SUNSI Review Complete
Template = ADM-013
E-RIDS=ADM-03
ADD= Antoinette Walker-Smith, James Park, Cinthya Cuevas Roman, Jenny Weil

COMMENT (113)
PUBLICATION DATE: 9/4/2018
CITATION 83 FR 44922

# PUBLIC SUBMISSION

**As of:** 11/20/18 10:26 AM
**Received:** November 19, 2018
**Status:** Pending_Post
**Tracking No.** 1k2-96na-m572
**Comments Due:** November 19, 2018
**Submission Type:** Web

**Docket:** NRC-2016-0231
Waste Control Specialists LLC's Consolidated Interim Spent Fuel Storage Facility Project

**Comment On:** NRC-2016-0231-0220
Interim Storage Partners LLC's Consolidated Interim Storage Facility

**Document:** NRC-2016-0231-DRAFT-0293
Comment on FR Doc # 2018-22810

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## General Comment

The accident analysis for the dry storage of spent nuclear fuel is grossly inadequate by omission of canister drops during transfers and also by omission of high likelihood (expected) and high consequence canister leakage due to canister corrosion such as chloride-induced stress corrosion cracking. The radiological consequences of through-wall canister cracking must be included in the license application. Chloride exposure can occur before canisters are transported to Texas, or while in Texas due to rich pot-ash chloride in the southwest region. The extent to which the nation's Greater-Than-Class-C waste will be buried at the WCS Texas site must also be clarified in the license application because of the extensive release of long-lived radionuclides expected over time from disposal at the WSC site from upward diffusion of carbon-14, iodine-129 and technetium-99 (and other radionuclides). The service life of the proposed facility is unlikely to support the capability of transporting the spent nuclear fuel to a disposal site, if one is secured. "Interim" can be expected to mean many decades, if not forever. The consolidated interim storage facility will not solve the growing waste problem from using nuclear reactors to generate electricity.

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## Attachments

CommentNRC2018Texas

**Public Comment Regarding Interim Storage Partners LLC's Consolidated Interim Storage Facility, Docket NRC-2016-0231**

**Comment submittal by Tami Thatcher on behalf of Environmental Defense Institute, Troy, Idaho, http://www.environmental-defense-institute.org/ November 19, 2018. See https://www.regulations.gov/document?D=NRC-2016-0231-0220**

Interim Storage Partners LLC has submitted a license application for a Consolidated Interim Storage Facility for spent nuclear fuel and greater-than-class C waste at the Waste Control Specialists (WCS) site in Andrews County, Texas. [1] Interim Storage Partners LLC (ISP) is jointly owned by Orano CIS (51%) and Waste Control Specialists LLC (49%). [2] Orano was previously part of Areva, a company which no longer exists due to financial problems in failure to deliver on its promises in the nuclear industry.

The proposed Consolidated Interim Storage (CIS) [or Consolidated Interim Storage Facility (CISF)] for Andrews County, Texas [3] is similar to the Holtec facility proposed for New Mexico. The Waste Control Specialists site has low-level radioactive waste disposal now, and is under serious consideration for disposal of the nation's entire inventory of Greater-Than-Class-C waste. This license application for a Consolidated Interim Storage Facility at the Waste Control Specialists site in Andrews County, Texas must be denied by the U.S. Nuclear Regulatory Commission because the accident analyses contained in the submittal is inadequate. Specifically, accidents during canister transfers are inadequate. And, the high likelihood and high consequence accident involving spent nuclear fuel canister through-wall corrosion cracking has been omitted.

This license application for a Consolidated Interim Storage Facility (CISF), where the condition of the spent nuclear fuel (SNF) condition will not be monitored nor is canister repackaging capability available, must also be denied because the "interim" storage is likely to extend for many more decades beyond the forty years addressed by the license application. Many decades of storage, over which unacceptable degradation of canisters and structures will occur, are to be expected even in the best-case scenario that a permanent disposal site is secured. Without permanent disposal, the dry storage of spent nuclear fuel, as the NRC knows, will result in catastrophic radiological consequences.

