UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
Holtec International	)	Docket No. 72-1051
	)	
(HI-STORE Consolidated Interim Storage Facility)	)	
	)	
	)	

EXPERT REPORT AND *CURRICULUM VITAE*
OF ROBERT ALVAREZ

Attached are the February 23, 2019 Report of Robert Alvarez and his *curriculum vitae*.

Declaration of Robert Alvarez on the Holtec International Application for a Consolidated Interim Storage Facility License (Docket No. 72-1051)

I have reviewed the Application for a License and related documents regarding a Consolidated Interim Storage Facility (CISF) by the Holtec International (Docket No. 72-1051) in light of Holtec's admission that the only lawful way to finance the project was from the licensee owners of the waste using the CISF for interim storage.

I am familiar with the subject of spent power reactor fuel management and disposition and have experience as a senior federal official. I have also written about it in detail in several prior articles, which are attached to this memorandum.

I have extensive experience with the topic of spent power reactor fuel management in particular, and with the workings of the Department of Energy (DOE) more generally. While serving in the U.S. Department of Energy I was involved in providing analysis and other support to the Secretary of Energy regarding the storage and disposal of DOE and civilian spent nuclear reactor fuel. I currently serve as an Associate Fellow at the Institute for Policy Studies, and Adjunct Professor at Johns Hopkins University, where I teach a graduate course about nuclear non-proliferation.

I previously served as senior policy adviser to the Secretary of Energy and deputy assistant secretary for national security and the environment from 1993 to 1999. During this tenure, I led teams in North Korea to establish control of spent nuclear fuel containing weapons materials. I also coordinated the Energy Department's nuclear material strategic planning and established the department's first asset management program.

Before joining the Energy Department, I served for five years as a senior investigator for the US Senate Committee on Governmental Affairs, chaired by Sen. John Glenn, and as one of the Senate's primary staff experts on nuclear policies. In 1975, I helped found and direct the Environmental Policy Institute, a respected national public interest organization. I have published articles in *Science*, *Science and Global Security*, the *Bulletin of Atomic Scientists*, *Technology Review*, and *The Washington Post*. I have been featured in the television programs *NOVA* and *60 Minutes*. In 2003, as senior scholar at the Institute for Policy Studies, I co-authored an extensive report on reducing the storage hazards of spent power reactor fuel in the United States,[1] and subsequent reviews by the National Research Council have been in general agreement with our findings. [2] [3]

Speculative and Unsupported Assumption of U.S. Government Ownership

1 Robert Alvarez, Jan Beyea, Klaus Janberg, Jungmin Kang, Ed Lyman, Allison Macfarlane, Gordon Thompson, and Frank N. von Hippel, Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States, *Science and Global Security, 11:1–51, 2003*

2 National Research Council, Board on Radioactive Waste Management, Committee on the Safety and Security of Commercial Spent Nuclear Fuel Storage, National Academies Press (2006)

3National Research Council, Committee on Lessons Learned from the Fukushima Nuclear Accident for Improving Safety and Security of U.S. Nuclear Plants, Phase 2, National Academies Press (2016)

In my opinion, the License Application by Holtec falls far short of what is logically or legally required, in large part because it adopted a highly speculative view of its pre-disposal responsibilities for spent nuclear fuel, in which the United States Government will assume ownership and liability. As conceded by Holtec's representative and Nuclear Regulatory Commission (NRC) staff before a panel of the Nuclear Regulatory Commission's (NRC) Atomic Safety and Licensing Board, transfer of title of 8,680 to 173,600 metric tons (MT or metric tons uranium MTU) of power reactor spent fuel that would go to the Holtec CISF requires legislative changes [4] and is very likely subject to annual funding authorization and appropriations. The necessary terms and conditions of a consolidated interim spent nuclear fuel storage contract with the U.S. Government do not exist. Nor, is there any degree of certainty that such federal legislation transferring title will occur.

Under the Nuclear Waste Policy Act (42 U.S.C. 10101 et seq) "the *Contract for Disposal of Spent Nuclear Fuel and/or High-level Radioactive Waste"* states clearly that "the DOE has the responsibility, following commencement of operation of a repository…"[5]

This license application contains strong elements of speculation regarding the nonexistent contractual ownership by the DOE. Thus, the assumptions made in this license application relative to government ownership have no legal basis.

Generally, utilities paying their own way will have to address expectations as to the spent nuclear fuel canistering that would be less economically onerous if DOE were involved. The timing for shipment to Holtec's facility of high burnup fuel, and requirements of shipment integrity are interrelated and will be different if DOE is not directing the traffic. Private payers will have budget constraints and economic priorities that are different--and so affect timing of moving the fuel around-- from a scenario where DOE is the contractor. Holtec will bear responsibility for repackaging spent nuclear fuel (SNF) at its CISF site, requiring dry transfer system capability

4 U.S. Nuclear Regulatory Commission, Official Transcript of Proceedings, Docket No. 72-1051 IFSI, Albuquerque, NM, January 24, 2019, P 250

5 U.S. Department of Energy, Contract for Disposal of Spent Nuclear Fuel and/or High-level Radioactive Waste, https://www.energy.gov/sites/prod/files/gcprod/documents/New_Standard_Contract.pdf

close to the beginning of operations, something they presently have no intentions of developing until the end of the short term, or even longer.

