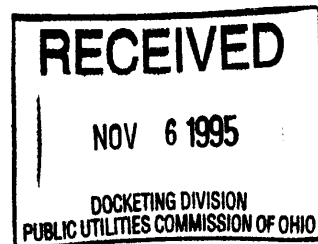


In the Matter of the Application of The)
Cleveland Electric Illuminating)
Company for approval of nuclear)
decommissioning cost estimates and)
Trust Fund Payment Levels.)

94-2026-EL-AAM

In the Matter of the Application of The)
Toledo Edison Company for approval of)
nuclear decommissioning cost)
estimates and Trust Fund Payment)
Levels.)

94-2027-EL-AAM



**Staff Report
for the Davis-Besse Nuclear Power Plant**

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BACKGROUND

The first nuclear generating unit owned by an Ohio utility was Beaver Valley Unit 1 (BV1), which went on-line in 1976, and is owned in part by Ohio Edison (OE), which owns 35.00% of the unit. Davis-Besse (DB) followed, going on-line in 1977, and is owned by Toledo Edison (TE) which owns 48.62%, and Cleveland Electric Illuminating (CEI), which owns 51.38 %. Since that time, the Perry Nuclear Power Station Unit 1 (PY) (owned by CEI and TE , at 31.11% and 19.91% respectively) and Beaver Valley Unit 2 (BV2) (owned by CEI, TE and Ohio Edison, at 24.47%, 1.65%, and 20.22% respectively) have come on line, both in November of 1987. Along with the placement of the nuclear units into service, came the responsibility to decommission those units when they reached the end of their useful life, generally defined as the end of the NRC Operational License.

Initially, this liability was treated as a part of the depreciation on the units, similarly to removal and disposal costs on any other item of equipment. However there began to be some concern both about the inflation in these costs, and about the ability of the utilities to finance the decommissioning costs when the time came, particularly since pairs of units entered service at close to the same time (BV1 and DB in 1976-77 and BV2 and PY in the same month of 1987), and hence would probably be shutting down at about the same time. Concern also arose at the Federal level, causing the NRC to propose revised and more stringent rules for assuring the financing of decommissioning, which were finalized on June 27, 1988

On August 19, 1987, the Commission opened an Commission Ordered Investigation in to the funding of nuclear decommissioning costs, Case No. 87-1183-EL-COI. In this docket, the Commission issued a series of questions addressing various ways of assuring the availability of funds for decommissioning, dealing with increases in decommissioning costs, and allocation of these costs to ratepayers over time. Comments in response to these questions were received from: The Centerior Energy Corp., Ohio Edison, The Ohio Consumers' Counsel, Toledo Coalition for Safe Energy. After reviewing these comments, and additional research carried on by the Commission Staff, the Commission issued an Entry on April 19, 1988. In this Entry, the Commission severed decommissioning funding from depreciation, and established a mechanism for assuring the availability of funds for decommissioning.

The mechanism established by the Commission had the following characteristics:

Nuclear decommissioning was estimated on a current-dollar basis (i.e. no inflation of the estimate is performed).

External trust funds were required to be established by each owner of each nuclear generating unit, however these funds could be pooled and administered by a single trustee (i.e. separate funds were required for each owner of each unit, but each trust does not need to have a separate trustee).

The periodic investment in the funds was determined on a straight line basis, to as to accrue the as yet unaccrued portion of the estimate over the as yet unexpired portion of the licensing period.

The return on the investment in the funds are to be reinvested in the funds, so as to allow the growth in the funds to cover the effects of inflation on the decommissioning cost estimates.

On December 22nd, 1994, The Cleveland Electric Illuminating Company and The Toledo Edison Company filed Case Nos. 94-2026-EL-AAM and 94-2025-EL-AAM to revise their decommissioning cost estimates, and the related periodic accruals into the decommissioning funds. The decommissioning cost estimates underlying these applications were performed by TLG Engineering, Inc., which is a recognized for its expertise in the field.¹

In their applications, Cleveland Electric Illuminating and Toledo Edison did not request any changes to the decommissioning funding mechanism prescribed by the Commission in its Entry in Case No. 87-1183-EL-COI. The Staff, after its review, recommends no change in the decommissioning funding mechanism at this time. However, the Staff feels that this should continue to be considered in future reviews.

The Staff also performed a review and analysis of the studies performed by TLG Engineering. This review and analysis was divided into two sections; a review of the Unit Cost Factor methodology employed by TLG Engineering, performed by Staff from the Accounts and Audits Division of the Utilities Department, and a review of some of the inputs into the Unit cost factor Methodology, performed by the Nuclear Safety Division of the Consumer Services Department. This report presents the results of these reviews.

¹ On May 9, 1995, Ohio Edison filed Case No. 95-475-EL-AAM, to set decommissioning cost estimates and periodic trust fund accruals for its share of Perry, Beaver Valley 1 and Beaver Valley 2. This application was also based on studies performed by TLG, Engineering Inc. However, some aspects of the Ohio Edison application differ from the CEI/TE applications. These aspects of the Ohio Edison application are still under investigation.