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[1] Consolidated Interim Storage of Spent Nuclear Fuel at Andrews County, Texas, Docket NRC-2016-0231-0220 https://www.regulations.gov/document?D=NRC-2016-0231-0220. The documents associated with this are at https://www.nrc.gov/docs/ML1822/ML18221A408.html

[2] https://www.nrc.gov/docs/ML1822/ML18221A397.html

[3] Notice issued by the Nuclear Regulatory Commission (NRC) "Interim Storage Partners LLC's Consolidated Interim Storage Facility" Docket ID: NRC-2016-0231-0220, Comments due November 29, 2018. https://www.regulations.gov/document?D=NRC-2016-0231-0220 and Information related to the ISP consolidated interim storage facility (CISF) project can be accessed on the NRC's project web page at: *https://www.nrc.gov/waste/spent-fuel-storage/cis/waste-control-specialist.html and https://www.nrc.gov/docs/ML1709/ML17095A968.html*

**SNF STRANDED UNTIL PERMANENT DISPOSAL FOUND**

The license application is based on the faulty assumption that the spent nuclear fuel in canisters will be moved to a disposal site within a few years. The technical reality is that some of the canisters are going to leak, with catastrophic radiological consequences for the regions. The difficulty in securing and sustaining shipments to a disposal facility for the SNF is proven by decades of failure to secure disposal for spent nuclear fuel. And as the problem is studied more, the solutions are not appearing easier to obtain.

The WCS site in Texas is near the border of New Mexico and approximately 6 miles from the city of Eunice, New Mexico. The WCS site is within a few miles of the proposed Consolidated Interim Storage Facility in New Mexico by Holtec. Both Holtec and ISP are focused on a portion of the nation's SNF having compatible technology for SNF storage.

Importantly, these consolidated interim storage facilities do not solve the growing waste problem from generating electricity with nuclear energy. In fact, the only "benefits" of interim storage are the short-term profits that will go to a few individuals and the **appearance** of having addressed the nuclear waste problem.

The cost and the risk of moving the spent nuclear fuel twice, once to an interim facility and then to a disposal site, does not make sense. The reality is that we are no closer to securing Yucca Mountain as a disposal site now than we were 30 years ago. In fact, much of what has been learned about the proposed Yucca Mountain repository proves that it is technically not a workable site because the geology of the mountain will not confine the radionuclides over time.

The request is for a 40-year license which can be extended. The SNF and GTCC will be "temporarily stored …until the waste is characterized and shipped to a licensed disposal facility." [p. 3-3 of Ch. 3] But there may never be a licensed disposal facility. And even if there is one, service life of the facility may not support safe storage or transferring of the canisters to another facility.

Both the WCS site in Texas and the Holtec facility proposed in New Mexico are within a few miles of the Department of Energy's underground salt mine defense transuranic waste facility, the Waste Isolation Pilot Plant (WIPP). It appears to me that the nuclear industry is hoping that New Mexico will be less resistant to allowing the disposal of SNF in WIPP once SNF canisters at the Holtec and/or WCS facility are leaking radionuclides into the air.

The initial phase of the ISP project at the WCS facility is limited to 5,000 metric tons (MT) of spent nuclear fuel from uranium or mixed oxide (MOX) fuel. Ultimately, 40,000 metric tons heavy metal (MTHM) are expected to be stored at the proposed facility. [4] Currently, fuel with assembly average burnup greater than 45 GWd/MTHM must be canned inside the canister which provides greater protection of the fuel, but that could be loosened later. Fuel with lower average burnup will be stored bare in the canister. And 231.3 MT (510,000 pounds) of Greater-Than-Class-C (GTCC) waste, in canisters, would be allowed.

[4] Chapter 3 of WCS Consolidated Interim Storage Facility Safety Analysis Report, Revision 2.

The SNF canisters are not likely to be accepted for disposal at Yucca Mountain even if the canisters are transportable decades from now. [5]

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.

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. [6]

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. [7]

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[5] 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.

[6] 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

[7] 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.

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. [8] [9]

(Footnotes continued) [10] [11] [12] [13] [14] [15]

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[8] 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 revealed 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."

[9] 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 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.

[10] 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

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

[12] 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

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

[14] 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

[15] 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.

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 license application 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 from either the proposed Holtec interim storage or the Interim Storage Partners interim storage at the Waste Control Specialists site in Andrews County, Texas, 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.

## INADEQUATE SNF STORAGE ACCIDENT ANALYSES

The radiological consequences that will result from inability to inspect, repair, prevent, or mitigate canister breach, both in the short term and in the long term has inexplicably been omitted from the license application.

This ISP proposal for an interim storage facility for SNF and GTCC at the WCS site in Andrews County, Texas, has incorrectly underestimated or omits **the likelihood** of canister through-wall cracking from exposure to chlorides, for example, via chloride-induced stress corrosion cracking. This ISP proposal also underestimates or omits the explanation of the **radiological consequences** of one or more canisters experiencing through-wall cracking. The facility has no way of preventing or mitigating the radiological disaster comparable to a severe nuclear reactor accident that will occur when through-wall canister cracking occurs.

