

ATTACHMENT 7

Commission Requested Information

Nuclear Waste Fund and U.S. Department of Energy (“DOE”) Lawsuit History

The Commission requested additional background information on (i) the Nuclear Waste Fund and (ii) the DOE lawsuit history, namely the case of Nuclear Energy Institute, KGE, KCPL, KEPCo, WCNO, et al. v. US Dept. of Energy (US Court of Appeals for the D.C. Circuit, Case No. 11-1068, filed March 8, 2011. Consolidated on March 10, 2011, with National Association of Regulatory Utility Commissioners v. US Dept. of Energy, Case No. 11-1066 filed on March 7, 2011.) (the “DOE Lawsuit”).

The Nuclear Waste Policy Act of 1982 (“Act”) created a timetable and procedure for establishing a permanent, underground repository for spent fuel from civilian nuclear reactors and other high-level radioactive waste (“Repository”) by the mid-1990s.

Various governmental agencies were assigned responsibility for various activities in connection with the repository. The DOE was tasked with siting, constructing, operating, and closing the Repository and established an Office of Civilian Radioactive Waste Management to implement the Act. The U.S. Environmental Protection Agency (“EPA”) was responsible for setting public health and safety standards for releases of radioactive materials from the Repository, and the U.S. Nuclear Regulatory Commission (“NRC”) was to promulgate regulations governing construction, operation, and closure of a repository.

The cost of constructing and operating the Repository would be financed from a Nuclear Waste Fund composed of fees levied against nuclear electric utilities. Initially, the fee was set at 1.0mill/kWh of nuclear electricity generated. The Nuclear Waste Fund has accrued fees and interest and currently has an unspent balance in excess of \$35 billion (approximately \$11 billion has been spent to date).

In 2011, the Nuclear Energy Institute and multiple nuclear utilities filed the DOE Lawsuit to suspend collection of fees following the government’s decision to discontinue developing Yucca Mountain and its failure to pursue an alternative waste management and disposal program.

Initially, the D.C. Circuit in June 2012 ruled that the fee was unlawful, and ordered the DOE to conduct a reevaluation of the Nuclear Waste Fund and report back to the court within six months. In January 2013, the DOE submitted a 180-page report, determining that "neither insufficient nor excess revenues are being collected in order to recover the costs incurred by the Federal Government" and unveiled a waste disposal strategy that called for a phased, consent-based approach to siting and implementing a nuclear waste management and disposal system and endorsed building a pilot interim storage facility by 2021.

NEI and the utilities challenged the report. A D.C. Circuit decision on November 19, 2013 found that DOE’s termination of the Yucca Mountain repository program prevented the agency from determining whether an appropriate fee was being collected. With no ability to assess a fee to offset the cost of an actual waste management and disposal program, the court ordered the DOE to submit a proposal to Congress to change the Nuclear Waste Fund fee to zero “until such time as either the Secretary chooses to comply with the Act as it is currently written, or until Congress

enacts an alternative waste management plan”.

On December 20, 2013, the DC Circuit rejected the DOE’ s motion to enlarge the time within which to request rehearing of the D.C. Circuit decision and granted the petitioners’ motion to issue the mandate for suspension of the Nuclear Waste Fund fees “forthwith”. On January 3, 2014, the DOE submitted a proposal to Congress that the fee be set at zero, effective after Congress had been in session for 90 consecutive days unless Congress disapproved the proposal. On March 18, 2014, the DC Circuit rejected the DOE request for the DC Circuit to rehear the case *en banc* (i.e. all judges of the DC Circuit would participate). The fee reduced to 0.0mill/kWh as of May 16, 2014, once the 90-day period elapsed. The fee currently remains at 0.0mill/kWh.

It remains possible that the federal government will not have removed all of Wolf Creek’s spent nuclear fuel and high-level radioactive waste from the station by the time the plant has been decommissioned.

Decommissioning

The Commission requested additional background information on decommissioning efforts to date for U.S. nuclear plants including (i) decommissioning methods employed; (ii) the reason for decommissioning if performed prior to the end of plant expectancy, and (iii) a comparison of actual costs of decommissioning to previous cost estimates for decommissioned plants. The following analysis is based on publicly available information.

1. Decommissioning Method(s) Employed

As discussed in more detail in “Decommissioning Cost Analysis for the Wolf Creek Generating Station (Document No. W11-1741-001), when a power company decides to permanently close a nuclear power plant, the facility must be decommissioned by safely removing it from service and reducing residual radioactivity to a level that permits release of the property and termination of the operating license. Licensees may choose from three decommissioning strategies: DECON, SAFSTOR, or ENTOMB.

- DECON (immediate dismantling) - soon after the nuclear facility closes, equipment, structures, and portions of the facility containing radioactive contaminants are removed or decontaminated to a level that permits release of the property and termination of the NRC license (assuming that the spent fuel has been removed from the site).
- SAFSTOR (safe-storage and deferred dismantling) - a nuclear facility is maintained and monitored in a condition that allows the radioactivity to decay; afterwards, the plant is dismantled and the property decontaminated.
- ENTOMB - radioactive contaminants are permanently encased on site in structurally sound material such as concrete. The facility is maintained and monitored until the radioactivity decays to a level permitting restricted release of the property. (In a draft regulatory basis document published in March 2017 in support of rulemaking that would amend NRC regulations concerning nuclear plant decommissioning, the NRC staff proposes removing any discussion of the ENTOMB option from existing guidance documents since the method is not deemed practically feasible.)

