REVIEW OF THE THREE MILE ISLAND-UNIT 2 CONSTRUCTION PROJECT

PREPARED BY TOUCHE ROSS & CO.

FOR THE

NEW JERSEY DEPARTMENT OF PUBLIC ADVOCATE

OCTOBER 1978

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TMI-2 CONSTRUCTION REVIEW

DATA AND ANALYSES UNDERLYING CONCLUSIONS

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LETTER

Touche Ross & Co.

October 25, 1978

William Gural, Director
Department of Public Advocate
Division of Rate Counsel
10 Commerce Court
Newark, New Jersey

Dear Mr. Gural:

We have completed our review of the Three Mile Island - Unit 2 (TMI-2) construction project and associated cost escalation. The letter describes the objectives and scope of the project, our approach to the engagement as well as the level of cooperation received by us. Attached to this letter is our report containing our conclusions and recommendations to which is appended our detailed findings.

A. Objectives

The objectives of our engagement were as follows:

- Review actual TMI-2 project costs versus a series of GPU internal estimates to ascertain the extent of increases including:
  - $ cost escalation by major cost component (i.e., direct labor and materials, design engineering, AFDC)
  - $ cost escalation by major contract within each cost component (i.e., direct materials include contracts with Westinghouse, Babcock & Wilcox, etc.)
  - Extension of TMI-2 in-service dates
- Review TMI-2 cost escalation and in-service date slippage with the assistance of GPUSC project management in relation to the history of the TMI-2 project to determine the causal factors that contributed to significant increases
- Areas specifically excluded from the TMI-2 construction review were:
  - Initial feasibility decision by GPU management to build TMI-2 including:

.. Justification of nuclear plant versus coal plant, and other alternatives

.. Justification of site selection

.. Justification of plant capacity versus projected load growth

. Interim analyses to support continuing TMI-2 construction versus other alternatives as cost escalation occurred

. Results of GPU's programs, organization development, and expenditures in Quality Assurance Area.

B. Approach

The TMI-2 construction review was not an audit but rather a review of GPU's planning and implementation of project organization, policies and control procedures in several key areas:

. Cost and scheduling

. Contract administration

. Site construction management

. Corporate financing

. Regulatory environment

. Internal auditing

R. Heward (GPUSC, Manager, Projects) and E. Bohn (GPUSC, Auditing Manager, Construction and Corporate) were full-time participants from GPUSC.

A list of people interviewed by Touche Ross and topics covered has been summarized on the following pages.

TMI-2 CONSTRUCTION PROJECT

MAJOR AREAS OF REVIEW

MAJOR AREAS/TOPICS COVERED	INDIVIDUALS INTERVIEWED	
	NAME	TITLE
- COST AND SCHEDULING	**- GPUSC**	
. TMI-2 cost escalation by major cost component including:	. E. Miller	Construction Control Manager
.. actual expenditures by year vs. periodic estimates of total cost	. C. O'Neill	Administrator, Cost & Schedule
.. extension of in-service date	. T. Ross	Mgr., Construction Accounting
.. comparison of TMI-2 vs. TMI-1 costs	**- UE&C**	
.. comparison of TMI-2 costs vs. available industry data of other nuclear plants	. E. Nagle	Project Manager
	. E. Hooper	Site Cost Engineer, Chief
. Evolution of project control systems (PCS) and GPUSC site cost and schedule organization		
. Site and home office accounting procedures		
. Review of reports utilized by GPU project management to control TMI-2 cost and schedule		
. Trend of unit cost reports and subsequent management action to improve productivity		
- CONTRACT ADMINISTRATION	**- GPUSC**	
. Evolution of GPUSC materials management organization, policies and procedures	. F. Glickman	V.P., Materials Management
	. M. Haimowitz	Mgr., Contracts, Construction
. Review of major contracts (in excess of $1 million) including:	. K. Pastor	Project Mgr., Forked River
	- UE&C	
.. initial contract date and amount	. E. Nagle	Project Manager
.. type of reimbursement	. A. Geronzik	Attorney
.. frequency of contract changes		
.. overall $ changes by year during the project	**- BURNS & ROE**	
	. W. Cobean	Project Manager

TMI-2 CONSTRUCTION PROJECT

MAJOR AREAS OF REVIEW

(continued)

MAJOR AREAS/TOPICS COVERED	INDIVIDUALS INTERVIEWED NAME	TITLE
- CONTRACT ADMINISTRATION (continued)		
. Detailed review of selected contracts including: .. documentation of original selection basis/adherence to competitive bidding policy .. rationale for subsequent contract changes		
. Review of Stone & Webster selection as construction manager for the current Forked River Nuclear Project		
- SITE CONSTRUCTION MANAGEMENT	- GPUSC	
. Chronology of TMI-2 significant events	. W. Gunn	Project Site Mgr., Generation
. Evolution of GPUSC site construction management organization	. R. Heward	Mgr. - Projects
. Methods (meetings, reports, etc.) utilized by GPUSC to control project at the site		
. Management of direct labor force including: .. impact of wide swings in direct labor force .. trend of unit cost reports and management action taken in response to declining productivity		
. Construction innovations implemented on TMI-2 project		

TMI-2 CONSTRUCTION PROJECT

MAJOR AREAS OF REVIEW

(continued)

MAJOR AREAS/TOPICS COVERED	INDIVIDUALS INTERVIEWED NAME	TITLE
- CORPORATE FINANCING	- GPUSC	
. Review of correspondence between all GPU operating companies and the Pa. and N.J. Public Utility Commissions in July and September 1974 regarding overall financial constraints impacting construction budgets	. F. Hafer . R. Arnold . H. Dieckamp	V.P., Rates V.P., Generation Division President
. Trend of actual expenditures by year versus project budgets including: .. TMI-2 .. TMI-1 .. total generation construction program		
. Impact of limited resources and subsequent allocation upon TMI-2 schedule extension and cost escalation		
- REGULATORY ENVIRONMENT	- GPUSC	
. Chronology of significant NRC regulatory events	. J. Thorpe	Mgr., Environmental Affairs
. Impact of regulatory changes upon TMI-2: .. qualitative .. quantitative	. R. Cutler . J. Kunkel	Project Engineer Logistics Support Manager
- INTERNAL AUDITING	- GPUSC	
. Evolution of GPUSC internal auditing function	. J. Farrel	Mgr., Auditing
. Review of TMI-2 internal auditing reports: .. findings and recommendations .. response by project management .. response by corporate management	. E. Bohn	Auditing Manager, Construction & Corporate

C. Cooperation Received

- GPUSC was very cooperative and provided extensive internal information to assist Touche Ross & Co. in the review of TMI-2.

  . However, as a result of the organizational transitions of responsibility for TMI-2, documentation was generally weak prior to the formation of GPUSC in 1971 (i.e., internal documentation of selection procedures for major TMI-2 contractors was generally unavailable).

- UE&C was uncooperative in providing requested information:

  . Touche Ross letter of January 30, 1978 was not answered by UE&C until March 20, 1978.

  . UE&C response included only 1 of 4 items requested (UE&C corporate brochure describing overall experience as A/E and construction manager).

- Burns & Roe, while cooperative, were not the project managers. To the extent that their role was confined to engineering, Touche Ross & Co. did not evaluate the specifics of TMI-2's design.

Touche Ross & Co. has not audited the historical financial and statistical data provided by GPU throughout this engagement. Accordingly, Touche Ross & Co. does not express any opinion concerning such data.

Please call either Steve Cooper or Jim Madan at (212) 397-8700 if we may provide any additional information.

Very truly yours,

Touche Ross & Co

Touche Ross & Co.

REPORT

TMI-2 COST ESCALATION*

- 21 cost and in-service date estimates were prepared for TMI-2 between 1969 and 1977:
  - . Total cost escalated from $190M to $659M** or an increase of $469M (247%).
  - . In-service date slipped from 5/73 to 5/78** or a 5-year total slippage.
- Cost and schedule escalation occurred consistently on a year-to-year basis from 1969-1974:
  - . Cost escalation continued during 1975-1977, however, at a reduced pace.
  - . In-service date of 5/78 has not changed since 9/74.
  - . Reduced rate of cost escalation and reliability of in-service date correlates with date (9/74) that TMI-1 began commercial operation.

SUMMARY OF COST/SCHEDULE ESTIMATES

Year	Number of estimates	Initial cost	Ending cost	Annual escalation	In-service date	Annual I.S.D. slippage (months)
1969	Original	$190M	$ -	$ -	5/73	-
1969	2	190M	214M	24M	5/74	12
1970	4	214M	285M	71M	5/74	-
1971	3	285M	345M	60M	5/75	12
1972	2	345M	465M	120M	5/76	12
1973	1	465M	525M	60M	5/77	12
1974	3	525M	580M	55M	5/78	12
SUBTOTAL	16	190M	580M	390M	5/78	60
1975	1	580M	630M	50M	5/78	-
1976	2	630M	637M	7M	5/78	-
1977	2	637M	659M	22M	5/78	-
TOTAL	21	$190M	$659M	$469M	5/78	60

* Escalation is defined as an increase in dollar cost or delay of an in-service date over a previous estimate. This term and its explanation is used in the same sense throughout this report.

** Estimates as of 12/77 are subject to change by the company.

Note: This entire section of the construction review report was prepared prior to the final delay caused by the malfunctioning of certain safety values. The current in-service estimated date is Novermber 1978 and the total cost approximately $687 million.

MAJOR ESCALATION COMPONENTS

- GPUSC has described the rationale for overall cost and schedule escalation in two stages.

From		To		Escalation	
Date	$	Date	$	$	I.S.D.
6/69	$190M	12/71	$345M	$155M	24 months
12/71	345M	12/77	659M	314M	36 months

  . Rationale for $190M to $345M escalation is difficult to track due to lack of comparable levels of detail between the 2 estimates*

SUMMARY OF $190M VS. $345M ESTIMATES

	$345M Estimate	$190M Estimate	Escalation $	Escalation %
Direct labor and materials	$178.1M	$120.6M	$57.5M	+ 48
A/E and construction supervision	31.4	18.6	12.8	+ 69
Temporary facilities and services	22.6	6.4	16.2	+253
AFDC	66.3	24.7	41.6	+168
Premium time, escalation	24.3	11.8	12.5	+106
Contingency	18.7	6.7	12.0	+179
Others	3.6	1.2	2.4	+200
Total cost	$345.0M	$190.0M	$155.0	+ 82

* The $190M estimate was based upon

  . OC-1 costs and Burns & Roe (A/E) experience
  . No drawings or material takeoffs

The $345M estimate is based upon material takeoffs of the engineering drawings available at the time.

SUMMARY OF $345M VS. $659M ESTIMATES

	$659M Estimate	$345M Estimate	Escalation $	Escalation %
Direct labor, materials and subcontracts	$292.0M	$178.1M	$113.9M	+ 64
A/E and consultants	59.5	16.3	43.2	+265
Construction mgmt.	39.5	12.4	27.1	+219
Temporary facilities and services	46.5	19.0	27.5	+145
Construction start-up	9.0	2.2	6.8	+309
Owner's engineering, project mgmt., start-up, insurance, taxes	33.5	5.4	28.1	+520
AFDC	165.0	66.3	98.7	+149
Premium, escalation and contingency	13.6	45.3	(31.7)	(70)
Total cost	$658.6M	$345.0M	$313.6M	+ 91

OVERALL $190M TO $659M ESCALATION

	$190M to $345M Escalation	$345M to $659M Escalation	Total TMI-2 Escalation
Direct labor, materials and subcontracts	$ 57.5M	$113.9M	$171.4M
A/E and consultants)		43.2)	
Construction mgmt.)	12.8	27.1)	83.1
Temp. facilities and services	16.2	27.5	43.7
Construction start-up	-	6.8	6.8
Owner's engineering, project mgmt., start-up, insurance, taxes	-	28.1	28.1
AFDC	41.6	98.7	140.3
Premium time, escalation and contingency and others	26.9	(31.7)	(4.8)
Total escalation	$155.0M	$313.6M	$468.6M

SUMMARY OF $345M VS. $659M ESTIMATES

	$659M Estimate	$345M Estimate	Escalation $	Escalation %
Direct labor, materials and subcontracts	$292.0M	$178.1M	$113.9M	+ 64
A/E and consultants	59.5	16.3	43.2	+265
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Premium, escalation and contingency	13.6	45.3	(31.7)	(70)
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OVERALL $190M TO $659M ESCALATION

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A/E and consultants)		43.2)	
Construction mgmt.)	12.8	27.1)	83.1
Temp. facilities and services	16.2	27.5	43.7
Construction start-up	-	6.8	6.8
Owner's engineering, project mgmt., start-up, insurance, taxes	-	28.1	28.1
AFDC	41.6	98.7	140.3
Premium time, escalation and contingency and others	26.9	(31.7)	(4.8)
Total escalation	$155.0M	$313.6M	$468.6M

SUMMARY OF TMI-2 VS. TMI-1 COST ESCALATION

	TMI-2 $659M Estimate	TMI-1 1/78 Final Estimate	Escalation $	Escalation %
Direct labor, materials and subcontracts	$292.0M	$197.7M	$ 94.3M	+ 48
A/E and consultants	59.5	19.7	39.8	+202
Construction mgmt.	39.5	22.1	17.4	+ 79
Temporary facilities and services	46.5	36.2	10.3	+ 28
Construction start-up	9.0	7.2	1.8	+ 25
Owner's engineering, project mgmt. start-up, insurance, taxes	33.5	20.9	12.6	+ 60
AFDC	165.0	82.1	82.9	+101
Premium, escalation and contingency	13.6	14.6	(1.0)	(7)
Total cost	$658.6M*	$400.5M	$258.1M	+ 64

* 12/77 estimate which is subject to change by the company

THREE MILE ISLAND UNIT 2 - CONTRACTS IN EXCESS OF $1,000,000
(COMMITMENTS AS OF 11/10/77)

Vendor	Description of Activity MEC No.	Date	Type Reimbursement	Base Contract ($1,000)	Change Order to Contract	Total Change Order Dollars ($1,000)	Total Contract Dollars ($1,000)	Percent Escalation
1. AC&S Inc.	Conventional Insulation (2073)	5/74	Lump sum T/M & U. P.	$ 860	38	$ 764	$ 1,624	89
2. B&W	Nuclear Steam Supply System (0005)	4/68	Lump sum	21,144	33	8,136	29,280	38
3. B&W	Nuclear Steam Supply System Installation (2109)	1 /73	Lump sum T/M & Incentive	16,095	12	(4,813)	11,282	(30)
4. Bethlehem Steel	Supply and Bend Rebar (5893)	10/71	Lump sum & U.P.	203	27	1,194	1,397	588
5. Brown & Crosby	NEPIA Insurance (1965)	10/69	Insurance rates	603	0	2,534	3,137	420
6. B&R	Architect Engineer (0002)	7/75	Cost Reim-) bursement) &)	10,486	14	39,249	49,735	374
7. B&R	Piping ISO's (0110)	7/75	Fixed fee)	1,077	2	4,030	5,107	374
8. Burns International Security	Construction Plant Security (2138)	2/75	Cost Reimbursement	184	6	1,166	1,350	634
9. Catalytic Inc.	Field Labor (1993)	9/77	Cost Reimbursement	9,000	0	0	9,000	-
10. Chemtrol Corp.	Penetration Seals (2160)	7/77	Lump sum	1,575	1	12	1,587	1
11. E. Comstock	Field Engineering Support Service (5926)	11/72	Cost Reimbursement	800	13	2,255	3,055	282
12. Conam Inspection	Quality Control Inspection (2139)	5/75	Cost Reimbursement	250	6	1,270	1,520	508
13. Crane Company	Station Valves and Accessories (0077)	2/71	Fixed Price & Escalation	760	24	269	1,029	35
14. Diamond Power	Reflective Insulation (2105)	3/75	Lump sum, T/M	1,549	23	(84)	1,465	(5)
15. General Electric	Substations (0061)	4/70	Lump sum, Escalation	758	20	371	1,129	49
16. General Electric	Step-up Transformers (0043)	7/69	Lump sum,	1,026	5	464	1,490	45
17. GAI	Consultant (1956)	4/69	Cost Reimbursement	120	0	1,258	1,378	1,048
18. Grinnell Fire	Fire Protection and Detection System (2099)	2/74	Lump sum, T/M	489	23	685	1,174	140

THREE MILE ISLAND UNIT 2 - CONTRACTS IN EXCESS OF $1,000,000
(COMMITMENTS AS OF 11/10/77)

Vendor	Description of Activity MEC No.	Date	Type Reimburse-ment	Base Contract ($1,000)	Change Order to Contract	Total Change Order Dollars ($1,000)	Total Contract Dollars ($1,000)	Percent Escalation
19. H.B. Alexander	Miscellaneous Structures (2091)	5/73	Lump sum, T/M	3,924	58	622	4,546	16
20. Ingersoll Rand	Multi Pressure Surface Condenser (0020)	10/68	Lump sum, T/M	1,039	5	5	1,044	1
21. LA Water Conditioners	Make-up Water Treatment Plant (0023)	12/68	Lump sum Escalation	600	11	412	1,012	69
22. Laman-Loesche	Power Tools (5312)	2/71	Lump sum	1,473	5	0	1,473	-
23. M.W. Kellogg	Pipe Fabrication & Hangers (2079)	11/71	Lump sum, U.P.	2,619	86	5,619	8,238	215
24. M.J. Doyle	HVAC (2069)	6/72	Lump sum, T/M Rates	2,745	184	2,909	5,654	106
25. Marley Company	Cooling Towers (10842)	6/69	Lump sum, U.P.	6,364	9	(2,101)	4,263	(33)
26. Mercury Company	Control Boards (0078)	3/71	Lump sum, U.P.	674	44	1,458	2,132	216
27. O.B. Cannon	Painting (2067)	8/72	Lump sum, commited Max.	1,554	31	572	2,126	37
28. PBI Industries	Structural Steel (2031)	11/70	Lump sum, T/M	1,073	23	99	1,172	9
29. Pitt Des Moines	Reactor Building Liner	11/69	Lump sum. T.M	3,179	65	2,282	5,461	72
30. PTL	Non-destructive Testing (2027)	11/69	Cost Reimbursement	150	21	2,245	2,395	1,497
31. Ragnar Bensen	Cooling Tower Concrete Work (40103)	7/70	Lump sum	3,060	0	0	3,060	-
32. SPB	Intake Structure (2068)	3/72	Lump sum	1,917	7	302	2,219	16
33. Stressteel Co.	Tendons (2009)	6/69	Lump sum converted to Cost Reimbursement	2,010	54	2,693	4,703	134
34. Struther Wells	Water Heater Coolers (0019)	9/68	Lump sum	1,143	9	16	1,159	1
35. Kerite Co.	Power Cable (0084)	10/71	Lump sum, U.P.	859	16	2,008	2,867	234
36. UE&C	UE&C Labor (1950)	1967	Cost Reimburs.	24,674	0	125,971	150,645	511

THREE MILE ISLAND UNIT 2 - CONTRACTS IN EXCESS OF $1,000,000
(COMMITMENTS AS OF 11/10/77)

Vendor	Description of Activity MEC No.	Date	Type Reimbursement	Base Contract ($1,000)	Change Order to Contract	Total Change Order Dollars ($1,000)	Total Contract Dollars ($1,000)	Percent Escalation
37. UE&C	Construction Management and Fee (1957)	1969	Cost Reimbursement	3,000	0	4,354	7,354	145
38. Velan Engineering	Valves (0080)	6/71	Fixed Prices	1,164	24	609	1,773	52
39. Westinghouse	Turbine Generator (0006)	4/68	Lump sum, Escalation	22,130	5	1,865	23,995	8
40. Westinghouse	Non-segregated Phase Bus Run	4/70	Lump sum	1,226	13	103	1,329	8
41. Westinghouse	Turbine Generator Erection (2087)	12/72	Lump sum, max. on labor	1,515	28	701	2,216	46
	TOTALS			$155,071	945	$211,504	$366,575	

ANALYSIS OF TMI-2 COST ESCALATION

- The period between 12/71 ($345M est.) and 2/75 ($630M est.) was analyzed in depth to understand the $285M escalation in relation to:
  - Schedule extension - 3 year in-service date slippage from 5/75 to 5/78
  - Increased costs associated with additional design development/changes in scope
- Schedule extension impact was estimated and quantified as follows:

