

1 costs of other Northeast BWRs.

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3 A. Limerick's \$2234/Kwe cost is significantly less (21%) than the updated average  
4 cost of all five Northeast plants at \$2818/Kwe. The cost for Northeast plants  
5 increased 6% since my original testimony was filed. It should be noted that  
6 Limerick 1 is also approximately 2% less expensive than the average non-Northeast  
7 first unit BWR, despite the adverse conditions specific to BWRs located in the  
8 Northeast.  
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15 Q. What conclusion have you drawn from this updated comparison?

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17 A. I have drawn the same conclusion as detailed in my direct testimony. Despite  
18 adverse conditions specific to BWRs located in the Northeast United States in  
19 general, and to Limerick in particular, the direct cost of constructing Limerick 1  
20 is lower than the industry average. The Limerick 1 schedule is only slightly longer  
21 than the average for all BWRs in the study. This demonstrates, I believe, that we  
22 have been able to effectively control cost and schedule, and the management  
23 team at Limerick has performed well. This comparison also indicates that the  
24 1976 and 1978 deferral announcements had little, if any, effect upon the costs or  
25 schedule of the project.  
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35 Q. Have you reviewed the cost quantification presented in Trial Staff Statement  
36 DPD-1?

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39 A. Yes. I have.

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41 Q. Please provide your analysis of this quantification.

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43 A. First, the entire cost quantification is based on an unsupported assumption that  
44 Limerick Unit No. 1 could actually have achieved commercial service by  
45 4/30/81. This fundamental premise of the analysis is completely unrealistic given  
46 Limerick and industry construction experience. In addition, aside from the  
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fundamental fallacy of relying on the 4/30/81 service date, Mr. Dougherty in performing his quantification makes numerous cost adjustment errors which further undermine his conclusions.

Q. Please proceed with your analysis of the construction schedule associated with Mr. Dougherty's proposed in-service date of April, 1981.

A. Mr. Dougherty has admittedly failed to address whether or not the plant could have actually been in service by April, 1981. As explained in other testimony, construction of Limerick to meet an April, 1981 in-service date was not possible given the external uncontrollable factors which were impeding construction progress at that time. Schedule 2 of PECO Statement 4 shows the schedule duration of all BWR's comparable to Limerick 1. The shortest schedule duration of these units (Construction Permit to Fuel Load) is 93 months, with the best 5 plants averaging a full 101 months. Yet Mr. Dougherty contends that Limerick 1 should have been constructed in 67 months (6/74 CP to a 1/80 Fuel Load, 15 months prior to the assumed April, 1981 service date). No comparable contemporary nuclear plant in the country achieved a construction schedule even close to this hypothetical result! Even OCA witness O'Brien admits that "it is not at all clear that it could have been done," and "my research shows that no U.S. Boiling Water Reactor (BWR) facility with a construction start contemporaneous with Limerick's completed construction anytime in 1981 or before". (OCA Statement No. 1, p. 6). In fact, Mr. O'Brien's own proposed Limerick Schedule, with which the Company also strenuously disagrees, results in a November 1983 service date, fully two years and seven months after that advanced by Mr Dougherty. Therefore, I contend that a 67 month schedule was clearly unattainable for Limerick 1, as amply demonstrated by overall construction

1 durations at plants built during the same time period.

2  
3 Mr. Dougherty has acknowledged the prudence of the overall scope of  
4 Limerick 1 (i.e. Quantities and Manhours Page 2, Line 7). However, he has  
5 completely failed to consider the schedule impact of this actual construction  
6 scope on the proposed April, 1981 service date. The testimony of Mr. James  
7 Coughlin conclusively demonstrates that, without regard to the cash restraints  
8 imposed after May, 1976, with the final scope of the plant, Limerick's critical  
9 path duration yields an earliest Fuel Load date of July, 1984. Adding the duration  
10 from Fuel Load to in-service of 15 months yields an in-service date of 10/85, four  
11 months in advance of the actual in-service date. Thus, Mr. Dougherty's 4/81 in-  
12 service assumption is by his own admission unrealistic given actual project scope.  
13 Mr. Dougherty has simply failed to address what schedule a prudent manager  
14 would have been able to meet. Thus, his cost quantification is without any logical  
15 support.  
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29 Another major flaw in Mr. Dougherty's assumption of an April, 1981 in-  
30 service date is that he ignores the nuclear licensing process in general and the  
31 Limerick 1 licensing process in particular. As explained by Mr. Boyer and Mr.  
32 Mattson, the earliest date on which Limerick 1 could have received an Operating  
33 License is 5/84 based on the PRA and SARA requirements imposed on the project  
34 in 1980 and beyond. This date is only 5 months earlier than the actual date  
35 Limerick 1 was licensed. Again, Mr. Dougherty's entire quantification is  
36 completely divorced from construction and regulatory reality.  
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45 In summary, I contend that the earliest Limerick 1 could have been in-  
46 service, based on the construction schedule outlined in the testimony of James  
47 Coughlin, was October, 1985, only 4 months prior to the actual date.  
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1 Furthermore, regulatory requirements unique to Limerick would have prevented  
2 Commercial Operation prior to the date actually achieved. Quantification of  
3 costs to an April, 1981 service date is clearly unsupported.  
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7 Q. What areas of Mr. Dougherty's cost quantification have you identified as being  
8 incorrect, given the erroneous use of an April, 1981 in-service date?  
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11 A. Mr. Dougherty has made several major errors in his quantification.  
12

13 Mr. Dougherty's reliance on data only as of 10/30/84 deprives the Company  
14 of substantial AFUDC costs which are reasonable and recoverable under his  
15 analysis. In using the 10/84 cutoff date, Mr. Dougherty ignores the substantial  
16 direct costs actually incurred during the Limerick startup and testing period  
17 required at every nuclear plant (i.e. 10/84 - 2/86). Therefore, under his  
18 quantification method substantially less direct costs are applied to the pre-4/81  
19 period to calculate reasonable AFUDC, and as a result the amount of reasonable  
20 AFUDC recoverable by the Company is significantly understated. Mr. Dougherty  
21 admits to this understatement, but alleges that it is somehow offset by his  
22 assumption that the post-4/81 reasonable costs were all spent on the first day of  
23 each applicable six month period. However, by his own admission he has made no  
24 analysis to establish this supposed offset.  
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37 Mr. Dougherty's reliance on 10/31/84 data results in further error in his  
38 quantification of delay. He uses plant costs from the 42-month period 4/30/81  
39 through 10/31/84, despite the fact that the plant did not actually achieve  
40 commercial operation until 2/1/86. Using Mr. Dougherty's own methodology, the  
41 actual period applied back should be 57 months (4/30/81 - 2/1/86). Applying this  
42 longer span to the pre-4/81 period results in the earlier compounding of AFUDC  
43 than Mr. Dougherty's analysis, and a lower cost of delay. Despite this obvious  
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1 error, he has already stated that his proposed adjustment will not be revised to  
2 reflect more recent actual data.  
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5 Mr. Dougherty has also not accounted for the increased cost to PECO  
6 associated with raising an additional \$1.027 billion of capital prior to 4/81 in  
7 accordance with his proposed cashflow. As explained by Mr. Hill, these additional  
8 expenditures would result in additional AFUDC costs and compounding of these  
9 expenditures.  
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11  
12 Mr. Dougherty's hypothetical cashflow is also completely unsupportable. For  
13 example, to compute AFUDC Mr. Dougherty takes "reasonable" plant costs from  
14 the 42-month period 4/81 to 10/84 and applies those expenditures to the pre-4/81  
15 period. However, he spreads these dollars evenly over this 42-month span, thereby  
16 assuming uniform monthly expenditures for the spread of dollars. This is grossly  
17 inconsistent with actual Limerick and historical industry experience. Schedule 4  
18 shows a comparison in constant dollars of Limerick's actual expenditures for the  
19 15 months prior to in-service with Mr. Dougherty's hypothetical cashflow. As can  
20 be seen, Mr. Dougherty's assumed cashflow ignores the ramping down of  
21 expenditures associated with the reduced construction effort and pre-commercial  
22 operation credits near the end of the power ascension program. A plot of actual  
23 Limerick expenditures would form a bell-shaped curve, having higher annual  
24 expenditures in the earlier years than shown by Mr. Dougherty. A higher and more  
25 accurate calculation of AFUDC than presented by Mr. Dougherty would result.  
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29 Mr. Dougherty also ignores the fact that PURTA taxes, which were expensed  
30 subsequent to 4/82, would have been capitalized using his assumptions. As  
31 explained by Mr. Hill, this would also result in increased AFUDC associated with  
32 the additional PURTA taxes being incurred prior to April, 1981.  
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1 Mr. Dougherty further errs in his use of the non-manual and manual average  
2 wage rates as outlined on page 13 of DPD No. 1. He calculates average wage  
3 rates at both April, 1981 and October, 1984. He then uses the difference in wage  
4 rates times the hours spent between 4/81 and 10/84 as the basis for his calculation  
5 of "delay costs". However, his calculation utterly ignores the impact of overtime,  
6 which is compensated at 150% - 200% of straight time and obviously has a  
7 substantial impact on wage rates in Mr. Dougherty's calculation. Non-manual and  
8 manual overtime prior to April, 1981 was 5.7% and 2.5% respectively. Between  
9 April, 1981 and October, 1984 overtime for non-manual and manual was 21.3% and  
10 11.3% respectively. Mr. Dougherty has not taken this change into account and  
11 thus proposes disallowing costs as inflationary and caused by delay when in reality  
12 they are partially a function of overtime. To this extent, his quantification is  
13 again erroneous.  
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26 Finally, Mr. Dougherty admits that use of October, 1984 producer price  
27 indices overstates the cost quantification. However, he says that this  
28 overstatement is offset by the assumption that all of these costs should have been  
29 spent in April, 1981. Once again, Mr. Dougherty has admittedly made no analysis  
30 to establish this alleged offset.  
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37 Q. What conclusions have you drawn regarding Mr. Dougherty's quantification of  
38 costs associated with Limerick not meeting an in-service date of April, 1981.  
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40 A. Mr. Dougherty on Page 2 states: "The method we selected to quantify the costs of  
41 the construction delays required no prior experience or knowledge with regard to  
42 the construction of a nuclear power plant". On the contrary, many of the  
43 numerous errors in his analysis, some of which are identified above, would have  
44 been avoided by an individual qualified for this task with experience in power  
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1 plant construction.

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3 Mr. Dougherty chooses an in-service date that has absolutely no basis in fact  
4 or logic and even the OCA delay quantification witness regards as unattainable.  
5  
6 In addition, after assuming this erroneous in-service date, Mr. Dougherty proceeds  
7 to make significant errors in the resulting quantification. These unsupportable  
8 assumptions and obvious methodological errors clearly invalidate the entire  
9 Dougherty analysis.  
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11 Q. Does this conclude your testimony?  
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13 A. Yes, it does.  
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Examples of As-Built Errors Contained in  
O'Brien - Krietzberg and Associates  
Schedule Analysis

<u>OKA Node and Description</u>	<u>OKA Late Finish</u>	<u>Actual Finish</u>	<u>Difference Between OKA to Actual</u>
A 130 to A 108 FRP Diaphragm Slab	23 Mar. 75	30 Jan. 76	-10 Mos.
A 74 to A 76 Cone Lifts 2 and 3	4 Feb. 76	23 Jun. 76	-4 1/2 Mo.
* A 77 to A 79 FRP Cone Lifts 4 and 5	4 Apr. 76	8 Oct. 76	- 6 Mos.
* A 91 to A 92 Test, Rig and Set RPV	26 May 76	8 Dec. 76	-6 1/2 Mo.
A 108 to A 109 Compl RPV Pedestal	7 Jul. 75	17 May 76	- 9 Mos.
* A 256 to A 260 Cmpt. Walls to 217	16 Feb. 75	12 Sept. 75	- 7 Mos.
* Critical Path on OKA Blue Print Schedule			

Startup Duration for Contemporaneous  
Single Unit Plants

<u>Plant</u>	<u>High Voltage Energization</u>	<u>Fuel Load</u>	<u>Startup Duration</u>
Limerick 1	7/82	10/84	27 Months
Byron	11/81	10/84	35 Months
Grand Gulf	5/79	6/82	37 Months
Palo Verde 1	10/81	11/84	37 Months
Calloway	3/81	6/84	39 Months
Wolf Creek 1	12/81	3/85	39 Months
San Onofre 2	10/78	2/82	40 Months
Susquehanna 1	5/78	7/82	50 Months
WPPSS 2	8/79	12/83	52 Months
LaSalle 1	10/77	4/82	54 Months

Schedule 3

**COST AND SCHEDULE COMPARISONS OF BWRs 1982 - 1989  
WITH COMMERCIAL OPERATION**

PLANT	NRC REGION	NET MW	DATE OF C.P.	FUEL LOAD	DURATION C.P. TO F.L. (MO.)	C.O.	TOTAL DIRECT COST MILLION \$'S	COS PER K
A	3	1078	9/73	4/82A	103			
B	1	1050	11/73	7/82A	104	10/82A	1043	968
C	2	1250	9/74	6/82A	93	6/83A	1611	1534
D	1	1055	6/74	10/84A	124	7/85A	2028	1622
E	3	1139	9/72	3/85A	150	2/86S	2357	2234
F	5	1103	3/73	12/83A	129	SP/86S	2729	2396
G	3	1205	5/77	12/85S	103	12/84A	2500	2267
H	3	950	2/76	3/86S	121	6/86S	2762	2292
I	1	1067	11/74	10/86	136	9/86S	3020	3179
J	4	934	3/77	8/85A	101	12/86S	3255	3051
K	1	809	4/73	11/84A	139	2/86S	3000	3212
L	1	1084	6/74	5/86S	143	12/86S	3027	3742
						1/87S	3827	3530
ALL BWRs					12 PLANT AVERAGE	1446		
						121	31159	30027
							2597	2502
NON-NORTHEAST BWRs					7 PLANT AVERAGE	800		
						114	17082	15935
							2440	2276
NORTHEAST BWRs					5 PLANT AVERAGE	646		
						129	14077	14091
							2815	2818

COMPARISON OF LIMERICK ACTUAL CASHFLOW  
WITH STAFF STATEMENT DPD-1  
FOR LAST 15 MONTHS PRIOR TO C.O.  
(MILLIONS \$)

<u>Months Prior To C.O.</u>	<u>Actual in Dougherty Earlier Dollars</u>	<u>DPD Cashflow</u>
15	\$15.7	\$36.8
14	16.9	36.5
13	10.2	38.0
12	7.2	39.1
11	12.5	36.2
10	10.2	37.0
9	12.9	36.1
8	8.9	35.2
7	9.4	39.9
6	8.9	36.8
5	6.7	42.1
4	6.5	36.8
3	5.9	37.3
2	7.7	38.6
C.O.	4.7	41.0

PECO STATEMENT NO. 4B

R-850152  
3/17/86

PENNSYLVANIA PUBLIC UTILITY COMMISSION  
v.  
PHILADELPHIA ELECTRIC COMPANY,  
DOCKET NO. R-850152

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MAR 19 1986

SUR-SURREBUTTAL TESTIMONY  
OF JAMES J. CLAREY

SECRETARY'S OFFICE  
Public Utility Commission

DOCKETED

MAR 24 1986

March 11, 1986

DOCUMENT  
FOLDER

SUR-SURREBUTTAL TESTIMONY  
OF JAMES J. CLAREY

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5 Q. Please state your name and business address.

6  
7 A. My name is James J. Clarey and my business address is P.O. Box A, Sanatoga  
8 Branch, Pottstown, Pennsylvania 19464.

9  
10 Q. Are you the same James Clarey who previously filed testimony in this proceeding?

11  
12 A. Yes, I am. I presented Statements 4 and 4A.

13  
14 Q. What is the purpose of your sur-surrebuttal testimony?

