

Backed Into A Corner: Cleaning Up Pennsylvania's Nuclear Power Plants

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Table-1

**Limerick 1 & 2 , Peach Bottom 2 & 3, Susquehanna 1 & 2,
and Three Mile Island 1**

<u>Reactor</u>	<u>Type/Mfg./AE</u>	<u>MW/Life & Death</u>
Limerick 1*	(BWR/GE/Bechtel)	1,055+ (2/86-2024)
Limerick 2*	(BWR/GE/Bechtel)	1,055+(1/90-2029)

Note: 100% owned and operated by PECO Energy/Exelon Generation.

<u>Reactor</u>	<u>Type/Mfg./AE</u>	<u>MW/Life & Death</u>
Peach Bottom 1	(HighTempGraphiteMod)	40 (1966-1974)
Peach Bottom 2	(BWR/GE/Bechtel)	1,065+/7/74 (2014; 2034)
Peach Bottom 3*	(BWR/GE/Bechtel)	1,065+/1274 (2014; 2034)

Note: Connectiv sold 7.5% per unit share of Peach Bottom 2 & 3 to Exelon and PSEG. Although there is joint ownership, 50%/50% Exelon operates Peach Bottom 2 & 3.

Connectiv sold 7.5% per unit share of Peach Bottom 2 & 3 to Exelon and PSEG. PSEG is the majority owner (57.51%) and operates Salem 1 & 2).

<u>Reactor</u>	<u>Type/Mfg./AE</u>	<u>MW/Life & Death</u>
Susquehanna 1*	(BWR/GE/Bechtel)	1,032+ (6/83-2023)
Susquehanna 2*	(BWR/GE/Bechtel)	1,091+ (2/85-2025)

Note: PPL owns 90% of both units and the Allegheny Electric Cooperative owns the remaining 10%.

<u>Reactor</u>	<u>Type/Mfg./AE</u>	<u>MW/Life & Death</u>
Three Mile Island -1*	(PWR/B&W/B&R)	819+/40 (1974-2014)

Note: = 100% owned and operated by AmerGen/Exelon Generation.

Analyses of TLG’s Operating Assumptions

All nuclear decommissioning studies rely on similar assumptions supplied by TLG Industries which is owned and operated by Entergy. TLG continues to base decommissioning estimates on “field” studies (1) extrapolated from small, minimally contaminated, and/or prematurely shutdown nuclear reactors. These estimates are based on Base Rate Case proceedings before the Pennsylvania Public Utility Commission (“PA PUC”). TLG Industries current estimates have increased **three fold since 1995**. The 1995 predictions witnessed a similar increase when compared to TLG’s 1990 assessments.

The table below documents the gross miscalculations in decommissioning projections from 1985 through 1995.

Table-2

<i>Generating Station(s)</i>	<i>1985 Study/1995 Study</i>	<i>\$ Increase</i>
Limerick 1 & 2	\$272m/\$986m	\$714m
Peach Bottom 2 & 3	\$273m/\$947m	\$674m
Salem 1 & 2	\$271m/\$701m	\$430m
Three Mile Island 1 (a)	\$60m(b)/\$368m or \$431m(c)	\$308-\$371

(a) GPU reported that the cost to decommission TMI-2 more than doubled in 48 months. By 1997, the decommissioning estimate had risen 110% in four years to \$433 million, 1997, GPU Annual Report.

(b) TMI-1 total, projected decommissioning expense based on ENTOMB, 1986, GPU Annual Report, p. 39.

(c) TLG’s estimate as referenced in the 1998, GPU Annual Report, p. 59.
(Source: PECO Energy’s Response to EE-I-4)

1 Shippingport (72 MWe; Light Water Breeder Reactor) is the largest commercial nuclear power plant to be fully decontaminated. The reactor vessel was shipped to the Hanford Reservation thus depriving the industry of critical hands-on decommissioning experience. In fact, Shippingport was dismantled and not decommissioned. Shippingport was owned and operated by Duquesne Light Company under special agreement with the Department of Energy.