	$ Impact (3 years)
. Direct labor escalation due to $0.58/hr composite craft rate increase ($9.14 to $9.72) on 15,538,125 man-hours	$ 9.0M
. Direct and indirect labor escalation assuming a minimum of 250 manual + non-manual always necessary on-site at 2,000 hrs/yr and $9.14/hr	13.7
. Direct material and subcontract escalation based upon 7.5% per year price escalation on $28,853,000 subject to price escalation and $250,000 layup charge for turbine generator	6.3
. A/E escalation at 7.5% on increased scope work plus a minimum Burns & Roe payroll of $1,000,000 per year for 3 years	9.6
. Construction mgmt. based upon minimum number (20-30) of key UE&C personnel at payroll of $480,000 per year	1.4
. Temporary facilities and services based upon 7.5% price escalation on increased scope plus a minimum operating cost of $1,200,000 per year	6.7
. Owner's engineering and project management based upon minimum number (40-50) of key personnel at payroll of $1,900,000 per year	5.7
. Start-up and test personnel including Met Ed and UE&C engineers based upon a minimum number (40-50) of key personnel at payroll of $2,900,000 per year	5.7

	$ Impact (3 years)
. Insurance, taxes and legal associated with carrying project 3 additional years	$ 1.1
. AFDC on $286,942,047 expended through 5/31/75 at 9-1/4% for 3 years and AFDC on balance to complete above scope	100.6
Total Schedule Extension Impact	$159.8M (3 yrs.)
Annual Schedule Extension Impact	$ 53.3 M

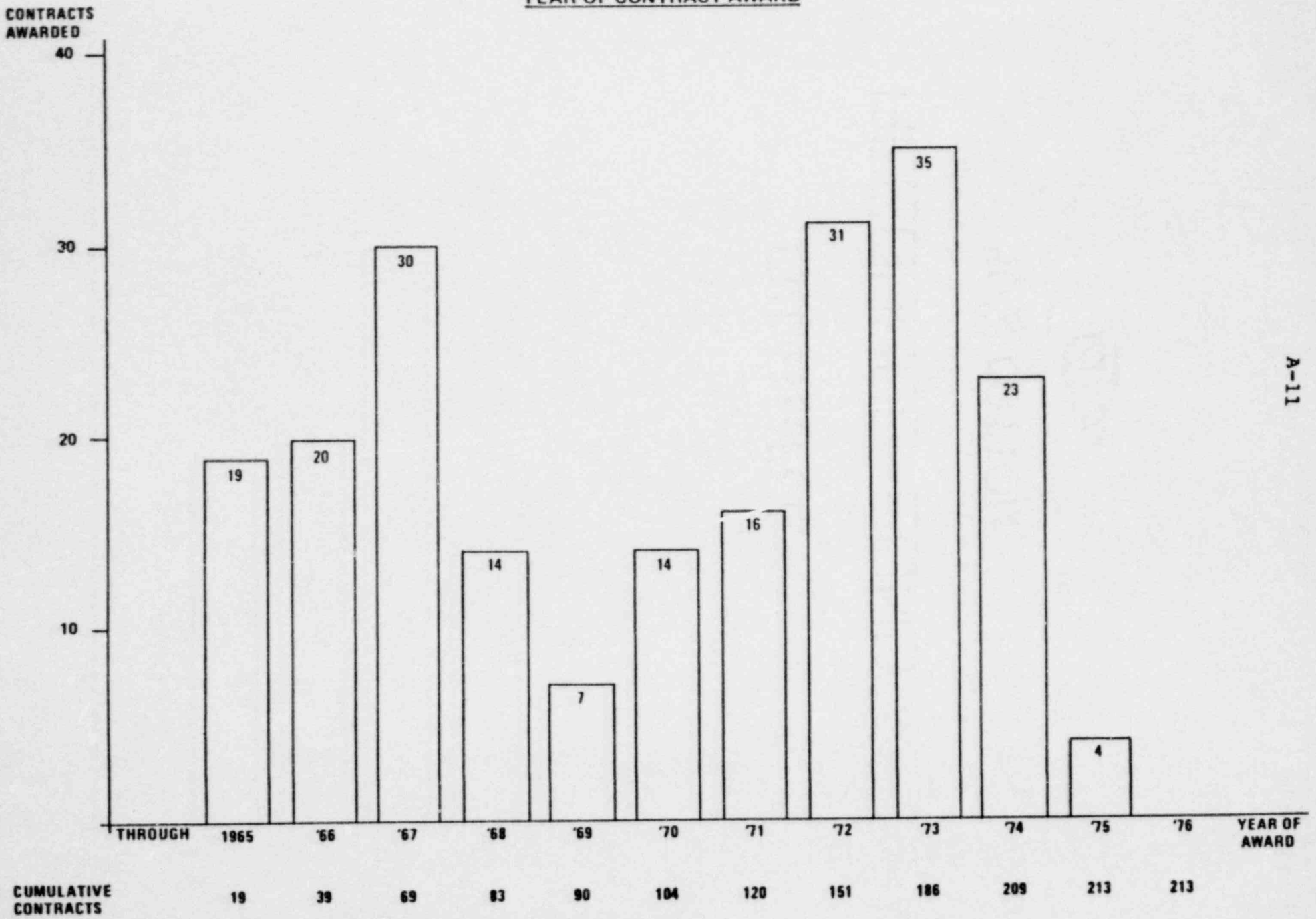
- Total escalation during the period analyzed was $285.0 M:
  - . Balance of $138.0 M escalation can be attributed to:
    - .. Design development (non-regulatory driven)
    - .. Regulatory requirements
    - .. Productivity changes.

SECTION II

INDUSTRY OVERVIEW

- The nuclear power plant industry is quite young
  - . As of 1970, only 104 NSSS had been ordered
  - . As of 1970, only 14 NSSS were scheduled for operation
- Lengthening of the construction period and slippage of original commercial operating dates appears to be widespread
  - . A comparison of orders placed tc scheduled operation indicates construction time has lengthened from 6-8 years to 10-12 years
  - . Of 169 plants giving original operating dates
    - .. 137 report slippage
    - .. 10 are now indefinite
    - .. 23 are still reporting on schedule
      - Of the 23 still reporting on schedule, the original dates were nebulous, or set well into the 1980's
- Regulation has increased significantly
- Studies indicate significant increases in cost
  - . Regulation
  - . Escalation of labor, material, professional services, and so forth.

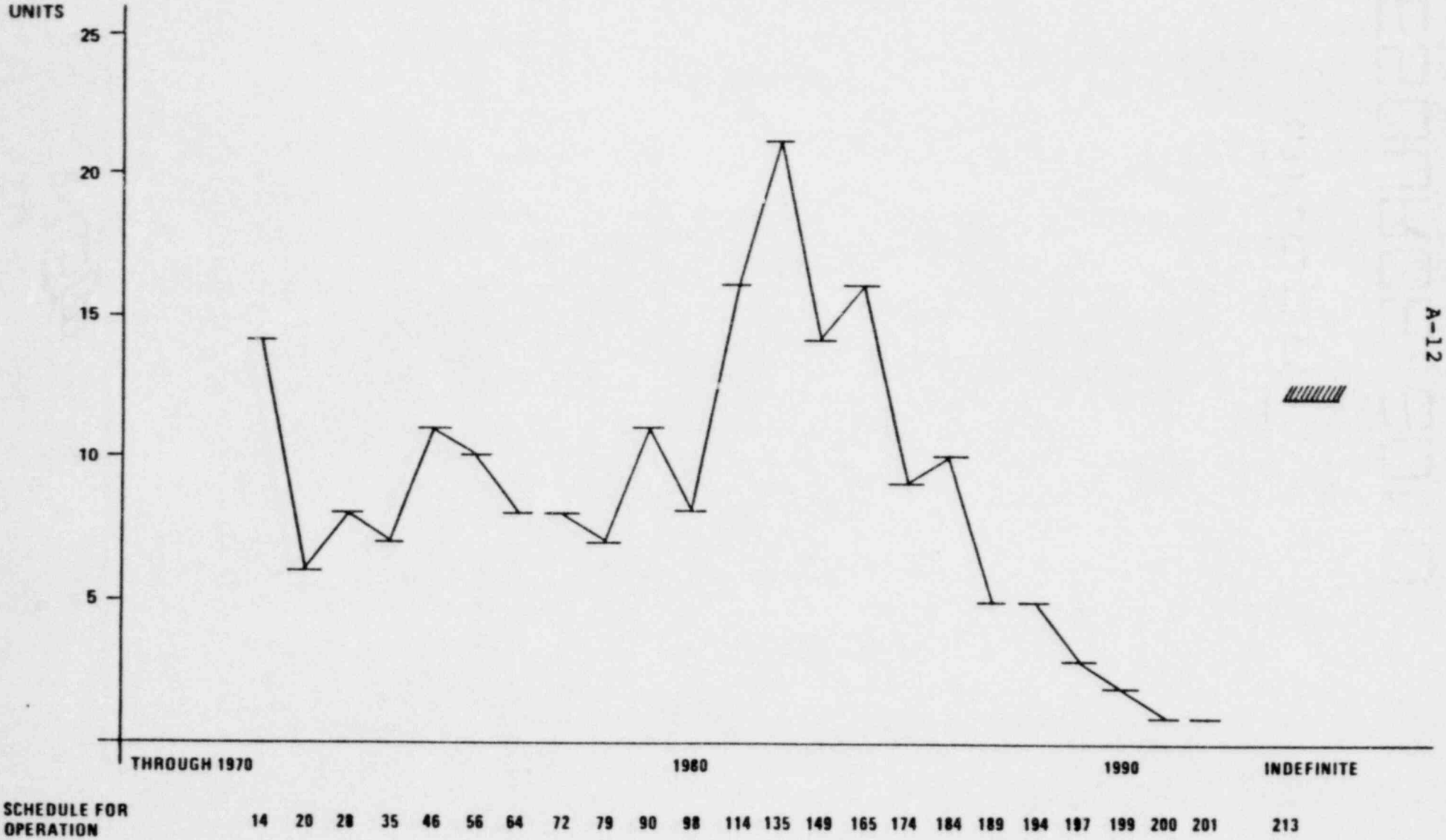
SUMMARY OR NUCLEAR POWER PLANT CONTRACTS BY YEAR OF CONTRACT AWARD



SOURCE: US ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION

NUCLEAR POWER PLANTS

SCHEDULED FOR COMMERCIAL OPERATION



A-12

SOURCE: US ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION

YEAR NSSS ORDERS PLACED VS. YEAR OF PLANNED COMMERCIAL OPERATION

	Orders Placed				Planned Commercial Operation			
	# of Orders	% of Total	Cumulative Orders	%	# of Units	% of Total	Cumulative Units	%
Through 1965	19	8.9	19	8.9				
	20	9.4	39	18.3				
	30	14.1	69	32.4				
	14	6.6	83	39.0				
	7	3.3	90	42.3				
Through 1970	14	6.6	104	48.9	14	6.6	14	6.6
	16	7.5	120	56.4	6	2.8	20	9.4
	31	14.6	151	71.0	8	3.8	28	13.2
	35	16.3	186	87.3	7	3.3	35	16.5
	23	10.8	209	98.1	11	5.2	46	21.7
Through 1975	4	1.9	213	100.0	10	4.7	56	26.4
	-				8	3.8	64	30.2
					8	3.8	72	34.0
					7	3.3	79	37.3
					11	5.2	90	42.5
Through 1980					8	3.8	98	46.3
					16	7.4	114	53.7
					21	9.8	135	63.5
					14	6.6	149	70.1
					16	7.5	165	77.6
Through 1985					9	4.2	174	81.8
					10	4.7	184	86.5
					5	2.3	189	88.8
					5	2.3	194	91.1
					3	1.4	197	92.5
Through 1990					2	.9	199	93.4
					1	.5	200	93.9
					1	.5	201	94.4
Through 1995	___	___	___	___	12*	5.6	213	100.0
Totals	213	100.0	213	100.0	213	100.0	213	100.0

*Indefinite

Source: US Energy Research and Development Administration

LEAD TIME EXTENSION - ORDERS PLACED TO SCHEDULED COMMERCIAL OPERATION DATES

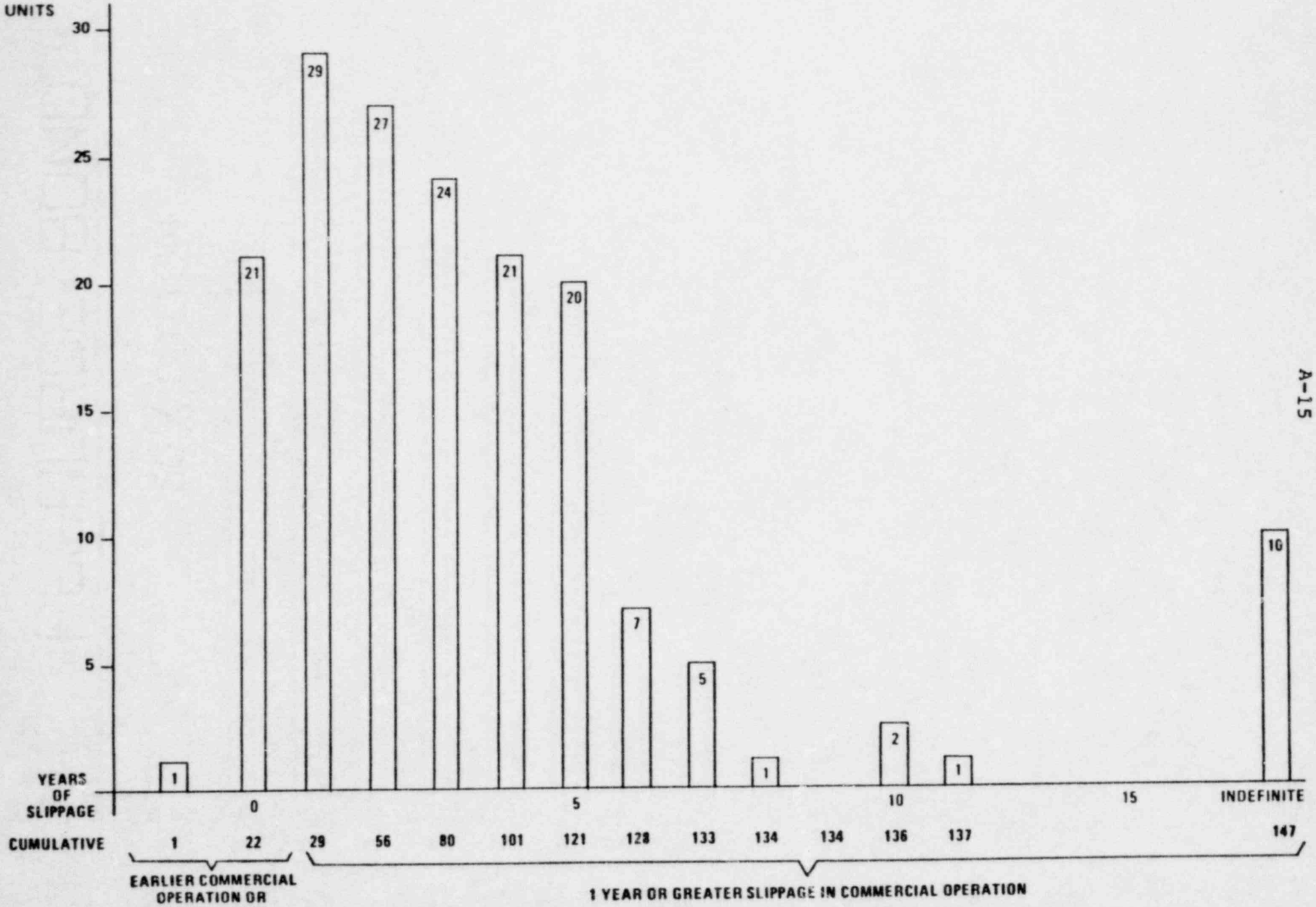
% of Orders	Order Placement: Cum. # of Units	Order Placement: Order place Year	Planned Commercial Operation: Cum. # of Units	Planned Commercial Operation: Sch. operation Year	Lead Time Difference # Years
9	19	1965	20	1971	6
18	39	1966	35	1973	7
32	69	1967	72	1977	10
42	90	1969	90	1979	10
56	120	1971	114	1981	10
71	151	1972	149	1983	11
87	186	1973	184	1986	13
100	213	1975	213*	1992	17

- Overall lead time including preliminary planning and engineering, construction and start-up/testing has increased substantially:
  - . Initial 10 - 20% of plants (orders placed 1965-66) had overall lead time of 6-7 years.
  - . Majority of plants thereafter (orders placed 1967-72) have overall lead time of 10-11 years.
  - . Orders placed after 1972 indicate indefinite commercial operation dates or increased lead times (13-17 years).

* Includes 12 nuclear power plants with indefinite commercial operation dates.

Source: US Energy Research and Development Administration

CURRENTLY REPORTED SLIPPAGE FROM ORIGINAL ON-LINE DATE



REPORTED SLIPPAGE FROM ORIGINAL COMMERCIAL OPERATION DATE

- 169 plants of total 213 plants have reported this data:

# of years Slippage	# of Plants Reporting	Cumulative Plants Reporting Slippage #	Cumulative Plants Reporting Slippage %
-1	1		
0	21		
1	29	29	17
2	27	56	33
3	24	80	47
4	21	101	60
5	20	121	72
6	7	128	76
7	5	133	79
8	1	134	79
10	2	136	80
11	1	137	80
Indefinite	10	147	87
Total plants	169	147	87

- Average commercial operation date slippage is 3 years:
  - Average is 2.7 years for 169 plants including 10 indefinite plants at zero slippage.
  - Average is 2.9 years for 159 plants excluding 10 indefinite plants.
  - Average is 3.3 years for 137 plants reporting 1 year or greater slippage.

Source: US Energy Research and Development Administration

Investment Cost Study - 1971 vs. 1976

	Wash - 1230 PWR 1031 MWe net output (1/71)	PWR 1139 MWe net output (1/76)	% Change
Concrete, cu.yds.	90,000	167,000	+ 86
Reinforcing Steel, lbs.	22.0×10^6	43.2×10^6	+ 96
Structural Steel, lbs.	8.8×10^6	21.8×10^6	+ 148
Professional Services	$ 33,750,000	$ 77,841,000	+ 228
Man Hours/Kilowatt	6.0	9.5	+ 58
Labor Rate, Avg/Hr	$8.86	$12.30	+ 39
Total Base Construction Costs*	$211,000,000	$568,800,000	+ 170
$/KW	$205	$499	+ 143

*Excludes AFDC, escalation and contingency

Source: NUREG - 0241, 6/1977 - "Capital Cost - PWR Plant"

OVERVIEW OF GPU'S NUCLEAR EXPERIENCE

- GPU's overall nuclear experience is probably as good or better than most privately owned utility companies.

  . As of 12/31/69 GPU had contracted for 4 of 90 NSSS in the U.S. This represents approximately 4.5% of all contracts awarded.

  . As of 12/31/69 GPU had 1 of 14 operating NSSS's in the U.S. This represents approximately 7.1% of all operating facilities.

  . GPU has not awarded a NSSS contract since 12/69.

  . The GPU system's lifetime nuclear output to date (12/77) ranks 4th among U.S. utilities.

  . The operating efficiency of GPU's nuclear plants (OC-1, TMI-1) is approximately 10% higher than the national average.

- GPU's experience with respect to construction period lengthening and slippage of initial in-service dates has been similar to the industry.