The licensee may also choose to adopt a combination of the first two choices in which some portions of the facility are dismantled or decontaminated while other parts of the facility are left in SAFSTOR. The decision may be based on factors besides radioactive decay, such as availability of waste disposal sites. Decommissioning must be completed within 60 years of the plant ceasing operations. A time beyond that would be considered only when necessary to protect public health and safety in accordance with NRC regulations.

As described in Table 1, the decommissioning methods employed by the 18 commercial nuclear power reactors that have shut down since 1989 have varied: 9 have employed DECON, 5 have employed SAFSTOR and 4 have employed combined SAFSTOR/DECON. Moreover, not all DECON sites have terminated their licenses. License termination is contingent upon the removal of the spent fuel from the site. For example, the plants listed in

Table 1 that elected the DECON option still have fuel on site (excluding Shoreham^[1]) in a licensed Independent Spent Fuel Storage Installation or ISFSI. While the decommissioning of these plants is considered complete, only those portions of the site, exclusive of the ISFSI, have been released for alternative and unrestricted use.

Table 1
Decommissioning Alternative(s) Selected
for Commercial Nuclear Power Reactors
(since 1989)^[1]

Unit	Location	MWt	Shut Down	Decommissioning Alternative Selected
Rancho Seco	Herald, CA	2,772	7-Jun-89	SAFSTOR/DECON ^[2]
Shoreham	Wading River, NY	2,436	28-Jun-89	DECON
Fort St. Vrain	Platteville, CO	842	18-Aug-89	DECON
Yankee-Rowe	Rowe, MA	600	1-Oct-91	DECON
Trojan	Rainier, OR	3,411	9-Nov-92	DECON
San Onofre 1	San Clemente, CA	1,347	30-Nov-92	SAFSTOR/DECON ^[3]
Zion 2	Zion, IL	3,250	19-Sep-96	SAFSTOR/DECON ^[4]
Connecticut Yankee	Haddam Neck, CT	1,825	5-Dec-96	DECON
Maine Yankee	Wiscasset, ME	2,700	6-Dec-96	DECON
Zion 1	Zion, IL	3,250	21-Feb-97	SAFSTOR/DECON ^[4]
Big Rock Point	Charlevoix, MI	240	29-Aug-97	DECON
Millstone 1	Waterford, CT	2,011	21-Jul-98	SAFSTOR
Crystal River 3	Crystal River, FL	2,609	20-Feb-13	SAFSTOR
Kewaunee	Carlton, WI	1,772	7-May-13	SAFSTOR
San Onofre 2	San Clemente, CA	3,438	12-Jun-13	DECON
San Onofre 3	San Clemente, CA	3,438	12-Jun-13	DECON
Vermont Yankee	Vernon, VT	1,912	29-Dec-14	SAFSTOR ^[5]
Fort Calhoun	Fort Calhoun, NE	1,500	24-Oct-16	SAFSTOR

Table 1 Notes:

^[1] Source: Table 1 data and information on reactors shut down since 1989 extracted from Appendix C of NRC's Information Digest 2016-2017, NUREG-1350, Volume 28, September 2016. Reactors shut down prior to 1989 include TMI-2 (accident) in 1979 and a number of smaller facilities constructed in the late 1950s and 1960s, under the Atomic Energy Commission, to demonstrate the peacetime use of nuclear power. These include the GE VBWR, GE EVESR, Pathfinder, Savannah, N.S. (ship), Saxton, Fermi-1, Indian Point-1, Peach Bottom-1, Humboldt Bay-3, Dresden-1, and La Crosse reactors. All of the facilities were initially placed into safe-storage (SAFSTOR). The reactors at Pathfinder, Saxton, Fermi-1, Humboldt Bay-3, and La Crosse were subsequently decommissioned or are currently in the process of being decommissioned.

^[1] The Long Island Lighting Company, owner and operator of Shoreham, paid Philadelphia Electric Company to take its fuel to the Limerick Nuclear Power.)

- [2] The Sacramento Municipal Utility District initially placed the reactor into safe-storage (until 2008). However, on January 9, 1997, the Board of Directors approved an "incremental decommissioning" project for Rancho Seco accelerating the decommissioning timeline.
- [3] Southern California Edison initially placed the reactor into safe-storage, planning to decommission Unit 1 along with Units 2 and 3, at the end of their licenses (2013). In 1998, the company notified the NRC that it would commence decommissioning operations in June 1999.
- [4] Commonwealth Edison initially placed the two reactors into safe-storage. On August 23, 2010, the Nuclear Regulatory Commission approved the transfer of Exelon's (ComEd's parent company) license to *ZionSolutions* for "prompt" decommissioning
- [5] Entergy initially placed the reactor into safe-storage after the December 2014 shutdown. On February 9, 2016, NorthStar Group Services filed an application (along with Entergy) with the NRC to acquire the license of the shutdown plant for "prompt" decommissioning.

2. Reason for Premature Decommissioning

The reactors identified in Table 1 all ceased operations prior to the expiration of their operating licenses (premature shutdown). As such, the opportunity to preplan the decommissioning was limited and often hampered by a shortfall in the funds available for decommissioning (since rate collections also disrupted).

The majority of the owners of reactors in Table 1 terminated operations due to economics, although poor operating histories, the prospect of expensive plant modification and repairs, and competition from less expensive generation also contributed to the decisions.

