




UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

January 17, 1983

MEMORANDUM FOR: Commissioner Palladino
Commissioner Gilinsky
Commissioner Ahearne
Commissioner Roberts
Commissioner Asselstine

FROM: James R. Tourtellotte, Chairman 
Regulatory Reform Task Force

SUBJECT: BACKFITTING IMPACT COSTS

Attached are some cost figures and analyses concerning backfitting. This information was compiled and submitted in response to several requests made in the course of meeting with industry representatives.

I have transmitted these papers to the Staff and OPE for comment by February 1, 1983. Consequently, no evaluation of the information has yet been made. However, it appears to at least establish a prima facie case that the financial impacts of backfitting are substantial and that backfitting is a pervasive regulatory problem.

Enclosure:
Nuclear Power Plant Backfitting
and Regulatory Impact Costs

cc w/encl:
OPE
OGC
SECY
EDO

NUCLEAR POWER PLANT
BACKFITTING AND REGULATORY IMPACT COSTS

Data was obtained from Duke Power Company and Commonwealth Edison Company on the actual backfitting cost experienced, after operating licenses had been received, on four nuclear power stations. Also, cost data ^{were} ~~was~~ obtained on three nuclear power stations that are nearly completed and a comparison made between the costs of the these stations and similar stations that were completed in 1973 and 1974.

This information is provided as an attempt to illustrate the magnitude of the cost experienced in the backfitting of operating plants and, separately, to provide a perspective of the magnitude of the changed regulatory environment as it has impacted nuclear units nearing completion at this time. No attempt was made to determine the value of any backfit or regulatory change in terms of safety enhancement. Each backfit or regulatory change was intended to provide some additional margin of safety in the plant operation. However, since no measurable basis of safety has been established or cost-benefit analysis provided for the changes, the actual safety value of the many changes is not definable.

BACKFITTING COST EXPERIENCE ON FOUR OPERATING NUCLEAR
POWER STATIONS

Oconee Power Station - 3 Units
Duke Power Company

The Oconee Power Station consists of three PWR nuclear units with a combined capacity of 2661 MWe. Commercial operation of the first unit was February 6, 1973, the second unit was October 6, 1973, and the third unit was July 19, 1974. Total cost of the units was \$493 million, equivalent to \$185 per KW.

Backfitting costs for the three Oconee units through June 30, 1982 has been \$179 million. These costs can be allocated as \$142.4 million for NRC imposed backfitting other than TMI lessons learned; \$21.4 million for TMI lessons learned backfitting; and \$15.2 million for utility initiated backfitting. An additional backfitting cost of \$121 million is anticipated for the Oconee units to satisfy the existing and projected projects required by the NRC. A detailed listing of the previous and projected backfitting costs is provided as Attachment A.

Dresden Power Station - 3 Units
Commonwealth Edison Company

The Dresden station consists of three BWR nuclear units with a combined capacity of 1795 MWe. Commercial operation of the first unit was in August 1960, the second unit in August 1970, and the third unit in October 1971. Total cost of the three units was \$219 million.

Backfitting costs for the Dresden units through July 1982 has been \$159 million. These costs can be allocated as \$106 million for NRC imposed backfitting other than TMI lessons learned; \$18 million for TMI lessons learned backfitting; and \$35 million for

utility initiated backfitting. An additional \$72 million is anticipated for near-term future backfitting costs to satisfy NRC requirements. A detailed listing of the previous and projected backfitting costs for the Dresden station is provided as Attachment B.

Quad Cities Power Station - 2 Units
Commonwealth Edison Company

The Quad Cities station consists of two BWR nuclear units with a combined capacity of 1578 MWe. Commercial operation of the first unit was in August 1972 and the second unit in October 1972. The total cost of the two units was \$262 million.

Backfitting costs for the Quad Cities units through July 1982 has been \$135 million. These costs can be allocated as \$95 million for NRC imposed backfitting other than TMI lessons learned; \$16 million for TMI lessons learned backfitting; and \$24 million for utility initiated backfitting. An additional \$73 million is anticipated for near-term future backfitting costs to satisfy NRC requirements. A detailed listing of the previous and projected backfitting costs for the Quad Cities stations is provided as Attachment C.

Zion Nuclear Power Station - 2 Units
Commonwealth Edison Company

The Zion station consists of two PWR nuclear units with a combined capacity of 2080 MWe. Commercial operation of the first unit was in October 1973 and the second unit in September 1974. The total cost of the two units was \$557 million.

Backfitting cost for the Zion units through July 1982 has been \$84 million. These costs can be allocated as \$41 million for NRC imposed backfitting other than TMI lessons learned; \$26 million for TMI lessons learned backfitting; and \$17 million for utility initiated backfitting. An additional \$17 million is anticipated for near-term future backfitting costs to satisfy NRC requirements. A detailed listing of the previous and projected backfitting costs for the Zion station is provided as Attachment D.