The use of thin-walled canisters to store spent nuclear fuel remains a technology that the NRC approved that was never intended to serve for multiple decades of above-ground storage. The NRC remains untethered to reality as it optimistically assumes a permanent disposal facility will be available…soon.

To clarify, the SNF is typically put into sealed thin-walled metal canisters in the spent fuel pool at the nuclear reactor site. The spent nuclear fuel inside the canisters must be adequately cooled to prevent overheating of the SNF inside the canister. The canisters provide little radiation shielding so the canisters are transported inside shielded transportation or transfer casks and then transferred from the casks into the concrete storage units. Radiation exposure near the canisters even while shielded inside casks or storage units is still significant, especially for repeated exposures. In contrast to the canister method used predominantly in the U.S., in other countries, spent nuclear fuel was not placed in thin-walled canisters but placed in thick-walled containers that allow transfer of the SNF inside hot cells.

There are dozens of different cask designs and their performance in a transportation accident is based on computer modeling, not actual performance tests. As fuel enrichment has increased from about 3 percent to over 5 percent, and also the accompanying higher burnup (number of days of reactor operation), the risk of criticality inside casks has increased. In the past, a cask containing fuel could remain subcritical even if water infiltrated the cask. That is no longer true. High burnup fuel is now loaded into the cask underwater with chemically borated water to prevent criticality. Transportation accidents involving submersion in water will no longer remain subcritical. Flooding a SNF storage site will now result in a criticality if a canister leaks. This CISF states that they carefully selected the canister materials to be resistant from corrosion and that may be true. But the fact is that stainless steel is and has long been known to be vulnerable to rapid chloride-induced stress corrosion cracking that can proceed through the canister wall, and removing the barrier to water infiltration.

Importantly, the inert gas around the SNF inside the canister will be replaced by air, facilitating reactions in the SNF. The rate of release of the fission products and actinides from the canister to the open air has not been determined by the NRC. The rate and amount of the release of radioactivity from a leaking canister will be similar to a severe reactor accident, and its likelihood, for hundreds of canisters, is basically expected or anticipated. This high likelihood and high consequence would dictate that the canisters and storage configurations be redesigned — and this may explain why the NRC has avoided publishing the radiological consequences of a leaking canister.

The NRC, along with inadequate analysis of the likelihood and consequence of expected through-wall canister failure, has failed to adequately analyze canister transfer accidents. The acceptable drop height of a cask or transfer container with a canister inside does not define the drop height that would damage a canister (not inside a cask) during transfer. A canister can weigh 49 tons. [16] The NRC has now had to acknowledge that a canister drop is not an analyzed condition. This was lack of adequate accident analysis during canister transfers was identified by David B. McCoy, Executive Director, Citizen Action New Mexico, in a Request for a Public Hearing, Docket No. 72-1050; NRC-2016-0231 dated April 27, 2017.

The NRC's continued practice of allowing deficit canister transfer accident analysis was illustrated this year at the San Onofre nuclear station when a canister perched precariously after not being aligned properly to be lowered into dry storage. It has now been admitted by the NRC that the acceptable drop height for a canister is unknown. [17] Even if a canister is not dropped

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[16] From SanOnofreSafety.org, each canister is approximately 49 tons, according to the NRC August 24, 2018 San Onofre Inspection Report (ML18200A400).

[17] From SanOnofreSafety.org, The NRC stated: "*It was estimated that the canister could have experienced an approximately 17-18 foot drop into the storage vault if the canister had slipped off the metal flange [MPC Guide] or if the metal flange failed. This load drop accident is not a condition analyzed in the dry fuel*

during transfer, there appear to be opportunities to scratch or otherwise degrade the canister surface during transfers, which may hasten to propagation of through-wall cracks, which breach a canister after introduction of stress corrosion contaminants such as chloride, commonly found in salt, sea water, or the pot-ash rich soils around the Texas and New Mexico proposed CISF sites. As of yet, there are no effective methods of inspecting canisters for damage, nor is there any way to repair or replace a canister.

The SNF facility would be designed to use both horizontal storage of SNF canisters by TN Americas and vertical storage systems by NAC International. The major activities at the WCS CISF for horizontal storage systems will include the receipt of the MP187 and MP197HB transportation casks, the lifting of the casks onto transfer vehicles, moving the casks to the outdoor storage pad, and placing SNF canisters into the horizontal concrete storage vaults (NUHOMS). The SNF canisters would be shipped by rail to the CISF. The major activities at the WCS CISF for vertical storage systems will be the receipt and unloading of transportation casks, the transfer of SNF canisters from transportation casks to the vertical concrete casks, and the transfer and placement of vertical concrete casks on outdoor storage pads.

