Public Hearing on Pennsylvania's Nuclear Waste Containment in Light of TMI's Impending Closure

Testimony before Environmental Resources and Energy Committee

Pennsylvania House of Representatives

April 29, 2019

Katie Tubb
The Heritage Foundation

Members of the House Environmental Resources and Energy Committee, thank you for the opportunity to testify today on the issue of nuclear waste management. It is a privilege to be back in Pennsylvania as I spent my college years in the western side of the state attending Grove City College.

Pennsylvania has an inspiring legacy with nuclear energy. Pennsylvania housed the first commercial reactor, experienced the nation's worst nuclear power accident and yet showed it could be managed safely, and except for Illinois is home to more nuclear power plants than anywhere in the country. I believe it is entirely in the capability and character of the Commonwealth to be able to successfully navigate nuclear power plant closures and decommissioning, and hopefully the continued service of other reactors and future nuclear technologies.

As requested, my testimony seeks to cover basic issues around the decommissioning process and management of nuclear waste. I have arranged my testimony in the form of Questions and Answers, according to what I hope is easy to navigate and useful for reference later.

What is the process for decommissioning a nuclear power plant?

The U.S. Nuclear Regulatory Commission (NRC) regulates and oversees the decommissioning of nuclear power plants. License holders have three options to complete decommissioning within 60 years of ending operations: DECON (immediate dismantling and decontamination), SAFSTOR (prolonged maintenance for eventual dismantling and decontamination), and ENTOMB (dismantling, storage, and disposal onsite). Most licensees have opted for SAFSTOR or a combination of SAFSTOR and DECON; no licensees yet have chosen ENTOMB.

There are four main phases of decommissioning[1]:

1 – The licensee notifies the NRC within 30 days of the decision to permanently close, and again once fuel has been permanently moved from the reactor. At this point, the licensee is no longer allowed to run the reactor.

2 – Within two years of ceasing operations, the licensee must submit a Post-Shutdown Decommissioning Activities Report (PSDAR) to the NRC. Major decommissioning activities cannot begin until 90 days after the NRC receives the licensee's PSDAR. This report describes the timeline of decommissioning activities, how environmental impacts will be handled, estimated costs, and plans to maintain funds for nuclear waste storage. The NRC uses this to check for consistency with its regulations, and while the NRC does not approve the licensee's PSDAR, it will notify the licensee of problems and incongruencies with NRC regulations. The PSDAR is posted in the *Federal Register* for public comment and a public

[1] https://www.nrc.gov/waste/decommissioning/process.html

hearing held by the NRC. The licensee must notify the NRC of any significant departures from the PSDAR.

Decommissioning activities include removing fuel into safe interim storage, dismantling radioactive components (like the reactor vessel) for a commensurate waste disposal facility, and cleaning and dismantling less contaminated materials either onsite or at an appropriate waste disposal facility.

The NRC notes that: "Many activities that occur during decommissioning are very routine and occur frequently in operating plants. These include decontamination of surfaces and components, surveys for radioactive contamination, waste packaging and disposal, and other activities. The inspection effort at plants being decommissioned is significantly less than at an operating reactor site. Rather than maintaining a continual presence, inspectors at a site being decommissioned will be provided to cover specific activities occurring there…During active decommissioning, NRC inspectors may be at the facility 2 or 3 weeks of the month. During a long-term storage period, they would be present several times a year."[2]

Three Mile Island Unit-1 submitted its PSDAR in April 2019 with plans to pursue SAFSTOR. Exelon has said it plans to move spent fuel to dry cask storage by the end of 2022 and "dismantle large components, including the station's cooling towers, beginning in 2074."[3]

3 – Within two years of completing decommissioning and license termination, the licensee must submit a License Termination Plan (LTP). This report requires:

- Site characterization;
- Remaining dismantlement activities;
- Plans for site remediation;
- Plans for the final radiation survey;
- Description of the end use of the site, if restricted;
- Updated 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.[4]

This plan is open for public comment and a public hearing held by the NRC, and requires approval by the NRC (unlike the PSDAR).