Specific Examples of Regulatory Impact

Examples of the major cost impact of regulation in two areas, security and fire protection, are provided as Attachment E.

REGULATORY IMPACT ON THREE NUCLEAR POWER STATIONS

Duke Power Company

McGuire Nuclear Power Station - 2 Units

The McGuire station consists of two PWR nuclear units with a combined capacity of 2360 MWe. The construction permits were issued by the NRC for these units in February 1973. At the time of receiving the CP's, the cost estimate for the two units was \$493 million with anticipated commercial operation dates of March 1976 and March 1977.

The current cost estimate for the two McGuire units in as booked dollars is \$1,955 million, equal to \$828 per KW. Commercial operation of the first unit was December 1981 and the second unit is scheduled for October 1983. A 1982 equivalent cost of the McGuire Station can be determined by escalating the dollars spent in each year during construction to equivalent 1982 dollars. Such a calculation provides a total cost in equivalent 1982 dollars of \$2,943 million, equal to \$1,247 per KW.

Catawba Power Station - 2 Units

The Catawba Power Station consists of two PWR nuclear units with a combined capacity of 2290 MWe. Construction permits were issued by the NRC for these units in August 1975. At the time of receiving the CP's, the cost estimate for the two units was \$1,054 million with anticipated commercial operation dates of January 1981 and January 1982.

The current cost estimate for the two Catawba units in as committed dollars is \$2,928 million, equal to \$1,279 per KW, based on commercial operation dates for the two units of March 1984 and September 1985. A revised increased cost estimate has not yet been completed for the new commercial operation dates of June 1985 for the first unit and June 1987 for the second unit. A 1982 equivalent value of Catawba, determined by escalating prior spent funds to 1982 dollars, is \$3,364 million equal to \$1,469 per KW.

Comparative Regulatory Cost Impact of Oconee, McGuire and Catawba Nuclear Power Stations

An approximation of the cost impact of regulatory changes can be illustrated by comparing the costs of the Oconee, McGuire and Catawba stations. All of the stations have pressurized water reactors and all three were designed and constructed by the Duke Power Company. The costs of the Oconee units may be used as a benchmark for comparison of the regulatory cost impact on the later units. Practically all of the materials were purchased and most of the labor performed for Oconee before 1974. Thus, conservatively, the actual Oconee cost of \$185 per KW can be taken to represent 1973 dollars. By using the Atlanta, Georgia, Bureau of Labor Statistics inflation factors and adjusting the number to account for three units at the station, the 1982 value of the equivalent Oconee plant cost would be about \$445 per KW for a two unit plant. This assumes that the regulatory environment remains constant between 1973 and 1982. Since a primary difference between 1973 and 1982 other than inflation is the regulatory environment, a majority of the additional costs for McGuire and Catawba stations may be assigned as a regulatory impact. While a portion of the added costs are the results of changes desired

by the utility, it is conservatively estimated that at least 60 percent of the increase is the result of NRC regulatory changes. The additional cost in 1982 dollars for the McGuire Station is \$1,893 million and for the Catawba Station is \$2,345 million. A 60 percent regulatory impact is \$1,136 million for McGuire and \$1,407 million for Catawba. This added regulatory impact on McGuire and Catawba, when compared to Oconee, is about 40 percent of the total station 1982 equivalent value.

Nuclear Station	Capacity (MWe)	Actual or Anticipated Dollar Value		1982 Equivalent Value	
		Total Station	Value/KW	Total Sta.	Value/KW
Oconee	2661	\$ 493,000,000	\$185	\$1,184,000,000	\$ 445
McGuire	2360	1,955,000,000	828	2,942,000,000	\$1,247
Catawba	2290	2,928,000,000	\$1,279	3,364,000,000	\$1,469

Comparison in 1982 Equivalent Dollars

McGuire Unit Cost	-	\$1247 per KW
Oconee Unit Cost	-	445 per KW
Difference		\$ 802 per KW

Additional McGuire Station Cost:

\$802 x 2,360,000 KW	=	\$1,892,000,000
Utility Improvements - 40 percent	=	\$757,000,000
Regulatory Impact - 60 percent	=	\$1,135,000,000

Catawba Unit Cost	-	\$1469 per KW
Oconee Unit Cost	-	445 per KW
Difference		1024 per KW

Additional Catawba Station Cost:

\$1024 x 2,290,000 KW	=	\$2,345,000,000
Utility Improvements - 40 percent	=	\$938,000,000
Regulatory Impact - 60 percent	=	\$1,407,000,000

Commonwealth Edison Company

Byron Nuclear Power Station - 2 Units

The Byron Station consists of two PWR nuclear units with a combined capacity of 2240 MWe. Construction permits were issued by the NRC for these units in December 1975. At the time of receiving the CP's, the cost estimate for the two units was \$1,164 million, with anticipated commercial operation dates of May 1980 and May 1982.

