.pdf This report from 1963 shows that Types 304 and 316 stainless steels are susceptible to stress-corrosion cracking from exposure to potassium chloride. Corrosion and pitting occurred from exposure to many of the halogen salts including magnesium chloride, see Table IX p. 13 of the report.

disposal facility for defense wastes and it is the DOE's wish to expand the use of WIPP for spent nuclear fuel.

The Holtec documents have very misleading statements about criticality. [24] Various Holtec documents do not let the reader know just how unsafe, from a criticality perspective, the PWR fuel and in particular, the high burn-up PWR fuel is.

It actually helps to have a sense of humor if you understand what they are actually saying. Because the facts of the situation are diametrically opposed to the impression they are straining to create. They try to say that three unlikely failures must occur for criticality to occur in a canister. But actually, for this significant number of PWR canisters, not even two unlikely failures have to occur.

Often it is difficult to locate information about criticality risks in the web of Holtec documents. But PWR fuel that had to be loaded using borated water in the canister is vulnerable to criticality if water enters the canister. PWR fuel and in particular the high burnup PWR fuel that must be loaded with borated water in order to prevent a criticality during loading of spent fuel into the canister does not meet the double contingency criteria for preventing criticality. And the assurance that they won't transport a fuel canister that is obviously leaking — is no assurance whatsoever!

The available canister inspection techniques do not allow detection of stress corrosion cracking. This means that a flooding event that occurs when a canister has through-wall cracking, which is far more probable than the U.S. Nuclear Regulatory Commission and Holtec want to admit is far more probable than an *unlikely* event.

---

[24] Holtec safety analysis Proposed Rev. OA has the most information about criticality issues at https://www.nrc.gov/docs/ML1731/ML17310A222.pdf It is on the page listing Holtec safety and environmental report documents for the proposed consolidated interim storage of spent nuclear fuel in New Mexico at https://www.nrc.gov/waste/spent-fuel-storage/cis/hi/hi-app-docs.html See p. 3-8, 180 of 581 [8th page of 409] where Holtec talks about rejecting canisters: "Only canisters that have been determined to have no credible leakage shall be stored at the HI-STORE CIS facility. [Note that they use the word credible and with an event is not credible it should mean a 1-in-one-million-year likelihood or less. Yet canister through-wall cracking is a greater likelihood than "unlikely" or 1-in-100-year likelihood. The determination that the canister's confinement boundary is intact and effective to prevent intrusion of any fluids including water is performed at both the plant of origin and upon its arrival at HI-STORE." The problem is that Holtec admits they have no effective method for determining whether stress corrosion cracking is occurring. "Thus, while the canister is qualified to remain subcritical even in the presence of water by virtue of its fixed basket geometry and fixed neutron absorbers installed in the canister's Fuel Basket, the guaranteed absence of water inside the canister at the HI-STORE CIS facility makes any loss of criticality safety non-credible. Therefore, no additional criticality prevention measures are needed." But Holtec forgot about the PWR canisters when they made this statement. See Chapter 8, beginning at p. 8-1 that PWR high burnup requirements for transport won't stay subcritical if the canister is flooded. They just say that the acceptance tests for loading for transport will be enough – and basically all that will ensure is that the canister is not already leaking when they transport it. Failure 1: Flooding; Failure 2: Canister leaks (and Holtec does not have an effective inspection technique to determine whether stress corrosion cracking is in progress AND IT MORE THAN LIKELY IS; Failure 3: Canister transportation requirement requires that fuel remain subcritical even if canister full of water [but this is no protection because the NRC said for PWRs not to worry about meeting this important safety requirement). So, Holtec does not meet the double contingency requirement except for BWR fuel and perhaps some low burnup PWR fuel.

Those leaking canisters subjected to water infiltration associated with a transportation accident or with flooding during storage at the proposed storage facility will result in a criticality event that sustains more fissions and can have greater radiological release consequences than a canister with simply with through-wall cracking. However, when a canister has through-wall cracking that allows oxygen to enter the canister, the likelihood and consequence of hydrogen explosion remains undocumented. [25]

Transportation Risks

High temperature fires burning longer than 30-minutes are more severe than spent fuel transportation casks were designed to withstand. There is currently no way to avoid sending spent fuel casks along with any number of oil tankers connected in route.

An EIS is Must Describe Scientifically Valid Radiation Health Harm

It is important to know that the public and the misinformed radiation workers will be receiving life shortening radiation doses even at when below allowable radiation protection standards. The U.S. NRC fails to acknowledge compelling and diverse studies of human epidemiology that show more harm than accepted radiation protection standards predict. The radiation exposure from transportation of the spent fuel to Holtec poses a risk to the public.