	Initial in-service date	Revised in-service date	Slippage
. Oyster Creek-1	1/68	12/69	23 months
. Three Mile Is.-1	12/71	9/74	33 months
. Three Mile Is.-2	5/73	5/78	60 months
. Forked River -1*	4/76	5/83	83 months

- GPU's experience with respect to cost escalation has been similar to industry cost escalation

	Initial cost estimate	Revised or final cost estimate	Difference	%
. Oyster Creek-1**	$ 68 million	$ 92 million	$ 24 million	35
. Three Mile Is.-1	110 million	400 million	290 million	264
. Three Mile Is.-2	190 million	659 million	469 million	247
. Forked River-1*	619 million	900 million	281 million	45

* Current estimates

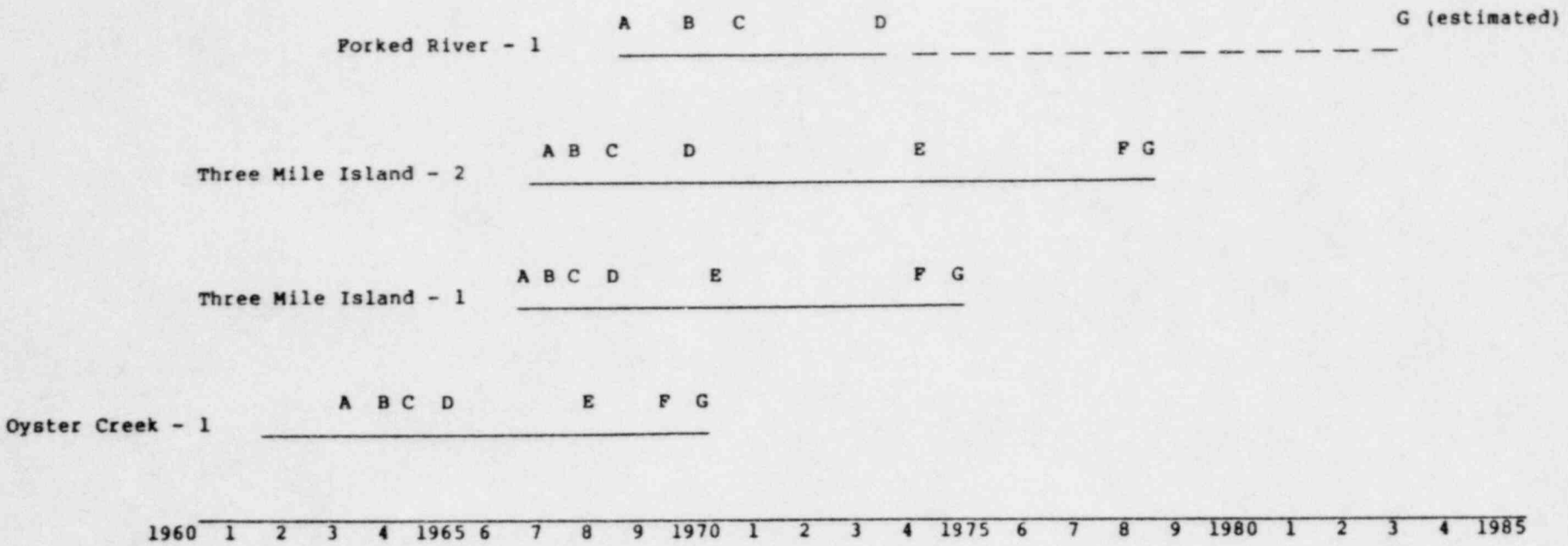
** Turnkey contract by General Electric - not comparable to cost of other GPU nuclear facilities

- Responsibility for project management has been shifted from the operating companies to GPUSC since 1971.

  . Prior to 1971, project management was the responsibility of the individual operating companies.

    .. Development of A/E and constructor relationships was on an operating by operating company basis.

GPU Nuclear Experience - Critical Event Timing



Legend:

A - Public announced
B - NSSS cont. award
C - CP applied
D - CP issued
E - OL applied
F - OL issued
G - Commercial service
__ - Initial in-service date

GPU - Nuclear Experience, Completed, Transferred and In Process

Unit	Type and** capacity (NMWe)	Project responsibilities: Owner and licensee	Architect engineer	Construction manager	Turbine supplier	NSSS supplier	Timing and cost: Construction permit to commercial CPS	Total $ (millions)
Oyster * Creek - 1	BWR - 620	JCP&L	Burns & Roe	General Electric Turnkey	General Electric	General Electric	5 yrs., 0 mos.	$ 92.0
Oyster Creek - 2	PWR - 900	JCP&L	Burns & Roe	Burns & Roe	Westing-house	Babcock & Wilcox	Moved to TMI	-
Three Mile Island - 1	PWR - 792	Met Ed	Gilbert Associates	UE&C	General Electric	Babcock & Wilcox	6 yrs., 4 mos.	$400.5
Three Mile*** Island - 2	PWR - 880	JCP&L Met Ed(L) Penelec	Burns & Roe	UE&C	Westing-house	Babcock & Wilcox	8 yrs., 6 mos.	$658.6
Forked*** River - 1	PWR - 1120	JCP&L (L) Met Ed Penelec	Burns & Roe	Stone & Webster	Brown Boveri	Combustion Engineering	9 yrs., 10 mos.	$900.0

* Turnkey by General Electric

** Capacity in Net Summer Megawatt Rating

*** Construction time and cost per latest estimate

(L) Licensee

GPU RESOURCE ALLOCATION

OVERALL

- A review of cost escalation indicates that a one-year schedule extension equates to approximately $50 - $60 million in additional project costs. This excludes replacement cost of merger.
  - . Increased APDC
  - . Escalation of labor and material costs
  - . Exposure to additional NRC regulations

HUMAN RESOURCES

- Force labor size was subject to significant fluctuating change
  - . 1969 and 1970 shifted labor resources from TMI-2 to TMI-1
  - . 1971 operating engineers and carpenters struck for 6 weeks
  - . 1972 force labor reduced 15% to attain better supervisory control
  - . 1974 force labor reduced 10% to insure budget maintenance
  - . 1976 force labor reduced 10% to insure budget maintenance
- Engineering
  - . 1971, 1972 key personnel diverted to rewriting FSAR's
- Productivity
  - . Unit 1 productivity through 1972 was less than expected
  - . Project management indicated that following the 1976 layoff, productivity (construction momentum) fell and never rose to prior levels
    - .. Work sampling studies and management reports generally support this contention

FINANCIAL RESOURCES

- As a result of underestimating the scope of nuclear construction projects, unanticipated levels of inflation and general market conditions, GPU was unable to support the overall generation construction program with adequate financial resources:

  . Correspondence between JCP&L (GPU) and N.J. P.U.C. in June and September, 1974 indicates GPU felt they had exhausted all possible means of securing additional financing sources:

    .. In 1974, GPU made an unsuccessful attempt to sell $35 million of preferred stock

    .. In 1974, GPU obtained SEC consent to increase short-term bank debt to $96 million (from $80 million) and exhausted this additional capital by June, 1974

    .. During 1974 minimum required interest coverage ratios of all operating companies precluded sale of additional bonds or debentures

    .. During 1974 additional capital secured from issuance of common stock was limited to $47.5 million based upon market price = 57% of book value

    .. During this time GPU regarded alternative to eliminate or reduce dividend payment as "disastrous"

  . Significant budget limitations resulted which impacted several construction projects during the period 1969-74:

    .. Total generation construction expenditures during 1969-74 were $1,153 million versus project budgets of $1,353 million for a difference of $200 million (15%)

  . Budget allocation decisions favored TMI-1 over TMI-2 during this period:

    .. TMI-1 expenditures were $385 million versus budgets of $354 million for an <u>increase</u> of $31 million (9%)

    .. TMI-2 expenditures were $312 million versus budgets of $401 million for a <u>decrease</u> of $89 million (22%)

'INANCIAL RESOURCES

- The impact of corporate decisions to allocate financial resources to other projects (i.e., TMI-1) contributed directly to schedule extension and cost escalation of TMI-2 including:

  . Labor rate escalation and productivity decline based upon substantial year to year swings in the direct labor force

  . Material price escalation and additional material requirements based upon extended exposure to regulatory changes

  . "Construction overhead expenses" including GPU project management, UE&C construction management, Burns & Roe engineering management and site expenses for temporary facilities which all increased by greater than 200% primarily as a result of consistently lengthening the required construction period

  . AFDC escalation resulting from both increases in design scope and consistent lengthening of construction period

- Final "bricks and mortar" costs account for less than one-half of the total project cost:

  . Direct materials, labor and subcontracts are $292 million or 44% of $659 million overall estimate

  . Direct materials, labor and subcontracts were $132 million or 70% of initial $190 million estimate

  . Escalation of "construction overhead" and AFDC expenses far exceeds direct materials and labor escalation:

    .. Construction overhead ($160 million) and AFDC ($140 million) escalation have a combined impact of $300 million or 46% of final estimated cost

    .. Direct material and labor escalation equals $170 million

GPU SYSTEM COMPANIES
MORTGAGE BOND RATINGS
(Through March 1978)

	JCP&L		Met-Ed		Penelec	
As of* -	Moody's	S&P	Moody's	S&P	Moody's	S&P
January 1, 1960	A	A	AA	AA	AA	AA
August 1963	A	AA	AA	AA	AA	AA
July 1966	A	A	AA	AA	AA	AA
May 1967	A	A	AA	AA	AA	A
September 1967	A	A	AA	A	AA	A
September 1968	A	A	A	A	AA	A
June 1969	A	A	A	A	A	A
January 1971	A	BBB	A	A	A	A
August 1971	A	BBB	A	A	A	BBB
October 1971	A	BBB	A	BBB	A	BBB
August 1972	Baa	BBB	A	BBB	A	BBB
March 1975	Baa	BBB	A	A	A	BBB
June 1975	Baa	BBB+	A	A	A	BBB
April 1977	Baa	A-	A	A	A	BBB

*Date of Change in Ratings

JERSEY CENTRAL POWER & LIGHT COMPANY

Debenture Indenture Coverage* 12 Mos. Ended by Months

Month	1977	1976	1975	1974	1973
January	2.30	2.56	2.62	1.91	2.78
February	2.62	2.10	2.68	1.85	2.88
March	2.71	2.12	2.49	1.94	2.74
April	2.84	2.12	2.47	1.89	2.66
May	2.65	2.14	2.46	1.96	2.64
June	2.68	2.05	2.48	2.10	2.70
July	2.81	2.07	2.29	2.24	2.71
August	2.80	2.04	2.36	2.40	2.69
September	2.84	2.12	2.36	2.59	2.58
October	2.82	2.29	2.28	2.70	2.19
November	2.79	2.41	2.30	2.67	2.15
December	2.76	2.48	2.23	2.80	1.98

* Coverage Ratios are as reported and do not reflect retroactive accounting changes or rate relief.

METROPOLITAN EDISON COMPANY

	Debenture Indenture Coverage* 12 Mos. Ended by Months				
Month	1977	1976	1975	1974	1973
January	2.74	2.70	3.19	2.09	2.40
February	2.80	2.59	3.51	2.03	2.51
March	2.93	2.11	3.75	1.99	2.60
April	3.02	2.00	3.31	1.94	2.55
May	3.14	1.89	3.44	1.89	2.54
June	3.16	2.36	3.47	1.96	2.64
July	3.16	2.39	3.58	1.94	2.66
August	3.18	2.38	3.69	1.98	2.62
September	3.22	2.34	3.66	2.12	2.63
October	2.98	2.40	3.16	2.28	2.58
November	2.98	2.47	3.00	2.51	2.56
December	2.90	2.64	2.83	2.86	2.09

* Coverage Ratios are as reported and do not reflect retroactive accounting changes or rate relief.

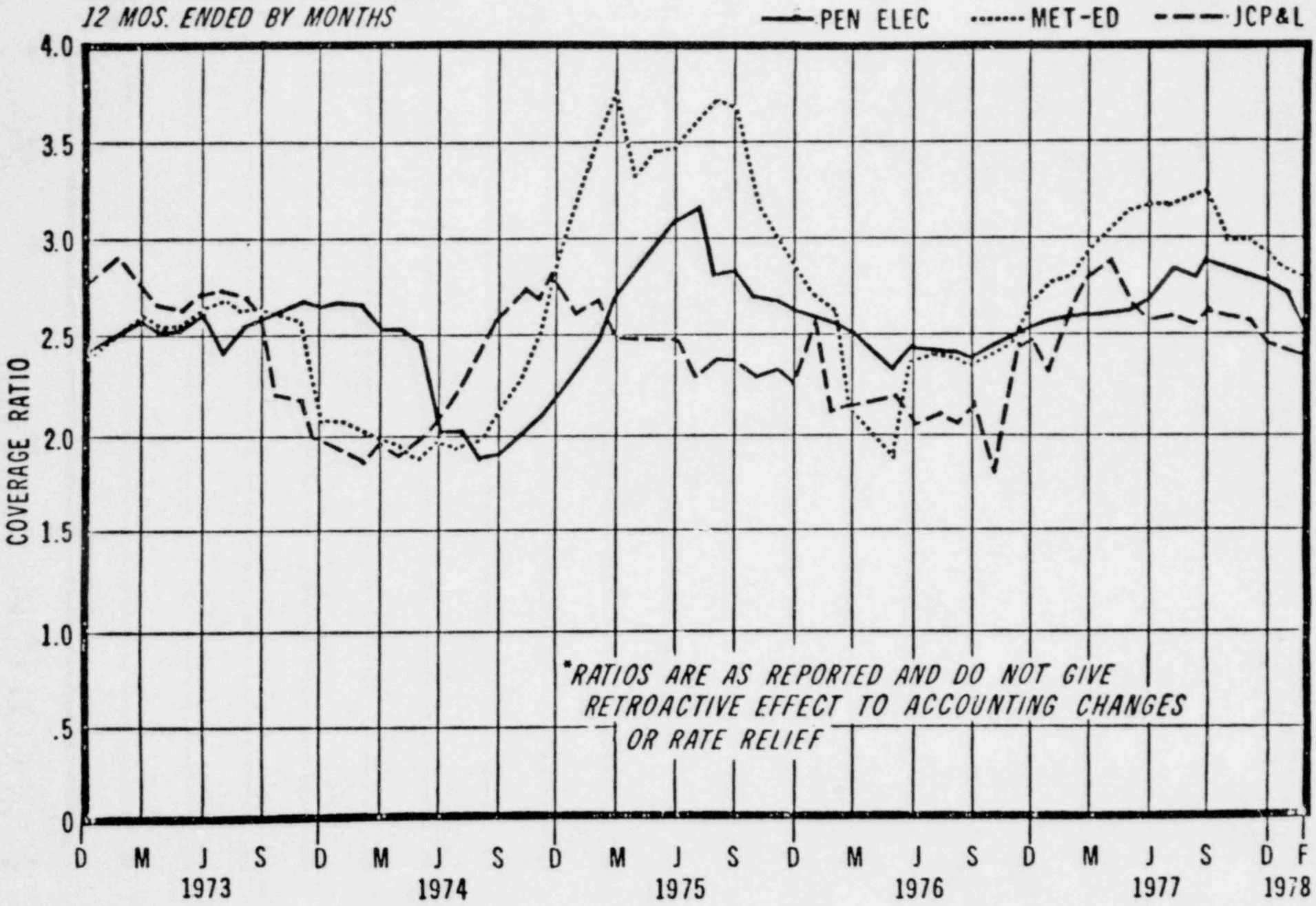
PENNSYLVANIA ELECTRIC COMPANY

	Debenture Indenture Coverage* 12 Mos. Ended by Months				
Month	1977	1976	1975	1974	1973
January	2.56	2.59	2.35	2.68	2.44
February	2.58	2.57	2.49	2.65	2.52
March	2.60	2.50	2.70	2.54	2.56
April	2.60	2.42	2.84	2.51	2.53
May	2.64	2.32	2.99	2.43	2.53
June	2.55	2.42	3.09	2.01	2.62
July	2.57	2.40	3.14	2.01	2.40
August	2.52	2.39	2.81	1.89	2.56
September	2.61	2.34	2.81	1.91	2.58
October	2.60	2.41	2.69	2.01	2.64
November	2.56	2.46	2.66	2.09	2.68
December	2.45	2.54	2.61	2.21	2.67

* Coverage Ratios are as reported and do not reflect retroactive accounting changes or rate relief.

DEBENTURE INDENTURE COVERAGE*

12 MOS. ENDED BY MONTHS



GENERAL PUBLIC UTILITIES CORPORATION

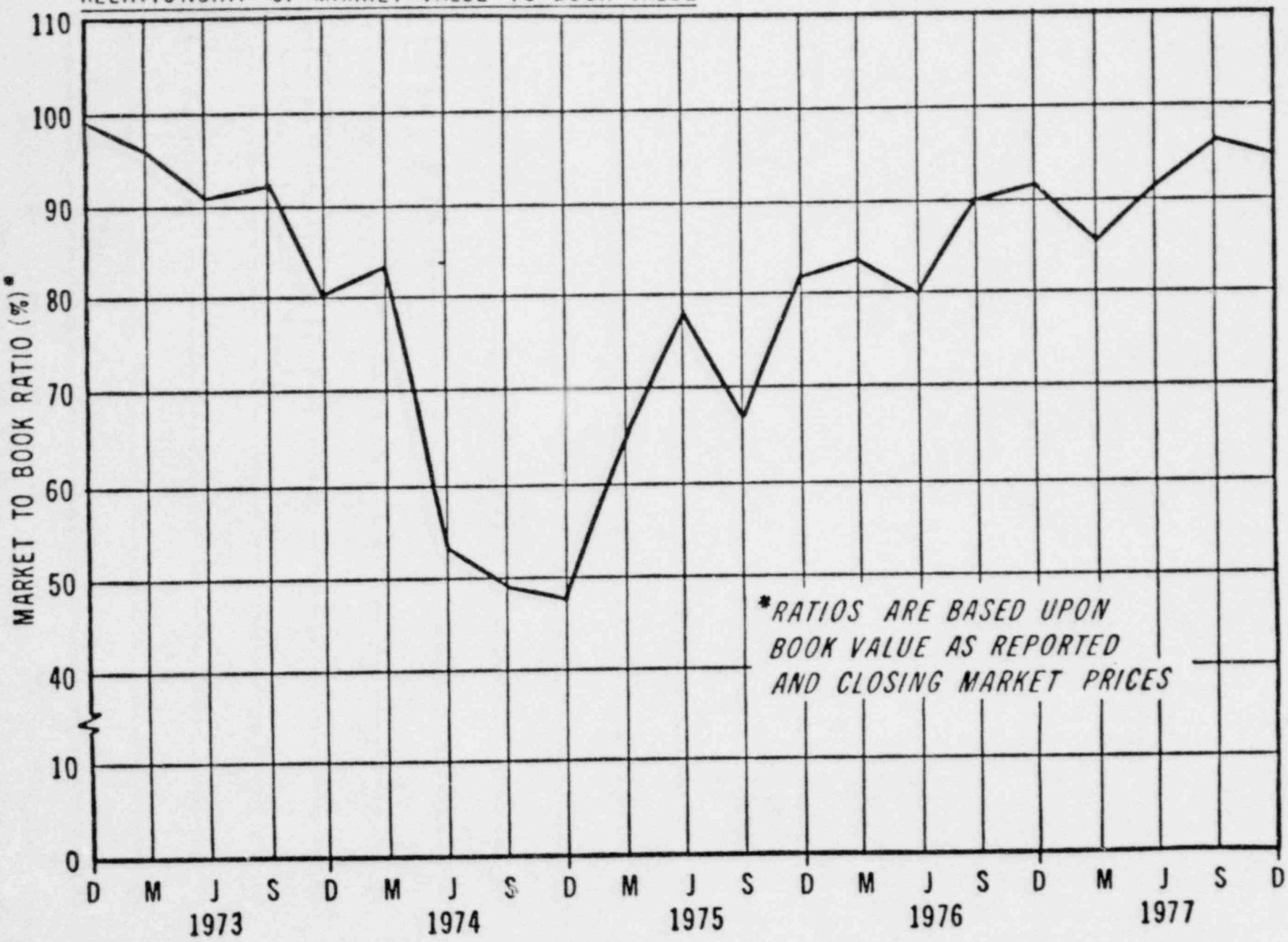
ANALYSIS OF MARKET PRICE TO BOOK VALUE RATIOS

	Market Price Per Share	Book Value Per Share*	Market Price/ Book Value (%)
Year 1972	21-5/8	$21.78	99%
Year 1973			
1st Quarter	21-1/8	22.03	96
2nd Quarter	19-3/4	21.74	91
3rd Quarter	20-1/8	21.96	92
4th Quarter	17-3/4	22.10	80
Year 1974			
1st Quarter	18-1/2	22.42	83
2nd Quarter	11-5/8	22.08	53
3rd Quarter	10-5/8	21.68	49
4th Quarter	10-1/2	21.87	48
Year 1975			
1st Quarter	13-7/8	21.74	64
2nd Quarter	16-7/8	21.70	78
3rd Quarter	14-1/4	21.31	67
4th Quarter	17	20.81	82
Year 1976			
1st Quarter	17-1/2	20.88	84
2nd Quarter	16-3/4	20.94	80
3rd Quarter	19	21.14	90
4th Quarter	19-1/2	21.41	91
Year 1977			
1st Quarter	18-3/4	21.71	86
2nd Quarter	20	21.70	92
3rd Quarter	21-1/8	21.80	97
4th Quarter	20-7/8	21.94	95

*Book values are as reported and do not reflect retroactive rate relief.