15  
16 A. The purpose of this testimony is to address certain issues raised by Trial Staff  
17 Witness Dennis P. Dougherty in his surrebuttal testimony regarding the alleged  
18 cost of not placing Limerick Unit 1 in service by April of 1981. In addition, I will  
19 address Staff Witness Robert A. Rosenthal's suggestion of improper costs  
20 associated with HVAC installation at Limerick.

21  
22 Q. Please present your analysis of Mr. Dougherty's surrebuttal testimony.

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24 A. In my rebuttal testimony, I explained the numerous errors in Mr. Dougherty's delay  
25 quantification analysis. His surrebuttal testimony does nothing to correct these  
26 errors.

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Mr. Dougherty continues to ignore the realities of nuclear power plant construction. He admits that his AFUDC calculation assumes a uniform monthly flow of Limerick construction expenditures. As demonstrated in my prior testimony, this assumption is totally inconsistent with actual Limerick and industry construction experience. Mr. Dougherty attempts to defend this hypothetical and unsupported cash flow by pointing out that he uses some actual AFUDC as one component of his total AFUDC allowance (Trial Staff Statement DPD-1, p. 5). However, the fact that a portion of Mr. Dougherty's quantification

1 is based on actual experience does nothing to mitigate the error which he admits  
2 is present in the rest of his calculation.  
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5 As I pointed out in Statement 4A, completion of Limerick for an April,  
6 1981 in-service date would have required a cash expenditure flow wholly different  
7 from that presented in the Dougherty analysis. Under a realistic cash flow  
8 analysis, substantially more dollars would have been spent earlier than assumed by  
9 Mr. Dougherty, resulting in a higher and more accurate calculation of allowable  
10 AFUDC.  
11  
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13 Q. Do you have any further comment on Mr. Dougherty's surrebuttal?  
14

15 A. Mr. Dougherty's entire analysis is based upon imprecise approximations and  
16 unsupported assumptions, apparently due to his admitted lack of experience in  
17 power plant construction and financing. The only effort Mr. Dougherty makes in  
18 his surrebuttal to correct his analytical errors is an attempted quantification of  
19 his understatement of allowable AFUDC due to the exclusion of all post-10/84  
20 direct costs from his AFUDC calculation (Trial Staff Statement DPD-2, p. 4).  
21 However, Mr. Dougherty leaves the other errors I have described in Statements 4  
22 and 4A uncorrected. For instance, he continues to use the 42-month period of  
23 direct costs for calculation of AFUDC (i.e. 4/81-10/84), when it has been amply  
24 demonstrated that the actual period should be 57 months (i.e. 4/81-2/86).  
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39 Mr. Dougherty attempts to justify his exclusion of post-10/84 direct  
40 expenditures as follows: "I am not convinced that there would have been a 15-  
41 month lag [between Fuel Load and Commercial Operation] had construction  
42 proceeded in accordance with the announced schedule. A comparison between the  
43 I-80100341 in-service date of April, 1981 and Schedule 33, Sheet 1 of 3 of PECO  
44 Statement No. 8, indicates that only a 6-month lag (10/80-4/81) between Fuel  
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1 Load and Commercial Operation was expected by the Company prior to  
2 announcing the 1976 delay." However, the 6-month duration cited by Mr.  
3 Dougherty was based on the power ascension program projected in 1976. As  
4 explained in the rebuttal and sur-surrebuttal testimonies of PECO Witnesses  
5 Boyer, Mattson, Helwig, and Sproat and PECO Exhibit RJM-1, NRC mandated  
6 regulations and licensing requirements increased dramatically after 1976. In  
7 addition, Mr. Dougherty would have us believe that licensing requirements in the  
8 immediate aftermath of the TMI accident would permit a 6-month duration for  
9 power ascension testing. As demonstrated in PECO Statement 4A and Exhibit 2,  
10 this is extremely unrealistic. Furthermore, Schedule 2 of PECO Statement 4A  
11 demonstrates that for contemporary BWR's, Limerick's power ascension testing  
12 duration of 15 months is approximately average. Finally, Mr. Dougherty's analysis  
13 fails to allow even the 6-month lag he admits as a minimum duration between Fuel  
14 Load and Commercial Operation. Incorporation of this period would result in a  
15 48-month spread of dollars and additional compounding of AFUDC. Thus, Mr.  
16 Dougherty's analysis contains further admitted quantification errors.

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33 Q. What area of Robert A. Rosenthal's surrebuttal testimony are you going to  
34 address?  
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37 A. I would like to address Mr. Rosenthal's assertion on page 3 of Trial Staff  
38 Statement RAR-2 that "[o]ther issues were discovered in the course of our field  
39 audit but have not been specifically incorporated into any Staff adjustment. An  
40 example of this would be the HVAC work associated with subcontractor Schneider  
41 Sheet Metal, Inc. which was for an original fixed price of \$11.5 million and  
42 ultimately cost \$58 million. Similar work at Susquehanna cost only \$21 million."  
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49 Q. What is your response to this assertion?  
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1 A. Mr. Rosenthal has failed to address why HVAC costs at Limerick have increased  
2 since the original bid and why they are greater than those incurred at  
3 Susquehanna. Comparison of actual costs with the original award value are  
4 misleading for the following reasons:  
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- 8  
9 o The base award value to Schneider for \$11.5 million  
10 was in 1977 dollars and did not account for  
11 unanticipated escalation.  
12  
13 o The \$11.5 million stated by Mr. Rosenthal was based  
14 on design and regulatory requirements as known in  
15 1976 and 1977. As stated previously in PECO Exhibit  
16 2, significant regulatory changes after 1979 have  
17 impacted the project. Those affecting HVAC include  
18 Equipment Qualification and I&E Bulletin 79-02.  
19 These factors, in conjunction with the impact of  
20 regulatory changes on commodities being installed in  
21 proximity to and at the same time as HVAC, had a  
22 significant impact on the final installation cost of  
23 HVAC systems at Limerick.  
24

25 In addition, gross comparison of Limerick HVAC cost to Susquehanna is  
26 inappropriate. As pointed out in PECO Statement 5A, Limerick design differences  
27 necessitated significantly greater quantities of duct and hangers at Limerick than  
28 at Susquehanna, along with the associated difficulty of installing larger duct  
29 pieces in concert with other commodities.  
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32 In summary, Mr. Rosenthal's suggestion of excessive HVAC costs is totally  
33 unfounded.  
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36 Q. Does this conclude your sur-surrebuttal testimony at this time?  
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38 A. Yes, it does.  
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PECO STATEMENT NO. 4C

R-850152  
3-17-86

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**Public Utility Commission**

PENNSYLVANIA PUBLIC UTILITY  
COMMISSION

v.

PHILADELPHIA ELECTRIC COMPANY  
DOCKET NO. R-850152

SUR-SURREBUTTAL TESTIMONY OF  
JAMES J. CLAREY

ERRORS IN OCA WITNESS  
ASSERTIONS REGARDING PECO/BECHTEL  
JOINT SCHEDULE ANALYSES CONTAINED  
IN EXHIBIT JJC-1/JRC-1

**DOCKETED**  
MAR 24 1986

**DOCUMENT**  
**FOLDER**

March 13, 1986

Sur-Surrebuttal Testimony of  
James J. Clarey

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4 Q. Please state your name and business address.

5  
6 A. My name is James. J. Clarey, and my business address is P.O. Box A, Sanatoga  
7  
8 Branch, Pottstown, Pennsylvania 19464.

9  
10 Q. Are you the same James J. Clarey who has previously submitted testimony in this  
11  
12 proceeding.

13  
14 A. Yes, I am. I have previously filed direct and rebuttal testimony identified as  
15  
16 PECO Statement Nos. 4 and 4A, respectively.

17  
18 Q. What is the purpose of your sur-surrebuttal testimony?

19  
20 A. The purpose of my testimony is to rebut various criticisms of the joint  
21  
22 PECO/Bechtel schedule analysis set forth in Exhibit JJC-1/JRC-1 which are  
23  
24 contained in the surrebuttal testimony of OCA witness James J. O'Brien.

25  
26 Q. On page 9 of his testimony, Mr. O'Brien states that PECO construction witnesses  
27  
28 have relied heavily on as-built information in developing a schedule analysis for  
29  
30 Limerick. Please comment on this statement.

31  
32 A. Mr. O'Brien mischaracterizes the Company's testimony by suggesting that the  
33  
34 Company's schedule analyses reflect nothing but as-built information and  
35  
36 therefore do not accurately reflect an "as should have been" completion  
37  
38 schedule. This is not correct and reflects Mr. O'Brien's lack of understanding  
39  
40 regarding the schedule analyses presented by the Company in this proceeding.

41  
42 As detailed in my and Mr. Coughlin's rebuttal testimony, a three part  
43  
44 analysis was performed in order to correct significant errors contained in Mr.  
45  
46 O'Brien's schedule analysis because of his reliance upon a 1974 MSCS construction  
47  
48 schedule. In view of Mr. O'Brien's acceptance of actual conditions at Limerick up  
49  
50 through the 1976 deferral announcement, his proposed schedule was adjusted to

1 reflect as-built civil/structural schedule logic and durations through May 1976. In  
2 addition, the as-built startup logic and duration were added because these  
3 activities would have been performed as-built regardless of the final project  
4 completion date and could not have been completed within a shorter duration than  
5 actually achieved. Mechanical and electrical activities were also adjusted to  
6 reflect manhours required to actually install the increase in work scope which was  
7 unanticipated in 1974 as a result of changing requirements and other factors.  
8 These manhours were also accepted by Mr. O'Brien. The remainder of the three  
9 part schedule analysis was performed by application of realistic assumed  
10 construction restraints, such as maximum sustained manpower density limitations,  
11 reasonable assumptions regarding the use of second shifting and maximum  
12 foreseeable cash requirements.  
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25 Thus, although the Company's analyses reflect certain as-built logic and  
26 durations, these conditions were either accepted by Mr. O'Brien or could not have  
27 been avoided. Moreover, the Company's analyses clearly do not simply reflect an  
28 as-built schedule, as Mr. O'Brien contends. Rather, they reflect realistic  
29 conditions under which the project would have been constructed in attempting to  
30 meet Mr. O'Brien's proposed July 1982 schedule. As explained in my rebuttal  
31 testimony, these analyses demonstrate that the realities of constructing the  
32 project would have precluded a completion date prior to July 1984 despite the  
33 announcement of construction deferrals in 1976 and 1978.  
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- 43 Q. Have you prepared an exhibit which demonstrates the errors and  
44 misunderstandings of Mr. O'Brien concerning manpower densities?  
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46  
47 A. Yes, I have. In conjunction with Bechtel, the Company's Construction Division  
48 developed Exhibit JJC-2/JRC-2 which demonstrates the errors contained in Mr.  
49  
50

1 O'Brien's criticism of density levels used in our schedule analyses contained in  
2 Exhibit JJC-1/JRC-1 and described in PECO Statement Nos. 4A and 33. My role  
3 was to provide overall review of the preparation of the Exhibit. All major  
4 conclusions depicted in Exhibit JJC-2/JRC-2 were reviewed by my staff to assure  
5 correctness in its criticism of Mr. O'Brien and to assure proper representation of  
6 density definitions and limits.  
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12  
13 Q. On pages 16-18 of his surrebuttal testimony, Mr. O'Brien compares the manpower  
14 density assumptions employed in Exhibit JJC-1/JRC-1 with data contained in  
15 Forecast 7, Part 2, and concludes that they are unreasonably low. Do you agree  
16 with this statement?  
17  
18

19  
20  
21 A. No, I do not. Mr. O'Brien has confused Peak Manpower Densities and Maximum  
22 Sustained Manpower Densities throughout his testimony and his analysis. As  
23 explained and shown in PECO Exhibit JJC-2/JRC-2, Mr. O'Brien has incorrectly  
24 used a basic scheduling technique in confusing Peak Manpower Levels with  
25 Maximum Sustained Manpower Levels, and he fails to recognize the significance  
26 of the separation of the containment into the drywell and wetwell areas. As is  
27 clearly shown in the referenced exhibit, Mr. O'Brien's peak manpower levels in the  
28 containment for a 7/82 fuel load far exceed reasonable peak manpower levels by  
29 60% (566/352) when proper comparisons are made to averages of several plants,  
30 including Susquehanna. The significance of the separation of the containment into  
31 its drywell and wetwell components has previously been presented in PECO  
32 Statement Nos. 4A and 33.  
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45 I would like it to be clearly noted that Mr. O'Brien has chosen only the  
46 higher manpower peak level references from Forecast 7, Part 2, when he  
47 compares the peak manpower density levels between plants, and does not include  
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49  
50

1 the entire list of plants that were shown. He thus once again selects only those  
2 comparisons which are favorable to his conclusions.  
3  
4

5 Q. Do you agree with Mr. O'Brien's statements on pages 16 and 20 of his testimony  
6 that PECO's manpower density study was done for purposes of the Limerick 2  
7 proceedings and, therefore, is not relevant to Unit 1?  
8  
9

10  
11 A. No, I do not. Mr. O'Brien states:  
12

13 "Thus, the new Bechtel/PECO study was done for a very limited purpose  
14 having little to do with Limerick Unit 1 as it was actually man loaded, or as  
15 it might have been man loaded had the various target schedules been real  
16 targets."  
17

18 The study referenced in PECO Statement Nos. 4A and 33 was not  
19 performed as part of the litigated proceedings involving Limerick 2. Rather, it  
20 was prepared as an internal planning measure to verify the feasibility of  
21 accomplishing the aggressive schedule for Unit 2 set forth in Forecast 7, Part 2,  
22 which PECO agreed to under the PUC's cost containment cap for that unit.  
23 Indeed, the necessity for preparation of the study was expressly anticipated in  
24 Forecast 7, Part 2, which states "Upon approval of a specific schedule, a detailed  
25 construction schedule will be developed." (Exhibit JJO'B-27, page 4).  
26  
27

28 • In addition, as explained in my rebuttal testimony and in Exhibit JJC-  
29 2/JRC-2, this study reflects the most current and accurate information available  
30 on manpower densities based on the complexity, congestion, and access to the  
31 known scope of work for the Limerick project. It therefore is clearly relevant and  
32 contains the most appropriate information to be used in performing a schedule  
33 analysis for Limerick 1. In fact, if we had had the experience to prepare this  
34 information for the known scope of work for Limerick 1, we would undoubtedly  
35 have used it in actually scheduling the construction of Limerick 1.  
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50 Q. Have you evaluated Mr. O'Brien's contention, on page 19 of his testimony, that the

1 period through June of 1976 contained unexplained and avoidable delays in  
2 civil/structural activities and therefore the as-built logic for this phase should not  
3 have been added to his schedule?  
4  
5

6  
7 A. Yes, I have. First, I should note that Mr. O'Brien has provided no analysis  
8 whatsoever to support his statement.  
9

10  
11 More importantly, however, as explained in my rebuttal testimony, PECO  
12 applied necessary resources to critical areas of the job and continued to maintain  
13 an October 1980 or earlier fuel load from June 1974 through May 1976. In fact, in  
14 March of 1976, the project was on schedule for a target fuel load date of July 29,  
15 1980, which is substantially earlier than Mr. O'Brien's recommended fuel load of  
16 July 1982. This information, which Mr. O'Brien conveniently ignores,  
17 demonstrates that the project continued to work critical path areas of the job to  
18 achieve early target fuel load dates and, further, that the project did not  
19 experience "unexplained and avoidable delays" through May of 1976 that would  
20 have affected Limerick's ability to achieve an early-as-possible fuel load date.  
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23  
24 Finally, Mr. O'Brien's assertion is inconsistent with his own schedule  
25 analysis. As explained in his direct testimony, the only delays not accepted by Mr.  
26 O'Brien are those which he attributes to the 1976 and 1978 deferral  
27 announcements. Since the 1976 announcement did not occur until May 1976, all  
28 as-built conditions up to that time were accepted by Mr. O'Brien and should have  
29 been reflected in his analysis.  
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31