Nuclear licensees face both technical management and liability costs that make it prohibitive to transfer spent nuclear fuel to a CISF temporary site. This declaration focusses on the physical management costs and does not include the additional transportation costs and risks which would be incurred if waste is moved to a CISF.

Failure to Address Life-Cycle Costs

There currently are approximately 80,150 metric tons of SNF stored at 75 reactor sites, at which 98 units remain operational.[6] Holtec proposes to store 8,680 MTU in the first of 20 phases, which would total 100,000 to 173, 600 MTU during the first, 40 year, license term.

As of 2012, spent nuclear fuel in the United States was estimated to contain a total of 851,000 PBq (23 billion curies) of radioactivity. [7] Each year about 2,200 MT of SNF are generated and is expected to reach a total of about 146,500 MT by 2048 containing more than 1,221,000 PBq (>33 billion curies).

A study in which Holtec was a participant provides estimated life cycle costs for a consolidated interim storage facility (CISF) containing approximately 5,000 MT. [8] The costs to be borne by the rate payer or tax payer are significant – about $2.4 billion over 40 years and $4.72 Billion over an 80-year period. (See Table 1) After 40 years, the life cycle storage cost per metric ton would average about $436,000.00. After 80 years the average per metric ton would average about $850,000.00 per metric ton.

6 Peter Swift, Recent developments in the disposal of high-level waste and spent nuclear fuel, U.S. Department of Energy, National Nuclear Security Administration, Sandia National Laboratory, October 18, 2017. https://www.energy.gov/sites/prod/files/2017/11/f46/Peter%20Swift%20PRACoP%202017%20final.pdf

7 U.S. Department of Energy, Nuclear Waste Technical Review Board, Commercial spent Nuclear Fuel (2017). http://www.nwtrb.gov/docs/default-source/facts-sheets/overview_snf_hlw.pdf?sfvrsn=15

8 FCRD-NFST-2014-000602, Revision 2 (2016), DOE Generic Design Alternatives for Dry Storage of Spent Nuclear Fuel, Appendix A-6 (2015)

Table 1

Estimated Costs for Consolidated Storage of "Stranded" Spent Nuclear Fuel

Reactor	Assemblies	Metric Tons	40 years	80 years
Haddam Neck	1019	413.5	$179,848,984	$ 351,220,675.00
Duane Arnold	2825	531	$231,234,408	$ 451,569,440.00
Lacrosse	333	38	$16,547,848	$ 32,315,704.00
Oyster Creek	4711	753	$327,908,580	$ 640,361,183.00
Yankee Rowe	533	127.2	$55,391,745	$ 108,172,566.00
Maine Yankee	1432	542.3	$236,155,215	$ 461,179,109.00
Zion 1&2	2226	1019.4	$443,917,807	$ 866,911,275.00
Kewaunee	1335	518.7	$225,878,131	$ 441,109,357.00
Songs 1,2&3	3855	1606.1	699,407,877	$ 1,365,848,733.00
TOTAL	18269	5549.2	$2,416,823,595	$ 4,718,688,042.00

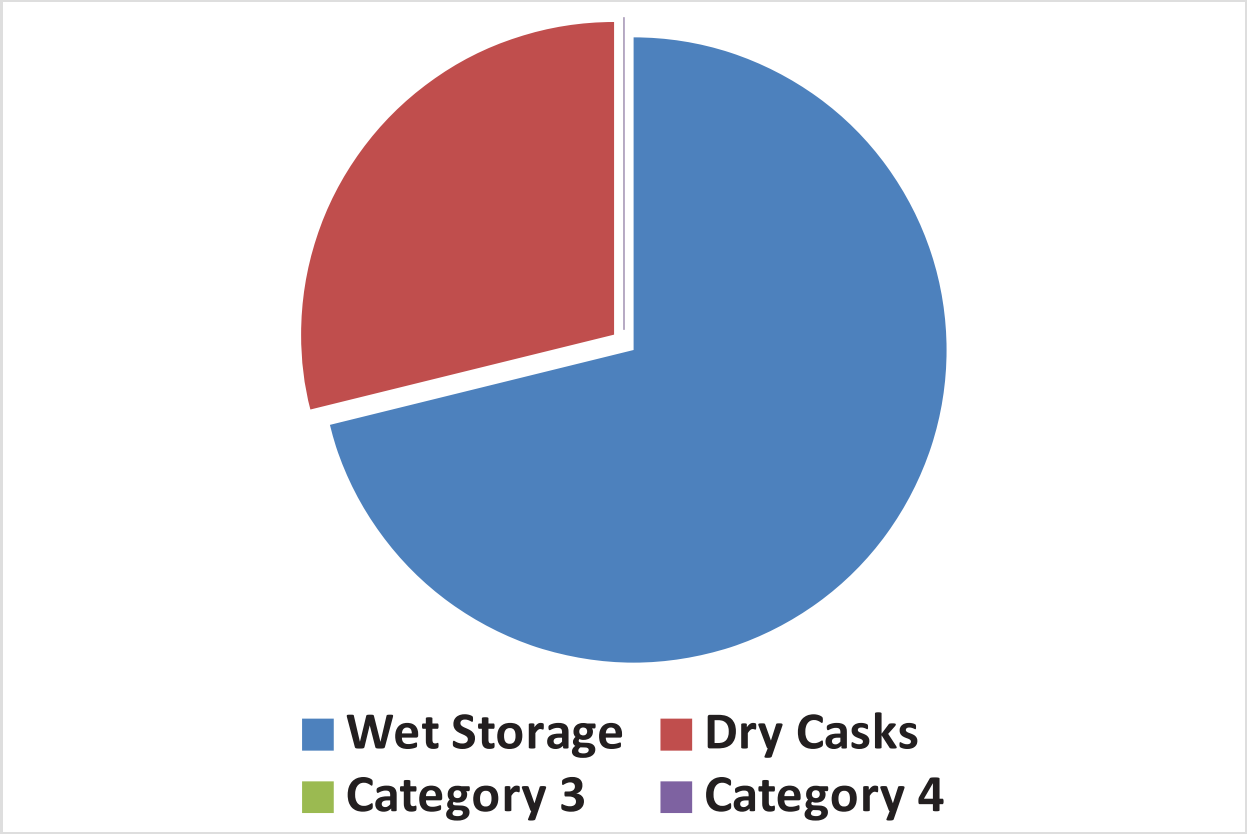
SourcWaste Control Specialists, License Application, Docket-72-150, FCRD-NFST-2014-000602, Revision 2 (2016), , DOE Generic Design Alternatives for. Dry Storage of Spent Nuclear Fuel , Appendix A-6 (2015)