INTRODUCTION

This report evaluates the Thomas LaGuardia Services, Inc. (TLG, a Bridgewater, Connecticut consulting firm) decommissioning cost study of the Centerior Energy Corporation's Davis-Besse Nuclear Power Station, Unit 1 (Davis-Besse). Davis-Besse, located approximately 21 miles east of Toledo, is a pressurized water reactor (PWR) with a design thermal rating of 2772 megawatts (MWt) and a design electrical rating of 906 MWe. The plant began licensed operation on April 22, 1977 and commercial operation on July 31, 1978.

The purpose of this evaluation is to assist the commission in determining the adequacy and reasonableness of TLG's cost estimates. For the purposes of the report, adequate cost estimates will be considered those which have addressed all cost sources; reasonable cost estimates will be those based on accepted industry standards and methodologies, as informed by industry experience and studies.

Decommissioning begins at the end of a nuclear plant's operating life, which usually is between 30 and 40 years. Decommissioning activities include draining fluid systems; decontaminating pipes, equipment and structural materials that have become radioactive; dismantling the reactor and surrounding structures; and shipping the radioactive waste to a waste disposal facility. Removal and disposal of spent fuel, considered to be operational activities, and the removal and disposal of non-radioactive structures and materials beyond those necessary to terminate the Nuclear Regulatory Commission (NRC) license, are not considered decommissioning activities under NRC regulation.

The decommissioning cost estimate is based on Davis-Besse operating for the full 40 years granted by its license, terminating April 22, 2017. Also, this decommissioning evaluation may not be valid if the plant is granted a license renewal beyond its 40 year license.

The NRC requires that nuclear power plants maintain a fund sufficient to pay for the facility's decommissioning. Because plant owners pay into the fund by installment, the amount of money in the fund increases as the plant gets older and nears retirement. In the past, decommissioning cost estimates for Davis-Besse were based on the NRC's decommissioning cost projections for model nuclear plants. The Decommissioning Trust Funds established by the Ohio owners of Davis-Besse are valued at \$50,851,259 (as of 12/91/94). Plant decommissioning costs were previously estimated (and approved by the PUCO) to be \$122,000,000 (1985 dollars). The new estimate, based on the site-specific methodology, is \$346,449,900.

DECOMMISSIONING METHODOLOGY

TLG used a site-specific methodology to estimate the cost of decommissioning Davis Besse. Site-specific methodologies identify particular tasks and problems which might

be encountered in the actual decommissioning. Generic methodologies estimate decommissioning expenses by adjusting cost estimates already prepared for typical plant designs. While a site-specific methodology provides greater detail of the decommissioning process and identifies particular tasks, a site-specific cost estimate tends to be higher than a generic estimate, perhaps because it includes various activities which a generic estimate overlooks. Little experience exists in decommissioning large nuclear power plants, and it is important to note that site-specific methodologies estimate costs largely through engineering calculations and theory.

DECOMMISSIONING ALTERNATIVES

There are three alternatives for decommissioning a nuclear power plant: DECON, SAFSTOR, and ENTOMB. DECON removes or decontaminates radioactive equipment, structures, and portions of a facility and its site to a level that permits the property to be released for unrestricted use. SAFSTOR places the nuclear facility in a condition that allows it to be safely stored until the site can be subsequently decontaminated (deferred decontamination) to levels that permit its release for unrestricted use. ENTOMB encases radioactive contaminants in a structurally long-lived material, such as concrete.

Centerior chose DECON for its Davis-Besse, which, according to the NRC, is the least expensive approach in constant dollars, and is about equivalent to SAFSTOR in present value. Another DECON advantage is its elimination of a potential long-term safety hazard by decommissioning the facility immediately following its operating life.

Major disadvantages of SAFSTOR and ENTOMB are the additional costs incurred, e.g., surveillance and facility maintenance, to place the facility into the storage mode.

TLG estimates the total DECON decommissioning costs for Davis-Besse to be \$346,449,900 (in 1993 dollars). More than \$28 million of this figure is estimated to be necessary to protect the spent fuel on site immediately after plant shutdown ("caretaking"). DECON cost minus "caretaking" is estimated to be \$318,060,300.

SUMMARY OF TLG DECOMMISSIONING COST STUDY

TLG completed its decommissioning cost study for Centerior Energy Corporation's Davis-Besse plant in May 1994. The Unit Cost factor methodology used by TLG to estimate the decommissioning costs for Davis-Besse is essentially that outlined in the "Decommissioning Handbook", published by the US DOE. The Unit Cost Factor methodology divides costs into two categories; "activity dependent" and "period dependent". Activity dependent costs are those costs that vary primarily with the type and quantity of work performed. For example, the cost of labor and consumables required to remove a cubic yard of contaminated concrete is reasonably consistent, so the total cost varies primarily with the total number of cubic yards to be removed. Period dependent costs are those costs which vary primarily with the time over which the work is performed. To continue our example, rental charges for the heavy equipment used to load and pack the cubic yard of contaminated concrete into a disposal container are generally assessed on a per day basis, so the total cost varies primarily with the number of days required to perform the work.