GENERAL PUBLIC UTILITIES CORPORATION

RELATIONSHIP OF MARKET VALUE TO BOOK VALUE



TMI-2 ACTUAL SPENDING VS. COST ESTIMATES

($ Millions)

	1969	1970	1971	1972	1973	1974	1975	1976	1977	Total
- Actual Spending										
. Project total	$ 13.1	34.3	41.2	71.8	78.2	78.8	88.8	101.9	106.8	$614.9
. Without AFDC	$ 12.4	32.1	36.3	63.1	62.7	58.6	63.1	69.0	70.3	467.6
. Present value* - 1969 @ 7-1/2% disc.	$ 12.4	29.9	31.4	50.8	47.0	40.8	40.9	41.6	39.4	334.2
.. Direct Labor	-	2.3	3.1	10.5	10.9	11.5	9.6	13.5	9.8	71.2
- Estimate vs. Spending										1978
. Total project estimate (at beginning of yr.)	$190.0	214.0	285.0	345.0	465.0	525.0	580.0	630.0	637.0	658.6
. Est. without AFDC	$165.3	182.9	240.2	278.7	367.1	396.7	416.3	459.5	471.3	493.6
. Balance to complete	$165.3	170.5	195.7	197.9	223.2	190.1	151.1	131.2	74.0	26.0
. Actual spending	(12.4)	(32.1)	(36.3)	(63.1)	(62.7)	(58.6)	(63.1)	(69.0)	(70.3)	N/A
. Additions during year	17.6	57.3	38.5	88.4	29.6	19.6	43.2	11.8	22.3	N/A
. Net change	5.2	25.2	2.2	25.3	(33.1)	(39.0)	(19.9)	(57.2)	(38.0)	N/A
- In-service date slippage (months)	12	12	-	12	12	12	-	-	-	

* Present value discounting is not utilized in any subsequent calculations. It is included to illustrate that "real spending" declined on TMI-2 after 1972.

ACTUAL CONSTRUCTION EXPENDITURES VS. ORIGINAL CAPITAL BUDGET*

($ Millions)

	TMI - 2				TMI - 1				Total generation construction			
			Difference				Difference				Difference	
Year	Act.	Bud.	$	%	Act.	Bud.	$	%	Act.	Bud.	$	%
1969	$ 13.1	$ 15.2	$ (2.1)	(16)	$ 36.7	$ 48.1	$(11.4)	(24)	$ 121.9	$ 129.3	$ (7.4)	(6)
1970	34.3	27.5	6.8	25	94.6	90.8	3.8	4	163.8	168.1	(4.3)	(3)
1971	41.2	52.3	(11.1)	(21)	63.4	70.5	(7.1)	(10)	185.3	243.5	(58.2)	(31)
1972	71.8	96.3	(24.5)	(26)	76.0	47.2	28.8	61	228.6	229.0	(0.4)	(0.2)
1973	78.2	115.2	(37.0)	(32)	69.0	58.4	10.6	18	235.0	300.2	(65.2)	(22)
1974	78.8	94.5	(15.7)	(17)	45.0	38.6	6.4	17	218.0	282.6	(64.6)	(23)
1975	88.8	82.2	6.6	8	2.6	4.7	(2.1)	(45)	237.9	222.5	15.4	7
1976	101.9	89.0	12.9	8	2.1	1.0	1.1	110	237.0	226.5	10.5	5
1977	106.8	92.0	14.8	16	-	-	-	-	254.7	231.2	23.5	10
Total Period	614.9				389.4				1,882.2			
Total 1969-74	317.4				384.7				1,152.6			

* Capital budgets as of January 1, 19xx as approved by the Board of Directors. Based upon internal/external changes these budgets may have been (were) modified as appropriate.

TMI-2 BUDGET VS. PROJECT ESTIMATE

CASH FLOW REQUIREMENTS

($ Millions)

Year	TMI-2 budget	Project est. cash flow	Difference	Est. date
1969	15.2	N/A	N/A	
1970	27.5	32.1	(4.6)	10/70
1971	52.3	60.4	(8.1)	10/70
1972	96.3	99.8	(3.5)	12/71
1973	115.2	115.2	-	12/72
1974	94.5	99.4	(4.9)	6/73
1975	82.2	79.6	2.6	9/74
1976	89.0	100.0	(11.0)	2/75
1977	92.0	93.5	(1.5)	11/76

- Separate from actual expenditures vs. budget, it appears that budgets were somewhat less than cash flow requirements based upon cost estimates

GPU PROJECT MANAGEMENT EVOLUTION

OWNERS ORGANIZATION

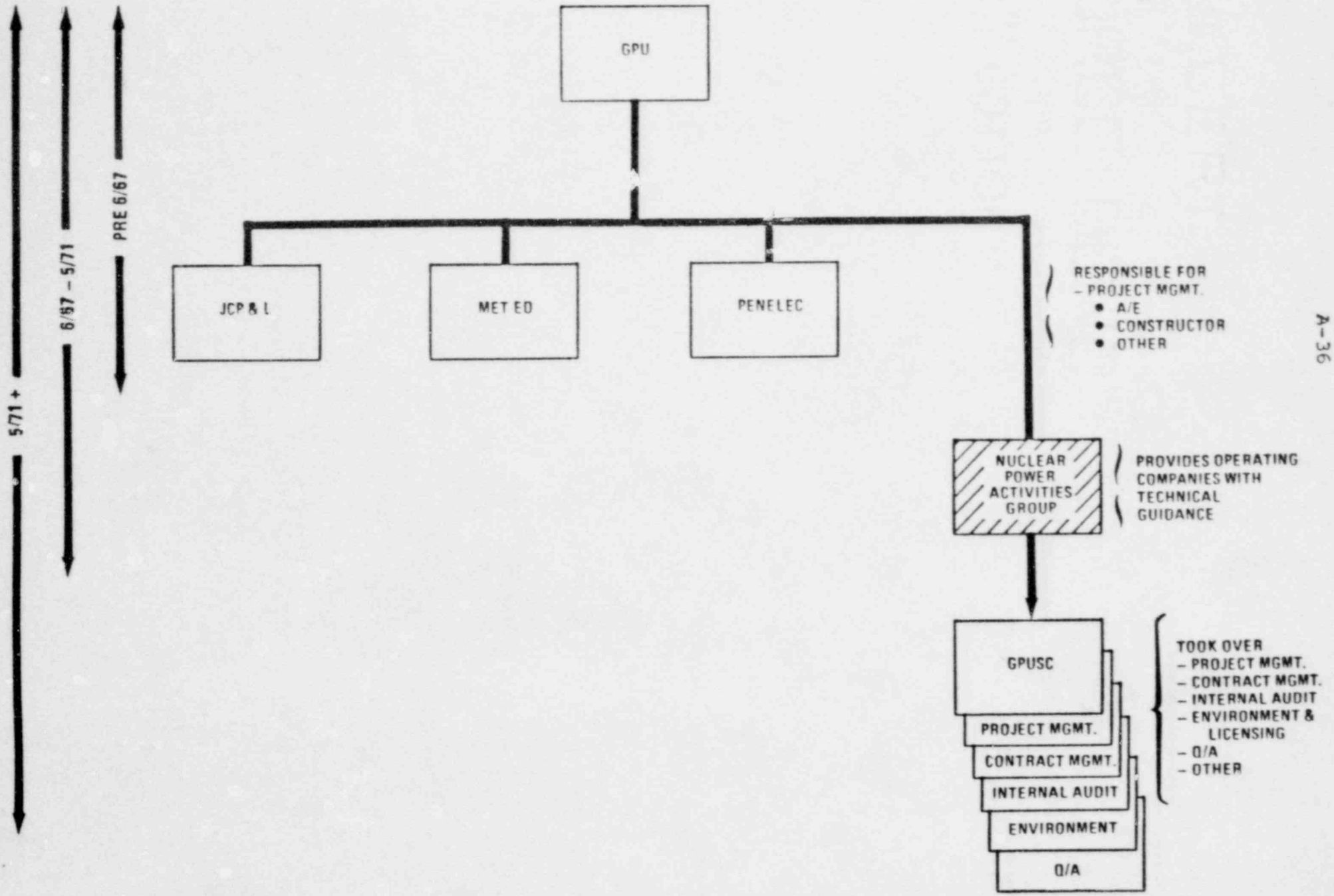
- Responsibility for the OC-2/TMI-2 project shifted three times within the GPU organization.

. Jersey Central	Project inception - 4/69
. Met Ed	4/69 - 9/71
. GPUSC	9/71 - completion

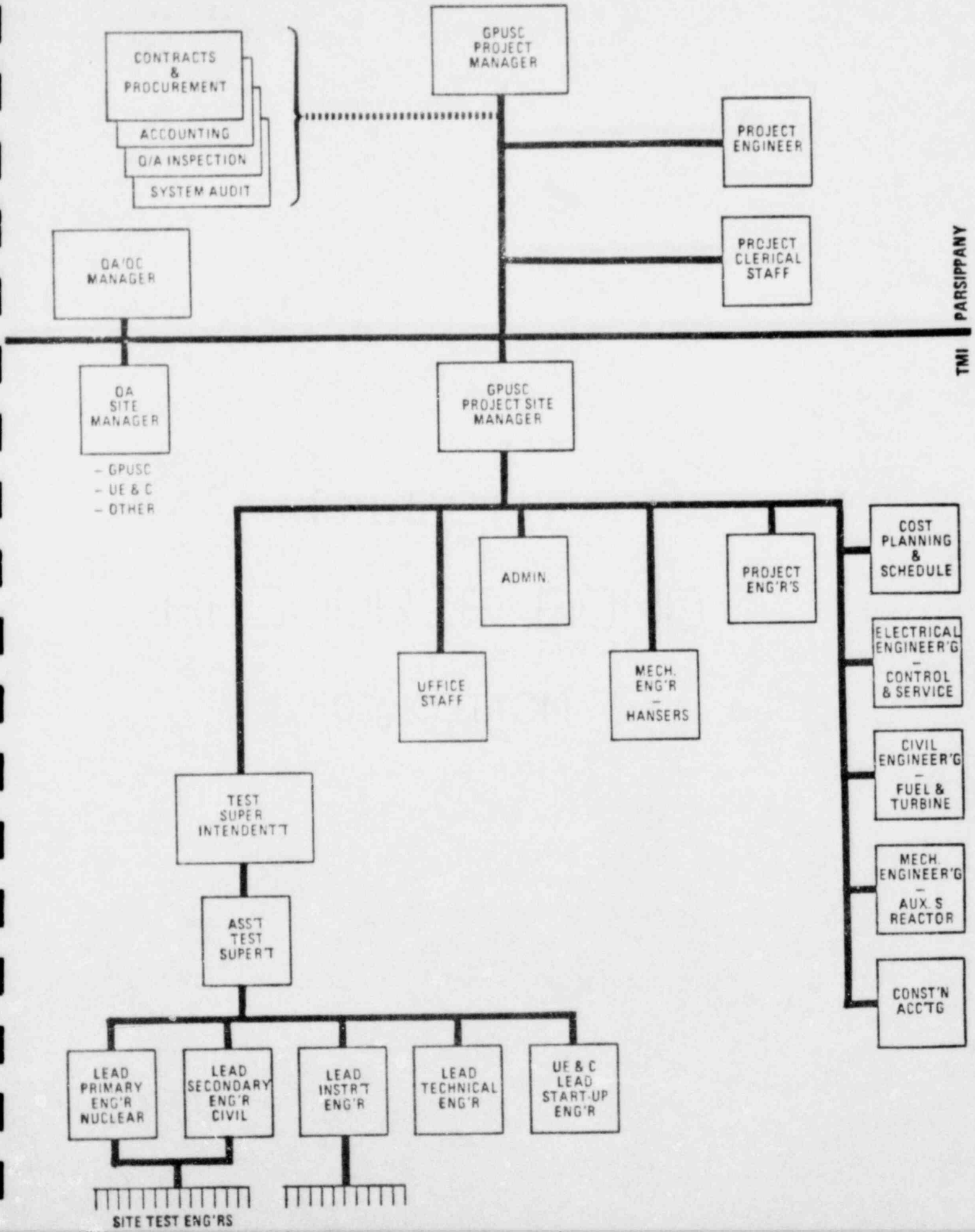
- GPU with the organization and incorporation of GPUSC moved from a decentralized to centralized project management and project support mode
  - . Assumed responsibility for engineering and construction as agent for owners - 9/71
  - . Assumed responsibility for start-up and test - 10/71
  - . Assumed responsibility for quality control inspection at site - 12/72
  - . Issued in 8/72 the project's first project organization and responsibilities document (PORD)

- The GPUSC organization expanded from incorporation (5/71) through the present time to accommodate growing project and other centralized responsibilities
  - . Project management
  - . Contract management
  - . Internal auditing

GPU – OVERVIEW OF PROJECT MANAGEMENT ORGANIZATIONAL EVOLUTION



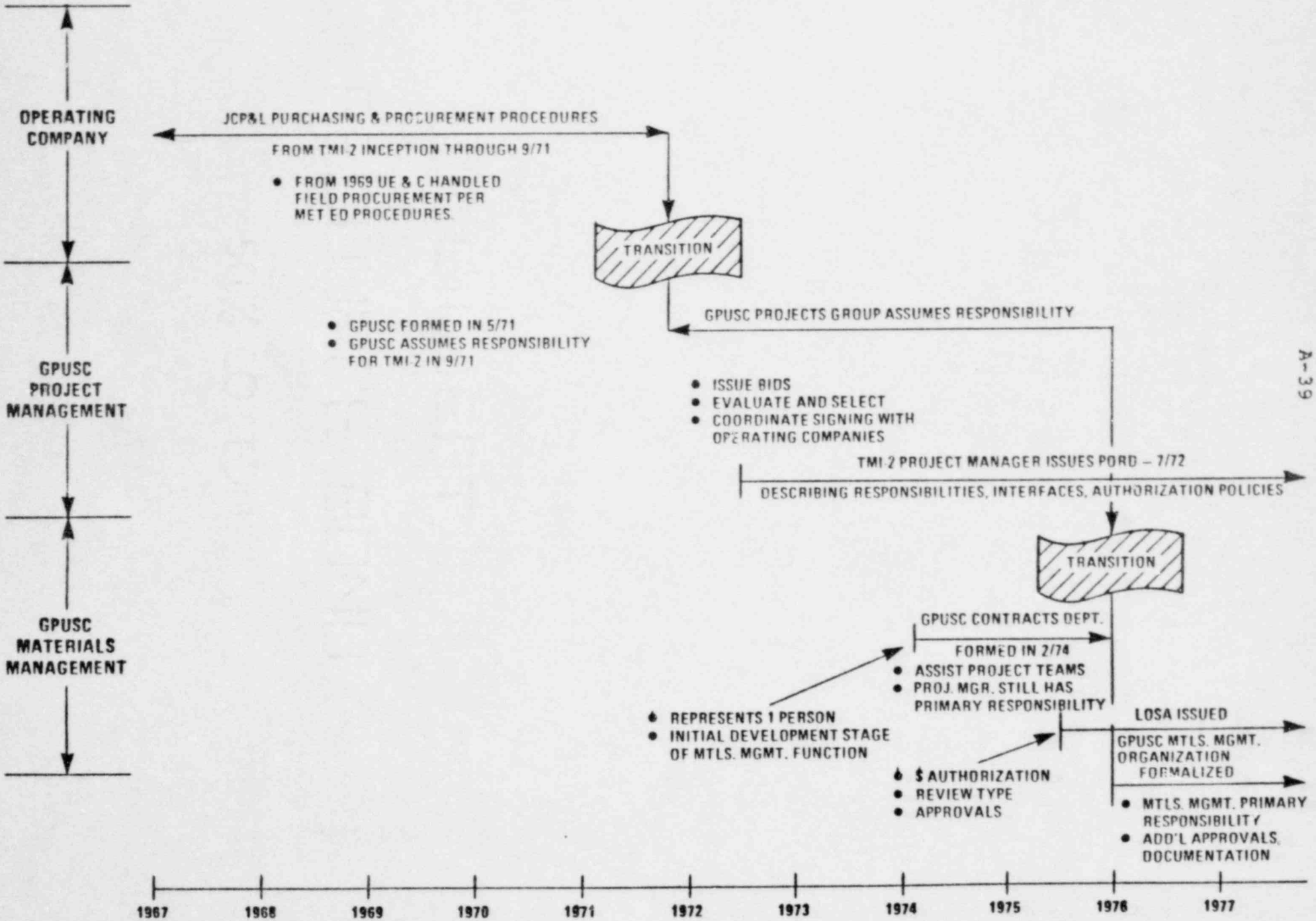
GPUSC – OWNERS ORGANIZATION OVERVIEW



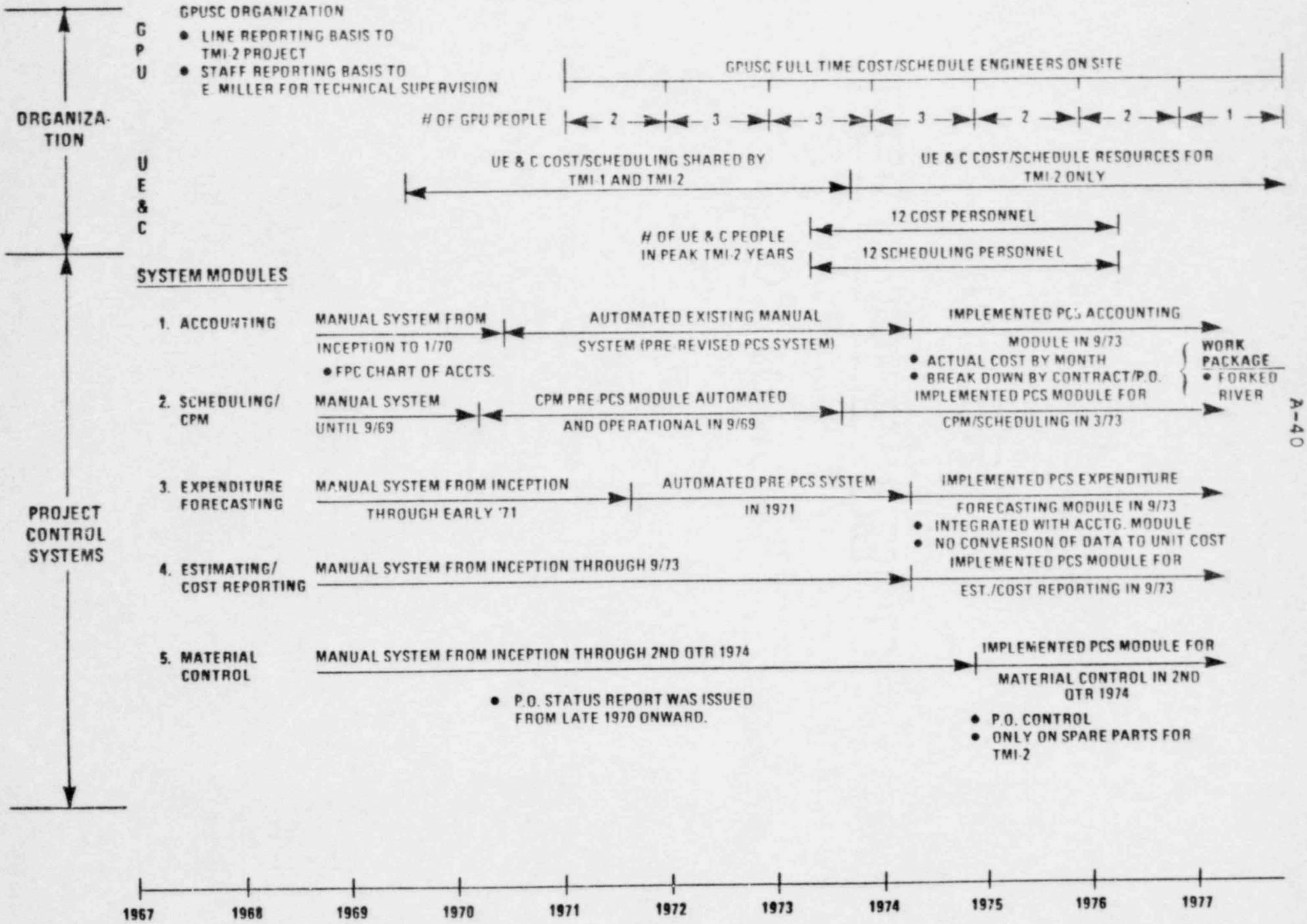
RESPONSIBILITY* / PROJECT INTERFACE	MGR. CONSTRUCTION	MGR. ENGRG.	MGR. QA	MGR. ENVIR.	MGR. CONTRACTS	MGR. PROJECTS	PROJECT MGR.	A.E. (B&R)	NSSS (B&W)	CONST. MGR. (VERC)	TURBINE (WEST)	CONSULTANTS	MET ED SUPVR.
1. SCHEDULE PREPARATION	X					X	X			X			
2. CONSTRUCTION PROGRESS vs. SCHEDULE AND BUDGET	X					X	X			X			
3. CONSTRUCTION CONTRACTOR PERFORMANCE	X						X			X			
4. PLANT DESIGN/TECHNICAL REVIEW AND SUPPORT		X					X	X	X		X	X	X
5. ESTABLISH QA PLAN			X					X				X	
6. QA SURVEILLANCE AND AUDITING			X					X		X		X	
7. EVALUATE LAWS/REGULATIONS			X	X			X					X	X
8. PSAR, FSAR/ENVIR. REPORT				X			X	X	X		X	X	X
9. NEGOTIATE MAJOR CONTRACTS					X		X			X			
10. APPROVAL REVISIONS/ESCALATIONS					X		X			X			
11. ESTABLISH PROJECT ORGANIZATION						X	X						
12. SELECTION OF SUPPLIERS							X	X		X			
13. SELECTION OF CONTRACTORS							X	X		X			
14. PLANT OPERATING AND MAINTENANCE PROCEDURES													X
15. PROJECT PROCUREMENT							X	X		X			

*The company with respect to certain purchases also has a comprehensive Level of Signature Authority (LOSA) procedure.