Science requires the constant review of new evidence. But the U.S. NRC has not only ignored valid evidence from epidemiology in other countries and in multi-country studies, the NRC has refused to conduct epidemiology near U.S. nuclear facilities that would reveal increased childhood cancer and leukemia. The NRC ignores extensive and diverse evidence that there is more harm from radiation exposure to people than the U.S. nuclear industry has assumed.

The NRC continues to use radiation health models that underestimate the actual health harm to humans from radiation exposure. [26]

Radiation workers receiving an average 400 mrem/yr had greater cancer risk, yet the annual limit is 5000 mrem/yr for a worker. [27] The reproductive health effects are larger than workers realize,

---

[25] Transmittal by Susan Corbett, Sierra Club, "Docket NRC-2015-0070 Advanced Notice of Proposed Rulemaking (ANPR): Regulatory Improvements for Decommissioning Power Reactors Comments," March 21, 2016. See comments at http://www.nrc.gov/docs/ML1608/ML16082A004.pdf

[26] "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.

[27] 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 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.

in terms of sterility and in terms of increased risk of birth defects. And reproductive effects may be worse for workers whose work requires being near spent fuel canisters because of the potential for neutron exposure from the fissile material. The neutron exposure is not measured by typical radiation detectors.

The NRC marches on as though its emergency planning and environmental monitoring of radionuclide emissions are adequate, despite evidence to the contrary. The truth about the lives shortened by the Three Mile Island Unit 2 accident matters. [28]

The US Nuclear Regulatory Commission refuses to fund epidemiology studies near US nuclear power plants. The framework for the study was reported in "Analysis of Cancer Risks in Populations Near Nuclear Facilities; Phase I (2012). [29] After 5 years in planning for the study, the NRC decided it would take too long and cost too much. I think the NRC knows that a credible study would be the end of licensing new nuclear plants.

Epidemiology conducted in Europe includes the study 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 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 NRC issued a statement [30] explaining their decision which included this excuse: "For example, the German study initially found an association of increased childhood leukemia risk within 5 kilometers of the facilities. However, upon examination of the offsite exposures, the authors concluded the increased risk could not be explained by the releases from the facilities." In other words, it couldn't happen, so it didn't.

In Illinois, near the Braidwood and Dresden nuclear power plants, one family learned that many children in the area had cancer, brain cancer, and leukemia, after their daughter Sarah was diagnosed with brain cancer when she was seven. [31] Cindy and Joe Sauer lived in the area of these reactors from 1998-2004. Joe Sauer, a medical doctor, conducted his own epidemiology

[28] 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

[29] See cancer risk study at nap.edu.

[30] NRC Policy Issue Information SECY-15-0104, August 21, 2015 "Analysis of Cancer Risks in populations Near Nuclear Facilities Study," http://pbadupws.nrc.gov/docs/ml1514/ML15141A404.pdf

[31] Read about Cindy and Joe Sauer and what they learned about childhood cancer near nuclear power plants: http://ieer.org/resource/commentary/on-life-near-two-nuclear-power-plants-in-illinois/ and read Joe Sauer, MD, presentation on elevated cancer rates near the Dresden and Braidwood nuclear plants at http://ieer.org/wp/wp-content/uploads/2013/06/Health-Concerns-and-Data-Around-Illinois-Nuclear-Plants-slides-for-SDA-2013.pdf

study which showed clear increases in childhood cancers near the plants. Read his findings of elevated brain and other cancers near these plants and other studies. [32] [33]

An EIS for an "Interim" Storage Facility Must Acknowledge That A Permanent Disposal Facility May Not Open

For the proposed consolidated interim storage facility in New Mexico (or any other state), there is magical thinking that a disposal facility, i.e. Yucca Mountain, will be opening soon. Promoters of the Holtec facility don't mention that they are actually dooming New Mexico to have to dispose of the spent nuclear fuel in their state because its going to be that or have it blowing in the wind. An EIS that is not honest about the reality that a spent fuel repository will not open is simply not honest about the dire reality of hosting an "interim" consolidated storage facility.

The short service life of the Holtec facility, of perhaps 40 years, will be determined by the degradation of the concrete and spent fuel canisters and other equipment. The EIS must acknowledge what will happen as structures and equipment ages and what sort of provisions it has for that event. The radionuclides in the spent nuclear fuel that are radio-toxic for over a million years. The lack of provision for replacing aging structures such as the concrete the canisters are stored in and transported over or replacing the spent fuel canisters must be acknowledged.