The current cost estimate for the two Byron units is \$2,764 million. The fuel load dates for the two units are August 1983 and August 1984.

Comparative Regulatory Cost Impact of Zion and Byron Nuclear Power Stations

An approximation of the cost impact of regulatory changes can be illustrated by comparing the costs and time of construction of the Zion and Byron power stations. Each station has two pressurized water reactors of about the same size, from the same manufacturer, were designed by the same A-E and constructed by the same contractor.

The actual cost of the Zion station was \$582 million, with a 52-month construction period and commercial service in October 1973. The estimated cost for the Byron station is \$2764 million, with a 92-month construction period and commercial service of February 1984. When Zion costs are escalated to correspond with the Byron cost estimate, the result is a comparative Zion cost of \$954 million. The difference between the "Escalated Zion Cost" and the "Estimated Byron Cost" is \$1810 million. While some of the cost and schedule increases are due to company initiated

operability, maintainability and reliability improvement, the largest percentage of this increase is considered to be due to NRC regulatory action. It is conservatively estimated that at least 60 percent of this increase, or \$1,100 million, is due to NRC regulatory impact. Thus, the added regulatory impact for Byron when compared to Zion, is about 40 percent of the current total station estimated cost.

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OCONEE
ACTUAL COSTS OF BACKFITTING
TOTAL THROUGH JUNE 30, 1982

SUMMARY

(a) COSTS FOR NRC IMPOSED BACKFITTING

1. Hardware	\$ 139.5 M
2. Analytical	\$ 2.9 M
Total	\$ 142.4 M

(b) COSTS FOR NRC TMI LESSONS LEARNED BACKFITTING

1. Hardware	\$ 20.2 M
2. Analytical	\$ 1.2 M
Total	\$ 21.4 M

(c) COSTS FOR UTILITY INITIATED BACKFITTING

1. Hardware	\$ 7.8 M
2. Analytical	\$ 7.4 M
Total	\$ 15.2 M

(a) COSTS FOR NRC IMPOSED BACKFITTING - DETAIL

1. HARDWARE

10022	Spent Fuel Transport Casks	0.8
10025	Upgrade Waste Management Facility	0.3
10085	Radwaste Facility	13.7
10261	Additional HPI Flow Path	1.5
10265	High Density Spent Fuel Racks	4.5
10355	Station Security System	0.5
10417	Pipe to Mix Radwaste	0.3
10432	Reactor Bldg Ventilation	1.1
10469	Rerack Spent Fuel Pool	2.9
10624	Reactor Bldg Cool Study	1.3
10694	IRWB Solidification Area	0.7
10696	RC Pump Oil Contain Sys	0.7
10735	Poison Rerack & Pin Stg	0.1
13064	Waste Management Facility	2.7
13476	Add Waste Water Collection Basin	0.2
16602	Safe Shutdown Facility	58.7
16627	Addl Office Space	11.3
16891	Replace Spent Fuel Storage Racks	2.3
17749	Flood Protection Turbine Bldg Basement	0.7
18409	Fire Protection Program	2.5
18913	Improve Reactor Bldg Ventilation	0.4
19146	Radiation Monitors Sump	0.1
19272	Boron Concentration Prevent Sys	0.3

(a) 1. Cont.

30278	Seismic Investigation Jocassee Dam	0.1
30664	Replace Masonry Walls IEB 80-11	2.7
30718	NAC-1 Full Cask Relicensing	0.4
31030	Work Associated w/IEB 79-02, Unit 3	2.2
31031	Work Associated w/IEB 79-02, Unit 1-2 IEB 79-14 01, Unit 1-3	26.1
31036	Emergency Investigation equipt Qualification IEB 79-01B	0.4
HARDWARE TOTAL		<u>\$139.5</u>

2. ANALYTICAL

Reactor Vessel Pressurized Thermal Shock Evaluation	0.4
Asymmetric LOCA Loads	0.1
FSAR Update	0.4
Reactor Vessel Materials Surveillance (per 10CFR50, App G, H)	0.5
Anticipated Transients Without Scram	0.1
Miscellaneous Small Tasks w/NSSS Vendor (35)	1.0
1975-78 ECCS Reanalysis Efforts	<u>0.4</u>
ANALYTICAL TOTAL	\$ 2.9
HARDWARE & ANALYTICAL TOTAL	<u>\$142.4</u>

(b) COSTS FOR NRC TMI LESSONS LEARNED BACKFITTING - DETAIL

1. HARDWARE

10443	Emergency F/W Pumps Units 1-3	5.9
10446	Hydrogen Recombiner - Contain Bldg	0.5
10470	Building for Simulator	0.8
10521	Station Modification NUREG 0578	6.9
10578	Anticipatory Reactor Trip	1.4
10581	Ocone Simulator	3.5
10692	Emergency Alerting System	0.7
30528	Cost to Remove F/W Pumps	0.1
30529	Install F/W Pumps	0.1
31028	Technical Review TMI as to Ocone	<u>0.3</u>
HARDWARE TOTAL		<u>\$20.2</u>

(b) Cont.