Rancho Seco Nuclear Generating Station

Reactor Type:	Pressurized Water Reactor (PWR)
Operating License Issued:	16 August 1974
Shutdown:	07 June 1989

The plant operated commercially from April 1975 to June 1989, but at a lifetime capacity under 50%. A number of incidents at the plant precipitated an NRC mandated re-start program that would have involved a significant effort and cost. In accordance with the results of a public referendum on June 6, 1989, the Sacramento Municipal Utility District decided to permanently shut down the plant on June 7, 1989.

Shoreham Nuclear Power Station

Reactor Type:	Boiling Water Reactor (BWR)
Operating License Issued:	21 April 1989
Shutdown:	28 June 1989

The plant was completed in 1984 and received federal permission for low-power (5 percent) testing. The owner, Long Island Lighting Company (LILCO), faced considerable public opposition after the 1979 Three Mile Island accident, with Suffolk County legislators claiming that the county could not be safely evacuated in the event of an accident. Governor Mario Cuomo ordered state officials not to approve any LILCO-sponsored evacuation plan - effectively preventing the plant from operating at full capacity. On May 19, 1989, LILCO agreed not to operate the plant in a deal with the state under which most of the \$6 billion construction cost was passed on to Long Island ratepayers.

Fort St. Vrain Nuclear Generating Station

Reactor Type:	GCR (Gas-Cooled Reactor)
Operating License Issued:	21 December 1973
Shutdown:	18 August 1989

The helium cooled, graphite moderated reactor went into commercial operation on July 1, 1979 and operated for a little more than 10 years. On August 18, 1989, while the plant was shut down to repair a stuck control rod pair; numerous cracks were discovered in several steam generator main steam ring headers. The required repairs were determined by the Public Service Company of Colorado Board of Directors to be too extensive to justify continued operation. On August 29, 1989, the Board decided to termination operations.

Yankee Nuclear Power Station

Reactor Type:	PWR
Operating License Issued:	24 December 1963
Shutdown:	01 October 1991

The small, 185 megawatt nuclear reactor operated from 1961-1992 when it was permanently shut-down on February 26, 1992 by the Board of Directors of the Yankee Atomic Electric Company (Yankee Atomic). Although economics was cited in the decision by the board, it was the perceived viability of the plant's reactor vessel and related questions raised by the NRC's staff that likely contributed to the permanent shutdown. The inability to accurately quantify the actual level of embrittlement in the Yankee Rowe reactor vessel cast doubt on the vessel's ability to survive a thermal shock when cold water is injected during an accident condition. Potentially fixes (e.g., replacing or annealing the vessel in situ) were both untried and unproven options and very costly.

Trojan Nuclear Plant

Reactor Type:	PWR
Operating License Issued:	21 November 1975
Shutdown:	09 November 1992

In announcing the permanent cessation of operations in early 1993, the Directors of Portland General Electric (PGE), cited the cost of replacing the plant's steam generators (estimated then at \$200 million) as the basis for the decision. The generators had experienced significant tube degradation and failures, beginning shortly after the plant when on line. (In a 1997

Technical Issues summary, the NRC noted that steam generator tube degradation was responsible for multiple steam generator tube rupture events across the industry, extensive repairs, forced outages, replacement of the generators at 15 plants and contributed to the decision to shut down two nuclear power plants: San Onofre, Unit 1, and Trojan.)

There was also significant environmental opposition to the operation of the Trojan plant, with the owners surviving multiple state referendums that attempted to close the plant.

San Onofre Nuclear Generating Station, Unit 1

Reactor Type:	PWR
Operating License Issued:	27 March 1967
Shutdown:	31 November 1992

Unit 1 entered commercial operation in January of 1968. It had a capacity factor of approximately 73 percent over its first twelve years of operation, but half that value over the succeeding thirteen years (through 1992). The change in performance was due to several extended outages for major plant repairs (e.g., steam generator tube sleeving and redesign of the reactor vessel thermal shield supports) and upgrades (e.g., in seismic design, fire protection, and from post-Three Mile Island (TMI) requirements). Southern California Edison's (SCE) attempt to convert its Provisional Operating License to a Full-Term Operating License was hindered by its high costs and the opposition of the Ratepayer Advocate to recover such costs in rates, arguing declining performance and possible need to replace the steam generators. Ultimately, a settlement was reached to permanently shut down the unit and recoup sunk costs.

Zion Nuclear Power Station

Reactor Type:	PWR
Operating License Issued:	19 October 1973 / 14 November 1973
Shutdown:	21 February 1997 / 19 September 1996

The 1998 press release announcing the permanent shutdown of the Zion reactors after nearly 25 years of operations, cited economics as the rationale. "A thorough analysis of the projected costs to produce power at the station and the expected price of electricity in a deregulated market led us to one conclusion: Zion Station will not be able to produce competitively priced power in a deregulated marketplace over the remaining useful life of the plant. The analysis was based on three factors: the cost of operating and supporting the plant, the amount of power it was expected to generate and the projected price of electricity in a deregulated market. "

The station had had a troubled past and was on the NRC's "watch list" prior to its announcement to permanent cease operations (along with two other nuclear stations operated by Commonwealth Edison). The decision to shut down followed an earlier announcement not to replace the plants steam generators. The shutdown decision was viewed by investors as an opportunity for the owner/operator to reallocate its resources to its other troubled facilities.

