

# **PILGRIM WATCH**

*What Citizens Need to Know*



## **Pilgrim Nuclear Power Station Decommissioning – June 1, 2019 – Forward**



Pilgrim Watch is a public interest group focused on providing factual information on safety issues pertaining to the Pilgrim Nuclear Power Station, located in Plymouth Massachusetts. Pilgrim ceased operations May 31, 2019 and began the decommissioning process. It is important for the public and community leaders to be informed and to participate effectively to bring about a safer and cleaner outcome, and to not leave the Commonwealth to be the payer of last resort.

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# PILGRIM NUCLEAR POWER STATION - FACTS

**Owner:** Holtec Pilgrim LLC (licensed owner) Holtec Decommissioning International LLC (licensed operator since August 2019; prior owners Entergy and originally Boston Edison.

**Location:** Plymouth, Mass., on shore of Cape Cod Bay

**Type:** Boiling Water Reactor, General Electric Mark I (same design as Fukushima)

**Size:** 688 MWE

**Cooling Water Source:** Cape Cod Bay via once-through-cooling; no cooling tower

**Number of Employees during operations:**<sup>1</sup> approximately 650 (2018)

Pilgrim was constructed between 1967 and 1972 (its reactor was ordered on August 7, 1965), at a cost of about \$200 million. When Massachusetts deregulated its electric market in 1999, Entergy Nuclear Generation Company bought Pilgrim from Boston Edison for \$14 million plus \$67 million for fuel.<sup>2</sup>

In June of 1972, the NRC granted Pilgrim a 40 year license to operate until June 8, 2012. Pilgrim began operations on December 9, 1972.

In January of 2006, Entergy filed an application to extend Pilgrim's operating license for 20 years, to June 8, 2032. The NRC granted the extended license on May 12, 2012, despite the fact that a number of still unresolved issues brought forward by Pilgrim Watch remained pending before the Commission and its Atomic Safety and Licensing Board.

Pilgrim closed May 31, 2019 because it could not compete with cheaper sources of electricity, mainly natural gas.

In November of 2018, Entergy and Holtec submitted a License Transfer Application (LTA) to the NRC, asking that Pilgrim be sold, and its licenses transferred to Holtec. In February of 2019, the Commonwealth and Pilgrim Watch filed separate motions with NRC to intervene and request a hearing in Pilgrim's license transfer proceeding. Without deciding the Commonwealth and Pilgrim Watch Motions, the NRC granted Entergy's and Holtec's sale and license transfer request in August of 2019.

On June 16, 2020, the Commonwealth of Massachusetts reached an agreement with two subsidiaries of Holtec International, Holtec Decommissioning International, LLC (HDI) and Holtec Pilgrim LLC, to settle the Commonwealth's challenge to transferring Pilgrim Nuclear Power Station ownership and licenses from Entergy to these two Holtec subsidiaries.<sup>3</sup>

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<sup>1</sup> [http://www.entergy-nuclear.com/plant\\_information/pilgrim.aspx](http://www.entergy-nuclear.com/plant_information/pilgrim.aspx)

<sup>2</sup> <http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/Appendices/Nuclear-Power-in-the-USA-Appendix-2-Power-Plant-Purchases/>

<sup>3</sup> [https://www.mass.gov/doc/pilgrim-settlement-agreement/download?\\_ga=2.17996410.231772208.1594154244-2049834566.1591123061](https://www.mass.gov/doc/pilgrim-settlement-agreement/download?_ga=2.17996410.231772208.1594154244-2049834566.1591123061)

The settlement agreement covers many topics, including financial assurance, site restoration standards, funding commitments to state agencies, and security. As part of the settlement, the Commonwealth agreed to withdraw its contentions with NRC to intervene and request for hearing in Pilgrim's license transfer agreement and its pending Petition with the US Court of Appeals for the DC Circuit.

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## **DECOMMISSIONING BASICS**

### **What Is Decommissioning**

**NRC is responsible for regulating decommissioning.**

The Nuclear Regulatory Commission (NRC) defines decommissioning as “safely removing a facility or site from service and reducing residual radioactivity to a level that permits either of the following actions:

- Release the property for unrestricted use and terminate the license.
- Release the property under restricted conditions and terminate the license.<sup>4</sup>

For nuclear power reactors, the decommissioning process begins when a licensee decides to permanently cease operations. The major steps that make up the reactor decommissioning process are certification to the NRC of permanent cessation of operations and removal of fuel; submittal and implementation of the post-shutdown decommissioning activities report (PSDAR); submittal of the license termination plan (LTP); implementation of the LTP; and completion of decommissioning.<sup>5</sup>

The NRC's “Decommissioning program activities include (1) developing regulations and guidance to assist staff and the regulated community; (2) conducting research to develop data, techniques, and models used to assess public exposure from the release of radioactive material resulting from site decommissioning; (3) reviewing and approving decommissioning plans (DPs) and license termination plans (LTPs); (4) reviewing and approving license amendment requests for decommissioning facilities; (5) inspecting licensed and non-licensed facilities undergoing decommissioning; (6) developing environmental assessments (EAs) and environmental impact statements (EISs) to support the NRC's reviews of decommissioning activities; (7) reviewing and approving final site status survey reports; and (8) conducting confirmatory surveys.”<sup>6</sup>

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<sup>4</sup> <https://www.nrc.gov/waste/decommissioning.html>; 10 C.F.R § 50.2

<sup>5</sup> <https://www.nrc.gov/waste/decommissioning/process.htm>

<sup>6</sup> <https://www.nrc.gov/waste/decommissioning.html#how>

Consistent with its definition, NRC Rules restrict use of the Decommissioning Trust Fund to “expenses for legitimate decommissioning activities consistent with the definition of decommissioning in § 50.2.” However,

“Activities that go beyond the scope of decommissioning, as defined in 10 C.F.R. § 50.2, such as restoration costs to prepare the site for its next use after license termination is complete, are not decommissioning activities. Decommissioning activities also do not include the removal, storage, management and disposal of spent fuel, or the disposal during operation of radiologically contaminated materials or the removal and disposal of nonradioactive structures and materials beyond that necessary to terminate the NRC license. Disposal of nonradioactive hazardous waste not necessary for NRC license termination is not covered by these regulations but would be treated by other appropriate agencies having responsibility over these wastes.”<sup>7</sup>

The NRC has taken the view that “**decommissioning activities include** such things as property taxes, emergency planning, liability insurance, and legal and lobbying fees. It has also granted Pilgrim, and others, exceptions from 10 C.F.R. § 50.2, and allowed them to withdraw funds from the DTF for non-decommissioning expenses such as spent fuel storage and site restoration.

### **What will Pilgrim’s Decommissioning Look Like, According to Holtec?**

After Holtec bought Pilgrim in 2019, Holtec Decommissioning International published a paper, “*Pilgrim Nuclear Power Station Decommissioning*,” outlining Holtec’s decommissioning plans.<sup>8</sup>

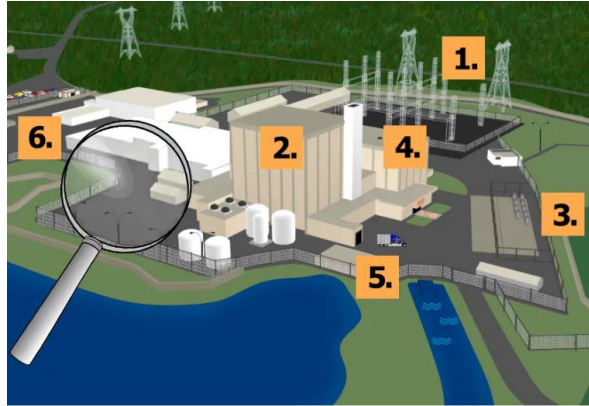


Holtec first outlined the steps that would occur at Pilgrim:

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<sup>7</sup> <https://www.nrc.gov/docs/ML1533/ML15335A187.pdf>

<sup>8</sup> Pilgrim Nuclear Power Station Decommissioning, <https://hdi-decom.com/our-fleet/pilgrim-decommissioning/>.



1. Pilgrim shut down its reactor for the final time on Friday, May 31, at 5:28 p.m. This removed 670 megawatts of electricity from the regional grid.
2. Pilgrim's nuclear fuel has been removed from the reactor vessel core and placed in the spent fuel pool to cool.
3. Once cooled, the fuel will be placed in stainless steel canisters and transported to the Independent Spent Fuel Storage Facility (ISFSI) on station property.<sup>9</sup>
4. Radioactive equipment and components are dismantled by the decommissioning plan that is reviewed but not approved by the NRC.
5. Contaminated components are dismantled, packaged, and transported to a licensed off-site facility.
6. The site is inspected by state and federal agencies to ensure the property has been returned to conditions outlined in the decommissioning plans. Both the State and Federal agencies will continue to monitor the site.

Holtec's "*Pilgrim Nuclear Power Station Decommissioning*" also noted that NRC regulations allow a company what decommissioning option to use:

SAFSTOR (Safe Storage) - Plant is kept intact, all fuel is placed in spent fuel pool or dry storage casks and time is used as a decontaminating agent. The plant is then dismantled similar to DECON once radioactivity has decayed to lower levels.

DECON (Decontamination) - Contaminated equipment and materials are removed (used nuclear fuel rods and equipment account for over 99 percent of the plant's radioactivity). The plant is then dismantled - this phase can take five years or longer. Holtec International LLC chose this option.

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<sup>9</sup> This will take place over a period of 2-3 years. Initially the fuel will be placed on a pad close to Cape Cod Bay. A new pad is being constructed on higher ground (75' above MSL) 362' from a public road, Rocky Hill Road. The new pad will be completed in 2021, and all canisters will be transported from the old pad to the new.

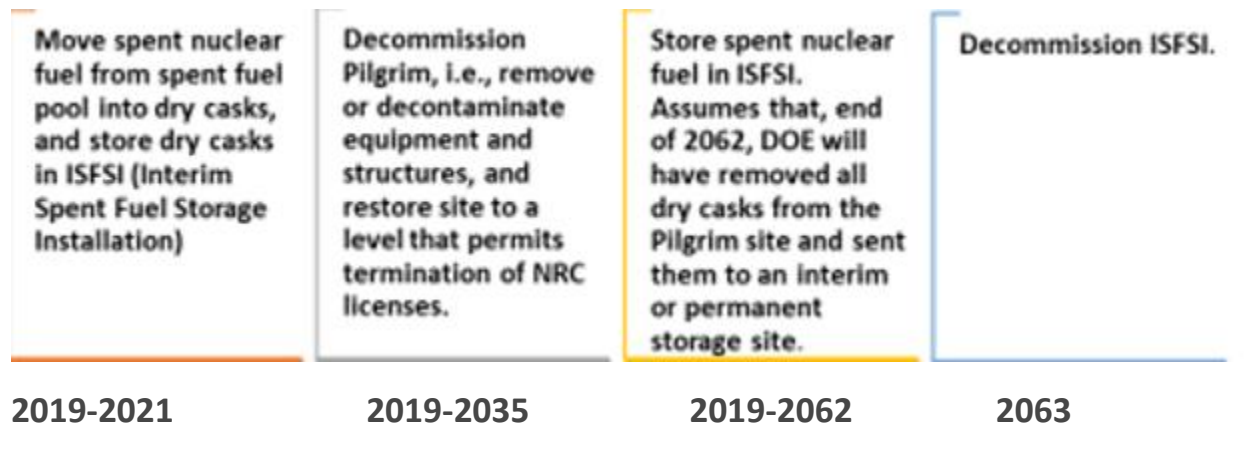
Holtec has chosen DECON.

Finally, Holtec described the process for terminating the NRC license and releasing the site.

As the DECON phase nears completion, the company must submit a license termination plan to the NRC. This needs to occur within two years of the proposed license termination date. After the NRC receives the license termination plan, affected states, local communities and tribes may submit comments on the plan at a public meeting near the facility. The public also has the opportunity to request an adjudicatory hearing. Members of the public may observe any meeting the NRC holds with the company, unless the discussion involves proprietary, sensitive, safeguarded, or classified information.

Once public concerns are addressed, the NRC will terminate the license if all work has followed the approved license termination plan, and the final radiation survey shows that the site is suitable for release. Most plans foresee releasing the site to the public for unrestricted use, meaning any residual radiation would be below NRC's limits of 25 millirem per year. This completes the decommissioning process. The Independent Spent Fuel Storage Installation has a separate license. It will not be terminated until the fuel leaves the site.

In 2023, Holtec's decommissioning schedule was extended eight years due to a \$307 M drop in the Decommissioning Trust Fund resulting from a fall in the stock market and inability to dispose of contaminated water in Cape Cod Bay. The new schedule is as follows,



## Decommissioning a Nuclear Power Plant

### Frequently Asked Questions

There are many questions about decommissioning in general,<sup>10</sup> and decommissioning Pilgrim in particular, that a paper prepared by the Holtec paper cited did not answer.

## **What is Decommissioning? How Long? Who Pays?**

### **Q1. What is decommissioning?**

A1. According to the NRC, decommissioning refers to the process of removing residual radioactivity at a commercial nuclear plant once it has been permanently retired. Nuclear power plant decommissioning is regulated by the Nuclear Regulatory Commission (NRC) and involves removing a facility from service and reducing residual radioactivity to a level that permits release of the property and termination of the license.<sup>11</sup>

NRC regulations allow a site to be released for unrestricted use if the residual radiation is not more than 25 millirem/year, and for the site to be released for restricted use if the level of residual radiation is as much as 100-500 millirem/year. Some states have more conservative limits. The Commonwealth received an agreement from Holtec to a **less than 10 millirem/year limit and less than 4 millirem/year in drinking water sources of groundwater.**

The decommissioning process for Pilgrim involves disposal of radioactive components and materials; cleanup of radioactivity; and dismantling of the plant so the site can be released for other purposes. Pilgrim's owner, Holtec Pilgrim LLC, remains accountable to the NRC until decommissioning has been completed, and the NRC has terminated Pilgrim's licenses.

Although most assume otherwise, the NRC definition of decommissioning does not include the cleanup of non-radioactive hazardous waste, the removal or storage of spent fuel, the demolition or removal of decontaminated structures, or restoring the site to its original condition.

### **Q2. Why are nuclear power plants decommissioned?**

A1. Nuclear power plants are initially licensed for 40 years, with the option to seek 20-year license extensions. Pilgrim's license was extended in 2012 for an additional 20 years. Entergy decided to close Pilgrim before the extended license expired because continued operation of Pilgrim was not economically feasible.

### **Q3. How long will decommissioning take?**

A1. The NRC requires that nuclear plants be decommissioned within 60 years after permanently ceasing power operations. Holtec plans to decommission Pilgrim on a schedule that will complete decommissioning and will permit NRC to release the site (except for spent fuel storage ISFSI) and terminate Pilgrim's operating license, in about twelve years, 2033-2035. A considerably longer

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<sup>10</sup> NRC documents addressing frequently asked questions about decommissioning include <https://www.nrc.gov/waste/decommissioning/fqg.html> and NUREG – 1628 <https://www.nrc.gov/docs/ML0037/ML003726190.pdf>

<sup>11</sup> See <https://www.nrc.gov/reading-rm/basic-ref/glossary/decommissioning.html>

time schedule than Vermont Yankee NPS (VTNPS) due to Vermont's decision to ship its contaminated offsite needed to take down the reactor building. VTNPS started decommissioning about one year earlier than Pilgrim. VYNPS reported it is about eighty percent complete. Holtec, instead, decided to discharge the water into Cape Cod Bay, opposed by DEP and currently in adjudication; and at the same time evaporate the water, a slower process. David Noyes, HDI, said to the NDCAP January 2025 that if deposition of the wastewater were not a factor, it could complete the site decommissioning process in 4-6 years. The ISFSI will remain until all spent nuclear fuel has been removed from the site, after which it will be decommissioned, and the separate ISFSI license will be terminated.

#### **Q4. Who pays for decommissioning and how much will it cost?**

A1. In theory, Pilgrim's decommissioning costs will be paid by Pilgrim's licensees, Holtec-Pilgrim LLC. and Holtec Decommissioning International LLC., using the Decommissioning Trust Fund (DTF). The DTF is essentially the licensee's only asset. An important question is whether the DTF has enough money to pay not only for decommissioning (as defined by the NRC) but also spent fuel storage and site restoration.

According to the NRC, a DTF must provide financial assurance for decommissioning (again as defined by the NRC) by one or more of the following methods:

- **Prepayment:** In this case, at the start of operations, the licensee deposits enough funds to pay the decommissioning costs into an account. The account is segregated from the licensee's other assets and remains outside the licensee's control of cash or liquid assets. Prepayment may be in the form of a trust, escrow account, government fund, certificate of deposit, or deposit of government securities.
- **External sinking fund:** An external sinking fund is established and maintained by setting funds aside periodically into an account segregated from licensee assets and outside the licensee's control. The total amount of these funds will be sufficient to pay decommissioning costs when it is anticipated that the licensee will cease operations. An external sinking fund may be in the form of a trust, escrow account, government fund, certificate of deposit, or deposit of government securities.
- **Surety method, insurance, or other guarantee method:** A surety method may be in the form of a surety bond, letter of credit, or line of credit. Any surety method or insurance used to provide financial assurance must be open-ended or, if written for a specific term, such as 5 years, must be renewed automatically. An exception is allowed when the issuer notifies the Commission, the beneficiary, and the licensee of its intent to not renew within 90 days or more preceding the renewal date. The surety, or insurance must also provide that the full face amount be paid to the beneficiary automatically preceding the expiration date without proof of forfeiture if the licensee fails to provide a replacement acceptable to the Commission within 30 days after receipt of notification of cancellation. In addition, the surety, or insurance, must be payable to a trust established for decommissioning costs, and the trustee

and trust must be acceptable to the Commission. The surety method or insurance must remain in effect until the Commission has terminated the license.

Pilgrim’s DTF was funded through customer contributions established when the reactor initially went online in 1972, and the fund grew through investments managed by its Trustee in New York. **None of Pilgrim’s owners (Boston Edison, Entergy, Holtec Pilgrim) has put a dime into the Decommissioning Trust Fund (DTF).**

Holtec’s 2018 Post-Shut Down Activities Report (PSDAR) said that total decommissioning costs would be \$1.134 billion, that withdrawals from the trust fund would also total \$1.134 billion, and that \$3.6 million would be left over at the end of 2063.

The Pilgrim Nuclear Decommissioning Trust (NDT) **fund balance as of December 31, 2023**<sup>12</sup> (the most recent NRC report) was **\$542.8M**, a \$307 M drop during 2022, reflecting expenditure and a dramatic drop in the stock market. When that fund is spent, it will not be possible to get more money from the owner, Holtec Pilgrim LLC, or HDI LLC, the operator. There is no parent company guarantee from Holtec International. The owner and operator are Holtec limited liability subsidiaries. There are no bonds or other financial guarantees. NRC suggested that monies recovered from DOE, for spent fuel management expenses for DOE’s breach of contract for not taking the spent fuel by 1998 as promised, could be used by the licensee. But the NRC cannot require any DOE recovery actually be available to pay decommissioning costs. If cleanup costs exceed what is left in the DTF, or spent fuel remains on site after 2062, the state likely will be left as payer of last resort. The owners have the potential to make over \$800 million to one billion in profit from decommissioning Pilgrim irrespective of whether there is enough money in the DTF to complete the job.

Pilgrim Nuclear Power Station Annual Decommissioning Funding and Spent Fuel Management Status and Financial Assurance Report, NRC Library, Adams, Accession Number ML 24089A117-Enclosure 2, Table 1 Summary Information as of December 31, 2023

| Remaining Decommissioning Estimated Cost – 10 CFR 50.82(a)(8)(v)(B); 50.82(a)(8)(vii)(B) |                     |                 |                  |                    |                                     |
|------------------------------------------------------------------------------------------|---------------------|-----------------|------------------|--------------------|-------------------------------------|
| Year                                                                                     | License Termination | Spent Fuel Mgmt | Site Restoration | Total <sup>1</sup> | Comments                            |
| 2024                                                                                     | \$235M              | \$339M          | \$18M            | \$592M             | Estimated in 2023 Dollars (Table 2) |

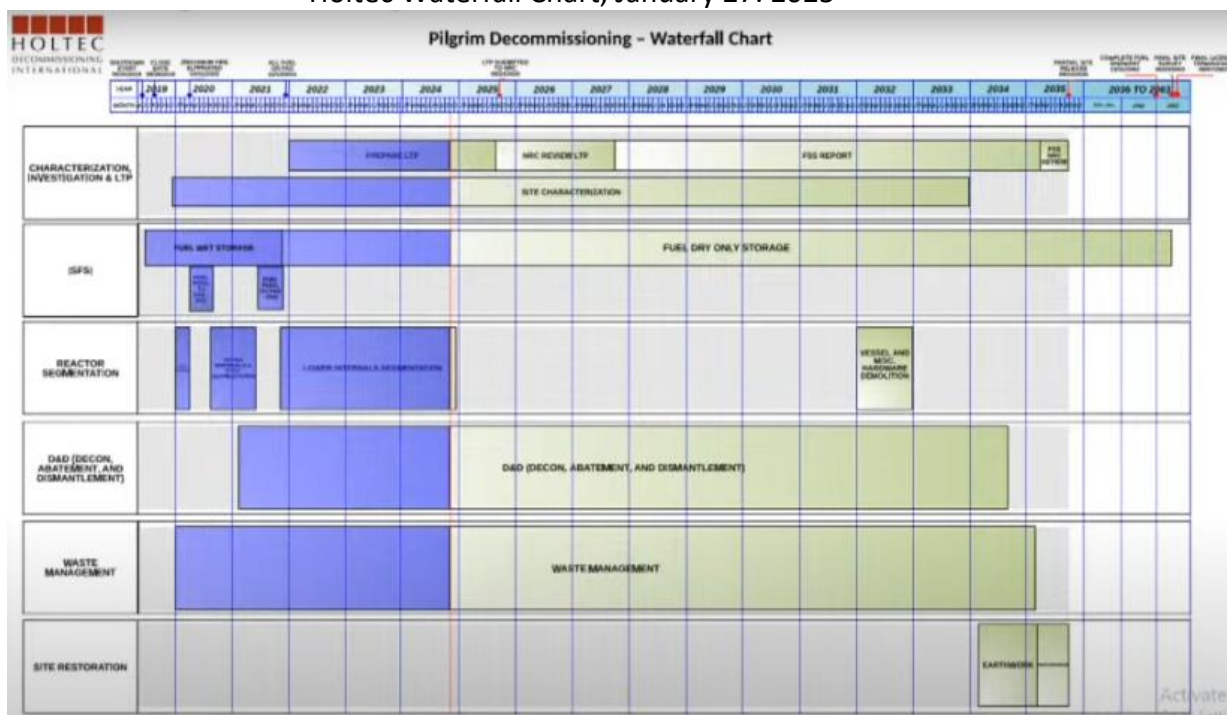
#### Q5. What is the status of Pilgrim’s decommissioning, September 2023?

<sup>12</sup> Pilgrim Nuclear Power Station Annual Decommissioning Funding and Spent Fuel Management Status and Financial Assurance Report, NRC Library, Adams, Accession Number ML 24089A117

**A1. Decommissioning Schedule:** The decommissioning schedule's termination date, excluding removal of spent fuel, was delayed eight years, from 2027 to 2035, for two reasons. First the decommissioning trust fund (DTF) lost \$ 307 million dollars due to the stockmarket's decline. Holtec-Pilgrim decided to reduce expenditures and withdrawals from the DTF so that the fund would have a better chance to grow as the market improved.

Second, Holtec's refusal to ship the wastewater to a licensed facility offsite, as Vermont Yankee did. VYNP started decommissioning one year before Pilgrim and it reported its decommissioning is 80% completed. It estimated completion in 2026 or 2027. Dave Noyes, Holtec, said at NDCAP's January 2025 meeting that if the water was not a factor the decommissioning process could be completed in 4-6 years. The water must be removed before the reactor building can be demolished.

Holtec Waterfall Chart, January 27. 2025<sup>13</sup>



The site is supposed to be returned to “greenfield” for unrestricted use - radioactivity and chemical contamination cleaned up. This is important to communities along Cape Cod Bay’s 300-mile coastline to ensure that contaminants left on site will not run-off and pollute the bay. Also, it is important because the state’s second largest aquifer is located underneath Pilgrim. The state’s radiological cleanup standard, less than 10 millirem per year from all pathways, is

<sup>13</sup> NDCAP January 27, 2025 Meeting, report by Dave Noyes (HDI) at 2hours  
[https://www.google.com/search?q=ndcap+video+jan+2025&oq=ndcap+video+jan+2025&gs\\_lcrp=EgZjaHJvbWUyBggAEEUYOTIHCAEQIRigATIHCAIQIRigATIHCAQQIRigATIHCAUQIRigAdIBCjEwNTQwajBqMTWoAgiwAgE&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:e4c149d0,vid:INUZfqMl1sQ,st:0](https://www.google.com/search?q=ndcap+video+jan+2025&oq=ndcap+video+jan+2025&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIHCAEQIRigATIHCAIQIRigATIHCAQQIRigATIHCAUQIRigAdIBCjEwNTQwajBqMTWoAgiwAgE&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:e4c149d0,vid:INUZfqMl1sQ,st:0)

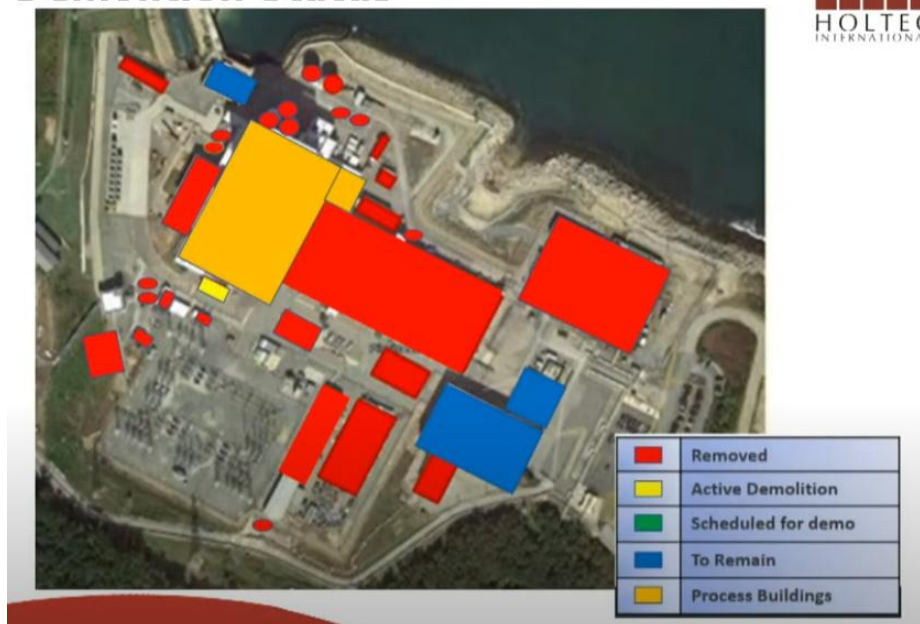
stricter than the federal standard. Chemical contaminants, including, for example, oils, PCBs, asbestos, herbicides, and PFAS must be removed to meet Massachusetts and EPA standards.

An initial Site Assessment Plan by Holtec's contractor, ERM, was issued in 2020. The Commonwealth said that it was insufficient. A revised Site Assessment Plan also was prepared (<https://www.mass.gov/doc/may-28-2021-environmental-site-assessment-work-plan-for-pilgrim/download>). It did not meet the requirements set out in the Settlement Agreement between the state and Holtec. The Revised Site Assessment concluded there was no significant soil radiological contamination; and there is PFAS in groundwater and numerous metals exceedances in groundwater, attributed to turbidity. We concluded that a more robust analysis and site assessment plan would conclude otherwise. The NRC requires a final site characterization two years prior to the date of license termination. The license termination plan review is subject to a hearing opportunity. Split samples will allow independent MDPH verification of analytical results.

**Demolition:** To date only secondary, support buildings have been taken down. The highly contaminated buildings have not been demolished. For example, the main reactor building (yellow building to left of large red rectangle in center) cannot be removed until the 1.1 million gallons of waste water is removed. In the interim, the company says that the wastewater is needed to shield interior demolition workers from intense radiation, unless the company chose to move to fixatives. All spent fuel is located on the spent fuel storage pad (ISFSI) adjacent to Rocky Hill Road.

Demolition Status reported by Holtec at the January 27, 2025 NDCAP meeting.

## Demolition Status



## Radioactive Waste

### Q1. What kinds of radioactive waste are there and how are they classified?

A1. Radioactive wastes are classified, not according to the threat they pose to human health or the environment or how long that remain radioactive, but according to the process which produced the waste. There are two general categories: High Level Waste, and Low Level Waste. One category of Low Level Waste, Greater than Class C Waste, is highly radioactive.

### Q2. What is High Level Waste (HLW)?<sup>14</sup>

A1. HLW means the highly radioactive materials produced as byproducts of fuel reprocessing or of the reactions that occur inside nuclear reactors. HLW includes:

- Irradiated spent nuclear fuel discharged from commercial nuclear power reactors
- The highly radioactive liquid and solid materials resulting from the reprocessing of spent nuclear fuel, which contain fission products in concentration (this includes some reprocessed HLW from defense activities and a small quantity of reprocessed commercial HLW)

### Q3. What is Spent Nuclear Fuel?

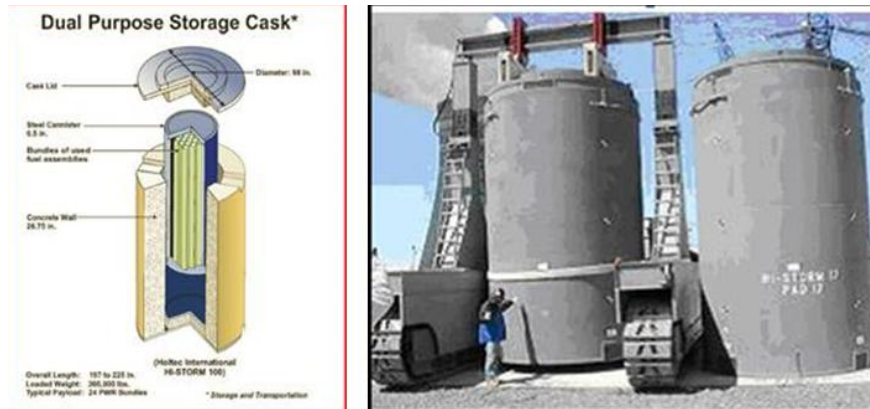
A1. When spent nuclear fuel is removed from a reactor, usually after several years of power production, it is thermally hot and highly radioactive. The spent fuel is in the form of fuel assemblies, which consist of arrays of metal-clad fuel rods 12-15 feet long. A fresh fuel rod, which emits relatively little radioactivity, contains pellets made of uranium that have been enriched in the isotope U-235 (usually to 3%-5% from its natural level of 0.7%). But after nuclear fission has taken place in the reactor, most of the U-235 nuclei in the fuel rods have been split into a variety of highly radioactive fission products. Some of the nuclei of the dominant isotope U-238 have absorbed neutrons and then decayed to become radioactive plutonium, some of which has also split into fission products (and some of which are gases).

### Q4. How is Spent Fuel Stored?

A1. Pilgrim NPS will store its spent nuclear fuel onsite in 61 dry casks until an offsite repository is available, either a deep geological repository or consolidated interim site. Three additional casks will be used to store Greater-Than-Class-C radioactive waste that eventually also must go to a deep geological repository. The casks are lined up on a concrete pad, called an Independent Spent Fuel Storage Installation (ISFSI). The pad and casks are NOT enclosed in a building or protected from line-of-sight attack by a reinforced wall, nor are they covered.

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<sup>14</sup> See: <https://www.nrc.gov/reading-rm/basic-ref/glossary/high-level-waste.html>



**Q5. Will the Independent Spent Fuel Storage System (ISFSI), casks and concrete storage pad, remain on the site even after decommissioning is completed?**

A1. Holtec, and its cost estimates, assume that the Department of Entergy will take title to the spent fuel and remove it from Pilgrim's site by 2062. However, there is no offsite storage available. Holtec has applied to build a consolidated interim storage facility for spent fuel, called HI-STORE<sub>2</sub> in New Mexico. Pilgrim's used fuel could be relocated to this facility. The site is opposed by the State of New Mexico, a local Native American tribe and public interest groups. Litigation is ongoing. Waste Control Storage Services (WCS) applied to build a consolidated interim storage facility for spent fuel in Texas. It also faces state and public opposition.

The only realistic assumption is that Pilgrim's spent nuclear fuel nuclear waste will be stored at Pilgrim for years after 2062, perhaps indefinitely. The NRC's 2014 Continued Storage Rule<sup>15</sup> recognizes that spent fuel may be stored on-site for 300 years and claims it can safely be stored for that period of time. There are no analyses to support NRC's assumptions The Rule requires that the casks and the pad are changed every hundred years. There is no way to do so at present.

**Q6. How much used nuclear fuel is stored at Pilgrim?**

A1. There are 4,114 fuel assemblies at Pilgrim; all the nuclear fuel that has been used at Pilgrim since the plant started generating electricity in 1972. The spent nuclear fuel in the assemblies will stay radioactive for thousands of years.

## Waste Disposal and Shipping

**Q1. What type of waste will be removed from the plant?**

A1. Generally, there are two broad types of radioactive waste at Pilgrim and other commercial nuclear plants: used nuclear fuel which is high-level waste, and low-level waste such as

<sup>15</sup> <https://www.nrc.gov/waste/spent-fuel-storage/wcd.html>

demolition debris. Some of which are highly radioactive and long-lived. This waste will be disposed of according to NRC guidelines.

Additionally, there is also non-radioactive but hazardous industrial/chemical waste. Construction materials, mainly concrete and steel, must be removed from Pilgrim during decommissioning, along with oil, PCB, asbestos, and other hazardous materials.

## **Q.2 How will Pilgrim's radioactive waste be stored offsite?**

**A1. LLRW Offsite Storage:** Pilgrim used to send its low-level radioactive waste to Barnwell, South Carolina. Massachusetts lost that option. Now Pilgrim sends its low-level radioactive waste to a couple of locations. One site is in Clive, Utah; Pilgrim sends LLRW waste after it is blended at the Irwin Resin Processing Facility in Irwin, Tennessee. WCS in Aberdeen Texas also accepts Pilgrim's LLRW. Massachusetts General Laws Chapter 111 H established the Low - Level Radioactive Waste Management Board (Board) to manage the options available to the Commonwealth for dealing with low level radioactive waste.<sup>16</sup> See its website for information on LLRW in the state. Decommissioning produces large volumes of low level and Greater-Than-Class C waste.

**A2. Spent Fuel & Greater-Than Class C Waste Offsite Storage:** Deep geological repository or in an interim consolidated site once developed and available.

## **Q3. How will the waste be removed from the site?**

A1. Holtec says that it continues to explore all options for removal of materials from the site, including trucking and trucking to rail - barging waste is off the table.<sup>17</sup>

## **High Burnup Spent Fuel**

### **Q.1 What is High Burnup Fuel (HBU)?**

**A1.** Pilgrim's spent fuel contains 35-37% HBU. This fuel contains a higher percentage of uranium 235, allowing reactor operators to effectively double the amount of time the fuel can be used in the core to generate heat and electricity. 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, creating leakage.

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<sup>16</sup> See MDPH website for information.

<http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/radiation/low-level-radioactive-waste.html>

<sup>17</sup> See transportation routes to Yucca Mountain at <http://www.state.nv.us/nucwaste/whatsnew.htm>

**Critics<sup>18</sup>** say that high-burnup fuel 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; 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.<sup>19 20 21</sup> 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. At Maine Yankee and Zion, high burnup used nuclear fuel assemblies are packaged in damaged fuel cans, which eliminates the concern over the transportability of this high burnup fuel.<sup>22</sup>

**NRC says** that HBU can be stored or transported safely for 60 years but has not provided all supporting documentation, nor indicated what will happen after 60 years.<sup>23</sup>

## Environmental Cleanup

### Q1. When will a site characterization occur?

A1. Holtec and the NRC appear to agree that an accurate cost estimate is necessary for safe and timely plant decommissioning (NUREG-0586, Supplement 1, p. 68; DCE, p.55.) But, at the time Holtec filed its PSDAR, Holtec had not characterized the Pilgrim site and did not know what radioactive materials and hazardous waste contaminants are on the site or what it would cost to remove them. Holtec's PSDAR said that it would conduct a site assessment sometime in the future, and subsequently it subcontracted a site characterization study in 2020. NRC regulations require Holtec to perform a final status survey at least two years before the partial site release.

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<sup>18</sup> See for example Spent Power Reactor Fuel: Pre-Disposal Issues, Robert Alvarez, Institute for Policy Studies, March 3, 2017, at [http://www.lasg.org/waste/Alvarez\\_SNF\\_closed\\_reactors\\_rev3\\_3Mar2017.pdf](http://www.lasg.org/waste/Alvarez_SNF_closed_reactors_rev3_3Mar2017.pdf); and <https://www.nrc.gov/docs/ML1831/ML18317A443.pdf>

<sup>19</sup> 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/2012/2012-0034scv.pdf>

<sup>20</sup> 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](http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1490_web.pdf)

<sup>21</sup> Ibid. p.69.

<sup>22</sup> U.S. Department of Energy, Preliminary Evaluation of Removing Used Nuclear Fuel from Nine Shutdown Sites, PNNL-22418, April 30, 2013. [http://www.pnnl.gov/main/publications/external/technical\\_reports/PNNL-22418.pdf](http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22418.pdf)

<sup>23</sup> NRC NUREG 2224 Dry Storage and Transportation High Burnup Spent Fuel Draft Report for Public Comment, Sept 6, 2018 ( NRC Library, Adams, Accession Number ML18247A321) <https://www.nrc.gov/docs/ML1824/ML18247A321.pdf>

## **The Commonwealth's Settlement:**

Paras. 10(a)-(c) and (e)-(m) are concerned with what Holtec does to assess the condition of the Pilgrim site and to remediate it. Para. 11 requires Holtec to "submit to DEP and DPH for their review and approval the Initial Pilgrim Environmental Site Assessment work plan prepared by the LSP (Licensed Site Professional) retained in accordance with Paragraph 10(b)." Paragraph 12 requires Holtec, DPH and DEP to meet and confer, and for Holtec eventually to "perform all actions in the Initial Pilgrim Environmental Site Assessment work plan."

These paragraphs of the Settlement Agreement are directed to "plans;" and exactly what any approved plan will require is unclear. The Settlement Agreement says little or nothing about how the Commonwealth is to ensure that Holtec has properly "perform[ed] all actions in the Initial Pilgrim Environmental Site Assessment work plan."

Moreover, Para. 10(a) of the Agreement carefully limits the information that Holtec must provide DEP and DPH to documents "related to radiological and non-radiological contamination at the Site that it or Holtec International possesses or may come to possess through a request to Entergy" within 60 days of the Agreement's effective date. It avoids documents prior to deregulation when Pilgrim was operated by BECO and had significant radiological releases.

We are concerned that Holtec's site assessment will be inadequate, and that it will be carefully designed to discover as little contamination as possible and to ensure that as little remediation as possible will be done, resulting in DTF costs down and Holtec profits up.

## **Q2. Will buildings and structures be removed below grade?**

A1. According to Holtec's 2018 PSDAR, during demolition, above-ground structures will be removed to a nominal depth of three **(3) feet below the surrounding grade level**; characterization surveys will then be performed in the remainder of the below ground structures and any areas with activity exceeding established DCGLs will be removed; and Final Status Surveys, including NRC verification surveys, will be conducted. Once the NRC approves the Final Status Surveys, Holtec says that affected area(s) will be backfilled with suitable fill materials, graded, and appropriate erosion controls established. Site restoration activities will begin in non-radiological areas after the demolition of buildings and structures outside the radiologically controlled area. Final site restoration will be completed after ISFSI decommissioning and demolition is completed.

According to Holtec's PSDAR, site restoration will include only "conventional dismantling, demolition, and removal from the site of structures and systems after confirmation that radioactive contaminants have been removed" (pg.19), and only a "relatively small amount of the decommissioning cost ... [is] for the demolition of uncontaminated structures and restoration of the site." (p. 62).

According to the June 2020 Settlement the Switchyard shall remain and those structures DEP approves can remain onsite. Holtec may retain shoreline and in-water structures subject to MGL

c.91 as they are licensed by DEP or in the case of the seawall approved by DEP and Holtec proves removing them would be more detrimental than leaving them in place.<sup>24</sup>

### **Q3. What will happen to the water in the reactor cavity, dryer separator and spent fuel pool?**

A1. When Holtec bought Pilgrim NPS, there were over 2 million gallons of radioactive and chemically contaminated wastewater to dispose of before the reactor building could be taken down. NRC allows four options- discharging into Cape Cod Bay, evaporation, storage onsite, and shipping to a licensed facility. Holtec first opted to discharge the wastewater into Cape Cod Bay. The public and elected officials objected. Holtec submitted a request to DEP to modify its discharge permit to allow discharge. DEP issued an order, July 2024, that rejected Holtec's request to allow discharge into Cape Cod bay. August 14, 2024, Holtec appealed DEP's order to DEP's Office of Appeals Resolution (OADR Docket 2024). In the meantime Holtec is evaporating the **unfiltered** water 24/7. Since Holtec bought Pilgrim NPS in 2019, it has evaporated over 1 million gallons. As of January 15, 2025, **868,683 gallons remain. All the water can be evaporated within 4 years**, impacting the environment, marine economy, and public health.

## **Emergency Preparedness**

### **Q1. Does Pilgrim continue to have emergency preparedness plans in place in case there is a radiological problem?**

A1. Yes and no. Before the shut-down, Pilgrim was required to have both on-site and off-site radiological emergency plans. Ten (10) months after defueling, April 1, 2020, Pilgrim was not required by NRC to have, and has discontinued, off-site emergency planning. The NRC exempted Pilgrim from offsite radiological emergency planning obligations.<sup>25</sup>

On April 1, 2020, Holtec informed the Commonwealth and neighboring communities that offsite emergency response facilities including Pilgrim's primary and alternate Emergency Offsite Facility, Joint Information Center, community reception centers, and town emergency facilities (with the exception of Plymouth) will no longer be part of response plans. Also, the 113 Prompt Alert Notification System sirens will be disabled, and Holtec will tell only the Town of Plymouth and the NRC if there has been an accident.

The NRC's stated justification for not requiring off-site emergency planning is the NRC's misguided and erroneous "assurance that an accident at Pilgrim can no longer credibly challenge radiological Protective Action Guidelines beyond the site boundaries." The fact of the matter is that the risk "beyond the site boundaries" is more than "credible;" it certainly is not zero. There is far more radiation in the casks than in the reactor core when Pilgrim was operating. Risk will remain until the spent fuel leaves the site. FEMA, Massachusetts, and other states are on record saying that their "all-hazards planning" would not be adequate to respond - "radiological

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<sup>24</sup> Settlement Agreement between the Commonwealth of Massachusetts and Holtec Pilgrim LLC an Holtec Decommissioning International LLC Regarding Pilgrim..., June 2020, Section III, 3, g, 2

<sup>25</sup> <https://www.nrc.gov/reading-rm/doc-collections/news/2019/19-056.pdf>

[emergency planning] is unique.” We are at risk mainly because of the spent nuclear fuel now owned by Holtec and created by its predecessors.

Holtec initially refused to continue or pay the costs of offsite radiological emergency planning including training and equipment, with the exception that Plymouth will receive funds until the spent fuel pool is emptied. Subsequently, the Settlement Agreement between the Commonwealth and Holtec Pilgrim and HDI, June 2020, included a payment schedule to MEMA. (Settlement Section IV, Table 2) The payment schedule for a specified scope of work is far less than during operations and decreases to a mere \$15,000/year from 2029 until license termination, expected in 2062-3. Money for EPZ towns and Reception Center communities to provide radiological emergency planning is not included in the Settlement. The five towns within Pilgrim’s Emergency Planning Zone and the three towns hosting Reception Centers later negotiated separate agreements with Holtec Pilgrim/HDI. The money was far less than they previously received and far less that they believed needed to protect the community in a radiological disaster.<sup>26</sup> The Town of **Marshfield has sued Holtec to continue payments.**<sup>27</sup>

## License Termination

### Q1. When will the station’s NRC license be terminated?

A1. Termination of Pilgrim’s license will take place when site building demolition and remediation operations are completed, and the remaining grounds have been surveyed to ensure they meet the NRC criteria for residual radioactivity levels. The specific activities and radiological criteria will be defined in the plant’s termination plan, which must be filed with the NRC at least two years prior to license termination.

Termination of the Independent Spent Fuel Installation Facility (ISFSI) license will take place when the spent fuel leaves the site. and the pad area has been surveyed and remediated, if required.

### Q2. What is Holtec’s plan for the Pilgrim site and adjacent property after it completes decommissioning?

A1. Holtec says that it currently has no immediate plans for its property where the reactor is located. As decommissioning proceeds further along, Holtec says it will work with the local

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<sup>26</sup> Carver- \$75,000 for three months of EPZ and to unwind the RERP and breakdown the alternate EOF. Duxbury- \$63,750, broken down as \$21,250 for the three months of the EPZ in 2020 and \$42,500 to unwind the RERP – also has language that at any point during the 8-year decommissioning if they provide mutual aid to the site and their equipment becomes contaminated Holtec will provide replacement at no cost to the community. Kingston - \$63,750, same break down as Duxbury and language. Marshfield - \$120,196.21 three months of EPZ payment. Marshfield is suing Holtec Pilgrim to maintain emergency planning funding. Plymouth has a 2 ½ year agreement through June 30, 2022, as the host community for Police and Fire services. Break down as \$150,000 1/1/20 to 6/30/20 and then \$230,000 the following two years 7/1/20-6/30/21 and 7/1/21-6/30/20. Braintree RC - \$42,000 Three months plus costs to breakdown the program. Taunton RC - \$56,500 three months plus costs to breakdown the program. Bridgewater RC - \$57,500 three months plus costs to breakdown the program.

<sup>27</sup> Plymouth Superior Court Dept. Trial Court Civil Action, 2083CV00266

community about possible future uses. It is zoned for light industrial use. The Town of Plymouth would like Holtec to give the town the property located between Rocky Hill Road and Route 3A or offer the town first refusal.

## **Regulatory Oversight/Permitting**

### **Q1. What state and federal agencies are involved in the decommissioning processes**

A1. Several agencies have important roles, especially: The Massachusetts Attorney General; and the Executive Branch - Governor, Secretary Health & Human Services, Secretary Energy and Environmental Affairs, and the Secretary Public Safety. On the federal level, primarily the Nuclear Regulatory Commission and Environmental Protection Agency. The Department of Entergy will be responsible for the spent nuclear fuel.

A2. Massachusetts formed two advisory groups. An Interagency Working Group was established within the Executive branch to monitor pre- and post-shutdown processes at Pilgrim, and to lead and coordinate state agency involvement in any matters pertaining to decommissioning within the respective agencies' jurisdiction. The legislature established a Nuclear Decommissioning Citizens Advisory Panel to advise the Governor and educate citizens on activities related to Pilgrim's decommissioning.<sup>28</sup>

## **Regulations**

### **Q1. What are the NRC Decommissioning Regulations?**

A1. The requirements for decommissioning a nuclear power plant are set out in several NRC regulations - Title 10 of the Code of Federal Regulations, Part 20 Subpart E, and Parts 50.75, 50.82, 51.53, and 51.95. In August 1996, a revised rule went into effect that redefined the decommissioning process and required owners to provide the NRC with early notification of planned decommissioning activities. The rule allows no major decommissioning activities to be undertaken until after certain information has been provided to the NRC and the public. The NRC is currently developing new regulations. These regulations are expected to be final by 2022.

## **Public Involvement**

### **Q1. What opportunities are there for public involvement?**

A1. The NRC held a public meeting in Plymouth after submitting the post-shutdown decommissioning activities reports to the NRC. Another public meeting will be held when NRC receives the license termination plan. Members of the public may be allowed to observe other meetings of the NRC and licensees (except when the discussion involves proprietary, sensitive, safeguards, or classified information).