ComEd, the other half of Exelon, has documented that net nuclear decommissioning costs have risen from 3,089 million in 1990 to 5,426 million in 1999. (PECO Energy's Response to EE-I-4.) (2)

Proportional Confusion

At the Susquehanna Steam Electric Station, projected costs for decommissioning have **increased by at least 553%** in the last 19 years. In 1981, PP&L engineer Alvin Weinstein predicted that PP&L's share to decommission SSES would fall between \$135 and \$191 million. By 1985, the cost estimate had climbed to \$285 million, and by 1991 the cost in 1988 dollars for the "radioactive portion" of decommissioning was \$350 million. The Company then contracted out for a site-specific study which projected that the cost of immediate decommissioning [DECON] would be \$725 million in 1993 dollars. The 1994 cost estimate remained steady at \$724 million, but the market value of securities held and accrued in income in the trust funds declined, and thus the estimate reflected another increase in decommissioning costs (PP&L Base Rate Case, Page, 1016, Lines 7-27 and Page 1017, Lines 1-24.)

The Susquehanna Steam Electric Station is owned by PP&L (90%) and the Allegheny Electric Cooperative (10%). The Allegheny Electric Cooperative (AEC) is responsible for 10% of the cost of decommissioning. PP&L's consultant, TLG, estimated PP&L's decommissioning share to be \$724 million. Therefore, the AEC is responsible for the remaining 10%, or \$79 million, of the \$804 million projected funding "target" for nuclear decommissioning. However, the AEC is saving for decommissioning by **setting aside 5%** (rather than 10%) of its projected share of nuclear decommissioning. Laurence V. Bladen, Director of Finance and Administrative Services told Mr. Epstein that AEC is basing its decommissioning estimates on **data supplied by PP&L** (Telephone conversation between Mr. Epstein and Mr. Bladen, March 30, 1995.)

2 Comparative analyses of early ComEd estimates are unavailable: "A search of ComEd's records reveals that ComEd does not have records of the initial estimates of the indicated decommissioning costs" (PECO's Response to EE-Informal-I-4.)

(Telephone conversation between Mr. Epstein and Mr. Bladen, March 30, 1995.)
“Allegheny’s portion of the estimated cost of decommissioning SSES is approximately \$37.8 million and is being accrued over the estimated useful life of the plant.”

(Allegheny Electric Cooperative 1994 Annual Report, The Power of Initiative: Seizing Opportunities on the Horizon. Decommissioning Trust Fund, **Cost of Decommissioning Nuclear Plant**, p.49.)

Complicating the matter is PP&L’s steadfast refusal to actively monitor AEC’s obligations. Mr. Ronald E. Hill, senior vice-president of Finance for PP&L was questioned by Mr. Epstein during the PP&L Base Rate Case (1995) on the relationship between AEC and PP&L, and he exhibited this distant and negligent attitude:

Q: Have you read Allegheny Electric Cooperative’s annual report from last year by any chance?

Witness: I believe I glanced at it, but I can’t recall specifics (Page 448, Lines 15-22.)

Q: Can you tell me why they’re [AEC] only putting aside \$37.8 million?

Witness: “Not specifically except they’re probably using a different estimate than we used” (Page 449, Lines 5-8.)

Q: “Allegheny could be planning it [decommissioning] on entomb, they could be planning it on decon?”

Witness: “They could be basing they’re estimate on the NRC required funding level, too. There are several different methodologies of coming up with the estimate to decommission plants.”

Q: “But it’s possible that you could be putting aside money -- I believe, actually, your method is decon and their method is safe store.”

Witness: “I don’t know what their method is. I don’t believe it’s safe store.”
(PP&L Base Rate Case, Page 450, Lines 11-25 and Page 451, Lines 1-12.)

Unfortunately, **AEC does not know** what method it is employing to calculate decommissioning costs either. On March 30, 1995, Mr. Epstein contacted Mr. Bladen of the Allegheny Electric Cooperative. Mr. Bladen informed Mr. Epstein that decommissioning costs were based on estimates supplied by PP&L. Bladen noted: “It’s not like we could decommission [Susquehanna] using a different method.” However, Mr. Bladen could not identify the decommissioning mode. Mr. Epstein called again on May 12, 1995 and Mr. Bladen informed him that the method for decommissioning Susquehanna was “Greenfield.” Mr. Epstein informed Mr. Bladen that Greenfield is not a decommissioning mode and Mr. Bladen responded, “I’ll have to do some further checking.” Mr. Epstein recontacted Mr. Bladen on June 5, 1995, at which time Mr. Bladen replied, “I keep asking the engineers. I know its not **ENTOMBMENT.**”

Mr. Bladen is charged with financial oversight of AEC, and although sincere and responsive, has absolutely no idea about the method and financial expectations associated with the decommissioning of Susquehanna.