Annual cost inflation =1.9%
Discount Rate=3.4%

According to data collected in the Energy Department, there are some 244,000 spent nuclear fuel assemblies that have accumulated since 1962. [9] Other significant costs remain for the emplacement of spent nuclear fuel in dry casks. As of December 2013, 71 percent (173,599 assemblies) were stored in reactor pools (See Figure 1). When the reactor is permanently shut down, freshly discharged and high heat spent fuel requires further cooling in the reactor's storage pool before being placed in dry storage canisters. Minimum cooling times before all spent fuel can be loaded into a dry cask depends on the amount of time it has been irradiated in the reactor core before discharge. For instance, six years of cooling in the storage pool at the Vermont Yankee plant, a recently closed boiling water reactor, is expected prior to loading the balance of spent nuclear fuel in dry casks, to cost $149 million.[10]

Figure 1

9 U.S. Department of Energy, Energy Information Administration, Nuclear Fuel Data Survey, GC-859, (2013)
10 Entergy Corporation, Post Shutdown Decommissioning Activities Report, Vermont Yankee Nuclear Power Station, December 19, 2014. https://www.nrc.gov/docs/ML1435/ML14357A110.pdf



Source: DOE GC-859 (2013)

Based on the assumption of DOE that a repository will be open by the year 2048, the onsite storage costs for a reactor operator, prior to opening of a repository, are substantially less than to send the spent fuel for consolidated interim storage

For instance, if the spent nuclear fuel remains on the site until DOE proposed opening of a repository occurs in 2048, the Columbia Generating Station (CGS) will have accumulated about 8,100 spent fuel assemblies stored in 119 casks. The estimated on site storage costs prior to removal for disposal, over 40-50 years based on data from Energy Northwest[11] and the U.S. Government Accountability Office, [12] is approximately $215 million (2015 dollars). By contrast,

11 The United States Court of Federal Claims, No 0410C, Energy Northwest v the United States, February 26, 2010, p. 3. http://www.uscfc.uscourts.gov/sites/default/files/opinions/DAMICH.ENERGY022610.pdf

12 U.S. Government Accountability Office, Spent Nuclear Fuel Management, Outreach Needed to Help Gain Public Acceptance for Federal Activities That Address Liability, P. 16. http://www.gao.gov/assets/670/666454.pdf

the cost of consolidated storage for the Oyster Creek spent nuclear fuel, which constitutes about 58% of the total to be generated by CGS over a comparable time period is approximately $328 million (See Table 1).

High Burnup Spent Nuclear Fuel

Significant uncertainties surround prolonged storage of high-burnup spent nuclear fuel. This fuel generally contains a higher percentage of uranium-235, allowing reactor operators to effectively double the amount of time the fuel can be used. Once it is used, high burnup significantly boosts the radioactivity in spent fuel and its commensurate decay heat. Of concern is the damage that high-burnup fuel may have on the cladding of the fuel. The Nuclear Regulatory Commission (NRC) and the nuclear industry do not have the necessary information to determine if prolonged storage of high-burnup fuel may damage fuel cladding and create leakage. Even NRC admits, "there is limited data to show that the cladding of spent fuel with burnups greater than 45,000 MWd/MTU will remain undamaged during the licensing period."[13] As of 2014 there were 37 reactor sites that lack approval for storage of high burnup SNF in dry casks.[14]

Research shows that under high-burnup conditions, the zirconium cladding of the fuel rods may **not** be relied upon as a key barrier to prevent the escape of radioactivity, especially during prolonged storage in the "dry casks" that are the preferred method of temporary storage for spent fuel. High-burnup waste reduces the fuel cladding thickness and a hydrogen-based rust forms on the zirconium metal used for the cladding, which can cause the cladding to become brittle and fail. In addition, under high-burnup conditions, increased pressure between the uranium fuel pellets in a fuel assembly and the inner wall of the cladding that encloses them causes the cladding to thin and elongate. In addition, the same research has shown that high burnup fuel temperatures make the used fuel more vulnerable to damage from handling and transport;