2. ANALYTICAL

Fund EPRI to do Relief & Safety Valve Testing *	
Operator Guidelines (ATOG)	0.6
Small Break LOCA Methods Program	0.3
Emergency Support Facilities	*
Shift Technical Advisor, Upgraded SRO/RO Training	*
Meteorological Sys Upgrades	0.2
30870 Nuclear Plant Control Room Review	<u>0.1</u>
	ANALYTICAL TOTAL \$ 1.2
	HARDWARE & ANALYTICAL TOTAL \$21.4

*Cost information not available.

(c) COSTS FOR UTILITY INITIATED BACKFITTING - DETAIL

1. HARDWARE

Revise Computer System	0.40
Install 3 Stage RCP Seals	0.40
Install Removable Ladder & Platforms	0.10
Air Breathing Stations	0.30
OTSG Recirculation System	0.30
Radwaste System Improvements	0.30
Tube Bundle MS Reheater	4.70
Refueling Equipment Improvements	0.50
Guardrails - Intake Dike	0.06
Body-Burden Counting Chair	0.04
Upgrade Aux Steam System	0.20
Add Platforms - Polar Crane	0.02
Remote Control - Polar Crane	0.08
Replace Feedwater Check Valves	<u>0.40</u>
	HARDWARE TOTAL \$ 7.8

2. ANALYTICAL

Evaluation of Allowable Operating Transient Cycles	0.4
Thermal Shield Bolt Failure	6.0
PRA	0.6
RV Surveillance Holder Tube (1976)	<u>0.4</u>
	ANALYTICAL TOTAL \$ 7.4
	HARDWARE & ANALYTICAL TOTAL \$15.2

OCONEE
 PROJECTED ADDITIONAL COSTS FOR NRC
 IMPOSED BACKFITTING REQUIREMENTS
 EXISTING AND FUTURE PROJECTS

10085	Radwaste Facility	94.4
10265	High Density Spent Fuel Racks	0.2
10469	Rerack Spent Fuel Pool	0.1
16602	Safe Shutdown Facility	17.8
31030	Work Associated w/IEB 79-02, Unit 3	0.3
	Reactor Coolant System Inventory/Reactor Vessel Water Level System	4.0
	Test Facility to Benchmark Small Break LOCA Computer Codes	*
	Automatic Trip of Reactor Coolant Pumps	*
	Reactor Vessel Materials Surveillance (per 10CFR50, App G, H)	0.5
	Rerack Oconee 3 Spent Fuel Pool	<u>4.0</u>
		\$121.3

*Cost information not available.

Dresden Units
NRC Imposed Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
1030	Off-Gas Treatment Unit 1	3,364.8
1031	Off-Gas Treatment Unit 2	2,838.7
1032	Off-Gas Treatment Unit 3	2,834.1
1802	Modifications to Satisfy NRC Requirement Unit 1	2,931.9
1804	Fire Stops and Automatic Fire Protection Equipment	5,696.7
1823	ATWS Events Units 2 and 3	929.7
1824	Design Improvements for Emergency Core Cooling and Control Rod Drive Unit 1	1,594.6
1834	Security System Upgrade	7,700.8
1848	High Pressure Coolant Injection System Unit 1	19,249.0
1851	ATWS Alternate Units 2 and 3	202.5
1852	Replace Safety Related Electrical Equipment	50.0
1856	Upgrade Masonry Walls	277.1
1857	Safety Related Piping	12,067.4
1873	Long Term Scram Modifications Units 2 and 3	1,851.4
1876	Core Spray Modifications Unit 1	1,010.6
1891	Modifications to the Torus Support Columns	26,870.9
1896	High Energy Pipe Rupture Modifications Unit 1	213.1
	Total	<u>\$89,683.3</u>

(1) Expenditures are for the period between receipt of OL and July, 1982

Dresden Units
Other NRC Imposed Projects

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
80008	Study for Mark I Containment	2,615.1
80015	Study for Replacement of Safe Ends Unit 2	658.1
80042	Study for Systematic Evaluation Program	1,791.0
80073	Study for Qualification of Safety Related Electrical Equipment	699.9
80078	Study for Seismic Adequacy of Safety Related Equipment	237.8
80082	Study of Masonry Wall	722.3
80086	Study of Safety Related Piping	5,897.3
80089	Study for Seismic Qualification for Cable Trays	124.9
80122	Study for Seismic Interaction	212.0
80125	Study for High Energy Line Break	430.9
80063	Study for Expansion Anchor Inspection and Replacement Program	3,069.1
80103	Study for Final Safety Analysis Report	96.6
	Total	<u>\$16,555.0</u>