The nuclear industry wants to move most of the SNF away from populated areas to Texas or New Mexico. But they still want to expand the use of nuclear power and so the problem of where to dispose of spent nuclear fuel just expands, despite having more SNF right now than the proposed Yucca Mountain repository can hold. There are going to be canisters that can't be transported and canisters that leak in these populated areas before they are transported. So, the sacrifice of New Mexico and/or southwest Texas is really for nothing. Nothing, that is, except for some large profits in the pockets of some ISP owners in the short term.

ISP wants you to believe, without any references, that the canisters should last for at least 80 years. The fact is that once chloride-induced stress corrosion cracking starts, these canisters will be leaking within less than 20 years. They don't even plan to monitor for fission product release — you'll get the hint when your animals are dead or aborting their young or you are vomiting and your hair falls out. But don't worry — they will claim your dose did not exceed 5 rem — no matter what your radiation dose actually was.

The Interim Storage Partners license application is lacking basic information necessary in order for protection of human health and the environment and 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 facility will be released directly to the environment.
- Include valid estimates of the number of through-wall cracked canisters likely to occur at the facility.

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*storage system's Final Safety Analysis Report (FSAR)*." NRC Inspection Charter to Evaluate the Near-Miss Load Drop Event at San Onofre Nuclear Generating Station, August 17, 2018 (ML18229A203)

- 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 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 interim storage facility and the implications for other stranded fuel sites.

**Background about the Dry Storage of Spent Nuclear Fuel**

Interim Storage Partners 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, [18] 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 or horizontally in concrete structures for shielding and must maintain open vents to allow the air flow necessary to cool the canisters. It is important to understand that the stored canisters are and must be in contact with circulating air. Any breach of a canister in the storage 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 Texas (or 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 Texas or New Mexico, is likely to force New Mexico to open a repository.

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

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

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. [19] 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." [20]

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 Facility?**

There has been acknowledgement by the NRC that spent nuclear fuel canisters will leak. There just has not been an estimate of how many canisters will leak. How can a valid EIS or NRC license application 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*. [21] 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.

**Inability to Perform Adequate Inspection of Canisters Assures Canister Failure**

[19] 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…

[20] 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.

[21] 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,"

An adequate accident analysis for interim spent nuclear fuel storage at a proposed interim 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 facility at the WCS site in Andrews County, Texas 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. 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. [22] [23] [24] [25] Neither the ISP facility proposed for the WCS site in Texas, the Holtec facility proposed 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. [26]

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. [27] I worked at a Department of Energy nuclear facility that

[22] 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

[23] 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.

[24] 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.

[25] 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

[26] 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.

[27] 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 growth rates as a function of temperature and assuming the conditions necessary for stress corrosion cracking

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. [28]

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. [29] [30] [31] [32]

At dry fuel storage sites around the U.S. as well as at the facilities proposed by ISP and by Holtec, so far there is no way for canisters to be effectively inspected for cracking. [33] [34] 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*. [35] 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. The ISP license application is no better than the Holtec application.

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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."

[28] 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

[29] 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.

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

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

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

[33] See SanOnofreSafety.org

[34] 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

[35] 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 [36]). 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**

Nuclear cask and canister provider's track record on cask and canister quality assurance certainly appears questionable and the NRC has enabled shoddy construction practices. [37] 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. [38] 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**

NRC regulations prohibit transportation of damaged canisters. 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

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[36] 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,"

[37] 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/

[38] 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.

enters the canister. [39] The goal of returning stranded nuclear sites back to green field status will not be met when flawed canisters are not accepted at the consolidated interim storage facilities. The number of rejected canisters must be estimated and the reality that there may 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 license application.

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. [40] And it is a fact that the proposed ISP

[39] 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

[40] 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

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

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 can go critical is the canister is infiltrated with non-borated water.

The available canister inspection techniques do not allow detection of stress corrosion cracking.

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. [41]

## GREATER-THAN-CLASS-C WASTE DISPOSAL FOR ENTIRE NATION AT WCS SITE

The GTCC waste would be solid reactor-related waste consisting of activated reactor vessel internals and other in-core instrumentation. In this proposal for CISF there would be no liquid or process GTCC waste stored at the WCS CISF. The GTCC waste will be stored in canisters similar to the canisters used for SNF.

It is crucial to note that there is a separate project for shallow burial of the nation's entire GTCC inventory at the Andrews, Texas WCS facility. [42] In its Environmental Assessment of burial of

chloride. Corrosion and pitting occurred from exposure to many of the halogen salts including magnesium chloride, see Table IX p. 13 of the report.