32  
33 Q. On page 33 of his surrebuttal testimony, Mr. O'Brien discusses his provision for  
34 "excess Bechtel Power Corporation Indirect Costs" and claims that it is  
35 understated as it does not include Home Office Overhead costs. Do you agree?  
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39 A. No, I do not. In OCA Statement No. 1A, Mr. O'Brien utilized project cost data to  
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1 reconstruct Bechtel indirect and overhead costs associated with a schedule delay  
2 from mid-1982 to October 1984. These data indicate that indirect and overhead  
3 costs for this 27 month delay for Limerick Unit 1 and 100% of Common Facilities  
4 were \$137.2 million. Mr. O'Brien apparently believes that these estimates of  
5 Bechtel indirect and overhead costs do not include Home Office Overhead costs,  
6 because this particular expense was not noted during the cross-examination of  
7 TB&A witnesses. However, these costs were indeed included in the \$137.2 million  
8 total.  
9

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17 Q. On page 34 of his surrebuttal testimony, Mr. O'Brien contends that startup and  
18 operating staff probably began activities prior to 1979 and therefore PECO  
19 indirect and overhead costs associated with these activities are likely overstated  
20 due to the alleged 27 months of imprudent delay. Do you agree with this  
21 assertion?  
22

23  
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26  
27 A. No. Mr. O'Brien continues to incorrectly represent direct costs as being indirect  
28 costs or overheads that increase with project duration. As explained in my  
29 rebuttal testimony, all costs cited in Mr. O'Brien's surrebuttal testimony would  
30 have been incurred regardless of when the plant was completed.  
31

32  
33  
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35 To further demonstrate this point, my staff researched historical costs to  
36 determine the timing of actual expenditures for the PECO accounts which Mr.  
37 O'Brien claims are indirect. These accounts are: Public Notification, Training,  
38 Plant/Startup Staff, and Maintenance. The following table summarizes the actual  
39 costs for these accounts as of July 1982 and January 1986. I should note this  
40 information has been obtained from the Engineering and Research Monthly  
41 Expenditure Reports which have been available for review by all parties, including  
42 Mr. O'Brien.  
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<u>Description</u>	<u>E &amp; R Accounts</u>	<u>To-Date July 1982</u>	<u>To-Date Jan. 1986</u>	<u>% Expended as of July 1982</u>
Training	8231-8234	\$5,082	\$23,987	21%
Maintenance	353,354	-----	13,133	0%
Public Notification	352	-----	6,761	0%
Plant/Startup Staff	8,235	<u>4,092</u>	<u>44,716</u>	<u>9%</u>
Total		\$9,174	\$88,597	10%

As demonstrated by the above table, only 10% of these costs were expended prior to July 1982. This 10% was expended in support of the actual startup schedule which commenced in force with the energization of 13KV switchgear in July 1982. Thus, Mr. O'Brien's claim that these costs are indirect overheads associated with a schedule delay beyond July 1982 is totally erroneous and without substance. As I previously stated, these costs are associated with Limerick's actual startup program and would all have been incurred even if the plant had been completed in July 1982 (albeit in deflated dollars which Mr. O'Brien has already accounted for).

Apparently recognizing the lack of support for his claim, Mr. O'Brien attempts to dismiss these costs by claiming that they are "insignificant matters when compared with PECO's failure to divulge the entirety of Bechtel Power Corporation's overhead and indirect costs during the 27 month period." However, this is at best a weak attempt to avoid a factual quantification of costs associated with his purported schedule delay. In fact, Mr. O'Brien has been given the appropriate Bechtel information but has chosen to ignore such information. As shown in Schedule 1, Mr. O'Brien's calculation of disallowable PECO indirect costs should be reduced from \$101.5 million to \$33.6 million. I should note here that this figure has been corrected since the filing of my rebuttal testimony to account

1 for Mr. O'Brien's revised AFUDC calculations in OCA Statement 1A.  
2

3 Q. Mr. Clarey, were witnesses O'Brien and Hanauer permitted by the Company to  
4 engage in informal discovery of Limerick 1 construction data prior to filing of the  
5 instant rate case?  
6

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9 A. Yes, they were. Over a period of many months, virtually all Limerick 1 related  
10 construction and engineering documents were made available to Messrs. O'Brien  
11 and Hanauer, a number of interrogatory requests were answered and two days of  
12 interviews were held with Company executives responsible for Limerick activities.  
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17 Q. Does this conclude your testimony?

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19 A. Yes, it does.  
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PECO Indirects Per OCA Statement 1A

	<u>Millions</u>
Directs	\$ 77.7
Taxes	3.4
AFUDC	<u>20.4</u>
	\$101.5

Ratio to AFUDC to Directs =  $\frac{\$20.4}{\$77.7} = 26.3\%$

\$77.7

Cost Identified Incorrectly by O'Brien

Directs (Per PECO Statement 4A)	\$53.8 million
AFUDC (Directs x 26.3%)	<u>14.1 million</u>
Total	\$67.9 million

Corrected OKA Calculation of PECO Indirects:

$\$101.5 - \$67.9 = \$33.6 \text{ million}$

PECO Indirects Per OCA Statement 1A

	<u>Millions</u>
Directs	\$ 77.7
Taxes	3.4
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	\$101.5

Ratio to AFUDC to Directs =  $\frac{\$20.4}{\$77.7} = 26.3\%$

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Corrected OKA Calculation of PECO Indirects:

$\$101.5 - \$67.9 = \$33.6 \text{ million}$

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Public Utility Commission**

PECO STATEMENT NO. 8A

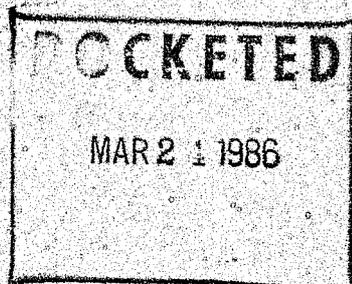
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PENNSYLVANIA PUBLIC UTILITY COMMISSION, ET AL.

V.

PHILADELPHIA ELECTRIC COMPANY,

DOCKET NO. R-850152



REBUTTAL TESTIMONY OF

JAMES O. LOVE

AND BASIL P. KONONETZ

THEODORE BARRY & ASSOCIATES



INDEPENDENT ASSESSMENT OF THE REASONABLENESS  
OF THE CONSTRUCTION SCHEDULE FOR THE  
LIMERICK 1 AND COMMON PLANT PROJECT;  
ERRORS IN THE QUANTIFICATION OF  
THE IMPACTS OF ALLEGED IMPRUDENCE

February 19, 1986

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TESTIMONY OF JAMES O. LOVE  
AND BASIL P. KONONETZ  
THEODORE BARRY & ASSOCIATES

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, ADDRESS AND OCCUPATION.

A. My name is James O. Love. I am an Executive Vice President and Principal in the management consulting firm of Theodore Barry & Associates ("TB&A"), a California corporation, whose principal business address is 1520 Wilshire Boulevard, Los Angeles, California 90017. I am TB&A's Engagement Director responsible for our retrospective assessment of the Limerick Unit 1 and Common project.

Q. PLEASE STATE YOUR NAME AND OCCUPATION.

A. My name is Basil P. Kononetz. I am a Principal with TB&A and have served as TB&A's Project Manager for our retrospective assessment of the Limerick Unit 1 and Common project.

Q. ARE YOU THE SAME JAMES O. LOVE AND BASIL P. KONONETZ WHO PREVIOUSLY PRESENTED TESTIMONY ON THE PRUDENCE OF LIMERICK 1 AND COMMON PROJECT MANAGEMENT IN THIS PROCEEDING?

A. Yes, we are. Our prepared direct testimony was presented as PECO Statement No. 8, filed September 27, 1985, at Docket No. R-850152 in this proceeding.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of this testimony is to explain several major errors by Staff and OCA witnesses in this proceeding when they attempted to quantify the impacts of PECO's alleged imprudent management decisions and actions.

Q. PLEASE GIVE A BRIEF SUMMARY OF THE SCOPE OF YOUR REBUTTAL TESTIMONY.

A. This testimony provides a basis for understanding the pitfalls to be avoided when

1 attempting to quantify the impacts of imprudence and presents examples of errors  
2 made by the Office of Consumer Advocate (OCA) and Pennsylvania Public Utility  
3 Commission (PPUC) Staff witnesses when they failed to avoid these pitfalls in their  
4 testimony in this proceeding.  
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9 This testimony also presents the results of TB&A's investigation into the actual  
10 project schedule, the "as-built" schedule, for constructing Limerick Unit 1 and  
11 Common Plant. This analysis was prepared over the last several months principally to  
12 respond to the testimony of Consumer Advocate witnesses. Our investigation covers  
13 the period from receipt by PECO of the construction permit from the NRC in June,  
14 1974 through fuel load of Limerick 1 in October, 1984 and focuses on the critical path,  
15 and near-critical path activities of the project. The "as-built" schedule reconstructed  
16 by TB&A for Limerick 1 and Common plant is then contrasted with the schedule  
17 analysis performed by OCA witness O'Brien, which is based partly on assumptions  
18 introduced by OCA witness Hanauer.  
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29 TB&A further presents an independent assessment of the results of the  
30 PECO/Bechtel analysis of the Limerick Unit 1 and Common schedule as summarized in  
31 PECO Rebuttal Statement No. 1A. These results are then contrasted with the  
32 schedule analysis performed by OCA witness O'Brien.  
33  
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37

38 Finally, our testimony summarizes errors of fact, concept or assumptions  
39 introduced by OCA and PPUC Staff witnesses in their testimony in this proceeding.  
40

41 Q. HOW HAVE YOU ORGANIZED YOUR TESTIMONY?  
42

43 A. In addition to this Introduction section, TB&A testimony is divided into the following  
44 four sections:  
45

- 46 • Quantification of the impacts of alleged imprudence
- 47 • The "as-built" schedule analysis of Limerick 1 and Common  
48  
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- Review of PECO/Bechtel Limerick schedule analyses
- Summary of OCA and Staff errors of fact, concept or assumption.

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7 II. QUANTIFICATION OF THE IMPACTS OF ALLEGED IMPRUDENCE

8  
9 Q. WHY IS IT IMPORTANT TO FOCUS ON THE APPROPRIATE STANDARD OF  
10 PRUDENCE TO BE USED WHEN ATTEMPTING TO QUANTIFY THE IMPACTS OF  
11 ALLEGED IMPRUDENCE?  
12  
13

14  
15 A. It is important because the standard of prudence contains the "rules" for assessing  
16 management actions and decisions which regulators have provided as the core basis for  
17 quantifying alleged imprudence. In other words, the magnitude of the costs  
18 attributable to imprudence can only be defined in relation to that specifically which  
19 is, or can be found, imprudent. Further, unless the costs are demonstrated to have  
20 been caused by the imprudence found, they cannot be disallowed.  
21  
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23  
24  
25 Q. PLEASE RESTATE THE STANDARD TB&A APPLIED IN YOUR RETROSPECTIVE  
26 REVIEW OF LIMERICK.  
27

28  
29  
30 A. In TB&A's independent assessment of the prudence and reasonableness of Limerick 1  
31 and Common plant project management we applied the same standard we have utilized  
32 in all of our recent major project retrospective reviews:  
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35

36  
37 "Whether PECO, in managing the Limerick Project, made the decisions and  
38 took the actions, including implementation of management and control systems,  
39 that a reasonable, experienced and competent manager would want and need in  
40 order to assure that a project of this size and complexity had a good chance of  
41 being completed in a reasonably cost-effective manner. And, where it  
42 appeared that such actions were possibly not being taken, and systems not  
43 implemented, we looked to see whether PECO top management took reasonable  
44 and timely steps to correct the situation." (PECO Statement No. 8, pg. 10,  
45 lines 26-42)  
46

47 Further, as TB&A noted in our pre-filed direct testimony in this proceeding,  
48 "... an assessment of management performance must focus on the reasonableness and  
49  
50

1  
2 appropriateness of decisions and actions related to the controllable aspects of a  
3 project in the context of information and courses of action contemporaneously  
4 available...." (Emphasis added) (PECO Statement No. 8, pg. 11, lines 17-23)  
5  
6

7  
8 In TB&A's opinion, this standard is the same as that generally employed by  
9 regulators in their determinations of management prudence, including determinations  
10 made by the Pennsylvania Commission.  
11

12  
13 Q. WHAT IS TB&A'S POSITION ON THE USE OF HINDSIGHT IN APPLYING THE  
14 STANDARD OF PRUDENT AND REASONABLE MANAGEMENT YOU HAVE  
15 ESPOUSED?  
16  
17

18  
19 A. TB&A has consistently taken the position we enunciated in our pre-filed direct  
20 testimony in this proceeding, that:  
21  
22

23  
24 "... Evaluation must be made without falling into the trap of hindsight. The  
25 outcome resulting from a specific decision, action, or sequence of actions, is  
26 not the proper indicator of the reasonableness of management's action. An  
27 outcome may be adverse through no fault of management, and regardless of  
28 entirely appropriate and even superior management practices and actions. In  
29 short, the results achieved are not a test of the reasonableness or prudence of  
30 management conduct. Nor is it appropriate to rely upon data or management  
31 procedures not reasonably available to management in asserting that better or  
32 different results could have been achieved." (Emphasis added) (PECO  
33 Statement No. 8, pg. 11, lines 23-41)  
34

35 We also noted that in applying the TB&A "standard to the facts available to  
36 TB&A, we drew on well known and accepted principles of management science that  
37 were available and in use contemporaneously with PECO's needs for, and choice of,  
38 management alternatives to apply to the management of the Limerick project."  
39 (Emphasis added) (PECO Statement No. 8, pg. 11, lines 3-11).  
40  
41

42  
43 The use of hindsight implies that management had the ability to adjust its past  
44 decisions and actions based on the known outcome of future events. TB&A believes  
45 that the utilization of hindsight interferes with developing a clear and specific  
46 identification of both the nature and impacts of imprudence and is not a sound basis on  
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1 which regulators can rely in making judgments of the reasonableness of, and the  
2 impacts of management's decisions and actions.  
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5 Q. HAVE OTHERS TAKEN A SIMILAR POSITION WITH REGARD TO THE ERROR OF  
6 USING HINDSIGHT IN MAKING A DETERMINATION OF PRUDENCE?  
7

8  
9 A. Yes. For example, the National Regulatory Research Institute (NRRI) in an April 1985  
10 publication (NRRI-84-16), The Prudent Investment Test In The 1980's, addressed the  
11 utilization of hindsight. The NRRI report, in its Executive Summary, noted that  
12 recent court rulings have indicated that in order for a court to uphold a commission  
13 ruling on prudence, it appears that four guidelines should be met:  
14  
15

- 16 • There should be a presumption that the investment decision of a utility is  
17 prudent, a presumption that can be overcome only by substantive evidence  
18 creating a serious doubt concerning the prudence of the decision  
19
- 20 • A standard of reasonableness under the circumstances that were known or could  
21 have been known at the time the decision was made should be used  
22
- 23 • The use of hindsight is to be avoided  
24
- 25 • Prudence should be determined in a retrospective, factual inquiry  
26  
27

28 The NRRI report, at page 58, cited a recent case where the Massachusetts  
29 Department of Public Utilities determined that:  
30  
31

32 "[A utility's] actions should be judged by asking whether they were prudent at  
33 the time, under all the circumstances, considering that the Company had to  
34 operate at each step of the way prospectively rather than in reliance on  
35 hindsight. Accordingly, the Department will base its findings on how  
36 reasonable individuals would have responded to the particular circumstances  
37 and whether the Company's actions were prudent in light of all conditions and  
38 circumstances which were known or which reasonably should have been known  
39 at the time the decisions were made." (Emphasis added)  
40  
41

42 As will be demonstrated below, applying contemporaneous standards and  
43 avoiding hindsight is of critical importance to an accurate quantification of the  
44 effects of imprudence.  
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48 Q. WHY IS A RETROSPECTIVE, FACTUAL INQUIRY AN IMPORTANT FACET OF THE  
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APPROPRIATE PROCESS FOR DETERMINING PRUDENCE?