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<sup>28</sup> <https://www.mass.gov/orgs/nuclear-decommissioning-citizens-advisory-panel>

A2. The Atomic Energy Act requires the NRC to provide an opportunity for a public hearing prior to the issuance of a license amendment approving a plan or any other license amendment request. The state, townships, public interest groups, and individuals may file motions to intervene. In February of 2019, the Massachusetts Attorney General on behalf of the Commonwealth and Pilgrim Watch filed petitions requesting a public hearing on whether Pilgrim's licenses should be transferred to Holtec and asking to intervene. The NRC allowed the licenses to be transferred to Holtec in August of 2019, but it had taken no action on the Commonwealth's or Pilgrim Watch's requests.<sup>29</sup> June 2020, the Commonwealth agreed to drop its litigation with NRC and the DC Circuit when it signed the Settlement Agreement. Pilgrim Watch was not part of the settlement. On November 12, 2020, the NRC Commission denied Pilgrim Watch's Motion to Intervene and Request for Hearing (CLI-20-12)<sup>30</sup> with two of the five NRC Commissioners (Commissioners Baran and Hanson) dissenting. Again, NRC issued its denial without taking any action on Pilgrim's Watch's petition. Pilgrim Watch was given sixty days to appeal the Order to Federal circuit court.

### Recommended Reading

#### PILGRIM WATCH & COMMONWEALTH'S MAIN FILINGS IN PILGRIM LICENSE TRANSFER APPLICATION

To access filings, go to the NRC website's front page- <https://www.nrc.gov/>. In the upper right corner of the front page, enter ML number in search box.

|                                                                                                                                                                       |              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Pilgrim Watch Petition to Intervene & Request for Hearing                                                                                                             | ML19051A019  |
| Commonwealth Petition to Intervene & Request for Hearing                                                                                                              | ML19051A114  |
| Pilgrim Watch Comments relative to Holtec PSDAR and Decommissioning Cost Estimate                                                                                     | ML19064B330  |
| Applicants Oppose Pilgrim Watch Motion                                                                                                                                | ML19077A235  |
| Applicants Oppose Commonwealth Motion                                                                                                                                 | ML19077A232  |
| Pilgrim Watch Reply to Applicants' Answer Opposing Pilgrim Watch Motion                                                                                               | ML19091A189  |
| Pilgrim Watch Supplement to Motion (Biodiversity)                                                                                                                     | ML191129A473 |
| Pilgrim Watch Motion to File New Contention (Holtec/SNC-Lavalin Malfeasance)                                                                                          | ML19197A330  |
| Application for a Stay of Staff's Actions Approving the License Transfer and Request for Exemption to Use Decommissioning Trust Fund for Non-Decommissioning Purposes | ML19247B429  |

- **NRC Order Approving License Transfer**, August 2019 NRC Adams Accession No., ML19170A101
- NRC Order (CLI 20-12) Entergy Nuclear Operations, Inc., Entergy Nuclear Generation Company, Holtec International, and Holtec Decommissioning International LLC (Pilgrim Nuclear Power Station), November 2020  
<https://www.nrc.gov/docs/ML2031/ML20317A117.pdf>

<sup>29</sup> Pilgrim Watch Petition to Intervene & Request for Hearing, NRC Electronic Library, Adams, Accession Number ML19051A019; Commonwealth Petition to Intervene & Request for Hearing, NRC Electronic Library, Adams, Accession Number ML19051A114

<sup>30</sup> <https://www.nrc.gov/docs/ML2031/ML20317A117.pdf>

- Settlement Agreement between the Commonwealth and Holtec Pilgrim LLC and Holtec Pilgrim International LLC <https://files.constantcontact.com/4ef44f21401/5ff23c7f-c2a4-43a3-af24-dd6d7f45ea31.pdf>
  - NRC-Backgrounder on Decommissioning <https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/decommissioning.html>
  - Staff Responses to Frequently Asked Questions Concerning Decommissioning of Nuclear Power Reactors (NUREG-1628) <https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1628/>
  - Questions and Answers on Decommissioning Financial Assurance <https://www.nrc.gov/docs/ML1119/ML111950031.pdf>
  - Mass DEP Tentative Determination to Deny a Surface Water Discharge Permit Modification for Pilgrim Nuclear Power Station <https://www.mass.gov/info-details/massdep-permits-approvals-for-comment>
  - EPA Pilgrim Decommissioning that includes links to important documents<https://www.epa.gov/npdes-permits/pilgrim-nuclear-power-station>
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## **PILGRIM'S DECOMMISSIONING – HOLTEC**

Holtec International is a privately-owned company that is best known for manufacturing dry casks used to store spent nuclear fuel. It recently expanded its business to include decommissioning retired commercial nuclear power reactors. Over the last two years, Holtec has purchased, or agreed to purchase, and decommission 6 reactors: Oyster Creek, Palisades, Indian Point (3 reactors) and Pilgrim.<sup>31</sup> Holtec now is expanding further to manufacturing small nuclear reactors. Holtec is quoted saying in a 42-page July 2022 Holtec application for DOE funding, that:

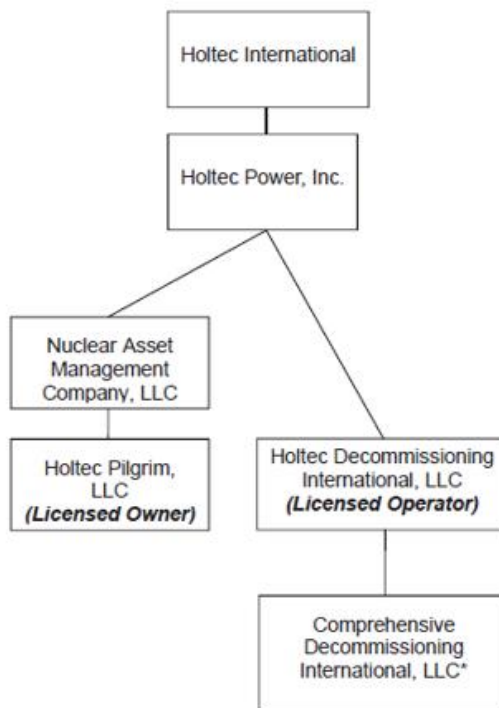
Despite the success in decommissioning, we are not loath to admit that we are unabashed promoters of nuclear energy...In fact, one of the principal reasons Holtec has been acquiring aging nuclear plants is because such sites are near-perfect locations for building the SMR-160 reactors that the company has been developing for over a decade. ("Page 1", p.3 on PDF counter.)

The purchase of Pilgrim from Entergy was completed in August of 2019. We understand that the purchase price was "nominal," probably close to the \$1000 for which Entergy sold Vermont Yankee to NorthStar. In exchange, Holtec acquired the about-to-retire Pilgrim plant, its roughly billion-dollar decommissioning trust fund, thousands of assemblies of spent nuclear fuel, the obligation to decommission, and potential for hundreds of millions of dollars profit.

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<sup>31</sup> <https://hdi-decom.com/our-fleet/>

The corporate structure that Holtec International created to accomplish the purchase and decommissioning is described in detail in the License Transfer Application (LTA) filed with the NRC on November 16, 2018.<sup>32</sup> It is shown in the simplified post-transfer organization chart below.



Note:

\* Comprehensive Decommissioning International, LLC ("CDI") is jointly owned by Holtec (through its subsidiary, Holtec Decommissioning International, LLC ("HDI"), the majority owner) and SNC-Lavalin (through its subsidiary, Kentz USA, the minority owner). HDI will contract with CDI through a Decommissioning General Contractor Agreement.

Except that it is now indirectly owned by Holtec International and has a new name, Holtec Pilgrim is the same legal entity as Entergy Nuclear Generating Co. (ENGCO) that owned Pilgrim prior to the transfer. As a result of the transaction, Holtec Pilgrim now owns the Pilgrim plant, the Pilgrim site, and the Pilgrim Decommissioning Trust Fund.

Holtec Decommissioning International, LLC ("HDI") is another indirect wholly owned subsidiary of Holtec International. HDI is a special purpose entity that was recently formed by Holtec to be the licensed operator for all Holtec-owned nuclear power plants. HDI will be the licensed operator that will decommission all the nuclear power plants, including Pilgrim, owned by Holtec International; and will manage the decommissioning trust fund as well as licensing strategy, insurance, land, and government interface.

According to the License Transfer Agreement (LTA), Holtec Pilgrim will enter into a Decommissioning Operator Services Agreement with HDI, which will provide for HDI to act as

<sup>32</sup> <https://www.nrc.gov/docs/ML1832/ML18320A031.pdf>

Holtec Pilgrim's agent and for Holtec Pilgrim to pay HDI's costs of post-shutdown operations, including decommissioning costs and spent fuel management costs.

Comprehensive Decommissioning International, LLC ("CDI") is a little different. It was formed in 2018 by Holtec International through its subsidiary HDI, with the express purpose of creating a company to provide all-encompassing project solutions for the accelerated decommissioning of retired nuclear power plants."<sup>33</sup> CDI is jointly owned by HDI (the majority owner) and by HDI and a Canadian company, SNC-Lavalin ("SNCL"). Pursuant to a Decommissioning General Contractor Agreement between it and HDI, CDI will be the decommissioning general contractor, and will manage and perform Pilgrim's day-to-day activities, including decommissioning activities, subject to HDI's direct oversight and control as the licensed operator. In February 2022, the press announced that SNC-Lavalin Group Inc. and U.S. energy technology specialist Holtec International are breaking off a four-year-old joint venture that works on cleaning up and dismantling nuclear plants in the United States after an unspecified dispute. Comprehensive Decommissioning International LLC is being disbanded.<sup>34</sup>

**Exit CDI and SNC-Lavalin<sup>35</sup>:** Patrick O'Brien, HDI- Senior Manager, Government Affairs & Communications, explained in a February 2022 email that: In December 2021, HDI exercised its termination for convenience rights under the Decommissioning General Contractor Agreement with CDI. **Effective January 19<sup>th</sup>, HDI performs all activities previously performed by CDI at all of its sites**, including managing and performing decommissioning and spent fuel management activities. The termination of CDI as a General Contractor was precipitated by a private dispute between the owners of CDI, of which Holtec is the majority owner. Certain key on site personnel have always been HDI employees (e.g., Site VP and Regulatory, QA and Security Leads), former CDI employees at Holtec sites became HDI/Holtec employees, so there will be no loss of site personnel or decommissioning expertise. This simplifies the organizational structure and eliminates a layer / entity between the licensee and the subcontractors actually performing decommissioning.

In summary, there are at least six (6) things to note.

1. **All the companies that will have anything to do with decommissioning are Limited Liability Corporations.** All are wholly owned subsidiaries of Holtec International. All are new companies, none of which has decommissioned a nuclear power plant before.
2. Holtec International chose this corporate structure for a reason – **to avoid potential liability and financial responsibility.** Because Holtec Pilgrim and HDI are LLCs, neither Holtec International, nor Holtec Power Inc., nor Nuclear Asset Management Company,

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<sup>33</sup> [https://cdidecom.com/about us](https://cdidecom.com/about-us).

<sup>34</sup> [SNC-Lavalin and U.S. firm end joint venture formed to dismantle nuclear plants - The Globe and Mail](https://www.theglobeandmail.com/business/article-snc-lavalin-and-us-firm-end-joint-venture-formed-to-dismantle-nuclear/)

<sup>35</sup> <https://www.theglobeandmail.com/business/article-snc-lavalin-and-us-firm-end-joint-venture-formed-to-dismantle-nuclear/>

LLC, have or had any financial responsibility if Holtec Pilgrim and HDI do not have sufficient funds to pay the costs of decommissioning, or any liability if some aspect of decommissioning goes wrong

3. Only Holtec Pilgrim and HDI are licensed by the NRC. The NRC has no authority to require Holtec International, Holtec Power, Inc. Nuclear Asset Management Company to pay.
4. **The NRC will tell you that its regulations provide “reasonable assurance of obtaining the funds necessary ... for decommissioning.” Unfortunately, this is simply not so. The NRC cannot require any entity that is not a licensee to pay. Here, the only licensees are HDI and Holtec Pilgrim.**
5. Holtec’s plan is to decommission six reactors at four nuclear stations located in four different states - Massachusetts, New York, New Jersey, and Michigan – at basically the same time. At the Michigan site, Palisades, Holtec hopes to restart the reactor, although it has no experience operating a reactor. Also Holtec is designing Small Modular Nuclear Reactors (SMRs)<sup>36</sup> and hopes to place them at some of its sites-such as Oyster Creek. At essentially the same time, Holtec also plans to build a Consolidated Spent Fuel storage site in New Mexico. We fear that Holtec has bitten off far more than it can chew, and that this will negatively impact on the quality of oversight and attention to detail needed to properly decommission Pilgrim Station.
6. Numerous news media have reported that Holtec and SNC-Lavalin (SNCL) have a long-standing history of corruption, fraud, bribery and lying in connection with their business dealings.<sup>37</sup> According to these reports, **SNCL**, the company that supposedly brought technical experience and expertise to the decommissioning process, has been charged with corruption, fraud, bribery, misleading investors, paying public officials to influence government decision, defrauding other organizations, forging documents, and making illegal political contributions. The reports say that **Holtec has made misrepresentations** to both the NRC and the State of New Mexico in connection with Holtec’s planned New Mexico waste storage facility, and that its CEO, Dr. Singh has made false statements to New Jersey government officials and attempted bribery in connection with Holtec’s nuclear waste storage business with respect to quality assurance violations.

On July 17, 2019, Pilgrim Watch filed a motion in Pilgrim’s license application proceeding to require the NRC to investigate these allegations and to determine if Holtec and SNC-Lavalin are trustworthy and reliable and otherwise possesses the character prerequisite

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<sup>36</sup> <https://holtecinternational.com/products-and-services/smr/>

<sup>37</sup> Corruption media reports, please see: Pilgrim Watch Motion to File a New Contention, July 16, 2019.NRC Electronic Library, Adams, Accession Number ML19197A330 ; [Radioactive and Other Skeletons in SNC-Lavalin's closet...](http://www.beyondnuclear.org/decommissioning/2019/7/26/radioactive-and-other-skeletons-in-snc-lavalins-closet.html)Journal Entry by admin on July 26, 2019,Articles, and other posts : Posted January 10, 2020. <http://www.beyondnuclear.org/decommissioning/2019/7/26/radioactive-and-other-skeletons-in-snc-lavalins-closet.html>; News reports listed in NRC Library Adams, Accession No. ML19009A326.

to allowing them to participate in or control Pilgrim's decommissioning.<sup>38</sup> The NRC did not respond to the motion.

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## FINANCES - IS THERE ENOUGH MONEY?

Holtec Pilgrim is supposed to pay all the costs of decommissioning Pilgrim, storing its spent nuclear fuel, and restoring the Pilgrim site. Its only significant asset is the Pilgrim DTF. So far as we know, the DTF is Holtec Pilgrim's only significant asset, and HDI, the other Pilgrim licensee, has no significant assets. In 2020, Holtec changed the DTF trustee from Mellon to Northern Trust.

Holtec's 2018 PSDAR said that total decommissioning costs would be \$1.134 billion, that withdrawals from the trust fund would also total \$1.134 billion, and that \$3.6 million would be left over at the end of 2063.

As discussed below, these estimates are far too low and are based on many unsupportable assumptions.



### Holtec Decommissioning International, LLC

In March 2024, Holtec filed its **latest annual financial report** with NRC, Pilgrim Nuclear Power Station Annual Decommissioning Funding and Spent Fuel Management Status and Financial Assurance Report<sup>39</sup> The report's Table 1 summarizes information as of December 31, 2023.

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<sup>38</sup>Pilgrim Watch Motion to File a New Contention, <https://www.nrc.gov/docs/ML1919/ML19197A330.pdf>

<sup>39</sup> NRC Library Adams Accession Number ML24089A117

ENCLOSURE 2

Table 1

Holtec Decommissioning International, LLC  
Pilgrim Nuclear Power Station

Summary Information as of December 31, 2023

| Decommissioning Trust Fund Balance - 10 CFR 50.82(a)(8)(v)(A), 10 CFR 50.82(a)(8)(vii)(A)                    |                       |                              |                  |                     |                                                     |
|--------------------------------------------------------------------------------------------------------------|-----------------------|------------------------------|------------------|---------------------|-----------------------------------------------------|
| Year                                                                                                         | Type of Trust         | Fund Balance                 |                  |                     | Comments                                            |
| 2023                                                                                                         | Decommissioning Trust | \$542.8M                     |                  |                     | As of 12/31/2023; net of tax liabilities            |
| Other Financial Assurance Methods Being Relied Upon - 10 CFR 50.82(a)(8)(v)(B)                               |                       |                              |                  |                     |                                                     |
| NONE                                                                                                         |                       |                              |                  |                     |                                                     |
| HDI Decommissioning Expenditures Since License Transfer - 10 CFR 50.82(a)(8)(v)(A)                           |                       |                              |                  |                     |                                                     |
| Year                                                                                                         | License Termination   | Spent Fuel <del>Manag.</del> | Site Restoration | Total <sup>1</sup>  | Comments                                            |
| 2019                                                                                                         | \$45M                 | \$56M                        | \$0M             | \$101M              | 2019 Costs in as-Spent Dollars                      |
| 2020                                                                                                         | \$106M                | \$67M                        | \$3M             | \$175M              | 2020 Costs in as-Spent Dollars                      |
| 2021                                                                                                         | \$105M                | \$113M                       | \$2M             | \$221M              | 2021 Costs in as-Spent Dollars                      |
| 2022                                                                                                         | \$64M                 | \$28M                        | \$7M             | \$99M               | 2022 Costs in as-Spent Dollars                      |
| 2023                                                                                                         | \$53M                 | \$29M                        | \$4M             | \$86M               | 2023 Costs in as-Spent Dollars                      |
| Total Spent to Date                                                                                          | \$373M                | \$294M                       | \$16M            | \$683M <sup>1</sup> | As Spent Dollars                                    |
| Prior Year Expenditures Variance to Total HDI Estimated Cost - 10 CFR 50.82(a)(8)(v)(B)                      |                       |                              |                  |                     |                                                     |
| Year                                                                                                         | License Termination   | Spent Fuel <del>Manag.</del> | Site Restoration | Total <sup>1</sup>  | Comments                                            |
| 2023 Estimated                                                                                               | \$44M                 | \$13M                        | \$5M             | \$63M               | Estimate in 20 <sup>2</sup> 2 Dollars (Reference 2) |
| 2023 Actuals                                                                                                 | \$53M                 | \$29M                        | \$4M             | \$86M               | 2023 Costs in as-Spent Dollars                      |
| Remaining Decommissioning Estimated Cost - 10 CFR 50.82(a)(8)(v)(B); 50.82(a)(8)(vii)(B)                     |                       |                              |                  |                     |                                                     |
| Year                                                                                                         | License Termination   | Spent Fuel <del>Manag.</del> | Site Restoration | Total <sup>1</sup>  | Comments                                            |
| 2024                                                                                                         | \$235M                | \$339M                       | \$18M            | \$592M              | Estimated in 2023 Dollars (Table 2)                 |
| Decommissioning Criteria Upon Which the Estimate is Based - 10 CFR 50.82(a)(8)(v)(B)                         |                       |                              |                  |                     |                                                     |
| DECON                                                                                                        |                       |                              |                  |                     |                                                     |
| Any Modification to Method of Providing Financial Assurance - 10 CFR 50.82(a)(8)(v)(A) and 50.82(a)(8)(v)(C) |                       |                              |                  |                     |                                                     |
| NONE                                                                                                         |                       |                              |                  |                     |                                                     |
| Any Material Changes to Trust Agreement Since Previous Report - 10 CFR 50.82(a)(8)(v)(D)                     |                       |                              |                  |                     |                                                     |
| See Item (F) in Enclosure 2                                                                                  |                       |                              |                  |                     |                                                     |
| Need for Additional Financial Assurance - 10 CFR 50.82(a)(8)(v)(C) and 50.82(a)(8)(vii)(C)                   |                       |                              |                  |                     |                                                     |

<sup>1</sup> Columns may not add due to rounding

<sup>2</sup> \$95.8M of incurred costs have not been reimbursed as of 12/31/23.

Holtec's decommissioning milestones are summarized in the Holtec Decommissioning International, LLC , Milestone Summary - **Annual Decommissioning Funding and Spent Fuel Management Status and Financial Assurance Report, Enclosure 7** (As of December 31, 2023)

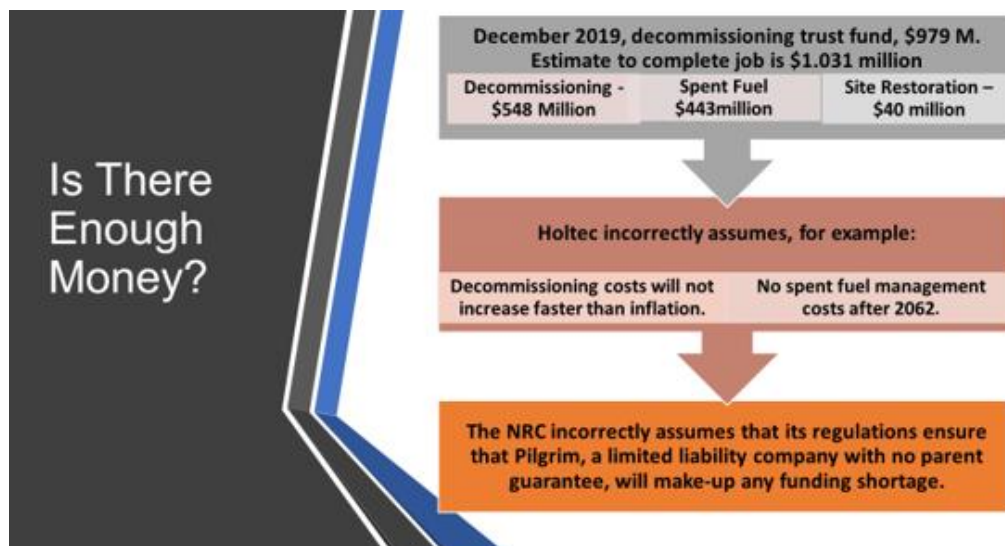
| Project / Milestone                                      | PSDAR/DCE/LTA<br>(per project<br>below) | DCE Annual<br>Update (2023) | Notes                                                                                                                                              |
|----------------------------------------------------------|-----------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Oyster Creek (PSDAR/DCE/LTA issued on 09/28/2018)</b> |                                         |                             |                                                                                                                                                    |
| License Transfer                                         | 07/01/2019                              | 07/01/2019                  | Complete                                                                                                                                           |
| Zirc Fire Elimination                                    | 09/17/2019                              | 06/29/2019                  | Complete                                                                                                                                           |
| Fuel on Pad                                              | 06/23/2023                              | 05/23/2021                  | Complete                                                                                                                                           |
| Segmentation Reactor<br>Vessel Internals (RVI):          | 02/03/2022                              | 01/27/2023                  | Complete                                                                                                                                           |
| Segmentation Reactor<br>Pressure Vessel (RPV):           | 09/19/2022                              | 08/19/2028                  |                                                                                                                                                    |
| Partial Site Release                                     | 10/24/2025                              | 11/03/2029                  |                                                                                                                                                    |
| Fuel Shipment Begins                                     | 01/03/2025                              | 01/03/2030                  |                                                                                                                                                    |
| Fuel Shipment Ends                                       | 03/28/2035                              | 03/28/2035                  |                                                                                                                                                    |
| License Termination                                      | 12/01/2035                              | 12/03/2035                  |                                                                                                                                                    |
| <b>Pilgrim (PSDAR/DCE/LTA issued on 11/16/2018)</b>      |                                         |                             |                                                                                                                                                    |
| License Transfer                                         | 07/31/2019                              | 08/26/2019                  | Complete                                                                                                                                           |
| Zirc Fire Elimination                                    | 03/30/2020                              | 03/31/2020                  | Complete                                                                                                                                           |
| Fuel on Pad                                              | 11/26/2021                              | 12/13/2021                  | Complete                                                                                                                                           |
| Segmentation RVI                                         | 10/12/2020                              | 05/30/2024                  | 2024 Schedule update                                                                                                                               |
| Segmentation RPV                                         | 09/18/2022                              | 12/31/2032                  | See Enclosure 2.G                                                                                                                                  |
| Partial Site Release                                     | 01/28/2025<br>[09/24/2027] *            | 09/24/2035                  | *2021 Schedule change noticed in 2019 Annual<br>Decommissioning Funding and Spent Fuel<br>Management Report (ML20091M858)<br><br>See Enclosure 2.G |
| Fuel Shipment Begins                                     | 01/02/2030                              | 01/02/2030                  |                                                                                                                                                    |
| Fuel Shipment Ends                                       | 12/31/2062                              | 12/31/2062                  |                                                                                                                                                    |
| License Termination                                      | 09/07/2063                              | 09/07/2063                  |                                                                                                                                                    |

Holtec's latest financial report to the NRC showed that the value of the Decommissioning Trust Fund, that finances decommissioning Pilgrim, fell largely due to the stock market and costs for decommissioning, like all costs, increased- especially costs surrounding discharge of Pilgrim's radiological and chemically contaminated wastewater. The result of the financial drop, Holtec's decision not to ship the wastewater to an out-of-state licensed facility, as Vermont Yankee did, and inflation is a now eight-year delay in completing decommissioning to partial site release to 2035.

The Commonwealth and Pilgrim Watch Motions to Intervene, and subsequent filings by the Commonwealth and Pilgrim Watch to the NRC, explain in detail the **reasons that they predict there will be insufficient funds in the Decommissioning Trust Fund (DTF) to decommission Pilgrim**. The principal reasons are that (i) Holtec's estimates of the cost properly to complete decommissioning are too low, (ii) there is not enough money in the DTF to pay them,<sup>40</sup> (iii) no

<sup>40</sup> See "Costs the DTF will not be able to pay," below.

other Holtec entity will agree to make up any shortfall, and (iv) the NRC has no ability to force Holtec International or any other company that has the necessary assets to do so. Detail follows.



### Decommissioning Trust Fund (DTF)

The money needed to decommission and to clean-up Pilgrim will come solely from Pilgrim’s DTF. The amount of money that a licensee must have in the DTF is ordained by the NRC cost formula for decommissioning estimates in 10 CFR §50.75. The formula only considers the costs of “decommissioning,” it does not consider any other costs such as spent fuel storage or restoring the site for future use.

The NRC’s formula also is generic, **not site specific**. It relies upon the age of each nuclear plant, the power level at which the nuclear plant was operated, and whether it is a boiling water reactor (BWR) or pressurized water reactor (PWR). It does not consider hazardous materials, radiological leaks or other environmental or radiological damage to the specific site environment, the cost of massive site remediation, or the conditions, topographical and geological challenges that actually exist at Pilgrim.

The NRC admits that the formula “provides only a “reference level established to assure ... that the bulk of the funds necessary for a safe decommissioning are being considered and planned for early in facility life,” and that it “does not represent the actual cost of decommissioning.”<sup>41</sup> Our understanding is that the decommissioning formula created by and applied by the NRC has never correctly estimated the true cost to decommission any nuclear power plant in the United States.

<sup>41</sup> NRC Questions and Answers on Decommissioning Financial Assurance, <https://www.nrc.gov/docs/ML1119/ML111950031.pdf>

Our understanding is that **no commercial nuclear reactor has been decommissioned for the formula amount.** For example, the estimated cost to decommission Big Rock Point was \$220 million; the actual cost was almost twice as much - \$390 million.<sup>42</sup>

The NRC formula does not and is not intended to ensure that there is enough money in the Pilgrim DTF to do the job. Neither does it provide decommissioning cost information that would enable states to make rational decisions. Simply knowing how much money is currently in Pilgrim's decommissioning fund and then arbitrarily comparing that fund balance against the formula does not make it possible for any governing or regulating body to make an informed decision about how much it really will cost to decommission and clean-up Pilgrim, and what costs Massachusetts and its taxpayers will have to pay.

### **No Parent Company Guarantee**

The NRC has the ability to ask a parent company, such as Holtec International, to provide a parent company guarantee (PCG). A "PCG is defined in Appendix A to 10 CFR Part 30; it is a guarantee between the parent and its subsidiary-licensee stating that the parent company will pay a specific amount of the decommissioning costs of its subsidiary-licensee, if the subsidiary-licensee fails to meet its decommissioning obligation."<sup>43</sup>

Holtec has refused to provide such a guarantee. Holtec also has refused to use any of its assets or any assets of any of its other subsidiaries, to pay for decommissioning costs if the DTF funds run out.

The likely need for a PCG or some other guaranteed source of additional funds is increased by two facts:

1. the NRC has allowed Holtec to use the DTF for spent fuel management and site restoration activities costs, although those funds by regulation are restricted only for radiological decommissioning and permitting them to be used for other purposes will reduce the amount of money available for decommissioning.<sup>44</sup>
2. Holtec will sue the Department of Energy (DOE) to recover, and put in its profit pocket, at least the \$500 million it will spend on spent fuel management costs – even though none of this money was Holtec's but rather was taken out of the DTF funded by the public.<sup>45</sup>

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<sup>42</sup> <https://www.nrc.gov/waste/decommissioning/faq.html#19>; [https://en.wikipedia.org/wiki/Big\\_Rock\\_Point\\_Nuclear\\_Power\\_Plant](https://en.wikipedia.org/wiki/Big_Rock_Point_Nuclear_Power_Plant)

<sup>43</sup> <https://www.nrc.gov/docs/ML1119/ML111950031.pdf>

<sup>44</sup> <https://www.nrc.gov/docs/ML1919/ML19192A086.pdf>;

<sup>45</sup> See Holtec's Expected Profit, below

## **NRC Regulations provide no guarantee.**

The NRC Staff's statements that the NRC has "the ability to take action on any actual or potential funding deficiencies" are wrong and ignore reality. NRC regulations say a *licensee* must make-up the balance of any shortfall (10 CFR 72.30(g)), but these regulations apply only to licensees, i.e., only to Holtec Pilgrim (whose only assets are Pilgrim, a lot of spent fuel, and the DTF) and Holtec Decommissioning International (that has essentially no assets). They do not apply to Holtec International, the "mother company" with assets.

The reality is that that if the DTF runs out of money no licensee, neither Holtec Pilgrim nor HDI will have any assets or other ability to eliminate "any actual or potential funding deficiencies;" A essentially bankrupt licensee cannot "make-up" anything; and the NRC has no legal ability or power to require a non-licensee – such as Holtec International, Holtec Power, Nuclear Asset Management Company - to pay anything.

## **Costs the Commonwealth likely will have to pay.**

The Commonwealth and Pilgrim Watch Motions to Intervene, and subsequent filings by the Commonwealth and Pilgrim Watch to the NRC, show in detail that there are insufficient funds in the Decommissioning Trust Fund (DTF) to decommission Pilgrim. The motions also explain why neither a Holtec nor Entergy entity will pay for any shortfall.

The Commonwealth and its taxpayers probably will have to pay hundreds of millions of dollars - likely more than \$650 million, and potentially more than a billion - for which Pilgrim alone should be fully responsible.

Even if the NRC had not allowed Holtec to withdraw almost half of the DTF to pay non-decommissioning expenses, there are six categories of costs that the DTF clearly will be insufficient to cover, and that the Commonwealth will have to pay.<sup>46</sup> These include:

- a. \$113 million to \$212 million of inflation-increased decommissioning costs
- b. Potentially several hundred million dollars to remove hazardous materials and radiological contamination, in soil and ground water.
- c. At least \$85 million to \$102 million in additional project management and overhead costs resulting only from the to-date 2½ year delay in Holtec's work schedule. (Mass. Attorney General)
- d. \$150 million to \$450 million to build a facility to transfer spent fuel from one cask to another. (GAO)
- e. \$261.77 million to repackage canisters for shipment offsite (Alvarez)

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<sup>46</sup> Holtec is allowed to take spent fuel management costs out of the decommissioning trust fund. Holtec, like all licensees, can and will sue DOE for all of its spent fuel management costs. The suits will be based on DOE's breach of contract-not providing an offsite repository for spent fuel by 1998. Monies recovered are not required to be placed back into the decommissioning fund to reimburse for monies taken out of the fund for spent fuel management costs.

- f. From \$380 million (ignoring inflation) to several billion dollars in spent fuel costs after 2062, based on NRC predicted inflation and the length of time that the spent fuel likely will remain on site.

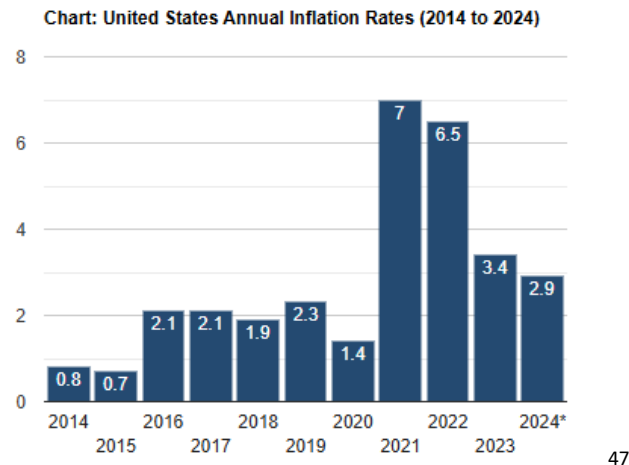
Each of these, and numerous other potential costs that Holtec's PSDAR does not consider and will also be left to the Commonwealth and its taxpayers, are discussed below.

## 1. Higher Decommissioning Costs Resulting From Inflation

Holtec based its decommissioning costs on the faulty assumption that decommissioning costs will not increase with inflation during the decommissioning period.

"The decommissioning costs presented in this report are reported in 2018 dollars. Escalation of future decommissioning costs over the remaining decommissioning project life cycle are excluded." (PSDAR, p. 19; DCE, pp. 7, 18)

That assumption is flatly contradicted by both the NRC and history.



The NRC's Questions and Answers on Decommissioning Financial Assurance<sup>48</sup> are clear: decommissioning costs will increase at a rate higher than the rate of inflation, and that over a period of only 20 years (40 years less than the 60 year period allowed for decommissioning) there will be 2.5 to 5.6 times an increase in costs, i.e., *the annual increase in costs will be 5% to 9%*:

The NRC formulas represent the cost to decommission today, not in the future. *Due to rising costs, the future value of decommissioning will be much larger than the NRC formula calculated today.* For example, using the range of cost escalation rates based

<sup>47</sup> <https://www.usinflationcalculator.com/inflation/current-inflation-rates/>

<sup>48</sup> Callan 2023 NDT Study, <https://www.callan.com/blog-archive/2023-ndt-study/#:~:text=Our%20study%20also%20found%20that,cost%20figures%20offset%20one%20another.NRC> Electronic Library, Adams, Accession Number ML1119/ML111950031

on NUREG - 1307, the **increase in cost over a 20-year license renewal period would range from 2.5 to 5.6 times today's estimated cost, not counting costs that are not included in the formula, such as soil contamination.** *The rates of increase in decommissioning cost are higher than general inflation.* (Emphasis added)

Its 2015 Nuclear Decommissioning Funding Study said, "Total decommissioning cost estimates have risen 60% since 2008," and that "2014 decommissioning cost estimates rose approximately 11% from the previous year." The 2018 Study reported that decommissioning costs increased by about 80% (from \$55 billion to \$89 billion, an annual rate of about 5 percent) from 2008 and 2017. The trend continued in 2019: "cost estimates rose \$7.4 billion (8.4%) from a year earlier to over \$96 billion in 2018.

Simply stated, the NRC says that decommissioning costs will increase, and Callan Associates says that they have increased, at an annual rate that is much greater than inflation. There is no reasonable basis for Holtec's "no inflation" cost estimates.

## **2. Costs to remove hazardous materials and radiological contamination- Holtec assumes the site is essentially clean.**

The NRC's Decommissioning Rule, 10 C.F.R. §20.151 recognizes the importance of a site assessment and an evaluation of "the magnitude and extent of radiation levels; and the concentrations of residual activity." In the Federal Register notice establishing this rule, the NRC was quite clear that "To adequately assure that a decommissioning fund will cover the costs of decommissioning, the owner of a facility must have a reasonably accurate estimate of the extent to which residual radioactivity is present at the facility, particularly in the subsurface soil and groundwater," that "soil or ground-water contamination can increase decommissioning costs" and "increase decommissioning costs above the original estimate." 76 Federal Register 33514, 33517.

Holtec, however, admits that when it prepared its site restoration estimates *it did not know* what radiological and hazardous waste actually existed on Pilgrim's site.<sup>49</sup>

Nonetheless, Holtec based its decommissioning and site restoration costs estimates on the baseless, and incorrect, assumption that there is "no significant contamination" on the Pilgrim site (DCE, p. 22). It compounded its error by included **only** "those costs associated with conventional dismantling, demolition, and removal from the site of structures and systems" (PSDAR, p 19) in its **estimated \$40 million site restoration cost.**

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<sup>49</sup>Revised Post-Shutdown Decommissioning Activities Report and Revised Site-Specific Decommissioning Cost Estimate for Pilgrim Nuclear Power Station NRC Electronic Library, ADAMS Accession No. ML18320A040, (Holtec PSDAR 8-11; DCE pg., 14)

Pilgrim Watch and the Commonwealth know, and we suspect that Entergy and Holtec also know, that there is “significant contamination” on the Pilgrim site, and that site restoration will require far more.<sup>50</sup>

Pilgrim NPS opened with bad fuel and no off-gas treatment system. Later, it blew its filters prompting Mass Dept. Public Health to do a case-control study of adult leukemia, finding a four-fold increase, and confirming the hypothesis that the closer you lived or worked at Pilgrim there would be an increase in leukemia.

Radionuclides, including for example tritium, manganese-54, cesium-137, Sr-90, I-131, cobalt-60, plutonium, and neptunium have been found off-site, and also in the surface water, groundwater, and soils at Pilgrim at levels exceeding “background” levels. Monitoring wells placed onsite from 2007 forward shows consistent levels of radiological contamination—contamination not yet removed. Hazardous waste was illegally buried onsite. See Pilgrim Watch Motion to Intervene, pp 36-46.

The Commonwealth’s Motion to Intervene included a declaration from John M. Priest Jr, director of radiation control MDPH and a former Pilgrim employee. Mr. Priest said that:

9. Based on my site knowledge, contamination has previously been identified by the utilities in the soil in the vicinity of the condensate water storage tank, the reactor truck lock and radioactive waste building. Further, there were other releases into the environment associated with a former condenser tube refurbishment building east of the radioactive waste truck lock. Historically, contaminated soil from previous site remediation has been “stockpiled” on a small hill along the east protected area fence. DPH does not know whether these sites and others were captured as part of decommissioning records required by 10 C.F.R. § 50.75(g), communicated to Holtec and evaluated by Holtec in its decommissioning cost estimate. Based on my knowledge of this site and experience at other nuclear power plants, it is reasonable to assume based on this site’s history that other contaminants will be identified once excavation and demolition begins.

10. Long-lived radionuclides are likely to be found in soils and groundwater far from the small excavation made to repair the leaks that likely allowed reactor condensate to enter into the site soils for many years. In addition, these same long-lived radionuclides are likely to be found in many other structures, systems, and components, which may also have unknowingly leaked over the decades into soils and the groundwater at the Pilgrim property.

**Experience at other decommissioned reactors showed significant cost increases from “unknown” contamination discovered only later.** At Connecticut Yankee, for example,

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<sup>50</sup> Pilgrim Watch Petition to Intervene & Request for Hearing, NRC Electronic Library, Adams, Accession Number ML19051A019; Commonwealth Petition to Intervene & Request for Hearing, NRC Electronic Library, Adams, Accession Number ML19051A114

previously undiscovered strontium-90 contributed to the actual cost of decommissioning Connecticut Yankee being *double* what had been estimated. Connecticut ratepayers had to pay a \$480 million shortfall for cleanup of CT Yankee.<sup>51</sup> During the decommissioning of Maine Yankee, the licensee encountered pockets of highly contaminated groundwater dammed up by existing structures, leading to cost increases. The Yankee Rowe site in Massachusetts incurred significant cost increases during decommissioning when PCBs were discovered in paint covering the steel from the vapor container that housed the nuclear reactor, as well as in sheathing on underground cables. Other plants have also ended up costing much more than what was estimated for decommissioning- Diablo Canyon 1&2, San Onofre 2&3.<sup>52</sup>

At this point in time, no one knows how much hazardous waste and radiological contamination must be removed from the Pilgrim site, or what the actual cost of removing it will be. However, three things are clear – the site is contaminated, there is not enough money in the DTF to pay to remove it, what the costs will be, and unless these contaminants are properly removed they will end up in Cape Cod Bay and perhaps the Plymouth-Carver Aquifer underneath the site.

### **3. Spent Fuel Costs After 2062**

Projected spent fuel management costs in Holtec's PSDAR, DCE and LTA rest on at least three unexplained and unlikely assumptions: that DOE will remove all spent fuel from the Pilgrim site by 2062. (Holtec PSDAR, pgs., 23 and 58); that Holtec will never have to repair or replace any failed casks or pads, and that Holtec will not have to repackage spent nuclear fuel into new containers approved by DOE for transportation. None of these assumptions are justified.

Holtec's projected costs assume that "DOE will commence acceptance of PNPS's spent fuel in 2030 and ... the spent fuel [will] be fully removed the Pilgrim site in 2062" (DCE, p. 23) is based on DOE's January 2013 *Strategy for The Management and Disposal of Used Nuclear Fuel and High -Level Radioactive Waste*. ("DOE Strategy").<sup>53</sup> But the Holtec cost estimates ignore that the DOE Strategy is simply "a framework for moving toward a sustainable program to deploy an integrated system capable of transporting, storing, and disposing of used nuclear fuel" (DOE Strategy, p. 1). The strategy does not even try to guess by when an interim or geologic repository to which the spent fuel would be moved might actually exist.

The DOE Strategy itself says that it is nothing more than a "plan" or "goal" for which "legislation is needed in the near term" (DOE Strategy, pp.13-14) Seven years have now passed. There is no Congressional legislation or appropriation, and no plan has been implemented.

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<sup>51</sup> Hartford Current, November 12, 2005 <http://www.courant.com/news/local/cynukemess.artnov12,0,6222764.story?col l=hc-headlines-home>

<sup>52</sup> See, e.g., NRC, SECY-13-0105, at Summary Table, available at <http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2013/2013-0105scy.pdf>.

<sup>53</sup> U.S. Department of Energy, Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste, January 2013. <http://www.energy.gov/sites/prod/files/Strategy%20for%20the%20Management%20and%20Disposal%20of%20Used%20Nuclear%20Fuel%20and%20High%20Level%20Radioactive%20Waste.pdf>

The NRC has been more realistic. Its 2014 Continued Storage Rule envisions onsite storage for 300 years,<sup>54</sup> and the casks and pad would need to be changed every 100 years.

Holtec estimated on-going spent fuel storage costs would be \$7.2 million per year in 2018 dollars. Even if one were to assume that there would be no greater-than-inflation increase in those costs and the fuel, if the spent fuel were to remain on-site for 100 years after Pilgrim shut down, the 57 additional years of spent fuel would add more than \$380 million to Holtec's estimated cost. The NRC's predicted 5% to 9% annual cost increases would add billions.

#### **4. Cost of Repackaging Spent Fuel Canisters For Shipment Offsite**

DOE's Standard Contract under the Nuclear Waste Policy Act requires reactor operators to pay to repackage fuel into new DOE approved containers prior to transportation to an offsite storage facility or repository (AGO Motion to Intervene in LTA, Brewer Decl, pg.,8). Repackaging spent fuel so that it can be transported off-site will be expensive, but that cost has been ignored by Holtec.

According to Task Order 12: Standardized Transportation, Aging, and Disposal Canister Feasibility Study, Option 3 (1 PWR/1 BWR/13.1/U) it will cost \$34,311,000,000 to repackage 140,000 MT; the per ton cost is \$245,078.00.<sup>55</sup> Dr. Alvarez says that **repackaging at the Pilgrim site could add \$261,770,600 to the predisposal costs.**<sup>56</sup>

No repackaging costs are included in Holtec's estimates. And again, repackaging would be required no matter when the spent fuel is shipped, so it is not likely that the cost would be reimbursed by DOE.

#### **5. Cost of A Spent Fuel Transfer Facility To Repackage Canisters**

There are a number of circumstances in which Holtec will have to move spent fuel from one canister to another. One is when a canister has failed. Another is when spent fuel is moved into the canisters that will be stored at a long-term geological depository such as Yucca Mountain.

Dr. Brewer's declaration filed with the Attorney General's Motion to Intervene says that the **construction of a Dry Fuel Transfer Station needed to move spent fuel from one canister to another would cost between \$150 and \$450 million.** This estimate assumes that Holtec will need one large, centralized repackaging facility handling the entire projected SNF inventory. If Holtec or another reactor operator has to establish repackaging infrastructures at decommissioned or closed reactors, repackaging becomes an even more expensive proposition.

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<sup>54</sup> <https://www.nrc.gov/docs/ML1423/ML14238A326.pdf>

<sup>55</sup> [https://curie.ornl.gov/system/files/documents/not%20yet%20assigned/STAD\\_Canister\\_Feasibility\\_Study\\_AREVA\\_Final\\_1.pdf](https://curie.ornl.gov/system/files/documents/not%20yet%20assigned/STAD_Canister_Feasibility_Study_AREVA_Final_1.pdf) (p-5-2)

<sup>56</sup> Robert Alvarez Analysis For Pilgrim 2018, <https://ips-dc.org/ips-authors/Robert-Alvarez/>; 3 U.S. Government Accountability Office, Gao-10-48, Nuclear Waste Management: Key Attributes, Challenges, And Costs For The Yucca Mountain Repository And Two Potential Alternatives 55 (Nov. 2009), <https://www.gao.gov/assets/300/298028.pdf>.

The Holtec estimates do not include this cost. Since the need for a transfer facility would exist no matter when the spent fuel is shipped, it is not likely that the cost will be reimbursed by DOE.

## **6. Costs Resulting From Decommissioning Delays – Time Is Money**

A slide presentation made by Holtec International (“Holtec” and Comprehensive Decommissioning International (“CDI”) to the Pilgrim Nuclear Decommissioning Citizens Advisory Panel (“NDCAP”) on November 14, 2019, shows that Holtec’s planned decommissioning already has slipped at least 2-3 years and has increased in duration. Both the delay and longer decommissioning period will further increase costs to decommission Pilgrim.

In a supplement to its Motion to Intervene the Massachusetts Attorney General said that delay to-date will add **\$85-\$102 million** to the project in management overhead alone compared to cost estimates given by Holtec in its PSDAR.

The time it will take to cleaning up previously known and unknown radiological and non-radiological contamination will additionally delay and lengthen the work schedule, further escalating costs. There inevitably will be other delays as there always are in large projects. Holtec is new to decommissioning; severe and more frequent storms are occurring.

## **7. Holtec’s Decommissioning Cost Estimate (DCE) Fails To Consider Costs Likely To Result From Climate Change Impacts.**

Based on current levels of greenhouse gas prediction, the UN Intergovernmental Panel on Climate Change (IPCC) 2018 Report<sup>57</sup> concluded that sea levels will rise more rapidly; severe storms will occur more frequently, coinciding with high tides and exceptional wave heights, that groundwater tables will rise, and floods will be more severe.

The National Geographic (December 16, 2015) identified Pilgrim among the 13 nuclear reactors impacted by sea-level rise and predicted that, “if significant protective measures were not taken, these sites could be threatened.”<sup>58</sup>

The numerous negative impacts resulting from climate change not considered by Holtec that would likely increase decommissioning costs include increased flooding and storm surge resulting from climate change likely to cause corrosion of underground piping, tanks and structures and subsequent leakage.

Severe storms and flooding could present conditions at Pilgrim so that workers could not perform their jobs- decrease Holtec’s capability to cleanup and cause delay in work schedule; both will increase costs.