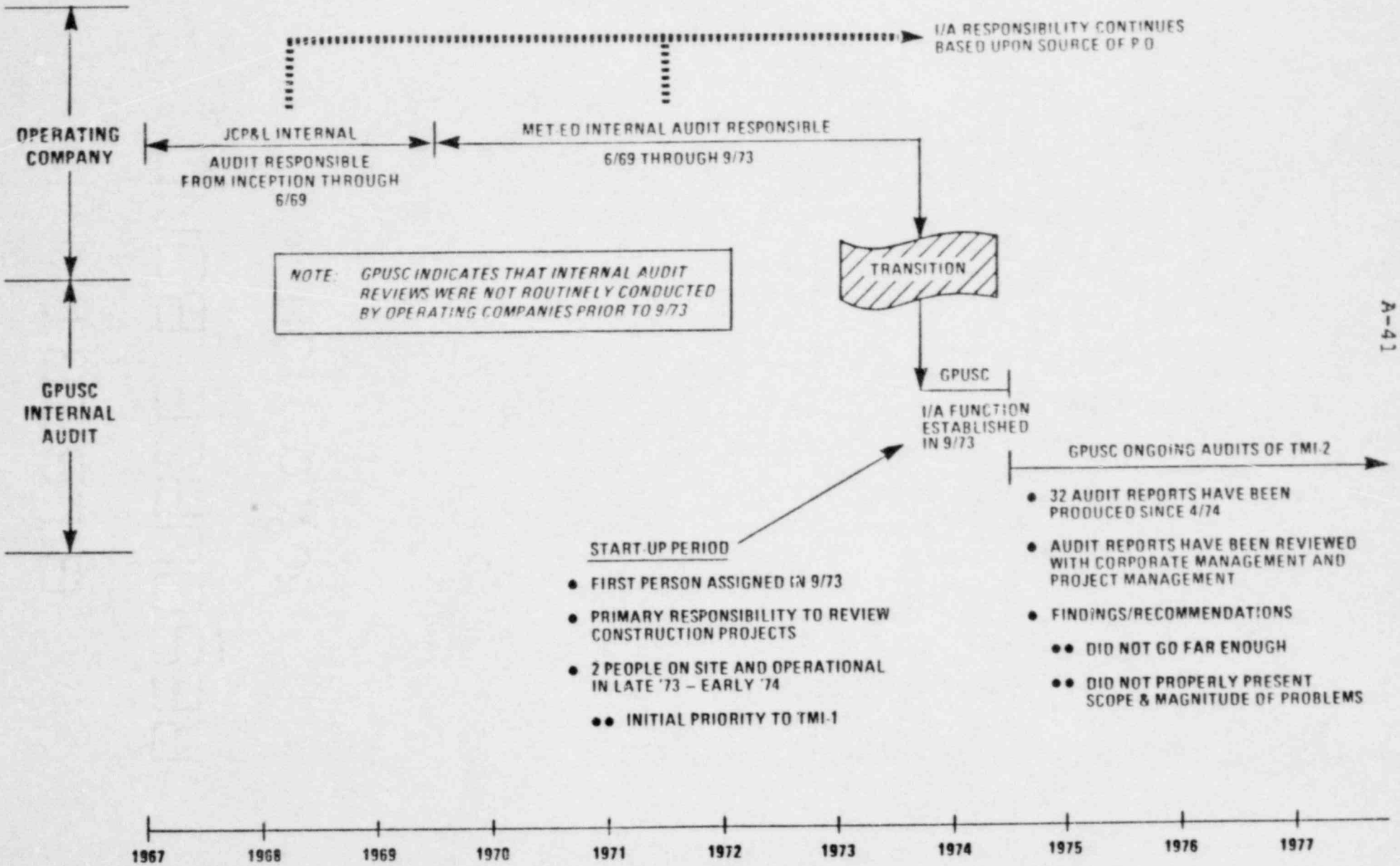
GPUSC PURCHASING AND PROCUREMENT EVOLUTION



GPUSC COST & SCHEDULING EVOLUTION



GPUSC INTERNAL AUDIT EVOLUTION



GPU - TMI-2 - OVERVIEW CHRONOLOGY

- One site change, Oyster Creek to Three Mile Island

- Repeated changes in project management responsibility

		From	To
.	JCP&L	Project Start	4/69
.	Met Ed	4/69	9/71
.	GPUSC	9/71	Present

- Repeated changes in construction responsibility

			From	To
.	JCP&L	+ Burns & Roe	Project Start	12/68
.	JCP&L	+ UE&C	1/69	4/69
.	Met Ed	+ UE&C	4/69	9/71
.	GPUSC	+ UE&C	9/71	8/77
.	GPUSC	+ Catalytic Conversion	8/77	Present

- Repeated changes in project manager

		From	To
.	Neely	Project start	4/69
.	Neely (design) and Bierman (constr.)	4/69	9/69
.	Williams (design) and Bierman (constr. and common facilities)	9/69	12/69
.	Bierman	1/70	9/71
.	Heward	9/71	9/77
.	Barton	9/77	Present

- Dramatic swings in labor force

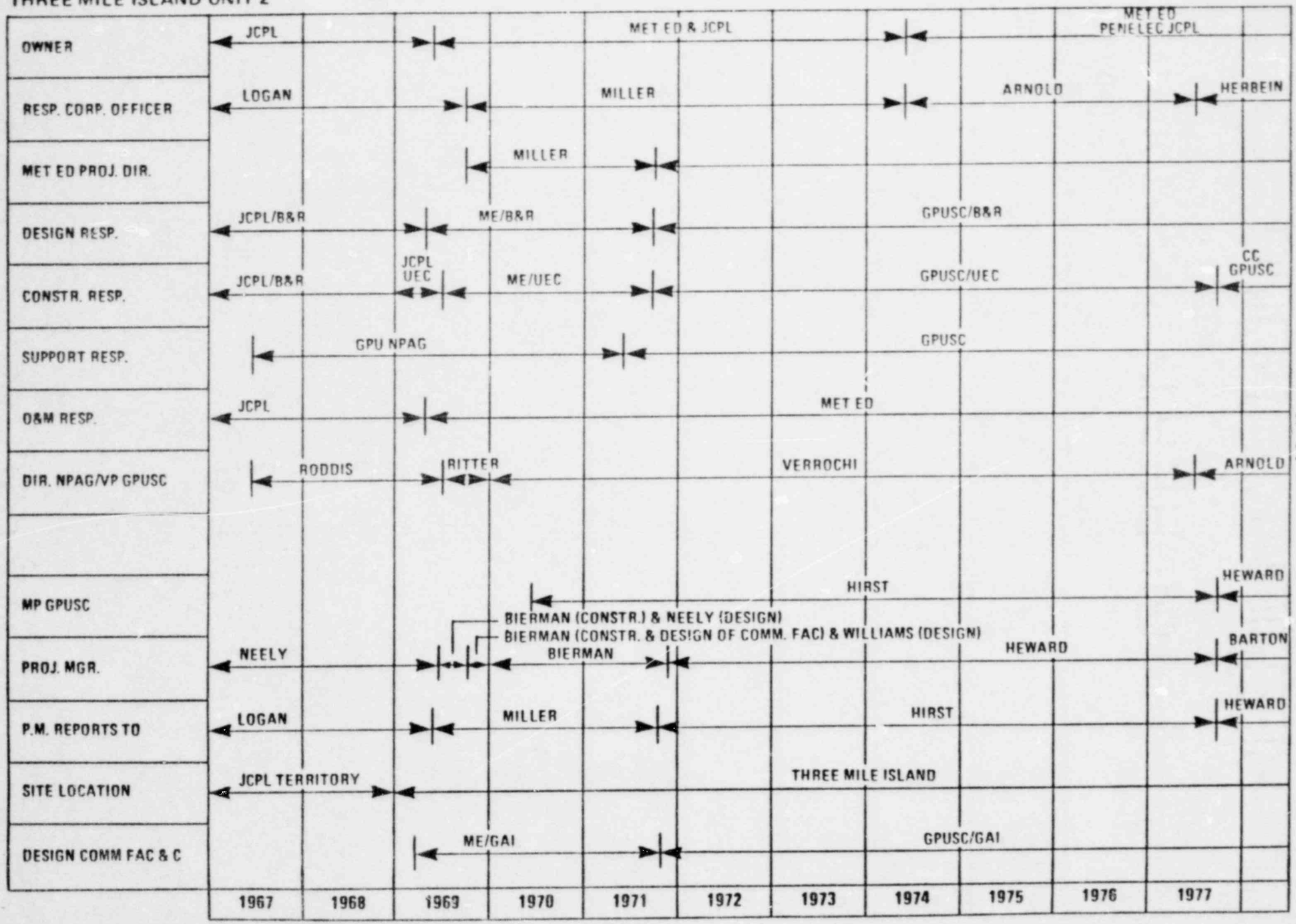
  . Reductions in 1972, 1974, 1976

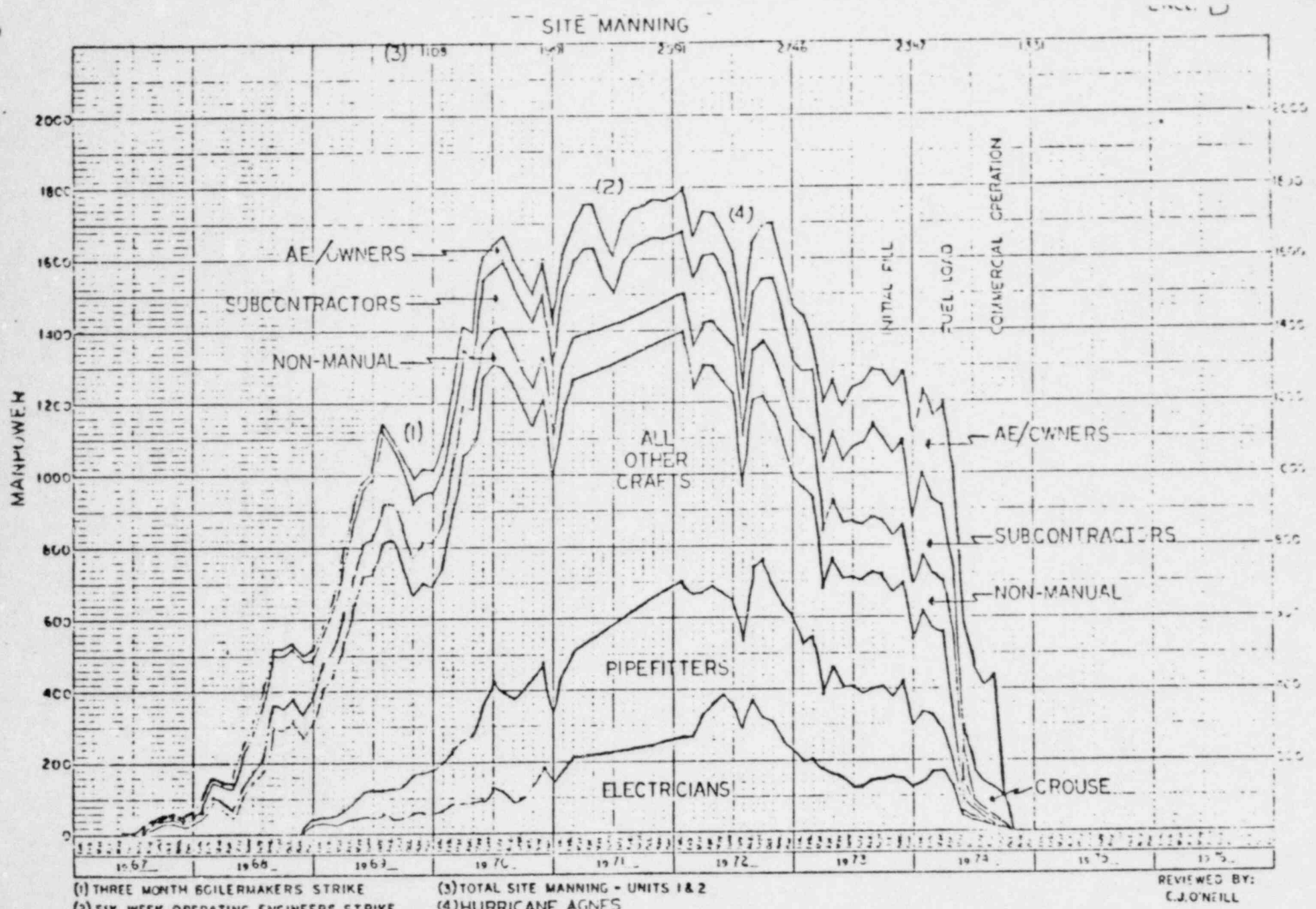
Rationale for move - Oyster Creek to Three Mile Island

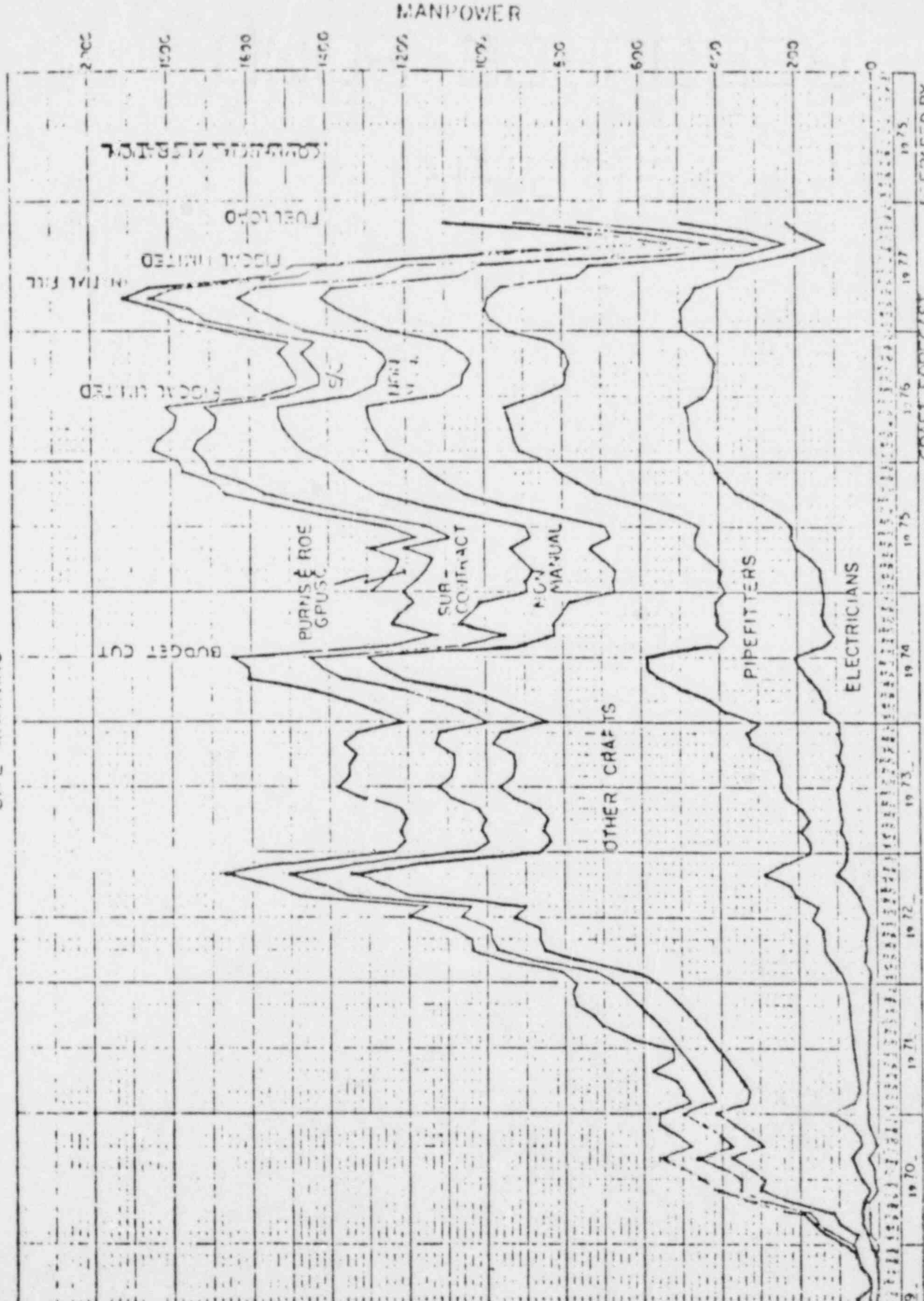
Why move Oyster Creek to TMI?	Why not duplicate TMI-1?	Why not switch A/E?	Why retain UE&C as constructors?
. Potential labor shortage in New Jersey	. Letter of intent to buy Westinghouse turbine issued 5/15/67 .. P.O. 4/3/68		. Burns & Roe over-extended
. Falling labor productivity in New Jersey			. UE&C .. near location .. fair amount of nuclear experience
	. Westinghouse turbine w/reheat G/E without reheat		
. Cooling system concerns .. salt water towers were not proven	.. availability of excess power worth $10 million/yr		. Difficult to have two managers competing for labor
.. potential ocean pipeline	. Significant rework given different turbine - question of delivery time	_____	
	. Both units share common facilities		
	. Assumed B&R was 40% complete	_____	
	.. $3.8 in fees in late '68		
	. Risk of extension of licensing time	_____	
	.. significant rework to pass as unit 2		
	. Problem in duplicating peripheral equip.	. Some concern regarding GAI capacity	