The impact of this uncertainty between decommissioning partners is crucial and potentially debilitating. Since PP&L has no enforcement mechanism to compel Allegheny Electric to fund 10% of the decommissioning costs for SSES, the question of financial responsibility looms large. Mr. Epstein queried the Company witness during PP&L Base Rate Case (1995), Mr. Ronald Hill, about the relationship:

Q: “But there is actually no coordination?”

A: “There is coordination, but they’re under no obligation to accept our estimate and to fund in the same manner that we do. They are obligated to come up with their share of the money at the end.”

Judge Christianson: “Coordination but not control.”

Witness: “That’s right your honor.”

Q: “Do you know what method right now they’re anticipating Susquehanna will be decommissioned as?”

A: “No, I don’t.”

Q: “So it’s possible they may be envisioning the decommissioning of Susquehanna say, entomb, whereas right now you’re envisioning it as decon?”

Witness: They may be (Page 450, Lines 11-25 and Page 451, Line 1-12.)

The Allegheny Electric Cooperative is owned and controlled by fourteen (14) distribution cooperatives. The AEC is not regulated by the Public Utility Commission nor does the company have publicly traded stock. Therefore, there is no behavior modifying mechanism afforded to state regulators or PP&L shareholders to oversee AEC’s contributions. If current trends continue unabated, AEC’s expected decommissioning savings will be grossly inadequate and will therefore undermine PP&L’s decommissioning plans for Susquehanna.

Non-Radiological Decommissioning

The cost estimates for non-radiological decommissioning, (an imprecise term), are not mandated by the NRC although the agency stipulates that all nuclear power plants be returned to Greenfield, i.e. the original environmental status of the facilities prior to construction of the nuclear power plant. Furthermore, Greenfield has not been achieved by any large commercial nuclear plant and utilities are not required to save for this mandated eventuality, placing additional strain on the companies ability to finance radiological and non-radiological decommissioning.

Q. 6. a. “How much additional moneys does the Company estimate will be needed for non-radiological decommissioning in order to restore the site to “Greenfield?”

b. “How is PP&L saving for this mandated eventuality?”

A. 6. “A. None. Non-radiological equipment was included in the TLG decommissioning study.”

b. “See response to item A.”

(Pennsylvania Power & Light Company Response to Interrogatories of Eric Joseph Epstein, Dated June 3, 1997.)

Low Level Radioactive Waste Isolation

TLG provided nuclear waste storage and nuclear decommissioning costs estimates for all Pennsylvania utilities regulated by the Public Utility Commission. However, TLG’s testimony during the 1995 PP&L Base Rate Proceeding discredits their projections. Mr. La Guardia, President of TLG, based his cost estimates for low-level radioactive waste disposal on the assumption that the Appalachian Compact would be available when the SSES closes (PP&L Base Rate Case, Page 1034, 17-20). He concluded that the disposal of LLW is the most expensive component (3) in the decommissioning formula (Page 2091, Lines 21-25.) Furthermore, Mr. LaGuardia conceded it may be necessary to recompute cost estimates for disposal because it now appears imminent that Barnwell will open for seven to ten years for all states except North Carolina (Page 2108, Lines 4-9.) However, the Company has not yet taken the step of reconfiguring costs of LLW disposal now that Barnwell has been open since **July 5, 1995**.