(1) Expenditures are for the period between receipt of OL and July, 1982

Dresden Units
NRC TMI Lessons
Learned Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
1817	TMI Review Modifications Short Term Units 2 and 3	14,842.2
1818	TMI Review Modifications Long Term Units 2 and 3	358.6
1871	Prompt Notification System	673.5
2995	Emergency Operational Facility	468.7
	Total	<u>\$16,343.0</u>

Other Projects Applicable to TMI Lessons Learned

80128	TMI Accident Review Studies	Total	<u>\$1,203.9</u> \$1,203.9
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(1) Expenditures are for the period between receipt of OL and July, 1982

Dresden Units
Utility Initiated Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
1038	Spray Cooling Modules Unit 2 and 3	1,598.1
1041	Non-Thermal Radioactive Waste Water Discharge	2,618.7
1043	Modify Radwaste System Unit 1	1,351.9
1049	Radwaste System Units 2 and 3	3,155.3
1053	Radwaste Solidification System Units 2 and 3	5,703.8
1803	Turbine Crossaround Relief Valves Units 2 and 3	220.9
1809	Increase Spent Fuel Storage Capacity	424.9
1817	Fuel Transfer Canal Facilities Unit 1	187.0
1825	Nuclear Simulator Training Units 2 and 3	643.3
1826	Secondary Feedwater Heater Tube Bundle Unit 1	297.4
1827	Retube Main Condenser	348.6
1828	Replace Clean-up Loop Heat Exchanger Unit 1	185.1
1829	BWR Control Rod Drives Units 2 and 3	889.1
1830	Rectify Priority Punch List Items Units 1 and 2	834.9
1832	Mechanical Structure Restraints Units 2 and 3	384.5

Dresden Units
Utility Initiated Backfitting (Con't)

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
		7,532.5
1842	Modify Feedwater Nozzles Units 2 and 3	
1847	Absorber Spent Fuel Racks	7,985.7
1853	Ultrasonic Resin Cleaner Units 2 and 3	284.3
1858	Install Two Unloading Heat Exchangers	244.9
1048	Circulating Water Diffuser Unit 1	292.8
	Total	<u>\$35,182.8</u>

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(1) Expenditures are for the period between receipt of OL and July, 1982

Dresden Units
Future Costs for
NRC Imposed Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
1804	Fire Stops and Automatic Fire Protection Equipment	4,579.0
1819	Seismic Modifications Resulting from SEP Unit 3	2,650.0
1826	Qualification of Mechanical Equipment	4,000.0
1827	Heavy Load Modification	800.0
1834	Security System Upgrade	41.0
1835	Seismic Modifications Resulting from SEP Unit 2	2,650.0
1841	HELB Inside Containment SEP Unit 2	4,000.0
1846	HELB Inside Containment SEP Unit 3	3,900.0
184E	High Pressure Coolant Injection System Unit 1	130.0
1851	ATWS Alternate Units 2 and 3	7,195.0
1852	Replace Safety Related Electrical Equipment	4,950.0
1856	Upgrade Masonry Walls	600.0
1857	Safety Related Piping	13,853.0
1873	Long Term Scram Modifications Units 2 and 3	3,200.0
1875	Modifications Derived from SEP Review Units 2 and 3	500.0
1891	Modifications to the Torus Support Columns	15,971.0
	Total	<u>\$69,019.0</u>

(1) Projected Costs for the period 1983 and beyond

Dresden Units
Future Costs for
NRC Imposed Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
	<u>Other Imposed Projects</u>	
80008	Study for Mark I Containment	21.0
80015	Study for Replacement of Safe Ends Unit 2	250.0
80042	Study for Systematic Evaluation Program	77.0
80073	Study for Qualification of Safety Related Electrical Equipment	180.0
80089	Study of Seismic Qualification for Cable Trays	168.0
80122	Study for Seismic Interaction Unit 2	150.0
80125	Study for High Energy Line Break	407.0
N/A	Study of Seismic Functionality	310.0
N/A	Study of Bingham Amendment SEP	1,000.0
N/A	Study of Seismic Interaction Unit 3	500.0
	Total	<u>\$3,063.0</u>

(1) Projected Costs for the period 1983 and beyond

Quad Cities Units
NRC Imposed Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
1 1033	Off-Gas Treatment Unit 1 } AOG	2,326.4
2 1034	Off-Gas Treatment Unit 2 }	2,261.2
3 1035	Circulating Water Diffusers <i>diffusers into main one main system (10/82) to meet State Std. (Ill.)</i>	6,782.7
4 1051	Closed Cycle Spray Canal Units 1 and 2 <i>What are spray canals? State of Ill. Std.</i>	16,430.9
5 1320	Security System Upgrade	6,598.5
6 1322	Fire Stops and Automatic Fire Protection	4,598.1
7 1328	Masonry Wall Upgrade <i>IEB 80-11</i>	258.8
8 1330	ATWS Recirculating Pump Trip <i>Order</i>	921.4 <i>was previously est. 200-500,000</i>
9 1345	Mark I Containment Modification <i>Order</i>	27,774.1
10 1346	Implementation Results of As Built Verification (<i>IEB 79-07 and 79-14</i>)	13,901.2
11 1355	ATWS Alternative 3 Units 1 and 2	183.2
12 1356	Environmental Qualification Electrical Equipment <i>EQE</i>	47.1
13 1356	Long Term SDV-Instrument Volume Modification <i>They've got a problem here</i>	896.2
Total		<u>\$82,979.8</u>