13 U.S. Nuclear Regulatory Commission, Standard Review Plan for Spent Fuel Dry Storage Facilities, Final Report NUREG-1567, March 2000. P. 6-15. http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1567/sr1567.pdf
14 U.S. Nuclear Regulatory Commission, Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel, Final Report, NUREG-2157, September 2014, Table G-4.

cladding can fail when used fuel assemblies are removed from cooling pools, when they are vacuum dried, and when they are placed in storage canisters. [15] [16] [17] [18] [19] [20]

The pickup and transportation order of spent fuel has yet to be determined. It has been assumed that the oldest would have priority, leaving sites with fresher and thermally hotter fuel that may be "trapped" at sites to cool down further. As of the end of 2013, data provided to DOE indicates that about 24 percent of some 244,000 spent nuclear fuel assemblies in the United States are high burnup. About 83 percent of some 58,745 high-burnup assemblies remained in pools.[21] Only 8 percent the spent nuclear fuel in dry casks as of 2013 was high burnup. (See Figure 2) These data clearly indicates that because of the greater heat, and radioacivity in high-burnup spent nuclear fuel, much greater care must be taken over a longer period of time before emplacement and transport can occur.

Approximately 23 percent of spent nuclear fuel at closed reactors and reactors expected to close over the next few years is high burnup (>45GWd/t) (see Figure 3). This is a significant issue because of the lack of data regarding the impacts on high-burnup spent fuel by transportation and multi-decade dry storage. The NRC and the nuclear industry do not have the necessary information to predict when storage of high-burnup fuel may cause problems. To err on the side of caution, high-burnup fuel might have to be left in cooling pools for 25 years—as opposed to the current three to five years for lower burnup spent fuel— to allow cladding temperatures to drop enough to reduce risks of cladding failure before the fuel is transferred to dry storage. Also, the cooling pools at US commercial reactors are rapidly filling, with more than 70 percent of the nation's 77,000 metric tons of spent fuel in reactor pools, of which roughly a fourth is high

15 U.S. Nuclear Regulatory Commission, Rulemaking Issue, Notation Vote, Memorandum from: R.W. Borchardt, Executive Director for Operations, Subject: Proposed Rulemaking – 10CFR 50.46c Emergency Core Cooling System Performance During Loss-of-Coolant Accidents (RIN 3150-AH42), SECY-12-0034, March 1, 2012, p. 2. http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2012/2012-0034scy.pdf

16 Ibid.

17 Ibid

18 International Atomic Energy Agency, Impact of High-Burnup Uranium Oxide and Mixed Uranium – Plutonium Oxide Water Reactor Fuel on Spent Fuel Management, IAEA Nuclear Energy Series, No... NF-T-3.8, June 2011. P. 39. http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1490_web.pdf

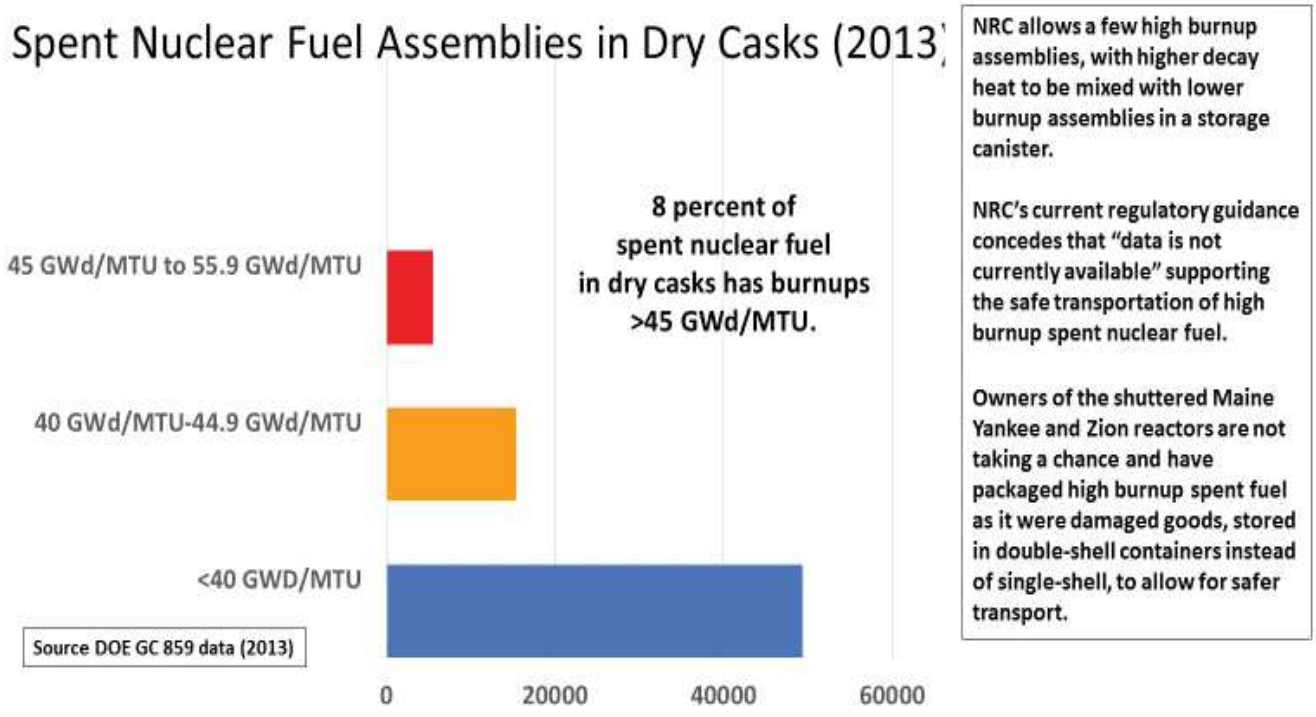
19 Ibid.