Activity dependent unit costs were developed by TLG based on labor and materials costs provided by CEI and TE. These unit cost factors are expressed in dollars per unit of work; concrete removal in \$/cubic yd of concrete, steel removal in \$/ton of steel, cutting piping in \$/inch of cut., and so on. For each unit cost factor, a quantity associated with each factor (cubic yards of concrete, tons of steel, inches of cut required, etc.) is developed from plant drawings and other records. For each factor, the cost per unit is multiplied by the number of units. The results of these calculations are then summed to arrive at a total activity dependent cost for the process.

A critical path analysis was the basis for the period dependent costs, and was used to determine the time spans required for the various period dependent cost factors. CEI provided labor rates and salary information for personnel, and equipment rental costs were determined from the R.F. Means "Building Construction Cost Data" publications. In addition, the demolition costs of non-radioactive structures, landscaping, and other activities outside of the NRC definition of decommissioning² were determined based on R.F. Means "Building Construction Cost Data" publications.

The Unit Cost methodology is a recognized method of estimating demolition costs and, properly applied, provides a high degree of confidence in the results. Based on the Staff's review of the cost estimates performed by TLG Engineering and the supporting workpapers provided, the Staff is of the opinion that the Unit Cost methodology is an appropriate method for determining site specific cost estimates for the nuclear units under discussion. In addition, the Staff is satisfied that the methodology has been applied appropriately and consistently to the problem, and that,

² The NRC defines decommissioning as: "to remove (as a facility) safely from service and reduce residual radioactivity to a level that permits release of the property for unrestricted use and termination of license." 10 CFR Part 30 §30.4

in general, labor, materials and other costs may be relied upon as reasonably indicative of the current costs.

The TLG estimate was based on the DECON (immediate dismantlement) decommissioning alternative. Total DECON decommissioning costs were estimated to be \$346,449,900 (in 1993 dollars). This amount does not include the cost of spent fuel disposal, which is a Department of Energy (DOE) responsibility. Prior to transferring the spent fuel to the DOE, "caretaking" (e.g., spent fuel management and storage) is required for approximately five years. Caretaking activities are required by the NRC and are appropriately considered part of the DECON decommissioning cost. This cost is estimated to be \$28,389,600.

TLG projects that the decommissioning process will take 90.3 months. Activities will commence at unit shutdown and end when site restoration is complete. The process is divided into three periods.

Period 1 - Fuel Delay and Preparation

The TLG study assumes that spent fuel generated over the operating life of the plant will remain on-site following shutdown for approximately five and one-half years, after which time the U.S. Department of Energy (DOE) will provide off-site temporary or permanent storage for the fuel. During the interim period of on-site wet storage, the existing spent fuel facilities will remain operational. Decommissioning activities will be scheduled to minimize the effect upon the overall program schedule and to continue safeguarding the spent fuel bundles.

Preparation activities begin at the end of plant operation. These activities include engineering planning, surveys of contamination levels throughout the plant, vessel and internal component analysis, and the establishment of a decommissioning management organization. Period 1 ends when the NRC grants a decommissioning order.

Period 2 - Decommissioning Operations and License Termination

This stage commences once Davis-Besse receives the dismantling order from the NRC. The activities occurring during this period generally include decontamination and demolition of systems and structures, and shipment and burial of all remaining radioactive materials. Period 2 ends when the NRC verifies that all activities have been completed satisfactorily. The site can then be released for unrestricted use and conventional demolition.

Period 3 - Site Restoration

During this period, the turbine, control, and radwaste buildings, and other above-ground site structures are removed, and the plant area is graded and landscaped. Site restoration is not required by the NRC but has been included in the TLG decommissioning cost study.

The table below is a summary of the TLG DECON decommissioning cost estimate for Davis-Besse.

Table 1. Summary of DECON Decommissioning Costs (1993 Dollars)

YEAR	Period 1 Fuel Delay	Period 1 Preparations	Period 2 Decommissioning	Period 3 Site Restoration	Yearly Totals
2017	\$10,112,994				\$10,112,994
2018	\$14,532,452				\$14,532,452
2019	\$3,384,270	\$22,149,285			\$25,533,555
2020		\$6,723,890	\$54,373,992		\$61,097,882
2021			\$71,292,644		\$71,292,644
2022			\$71,175,350		\$71,175,350
2023			\$46,743,066	\$13,301,918	\$60,044,984
2024				\$32,659,994	\$32,659,994
Total	\$28,029,716	\$28,873,176	\$243,585,052	\$45,961,912	\$346,449,856