Connecticut Yankee Atomic Power Station

Reactor Type:	PWR
Operating License Issued:	30 June 1967 (Provisional)
Operating License Issued:	27 December 1974 (Full Term)
Shutdown:	05 December 1996

The Connecticut Yankee Atomic Power Company Board of Directors voted to permanently close the Haddam Neck plant in December 1996. Press releases by the company identified three factors: the age of the plant, its relatively small size, and its high operating cost compared to alternative energy sources (e.g., oil and natural gas). The plant also had a troubled past, having been shut down since the previous July for safety reasons (as reported by the NRC in its 1997 notice of violation and referenced inspections in 1995 and 1996).

Maine Yankee Atomic Power Station

Reactor Type:	PWR
Operating License Issued:	29 June 1973
Shutdown:	06 December 1996

While the plant's operating history had been one of successful low-cost, reliable generation, the two years preceding its closure were marked by unscheduled outages, increased regulatory scrutiny, and considerable media attention. As a result of extensive outages in 1995 and 1996, and growing concerns about steam generator reliability, the plant owners conducted detailed economic analyses on the viability of continuing plant operation, versus permanently closing the facility. The Maine Yankee Atomic Power Company Board voted on August 6, 1997 to decommission the plant. David Flanagan, chair of the Maine Yankee Atomic Power Company Board, stated that "an economic analysis of operations, rising expenses for plant upgrades and the projections for stable power costs fueled the decision by Maine Yankee's eight owners to explore permanent shutdown."

Big Rock Point Nuclear Plant

Reactor Type:	BWR
Operating License Issued:	01 May 1964
Shutdown:	29 August 1997

Consumers Energy announced on June 11, 1997, that the nation's longest running and oldest operating unit would be permanently shut down on August 30, 1997. The announcement cited the plant's relatively small generating capacity (67 megawatts), high cost of operation in an increasingly competitive environment, improvements to the plant that would be needed to meet future regulatory requirements and the limited time left on its operating license (3 years).

Millstone Power Station, Unit 1

Reactor Type:	BWR
Operating License Issued:	31 October 1970 (Provisional)

Operation License Issued: 31 October 1986 (Full Term)
Shutdown: 21 July 1998

On July 17, 1998, Northeast Utility decided to permanently shut down the Unit 1 reactor (it had been shut down for refueling in November of 1995 and not restarted). The company concluded that the cost to restore the plant to full operations would only bring a slight economic benefit to its customers. Once recognized as one of the best performing boiling water reactors, Unit 1, along with the adjacent two units at the site were on the NRC's watch list at the time the decision was made to close and the company had been assessed the largest fine ever imposed by the NRC (citing more than 50 violations from October 24, 1995 to December 31, 1996). Restart of any of the three units was contingent, at that time, on approval from an independent consultant and a vote from the regulatory agency.

Crystal River Nuclear Plant, Unit 3

Reactor Type: PWR
Operating License Issued: 03 December 1976
Shutdown: 20 February 2013

In 2009, Progress Energy replaced the unit's two steam generators during a scheduled maintenance and refueling outage. In the process, engineers discovered a delamination, or separation of concrete, within the reactor building that surrounds the reactor vessel. Although the initial damage was successfully repaired, additional delamination was discovered in two different areas of the reactor building in 2011.

An independent review commissioned in 2012 confirmed that repairing the containment building was technically feasible but included significant risks that could raise the cost of the repair and extend the repair schedule significantly. On February 5, 2013, Duke Energy (having acquired Progress Energy in 2012) announced its decision to retire the nuclear unit instead of pursuing repair to the plant's containment building.

Kewaunee Power Station

Reactor Type: PWR
Operating License Issued: 21 December 1973
Shutdown: 07 May 2013

On October 22, 2012, Dominion Resource Inc. announced that they would shut down the nuclear unit in mid-2013 after they were unable to find a buyer for the plant. The announcement cited the low price of natural gas, (e.g., from record shale production), expiring purchase power agreements, the plant's age, and Dominion's inability to grow its nuclear fleet in the Midwest (which would have provided some economics in operations).

San Onofre Nuclear Generating Station, Units 2 and 3

Reactor Type: PWRs
Operating License Issued: 16 February 1982 / 15 November 1982
Shutdown: 13 June 2013

On June 7, 2013, Southern California Edison (SCE) decided to permanently retire Units 2 and 3 at its San Onofre Nuclear Generating Station (San Onofre). The Chairman and CEO of Edison International cited continuing uncertainty about when or if the units might return to service as the deciding factor. In particular, ongoing regulatory and administrative processes and appeals were expected to cause extended delays. Both units had been shut down since January 2012, Unit 2 for refueling and Unit 3 after small leaks were detected in the newly replaced steam generators (the steam generators had been replaced in Unit 2 in 2009 and in Unit 3 in 2010). A subsequent investigation concluded that the steam generators, manufactured by Mitsubishi Heavy Industries, had design flaws.

Vermont Yankee Nuclear Power Station

Reactor Type: BWR
Operating License Issued: 21 March 1972
Shutdown: 29 December 2014

On August 27, 2013, Entergy Corporation announced that Vermont Yankee would cease operations in the fourth quarter of 2014 for economic reasons. Reasons cited included; sustained, low natural gas prices and wholesale energy prices, a high cost structure for the single unit plant (since 2002, the company invested more than \$400 million in the safe and reliable operation of the facility), the financial impact of cumulative regulation, and artificially low energy and capacity prices in the region that did not provide adequate compensation to merchant nuclear plants for the fuel diversity benefits they provide.