(1) Expenditures are for the period between receipt of OL and July, 1982

Quad Cities Units
Other NRC Imposed Projects

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
14 80009	Study for Mark I Containment	2,613.4
15 80063	Study for Expansion Ancnor Inspection and Replacement Program <i>(IEB 79-02)</i>	3,069.1
16 80074	Study for Qualification of Safety Related Electrical Equipment <i>EEQ IEP 79-01B</i>	637.1
17 80077	Study for Seismic Adequacy of Safety Related Equipment <i>(?)</i>	237.8
19 80083	Study of Masonry Walls <i>IEB 80-11</i>	664.2
19 80087	Study of Safety Related Piping <i>Follow-on to 1396</i>	4,842.3
20 80105	Study for Final Safety Analysis Report	94.1
	Total	<u>\$12,158.0</u>

(1) Expenditures are for the period between receipt of OL and July, 1982

Quad Cities Units
NRC TMI Lessons
Learned Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
21 1343	TMI Review Modification-Short Term	13,964.0
22 1344	TMI Review Modification-Long Term	197.3
23 1361	Emergency Offsite Operational Facility	407.9
24 1362	Prompt Notification System	708.9
	Total	<u>\$15,278.1</u>
<u>Other Projects Applicable to TMI Lessons Learned</u>		
25 80129	TMI Accident Review Studies	\$1,151.1
	Total	<u>\$1,151.1</u>

(1) Expenditures are for the period between receipt of OL and July, 1982

Quad Cities Units
Utility Initiated Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
1045	Modify Radwaste System	4,429.6
1308	Nuclear Simulator Training Units 1 and 2	668.8
1309	Air Surge Backwash System Units 1 and 2	499.7
1310	Rectify Priority Punch List Items Units 1 and 2	590.1
1318	RHR Service Water Modification Unit 1	74.5
1323	Absorber Spent Fuel Racks Units 1 and 2 <i>1981/2</i>	3,754.9
1329	Control Rod Drive Assemblies	741.8
1332	Turbine Cross Around Relief Valve Units 1 and 2	258.3
1333	Increase Spent Fuel Storage Capacity <i>Is this the early version (1977)</i>	457.7
1337	Mechanical Seismic Restraints Units 1 and 2 <i>(different from IEB 79-14?)</i>	616.7
1342	Onsite Low Level Radwaste Storage Facility <i>1979</i>	401.2
1348	Feedwater Nozzle/Sparger Modification <i>Replace w/ stainless steel spargers, dechlorination of nozzles</i>	5,878.8
1357	Heater Drain Line Support Units 1 and 2	198.1
1363	One Spare LP Rotor	5,161.4
1372	Install Residual Heat Removal Line Unit 1	819.2
	Total	<u>\$24,550.8</u>

(1) Expenditures are for the period between receipt of OL and July, 1982

Quad Cities Units
Future Costs for
NRC Imposed Backfitting

*Estimates of
Future Expenditures?*

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
20 1320	Security System Upgrade	40.0
21 1322	Fire Stops and Automatic Fire Protection	4,246.0
22 1345	Mark I Containment Modification	16,600.0
29 1346	Implement Results of As Built Verification <i>Bring all safety related piping to original design margin for assessment</i>	13,853.0
30 1350	Modifications Derived from SEP Review	600.0
31 1351	Seismic Modifications Resulting from SEP Unit 1	2,650.0
32 1352	Seismic Modifications Resulting from SEP Unit 2	2,650.0
33 1353	HELB Inside Containment SEP Unit 1	3,900.0
34 1354	HELB Inside Containment SEP Unit 2	3,900.0
35 1355	ATWS Alternative 3 Units 1 and 2	7,192.0
36 1356	Environmental Qualification Electrical Equipment	4,950.0
37 1365	Long Term SDV - Instrument Volume Modification	5,528.0
38 1367	Qualification of Mechanical Equipment	3,750.0
38 1368	Heavy Load Modification	800.0
	Total	<u>\$70,659.0</u>
<u>Other NRC Imposed Projects</u>		
39 80009	Study for Mark I Containment	\$21.0
40 80074	Study for Qualification of Safety Related Electrical Equipment	180.0
41 N/A	Study of Bingham Amendment SEP	1,000.0
42 N/A	Study of Seismic Interaction of Units 1 and 2	1,000.0
	Total	<u>\$2,201.0</u>