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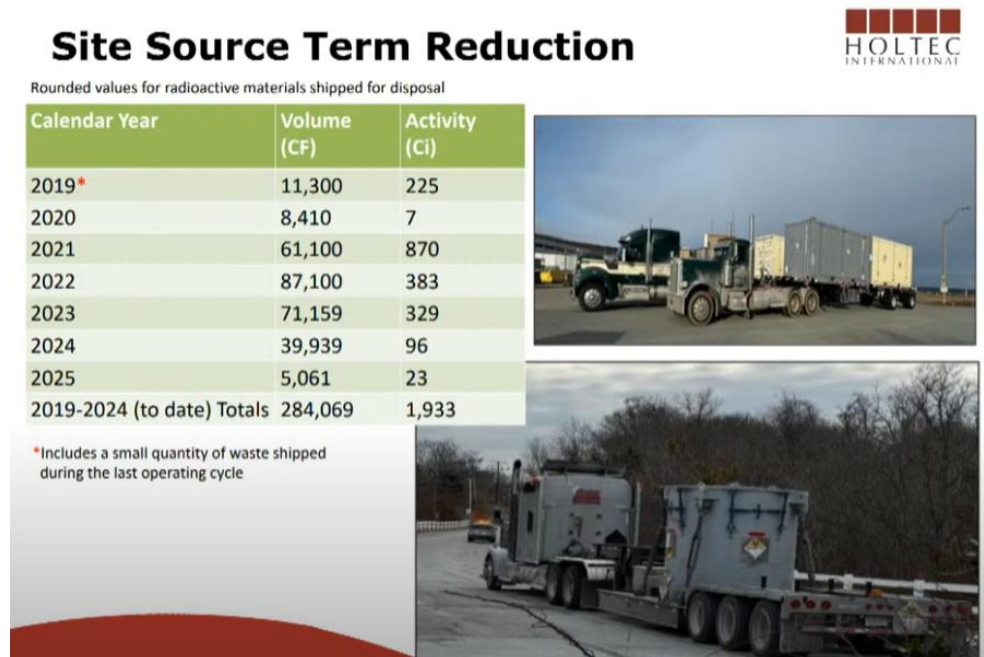
<sup>57</sup> <https://research.un.org/en/climate-change/reports>

<sup>58</sup> <https://research.un.org/en/climate-change/reports>;

<http://news.nationalgeographic.com/energy/2015/12/151215-as-sea-levels-rise-are-coastal-nuclear-plants-ready/>

8. **Holtec's Cost Estimate Assumptions Ignore The Cost Of Managing Low Level Radioactive Waste (LLRW).** In addition to spent fuel, Class A, B, C and Greater-than-Class C radioactive waste will be stored at Pilgrim. Decommissioning also will generate a huge quantity of LLRW.

Texas now is accepting Pilgrim's LLRW, although we are not part of its compact. Potentially higher fees are not factored into Holtec's cost estimates. Huge amounts of Class A, B and C radioactive waste will result during the decommissioning process, and likely more of these dry cask storage containers will be needed. Waste shipments were summarized at the NDCAP January 27, 2025 meeting. As of January 2025, Holtec has sent 307 LLRW shipments with no spills or accidents.<sup>59</sup> Shipments will increase considerably once the reactor building is decommissioned, and site contamination assessed.



Holtec assumed it could discard its 1.1 million gallons of radiological and contaminated wastewater into Cape Cod Bay and proceed with dismantling the reactor building. DEP issued a decision that did not allow discharge. This, added to the decline in the stock market, has prolonged Holtec's timetable for dismantlement.

<sup>59</sup> David Noyes (Holtec) January 27, 2025

NDCAP [https://www.google.com/search?q=ndcap+video+01.25&oq=&gs\\_lcrp=EgZjaHJvbWUqCQgDECMYJxjqAjlJCAAQlxgnGOoCMgkIARAJGCcY6glyCQgCECMYJxjqAjlJCAMQlxgnGOoCMgkIBBAJGCcY6glyCQgFECMYJxjqAjlJCAyQlxgnGOoCMgkIBxAJGCcY6gLSAQkzNzA3ajBqMTWoAgiwAgE&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:86afd9d8,vid:DR11MF-Y9dl,st:0](https://www.google.com/search?q=ndcap+video+01.25&oq=&gs_lcrp=EgZjaHJvbWUqCQgDECMYJxjqAjlJCAAQlxgnGOoCMgkIARAJGCcY6glyCQgCECMYJxjqAjlJCAMQlxgnGOoCMgkIBBAJGCcY6glyCQgFECMYJxjqAjlJCAyQlxgnGOoCMgkIBxAJGCcY6gLSAQkzNzA3ajBqMTWoAgiwAgE&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:86afd9d8,vid:DR11MF-Y9dl,st:0) at 30 minutes.

## 10. Other Costs That The DTF Will Not Be Able To Pay

**Holtec's cost estimates ignore the costs of mitigating radiological accident(s).** Potential accidents include human error, terrorist attack; line of sight or air attack on dry casks that each contains about 1/3 to ½ the Cesium-137 released at Chernobyl; corrosion cask and radiological leaks.<sup>60</sup>

**Holtec ignores potential costs from fires in structures, systems and components containing radioactive and hazardous material.** Fire in a building would result in an increase in mixed waste adding to cost and also impacting workers and potentially public health. Holtec's cost estimates should, but do not, include the cost of an adequate study to locating sites where potential masses of contaminated material susceptible to ignition might accumulate during decommissioning and the costs of forestalling a fire by removing or limiting heat, oxygen, and/or fuel. Holtec's cost estimates also should include costs for training and equipment for offsite fire personnel that are counted on in an emergency.

### Holtec's Likely Profit

When Holtec purchased Pilgrim (likely for about \$1,000) it was given a DTF worth more than a billion dollars. According to Holtec's PSDAR and new financial report, decommissioning will cost more than a billion dollars, only a very, small percentage of the DTF will be left over.

The reality is that that the DTF likely will run out of money, and there will be nothing left over. Moreover, no licensee will have any assets or other ability to make-up any shortfall.; neither NRC nor the Commonwealth has the legal ability or power to require a non-licensee – such as Holtec International, Holtec Power, Holtec Decommissioning International - to pay anything; and the cost to the Commonwealth likely will be hundreds-of-millions, if not more than a billion, dollars.

**Nonetheless, Holtec may walk away with as much as \$800 + million in “profit.”**

How could this be true? The answer seems remarkably simple.

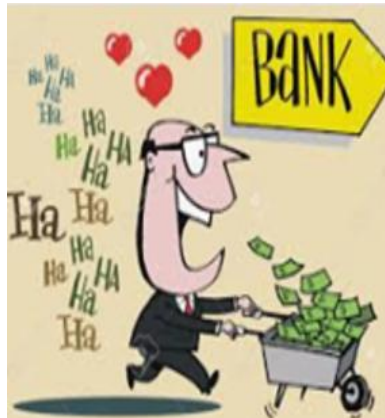
- a. A Holtec representative told Jim Lampert that Holtec had included its expected profit in its estimated decommissioning costs. Our understanding is that, for a project of this magnitude that will extend over a number of years, a company would expect a profit in the

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<sup>60</sup> Email from Dr. Gordon Thompson, February 19, 2022: “...specified a Reference MPC (cask) at Pilgrim. The Reference MPC will, in 2029, contain 25 PBq of Cs-137. Thereafter, its Cs-137 inventory will decline by 50% every 30 years. A frequently cited estimate of the Cs-137 release from Chernobyl is 85 PBq. Earlier: Environmental Impacts of Storing Spent Fuel and High-Level Waste from Commercial Nuclear Reactors: A Critique of NRC's Nuclear Waste Confidence Decision and Environmental Impact Determination, Gordon Thompson, February 6, 2009; Comments on the US Nuclear Regulatory Commission's Draft Consequence Study of a Beyond Design Basis Earthquake Affecting Spent Fuel Pool for a US Mark 1 Boiling Water Reactor, Gordon Thompson, August 1, 2013, pg., 30

range of not less than 25% to 35%, i.e., a profit of between about \$250,000 and \$350,000 on a billion dollar job.

- b. Many years ago, DOE entered into a contract with the nuclear industry in which DOE agrees to remove spent nuclear fuel from nuclear reactor sites by 1998. It has not done so. As a result, the owners of nuclear power plants have regularly sued DOE to recover their spent fuel costs, and they have regularly won.
- c. In filings with the NRC, Holtec has said that it expects to spend over \$500 million of the approximately \$1 billion in the DTF for spent fuel management, and that it expects to recover these costs from DOE.
- d. Holtec has consistently refused to agree to put the money it will recover from DOE back into the DTF, even though money from the DTF was used to pay the very same spent fuel management costs that DOE would have reimbursed. No NRC regulation requires that money recovered from the DOE be used for decommissioning. It seems clear that Holtec plans to keep this \$500 million as additional profit.
- e. **Total likely Holtec profit: \$250-300 million profit built into Holtec's estimated costs of decommissioning, and another \$500 million in profit from DOE.**



**Settlement Agreement Between the Commonwealth of Massachusetts and Holtec Pilgrim LLC and Holtec Decommissioning International LLC, June 16, 2020. Are its Financial Assurance Requirements Sufficient?**

The Settlement Agreement requires Holtec Pilgrim to keep at least **\$193.3 million** in the Trust Fund until NRC approves HDI's application for partial site release (releasing all except the ISFSI) of the property for unrestricted use meeting NRC's regulation 10 C.F.R. § 50.83.<sup>61</sup> After partial site release, Holtec Pilgrim must maintain **\$38.4 million** in the DTF until the spent fuel is removed from the site. (Settlement, 3(a)(1))

If the amount in the DTF falls below those levels, the Settlement Agreement requires Holtec Pilgrim and HDI to "use money equivalent to that which it recovers through litigation or settlement from DOE." If what Holtec Pilgrim and HDI have recovered from DOE is insufficient to make-up any shortfall, the Settlement requires them to "utilize funds from an alternative source or other financial assurances of equivalent value in the form of a parent guarantee, letter of credit, or other mutually acceptable instrument."

#### **General Comments:**

- a. The fundamental problem with the Financial Assurance Requirements of the Settlement Agreement is that only HDI and Holtec Pilgrim are required to put any money into any fund, and that they are the Holtec entities that are most likely to run out of money. If there is not enough money in the DTF (that is essentially their only asset), neither will have available money to deposit into any trust fund.
- b. If Holtec Pilgrim and HDI are essentially out-of-money, it seems unlikely that either would be able to obtain "funds from an alternative source or other financial assurances of equivalent value in the form of a parent guarantee, letter of credit, or other mutually acceptable instrument." Holtec International has consistently refused to provide a parental guarantee.

#### **Comments on Partial Site Release- \$193.3 Million (Paragraph 3-a)**

- a. We do not know where \$193.3 million came from.
- b. As a practical matter, this provision of the Agreement is unlikely ever to come into play. Holtec initially assumed that partial site release would take place in 2025, and its PSDAR said \$225.5 million would remain in the DTF at the end of 2025. Its 3/31/2020 NRC filing says that partial site release will be in 2027, and that the DTF

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<sup>61</sup> 20.1402 Radiological criteria for unrestricted use: A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed **25 mrem** (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must consider consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal. <https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-1402.html>

balance at the end of 2027 will be \$257 million. Both estimates are *significantly more than the \$193.3 million trigger*.

- c. Unless Holtec spends far more than it expects to onsite restoration before meeting the NRC requirements for partial site release, it seems likely that the amount in the DTF will not fall below \$193.3 million prior to partial site release.
- d. It also seems unlikely that any money will be recovered from DOE before partial site release. Any suit against DOE to recover costs probably will not even be filed until five years after the license transfer took effect.
- e. A parent guarantee is unlikely. The corporate structure was set up to shield the parent company. Who would give a letter of credit or issue a bond to an essentially bankrupt LLC?

#### **Comments on After Partial Site Release- \$38.4 Million (Paragraph 3-b)**

- a. We have no idea where \$38.4 million came from. It approximates Holtec's estimated cost of storing spent nuclear fuel for five (5) years.
- b. The amount needed in the DTF likely will be far more than \$38.4 million.
  - (i) Holtec assumes that DOE will move all spent fuel offsite by the end of 2062. This is extremely unlikely. Far more likely is that Pilgrim's spent nuclear fuel will remain on site for many years after that. Onsite spent fuel storage until 2073, only ten years longer than Holtec projects, would add at least \$70 million in costs.
  - (ii) The potential costs of repacking the spent nuclear fuel, either for off-site shipment or because of canister failure, are hundreds of millions of dollars.
- c. Same reasons as described above with respect to dim prospects of recovering money into the decommissioning fund from the licensee's DOE suits, parent guarantees and securing bonds.

**\$30 million Insurance (Paragraph 4)** - names the Commonwealth as an additional insured party and provides coverage for "Contractor's Pollution Liability" (*non-radiological contamination* exacerbated by certain decommissioning and Site restoration activities) and "Pollution Legal Liability" (for *previously unknown non-radiological conditions* identified at the Pilgrim Site after August 26, 2019).

#### **Comment:**

This insurance does not cover (i) any radiological contamination or (ii) any known non-radiological contamination that was not “exacerbated by certain decommissioning and Site restoration activities.”

**Subcontractors (contract not less 25 M) - Post Performance Bonds or equivalent performance assurance - not less than 25% contract value (Par. 5)**

**Comments**

- a. This bond requirement explicitly does not apply “to Holtec’s existing contract for Pilgrim reactor segmentation with GE-Hitachi Nuclear Energy and Holtec’s contract for Pilgrim radioactive waste management (including disposal and transportation).” Reactor segmentation and radioactive waste management are the two biggest and most expensive components of decommissioning.
- b. We have found nothing in this agreement requiring a performance bond for reactor segmentation or radioactive waste management.

**Financial Reports to State (Paragraphs 6, 8)**

Para. 6 requires Holtec Pilgrim/HDI to “provide copies to the Commonwealth, EEA, DEP, DPH, and MEMA of Holtec’s annual decommissioning and spent nuclear fuel management funding assurance reports filed with the NRC pursuant to 10 C.F.R. § 50.75(f)(1) and 10 C.F.R. § 50.82(a)(8)(v) (NRC Annual Trust Fund Status Reports).

**Comments**

- a. These reports to the NRC contain very little information, essentially only current decommissioning cost estimates and the current balance in the decommissioning trust fund.
- b. Nothing in the Settlement Agreement gives the Commonwealth the right or ability to audit what decommissioning work has been done, expenditures from the decommissioning trust fund for the various aspects of the work or expected future expenses.

Para. 8 says “Subject to the confidentiality terms in Paragraph 32,<sup>62</sup> no later than the last business day of each month, Holtec shall provide to the Commonwealth Holtec’s monthly project status

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<sup>62</sup> 32. Confidentiality. To the extent that Holtec determines that the information it must submit to the Commonwealth, DEP, DPH, EEA, or MEMA pursuant to this Agreement constitutes a Holtec trade secret or confidential business information or other information that is exempt from disclosure under the Massachusetts Public Records Act, Mass. Gen. Laws c. 66, § 10, Mass. Gen. Laws c. 4, § 7(26)(a-q), Holtec

reports, which shall include safety record, status of major project activities (e.g., reactor vessel segmentation, building demolition, and spent nuclear fuel loading), project schedule, project budget (including comparison of budgeted costs against actual costs), staffing, waste management, and regulatory assurance and compliance.

#### **Comments**

- a. Note that these are nothing more than “monthly project status reports.” Like the annual report to the NRC, they are very unlikely to provide any meaningful information.
- b. We expect Holtec to take advantage of Para. 32 and ensure that even the limited information these status reports might contain will be hidden from the public.

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## **RADIOACTIVE WASTE**

Radioactive wastes are classified, not according to the threat they pose to human health or the environment or how long that remain radioactive, but according to the process that produced the waste. There are two general categories: High Level Waste, and Low Level Waste. One category of Low Level Waste, Greater than Class C Waste, is highly radioactive and must be stored with spent fuel.

### **LOW LEVEL WASTE - WATER & SOLID WASTE**

#### **Contaminated Wastewater Disposal Options**

NRC permits Holtec, Pilgrim’s owner, four options to “dispose of” **1.1 million gallons** remaining in 2023 of Pilgrim’s radioactive and chemically contaminated water - dump it directly into Cape Cod Bay, evaporate it, store onsite, or send the water out-of-state to an existing radioactive waste site. Vermont Yankee NPS asked and received permission from NRC to send its **2 million gallons** of radioactive water to a waste site rather than dumping it into the Connecticut River. There were no reported transport spills or incidents. There is no acceptable reason for Holtec not to do the same.

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shall designate the information as such and shall provide a redacted version for public disclosure, unless redaction would render the document meaningless.

Experience makes it clear Holtec will take the cheapest route. The Nuclear Regulatory Commission (NRC) says that Holtec can dump whenever it wants to if the discharge is within NRC dose limits. Holtec says it will do anything the NRC allows, but that does not make it safe.

### **Dumping Contaminated Wastewater into Cape Cod Bay (Option 1)**

**Overview:** Dumping into Cape Cod Bay is clearly among the cheapest way for Holtec to dispose of the contaminated water. Cape Cod Bay and adjacent waters such as Plymouth Bay, Duxbury Bay, and Kingston Bay are all protected ocean sanctuaries. Cape Cod Bay is a critical habitat for right whales and other endangered or special species. Dumping this radioactive and chemically contaminated wastewater into them would cause incalculable economic damage and would harm both the environment and public health. Holtec planned to dump the water in Cape Cod Bay in the first quarter of 2022. Public outcry changed its mind, and the company decided not to dump in 2022 but instead evaluate its options.



Dumping into the bay is Holtec’s favorite option. It argues that Pilgrim during operations routinely discharged into Cape Cod Bay, and no one complained then so why the ruckus now? This is a red herring. Holtec has a choice to follow Vermont’s example and ship out of state, a far safer solution. Holtec made an agreement with the state to adhere to the state’s environmental and health laws. There are many laws that prohibit dumping contaminated waste into the bay. Again, Holtec does not have to dump. NRC provides four options to dispose of its wastewater.

Dumping harms our marine life, marine economy, and health. For example, bioaccumulation is an important factor. The bay and coastal waters are already affected by an array of pollution ranging from previous Pilgrim discharges, excessive nitrogen from development to other chemicals like PFAS. Adding more insults makes no sense at all, especially when there is no need to do so.

### **Status**

The Massachusetts Department of Environmental Protection (MassDEP) denied the request for a permit modification sought by Holtec Decommissioning International, LLC, to discharge up to

1.1 million gallons of industrial wastewater from the former Pilgrim Nuclear Power Station into Cape Cod Bay. Cape Cod Bay is a protected ocean sanctuary as defined under the Massachusetts Ocean Sanctuaries Act, which prohibits the dumping or discharge of industrial wastes into protected state waters.

Pilgrim stopped generating electricity in May 2019. As part of its decommissioning of the plant, Holtec requested that MassDEP modify Pilgrim's state Surface Water Discharge Permit to authorize Holtec to discharge up to 1.1 million gallons of treated wastewater from the facility into Cape Cod Bay.

MassDEP reviewed the Holtec application, and after consultation with the Massachusetts Office of Coastal Zone Management, determined that Cape Cod Bay is a protected ocean sanctuary. The Ocean Sanctuaries Act prohibits the "dumping or discharge of commercial, municipal, domestic or industrial wastes" into ocean sanctuaries. The water that Holtec proposes to discharge qualifies as industrial wastewater, and therefore, the proposed discharge is prohibited.

MassDEP issued its final determination July 18, 2024 after holding a public hearing, public comment period, and conducting an extensive review of the more than 13,300 pages of written comments - no more than 25 were in favor of dumping. The [final determination](#) and the public comments are available [online](#). Holtec filed an adjudicatory appeal, August 16, 2024.<sup>63</sup> Motions were filed in support of DEP's final determination barring dumping by DEP, Plymouth, Barnstable, the Association to Protect Cape Cod, and a 10 -Person Environmental Group, represented by James Lampert. The trial is scheduled for June 2025.

### **Dumping is illegal- Violates Massachusetts' Laws that Holtec agreed to follow**

Dumping into Cape Cod Bay violates the Ocean Sanctuary Act (MGL Ch. 132A, §§ 12A-16K), and its associated regulations. The legislature recognized back in 1972 that Cape Cod Bay's economic, ecological, recreational/ascetic values needed high level protection. We believe that for these same reasons, Holtec's desired discharge also would violate: The Massachusetts Endangered Species Act (MGL.ch 131A); the National Sanctuary Act that protects Stellwagen Bank, six miles off the coast of Provincetown; the Massachusetts Crimes Against Public Health (MGL ch 270) that makes it a crime to deposit or discharge "waste or other material of any kind on a public highway or within 20 yards of a public highway, or on any other public land, or in or upon coastal or inland waters ... or on property of another;" the Massachusetts Oil and Hazardous Material Release Prevention Act (ch 21E); and the states anti-degradation requirements (314 CMR 404). DEP did not mention these other environmental regulations in its final determination denying Holtec from dumping-only the Protected Ocean Sanctuaries Act.

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<sup>63</sup> <https://www.mass.gov/doc/pilgrim-nuclear-power-station-holtec-notice-of-claim-for-adjudicatory-appeal/download> Pilgrim Watch comments on DEP's Tentative Denial, Comment 40. and Appendix Interactive Effects Metals and Radionuclides, comment 67; James Lampert's comments on DEP's Tentative Denial Comment, comment 101; Holtec comments on DEP's Tentative Denial, Comment <https://www.mass.gov/doc/holtec-comments-on-the-tentative-determination/download>

Holtec agreed to follow state and federal laws in its June 2020 Settlement Agreement with the Commonwealth (at Section III, 10, I)- an enforceable contract. Specifically, Holtec agreed to comply with state laws and regulations; and at paragraph 48 in the settlement it says, “ No Party to this Agreement (or any person or entity affiliated or related to a Party to this Agreement) shall assert that any provision of this Agreement (or the Agreement itself) is invalid under any federal law or any provision of the U.S. Constitution.” In other words, they agreed there would be no claim to preemption.

### **Pre-emption-State Authority**

Holtec incorrectly claims that the NRC has the final word, and it approves dumping wastewater. But the NRC does NOT have exclusive authority over all nuclear reactor issues. The Commonwealth CAN prevent Holtec’s planned dumping if it wants to.

First, the U.S. Supreme Court has decided four Nuclear Preemption cases: *Pacific Gas and Electric; Silkwood; English; and Virginia Uranium*. In each, the nuclear industry tried to use preemption to avoid state laws. In all four, the nuclear industry lost. The Supreme Court decisions seem clear.

- The NRC does **not** have exclusive authority over “all things nuclear.”
- Companies like Holtec must comply with state laws intended to protect a state’s economic interests.
- They also must pay for the damage they cause.

Second, the EPA agrees that Massachusetts has the authority it needs. An EPA publication explicitly says that States **do** have the authority to establish limits on radionuclides in discharges.<sup>64</sup>

Third, as we explained, Holtec has given up any right it might otherwise have to use preemption to justify its proposed dumping when it signed the Settlement Agreement with the Commonwealth.

### **Dumping is not in the public interest for the following reasons.**

#### **Economic Damage:**

The economic harm from dumping cannot be overstated. The fishing, marine-related industries, real estate, and tourism are valued over many billions of dollars.

These industries correctly fear that the dumping will contaminate the water, and millions of oysters, lobsters, mussels, clams, scallops, and fish. They also rightfully believe that public perception of radioactive contamination of our waters could destroy hundreds of millions of

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<sup>64</sup> [https://cfpub.epa.gov/safewater/radionuclides/radionuclides.cfm?action=Rad\\_Disposal%20Options](https://cfpub.epa.gov/safewater/radionuclides/radionuclides.cfm?action=Rad_Disposal%20Options)

dollars aquaculture and other fishing industry. The state's premier aquaculture industry is here. There are millions of oysters in Duxbury Bay alone.

|  | A                                              | B                   | C            |
|--|------------------------------------------------|---------------------|--------------|
|  | <b>Duxbury 2024 Shellfish Landings / Value</b> |                     |              |
|  | <b>SPECIES</b>                                 | <b>LBS / Pieces</b> | <b>VALUE</b> |
|  | CLAM, QUAHOG, NORTHERN                         | 49,941              | \$110,829    |
|  | CLAM, RAZOR, ATLANTIC                          | 23,801              | \$129,645    |
|  | CLAM, SOFT                                     | *                   | *            |
|  | CLAM, SURF, ATLANTIC                           | *                   | *            |
|  | OYSTER, EASTERN (Pieces)                       | 12,054,693          | \$7,118,239  |
|  | SOURCE: ACCSP Data Warehouse                   |                     |              |
|  | * Confidential                                 |                     |              |

Holtec's planned dumping will also have similar serious impacts on many boat and marine industries, to say nothing of tourism and our beaches, on which the livelihoods of our towns depend.

Our economic viability depends on the waters in Cape Cod Bay and Plymouth, Duxbury, and Kingston Bays being clean - not polluted with long-lived and highly toxic radionuclides and chemicals. Public health, the environment, the right whales, and other endangered species that regularly swim past Pilgrim, require uncontaminated water.

### **Dumping Is Not Safe- for humans or marine life.**

The NRC says that Holtec's dumping is safe. Not so, among other things, the NRC allowable release

- Radionuclides and chemicals work synergistically.
- Recent scientific evidence shows much greater risk from radiation than previously understood. <sup>65</sup> See National Academies of Sciences Biological Effect of Radiation Report (BEIR VII) that says there is no safe dose, and its impact is linear.
- Allowable doses focus only on cancer and underestimate its actual impacts. The increased risks to pregnant women and the embryo/fetus include early miscarriages, malformations, and genetic defects.
- Does not calculate harm to the wider population, only to an individual.
- Ignores the research of the interaction radionuclides, metals and chemicals on marine life.
- It ignores that it is not possible to filter some very harmful radionuclides such as Tritium. NRC and Holtec ignore organically bound tritium that produces more serious health risks than tritiated water for the same amount of tritium intake.
- Does not consider the economic or environmental effect of the release.
- Self-Reporting: NRC relies on what Pilgrim reports, and only reviews Pilgrim's discharge program and past releases annually. MDPH does not monitor the releases at all.

<sup>65</sup>[https://nap.nationalacademies.org/resource/11340/beir\\_vii\\_final.pdf](https://nap.nationalacademies.org/resource/11340/beir_vii_final.pdf)

Holtec says that it is safe to dump one million plus gallons of radioactive and chemically contaminated water in the bay because it will be below NRC's allowed threshold. However, Ken Buesseler a radiochemist from Woods Hole Institute (WHOI) who studies the fate of radioactive elements in the ocean, explained that it is not possible to determine the impact "Until we have an accounting of what different radioactive elements that will be released and their concentrations... actual values for the stored water today, by isotope, detection limit, volume." To date, only a gamma analysis was done on split samples with the state of the water. MDPH says it will wait to analyze hard to detect beta and alpha particles after they are filtered prior to discharge. Buesseler explained "radioactive contaminants have vastly different fates in the ocean depending on their chemical nature. Some dilute and mix and are transported the same as water, like tritium. Others are more likely to be associated with marine sediments, like cobalt-60, and others accumulate in marine biota. Usually cesium isotopes and strontium-90 are of concern." He spoke to NDCAP, November 25, 2024.<sup>66</sup>

**Dr. Ken Buesseler (WHOI) slides from November 25, 2024 NDCAP Presentation**

**What happens to radioactive elements released from Pilgrim NPP to the ocean? It all depends...**

- Clean up will set accumulation in marine life and on seafloor
  - Not enough info to assess impacts and pre/during/post monitoring needed
- Sets precedent for disposal of radioactive waste in the ocean
  - Consider as waste since NPP no longer providing public benefit of electricity

| Tritium                            | Cesium-137                 | Strontium-90      |
|------------------------------------|----------------------------|-------------------|
| Passes through as H <sub>2</sub> O | Taken up in muscles/organs | Taken up in bones |



<sup>66</sup> Video- Buesseler speaking at NDCAP Dr. Ken Buesseler (WHOI) slides from November 25, 2024 NDCAP Presentation at 21 minutes

## Does it matter which radioactive elements enter the ocean?

Yes

- Different health concerns
- Different biological accumulation
- Different seafloor accumulation
- Different times for loss by decay

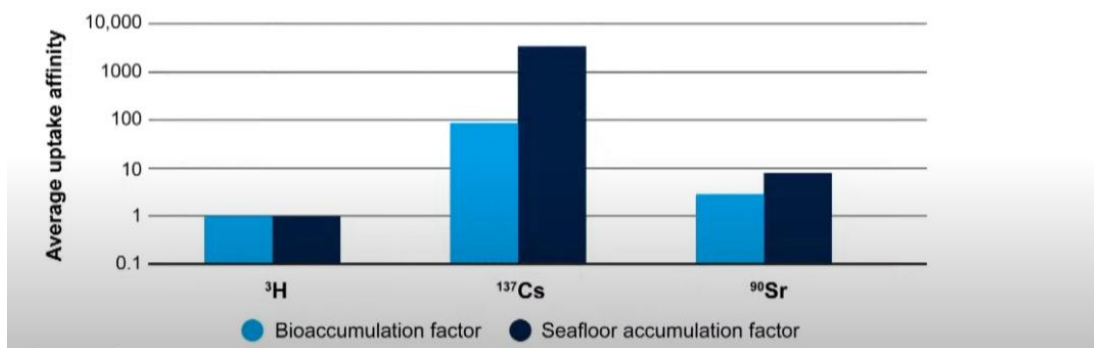
Increasing health concerns



| Isotope               | Measure of safety         | Bioconcentration          | Measure of sediment accumulation | How long does it remain |
|-----------------------|---------------------------|---------------------------|----------------------------------|-------------------------|
|                       | dose coefficient (nSv/Bq) | $K_{bio}$ for marine fish | $K_d$ for seafloor sediment      | half-life (years)       |
| $^3\text{H}$ -tritium | 0.04                      | 1                         | 1                                | 12.35                   |
| $^{54}\text{Mn}$      | 0.7                       | 500                       | 2,000,000                        | 0.86                    |
| $^{60}\text{Co}$      | 3.4                       | 700                       | 300,000                          | 5.27                    |
| $^{65}\text{Zn}$      | 3.9                       | 2000                      | 70,000                           | 0.66                    |
| $^{137}\text{Cs}$     | 13                        | 100                       | 4,000                            | 30.0                    |

## Behavior of many radionuclides differs from tritium in the ocean

- Higher biological concentration factors – potential fisheries concern
- Higher sediment partitioning – accumulate near outfall pipe



## Ecological Damage

When considering the current health of the bay, it is important to remember that assaults are cumulative. Toxins interact with each other accentuating one another's damage and are persistent poisons.<sup>67</sup> Some radionuclides have exceedingly long half-lives, some mere seconds, but others have half-lives of millions of years. Research has shown that radionuclides, chemicals, and metals interact, enhancing one another's mischief, and can pose enhanced threats to marine

<sup>67</sup> See <https://www.mass.gov/doc/pilgrim-nuclear-power-station-holtec-notice-of-claim-for-adjudicatory-appeal/download> Pilgrim Watch Comment on DEP's Tentative Denial, Appendix *Interactive Effects Metals and Radionuclides*, comment 67. It provides the abstracts or summaries of countless research papers.

life. Contaminants cannot be evaluated one at a time in isolation. Unfortunately, that has been the case. Cape Cod Bay, and associated embayments, are under stress now from overdevelopment, runoff invasive species, and climate change. This is no time to add additional stressors-Pilgrim's chemicals and radionuclides.

## **Circulation of Contaminants in Cape Cod, Plymouth, Kingston, Duxbury Bays - Large Area Impacted**

Dr. Irina Rypina, WHOI, summarized contaminant transport, NDCAP November 25, 2024

### **Summary**

- The probability of a plume coming close to the inner-Bay shoreline, including coastal waters of Dennis, Wellfleet, and Provincetown, is high.
- The probability of a plume leaving the Bay without coming close to the inner-Bay shoreline is low.
- When some portion of a plume leaves the Bay, it passes north of Provincetown and flows southward along the outer Cape.
- The spreading of a plume depends on the timing of a release.
- In winter and fall the probability of leaving the Bay without coming close to the inner-Bay shoreline is virtually zero and is slightly larger but still low in spring and summer.
- Seasonal differences can be linked to wind conditions.

 WOODS HOLE OCEANOGRAPHIC INSTITUTION

Cape Cod Bay is not a good place to dump one million gallons of radioactive and chemically contaminated water. An ocean currents expert at Woods Hole Oceanographic Institution (WHOI), Dr. Irina Rypina, explained the water would be trapped in the bay for a month or so rather than filtering quickly into the ocean.<sup>68</sup>

The shape of the land creates a semi-enclosed space. Whatever is put in the bay would stay there a long time and would not flush out quickly. She explained that a tracer released into Cape Cod Bay would recirculate and stay in the waters within the bay for a long time and then likely end up in the sediment on the ocean floor or on the beaches inside the bay. The same thing would happen to radionuclides and other contaminants in the released water, confirming the fears of the fishing community and coastal property owners.

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<sup>68</sup> <https://www.whoi.edu/press-room/news-release/proposed-wastewater-release-into-cape-cod-bay-likely-to-remain-in-bay-for-at-least-one-month-study-finds/>

Daily tides will bring the contaminants into Plymouth, Kingston, Duxbury Bays, and likely up rivers such as Jones River, Eel, and Blue Fish Rivers, and into the marsh lands that are also semi-enclosed spaces.

These bays are rich in marine life and aquaculture. The bottom of the Bays supports huge populations of numerous kinds of invertebrates, most of which live by filter feeding. The most abundant are various types of bivalve mollusks – oysters, clams, and mussels. They filter out and consume huge amounts of phytoplankton, as well as bacteria and other particles, thereby making an enormous contribution to maintaining water quality. They remove microscopic food particles that risk being contaminated from Pilgrim's releases. The radionuclides bioaccumulate as they move up the food chain. Studies have shown that an individual mussel or oyster can filter over a gallon of water per hour.

The following figures provided by the Massachusetts Water Resources Authority,<sup>69</sup> show circulation in Massachusetts and Cape Cod Bays.

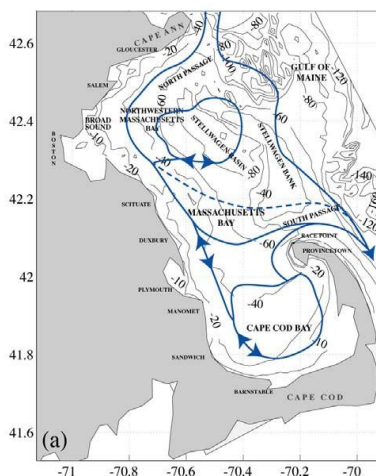


Figure 4-1 Summary of circulation within Massachusetts Bay (Lermusiaux et al. 2001.)

The dispersion of discharges also varies seasonally as shown in Figure 4-12 below.

<sup>69</sup> Physical and Biological Oceanography of Massachusetts, Wendy Leo, Rocky Geyer, Mike Mickelson  
[http://www.mwra.state.ma.us/harbor/enquad/pdf/ms-085\\_04.pdf](http://www.mwra.state.ma.us/harbor/enquad/pdf/ms-085_04.pdf)

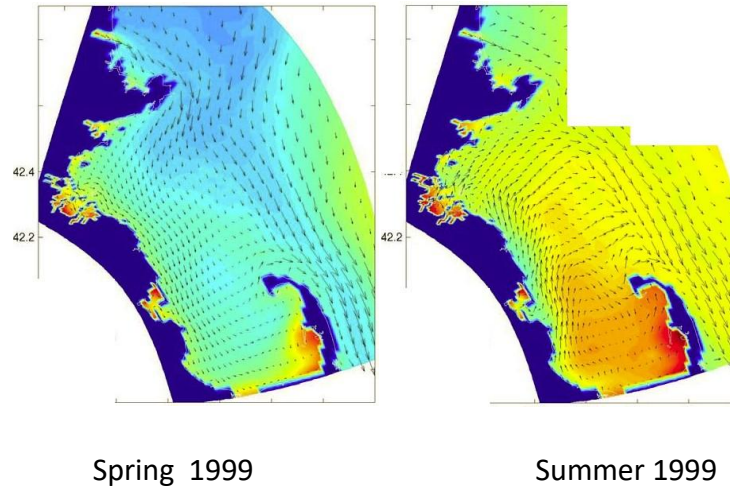
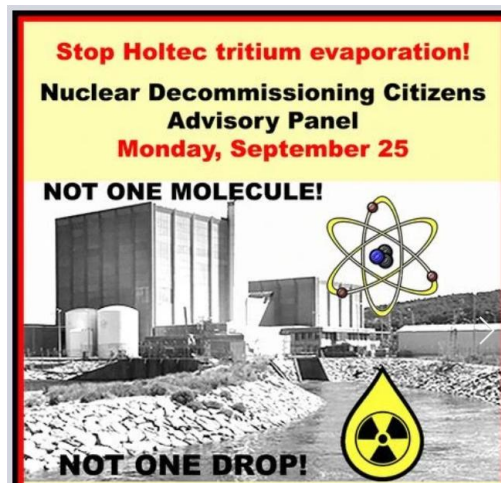


Figure 4-12 Modeled surface temperature and circulation patterns in spring 1999 (left panel) and summer 1999 (right panel) showing northward flow along the coast (figure courtesy Mingshun Jiang, UMass/Boston.) Color shows surface temperature (4-8 C in spring, 10-20 C in summer).

## Evaporating Contaminated Wastewater Into Our Air (Option 2)



Evaporation, like dumping, was described by the director of MDPH's Radiation Control Department as a "lousy idea." The contaminated water is **unfiltered**, released from the reactor building vent without real-time monitoring or monitoring by the state, and eventually falls to the ground or into the water - wherever the wind takes it.

Neither NDCAP nor the public knew evaporation of the contaminated wastewater was occurring 24/7 since Holtec bought the reactor. Word got out when Holtec and NRC discussed evaporation at the January 2024 NDCAP meeting and previously on September 25, 2023. NDCAP meetings are

available on video.<sup>70</sup> It also was brought forward earlier in an NRC Inspection Report<sup>71</sup> and a worker's anonymous letter to MDPH and Cape Downwinders. The NRC Inspection Report said inspectors discovered nine submerged heaters were being used in the reactor cavity when they did a routine check of Pilgrim in June 2023. Holtec had not notified the NRC that it had installed immersion heaters in February in the wastewater-filled reactor cavity. The purpose, Holtec officials said, was to speed up the drying time for waste boxes holding irradiated segments of the reactor's internal parts when they were removed from the cavity; and to provide heat for workers. The heaters obviously speed up evaporation.

**Evaporation rate:** At the January 2024 NDCAP meeting, we learned that the amount of wastewater in the reactor when they bought the plant in **2019 was between 1.9 to 2 million gallons**. In January 2021, they had 1.1 million gallons. In January 2024, they had approximately 950,000 gallons, and as of **January 15, 2025, (868,683) gallons remain**. It appears that evaporation will take care of the wastewater by the time they are ready to dismantle the reactor building in 2032.

In September 2023, Holtec reported that the amount of tritium released as a result of heating the water cavity was 1.2 curies, a smaller amount than released previously as shown in slide below from the Sept. 25, 2023 NDCAP meeting.

| Calendar Year                    | Gaseous Tritium Released (Ci) | Equivalent Dose Released due to Tritium (mr) |
|----------------------------------|-------------------------------|----------------------------------------------|
| 2023 (heating period / prorated) | 1.2 / 4.8                     | 0.00003 / 0.00012                            |
| 2022                             | 2.38                          | 0.000070**                                   |
| 2021 FOP                         | 8.00                          | 0.000235**                                   |
| 2020                             | 7.70                          | 0.000265**                                   |
| 2019 SD                          | 30.6                          | 0.0009**                                     |
| 2018                             | 34.0                          | 0.001**                                      |
| 2017                             | 48.0                          | 0.0014**                                     |
| 2016                             | 64                            | 0.00188**                                    |

The amount released, according to NRC, was bounded by the Offsite Dose Calculation Manual and significantly lower than the routine releases experienced during plant operation, when newly spent reactor fuel was stored in the spent fuel pool. We were not told what other radionuclides and chemicals were released.

<sup>70</sup>

<https://www.youtube.com/watch?v=IFmVulbAlch>[https://www.google.com/search?q=ndcap+sept+25+2023&rlz=1C1KDEC\\_enUS827US827&oq=ndcap+sept+25&gs\\_lcrp=EgZjaHJvbWUqCQgAEEUYOxigATIJCAAQRRg7GKABMgYIARBFgDkyBggCEEUYOzIGCAMQRRg80gEJNzlxMmowajE1qAIAAsAIA&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:91948be4,vid:LAdDAI\\_HNHk,st:0](https://www.google.com/search?q=ndcap+sept+25+2023&rlz=1C1KDEC_enUS827US827&oq=ndcap+sept+25&gs_lcrp=EgZjaHJvbWUqCQgAEEUYOxigATIJCAAQRRg7GKABMgYIARBFgDkyBggCEEUYOzIGCAMQRRg80gEJNzlxMmowajE1qAIAAsAIA&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:91948be4,vid:LAdDAI_HNHk,st:0)

<sup>71</sup> NRC Inspection Report NO. 05000293/2023002, August 4, 2023

**Monitoring:** David Noyes (Holtec) in January, 2024 and September 25, 2023, NDCAP meetings said that the evaporation from the refueling floor was NOT monitored to remove tritium or particulates but was monitored in the sense to determine what was being released.<sup>72</sup> **There is no filtration prior to release.**

Neil Sheehan, NRC, was asked if there are real-time monitors on the ventilation pathways at Pilgrim? He explained that:

There is currently no continuous radiation monitor on the reactor building vent; it was only in place to monitor for radioactive noble gases, and there is no longer a source of noble gases since the fuel has been removed. Pilgrim's Off-site Dose Calculation Manual (ODCM) requires monthly sampling for tritium released from the reactor building vent or an estimation using a technical evaluation based on concentration in the water and evaporation rate.

One of our decommissioning inspectors for Pilgrim checked with Holtec on this and the company is currently sampling for tritium weekly or biweekly.

The company is also continuing with weekly sampling for particulates at that release point, as required by the ODCM.

Jack Priest, MDPH director Radiation Control Program, replied by email that, "The state does not monitor the Reactor Building vent. **Such monitoring is the regulatory authority of the USNRC.**" We disagree that the state has no authority.

**Will Evaporation be used in the future?** Yes, until the wastewater is gone. Natural evaporation will occur anyway. Using heaters speeds the process.

### **Transporting Contaminated Wastewater Offsite (Option 3)**

We believe shipping is the best and most feasible option. From 2019-2023, Holtec-Pilgrim shipped 225,652 cubic feet (CF) of solid waste to WCS in West Texas with no spills or incidents; and the shipments will increase dramatically as decommissioning progresses. Vermont Yankee shipped 2 million gallons of wastewater to WCS in Texas so as not to contaminate the Connecticut River. There were no reported spills or incidents.

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<sup>72</sup> [https://www.youtube.com/watch?v=LAdDAI\\_HNHk](https://www.youtube.com/watch?v=LAdDAI_HNHk) at 33 minutes

NDCAP Meeting: 9/25/23: Nuclear Decommissioning Citizens Advisory Panel #Plymouth

## Waste Management

Rounded values for waste shipped for disposal

| Calendar Year    | Volume (CF) | Activity (Ci) |
|------------------|-------------|---------------|
| 2019*            | 11,300      | 225           |
| 2020             | 8,410       | 7             |
| 2021             | 58,000      | 933           |
| 2022             | 87,100      | 383           |
| Thru 9/20/2023   | 60,842      | 241           |
| 2019-2023 Totals | 225,652     | 1,789         |

\* Includes a small quantity of waste shipped during the last operating cycle



**Environmental justice** is not a viable excuse for Holtec to oppose shipping wastewater to Texas. The US Census bureau shows Plymouth County has more indigenous and citizens in poverty than Aberdeen County in Texas where WCS is located; and the Massachusetts Environmental Justice Map show the numbers of poor and indigenous people are larger around Pilgrim Station than in the rest of Plymouth County. The argument Plymouth benefited by producing the waste, therefore should own it does not hold water either. The energy produced by Pilgrim went into the grid. Plymouth has far fewer people consuming energy than many other parts of the state. Shouldn't those consumers get stewardship of their portion of the waste based on electric usage?

The supposed cost of shipment is not an excuse either. Holtec's unsubstantiated \$20 million dollar estimated cost of shipping is about 2% of Holtec's likely profit. Holtec had never told anyone what other disposal methods would cost, and neither Holtec nor any other Pilgrim owner ever contributed a cent to the Decommissioning Trust Fund that will pay the cost.

### Storage Onsite (Option 4)

Storage onsite is another NRC approved option, but it too has downsides. Holtec says if it is not allowed to discharge the water, it may store the water in the torus, located in the bottom of the reactor building close to Cape Cod Bay's shoreline. The shoreline is subject to climate change-sea level rise, storm surges, flooding. The base mat beneath the torus is cracked-made public in 1996 during license renewal. For how long do advocates envision storage- until all radionuclides decay by ½ or more? What happens to the water after it decays to some "acceptable" level? Pilgrim cannot be decommissioned so long as the contaminated water remains on site. The host community, Plymouth, wants the site decommissioned ASAP to allow development of the property for tax purposes. It might be possible to store the wastewater in casks or canisters in a new or expanded storage pad, but that would require purchasing robust containers for the water, moving containers to high ground due to rising sea levels, and establishing a maintenance program for the storage containers going forward. Containers will corrode exposed to our marine

environment. Who believes Holtec will do what is necessary to best protect public safety? Who believes Holtec Pilgrim LLC. will be viable as long as the wastewater is toxic?

### **Health Impacts- Discharge Into Air/Water Not Harmless**

Evaporation followed by discharge of radioactive and chemically contaminated wastewater poses the greatest threat to public health and the environment. Storage onsite and shipping are preferable as long as accidents are avoided, and proper maintenance followed.

**Radionuclides:** In its most recent Report on the Health Risks from Exposure to Low Levels of Ionizing Radiation,<sup>73</sup> the National Academy of Sciences concluded that:

“Current scientific evidence is consistent with the hypothesis that there is a linear, no-threshold dose-response relationship between exposure to ionizing radiation and the development of cancer in humans.”

In other words, there is no completely safe level of radioactivity. The risk that a person or marine organism will develop cancer or other radiation-linked disease increases linearly as the amount of radiation increases. The actual risk depends on age and sex. Also, contaminated water will evaporate into the atmosphere from the rapidly warming bay water and from beaches where the water came ashore, eventually returning to the groundwater and water supplies in the form of fog and rainfall.

Radiation works synergistically with other contaminants. Holtec admits that it will release both radiological and chemical contaminants. Recent research shows radiation increases the impact of metals on marine organisms. In addition, radiological and chemical contaminants are already in Cape Cod Bay, although minimized by Pilgrim’s licensees. Pilgrim’s Annual Environmental Reports during operations are insufficient.

Also significant is that radionuclides have both short and very long half-lives-some millions of years. Therefore, once released they present a hazard in Cape Cod Bay for years to come.

**Filtration-Water Discharge:** Contrary to Holtec, Holtec’s filtration will not solve the danger or result in the discharge meeting state laws - zero pollutants. Pilgrim’s reports to the NRC say that

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<sup>73</sup> Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2 (2006), Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation, Board on Radiation Effects Research, Division on Earth and Life Studies, National Research Council of the National Academies, The National Academies Press, Washington DC, <https://www.nap.edu/read/11340/chapter/1#xv>

filters<sup>74</sup> only will remove 90-95% of the particles; 5-10% will remain. Holtec's application for a modified permit admits that even after treatment Pilgrim's wastewater will contain both chemical and radioactive materials. Tritium, contrary to Holtec, that cannot be filtered is not harmless to marine and human life; neither are the other radionuclides that will be released despite filtering. The National Academies of Sciences conclusively concluded (BEIR VII) no amount of radiation is safe. Radiation interacts with chemicals and metals, each enhancing one another's mischief.

According to Holtec, "The only radionuclide expected to remain in consistent concentrations above detection limits post-treatment would be tritium.<sup>75</sup> Mn-54, Co-60, Zn-65, Cs-137, and potentially other isotopes that have been reported in past Annual Radiological Environmental Operating Reports may exist at levels slightly above detection limits." Ken Buesseler, Senior Scientist WHOI, commented to Christine Legere, reporter for the Provincetown Independent, that, "This is not about "filtration," it is about removal of dissolved radioactive elements that pass through filters." You need to know, "what amount of 'dissolved' radioactive cesium, strontium, plutonium, etc. are removed. FYI for all of those 3 (and there are others), >90% is not removed by a 0.75 um filter. You would need some reactive material (clays, resin, charcoal) that takes the dissolved radionuclides out of water." David Noyes, Holtec, did not respond to a question asking what particles are expected to be in the water smaller than 0.75 microns.

**Filtration- Evaporation:** There is no filtration of the vapors released from the reactor vent, irrespective of whether the water naturally evaporates or evaporates as a result of heating.