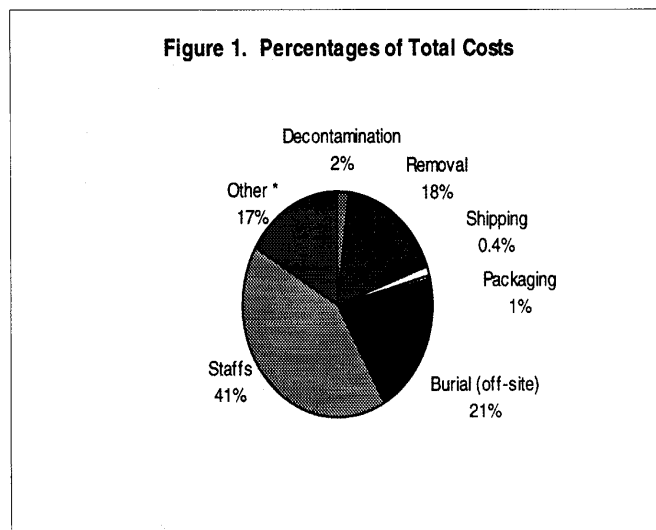
A large portion of the DECON decommissioning cost is attributed to labor and burial expense. Table 2 shows a list of the major decommissioning activities and their associated costs.

Table 2. Summary of Activity Costs (1993 dollars)

Work Category	Cost (thousands)	Percent of Total Cost
Decontamination	6,459	1.86%
Removal	61,761	17.83%
Packaging	3,947	1.14%
Shipping	1,505	0.43%
Burial (off-site)	72,021	20.79%
Decommissioning Staffs	142,972	41.27%
Other *	57,784	16.68%
Total**	346,450	100.00%

* Engineering and preparations, property tax payments, insurance premiums, off-site low-level radioactive waste (LLRW) recycling costs and plant energy budget.

** The total includes approximately \$28,389,600 of spent fuel-associated costs.



A more detailed description of TLG's cost analysis appears in Table 3 below.

Table 3: Detailed DECON Decommissioning Costs for Davis-Besse

Total Cost to Decommission with 17.15% contingency:	\$346,449,856
Total NRC Termination Cost is 84.78% or:	\$293,733,248
Non-Nuclear Demolition Cost is 15.22% or:	\$52,716,620
Total Radwaste Volume Buried:	180,440 cubic feet
Total Scrap Metal Removed:	28,832.4 tons
Total Craft Labor Requirements:	1,170,568.8 man-hours
Total Personnel Radiation Exposure:	649.0 man-rem
Total Craft Labor Cost with 22.93% contingency:	\$47,313,012
Total Contingency Cost:	\$50,719,000
Total Burial Cost (contingency cost not included):	\$61,339,000

FINDINGS

To evaluate the TLG decommissioning study, staff selected major cost contributors, including low level radioactive waste, site restoration costs and contingency factors. Low level radioactive waste burial charges make-up approximately 21% of the total TLG decommissioning cost estimate. Currently, Ohio does not have a facility that will accept and dispose low level radioactive waste, thus, the nuclear division performed extensive cost analyses to estimate disposal costs for Ohio's proposed facility. Site restoration costs, or non-nuclear demolition, make-up 15.22% of the total TLG estimated decommissioning costs. Some of these costs include restoring the site to "green field" conditions, meaning to restore the site to its original condition prior to the existence of the nuclear power facility. The determining factor as to whether or not to restore a site to "green field" should be based on future plans for the site.

"Green Field" Restoration

Green field restoration means that all major structures would be removed, and the sites would be graded and landscaped to return them to a condition similar to that which existed before construction began. It is not required by an NRC regulation. The NRC decommissioning regulations only apply to the radioactive portion of the plant.

The TLG study assumed the Davis-Besse site would be cleared of all above-grade structures and site improvements, and the land returned to a state consistent with adjacent areas. TLG has estimated the non-nuclear demolition (green field restoration) cost to be \$52,716,620 (15.22% of total decommissioning costs).

Some former nuclear power sites have been re-used to site other types of power generating facilities. For the Davis-Besse site though, it will most likely be restored to "green field" condition. The main reason for this is because the Davis-Besse site is surrounded by wetlands. Other types of power generating facilities, such as coal and oil, would require large facilities for fuel storage, thus could not fit on the Davis-Besse site. The chance of re-using the site to construct another nuclear power facility is also unlikely since no nuclear power generating facilities have been constructed in the US since 1987.

Contingency Factors

TLG uses contingency factors to estimate decommissioning costs. Contingency factors are intended to cover potential decommissioning costs incurred from unspecified events such as bad weather, equipment problems, and schedule delays. TLG has applied a 22.93% contingency factor to the craft labor resulting in a total labor cost of \$47,313,012. The total cost to decommission includes an average contingency of 17.15% (\$50,179,000). The contingency factors TLG applied to the decommissioning study were comparable to contingency factors used in the construction industry for project planning.

Radioactive Waste Disposal

To decommission Davis-Besse, high-level radioactive waste (HLRW) and low-level radioactive waste (LLRW) must be removed from the plant site. Spent nuclear fuel is considered high-level waste, and items such as turbine and condenser or contaminated clothing and tools are examples of low-level waste. The DOE is responsible to eventually dispose the HLRW, but it is the licensee's responsibility to dispose the LLRW generated both during the plant's useful life and during decommissioning.