(1) Projected Costs for the period 1983 and beyond

Zion Units
NRC imposed Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
1610	Security System Upgrade	6,369.4
1611	Fire Stops and Automatic Fire Protection Equipment	5,809.5
1625	Loose Parts Monitoring System	381.9
1629	J-Nozzle In Feedwater Ring	1,444.1
1634	Pipe Restraints for Asymm Vessel Loads	-
1636	Upgrade Masonry Walls	211.6
1637	Safety Related Piping	9,289.5
1643	Replace Safety Related Electrical Equipment	-
	Total	<u>\$22,061.9</u>

Other NRC Imposed Projects

80048	Study for Rx Vessel Support Analysis	\$322.3
80062	Study for Expansion Anchor Program	360.0
80063	Study for Expansion Anchor Inspection and Replacement Program	3,069.1
80065	Study of Safety Related Piping	13,760.9
80075	Study for Qualification of Safety Related Electrical Equipment	709.8
80080	Study for Seismic Adequacy of Safety Related Equipment	62.8
80084	Study of Masonry Walls	451.2
80109	Study for Rx Vessel Integrity Analysis	215.4
80104	Study for Final Safety Analysis Report	39.4
	Total	<u>\$18,990.9</u>

(1) Expenditures are for the period between receipt of OL and July, 1982

Zion Units
NRC TMI Lessons
Learned Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
1614	TMI Review Modifications Short Term	19,030.0
1615	TMI Review Modifications Long Term	115.9
1641	Emergency Operational Facility	469.4
1642	Prompt Notification System	364.2
	Total	<u>\$19,979.5</u>
<u>Other Projects Applicable to TMI Lessons Learned</u>		
80130	TMI Accident Review Studies	\$5,630.3
	Total	<u>\$5,630.3</u>

(1) Expenditures are for the period between receipt of OL and July, 1982

Zion Units
Utility Initiated Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
1042	Non-Thermal Radioactive Waste Water Discharge	2,114.0
1603	Replace MSR Chevrons	313.3
1609	Increase Spent Fuel Storage Capacity	982.5
1612	Modify Nozzle Inspection Covers Unit 2	195.4
1616	Upgrading Modification Units 1 and 2	769.9
1617	Bulk Cement Storage Handling Systems	400.9
1618	Zion Units 1 and 2 Basic Completion Work	1,723.7
1620	Modify Moisture Separator Reneaters Unit 2	648.3
1621	Pressurizer Spray Valves	868.2
1623	Nozzle Inspection Covers Unit 1	174.8
1624	Modify Moisture Separator Reneater Unit 1	681.0
1626	Absorber Spent Fuel Racks Units 1 and 2	5,212.9
1631	Modify Radwaste System	2,469.7
1633	Onsite Low Level Radwaste Storage Facility	115.3
1644	Boron Injection Tank Unit 1	507.5
	Total	<u>\$17,177.4</u>

(1) Expenditures are for the period between receipt of OL and July, 1982

Zion Units
Future Costs for
NRC Imposed Backfitting

<u>Budget</u>	<u>Description</u>	<u>Total Expenditures (1)</u> <u>(\$000's)</u>
1611	Fire Stops and Automatic Fire Protection Equipment	\$759.0
1634	Pipe Restraints for Asymm Vessel Loads	100.0
1637	Safety Related Piping	2,863.0
1643	Replace Safety Related Electrical Equipment	5,720.0
1619	ATWS Mitigation System	1,000.0
1647	Qualification of Mechanical Equipment	4,000.0
1648	Heavy Load Modifications	400.0
	Total	<u>\$14,842.0</u>
<u>Other NRC Imposed Projects</u>		
80065	Study of Safety Related Piping	534.0
80075	Study for Qualification of Safety Related Electrical Equipment	410.0
80109	Study for Rx Vessel Integrity Analysis	160.0
N/A	Study of Bingham Amendment SEP	1,000.0
	Total	<u>\$2,104.0</u>

(1) Projected Costs for the period 1983 and beyond

Examples of Cost Increases for Backfitting
Operating Units Resulting from Lack of
Predictability and/or Timeliness of NRC Actions

1. Security Systems

In 1971, the NRC issued Safety Guide 1.17, which provided guidelines for nuclear station security systems.

In June 1973, a station security requirement was published in the Federal Register as 10CFR50.34 paragraph (c), Physical Security Plan. This requirement, supplemented by Regulatory Guide 1.17 "Protection of Nuclear Power Plants Against Industrial Sabotage" and ANSI 18.17 "Industrial Security for Nuclear Power Plants" was the basis for requiring that Dresden, Quad-Cities and Zion Stations provide:

- a. A new gatehouse to contain additional guard force and perimeter monitoring equipment.
- b. Perimeter intrusion alarms.
- c. Fenceline lighting to a defined minimum level.
- d. Closed circuit television to monitor the perimeter fence.
- e. A second monitoring station in the control room remote from the gatehouse.