**Dilution-Water Discharge:** Holtec incorrectly implies that dilution with seawater is a solution to pollution. Dilution will decrease the concentration of the radionuclides and other pollutants that will enter the bay, making radionuclides and chemicals in the discharge harder to detect by monitors. Dilution does not remove any and will not reduce how much pollution the bay and shoreline will receive.

**Tritium:** Tritium is worth a short discussion. Tritium (a beta particle) is a radioactive form of water that cannot be filtered. Contrary to Holtec's statements, it is dangerous. It is incorporated into all parts of the body that contain water - most of our body's tissues. It has been shown in animal experiments that tritium causes genetic damage of all kinds, both chromosomal and non-

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<sup>74</sup> David Noyes, Holtec, response by email to Mary Lampert's questions regarding filtration, June 6, 2023. A copy is available upon request.

<sup>75</sup> Holtec downplays the risk of tritium, likely because it cannot be filtered. Exposure occurs through ingestion, skin absorption, and inhalation. As radioactive water, tritium can cross the placenta, posing risk of birth defects and early pregnancy failures. Ingestion of tritiated water also increases cancer risk. It has a half-life of 12.3 years. Ten half-lives typically render it safe-123 years. Resources: [Exploring Tritium Dangers \(https://ieer.org/wp/wp-content/uploads/2023/02/Exploring-Tritium-Dangers.pdf\)](https://ieer.org/wp/wp-content/uploads/2023/02/Exploring-Tritium-Dangers.pdf); [The Hazards of Tritium \(https://www.ianfairlie.org/news/the-hazards-of-tritium/\)](https://www.ianfairlie.org/news/the-hazards-of-tritium/)

chromosomal. Tritium ingested by a pregnant female passes through the umbilical cord to the embryo and the developing fetus in fact gets a larger radiation dose than the mother. Tritium has been shown to cause physical deformities and more subtle developmental abnormalities in embryos of experimental animals. It can be absorbed directly through the skin. Once inside the body it goes everywhere (all organs) and is known to be at least 2-3 times more biologically damaging (per unit of absorbed energy) than gamma radiation. Although this “discrepancy” has been known for decades, and is not disputed, NONE of the regulatory bodies take it into account. After careful study, the UK Committee Examining Radiation Risks of Internal Emitters (CERRIE) has concluded that the biological damage of tritium (per unit of absorbed energy) may be as much as 15 times greater than the damage from gamma radiation.<sup>76</sup>



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## Solid Low Level Radioactive Waste

Demolition of the main reactor building and other buildings with likely sizable contamination has been delayed due to financial considerations (dip in the stock market and its effect of the DTF) and opposition to disposing the waste water into Cape Cod Bay. Therefore the volume and curies of contaminated waste is low to date. This waste is currently shipped to a low level radioactive waste site in Texas.

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<sup>76</sup> [www.ccnr.org/tritium\\_paper\\_CERRIE.pdf](http://www.ccnr.org/tritium_paper_CERRIE.pdf)

## Site Source Term Reduction



Rounded values for radioactive materials shipped for disposal

| Calendar Year              | Volume (CF) | Activity (Ci) |
|----------------------------|-------------|---------------|
| 2019*                      | 11,300      | 225           |
| 2020                       | 8,410       | 7             |
| 2021                       | 61,100      | 870           |
| 2022                       | 87,100      | 383           |
| 2023                       | 71,159      | 329           |
| 2024                       | 39,939      | 96            |
| 2025                       | 5,061       | 23            |
| 2019-2024 (to date) Totals | 284,069     | 1,933         |

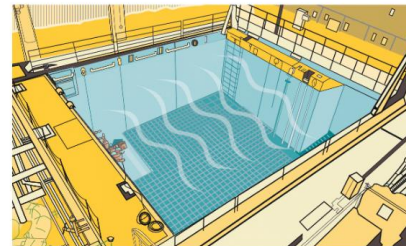
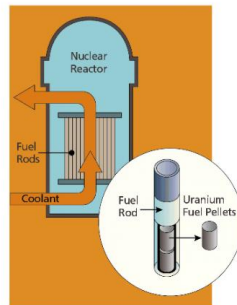
\*Includes a small quantity of waste shipped during the last operating cycle



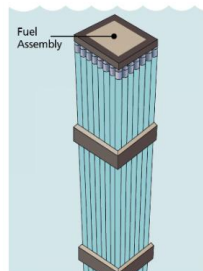
## HIGH-LEVEL RADIOACTIVE WASTE SPENT NUCLEAR FUEL

### Spent Fuel Generation and Storage after Use

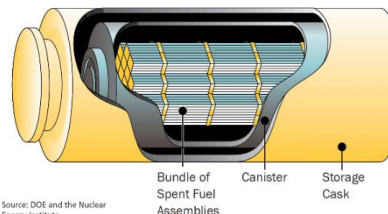
**1** A nuclear reactor is powered by enriched uranium-235 fuel. Fission (splitting of atoms) generates heat, which produces steam that turns turbines to produce electricity. A reactor rated at several hundred megawatts may contain 100 or more tons of fuel in the form of bullet-sized pellets loaded into long metal rods that are bundled together into fuel assemblies. Pressurized-water reactors (PWRs) contain between 150 and 200 fuel assemblies. Boiling-water reactors (BWRs) contain between 370 and 800 fuel assemblies.



**3** Commercial light-water nuclear reactors store spent radioactive fuel in a steel-lined, seismically designed concrete pool under about 40 feet (12.2 meters) of water that provides shielding from radiation. Water pumps supply continuously flowing water to cool the spent fuel. Extra water for the pool is provided by other pumps that can be powered from an onsite emergency diesel generator. Support features, such as water-level monitors and radiation detectors, are also in the pool. Spent fuel is stored in the pool until it can be transferred to dry casks onsite (as shown in Figure 12) or transported offsite to a high-level radioactive waste disposal site.



**2** After 5–6 years, spent fuel assemblies—typically 14 feet (4.3 meters) long and containing nearly 200 fuel rods for PWRs and 80–100 fuel rods for BWRs—are removed from the reactor and allowed to cool in storage pools for a few years. At this point, the 900-pound (409-kilogram) assemblies contain only about one-fifth the original amount of uranium-235.



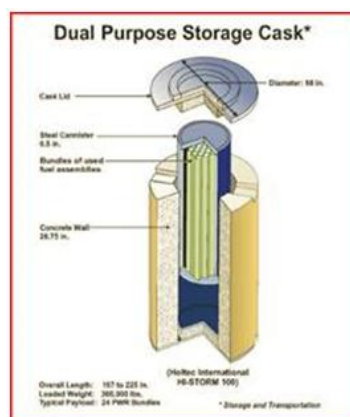
Source: DOE and the Nuclear Energy Institute

There are about 4,100 assemblies of spent nuclear fuel at Pilgrim; all of the nuclear fuel that Pilgrim has used since it started generating electricity in 1972. Each assembly contains thousands of curies of radioactive cesium and strontium.<sup>78</sup> Pilgrim first loaded fuel into dry casks in 2015 - 3 casks were loaded.<sup>79</sup> **All the spent fuel was removed from the spent fuel pool and placed in dry casks on December 13, 2021.** The canisters were loaded into 62 HI-STORM 100 systems and stored at Pilgrim's new Independent Spent Fuel Storage Installation (ISFSI). They will remain onsite until the U.S. Government takes possession of it, which they are required to do under a 1982 law, or the canisters are transferred to an alternative location, such as Holtec's proposed HI-STORE Consolidated Interim Storage Facility (CISF) in New Mexico or another site in Texas. Both sites are opposed by their respective Governors and Attorney Generals.

Perhaps the most important thing to remember about spent nuclear fuel is that it will remain dangerous for thousands of years.



**Pilgrim's Dry Cask Storage**



<sup>77</sup> <https://www.nrc.gov/images/waste/spent-fuel-storage/generation-storage.gif>

<sup>78</sup> [https://en.wikipedia.org/wiki/Intermediate-level\\_nuclear\\_waste](https://en.wikipedia.org/wiki/Intermediate-level_nuclear_waste)

<sup>79</sup> <https://plymouth.wickedlocal.com/article/20150107/NEWS/150108310>

**Casks:** Entergy is using Holtec Hi-Storm 100, Version B, MPC-68 casks to hold and store 61 dry casks filled with highly radioactive spent fuel assemblies. Additional casks will store Greater-Than-Class-C radioactive waste, a waste category that must go to a deep geological repository too.

The cask system is comprised of three primary components: MPC-68, HI-TRAC 100 D, and HI-STORM 100S. The MPC-68 is a metal canister that has a storage capacity of 68 BWR spent fuel assemblies.

The HI-TRAC (transfer cask) is a metal transfer cask that provides a means to lift and handle the canister as well as providing radiological shielding of the spent fuel assemblies.

The HI-STORM 100-S Version B storage overpack is a stainless steel-encased concrete storage cask that provides physical protection and radiological shielding for the metal canister when in storage. Dropping the canister into the overpack risks scraps on the stainless steel canister, initiating later corrosion.

The storage cask is vented for natural convection to dissipate the spent fuel decay heat. The casks are stored in a vertical position outdoors on a storage pad.<sup>80</sup>

Each cask, with its overpack, weighs about **200 tons when placed on the outside pad**. The pad is not enclosed or covered in any way.

The casks will be onsite for a long-time. The NRC's Continued Storage final rule and generic environmental impact statement claimed that the spent fuel assemblies may be safely kept in dry casks onsite for 300 years or more , assuming that the dry cask pad and casks are changed every 100 years

## Dry Cask Storage Safety Issues

Dry cask storage is far safer than pool storage, but there are problems.

According to the NRC:

- ▶ The thin (0.5") stainless steel canisters may crack within 30 years. Pilgrim began loading (3 casks) in 2014 - in 2044 these will be 30 years old. By 2022, 61 casks will have loaded.
- ▶ Currently, no technology exists to inspect, repair or replace cracked canisters.
- ▶ No pressure monitoring or pressure relief valves on canisters
- ▶ With limited monitoring, we will only know after the fact that a canister leaks radiation .
- ▶ Each cask needs monitors for radiation, heat, and helium & pressure relief valves.
- ▶ There is a risk of criticality from, for example, unborated water entering canister.

**Each cask contains ½ as much Cesium-137 as the total released at Chernobyl**

<sup>80</sup> Entergy Letter No. 2.13.042, pg., 3 (NRC Electronic Library, ADAMS, Accession Number ML13346A026)

Although dry cask storage is far safer than pool storage, there are problems to consider.<sup>81</sup>

- The thin (0.5”) stainless steel canisters may crack within 30 years.
- The canister does not stop gamma and neutron radiation from escaping NRC/industry claim releases are well within regulatory limits.
- Blocking Air Ventilation Vents: Casks have air holes at bottom and top of casks for ventilation. If the holes are blocked by ice, snow, debris, or bird nests cooling will not occur.
- No current technology exists to fully inspect, repair or replace cracked canisters.
- With limited monitoring, we will only know after the fact that a cask has leaked radiation.
- Susceptible to criticality
- Vulnerable to terrorist attack – planting a vegetation screen will not protect it.

Nevertheless, the Nuclear Regulatory Commission’s (NRC), Waste Confidence Final Rule 2014 said that spent fuel can be stored at nuclear plants for 60 years (short-term), 100 years (long-term) and thereafter indefinitely.<sup>82</sup> But the NRC currently only initially certifies dry cask storage systems for 20 years. Can we depend on NRC’s approval of license extensions that are now being handed out? The NRC, the Electric Power Research Institute (EPRI), and numerous government and scientific sources report the following problems with the current steel/concrete U.S. spent nuclear fuel dry storage systems:

### **Safety Issues in Greater Detail<sup>83</sup>**

**Canisters may need to be replaced within 30 years or sooner - Stress Corrosion Cracking:** The thin 1/2” welded stainless steel canisters may have premature stress corrosion cracking within 30 years, caused by our marine environment, manufacturing defects, scrapes from placing canister into the overpack.<sup>84</sup> This could result in major radiation releases. Cracks in similar materials at nuclear power plants caused component failures in less than 30 years, example at San Onofre.<sup>85</sup> Other cask systems, such as the German CASTOR V/19 (~20” thick) ductile cast iron

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<sup>81</sup> See: San Onofre Dry Cask Storage Issues analyses at:

<https://sanonofresafety.files.wordpress.com/2011/11/drycaskstorageissues2014-09-23.pdf>

<sup>82</sup> U.S Nuclear Regulatory Commission’s (NRC) Nuclear Waste Confidence renamed Continued Storage of Spent Nuclear Fuel Generic Environmental Impact Statement (GEIS) and Rule, 79 Fed. Reg. 56,238-56,263 (Sept. 19, 2014) (Effective October 20, 2014). The decision is under appeal by the NY, MA, Vermont AGO and independent groups.

<sup>83</sup> We recommend that you visit San Onofre Safety Website at <https://sanonofresafety.org/nuclear-waste/>

<sup>84</sup> Chloride-Induced Stress Corrosion Cracking Tests & Example Aging Management Program, Darrell S. Dunn, NRC/NMSS/SFST, Public Meeting with NEI on Chloride Induced Stress Corrosion Cracking Regulatory Issue Resolution Protocol, August 5, 2014, <https://sanonofresafety.files.wordpress.com/2013/06/8-5-14-scc-rirp-nrc-presentation.pdf>

<sup>85</sup> Outside Diameter Initiated Stress Corrosion Cracking Revised Final White Paper, PA-MSC-0474, October 13, 2010.

casks, do not have this problem.<sup>86</sup> The concrete overpacks also have aging issues that are accelerated in coastal environments.

*Our Recommendation:* Pilgrim's casks are stored outside on a pad, perhaps indefinitely. Because the Holtec system is susceptible to stress corrosion cracking exacerbated by a salt environment, Pilgrim Watch believes the ISFSI should be inside a building and inspected more frequently.

**Blocking Air Ventilation Vents:** Casks have air holes at bottom and top of casks for ventilation. If the holes are blocked by ice, snow, debris, or bird nests cooling will not occur.

*Our Recommendation:* Provide mitigation to prevent blockage, such as placing casks inside an enclosed building or installing an overhead roof and ensure in the design that there is drainage around each cask. Currently the vents are visually inspected by workmen.

**No technology to adequately inspect canisters for stress corrosion cracking.** There is very limited available technology to inspect the outside of the stainless steel canisters for cracks once they are loaded with nuclear waste. The canisters are covered by concrete. The industry is working to improve robots outfitted with cameras to travel down the ventilation channels. Currently, robots have limited success and have not shown the ability to determine the depth of a crack. There is no information about whether Holtec plans to use robots; and if so, whether they would inspect all four ventilation channels. There is no way to actually examine the area between the ventilation channels.

### **Pilgrim's Dry Cask Monitoring Plan, 2023**

The first aging management inspections are conducted at the ISFSI site at the approximate time the ISFSI enters the period of extended operations, 20 years after the HI-Storm 100 system was placed in service, Pilgrim first deployed the HI-STORM 100 system on January 15, 2015. So, that would put the start of the "period of extended operation" at Pilgrim on Jan. 15, 2035. All future inspections will occur with a 5- year frequency (+/- 1.25 years) starting from the baseline date. Only one cask will be inspected. This schedule applies to the canister external inspection and overpack internal inspections. NRC also looks at the physical condition of the casks (exterior only) and the pad, reviews any site-completed aging management reviews, and reviews any required surveillances.<sup>87</sup>

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<sup>86</sup> See Top 10 Reasons to Buy Thick Casks, San Onofre Safety at:

<https://sanonofresafety.files.wordpress.com/2014/10/thincanistersvsthickcasks2014-10-14.pdf>

<sup>87</sup> Source Neil Sheehan, NRC Public Affairs (October 5, 2023) : The HI-STORM 100 certificate of compliance (CoC) renewal became effective on Aug. 2, 2023. Here is a link to the CoC renewal package: [ML23068A384](#) .The CoC renewal requires Holtec (the CoC holder) to update the HI-STORM 100 final safety analysis report (FSAR), specifically to include the FSAR supplement in Appendix D of the HI-STORM 100 CoC renewal application, Revision 1, dated April 23, 2021 (at [ML21113A203](#)). This is the updated/final version of the renewal application.

- **There are no monitors installed on each cask to measure heat, helium, and radiation to provide early warning.** The NRC's reasons that there are not monitors are unconvincing. NRC claims that the canisters used at Pilgrim are welded closed and therefore do not require the use of instrumentation to assure the safe storage of spent fuel. Prior to being placed on the ISFSI pad, the welds are examined and tested to confirm their integrity, and radiation measurements are taken. In accordance with the Certificate of Compliance (CoC) for the HOLTEC HI- STORM 100 system, surveillance of the passive heat removal system (air inlet and outlet vents) is required daily to ensure system operability. This can be achieved by either monitoring the inlet and outlet vent temperatures or performing a visual inspection daily to ensure that the vents are not blocked. Pilgrim has elected to perform daily visual inspections to ensure the air inlet and outlet vents do not become blocked and the passive heat removal system remains operable.
- NRC also says that Thermoluminescent dosimeters (TLDs) will be placed around the ISFSI (cask storage pad). NRC Ray McKinley said that, "The NRC intends to inspect Entergy's plans for radiation monitoring of their independent spent fuel storage installation (ISFSI) at Pilgrim during upcoming inspection activities. Typically we have seen licensees at other sites install thermoluminescent type dosimeters at the ISFSI periphery. The frequency that licensees have performed radiological monitoring from dosimeters has varied from quarterly to yearly based on their specific program requirements. The results of radiological monitoring associated with the ISFSI are included in the licensee's REMP report."

*Our Recommendation:* The public would be better protected if each cask had real-time heat, helium and radiation monitors, considering that the canisters and concrete outer packs are prone to cracking and, especially in our marine environment. TLDs only provide an average figure, can only read to a maximum threshold, that is, like a film badge they can only read so high, and do not read high or low alpha and beta. A more robust aging management program sampling multiple casks, with more frequent inspections are needed.

### **No Pressure monitoring or Pressure Relief Valves for canisters.**

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Appendix D (FSAR changes) start on p. D-1 (p. 126 of the PDF). The specific Aging Management Programs (AMPs) that include the inspection frequency you reference start on p. D-26 (p. 151 of the PDF). The multi-purpose canister (MPC) AMP starts on p. D-28 (p. 153 of the PDF).

- Note that these AMPs in Appendix D match those in Appendix A that you referenced. Appendix A starts on p. A-1 (p. 92 of the PDF), with the MPC AMP beginning on p. A-2 (p. 93 of the PDF).

Additionally, the CoC renewal requires general licensees using the system to implement the applicable AMPs in the FSAR, once the general licensee is in its period of extended operation (20-years after deploying the storage system at the ISFSI).

- ▶ Canisters are pressure vessels.
- ▶ NRC does not require pressure monitoring or pressure relief valves, making the canisters vulnerable to hydrogen gas and other types of explosions.
- ▶ The NRC allows these and other exemptions to American Society of Mechanical Engineers (ASME) pressure vessel safety standards. ASME standards should be enforced, not exempted.



**No current method to replace failing canisters.**

Dr. Kris Singh, CEO, Holtec International has said:

"...It is not practical to repair a canister if it were damaged... You will have... millions of curies of radioactivity coming out of canister... A canister that develops a microscopic crack (all it takes is a microscopic crack to get the release) .... To precisely locate it ... is a tall order. And then if you try to repair it (remotely by welding) ... the problem with that is you create a rough surface which becomes a new site for corrosion down the road.... I don't advocate repairing the canister."

(<https://www.youtube.com/watch?v=euaFZt0YPI4&t=37s>, Dec. 2014)

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"Finally, how about fixing a crack in the MPC wall? I have stated that although it may be theoretically possible to repair a leak (or crack) in a canister, in my opinion it is not practical when one considers efficiency and radiation dose to the workers."

(August 17, 2018 White Paper)

**Using a spent fuel pool to inspect or repair casks is not an option.**

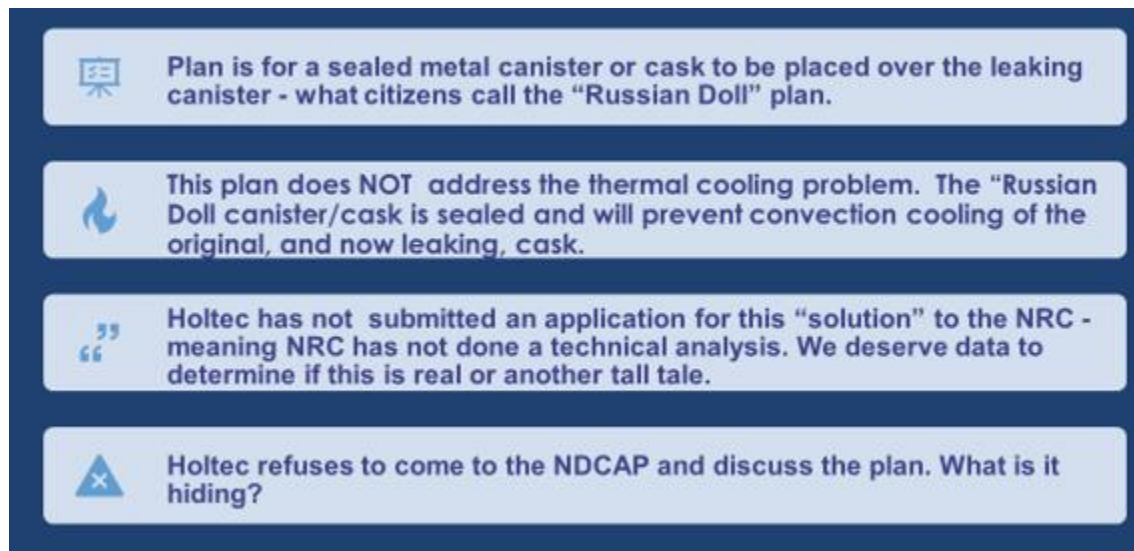
The current spent fuel pool will be gone - otherwise the company would have to defer dismantlement and maintain extra staff, or to build a new pool – all of which would cost money that Holtec is not likely to spend.

Due to high temperatures inside a cask, opening it under water could result in a steam flash - rapid temperature change with the water could damage the fuel cladding.

If a cask is already cracked, placing it in the pool could allow water into the cask, creating steam pressure, hydrogen, and damaging the fuel cladding.

Risk of water boiling off and having to re-flood the pool if a canister is put back in and opened up. Water boils at 100 degrees and the temperature of the defective canister's contents would be 300 or up to 800 degrees.

Holtec's latest solution placing another canister over the leaking canister - Russian Doll - not a solution, either.



#### Hot or Dry Cells are not available to replace a failed canister.

The industry and NRC believe hot, or dry cell technology may be the solution. Placing the leaking canister in a pool is out; however, dry handling of the cask and fuel is important to avoid disturbing the properties of the cask, cladding, fuel, and related hardware that would occur if the materials were rewetted and rapidly cooled. But there are no dry handling facilities available in the nation that are large enough to handle these canisters. The only US hot cell large enough to transfer fuel assemblies from one canister to another, the Idaho National Lab Test Area North hot cell, was destroyed in 2007. A hot cell, for example, is in Switzerland" Zwiilag spent fuel storage facility.

*Our Recommendation:* Require more robust dry casks and adequately fund DOE to develop and build the equipment that is needed as quickly as possible. We cannot risk thousands of thousands of casks of spent nuclear fuel, spread throughout the United States, with no way to repair or replace them. Hot cells should be at each ISFSI; apart from that, portable hot cells should be placed in areas of the country to service reactors in those areas.

**Criticality Risk:** Holtec admitted to the NRC that if unborated water enters the canister [criticality](#) can occur. The NRC confirmed this. However, NRC claims canisters will not have through-wall cracks, so it will not happen. They ignore the fact that even microscopic scratches, pits, or other corrosion, such as from moist salt air, can trigger cracking.

**ISFSI (IN)SECURITY**  
**62 loaded dry casks - 61 for spent fuel, 1 for Greater than Class C Waste**  
**Visible & Vulnerable**



**Pilgrim's dry casks are visible and vulnerable to attack. . Just drive down Rocky Hill Road in Plymouth. Why were they put there?**

**Why are the public, officials, and regulators silent?**

**· Risk Ideology: NUREG-2157, Section 4.19**

“The environmental impacts of a successful terrorist attack [on stored SNF], if one occurs, could be significant and destabilizing. The impact determinations for these attacks, however, are made with consideration of the low probability of successful attack. The environmental impact determination with respect to successful terrorist attacks, therefore, is based on **risk, which the NRC defines as the product of the probability, even if only a qualitative assessment of probability is available, and the consequences of a successful attack.** This means that a high-consequence, low-probability event could result in a small impact determination if the risk is sufficiently low.”

Comment: This definition of risk is ideology, not science.

**Vulnerable terrorist target:** Pilgrim is a symbolic target located in “America’s Hometown.” The threat against nuclear power plants is real. According to the 9/11 Commission report, the Sept. 11, 2001 terrorists initially considered attacking a nuclear power reactor.<sup>88</sup> According to a report “Protecting U.S. Nuclear Facilities from Terrorist Attack: Re-assessing the Current ‘Design Basis

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<sup>88</sup> <http://www.resilience.org/stories/2004-07-25/911-report-reveals-al-qaeda-ringleader-contemplated-ny-area-nuclear-power-plant-p>

Threat' Approach,"<sup>89</sup> prepared under a contract for the Pentagon by the Nuclear Proliferation Prevention Project (NPPP) at the University of Texas at Austin's LBJ School of Public Affairs finds that none of the 104 commercial nuclear power reactors in the United States is protected against a maximum credible terrorist attack, such as the one perpetrated on September 11, 2001, nor against airplane attacks, nor even against readily available weapons such as rocket propelled grenades and 50-caliber sniper rifles.

**The ISFSI is located 362' from a public road.** It is visible; it is vulnerable to weapons, delivered either on or offsite, that are available today and potentially to an air attack. It is not protected, as it should be, by a barrier or reinforced building to protect against a line of sight attack. For protection against external missiles, David Lochbaum and Dr. Gorn Thompson have long advocated erecting a berm around the ISFSI. Activists in Maine successfully advocated for such a protective feature around the ISFSI at Maine Yankee. It does not afford absolute protection against external sabotage but provides some protection that is literally dirt cheap if the berm is made of soil (as at Maine Yankee and North Anna.)

**Shrinking Protected Area:** Holtec filed a License Amendment Request to NRC June 22, 2021 (NRC Library, Adams Accession No. ML21173A328) seeking to reduce the scope of the physical protection (security) plan for Pilgrim. NRC approved the ISFSI-only physical security plan for Pilgrim ( August 5,2021). The NRC staff's review of the plan determined that it continues to meet all applicable provisions of 10 CFR 72.212(b)(9) and 10 CFR 73.55 and is adequate to provide protection of the spent fuel in the ISFSI, including against acts of sabotage or insider threats.

Analysis: The Protected Area did shrink from being the security fence around key plant buildings to the fence around the ISFSI. Workers who have unescorted access privileges to the Protected Area only do so after a background check where fingerprint cards are sent to the FBI and 5-year past history is reviewed. In addition, workers with unescorted access are subject to initial and random drug and alcohol checks to guard against performance impairing substances. Now that the Protected Area is shrunk to just the ISFSI, **most of the workers doing the dismantling activities will not be subject to background checks and drug/alcohol testing.** The 9/11 terrorists took advantage of less-robust screening at the airport to carry weapons aboard and then hijack airliners. Tomorrow's terrorists might gain cover employment at a nuclear plant being decommissioned and use the equipment provided by the company at the site to damage the ISFSI casks. Picture a bulldozer toppling a vertical cask and rolling it down to the sea. No background checks- no protection against those intent on doing harm.

**2-Person Worker Rule:** A worker (or drone) inserting a caustic fluid in the upper or exhaust vent of cask(s) could result in damage to the canister(s) inside. Workers at Surry in the early 1980s damaged new fuel assemblies in the new fuel vault by dumping caustic materials into the vault. David Lochbaum, formerly with NRC and the Union of Concerned Scientists, advocated protecting against such worker sabotage invoking the two-person rule long used within the US military for access to nuclear materials. For ISFSIs, the second person could be a camera

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<sup>89</sup> <http://sites.utexas.edu/nppp/files/2013/08/NPPP-working-paper-1-2013-Aug-15.pdf>

monitoring the pad (as long as there's a breathing (*and alert*) security officer watching the monitor screen during worker access within the ISFSI fence.)

July 2021, a Pilgrim security worker alleged that security at the plant is insufficient; and photos taken by two undeterred “uninvited guests” wandering around Pilgrim’s site were widely circulated.

### **Commonwealth of Massachusetts and Holtec Pilgrim LLC and Holtec Decommissioning International LLC Settlement Agreement, June 16, 2020 (Section IV, paragraphs 22-23)**

The Settlement Provisions regarding ISFSI Security are Inadequate. Pilgrim Watch has consistently said that some type of barrier to a line-of-site terrorist attack is essential. The Town of Plymouth Board of Selectmen apparently did not lobby for that idea and advocated, instead of real protection, planting arborvitae between the ISFSI and Rocky Hill Road.

Holtec’s press release says nothing about protection. Rather, it says that the Settlement Agreement provided “Reasonable aesthetical requirements for the new ISFSI protected area, including some screening from Rocky Hill Road.” The Settlement itself says:

An enhanced vegetation planting scheme consisting of trees and/or other species that retain year-round foliage for the area between the outer ISFSI fence and the top and downward slope of the hill on the Rocky Hill Road side of the ISFSI to better or completely obscure the ability to view the ISFSI and related buildings from Rocky Hill Road; b) (i) a vegetation planting scheme consisting of arborvitae or a like species that retains year-round foliage for the area in front of the Rocky Hill Road facing surface of the proposed vehicle barrier to obscure the ability to view the vehicle barrier wall from Rocky Hill Road and (ii) a scheme to install a rock or other appealing facade on the face of the of Rocky Hill Road facing surface of the proposed vehicle barrier wall and a planting scheme for Ivy or a like species along the same.

Does anyone really believe that a “vegetation planting scheme” will protect the ISFSI from attacks such as those described by Dr. Thompson?

### **Cybersecurity**

The NRC exempted Pilgrim from the requirement to defend against cyberattacks.<sup>90</sup> The exemption becomes effective on April 1, 2020, 10 months after the cessation of power generation. This means that digital security communication equipment and security cameras needed to protect the spent nuclear fuel are now vulnerable.

The New York Times in 2017 reported that *Hackers Are Targeting Nuclear Facilities*,

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<sup>90</sup> NRC Electronic Library, Adams, Accession Number ML19276C420

*Homeland Security Dept. and F.B.I. Say.*<sup>91</sup> Terrorist threats have increased, not decreased, since 2017.

***Russian Cyber Attacks Call for Stringent Security Standards at US Nuclear Plants, But Plant Owners Want Them Weakened***, Union of Concerned Scientist, Dr. Edwin Lyman.<sup>92</sup> The press release explains the threat to spent fuel storage from cyber-attacks at decommissioned plants such as Pilgrim.

WASHINGTON (March 16, 2018)—Yesterday, the Department of Homeland Security and the Federal Bureau of Investigation officially confirmed that Russian hackers have been targeting US nuclear power plants and other critical facilities since at least 2016. Regardless, the US nuclear industry has been pressuring the Nuclear Regulatory Commission to relax its cyber security standards.

Below is a statement by Edwin Lyman, a senior scientist at the Union of Concerned Scientists.

“The Department of Homeland Security alert is a stark reminder that nuclear power plants are tempting targets for cyber attackers. Although the systems that control the most critical safety equipment at US nuclear plants are analog-based and largely immune to cyber-attacks, many other plant systems with important safety and security functions are digital and could be compromised. For instance, electronic locks, alarms, closed-circuit television cameras, and communications equipment essential for plant security could be disabled or reprogrammed. And some plants have equipment, such as [cranes that move highly radioactive spent fuel](#), that utilize computer-based control systems that could be manipulated to cause an accident.

“Reports that the recent attacks on nuclear power plants were limited to their administrative systems and did not affect systems that have direct safety and security functions are not cause for complacency. Sophisticated cyber intruders could access administrative systems to obtain—or plant—compromising information to coerce key personnel to assist in a damaging attack.

“Therefore, the nuclear industry’s [petition to limit the scope](#) of Nuclear Regulatory Commission cyber-protection safeguards to only those systems with a direct impact on safety is foolhardy at best and, at worse, downright dangerous. The NRC has been deliberating over the industry’s ill-conceived proposal for nearly four years. In light of the growing cyber threat to nuclear plants highlighted by yesterday’s alert, the agency should now simply reject it.”

## Settlement Agreement

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<sup>91</sup> <https://www.nytimes.com/2017/07/06/technology/nuclear-plant-hack-report.html>

<sup>92</sup> <https://ucsusa.org/about/news/russian-cyber-attacks>

Paragraph 23 is concerned with cybersecurity. It requires HDI, “within thirty (30) days of the Effective Date, certify to the implementation of a cybersecurity plan at Pilgrim, which shall, at the very least, include [10] cybersecurity measures.” In substance, the ten measures seem to be what should be standard business practice, e.g., eliminating exposure of Critical Digital Assets to external networks, implementing network segmentation, using secure remote access methods, and using only strong passwords.

The NRC will not release any cybersecurity details.

### Independent Expert Security Analysis

Holtec in its April 2, 2020 Pilgrim Nuclear Power Station, Physical Security Plan Revision and License Amendment Request to Incorporate Additional Independent Spent Fuel Storage Installation described its security modifications associated with the proposed license amendment. These included: new security systems for lighting, intruder detection systems, protected area boundary fencing, access control systems, telecommunications equipment, a vehicle barrier system, and a central alarm station. Although details were omitted for safeguard reasons,<sup>93</sup> none of these appear to address an attack on the dry casks of spent nuclear fuel from outside the protected area.

The following table, prepared by Dr. Gordon Thompson for the Massachusetts Attorney General,<sup>94</sup> summarizes available means of attack.

| Mode of Attack                   | CHARACTERISTICS                                                                                                                                                                                              | PRESENT DEFENSE                                                                                                                     |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Commando-style by land           | <ul style="list-style-type: none"> <li>• Could involve heavy weapons/sophisticated tactics</li> <li>• Attack requiring substantial planning and resources</li> </ul>                                         | Alarms, fences, lightly-armed guards, with offsite backup                                                                           |
| Commando-style by water          | <ul style="list-style-type: none"> <li>• Could involve heavy weapons/sophisticated tactics</li> <li>• Could target intake canal</li> <li>• Attack may be planned to coordinate with a land attack</li> </ul> | 500 yard no entry zone – marked by buoys – simply, “no trespassing” signs<br><br>Periodic Coast Guard surveillance by boat or plane |
| Land-vehicle bomb                | <ul style="list-style-type: none"> <li>• Readily obtainable</li> <li>• Highly destructive if detonated at target</li> </ul>                                                                                  | Vehicle barriers at entry points to Protected Area                                                                                  |
| Anti-tank missile                | <ul style="list-style-type: none"> <li>• Readily obtainable around world to those with ideological grievances</li> <li>• Highly destructive at point of impact</li> </ul>                                    | None if missile is launched from offsite                                                                                            |
| Commercial aircraft              | <ul style="list-style-type: none"> <li>• More difficult to obtain than pre-9/11</li> <li>• Can destroy larger, softer targets</li> </ul>                                                                     | None                                                                                                                                |
| Explosive-laden smaller aircraft | <ul style="list-style-type: none"> <li>• Readily attainable</li> <li>• Can destroy smaller, harder targets</li> </ul>                                                                                        | None                                                                                                                                |

<sup>93</sup> <https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML20141L057> Attachment 1, pg.,4

<sup>94</sup>The Massachusetts Attorney General’s Request for a Hearing and Petition for Leave to Intervene With respect to Entergy Nuclear Operations Inc.’s Application for Renewal of the Pilgrim Nuclear Power Plants Operating License and Petition for Backfit Order Requiring New Design features to Protect Against Spent Fuel Pool Accidents, Docket No. 50-293, May 26, 2006 includes a Report to The Massachusetts Attorney General On The Vulnerability of Pilgrim’s Spent Fuel Pool - Risks and Risk-Reducing Options Associated with Pool Storage of Spent Nuclear Fuel at the Pilgrim and Vermont Yankee Nuclear Power Plants, Gordon Thompson, May 25, 2006

**Drones, an added threat:** Drones pose a number of security concerns for ISFSI security. Payload drones could deliver explosives to attackers onsite. February 14, 2025 New York Times reported that *Russian Drone Damages Radiation Shield at Chernobyl, Ukraine Says*.<sup>95</sup> “Russia’s military used a drone with a high-explosive warhead to hit the former Chernobyl nuclear power plant in Ukraine overnight, damaging the protective shelter that prevents radiation leaks, President Volodymyr Zelensky of Ukraine said on Friday.” Kremlin denied that Russia attacked the plant. But the attack came as world leaders are gathered in Munich for an annual security conference on war in the Ukraine. Drones can be used as a “negotiating tool.”

Another concern is that drones could enhance tactical advantage. For example, drones could distract the security guard force during a ground attack, slowing their response or causing them to be mispositioned to the advantage of the attackers; and drones could target the security cameras, motion sensors, etc. to mask ground attackers. The timelines for security force personnel to deploy and prevent attackers from successfully sabotaging key equipment are short. Anything that prevents timely and proper response by the guard force could be a problem.

### Impact of Shaped Charge

Dr. Gordon Thompson also analyzed the impact of a shaped charge as one potential instrument of attack.<sup>96</sup> The analysis shows that the cylindrical **wall of the canister is about 1/2 inch (1.3 cm) thick, and could be readily penetrated by available weapons**. The spent fuel assemblies inside the canister are composed of long, narrow tubes made of flammable zirconium alloy, inside which uranium oxide fuel pellets are stacked. The walls of the tubes (the fuel cladding) are about 0.023 inch (0.6 mm) thick.

Four of Dr. Thompson’s slides, showing the impact of a shaped charge and atmospheric releases from different attack scenerios, are below.

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<sup>95</sup> <https://www.nytimes.com/2025/02/14/world/europe/chernobyl-drone-ukraine-russia-nuclear.html?searchResultPosition=1>

<sup>96</sup> Gordon R. Thompson, *Environmental Impacts of Storing Spent Nuclear Fuel and High- Level Waste from Commercial Nuclear Reactors: A Critique of NRC’s Waste Confidence Decision and Environmental Impact Determination* (Cambridge, Massachusetts: Institute for Resource and Security Studies, 6 February 2009). Tables also in Declaration of 1 August 2013 by Gordon R. Thompson: Comments on the US Nuclear Regulatory Commission’s Draft Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a US Mark I Boiling Water Reactor.



# Impact of Shaped Charge

Canister - 0.5" thick/ Concrete outer wall - 26.8"



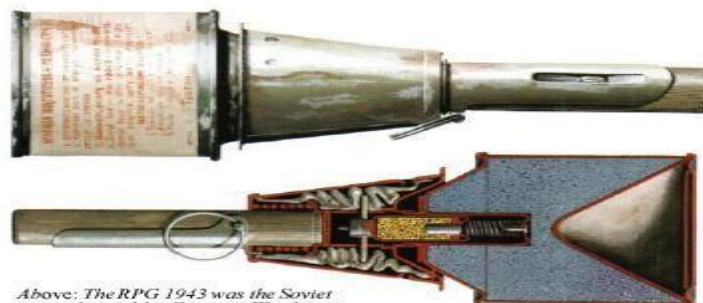
## ► Performance of US Army Shaped Charges, M3 and M2A3

| Target Material     | Indicator                                               | Type of Shaped Charge                  |                                          |
|---------------------|---------------------------------------------------------|----------------------------------------|------------------------------------------|
|                     |                                                         | M3                                     | M2A3                                     |
| Reinforced concrete | Maximum wall thickness that can be perforated           | 60 in.                                 | 36 in.                                   |
|                     | Depth of penetration in thick walls                     | 60 in.                                 | 30 in.                                   |
|                     | Diameter of hole                                        | • 5 in. at entrance<br>• 2 in. minimum | • 3.5 in. at entrance<br>• 2 in. minimum |
|                     | Depth of hole with second charge placed over first hole | 84 in.                                 | 45 in.                                   |
| Armor plate         | Perforation                                             | At least 20 in.                        | 12 in.                                   |
|                     | Average diameter of hole                                | 2.5 in.                                | 1.5 in.                                  |

**Notes:** (a) Data are from: Army, 1967, pp 13-15 and page 100. (b) The M2A3 charge has a mass of 12 lb., a maximum diameter of 7 in, and a total length of 15 in including the standoff ring. (c) The M3 charge has a mass of 30 lb., a maximum diameter of 9 in, a charge length of 15.5 in, and a standoff pedestal 15 in long<sup>97</sup>

Following four slides are from Dr. Gordon Thompson" presentation to NDCAP January 27, 2025.

**Shaped Charge Warhead-available around the world today.**



*Above: The RPG 1943 was the Soviet equivalent of the German Wurfmine, but it used a fabric strip stabilizer tail to keep the hollow charge warhead pointing towards the target tank when in flight. The tail was ejected from the throwing handle after the grenade had been thrown and after the arming pin had been removed.*

<sup>97</sup> Ibid.

## Raytheon Shaped-Charge Test-Before Raytheon Shaped-Charge Test-After



## Amount Cesium-137:Chernobyl, Fukushima, Pilgrim

|                                                  |                                                            |
|--------------------------------------------------|------------------------------------------------------------|
| Chernobyl release to atmosphere (1986)           | 85 <u>PBq</u>                                              |
| Fukushima #1 release to atmosphere (2011)        | 10-35 <u>PBq</u><br>(about 20% deposited on land in Japan) |
| In one MPC at the Pilgrim ISFSI                  | 25 <u>PBq</u><br>(reference MPC in 2029)                   |
| An “MPC fire” reference release at Pilgrim ISFSI | 5-25 <u>PBq</u> (10-50% per MPC, 2 MPCs)                   |

1 PBq =  $1 \times 10^{15}$  disintegrations per second

1 PBq of Cs-137 has a mass of about 300 grams

## Atmospheric Releases from Attack Scenarios

In one type of release, gases and small particles are swept out of the MPC during a blowdown of gases in the MPC through a comparatively small hole. That release would expose a person downwind to a comparatively small inhalation dose.

In the second type of release, air would enter and leave the MPC through one or more holes, and the zirconium alloy cladding of the spent fuel would be ignited by use of incendiary material. That release could include a large amount of cesium-137 that would cause significant radiological harm at distances of tens of km downwind. An attacking group seeking to maximize the impact of its attack would clearly prefer the second type of release.

## Types of Atmospheric Releases from Attack

| Type of Event                          | Module Behavior                                                                                                                                                                                                                  | Relevant Instruments and Modes of Attack                                                                                                                                             | Characteristics of Atmospheric Release                                                                                                                                                                                                                                          |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type I: Vaporization                   | <ul style="list-style-type: none"> <li>Entire module is vaporized</li> </ul>                                                                                                                                                     | <ul style="list-style-type: none"> <li>Module is within the fireball of a nuclear-weapon explosion</li> </ul>                                                                        | <ul style="list-style-type: none"> <li>Radioactive content of module is lofted into the atmosphere and amplifies fallout from nuclear explosion</li> </ul>                                                                                                                      |
| Type II: Rupture and Dispersal (Large) | <ul style="list-style-type: none"> <li>MPC and overpack are broken open</li> <li>Fuel is dislodged from MPC and broken apart</li> <li>Some ignition of zircaloy fuel cladding may occur, without sustained combustion</li> </ul> | <ul style="list-style-type: none"> <li>Aerial bombing</li> <li>Artillery, rockets, etc.</li> <li>Effects of blast etc. outside the fireball of a nuclear weapon explosion</li> </ul> | <ul style="list-style-type: none"> <li>Solid pieces of various sizes are scattered in vicinity</li> <li>Gases and small particles form an aerial plume that travels downwind</li> <li>Some release of volatile species (esp. cesium-137) if incendiary effects occur</li> </ul> |

## Types of Atmospheric Releases from Attack

|                                         |                                                                                                                                                                                                    |                                                                                                                                                                                                        |                                                                                                                                                                                                |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type III: Rupture and Dispersal (Small) | <ul style="list-style-type: none"> <li>MPC and overpack are ruptured but retain basic shape</li> <li>Fuel is damaged but most rods retain basic shape</li> <li>No combustion inside MPC</li> </ul> | <ul style="list-style-type: none"> <li>Vehicle bomb</li> <li>Impact by commercial aircraft</li> <li>Perforation by shaped charge</li> </ul>                                                            | <ul style="list-style-type: none"> <li>Scattering and plume formation as for Type II event, but involving smaller amounts of material</li> <li>Little release of volatile species</li> </ul>   |
| Type IV: Rupture and Combustion         | <ul style="list-style-type: none"> <li>MPC is ruptured, allowing air ingress and egress</li> <li>Zircaloy fuel cladding is ignited and combustion propagates within the MPC</li> </ul>             | <ul style="list-style-type: none"> <li>Missiles with tandem warheads</li> <li>Close-up use of shaped charges and incendiary devices</li> <li>Thermic lance</li> <li>Removal of overpack lid</li> </ul> | <ul style="list-style-type: none"> <li>Scattering and plume formation as for Type III event</li> <li>Substantial release of volatile species, exceeding amounts for Type II release</li> </ul> |

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**One scenario for an atmospheric release** from a dry cask would involve mechanically creating a comparatively small hole in the canister. This could be the result, for example, of the air blast produced by a nearby explosion, or by the impact of an aircraft or missile. If the force was sufficient to puncture the canister, it would also shake the spent fuel assemblies and damage their cladding. A hole with an equivalent diameter of 2.3 mm ( 0.09 inch), radioactive gases and particles released would result in an inhalation dose (CEDE) of 6.3 rem to a person 900 m (0.56 miles) from the release. Most of that dose would be attributable to release of two-millionths (1.9E-06) of the MPC's inventory of radioisotopes in the "fines" category.

**Another scenario** for an atmospheric release would involve the creation of one or more holes in a canister, with a size and position that allows ingress and egress of air. In addition, the scenario would involve the ignition of incendiary material inside the canister, causing ignition and sustained burning of the zirconium alloy cladding of the spent fuel. Heat produced by burning of the cladding would release volatile radioactive material to the atmosphere. Heat

from combustion of cladding would be ample to raise the temperature of adjacent fuel pellets to well above the boiling point of cesium.

## Potential for Release from a Cask and Consequences

Dr. Thompson observed that casks are not robust in terms of its ability to withstand penetration by weapons available to sub-national groups. A typical cask would contain 1.3 MCi of cesium-137, about half the total amount of cesium-137 released during the Chernobyl reactor accident of 1986. Most of the offsite radiation exposure from the Chernobyl accident was due to cesium-137. Thus, a fire inside an ISFSI module, as described in the preceding paragraph, could cause significant radiological harm.

## Options To Reduce Risk

**Barrier Wall:** The MA Attorney General tried to get agreement in the Settlement Agreement to require a barrier wall around the ISFSI to reduce opportunity for attack. Holtec refused claiming that the site was too close to the edge of a hill. Another option would have been to sink the ISFSI storage pad lower into the ground to allow for a shorter barrier wall. Neither options were accepted by Holtec.

**Casks:** Use thick-walled casks, dispersal of the casks, and protection of the casks by berms or bunkers in a configuration such that pooling of aircraft fuel would not occur in the event of an aircraft impact.