20 Ibid. p.69.

21 U.S. Department of Energy, Energy Information Administration, Nuclear Fuel Data survey, Form-859, 2013

burnup. So far, a small percentage of high-burnup used fuel assemblies are sprinkled amid lower burnup fuel in dry casks at reactor sites. But by 2048—the Energy Department's date for opening a permanent geologic disposal site—the amount of spent fuel could double, with high burnup waste accounting for an even signficantly larger percentage of the inventory.

Figure 2

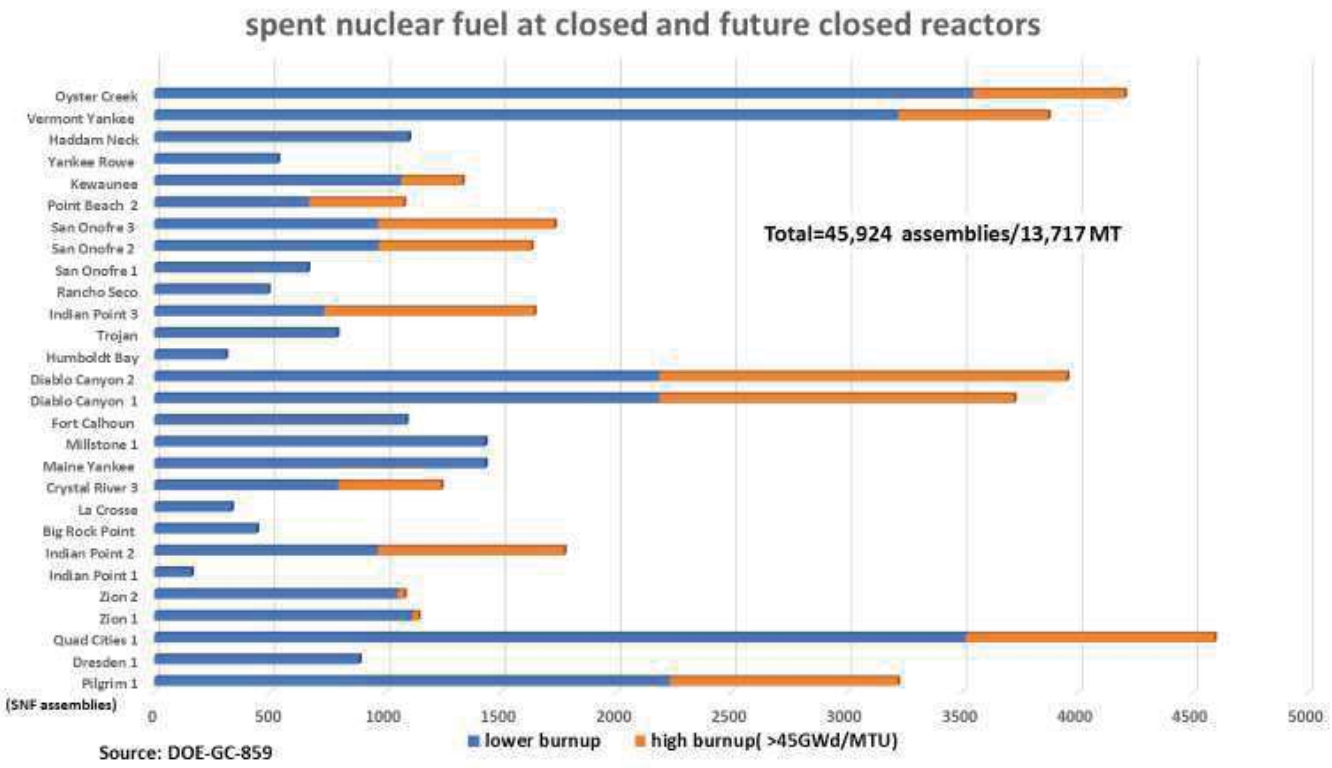


The impacts of decay heat from high-burnup spent fuel on the internal environment of commercial dry casks are virtually impossible to monitor, according to a 2014 NRC-sponsored study, "because of high temperatures, radiation, and accessibility difficulty."[22] The uncertainties of storing a mix of high- and low-burnup spent fuel in a canister are compounded by the lack of data on the long-term behavior of high-burnup spent fuel. This problem was highlighted by the Nuclear Waste Technical Review Board, an expert panel that provides scientific oversight for DOE on spent fuel disposal. That panel said there is little to no data to support dry storage and transport for spent fuel with burnups greater than 35 gigawatt days per metric ton of uranium.[23] In a May 2016 letter to DOE, the board raised elemental questions that should have been answered before the NRC and reactor operators took this leap of faith: "What could go wrong? How likely is it? What are the consequences?"[24] To date, no answers to those questions, based on actual data, have been provided by the NRC or DOE.