ORGANIZATION HISTORY

THREE MILE ISLAND UNIT 2

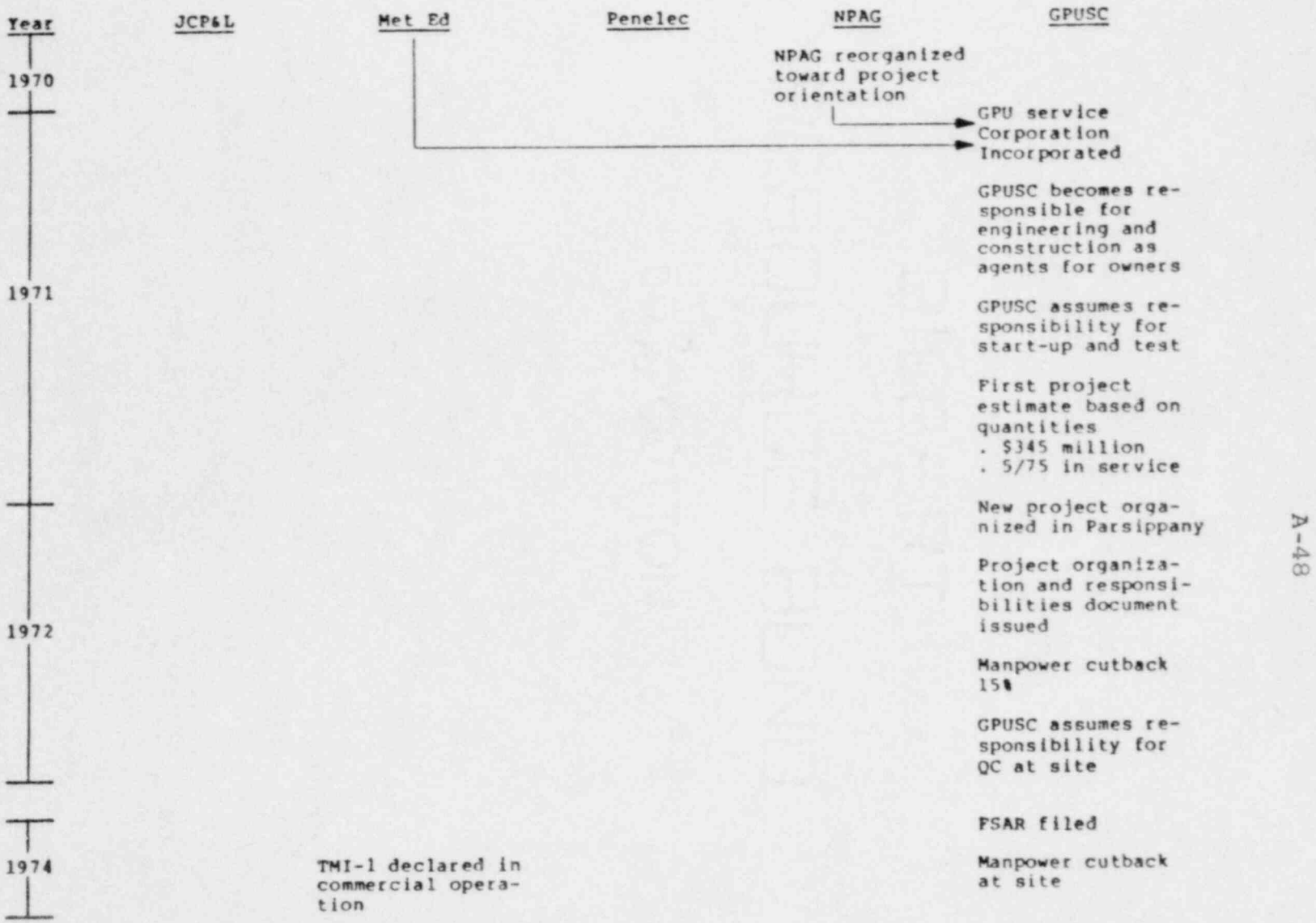



SITE MANNING
MANPOWER
MANPOWER
2000
1800
1600
1400
1200
1000
800
600
400
200
0
(3)
(2)
(4)
(1)
AE/OWNERS
SUBCONTRACTORS
NON-MANUAL
ALL OTHER CRAFTS
PIPEFITTERS
ELECTRICIANS
AE/OWNERS
SUBCONTRACTORS
NON-MANUAL
CROUSE
INITIAL FILL
FUEL LOAD
COMMERCIAL OPERATION
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
(1) THREE MONTH BOILERMAKERS STRIKE
(2) SIX WEEK OPERATING ENGINEERS STRIKE
(3) TOTAL SITE MANNING - UNITS 1 & 2
(4) HURRICANE AGNES
REVIEWED BY:
C.J. O'NEILL


MANPOWER
SITE MANNING
BUDGET CUT
BURNS & ROE GPUSC
SUB-CONTRACT
NON MANUAL
OTHER CRAFTS
PIPEFITTERS
ELECTRICIANS
CRAFT FORECAST
PREPARED BY C.J. ONEILL
0
200
400
600
800
1000
1200
1400
1600
1800
2000

TMI -2 - Significant Chronology

Year	JCP&L	Met Ed	Penelec	NPAG	GPUSC
1966		Purchased 1 NSSS from B&W - for TMI-1 - option on 2nd unit			
	Option on 2nd B&W NSSS picked up for OC-2 (TMI-2)			Group formed, reporting to GPU	
1967	Contract awarded to Burns & Roe for OC-2 . A/E . Constructor				
	PSAR filed with NRC				
1968				Quality assurance plan developed	
	Project site moved from Oyster Creek to TMI				
		Responsibilities established . A/E = Burns & Roe . Common facilities = Gilbert . Constr.Mgr. = UE&C . Project Mgr. = Met Ed			
1969		First official project estimate . $190 million . 5/73 in service			
		Construction permit issued by NRC			
		Poured first structural cement			


Year
JCP&L
Met Ed
Penelec
NPAG
GPUSC
1970
NPAG reorganized toward project orientation
GPU service Corporation Incorporated
GPUSC becomes responsible for engineering and construction as agents for owners
1971
GPUSC assumes responsibility for start-up and test
First project estimate based on quantities
. $345 million
. 5/75 in service
New project organized in Parsippany
Project organization and responsibilities document issued
1972
Manpower cutback 15%
GPUSC assumes responsibility for QC at site
FSAR filed
1974
TMI-1 declared in commercial operation
Manpower cutback at site

Year	JCP&L	Met Ed	Penelec	NPAG	GPUSC
1976					Estimates revised . $637 million . 5/78 in service
1977					Catalytic construction hired for maintenance and cleanup
1978					Load fuel Begin commercial operation

Architect/Engineer

- Burns & Roe was initially retained to engineer Oyster Creek-2. When the site was changed:
  - . Burns & Roe was kept on as the lead architect for TMI-2
  - . Gilbert Associates, Inc. (A/E on TMI-1) was retained to design the common facilities

Construction Manager

- Burns & Roe was initially retained as construction managers on Oyster Creek-2. When the site was changed:
  - . UE&C (construction manager TMI-1) replaced Burns & Roe as the construction manager

Nuclear Steam Supply System

- Babcock & Wilcox pressurized water reactors were used in both TMI units
  - . Babcock & Wilcox provided erection labor/management for TMI-2

Equivalent Man-Years of Effort - TMI-2

	GPUSC	JCP&L	Met Ed	Burns & Roe	
				H.O.	Site
1967	-)		-	14.8	-
1968	-)	38	74.8	-	
1969	-)		2	104.3	-
1970	-	12	4	113.5	.9
1971	3.4	-	29	102.6	2.6
1972	17.1	-	23	90.9	19.8
1973	16.2	-	28	109.5	41.0
1974	33.1	-	39	167.0	76.7
1975	42.6	-	50	201.0	102.7
1976	37.5	-	118	132.8	73.1
1977	32.8*	-	249**	75.5	36.7

* Through 10/77

** Through 8/77

IMPACT OF REGULATORY REQUIREMENTS/ CHANGES UPON TMI-2

Year	Significant Regulatory Event	Impact upon TMI-2
1968-69	PSAR filing Approval of construction permit (NRC design basis consisted of 27 word statements of general design criteria)	- Change design basis of flood dike - In-service inspection required on all piping systems - Loose part monitor design basis additional requirement - Change design basis of hydrogen recombiner for loss of coolant accident - Low level radiation studies required (55 pathways, 50 mile radius) - Site meteorological data required on ongoing basis - NRC site inspection group initiated (inspection and enforcement)
1970	Appendix B (18QA criteria became legal requirement)	- NPAG had developed GPU QA guidelines for construction and implemented in 1968 - GPU existing QA guidelines satisfied Appendix B requirements
	NEPA (Comprehensive environmental report and public hearing required prior to issuance of operating license)	- GPU required to prepare comprehensive environmental report (3 volumes)
	Safety Guides (34 specific methods for meeting NRC general design criteria)	- GPU evaluation indicated certain guides in conflict with construction permit - Safety guides were not legal requirements at the time - GPU took position not to change design basis, however, to keep current with impact upon other utilities

Year	Significant Regulatory Event	Impact upon TMI-2
1971	SAR Guide issued	- Initial FSAR was 95% complete - Substantial revisions were required to accommodate format and substance changes - Engineering resources to support site engineering, construction were adversely impacted
	Revised design criteria (NRC design basis changed from 27 to 76 guidelines)	- No impact; GPU assumed original 27 guidelines hold for TMI-2
	Calvert Cliff decision (Successful suit by Maryland Environmental Group vs. AEC)	- Dramatic change in scope of environmental reports - New site report issued for TMI-1, 2 at end of 1971 (second report more comprehensive)
	Revised design criteria (NRC design basis reduced from 76 to 67 guidelines)	- No impact upon TMI-2 design basis - GPU required to report on compliance
	Revised Appendix B (QA Law)	- No major impact; GPU internal guidelines still acceptable
1972	Revised SAR Guide	- Significant progress had been made on second version of SAR - Substantial revisions required to accommodate FSAR filing - Engineering resources to support site engineering were adversely impacted
	Safety Guides (33 additional methods for meeting NRC design criteria; total to date = 77 guides)	- No impact at that time - GPU decided to await FSAR filing prior to changing design basis

Year	Significant Regulatory Event	Impact upon TMI-2
1973	None	
1974	FSAR filed	- Based upon original work plus 2 revisions
	Branch technical positions (56 licensing technical positions issued by NRC branches to NRC staff)	- Carried no legal weight, however, represented practical guidelines for NRC staff involved with licensing evaluation - 800 FSAR questions in part based upon branch technical positions
1975	Revised QA Law	- No impact
	Standard technical specs. (Rules for opertion of facility - part of basis for operating license)	- Significant impact on Met-Ed - Draft technical specs are in FSAR
	Std. review plans issued (329 position papers to provide guidance to NRC FSAR reviewers)	- 800 FSAR questions in part based upon std. review plans
1976	Revised design criteria	- No impact
	SER issued by NRC (Safety evaluation report)	- Summary of NRC finding for TMI-2 FSAR review - List of open items which represent TMI-2 areas of change to meet compliance standards - GPU and NRC in agreement
1977	ASLB hearing (Atomic Safety and Licensing Board)	- No major impact - 4-month public hearing - No changes to plant; some additional testing required

Year	Significant Regulatory Event	Impact upon TMI-2
1977	Safety guides (135 specific methods for meeting NRC general design criteria)	- No impact
1978	Operating license issued for TMI-2	- License has 13 conditions which indicate areas requiring corrective action by Met Ed by specific date

CONSTRUCTION MANAGEMENT - TECHNIQUES EVOLUTION

- Description of Technique Improvement	Plant impacted TMI-1	TMI-2	FR
. Scale modeling - although late in TMI-2 construction, proved of significant advantage in identification of potential interferences; aided in placement of small bore pipe		X	X
. Rebar bending off-site - implemented in '72 resulting in reduction of excessive rebar handling on-site		X	X
. Steel ring girder form - utilized for multiple concrete pours in upper sections of reactor building; will be shipped to Forked River for additional use		X	X
. Reactor building topless construction - UE&C idea to allow inside and outside construction work to proceed simultaneously		X	X
. Grouted tendons - developed jointly by Gilbert and GPU; eliminates maintenance associated with greased tendon installation for lifetime of plant		X	X
. Pre-fab shop and pipe bending for small bore pipe - centralized piping fabrication resulted in improved productivity; pipe bending reduced welding requirements		X	X
. Instrument racks assembled and inspected at supplier plant - reduce delays associated with site inspection, assembly and return shipment (in the event of quality problems)		X	X
. Area superintendent - additional level of field supervision required of UE&C by GPU to supplement functional supervision. Area superintendent became coordinator for all disciplines working in a given area and had primary responsibility for managing schedule completion dates		X	X
. Use of speciality contractors (i.e., Westinghouse to install turbine generator) - reduce problems associated with material suppliers and construction manager (UE&C) disputes in event of problems		X	X

CONSTRUCTION MANAGEMENT - TECHNIQUES EVOLUTION

- Description of Technique Improvement	Plant impacted		
	TMI-1	TMI-2	FR
. A/E field engineering group to design small bore piping - design was improved based upon use of scale model at the site together with ability to base design upon actual field measurements		X	X
. Hydrolaser use - reduce start-up group manpower required to clean river water intake, fuel pools and equipment		X	X
. Different heat trace used on TMI-2 vs. heat trace for TMI-1. TMI-2 heat trace is cheaper and requires less man-hours to install		X	X
. Piping installation by area on a pre-planned schedule - to obtain maximum use of scaffolding		X	X
. Computerized cable pull slip program - improved project control of electrical cable, raceway installation	X	X	X
. Use of silicone foam/firewall 50 mixture - developed and qualified jointly by Chemtrol and GPU resulting in 50% reduction in cost compared to silicone only		X	X
. Cement pumping - reduce labor associated with concrete placement	X	X	X
. Creta-crane utilization - endless belt	X	X	X

PROJECT CONTROL SYSTEMS

REVIEW OF PROJECT REPORTS

- Unit cost reports by functional discipline (i.e., civil, piping, electrical) were the primary tool utilized by GPU and UE&C to control construction costs for TMI-2:
  - . Reports were prepared on a weekly basis by UE&C's cost department
  - . Report preparation required substantial manual preparation resulting in approximately one week lag in reporting
  - . Labor hours expended and work completed were subject to different timing bases of reporting
  - . Cost reporting in many areas presented an "average" statement of performance:
    - .. Reports did not measure individual supervisors performance below the functional superintendent level
    - .. Reports tended to average an "unaverage situation"
- Estimates prepared by UE&C were the basis for comparing actual performance:
  - . Unit cost estimates or "standards" were changed frequently to reflect actual or anticipated declines in productivity
  - . Variances were minimized based upon frequency of "standards" changes
  - . "Standards" changes in many cases were substantial in magnitude and resulted in approval/authorization by GPU of project cost increases in advance of experiencing unfavorable labor costs
- Trend of unit cost reporting indicated declining productivity occurred as the project progressed:
  - . Notwithstanding the expected increased degree of difficulty associated with congestion, etc., as construction proceeds, unit cost in several areas shows substantial increases which could not be explained by UE&C
  - . Work sampling studies (which are not definitive indicators of productivity, but rather a pointer) performed by Emerson Consultants (10/74) and GPUSC internal audit (2/75, 10/75) and GPU project management reports appear to support this contention

PROJECT CONTROL SYSTEMS
REVIEW OF PROJECT REPORTS

Report Title	Prepared by	Frequency	Area(s) of primary emphasis: Cost	Schedule	Other
A - ENGINEERING					
1. A/E Monthly Progress	Burns & Roe Project Mgr.	Monthly		X	
2. Electrical Activities	"	Weekly		X	
3. Engineering Schedule Progress	"	Monthly		X	
4. Weekly Isometric and Revision	"	Weekly		X	
5. Specification List for Prepurchased Equipment	"	Periodic		X	
B - ACCOUNTING					
1. Accounting, Purchasing and Material Department Volume Data	UE&C Accounting	Monthly			X
2. Accounts Receivable Statement	"	Monthly			X
3. Field Purchasing Report	"	Monthly	X	X	
4. Current Month Purchase Orders	"	Monthly		X	
5. Construction Equipment Inventory	"	Semi-annual			X
6. Office Equipment Inventory	"	Semi-annual			X
7. Invoice Register Recap	"	Monthly (started April, 1977)		X	

PROJECT CONTROL SYSTEMS
REVIEW OF PROJECT REPORTS

Report Title	Prepared by	Frequency	Area(s) of primary emphasis: Cost	Schedule	Other
8. Statement of Expenditures and Retentions	GPUSC Accounting	Monthly	X		
C - COST CONTROL					
1. Unit Cost Report - Waterproofing	UE&C Cost Department	Monthly	X		
2. Unit Cost Report - Piping	"	Weekly	X		
3. Unit Cost Report - Civil	"	Weekly	X		
4. Unit Cost Report - Instrumentation	"	Weekly	X		
5. Unit Cost Report - Electrical	"	Weekly	X		
6. Unit Cost Report - Main Condenser	"	Weekly	X		
7. Craft Manpower Report	"	Weekly			X
8. Craft Labor Overtime Worked	"	Weekly			X
9. Craft Man-hour Graphs	"	Monthly (Discontinued '75/'76)			X
10. UE&C Start-up Labor	"	Weekly	X		
11. Indirect Labor, Small Tool and Consumable Supply Costs	"	Weekly (Discontinued '75/'76)	X		
12. Weekly Cash Forecast and Five Week Projection	"	Weekly			X

PROJECT CONTROL SYSTEMS
REVIEW OF PROJECT REPORTS

Report Title	Prepared by	Frequency	Area(s) of primary emphasis: Cost	Schedule	Other
13. Budget Status Report	UE&C Cost Department	Monthly	X		
14. Force Report	Time Office	Daily			X
15. B&W Cost Report	B&W Project Manager	Weekly	X		
16. Final Unit Cost Report	UE&C Cost Department	One time	X		
D - SCHEDULE CONTROL					
1. Construction Turnover Meeting	Systems Turnover Supervisor	Weekly		X	
2. 3 Month Look Ahead	UE&C Schedule Department	Bi-weekly		X	
3. Bi-weekly Schedule Review	"	Bi-weekly		X	
4. Piping Progress Report	"	Weekly			X
5. Electrical Progress Report	"	Weekly			X
6. Construction Progress Report (Graphs of 4. and 5.)	"	Weekly			X
7. Planning Meeting Agenda	"	Bi-weekly		X	X
8. Shipping Schedule	UE&C Home Office Expediting	Monthly		X	
9. Building Detailed Barchart	UE&C Schedule Department	Every 6 weeks		X	

PROJECT CONTROL SYSTEMS
REVIEW OF PROJECT REPORTS

Report Title	Prepared by	Frequency	Area(s) of primary emphasis: Cost	Schedule	Other
10. Monthly Progress Report	UE&C Project Manager	Monthly		X	
E - GPUSC REPORTS					
1. Monthly Project Mgmt. Meeting	GPUSC Project Manager	Monthly	X	X	
2. Electrical Design Status	GPUSC Resident at Burns & Roe office	Weekly (Limited Period)		X	
3. Main Event Schedule	GPUSC Project Manager	Quarterly		X	
4. UE&C Planning and Scheduling Progress Report	GPUSC Site Cost and Schedule Mgr.	Monthly		X	
5. Owner's Manpower Allocation	GPUSC Home Office Cost Manager	Monthly	X		
6. Productivity Curves - Small Bore Pipe, Conduit, Cable Pull & Terminations	GPUSC Site Cost and Schedule Manager	Weekly		X	
7. Owner's Cost - Bookings vs. Budget	"	Monthly	X		
8. Met Ed Budget Status	"	Monthly	X		
9. Expenditure Forecast Report	"	Monthly	X		
10. Monthly Progress Report	GPUSC Project Manager	Monthly	X	X	X

PROJECT CONTROL SYSTEMS

REVIEW OF PROJECT REPORTS

Report Title	Prepared by	Frequency	Area(s) of primary emphasis: Cost	Schedule	Other
11. Project Objectives	GPUSC Project Manager	Quarterly		X	
12. Summary Progress Report	VP Generation to Board of Directors	Monthly	X	X	
13. Expenditure Deviation Report	GPUSC Home Office Cost Manager	Monthly	X		
14. Nuclear Plant Management Review	GPUSC Project Team	Annual	X	X	X

TMI-2 COST REPORTING/CONTROL

TREND OF UNIT COST ESTIMATES

Category	12/71 Estimate	2/75 Estimate	Actual (Final unit cost)	% Change (Final unit cost vs. 12/71 estimate)
- CIVIL DEPARTMENT				
Formwork (SF)	0.946	1.134	1.08	+ 14
Rebar (tons)	38.9	49.8	47.4	+ 22
Concrete (CY)	3.6	4.3	5.12	+ 42
Cadwelds (each)	4.1	2.6	2.23	- 46
- PIPING DEPARTMENT				
2-1/2" + Piping (lbs.)	0.165	0.146	0.106	N/A[1]
2-1/2" + Valves & Hangers (ea.)	-	37.5	36.17	- 3
2-1/2" + Welding (lbs.)	15.75	8.9	9.07	- 42
2" - Piping (lf)	2.6	4.15	5.11	+ 96
- ELECTRICAL DEPARTMENT				
Conduit (lf)	0.83	1.35	1.38	+ 66
Tray (lf)	3.1	4.3	3.78	+ 22
Lighting Fixtures (ea.)	24.1	38.7	38.9	+ 61
Power Cable Pull (lf)	0.215	0.314	0.249	+ 16
Control & Instr. Cable Pull (lf)	0.08	0.137	0.134	+ 68
Terminations - C&I (ea.)	0.4	0.55	0.54	+ 35
Terminations - Power (ea.)	2.0	2.27	1.81	- 10
Grounding (lf)	0.33	0.77	0.82	+248

[1]Valves and hangers are included in 12/71 estimate for 2-1/2" + piping and separated thereafter (comparison not applicable).