Fort Calhoun Station

Reactor Type: PWR
Operating License Issued: 09 August 1973
Shutdown: 24 October 2016

On June 16, 2016, the Omaha Public Power District's Board of Directors determined that it was in the best financial interest of the District and its customer-owners to retire Fort Calhoun Station by the end of 2016. Market conditions were cited as a primary factor in the decision, including historically low natural gas prices and a reduced demand for electricity. Fort Calhoun was also the smallest rated commercial unit in the United States at the time, making it difficult to absorb the higher, fixed production costs.

3. Actual v. Projected Cost of Decommissioning

In general, the financial information available on the decommissioning projects that have been completed is limited, beyond that provided in periodic NRC-required filings on financial assurance. Decommissioning contractors believe that the release of detailed cost information can cause irreparable harm to their competitive position in bidding future work and plant owners generally release only what is required by regulators. As such, cost data in the public record is typically presented at a very high level or heavily redacted.

The NRC's regulations require licensees to demonstrate financial assurance throughout the operating life of the reactor, including biennial comparisons to the NRC's threshold funding amounts. In addition, licensees are required to file several, site-specific estimates as the plant nears its end of operating life and following the permanent cessation of operations:

- a preliminary decommissioning cost estimate at or about 5 years prior to the projected end of operations (10 CFR 50.75(f)(2)) which includes an up-to-date assessment of the major factors that could affect the cost to decommission;
- an estimate of expected costs for the activities being proposed in the Post-Shutdown Decommissioning Activities Report (PSDAR), submitted prior to or within 2 years following permanent cessation of operations;
- a site-specific decommissioning cost estimate within 2 years following permanent cessation of operations. This requirement may be satisfied by including a site-specific estimate as part of the PSDAR. (10 CFR 50.82(a)(8)(iii)); and
- an updated site-specific estimate of remaining decommissioning costs as part of a License Termination Plan (LTP) at least 2 years before termination of the license (10 CFR 50.82(a)(9)(ii)(F)).

The following chronologies were extracted from the licensee's NRC filings and referenced documents, as available, for projects that have been recently completed or are nearing completion. Decommissioning, for purposes of this discussion, is tied to the completion of the radiological remediation work at the site since, in most instances, the site will remain under a NRC license until the spent fuel can be removed by the Department of Energy (DOE), i.e., there is still an ongoing caretaking cost being reported at most sites for the operation of an ISFSI.

The chronologies reflect a degree of volatility in the early decommissioning cost estimates (prepared in the late 1980s and early 1990s). This can be attributed to issues such as:

- Premature shutdown adding costs with longer and less efficient transitions from plant operations to decommissioning (since little or no pre-planning had been done).
- Minimal regulatory guidance as the NRC had not anticipated the wave of early plant closures. Decommissioning planning was also more cumbersome in the pre-PSDAR era and regulatory relief was on a case-by-case basis.
- ISFSIs were required to off-load storage pools and reduce plant operating costs (earlier decommissioning estimates had assumed that the spent fuel would be removed by the DOE in accordance with the standard contract).
- The decommissioning trust funds were not fully funded due to the abbreviated operating periods – limiting options and favoring deferred action or temporary actions while funding was secured.
- Low-level radioactive waste disposal costs were in flux with the failed attempts to create state compacts and develop new disposal sites.

In 1996, in an effort to streamline the regulatory process for those plants that had prematurely ceased operations, the NRC published revisions to its general requirements for decommissioning nuclear power plants. The rule was intended to clarify ambiguities and codify procedures and terminology as a means of enhancing efficiency and uniformity in the decommissioning process. The 1996 rule, along with other NRC staff guidance (for example,

Regulatory Guide 1.184 issued in July 2000), provided a more predictable path to license termination and added an additional degree of certainty to later decommissioning estimates.

Rancho Seco Nuclear Generating Station

On May 20, 1991, the District submitted a proposed Decommissioning Plan to the NRC. The plan outlined a scenario that placed the plant into “Hardened SAFSTOR”. The spent fuel would be moved into dry storage and the plant placed into a safe, dormant condition with a small site maintenance staff until 2008 (original license expiration) when a Decommissioning Operations Contractor would be brought in to complete decommissioning. The timeline allowed for the Decommissioning Trust Fund to be fully funded before dismantlement began. The NRC issued a decommissioning order and approved the Rancho Seco decommissioning funding plan on March 20, 1995.

Shortly thereafter, the District engaged TLG Services, Inc. (TLG) to develop alternatives to the SAFSTOR scenario (due to delays and increased cost of the dry fuel storage project), including using the on-site staff for limited decontamination and dismantling activities. In January of 1997, Board of Directors (the Board) approved a trial project involving the limited physical dismantlement of the facility. In 1999, the Board approved expansion of the Incremental Decommissioning Project to include all activities necessary for license termination.

The cost estimate prepared by TLG in 1999 represented both the shift to a plant area-based approach and the schedule change associated with accelerating the decommissioning timeline. With the commencement of active decommissioning came the requirement to perform annual updates to the cost estimate. In 2000, TLG prepared an update to the 1999 area-based cost estimate. By that time, relatively long-term contracts were in place to provide labor, technical staff, transportation, radwaste packaging materials, radwaste processing, and radwaste disposal to support the decommissioning process. TLG used this actual information when preparing the 2000 cost estimate.