Q. 7. “Has TLG or the Company recomputed decommissioning estimates since Barnwell has reopened?”

A. 7. “No.” (Pennsylvania Power & Light Company Response to Interrogatories of Eric Joseph Epstein, dated June 3, 1997.)

3 LLW “disposal” fees account for 15% to 25% of the total cost of radiological decommissioning.

TLG used “rate schedules” for Barnwell **and** Envirocare claiming it may prove more “cost effective” to ship LLW to Utah rather than South Carolina (Limerick p. xi, Peach p. 187, and Salem p. 10). **This claim is absurd and is based on speculation that a nonmember of a Compact could gain access to another site because the nonmember was paying more for LLW isolation at its own restricted facility.**

TLG has failed to qualify and quantify the proportion, volume, curie content and classes of waste being shipped to Barnwell as opposed to Clive. However, it is implied in Appendix B (based on the cost of cask-liners) that all LLW will be shipped to “CNSI”, i.e., Barnwell (Limerick, p. 8).

Please note that HB 237 before the Utah House Political Subdivisions Committee seeks to **ban Class “B” and Class “C” Wastes** (*Salt Lake Tribune*, February 14, 2003). And Charles Judd, the former President of Envirocare is seeking to build a new radioactive landfill right across from Envirocare’s existing site in Tooele County. Judd’s proposal comes:

...amid a firestorm of controversy in Utah about radioactive waste. In the fall [of 2003] voters defeated Initiative 1, a measure that would outlaw hotter waste and boost taxes on low-level waste already permitted. Meanwhile, the state is battling a high-level waste site proposed for the Skull Valley Goshute Reservation, and some state leaders are talking about the the prospect of a second high-level site, dubbed plan B (*More Nuclear Waste to Be Coming Utah's Way*, “Salt Lake Tribune”, February 15, 2003).

Since Limerick will be coming off-line last, the assumption should be that the waste will be transported to Utah. However, the State of Utah has not given approval for Envirocare's site to handle Class “B” and “C” LLW, and the Goshute Reservation storage facility remains in abeyance. In fact, Utah is actively attempting to bar the importation of Class “B” and “C” waste (Refer to 1.3.2).

If Barnwell closes in 2008, the only alternatives for LLW disposal are in Utah. TLG assumes that Barnwell and Envirocare (which currently accepts only Class “A” LLW) are suitable “prox[ies]” for cost predicting purposes (Limerick, Section 1, pp. 5-6, Peach p. 196, and Salem p. 19). In fact, TLG has explicitly and implicitly recognized that “B” and “C” wastes are shipped to Barnwell, e.g., “More highly contaminated and activated materials will be sent to Barnwell” (Limerick, Section 3, pp. 11-12, Peach, Section 3, p. 11, and Salem, p. 40).

Recently, the Southwestern Compact (Arizona, California, North and South Dakota) asked the federal government to “revisit” the issue of LLW management since no new site has been opened in 20 years.

Please note that LLW costs may be further ameliorated by the NRC’s proposal of 56 “realistic reuse scenarios” that would allow, “Nuclear power plant operators to market their radiologically constrained soils to construction companies, farmers, golf courses and other commercial entities...” Some of the proposed consumer uses include: paving; bricks; ash fill, and fertilizer. (*Environmental News Service*, October 19, 2000)

TLG needs to get past inert definitions, i.e., “Very low-level radioactive material...will be sent to Envirocare. More highly contaminated and activated material will be sent to Barnwell” (Limerick, Section 3, pp. 3-4, Peach, Section 3, p.11, and, Salem p.40). Low-level radioactive waste isolation requires: 1) Classification by curie content; 2) Estimated number of LLW shipments from each reactor to Barnwell and Clive; 3) Factor waste compaction at SEG; and, 4) Provide estimates of mixed-waste disposal costs.

Low level radioactive waste projections need to be adjusted upward to factor license extensions, and account for recent legal developments. For example, the federal government and nuclear industry have instituted a strategy of manipulating waste classifications and definitions nuclear as a means of “disposing” nuclear waste.

WASHINGTON, Sept. 30 - The Energy Department has asked Congress to allow it to redefine some nuclear waste so it can be left in place or sent to sites intended for low-level radioactive material, rather than being buried deep underground.

Department officials say they thought they had flexibility in classifying what constituted high-level nuclear waste, but in July, a federal district judge in Idaho ruled that the department's plan for treating waste there violated the Nuclear Waste Policy Act, a 1982 law requiring the deep burial of high-level waste.

The argument concerns tens of millions of gallons of salts and sludges left over from weapons production that are now in tanks in Idaho, South Carolina and eastern Washington. High-level waste is supposed to be encapsulated in glass for burial. The department has chosen Yucca Mountain, Nev., as the repository site, but the site has not yet opened and when it does, it will not be big enough for all the solidified wastes and spent reactor fuel.