A. In TB&A's opinion, a thorough factual inquiry obtained through a detailed retrospective audit of management processes, specific practices applied and decisions made -- when supported by contemporaneous documentation -- provides a firm foundation for the determination not only of management reasonableness and prudence, but also for determining the impacts of imprudence. It is only when a determination of imprudence is clearly drawn, and the specific nature of the imprudence is carefully and precisely defined that it provides the proper insight into the implications and impacts of the management action. Without such insight, accurate quantification is not possible.

To state this concept in a slightly different form, it is essential to know the specific nature of, and boundaries of, the management imprudence before the consequences of the action or decision can be understood. And unless the consequences are understood, it is impossible to attribute a valid cost to those consequences, because central to the quantification of the impacts of imprudence is the ability to compute the incremental cost associated with specific acts of imprudence.

Proper regulatory treatment of imprudence requires first, the precise definition and identification (and proof) of the specific nature of imprudence and second, the careful, reasoned analysis of the incremental costs, if any, associated with the imprudent management actions or decisions.

A. TYPICAL QUANTIFICATION ERRORS

1. INACCURATE SEGREGATION OF THE IMPACTS OF IMPRUDENCE  
FROM PRUDENT MANAGEMENT ACTIONS

Q. CAN YOU GIVE AN EXAMPLE OF THE FAILURE TO ACCURATELY SEGREGATE

1 THE IMPACT OF PRUDENT FROM IMPRUDENT MANAGEMENT?  
2

3 A. Yes. A hypothetical example could be a quantification that removes all costs  
4 associated with the construction of a nuclear reactor containment based upon a  
5 determination that management made an unreasonable and imprudent selection of the  
6 type of containment to be used. Presume for a moment that the assessment of  
7 management imprudence was validly based on a sound factual understanding of the  
8 contemporaneous alternatives available and, further, even documented by a  
9 contemporaneous internal memorandum wherein management judged itself to have  
10 acted unreasonably. Even in this hypothetical example, it is clear that there would  
11 still have been some costs associated with even the optimum choice among  
12 containment alternatives. Thus, the quantification removing all costs associated with  
13 the initially selected reactor containment decision would be unfounded. The error in  
14 this example is in failing to distinguish between the consequences of the prudent and  
15 imprudent management actions, and failure to correctly segregate the cost  
16 consequences of imprudence.  
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31 Q. HAVE ANY OF THE WITNESSES IN THIS PROCEEDING FAILED TO ACCURATELY  
32 SEGREGATE THE IMPACTS OF THEIR ALLEGED IMPRUDENT ACTIONS ON THE  
33 PART OF PECO IN MANAGING THE LIMERICK PROJECT?  
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37 A. Yes. For example, OCA Witness O'Brien computes a deduction of all costs associated  
38 with the Mark II modifications to the Limerick containment without distinguishing  
39 those costs that would have been incurred even if OCA Witness Hanauer's alleged  
40 imprudence -- the failure to have all of the Mark II hydrodynamic forces identified at  
41 an early stage of the Limerick design -- had not occurred.  
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47 Q. HOW CAN THE INCREMENTAL COSTS OF AN IMPRUDENT ACTION BE  
48 COMPUTED?  
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1 A. The classical computation is for the analyst to compute the effects with the  
2 imprudent action and compare the results to a computation which excludes the  
3 imprudent action while substituting a reasonable and prudent alternative action. In  
4 the regulatory arena, the ideal quantification would be the incremental present worth  
5 of all future minimum revenue requirements incurred as a result of the imprudent  
6 decision or action.  
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13 Q. WHAT ARE THE CONSEQUENCES OF NOT COMPUTING INCREMENTAL IMPACTS  
14 WHEN ATTEMPTING TO QUANTIFY IMPRUDENCE?  
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17 A. The quantification would be incomplete and one-sided, and therefore invalid, unless all  
18 of the incremental impacts of an alleged imprudent management action or decision  
19 had been evaluated.  
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23 For example, for the PPUC to consider only the cost increase aspects of a  
24 utility's action or decision, and ignore the associated cost decrease or cost benefit  
25 aspects, would be unreasonable. The PPUC would not be sending the utility the  
26 correct signal that minimizing the net impact on the ratepayer (present worth of all  
27 future minimum revenue requirements) is of paramount importance. Rather, the  
28 PPUC would be signalling that the utility should not risk taking actions that might  
29 maximize benefits to the ratepayer, because of the danger that a one-sided prudence  
30 assessment might address only the costs of providing those benefits rather than the  
31 expected value of those benefits net of costs.  
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41 Q. HAS TB&A FOUND EXAMPLES OF THE FAILURE TO COMPUTE THE  
42 INCREMENTAL CONSEQUENCES OF AN ALLEGED IMPRUDENCE BY WITNESSES  
43 IN THIS PROCEEDING?  
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47 A. Yes. For example, OCA witness O'Brien fails to compute any of the beneficial  
48 consequences of an alleged imprudent action by PECO -- specifically the decision by  
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1 PECO to await final resolution of the hydrodynamic forces in the Mark II containment  
2 instead of gambling on the efficaciousness of an anticipated solution. Included among  
3 these benefits is avoidance of the added costs of rework experienced by others who  
4 pursued the gambit recommended by OCA witnesses Hanauer and O'Brien. OCA  
5 witness O'Brien's computations for his alleged imprudent decision are incomplete  
6 because they fail to address all of the consequences and their incremental impacts on  
7 total project costs.  
8

9 OCA witness O'Brien also expresses the opinion "that reasonable and prudent  
10 project management should dedicate itself to completing a project such as this as  
11 expeditiously as prudently possible." (emphasis added) (OCA Statement No. 1, p. 7)  
12

13 Taken together, the pressure to gamble, and the emphasis on completing a  
14 project as expeditiously as possible, is not prudent project management.  
15

16 Q. WHY IS THIS SO?  
17

18 A. If the PPUC were to accept this basic premise of OCA witness O'Brien's, the signal to  
19 the utility companies under its jurisdiction would be to emphasize schedule  
20 performance at the expense of increased project costs. This signal might well cause  
21 increased capital costs for a project. For instance, in the case of the Trans Alaska  
22 Pipeline System, the Senior Project Manager for the owners admitted that  
23 "unfortunately, an attitude of 'Gold Plating' has evolved... manifested in slugging the  
24 project with people, equipment, etc.". (Document 2-1-38, FERC Docket No. OR 78-  
25 1). This undue emphasis on schedule performance resulted ultimately in higher project  
26 cost levels.  
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28 Other consequences of undue schedule emphasis could include a utility's  
29 deciding to postpone modifications designed to increase the efficient and reliable  
30 operation of the plant which could result in decreased net benefits to the ratepayer.  
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2. IMPLICIT USE OF HINDSIGHT IN QUANTIFYING IMPRUDENCE

Q. WHAT DO YOU MEAN BY THE IMPLICIT USE OF HINDSIGHT, AND HOW DOES THIS ERROR OCCUR?

A. The implicit use of hindsight most often occurs during the process of quantification when numerical values must be supplied in the quantification calculation. The numerical values closest to hand are often current values known at the time of quantification but unknown at the time of the alleged imprudent action or decision. The error typically occurs because the specific nature, consequences and boundaries of the alleged imprudent action or decision have not been clearly defined before quantification, nor with a view toward being helpful to the quantification.

Q. HAVE YOU FOUND ANY EXAMPLES OF THE IMPLICIT USE OF HINDSIGHT IN THIS PROCEEDING?

A. Yes. The cashflow requirements which OCA witness O'Brien introduced as implicit assumptions into his schedule analysis, where he purports to arrive at a 12/81 completion date for Limerick 1 and Common, were not the requirements anticipated by either Bechtel or PECO at the time these dollars were to have been supplied. The cashflows for the period from 1975 through 1982 were derived from a hindsight analysis, implying a prediction of regulatory requirements (and their cost impacts) as early as 1975 that were not known or knowable until several years later.

3. FAILURE TO RECOGNIZE THE UNREALISTIC NATURE OF SOME "WHAT-IF?" QUESTIONS WHEN QUANTIFYING

Q. PLEASE DESCRIBE WHAT YOU MEAN BY THE UNREALISTIC NATURE OF "WHAT-IF?" QUESTIONS IN THE CONTEXT OF QUANTIFYING ALLEGED IMPRUDENCE.

A. In alleging imprudence, one of the common errors is to ignore the question of whether an action or decision is within management's control, as opposed to the control of an

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1 external force or party. Often the allegation of imprudence oversimplifies the  
2 environment by ignoring the role and impact of regulatory bodies and their  
3 requirements.  
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6 For "What-if?" purposes, it is easy to wave away the impacts of regulatory  
7 requirements and/or to minimize the impacts that complying with those requirements  
8 have in the real world. It is not unusual for the presentation of the quantification of  
9 an alleged imprudence (in terms of an alleged reasonable alternative or "What-if?"), to  
10 have glossed over the lack of a factual basis for the "What-if?" and the false portrayal  
11 of reality it represents.  
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13

14 Q. HAVE ANY WITNESSES IN THIS PROCEEDING FAILED TO RECOGNIZE THE  
15 UNREALISTIC NATURE OF A "WHAT-IF?" THEY HAVE PRESENTED?  
16

17 A. Yes. OCA witness Hanauer presents his conclusion that non-Mark II regulatory  
18 requirements could have been resolved by PECO for Limerick I and Common in time  
19 for a mid-1982 completion date of Limerick. This "What-if?" is then used by OCA  
20 witness O'Brien in his quantification of the alleged imprudence due to schedule delays  
21 for Limerick.  
22

23 What is unfortunately glossed over, is the unrealistic nature of the "What-if?"  
24 that OCA witness Hanauer has introduced when he ignores the unique nature of the  
25 regulatory requirements for non-Mark II issues which PECO had to resolve for  
26 Limerick in compliance with specific NRC edicts. For example, OCA witness Hanauer  
27 admits that the requirement of a Probabilistic Risk Assessment (PRA) for Limerick  
28 was unique in the industry, but he ignores the fact that this non-Mark II requirement  
29 set off a chain of related events which became near critical to the Limerick schedule  
30 completion date of October 26, 1984. These events which culminated in the  
31 September 1, 1984 completion of ATWS modifications, included:  
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- The NRC requirement of a PRA for Limerick
  - The comprehensive review process for the PRA after submittal to the NRC
  - PECO's submittal of its FSAR to the NRC to obtain a low power license being delayed approximately 3 months until the PRA review was completed.
  - The PRA's showing that a sophisticated solution to Anticipated Transient Without Scram (ATWS) would reduce the overall "risk" associated with Limerick's high population density site
  - The NRC specification of a "maximum" solution to ATWS, denoted "Alternate 4A", for Limerick -- more extreme than for low population density sites<sup>1/</sup>
  - PECO's persuasion of the NRC to adopt ATWS solution "3A", which was not as extreme as "4A"
  - The licensing-design-procurement-installation-testing of the ATWS "3A" solution which became a near critical activity sequence in the completion of Limerick Unit 1 and Common.

29 Q. HAS OCA WITNESS HANAUER DEMONSTRATED AN UNAWARENESS OF THE  
30 NRC'S POSITION, AND IMPACT OF, LIMERICK-SPECIFIC ATWS REQUIREMENTS?  
31  
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33 A. Yes. In response to several questions, OCA witness Hanauer separately demonstrated  
34 that he is unfamiliar with, and does not believe that the NRC took the specific position  
35 in April, 1980, that "for those reactors at sites with higher population densities,  
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42 <sup>1/</sup> NRC caution with regard to Limerick was expressed in an  
43 April 16, 1980 letter from Milton S. Plesset, Chairman of  
44 the Advisory Committee on Reactor Safeguards (ACRS) to John  
45 F. Ahearne, Chairman of the Nuclear Regulatory Commission.  
46 Mr. Plesset wrote that, "The ACRS believes that for those  
47 reactors at sites with higher population densities,  
48 additional considerations are appropriate ... Limerick  
49 should be provided with a boron injection system having the  
50 reliability and reactivity reduction capability of Alternate  
4A ...."

1 additional considerations are appropriate. . . Limerick should be provided with a boron  
2 injection system having the reliability and reactivity reduction capability of Alternate  
3 4A". <sup>2/</sup>  
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7 For example, when asked if he would not expect the NRC to require a plant  
8 located in a higher population density area to install greater safety features of an  
9 engineering and construction nature than in a plant not located in such a zone, OCA  
10 witness Hanauer replied:  
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12  
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14 "I feel this is not the case and it used to be a very strongly held position of the  
15 Atomic Energy Commission and the later NRC that they would not do this".  
16 (Transcript pg. 2819, lines 15-22).  
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19 OCA witness Hanauer also testified, when questioned about the greater costs and  
20 schedule a plant located in a high population density zone would experience, that:  
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23 "I don't really know that. If we are talking now about construction costs it would  
24 cost more only if it had different design features, and I have testified that this  
25 plant (referring to Limerick) did not end up with significantly different design  
26 features as far as I know due to its high population density". (Transcript pg. 2819,  
27 lines 3-8)  
28

29 and further that:  
30

31 "I don't know any reason for the construction schedule to be affected by the high  
32 population density." (Transcript p. 2819, lines 13-14).  
33

34 Q. HAS OKA ACKNOWLEDGED ON OTHER NUCLEAR PROJECTS THAT NON-MARK II  
35 REGULATORY CHANGES HAVE HAD A SIGNIFICANT COST AND SCHEDULE  
36 IMPACT?  
37

38 A. Yes. The following are examples of previous OKA statements on the impact of  
39 regulatory change:  
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42 On page 4-11 and 4-12 of the OKA report on Callaway, OKA states:  
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45 "There is no doubt at all that the regulatory requirements  
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50 <sup>2/</sup> IBID.

1 for nuclear power plant design, construction, and operation increased  
2 substantially with time over the period of design and construction of  
3 Callaway . . . At the outset, we wish to reiterate that regulatory  
4 requirements escalation was real, and no doubt caused significant  
5 increases in Callaway."  
6

7 On page 5-7 of the OKA report on Zimmer, OKA states:  
8

9 "The TMI changes in NRC requirements (listed in Table 5-3) caused  
10 rework, and imposed delays in the range of one to two years. The  
11 cost of this delay was in addition to the cost of the new equipment  
12 required for TMI. In those plants where there was no allowance for  
13 payment of construction work in progress (CWIP), the growth in the  
14 interest rates and the added delay combined to make increase in  
15 Allowance for Funds Used During Construction (AFUDC) dramatic. In  
16 many of these post-TMI plants, the AFUDC will be approximately half  
17 of the total cost of the plant at the time of fuel load."  
18

19 On page 6 of the Hanauer Surrebuttal at Callaway, Hanauer states:  
20

21 "Following the Brown's Ferry fire, the NRC issued drastically  
22 upgraded fire protection requirements in 1976, and has been  
23 clarifying, interpreting and improving them ever since."  
24

25 4. OVERSIMPLIFICATION OF COMPLEX EVENTS  
26

27 Q. WHAT ARE THE IMPLICATIONS OF THE OVERSIMPLIFICATION OF COMPLEX  
28 EVENTS AS APPLIED TO THE QUANTIFICATION OF ALLEGED IMPRUDENCE?  
29

30 A. Simply stated, it is often convenient when attempting to maximize the cost reduction  
31 associated with an alleged imprudence to ignore the realities of the true complexities  
32 associated with a major project construction. Often this simplification takes the form  
33 of compressing a project schedule, for purposes of attributing a maximal delay to the  
34 alleged imprudent decision or action, to a point of absurdity. A schedule compression  
35 of this type most often ignores external realities.  
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42 Q. HAVE ANY OF THE WITNESSES IN THIS PROCEEDING OVERSIMPLIFIED THE  
43 EXTERNAL REALITIES FACING LIMERICK IN THEIR PROPOSED  
44 QUANTIFICATION OF ALLEGED MANAGEMENT IMPRUDENCE?  
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48 A. Yes. PPUC Staff witness Dougherty in defining the delay associated with PECO's  
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alleged imprudent decision to defer the completion date of Limerick Unit 1 and Common asserts "that without these delays, Limerick Unit 1 would have been completed in April 1981" (Trial Staff DPD No. 1, pg. 2). In his quantification of the schedule delay costs associated with PECO's alleged imprudent deferral decisions of 1976 and 1978, Staff witness Dougherty refers several times to "April 1981" as the achievable in-service date for Limerick Unit 1 and Common. Even OCA witness O'Brien acknowledged that, despite his hypothetical alternative schedule completion date for Limerick 1 of December 1981, "no U.S. Boiling Water Reactor (BWR) facility with a construction start contemporaneous with Limerick's completed construction any time in 1981 or before" (OCA Statement No. 1, pg. 6). When questioned further as to "Why not?", OCA witness O'Brien replied:

"There were many reasons - economic, political, social and commercial. Of these, it is clear that the most important was a class of externally-imposed regulatory changes...." (OCA Statement No. 1, pg. 13)

And as OCA witness O'Brien notes in his analysis, the most important reason (which Staff witness Dougherty ignores) that no unit was able to achieve a fuel load date earlier than 1982 was "a class of externally-imposed regulatory changes".