By the way, the canisters used by Holtec are not likely to be accepted for disposal at Yucca Mountain even if the canisters are transportable decades from now. [34]

There is considerable lack of understanding by the public about the longevity and toxicity of long-lived radiative waste. It is not like natural uranium and thorium bound up in rock. The longevity and toxicity of radionuclides that dominant repository contamination migration studies include, for example, chlorine-36 (301,000 year), iodine-129 (17,000,000 year), technetium-99 (213,000 year), uranium-234 (245,500 year), neptunium-237 (2,144,000 year), americium-241 (432 year but decays to Np-237), plutonium-238 (87.7 year but decays to U-234), plutonium-239 (24,000 year but decays to U-235). We are not talking about a mere 150,000 years of radiotoxic material. The 10,000-year timeframe once proposed for Yucca Mountain was never adequate. And, even the one-million-year analysis timeframe for the waste migration may not be sufficient. The stable end product for uranium, thorium and plutonium is lead which is not good to have in your water either.

---

[32] Dr. Paul Dorman, "Why UK nuclear power plants may cause childhood cancer and leukaemia," May 16, 2011, **https://www.escosubs.co.uk/theecologist/promotion.asp?code=RF2011ROW**

[33] Steve Wing, David B. Richardson, Wolfgang Hoffman, "Cancer Risks Near Nuclear Facilities," Environ Health Perspect. 2011;119(4):417-421.

[34] Robert Howard and Bret van den Akker, Oak Ridge National Laboratory, *Symposium on Recycling of Metals arising from Operation and Decommissioning of Nuclear Facilities, Nykopiong Sweden, April 8-10, 2014*, "Considerations for Disposition of Dry Cask Storage System Materials at End of Storage System Life," 2014. http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/46/062/46062901.pdf Includes overview of U.S. dry storage systems for spent nuclear fuel. Notes that current canisters are not approved for disposal in a repository.

The Yucca Mountain repository is destined to fail because the geology of the porous mountain located above groundwater does not isolate the spent nuclear fuel which is not protected from corrosion. The low radiation doses from ingestion of contaminants from the proposed Yucca Mountain repository rely on titanium drip shields which have not been designed nor has the method for their installation been developed. It may be impossible to robotically install the relied upon titanium drip shields in the dusty, collapsing tunnels after a few centuries of cooling the SNF. Any realistic assessment of the likelihood of failure to install the titanium drip shields or failure of their adequate performance has not been included by the NRC's optimistic study of contaminant migration from Yucca Mountain. The NRC was supposed to review the Department of Energy's Yucca Mountain submittal but ended up preparing the cornerstone estimate of the repository's estimated radionuclide releases. [35]

The geology of Yucca Mountain does not prevent corrosion of the SNF or its containers and does not prevent the migration of radionuclides into nearby watersheds. The technology to monitor or retrieve the spent fuel does not exist. [36]

Arguments that migration of the contaminants from the repository will be acceptably low hinge on the assumed protection of 1,500 5-ton titanium drip shields to be robotically installed after the waste is in place. [37] [38]

---

[35] U.S. NRC, "Supplement to the U.S. Department of Energy's Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada," NUREG-2184, May 2016. https://www.nrc.gov/docs/ML1612/ML16125A032.pdf

[36] U.S. Nuclear Waste Technical Review Board, "Geologic Repositories: Performance Monitoring and Retrievability of Emplaced High-Level Radioactive Waste and Spent Nuclear Fuel," May 2018.

[37] State of Nevada, Office of the Governor, Agency for Nuclear Projects, "Report and Recommendations of the Nevada Commission on Nuclear Projects." December 10, 2010. https://www.leg.state.nv.us/Division/Research/Library/Documents/ReportsToLeg/2010/61-10.pdf

Excerpt: "For example, the current license application includes covering all the waste canisters with 11,500 titanium drip shields to protect them from rock fall and highly corrosive groundwater. But the drip shields themselves (estimate to cost $12 billion or more) are only proposed to be installed 80 to 100 years after the waste is put into the mountain, using yet-to-be developed robotics due to the extreme thermal and radiological environment that would exist within the emplacement tunnels. Despite this, potentially disqualifying conditions were reveal ed at the site (i.e., fast groundwater pathways, unacceptably high level potential for escaping radioactive gasses, recent volcanism, high levels of seismicity, etc.). To get around this, DOE petitioned Congress to exempt the site from health and safety regulations and then scrapped its own site evaluation guidelines altogether."