[41] 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

[42] U.S. Department of Energy, Environmental Assessment for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste at Waste Control Specialists, Andrews County, Texas, DOE/EA-2082, October 2018. https://www.energy.gov/sites/prod/files/2018/11/f57/final-ea-2082-disposal-of-gtcc-llw-2018-10.pdf The inventory of GTCC and GTCC-like waste is about 12,000 cubic meters (420,000 cubic feet) in volume and contains about 160 million curies of radioactivity. "Since the site is in a semi-arid environment, most of the transport of radionuclides to the environment is expected to be through upward diffusion of volatile radionuclides, including helium-3, carbon-14, argon-39, krypton-85, iodine-129, and radon-222, to the surface rather than via groundwater." "The peak dose is dominated by upward diffusion of technetium-99." "Because of the geologic conditions at the site, as well as the license mitigation measures, releases would not be expected until well after most of the radionuclides had decayed away. Only very long-live [sic] radionuclides would be expected to remain…Transport of radionuclides from the waste to the surface or underlying groundwater would still be limited by diffusion through the unsaturated soils." The EA provides effective dose after loss of institutional control that increases over time, higher at 100,000 years after closure.

GTCC waste at the WCS facility, the Department of Energy writes about burial at the Andrews County, Texas waste site that "Because of the geologic conditions at the site, as well as the license mitigation measures, releases would not be expected to show up until well after most of the radionuclides had decayed away. Only very long-live [sic] radionuclides would be expected to remain."

The DOE supposes that since only those long-lived radionuclides would be a problem in the future, why would anyone object to poisoning people and all living things at a date beyond which the Department of Energy's staff will have long since retired and departed.

The Department of Energy does not trouble itself with the health of current populations, so why would anyone be surprised that is does not trouble itself with future generations? The problem is the extent to which these long-lived radionuclides in the GTCC waste will not be confined by shallow burial at the WCS facility. The burial depth will extend from 100 ft deep to near surface as containers of GTCC waste are stacked.

The problem is the extent that, especially the volatile radionuclides that migrate to the surface will be inhaled. The other problem is the extent that the long-lived radionuclides could migrate to groundwater through cracks in the clay (the "highly impermeable red-bed clay") below the buried waste. The Dockum, Ogallala, Pecos Valley, and Edwards-Trinity aquifers need to be protected. Ignoring the full range of WCS storage and disposal activities and ignoring the actual risks of so-called "interim" storage of SNF that omits highly likely and high consequence canister cracking that initiates a large radiological release is unacceptable and the license request must be denied.

With the NRC not knowing whether the nation's GTCC waste may be buried at the Waste Control Specialists waste site, and citizens generally not understanding the added GTCC waste issue at the WCS site, the NRC should not be adding to the regions radiation dose from opening interim storage of spent nuclear fuel. An interim storage facility for SNF involves transportation routine dose, transportation accident doses from a SNF canister, and the inevitable canister failure in storage at the interim storage site due to chloride-induced stress corrosion cracking of a canister, which can proceed through the thin-walled canister within 18 years.

## THE NEED FOR SCIENTIFICALLY VALID RADIATION HEALTH MODELS

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

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Because the radionuclides ingested are not delineated, the effective dose which may appear low may in reality cause serious developmental problems or premature death to children.

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.

Special note to radiation workers: Please understand what the nuclear industry is not going to tell workers: your life will be shortened by these exposures. And for your children's sake, have your children before you work near these installations, like the CISF proposed at the WCS site in Andrews County, Texas.

The NRC continues to use radiation health models that underestimate the actual health harm to humans from radiation exposure. [43]

Radiation workers receiving an average 400 mrem/yr had greater cancer risk, yet the annual limit is 5000 mrem/yr for a worker. [44] The reproductive health effects are larger than workers realize, 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. [45]

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). [46] 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

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[43] "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.

[44] 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.

[45] 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

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

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 [47] 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. [48] Cindy and Joe Sauer lived in the area of these reactors from 1998-2004. Joe Sauer, a medical doctor, conducted his own epidemiology 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. [49] [50]

## TRANSPORTATION ACCIDENTS

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.

The U.S. Nuclear Regulatory Commission has refused to conduct more rigorous testing of spent nuclear fuel transportation containers. After a National Academy of Sciences study strongly endorsed full-scale tests be conducted on spent nuclear fuel transportation casks in 2006 [51] and the U.S. Nuclear Regulatory Commission Package Performance Study suggested full-scale transportation accident tests in 2003, [52] so far as of 2018 there has been no testing performed to verify that shipping containers will perform as predicted by computerized analysis.