4 – In order for a license to be terminated, the NRC must first confirm that the licensee has completed the terms of its NRC-approved License Termination Plan and that the final radiation survey report is acceptable. NRC oversight ends once a license is terminated.

What are the radiological standards for final closure?

Licensees can either prepare the decommissioned site for restricted access or public use. For unrestricted public use, a licensee must clean a site to ensure a member of the public would receive a dose limit of no more than 25 millirem per year. If access is restricted, the licensee may clean the site to a dose level of 100 millirem per year or 500 millirem – depending on the steps taken to restrict public access.[5]

---

[2] https://www.nrc.gov/waste/decommissioning/oversight.html
[3] https://www.exeloncorp.com/newsroom/exelon-generation-files-tmi-unit-1-decommissioning-report
[4] https://www.nrc.gov/waste/decommissioning/process.html
[5] https://www.nrc.gov/waste/decommissioning/faq.html

As with anything to do with radiation, context is important. 25 millirem is roughly equivalent to two chest x-rays (10 millirem apiece), or a year of the cosmic radiation we all receive (30 millirem). Americans receive roughly 310 millirem a year from background/natural sources of radiation. Living within 50 miles of a nuclear power plant exposes an individual to 0.0009 millirem.[6] Radiation is a part of our everyday lives. It is critical that regulators, politicians, and media communicate risk accurately rather than turning every exposure or source of radiation into a risk.

What have been the historical costs of decommissioning and what financial assurances are there that decommissioning is completed?

Nuclear power licensees are required to set aside funds sufficient for decommissioning and must report the status of these funds to the NRC once every 2 years while operating, and annually 5 years before shutdown and thereafter.[7] Three Mile Island Unit 1 decommissioning costs are estimated to be $467.8 million by the NRC; funds set aside for decommissioning total $625.9 million.[8] NRC's estimated minimum requirements for Three Mile Island Unit 2 are $486.5 million; funds set aside for decommissioning total $834.3 million.[9]

The NRC estimates decommissioning costs $280 million to $612 million.[10] Ten reactors have been fully decommissioned and had their licenses terminated; the NRC lists costs for several which may be instructive:[11]

Reactor	cost
Fort St. Vrain (330-megawatt-electric (MWe) high-temperature gas-cooled reactor)	$189 million
Trojan (1130-MWe pressurized-water reactor)	$362 million
Haddam Neck (619-MWe pressurized-water reactor)	$426.7 million
Maine Yankee (830-MWe pressurized-water reactor)	$377.6 million
Big Rock Point (67-MWe boiling-water reactor)	$290 million
Rancho Seco (913-MWe pressurized-water reactor)	$441 million
Yankee Rowe (175-MWe pressurized-water reactor)	$306.4 million

[6] https://www.nrc.gov/about-nrc/radiation/around-us/doses-daily-lives.html
[7] https://www.nrc.gov/waste/decommissioning/finan-assur.html
[8] https://www.nrc.gov/docs/ML1809/ML18096B543.pdf
[9] https://www.nrc.gov/docs/ML1807/ML18075A256.pdf
[10] https://www.nrc.gov/waste/decommissioning/finan-assur.html
[11] https://www.nrc.gov/waste/decommissioning/faq.html

How are other communities navigating nuclear power plant closures?