TREND OF UNIT COST REPORTS

ELECTRICAL DEPARTMENT - CONDUIT (LF)

REVISED ESTIMATE VS. ACTUAL UNIT COST

	Revised Estimate			Actual to Date			
Report Date	Date	Unit Cost	Growth Rate	Date	% Complete	Unit Cost	Growth Rate
6/27/73	4/73	.888	-	6/17/73	2.97	2.071	-
12/31/73	10/73	.917	+.033	12/16/73	6.95	1.263	-.39
7/8/74	2/74	.917	-	6/23/74	14.0	1.14	-.097
4/9/75	12/74	1.35	+.472[1]	3/23/75	39.68	1.02[1]	-.105
7/7/75	6/75	1.29	-.044	6/22/75	60.86	.96	-.059
1/13/76	9/75	1.17	-.093	12/28/75	54.45*	1.03	+.073
6/28/76	1/76	1.17	-	6/13/76	81.23	1.11	+.078
1/4/77	7/76	1.31	+.12	12/19/76	86.88	1.31	+.18
7/5/77	7/76	1.31	-	6/19/77	101.87	1.38	+.053
	TOTAL INCREASE = 47.5%			DIFFERENCE VS. INITIAL ESTIMATE = 55.4%			

[1]Unit cost estimate increased by 47%:

- Actual unit cost trend on 40% of installed quantity is consistently declining
- 47% overall increase implies a 79% increase in unit cost for last 60% of installation:
  - Standard raised, in effect, from .917 to 1.64 which is 60% higher than cum. unit cost to date of 1.02

*Est. Quantity increased from 330,000 lf to 588,000 lf

Est. Quantity changes	
Date	Quantity
4/73	568,400
10/73	533,400
12/74	400,000
6/75	330,000
9/75	588,000

TREND OF UNIT COST REPORTS

CIVIL DEPARTMENT - CONCRETE (CY)

REVISED ESTIMATE VS. ACTUAL UNIT COST

Report Date	Revised Estimate Date	Revised Estimate Unit Cost	Revised Estimate Growth Rate	Actual to Date Date	Actual to Date % Complete	Actual to Date Unit Cost	Actual to Date Growth Rate
1/18/72	12/71	3.62	-	1/4/72	30.32	2.10	
7/12/72	4/72	4.02	-	6/27/72	41.17	3.81	+.814
1/8/73	11/72	4.50	-	12/19/72	54.22	3.53	-.073
7/3/73	4/73	4.58[1]	+.265	6/26/73	64.64	3.74[1]	+.059
1/10/74	10/73	4.42	-.035	12/25/73	83.03	3.95	+.056
7/24/74	2/74	4.53	+.025	7/9/74	91.11	4.29	+.086
9/21/77	-	-	-	8/30/77	99.76	5.12	+.193

TOTAL INCREASES = 25%

DIFFERENCE VS.
INITIAL ESTIMATE = 41%

[1]Unit cost estimate increased by 26.5% through 6/73:

- Actual unit cost trend on 65% of installed quantity is within 3% of initial unit cost estimate of 3.62
- 26.5% increase of overall unit cost implies a 75% increase in unit cost for last 35% of installation:
  - Standard raised in effect from 3.62 to 6.33 MH/CY for balance of construction

TREND OF UNIT COST REPORTS

CIVIL DEPARTMENT - CADWELDS (EACH)

REVISED ESTIMATE VS. ACTUAL UNIT COST

Report Date	Revised Estimate			Actual to Date			
	Date	Unit Cost	Growth Rate	Date	% Complete	Unit Cost	Growth Rate
12/71	4.1	-	-	1/4/72	20.45	2.24	-
4/72	3.93	-	-	6/27/72	27.19	2.44	+.089
11/72	3.79	-	-	12/19/72	35.32	2.49	+.02
4/73	3.53	-	-	6/26/73	-	2.18	-.124
10/73	3.53[1]	-.139	-	12/25/73	69.71	2.11[1]	-.03
2/74	2.60	-.263		7/9/74	80.49	2.10	-
-	-	-	-	8/30/77	99.57	2.23	+.062

TOTAL DECREASE = 36.6%

DIFFERENCE VS.
INITIAL ESTIMATE = -45.6%

[1]UE&C estimates appear inconsistent in terms of anticipating benefits (i.e., reduced costs) as well as increases in cost:

- Actual unit costs through 70% of installation are 49% lower than initial estimate of 4.1 MH/ea. and yet estimate has been reduced by only 14%
- 3.53 estimate at 12/73 for overall unit cost implies that unit cost for remaining 30% of installation will be 6.84 MH/ea.:
  - 6.84 MH/ea. is 325% of actual unit cost to date

PROJECT CONTROL SYSTEMS

REVIEW OF WORK SAMPLING

- Work sampling was undertaken by both outside consultants and GPUSC's internal audit function:
  - Emerson Consultants performed the initial work sampling study in 10/74 and GPUSC internal audit function repeated work sampling studies in 2/75 and 10/75
  - Work sampling is not a definitive measure of productivity but rather an indicator of overall work activity
- While specific recommendations for improving work activity were subject to dispute, the data generated by work sampling was not disputed by UE&C or GPU project management.
  - Observations indicated direct work activity declined during 1975:
    - 10/74 - Direct Work = 38%*
    - 2/75 - Direct Work = 40%
    - 10/75 - Direct Work = 31%
  - Other management controllable activities (i.e., late starts, early quits, waiting, travel, idle unexplained, transportation, unauthorized breaks, receiving instructions, tools & material, planning work, reading drawings) were increasing
- In addition, GPU project management in annual progress reports and interviews conducted during the TMI-2 project review stated that productivity declined over the course of the project:
  - W. Gunn and D. Heward indicated that productivity (construction momentum) was improving in early 1976 until layoffs were required due to financing constraints:
    - During early 1976, morale and productivity (construction momentum) appeared to be improving
    - At mid-year 1976, the 15% layoff required due to financing constraints caused morale and productivity (construction momentum) to substantially decline and "the job never recovered"
    - Productivity (construction momentum) "bottomed out" in mid-1977 just prior to replacement of UE&C with Catalytic construction cleanup
  - To be noticeable to project management, the decline in productivity (construction momentum) was probably in the range of 10 - 20%

*Emerson consultants indicated at that time that direct work activity was as good or better than activity at four fossil fuel plants.

DOCUMENTATION SOURCES

The following sources provided data/information to Touche Ross& Co. Analyses and resulting conclusions derived from this data/information have been developed by Touche Ross & Co.

PAGE	SOURCE
A-1	GPU/GPUSC
A-2	GPU/GPUSC
A-3	GPU/GPUSC
A-4	GPU/GPUSC
A-5	GPU/GPUSC
A-6	GPU/GPUSC
A-7	GPU/GPUSC
A-8	GPU/GPUSC
A-9	GPU/GPUSC
A-10	U.S. ENERGY, RESEARCH AND DEVELOPMENT ADMINISTRATION
A-11	NOTED
A-12	NOTED
A-13	NOTED
A-14	NOTED
A-15	NOTED
A-16	NOTED
A-17	NOTED
A-18	U.S. ENERGY, RESEARCH AND DEVELOPMENT ADMINISTRATION/GPU
A-19	GPU/GPUSC
A-20	FPC/GPU
A-21	FPC/GPU

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A-67	GPU/GPUSC
A-68	GPU/GPUSC

CONCLUSION

TMI-2 CONSTRUCTION AUDIT

CONCLUSIONS

1. The final cost and in-service date of the TMI-2 project will substantially exceed initial estimates. In summary:

   . The initial cost estimate of $190 million was exceeded by $469 million for a total estimated cost of $659 million prior to the final delay caused by the malfunctioning of certain safety valves. This is an increase of 250% over the initial estimate. The final estimated cost now appears to be approximately $687 million. Final figures will be available after TMI-2 is placed in service in November 1978 (most current estimate).

   . The initial cost estimate of $190 million (June 1969), although significant from a historical standpoint, was based on generally inadequate information that characterized the utility industry in that time frame - mid-late 1960's. The first estimate of the TMI-2 project, based upon partial engineering drawings and material take-offs, was made in December 1971. This estimate of the cost of the TMI-2 project was $345 million. This estimate was exceeded by $314 million, for the total estimated cost of $659 million prior to the final delay caused by the malfunction of certain safety valves. This is an increase of 91% over the initial estimate based upon partial engineering drawings and material take-offs.

. The planned in-service date of TMI-2 slipped by five years from May 1973 (which estimate was made in June 1969) to May 1978 (which estimate was made in September 1974). (The in-service date is now estimated to be 11/78 - a five-year, seven-month slippage.)

2. The reasons for the escalation of cost from initial estimates can be categorized into those reasons over which the Company had no effective control, and those reasons over which the Company did have effective control. These are discussed in more detail later.

3. The initial approaches taken in organizing and executing the project were based on limited knowledge and experience, and as a result, they have been changed several times during the time period under consideration (1969 to 1978). We believe that this evolving nature of the approach to project organization and execution characterized the utility industry in general. As a result of its initial limited knowledge and experience, however, corporate management significantly underestimated the scope of its nuclear projects with respect to resource requirements, time, and the evolving environmental and nuclear regulations. This initial underestimation of project scope had severe consequences with regard to the project in-service date and cost.

. With regard to the Company's limited initial knowledge and experience in large-scale construction, we would point out the following:

.. Oyster Creek-1, the Company's (and nation's) first major nuclear generating station, was a "turn-key" contract executed by General Electric. From an execution standpoint the Company's involvement was, therefore, of a minimal nature. Although cost information was not released it was generally believed that GE spent approximately $100 million more than the approximately $60.5 million it was paid for the contract.

.. The relative stability of constructing nonnuclear power plants had deferred the Company's need to create a strong internal project management organization, as well as project and construction control systems. In addition, the undertaking of joint ventures and their management of such ventures by committee further deferred this need. As a result, architects/engineers and constructors generally provided project management and systems support.

4. The impact of undertaking two major generating projects - TMI-1 and OC-2 (later TMI-2), while significantly underestimating the resource requirements, was eventually to delay the projects and severely escalate the costs as the true requirements became known.

. The skilled labor available in the Harrisburg area was not always adequate to satisfy the demands of both projects. This resulted in schedule delays, varying productivity (construction momentum), and less than ideal staffing patterns for the TMI-2 project.

. Project management and construction supervision was also in short supply both in the early phases and during the peak of construction activity. This lack of effective supervision may have affected manpower productivity (construction momentum) and schedule slippage.

. Budget cutbacks frequently took place over the life of the project. GPUSC planning overestimated what the Company was eventually able to do. The lack of financial resources had a severe effect on the project. The major problem caused by the lack of financial resources was a delay in the completion of the project necessitated by a "stretchout" of the resources to be committed over time. This delay in project completion had the following consequences.

.. Exposure to additional federal regulatory requirements that were effected in the extended time frame with the associated additional cost required to meet the regulatory requirements.

.. Material cost and quantities escalated due to both inflation and additional regulatory requirements. These costs were generally passed on to the Company per contractual agreements.

.. Force labor (manning levels) was subjected to wide fluctuations because of budget cutbacks. There was also a simultaneous decline in productivity (construction momentum) which would appear connected to the labor fluctuations.

.. AFDC and "fixed" construction overhead expenses escalated as a result of schedule slippage.

5. The initial determination of the size and mix of the construction program was developed by the Company (i.e., the decision to construct TMI-1 and Oyster Creek-2 in the initial planned time frame) and presented to the various regulatory bodies. With hindsight it is apparent that the resources available to the Company could not have sufficed for the completion of the program in the called for time frame. Further, no evidence has been brought to our attention that information was available that would have indicated that alternate sources of generation should be economically preferred. In response to this situation, the Company took several actions to minimize the impact and economic consequences. The Company changed its project organization to better respond to changing conditions. The Company implemented a program to acquire in-house control

over many aspects of the construction program, and undertook the development of information systems to better manage construction activities. On the other hand, there appear to be a number of items that the Company directly controlled even under these changing circumstances that adversely affected cost and completion. In summary these are:

. Construction budget cutbacks were frequent and severe. While some budget cutbacks were inevitable, the amount was always subject to discretion. In addition, failure to accelerate construction funds as required by the construction manager in relatively modest amounts (approximately $10 - $20 million cut back in 1976 for example) in the final stages of completion resulted in a possible extension of completion date of several (4 to 6) months, as well as a measurable decrease in labor productivity, which has been ascribed to lower worker morale resulting from the cutbacks.

. The Company, through their construction manager, did not procure sufficient project and construction management personnel to control and monitor the progress of the projects at in-depth levels.

. The skilled labor force was shifted downwards to meet/equalize expenditures of available budget monies. As a result, peak construction requirements (force labor) were not always met.

GPUSC has continued the trend toward greater system centralization in the areas of material and contracts management, licensing, data processing and internal auditing.

. From this shift in organization and philosophy, project management and control systems have grown.

The impact of this process upon TMI-2 current and future major construction projects includes:

.. Stabilization and continuity of project management responsibility and accountability. Prior to the formation of GPUSC, corporate decisions impacting plant location could adversely impact the continuity of owner personnel.

. GPU has undertaken the creation and maintenance of more and better project management resources. Project management hours prior to 1971 appear to be insufficient to effectively monitor and control project performance. We also believe that the cost and schedule organization was too small to adequately monitor project progress, especially during periods of peak construction activity.

. GPU's development of control and reporting systems, while making progress, has lagged in maintaining pace with the organization. Specifically:

.. Quality and schedule reporting systems appear adequate, while cost control systems still appear to be insufficient for a major project such as TMI-2.

.. Cost systems appear to have appropriate "accounting controls." However, management information derived from these systems is inadequate to control costs as it applied to TMI-2.

.. Contracting and purchasing systems have improved significantly since 1971.

.. Internal audit reporting, while still needing improvement, has made progress. The initial audits of TMI-2 were weak - the scope, findings and recommendations were often not dependable.

The initial internal audit reports of TMI-2 appeared to lack credibility with project management and we believe that the normal process of resolving and discussing the internal audit reports' recommendations lacked effectiveness. This situation has been improved over time. The credibility of the auditing function and the quality of its reports has improved.

8. With the benefit of history and a detailed review of this project, we conclude that the interactive process between the Company, the Board of Public Utilities, other government agencies and interested parties was inadequate.

Although the Company on a number of occasions attempted to encourage interaction between itself and other regulatory and governmental agencies, the rate proceeding forum appears to be the place where meaningful interaction took place. This forum has time pressures, many interested parties and a procedure that does not lend itself well to the understanding and resolution of a complicated issue. Also, given what tends to be the adversary nature of these proceedings, the association of the solution of TMI-2 construction problems to rate relief was always met with a great deal of skepticism. It is important to point out that when the first appeal for additional rate relief to alleviate its cash flow problem was made by the Company (1974), the in-service date of this project had already slipped more than three years of an eventual slippage of five years. Finally, the information contained in the limited filing made during the rate cases did not contain the vast amounts of other relevant data that were made available during this review. From the Board of Public Utilities, other government agencies and interested parties, the procedure on this project poses a major dilemma. This review has been taken after the fact. The money has been expended and the project is scheduled to begin earning a rate of return. With hindsight, alternate actions by both the BPU and the Company could have led to a lower cost in net terms to the ratepayers.

The Board must begin the difficult task of ascertaining if the Company did everything in its control to minimize the cost of the project. Given the uncertainty underlying the Company and

the industry in general, many of these areas are gray in terms of controllability by the Company. Finally, the Board must consider its actions on the capital markets so as to signal that a reasonable rate of return will be permitted on prudent expenditures.

RECOMMENDATIONS

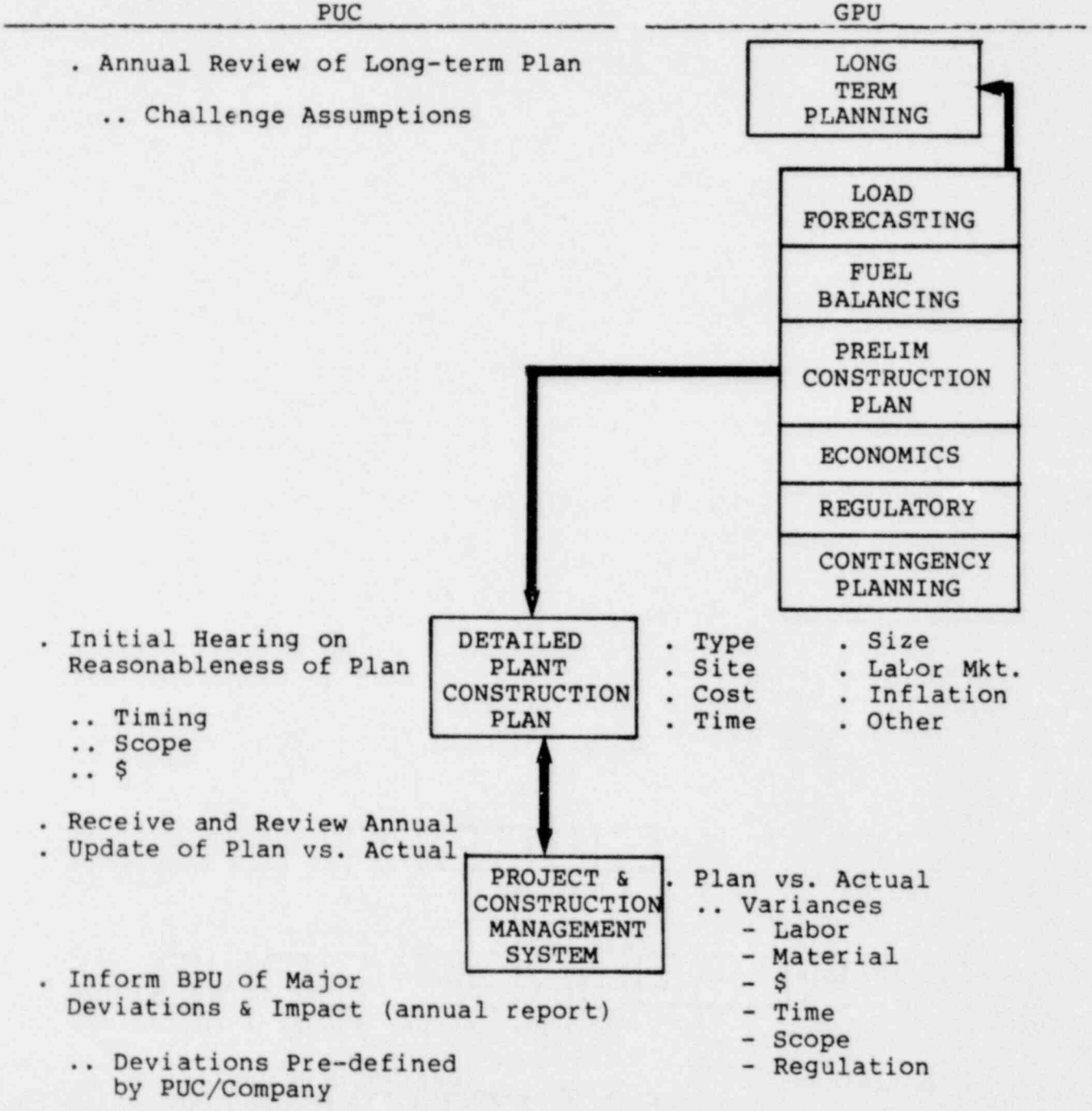
Review Procedures

Upon review of the situation, we believe that a new approach to the review and treatment of construction projects must be undertaken. Considering the rate increases that the Board has granted over the last eight years of intensive rate case activity and after thoroughly detailed reviews, we believe the inclusion of TMI-2 contains a significant rate increase required to recover capital costs over the first engineered estimate.