The NRC decided that full scale testing of severe accident conditions would be expensive and that Yucca Mountain is not happening anytime soon. The Blue Ribbon Commission report told the NRC that the status of the Yucca Mountain repository should not drive NRC's decision to not

[47] 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

[48] 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

[49] 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**

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

[51] National Academy of Sciences, *Going the Distance: The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States*, National Academies Press, 2006.

[52] U.S. Nuclear Regulatory Commission, *Package Performance Study Test Protocols*, NUREG-1768, 2003.

perform transportation accident testing because of their opinion that an interim storage site needed to be developed. [53]

Don't let the title of the 2014 report by Sandia Laboratory for the Department of Energy fool you. Absolutely no testing has been conducted. **In its report "Full-Scale Accident Testing in Support of Spent Nuclear Fuel Transportation," the Department of Energy spins a gibberish excuse that all they really need to do is convince themselves that the public perception of spent nuclear fuel transportation is satisfactory and therefore no full-scale transportation accident testing is needed.** [54]

Other countries don't just pretend to care about citizen safety — other countries have conducted more rigorous testing of spent nuclear fuel shipping containers and they impose far more restrictive speed limits and so forth for their transportation by truck or rail. See the U.S. Nuclear Waste Technical Review Board meeting presentation at the June meeting by the nuclear power program in Switzerland. [55]

In the U.S. an increasing number of severe train accidents have occurred. And crumbling road and bridge infrastructure is real.

The number of past spent nuclear fuel shipments in the U.S. for commercial spent nuclear fuel from 1964 to 1989 is 2623 casks shipments. [56] [57] Of these, 223 shipments were between 3.1 and 3.3 MTU with the remaining 2400 shipments less than 2 MTU per cask, usually far less.

There have been 850 naval spent fuel shipments, 236 U.S. research fuel shipments and 250 foreign research fuel shipments, totaling 1336 shipments.

Future spent nuclear fuel shipments of 10 MTU per cask involve much more fuel per cask and much more weight of the fuel and cask combination. In fact, should spent fuel shipping to a repository commence as planned, with 35,000 to 100,000 shipments over 25 years, there would be more spent nuclear fuel shipped in a single year than has been shipped in the U.S. since the

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[53] Blue Ribbon Commission on America's Nuclear Future, Report to the Secretary of Energy, 2012.

[54] U.S. Department of Energy, *Full-Scale Accident Testing in Support of Spent Nuclear Fuel Transportation*, Fuel Cycle Research & Development, Sandia National Laboratories, FCRD-NFST-2014-000375, September 2014. http://large.stanford.edu/courses/2017/ph241/watson2/docs/sand2014-17831r.pdf

[55] Mark Whitmill, Kernkraftwerk Gosgen Daniken AG (KKG), Switzerland, U.S. Nuclear Waste Technical Review Board Summer Board Meeting in Idaho Falls, June 13, 2018. See www.nwtrb.gov The government of Switzerland makes exacting requirements for cask design and requires that they "demonstrate that the casks will withstand all static and dynamic loads during normal operation and under hypothetical accident conditions." A double lid system is mandatory. They require sub-criticality for the most unfavorable cask arrangement and complete flooding. They require demonstrating adequate performance including resistance to aging effects during the planned usage period for all materials. They have far fewer cask shipments and far fewer miles to travel across their country than the U.S. Switzerland has voted to phase out nuclear energy.

[56] Science Applications International Corporation, Oak Ridge, Tennessee, "Historical Overview of Domestic Spent Fuel Shipments Update," ORNL/Sub—88-997962/1, July 1991. https://www.osti.gov/servlets/purl/5430848

[57] NEI webpage Factsheet at https://www.nei.org/resources/fact-sheets/safe-secure-transportation-used-nuclear-fuel says that the NRC says there have been 1300 safe SNF shipments in the U.S. based on NRC document NUREG/BR-0292, Rev. 2 at https://www.nrc.gov/reading-rm/doc-collections/nuregs/brochures/br0292/ It is unclear how the 1300 safe SNF shipments number was determined from the NUREG/BR-0292 document over the past 35 years.

first nuclear plants began operating. [58] And in that time, road, bridge, and rail infrastructure has been crumbling and rail accidents from human error and other causes increasing and have continued increasing since the NRC study reexamined accident frequencies in 2000. [59] The severity of accidents also has increased due to increased transportation of oil that sustains long burning high temperature fires.