There are currently 21 nuclear power reactors and 3 research reactors in the process of decommissioning around the United States.[12] Pennsylvania should find itself in good shape to work with the NRC should licensees begin decommissioning nuclear reactors again in Pennsylvania: the NRC has shifted resources to accommodate increased need for decommissioning services and notes in a 2016 "lessons learned" report the progress made in overcoming a considerable learning curve by the NRC and others to meet these needs.[13]

Theoretically, land could be used for any activity once a site is fully decommissioned for use without restrictions. Some existing plants are already incredible natural habitats (for example, Salem and Hope Creek generating stations[14]), and land could be maintained for that purpose after closure. Sites also could be used for further industrial purposes. Indeed, Fort Saint Vrain in Colorado – formerly a 330 MW nuclear power plant that closed in 1989 and decommissioned in 1996 – is now a natural gas power plant owned by Excel Energy.[15]

Other communities have steadily maintained sites until the Department of Energy (DOE) takes final ownership and title of nuclear waste for disposal. Dairyland Power holds the license to one of the smallest reactors in America in southwest Wisconsin, which closed in 1987. Most of the nuclear infrastructure has been demolished in the last several years, but the site remains home to a coal power station. Fuel was moved to dry cask storage in 2012 and Dairyland spends about $3 million per year to maintain and secure the fuel; the town of Genoa receives some financial support from the state. While Dairyland continues to hold routine public meetings, public interest is minimal. Dairyland continues to collaborate with regional groups like the Midwestern Radioactive Transportation Project and expends effort lobbying the federal government to address nuclear waste disposal.

Some communities have approached decommissioning more aggressively. Oyster Creek generating station in New Jersey is being decommissioned after nearly 50 years of operating.[16] The NRC is currently reviewing plans for its sale by Exelon to Holtec, which plans to demolish the facility in six years for unrestricted use, with the exception of dry cask spent fuel storage.[17] Holtec is also seeking and NRC license to construct and operate a consolidated interim storage facility, as is Interim Storage Partners in Andrews, Texas.[18]

Pennsylvania likely would benefit from studying and talking with these 21 communities. However, it would not be surprising if some of the best people and resources for navigating decommissioning are in Pennsylvania itself. Unlike perhaps any other state, Pennsylvania already has significant experience decommissioning and removal of fuel at Three Mile Island's Unit 2 and Shippingport. In the case of Three Mile Island, 22 rail shipments of 49 casks containing 342 canisters of damaged fuel was safely and successfully shipped to Idaho National Lab under contract with the DOE. Three Mile Island provided all the canisters, packaging, inspection, preparation, and loading. The DOE took title and possession of the

---

[12] https://www.nrc.gov/info-finder/decommissioning/power-reactor/
[13] https://www.nrc.gov/docs/ML1608/ML16085a029.pdf
[14] https://corporate.pseg.com/corporatecitizenship/environmentalpolicyandinitiatives/estuaryenhancementprogram
[15] https://www.xcelenergy.com/energy_portfolio/electricity/power_plants/fort_st._vrain
[16] https://www.nj.com/news/2018/09/oyster_creek_nuclear_plant_closing_what_are_the_im.html
[17] https://holtecinternational.com/2018/05/16/proto-prompt-decommissioning-reaches-maturity-as-a-core-holtec-business-undertaking/
[18] https://www.nrc.gov/waste/spent-fuel-storage/cis.html

waste and provided transportation, storage, and disposal.[19] Decommissioning and transportation of nuclear waste *can* be done safely as indeed Pennsylvania has done it. That legacy is incredibly important for the future as the national conversation on nuclear waste storage and disposal continues.

What happens to nuclear waste after a plant stops operating?

Nuclear power plants use two means of storing nuclear waste. Onsite spent fuel pools are used for initial cooling of spent fuel assemblies. These pools cover fuel assemblies in at least 20 feet of water and are made of steel reinforced concrete and steel liners. They are very durable, such that none of the spent fuel pools at Japan's Fukushima Daiichi facility were damaged by the earthquake or subsequent tsunami.