Low Level Radioactive Waste

LLRW disposal is a significant part of the total Davis-Besse decommissioning cost estimate. It is difficult to project exactly how much it will cost to decommission Davis-Besse because a low level radioactive waste facility that will accept Davis-

Besse's waste does not exist. In the past, Davis-Besse, like other nuclear power plants in the eastern half of the United States, shipped LLRW to a facility in Barnwell, South Carolina. In June of 1994, however, the Barnwell facility closed to generators of LLRW that fall under the jurisdiction of other LLRW disposal compacts. Two LLRW disposal facilities, one of which is located in Nevada and the other in Washington, also stopped accepting waste from outside their compacts between 1992 and 1993.

The U.S. Department of Energy's National Low-Level Waste Management Program published a report entitled "Economics of a Small-Volume Low-Level Radioactive Waste Disposal Facility" (DOE/LLW-170). Since actual costs to dispose low level radioactive waste at a facility in the Midwest (or in Ohio) are not available, the Staff used the DOE model described in the report to estimate burial costs for Ohio's low level radioactive waste.

According to the Ohio EPA's Low-Level Radioactive Waste Project, the parameters planned for the proposed Ohio disposal facility are: a waste receipt rate of 67,000 ft³/yr, an operating life of 20 years, a total capacity of 2.25 million cubic feet and a 100% private financing source. The calculations made in this cost study were based on these values and an approximated real interest rate of 7%. Table 4 below shows the DOE-170 "base case" parameters and Ohio's proposed facility's parameters. Based on the DOE-170, the estimated low level waste burial charges for Ohio are \$218.64 per cubic foot (in 1992 dollars).

Table 4. Technical and analytical parameters used for DOE-170 and this study

Parameter	DOE-170 Base Case	Ohio's Proposed Facility
Annual Waste Receipt Rate	30,000 ft ³ /yr	67,000 ft ³ /yr
Operating Life	30 years	20 years
Financing Source	50% private, 50% public	100% private
Interest Rate	4%	7%

The estimated \$218.64 per cubic foot does not include potential surcharges for disposing low level radioactive waste. Other factors not accounted for in this cost study include property costs and taxes. These factors were also excluded in the DOE-170 study. The property cost is very small when compared to the overall costs of a low level radioactive waste facility, thus the impact would be minimal.

Centerior Energy has estimated the low level waste burial cost to be \$253.47 per cubic foot. This estimate was also based on the DOE-170 study but Centerior Energy varied only one parameter (the operating life) from the DOE-170 base case. Table 5

compares the parameters used by Centerior Energy to the parameters used for this study.

Table 5. Parameters Used for the DOE-170 Base Case, Centerior and this study

Parameter	DOE-170 Base Case	Centerior	Ohio's Proposed Facility
Annual Waste Receipt Rate	30,000 ft ³ /yr	30,000 ft ³ /yr	67,000 ft ³ /yr
Maximum Capacity	900,000 ft ³ /yr	600,000 ft ³ /yr	2,250,000 ft ³ /yr
Operating Life	30 years	20 years	20 years
Financing Source	50% private, 50% public	50% private, 50% public	100% private
Interest Rate	4%	4%	7%

Centerior Energy estimated its disposal charge before the EPA had made the parameters for Ohio's proposed facility publicly available. As a result, Centerior Energy could only vary the operating life (20 years) since that was the only known parameter for Ohio's facility (refer to Table 6).

The estimate made by TLG Services, Inc. used the base burial rate calculated by Centerior Energy (\$253.47) and added tax making the total \$262.85 per cubic foot. TLG also developed a cost list that includes surcharges imposed by Barnwell for different waste classes (e.g., Class A, B, C or greater than C waste). These surcharges are also based on the weight and the levels of radioactivity. (Refer to Appendix A for TLG estimated costs).

TLG has estimated that Davis Besse will dispose 108,440 ft³ of low level radioactive waste during decommissioning. Applying the nuclear division's base rate of \$218.64 per cubic foot to the total volume of low level radioactive waste, the estimated low level radioactive waste base rate burial charges total \$39,451,402. Incorporating TLG's tax and surcharge estimates of \$1,692,527 and \$13,910,346 respectively, the total low level radioactive waste burial estimate is **\$55,054,275 (in 1992 dollars)**. This estimate is \$6,284,725 less than the TLG estimate. The total estimate in **1993 dollars is \$57,146,337**.

High Level Radioactive Waste

The Nuclear Waste Policy Act (NWPA) mandates that the DOE will dispose of high-level radioactive waste, including spent nuclear fuel (SNF) from the nation's commercial nuclear power plants. The act also obligates operators of commercial nuclear power plants to contribute one mil per kWh produced into a fund managed by Congress to pay for the DOE program to dispose high level radioactive waste. These

obligations are established in contracts between DOE and the commercial nuclear power plants.

The DOE is not currently prepared to take the HLRW from nuclear power plants. Many owners and operators of nuclear power plants believed that the DOE should be able to accept spent fuel by the NWPA's projected date of 1998, and several states and utilities, including Centenor Energy Corporation, are suing the DOE for both breach of contract and equitable estoppel. The ruling in that lawsuit may alter the rights and duties of the states, the U.S. DOE, and the operators of commercial nuclear power plants.