In 1974, the above changes were implemented at Dresden, Quad-Cities and Zion Stations. The cost of implementation was as follows:

	<u>Professional Engineering</u>	<u>Direct Cost</u>	<u>Total</u>
Dresden	\$ 70,000	\$ 550,000	\$ 620,000
Quad Cities	70,000	550,000	620,000
Zion	<u>70,000</u>	<u>550,000</u>	<u>620,000</u>
TOTAL	\$210,000	\$1,650,000	\$1,860,000

In February 1977, more stringent and more detailed system security requirements were published in the Federal Register 10CFR73.55 "Requirements for Physical Protection of Licensed Activities in Nuclear Power Reactors Against Industrial Sabotage". The new requirements of 10CFR73.55 were effective in March 1977.

The cost of implementation to the 1977 requirement was:

	<u>Professional Engineering</u>	<u>Direct Cost</u>	<u>Total</u>
Dresden	\$ 800,000	\$ 6,200,000	\$ 7,000,000
Quad-Cities	800,000	6,200,000	7,000,000
Zion	<u>800,000</u>	<u>6,200,000</u>	<u>7,000,000</u>
TOTAL	\$2,400,000	\$18,600,000	\$21,000,000

The costs incurred in implementing the requirements defined in 1974 were largely lost since the new gatehouses had to be abandoned and only some of the original surveillance equipment could be retained.

2. Fire Protection

The fire in TVA's Browns Ferry plant occurred on March 22, 1975.

On May 1, 1976, the Branch Technical Position 9.5-1 on fire protection was issued.

By letter dated May 11, 1976, Commonwealth Edison Company was requested to compare the existing fire protection provisions at their facilities with new NRC guidelines as set forth in Branch Technical Position (BTP) 9.5-1, "Fire Protection", dated May 1, 1976, and to describe (1) the implementation of the guidelines met, (2) the modifications or changes underway to meet the guidelines that will be met in the near future, and (3) the guidelines that will not be met and the basis thereafter.

By letter dated September 30, 1976, Commonwealth Edison Company was requested to provide the results of a fire hazards analysis and propose Technical Specifications pertaining to fire protection. Commonwealth Edison Company was also provided a copy of Appendix A to BTP 9.5-1, which includes acceptable alternatives to the guidelines of BTP 9.5-1 for operating plants and plants with construction permits issued prior to July 1, 1976.

In mid-1979, a Safety Evaluation Report (SER) was received for Dresden, Zion, and Quad-Cities Stations. The major open issue in each SER at this point in time was safe shutdown.

The estimated costs for compliance with the BTP, excluding safe shutdown requirements, were:

Dresden (3 units) - \$3,435,184
Quad-Cities (2 units) - \$2,142,733
Zion (2 units) - \$3,680,000

The initial NRC position concerning safe shutdown in the event of a fire was issued on May 30, 1977.

In May 1978, a revised and expanded NRC safe shutdown position titled "Staff Requirements for Minimum Safe Shutdown Systems" was received.

In September 1979, a second revision with a further expanded scope titled "Staff Position on Safe Shutdown Capability" was received.

In February 1981, 10CFR50 Appendix R became effective. At the same time, the NRC issued an information request asking for answers to all questions itemized in the September 1979 Staff Position. In addition, a new request was made for lists of all safe shutdown equipment, all essential and associated circuits, all applicable cable routes, and all necessary modifications to meet the requirements defined in Appendix R.

It should be noted that each issue of a staff position on safe shutdown included new requirements and a requirement for submittal of additional information. The associated circuit issue did not appear until the final draft of Appendix R in February 1981.

The costs of developing the safe shutdown information and the associated circuit analysis required by Appendix R are as follows:

Dresden (2 units*) - \$355,000
Quad-Cities (2 units) - \$293,000
Zion (2 units) - \$240,000

*The fire protection analysis for Dresden Unit 1 has been postponed until Dresden Unit 1 is returned to service.

The safe shutdown information required by Appendix R has been submitted to the NRC. Actual cost estimates of the implementation of a safe shutdown system cannot yet be made accurately because the NRC Staff may not accept the solutions to problems as proposed. If the safe shutdown system is accepted as proposed, the estimated costs to implement the system are as follows:

Dresden (2 units) - \$2,000,000 to \$4,000,000
Quad-Cities (2 units) - \$4,500,000 to \$9,000,000
Zion (2 units) - \$2,000,000 to \$4,000,000

As of June 1982, the total expenditures for fire protection since the Browns Ferry fire are as follows:

Dresden - \$5,900,000
Quad-Cities - \$4,900,000
Zion - \$5,900,000