1. 1999 TLG Estimate (license termination) TLG Document No. S11-1337-003, Rev. 0	\$420.178 million (\$1999)
2. 2000 TLG Estimate (license termination) TLG Document No. S11-1360-002, Rev. 0	\$495.416 million (\$2000)
3. Update of Site-Specific Decommissioning Costs Rancho Seco License Termination Plan, Rev. 2 October 2014	\$534.185 million (\$2005)
4. 2011 Decommissioning Cost Estimate 18 June 2012 Letter to NRC (DPG 12-305)	\$517.1 million (\$2011) ^[1]
5. Report on Decommissioning Funding Status 14 March 2016 Letter to NRC (DPG 16-0620)	\$518.34 million ^[2]

Notes: ^[1] \$487.2 spent to date for site remediation (site is released except for that area around the Interim Onsite Storage Building). Future costs for remaining activities are estimated at \$29.9 million for a total 2011 Decommissioning Cost Estimate of \$517.1 million. Remaining activities include: the transfer of Greater Than Class "C" (GTCC) Radioactive Waste to the DOE in 2027; disposal of Class B & C low-level radioactive waste (LLRW) in 2016 and oversight of the LLRW until disposal; and license termination activities following disposal of the LLRW.

^[2] Remaining activities include: the transfer of the used nuclear fuel and GTCC, license termination activities for the area licensed under Part 50 begun in 2015 and scheduled to be completed in 2016; and, license termination activities for the Part 72 licensed facility following removal of the material from the ISFSI.

Yankee Nuclear Power Station

The Decommissioning Plan, which was submitted in December 1993 by the Yankee Atomic, involved placing the plant into SAFSTOR until a low-level waste disposal facility was available (expected in 2000), when dismantlement (DECON) would begin. The Decommissioning Plan included a cost study for operating the facility through a safe storage period, decommissioning the facility, restoring the site, and storing spent fuel until its transfer to the DOE. In October 1994, Yankee Atomic completed a revised cost study to assist the NRC in its review of the Decommissioning Plan and to fulfill a commitment to Federal Energy Regulatory Commission (FERC). This 1994 cost study was also based on the assumption that dismantlement activities would not begin until a low-level radioactive waste disposal site became available.

In June 1995, the State of South Carolina re-opened the low-level waste facility in Barnwell, South Carolina, to radioactive waste generators throughout the United States. In response, Yankee Atomic updated the cost estimate to reflect several significant changes in parameters affecting decommissioning costs. This study, called the 1995 Cost Study, was filed with FERC in August 1995. In this study, the 1994 Cost Study was adjusted for differences in decommissioning timing, waste disposal costs, and one year of escalation. The 1995 Cost Study estimate of "to-go" costs remaining as of January 1995 was \$303.2 million. In addition, as part of the final December 1995 FERC settlement, Yankee Atomic was allowed to collect another \$3.2 million in the decommissioning trust fund to adjust for adjudicatory delays during re-approval of the Decommissioning Plan, bringing the total January 1995 "to-go" cost to \$306.4 million (1995 dollars).

As required by the FERC settlement, an updated cost estimate was filed in December 1999.

Yankee Atomic submitted a new decommissioning cost estimate to FERC in April 2003 seeking additional revenue. The 2003 estimate superseded the 1999 "to go" cost estimate. It was reported that, as of January 1, 2003, the remaining cost to complete the NRC required decommissioning activities was estimated at \$121.1 million, stated in 2003 dollars.

Decommissioning was completed and the plant's operating license was amended (for continued ISFSI operations) in August 2007.

1. 1995 Cost Study ("to go" costs) \$306.4 million (1995 dollars)
2. 1999 Cost Estimate \$453.0 million (1999 dollars) ^[3]
3. Yankee Atomic LTP, Rev. 1 \$636.4 million (\$2003) ^[4]
YAEC to NRC, BYR 2004-133
19 November 2004

Notes: ^[3] The total includes \$207.1 million spent to date, \$147.7 million in projected expenditures for dismantling and \$98.3 million in spent fuel storage costs

^[4] The total includes \$347.9 million spent to date, \$288.5 million in projected expenditures (2003 - 2022) in 2003 dollars. The \$288.5 million included the remaining cost to complete the required decommissioning activities (\$121.1 million), contingency, long term spent fuel storage costs through 2022, and site restoration.

Trojan Nuclear Plant

Portland General Electric (PGE) reported that the decommissioning cost estimate in the initial Decommissioning Plan was based largely on a site-specific cost estimate performed for PGE by TLG Services, Inc. in May 1994.

In a March 8, 2005 meeting before the Oregon Public Utility Commission, PGE reported that radiological decommissioning was expected to be complete by June 2005 and that their overall radiological decommissioning cost performance was approximately 8% under budget

Decommissioning was completed and the plant's operating license terminated (ISFSI operations continue under a separate license) in May of 2005.

1. TLG Document No. P15-25-002, Rev. 1 \$289.8 million (\$1993)
18 August 1994
(excludes the cost of the large component removal project, i.e., disposition of the reactor vessel, steam generators, pressurizer)
2. PGE Decommissioning Plan and LTP, Rev. 16 \$429.7 million (\$1997) ^[5]
27 March 2003
3. PGE Decommissioning Plan and LTP, Rev. 21 \$421.9 million (\$1997) ^[6]
31 March 2005

Note: ^[5] total cost includes radiological, non-radiological, dry spent fuel management and financing costs

- [6] total cost includes \$211.7 million for radiological decommissioning activities, \$40.2 million for non-radiological, \$169.9 million for dry spent fuel management and \$16 thousand for financing costs

Zion Nuclear Power Station

Commonwealth Edison Company (now Exelon Generation Company) submitted a PSDAR on February 14, 2000, following the permanent cessation of operations of the two nuclear units at the Zion Nuclear Power Station in 1998.