Davis-Besse, one of the parties in a contract with the DOE for disposal of HLRW, has paid into the fund for a permanent waste repository since the plant began operations. Davis-Besse now stores its SNF in spent fuel pools on site and will also be storing it in dry casks, but when the plant is ready to be decommissioned, the spent nuclear fuel must be moved to another location. At that point, the DOE is expected to be prepared to accept the high-level waste.

OTHER STATE'S EXPERIENCES

Although the NRC has set decommissioning requirements, all states' nuclear power plants use different methodologies to estimate decommissioning costs. The paragraphs below describe decommissioning cost estimate experiences in Illinois and New York.

ILLINOIS

The Commonwealth Edison Company has 13 nuclear units at six different nuclear stations throughout Illinois. The oldest of these nuclear power plants may begin decommissioning as early as 2007 while the newer plants may begin in 2028. Decommissioning cost estimates for these units were performed by META, a consulting firm specializing in decommissioning planning, emergency planning and control of radioactive material and radiation. Mr. Mingst, who is the founder of META, testified before the Illinois Commerce Commission on contingency factors. META recommended that a 25% contingency factor be placed over the entire decommissioning costs. Some intervenors have argued that no contingency factor is necessary, while others argued that a 3% contingency factor would be adequate. The Illinois Commerce Commission made the decision to have no contingency factor included in the decommissioning costs. According to the Commission, the Commonwealth Edison Company "did not adequately justify the contingency they were proposing". META's methodology of placing contingency factors on decommissioning costs for Illinois's nuclear power plants differs from the methodology TLG used for the Perry plant. META applied one contingency factor to the total decommissioning cost, while TLG used different contingency factors for different decommissioning activities. For example, TLG may place higher contingency factors on riskier parts of the project. It is important to note that

Commonwealth Edison has made a commitment to re-evaluate the decommissioning costs annually.

Decommissioning cost estimates for Illinois' boiling water reactors (BWRs) were based on a site-specific methodology. Pressurized water reactors (PWRs), such as Davis-Besse cost estimates were mostly based on a generic methodology. The main reason for the difference in approach is due to a recently published report by the Battelle Memorial Institute, "Estimating PWRs' Decommissioning Costs." The report provides updated information on decommissioning PWR plants and serves as an excellent reference for calculating decommissioning costs on a generic basis. Battelle has also published "Estimating BWRs' Decommissioning Costs." However, the information contained in this report was not as current, and therefore a site-specific methodology was used to estimate Illinois BWRs' decommissioning costs.

Green field restoration was another issue discussed before the Illinois Commerce Commission. META included "green field" restoration costs in the decommissioning estimate. The average estimated cost for green field restoration for a single PWR unit was between \$8.5 to \$8.8 million and for a single BWR unit was approximately \$15 million (or \$30 million for the BWR facilities with two units). The Illinois Commerce Commission did not allow Commonwealth Edison Company to collect funds for "green field" because the company did not adequately justify demolishing non-radioactive buildings and because the company did not look into alternative uses for the buildings.

Spent fuel has not been a major issue in Illinois. Except for the caretaking activities prior to transport to a permanent repository, which will be treated as a decommissioning expense, spent nuclear fuel has been treated as a DOE responsibility.

The estimate for low-level waste disposal was based on disposal costs at the Barnwell, South Carolina site, which discontinued accepting waste from other states in June 1994.

The average decommissioning costs for a 1100MW PWR in Illinois range between \$250 and \$255 million. For a 1100MW BWR, the decommissioning costs are estimated to be between \$280 and \$320 million. It is important to note that Commonwealth Edison Company has made a commitment to re-evaluate the decommissioning costs on an annual basis.

NEW YORK

TLG performed a decommissioning cost study for the nuclear power facilities in New York, where high- and low-level radioactive waste disposal is a significant decommissioning cost issue. TLG placed a 25% contingency factor on decommissioning costs which the New York Public Service Commission approved.

TLG also included costs for green field restoration which were approved by the New York Public Service Commission.

The TLG study included \$252.4 million for spent fuel storage; however, the New York Department of Public Service staff testimony recommended this cost be disallowed because money was already being collected by the DOE in the Nuclear Waste Fund (NWF). As of July 1994, Consolidated Edison Co. had paid more than \$95 million into the NWF.

The decommissioning cost for low-level radioactive waste disposal was also an issue for the New York Department of Public Service. TLG based its estimate of LLRW disposal on burial charges at the Barnwell facility. The New York Department of Public Service argued that because of the high escalation rate experienced at Barnwell, that rate would not be an appropriate basis for predicting future low-level waste disposal costs.

The 1994 total estimated decommissioning costs for New York's Indian Point Units 1 & 2 can be broken down to \$252 million for interim high level waste storage (which is part of the Nuclear Waste Fund), \$225 million for decontamination and \$175 million for low level waste burial (both of which are included in the decommissioning fund) and \$6 million for demolition (which is not part of the decommissioning fund). These figures sum to a total of \$658 million.