Another excerpt: "It posits the existence of titanium alloy 'drip shields', one 5-ton drip shield over each of the 11,500 waste packages, to ward off the corrosion-promoting water. However, these extremely expensive drip shields are not part of the current waste installation plan but are intended to be installed by a yet-to-be-designed, remote-controlled robotic mechanism about one hundred years after the wastes have been emplaced."

[38] The Department of Energy was planning to use a consent-based approach for siting spent nuclear fuel and high-level waste storage and disposal facilities including: (1) a pilot interim storage facility, (2) consolidated interim storage facilities, and (3) permanent geologic disposal facilities, one for commercial spent nuclear fuel and the other for defense spent nuclear fuel and high-level waste.

A consent-based approach was recommended in the 2012 Blue Ribbon Commission report on the nation's problem of spent nuclear fuel disposal, but no one knows what a consent-based approach entails. What we do know that even with local support, state opposition effectively stymied efforts to obtain authorization to construct the geologic waste disposal at Yucca Mountain at Nevada and prevented a proposed interim storage site at Skull Valley, Utah. The DOE held meetings in 2016 around the country seeking public input on the consent-based process, including one in Boise, Idaho. The Department of Energy successfully disposed of the consent-based

(Footnotes continued) [39] [40] [41] [42] [43] [44]

Despite any appearance of progress toward a repository, there are numerous ways that removal of spent nuclear fuel from either stranded fuel sites or consolidated interim storage may continue to be delayed: failure to grant a license for permanent storage, delayed licensing, construction delays, lack of funding, delays in licensing or procuring transportation overpacks, or an accident that causes an interruption in shipping. Needed roads and railways don't necessarily connect the utility to the highway or railway or may be inadequate for the heavy loads.

The EIS must acknowledge that once the spent nuclear fuel is at a consolidated interim storage site, it will likely force that state to open a permanent repository. New Mexico, while accepting the burial of transuranic defense waste at WIPP, has opposed burial of spent nuclear fuel. But once the airborne radionuclides are blowing in the wind from leaking canisters, and there is no way to transport damaged canisters or the aging fuel in the canisters, New Mexico may be forced to allow burial of spent fuel in underground salt.

The amount of spent nuclear fuel considered in the environmental analysis has assumed the amount of spent fuel that has already been created and that would be created by existing plants prior to their end of life. An environmental analysis must also evaluate the consequences of not phasing out new construction of nuclear power plants.

Sincerely,

Tami Thatcher, Idaho Falls, ID, on Behalf of Environmental Defense Institute, Troy, ID
http://www.environmental-defense-institute.org/

---

approach and the public comments collected following the appointment of Rick Perry as the Secretary of Energy in 2017.

The majority of the spent nuclear fuel is from commercial electricity generation from US nuclear power plants. As of 2013, there was 70,000 metric tons heavy metal, enough for the stymied Yucca Mountain repository. The inventory is expected to roughly double as the existing fleet of US nuclear reactors operates for its expected life. Utilities are winning billions in compensation from the DOE over the continuing costs of storing the spent nuclear fuel because of the DOE's failure to provide a disposal facility.

The rest of the spent nuclear fuel is from DOE research and defense reactors, including nuclear submarines and carriers. The DOE's high-level waste is in various forms ranging from liquid waste at Hanford awaiting vitrification, highly soluble powder-like calcine at Idaho and vitrified waste as other sites.

[39] Before ending the consent-based siting effort, information found about the Department of Energy's consent-based siting at www.energy.gov/consentbasedsiting and its Integrated Waste Management and Consent-based Siting booklet at http://energy.gov/ne/downloads/integrated-waste-management-and-consent-based-siting-booklet

[40] State of Nevada's website reflecting its opposition to Yucca Mountain, see http://www.state.nv.us/nucwaste/

[41] Utah Department of Environmental Quality reflects state leaders' views and offers this information on its opposition to storage of spent nuclear fuel at the facility proposed on the Skull Valley Goshute Indian Reservation at http://www.deq.utah.gov/Pollutants/H/highlevelnw/opposition/concerns/concerns.htm

[42] See Yucca Mountain Environmental Impact Statement, DOE/EIS-0250F-S1.

[43] Department of Energy Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste, January 2013. p. http://energy.gov/em/downloads/strategy-management-and-disposal-used-nuclear-fuel-and-high-level-radioactive-waste

[44] Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy, January 2012. http://energy.gov/sites/prod/files/2013/04/f0/brc_finalreport_jan2012.pdf.