**HI-STORM 100U module:** Holtec has developed a design for a new ISFSI storage module that it said to be more robust against attack than present modules. The new module is the HI-STORM 100U module, which would employ the same canister used in the present Holtec modules. For most of its height, the 100U module would be underground. Holtec has described the robustness of the 100U module as follows<sup>[31]</sup>:

"Release of radioactivity from the HI-STORM 100U by any mechanical means (crashing aircraft, missile, etc.) is virtually impossible. The only access path into the cavity for a missile is vertically downward, which is guarded by an arched, concrete-fortified steel lid weighing in excess of 10 tons. The lid design, at present configured to easily thwart a crashing aircraft, can be further buttressed to withstand more severe battlefield weapons, if required in the future for homeland security considerations. The lid is engineered to be conveniently replaceable by a later model,

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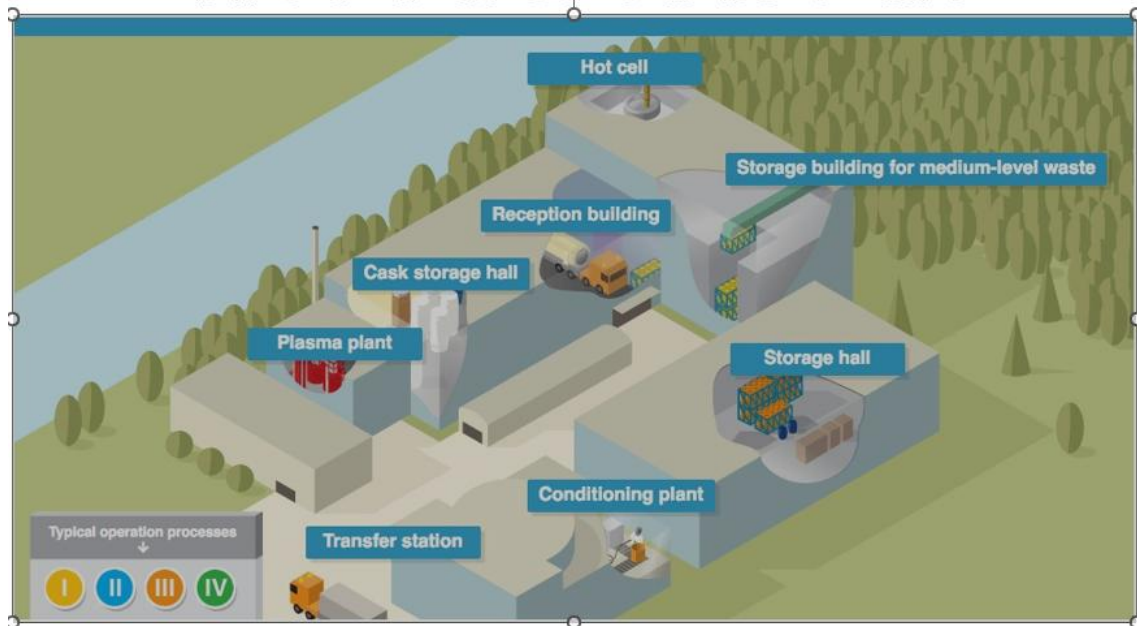
<sup>[31]</sup> Holtec International, "The HI-STORM 100 Storage System", accessed at

<http://www.holtecinternational.com/hstorm100.html> on 17 June 2007.

if the potency of threat is deemed to escalate to levels that are considered non-credible today."

### Real Solution To Reduce Risk- Switzerland's Onsite Spent Fuel Storage

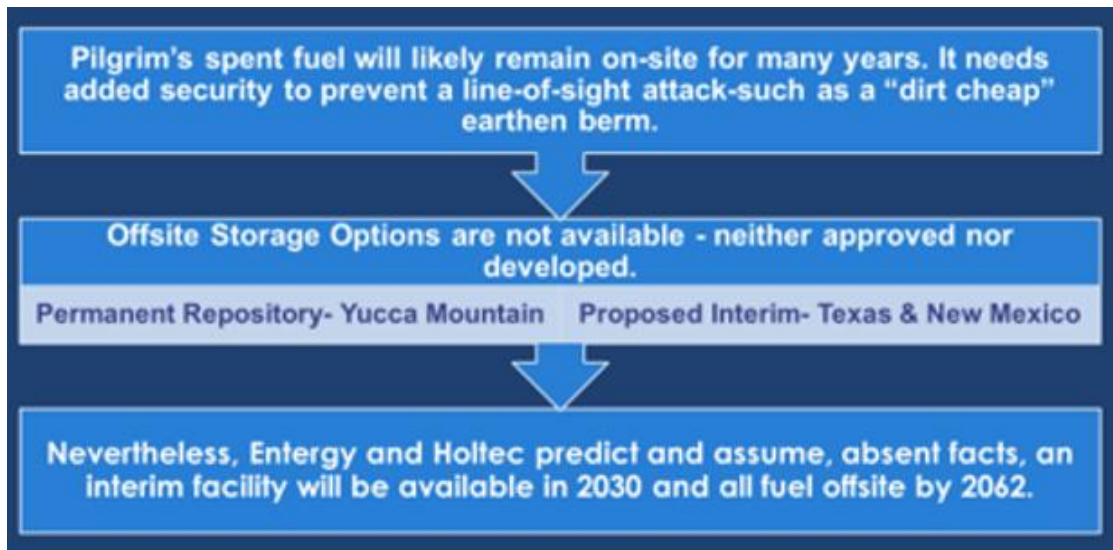
## Zwilag Radioactive Waste Facility in Switzerland: General Schematic



## Cask Storage Hall at Zwilag Facility



## Offsite Storage Options



The long term goal is to move spent fuel to a permanent repository - a storage facility located deep underground and designed for long-term safe disposal so that it will be isolated from the environment for the tens of thousands of years that it will remain toxic. The potential interim goal is consent based consolidated storage. There is no perfect answer to storing nuclear waste that will be lethal for over 250,000 years-longer than humans have been on this earth.

But should efforts to find the perfect solution stand in the way of a good solution? Pilgrim Watch believes that storing waste in 70 or so separate locations around the country is a bad plan. Reactors are located adjacent to bodies of water, needed to provide cooling to dissipate excess heat. Proximity to water is exactly the wrong places to store nuclear waste. Also, Pilgrim, and some other reactors, are close to densely populated areas making a timely evacuation impossible. Reactor sites are tempting terrorist targets, especially those in symbolic locations, like "America's Hometown", Plymouth. Last host communities, like Plymouth, never agreed to storing spent fuel. We were told that the fuel would be reprocessed and never accumulate onsite.

NRC and industry claim spent fuel will leave Pilgrim by 2063, **NRC has a Plan B in case it remains onsite.**

## NRC's Nuclear Waste Rule

- Allows spent fuel to stay in either the pool or in dry casks for 60 years
- During subsequent 300 years, allows spent fuel assemblies to remain in dry casks onsite, but the pad and casks must be changed every 100 years.

Will dry/hot cells be developed by then to make it possible to change canisters?

Will Holtec be around?

Who will pay?

## Federal and Congressional (In) Actions for Offsite Storage

### Timeframe for managing spent fuel at Pilgrim

- Holtec predicts that SNF will be stored at Pilgrim until 2062.
- The Nuclear Waste Policy Act of 1982 created a process to establish an underground repository for SNF.
- In January 2025 the USA has no credible program to develop a repository for SNF.
- Transfer of SNF from present ISFSI sites to other storage sites has been proposed.
- NRC says that SNF could remain at present ISFSI sites indefinitely.
- NRC assumes that ISFSIs will be rebuilt at 100-year intervals, with use of a dry transfer system (i.e., hot cell).

**Nuclear Waste Policy Act:** The Nuclear Waste Policy Act of 1982 (NWPAA) calls for disposal of spent nuclear fuel in a deep geologic repository. NWPAA requires the Department of Energy (DOE) to develop such a repository, which would be licensed by the Nuclear Regulatory Commission (NRC). Overview: <https://www.scientificamerican.com/article/nuclear-waste-is-piling-up-does-the-u-s-have-a-plan/> By [Allison Macfarlane](#), [Rodney C. Ewing](#), March 6, 2023

### Yucca Mountain



Amendments to NWPA in 1987 restricted DOE's repository site studies to Yucca Mountain in Nevada. DOE submitted a license application for the proposed Yucca Mountain repository to NRC on June 3, 2008. The State of Nevada strongly opposes the Yucca Mountain project, citing excessive water infiltration, earthquakes, volcanoes, human intrusion, and other technical issues.<sup>98</sup>

Licensing and design work for the proposed Yucca Mountain repository was halted under the Obama Administration, which cited continued opposition from Nevada. To develop an alternative nuclear waste policy, the Obama Administration established the Blue- Ribbon Commission on America's Nuclear Future, which in 2012 recommended a "consent based" process for siting nuclear waste storage and disposal facilities.<sup>99</sup>

The Trump first Administration included funds to restart Yucca Mountain licensing in its FY2018, FY2019, and FY2020 budget submissions to Congress; but it said it would not seek funds in FY 2021 due we presume to the November election. The FY2018 and FY2019 Yucca Mountain funding requests were not enacted. For FY2020, the House did not provide funding for Yucca Mountain in the Energy and Water Development appropriations bill (H.R. 2740), and the Senate Appropriations Committee also provided no funding in its version of the bill (S. 2470), approved September 12, 2019.

The Biden Administration opposed Yucca Mountain; on June 30, 2021, it announced it was beginning a consent-based process to find a new site to store spent fuel. States will be compensated if they agree to host nuclear waste interim storage sites. Who knows what the Trump Administration will do in his second term of office, 2025-.

### **Several Nuclear Waste Bills Have Been Introduced In The 116th Congress**

See tables prepared by the Congressional Research Service.<sup>100</sup> The Senate Energy and Natural Resources Committee held a hearing June 27, 2019, on a bill to create a Nuclear Waste Administration to implement a consent-based siting process for nuclear waste facilities (S. 1234). Newly proposed waste sites would require consent by host states and affected local governments and Indian tribes. How consent is determined is not spelled out. The bill would not affect the existing Yucca Mountain licensing process.

A bill to provide the necessary land controls for the planned Yucca Mountain repository, H.R. 2699 was introduced May 14, 2019. The bill also would authorize DOE to store commercial waste from nuclear power plants at a nonfederal interim storage facility and ease the capacity limit on the Yucca Mountain repository from 70,000 to 110,000 metric tons, in comparison with the approximately 80,000 metric tons currently stored at U.S. nuclear plants. It is similar to a bill passed by the House in the 115th Congress (H.R. 3053, H.Rept. 115-355).

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<sup>98</sup> See the State of Nevada website for updated reports <http://www.state.nv.us/nucwaste/whatsnew.htm>

<sup>99</sup> [https://www.energy.gov/sites/prod/files/2013/04/f0/brc\\_finalreport\\_jan2012.pdf](https://www.energy.gov/sites/prod/files/2013/04/f0/brc_finalreport_jan2012.pdf)

<sup>100</sup> Civilian Nuclear Waste Disposal, Mark Holt, Sept 16, 2019, Congressional Research Service [https://www.everycrsreport.com/files/20190916\\_RL33461\\_b58c25fcf4f40e7eb5dfbe1befe2c65e4bf07863.pdf](https://www.everycrsreport.com/files/20190916_RL33461_b58c25fcf4f40e7eb5dfbe1befe2c65e4bf07863.pdf)

Other nuclear waste bills in the 116th Congress would prohibit expenditures on the Yucca Mountain repository without state and local consent (H.R. 1544, S. 649), establish priorities for nuclear waste disposal (H.R. 2995), and authorize grants to communities to compensate for continued waste storage at closed reactors (S. 1985), among others.

**Deep Isolation Technology:**<sup>101</sup> Deep Isolation’s disposal concept leverages directional drilling expertise to isolate spent nuclear fuel and high-level radioactive waste in horizontal drill holes located deep underground in suitable rock formations. The website describes the process as, “Rather than creating large tunnels, Deep Isolation will place nuclear waste in narrow 18-inch horizontal drill holes in rock that has been stable for millions of years. No humans need to go underground. The Deep Isolation repository begins with a vertical access drill hole extending thousands of feet deep and will gently turn horizontal. Canisters containing nuclear waste would be stored in the horizontal section.”

### **Private Interim Storage**

Nonfederal interim storage facilities for spent nuclear fuel are being proposed in New Mexico and Texas. Both Governors and Attorney Generals oppose the sites. Interim storage proponents contend that DOE could fulfill its disposal obligations under NWPAA by taking the title to spent fuel at nuclear plant sites and storing it at private facilities until a permanent underground repository could be opened.

**Texas, WCS:** The waste management company Waste Control Specialists (WCS) filed an application on April 28, 2016, for an NRC license to develop a consolidated interim storage facility for spent nuclear fuel in Texas. WCS asked NRC to suspend consideration of the license application until April 18, 2017, citing estimated licensing costs that were “significantly higher than we originally estimated.” However, WCS subsequently formed a joint venture with Orano USA called Waste Control Partners, which submitted a renewed application for the Texas facility on June 11, 2018. The proposed WCS spent fuel storage facility would be built at a 14,000-acre WCS site near Andrews, TX, where the company currently operates two low-level radioactive waste storage facilities with local support. The facility would consist of dry casks on concrete pads. Construction would take place in eight phases, with each phase capable of holding 5,000 metric tons of spent fuel, for a total capacity of 40,000 metric tons. Under the WCS proposal, DOE would take the title to spent fuel at nuclear plant sites, ship it to the Texas site, and pay WCS for storage for up to 40 years with possible extensions, according to the company. DOE’s costs would be covered through appropriations from the Nuclear Waste Fund, as were most costs for the Yucca Mountain project. WCS contends that a privately developed spent fuel storage facility would not be bound by NWPAA restrictions that prohibit DOE from building a storage facility without making progress on Yucca Mountain. NRC Staff offered initial support in its draft version of the environmental impact statement, May 2020. NRC intends to complete its environmental impact in a year, following a public comment period and public meetings.<sup>102</sup> The Governor of Texas is opposed.

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<sup>101</sup> <https://www.deepisolation.com/technology/>

<sup>102</sup> NRC Staff Backs Licensing for Second Spent-Fuel Storage Site, Exchange Monitor, May 4, 2020

**New Mexico, Holtec:** An NRC license application for a spent fuel storage facility in New Mexico was filed March 30, 2017, by Holtec International, a manufacturer of spent fuel storage systems. The facility would be located on 1,045 acres of land provided by a local government consortium near the Waste Isolation Pilot Plant in New Mexico, the Eddy-Lea Energy Alliance (ELEA). The proposed facility, called the Holtec International Storage Module (HI-STORM) Consolidated Interim Storage Facility, would hold up to 173,600 metric tons of spent fuel in 10,000 canisters. The facility would be developed in 20 modules holding 500 canisters each, using about 288 acres of the site. Each canister would be stored vertically in an underground cavity covered by a radiation-shielding lid. Holtec recently purchased retired nuclear plants and plan to use the plants' decommissioning funds to dismantle the plants. The proposed storage facility in New Mexico could allow the company to remove all the spent fuel from its decommissioned nuclear plants without necessarily having to transfer title to the fuel to DOE beforehand. "Holtec hopes to ship the multi-purpose canisters (MPCs) containing the used fuel to the Company's proposed consolidated interim storage facility ...," according to a company news release. The news release also said Holtec's reactor decommissioning business "will welcome several more nuclear plants in the next two years." The news release did not specify whether the costs of spent fuel shipment and storage at the New Mexico facility would be paid from reactor decommissioning funds, the Nuclear Waste Fund, the Judgment Fund, or other sources.

Opponents of Holtec's plan, including Beyond Nuclear, a nonprofit organization with members nationwide, said the application violates the Nuclear Waste Policy Act "because they contemplate federal ownership of spent fuel during transportation to and/or storage" at the private facilities, according to a March 2019 lawsuit the nonprofit filed against the federal government and the NRC.

Under the NWPA, the federal government cannot take title to privately produced spent nuclear fuel until a final repository is operational. However, in this ruling the NRC found the license, if approved, would authorize Holtec to take possession of the spent fuel at its site and would not violate the NWPA by transferring title to the fuel. Additionally, the license would not sanction Holtec or the Department of Energy to enter into storage contracts.

"Holtec and DOE acknowledge that it would be illegal under NWPA for DOE to take title to the spent nuclear fuel at this time, although Holtec states that it hopes that Congress will amend the NWPA in the future," according to the April 23 ruling. "The NWPA does not prohibit a nuclear power plant licensee from transferring spent nuclear fuel to another private entity." Opponents argued in front of the Atomic Safety Licensing Board in January 2019. The proceedings were to determine if the opponents had standing to argue the case. In May 2019, the ASLB determined they failed to show cause for intervening. The Governor and local Native Americans also object.

**Wyoming:** A committee of the Wyoming legislature in July 2019 began studying the possibility of storing spent fuel in the state, according to media reports.

**No Congressional Authorization:** As noted above, legislation that would explicitly authorize DOE to enter into contracts with privately owned spent fuel storage facilities (H.R. 2699, H.R. 3136)

was introduced in the 116th Congress. Similar provisions were included in bills introduced but not enacted in the 115th Congress (H.R. 474) and (H.R. 3053), and the 114th Congress (H.R. 3643)

**Roadblocks to Consolidated Storage:** Critics say transporting highly radioactive material through densely populated areas will pose risks to residents of Texas and nearby New Mexico, and other regions of the country. Spent nuclear fuel from power plants could be vulnerable in transit to accidents or attacks, exposing people and land to long-term radioactive poisoning, opponents of the Texas and New Mexico projects say. Public interest groups have a national campaign to “Stop Fukushima Freeways” (<http://www.nirs.org/>) to oppose consolidated sites.

**Licensees sue DOE for breach of contract:** NWPA required DOE to begin removing spent fuel from reactor sites by January 31, 1998. Because that deadline was missed, nuclear utilities have sued DOE to recover the additional storage costs they have incurred, with damage payment so far totaling \$7.4 billion<sup>103</sup>

## **Reprocessing- Not the Answer to Our Spent Fuel Waste Problem**

The Yucca Mountain nuclear waste repository may never happen; and Consolidated Storage is not a sure thing by any means. Now we are back to square one on the question: What are we going to do with all the radioactive waste accumulating at U.S. nuclear power reactors? Some are suggesting that we go back to re-processing - a process that takes spent nuclear fuel and dissolves it to separate the uranium and plutonium from the highly radioactive fission products. The plutonium and uranium are then recycled to make new reactor fuel, thereby reducing the amount of fresh uranium required by about 20% but also increasing the supply of weapons grade plutonium.

Pilgrim Watch does not support reprocessing because it does not solve the waste problem; rather it exacerbates it by creating numerous additional waste streams that have to be managed. It is expensive, polluting and increases nuclear weapons proliferation threats.<sup>104</sup>

**Expensive:** Based on French and Japanese experience, the cost of producing this recycled fuel produced in reprocessing is several times that of producing fresh uranium reactor fuel. In the past, about half of France's reprocessing capacity was used to process spent fuel from foreign reactors. Because of the high cost, however, virtually all of those foreign customers have decided to follow the U.S. example and simply store their used reactor fuel.

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<sup>103</sup> Civilian Nuclear Waste Disposal, Mark Holt, Sept 16, 2019, Congressional Research Service  
[https://www.everycrsreport.com/files/20190916\\_RL33461\\_b58c25fcf4f40e7eb5dfbe1befe2c65e4bf07863.pdf](https://www.everycrsreport.com/files/20190916_RL33461_b58c25fcf4f40e7eb5dfbe1befe2c65e4bf07863.pdf)

<sup>104</sup> The history of reprocessing is not good. See, for example:  
<https://www.ucsusa.org/resources/nuclear-reprocessing-dangerous-dirty-and-expensive>  
[http://static1.1.sqspcdn.com/static/f/356082/3578174/1247507286417/top\\_ten\\_talking\\_points\\_on\\_reprocessing\\_envl\\_impacts\\_11202008.pdf?token=mZF46sRecMFHjoij0LvY8wPm7j0%3D](http://static1.1.sqspcdn.com/static/f/356082/3578174/1247507286417/top_ten_talking_points_on_reprocessing_envl_impacts_11202008.pdf?token=mZF46sRecMFHjoij0LvY8wPm7j0%3D)

The French reprocessing company AREVA claims that its method reduces the volume and longevity of the radioactive waste produced by nuclear power reactors. But when you take into account the additional radioactive waste streams created by reprocessing and plutonium recycling, the volume of the long-lived radioactive waste is not reduced. And most of the recycled plutonium is neither destroyed nor reused. Its makeup makes it difficult to use in existing reactors, so AREVA simply stores most of it at the reprocessing plant. Reprocessing as practiced in France amounts to an expensive way to shift France's radioactive waste problem from its reactor sites to the reprocessing plant.

**Dangerous:** Security: Reprocessing is enormously dangerous. The amount of radioactivity in the liquid waste stored at France's reprocessing plant is more than 100 times that released by the Chernobyl accident. That is why France's government set up anti-aircraft missile batteries around its reprocessing plant after the 9/11 attacks.

Leaks: It is also dangerous due to leaks. The biggest experiment in reprocessing was at Sellafield in Britain. In 2005, after decades of contamination and leaks into the ocean, air, and land around the reprocessing plant, Sellafield was shut down because a bigger-than-usual leak of fuel dissolved in nitric acid — some tens of thousands of gallons — was discovered. It contained enough plutonium to make about 20 nuclear bombs. Radioactive leaks are documented around Areva's reprocessing facilities in France.

Nuclear Proliferation: Even more dangerous, however, is the fact that reprocessing provides access to plutonium, a nuclear weapon material. That is why the U.S. turned against it after 1974, the year India used the first plutonium separated with U.S.-provided reprocessing for a nuclear explosion. President Gerald Ford and Henry Kissinger, his secretary of State, managed to intervene before France and Germany sold reprocessing plants to South Korea, Pakistan and Brazil, all of which had secret weapons programs at the time. Japan is the only non-nuclear weapon state that still does today. If the U.S. began to reprocess again, that would legitimize another route to the bomb for nuclear weapon wannabes.

Bob Alvarez, former Department of Energy official and national expert on nuclear issues, summarized in an article he wrote in the Bulletin of Atomic Scientists:

"Reprocessing plants release about 15,000 times more radioactivity into the environment than nuclear power plants and generate wastes with high decay heat. Other efforts to build what is called a "closed fuel cycle," where waste is recycled and reused in reactors have failed for 50 years. Such failure has left about 250 tons of excess plutonium stored at reprocessing plants around the world—enough for some 30,000 nuclear weapons. It's time to accept that a once-through nuclear fuel cycle, where spent fuel is put into permanent geologic storage, is the only sensible option."  
- Bulletin of Atomic Scientists, Bob Alvarez, Advice for the Blue-Ribbon Commission, March 24, 2010.

## **Lessons Learned from Europe's & U.S. Reprocessing**

## **Top Ten Talking Points on Environmental Devastation Caused by Reprocessing High-Level Radioactive Waste**

Compiled by Kevin Kamps, Radioactive Waste Watchdog at Beyond Nuclear For more information: kevin@beyondnuclear.org, www.beyondnuclear.org, (301) 270-2209x1

### **FRANCE**

1. Areva's La Hague reprocessing plant has annually discharged 100,000,000 gallons of radioactive liquid wastes into the English Channel via an underwater pipeline.(1) The sediments at the foot of this pipe would be considered intermediate level radioactive waste under British laws and regulations, requiring deep geologic disposal. Despite this, they are allowed to remain on the seafloor, eroding and carried away by the ocean's currents. Nearby beaches have been closed to public access due to radioactive contamination. Elevated rates of leukemia have been detected in neighboring populations. Radioactivity from La Hague has been detected as far away as waters in the Canadian Arctic.(2) Additionally, in the late 1960s, the French reprocessing plant at Marcoule dumped nearly 50,000 waste barrels into the sea off the coasts of Spain and Brittany.(3)

2. Areva's radioactive gaseous discharges to the atmosphere are even larger than its liquid waste releases. These gaseous discharges include krypton-85 (11-year half-life) and carbon-14 (5,736-year half-life). These radioactive gaseous discharges blow downwind, resulting in global, collective doses to human beings for millennia to come. Taken together, La Hague's liquid and gaseous radioactivity discharges will cause a fatal cancer toll of 3,250 lives over the next 100,000 years.(4)

3. Rather than solve France's radioactive waste dilemma, reprocessing complicates it. Multiple radioactive waste streams are generated, most of which lack permanent, safe, sound disposal solutions. 75% of long-lived intermediate-level radioactive waste resulting from reprocessing, and all long-lived low-level radioactive waste is currently stored under inappropriate conditions. High-level radioactive waste represents less than 1% of total reprocessing waste volume, but risk major releases while in liquid form; 2 nearly a third of high-level radioactive waste are currently stored in such risky forms.(5) Reprocessed uranium stored in the Champagne region of France has begun leaking into the aquifer used to irrigate vineyards in this world-famous region.(6)

4. In the 1990s, many hundreds of high-level radioactive waste shipments to La Hague – one-quarter to one-third of all shipments – involved transport containers that were externally contaminated in excess of "allowable" radiation doses. A large number emitted 500 times more radiation than allowed by law and regulation. One shipment emitted 3,000 times the allowable radiation dose. Such contaminated shipments not only put workers at risk, but also unsuspecting members of the public who came in contact with such shipments.(7)

5. Reprocessing risks to workers – and by extension, the public – seem to be increasing. The French General Confederation of Labor trade union warned in 2007 that "...the request for

drastic cost reductions in reprocessing-recycling, would not be without consequences on safety, security and working conditions.”(8)

#### **UNITED KINGDOM**

6. British reprocessing at Sellafield has discharged 1,000 pounds of plutonium into the Irish Sea. Plutonium has been detected in children’s teeth hundreds of miles downstream, with decreasing concentration over distance, indicating that Sellafield (not global fallout from atmospheric nuclear weapons testing) is the likely culprit.(9)

7. According to a 2001 report published by the European Parliament's Scientific and Technological Options Assessment (STOA), 80% of the collective radiation dose of the entire French nuclear power industry, and 90% of the radioactive emissions and discharges from the British nuclear power program, come from commercial waste reprocessing. The collective radiation dose from 70 years of "routine" (that is, accident- free) operations of the French and British reprocessing plants would be equivalent to the collective radiation dose from the Chernobyl nuclear catastrophe.(10)

#### **UNITED STATES**

8. The West Valley, New York reprocessing plant near Buffalo operated for only six years (from 1966 to 1972) but caused so much radioactive contamination of the surrounding environment that it will cost \$5.2 billion in Year 1996 dollars (\$6.8 billion in Year 2007 3 dollars) to clean up. If not cleaned up, the radioactive contamination on-site will erode into adjacent waterways and flow downstream into Lake Erie and Lake Ontario over the next millennium.(11) During its operations, West Valley had among the highest worker exposures, and worst water contamination, in the U.S. nuclear power industry. West Valley suffered so many accidents (including fires), technical glitches and failures that only one year’s worth of projected reprocessing “throughput” was accomplished in six years of operations.(12)

9. Reprocessing at Hanford, Washington, Idaho National Lab, and Savannah River Site, South Carolina resulted in so much radioactive contamination that it will cost tens to hundreds of billions of dollars to clean up. The U.S. Department of Energy plans on abandoning high-level radioactive waste sludge resulting from reprocessing in underground storage tanks, deeming them too difficult or expensive to remove. But this risks severe radioactive contamination of the Columbia River, Snake River Aquifer, Savannah River, and Tuscaloosa Aquifer. This could make these major rivers and aquifers unfit for human drinking water, and make associated fisheries unfit for human consumption.(13)

10. Reprocessing does not solve or reduce the radioactive waste problem. On the contrary, it complicates it. Reprocessing generates numerous new, difficult to manage radioactive waste streams.(14) Liquid high-level radioactive wastes must be re-solidified into glass logs, a process that has encountered technical difficulties at such sites as Hanford, Washington, leading to

skyrocketing costs.(15) Once vitrified, the high-level radioactive waste glass logs require a deep geologic repository, something no country on Earth has yet opened. Even then, fears persist that the intense radioactivity and thermal heat of the waste will degrade the glass, leading to its release into the environment over time.(16)

### **Should any community build a reprocessing plant and become the next West Valley?**

Remember, too, that the federal agencies in charge (NRC and DOE) have a long and poor track record - not prioritizing public safety, health, and the environment. They will be in charge of reprocessing going forward. Do you expect any difference?

**There is no perfect solution**, but let's focus on what might be realistic and does not: produce numerous additional waste streams that have to be managed; is not exceedingly expensive; is not exceedingly polluting; and. does not increase nuclear waste proliferation.<sup>105</sup>

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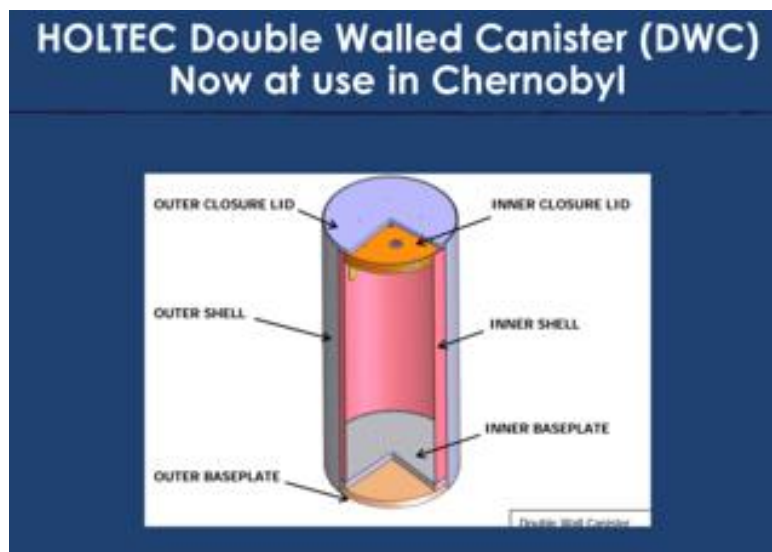
#### <sup>105</sup> **References to top ten:**

- (1) Arjun Makhijani, Carbon-Free, Nuclear-Free: A Roadmap for U.S. Energy Policy Michigan book tour, October 3-4, 2008.
- (2) Kevin Kamps, "Muddying the Waters: COGEMA's Hidden Environmental Crimes," NIRS Nuclear Monitor newsletter, March-April 2000, viewable at <http://www.nirs.org/mononline/cogemamonitor.htm>; see also "Leukemia near La Hague, France" in Annie Makhijani, Linda Gunter, and Arjun Makhijani, COGEMA: Above the Law? Concerns about the French Parent Company of a U.S. Corporation 4 Set to Process Plutonium in South Carolina, Institute for Energy and Environmental Research and Safe Energy Communication Council, May 7, 2002, viewable at [www.beyondnuclear.org](http://www.beyondnuclear.org) under "The French Connection" section.
- (3) Mycle Schneider and Yves Marignac, "Spent Nuclear Fuel Reprocessing in France," International Panel on Fissile Materials, April 2008, viewable at [http://www.fissilematerials.org/ipfm/site\\_down/rr04.pdf](http://www.fissilematerials.org/ipfm/site_down/rr04.pdf)
- (4) Ibid.
- (5) Ibid.
- (6) Shaun Burnie, "French Nuclear Reprocessing – Failure at Home, Coup d'Etat in the United States," May 2007, viewable at: <http://www.citizen.org/documents/Burnie%20paper%20on%20French%20reprocessing.pdf>
- (7) Mycle Schneider, "Transport Special," Plutonium Investigation No. 6/7, June 1998, viewable at <http://www.wise-paris.org/> under "Bulletins."
- (8) Mycle Schneider and Yves Marignac, "Spent Nuclear Fuel Reprocessing in France," International Panel on Fissile Materials, April 2008, viewable at [http://www.fissilematerials.org/ipfm/site\\_down/rr04.pdf](http://www.fissilematerials.org/ipfm/site_down/rr04.pdf)
- (9) "Plutonium in Children's Teeth," Cumbrians Opposed to a Radioactive Environment press release, Dec. 11, 2003, <http://www.corecumbria.co.uk/>.
- (10) Mycle Schneider, Xavier Coeytaux, Yacine B. Faid, Ian Fairlie, David Lowry, Yves Marignac, Emmanuel Rouy, David Sumner, Gordon Thompson, "Possible toxic effects from the nuclear reprocessing plants at Sellafield (UK) and Cap de La Hague (France)," STOA Report, European Parliament, November 2001, viewable at [www.wise-paris.org/english/reports/STOAFinalStudyEN.pdf](http://www.wise-paris.org/english/reports/STOAFinalStudyEN.pdf).
- (11) Table 5-9, "Summary of Closure Costs for Implementing Alternative I (Removal)," pg. 5-35, U.S. Department of Energy and New York State Energy Research and Development Authority, Draft Environmental Impact Statement for Completion of the West Valley Demonstration Project and Closure or Long-Term Management of Facilities at the Western New York Nuclear Service Center, January 1996.
- (12) Diane D'Arrigo, Radioactive Waste Project Director, Nuclear Information and Resource Service, November, 2008. See <http://www.nirs.org/radwaste/decommissioning/decommissioninghome.htm>.
- (13) See, for example, Arjun Makhijani and Michele Boyd, "Nuclear Dumps by the Riverside: Threats to the Savannah River from Radioactive Contamination at the Savannah River Site (SRS)," Institute for Energy and Environmental

Long term, we must look for and develop a scientifically sound deep geological repository or repositories based on consent-based siting. In the short term, there are ways to reduce the risks of on-site dry cask storage.

## Safer Cask Designs and Storage

**Double Walled Canisters.** Holtec Double Walled Canisters are now in use at Chernobyl. Holtec says that this design is far less likely to fail as the result of corrosion than are the canisters now at Pilgrim. An interesting admission by Holtec that Pilgrim's canisters may be likely to fail.



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Research, 2004, viewable at <http://www.ieer.org/pubs/index.html> under "IEER Technical Reports"; see also "Danger Lurks Below: The Threat to Major Water Supplies from US 5 Department of Energy Nuclear Weapons Plants," Alliance for Nuclear Accountability, viewable at

<http://www.ananuclear.org/Issues/EnvironmentalCleanup/tabid/76/Default.aspx>

(14) See Chapter VI., Waste Generation, and Figure 3, "Waste and materials generated in the nuclear fuel chain," in Mycle Schneider and Yves Marignac, "Spent Nuclear Fuel Reprocessing in France," International Panel on Fissile Materials, April 2008, viewable at [http://www.fissilematerials.org/ipfm/site\\_down/rr04.pdf](http://www.fissilematerials.org/ipfm/site_down/rr04.pdf). See also the Center for Arms Control and Non-Proliferation's "Graph Representing Department of Energy/Argonne National Laboratory's proposal for reprocessing and transmuting nuclear waste as part of the Global Nuclear Energy Partnership (2007 iteration), viewable at [http://www.beyondnuclear.org/High-Level\\_Radioactive\\_W.html](http://www.beyondnuclear.org/High-Level_Radioactive_W.html)

(15) Lesley Stahl, "Lethal and Leaking," 60 Minutes, CBS News, April 30, 2006, viewable at [http://www.cbsnews.com/video/watch/?id=1561703n%3fsource=search\\_video](http://www.cbsnews.com/video/watch/?id=1561703n%3fsource=search_video)

(16) Arjun Makhijani, Glass in the Rocks: Some Issues Concerning the Disposal of Radioactive Borosilicate Glass in a Yucca Mountain Repository," Takoma Park, MD: IEER, Jan. 29, 1991.

## Holtec's "New" Double Walled Canisters (DWC)

Holtec HTB-020 bulletins describe a DWC (total wall thickness about 0.4 to 2 inches – (US Patent 10,026,514) that, according to Holtec, "offers several crucial operational advantages over a single wall multi-purpose canister" such as those at Pilgrim, including:

- Completely isolating the inner shell (the only shell in Pilgrim's multi-purpose canisters (MPC's) from the environment;
- Minimizing the potential for corrosion of the exterior vessel exposed to the environment; and
- Preventing release to the environment even if there is through-wall cracking of the exterior vessel.

Holtec says that "any current MPC user can switch to the DWC design without incurring a significant switching cost."

Will Holtec use DWC canisters with "crucial operational advantages" at Pilgrim as soon as they have been licensed by the NRC?

**DWC Downsides:** They are buried; excepting the very top; they cannot be inspected. Water can fill the cavity. This is a problem at San Onofre. The casks are located beside the ocean- especially vulnerable to climate change.

**Switch to thick walled casks, like those used in much of Europe.** Even though the thick-walled CASTOR casks are vulnerable to anti-tank weapons, and weapons technology has improved since the 1998 test described in <http://archives.nirs.us/factsheets/nirsfctshdrycaskvulnerable.pdf>, thick walled casks present several advantages relative to those use at Pilgrim.

## Ten reasons to use thick nuclear waste storage casks

| Safety Features                      | Thin canisters | Thick casks |
|--------------------------------------|----------------|-------------|
| 1. Thick walls                       | 1/2"- 5/8"     | 10"- 19.75" |
| 2. Won't crack                       |                | ✓           |
| 3. Ability to repair, replace seals  |                | ✓           |
| 4. Ability to inspect (inside & out) |                | ✓           |
| 5. Monitor system prevents leaks     |                | ✓           |
| 6. ASME container certification      |                | ✓           |
| 7. Defense in depth (redundancy)     |                | ✓           |
| 8. Store in concrete building        |                | ✓           |
| 9. Gamma & neutron protection        | Need overpack  | ✓           |
| 10. Transportable w/o add'l cask     |                | ✓           |
| Market leader                        | U.S.           | World       |



CASTOR - Type N10 cask

SanOnofreSafety.org

**Store casks in reinforced buildings or surround each cask with an earthen berm, a dirt-cheap solution.**

The arrangement below is being used to store Holtec casks at San Onofre, and is what Holtec plans to use at its proposed interim storage facility



### Swiss Zwilag Interim Facility exceed US Safety Standards - Example<sup>106</sup>

Safety Standards: The [Swiss Zwilag interim nuclear waste dry storage facility](#) meets much higher safety standards than US nuclear waste dry storage systems. The US NRC ignores its own safety regulations, US ASME N3 safety codes and other US safety requirements in order to approve inferior thin-wall canisters that cannot be monitored or maintained to prevent [major radiological releases](#). Switzerland and most countries use safer thick-wall casks that meet US and other safety requirements.

[Hot cell facilities needed](#) in US: Zwilag has an on-site hot cell facility (dry transfer system) for inspection, maintenance and for repackaging fuel assemblies to new casks, as needed. [Watch hot cell video](#). The US has [no hot cells](#) large enough or designed to inspect, maintain, or repack fuel assemblies to new casks. The last US hot cell facility large enough to repack large nuclear waste storage containers, the Idaho National Lab Test Area North Hot Cell Facility (TAN), was [destroyed](#) in 2007.

Storage buildings for environmental and security protection: Zwilag stores nuclear fuel waste casks in hardened buildings for additional environmental and security protection. With 24 hour remote continuous monitoring systems of various types, they can identify and fix problems BEFORE radioactive releases. [Watch cask storage hall video](#). The US stores cask and canister systems are stored outdoors at existing nuclear waste generating stations in what are called Independent Spent Fuel Storage Installations (ISFSIs). Many of these outdoor sites are located in areas vulnerable to numerous environmental and security risks.

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<sup>106</sup> <https://sanonofresafety.org/swiss/>

Onsite Storage: Rolling Stewardship-Proposal from Dr. Gordon Edwards, a Canadian nuclear scientist.<sup>107</sup>

## PROPOSAL:

A new nuclear waste policy **based on frankness**.

We begin by admitting we have at present **no proven solution**.

One alternative to abandonment is **Rolling Stewardship**.

Wastes are monitored and retrievable **for the foreseeable future**.

Wastes are packaged safely for extended periods & **repackaged later**.

This is not a solution – it is only **an ethical waste management scheme**.

Rolling Stewardship is needed **until a “genuine solution” is found**.

The production of additional wastes can/should be **phased out**.

## Recap: Chernobyl-Type Disaster in Each Canister - Each contains half as much Cesium - 137 as the total released at Chernobyl

- ▶ Short term crack and leak risk in thin-wall stainless steel canisters from environmental and other conditions
- ▶ Criticality risk, for example if unborated water enters canister.
- ▶ No analysis of cask/pad integrity using Pilgrim's updated earthquake risk.
- ▶ No workable plan to prevent or stop leaks, explosions or criticalities in Pilgrim's thin-wall canisters.

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<sup>107</sup> Nuclear Wastes - Out of Sight, Out of Mind (video, 29m) <https://youtu.be/s6xbvOqkpEk>

## SITE CLEANUP

**How Clean is Pilgrim**

**Holtec assumes that the Pilgrim site is “clean,” but -**

- Pilgrim has a long history of contamination.
- Holtec has not characterized the site to identify and quantify radiological and hazardous waste.
- Holtec’s planned site restoration costs (\$40.1 M) include only the “costs associated with conventional dismantling, demolition and removal from the site of structures and systems.” Does not mention soil.

**The Attorney General and Pilgrim Watch know that the site is not clean.**

- Contaminated radiological and hazardous materials have been buried on site.
- There is a serious risk that contaminated materials will flow into Cape Cod Bay and the Plymouth Aquifer.

The bottom line here is clear: The Pilgrim site must be cleaned up and, so far as possible, be restored to its pre-nuclear power plant condition. This must be done not only to ensure that the site will meet the Commonwealth’s residual radiation standard after it is released by the NRC, but also to ensure that decommissioning is accomplished in a way that minimizes the release of radiological and hazardous materials to ensure that the health and safety of the public will be protected.

Holtec hired ERM to perform an Initial environmental Site Assessment Plan <https://www.mass.gov/doc/initial-erm-assessment-work-plan-10-14-20/download> and subsequently an Amended Initial Environmental Site Assessment Work Plan Pilgrim Nuclear Power Station 28 May 2021 Project No.: 0552 (<https://www.mass.gov/doc/may-28-2021-environmental-site-assessment-work-plan-for-pilgrim/download> )

DEP and DPH reviewed the latest Site Assessment Plan and submitted its review to the Attorney General’s Office. The Attorney General has not signed off on the plan, as of January 31 2025.

Despite not having a state approved plan, Holtec continues to work on the site’s cleanup. The state rationalizes this process, act before approval, saying if a portion of the plan does not meet the standards in the Settlement Agreement, Holtec can redo the work- risking unnecessary depletion of DTF. We believe this is backwards.

Neither the initial nor the amended plan met the specific requirements of the Settlement Agreement between the Commonwealth and Holtec, the requirements spelled out in paragraphs 11 and 12.

The Amended Work Plan largely consisted of about 3000 pages detailing the work that has been done to date; only a small part refers to what additional characterization may be done in the future. The report's "rosy" and we suspect insufficient conclusions reflect reliance on the licensee's historical record; the licensee's own environmental reports; an assumption that contamination is likely to be found only immediately around the power block area; and limiting contaminants of concern.

### **Background- earlier reports & assumptions**

Holtec, when it prepared its site restoration estimates in its Post Shutdown Decommissioning Activities Report (PSDAR), admitted that *it did not know* what radiological and hazardous waste actually exists on Pilgrim's site. (Holtec PSDAR 8-11; DCE pg., 14). Instead, it made the incorrect assumption, based on outdated and incomplete historical data, that there is "no significant contamination" on the Pilgrim site (Decommissioning Cost Estimate, p. 22); and its estimated \$40 million site restoration cost included only, "those costs associated with conventional dismantling, demolition, and removal from the site of structures and systems." (PSDAR, p 19).

Pilgrim Watch and the Commonwealth know that there is "significant contamination" on the Pilgrim site, and that site restoration will require far more.<sup>108</sup>

Pilgrim opened with bad fuel and no off-gas treatment system. Later, it blew its filters prompting Mass Dept. Public Health to do a case-control study of adult leukemia, confirming that the closer you lived or worked at Pilgrim the greater the increase in leukemia.

Radionuclides, including for example tritium, manganese, cesium-137, Sr-90, I-131, cobalt-60, Plutonium, and neptunium were found offsite, and also in the surface water, groundwater, and soils at Pilgrim at levels exceeding "background" levels; monitoring wells placed onsite from 2007 forward show consistent levels of radiological contamination-contamination not yet removed. The base of the torus is cracked; other structures, pipes and tanks containing or carrying radioactivity or hazardous material also may have cracked or may do so. Hazardous waste was illegally buried onsite. See Pilgrim Watch Motion to Intervene, pp 36-46.

Experience at other decommissioned reactors showed significant cost increases from "unknown" contamination discovered only later. At Connecticut Yankee, for example, previously undiscovered strontium-90 contributed to the actual cost of decommissioning Connecticut Yankee being *double* what had been estimated. Connecticut ratepayers had to pay a \$480 million shortfall for cleanup of CT Yankee.<sup>109</sup> During the decommissioning of Maine Yankee, the licensee encountered pockets of highly contaminated groundwater dammed up by existing structures, leading to cost increases. The Yankee Rowe site in Massachusetts incurred significant cost

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<sup>108</sup> Pilgrim Watch Petition to Intervene & Request for Hearing, NRC Electronic Library, Adams, Accession Number ML19051A019; Commonwealth Petition to Intervene & Request for Hearing, NRC Electronic Library, Adams, Accession Number ML19051A114

<sup>109</sup> Hartford Current, November 12, 2005

<http://www.courant.com/news/local/hccynukemess.artnov12,0,6222764.story?col l=hc-headlines-home>

increases during decommissioning when PCBs were discovered in paint covering the steel from the vapor container that housed the nuclear reactor, as well as in sheathing on underground cables. Other plants have also ended up costing much more than what was estimated for decommissioning- Diablo Canyon 1&2, San Onofre 2&3.<sup>110</sup>

At this point in time, no one knows how much hazardous waste and radiological contamination must be removed from the Pilgrim site, or what the actual cost of removing it will be. However, three things are clear – the site is contaminated, there is no money in the DTF to pay to remove it, what the costs will be, and unless these contaminants are properly removed they will end up in Cape Cod Bay and perhaps the Plymouth-Carver Aquifer underneath the site.

The primary goals of site clean-up and restoration are protecting the environment and to making it possible to return the site for unrestricted use. Many radioactive and chemical contaminants will persist for thousands of years. Specific priorities to help ensure that this goal is achieved include the following.

1. Radiological Clean-Up Standard
2. Dose Assessment
3. Early Site Assessment
4. Site Clean-Up and Restoration
5. Interim Inspection and Sampling
6. Environmental Monitoring
7. License Termination Plan and Final Status Survey Report

## **Radiological Cleanup Standard**

**The NRC radiological cleanup standard** is 25 millirem/year for unrestricted use sites and 100-500 millirem/year for restricted use sites. It is based on outdated research on the health effects from exposure to radiation; more recent research from the National Academies of Sciences Biological Effects of Ionizing Radiation Report,<sup>111</sup> (BEIR VII) found health impacts to be more serious.

**In April of 2018, the Commonwealth proposed a more conservative standard** to Entergy and Holtec. It said that the maximum residual radiation level, distinguishable from background radiation, should be as low as reasonably achievable and should result in a total effective dose equivalent that is less than 10 mrem/year and less than 4 millirem/year for drinking water sources of groundwater, and that the standard should apply to each portion of the site, rather than being an average over the site.

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<sup>110</sup> See, e.g., NRC, SECY-13-0105, at Summary Table, available at <http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2013/213-0105scy.pdf>.

<sup>111</sup> <https://www.nap.edu/catalog/11340/health-risks-from-exposure-to-low-levels-of-ionizing-radiation>

Both Entergy and Holtec then refused to sign. However, a residual radiation standard is part of the June 2020 Settlement Agreement, as discussed below. In its Press Release, Holtec said that a major highlight of the agreement was Holtec’s “Commitment to meeting Commonwealth’s radiological standard of 10 millirem for all pathways, which is 40% of the Federal standard of 25 millirem.”<sup>112</sup>

How much residual radiation remains on Pilgrim’s site, in Cape Cod Bay, and in the Plymouth-Carver aquifer will have a major effect on public health, principally the risk of cancer.

The following table, based on the latest National Academies Biological Effects of Ionizing Radiation Report (BEIR VII), shows the difference in health impact between NRC’s standard and the Commonwealth’s.