CONCLUSIONS

Although much research has gone into the decommissioning of large nuclear power facilities, there is very little actual experience in performing decommissioning activities. The decommissioning cost study prepared by TLG for Centerior Energy used a site-specific methodology to calculate the DECON decommissioning cost for the Davis-Besse Nuclear Power Station. Although the estimated costs using this approach tend to be higher than estimated costs from a generic methodology, the site-specific process provides greater detailed information about decommissioning activities.

The DECON decommissioning alternative offers advantages over the SAFSTOR or ENTOMB alternatives. DECON is an immediate decontaminating process that eliminates the long-term safety hazard which may exist with the SAFSTOR or ENTOMB alternatives. DECON is also less costly than the other because immediate decommissioning eliminates the expense of placing the facility in a storage mode.

Under the DECON alternative, decommissioning funds must be available when the plant's operating life is terminated. Although Davis-Besse is licensed by the NRC to operate for 40 years, it should be noted though that Davis-Besse, like any other plants, could be shut down prematurely. (The Trojan, Ft. St. Vrain, and Rancho Seco nuclear power plants prematurely shutdown).

Davis-Besse's decommissioning cost estimate should include costs to restore the site to green field condition. Once the plant shutdowns, it is unlikely that the site would be used for another power generating facility. The site is surrounded by wetlands and is not large enough for a coal or oil powered generating facility. In order to construct these types of facilities, the site must be expanded which according to the Environmental Protection Agency and the Army Corp of Engineers, would require moving wet lands to other locations.

Contingency factors (intended to cover costs of unforeseeable events) should be included in the decommissioning costs for Davis-Besse. There has been little experience decommissioning large nuclear power facilities. As experienced is gained though, the number of unforeseeable events will diminish. Davis-Besse's operating license expires in 2017, more than 20 years from now. Placing a contingency factor on today's decommissioning cost provides a cushion to account for additional decommissioning activities that are unknown today. As Davis-Besse approaches the end of its license, the unknowns will become known and thus the contingency factor will decrease.

Staff has estimated low level radioactive waste burial costs to be \$218.64 per cubic foot (1992 dollars) for Ohio's proposed low level radioactive waste facility. This estimate was based on the Department of Energy's published report entitled

"Economics of a Small-Volume Low-Level Radioactive Waste Disposal Facility" (DOE/LLW-170). The DOE-170 report contained a model design facility ("base case" condition) which used specific estimated values for five cost recovery items: the annual waste receipt rate, the maximum capacity, the operating life, the financing source, and the interest rate. DOE-170 used these values to calculate the total cost for a low level radioactive waste facility. The total cost was then converted to cost per cubic foot of low level radioactive waste for the "base case" condition.

Various factors have the potential to significantly impact the low level waste disposal costs. One of these factors is the surcharges for different types of waste. Surcharges are based on waste characteristics such as radioactivity levels, size or weight. This cost study applies the surcharges estimated by TLG to the base rate calculated by the Staff. The TLG surcharge estimates are based on the prices charged by Barnwell. (This is the most recent data available to the Staff). Another factor may be the land characteristics of the site. This cost study assumed that a generic site, as the one modeled in the DOE-170, was also used for Ohio's site (refer to DOE-170, Appendix A, "Land Requirements").

RECOMMENDATIONS

The Staff recommends that the Commission allow Centerior to collect funds to restore the Davis-Besse Nuclear Power Station to green field conditions. The Davis-Besse site is surrounded by wetlands and is too small to be used in the future for other types of power generating facilities.

The Staff recommends that the Commission allow the contingency factors applied to the cost estimate in the decommissioning cost estimate study because they are reasonable and within industry practices. The Company should re-evaluate the decommissioning cost estimate annually and perform research and analysis on decommissioning processes to reduce the uncertainties and thus to reduce the contingency factors. The Company should only apply contingency factors for unknowns that could affect decommissioning activities.

The Staff also recommends that the Commission allow Centerior to recover for LLRW disposal based on the staff's estimate of \$57,146,337 (1993 dollars). This number is based on recent data provided by the Ohio EPA regarding parameters for Ohio's proposed low level waste burial facility and on a study published by the U.S. Department of Energy's National Low-Level Waste Management Program entitled "Economics of a Small-Volume Low-Level Radioactive Waste Disposal Facility" (DOE/LLW-170). The estimate of \$ 57,146,337 for disposal of low level radioactive waste includes surcharges of \$14,438,939. This estimate should be re-evaluated once the operators of Ohio's Low-Level Radioactive Waste Facility determine the actual surcharges. One should also note that until a facility becomes available that will accept Ohio's LLRW, there will always be some degree of uncertainty in LLRW disposal estimates.

Table 7 below summarizes the adjustments the staff recommends the Commission to place on TLG's recommended decommissioning cost for Centerior's Davis-Besse Nuclear Power Station. Appendix B of this report calculates the annual decommissioning trust fund investment based on the Staff's recommended adjustments.