It will take DOE at least a decade to complete a study involving temperature monitoring in a specially designed dry cask containing high burnup fuel. Meanwhile, as high-burnup inventories increase, the higher amounts of radioactivity and decay heat associated with high-burnup fuel assemblies are putting additional stress on cooling pool storage systems.

22 U.S. Nuclear Regulatory Commission, Xihua He e al, AVAILABLE METHODS FOR FUNCTIONAL MONITORING OF DRY CASK STORAGE SYSTEMS, November, 2014, P. iv. https://www.nrc.gov/docs/ML1432/ML14323A067.pdf
23 U.S. Nuclear Waste Technical Review Board, Letter to John Kotek, Acting Assistant Secretary, U.S. Department of Energy, From Rodney Ewing, NWTRB Chair, May 23, 2016. https://www.nwtrb.gov/docs/default-source/correspondence/rce0516.pdf?sfvrsn=15
24 Ibid.

Figure 3



In its NRC license application for a consolidated storage facility in Andrews County, TX, Waste Control Specilists recognizes the concerns and uncertainties surrounding high burnup spent nuclear fuel by stipulating in its license application that, "all fuel with assembly average burnup greater than 45 GWd/MTHM shall be canned inside the canister."[25] Holtec does not plan to require double containment for high-burnup spent nuclear fuel; and instead is relying on

25 U.S. Nuclear Regulatory Commission, LICENSE FOR INDEPENDENT STORAGE OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE, NRC Form 588, Docket No.72-1050, page 2.

speculative assumptions regarding the outcome of expirimental data several years from now from the Energy Department, and undocumented regulatory changes by the NRC, which only permits transport of high-burnup spent nuclear fuel on a case-by-case basis.

Six closed sites, Maine Yankee, Zion, Crystal River, Kewaunee, San Onofre, and Vermont Yankee, have high burnup spent nuclear fuel assemblies in storage (>45 gigawatt-day per metric ton heavy metal [GWd/MTHM]). At Maine Yankee and Zion, these high burnup used nuclear fuel assemblies are packaged in damaged fuel cans, which eliminates the concern over the transportability of this high burnup fuel. Holtec appears to adopt no such contingencies.

The failure of high burnup spent fuel in a single-shell container poses large potentially large public and worker hazards, not to mention the logistical difficulties and greater expense of repackaging.

Repackaging for Disposal

Dry cask storage systems are either single purpose (storage only) or dual purpose (storage and transportation). None are currently licensed for disposal. "Direct disposal of the large canisters currently used by the commercial nuclear power industry is beyond the current experience base globally," a 2013 DOE study observes, "and represents significant engineering and scientific challenges."[26] A 2013 report by the staff of the Nuclear Waste Technical Review Board concludes, "repackaging the SNF may be a lengthy process and could impact operational schedules at the utility sites, at a consolidated storage facility, or at the repository, depending on where repackaging is performed."[27] It's not out of the question that if DOE assumes title for spent nuclear fuel for a pilot consolidated storage facility it may elect to do detailed development of repackaging as recommended by some in the nuclear industry.[28]

26 U.S. Department of Energy, Office of Nuclear Energy, Task Order 12: Standardized Transportation, Aging, and Disposal Canister Feasibility Study, June 14, 2013. https://curie.ornl.gov/system/files/documents/not%20yet%20assigned/STAD_Canister_Feasibility_Study_AREVA_Final_1.pdf

27 U.S. Department of Energy, Nuclear Waste Technical Review Board, Staff Briefing Document Framework for the Technical Workshop on the Impacts of Dry-Storage Canister Designs on the Future Handling, Storage, Transportation, and Geologic Disposal of Spent Nuclear Fuel in the United States Washington, DC, November 18–19, 2013. http://www.nwtrb.gov/meetings/2013/nov/framework.pdf

28 Op cit ref. 20

Under the Nuclear Waste Policy Act (42 USC 10101), which sets forth the process for disposal of high-level radioactive wastes, the U.S. Government cannot accept title to spent nuclear fuel until it is received at an open permanent repository site. According to the law, "the persons owning and operating civilian nuclear power reactors have the primary responsibility for providing interim storage of spent nuclear fuel from such reactors." [29] The U.S. Government Accountability Office reported in 2014: "per DOE, under provisions of the standard contract, the agency does not consider spent nuclear fuel in canisters to be an acceptable form for waste it will receive. This may require utilities to remove the spent nuclear fuel already packaged in dry storage canisters".[30]

In 2012, DOE researchers concluded that "waste package sizes for the geologic media under consideration …are significantly smaller than the canisters being used for on-site dry storage by the nuclear utilities."[31] A nuclear industry study concluded in 2014 that "casks and canisters being used by the power utilities will be at least partially and maybe largely, incompatible with future transport and repository requirements. This means that some if not all, of the [used nuclear fuel] that is moved to dry storage by the utilities will ultimately need to be repackaged."[32] Existing large canisters can place a major burden on a geological repository, such as: handling, emplacement and post closure of cumbersome packages with higher heat loads, radioactivity and fissile materials. Repackaging expenses rely on the transportability of the canisters, but more importantly on the compatibility of the canister with heat loading requirement for disposal.