In the Idaho case, the Energy Department had said that some of the high-level waste was "incidental" and need not be removed from the tanks. The Natural Resources Defense Council and the Snake River Alliance, a local environmental group, along with two Indian tribes, successfully argued that the order violated a longtime policy that high-level waste must be deeply buried.

The ruling also could affect waste from a defunct civilian reprocessing plant in West Valley, N.Y., near Buffalo. The waste has already been solidified, and department officials said Tuesday that the resulting glass logs would be shipped for deep burial. But the officials said that contaminated buildings and equipment there might be left on site.

A department official said, however, that it would not change what was acceptable at the Carlsbad plant, which is designed for plutonium and other long-lived materials.

Tom Cochran, a nuclear expert at the Natural Resources Defense Council, said, "Basically what they're doing is allowing the D.O.E. to abandon high-level waste and treat it under standards written for low-level waste."

High-Level Radioactive Waste Management

Nuclear decommissioning studies assume a facility for high-level radioactive waste (HLW) will be operational by 2015 (Limerick, p. xii & Section 1, p. 5; Peach p. 188 & p. 195, Salem p. 11 & p. 18). Ironically, all studies carefully traced the decades-old trail of delays. Without explanation, TLG now assumes a repository will be ready in a timely fashion (Limerick, Section 1, pp. 4-5, Peach pp. 194-195, Salem pp. 17-18). Even if this optimistic scenario is realized it will be irrelevant. Based on Peach Bottom's license extensions and Limerick and Salem's estimated operating lives, all three plants will be operating past 2020.

The Studies do not indicate if the Waste Isolation Pilot Project (WIPP) MRC facility is assumed to supplement Yucca Mountain. WIPP would have limited use in that the 2,150' deep geologic repository operated by the Department of Energy (DOE) only accepts transuranic wastes. Perhaps the stopgap site TLG has in mind is the "temporary" nuclear waste facility (40,000 tons for 40 years) proposed on the Skull Valley Goshute Indian Reservation in Utah which is not approved.

Even if spent fuel storage capacity is increased, the additional cost will have a significant impact on decommissioning. For example, at the Susquehanna Steam Electric Station **spent fuel costs were omitted from TLG's decommissioning estimate**: "None of the estimates we have prepared include the cost of disposal of spent nuclear fuel," PP&L Base Rate Case, Page 1032, Lines 20-12). But spent fuel is the main contributing factor in the escalation of decommissioning costs at Yankee Rowe. Thomas LaGuardia, the Company's witness, admitted the increase during cross examination:

Mr. Epstein: “Are you aware that the cost has increased for the decommissioning of Yankee Rowe from \$247 million to \$370 million over the last two years?”

Witness: “Yes. I’m aware of what the estimate concludes.”

Mr. Epstein: “And half of the cost was attributable to spent fuel storage?”

Witness: “That’s correct” (PP&L Base Rate case, Page 1029, Lines 16-22.)

Isolation of high-level radioactive waste, which is primarily composed of spent nuclear fuel, **can not be separated from nuclear decommissioning**. At the earliest, Yucca Mountain will be available in 2010. If Yucca opened today, it would be forced to confront “under capacity” and “overflow” from 103 nuclear reactors storing 50,000 tons of waste at 72 sites in 33 states. This number can only grow. An average reactor generates up to 30 metric tons of HLW annually and that figure does not include power uprates. Nuclear generating stations can not be immediately decontaminated and decommissioned with the presence of spent fuel onsite or inside the reactor vessel. Aggressive and destructive decontamination cleanup processes will be unavailable until spent fuel is removed the nuclear generating stations’ temporary storage facilities. Additionally, front-end decommissioning tasks require skilled workers for site-specific tasks. Labor costs are erratic and should be linked to inflationary indices. The NRC and the nuclear industry devote scant resources to decommissioning research and development. This laissez-faire approach should not be rewarded by financially penalizing rate payers and tax payers.