# Cleanup Standards and Health Effects

| Lifetime Exposure (millirem/year)                                                                                                     |     | 70 year Risk of Developing Any Cancer                                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Current MA limit for <u>Unrestricted Use</u> for its licensees. <u>Does not Apply to Pilgrim, an NRC licensee</u>                     | 10  | 70/100,000 (0.7/1,000)                                                                                                                                                                                                   |
| NRC Limit for <u>Unrestricted Use</u>                                                                                                 | 25  | 175/100,000 (1.75/1,000)                                                                                                                                                                                                 |
| NRC Limit for <u>Restricted Use</u>                                                                                                   | 100 | 700/100,000 (7/1,000)                                                                                                                                                                                                    |
| NRC Limit for <u>Restricted Use</u>                                                                                                   | 500 | 3,500/100,000 (35/1,000)                                                                                                                                                                                                 |
| Risk of <u>Fatal</u> Cancer is one half to two thirds the risk of developing <u>any</u> cancer.                                       |     | Reproductive disorders occur at lower levels of radiation exposure than cancer.                                                                                                                                          |
| The level of risk for radionuclides is significantly higher than the allowed risk for chemicals.                                      |     | DEP's risk level goal for a mixture of <u>chemicals</u> is a lifetime cancer incidence risk of <u>1 in 100,000</u> . DEP risk level goal for one chemical is a lifetime cancer incidence risk of <u>1 in a million</u> . |
| DPH Proposed Radiological Clean-Up Standard:<br>All pathways - <10 mrem/year<br>Ground water sources of drinking water- < 4 mrem/year |     |                                                                                                                                                                                                                          |

A residual radioactivity standard of < 10 ml/rem and < 4 ml/rem is not radical. Indeed, it is far less protective of public health than is EPA and DEPs standard for chemicals. EPA’s and DEP’s risk level goal for a **mixture of chemicals** is a lifetime cancer incidence risk of **1 in one hundred thousand (1/100,000)**. DEP’s risk level goal for **one chemical** is lifetime cancer incidence risk of **1 in a million (1/1,000,000)**. Also, Lifetime Cancer Risk estimates based on BEIR VII are much higher. The Table, based on BEIR VII’s conclusion that “the BEIR VII lifetime risk model predicts that approximately **1 person in 100 would be expected to develop cancer (solid cancer or leukemia) from a dose of 0.1 Sv [10,000 millirem] above background**” (BEIR VII, p. 8) shows the risk from a lifetime (70 year) exposure to various levels of radiation.

Because Holtec would not sign an agreement with DPH when it was first proposed, we suggested that Massachusetts (or any state) should issue a regulation establishing a standard more conservative than NRC’s, to become effective only after the effected site is released by NRC. After

<sup>112</sup> The Settlement Agreement does not include the < 4 ml/rem/year for drinking water sources of ground water, apparently because this is required by current EPA regulations. However, these regulations, and the groundwater <4 ml/rem standard, could change depending on the Administration in DC.

the NRC releases a site, there can be no preemption. The NRC's Frequently Asked Questions About Decommissioning make it quite clear that, after the NRC has terminated Pilgrim's operating license and released Pilgrim's site, the NRC no longer has any authority over the released site or any right to control what is done with the released site.

Both Maine and New Jersey require that the residual radioactivity at a site that has been decommissioned and is no longer licensed be lower than 25 millirems/year. Maine law says the residual radioactivity of a decommissioned plant cannot be more than 10 millirems per year; New Jersey requires that a site be remediated to less than 15 millirems per year once it is decommissioned. Massachusetts Department of Public Health has a <10 millirem/year standard for radioactive material users it regulates, such as hospitals and labs.

A less than 10 ml/rem/year standard is indeed technologically feasible. NRC's Bruce Watson, Chief of the Reactor Decommissioning, informed us on January 3, 2018, that "Since (he) was involved with the 7 power reactors to various degrees that had their licenses terminated since 1997, the final residual activity was typically a small fraction of the unrestricted release criteria, a few mrem per year with some that I am more familiar with ended at ~1 to 3 mrem per year."

### **Commonwealth Settlement**

Section III Site Restoration and Environmental Requirements and Reporting, Paragraph 10(d), is directed at "addressing radiological contamination at the Site."

Paragraph 10(d)(1) says that, at the time of partial site release,

"Holtec shall ... demonstrate compliance, or progress toward compliance, with 105 C.M.R. § 120.245, the Massachusetts radiological standard for unrestricted use of <10 millirem per year for all pathways, and reduction of residual radioactivity to levels that are otherwise as low as reasonably achievable ("ALARA");"<sup>113</sup>

Paragraph 10(d)(2) allows Holtec to delay compliance with the Massachusetts standard for at least five years after Partial Site release "subject to DPH approval, which shall not be unreasonably withheld;" and Para.10(d)(3) allows the time for compliance to be further "extended by mutual agreement, which shall not be unreasonably withheld by DPH, for a reasonable period of time in the event of unforeseen conditions or circumstances beyond Holtec's control.

The Settlement does not set a hard date by which Holtec must meet the Massachusetts standard.

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<sup>113</sup> The Settlement Agreement does not include the < 4 ml/rem/year for drinking water sources of ground water, apparently because this is required by current EPA regulations. However, these regulations, and the groundwater <4 ml/rem standard, could change depending on the Administration in DC.

## Dose Assessment

No matter what the standard, it will be protective of public health and safety only if conservative models are used to assess dose. Dose should be determined using the Resident Farmer Scenario and Basement Inventory Model.

### Resident Farmer Scenario

The dose assessment to determine compliance with the standard should be based on the “Resident Farmer Scenario”- the most conservative method used and the one followed, for example, by Maine Yankee, Yankee Atomic, Connecticut Yankee, Humboldt, and Trojan. NorthStar agreed on the resident farmer model for Vermont Yankee. Also, the NRC uses the Resident Farmer Scenario in assessing doses.

A July 8, 2005, NRC slide presentation (ML051860189) said that the “ultimate goal of dose modeling is to estimate the dose to a specific reactor,” and there are several potential scenarios.



*United States Nuclear Regulatory Commission*

### Resident Farmer Scenario

- Used for residual radioactivity in soils and sediments
- Key Assumptions:
  - Large portion of diet grown on the site
  - Individual spends portion of time both indoors and outdoors
- Pathways include:
  - external exposure from soil
  - inhalation to (re)suspended soil
  - ingestion of soil
  - ingestion of drinking water from aquifer
  - ingestion of plant products grown in contaminated soil and using aquifer to supply irrigation needs
  - ingestion of animal products grown onsite (using feed and water derived from potentially contaminated sources)
  - ingestion of fish from a pond filled with water from the aquifer

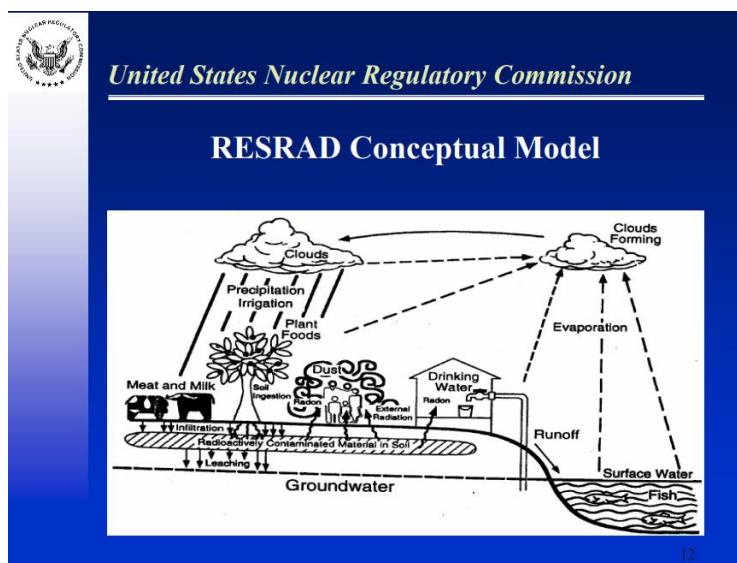
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The Resident Farmer. The NRC presentation explained that a principal difference between the two and another possible scenario, Building Occupancy, is that the latter is “used for residual radioactivity on indoor building surfaces.”

A 2012 NRC Safety Evaluation Report (ML12314A076) was clear that one important aspect of a scenario is whether “it considers the potential routes of exposures of the critical group.”

The pathways considered by the Resident Farmer Scenario “cover all the potential routes of exposures” ([ML051860189 - Dose Assessment for Decommissioning.](#)) “Because the exposure

pathways considered for the resident farmer scenario cover all the likely routes of exposures, it is unlikely that any other set of reasonably plausible human activities postulated for the site would result in a dose exceeding that calculated for the hypothetical farmer.” (NRC Adams Library Accession No. ML051430520). Potential exposure pathways relevant to a site such as Pilgrim are shown in the following slide.



The NRC’s 2012 Safety Evaluation Report noted that “the use of the Resident Farmer Scenario is consistent with the NRC guidance in NUREG-1757 and NUREG/CR-5512, Residual Radioactive Contamination from Decommissioning, Technical Basis for Translating Contamination Levels to Annual Total Effective Dose Equivalent.

### Basement Inventory Model

The basement inventory model also should be used to calculate dose, in particular to determine the amount of residual radioactivity that remains in any remaining below-grade structures or building materials that will be used as backfill. What remains below grade must be “cleaned” to remove radioactivity to the agreed radiological standard before the hole is filled with dirt, cement or whatever. The lion’s share of the volume of the filled basement will be the clean fill. If the fill can be part of the dose average it will “water- down” the reading. In the basement inventory model, the fill cannot be counted in the calculation of dose.

### Commonwealth Settlement:

Section III Site Restoration and Environmental Requirements and Reporting, Para. 10(d)(5), is directed to dose models. It says:

“To demonstrate compliance with Paragraph 10(d), Holtec shall use ... the “resident farmer scenario” and “basement inventory model” to model the potential exposure to residual radioactivity in all pathways.”

However, para. 10(d)(5) also says that **Holtec does not need to use the conservative “resident farmer scenario” or “basement inventory model”** if “the Parties ... mutually agree to an alternative standard for modeling if an approved future reuse supports the use of such an alternative standard.” What more permissive models might be substituted or what such an “approved future reuse” might be are nowhere explained.

Para. 10(d)(4) says “Holtec shall not sell, transfer, and/or lease control, use, or ownership of or over the Site prior to compliance with the terms of Paragraph 10(b).” We would expect Holtec to say that it has complied with Paragraph 10(d) long before the Commonwealth would agree that they have. Exactly what is required for “compliance with the terms of Paragraph 10(d)” is much less clear that we would have hoped.

### **Early Site Assessment**

Until and unless Holtec conducts a thorough and complete characterization of the Pilgrim site, neither it nor anyone else will know what radiological and hazardous contamination is on site, how that contamination will be remediated, and what the actual costs will be.

The Pilgrim site will not be properly cleaned up and restored *unless*:

- a. Holtec completes a thorough early assessment of the Pilgrim site for the impacts of climate change on Pilgrim’s site (sea level rise, severe storms coinciding with high tides and exceptional wave heights, rising groundwater tables, flooding, and increased acidity contributing to corrosion of any underground structures); and an assessment of radiological materials and non-radioactive hazardous materials in 2020. Without such assessments, Holtec cannot accurately plan, or estimate the costs of decommissioning.
- b. Holtec provides the Commonwealth with protocols for its review of climate change impacts and radioactive and hazardous waste assessments and will give the Commonwealth the opportunity to provide comments with respect to the protocol.
- c. The Commonwealth is given access to the site and the opportunity to take and analyze samples and make observations.
- d. Within 30 days following completion of the assessment, Holtec gives the Commonwealth a detailed report of the results of the assessments, including all data and other information learned during or as a result of the assessments.

### **Commonwealth Settlement**

Paragraph 11 of the Settlement Agreement is directed to “plans.” It requires Holtec to “submit to DEP and DPH for their review and approval the Initial Pilgrim Environmental Site Assessment work plan prepared by the LSP (Licensed Site Professional) retained in accordance with Paragraph 10(b)” that “is consistent with recommendations contained in the HSA.” In addition to a “description” of how Holtec would characterize and remove structures “necessary for Partial Site Release, Par. 11 also says that the work plan must include nine (9) “proposed” lists, plans and

schedules. Exactly what the plans, and particularly any approved revised work plan, will require is nowhere stated.

Paragraph 12 requires Holtec to “meet and confer with DEP and DPH to discuss the terms of the work plan and a reasonable schedule for conducting the Initial Pilgrim Environmental Site Assessment.”

However, Paragraph 10(a) of the Agreement limits the information that Holtec must provide the Commonwealth to “documents referenced in section 10 of the Historical Site Assessment for Pilgrim dated December 8, 2018 (“HSA”) and any other document related to radiological and non-radiological contamination at the Site that it or Holtec International possess or may come to possess through a request to Entergy within the sixty-day (60) period.

There is no requirement to give the Commonwealth documents written prior to deregulation when Pilgrim was operated by BECO and had significant radiological releases. Neither is there anything to indicate that the site assessment will encompass the radiological and hazardous waste issues specifically identified in the Commonwealth’s or Pilgrim Watch’s Petitions to intervene. At the June 22, 2020, NDCAP meeting, Patrick O’Brien of CDI refused to say that Holtec would look at any of them.

We remain concerned that Holtec’s site assessment will be inadequate, and that it will be carefully designed to ensure that as little contamination as possible is found that requires remediation. The only Site Restoration costs that Holtec’s PSDAR foresaw “are those costs associated with conventional dismantling, demolition, and removal from the site of structures and systems after confirmation that radioactive contaminants have been removed.” We have seen nothing to indicate that Holtec intends to look at anything else.

**Example- the “Donut Hole.”** Numerous sources have reported that drums of hazardous waste were buried on the Pilgrim site in the 1980s and/or 1990s. Barrels of chemical waste were reportedly shipped from New Jersey and were buried along the Powerhouse Road, that runs between Rocky Hill Road and Route 3A; and then overplanted with evergreen trees. The trees subsequently died. Google Earth shows the site and absent trees it looks like a hole in the landscape-hence the name “donut hole.” Holtec’s Licensed Site Contractor placed monitoring wells east of the donut hole; Holtec then explained to NDCAP that the wells showed no releases from that site, concluding no problem. Wrong. The fact the monitoring wells were “clean” likely showed that any barrels or containers of waste had not been breached and then migrated to the monitoring wells. It did not show the waste was not buried there. The Town of Plymouth hopes to be given or buy the land from Rocky Hill Road to Route 3A. It is in the town’s interest to ensure the property is clean. Lesson learned- improper testing of that site provides little confidence in tests of other sites on the property.

## Site Clean-Up and Restoration

To ensure the essential clean-up and restoration, Holtec should enter into written agreements to do what is listed in items a-k below, all of which were **agreed to by NorthStar in Vermont**. If Holtec does not agree, the Commonwealth should require that Holtec (or as applicable to any future owner of the Pilgrim site or any portion thereof, comply with all of these requirements before any released portion of the Pilgrim site is used for any purpose, or is sold, leased, or otherwise transferred to any third party.

- a. All decommissioning and spent fuel storage activities conducted at the Pilgrim site must comply with all applicable state environmental and human-health based laws, standards, and regulations.
- b. Holtec must provide the Commonwealth and Nuclear Decommissioning Citizens Advisory Panel (NDCAP) with the following:
  - An identification and description of historical uses of all below grade structures, including all materials known or suspected to be generated, stored, contained, spilled, released, or disposed of in each structure.
  - A description of any process that has been or will be used to characterize each below grade structure, including all steps that have been or will be taken to remove and manage all materials generated, stored, contained, spilled, released, or disposed of in each below-grade structure; and
  - A description of any process that has been or will be used to characterize soil and groundwater near each below-grade structure.
- c. Holtec must provide the Commonwealth and NDCAP with:
  - A detailed description of all concrete used or proposed to be used as fill material, including:
    - identification of the structures from which the concrete will be obtained
    - identification of any paints and other coatings on the structures; and
    - a description of all non-radiological wastes or materials that have been stored in each of the structures, any non-radiological wastes or materials which have contaminated the structures, and any wastes or materials which have been discharged from the structures.
  - Holtec must provide a detailed description of how the concrete material will be processed and managed on site, including:
  - Holtec must provide a detailed description of how concrete materials will be processed (removal of rebar and other reinforcing materials), and resulting size specifications of resulting aggregate material; and
  - Holtec must provide a detailed description of the total volume of crushed aggregate material to be used as fill (expressed in cubic yards).

- Holtec must provide a detailed Identification of the specific location(s) at the site where concrete will be managed and used as fill. This shall include, at a minimum, a site map (minimum dimensions of 8½" by 11") that identifies: the location(s) on site where concrete fill material will be stockpiled; the locations(s) on site where the fill material will be disposed of; the waste management boundary of the disposal site(s); and any other siting information required by the Commonwealth.
  - Holtec must provide a detailed schedule of all activities undertaken or proposed to be undertaken under the plan (including characterization, demolition, on-site management, and filing activities).
  - Holtec must provide a characterization of all concrete used or proposed to be used as fill on site that includes, at a minimum, the following:
  - Holtec must provide a list of all non-radiological contaminants for which the concrete from each structure will be characterized; and
  - Holtec must provide a detailed description of the specific sampling and analysis methods and processes that will be used to characterize the concrete from each structure (including all coatings or paints) for non-radiological contaminants.
  - Holtec must provide a proposed plan for the use of any off-site materials proposed as fill on site, such a plan to include a plan to characterize any such off-site materials that includes, at a minimum, the following:
    - a list of all non-radiological contaminants for which the offsite materials will be characterized; and
    - specific sampling and analysis methods and processes that will be used to characterize the off-site materials.
- d. All underground structures at Pilgrim—including building foundations, buried piping, and contained piping<sup>114</sup>— must be removed to a depth of 3 feet below ground surface ("ground surface" means existing site contours, which are depicted in the most recent site map) and to a greater depth wherever required to meet the Commonwealth's residual radiation standards.
- e. All pipes and other spaces with void space that are 3 feet or more below ground surface and are to be left in place must be filled with concrete or other material as necessary to ensure stability of the ground above.<sup>115</sup>
- f. All regulated substances from pipes and other structures are managed in accordance with applicable standards, and that all sheathed cables with PCB coatings must be excavated and managed and disposed of in accordance with the Commonwealth's Hazardous Waste Management Regulations and other applicable standards.

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<sup>114</sup> "Buried piping" means piping that is underground and in direct contact with the ground/soil; "contained piping" means piping that is underground but within some other structure and thus not in direct contact with the ground/soil.

<sup>115</sup> In the case of a pipe the top portion of which is above the 4-foot cut-off, and the bottom portion of which is deeper than the 4-foot cut-off, the licensee shall remove the portion that is above the 4-foot cut-off and shall be permitted to leave in place the portion that is deeper than the 4-foot cut-off.

- g. All asbestos-containing material must be removed, regardless of depth.
- h. No concrete or other materials from buildings or structures on the Pilgrim Station site can be used as fill at the Pilgrim Station site, with the exception that concrete from the Pilgrim Station can be used as fill if: (1) it contains no reactor-derived radionuclides as distinguishable from background for the Pilgrim Station site pursuant to the material characterization process employed at the Yankee Rowe Nuclear Power Station for onsite reuse of backfill material; and (2) any non-radiological contamination in that concrete does not exceed background soil concentrations, or site-specific background concentrations approved by DEP.
- i. Any sub-surface soil excavated as part of demolition can be used at Pilgrim only to the extent that it complies with Commonwealth radiological and non-radiological standards.
- j. Structures more than 3 feet below ground level can remain in place only if:
  - o No residual radioactivity in the structures exceeds the Commonwealth's residual radioactivity standards.
  - o No non-radiological contamination in the structures exceeds the approved non-radiological remediation standards set forth by the Commonwealth or other site-specific remediation standard approved by DEP; and
  - o Results of characterization of soil and groundwater in proximity of the structures do not exceed non-radiological remediation standards.
  - o Buried piping and enclosed structural chambers that are more than 3 feet below ground surface remain in place only after a survey demonstrates that any radiological contamination on the inner surfaces of such pipes and structures does not exceed the Derived Concentration Guideline Levels for < 10 mrem/year from all pathways combined and <4 for all drinking water sources ground water.
- k. Upon completion of decommissioning and site restoration of the Pilgrim Station site, Holtec must provide MDPH, DEP, NDCAP and the Town of Plymouth with a comprehensive survey and site plan identifying the location and depth of all below-grade structures remaining at the site and confirming that every remaining subsurface structure meets the release criteria described in this section. Holtec will record the comprehensive survey and site plan in the land records of the Town of Plymouth and will erect field monumentation on the Pilgrim Station site to provide notice of all remaining below-grade structures in a manner that does not impede future use of the site.

### **Commonwealth Settlement**

Paragraph 10 says that the Commonwealth and Holtec “agree that the site restoration standards and requirements identified below shall apply to the Pilgrim Site.” These “standards and requirements” address, albeit in far less detail than we would have hoped, some of what needs to be done. For example:

- a. Par. 10(g) requires Holtec to remove “all structures at the Pilgrim Site necessary for Partial Site Release (including the shoreline and in- water structures), other than the seawall, water intake structure, ISFSI and associated security facilities or other structures approved by DEP to remain on Site” before Partial Site Release, and “By the License Termination date [to] remove all structures that remain at the Pilgrim Site including the ISFSI and associated security facilities, other than the Switchyard and those structures DEP approves to remain on Site;”
- b. Par. 10(h) says that “Holtec shall remove the radioactive waste materials from the Site necessary to meet the NRC radiological release criteria and the terms of this Agreement “ and that it “may not dispose of any radioactive waste materials on the site or use rubblized radioactive waste materials as fill at the site;”<sup>116</sup>
- c. Par. 10(i) requires Holtec to “abate all asbestos and lead containing materials prior to any demolition activities and remove all asbestos and lead containing material from the Site for disposal at an authorized off-Site location, unless otherwise approved and agreed to in writing by DEP;”
- d. Par. 10(j) says that, unless otherwise approved by DEP and DPH, Holtec shall “fill all subsurface voids, regrade the land to the currently existing-site ground elevations, and reseed the land;”
- e. Par.10(k) says that “Holtec shall address polychlorinated biphenyl (PCBs) contamination at the Site;” and
- f. Par. 10(l) says that “Holtec shall comply with all applicable environmental and human-health based standards and regulations of the Commonwealth.”

Paragraph 12 says that Holtec will do what the revised and approved Pilgrim Environmental Site Assessment work plan requires.

Paragraph 13 says that “Following the identification of radiological or non-radiological contamination in the Initial Pilgrim Environmental Assessment conducted pursuant to the work plan approved by DEP and DPH under Paragraph 12 and subsequent to timely notification of any Reportable Conditions as defined in the MCP and Chapter 21E to DEP and DPH, Holtec shall perform comprehensive site assessment and response actions in accordance with the MCP and under the oversight of the LSP retained by under Paragraph 10(b).”

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<sup>116</sup> Rubblization is a process in which above-grade structures are demolished into rubble and buried in the structure's foundation below ground. The site surface is then covered, regraded, and landscaped for unrestricted use. It creates copious quantities of radioactive dust, “appears” to lessen the concentration of radioactivity by down blending the count of the radioactivity left on site but without reducing the total amount of radiation in the material, poses a threat to public health and decreases the long-term stability of the land.

The only supposed “advantage” of rubblization is that it may cheaper; but there are numerous reports that it is not.

Paragraph 14 is directed to the Switchyard. Although located close to the reactor building, it likely will remain, and be used by some electric power company, after decommissioning. We expect that there will be no site restoration of the Switchyard while any of its equipment remains in place.

We are concerned that the Settlement Agreement seems not to address how the Commonwealth is to ensure that Holtec has properly done what an approved revised work plan requires. Most of what Holtec is required to do simply is to give Commonwealth copies of Holtec's reports to the NRC.

### **Interim Inspection and Sampling**

To ensure proper clean-up and restoration of Pilgrim, Holtec should give the Commonwealth access to the Pilgrim site during decommissioning to the extent reasonably required for Commonwealth personnel to accompany NRC personnel during NRC inspections and to take and test its own samples and split samples. In other words, to test and verify.

We have found nothing in the Settlement Agreement that gives the Commonwealth these important rights.

### **Environmental Monitoring**

What Should Happen to Protect Public Health and Safety.

Pilgrim Watch believes that for environmental monitoring to be effective the following should be required:

- Holtec must agree to provide sufficient monies, that include funding state laboratories, to cover the Massachusetts Department of Public Health (DPH) expenses for offsite and onsite radiological monitoring and testing until the spent fuel leaves the site.
- Holtec must work cooperatively with MDPH and DEP to develop appropriate protocols related to radiological and non-radiological remediation and site restoration for information sharing, obtaining samples from onsite environmental media, conducting site visits and inspections, site characterization, remediation, site restoration, and notifications.
- These protocols must be acceptable to MDPH and DEP, be made publicly available, and shall recognize that MDPH and DEP must approve all work plans and testing protocols prior to implementation and retain authority over all determinations of compliance related to non-radiological site characterization and remediation, nonradiological site closure, and site restoration.
- Holtec must provide MDPH & DEP copies of all decommissioning radiological surveys and radiochemical analysis data provided to the NRC or maintained on site as required by NRC regulations.

- MDPH and DEP shall have the right to obtain confirmatory measurements and sampling through decommissioning and site restoration, provided that it does not interfere with the licensee's schedule.
- MDPH and DEP must work expeditiously with Holtec to develop and review the workplans necessary to facilitate Holtec's pre- and post-closing site restoration activities at the Pilgrim Station Site.

#### Offsite Monitoring:

- MDPH's real-time air monitoring stations must be maintained; environmental media sampling and testing must continue on a regular basis.
- Holtec must agree to perform regular offsite radiological surveys and provide an annual report to the NRC and the Commonwealth with the location of the samples and findings. The report must be available to the public,

#### Onsite Monitoring:

- The Commonwealth must maintain the current monitoring well program, and the addition of additional monitors as required.
- Holtec must agree to provide the State with split samples during decommissioning and split samples from the final status surveys that are intended to document that soil and structure remediation will allow the site to be released for unrestricted use at NRC license termination and conform to state <10 ml/rem/yr. and < 4 ml/rem/yr. in drinking water sources of water.
- Holtec must agree to perform a new hydrological assessment required when structures on the site are removed and agrees to participation of relevant state agencies in reviewing the protocol and findings.
- Holtec must agree to add additional monitoring wells as required by the Commonwealth to make assessment when the hydrology has changed due to the removal of onsite structures.
- Holtec must agree to remediate or remove structural materials or soil containing detectable tritium, even if the level of tritium is less than required by the NRC for license termination, as was done at Yankee Rowe.
- Holtec must agree to remediate or remove structural materials or soil containing detectable tritium, even if the level of tritium is less than required by the NRC for license termination, as was done at Yankee Rowe.
- Holtec must perform biannual radiological monitoring of groundwater (including both previously impacted and downgradient monitoring wells) until the NRC has released the site for unrestricted use. A post-completion monitoring plan approved by NRC, MDPH, DEP will identify the sampling locations and analytical parameters specific to each location.
- The NRC must provide the state with splits of any samples NRC has taken as part of its oversight program and also provide MDPH with sampling locations and copies of its analysis of any and all samples taken from the site.

#### a. Spent Fuel-Dry Cask & Pad Monitoring

- Holtec must agree to monitor in real-time each cask for heat, helium and radiation recognizing that the canisters and concrete outer packs are prone to cracking, exacerbated by salt corrosion. MDPH shall be linked to readings, as is the case with the current ring-monitors.  
Rationale: Measuring for heat and helium will provide early warning so that overpacks can be ordered and located onsite. Monitors used, unlike TLDs, shall provide on-going measurements rather than providing an average figure, and shall not be limited to reading only to a maximum threshold, and will read both high and low let alpha and beta.
- The pad for the casks is subject to corrosion. The Commonwealth must have the ability to inspect the pad and shall receive reports documenting Holtec and NRC inspections.
- Vermont has temperature and radiation monitors. The temperature monitors are read twice a day. The radiation monitors are read once a day.

### **Commonwealth Settlement - What we got.**

Because all the fuel is in dry casks, the payments to DPH dropped from \$386,236 (2022) to \$200,000 ), and they will remain at that level until Partial Site Release, which Holtec expects to take place in 2027 . Even after Partial Site Release, annual \$100,000 payments to DPH are required for 2007 and thereafter until the Massachusetts radiological standard is met.

We seriously doubt that these payments will be enough for DPH to do what it must do to protect public health and safety so long as spent nuclear fuel remains on the Pilgrim site.

These payments are based on several questionable, and incorrect, assumptions. We know that the spent fuel dry casks are vulnerable to attack and corrosion until they leave the site. We know from NRC and Holtec documents that casks leak radiation 24/7. Explained in the previous section on spent fuel.

### **License Termination Plan and Final Status Survey Report**

Holtec should be required to give the Commonwealth a copy of any license termination plan or survey report provided to the NRC within five (5) days of the date on which any such plan or support was submitted to the NRC; and also, must give the Commonwealth the opportunity to provide comments to the NRC with respect to any such plan.

NRC Regulations require Holtec to submit a License Termination Plan (LTP) at least 2 years before the license termination date, and, at the conclusion of decommissioning activities, to submit a final status survey report (FSSR). The NRC typically permits third parties to submit written comments with respect to the LTP.

According to the NRC, the LTP must include:

- a site characterization.
- identification of remaining dismantlement activities.
- plans for site remediation.
- detailed plans for the final radiation survey.

- a description of the end use of the site, if restricted.
- an updated site-specific estimate of remaining decommissioning costs; and a supplement to the environmental report describing any new information or significant environmental change associated with the licensee's proposed termination activities; and
- identification of parts, if any, of the facility or site that were released for use before approval of the LTP.

The FSSR must document the final radiological conditions of the site, and request that the NRC either: (1) terminate the 10 CFR Part 50 license; or (2) if the licensee has an ISFSI, reduce the 10 CFR Part 50 license boundary to the footprint of the ISFSI. The NRC will approve the FSSR and the licensee's request if it determines that the licensee has met both of the following conditions:

- the remaining dismantlement has been performed in accordance with the approved LTP; and
- the final radiation survey and associated documentation demonstrate that the facility and site are suitable for release in accordance with the LTR.

### **Commonwealth Settlement**

Paragraph 10(m) requires Holtec to “copy DEP, DPH, and MEMA on Holtec’s formal submittals to the NRC related to decommissioning and/or site restoration, that presumably would cover the LTR and FSSR. However, we have found nothing in the Settlement Agreement giving the Commonwealth the right to comment on either the LTR or FSSR.

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## **HEALTH IMPACTS**

### **Overview**

**Operations & Decommissioning:** Most people think once operations cease that there is no longer any reason to worry about threats to health, safety, property, and the environment. Not so.

Over the years of operations, the site became contaminated with radionuclides and chemicals from spills, leaks, and emissions into the air and water. If the site is not properly cleaned up, contaminants will eventually leak into the bay and perhaps into the Plymouth-Carver Aquifer underneath the site, the second largest aquifer in the state. Dismantling contaminated buildings can result in dispersing particulates impacting workers on sites and neighbors. Discharging contaminated water either into Cape Cod Bay or evaporating the water will take its toll. A successful attack on a spent fuel cask can result in the release of 1/3 to 1/2 Cesium-137 (depending on fuel’s age) released at Chernobyl making a very large area permanently uninhabitable. Corrosion of a spent fuel cask resulting in a leak will likewise result in significant contamination.

## Do Nuclear Power Plant Emissions Cause Cancer? <sup>117</sup>

In the U.S., all nuclear power plants regularly release low level radioactive effluents into the atmosphere, oceans, and waterways, and some higher levels of radioactivity. Few nuclear power plants announce these releases in advance, and the nuclear industry and NRC make efforts to focus only on the concentration of a single release rather than the accumulation of discharges over many decades. The problem is that the health effects of radioactive exposure are cumulative and may take years to develop.

Cancer is now the number one killer in most states, and many wonder if the vast amounts of low-level radiation pumped into the environment for so many decades may have serious health consequences for the public. Over 100 million Americans live near a nuclear power plant. Is it possible that they have higher rates of cancer?

It has long been known that ionizing radiation can cause serious damage to biological tissue. High doses can be lethal. Lower doses can alter cell DNA resulting in various forms of cancer years or decades later. Ionizing radiation is especially dangerous for embryonic tissue or where there is rapid cell division. This is why women and children are much more vulnerable (and the human fetus the most vulnerable of all). Nevertheless, the nuclear industry uses the adult male (called “standard man” or “reference man”) to calculate dose tolerance.

The radiation regularly released from all nuclear power plants is regulated by the Nuclear Regulatory Commission (NRC). The NRC has permissible limits and also a meaningless concept called ALARA -as low as reasonably achievable. to whom and based on what? NRC’s limits are based on outdated science.

**ALARA** according to NRC is defined in Title 10, Section 20.1003, of the *Code of Federal Regulations* ([10 CFR 20.1003](#)), ALARA is an acronym for "as low as (is) reasonably achievable," which means making every reasonable effort to maintain [exposures](#) to [ionizing radiation](#) as far below the dose limits as practical, consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of

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<sup>117</sup> Excerpts from:

[https://www.samuellawrencefoundation.org/files/ugd/6a4539\\_7a708164f21f4ae783b7ed795da3701a.pdf](https://www.samuellawrencefoundation.org/files/ugd/6a4539_7a708164f21f4ae783b7ed795da3701a.pdf) “Do Nuclear Power Plant Emissions Cause Cancer?” *Federal Agencies block Cancer Studies*, Roger Johnson, 2023 (retired Professor Emeritus formerly on the faculties of Amherst College, Tufts University, and of Ramapo College of New Jersey.)

[nuclear energy](#) and [licensed materials](#) in the public interest. For additional detail, see [Dose Limits for Radiation Workers](#).

ALARA was described by Dr. John Gofman (Professor Emeritus of Molecular and Cell Biology at the [University of California at Berkeley](#) and work on Manhattan Project where he co-discovered uranium-233 and separated plutonium) in court as permitting human deaths. He said, "Because ALARA does not say -- see, the only way you could avoid deaths from the nuclear fuel cycle is to have zero releases. ALARA says keep the releases as low as you can reasonably achieve with the economics that you want to spend on it, and the equipment that you have available and so forth. So it is a planned emission of radioactivity, and that in effect means planned deaths."<sup>118</sup>

**Permissible Releases Do Not Mean Safety.** NRC's regulations allow "permissible" levels of contamination, far higher than EPA allows for chemicals. However, there is no safe threshold to exposure to radiation according to the National Academies, so "permissible" does not mean "safe." The Commonwealth negotiated a settlement with Holtec Pilgrim for a lower cleanup standard than NRC's - 10 millirem/year- not 25 to 500.

| EPA/DEP's risk level goals                                                                                                                                                                                                                                     |                                |                                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li><b>Mixture of chemicals:</b> lifetime cancer incidence risk - <b>one in 100 thousand (1 in 100,000)</b></li> <li><b>One chemical:</b> lifetime cancer incidence risk - <b>one in a million (1/1,000,000)</b></li> </ul> |                                |                                                                                                                               |
| Lifetime Cancer Risk estimates based on BEIR VII are much higher                                                                                                                                                                                               |                                |                                                                                                                               |
| Exposure-millirem/year                                                                                                                                                                                                                                         | Lifetime Cancer Incidence Risk | Cleanup Standards                                                                                                             |
| 10 millirem/year                                                                                                                                                                                                                                               | 70/100,000                     | Applies to Pilgrim's Cleanup.<br><br><10 Millirem/year is Current Massachusetts Limit For Unrestricted Use For Its Licensees. |
| 25 millirem/year                                                                                                                                                                                                                                               | 175/100,000                    | NRC Limit for <u>Unrestricted</u> Use site                                                                                    |
| 100 millirem/year                                                                                                                                                                                                                                              | 700/100,000 (7/1,000)          | NRC & Mass. Limit for <u>Restricted</u> Use site                                                                              |
| 500 millirem/year                                                                                                                                                                                                                                              | 3,500/100,000 (35/1,000)       |                                                                                                                               |
| Cancer Incidence Risk resulting from whole body exposure is about <u>2 times mortality risk</u>                                                                                                                                                                |                                | Reproductive disorders occur at lower levels of radiation exposure than cancer                                                |

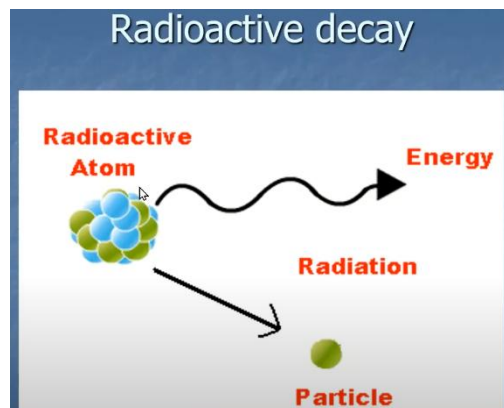
<sup>118</sup> Gofman's statements can be found in "Shut Down: Nuclear Power on Trial: Experts Testify in Federal Court" ISBN 0-913990-21-3, published in 1979 in the U. S. by The Book Publishing Company, 156 Drakes Lane, Summertown, Tennessee, 38483.)

## It's Bananas To Believe Reactor Releases are Equivalent to Eating a Banana

BANANAS- Dr. Ian Fairlie

When these tiny amounts of K-40 (potassium) decay, it mostly decays with the emission of a beta particle with a max energy of 1,300 keV. This is considerably larger than that of tritium's beta particle max energy of 18 keV. Almost all of K-40's betas will escape the human body as they are so energetic. But all of tritium's betas will stay inside the body as its mean free path in tissue is 0.6 microns which is the diameter of a human chromosome. Again, we should not worry unduly about K-40.

We conclude that the banana story is just a distraction and an unhelpful, misleading, and scientifically illiterate one.



## What Independent Scientists Say

### National Academy of Sciences, BEIR VII Report, June 2005<sup>119</sup>

The National Academy of Sciences (NAS) latest report on radiation risk, called the BEIR VII report ("BEIR" stands for the Biological Effects of Ionizing Radiation) was issued June 2005. Its conclusion was simple: No amount of radiation is safe, and women and children are the most at risk.

**Women and Children Most at Risk:** The National Academy reported that overall cancer mortality risks for females are 37.5 percent higher than for men, and the risks for all solid tumors (lung, breast, and prostate) are almost 50 percent higher. The differential risk for children is even greater. The same radiation in the first year of life for children 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.

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<sup>119</sup> The National Academy's Report is available on the Web at <http://books.nap.edu/>

**Impact Offspring from Parents Exposure:** While the report states there is no direct evidence of harm to human offspring from exposure of parents to radiation, the committee noted that such harm has been found in animal experiments and that there is “no reason to believe that humans would be immune to this sort of harm.” This should be of concern to nuclear worker’s families.

**Heart Disease and Stroke:** Here again, the National Academy stated that no amount of radiation exposure is safe; and noted that relatively high levels of radiation exposure increase risk not only of cancer but also of heart disease and stroke.

**What does this mean for us?** The 1 in 100 risk of cancer posed by the NRC’s 100 millirem/year standard far exceeds the risk that other agencies allow for other carcinogens.<sup>120</sup> These risks are much higher than permitted for other carcinogens - the allowable release for one chemical from a factory is a lifetime cancer incidence risk of (1) in a million. Apparently it is permissible for Pilgrim to cause cancer in TEN THOUSAND times as many people that would be permitted for an ordinary chemical factory. Why is radiation a privileged pollutant?

### **Updating the National Academies BEIR VII Report- Politics over Public Health**

A recent article , *Do Nuclear Power Plant Emissions Cause Cancer?* In the Samuel Lawrence Foundation Journal by Roger Johnson explains how the industry, NRC, HHS stopped the National Academies plans.<sup>121</sup> It says that:

Because of the importance of this issue, **in 2010 the prestigious U.S. National Academy of Sciences was charged with studying this issue.** Two years later the NRC released a detailed 427-page report which concluded that more research is necessary. In 2014 it released a second report which proposed a pilot study at seven nuclear facilities in Illinois, Connecticut, California, New Jersey, Tennessee, and Michigan.

Both reports were sponsored by the Nuclear Regulatory Commission whose motto is “Protecting People and the Environment”. But instead of supporting the research, the NRC terminated the project saying that the research would probably fail, and it could not afford the \$8 million cost.

Not to be deterred, many in Congress worked hard to support the research and get it moved to a different agency. In 2022, Congress finally funded the project and directed Health and Human Services to administer it. But HHS did nothing until Rep. Levin, Porter, and Carbajal wrote to Secretary Becerra in July of 2022 requesting that the HHS transfer the funds to NAS and get the project started.

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<sup>120</sup> For a worker, risk is even greater. The National Academy estimate is that 1 in about 5 workers would get cancer if exposed to the legally allowable radiation occupational doses over their 50 years in the workforce.

<sup>121</sup> [https://www.samuellawrencefoundation.org/\\_files/ugd/6a4539\\_7a708164f21f4ae783b7ed795da3701a.pdf](https://www.samuellawrencefoundation.org/_files/ugd/6a4539_7a708164f21f4ae783b7ed795da3701a.pdf)  
“Do Nuclear Power Plant Emissions Cause Cancer?” *Federal Agencies block Cancer Studies*, Roger Johnson, 2023 (retired Professor Emeritus formerly on the faculties of Amherst College, Tufts University, and of Ramapo College of New Jersey.)

To everyone's surprise, Secretary Becerra refused to do so saying that any research is premature and that he would instead assemble a Roundtable to discuss the issue. The HHS Roundtable was finally convened in Feb. of 2023. Representatives of various government agencies including the NRC were invited but scientists from the National Academy of Sciences were excluded.

The Roundtable then concluded that cancer research should not be conducted because each dose from nuclear power plant emissions is small, and the research would probably fail. In sum, the U.S. Government appears to be blocking cancer research on this issue. This raises eyebrows in light of the Biden administration's supposed commitment for a "moonshot" on cancer. The HHS did not post the rejection on their website or circulate it to the public. Many months later, copies finally surfaced. Below are links to the two National Academy of Sciences reports and the recent HHS report." Analysis of Cancer Risks in Populations Near Nuclear Facilities Phase 1 (National Academies Press 2012, 412 pages) available online:

<https://nap.nationalacademies.org/catalog/13388/analysis-of-cancer-risks-in-populationsnear-nuclear-facilities-phase> Analysis of Cancer Risks in Populations Near Nuclear Facilities Phase 2: Pilot Planning (National Academies Press 2014)  
<https://www.nrc.gov/docs/ml1503/ML15035A135.pdf>

### **Pilgrim- Radiation Health Impacts - Southeast Mass.**

Increases in radiation-linked disease in the communities around Pilgrim were in part attributed to operating with defective fuel; operating without the off-gas treatment system in the first years; poor management and practices culminating in the releases in June 1982 that coincided with weather conditions that held the releases over surrounding communities and parts of Cape Cod.

#### **Pilgrim Radiological Environmental Monitoring Program Report 1982**

| <b>MEDIA</b> | <b>PAGE</b> | <b>RADIONUCLIDE</b> | <b>TIMES EXPECTED</b>      | <b>HALF-LIFE</b> |
|--------------|-------------|---------------------|----------------------------|------------------|
| SHELLFISH    | 3-43        | Cs-137              |                            | 30 yrs           |
|              |             | Co-60               |                            |                  |
|              |             | I-131               | High, discharge canal      | 8 days           |
| FISH         | 3-60        | Cs-137              |                            | 30-yrs           |
|              |             | I-131               |                            | 8 days           |
| SEDIMENT     | 3-62        | I-131               | Highest mean in Marshfield | 8 days           |
|              |             | Co-60               |                            |                  |
| MILK         | 3-69        | Cs-137              | 1,000,000                  | 30 yrs           |
|              |             | Sr-89/90            | 1,000,000                  | 29 yrs           |
|              | D-3         | I-131               | 2X Regulatory Guide 4.8    |                  |
| CRANBERRIES  | 3-76        | Cs-137              |                            | 30 yrs           |
|              |             | I-131               |                            | 8 days           |
| VEGETATION   | 3-80        | Cs-137              | 1,000,000                  | 30 yrs           |

NOTE Effluent & Waste Disposal Semi-Annual report (1982), page 8A, said that a total of more than 819 curies of spent resin, filter sludges, evaporator bottoms were transported out of Pilgrim. It was the year that Pilgrim blew their filters, on June 11, 1982

The cancers found in the communities around the power station were studied by Dr. Sidney Cobb and Dr. Richard Clapp and their results were published in a peer reviewed journal in 1987. They included elevated rates of Myelogenous Leukemia – a type of cancer most likely to be triggered by exposure to radiation.<sup>122</sup> This led to a case-control study carried out by the Massachusetts Department of Public Health that showed a fourfold increase in adult Leukemia between 1978 and 1983. The report stated, "a dose-response relationship was observed in that the relative risk of leukemia increased as the potential for exposure to plant emissions also increased."<sup>123</sup>

### **Massachusetts Department of Health Southeastern Massachusetts Health Study 1990**

The Massachusetts Department of Health's own case-controlled study, *The Southeastern Massachusetts Health Study* [published in the *Archives of Environmental Health*, Vol. 51, p.266, July-August 1996] found a four-fold increase in adult leukemia the closer one lived or worked to the Pilgrim NPS.

### **Recommendations Made by MDPH's Southeastern Massachusetts Study- Status**

1. Implement a system of real-time monitoring of radionuclide emissions so that reliable and timely data are available by which exposure can be assessed more precisely. The Sage System was put in place for public relations purposes not for its effectiveness. It consisted of 14 monitors on the edge of Pilgrim's property, too close, and MDPH did not analyze or make the data public. MDPH within the past few years took over the Sage System (now Evinet) started in earnest to work on the 1990 SMHS monitoring recommendation – see following monitoring section.
2. Develop and implement a state air quality standard more stringent than that currently in use by federal regulatory agencies and other states. The air quality standard was too high and not enforced.
3. DPH survey cancer occurrence in the Plymouth area through data collected by the Massachusetts Cancer Registry. Massachusetts Cancer Registry data is available however the Registry does not have data refined to see patterns of disease at the neighborhood level and there is no registry for birth defects and reproductive disorders.
4. Based upon the availability of resources, interviews of the families of childhood leukemia cases be conducted. Not done

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<sup>122</sup>An epidemiological analysis of five towns around Pilgrim shows a 60 percent increase in leukemia rate, excluding leukemias not caused by radiation exposure. - Dr. Sidney Cobb, et.al. *Lancet*, 1987. The rate of myelogenous leukemia (the type most likely to be triggered by exposure to radiation) among males in the 5 towns around the Pilgrim reactor was found to be 2 1/2 times greater than the statewide average. *Leukemia in Five Massachusetts Coastal Towns*, Dr. Sydney Cobb, et al., Abstract for the American Epidemiologic Society, March 18, 1987; and *Leukemia near Massachusetts Nuclear Power Plant*, letter, Clapp, R.W., Cobb, S, Chan, C.K., Walker, B., *Lancet* 1987;2:1324-5.

<sup>123</sup>Adults living and working within ten miles of the Pilgrim reactor had a fourfold increased risk of contracting leukemia between the years of 1978 and 1983 when compared with people living more than 20 miles away, according to a 1990 study by the Massachusetts Department of Public Health. *Southeastern Massachusetts Health Study 1978-1986*, Morris, M.S., Knorr, R.S., Massachusetts Department of Health, Southeastern Massachusetts Health Study, Oct. 1990. *Archives of Environmental Health*, Vol. 51, p266, 1996, July-Aug. #4

### **Denial: Response to MDPH's Southeastern Massachusetts Health Study**

The Southeastern Massachusetts Health Study was conducted, peer reviewed, and made public during the Dukakis Administration. The department (MDPH) began the process to address the first two recommendations – monitoring and establishing a more conservative radioactive air emission standard.

However, there was a complete about face in November 1990 when Governor Weld took office. December 1990, Governor Weld sent his Executive Secretary of HHS to accompany Pilgrim's Vice President and Pilgrim's Health Physicist to visit Massachusetts' Interim Commissioner of Public Health, David Mulligan.

At that meeting Pilgrim gave their wish list. Pilgrim, the implicated industry, would be allowed to appoint a second peer review panel to re-review the Southeastern Massachusetts Health Study; and, until their own peer review panel decided whether the study was credible all the study's recommendations would be put on hold.

The second peer review panel could find nothing wrong with the study's methodology. The re-review panel stated clearly in their Executive Summary that, "The [original SMHS] study team adhered to generally accepted epidemiologic principles..." and "the findings of the SMHS cannot be readily dismissed on the basis of methodology errors or proven biases..." But somehow they just couldn't believe it - given Pilgrim's emissions. However for emissions data, they relied on data collected and provided by Pilgrim - not surprisingly it indicated that Pilgrim hardly emitted any radiation.

The story gets worse. Massachusetts Department of Public Health allowed Pilgrim, the implicated industry, to provide all the sound bites, press releases and public announcements about the re-review's findings, and refused to let their employees, who conducted the original study, speak to the press.

Once again, we see political science used to re-write real science on behalf of industry.