Eventually, spent fuel is moved to dry storage in large casks stationed on large concrete pads (technically known as ISFSIs – Independent Spent Fuel Storage Installations). There are dry cask storage facilities around the country at most nuclear power plants.[20] Two to six dozen fuel assemblies are packaged in steel cylinders which are surrounded by more steel and concrete, and are resilient to floods, earthquakes, tornadoes, projectiles, and extreme temperatures. These facilities are licensed and periodically checked by the NRC, which also determined in 2014 that dry cask storage was safe for humans and the environment indefinitely.[21]

Nuclear power operators developed dry cask storage as room in spent fuel pools became tight and it became clear that the DOE would not be able to collect nuclear waste on time as promised in contracts with operators. While interim storage on site at nuclear power facilities is safe, it is not a permanent, long term solution. No matter how waste may be processed or used in the future, a permanent repository will almost certainly be needed.[22]

While transporting nuclear waste may sound daunting, in fact thousands of shipments have taken place in the U.S. in the last 40 years and thousands more internationally. Packaged fuel has been shipped by rail, road, and barge without any negative public health impacts.[23]

Where is nuclear waste and how much does storage cost?

According to the Nuclear Waste Policy Act of 1982, the DOE entered into contracts with commercial nuclear power companies to collect and store nuclear waste from electricity generation. It was to begin doing so by 1998. After evaluating alternative sites, Congress amended the Act in 1987 to designate Yucca Mountain as the site for a national repository should the NRC approve a license. That facility has yet to be built.

Nuclear power plants were required to pay fees for waste disposal into a Nuclear Waste Fund according to how much electricity they generated. The Nuclear Waste Fund has a balance of $39.2 billion. Pennsylvania nuclear power plants and their customers have paid $1.97 billion which has accrued $2 billion in interest. This represents payment for 7,300 metric tons of waste.[24]

Because the DOE has failed to collect nuclear waste as contractually obligated, it has been found in partial breach of its contracts with nuclear power companies. Today, the federal government remains

---

[19] https://tmi2kml.inl.gov/Documents/4f-DOE/DOE-ID-10400,%20Historical%20Summary%20of%20the%20TMI-2%20Core%20Debris%20Transportation%20Campaign%20(1993-03).pdf
[20] https://www.nrc.gov/docs/ML1907/ML19071A163.pdf
[21] https://www.nrc.gov/docs/ML1423/ML14238A326.pdf
[22] http://energy.gov/downloads/report-president-and-congress-secretary-energy-need-second-repository
[23] https://www.nrc.gov/waste/spent-fuel-transp.html
[24] https://www.nei.org/resources/statistics/used-fuel-storage-and-nuclear-waste-fund-payments

liable for over 80,000 tons of commercial nuclear waste.[25] This liability grows as America's nuclear power reactors produce roughly 2,000 tons of nuclear waste every year as part of providing nearly 20 percent of the electricity used in the US.

According to the DOE's most recent count, $7.4 billion in settlements have been paid to nuclear utilities.[26] This money does not come from the Nuclear Waste Fund but from the Department of the Treasury's Judgement Fund as a "permanent, indefinite appropriation."[27] The DOE projects future liability to be $28.1 billion, but this could be misleadingly optimistic because it assumes work on Yucca Mountain will restart in 2020.[28] The nuclear industry estimates at least $50 billion in liabilities.

In other words, nuclear power licensees recover their costs for interim storage of waste from federal taxpayers, however time and human capital spent to recover those costs are lost.

What is happening in the federal government regarding long term nuclear waste disposal?

In 2018, the U.S. House of Representatives passed the Nuclear Waste Policy Amendments Act (HR 3053) by a vote of 340 in favor and 72 opposed, however it was not considered in the Senate. The bill, sponsored by Representative John Shimkus (R-IL) appropriates funds from the Nuclear Waste Fund to finish the review and licensing process for a geologic repository at Yucca Mountain and concurrently allows for a consolidated interim storage program by the private sector. Assuming the NRC approves a license for Yucca Mountain, the bill establishes a schedule for appropriations and provides funds to the state of Nevada to engage in the process.