Clearly any quantification based on the impossible, a quantification which ignores even the realities admitted by OCA witness O'Brien, is invalid and should be dismissed out of hand.

5. USE OF AN INCORRECT STANDARD

Q WHAT OTHER CATEGORY OF ERRORS HAVE YOU ENCOUNTERED IN YOUR REVIEW OF THE QUANTIFICATION TESTIMONY OF WITNESSES IN THIS PROCEEDING?

A. There is another common quantification problem which TB&A terms "standards creep" to refer to the fact that the standard applied in attempting to quantify the impacts of

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alleged imprudence can often move outside the bounds of the original definition intended by either the reviewer or the regulator. Some refer to this as the "moving target" problem for standards. In its most common form, the quantifier implicitly introduces a higher standard -- often tending toward a standard of perfection -- into his analysis.

For example, in this proceeding, OCA witnesses Hanauer and O'Brien, by comparing Limerick's completion date to that of LaSalle Unit 1 have implicitly introduced a standard of the best BWR schedule performance, as measured by the duration from receipt of construction permit to fuel load. Similarly, the Susquehanna Unit 1 completion date, which is close to the completion date of LaSalle Unit 1, has also been used incorrectly as a basis for comparison by OCA witness O'Brien.

In TB&A's opinion, neither the LaSalle Unit 1 nor Susquehanna Unit 1 completion dates are appropriate bases of comparison for quantifying the alleged imprudence associated with the actual Limerick Unit 1 and Common plant completion date on two counts:

- Comparisons of this type are inevitably unsound because they ignore the important differences between the units (such as uniqueness of design features, total quantities installed, site population density, unique regulatory requirements, intensity of regulatory scrutiny, etc.) in favor of superficial similarities--such as those cited by OCA witness O'Brien of "the same labor market, the same weather conditions" for Susquehanna and Limerick (Tr. 3110, lines 10-11), and
- Both LaSalle and Susquehanna are clearly at the very top end of the performance spectra, being the first two plants of Limerick's type to achieve fuel load, and therefore imply a standard of prudence which requires the best performance in

1  
2 order to be reasonable.

3  
4 6. USE OF INCONSISTENT ASSUMPTIONS

5 Q. ARE THERE ANY OTHER TYPES OF ERRORS YOU HAVE NOTED IN YOUR REVIEW  
6  
7 OF THE QUANTIFICATION TESTIMONY OF OCA WITNESSES IN THIS  
8  
9 PROCEEDING?

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11 A. Yes. I have noted that OCA witness O'Brien has made several assumptions in his  
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13 testimony which are inconsistent. In fact, he has treated related assumptions as if  
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15 they were independent, with the net affect that he has constructed an invalid  
16  
17 quantification that does not reflect the assumptions underlying his hypothetical  
18  
19 alternative schedule for Limerick 1 and Common plant.  
20

21 As OCA witness O'Brien acknowledges, his hypothetical alternative schedule  
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23 (JJO'B-13) is not based on an analysis of underlying commodities to be installed nor  
24  
25 the manpower required to install the commodities (Tr. pg. 3121-3122). This lack of a  
26  
27 connection between his hypothetical alternative completion date for Limerick of  
28  
29 December, 1981 and the underlying logic is compounded by his applying "as-built  
30  
31 experience" to develop a cashflow pattern (JJO'B-17) which is completely  
32  
33 "disconnected" from his hypothetical alternative schedule (JJO'B-13)-(Tr. 3122-3127).  
34  
35 That is, his resources applied are not consistent with the alternative schedule  
36  
37 completion date for Limerick which he offers.

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39 Q. HAVE YOU NOTED ANY INCONSISTENCIES IN POSITIONS TAKEN BY OCA  
40  
41 WITNESSES O'BRIEN AND HANAUER?

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43 A. Yes. In his prepared surrebuttal testimony<sup>3/</sup> "regarding regulatory effects on the cost  
44  
45 and schedule of the Callaway plant", Mr. Hanauer testified in support of Mr. O'Brien  
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48  
49 3/ Missouri Public Service Commission - Union Electric Company  
50 Case Nos. ER-84-168 and EO-85-17, November, 1984, pg. 6.

1 "because I participated in the analysis of Callaway design and construction that  
2 formed the basis of Mr. O'Brien's testimony." In summarizing the O'Brien-Hanauer  
3 review basis, Mr. Hanauer states<sup>4/</sup>:  
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7 "Our review properly concentrated on the results achieved ... it is  
8 the results rather than the process by which prudence should be  
9 judged, in our opinion."  
10

11 In contrast, OCA witness O'Brien in this proceeding testified that:  
12

13 "I don't believe that looking at the bottom line is an appropriate  
14 comparison as to whether something is prudent or imprudent."  
15 (Transcript pg. 3157, lines 2-4).  
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19 III. THE AS-BUILT SCHEDULE ANALYSIS OF LIMERICK UNIT 1 AND COMMON

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21 A. THE DEVELOPMENT OF AN AS-BUILT SCHEDULE FOR LIMERICK 1 AND  
22  
23 COMMON  
24

25 Q. WHY DID TB&A DEVELOP AN "AS-BUILT" SCHEDULE FOR LIMERICK?

26  
27 A. TB&A developed an "as-built" schedule for Limerick 1 and Common plant to provide a  
28 sound basis for assessing the validity of hypothetical alternative schedules offered by  
29 OCA witnesses Hanauer and O'Brien and PPUC Staff witness Dougherty.  
30  
31

32 The Limerick Unit 1 and Common "as-built" schedule provides a representation  
33 of the actual Limerick construction activities and identifies the critical and near  
34 critical path activities as they occurred on the project. An important aspect of  
35 reconstructing the critical path is that the "as-built" critical path is not necessarily  
36 always the same as the critical path as it was perceived during the course of the  
37 project, primarily due to the impact of unforeseen events which changed the course of  
38 critical path activities.  
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4/ I BID. pg. 25.

1 Q. WHAT IS THE BASIS OF TB&A'S "AS-BUILT" SCHEDULE?  
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3 A. TB&A utilized the multitude of available project schedule documentation to formulate  
4 an "as-built" schedule based on the documented sequence and duration of project  
5 activities. TB&A's "as-built" schedule consists of approximately 900 activities and  
6 includes project construction activities for the containment, reactor enclosure,  
7 control enclosure, turbine enclosure and the many other facilities that constitute the  
8 Limerick project.  
9

10 Q. PLEASE FURTHER DESCRIBE THE APPROACH TB&A USED IN DEVELOPING THE  
11 "AS-BUILT" SCHEDULE FOR LIMERICK.  
12

13 A. TB&A's "as-built" schedule begins with the receipt of the construction permit on  
14 June 19, 1974 and includes activities through initiation of fuel loading on October 26,  
15 1984. Information regarding the actual dates for activity start and completion,  
16 number of weeks required to accomplish an activity, and the sequencing logic of the  
17 activities was derived from various project schedules and documents including:  
18

- 19 - Master Schedule and Control System Schedules (MSCS)
- 20 - Intermediate Construction Schedules (ICS)
- 21 - Limerick 24 Month Construction Schedule
- 22 - Limerick 18 Month Construction Schedule
- 23 - Limerick 12 Month Construction Schedule
- 24 - Bechtel Monthly Progress Reports
- 25 - Limerick Startup Schedules
- 26 - Limerick Preop Status Table
- 27 - Limerick Monthly Project Status Reports
- 28 - Special Purpose Schedules

29 The period from receipt of the construction permit to mid-1979 was based  
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1 primarily on information regarding completed activities contained within the MSCS  
2 schedules. From mid-1979 through the beginning of the startup phase in mid-1982, the  
3 Intermediate Construction Schedules, and the 24, 18 and 12 month schedules were used  
4 to incorporate "as-built" information. Finally, for the startup phase of the project,  
5 from mid-1982 through October 1984, TB&A utilized the various revisions of the  
6 startup schedule supplemented by the information contained within the Preop Status  
7 Tables.  
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15 Q. WHAT INFORMATION REGARDING THE ACTUAL LIMERICK SCHEDULE DID  
16 YOUR ANALYSIS PROVIDE?  
17

18 A. Our analysis of the "as-built" schedule provided a determination of the 56 key  
19 activities and their durations that comprised the actual critical path for Limerick. In  
20 addition to the critical path activities, 22 near critical path activities and 17  
21 milestone events were identified. The critical path activities are presented in  
22 Appendix A.  
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29 Q. WHAT IS MEANT BY NEAR CRITICAL PATH ACTIVITIES?  
30

31 A. Near critical path activities are those activities whose durations are within a few  
32 months of becoming critical path activities. The duration of near critical path  
33 activities is important because they could become the critical path to project  
34 completion if either one of two conditions were realized; 1) if the Company were able  
35 to decrease the durations of actual critical activities by a few months or 2) if the near  
36 critical path activities schedule durations were extended.  
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43 Q. WHAT WERE THE ACTUAL MILESTONES THAT OCCURRED DURING THE  
44 CONSTRUCTION OF LIMERICK?  
45

46 A. A listing of the milestones derived from TB&A's "as-built" schedule analyses is  
47 presented in Schedule 1.  
48  
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SCHEDULE 1 - LIMERICK UNIT 1 & COMMON "AS-BUILT" MILESTONES

<u>ACTIVITY</u>	<u>DATE</u>
Receipt of the Construction Permit	June 19, 1974
Begin Forming, Reinforcing and Pouring Containment/Reactor Enclosure Basemat	June 19, 1974
Set Cranes for Containment Activities	December 11, 1974
Start Suppression Pool Rebar	January 29, 1975
Set Reactor Pressure Vessel	December 8, 1976
Start Reactor Shield	January 12, 1977
Start Mechanical and Electrical Work in the Drywell	December 7, 1977
Complete Drywell el. 272' & 286' Structural Steel	May 24, 1978
Phase I Post Tensioning of Fuel Pool Girders	August 16, 1978
Start Mechanical and Electrical Work at Elevation 283' in the Reactor Enclosure	August 30, 1978
Initial Energization of 13.2 KV system	July 7, 1982
Turnover of first system in Drywell (Core Spray System)	June 29, 1983
Turnover of first system at Elevation 283' in the Reactor Enclosure (Core Spray System)	June 29, 1983
Completion of the ATWS Modifications	September 1, 1984
Last Test Results Approved for system in Drywell (Feedwater System)	October 10, 1984
Last Test Results Approved for System at Elevation 283' in Reactor Enclosure, (Containment Atmospheric Control System)	October 24, 1984
Receipt of Low Power License & Initiation of Fuel Loading	October 24, 1984

Note: Dates may not be exact due to rounding within each calendar week.

1 Initial milestones are concrete and structural activities while subsequent  
2 milestones denote the start of mechanical and electrical activities in the post-1976  
3 period. The later milestones in the 1982 to 1984 period are the startup and system  
4 turnover activities leading up to fuel load.  
5  
6  
7  
8

9 Actual milestones are a basis for comparing alternate schedule scenarios with  
10 the "as-built" schedule for Limerick.  
11

12  
13 Q. WAS TB&A'S "AS-BUILT" SCHEDULE REVIEWED BY THE COGNIZANT PECO AND  
14 BECHTEL PERSONNEL?  
15

16  
17 A. Yes. Throughout the course of its development by TB&A, PECO and Bechtel personnel  
18 reviewed and verified the Limerick "as-built" schedule. This verification provided an  
19 additional level of assurance that the information and logic that was incorporated into  
20 the "as-built" schedule represented the durations and sequences of activities as they  
21 actually occurred during the construction of Limerick Unit 1 and Common.  
22

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25  
26  
27 B. AS-BUILT CRITICAL PATH ANALYSIS  
28

29 Q. PLEASE DESCRIBE THE RESULTS OF YOUR "AS-BUILT" SCHEDULE ANALYSIS?  
30

31 A. The results of TB&A's "as-built" schedule analysis are presented in Appendix A. In  
32 addition to a description of, and tabulation of critical path construction activities,  
33 Appendix A also displays a Gantt chart illustrating the logic sequence for each of the  
34 key critical path activities as well as a listing of all activities included in the "as-  
35 built" schedule analysis.  
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41 Q. WHAT OTHER ACTIVITIES IN ADDITION TO CONSTRUCTION ACTIVITIES MUST  
42 ONE CONSIDER IN DETERMINING THE ULTIMATE FUEL LOAD DATE?  
43

44  
45 A. In addition to construction activities, a nuclear power plant project schedule is  
46 controlled by a series of licensing and regulatory activities involving the NRC and  
47 other regulatory authorities. For example, although all construction and startup test  
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50

1 activities may have been completed, loading of fuel cannot commence until all of the  
2 licensing requirements have been resolved to the satisfaction of the NRC.  
3

4  
5 Q. PLEASE PROVIDE EXAMPLES OF LICENSING OR REGULATORY ACTIVITIES  
6 WHOSE RESOLUTION AND IMPLEMENTATION EXTENDED BEYOND MID-1982.  
7

8  
9 A. Two examples are the resolution of, and installation efforts associated with, the  
10 Radiation and Meteorological Monitoring System (RMMS), which was a result of the  
11 Three Mile Island Unit 2 incident and, the Anticipated Transient Without Scram  
12 (ATWS) modifications described earlier in Section II of this testimony.  
13

14  
15 Q. HOW HAS YOUR "AS-BUILT" SCHEDULE ACCOUNTED FOR REGULATORY ITEMS  
16 SUCH AS THOSE MENTIONED ABOVE?  
17

18  
19 A. Although TB&A's "as-built" schedule focuses on construction activities, it is important  
20 to recognize that these "as-built" activities include the licensing resolution efforts  
21 associated with each and every regulatory item that affected the Limerick project.  
22 Thus, an "as-built" schedule inherently incorporates the licensing and regulatory  
23 requirements and their impact on the project completion date. By contrast, the use of  
24 an earlier vintage schedule, such as the 1974 MSCS schedule which OCA witness  
25 O'Brien chose to use as the basis for his schedule analysis, requires that each of the  
26 subsequent regulatory requirements and their impacts be explicitly addressed.  
27

28  
29 Q. HAS OCA WITNESS O'BRIEN CONSIDERED THE MULTITUDE OF REGULATORY  
30 REQUIREMENTS IMPOSED ON THE PROJECT SUBSEQUENT TO 1974 AND THEIR  
31 IMPACT ON THE LIMERICK PROJECT?  
32