On January 25, 2008, Exelon and Zion Solutions, LLC (a wholly-owned subsidiary of EnergySolutions, LLC) submitted an Application for License Transfers to the NRC requesting that the NRC consent to the transfer of the plant to ZionSolutions. On March 18, 2008, ZionSolutions submitted an amended PSDAR stating their intention to accelerate the decommissioning schedule if the application for license transfers was approved.

The decommissioning cost estimate presented in the ZionSolutions PSDAR was based upon the plant commodities developed for an earlier TLG cost estimate completed in 2006 for Exelon.

1. Commonwealth Edison, PSDAR 14 February 2000	\$904.3 million (\$1996)
2. 2006 TLG Estimate TLG Document No. E16-1555-004, Rev. 0	\$1.043 billion (\$2006)
3. ZionSolutions, Amended PSDAR 18 March 2008	\$978.0 million (\$2007) [7]
4. Report on Decommissioning Funding Status 30 March 2016 Letter to NRC (ZS-2015-0044)	\$677.2 million (\$2014)
5. Report on Decommissioning Funding Status 29 March 2016 Letter to NRC (ZS-2016-0036)	\$667.3 million (\$2015) [8]

Notes: [7] The \$978.0 million in 2007 dollars includes provisions for storage of spent fuel and GTCC wastes on the Zion site until 2018, as well as site restoration costs for all areas except the ISFSI.

[8] Includes \$486.8 million spent to date (through December 31, 2015), \$158.9 million estimated costs to complete decommissioning and \$21.6 million for managing irradiated fuel at the site until 2020 when the site is scheduled to transition back to Exelon.

Maine Yankee Atomic Power Station

Maine Yankee submitted its site-specific decommissioning cost estimate to the NRC on November 3, 1998. The accompanying report, "Decommissioning Cost Analysis for the Maine Yankee Atomic Power Station," prepared by TLG and dated October 1997, provided the detailed analysis of the projected costs for the decommissioning activities (radiological decontamination, spent fuel management and site remediation/restoration).

The License Termination Plan (Rev. 2), submitted by Maine Yankee and dated October 15, 2002, escalated the TLG 1997 cost to 2001 dollars for comparison with the costs spent to date.

On March 30, 2005, Maine Yankee provided a decommissioning funding status report to the NRC (MN-05-014). In that submittal, the company reported that the plant "is nearing completion of decommissioning" and that "as of December 31, 2004, \$554 million has been expended for all decommissioning costs, of which \$405 million has been estimated as the allocation of actual expenditures for decommissioning activities, as defined by the NRC expenditures for decommissioning activities, as defined by the NRC in 10 CFR 50.2."

Decommissioning was completed and the plant's operating license was amended (for continued ISFSI operations) in September of 2005.

- | | |
|---------------------------------------------------------------|------------------------------------------|
| 1. TLG Document No. M01-1258-002, Rev. 1
28 October 1997 | \$508.2 million (\$1997) ^[9] |
| 2. License Termination Plan, Rev. 3
15 October 2002 | \$589.3 million (\$2001) ^[10] |
| 3. NRC Decommissioning Funding Status Report
30 March 2005 | \$554 million (YOE) ^[11] |

Notes: ^[9] Total cost for radiological decontamination, spent fuel management and site remediation/restoration

^[10] \$508 million escalated to \$2001

^[11] Total cost as of 31 December 2004 including \$405 million of decommissioning costs, excluding Department of Energy contract settlement credits

Big Rock Point

Consumers Energy filed a revision to their PSDAR on March 26, 1998. The decommissioning costs reported in that document were based on a detailed, site-specific cost estimate was prepared by TLG. Pursuant to State of Michigan requirements to prepare and file decommissioning cost estimate updates with the Michigan Public Service Commission (MPSC) at three year intervals, an update was prepared by TLG in 2000 and filed in March 2001 as a follow-up to a site-specific decommissioning cost estimate filed with the MPSC in March 1998.

The 2000 estimate, updated with actual costs incurred through 2002 and the latest forecast costs, served as the cost basis for the License Termination Plan submitted in 2003. The \$400.6 million estimated in 2001 was revised downward by Consumers Energy to \$382.4 million in year 2000 constant dollars. The \$18.2 million reduction was the result of a reduction in contingency dollars from \$45.0 million to \$13.0 million and an increase in projected spent fuel management costs from \$50.9 million to \$64.7 million.

Consumers Power noted in its LTP submittal that “entering the third year since the 2000 estimate was prepared, actual project cost performance has been on target and is expected to trend unchanged.

On March 31 2005, Consumers Power filed an update to the PSDAR (Rev. 4). The update included discussion on a revised cost estimate that had been presented to the MPSC in March 2004. The estimated cost to decommission the plant was based on the 2003 estimate study prepared by TLG. The estimate (in year of expenditure dollars) was \$439.4 million.

Decommissioning was completed and the plant’s operating license was amended (for continued ISFSI operations) in January of 2007.