The Nuclear Waste Administration Act is expected to be reintroduced in the Senate this year by Senator Lamar Alexander (R-TN). As introduced in 2015, the bill would transfer responsibility for nuclear waste facility siting, licensing, construction, and management from the DOE to a new government agency, the Nuclear Waste Administration. In the interim, it adopts the Obama Administration's *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste* for a consent-based process for interim storage facilities and a permanent repository, just like the one proposed at Yucca Mountain, by 2048.

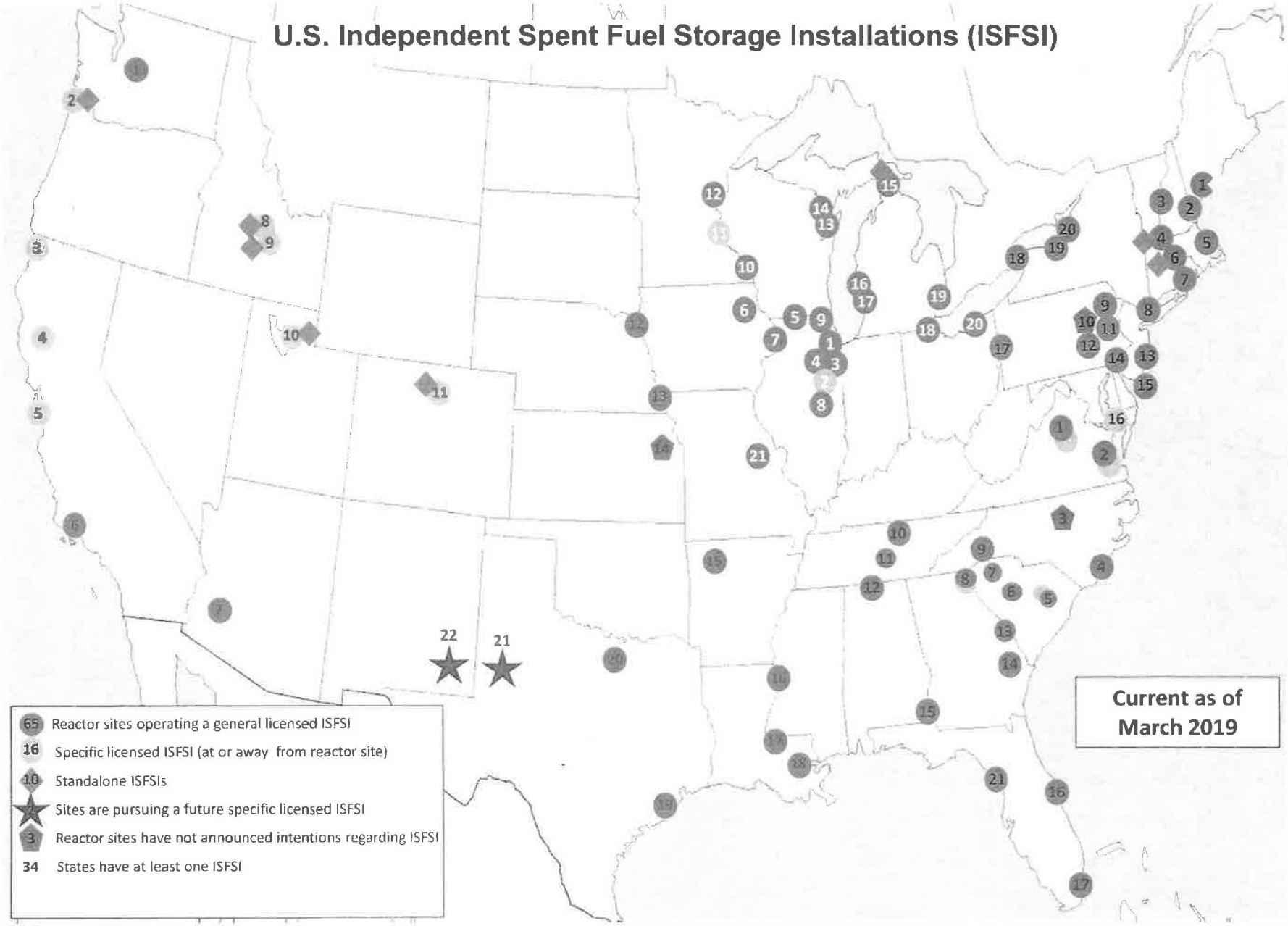
The House and Senate have not appopriated funds to complete the review of Yucca Mountain since 2010. In 2015, the NRC finished its safety evaluation report of the Yucca Mountain license and determined it would be technologically feasible and safe. However, contentions with the license application remain to be heard before the NRC's licensing board.