33  
34 A. No. Other than an adjustment for the resolution of the Mark II containment problem,  
35 OCA witness O'Brien has not made any explicit adjustments for regulatory  
36 requirements and their impact subsequent to 1974.  
37

38  
39 The magnitude of effort associated with the increased regulatory requirements  
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1 on the Limerick project is illustrated in Schedule 42 of PECO Statement No. 8 and is  
2 in the order of one billion dollars. The fraction of this increase that OCA witness  
3 O'Brien has accounted for, the \$136.1 million associated with Mark II plus  
4 approximately \$85 million of cost increases between December 1970 and June 1974  
5 which are inherent in the June 1974 MSCS schedule, is small.  
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10 Indeed as, OCA witness O'Brien stated during cross-examination neither the  
11 increased costs associated with non-Mark II regulatory items, nor the increased costs  
12 due to estimate refinements and other causes, were included in OCA witness O'Brien's  
13 schedule representation of the Limerick project. (Tr. pgs. 3114-3117.)  
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19 Q. WHAT REASON DID OCA WITNESS O'BRIEN PROVIDE FOR NOT INCLUDING  
20 THESE INCREASES?  
21

22 A. OCA witness O'Brien stated that it was his belief that the time provided as a result of  
23 the extension in 1974 and his derived Mark II extension was adequate to accomplish all  
24 these other changes. (Tr. pgs. 3116-3117.)  
25  
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29 OCA witness O'Brien has also confirmed that he did not do any analysis  
30 specifically related to the physical structures to be built, the space available in those  
31 structures, the commodities to be installed, or the manpower available for the  
32 installation to determine if his "enough time" assumption and that of Dr. Hanauer's  
33 was correct. (Tr. pg. 3117.)  
34  
35  
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39 Q. WHAT IS YOUR CONCLUSION REGARDING OCA WITNESS O'BRIEN'S ABOVE  
40 ASSUMPTIONS?  
41

42 A. His assumption that all of the project increases that occurred subsequent to 1974 and  
43 prior to 1982 could have been accomplished to support a 1982 fuel load, is incorrect.  
44 Our analysis of the Limerick "as-built" critical path as presented in the following  
45 sections III.C and IV of this testimony provides the basis for this conclusion.  
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C. COMPARISON OF TB&A'S "AS-BUILT" SCHEDULE FOR LIMERICK WITH OCA WITNESS O'BRIEN'S SCHEDULES.

Q. HAS TB&A REVIEWED OCA WITNESS O'BRIEN'S SCHEDULES AND ANALYSIS WHICH HE PRESENTS IN OCA STATEMENT 1?

A. Yes. TB&A compared the "as-built" schedule presented herein to the schedules in OCA Statement 1, Exhibits JJO'B-3, 4 and 13. This comparison included an analysis of activity durations, the sequencing of activities (logic), as well as a comparison of OCA witness O'Brien's critical path with the "as-built" critical path for Limerick.

Q. WHAT ARE THE DETAILS OF YOUR ASSESSMENT OF THE THREE SCHEDULES PRESENTED BY OCA WITNESS O'BRIEN?

A. OCA witness O'Brien's schedule presented in OCA Statement 1, Exhibit JJO'B-3, is an accurate representation of the June 1974 MSCS schedule provided to OCA by PECO. However this MSCS schedule was the project's estimate, as of June 1974, of the required schedule activities as recognized prior to receipt of the construction permit. It is missing the several construction activities and numerous activity sequence modifications that were added into subsequent MSCS schedules, none of which are recognized in any of OCA witness O'Brien's schedules.

Q. HAVE YOU REVIEWED THE METHODOLOGY USED BY OCA WITNESS O'BRIEN IN CREATING HIS ADJUSTED SCHEDULE PRESENTED IN OCA STATEMENT 1 EXHIBIT JJO'B-4?

A. Yes. This schedule is purported to represent the incorporation of the 1974 deferral decision, resultant cashflows and actual progress through May 1976, after which additional cash flow limitations were imposed. Thus, on a milestone basis, this schedule should reflect actual progress as of the end of May 1976. It does not however. OCA Exhibit JJO'B-4 shows that setting of the RPV is completed on April 7,

1 1976 whereas the actual project schedule issued April 9, 1976 projects RPV set to  
2 occur on September 3, 1976. Thus Exhibit JJO'B-4 erroneously shows the setting of  
3 the RPV occurring five months earlier than projected at a time prior to the 1976  
4 deferral decision.  
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9 This difference in dates for setting of the RPV directly affects his fuel load date  
10 (because RPV set is a critical path activity), by extending OCA witness O'Brien's fuel  
11 load five months beyond the October 1980 date in Exhibit JJO'B-4. This inaccuracy is  
12 caused by the fact that OCA witness O'Brien has erroneously inflated the cashflows  
13 for the 1975 through May 1976 period above those actually experienced, thereby  
14 incorporating a fallacious difference between actual and purported progress through  
15 May 1976 for his adjusted schedule.  
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23 This error is also incorporated in OCA Exhibit JJO'B-13, thus effectively denying  
24 PECO any benefit from the Commission's determination at Docket No. I-80100341  
25 that the 1974 deferral announcement was prudent in light of the financial  
26 circumstances of the Company at that time and during immediate subsequent  
27 periods. In light of the Company's financial condition during the late 1974 to early  
28 1976 period, and based upon TB&A's understanding of the Commission's Order, the  
29 correct methodology for reflecting this prudent action by the Company would have  
30 been to constrain project cash flow to actual levels through May 1976.  
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39 Q. HAVE YOU IDENTIFIED ANY OTHER ERRORS IN YOUR REVIEW OF EXHIBITS  
40 JJO'B-4 and JJO'B-13?  
41

42  
43 A. Yes, TB&A has. There are several errors in JJO'B-13 where key activity completions  
44 prior to June, 1976 do not agree with as-built dates. In addition, the schedules  
45 presented in OCA Statement 1, Exhibits JJO'B-4 and JJO'B-13 do not reflect the  
46 actual growth in commodities, unit rates and manual manhours that occurred on the  
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1 Limerick project.

2  
3 The 1974 MSCS schedule, which is the basis for the schedules presented in OCA  
4 Statement 1, Exhibits JJO'B-3, JJO'B-4 and JJO'B-13, represents only a fraction of the  
5 actual commodities, unit rates and manual manhours experienced at Limerick. The  
6 significance of the increases that occurred between Forecast 1 (August 1975) and  
7 Forecast 7 (June 1984) is illustrated in Schedules 2, 3 and 4. These Schedules have  
8 been prepared using Forecast 1, produced in August 1975, as a proxy for the values  
9 implicit in OCA witness O'Brien's schedule analyses, and Forecast 7 as a proxy for  
10 both TB&A's "as-built" schedule and as the basis for the PECO/Bechtel schedule  
11 analyses, which is discussed later. OCA witness O'Brien implicitly used values that  
12 were even lower than Forecast 1 since he used as his starting point an MSCS schedule  
13 produced in June 1974, some 14 months earlier than Forecast 1.  
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25 Q. WHAT ARE SOME OF THE MORE DRAMATIC CHANGES THAT OCCURRED FROM  
26 FORECAST 1 TO FORECAST 7?  
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29 A. The quantity of large pipe hangers, large pipe welds and conduit increased 80%, 95%  
30 and 208% respectively between Forecasts 1 and 7. The most notable unit rate  
31 increase was for hangers, increasing from 33 manhours/hanger in 1975 to 144  
32 manhours/hanger in 1984. It should be noted that the 1984 unit rate of 144  
33 manhours/hanger is a cumulative value, i.e., by 1984 each hanger that had been  
34 installed required an average of 144 manhours to install. The resultant impact on  
35 manual manhours was significant. For example, large pipe hanger installation  
36 increased 1.7 million manhours while small pipe hanger installation increased 1.6  
37 million manhours. Both of these activities directly affected, and thereby extended,  
38 the Limerick 1 & Common critical path.  
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49 Q. WHAT PORTION, IF ANY, OF THESE COMMODITY AND MANHOUR INCREASES  
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SCHEDULE 2 -- LIMERICK 1 & COMMON

COMMODITY COMPARISON - FORECAST 1 VS. FORECAST 7

	<u>Forecast 1</u> (August 1975)	<u>Forecast 7</u> (June 1984)	<u>Increase</u>	
			<u>Quantity</u>	<u>Percent</u>
Concrete (cu. yds)	227,502	271,395	43,893	19.3%
Structural Steel (tons)	8,185	8,305	120	1.5%
Rebar (tons)	15,957	21,016	5,059	24.1%
Form (sq. ft.)	2,212,713	2,391,502	180,789	8.2%
Large Pipe Welds (ea)	17,586	34,220	16,634	94.6%
Large Pipe (ft.)	303,163	346,587	43,424	14.3%
Large Pipe Hangers(hgr.)	7,468	13,418	5,950	79.7%
Small Pipe (ft.)	171,065	213,009	41,944	24.5%
Cable Tray (ft.)	47,300	53,325	6,025	12.7%
Conduit (ft.)	127,100	391,656	264,556	208.1%
Wire & Cable (ft)	4,151,016	5,933,590	1,782,574	42.9%
Terminations (ea.)	142,242	186,210	43,968	30.9%

SCHEDULE 3 -- LIMERICK 1 & COMMON

UNIT-RATE COMPARISON - FORECAST 1 VS. FORECAST 7

	<u>Units</u>	<u>Forecast 1</u> (August 1975)	<u>Forecast 7</u> (June 1984)
Concrete	Mhrs/cu. yd	2.83	2.99
Large Pipe	Mhrs/ft.	3.44	4.21
Small Pipe	Mhrs/ft.	2.19	9.24
Hangers	Mhrs/hgr.	33.03	144.00
Cable Tray	Mhrs/ft.	2.84	3.80
Wire & Cable	Mhrs/ft.	0.08	0.09

SCHEDULE 4 -- LIMERICK 1 & COMMON

MANUAL MANHOUR COMPARISON - FORECAST 1 VS. FORECAST 7

	<u>Manhours</u>		<u>Increase</u>	
	<u>Forecast 1</u> (August 1975)	<u>Forecast 7</u> (June 1984)	<u>Manhours</u>	<u>Percent</u>
Concrete	644,291	810,205	165,914	25.8%
Structural Steel	176,779	227,971	51,192	29.0%
Rebar	465,771	673,270	207,499	44.5%
Form	1,464,178	1,143,763	(320,415)	(21.8%)
Large Pipe Welds	417,410	484,111	66,701	16.0%
Large Pipe	1,042,730	1,459,121	416,391	39.9%
Large Pipe Hangers	246,670	1,932,180	1,685,510	683.3%
Small Pipe	374,900	1,969,000	1,594,100	425.2%
Cable Tray	134,418	202,574	68,156	50.7%
Conduit	140,993	1,201,684	1,060,691	752.3%
Wire & Cable	338,058	553,903	215,845	63.8%
Connections	84,957	172,420	87,463	102.9%
Other Directs	<u>4,673,662</u>	<u>10,826,372</u>	<u>6,152,710</u>	131.6%
Total Directs	10,204,817	21,656,574	11,451,757	112.2%
Distributables	<u>3,311,183</u>	<u>8,308,426</u>	<u>4,997,243</u>	150.9%
Total Manual	13,516,000	29,965,000	16,449,000	121.7%

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DID OCA WITNESS O'BRIEN ACCOUNT FOR THROUGH HIS CASH CONSTRAINT AND MARK II ADJUSTMENT IN HIS SCHEDULE ANALYSIS?

A. OCA witness O'Brien explicitly accounted for less than 5% of the total manual manhour increases which actually occurred. His only manual manhour adjustment was for the manhours associated with the Mark II containment new loads.

Q. HOW DOES THE MARK II ADJUSTMENT BY OCA WITNESS O'BRIEN AS DESCRIBED ABOVE COMPARE TO SIMILAR ADJUSTMENTS HE HAS MADE ON OTHER MARK II PROJECTS?

A. The only other Mark II project on which a publicly available O'Brien-Kreitzberg & Associates, Inc. (OKA) prepared document is available, is the Zimmer project. For Zimmer, OKA based their Mark II extension of containment durations on total budgeted containment manhours as of the end of 1974 (i.e., a budget prior to the identification of the Mark II problem so as to provide a realistic impact of the Mark II problem on containment activities).

Q. HOW WOULD OCA WITNESS O'BRIEN'S LIMERICK ADJUSTMENT FOR MARK II DIFFER IF HE HAD USED A METHODOLOGY SIMILAR TO THAT HE USED FOR THE ZIMMER PROJECT?

A. The OKA Zimmer methodology would have required OCA witness O'Brien to divide the 678,000 Mark II manual manhours for Limerick by the containment manhours as estimated in 1974 or 1975 (prior to the identification of the Mark II containment problem). The total manual manhour estimate from Forecast 1, in August 1975 is 13,516,000 manhours which OCA witness O'Brien computes as 1,216,440 manhours for containment activities (since OCA witness O'Brien assumes containment is 9% of total manual manhours). Using this 1975 estimate as a basis for the adjustment would have increased the duration of containment activities by 56%  $[(678,000 \div 1,216,440) \times 100]$