- | | |
|--------------------------------------------------------------------------------|------------------------------------------|
| 1. 1998 TLG Estimate
TLG Document No. C07-1267-004, Rev. 0
26 March 1998 | \$293.9 million (\$1997) |
| 2. 2001 TLG Estimate
TLG Document No. C07-1388-003, Rev. 0
01 March 2001 | \$400.6 million (\$200) ^[12] |
| 3. BRP License Termination Plan, Rev. 0
01 April 2003 | \$382.4 million (\$2000) ^[13] |
| 4. 2004 TLG Estimate
TLG Document No. C07-1479-001, Rev. 0
22 March 2004 | \$430.8 million (\$2003) |
| 5. BRP PSDAR, Rev. 4
31 March 2005 | \$439.4 million (YOE) |
| 6. BRP License Termination Plan, Rev. 2
27 September 2005 | \$439.4 million (YOE) ^[14] |

Notes: ^[12] \$323.0 million Radiological Decommissioning, \$50.9 million for Spent Fuel Management and \$26.7 million for Site Restoration

^[13] \$291.0 million Radiological Decommissioning, \$64.7 million for Spent Fuel Management and \$26.7 million for Site Restoration

^[14] \$333.9 million of radiological decommissioning costs, \$73.6 million of spent nuclear fuel storage costs, \$30.3 million of site restoration and \$1.6 million of post 9-11 incremental security costs. Consumers Energy has concluded that, based upon information currently available, that the estimate was adequate to complete the remaining decommissioning activities for the plant.

Independent Spent Fuel Storage Installation (ISFSI) Timing, Legal and Other issues

The Commission requested additional background information on WCNOG's current plan for executing an Independent Spent Fuel Storage Installation ("ISFSI").

The failure of the U.S. Department of Energy (DOE) to perform under the Standard Contract for the Disposal of Spent Nuclear Fuel and/or High Level Radioactive Waste ("Standard Contract") resulted in the need to increase the Wolf Creek Generating Station's ("Wolf Creek") on-site storage capacity for spent nuclear fuel assemblies to support continued operation. A rerack of the spent fuel pool ("SFP") was completed in early 2000, effectively increasing the wet spent fuel storage capacity to support plant operation to the end of the original license period (2025). The rerack project maximized the available wet storage capacity of the SFP.

Wolf Creek applied for and received a 20-year license extension in 2008. This extension resulted in the current licensed operating period being extended to 2045. The continuing failure of the DOE to perform under the Standard Contract has resulted in the need for Wolf Creek to pursue additional avenues to increase the on-site spent fuel storage capacity or develop offsite storage options.

Current DOE projections are to have a centralized interim storage facility ("CIS") by 2025 and a permanent repository available no earlier than 2048. Having one or more CIS in place by 2025 is a possibility; however, the initial "pilot" CIS would be focused on removing used fuel from "stranded" sites (i.e., ISFSI sites with no operating reactor).

Since the last triannual filing, WCNOG has made certain decisions with respect to the ISFSI. It has finalized its preferred site location for the ISFSI currently outside of the plant's Protected Area Boundary; the preferred location can accommodate a minimum of 38 canisters in an area that can be easily expanded to address additional dry storage capacity should the need arise. Each canister will hold 37 spent fuel assemblies. A wheeled transport vehicle will be used onsite for the haul path transport method to the ISFSI.

Nonetheless, key project decisions remain to be made that involve design, development, installation and operation of the ISFSI. These decisions will affect the ultimate capital and operating costs of the project and the timing of when those costs will be incurred. Some of the major decisions, none of which have yet been made, include:

- Designer of the project, vendor of the components, and builder of the project.
- In-ground or above ground storage casks.
- Whether the load team will be site personnel, a "partner" arrangement, or turnkey.
- Whether to own, lease or share transfer equipment.

WCNOG's current plan for executing the ISFSI project is as follows:

1. Summer and Fall, 2017. Issue requests for quotes, receive proposals, award contracts, and begin design development.

2. 2017-2019. Vendor design and procurement, develop and issue plant design change packages and field work packages, install pad, lighting, security systems, construct necessary additional buildings, and establish haul path.
3. January 2019. Begin ISFSI construction
4. June 2021. Complete readiness for onsite dry fuel storage.
5. Fall 2021. First load campaign.

Our review of selected available industry information, and informal inquiries from various industry sources, suggest that the range of total (not annual) capital cost for ISFSI projects has been between \$45 million and \$85 million. However, these cost differences are highly dependent upon the combination of key decisions made for each project. This cost range is presented here for illustrative purposes only and should not be deemed to be estimates for the Wolf Creek facility because of the various diverging influences discussed above. However, for purposes of the Decommissioning Cost Analysis, a representative decommissioning cost based on using above ground storage casks is included within the DECON and SAFSTOR estimates.

In addition to the numerous uncertainties mentioned above, another significant uncertainty is the number of years over which the ISFSI will be needed to store Wolf Creek's spent fuel. That uncertainty is caused in large part by the federal government's continued inability to achieve a workable solution for disposal, or at least temporary storage, of the nation's spent fuel.

Finally, certain ISFSI construction and operation costs will be recoverable from the DOE. Wolf Creek recently settled its claim with the DOE that the DOE was in partial breach of contract for failing to accept spent nuclear fuel from Wolf Creek. The settlement also provides for an annual claims process with the DOE, which will allow Wolf Creek to recover damages incurred through 2019 without having to litigate.