The solution appears to be in a modified process. The process should follow the project throughout its life so appropriate actions can be taken while the project is in process. This process will require a new set of skills. On the part of the Company, it will require providing data that can be monitored with variances reported promptly. It will require isolating those costs that are controllable and those that are not. On the part of the Board, other government agencies and interested parties, it will require the ability to evaluate the data presented, requesting other data as appropriate, to respond to potential situations which will arise regarding the financing of the projects in a manner that is of overall benefit to the ratepayers.

A schematic of what we believe to be the general concept of this approach is presented on the following page.

RECOMMENDED BUP/UTILITY REVIEW PROCESS



The following provides in outline form a greater level of detail than the chart.

DETAILED PLANT CONSTRUCTION PLAN

1. General Information on Proposed Plant

- Proposed Ownership/Operator/Licensee

- Proposed project participants, their top level organizations, type of contract and dollars or a proposed overview

  . A/E
  . Construction Manager
  . NSSS Supplier
  . Key Subcontractors
  . Turbine Generator Supplier

- Plant size

- Plant site

- Proposed in-service date

  . Key milestone chart

- Expected total cost

. Financing plan (total, not plant specific)

.. Internal

.. External

2. Financial Information

- Budget, by year, by major category, from project initiation to in-service

- Cash flow projections by year from project initiation to in-service

- Proposed skilled labor levels and cost by year

- Proposed % of completion by area, by year, from project initiation to in-service (key milestone chart)

3. Assumptions

- Detailed assumptions underlying the projections should accompany the construction plan. These assumptions should not be in conflict with the Company's long-term plan.

4. Annual Reporting

- Plan vs. actual budget by major category

- Plan vs. actual spending by major category

- Variance analysis with explanations as to why variances occurred

  . Impact on succeeding years

    .. $

    .. In-service date

- Changes in assumptions

Project Management Organization

- GPU should attempt to stabilize turnover of key project management personnel working for A/E's and construction managers

  . Contract strategies for developing turnover and training schedules should be developed

- GPU should expand its direct participation and control over constructors' cost and scheduling

  . The Company should consider developing a construction analysis group to enhance development, monitoring and control of outside construction estimates and schedules

- On-site GPU project management personnel should be increased in order to devote more time and effort to detailed review of construction costs and schedules

- The internal audit function should be reviewed and strengthened in order to gain greater credibility

  . Given I/A's growing scope, multifunctional disciline staffing should be considered

  . Existing procedures should be reviewed and expanded to cover

.. Operations and management audits

. Audit procedures should be examined and modified to enhance the quality of final reports

.. Scope of audits/impact

.. Assessments

.. Review procedures

.. Postaudit action plan development

- Implementing recommendations
- Follow-up

We understand that the Company has taken steps to improve/implement the above.

Project Management Control Systems

- Cost Reporting System

GPU should develop a comprehensive construction cost reporting system which will provide project management with the following types of general information to improve project controls:

. Organizational responsibility matrix for work performed including:

.. Functional work performed

.. Plant location/area of work performed

.. Individual responsible for work performed

. Actual material and labor usage by time period, including variance analysis:

.. Trend of previous performance by plant area and functional discipline

.. Comparison to "engineered standards" of material and labor requirements developed from scale model of plant design

- CPM/Scheduling System

GPU should modify the PCS/CPM scheduling module to integrate material requirements planning as a component of scheduling construction activities:

. Material requirements generated by the CPM system should improve efficiency of field procurement scheduling of vendor deliveries and management of on-site inventories

. Pre-planned material usage by major CPM activity will improve control of material requisition/distribution on-site and provide a basis for material usage variance analysis in the cost reporting system

. Short interval construction schedules can be compared to site inventories to ensure work is not scheduled in areas where materials are not available.

- Construction Data Base

GPU should develop a detailed data base reflecting known internal and external experience associated with the costs of design and construction for power plants (e.g., man-hours per cubic yard of concrete placement versus plant location, strength of concrete, density of resteel, average pour size, etc.). The data base should become an internal tool to aid project management in:

. Strengthening GPU's management of A/E's, construction managers and major subcontractors on existing projects in relation to review of construction progress, impact of proposed changes, etc.

. Strengthening GPU's ability to estimate costs associated with future nuclear power plants

. Strengthening GPU's contract administration procedures including work specification, vendor evaluation and negotiation processes

TESTIMONY

REGULATORY IMPACT OF THE THREE MILE ISLAND - UNIT 2

TMI-2 CONSTRUCTION PROJECT REVIEW

Q. What is the purpose of the testimony?

A. This testimony makes certain policy and financial impact recommendations to the state regulatory bodies that regulate the retail operations of the operating companies that own the TMI-2 nuclear generating station. The operating companies are the three GPU operating companies, Jersey Central Power and Light Company, Pennsylvania Electric Company (Penelec) and Metropolitan Edison Company (Met-Ed). The state regulatory bodies are the New Jersey Board of Public Utilities and the Pennsylvania Public Utility Commission. These recommendations are the result of a review of the TMI-2 construction project conducted by Touche Ross & Co.

Q. Was there a report prepared at the conclusion of the study?

A. Yes. The report was prepared primarily at the request of the Office of the Public Advocate in the State of New Jersey. The review, however, does have equal relevance in the State of Pennsylvania since the Pennsylvania operating companies own a majority of the unit:

Operating companies	State	Percent ownership of TMI-2
Jersey Central	New Jersey	25%
Penelec	Pennsylvania	25%
Met-Ed	Pennsylvania	50%

It is essential that the entire report entitled "Review of the Three-Mile Island - Unit 2 Construction Project" dated September 1978 be considered an integral part of this testimony. The scope of work performed, the conclusions reached by our review and the data and analyses underlying our conclusions must all be understood in the context of my recommendations. A copy of the report is included with this testimony.

Q. Could you indicate who would respond to further questions in connection with the report should they become necessary?

A. Yes. Mr. Steve Cooper, a manager in our New York office, would be available to answer any questions. Mr. Cooper was the manager responsible for conducting the review.

Q. Mr. Madan, could you now tell us why you have separated out the regulatory impact of the TMI-2 construction project review?

A. Yes. A review of a construction project such as this could occur at a variety of times through the life of the construction project. The findings, conclusions and recommendations of such reviews, were they to occur early in the construction project, could be acted upon, if appropriate, through the life of the construction project. In this particular case the review was conducted near the end of the project. The in-service date of the TMI-2 generating station has now been projected as sometime in November 1978. As such the station will then be placed in electric plant in service and the operating companies have requested full rate base and operating expense consideration be given in the current rate proceedings they have pending before the respective state commissions.

Therefore, in addition to our conclusions on the overall review, from an operating and management standpoint, we are faced with the question of whether there ought to be any financial impact in the current rate proceeding as a result of our review.

Q. Could you explain what set of circumstances could lead in general to a financial impact within a rate proceeding?

A. Yes. First let me explain what I mean by financial impact. By placing a generating unit in service (rate base) the Company would be allowed to earn a fair rate of return on those assets from current operations. In addition, the associated operating expenses such as depreciation, operating and maintenance expenses also need to be considered. Financial impact, therefore, can be considered as three separate items:

1. The amount to be included in rate base.
2. The rate of return to be awarded.
3. The inclusion of associated operating, maintenance and depreciation expenses less related savings.

The Company has proposed that all the costs associated with the construction of TMI-2 be included in rate base. It has also requested that its projected operating expenses associated with TMI-2 be given full recognition. First, with regard to rate base, there would have to be a judgment of the regulatory bodies that the amounts expended on that construction were reasonable and prudently expended, that the construction period was reasonable and that management exercised the required control over the construction process. Any indicated departure from the above could

result, if a commission chose, in a disallowance of certain amounts actually expended during construction from rate base. Second, with regard to rate of return the Commission has the possibility of permitting a "special" additional allowance for exceptional management performance as well as reducing the allowance to the barest minimum consistent with financial integrity to indicate displeasure with management perfomance. A related rate of return consideration is that the risk of an enterprise and the equity holders of that enterprise should be substantially lessened if a regulatory body automatically allows all costs of a new facility to go into rate base without adequate review.

Finally, the operating expenses should be examined to determine if they represent an efficient and prudent level of operating expenses, which are fully incremental to the current overall level of expenses.

Q. Please indicate on what you have based your recommendations in this proceeding.

A. My recommendations are based on the data contained in our report. The report contains the underlying data, analysis and conclusions. My recommendations in this proceeding are based on applying sound regulatory principles to the data and conclusions contained in the report. In addition, I have made recommendations with regard to the most recent delay. The information regarding the delay was made available to us after the preparation of the report.

Q. Would you please comment on some of the conclusions in the report?

A. I would like to single out one of our conclusions for special attention. As mentioned in the report (pages 9-11 of the Conclusions), the historical interactive process between the Company and the regulators has been inadequate with regard to the review and understanding of major construction projects. Our analysis indicates that very little interaction and analysis was made outside the context of a rate proceeding that presented the financial impact of any delay on the in-service date, construction costs and ultimate costs to the ratepayer. Similarly, there was no presentation made to indicate whether an acceleration of the program was possible. In the current environment such interaction and analysis is essential if the ultimate rates to ratepayers are to be held to a minimum. Another conclusion which should be stressed is that a review of this type should be undertaken periodically during the life of the project. This review has been made after the fact. The cost escalation has occurred. The options are more limited than if the review were done during the construction of the facility in the manner recommended by our report.

We have recommended an alternate approach and suggest that the approach be given serious consideration by both regulatory bodies. The approach has been outlined in our report (pages 12-17 of the Conclusions). The major difference in the approach is to recommend that such construction reviews and monitoring be done while the project is active. Then, corrective actions or alternate courses of direction can be discussed in a more meaningful fashion so as to be able to choose a desired action while it is possible.

Q. Mr. Madan, do you believe some regulatory action is warranted in these current rate proceedings?

A. Yes I do. I believe that certain conclusions can be reached from the data presented and that the regulatory bodies should deal with each one in the context of current rate proceedings.

Q. What conclusions can be reached regarding the cost of the project?

A. The overall cost of the project has escalated significantly. We do not have available the latest estimate after the recent delay in the in-service schedule from May to November 1978. The estimate prior to the final delay was $658 million, compared to the first somewhat detailed estimate of $345 million made in December 1971. The inclusion of the entire amount in rate base would represent tacit approval by the Commissions of all the actions taken by the Company and of all the factors that caused the costs to escalate.

Q. What would you recommend that the Commissions consider before reaching a decision?

A. The Commissions should review the report and evaluate the reasons for the escalation. The reasons, if possible, should be categorized into those factors over which the Company did have control and those areas over which the Company did not have control. In those areas where the

Company did have control the Commissions should make an independent evaluation as to whether a financial impact should be ascribed within the context of these rate proceedings. A review of our report spells out in detail our conclusions about the reasons for the escalations in cost, and whether the Company had control over these escalations. (See Summary of Conclusions pages and Data and Analyses Underlying Conclusions, Section I, pages A-1 to A-9.)

Q. Are there any specific factors that you would like to bring to the Commissions' attention?

A. Yes. I would begin by pointing out that there are several factors, each of which had a large impact on the overall cost escalation. In this proceeding I would like to discuss one item particularly over which the Company had some degree of control; that is, the delay in the in-service date.

Q. Please explain how a delay in the in-service date can escalate the overall cost of the project.

A. There are several ways, among these are:

1. Higher prices due to inflation in later years.
2. Additional costs due to paying fixed overheads for a longer period of time.
3. Additional costs for the capital cost of carrying the amounts expended to date (i.e., additional AFDC).
4. Additional costs due to additional regulatory and safety requirements which became mandatory in later time periods.

Q. Indicate the overall delay in this construction project.

A. From the original planned in-service date of May 1973 the project has slipped 67 months to November 1978.

Q. What were the reasons for such a delay?

A. There are several and they are described in our report. (See Data and Analyses Underlying Conclusions, page A-42 - A-55.) I would, however, like to focus on two specific reasons. First, the Company's claim that its financial condition necessitated a substantial delay. Second, the delay associated with the recent valve problem that stopped final testing and delayed the in-service date from May to November 1978.

Q. Do you agree that the financial condition of the Company necessitated a delay?

A. There appears to be evidence to suggest that in the 1970 to 1974 period the Company felt that its financial condition did not allow the original construction schedule to continue. During this period the in-service date slipped 48 months (page A-1). These conclusions of the Company were made known to the regulatory bodies. There was very little presented by the Company to indicate what the delay would mean in overall cost escalation and ultimately in rates. At certain times during this period the Company's financial condition did preclude additional long-term debt borrowing (pages A-25 to A-28).

Q. Did your review indicate any circumstances within the Company's control that could have accelerated the construction program?

A. Our review indicates that the construction personnel in charge of the project believed that additional funds could have accelerated the in-service date. Our analysis indicates that the failure to provide additional construction funds resulted in manpower cutbacks with resulting loss in construction momentum and worker productivity.

Q. Did the Company have access to the additional funds required during the latter part of the project?

A. The level of construction expenditures is not an exact science and is subject to certain management discretion. The specific time frame I am referencing here is the 1976 - 1977 construction budget. Within this budget and the facts existing at that time, there is evidence to suggest that an acceleration in construction in the order of $10 - $20 million could have accelerated the in-service date by four to six months.

This fact is evidenced by the following conclusion contained in our report:

> Construction budget cutbacks were frequent and severe. While some budget cutbacks were inevitable, the amount was always subject to discretion. In addition, failure to accelerate construction funds as requested by construction managers in relatively modest amounts (approximately $10 - $20 million cutback in 1976 for example) in the final stages of completion resulted in a probable extension of completion date of several (4 to 6) months, as well as a measurable decrease in labor productivity, which has been ascribed to lower worker morale resulting from the cutbacks.

Within this time frame it is evident that the Company had access to those amounts of additional funds. Our report (pages A-8, A-9) indicates that the annual impact of a one-year delay in the time period 1975 to 1978 resulted in an annual escalation in total cost of approximately $53 million. The impact of the 4-6-month delay would correspondingly be $18 to $26 million. The largest element of this would be the escalation in AFDC.

Q. Were there other delays to which you would recommend that the Commissions give financial impact in the current regulatory proceedings?

A. The most recent 6-month delay in in-service date from May to November 1978, which was due primarily to an engineering problem concerning certain steam safety valves, should be evaluated by the Commissions. It was necessary for the Company to substitute smaller valves of an older design for the larger untested valves of a new design that was chosen for this installation. Although the material costs of substitute valves are under $100,000, the overall cost of this delay has been preliminarily estimated to increase overall costs by $30 million. A substantial portion of the increased cost is due to increased AFDC.

The other incurred costs are due to increased fixed costs (i.e., taxes, insurance, testing personnel), the costs to repair the valves, and the costs to resume the testing program. Due to the fact that the facility is not yet in service, it is not possible to precisely define those costs. I therefore recommend that the Commissions require the Company to identify and specify the costs associated with this delay.

The responsibility for the decision to use the larger untested valves must be with the Company. Although the decision may have been reasonable when made, it has resulted in a delay of an abnormal nature with large financial costs. The regulatory concern in the context of these rate proceedings should be whether these costs are totally and automatically passed on to the customers.

Q. What regulatory principles should the Commissions consider concerning these delays?

A. First, I would point out that taking no action would imply approval of all the delays for this project along with the associated cost increases. The cost of all these delays if included in rate base would ultimately be borne by the ratepayers. At a minimum, if all costs are included in rate base, the Commissions should consider the impact on the cost of equity since it would appear that the risks of an enterprise are substantially reduced when all capital costs are automatically passed through to ratepayers. Regulation is intended as a substitution for competition. Under competition, if a Company builds a comparable facility that is more costly than a competitor's, it may not be able to price its product to recover all of its costs. If it did so, it may become noncompetitive and go out of business. This same logic should apply under regulation. If a Company builds a facility, which has excessive costs due to items which were either under its control or should have been under its control, it should not recover those costs. If some of these delays could have been avoided, then in some way the costs should be borne by someone other than the ratepayer.

Given all the facts, it is my judgment that the Commissions should give some indication that all the costs of the escalation should not be borne by the ratepayers. This is because there appears to be reason to suggest that the program could have been accelerated at an overall saving of cost. One way of giving such an indication is to provide for a sharing of cost escalation within the Company's control between ratepayers and stockholders. Such a sharing can be achieved by allowing associated expenses as a cost of service item while not permitting rate base treatment for those related items.

Q. What actions could the Commissions take?

A. I believe that there are two major courses of action.

First, the Commissions could make a specific rate base disallowance while allowing all the associated expenses. This method shares the cost of escalation between the ratepayers and the stockholders.

Second, the Commissions could award a lower rate of return in the current rate proceedings to indicate that some of the costs should be borne by the Company's stockholders.

Q. Which method do you recommend?

A. I would recommend the former. A rate base disallowance, while allowing the associated expenses as mentioned, represents a sharing of costs between ratepayer and stockholders.

Q. Is there any regulatory precedent for this type of sharing?

A. Such treatment has been used in several projects that have been abandoned by Jersey Central (Longwood Valley, Tocks Island) and Public Service Electric and Gas (Newbold Island, Tocks Island). In the case of TMI-1 the costs associated with a faulty concrete pour were also excluded from rate base by the Pennsylvania Commission.

Another example of a sharing of costs is when abnormal costs are incurred by a company for items such as storm damage or major forced outages. In these cases the company is allowed to recover these expenses amortized over a representative period, but is not allowed to recover unamortized capital carrying costs through rate base treatment.

Furthermore, in the case of suspended construction projects, the Uniform System of Accounts does not permit AFDC to be booked on those projects during the suspension period and therefore these costs are not passed on to ratepayers. In my opinion, these same regulatory principles which have been used either to share costs between ratepayer and stockholder or exclude costs completely should apply in situations where construction costs are escalated due to delays under the control of the company.

Q. What amount should be excluded from rate base?

A. Under the current circumstances based on the two items mentioned, I believe the Commissions have a basis for excluding from $48 million to $56 million from rate base, while allowing associated expenses.

I would recommend with regard to the savings from the acceleration in the project that the lower figure of $18 million be adopted by the Commissions. In connection with the recent delay, I recommend that approximately $30 million be excluded from rate base and would recommend that exact costs of the delay as I have outlined be provided by the Company and reviewed by the Commissions and other active parties in the proceeding.

Q. How should these amounts be allocated to the various operating companies?

A. In relation to their relative ownership of TMI-2. I would point out that there are differences in the treatment of TMI-2 costs between New Jersey and Pennsylvania, where New Jersey allowed "old AFDC" in rate base as well as a specific inclusion of approximately $74 million of CWIP (TMI-2) in rate base, while in Pennsylvania both these items were capitalized.

Q. Do you have any further remarks?

A. Yes. In addition to concerning themselves with the financial impact of these delays in the current rate proceedings, the Commissions should order that all future major construction projects by all major electric utilities be reviewed during the construction period in a manner similar to the method outlined in our report (pages 12-17 of the Conclusions).

It should now be evident that the lowest cost to the consumer could require constant regulatory attention to genuine utility problems.

It should be noted that the proposed sale of portions of TMI-2 to Jersey Central has not been approved. This leaves Jersey Central the task of financing alone the Forked River nuclear generating station at over $1.1 billion in the next four or five years.