The U.S. NRC knows that its transportation container requirements are not very stringent, but they expect the containers to withstand more serious fires than their regulations require. They claim that the likelihood of a release of radioactivity from a spent fuel container is one-in-one-billion. But they have also admitted that they assume that the plastic neutron shielding may be damaged during a fire. **But, they have carefully avoided explaining what this means to an emergency responder, in terms of neutron radiation dose and corresponding health and reproductive health effects. Neutron dose is not detected by typical radiation instrumentation.**

High burnup fuel (i.e., fuel with burnups generally exceeding 45 GWd/MTU) may have cladding walls that have become relatively thin from in-reactor formation of oxides or zirconium hydride. The maximum temperature is lower for high burnup fuel, 570 C. See NRC Interim Staff Guidance ISG-11, Rev. 3. [60] This may mean that transportation testing for lower burnup fuels may not be adequate for high burnup fuels. It also means that there may be pressure to accept higher radiological release likelihood and consequence from transporting higher burnup fuels because while arguing that the regulatory requirements are met, but the NRC is happy with regulatory requirements for transportation that don't provide safety in real world accident conditions. Various real-world accident conditions that have exceeded regulatory requirements are discussed in the presentation. [61]

On the NRC website, Office of Public Affairs, "Safety of Spent Fuel Transportation" February 2017 [62] they state that on the basis of studies that consider real world accidents (which the brochure does not identify) the brochure states that the NRC believes spent fuel can continue to be shipped safely. But the NRC has not studied accidents involving high burnup fuels above 45 GWd/MTU. And they want the public to believe transportation of spent nuclear fuel is safe — **despite the lack of regulations that would require transportation containers to be shown to actually meet real world accident conditions and despite the lack of testing to verify that modeling is adequate to show container performance.**

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[58] State of Nevada, Nuclear Waste Project Office, "Transportation of Spent Nuclear Fuel and High-Level Radioactive Waste to a Repository," Factsheet, 1999. http://www.state.nv.us/nucwaste/trans/trfact03.htm

[59] U.S. Nuclear Regulatory Commission, "Reexamination of Spent Fuel Shipment Risk Estimates," NUREG/CR-6672, 2000.

[60] U.S. Nuclear Regulatory Commission, Interim Staff Guidance-11, Rev. 3, "Cladding Considerations for the Transportation and Storage of Spent Fuel," 2003. https://www.nrc.gov/reading-rm/doc-collections/isg/isg-11R3.pdf

[61] Douglas J. Ammerman and Carlos Lopez, Technical Workshop for the 2016 NTSF Meeting held June 7-8, 2016, "Testing and Certification for SNF Transportation Containers," Sandia National Laboratories, SAND2016-5285PE, https://www.osti.gov/servlets/purl/1368738

[62] NRC website, Office of Public Affairs, "Safety of Spent Fuel Transportation" February 2017 at https://www.nrc.gov/docs/ML1703/ML17038A460.pdf#page=6&zoom=auto,-265,619

In addition to the unaddressed fuel cladding issues involving high burnup fuel, transportation safety issues **due to aging effects from years of dry storage beyond two decades** pose an unanalyzed problem for both low and high burnup spent nuclear fuel. The U.S. Nuclear Waste Technical Review Board stated in 2010: "The technical information currently available, together with the experience gained to date in the dry storage of used fuel, demonstrates that used fuel can be safely stored in short term and then transported for additional storage, processing or repository disposal, at least for low burnup fuel. **However, additional information is required in order to demonstrate, with similarly high confidence, that high burnup fuel can be safely transported and any type of used fuel can be stored in dry storage facilities for extended periods without the fuel degrading to the extent that it may not perform satisfactorily during continued storage and subsequent transportation**." [63]

Will emergency responders to spent nuclear fuel transportation accidents know their neutron dose? If you care about your reproductive health and you are an emergency responder to a spent nuclear fuel transportation accident fire, you may want to find out more about your potential neutron exposure and what it really means to your reproductive health as well as your overall health.

Neutrons are not stopped by lead or metal shielding. The neutrons are slowed by hydrogen. Therefore, the neutron shielding in a transportation case is made of plastic-like material. And the neutron shielding in a transportation cask is not assumed to survive for more than a few minutes after a fire.

In a U.S. Department of Energy document published in 2016, [64] it was stated that they made: "…**the assumption that the neutron shield disappears at the beginning of the fir**e, where neutron shields are typically hydrogenous materials which would provide some thermal shielding for minutes."

Some experts think the neutron shield will survive a fire. However, there are no requirements or testing to assure this. And there are so many variable container designs and fire accident conditions, that success in one event may not adequately inform you of the expected behavior in a different accident.