Table 7: Recommended Adjustments to the TLG Decommissioning Cost Estimate

TLG Estimated Decommissioning Costs (1993 dollars)	\$346,449,900
TLG LLRW Burial Costs (1992 dollars)	- \$61,339,000
Staff Recommended Decommissioning Costs*	
(LLRW Burial Costs not included)	\$285,110,900
Staff Recommended LLRW Burial Costs*	+\$57,146,337
<i>Staff Recommended Decommissioning Costs)*</i>	<i>\$342,257,237</i>

*Figures escalated to 1993 dollars

APPENDIX A
 TLG Services, Inc.
 Low-Level Radioactive Waste Burial Cost Estimates
 for the Davis-Besse Nuclear Power Station
 (1992 dollars)

Base Burial Rate = \$253.47
 Boxed LSA Rate w/ Tax = \$262.85

Table A.1. TLG Low-Level Radioactive Waste Burial Cost Estimates for Davis-Besse

PLANT EQUIPMENT	WASTE CLASS	WASTE VOLUME	BURIAL COST	COST/ CU-FT	REMARKS
Systems Removal	A	30,444	\$8,002,000	\$263	
Process Liquid Waste	B	8,365	\$3,608,000	\$431	Curie Surcharges Affecting Cost
Disposal of DAW	A	9,864	\$2,586,000	262	
Reactor Coolant Piping	A	3,377	\$941,000	\$279	Curie Surcharges Affecting Cost
Press. Relief Tank	A	363	\$100,000	\$275	Curie Surcharges Affecting Cost
ROP's & Motors	A	6,666	\$1,791,000	\$269	Curie Surcharges Affecting Cost
Pressurizer	A	2,675	\$746,000	\$279	Curie Surcharges Affecting Cost
Steam Generators	A	87,080	\$22,905,000	\$263	
CROM's & ICI's	A	1,407	\$401,000	\$285	Curie Surcharges Affecting Cost
Vessel Internals	A,B,C & >C Wst	2,732	\$12,421,000	\$4,545	Curie Surcharges Affecting Cost Overweight Surcharge >C \$20,000/cu-ft surcharge
Reactor Vessel	A&B	6,681	\$2,393,000	\$358	Curie Surcharges Affecting Cost Overweight Surcharge
Spent Fuel Racks	A	1,728	\$438,000	\$253	Compaction involved lowering burial volume
Structural Decontamination	A	19,069	\$5,012,000	\$263	

Total Low Level Waste Volume Buried for Decommissioning = 180441
Total Burial Cost for Decommissioning = \$61,339,000

APPENDIX B
The Cleveland Electric Illuminating Company
Case No. 94-2026-EL-AAM
Calculation of Annual Decommissioning Expense
Davis-Besse Nuclear Power Plant Unit 1

Line	Description	
1	Estimated Decommissioning Cost (a)	\$ 342,257,237
2	Company Share - % (b)	51.38%
3	Company Share of Decom. Cost (Line 1 x Line 2)	175,851,768
4	Internal Reserve (c)	7,447,114
5	Trust Fund Balance - Qualified (d)	22,388,440
6	Trust Fund Balance - Non-Qualified (d)	807,360
7	Decommissioning Cost to Recover (Line 3 - Lines 4 thru 6)	145,208,854
8	Remaining Months to Recover (e)	267
9	Monthly Expense (Line 7 / Line 8)	543,853
10	Annual Expense (Line 9 x 12)	<u>\$ 6,526,241</u>

(a) Table 7

(b) Application, Appendix A, Page 1 of 5, Line 2

(c) As of 7/1/1988; Per Application Appendix A, Page 1 of 5, Line 3

(d) As of 12/31/1994, per the annual statements required by the Entry in Case No. 87-1183-EL-COI

(e) Remaining months between December, 1994 and April, 2017

APPENDIX B
The Toledo Edison Company
Case No. 94-2027-EL-AAM
Calculation of Annual Decommissioning Expense
Davis-Besse Nuclear Power Plant Unit 1

Line Description	
1	Estimated Decommissioning Cost (a) \$ 342,257,237
2	Company Share - % (b) 48.62%
3	Company Share of Decom. Cost (Line 1 x Line 2) 166,405,469
4	Internal Reserve (c) 5,551,065
5	Trust Fund Balance - Qualified (d) 20,505,590
6	Trust Fund Balance - Non-Qualified (d) 1,847,716
7	Decommissioning Cost to Recover (Line 3 - Lines 4 thru 6) 138,501,098
8	Remaining Months to Recover (e) 267
9	Monthly Expense (Line 7 / Line 8) 518,731
10	Annual Expense (Line 9 x 12) \$ <u>6,224,768</u>

(a) Table 7

(b) Application, Appendix A, Page 2 of 5, Line 2

(c) As of 7/1/1988; Per Application Appendix A, Page 2 of 5, Line 3

(d) As of 12/31/1994, per the annual statements required by the Entry in Case No. 87-1183-EL-COI

(e) Remaining months between December, 1994 and April, 2017