29 42 U.S.C. 1010, Sections.123 & 131.

30 U.S. Government Accountability Office, Spent Nuclear Fuel Management: Outreach Needed to Help Gain Public Acceptance for Federal Activities That Address Liability, GAO-15.141, October 2014, P. 30. http://www.gao.gov/assets/670/666454.pdf

31 Ibid.

32 Chris Phillips, Ivan Thomas and Steven McNiven, Nuclear Industry Study on the Feasibility of Standardized Transportation, Aging and Disposal Canisters for Used Nuclear Fuel, Energy Solutions Federal EPC. WM2014 Conference, March 2-6, 2014, Phoenix, Arizona, USA. http://www.wmsym.org/archives/2014/papers/14011.pdf

According to DOE research the costs of repackaging at a centralized storage site are large,[33]with additional expenses ranging from about $40,000 to about $87,000 per assembly relative to loading and capital costs.[34]

If these per-assembly cost estimates are applied to data on some 244,000 spent nuclear fuel asssemblies collected by DOE, the total amount for repackaging is roughly estimated between $9.7 billion to $22.2 billion.

The total estimated costs of the Holtec endeavor needs to be carefully addressed. Costs facing reactor owners for onsite predisposal activities with or without offsite storage will cost billions of dollars. Cost data, of which Holtec was part of assembling for the Energy Department, indicate that a centralized storage facility proposed by Holtec is likely to cost several billions of dollars more, in addition to costs onsite. Holtec's failure to address the high costs of repackaging for ultimate disposal can effectively double or triple the high cost of interim storage.

In the end, electricity ratepayers and taxpayers will be saddled with very large costs for management and disposal of the spent nuclear fuel generated by the U.S. nuclear power fleet. Costs are and will continue to be a key element determining the viability of Holtec's proposal. Yet, a thorough discussion of costs is conspicuous by its absence. It will cost the licensees more to send to CIS than continue to manage at their own sites, thus it is not economically viable or realistic for NRC to license a facility under these conditions with Holtec's incomplete and speculative assumptions.

33 U.S. Department of Energy, Office of Nuclear Energy, Task Order 21: Operational Requirements for Standardized Dry Fuel Canister Systems Updated Final Report, June 19, 2015. http://energy.gov/sites/prod/files/2016/10/f33/energysolutions-task-order-21-updated-final-report-61915_1.pdf

34 U.S. Department of Energy, Office of Nuclear Energy, Standardized Transportation, Aging, and Disposal (STAD) Canister Design, Presentation to the Nuclear Waste Technical Review Board, June 24, 2015. http://www.nwtrb.gov/meetings/2015/june/jarrell.pdf

Conclusions

Holtec's license application relies heavily on illegal, nonexistent conditions and contract terms. Large amounts of spent fuel from commercial nuclear power fleet require very long term management and storage.

By assuming DOE would take title, the cost basis for the Holtec CISF relies on DOE bearing costs. Since this option is not legal, the nuclear licensees must pay all costs. Management costs are more for the licensees when they must pay all costs of onsite storage, transport to and from a CISF and all CISF operating and closure costs.

These costs of continued licensee ownership at a CISF have not been fully explored or revealed by Holtec and appear, based on existing information, to be significantly higher than management at the reactor sites.

High burnup fuel, an increasingly large portion of the waste inventory, needs longer cooling in wet storage and its cladding could have less integrity than that of lower burnup fuel, thus the long term impacts of repeated transport must be considered before permitting routine massive shipments to a temporary location.

High burnup fuel could need more protective storage such as double containerization to be moved and these costs have not been included.

Holtec does not include a dry transfer facility in its operations for at least the first century, but it will be needed well before that to repackage SNF for disposal and for the remediation of leaking, cracked or otherwise flawed and/or dangerous canisters.

I hereby certify that I have made the foregoing statements under the penalty of perjury.

February 23, 2019

Date

Robert Alvarez

ROBERT ALVAREZ

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CURRENT POSITIONS

ASSOCIATE FELLOW, INSTITUTE FOR POLICY STUDIES, WASHINGTON, D.C. 2001- to the present

ADJUNCT PROFESSOR, JOHNS HOPKINS SCHOOL OF ADVANCED STRATEGIC INTERNATIONAL STUDIES, 2013 to the present.

PREVIOUS EMPLOYMENT

SENIOR POLICY ADVISOR TO THE SECRETARY
U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C.

Years Employed: 1993 – 1999

Responsibilities:

- Led and coordinated initiatives and developed policies on behalf of the Secretary relative to nuclear weapons, worker illness compensation, nuclear non-proliferation, nuclear material controls, environmental cleanup, nuclear safety, and asset management.

- Performed technical and policy analyses for the Secretary regarding the U.S . nuclear weapons production complex, commercial nuclear energy, nuclear material management and disposition, nuclear arms reductions with Russia, environmental, safety and health and DOE management issues.

- Oversight of Department-wide labor policies for some 100,000 contract employees.

Accomplishments:

- Led DOE expert teams in a sensitive U.S. Nuclear nonproliferation project to safely secure plutonium-bearing spent fuel at the Yongbyon, nuclear weapons site in North Korea - as part of Agreed Framework between the United States and the Democratic Peoples Republic of Korea.

- Led and developed a successful legislative effort to establish a federal compensation program for Department of Energy nuclear weapons workers with occupational diseases.