### **Southeastern Massachusetts Childhood Leukemia Study - Mass. Dept. Public Health**

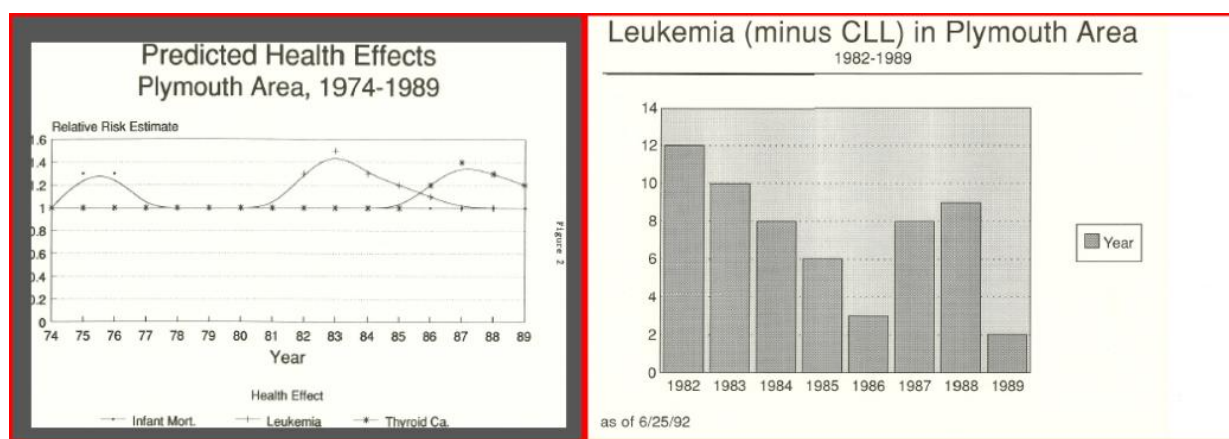
The study was funded and in the planning phase, 2002. However, the project was cancelled because funds appropriated were insufficient to perform a study that would be statistically significant.

**Massachusetts Cancer Registry:** The Massachusetts Cancer Registry (MCR) provides standardized incidence ratios (SIRs) for cancer in Massachusetts cities and towns. The SIRs are for 23 types of cancer over a five-year period. The town bytown registry has not been updated online since 2015; and did not provide updated information despite requests from the Physicians for Social Responsibility and the Plymouth Board of Health.

How to access the data <https://www.mass.gov/lists/cancer-incidence-city-town-supplement>

**Reviews of the MA Cancer Registry showed the “footprints” of radiation linked disease in communities impacted by Pilgrim.**

Evidence of radiation-linked disease continued. In a statement before the Southeastern Massachusetts Health Study Review Committee [June 26, 1992] Dr. Richard W. Clapp, the founder and former director of the Massachusetts Cancer Registry, presented a graphical assessment of the pattern of leukemia and thyroid cancer in the towns closest to Pilgrim during the period 1982-1989 and an *Analysis of 1974-1989 Massachusetts Cancer Registry for Leukemia & Thyroid Cancer*, Dr. Richard Clapp, DSc, MPH (2006), *personal communication*.



The graphs of the incidence leukemia and thyroid cancer in the Plymouth area show that the incidence of leukemia peaked in 1982 and subsequently declined until 1986. Then there was a second, smaller peak in 1987 and 1988 while declined in 1989. The number of cases exceeded the number expected in 1982-85 and 1987-88. The second graph depicts the pattern of thyroid cancer in the same set of towns. It shows a peak in the years 1987-1988. These patterns of cancer incidence are consistent with the predicted health effects of the radiation released in the early 1980s. A graph showing the predicted health effects is also shown in Exhibit F. A statistically significant increase in childhood leukemia was noted in communities near Pilgrim, too. Although Massachusetts Department of Public Health recommended a state sponsored case-controlled childhood leukemia study, it was not done.

The Massachusetts Cancer Registry also shows, for the years 1998-2002, a continuing increase of leukemia and thyroid cancer in the towns around PNPS. Specifically, there were 83 cases of leukemia reported to the Massachusetts Cancer Registry (MCR), where 72.9 would have been expected based on statewide rates. This results in a Standardized Incidence Ratio (SIR) of 114 (95% conf. int. = 91-143). In addition, there was excess thyroid cancer in these same towns for the same time period. The thyroid cancer SIR was 122 (95% conf. int. = 96-155). In other words, leukemia was 14% elevated over the statewide rate and thyroid cancer was 22% elevated. Neither of these calculations were statistically significantly elevated by the usual convention

( $P < .05$ ), but there were more cases than expected, nevertheless. This means there is a continuing excess of these two radiation-related cancers in the population, as there was in the 1980s. *Analysis of 1998-2002 Massachusetts Cancer Registry for Leukemia & Thyroid Cancer*, Dr. Richard Clapp, 2006, *personal communication*.

**Prostate cancer and multiple myeloma, both radiation-linked diseases, are also elevated and statistically significant for the years 1998-2002 in the seven towns most likely to be impacted near Pilgrim (Carver, Duxbury, Kingston, Marshfield, Pembroke, Plymouth, and Plympton).** *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2 (2006)*. Occupational Radiation Studies, Chapter 8,, National Academies Press, 2006. Specifically, data from the Massachusetts Cancer Registry indicates 613 cases of prostate cancer vs. 513.5 expected, SIR=119 (95% C.I.=110-129); multiple myeloma: 47 cases vs. 31.7 expected, SIR=148 (95% C.I.=108-198). *Analysis of 1998-2002 Massachusetts Cancer Registry for Leukemia & Thyroid Cancer*, Dr. Richard Clapp, 2006, *personal communication*.

**Massachusetts Cancer Registry- Radiation-linked Cancers in Towns Surrounding Pilgrim showing Statistical Significance of SIR a 95% level probability.**

**Mass. Cancer Registry latest town reports** online are from 2011-2015. The reports listing radiation linked cancers showing statistical significance:

2008-2012: Plymouth thyroid cancer, female; and all types of cancer, male and female.  
Duxbury, all types of cancer male and female. Marshfield, all types of cancer female  
2009-2013: Duxbury non-Hodgkin lymphoma male; all types of cancer female; Marshfield thyroid cancer male; and all types of cancer male and female. Plymouth thyroid female; all types of cancer male and female.  
2010-2014 Duxbury multiple myeloma, male; non-Hodgkin lymphoma, male; Marshfield multiple myeloma, male; and all types, female; Plymouth thyroid female and all types, male and female  
2011-2015: Duxbury multiple myeloma, male; all types, female. Plymouth thyroid, female.

Cancer Incidence and mortality are ranked higher for Plymouth County. But the county is large, encompassing many towns, most typically not downwind from Pilgrim.

## Cancer incidence and mortality in Massachusetts by county

Figure 21. Incidence Rates for all Cancer Sites in Massachusetts by County, 2016-2020

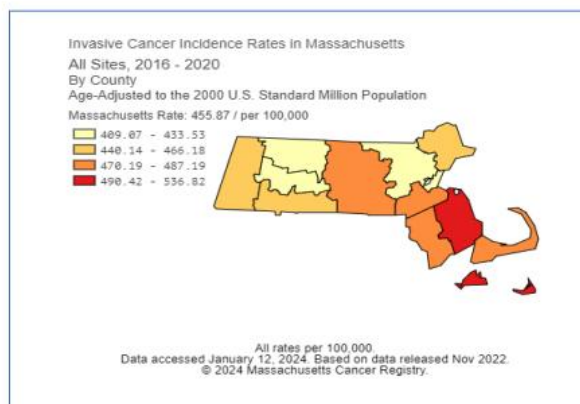
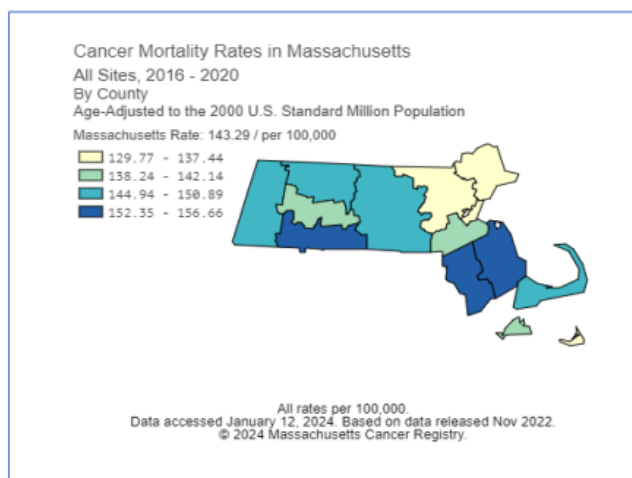


Figure 22. Mortality Rates for all Cancer Sites in Massachusetts by County, 2016-2020



For further updates, visit the Massachusetts Department of Public Health's Cancer Registry - data is listed by year for each town. <https://www.mass.gov/lists/cancer-incidence-city-town-supplement>. The registry is woefully behind.

Data posted, as of February 2025:

- [2011-2015](#)
- [2010-2014](#)
- [2009-2013](#)
- [2008-2012](#)

The registry says "You can obtain prior statewide reports by contacting the MCR"; however scientists making a request for updated reports in 2024, such as Boston Physicians for Social Responsibility and Harvard scientists, found no satisfaction.

**A summary of radiation-linked disease in communities impacted by the Pilgrim Nuclear Power Station is provided in the following affidavit by Dr. Richard Clapp.**

**AFFIDAVIT OF DR. RICHARD CLAPP, MPH, DSc IN SUPPORT OF PLAINTIFFS' OPPOSITION TO DEFENDANT ENTERGY'S MOTION TO DISMISS PLAINTIFFS' FIRST AMENDED COMPLAINT FOR LACK OF STANDING  
Plymouth SS Land Court Dept. Trial Court Civil Action NO. 13 MISC 479028-RBF**

1. My name is Richard W. Clapp. I am Professor Emeritus of Environmental Health at the Boston University School of Public Health and Adjunct Professor at the University of Massachusetts Lowell. I am an epidemiologist with over forty years of experience in public health practice, research, teaching and consulting. I have a master's in public health from Harvard School of Public Health and a DSc in Epidemiology from Boston University School of Public Health. A copy of my curriculum vitae is attached.
2. I was Director of the Massachusetts Cancer Registry and served as its founding director from 1980-1989. The Massachusetts Cancer Registry currently provides standardized incidence ratios (SIRs) for twenty-three types of cancer in the 351 cities and towns of Massachusetts for a five-year time period.  
<http://www.mass.gov/eohhs/gov/departments/dph/programs/health-stats/cancer-registry/data/>
3. My epidemiological research has included studies of cancer around nuclear facilities, in workers and military veterans, and in communities with toxic hazards. I served as a consultant to the U.S. EPA Science Advisory Board in 1995 and 2000.
4. I have performed extensive research on health effects from radiation exposures in people living near the Pilgrim Nuclear Power Station in Plymouth, Massachusetts (Pilgrim).
5. During routine operations, Pilgrim releases radiation into the air, water, and soil in the form of liquid, gaseous and solid radioactive wastes. There have also been accidental releases and leaks of radionuclides into the environment at Pilgrim. The Massachusetts Department of Public Health (MDPH) is overseeing a program of monitoring ongoing leaks of radionuclides from Pilgrim into the soil and groundwater at Pilgrim under its Radiation Control Program.  
<http://www.mass.gov/eohhs/gov/departments/dph/programs/environmental-health/exposure-topics/radiation/environmental-monitoring.html>
6. The radioactivity released by Pilgrim includes many isotopes only produced in nuclear reactors and atomic bombs, including Strontium-89, Strontium-90, Cesium-137, and Iodine-131. These four, and others, are carcinogenic. These radionuclides enter the human body either by inhalation or ingestion, through food. Each radionuclide concentrates in different parts of the human body. For example, iodine seeks out the thyroid gland, strontium concentrates in the bone and teeth (like calcium), and cesium is distributed throughout the soft tissues. These radionuclides are different from "background" radiation found in nature in cosmic rays and the earth's surface. Background radiation, while still harmful, is not as likely to specifically attack the thyroid gland, bones, or soft tissues.

7. Each of the radionuclides released by Pilgrim decays at varying rates; for example, iodine-131 has a half-life of eight days, and remains in the body only a few weeks. Strontium-90 has a half-life of 28.7 years, and thus remains in bone and teeth for many years.
8. Pilgrim has released radionuclides since 1972 when it began operations. During current and future operations of Pilgrim, under operating conditions allowed by the U.S. Nuclear Regulatory Commission (NRC) in Pilgrim's operating license, Pilgrim will continue to release radionuclides.
9. The NRC requires Entergy to document the types and amounts of radionuclides released from Pilgrim in Annual Environmental Monitoring Program Report. The reports are available each year on NRC's Electronic Library. <http://www.nrc.gov/reading-rm.html>. Pilgrim's docket number is 05000293.
10. The types of radionuclides Pilgrim releases into the environment are linked to certain types of cancer.
11. Studies and scientific data show increases in radiation-linked diseases in people living and working close to Pilgrim.
12. In the 1980s, the Massachusetts Cancer Registry (Cancer Registry) showed that the incidence of myelogenous leukemia in Plymouth and nearby towns was significantly higher than the state average rate. Myelogenous leukemia is a type of cancer that is likely to be triggered by exposure to the type of radiation emitted by Pilgrim.
13. In the 1980s, when I was Director of the Cancer Registry, Dr. Sidney Cobb brought to our attention the pattern of cancer around Plymouth, Massachusetts. As a result of statistical excesses shown by the Cancer Registry in the mid-1980s, MDPH conducted a formal case-control study of adult leukemia in Southeastern. The results of the study were published in a peer-reviewed scientific article in 1996. See, "*Southeastern Massachusetts Health Study, 1978-1986*, Morris M.S., Knorr, R.S. MDPH, Archives of Environmental Health, Vo. 51, p 266, 1996, July-Aug. #4 (Health Study). The Towns most likely to be impacted near Pilgrim are Carver, Duxbury, Kingston, Marshfield, Pembroke, Plymouth and Plympton.
14. The Health Study showed that adults living and working within ten miles of Pilgrim had a fourfold increased risk of contracting leukemia between the years of 1978 and 1983 when compared with people living more than 20 miles away. The report stated, "a dose-response relationship was observed in that the relative risk of leukemia increased as the potential for exposure to plant emissions also increased."
15. After the Health Study, data continued to show an increase in radiation-linked disease near Pilgrim. In a statement before the Southeastern Massachusetts Health Study Review Committee I presented a graphical assessment of the pattern of leukemia and thyroid cancer in the towns closest to Pilgrim during the period 1982-1989.
16. The Cancer Registry shows, for 1998 through 2002, a continuing increase of leukemia and thyroid cancer around Pilgrim. For the years 2002 through 2009 Plymouth had a statistically significant increased level of leukemia, at the 5% probability level. This means that chance is an unlikely explanation of the difference between the observed and expected cases. There also is a statistically significant increased level of prostate cancer, another radiation linked disease. Prostate cancer and multiple myeloma, both radiation-linked diseases, are

also elevated and statistically significant for the years 1998 to 2002. (see also, Cancer Registry pages for Plymouth, 2002-2009)

17. The National Academies of Science (NAS) a private, non-profit society of scholars established by Congress in 1863 charged with providing independent object advice to the nation on matters of science and technology, <http://www.nasonline.org/about-nas/mission/> has issued a report on radiation. Its latest report says there is no safe dose of radiation and that exposure to even very low levels of radiation is 3 times more dangerous than previously estimated – especially for children and women. *Health Risks from Exposure to Low Levels of Ionizing Radiation, BEIR VII, Phase 2, June 2005*, Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation, Board on Radiation Effects Research, Division of Earth and Life Sciences, National Research Council of the National Academies, The National Academies Press, Washington, D.C. (BEIR VII) The documented radionuclides released from Pilgrim in the past have long half-lives and bio-accumulate in the environment.
18. The effects of radiation exposure are cumulative. The radionuclides released from Pilgrim include substances that will remain active in the local environment for the foreseeable future and should be taken into account when actual on-going doses to the public and the environment are evaluated.
19. When Pilgrim was initially licensed by the NRC in 1972, the NRC had standards for radiation release into the environment. When the standards were set by the NRC for permissible releases of off-site radiation, low levels of radiation were considered harmless. However, new data and both epidemiological and experimental research have led the NAS to conclude that no amount of radiation is safe. There is a linear no threshold response to radiation, which means that any increase in exposure confers some increase in cancer risk. Since exposure to low levels of radiation is approximately three-times more dangerous than previously thought, this may explain why radiation-linked disease rates are higher than expected in people living and working near Pilgrim.
20. This new information from NAS about the lack of safe levels of exposure to radiation is particularly relevant to the issue of the continued operation of Pilgrim because the health and environmental effects are cumulative.
21. As the 1990 Southeastern Massachusetts Health Study concluded, the closer one lived to Pilgrim, the greater the risk of cancer. The longer and closer a person has lived to Pilgrim, the greater the risk of exposure to harmful radionuclides and the greater the chance of developing radiation-linked illnesses. For example, a person who lives or has lived within 2 to 10 miles of Pilgrim for a longer period of time has a greater risk of exposure than one who has not lived either as close, or for as long.
22. Continued exposure to radionuclides from Pilgrim's operations will have a greater impact on someone who has been exposed in the past.
23. I understand that the U.S. NRC has relicensed Pilgrim to operate until 2032, and that Entergy is building a dry cask storage facility at Pilgrim for spent nuclear fuel storage.

24. I understand that the storage of spent nuclear fuel in dry casks emits radionuclides into the environment because the casks have vents that allow air to circulate through to cool the fuel. Small amounts of radionuclides are likely to be emitted.
25. I understand that there is a risk of accidental releases of radionuclides from dry casks that could be at high levels, for example, during a terrorist attack.
26. For as long as Pilgrim continues to operate and release radionuclides into the air and water, it will continue to present a health risk to persons living in proximity to Pilgrim. The closer one lives, the higher the risk. If a person has been exposed to radionuclides in the past, the risk is higher yet.
27. I understand that information about the studies referred to above, and the Cancer Registry data, has often been reported in the media. Based on the studies, the cancer registry data, and media reports about them, a person who lives or has lived close to Pilgrim could reasonably be concerned that he or she has a significant risk of being diagnosed with a radiation-linked cancer.
28. On March 19, 2014, I testified in Plymouth District Court in the trial of several individuals who were being prosecuted for trespassing on Pilgrim property in an effort to raise awareness about the risks of Pilgrim. This trial and a summary of my testimony were published in various media outlets.

Signed under the pains and penalties of perjury this 2nd day of June 2014.



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## International Studies

### Childhood Leukemia Doubled Around French and German Reactors

A major epidemiological study published in the January 2012 edition of [The International Journal of Cancer](#) indicates there is “a possible excess risk” of acute leukemia among children living in close vicinity to French nuclear power plants (NPP). The study called for an “investigation for potential risk factors related to the vicinity of NPP, and collaborative analysis of multisite studies conducted in various countries.”

The study found a doubling of occurrence of childhood leukemia between the years of 2002-2007 among children under 5 years living within 5 km of nuclear plants – similar to the findings of the [German 2008 study](#) by the Cancer Registry in Mainz which found an association between the nearness of residence to nuclear power plants and the risk of childhood leukemia.

The epidemiological study was conducted by a team from the Institut National de la Santé et de la Recherche Médicale, the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) and the National Register of hematological diseases of children in Villejuif.

The German affiliate of the International Physicians for the Prevention of War published an analysis that showed a possible mechanism to explain the leukemia clusters close to German and French nuclear power plants. showing large releases of radioactivity during "routine" re-fueling of atomic reactors in Bavaria. The releases are hundreds of times higher than what is considered a "normal" release. The German IPPNW warns that fetuses would be especially vulnerable to these radioactive hazards. This physical, chemical, and biological delivery mechanism of radioactivity into fetal tissue is one possible explanation for statistically significant increases in childhood leukemia rates detected near nuclear power plants by German and French government health studies, which officially have "no explanation."

**To learn more see:** Childhood Leukemias Near Nuclear Power Stations, [July 25, 2014](http://www.ianfairlie.org/news/childhood-leukemias-near-nuclear-power-stations-new-article/)

<http://www.ianfairlie.org/news/childhood-leukemias-near-nuclear-power-stations-new-article/>; Commentary: childhood cancer near nuclear power stations, [Ian Fairlie](#), Environmental Health 2009,

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2757021/>; Childhood cancers near German nuclear power stations: hypothesis to explain the cancer increases, [PreviewView full textDownload full text](#)

## **Methodology- Studying Radiation Health Impacts**

It is difficult but not impossible to conduct epidemiological research in populations surrounding nuclear power plants. The National Cancer Institute attempted this in 1991 but the results were inconclusive, partly because the study analyzed where people died, not where they lived or worked. They used county boundaries rather than distance from the source of radiation and they failed to look closely at women and children who are far more vulnerable.

Dr. Busby recommends that in nuclear epidemiology: First, studies of adult cancer around nuclear sites should focus on common cancers like breast cancer, or indeed multiple cancers because there is more statistical power than rare cancers like leukemia.

Second, in such 'ecological studies' (where a region is taken as a surrogate for an exposure) the groups must be chosen because of determining where the radioactivity ends up, and not through some primitive circle drawing exercise. His article advises that this is an important message to the US Nuclear Regulatory Commission (NRC) who have been mulling over protocols for examining risk near US nuclear sites for several years now since they were bounced into it by pressure brought to bear on Congress by those people living near the nuclear sites, who can see what is happening to them and their friends. See: *Statistics Reveal the Link They Wanted to Hide: Breast Cancer and Nuclear Sites*, Dr. Chris Busby, May 19, 2015 at [HTTP://WWW.COUNTERPUNCH.ORG/2015/05/19/BREAST-CANCER-AND-NUCLEAR-SITES/](http://www.counterpunch.org/2015/05/19/breast-cancer-and-nuclear-sites/)

Case-controlled studies, like the Massachusetts Southeastern Massachusetts study, are far stronger than statistical studies.

## Post Accident Studies

### *Politics/Nuclear Promotion Versus Public Health -WHO and IAEA*

The impact of nuclear accidents has been downplayed by both WHO and IAEA as explained by Chris Busby, the ECRR's scientific secretary and visiting professor at the University of Ulster's school of biomedical sciences. He said, "The subordination of the WHO to IAEA is a key part of the systematic falsification of nuclear risk which has been under way ever since Hiroshima, the agreement (between WHO and IAEA) creates an unacceptable conflict of interest in which the UN organisation concerned with promoting our health has been made subservient to those whose main interest is the expansion of nuclear power. IAEA's main role has been to promote the interests of the nuclear power industry worldwide."

(<http://www.beyondnuclear.org/home/2011/3/21/world-health-organizations-toxic-link-to-iaea.html>)?

Fifty years ago, on 28 May 1959, the World Health Organization's assembly voted into force an obscure but important agreement with the International Atomic Energy Agency – the United Nations "Atoms for Peace" organization, founded just two years before in 1957. The effect of this agreement has been to give the IAEA an effective veto on any actions by the WHO that relate in any way to nuclear power – and so prevent the WHO from playing its proper role in investigating and warning of the dangers of nuclear radiation on human health.

The WHO's objective is to promote "the attainment by all peoples of the highest possible level of health", while the IAEA's mission is to "accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world". Although best known for its work to restrict nuclear proliferation, the IAEA's main role has been to promote the interests of the nuclear power industry worldwide, and it has used the agreement to suppress the growing body of scientific information on the real health risks of nuclear radiation.

Under the agreement, whenever either organization wants to do anything in which the other may have an interest, it "shall consult the other with a view to adjusting the matter by mutual agreement". The two agencies must "keep each other fully informed concerning all projected activities and all programs of work which may be of interest to both parties". And in the realm of statistics – a key area in the epidemiology of nuclear risk – the two undertake "to consult with each other on the most efficient use of information, resources, and technical personnel in the field of statistics and in regard to all statistical projects dealing with matters of common interest".

The language appears to be evenhanded, but the effect has been one-sided. For example, investigations into the health impacts of the Chernobyl nuclear accident in Ukraine on 26 April 1986 have been effectively taken over by IAEA and dissenting information has been suppressed. The health effects of the accident were the subject of two major conferences, in Geneva in 1995, and in Kiev in 2001. But the full proceedings of those conferences remain unpublished – despite claims to the contrary by a senior WHO spokesman reported in *Le Monde Diplomatique*.

Meanwhile, the 2005 report of the IAEA-dominated Chernobyl Forum, which estimates a total death toll from the accident of only several thousand, is widely regarded as a whitewash as it ignores a host of peer-reviewed epidemiological studies indicating far higher mortality and widespread genomic damage. Many of these studies were presented at the Geneva and Kiev conferences but they, and the ensuing learned discussions, have yet to see the light of day thanks to the non-publication of the proceedings.

The British radiation biologist Keith Baverstock is another casualty of the agreement, and of the mindset it has created in the WHO. He served as a radiation scientist and regional adviser at the WHO's European Office from 1991 to 2003, when he was sacked after expressing concern to his senior managers that new epidemiological evidence from nuclear test veterans and from soldiers exposed to depleted uranium indicated that current risk models for nuclear radiation were understating the real hazards.

Now a professor at the University of Kuopio, Finland, Baverstock finally published his paper in the peer-reviewed journal *Medicine, Conflict and Survival* in April 2005. He concluded by calling for "reform from within the profession" and stressing "the political imperative for freely independent scientific institutions" – a clear reference to the non-independence of his former employer, the WHO, which had so long ignored his concerns.

Since the 21st anniversary of the Chernobyl disaster in April 2007, a daily "Hippocratic vigil" has taken place at the WHO's offices in Geneva, organised by Independent WHO to persuade the WHO to abandon its the WHO-IAEA Agreement. The protest has continued through the WHO's 62nd World Health Assembly, which ended yesterday, and will endure through the executive board meeting that begins today. The group has struggled to win support from WHO's member states. But the scientific case against the agreement is building up, most recently when the European Committee on Radiation Risk (ECRR) called for its abandonment at its conference earlier this month in Lesvos, Greece.

At the conference, research was presented indicating that as many as a million children across Europe and Asia may have died in the womb as a result of radiation from Chernobyl, as well as hundreds of thousands of others exposed to radiation fallout, backing up earlier findings published by the ECRR in *Chernobyl 20 Years On: Health Effects of the Chernobyl Accident*. Delegates heard that the standard risk models for radiation risk published by the International Committee on Radiological Protection (ICRP), and accepted by WHO, underestimate the health impacts of low levels of internal radiation by between 100 and 1,000 times – consistent with the ECRR's own 2003 model of radiological risk (*The Health Effects of Ionising Radiation Exposure at Low Doses and Low Dose Rates for Radiation Protection Purposes: Regulators' Edition*).

According to Chris Busby, the ECRR's scientific secretary and visiting professor at the University of Ulster's school of biomedical sciences: "The subordination of the WHO to IAEA is a key part of the systematic falsification of nuclear risk which has been under way ever since Hiroshima, the agreement creates an unacceptable conflict of interest in which the UN organisation concerned with promoting our health has been made subservient to those whose main interest is the expansion of nuclear power. Dissolving the WHO-IAEA agreement is a necessary first step to restoring the WHO's independence to research the true health impacts of ionising radiation and publish its findings." (Source: *Beyond Nuclear*) We are dependent on independent studies.

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## **Post-Accident Studies**

### **Three Mile Island, Chernobyl, Fukushima**

### Three Mile Island 1979-2005

Author: Eric Epstein, Chairman, Three Mile Island Alert, October 2011

<http://www.tmia.com/taxonomy/term/12>

On March 30, 1979, Governor Richard Thornburgh recommended an evacuation for preschool children and pregnant women living within five miles of Three Mile Island ("TMI"). Data collected since the meltdown clearly demonstrate a significant nexus between radiation exposure and adverse health impacts to women and children.

A great deal of radiation was indeed released by the core melt at TMI. The President's Commission estimated about 15 million curies of radiation were released into the atmosphere. A review of dose assessments, conducted by Dr. Jan Beyea, (National Audubon Society; 1984) estimated that from 276 to 63,000 person-rem were delivered to the general population within 50 miles of TMI. David Lochbaum of the Union of Concern Scientists estimated between 40 million curies and 100 million curies escaped during the Accident.

- 1979-1988: Katagiri Health Surveys begin and involve 250 residents living around Three Mile Island. This field research documented increased cancer incidences and mortalities in population pockets exposed by radioactive plumes.
- March 1982, *The American Journal of Public Health* reported, "During the first two quarters of 1978, the **neonatal mortality rate** within a ten- mile radius of Three Mile Island was 8.6 and 7.6 per 1,000 live births, respectively. During the first quarter of 1979, following the startup of accident prone Unit 2, the rate jumped to 17.2; it increased to 19.3 in the quarter following the accident at TMI and returned to 7.8 and 9.3, respectively, in the last two quarters of 1979." (**Dr. Gordon MacLeod, Secretary, Pennsylvania Department of Health**)
- Penn State Professor Winston Richards reported, "Infant mortality for Dauphin County, while average in 1978, **becomes significantly above average in 1980.**"
- 1984: The first Voluntary Community Health Study was undertaken by a group of local residents trained by Marjorie Aamodt. That study found a 600 percent cancer death rate increase for three locations on the west shore of TMI directly in the plumes' pathway. The data were independently verified by experts from the TMI Public Health Fund.
- 1985: Jane Lee surveyed 409 families living in a housing development five miles from TMI. Lee documented 23 cancer deaths, 45 cancer incidences, 53 benign tumors, 31 miscarriages, stillbirths and deformities, and 204 cases of respiratory problems.
- By 1985, TMI's owners and builders had paid more than \$14 million for out-of-court settlements of personal injury lawsuits including \$12.250 million paid to 280 plaintiffs and **Orphans Court Cases**.
- August 1985: Marc Sheaffer, a psychologist at the Uniformed Services University of the Health Sciences in Bethesda, released a study linking TMI-related stress with **immunity impairments**.
- August 1987: Prof. James Rooney and Prof. Sandy Prince of Embury of Penn State University-Harrisburg reported that "**chronically elevated levels of psychological stress**" have existed among Middletown residents since the Accident.

- April 1988: Andrew Baum, professor of medical psychology at the Uniformed Services University of the Health Sciences in Bethesda discussed the results of his research on TMI residents in Psychology Today. "When we compared groups of people living near Three Mile Island with a similar group elsewhere, we found that the Three Mile Island group reported more physical complaints, such as headaches and back pain, as well as more **anxiety and depression. We also uncovered long- term changes in levels of hormones...**These hormones affect various bodily functions, including muscle tension, cardiovascular activity, overall metabolic and immune-system function..."
- James Fenwick, a researcher at Millersville University, found statistically **significant increases of kidney, renal, pelvis and ovarian cancer in women.** (April 1998)
- June 1991: Columbia University's Health Study (Susser-Hatch) published results of their findings in the American Journal of Public Health. The study actually shows a more than doubling of all observed cancers after the accident at TMI-2, including lymphoma, leukemia, colon and the **hormonal category of breast, endometrium, ovary, prostate and testis.** For leukemia and lung cancers in the six to 12 km distance, the number observed was almost four times greater. In the 0-six km range, colon cancer was four times greater. The study found "a statistically significant relationship between incidence rates after the accident and residential proximity to the plant."
- August 1996: A study by the University of North Carolina-Chapel-Hill, authored by Dr. Steven Wing, reviewed the Susser-Hatch (Columbia University) study released in June 1991. Dr. Wing reported "...there were reports of erythema, hair loss, vomiting, and pet death near TMI at the time of the accident...**Accident doses were positively associated with cancer incidence.** Associations were largest for leukemia, intermediate for lung cancer, and smallest for all cancers combined...Inhaled radionuclide contamination could differentially impact lung cancers, which show a clear dose-related increase.
- By 1996, the plant's owners, codefendants and insurers have paid over **\$80 million** in health, economic and evacuation claims, including a \$1.1 million settlement for a baby born with Down's Syndrome.
- **Thyroid cancer, 1995-2002:** Dr. Roger Levin, chief division of otolaryngology/head and neck surgery, Pinnacle Health System in Harrisburg, and clinical associate professor of surgery, Penn State College of Medicine. Findings: In reviewing state health data, Levin found **more thyroid cancer cases than expected in York County for every year except one between 1995 and 2002.** One plausible reason could be people were exposed to radiation during the 1979 Three Mile Island accident, he said.

For an analysis of what happened at TMI see <http://www.fairewinds.org/nuclear-energy-education/writing-the-nuclear-meltdown-playbook>

## Chernobyl

There is a huge disparity in reports on the health impacts that resulted from the Chernobyl disaster. The most authoritative report is Chernobyl Consequences Of The Catastrophe For

People And The Environment, Alexey V. Yablokov, Vassily B. Nesterenko, Alexey V. Nesterenko, Annals of the New York Academy of Sciences, Vol 1181.

([http://www.strahlentelex.de/Yablokov\\_Chernobyl\\_book.pdf](http://www.strahlentelex.de/Yablokov_Chernobyl_book.pdf)); and video

Summarizing the book (<http://blip.tv/envirovideo/chernobyl-a-million-casualties-4940000>)

We also recommend, the British Scientific Journal, ISIS Report 24/05/12 [Science in Society UK] reports Chernobyl deaths top a million.<sup>124</sup>

## Fukushima

The health impacts from Fukushima will need to be assessed for several decades. The World Health Organization (WHO) - which cannot pronounce on things nuclear without ceding to the nuclear-promoting International Atomic Energy Agency (IAEA)<sup>125</sup> - predictably downplayed the likely health impacts resulting from the Fukushima nuclear disaster. The Japanese government went even further, suggesting the WHO over-stated the likely impacts. Fundamentally, the WHO found, after a two-year study, that "the risk for certain types of cancers had increased slightly among children exposed to the highest doses of radioactivity, but that there would most likely be no observable increase in cancer rates in the wider Japanese population." However, the agency was at least forced to admit that "their assessment was based on limited scientific knowledge; much of the scientific data on health effects from radiation is based on acute exposures like those that followed the bombing of Hiroshima and Nagasaki and not chronic, low-level exposure."

**Thyroid Cancer:** A 2015 Japanese study that analyzed prefecture data on childhood leukemia up to December 31, 2014, published in the November 2015 issue of *Epidemiology* says that children living near the Fukushima nuclear meltdowns have been diagnosed with thyroid cancer at a rate 20 to 50 times that of children elsewhere, a difference the authors contend undermines the government's position that more cases have been discovered in the area only because of stringent monitoring<sup>126</sup>.

The highest incidence rate ratio was among people whose district was not evacuated, 50 to 60 km (30 to 40 miles approximately) west from the Fukushima nuclear reactors. Data show 605 thyroid cancer cases per million examinees. The expected cases of thyroid cancer for children is 1-2 per year per million. Ground contamination does not necessarily reflect exposure. Some of

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<sup>124</sup> [http://www.i-sis.org.uk/Chernobyl\\_Deaths\\_Top\\_a\\_Million.php](http://www.i-sis.org.uk/Chernobyl_Deaths_Top_a_Million.php) ISIS website is now archived by the British Library as part of UK national documentary heritage. ISIS is an independent, not-for-profit organisation dedicated to providing critical public information on cutting edge science, and to promoting social accountability and ecological sustainability in science.

<sup>125</sup> <https://www.nirs.org/radiation/whoiaestatment.pdf>

<sup>126</sup> <http://www.beyondnuclear.org/home/2015/10/8/new-study-claims-a-30-fold-increase-in-thyroid-cancer-in-fuk.html>; and, [http://www.nytimes.com/aponline/2015/10/08/world/asia/ap-as-japan-nuclear-childrens-cancer.html?\\_r=0](http://www.nytimes.com/aponline/2015/10/08/world/asia/ap-as-japan-nuclear-childrens-cancer.html?_r=0) (AP, NYT, October 8, 2015)

the most exposed people came from areas where radionuclide deposition was minimal, but *radioactive iodine in the air as a result of the catastrophe still exposed them.*

The magnitude of the increase is too great to be explained by increased screening since available data show a 2 to 3- and at most a 6 to 7-fold increase would be attributable to enhanced screening efforts. The data examined by Tsuda, the study's chief author, show cancer cases an order of magnitude higher.

The cancers found by this screening in Fukushima prefecture had metastasized to lymph nodes in 74% of cases (40 cases out of 54), meaning these cancers were not in early stages of development. Therefore, when interpreting the data, overtreatment is also not an issue; a conclusion shared by doctors who helped treat these patients.

Contrary to claims that we would not be seeing an increase in cancers this early (within a year after exposure to radioactivity), radioactivity from Fukushima could have caused this increase in thyroid cancers because excess cancers were observed subsequent to Chernobyl in the earlier years. Further, the US CDC recognizes a minimum empirical induction time for thyroid cancer of 2.5 years in adults; and 1 year in children for all cancers including thyroid. The minimum latency for leukemia is 0.4 years (146 days).

The Japanese study concludes: "In Chernobyl, excesses of thyroid cancer became more remarkable 4 or 5 years after the accident in Belarus and Ukraine, so the observed excess alerts us to prepare for more potential cases within a few years. Furthermore, we could infer a possibility that exposure doses for residents were higher than the official report or the dose estimation by the World Health Organization, because the number of thyroid cancer cases grew faster than predicted in the World Health Organization's health assessment report."

Earlier studies, 39 months after the three explosions at Fukushima, showed thyroid cancer rates among children living nearby increased to more than forty times (40x) normal. More than 48 percent of some 375,000 young people—nearly 200,000 kids—tested by the Fukushima Medical University near the reactors now have pre-cancerous thyroid abnormalities, primarily nodules and cysts. The nuclear industry and its apologists continue to deny these health effects. However the findings are consistent with impacts suffered among children near the 1979 accident at Three Mile Island and the 1986 explosion at Chernobyl, as well as findings at other commercial reactors.

The truth is that we do not have sufficient data to provide accurate information on the long-term impact. The reactors continue to release radiation and the cores have not been examined to make accurate exposure predictions. What we can say, though, is that there are very likely to be very significant long-term health impacts from prolonged exposure.

New emerging evidence from Fukushima shows that nuclear disasters and their aftermaths kill thousands of people due to necessary evacuations. In future, these deaths from ill-health and suicides should be included in assessments of the fatalities from nuclear disasters. In sum, the human toll from Fukushima is horrendous: 2,000 Japanese people have died from the evacuations and another 5,000 are expected to die from future cancers.

**1. Deaths from Necessary Evacuations** Official data from Fukushima show that nearly 2,000 people died from the effects of evacuations necessary to avoid high radiation exposures from the disaster, including suicides. [http://www.reconstruction.go.jp/topics/main-cat2/sub-cat2-1/20141226\\_kanrenshi.pdf](http://www.reconstruction.go.jp/topics/main-cat2/sub-cat2-1/20141226_kanrenshi.pdf) The uprooting to unfamiliar areas, cutting of family ties, loss of social support networks, disruption, exhaustion, poor physical conditions and disorientation can and do result in many people, in particular older people, dying. Increased suicide has occurred among younger and older people following the Fukushima evacuations, but the trends are unclear.

[www.pref.fukushima.lg.jp/uploaded/attachment/62562.docx](http://www.pref.fukushima.lg.jp/uploaded/attachment/62562.docx) (4 minutes to download). A Japanese Cabinet Office report stated that, between March 2011 and July 2014, 56 suicides in Fukushima Prefecture were linked to the nuclear accident. [http://www.japantimes.co.jp/news/2014/08/26/national/socialissues/fukushimas-high-number-disaster-related-suicides-likely-due-nuclear-crisis-cabinetoffice/#.Vcstm\\_mrGzl](http://www.japantimes.co.jp/news/2014/08/26/national/socialissues/fukushimas-high-number-disaster-related-suicides-likely-due-nuclear-crisis-cabinetoffice/#.Vcstm_mrGzl). This should be taken as a minimum, rather than a maximum, figure.

**2. Mental Health Consequences** It is necessary to include the mental health consequences of radiation exposures and evacuations. For example, Becky Martin has stated her PhD research at Southampton University in the UK shows that “most significant impacts of radiation emergencies are often in our minds”. She adds “...imagine that you’ve been informed that your land, your water, the air that you have breathed may have been polluted by a deadly and invisible contaminant. Something with the capacity to take away your fertility, or affect your unborn children. Even the most resilient of us would be concerned.... many thousands of radiation emergency survivors have subsequently gone on to develop Post-Trauma Stress Disorder (PTSD), depression, and anxiety disorders as a result of their experiences and the uncertainty surrounding their health.”

<http://www.theguardian.com/science/brain-flapping/2015/aug/09/nagasakianniversary-radiation-nuclear-mental-health>.

It is likely that these fears, anxieties, and stresses will act to magnify the effects of evacuations, resulting in even more old people dying or people committing suicide. The above sections should not be taken as arguments against evacuations: they are an important, life-saving strategy. But, as argued by Becky Martin, “we need to provide greatly improved social support following resettlement and extensive long-term psychological care to all

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<sup>127</sup> <https://www.ianfairlie.org/wp-content/uploads/2015/08/Summing-up-the-Effects-of-the-Fukushima-Nuclear-Disaster-10.pdf>; and Dr. Ian Fairlie’s CV [https://en.wikipedia.org/wiki/Ian\\_Fairlie](https://en.wikipedia.org/wiki/Ian_Fairlie)

radiation emergency survivors, to improve their health outcomes and preserve their futures”.

**3. Untoward Pregnancy Outcomes** Recently, Dr Alfred Körblein from Nuremberg in Germany noticed a 15% drop (statistically speaking, highly significant) in the numbers of live births in Fukushima Prefecture in December 2011, ie 9 months after the accident. This might point to higher rates of early spontaneous abortions. He also observed a (statistically significant) 20% increase in the infant mortality rate in 2012, relative to the long-term trend in Fukushima Prefecture plus six surrounding prefectures.

[http://www.strahlentex.de/Koerblein\\_Fukushimaupdate\\_engl.pdf](http://www.strahlentex.de/Koerblein_Fukushimaupdate_engl.pdf). These are indicative rather than definitive findings and need to be verified by further studies. Unfortunately, such studies are notable by their absence.

**4. Cancer and other late effects from radioactive fallout** Finally, we have to consider the health effects of the radiation exposures from the radioactive fallouts after the four explosions and three meltdowns at Fukushima in March 2011. Large differences of view exist on this issue in Japan. These make it difficult for lay people and journalists to understand what the real situation is.

*BOX: An explainer The Japanese Government, its advisors, and most radiation scientists in Japan (with some honourable exceptions) minimise the risks of radiation. The official widely-observed policy is that small amounts of radiation are harmless: scientifically speaking this is untenable. For example, the Japanese Government is attempting to increase the public limit for radiation in Japan from 1 mSv to 20 mSv per year. Its scientists are trying to force the ICRP to accept this large increase. This is not only unscientific, it is also unconscionable. Part of the reason for this policy is that radiation scientists in Japan (in the US, as well) appear unable or unwilling to accept the stochastic nature of low-level radiation effects. “Stochastic” means an all-or-nothing response: you either get cancer etc or you don’t. As you decrease the dose, the effects become less likely: your chance of cancer declines all the way down to zero dose. The corollary is that tiny doses, even well below background, still carry a small chance of cancer: there is never a safe dose, except zero dose. But, as stated by Spycher et al (2015) <http://ehp.niehs.nih.gov/1510111R/>, some scientists “...a priori exclude the possibility that low dose radiation could increase the risk of cancer. They will therefore not accept studies that challenge their foregone conclusion.” One reason why such scientists refuse to accept radiation’s stochastic effects (cancers, strokes, CVS diseases, hereditary effects, etc) is that they only appear after long latency periods - often decades for solid cancers. For the Japanese Government and its radiation advisors, it seems out-of-sight means out-of-mind. This conveniently allows the Japanese Government to ignore radiogenic late effects. But the evidence for them is absolutely rock solid. Ironically, it comes primarily from the world’s largest on-going epidemiology study, the Life Span Study of the Japanese atomic bomb survivors by the RERF Foundation which is based in Hiroshima and Nagasaki. [http://www.rerf.jp/index\\_e.html](http://www.rerf.jp/index_e.html)*

The mass of epidemiological evidence from the Chernobyl disaster in 1986 clearly indicates that cancer etc. increases will very likely also occur at Fukushima, but many Japanese (and US) scientists deny this evidence.

3 For example, much debate currently exists over the existence and interpretation of increased thyroid cancers, cysts, and nodules in Fukushima Prefecture resulting from the disaster. From the findings after Chernobyl, thyroid cancers are expected to start increasing 4 to 5 years after 2011. It's best to withhold comment until clearer results become available in 2016, but early indications are not reassuring for the Japanese Government. After then, other solid cancers are expected to increase as well, but it will take a while for these to become manifest.

The best way of forecasting the numbers of late effects (i.e.. cancers etc.) is by estimating the collective dose to Japan from the Fukushima fall out. We do this by envisaging that everyone in Japan exposed to the radioactive fallout from Fukushima has thereby received lottery tickets: but they are negative tickets. That is, if your lottery number comes up, you get cancer<sup>1</sup>. If you live far away from Fukushima Daiichi NPP, you get few tickets and the chance is low: if you live close, you get more tickets and the chance is higher. You can't tell who will be unlucky, but you can estimate the total number by using collective doses. The 2013 UNSCEAR Report ([http://www.unscear.org/docs/reports/2013/13-85418\\_Report\\_2013\\_Annex\\_A.pdf](http://www.unscear.org/docs/reports/2013/13-85418_Report_2013_Annex_A.pdf)) has estimated that the collective dose to the Japanese population from Fukushima is 48,000 person Sv: this is a very large dose: see below.

Unfortunately, pro-nuclear Japanese scientists also criticise the concept of collective dose as it relies on the stochastic nature of radiation's effects and on the Linear No Threshold (LNT) model of radiation's effects which they also refute. But almost all official regulatory bodies throughout the world recognise the stochastic nature of radiation's effects, the LNT, and collective doses.

**5. Summing Up Fukushima** About 60 people died immediately during the actual evacuations in Fukushima Prefecture in March 2011. Between 2011 and 2015, an additional 1,867 people in Fukushima Prefecture died as a result of the evacuations following the nuclear disaster. These deaths were from ill health and suicides.

<http://www.japantimes.co.jp/news/2015/03/15/national/death-tollgrows-in-311-aftermath/#.Vcn84PmrGzm>. From the UNSCEAR estimate of 48,000 person Sv, it can be reliably estimated (using a fatal cancer risk factor of 10% per Sv) that about 5,000 fatal cancers will occur in Japan in future from Fukushima's fallout. This estimate from official data agrees with my own personal estimate using a different methodology <http://www.ianfairlie.org/news/new-unscearreport-on-fukushima-collective-doses/>. In sum, the health toll from the Fukushima nuclear disaster is horrendous. At the minimum 1 Credit to Jan Beyea in the US for the negative lottery idea. 2 Correct as of March 2015. 3 In addition, 1,603 people were killed directly by the earthquake and tsunami in Fukushima Prefecture, and approximately 1,350 tsunami evacuee deaths occurred in Miyagi and Iwate Prefectures: in the latter cases, the evacuations were not radiation related.

- Over 160,000 people were evacuated most of them permanently.
- Many cases of post-trauma stress disorder (PTSD), depression, and anxiety disorders arising from the evacuations.

- About 12,000 workers exposed to high levels of radiation, some up to 250 mSv • An estimated 5,000 fatal cancers from radiation exposures in future.
- Plus similar (unquantified) numbers of radiogenic strokes, CVS diseases and hereditary diseases.
- Between 2011 and 2015, about 2,000 deaths from radiation-related evacuations due to ill-health and suicides.
- And, as yet unquantified number of thyroid cancers.
- An increased infant mortality rate in 2012 and a decreased number of live births in December 2011. Non-health effects include
- 8% of Japan (30,000 km<sup>2</sup>), including parts of Tokyo, contaminated by radioactivity.
- Economic losses estimated between \$300 and \$500 billion.