Government management of nuclear waste, as is the case today, has achieved neither public consent, nor permanent waste disposal. The Heritage Foundation maintains that incorporating free-market policies in nuclear-waste management could lead to far more innovative, less expensive, and mutually beneficial options for states to consider that make nuclear-waste management an opportunity, rather than a liability.[29] That starts with placing responsibility for nuclear-waste management with the nuclear industry.

---

[25]https://www.energy.gov/sites/prod/files/2018/12/f58/fy-2018-doe-agency-financial-report.pdf
[26]https://www.energy.gov/sites/prod/files/2018/12/f58/fy-2018-doe-agency-financial-report.pdf
[27] https://www.fiscal.treasury.gov/fsservices/gov/pmt/jdgFund/judgementFund_home.htm
[28]https://www.energy.gov/sites/prod/files/2018/12/f58/fy-2018-doe-agency-financial-report.pdf
[29] https://www.heritage.org/environment/report/real-consent-nuclear-waste-management-starts-free-market

U.S. Independent Spent Fuel Storage Installations (ISFSI)



Region I (in black numbers)
1) Maine Yankee
2) Seabrook
3) Vermont Yankee
4) Yankee Rowe
5) Pilgrim
6) Haddam Neck
7) Millstone
8) Indian Point
9) Susquehanna
10) Three Mile Island
11) Limerick
12) Peach Bottom
13) Oyster Creek
14) Hope Creek
15) Salem
16) Calvert Cliffs
17) Beaver Valley
18) Ginna
19) Nine Mile Pt.
20) FitzPatrick
21) Crystal River

Region II (in blue numbers)
1) North Anna
2) Surry
3) Shearon Harris
4) Brunswick
5) Robinson
6) Summer
7) Catawba
8) Oconee
9) McGuire
10) Watts Bar
11) Sequoyah
12) Browns Ferry
13) Vogtle
14) Hatch
15) Farley
16) St. Lucie
17) Turkey Point

Region III (in white numbers)
1) Dresden
2) Gt. Morris (wet)
3) Braidwood
4) LaSalle
5) Byron
6) Duane Arnold
7) Quad Cities
8) Clinton
9) Zion
10) LaCrosse
11) Prairie Island
12) Monticello
13) Point Beach
14) Kewaunee
15) Big Rock Pt.
16) Palisades
17) Cook
18) Davis Besse
19) Fermi
20) Perry
21) Callaway

Region IV (in red numbers)
1) Columbia
2) Trojan
3) Humboldt Bay
4) Rancho Seco
5) Diablo Canyon
6) San Onofre
7) Palo Verde
8) DOE TMI-2 Storage
9) DOE Idaho Spent Fuel Facility
10) Private Fuel Storage
11) Ft. Saint Vrain
12) Ft. Calhoun
13) Cooper
14) Wolf Creek
15) Arkansas Nuclear One
16) Grand Gulf
17) River Bend
18) Waterford
19) South Texas Project
20) Comanche Peak
21) Waste Control Specialists
22) Eddy-Lea

65 Reactor sites operating a general licensed ISFSI
16 Specific licensed ISFSI (at or away from reactor site)
10 Standalone ISFSIs
Sites are pursuing a future specific licensed ISFSI
3 Reactor sites have not announced intentions regarding ISFSI
34 States have at least one ISFSI

Current as of March 2019