Radioactive Scrap Metal & Rate Payer Equity

Nuclear companies need to account for radioactive scrap metal (RSM) values, cannibalization of parts, potential sale value of consumer grade materials, and the impact of NRC regulations that allow for “Below Regulatory Concern” (“BRC”) waste to be sold on the open market. The status quo is unacceptable.

Table-3
Estimated Radioactive Scrap Metal

Limerick	81,733 tons	(C-2, p. 23)
Peach Bottom	46,865 tons	(C-2, p. 21)
Salem	54,443 tons	(C-2, p.22)

RSM goes to straight to the heart of rate payer abuse and intergenerational equity. Rate payers need to be protected from poor management and duplicitous fiscal projections. And rate payers should be allowed to capture the full value of their hostage investment. Failing both, consumers will be forced to service debts for which they receive little to no service.

Transportation Methods

Transportation Costs have increase slightly, but these projections assumed LLW and HLW destinations are all **beyond** 500 miles (1995-1996 assumption). Moreover, compaction transportation costs are either omitted or unidentified.

TLG's credibility is undermined by ignoring and flat out missing the boondoggle associated with Southern California Edison's (SCE) aborted plan (February, 2003) to ship a 900+ million ton radioactive reactor, fused with concrete and metal, that was once San Onofre-1 (4).

SEC's original plan was to truck the San Onofre-1 reactor vessel to a barge where it would be set on a voyage to the Panama Canal...The railroad refused to carry the cask. Next, the Panama Canal Authority refused entry because the radioactive casket is six times heavier than the allowable limit, and the Port of Charleston refused entry (twice!). San Onofre-1, TLG's **self-proclaimed successful decommissioning operation**, remains in San Diego...

Postscript

ROSEMEAD, Calif. - Southern California Edison has arranged a route to ship its defunct nuclear reactor to a South Carolina disposal site, and the three month long trip could begin within weeks, a company spokesman said.

The 668-ton reactor will be driven from the San Onofre Nuclear Generating Station to Camp Pendleton, and will be shipped about 11,000 miles by barge around the tip of South America to Charleston, S.C...

Earlier this year, the Panama Canal Authority refused to grant a weight waiver to ship the reactor through the 50-mile waterway. The Port of Charleston said in February it would deny entry of the reactor due to terrorism concerns, but Golden said those fears have been allayed.

4 San Onofre-1, a 436 MWe, PWR, went on line in January, 1968, and operated for 35% of its projected operating life and was prematurely retired in November, 1992.

The plant is owned by Southern California Edison (80%) and San Diego Gas and Electric (20%).

Conclusion

No prudent financial officer operating outside of the nuclear industry in the real world of Sarbanes-Oxley would accept funding formulas and rate recovery strategies that relies on so many fluid caveats and assumptions. David Hayward, president of Hayward Consulting stated, "...nuclear plant owners have historically underestimated the cost of decommissioning nuclear power plants. Third, the issue of disposing nuclear waste has not been fully settled" (*Public Utilities Fortnightly*, "Plant Valuation: Book Value and Beyond", September 1, 1999, p. 58).

Nuclear power remains a heavily subsidized industry. The Bush Administration and Republican leaders have strayed from their free enterprise mantra to facilitate development a new generation of reactors. "Congress could pass a measure that would guarantee about \$15 billion in loans to nuclear power plant developers, all to offset the high, upfront capital costs that are preventing them from taking risks. It coincides with another bill to reauthorize the Price-Anderson Act that has limited nuclear power operators' liabilities risks since 1957 to \$9.3 billion." (5)

License extensions have created funding scenarios similar to fossil generating "service lifes". Over-recovery, based on "**service life**" (**45 to 55 years**) as opposed to "**life spans**" (**30 to 40 years**) should be factored as a contingency in decommissioning planning. Exelon is in the same quandary as other generators: "However, at this time, the Company cannot predict future changes in decommissioning technology, decommissioning costs or nuclear regulatory requirements. Accordingly, the Company cannot anticipate future decommissioning cost requirements or the associated rate recovery levels.

("Q. & A. 157", PP&L's Response to Interrogatories of the Environmentalists, Set 3, Dated: May 19, 1997).

5 "Nuclear Power Has Yucca Mountain to Climb", Ken Silverstein , Director, Energy Industry Analysis, Wednesday, October 22, 2003.