1  
2 as compared to the 34% used by OCA witness O'Brien in his expansion of Limerick  
3 activities in the MSCS schedule of June, 1974. This difference alone adds 264,410  
4 manual man-hours or about 127 man-years to the containment activities, which would  
5 cause a substantial extension of OCA witness O'Brien's duration for containment  
6 activities and would add several months to his hypothetical completion date of 12/81  
7 for Limerick.  
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10  
11 Even such an adjustment for Mark II manhours however, results in an accounting  
12 for less than 5% of the total manual manhour increases which actually occurred  
13 because of OCA witness O'Brien's disregard for non-Mark II caused manual manhour  
14 increases.  
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17  
18 Further, an implicit assumption within OCA witness O'Brien's analysis is that the  
19 duration of each and every activity is totally "elastic" with regards to shortening or  
20 lengthening of any particular duration. This assumption is incorrect; a construction  
21 manager is often not able to apply more manpower in a given area due to manpower  
22 density restraints within that area. Such is the case for the containment drywell  
23 where manpower density limitations directly impacted the rate of progress on the  
24 mechanical and electrical critical path activities.  
25  
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28 Q. HOW DOES THE CRITICAL PATH SHOWN IN OCA EXHIBIT JJO'B-13 DIFFER FROM  
29 THE "AS-BUILT" CRITICAL PATH?  
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32 A. There are three major differences between the two critical paths; 1) several critical  
33 path activities which actually occurred and are on the "as-built" schedule are missing  
34 from the critical path in OCA Statement 1, Exhibit JJO'B-13, 2) the critical paths  
35 flow through different activities during certain periods in the "as-built" and OCA  
36 Statement 1 Exhibit JJO'B-13 schedules, and 3) the durations of critical path activities  
37 differ between the "as-built" and OCA Statement 1 Exhibit JJO'B-13 schedules.  
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1 Q. HOW DO THE CRITICAL PATHS DIFFER DURING THE INITIAL CONCRETE AND  
2 STRUCTURAL PHASE OF THE PROJECT?  
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5 A. The differences between the critical paths is illustrated in Schedule 5 which shows  
6 that the "as-built" critical path goes through rebar installation in the containment  
7 suppression pool and drywell and continues through the containment cone lifts leading  
8 to RPV set. The activities in OCA Statement 1, Exhibit JJO'B-13, however, travel a  
9 very different critical path through the reactor enclosure walls and structural steel at  
10 various elevations and certain containment cone lifts (other than those in the "as-  
11 built") before leading to RPV set.  
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19 Q. WHAT DO YOU ATTRIBUTE AS THE CAUSE OF THIS DIFFERENCE?  
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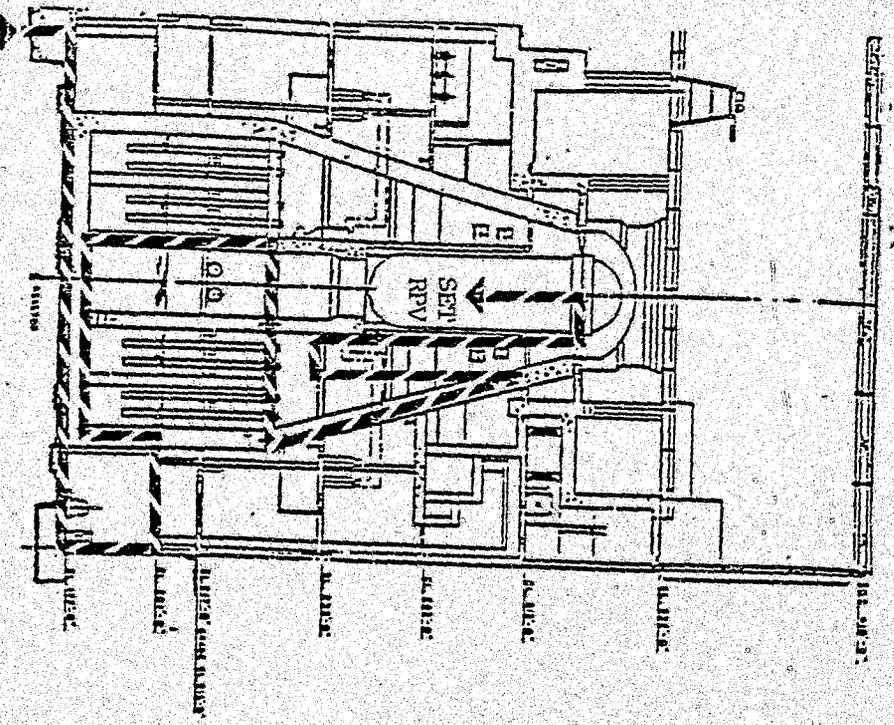
21 A. The difference between the "as-built" critical path and that presented by OCA witness  
22 O'Brien, which amounts to a total of 28 weeks, is caused by significant changes  
23 occurring in the construction schedule logic subsequent to the formulation of the June  
24 1974 MSCS schedule utilized by OCA witness O'Brien, which were not accounted for in  
25 OCA Statement 1, Exhibits JJO'B-4 and JJO'B-13.  
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31 Q. PLEASE DESCRIBE THE CRITICAL PATH DIFFERENCES FOR THE PERIOD FROM  
32 SETTING OF THE RPV THROUGH THE BULK COMMODITY INSTALLATION PHASE  
33 OF THE PROJECT?  
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36

37 A. From the "set RPV" milestone forward, OCA witness O'Brien's critical path is missing  
38 a number of activities following RPV set which were required to be completed prior to  
39 the start of mechanical and electrical work in the containment drywell. As shown in  
40 Schedule 6, these activities include RPV nuclear insulation, setting the reactor shield,  
41 completion of the reactor shield welds, and structural steel installation at elevations  
42 272' and 286'. The TB&A "as-built" schedule shows that mechanical work in the  
43 containment drywell could not start until 52 weeks after the setting of the RPV  
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**CRITICAL PATH COMPARISON  
CONCRETE & STRUCTURAL WORK THROUGH RPV SET**

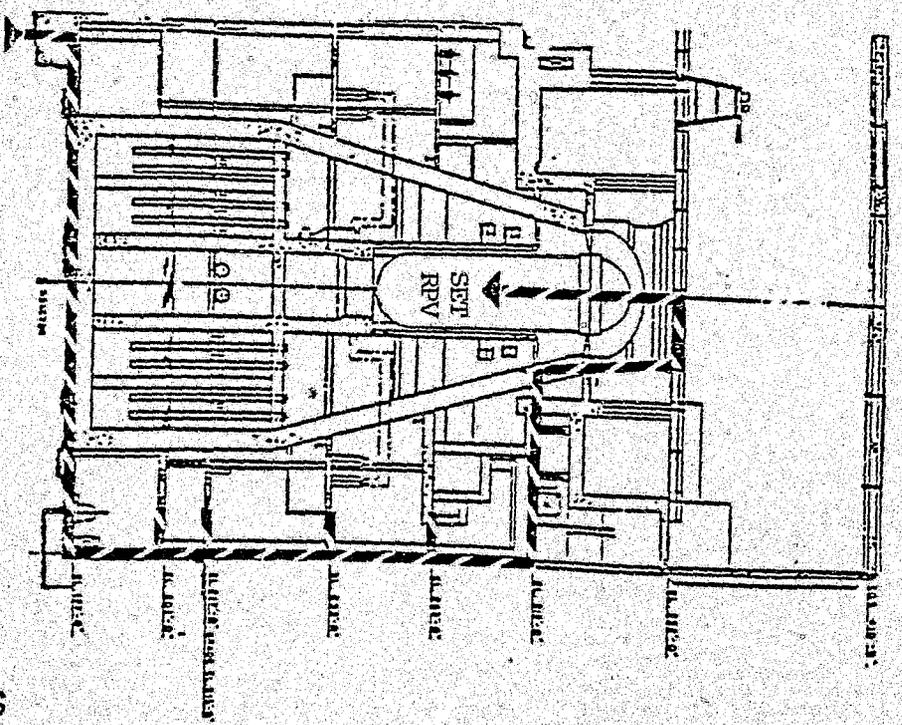
**T&A "AS-BUILT"**



**DURATION TO RPV SET: 129 WEEKS**

**CRITICAL PATH**

**OCA EXHIBIT JJO'B-13**

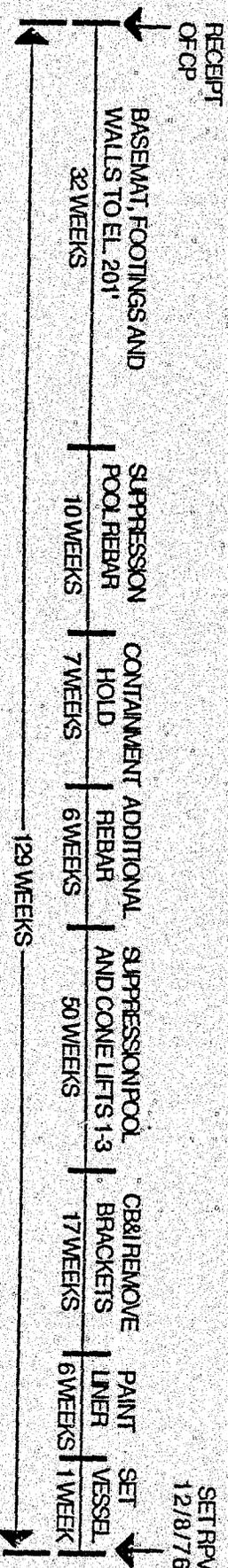


**DURATION TO RPV SET: 101 WEEKS**

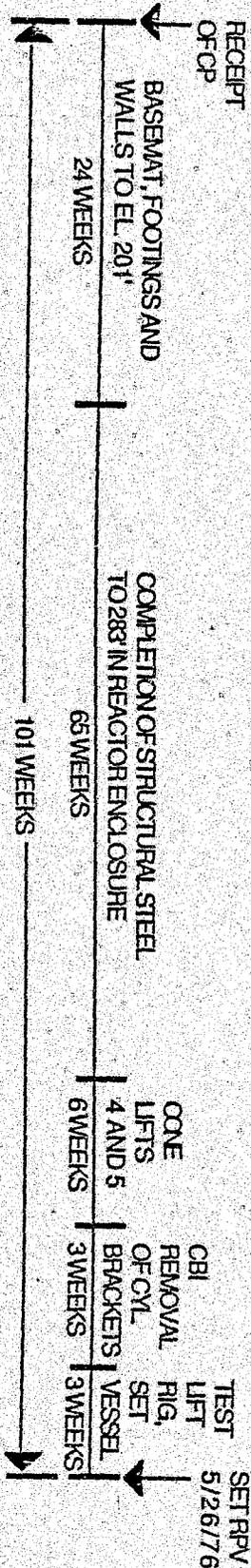
**SOURCE: T&A "AS-BUILT" SCHEDULE  
OCA EXHIBIT JJO'B-13**

COMPARISON OF CRITICAL PATH FROM CP TO RPV SET

TB&A "AS-BUILT" SCHEDULE



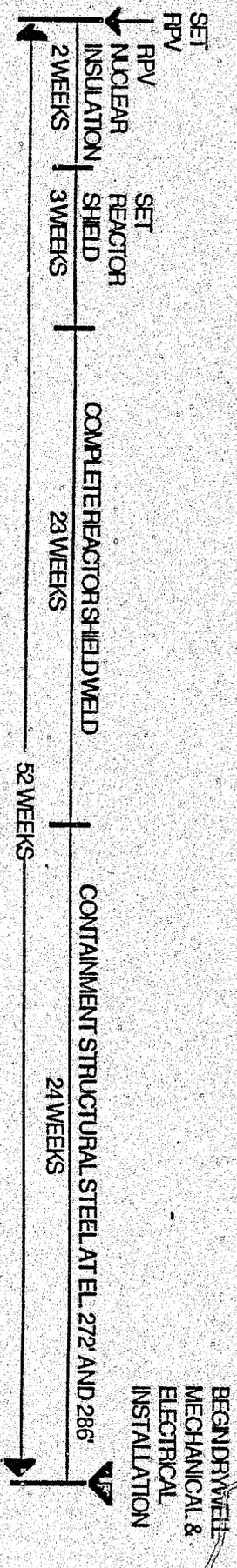
OCA EXHIBIT JJO'B-13



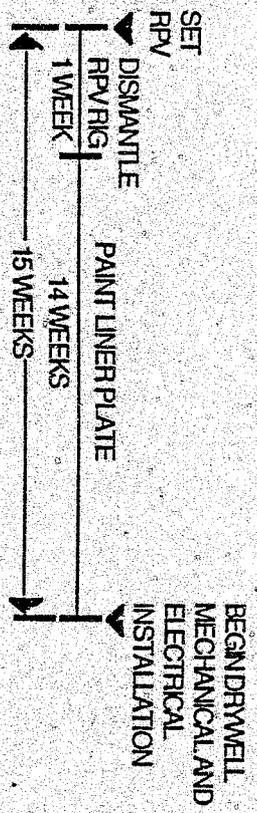
SOURCE: TB&A "AS-BUILT" SCHEDULE  
 OCA EXHIBIT JJO'B-13

**CRITICAL PATH COMPARISON - RPV SET TO START DRYWELL MECHANICAL & ELECTRICAL WORK**

**TB&A "AS-BUILT" SCHEDULE**



**OCA EXHIBIT JJO'B-13**



SOURCE: TB&A "AS-BUILT" SCHEDULE  
OCA EXHIBIT JJO'B-13

1 compared to the 15 weeks shown in OCA witness O'Brien's JJO'B-13 schedule (in  
2 reality, 14 of the 15 weeks noted by OCA witness O'Brien as required after RPV set  
3 were for painting of the drywell liner plate which Bechtel accomplished prior to RPV  
4 set.)  
5  
6  
7  
8

9 In addition, the duration for mechanical and electrical work within the drywell  
10 differs significantly for the two schedules, those durations being 278 weeks versus 218  
11 weeks respectively from the limited start of drywell activities i.e., a 60 week  
12 differential (254 weeks and 190 weeks respectively from the full start of drywell  
13 activities).  
14  
15  
16  
17  
18

19 Q. WHAT IS THE REASON FOR THIS 60 WEEK DIFFERENCE IN DURATIONS?  
20

21 A. The difference is the result of dramatically different scope and unit rates over those  
22 originally projected and also the manpower density limitations actually experienced  
23 within the drywell. OCA Statement 1, Exhibit JJO'B-13 does not reflect this  
24 manpower density constraint, nor does it explicitly take into account any additional  
25 scope or manhour expenditures other than those for Mark II resolution as discussed  
26 earlier. The basis and effects of these O'Brien omissions will be discussed further in  
27 connection with TB&A's discussion of the PECO/Bechtel analyses.  
28  
29  
30  
31  
32

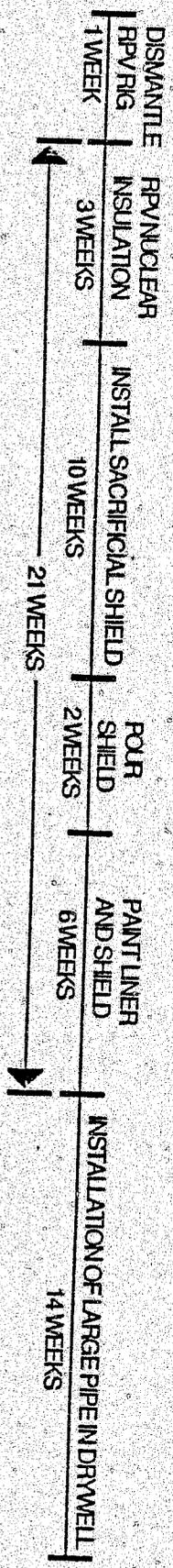
33 Q. DID OCA WITNESS O'BRIEN HAVE INFORMATION OR A SCHEDULE AVAILABLE  
34 TO HIM TO BE IN POSITION TO RECOGNIZE THE ABOVE SHORTCOMINGS IN HIS  
35 SCHEDULES?  
36  
37  
38  
39

40 A. Yes. However, OCA witness O'Brien chose to ignore the later version of MSCS (mid-  
41 1979), as well as the multitude of other project documentation provided to him, which  
42 included actual activity durations and sequences prior to mid-1979.  
43  
44  
45  
46

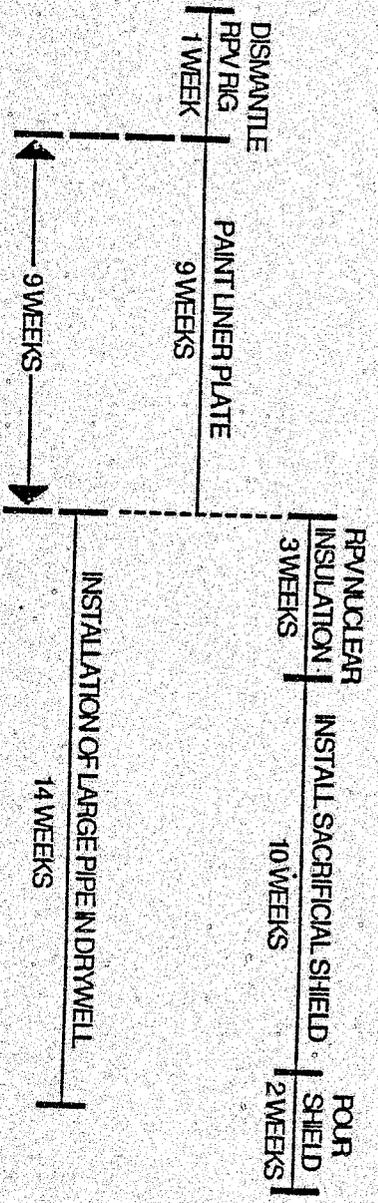
47 For example, the MSCS schedule was revised quarterly, yet he used only one  
48 version. The project status reports were issued monthly and were available to OCA  
49  
50

COMPARISON OF JUNE 1974 & DECEMBER 1974 MSCS LOGIC

DECEMBER 1974 MSCS (NOT USED BY OCA WITNESS O'BRIEN)



JUNE 1974 MSCS (USED BY OCA WITNESS O'BRIEN)



SOURCE: MSCS REV. 1 - JUNE 4, 1974  
 MSCS REV. 3 - DECEMBER 20, 1974

1 and OKA personnel, yet the "as-built" schedule information contained therein was  
2  
3 apparently not used at all by OCA witness O'Brien in formulating his three schedules.  
4