**6. Conclusions** The Fukushima accident is still not over, and its ill-effects will linger for a long time into the future. However we can say now that the nuclear disaster at Fukushima delivered a huge blow to Japan and its people. 2,000 Japanese people have already died from the evacuations and another 5,000 are expected to die from future cancers. It is impossible not to be moved by the scale of Fukushima's toll in terms of deaths, suicides, mental ill-health and human suffering. Fukushima's effect in Japan is similar to Chernobyl's massive blow against the former Soviet Union in 1986. Indeed, several writers have expressed the view that the Chernobyl nuclear disaster was a major factor in the subsequent collapse of the USSR during 1989-1990. It is notable that Mikhail Gorbachev, President of the USSR at the time of Chernobyl and Naoto Kan, Prime Minister of Japan at the time of Fukushima have both expressed their opposition to nuclear power. <http://bos.sagepub.com/content/67/2/77.full> Indeed Kan has called for all nuclear power to be abolished. <https://wallofcontroversy.wordpress.com/2014/03/17/japans-ex-prime-minister-naoto-kan-on-how-fukushima-changed-his-mind-about-nuclear-power/> Has the Japanese Government, and indeed other governments (including the UK and US), learned from these nuclear disasters? The US philosopher George Santayana (1863-1962) once stated that those who cannot learn from history are doomed to repeat it. Dr IAN FAIRLIE

To learn more, see: Dr. Helen Caldicott's March 11 and 12, 2013 NYC symposium, "The Medical and Ecological Consequences of the Fukushima Nuclear Accident," is now viewable online at <http://www.totalwebcasting.com/view/?id=hcf#>

### **Projected Health Consequences Of A Spent Fuel Accident Dry Cask Accident Or Leak**

Potential for Release from a Cask and Consequences: Dr. Thompson observed that casks are not robust in terms of its ability to withstand penetration by weapons available to sub-national

groups. A typical cask would contain 1.3 MCi of cesium-137, about half the total amount of cesium-137 released during the Chernobyl reactor accident of 1986. Most of the offsite radiation exposure from the Chernobyl accident was due to cesium-137. Thus, a fire inside an ISFSI module, as described in the preceding paragraph, could cause significant radiological harm.

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## **NRC REGULATORY EXEMPTIONS**

The NRC regularly grants exemptions from what its regulations require. The current regulation on exemptions is § 50.12 Specific exemptions.<sup>128</sup> The NRC is in the process of updating its decommissioning rules, expected completed by 2022. The proposed regulatory changes would specifically allow what the NRC now allows in its regulatory exemptions.

According to the NRC, these changes:

“...are over-all cost beneficial to the nuclear power industry, federal, state and local governments and the general public and ... would result in a net averted cost from \$12.5 million (7-percent NPV) to \$32.3 million (3-percent NPV). Most of the cost savings are attributable to the relief of exemptions and amendments that licensees would typically submit to the NRC for review and approval during decommissioning.”  
(NRC 154)<sup>129</sup>

The proposed changes would clearly result in significant savings for licensees and the NRC. Under current regulations, licensees are required to seek exemptions from significant regulatory requirements. As proposed, it would be unnecessary for a licensee to seek, or the NRC to review, these exemptions.

The “savings” to state and local governments and the public have nothing to do with public health and safety. Rather, the NRC found that there would be “beneficial” savings because state and local governments and the public would no longer have to spend time and money in efforts to convince the NRC and exemptions or amendments to an operating license such as Pilgrims should not be granted. Under the proposed new regulations, licensees would no longer have to submit proposed exemptions and amendments to the NRC for review, there would be no NRC review, and the public would have no opportunity to tell the NRC the other side of the story.

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<sup>128</sup> <https://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-0012.html>

<sup>129</sup> *Regulatory Analysis for Regulatory Basis: Regulatory Improvements for Power Reactors Transitioning to Decommissioning*, NRC-2015-0070; RIN 3150-AJ59. e NRC’s Adams Library, Accession Number, ML 173302A075

The NRC has already granted Important exemptions to Pilgrim, including the following: Licensees may use Decommissioning Trust Fund for spent fuel management and site restoration expenses; essentially ending responsibility for off-site emergency planning; no need to comply with cyber security requirements; and reduce offsite and on-site liability insurance.

### **Using the DTF for Spent Fuel Management and Site Restoration**

Title 10 of the Code of Federal Regulations, Section 50.2 (10 CFR 50.2) defines decommissioning as the safe removal of a facility from service and reduction of residual radioactivity to a level that permits termination of the NRC license. It followed that the Decommissioning Trust Fund was limited to “reduction of residual radioactivity to a level that permits termination of the NRC license.” NRC then expanded what the DTF could be used. On July 22, 2019 NRC informed Entergy that it will allow funds from the Decommissioning Trust Fund to be used for spent fuel management and site restoration.<sup>130</sup> On August 22, 2019, NRC granted Holtec Pilgrim and HDI an exemption from 10 CFR 50.82(a)(8)(i)(A) to allow them to use of a portion of the funds from the Pilgrim DTF for spent fuel management and site restoration activities consistent with the revised PSDAR and site-specific DCE dated November 16, 2018. NRC also allows use of the DTF for insurance, any emergency planning expenses, taxes, lobbying fees, and incidentals. These exemptions are effective upon the NRC’s issuance of a conforming license amendment reflecting HDI and Holtec Pilgrim as the licensees for Pilgrim, following NRC approval of the license transfer application and the Applicants’ completion of the transaction.<sup>131</sup>

Holtec’s Annual Decommissioning Funding and Spent Fuel Management Status Financial Report, as of December 31, 2019, said that:

|                                      |                          |
|--------------------------------------|--------------------------|
| Current decommissioning fund balance | \$979 M.                 |
| Estimate to complete decommissioning | \$1,031 M (2019 dollars) |
| License termination expenses         | \$548M                   |
| Spent fuel management                | \$443 M                  |
| Site Restoration costs               | \$40 M                   |

Before the exemption, the licensee presumably would be responsible for paying spent fuel management and soil restoration costs, about \$500 M or one-half the amount in the DTF. Holtec will recoup most of the spent fuel management costs from suing DOE for its failure to satisfy its contract to take Pilgrim’s spent fuel by 1998. Although Holtec never put a dime into the DTF, it is the public’s money, it will nevertheless pocket it.

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<sup>130</sup> NRC electronic Library, Adams, Accession Number ML19136A222.

<sup>131</sup> <https://www.nrc.gov/docs/ML1919/ML19192A086.pdf>

## Emergency Planning

On November 4, 2019, the NRC Commission exempted Entergy from requirements for offsite radiological emergency planning. On January 2, 2020, NRC extended the exemption to Holtec, the new owners of Pilgrim Station. These exemptions eliminate requirements for offsite radiological emergency planning, including emergency planning zones (EPZs) and all state & local funding for effectuate those plans ten months after the reactor shutdown date, April 1, 2020. NRC Commissioner Baran dissented from the majority opinion.<sup>132</sup> He noted among other points that state's all hazards emergency plans did not work for radiological emergencies, and that FEMA and states such as Massachusetts opposed the exemption.

The NRC allowed the exemptions largely based on its incorrect beliefs that (1) "the very low probability of beyond-design-basis events" that could initiate a zirconium fire in the spent fuel pool and (2) the staff's conclusion that, if such an event occurred, ten hours from the loss of spent fuel pool cooling "would be sufficient time to initiate appropriate [spent fuel pool] mitigating actions" and take any necessary offsite protective actions using an all-hazards emergency plan that would allow evacuation in a timely manner.

NRC's assumptions are not supported by FEMA, MEMA, Multi-State Committee on Emergency Response Planning of the Conference of Radiation Control Program Directors (CRCPD), the States of Ohio, Massachusetts, Vermont, Connecticut, and New York,<sup>133</sup> the Massachusetts legislature created Nuclear Decommissioning Citizen Advisory Group,<sup>134</sup> EPZ Boards of Selectmen and Emergency Planning Director,<sup>135</sup> or numerous public interest groups.<sup>136</sup>

### **NRC's assumptions are not credible:**

First, although the events that could cause a spent fuel pool fire or release from a dry cask may be fewer than from an operating reactor, radiological emergency planning has never been exclusively based on the probability of an accident; instead, it is based on preparation to protect public health and safety in the event an accident occurs. Unless you can say there is no evacuation potential, you need radiological emergency planning.

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<sup>132</sup> <https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML19305C739>

<sup>133</sup> <https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML19305C739> NRC Commissioner Baran's Dissent SECY-19-0078: Request by Entergy Nuclear Operations for Exemptions from Certain Emergency Planning Requirements for the Pilgrim Nuclear Power Station, Footnotes 5-19.

<sup>134</sup> <https://www.mass.gov/orgs/nuclear-decommissioning-citizens-advisory-panel> 2018 Annual Report, pg., 16.

<sup>135</sup> The Towns of Duxbury and Plymouth, for example, have made specific requests to the Pilgrim's licensee to continue financing offsite radiological planning. Documents can be provided on request. The Town of Duxbury at its Annual Town Meeting have voted in support of the licensee to continue funding radiological emergency planning until the spent fuel leaves the site-Article 29, 2014 and Article 39, 2019 available Duxbury Town Clerk.

<sup>136</sup> Examples: Clean Water Action, Toxics Action Center, MASSPIRG, Greater Boston Physicians for Social Responsibility, Plymouth League of Women Voters.

Second, FEMA, MEMA, local emergency directors and a long list of others agree radiological disasters are unique and existing all hazards emergency plans are not sufficient.

Third, absent monies for state and local radiological emergency plans that allow training, communication equipment, notification, traffic control, decontamination equipment and centers etc., NRC's statement that the public could evacuate within 10 hours is absurd on its face.

### **Risks and Consequences:**

- A spent fuel dry cask disaster can result from acts of malice; stress corrosion cracks in the 0.5" thin canister shell; and an earthquake. Each of the 61 dry casks contain 68 spent fuel assemblies, and ½ to 1/3 the Cesium-137 released at Chernobyl, depending on age of fuel in canister. Spent fuel canisters can develop cracks and leaks due to corrosion or manufacturing defects.
- A spent fuel pool fire can result from: a canister that weighs 40 tons drops in the pool during transfer and punctures the floor; a terrorist attack; malfunction of transfer equipment; an earthquake. The consequences, according to studies by the MAAGO,<sup>137</sup> NRC and Princeton University showed potential contamination to an area (4) times the size of Massachusetts and hundreds of billions in damages and cancers.<sup>138</sup>
- A fire onsite in contaminated building during decommissioning can spread radiation offsite.

Evacuation in the event of a radiological accident was impossible when Pilgrim was operating, and without off-site emergency planning it is even less adequate today.

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<sup>137</sup> The Massachusetts Attorney General's Request for a Hearing and Petition for Leave to Intervene With respect to Entergy Nuclear Operations Inc.'s Application for Renewal of the Pilgrim Nuclear Power Plants Operating License and Petition for Backfit Order Requiring New Design features to Protect Against Spent Fuel Pool Accidents, Docket No. 50-293, May 26, 2006 includes a Report to The Massachusetts Attorney General On The Vulnerability of Pilgrim's Spent Fuel Pool- Risks and Risk-Reducing Options Associated with Pool Storage of Spent Nuclear Fuel at the Pilgrim and Vermont Yankee Nuclear Power Plants, Gordon Thompson, May 25, 2006.

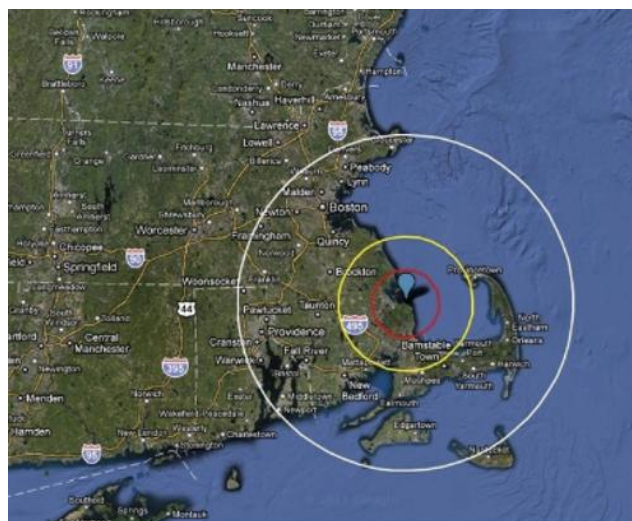
2. References: Risks and Risk-Reducing Options Associated with Pool Storage of Spent Nuclear Fuel at the Pilgrim and Vermont Yankee Nuclear Power Plants-A report for the Massachusetts Attorney General, Dr. Gordon Thompson, May 25, 2006; Comments on the US Nuclear Regulatory Commission's Draft Consequence Study of a Beyond-Design Basis Earthquake Affecting the Spent Fuel Pool for a US Mark I Boiling Water Reactor, Dr. Gordon Thompson, August 1, 2013; Environmental Impacts of Storing Spent Nuclear Fuel and High-Level Waste from Commercial Nuclear Reactors: A Critique of NRC's Waste Confidence Decision and Environmental Impact Determination, Dr. Gordon Thompson, Feb 6, 2009. Documents available on NRC Electronic Library, ADAMS

<sup>138</sup> Richard Stone, "Spent fuel fire on U.S. soil could dwarf impact of Fukushima," *Science*, May 24, 2016. (available at: <http://www.sciencemag.org/news/2016/05/spent-fuel-fire-us-soil-could-dwarf-impact-fukushima>)



### Consequences Extend Beyond the 5-town, 10-mile Emergency Planning Zone

First, MEMA will lose its yearly assessment needed to fund its radiological emergency planning department. Plans and equipment are needed not only for the towns close to the reactor but also for communities impacted that are downwind but further distant - well beyond 10 miles. Fearing a spent fuel pool fire at Fukushima, the US State Department recommended citizens within 50-miles of Fukushima evacuate. The outer ring on the map below marks 50-miles from Pilgrim. The Japanese Prime Minister, Nato Kan, said if Fukushima's spent fuel pool went, Tokyo, 149 miles from Fukushima, would need to be evacuated and the Japanese economy would crumble.



Second, citizens close to Pilgrim's site in a disaster will eventually evacuate and bring radiation with them on their cars, bodies, personal belongings, and pets. No planning means no decontamination centers. Therefore, where the evacuees travel, stop, washup, and lodge will become contaminated too - spreading contamination though the state and neighboring states.

Third, absent timely evacuation and decontamination, the probability of radiation-linked health impacts increases - cancers, birth defects and reproductive disorders. These will be costly to the state in health care and employment losses.

It is important to understand that emergency response from a disaster in a dry cask are far more significant than a disaster in an operating reactor due to the huge amount of fuel in a cask. In an operating reactor accident, the federal government and state will test areas for contamination and advise return, as appropriate. In a dry cask disaster, there is unlikely to be any return due to extensive contamination. Hence the public needs to be advised of that fact so they will take important documents and keepsakes.

### **Who should Pay for Radiological Emergency Planning?**

Neither the Commonwealth nor the impacted towns can afford to pay; nor should they pay. It is after all a risk brought on by one party – Pilgrim’s licensee. Now that off-site radiologically emergency planning has officially ended due to NRC’s decision, the State will lose over a million dollars a year and towns in Pilgrim’s emergency planning zone, that annually negotiate funding with Entergy, will lose approximately \$85,000/yr. to \$295,000/yr. (depending on the town) plus monies for training and equipment.

Holtec Pilgrim LLC, Pilgrim’s owner, and Pilgrim Decommissioning International LLC, Pilgrim’s operator can well afford to pay. Holtec bought the site for roughly \$1,000, received ratepayers Decommissioning Trust Fund (\$1.03 B) to decommission the site, and is likely to make a profit of \$800M and not complete the job. The Commonwealth should not be stuck with the bill to complete the work.

The Town of Marshfield is suing Holtec to continue its radiological emergency planning expenses. The case is in Plymouth Superior Court. Filings can be accessed there.

### **Commonwealth Settlement Agreement**

Nothing in the Settlement Agreement requires payment to any of the towns in the EPZ to cover their emergency planning costs – that they will continue to incur until all spent nuclear fuel has been removed from the Pilgrim site.<sup>139</sup>

Section IV, Payments, Radiation Monitoring, ISFSI, and Waste Transportation, Para. 18 requires Holtec Pilgrim/HDI to “make payments to ...MEMA [for its operating expenses associated with decommissioning planning, decommissioning activities, and the decommissioning process in accordance with ...Table 2 (MEMA).”

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<sup>139</sup> During operations and post operations, Pilgrim’s owner negotiates annual payments for radiological emergency planning expenses with the state and with each EPZ community. Holtec agreed to pay Duxbury \$65,000 but only for one year, 2020 We believe Kingston and Carver received the same. Marshfield has sued Holtec. Plymouth received considerably more but less than it wanted.

As with the Table 12 payments to DPH, the Table 2 payments are based on questionable assumptions and decrease over time.

2021 - \$1,170,864 or \$500,000 depending on whether federal emergency planning requirements are in effect.

2022 - \$275,000 if all spent fuel has been moved to the ISFSI.

2023-2027 - \$50,000 until Partial Site Release.

2028 - \$32,500 – a half year of decommissioning costs and a half year of ISFSI costs.

2029 until License Termination - \$15,000.

MEMA has an “all hazards plan,” but that plan is not adequate for a radiological emergency. Even Holtec admits that spent nuclear fuel will remain on site until at least 2063. Does anyone seriously think that MEMA can provide the needed plans and protection for \$15,000?

The payments to MEMA under the Settlement Agreement reflect several questionable assumptions:

- i. The costs of MEMA being prepared for a potential radiological emergency will dramatically decrease – from \$500,000 in 2021 to \$250,000 in 2022 (Holtec’s original goal to move spent fuel into dry casks), and then to \$50,000 for 2023-2027 (Holtec’s projected date for Partial Site Release, and to only \$15,000 after 2028.
- ii. Once spent fuel has been moved into dry casks, it incorrectly assumes that there is little or no risk of a radiological release no matter how long the cask remains on site – even though there is no way to effectively inspect the condition of its thin-wall canister and no currently available technology to replace a failed or failing canister.
- iii. It incorrectly assumes that a dry cask failure will have little potential effect on the public health and the economy even though each dry cask contains half as much Cesium-137 as the total released at Chernobyl.
- iv. Even though MEMA’s all-hazards emergency plan does not provide for radiological emergencies, once spent fuel has been moved into dry casks, all MEMA needs to do to protect the public is to review documents, conduct communication checks, and follow what is going on at Pilgrim and what DOE may be doing.
- v. Although Pilgrim’s spent nuclear fuel will remain on site indefinitely, possibly for hundreds of years, all MEMA needs to do after 2029 is to participate in drills and exercises and security meetings.

### **Settlement Agreements with EPZ Towns, Reception Center Communities and Holtec**

The five towns within Pilgrim’s Emergency Planning Zone and the three towns hosting Reception Centers (RC) negotiated separate agreements with Holtec Pilgrim/HDI.

Carver: \$75,000 for three months of EPZ and to unwind the RERP and breakdown the alternate EOF

Duxbury: \$63,750, broken down as \$21,250 for the three months of the EPZ in 2020 and \$42,500 to unwind the RERP. Also, it says that if Duxbury provides mutual aid to the site at any point during the 8-year decommissioning and its equipment becomes contaminated Holtec. will provide replacement at no cost to the community.

Kingston: \$63,750, with the same break down and language as Duxbury.

Marshfield: \$120,196.21 for three months of EPZ payment. Marshfield has chosen to go challenge Holtec in court.

Plymouth: It has a 2 ½ year agreement through June 30, 2022, as the host community for Police and Fire services. Breaks down as \$150,000 1/1/20 to 6/30/20 and then \$230,000 the following two years 7/1/20-6/30/21 and 7/1/21-6/30/20

Braintree RC: \$42,000 Three months plus costs to breakdown the program

Taunton RC: \$56,500 three months plus costs to breakdown the program

Bridgewater RC: \$57,500 three months plus costs to breakdown the program

## State Legislation

Bills were filed in the State Legislature in 2020-2024 but were not reported favorably out of committee. Another bill was filed in 2025. HD.2477- An Act to improve public health and safety in communities around aging nuclear power plants and high-level nuclear waste dump sites, filed by Rep. Michelle Badger (Plymouth) and Rep Luddy Hadley (4<sup>th</sup> Barnstable). A Senate companion bill to be filed. <https://malegislature.gov/Bills/>

## Cyber Security

On January 2, 2020, the NRC exempted Pilgrim from the requirement to defend against cyber-attacks.<sup>140</sup> The exemption becomes effective 10 months after the cessation of power. This means digital security equipment needed to protect the spent nuclear fuel is now vulnerable.

The New York Times in 2017 reported that *Hackers Are Targeting Nuclear Facilities, Homeland Security Dept. and F.B.I. Say*.<sup>141</sup> Terrorist threats have increased, not decreased.

***Russian Cyber Attacks Call for Stringent Security Standards at US Nuclear Plants, But Plant Owners Want Them Weakened***, Union of Concerned Scientist, Dr. Edwin Lyman. <sup>142</sup> The press

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<sup>140</sup> NRC Electronic Library, Adams, Accession Number ML19276C420

<sup>141</sup> <https://www.nytimes.com/2017/07/06/technology/nuclear-plant-hack-report.html>

<sup>142</sup> <https://ucsusa.org/about/news/russian-cyber-attacks>

release explains the threat to spent fuel storage from cyber-attacks at decommissioned plants such as Pilgrim.

WASHINGTON (March 16, 2018)—Yesterday, the Department of Homeland Security and the Federal Bureau of Investigation officially confirmed that Russian hackers have been targeting US nuclear power plants and other critical facilities since at least 2016. Regardless, the US nuclear industry has been pressuring the Nuclear Regulatory Commission to relax its cyber security standards.

Below is a statement by Edwin Lyman, a senior scientist at the Union of Concerned Scientists.

“The Department of Homeland Security alert is a stark reminder that nuclear power plants are tempting targets for cyber attackers. Although the systems that control the most critical safety equipment at US nuclear plants are analog-based and largely immune to cyber-attacks, many other plant systems with important safety and security functions are digital and could be compromised. For instance, electronic locks, alarms, closed-circuit television cameras, and communications equipment essential for plant security could be disabled or reprogrammed. And some plants have equipment, such as [cranes that move highly radioactive spent fuel](#), that utilize computer-based control systems that could be manipulated to cause an accident.

“Reports that the recent attacks on nuclear power plants were limited to their administrative systems and did not affect systems that have direct safety and security functions are not cause for complacency. Sophisticated cyber intruders could access administrative systems to obtain—or plant—compromising information to coerce key personnel to assist in a damaging attack.

“Therefore, the nuclear industry’s [petition to limit the scope](#) of Nuclear Regulatory Commission cyber-protection safeguards to only those systems with a direct impact on safety is foolhardy at best and, at worse, downright dangerous. The NRC has been deliberating over the industry’s ill-conceived proposal for nearly four years. In light of the growing cyber threat to nuclear plants highlighted by yesterday’s alert, the agency should now simply reject it.”

## **Settlement Agreement**

Section IV, Paragraph 23 is concerned with cybersecurity, and requires HDI, “within thirty (30) days of the Effective Date, certify to the implementation of a cybersecurity plan at Pilgrim, which shall, at the very least, include [10] cybersecurity measures.” In substance, the ten measures seem to be what should be standard business practice, e.g., eliminating exposure of Critical Digital Assets to external networks, implementing network segmentation, using secure remote access methods, and using only strong passwords.

## **Liability Insurance - Price Anderson**

**Off-Site Liability Insurance:** On Jan 6, 2020, the Nuclear Regulatory Commission approved Holtec's request to reduce Pilgrim Nuclear Power Station's required level of primary offsite liability insurance from \$450 million to \$100 million and completely eliminated the requirement for PNPS to have any secondary financial protection.<sup>143</sup> The amount now required is peanuts. For example, according to the Duxbury Assessors Office, the Town's total assessed value of real and personal property for FY 2019 is \$4,264,085,075 – more than 42 times what Holtec says is enough insurance.

Holtec argued, and NRC concurred, that this reduction in required insurance is justified because there is less risk of an accident once a reactor is permanently closed. However, although the probability of an accident is reduced, the risk does not disappear. Any such accident will have significant offsite economic consequences. Until all spent fuel has been moved from the spent fuel pool into dry casks, the risk of a spent fuel pool fire remains, resulting from acts of malice, a fuel handling accident during transfer, equipment failure or human error. The NRC estimated that the offsite consequences of a major pool fire could include contaminating as much as 38,610 square miles of land, forcing the evacuation of millions, and trillions of dollars in damages. There is less risk after all the spent fuel has been moved into dry casks; but dry casks are subject to sabotage, corrosion, and leaks that cannot be repaired. Each of the 62 or more dry casks that will remain indefinitely at Pilgrim will contain more than half as much Cesium-127 as was released at Chernobyl. Offsite consequences may also result from a significant fire in a contaminated building or from leakage of contaminants into Cape Cod Bay.

**On-Site Liability Insurance:** NRC accepted Holtec's request to reduce on-site liability insurance from \$1.06 Billion to \$ 50 million based on same argument presented for the reduction of off-site insurance.

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## **PROTECTING OUR COMMUNITIES - PRIORITIES**

The primary goal of decommissioning is protection of the public and the environment until Pilgrim or any site has been completely decommissioned, the site has been cleaned-up and restored, and no spent fuel or other high-level waste remains on the site. This is a multi-faceted issue. These were the priorities Pilgrim Watch advocated for, but many were not achieved, and hopefully will be useful at other sites undergoing decommissioning. See the Settlement Agreement between the Commonwealth and Licensee to see what was achieved.

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<sup>143</sup> NRC Electronic Library, Adams, Accession Number ML 19282A192

## 1. Financial

- a. **Reporting:** Holtec<sup>144</sup> shall send the Massachusetts Attorney General any report provided to the NRC with respect to 10 C.F.R. 50.75 or 50.82(a)(8)(v) within ten (10) days of the date upon which it was provided the NRC.

Not later than March 31<sup>st</sup> of each calendar year until one calendar year after all Pilgrim NRC licenses have been terminated, Holtec also shall send the Massachusetts Attorney General a report that includes the following information:

- i. The current status of the Decommissioning Trust Fund.
- ii. The amount spent on each decommissioning activity, spent fuel storage or management, or site restoration, and the source of the money spent.
- iii. The estimated amount to complete each such decommissioning activity, and the expected source of money to complete such activities.
- iv. An audited listing of all expenditures and withdrawals from any decommissioning fund during the previous calendar that includes an itemization of any project, work, service, or activity for which any expenditure was made.
- v. The balances of any decommissioning funds as of the end of the previous calendar year.
- vi. An estimate of the costs to complete decommissioning (license termination), and complete site restoration, of the Pilgrim site.

As used in this section 1(a), “decommissioning activity” means any activity that is described in any Holtec PSDAR for Pilgrim or that is within the scope of the NRC’s definition of “decommissioning”; and “site restoration” means restoring and remediating the Pilgrim site to a condition such that (a) no portion of the site has a radiation level greater than that set forth in 3(b) below, (b) all hazardous non-radioactive materials have been removed from the site, and (c) Massachusetts and local laws, ordinances, and regulations do not restrict the use of the site.

- b. **DOE Recovery:** All spent fuel management costs recovered from DOE must be put into the Decommissioning Trust Fund and used only to pay decommissioning costs.
- c. **Parent Company Guarantee:** Holtec International (not an LLC subsidiary) must provide a Parent Company Guarantee of not less than \$500 million, after the payment of all taxes.

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<sup>144</sup> As used herein, “Holtec” means, collectively, Holtec International together with its subsidiaries and affiliated companies; and “Licensees” means Holtec Pilgrim and Holtec Decommissioning International.

Note: This is slightly less than the \$515 funding assurances provided in Section J of the current license, except that the parent (that has assets) rather than an LLC subsidiary must provide it.

- d. **Monitoring:** Until all spent nuclear fuel has been moved into dry casks in the ISFSI, Holtec shall make annual payments to the Massachusetts Department of Public Health (MDPH) to defray the costs incurred by the department's radiation control program for offsite and onsite radiological monitoring and testing (including funding the state lab). With respect to 2019, the payment shall be \$500,000. With respect to each subsequent calendar year, the payment shall be in an amount equal to the costs incurred in the prior calendar year by the department's radiation control program. No decommissioning trust funds shall be used to make any of these payments.
- e. **Emergency Planning:** Until the calendar year after all spent fuel has been moved into dry casks, Holtec shall make annual payments to the Massachusetts Emergency Management Agency (MEMA), MDPH Radiation Control Program, and to each town any portion of which is within 10 miles of the Pilgrim site, to defray the costs incurred by MEMA, MDPH, and each of such towns with respect to provide emergency radiological planning. With respect to 2019, the payment shall be the amount paid by Entergy with respect to emergency planning for the calendar year 2018. With respect to each subsequent calendar year, the payment shall be in an amount equal to the costs incurred in the prior calendar year by MEMA and the respective towns. Holtec will continue to make annual payments to MEMA, MDPH, and each town within 10 miles of the reactor and the Commonwealth at a reduced level until all spent nuclear fuel has been removed from the site. No decommissioning trust funds shall be used to make any of these payments.

## 2. Environmental

- a. **Radiological Standard:** The maximum residual radiation level that is distinguishable from background radiation shall be as low as reasonably achievable and shall result in a total effective dose equivalent that is less than 10 mrem/yr.; for drinking water sources the maximum radiation level shall be less than 4 mrem/yr. This standard shall apply to each portion of the site; it is not an average over the site.
- b. **Dose Assessment:** The standard will be protective of public health and safety only if the models used to assess dose during remediation are conservative. Dose rates shall be determined using the Resident Farmer Scenario and Basement Inventory Model.
- c. **Rubblization:** All structures, components and soil having any detectible level of radiation distinguishable from background radiation shall be removed from the site. No structure shall be rubblized and buried on site.

Note: Rubblization is a process in which above-grade structures are demolished into rubble and buried in the structure's foundation below ground. The site surface is then

covered, regraded, and landscaped for unrestricted use. It poses a threat to public health and decreases the long-term stability of the land. Instead, the demolished rubble should be shipped to a licensed disposal site.

- d. Early Site Assessment:** Holtec will complete a thorough assessment of the Pilgrim site for the impacts of climate change on Pilgrim's site (including, but not limited to, flooding resulting from sea level rise, severe storms coinciding with high tides and exceptional wave heights, heavy precipitation, rising groundwater tables, and increased acidity contributing to corrosion of any underground structures), and an assessment of radiological materials and non-radioactive hazardous materials, not later than 31 December 2019 or 3 months after the license transfer, whichever comes first.

In advance of such assessment, The Settlement Agreement between the Commonwealth and Pilgrim's owners (Holtec Pilgrim LLC and Holtec Decommissioning International LLC) will provide the Commonwealth with the protocol for its reviews and will give the Commonwealth the opportunity to provide comments with respect the protocol. The Commonwealth received the revised site assessment plan in May 2021 and found it unsatisfactory. The Commonwealth also shall be given access to the site and the opportunity to take and analyze samples. Within 30 days following completion of the assessment, Holtec will give the Commonwealth a detailed report of the results of the assessment, including all data and other information learned during or as a result of the assessment.

- e. Interim Inspection and Sampling:** Holtec will give the Commonwealth access to the Pilgrim site during decommissioning to take samples; accompany NRC in its inspections; and be given split samples of any samples taken by Holtec or NRC.
- f. Final Environmental Site Assessment:** Holtec will give the Commonwealth a copy of any license termination plan provided to the NRC within five (5) days of the date on which any such plan was submitted to the NRC; and will give the Commonwealth the opportunity to provide comments to the NRC with respect to any such plan. Holtec also will give the Commonwealth access to the Pilgrim site to the extent reasonably required for Commonwealth personnel to accompany NRC personnel visiting the site in connection with any license termination plan, and to take and test samples.

**Site Restoration:** In the **Settlement Agreement** between the Commonwealth and Holtec Pilgrim LLC and Holtec Decommissioning International LLC (June 2020) to "comply with all applicable environmental and human-health based standards and regulations of the Commonwealth." Section III, 10 (I).

Section VI (48), both parties – Holtec and the Commonwealth – agree not to make preemption arguments. "No Party to this Agreement (or any person or entity affiliated or related to a Party to this Agreement) shall assert that any provision of this Agreement (or the Agreement

itself) is invalid under any federal law or any provision of the U.S. Constitution.”  
(<https://www.nrc.gov/docs/ML2109/ML21096A083.pdf>)

- g. Hazardous (non-radiological) Waste:** All hazardous waste shall be removed from the site to whatever level is required by federal, state, or local laws or regulations for unrestricted use of the site.
- h. Environmental Monitoring:** The Massachusetts Department of Public Health (MDPH) must continue offsite and onsite radiological monitoring until all spent nuclear fuel has been removed from the Pilgrim site. Holtec shall work cooperatively with MDPH and DEP to develop appropriate protocols related to non-radiological remediation and site restoration for information sharing, obtaining samples from onsite environmental media, conducting site visits and inspections, site characterization, remediation, site restoration, and notifications. Holtec shall pay the costs of such monitoring as set forth in 1(d), above.
- i. Offsite-Emergency Planning:** State and local (i.e., communities within 10 miles of Pilgrim) off-site radiological emergency planning must continue at its current level until all spent fuel is removed from the pool and placed in hardened dry casks, except that potassium iodide provisions may be eliminated 90 days after the reactor is de-fueled. Thereafter, it must continue at a reduced level until all spent nuclear fuel has been removed from the site. Holtec shall pay the costs of such monitoring as set forth in 1(e), above.
- j. Spent Fuel-Dry Cask & Pad Monitoring:** Holtec agrees to monitor in real-time each cask for heat, helium and radiation recognizing that the canisters and concrete outer packs are prone to cracking, exacerbated by salt corrosion, and to provide real-time monitoring data to MDPH. The Commonwealth shall have the ability to inspect the pad and casks and shall receive a copy of any report relating to any inspection of the pad or casks by Holtec or the NRC within ten (10) days after the date of any such report.
- k. ISFSI Security:** To reduce the potential of a line-of-site attack, either the casks shall be stored in a building for additional security and environmental protection or, at minimum, a barrier not less than five (5) feet higher than the height of any cask in the ISFSI shall be constructed around the ISFSI. While fuel remains onsite, security shall include: a protected area around the ISFSI, concrete vehicle barriers; lighting; cameras and intrusion detection equipment; and cyber security measures.

Note: On December 15, 2017, Pilgrim received an exemption until December 31, 2020 for completion of Milestone 8. Milestone 8 should be implemented. Cyber threats may impact or disable control of lighting, cameras, intrusion detection equipment, and communications equipment.

### 3. General

- a. **Removal of Spent Fuel from Spent Fuel Pool:** All spent fuel now in the reactor or spent fuel pool will be moved into dry casks, and all dry casks of spent nuclear fuel will be placed in the new ISFSI, by the end of 2021
  - b. **Plant Decommissioning:** Active decommissioning of the Pilgrim site (except for the ISFSI and switchyard) shall begin no later than 31 December 2019 and shall continue until completion.
  - c. **Site Restoration:** Site restoration of the Pilgrim site (except for the ISFSI and switchyard) shall be accomplished during the period of Plant Decommissioning. Restoration of the ISFSI site shall be accomplished no later than one (1) year after all casks of spent nuclear fuel have been removed from the Pilgrim site.
  - d. **ISFSI Decommissioning:** Decommissioning of the ISFSI shall begin no later than six (6) months after DOE removes all dry casks of spent nuclear fuel from the Pilgrim site. ISFSI decommissioning and restoration of the ISFSI site shall be completed within a period of no longer than one (1) year after all dry casks have been removed from the site.
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## State & Public Participation

The Union of Concerned Scientists asked, *What can ... the public do to improve nuclear safety?* They quipped that, *"It sometimes seems that NRC stands for Nielsen Ratings Commission. Letters to the editor and letters to elected officials urging them to pressure the NRC to fix the safety problems it has identified will hasten progress down that path."*

The public, the NDCAP panel, the Governor, and the Attorney General should follow this advice and take advantage of NRC Rules provide for public participation via rulemaking, licensing, enforcement, and hearings. The following NRC links provide basic information: <http://www.nrc.gov/public-involve.html>

More important, likely with greater effect, the Commonwealth and the Town of Plymouth should exercise the powers they now have to take actions relative to operations and decommissioning. Their existing powers are considerably greater than many assume. Town Boards of Health have considerable authority.

Although the Atomic Energy Act (AEA) gives the NRC authority and responsibility with respect to regulation of "the construction and operation of" a nuclear power plant, the NRC's exclusive authority is not unlimited. Rather, it extends *only* to the "field of nuclear safety regulation."

*Pacific Gas & Elec. Co. v. State Energy Resources Conservation and Development Comm'n*, [461 U.S. 190](#), 216 (1983).

Contrary to what many apparently assume, Massachusetts and other states have the right to “regulate [nuclear] activities for purposes other than protection against radiation hazards.” 42 USC Sec. 2021(k). “The [NRC]...does not purport to exercise its authority based on economic considerations... Congress intended the States to continue to make these judgments” (*Pacific Gas & Electric*, 461 U.S. at 207-208); and a state or local law grounded in economic purposes “lies outside the occupied field of nuclear safety regulation.” (*Pacific Gas & Electric*, 461 U.S. at 216).

Massachusetts also has rights, delegated to it by Congress, under the Clean Air Act and Clean Water Act.

The basic legal principles, recently reaffirmed by Judge (now Justice) Gorsuch in *Cook v. Rockwell International Corp.*, 790 F.3d 1088 (10<sup>th</sup> Cir. 2015), are that a court should presume that there is no preemption, and that a court has a duty to read a statute in a way that disfavor’s preemption, a duty that “is only ‘heightened’ where (as here) the area of law in question is one of traditional state regulation like public health and safety;” or, as in *Pacific Gas & Electric*, economics.

In the Settlement Agreement, signed by Holtec and the Commonwealth, both parties agree not to make preemption arguments. “No Party to this Agreement (or any person or entity affiliated or related to a Party to this Agreement) shall assert that any provision of this Agreement (or the Agreement itself) is invalid under any federal law or any provision of the U.S. Constitution.” (<https://www.nrc.gov/docs/ML2109/ML21096A083.pdf>)

In short, Massachusetts has the right, and the public should lobby the Governor and his Administration, Attorney General and the Great and General Court, to do what is needed, to ensure that Massachusetts interests are protected.

**Host Community, Plymouth:** Plymouth gained considerable revenue when Pilgrim operated from 1972-2019 from the licensee’s payment in lieu of taxes and donations to various charitable groups in town. It meant taxes were kept low. However, low taxes meant people moved to Plymouth resulting in an explosion in population and need to expand infrastructure. What does the town do now? One response is to **avoid actions that may displease Holtec** in the hope that it will continue to provide money to the town; give the town the property on the other side of Rocky Hill Road to 3A that could generate revenue to Plymouth from development; and perhaps give town support to Holtec to build its Small Nuclear Reactors (SMRs) on the water side of the property, where the reactor building is now. The infrastructure for SMRs is in place-switchyard and electric distribution system. Speculation is the foregoing explains why the Plymouth Board of Health has not been given permission by the Select Board to do what the BOH has authority to do regarding contaminated wastewater releases, one example.

## Nuclear Decommissioning Citizens Advisory Panel

The Massachusetts legislature established the panel, section 14, Chapter 188, Acts of 2016. Its members include: (6) state officials; (8) members appointed by state officials, Mary Lampert (Pilgrim Watch) appointed by the Senate President; (2) Entergy officials; (1) representative from the Utility Workers Union America Local 369 who either works or worked at Pilgrim; (1) representative from the Old Colony Planning Council; and (3) appointees from the Town of Plymouth. The committee is advisory. Its duties include: hold at minimum 4 public meetings a year; issue an annual report; serve as a conduit for public information; encourage community involvement; receive reports on decommissioning and the decommissioning trust fund. It is unfunded.

The Panel currently meets every other month (except for August and December) in Plymouth for about 2 hours. Initially, it met every month. The meeting dates and agenda are publicly available – see the Panel's website

<https://www.mass.gov/orgs/nuclear-decommissioning-citizens-advisory-panel>

**NDCAP Inaction:** The Panel's enabling legislation requires a vote of a majority of all its members to take any action. This has resulted in inaction. Motions from panel members usually are not able to reach a vote from the majority of NDCAP's membership, as required – 11 votes. Pilgrim's three members vote "no." The ten members representing the Administration usually abstain because they cannot vote without prior approval of the Administration - abstentions are counted as a "No" vote. Typically some members do not attend resulting in a tie vote or defeat. At the end of the meeting, a very limited amount of time is provided for comments and questions from the public.

### Section 14 of Chapter 188 of the Acts of 2016

SECTION 14. (a) There shall be created a nuclear decommissioning citizens advisory panel which shall consist of the following members or their designees: the secretary of health and human services, who shall serve ex officio; the secretary of energy and environmental affairs, who shall serve ex officio; the commissioner public utilities, who shall serve ex officio; the secretary of housing and economic development, who shall serve ex officio; the director of the Massachusetts Emergency Management Agency; 1 member from the Plymouth Nuclear Matters Committee as appointed by the Plymouth Board of Selectmen; 1 member from Massachusetts Department of Public Health Radiological Control Program appointed by the Bureau of Environmental Health; 1 representative of the Old Colony Planning Council or designee, selected by the Council; 2 representatives of the Town of Plymouth as selected by the Plymouth Board of Selectmen; 2 members appointed by the Governor; 2 members appointed by the Speaker of the House; 1 member appointed by the minority leader of the house of representatives; 2 members appointed by the President of the Senate; 1 member as appointed by the minority leader or the senate; 2 representatives of the Pilgrim Nuclear Power Station, also known in this section as PNPS or Station, as selected by the owner of the station; and a representative of the Utility Workers Union of America, UWUA, Local 369 selected by the UWUA who shall be a present or former employee at the PNPS.

(b) Each appointing authority initially shall appoint a member for a 3-year term and a member for a 4-year term. Subsequent appointments under this subdivision shall be for terms of 4 years. Ex officio members shall serve for the duration of their time in office or until a successor has been appointed.

(c) The commissioner of public utilities shall serve as the chair until the panel elects a chair or co-chairs under subsection (d).

(d) The panel annually shall elect a chair or co-chairs, and a vice chair, for 1-year terms commencing with its first meeting following the effective date of this section.

(e) A majority of the panel's members shall constitute a quorum. The panel shall act only by vote of a majority of its entire membership and only at meetings called by the chair or a co-chair or by any 5 of the members. The person or persons calling the meeting shall provide adequate notice to all its members.

(f) Members of the panel who are not ex officio members, employees of the Commonwealth of Massachusetts, representatives of the PNPS, or members representing towns outside Massachusetts, and who are not otherwise compensated or reimbursed for their attendance shall be entitled to \$50 per diem and their necessary and actual expenses.

(g) The executive office of energy and environmental affairs shall furnish administrative support for the panel.

(h) The chair shall: (1) manage the provision of administrative support to the panel, including scheduling meetings and securing meeting locations, providing public notice of meetings, producing minutes of meetings, and assisting in the compilation and production of the panel's annual report; (2) keep the panel informed of the status of matters within the jurisdiction of the panel; (3) notify members of the panel in a timely manner upon receipt of information relating to matters within the jurisdiction of the panel; (4) upon request, provide to all members of the panel all relevant information within the control of the department of public utilities relating to subjects within the scope of the duties of the panel; (5) provide workshops or training for panel members as may be appropriate; and (6) hire experts, contract for services, and provide for materials and other reasonable and necessary expenses of the panel as the commissioner may consider appropriate on request of the panel from time to time.

(i) The Panel shall serve in an advisory capacity only and shall not have authority to direct decommissioning of the PNPS. The duties of the panel shall be: (1) to commence public meetings beginning on or about June 1, 2017, at a frequency of quarterly until the shutdown of the Pilgrim Nuclear Power Station (PNPS) for the purpose of discussing issues related to decommissioning planning activities; (2) to hold a minimum of four public meetings each year for the purpose of discussing issues relating to the progress of decommissioning of the PNPS beginning on or about June 1, 2019, or when the PNPS permanently ceases power operations; provided that the panel may hold additional meetings; (3) to advise the governor, the general court, the agencies of the commonwealth, and the public on issues related to the decommissioning of the PNPS, with a written report being provided annually to the governor and to the energy committees of the General Court; (4) to serve as a conduit for public information and education on and to encourage community involvement in matters related to the decommissioning of the PNPS and to receive written reports and presentations on the decommissioning of the Station at its regular meetings; (5) to periodically receive reports on the Decommissioning Trust Fund and other funds associated with decommissioning of the

PNPS, including fund balances, expenditures made, and reimbursements received; (6) to receive reports regarding the decommissioning plans for the PNPS, including any site assessments and post-shutdown decommissioning assessment reports; provide a forum for receiving public comment on these plans and reports; and to provide comment on these plans and reports as the panel may consider appropriate to state agencies and the owner of the PNPS and in the annual report described in clause (3).

On July 1, the NRC Commission approved a Letter to the Honorable John A. Barrasso and Frank Pallone, Jr., submitting the report on Best Practices for Establishment and Operation of Local Community Advisory Boards During Decommissioning Activities. The report is now publicly available and is posted on the NRC public website.<sup>145</sup>

## Legislation

Each year a number of nuclear-related bills are introduced to the State Legislature. Legislator's contact information, Committees, hearings before committees, laws, and bills filed can be located here <https://malegislature.gov/>.

In 2025 the bills relating to nuclear power filed included the following. Check the State House Website on the status of the bills at <https://malegislature.gov/>

- **HD. 2477** An Act to improve public health and safety in communities around aging nuclear power plants and high-level nuclear waste dump sites, filed by Rep. Michelle Badger (Plymouth) and Rep. Hadley Luddy (Barnstable). Extends radiological emergency planning zone to 50-miles and includes sites with ISFSIs, Pilgrim and Rowe.
- **SD.356** -An Act to improve public health and safety in communities around aging nuclear power plants and high-level nuclear waste storage sites filed by Senator Patrick O'Connor. It requires real-time monitors on each cask to monitor 24/7 radiation, helium, and heat, connected to the state and date made public.
- **HD.2490** - An Act relative to monitoring dry casks of spent nuclear fuel filed by Rep. Michelle Badger (Plymouth) and Rep. Hadley Luddy (Barnstable). Currently, there is no 27/7 real time monitoring. Holtec uses only visual scan and on the ground monitors-TLDs as assessment. With this-walled canisters subject to corrosion from a marine environment, monitors are necessary to detect leaks.
- **SD.1444** -Resolve preventing the discharge of radioactive materials. filed by Senator Dylan Fernandes that DEP and DPH will report on environmental and economic impacts of Holtec's evaporation of radioactive and chemical industrial wastewater and make recommendations to stop evaporation until the report is finalized.. Stop discharge until the report is finalized.

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<sup>145</sup> [ML20122A112 https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML20122A112](https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML20122A112)

- **SD.1217** -An Act defining clean energy filed by Senator Jo Comerford that repeals the provision including nuclear fusion from the definition of clean energy.

## LINKS

### **Southeastern Massachusetts Groups Focused On Pilgrim**

- Pilgrim Watch <http://www.pilgrimwatch.org/>
- Cape Downwinders <http://www.capedownwinders.info/>
- Save Our Bay MA <https://www.saveourbayma.com/>

### **Regional Groups**

- C-10 Research and Education Foundation (Seabrook) <http://www.c-10.org/>
- Citizens Awareness Network (Vermont Yankee) <http://www.nukebusters.org/>
- New England Coalition (Vermont Yankee) <http://necnp.org/>
- Safe and Green Campaign (Vermont Yankee) <http://www.safeandgreencampaign.org/>

### **National Nuclear Safety Organizations**

- Beyond Nuclear <http://www.beyondnuclear.org/>
- Nuclear Information Service <http://www.nirs.org/>
- Institute of Energy and Environmental Research <https://ieer.org/>
- Bulletin of Atomic Scientists <http://thebulletin.org/>
- Fairewinds Energy Education <http://www.fairewinds.org/>
- Union Concerned Scientists [http://www.ucsusa.org/nuclear\\_power/](http://www.ucsusa.org/nuclear_power/)
- Nuclear Decommissioning Citizen Advisory Panel -Vermont  
<http://publicservice.vermont.gov/electric/ndcap>
- SanOnofre Safety <https://sanonofresafety.org/>

### **Government**

- Nuclear Regulatory Commission <http://www.nrc.gov/>
- NRC Library (web based, includes hearing docket) <http://www.nrc.gov/reading-rm/adams.html>
- NRC Meeting Schedule <http://www.nrc.gov/public-involve.html>
- EPA Pilgrim <https://www.epa.gov/npdes-permits/pilgrim-nuclear-power-station>
- Nuclear Decommissioning Citizens Advisory Panel <https://www.mass.gov/orgs/nuclear-decommissioning-citizens-advisory-panel>

### **Holtec**

- Pilgrim Decommissioning <https://holtecinternational.com/company/divisions/hdi/our-fleet/pilgrim/>