So, even if the SNF transportation cask/canister survive the fire and prevent the release of radioactive gaseous and particulates emissions from the spent fuel, and the gamma shielding of the container remains effective, the neutron dose could be large in any fire event involving spent

[63] United States Nuclear Waste Technical Review Board, "Evaluation of the Technical Basis for Extended Dry Storage and Transportation of Used Nuclear Fuel," December 2010. https://sanonofresafety.files.wordpress.com/2013/06/usnwtrb-evaloftechbasisforextendeddrystorageandtransportofusednuclearfuel2010-dec-eds_rpt.pdf

[64] U.S. Department of Energy, Nuclear Fuels Storage and Transportation Planning Project, "A Historical Review of the Safe Transport of Spent Nuclear Fuel," FCRD-NFST-2016-000474, Rev. 1 or ORNL/SR-2016/261, Rev. 1, August 31, 2016. See p. 61 at https://www.energy.gov/sites/prod/files/2017/03/f34/Enhanced%20safety%20record%20report%20-%20final%20public%20release_0.pdf

nuclear fuel. [65] Should the transportation cask/canister be breached, over 8 million curies could be at risk of being released. See NUREG-2125 [66]

Damage to the neutron shielding is not going to be visible, and your radiation detection equipment may not include the capability of detecting neutron radiation.

On the NRC website, Office of Public Affairs, "Safety of Spent Fuel Transportation" February 2017 [67] t**hey state that the dose to the most affected individual would not cause immediate harm** which means what exactly? That you won't necessarily die right away? **They state that there is less than 1 in 1 billion chance that radioactive material would be released in an accident** unless, of course, any of their many unvalidated assumptions turns out to be wrong.

Read more about neutron exposure and your health in the Environmental Defense Institute's August 2018 newsletter article "Neutron exposure during glovebox work and other handling of fissile material at the Idaho National Laboratory and Idaho Cleanup Project."

**SUMMARY**

In Summary, the ISP has no plan for aging management of degrading canisters, and no facility for SNF canister repackaging or replacement, i.e., no spent fuel pool or dry hot cell facilities when canisters fail.

The CISF would be located just across the boundary of New Mexico and close to the proposed Holtec dry storage facility and close to the Waste Isolation Pilot Plant (WIPP), although WIPP currently prohibits disposal of spent nuclear fuel.

New Mexico will effectively be stuck with the SNF whether at the N.M. Holtec facility and/or at the proposed Andrews County, Texas facility. Once canisters start leaking/exploding, likely within just a few years, New Mexico could be forced to accept the SNF for salt mine burial, despite government promises that WIPP would not accept SNF.

In another proposal, the Department of Energy would greatly increase the GTCC waste by disposing of the waste at the Waste Control Specialists facility at Andrews County, Texas, to include all of the nation's GTCC waste. See recently released DOE Environmental Assessment for sending the nation's GTCC waste to Texas. [68]

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[65] U.S. Nuclear Regulatory Commission brochure, NUREG/BR-0292 https://www.nrc.gov/docs/ML1703/ML17038A460.pdf Cites within http://pbadupws.nrc.gov/docs/ML1219/ML12192A283.pdf, http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr4829/, http://pbadupws.nrc.gov/docs/ML0036/ML003698324.pdf, and http://pbadupws.nrc.gov/docs/ML1403/ML14031A323.pdf

[66] U.S. Nuclear Regulatory Commission, "Spent Fuel Transportation Risk Assessment – Final Report," NUREG-2125, January 2014. https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2125/

[67] NRC website, Office of Public Affairs, "Safety of Spent Fuel Transportation" February 2017 at https://www.nrc.gov/docs/ML1703/ML17038A460.pdf#page=6&zoom=auto,-265,619

[68] Department of Energy, Office of NEPA Policy and Compliance, "EA-2082: Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste at Waste Control Specialists, Andrews County, Texas," DOE/EA-2082, October 2018. https://www.energy.gov/nepa/ea-2082-disposal-greater-class-c-gtcc-low-level-radioactive-waste-and-gtcc-waste-waste-control

The proposed consolidated interim spent nuclear fuel storage facility by Interim Storage Partners for the Waste Control Specialists site at Andrews County, Texas must be denied because of grossly inadequate spent nuclear fuel storage accident analysis and inadequate service life for 40 years for what will be stranded spent nuclear fuel at the WCS site.

The citizens studying this issue need to acknowledge the imperative need to phase out nuclear energy in light of the peril facing communities near stranded fuel sites and any proposed interim storage facility, whether in Texas, New Mexico, or elsewhere. Citizens in other countries have the sanity to phase out nuclear power plants.

Sincerely,

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