- Participated in vulnerability assessments regarding spent nuclear fuel, plutonium and highly-enriched uranium at DOE sites.

- Developed first DOE-wide strategic “Roadmap” for strategic management of the DOE’s nuclear material inventory.

- Established the first Department-wide Asset Inventory and Management program that

generated some $60 million in revenues.

- Developed successful procurement plan to stabilize some 700,000 metric tons of depleted uranium hexafluoride - roughly half of the uranium ever mined in the world.

- Established a medical monitoring program for former DOE nuclear weapons workers.

CHIEF INVESTIGATOR
COMMITTEE ON GOVERNMENTAL AFFAIRS
U.S. SENATE, WASHINGTON, D.C.

Years Employed: 1988-93

Responsibilities:

- Prepared and reviewed legislation for the Chairman relative to energy, labor, environment, safety, health, and nuclear weapons issues.
- Oversight, investigations, studies and audits of the U.S. Department's of Energy, Defense, and Interior, Food and Drug Administration, Nuclear Regulatory Commission, National Aeronautic and Space Administration, and Environmental Protection Agency.
- Produced reports, prepared Committee hearings and speech writing for the Chairman.

Accomplishments:

- Drafted and helped enacted several pieces of legislation including: the creation of the Defense Nuclear Facility Safety Board (1988); control of radioactive emissions under the Clean Air Act (1990); establishment of a hazards material worker training program for the Department of Energy (1991); a workforce restructuring and community transition program for shutdown nuclear weapons facilities. (1992); and the termination of the U.S. atmospheric nuclear weapons test readiness program (1993).
- Helped create and foster the Department of Energy's Office of Environmental Restoration and Waste Management Program. (1988-89)
- Organized over 25 Committee hearings on a wide array of subjects.

FOUNDER, AND MEMBER OF THE BOARD OF DIRECTORS
ENVIRONMENTAL POLICY INSTITUTE
WASHINGTON, D.C. Years Employed: 1975-88

Responsibilities:

- Managed the Institute's research, Congressional communications, and citizen involvement relative to energy, environmental, health and military nuclear issues.
- Public speaking, political organizing and lobbying.
- Fund-raising for a $1.5 million annual budget.

Accomplishments:

- Provided the first credible independent technical research on the environmental, safety and health risks and legacies associated with the U.S. nuclear weapons program.
- Helped enact environmental legislation including the 1977 Clean Air Act, The Resource Conservation and Recovery Act amendments of 1986-92, The 1986 Superfund Act; as well as legislation to dispose of nuclear wastes (The Uranium Mill Tailings Radiation Control Act, 1978, The Nuclear Waste Policy Act, 1982, the Low-Level Waste Policy Act, 1987); and

legislation to prevent the spread of nuclear weapons.

- Led the national environmental effort to strengthen radiation protection standards and provide compensation for radiation victims.
- Helped organize a Congressional investigation and successful lawsuit on behalf of the parents and children of Karen Silkwood, a deceased nuclear "whistle blower." In 1984 the Supreme Court upheld the jury verdict against the company that employed Ms. Silkwood.
- Helped organize diverse political coalitions around the country.
- Organized several scientific conferences and sponsored scientific and medical research published in peer-reviewed journals.

LEGISLATIVE AIDE
U.S. SENATOR JAMES ABOUREZK (D-SD), Washington D.C. Years Employed: 1973-75

Responsibilities:

- Indian affairs, environment, and energy issues.

Accomplishments:

- Helped enact the Indian health care Improvement Act.
- Defended Indian water rights in the Upper Colorado River Basin against large water diversions for environmentally destructive coal gasification plants.
- Uncovered a systematic effort by the Bureau of Indian Affairs and the US Public Health Service to have Indian women sterilized and to have Indian children serve as experimental subjects for drugs without proper informed consent.

AWARDS AND SPECIAL RECOGNITION

- Awarded two Secretarial Gold Medals, the highest honors bestowed by the Department of Energy.
- The John Barlow Martin Prize for Public Interest Journalism, Medill School of Journalism, Northwestern University, in 1989.
- Featured in National Public Television's Nova documentary - Hanford: the Nuclear Legacy - broadcast in February and August of 1990.
- Featured on CBS 60 Minutes story regarding my efforts to uncover military human radiation experiments -- broadcast in March 1994 and August 1995.
- Featured in an October 16, 1999 New York Times article regarding DOE high-level radioactive wastes.
- Featured on the History Channel program, "History's Mysteries" regarding the Karen Silkwood case (November 1999)
- Featured in a January 29, 2000 New York Times article regarding radiation risks to U.S. nuclear weapons workers.
- Featured in a January 30, 2000 Washington Post Article regarding health risks of nuclear weapons workers.
- Featured in the New York Times on April 30, 2000 and on National Public Radio's All Things Considered on May 8, 2000 regarding my experiences in the U.S. Department of Energy.
- Featured on CBS 60 Minutes on March 17, 2002 regarding Defense High-Level Radioactive Wastes.
- Featured on National Public Radio's All Things Considered in May 2003, and May 2010 regarding my experiences at North Korea's nuclear site and a primer on controlling nuclear materials.

EDUCATION

Attended the Dana School of Music in Youngstown, Ohio 1964-68, Majored in music theory and composition.

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