5 Q. COULD YOU PLEASE PROVIDE AN EXAMPLE OF HOW THIS INFORMATION  
6  
7 COULD HAVE BEEN USED BY OCA WITNESS O'BRIEN TO CORRECTLY  
8  
9 REPRESENT SCHEDULE ACTIVITIES?  
10

11 A. Yes. An example of a schedule logic change is contained in MSCS Rev. 3, issued  
12  
13 approximately six month after the MSCS Rev. 1 schedule issue which OCA witness  
14  
15 O'Brien relied upon.  
16

17 This change, which is illustrated in Schedule 7, shows that the three activities,  
18  
19 install RPV nuclear insulation, install sacrificial shield, and pour shield were required  
20  
21 to be completed prior to the beginning of drywell large pipe work, in the December  
22  
23 1974 revision of MSCS. In the June 1974 version of MSCS however, the same  
24  
25 activities were shown to begin at the same time as large pipe work started in the  
26  
27 drywell. This change in the December 1974 revision of MSCS added twelve weeks to  
28  
29 critical path activities, which OCA witness O'Brien did not consider.  
30

31 Q. WHAT ARE THE ACTIVITIES IN THE START-UP TESTING PHASE OF THE  
32  
33 LIMERICK PROJECT?  
34

35 A. Start-up testing consists of "blue tag" testing (instrument calibration), turnover of the  
36  
37 system, test procedure writing, Test Review Board (TRB) approval of pre-operational  
38  
39 test procedures, performance of the startup tests, and TRB approval of the test  
40  
41 results.  
42

43 Q. WHAT ARE THE DIFFERENCES BETWEEN THE CRITICAL PATHS SHOWN IN OCA  
44  
45 STATEMENT 1, EXHIBIT JJO'B-13 AND THAT IN THE "AS-BUILT" SCHEDULE  
46  
47 DURING THE STARTUP TESTING PHASE OF THE PROJECT?  
48

49 A. Two important differences are that in his JJO'B-13 schedule, OCA witness O'Brien 1)  
50

1  
2 grossly oversimplifies the startup and pre-operational testing phase of Limerick 1 and  
3 Common and 2) he portrays a non-critical sequence of activities as being on the  
4 critical path. As shown in Schedule 8, the "as-built" critical path during the start-up  
5 testing phase is complex due to the multitude of systems being tested.  
6  
7  
8

9  
10 In the "as-built" schedule, TB&A identified the various systems that were  
11 required to be "turned over" from the construction organization to the start-up  
12 organization for testing for each elevation or area of the plant -- this consisted of ten  
13 major systems for the containment drywell and eleven major systems for elevation  
14 283' of the reactor enclosure.  
15  
16  
17  
18

19  
20 No single system formed the critical path throughout the start-up phase but,  
21 rather it was a combination of systems interdependent on other start-up and  
22 construction activities that formed the critical path as illustrated in Schedule 8. In  
23 the "as-built" schedule, the systems controlling the critical path were the core spray  
24 system (drywell and reactor enclosure elev. 283'), the feedwater system (drywell) and  
25 the containment atmospheric control system (reactor enclosure elev. 283').  
26  
27  
28  
29  
30  
31

32 In contrast, as depicted in Schedule 8, OCA witness O'Brien uses one system to  
33 measure the critical path duration through the start-up testing phase -- that being the  
34 emergency cooling water system which is associated with reactor enclosure elevations  
35 that are not on the "as-built" critical path.  
36  
37  
38

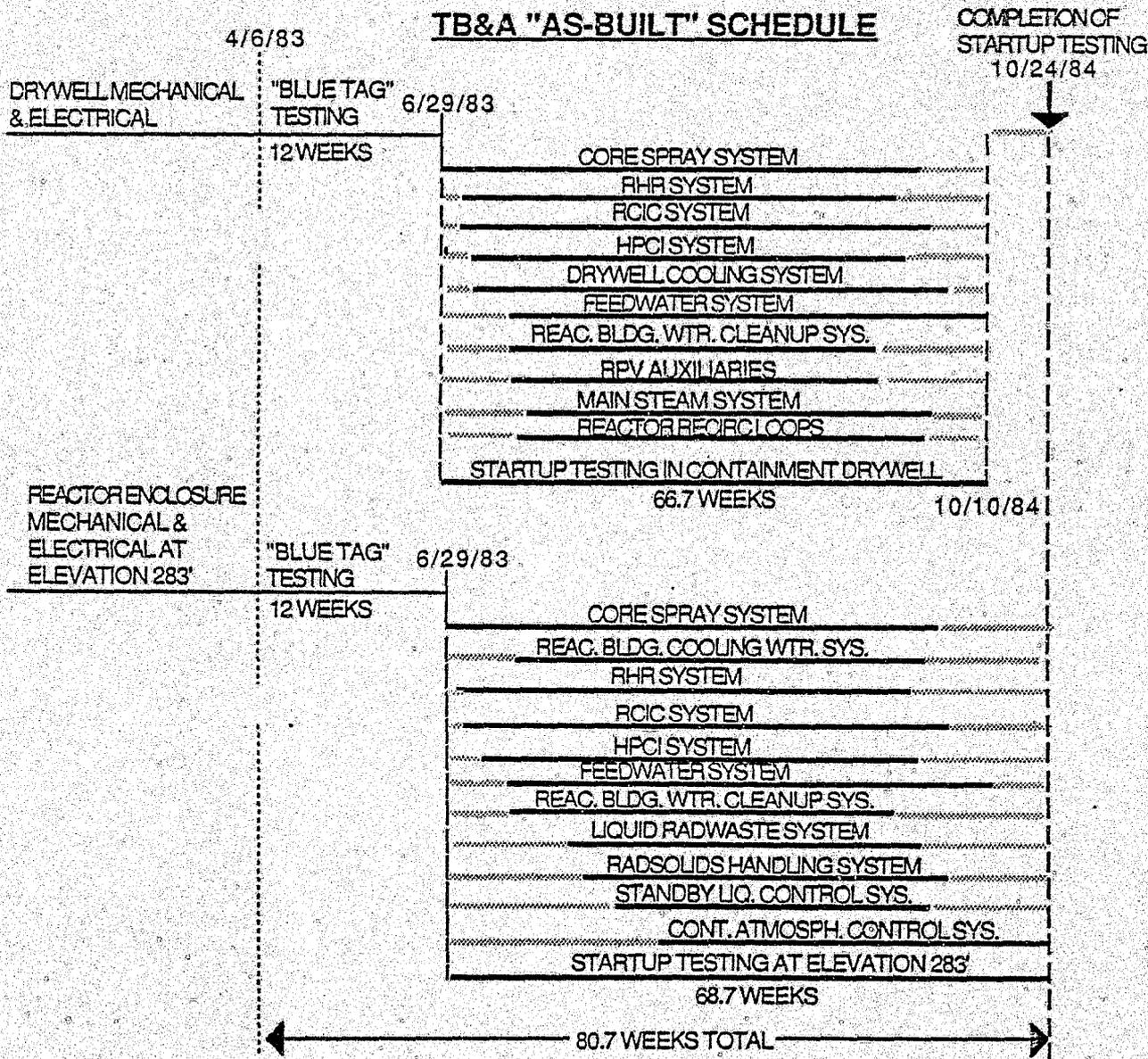
39 Q. WHAT IS THE SIGNIFICANCE OF THIS CRITICAL PATH DIFFERENCE DURING THE  
40 START-UP TESTING PHASE?  
41

42 A. During the start-up phase alone, the "as-built" critical path is 34.7 weeks longer than  
43 that presented by OCA witness O'Brien.  
44

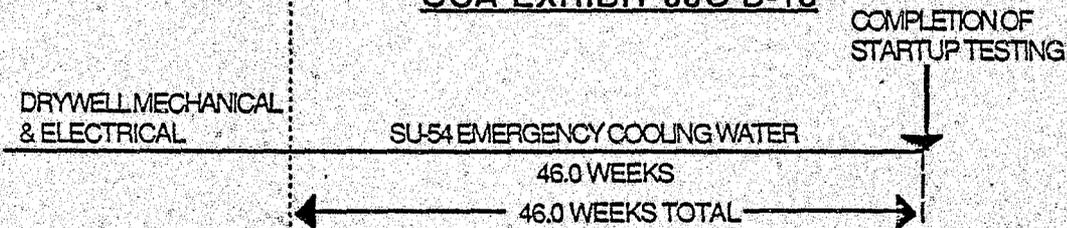
45 Q. WHAT IS THE CUMULATIVE RESULT OF THE ABOVE IDENTIFIED OMISSIONS AND  
46 ERRORS IN OCA WITNESS O'BRIEN'S CRITICAL PATH ACTIVITIES?  
47  
48  
49  
50

**CRITICAL PATH STARTUP SCHEDULE COMPARISON**

**SCHEDULE 8**



**OCA EXHIBIT JJO'B-13**



SOURCE: TB&A "AS-BUILT" SCHEDULE;  
 OCA EXHIBIT JJO'B-13

1 A. Adding the durations for activities OCA witness O'Brien overlooked (12.9 months, i.e.,  
2 28 weeks during the initial concrete and structural phase, plus 37 weeks from RPV set  
3 through bulk commodity installation (less 9 weeks that OCA witness O'Brien includes  
4 for a weather allowance), correcting the duration for the mechanical and electrical  
5 work in the drywell (13.8 months, i.e., 60 weeks) and correcting the duration for the  
6 startup activities (8.0 months, i.e., 34.7 weeks) adds 34.7 months to the OCA  
7 Statement 1, Exhibit JJO'B-13 fuel load date. This extends OCA witness O'Brien's  
8 hypothetical alternative fuel load date from December, 1981 to October, 1984, very  
9 close to that which actually occurred.

10  
11  
12 Q. DO YOU HAVE AN OPINION AS TO WHY OCA WITNESS O'BRIEN CAME TO HIS  
13 ERRONEOUS CONCLUSIONS ON A HYPOTHETICAL LIMERICK 1 FUEL LOAD?

14 A. Yes. OCA witness O'Brien's fallacious conclusion that a December, 1981 fuel load  
15 date was possible for Limerick 1 is due to the underlying errors on which his analysis is  
16 founded, i.e., a 1974 project schedule that has not properly accounted for:

- 17 • Significant events that subsequently occurred,
- 18 • Commodity and manhour increases,
- 19 • Manpower density limitation factors,
- 20 • Revised activity logic,
- 21 • Added construction activities, and the
- 22 • Impact of numerous licensing and regulatory requirements.

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These and other errors noted in Section II of this testimony make the schedule  
analysis proffered by OCA witness O'Brien useless in this proceeding.

IV. REVIEW OF PECO/BECHTEL LIMERICK SCHEDULE ANALYSIS

Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?

A. The purpose of this Section of testimony is to present TB&A's assessment of the

1 schedule analysis presented by PECO/Bechtel as summarized in PECO Statement No.  
2  
3 1A.

4  
5 Q. WHAT WAS TB&A'S ROLE IN THE SCHEDULE ANALYSIS PERFORMED BY PECO  
6  
7 AND BECHTEL?  
8

9 A. TB&A's role was that of an independent reviewer. TB&A monitored the schedule  
10  
11 analysis effort, including participation in the initial criteria formulative meetings, and  
12  
13 performed reviews and analyses of the various schedule scenarios and results. In  
14  
15 addition, TB&A has reviewed both the methodology employed and the results obtained,  
16  
17 for reasonableness.  
18

19 Q. PLEASE DESCRIBE THE SIGNIFICANT ASPECTS OF THE PECO AND BECHTEL  
20  
21 SCHEDULE ANALYSIS EFFORT?  
22

23 A. The PECO and Bechtel schedule analysis effort consisted of modifying the 1974 MSCS  
24  
25 schedule to appropriately reflect post-1974 conditions and events which impacted the  
26  
27 project. The significant modifications include the use of actual commodity quantities,  
28  
29 actual unit rates, and resultant actual manual manhour expenditures. To properly  
30  
31 model the actual Limerick conditions, craft manual manpower density limitations  
32  
33 were also considered. It was also important to test the need for, and impact of  
34  
35 hypothetically-available additional funding in the late 1970's.  
36

37 Q. WHAT, IN YOUR OPINION, WAS THE PURPOSE IN PERFORMING THIS SCHEDULE  
38  
39 ANALYSIS?  
40

41 A. The purpose of performing this schedule analysis was to determine the probable  
42  
43 resultant fuel load date for Limerick Unit 1 and Common as a result of modifying the  
44  
45 1974 schedule to reflect actual project conditions coupled with hypothetically-  
46  
47 available increased project funding.  
48

49 Q. WHAT QUALIFIES TB&A TO CONDUCT AN INDEPENDENT REVIEW OF THIS  
50

1 SCHEDULE ANALYSIS?  
2

3 A. TB&A, as the result of its extensive independent retrospective review of the Limerick  
4 Unit 1 and Common project, as presented in PECO Statement No. 8, has gained  
5 considerable insight into project events and activities and has also performed many  
6 schedule related analyses of its own. These schedule studies collectively presented a  
7 comprehensive picture of critical schedule activities and related events and  
8 encompass the following categories:  
9

- 10 • Licensing schedules
- 11 • Engineering schedules
- 12 • Procurement schedules
- 13 • Site construction schedules
- 14 • Startup and preoperational testing schedules
- 15 • Financial plans and schedules.

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TB&A also performed a cost reconciliation analysis jointly with PECO, as  
presented in PECO Exhibit No. 2, which explained the factors which drove cost and  
schedule growth. This analysis gave TB&A the opportunity to challenge, verify and  
understand Limerick activities and the driving forces behind those activities, through  
discussions with the appropriate PECO and Bechtel personnel.

The cumulative knowledge gained from the above analyses provided TB&A with  
an appropriate foundation for independently assessing the reasonableness of the  
judgments and computations required to represent the actual project constraints in a  
schedule modelling and analysis effort such as that performed by PECO and Bechtel.

TB&A believes that, aside from the Limerick project participants i.e., PECO and  
Bechtel, the extensiveness and comprehensiveness of TB&A's project and schedule  
analysis efforts have provided us with an understanding and knowledge of the Limerick

1 project unmatched by any other third party.

2  
3 Q. HOW DOES THE PECO/BECHTEL SCHEDULE ANALYSIS DIFFER FROM THAT PUT  
4 FORTH BY OCA WITNESS O'BRIEN IN OCA STATEMENT 1?  
5

6  
7 A. The same starting point and information were used by both PECO/Bechtel and OCA  
8 witness O'Brien, i.e., the 1974 MSCS schedule. However, PECO's analysis properly  
9 considered the major schedule determinants such as quantities, unit rates, manpower  
10 densities, and NRC licensing requirements, whereas OCA witness O'Brien's effort does  
11 not.  
12

13  
14 As discussed earlier, the PECO/Bechtel analysis is based on commodities, unit  
15 rates and manhours in the order of those identified in Forecast 7, whereas OCA  
16 witness O'Brien's analysis is incorrectly based on commodities, unit rates and  
17 manhours prior to Forecast 1.  
18

19  
20 Q. WHAT OTHER SIGNIFICANT DIFFERENCES EXIST BETWEEN THE PECO/BECHTEL  
21 AND OCA WITNESS O'BRIEN METHODOLOGIES?  
22

23  
24 A. The most significant difference relates to manual manpower density limitations.  
25

26  
27 Q. PLEASE DISCUSS THE DIFFERENCE IN THE TREATMENT OF MANUAL  
28 MANPOWER DENSITY LIMITATIONS.  
29

30  
31 A. OCA witness O'Brien has not considered manual manpower density limitations whereas  
32 these limitations have been considered in the PECO/Bechtel analysis. Manpower  
33 density limitations, especially as they exist in volume-limited work areas, such as the  
34 containment drywell, must be accounted for in a schedule model to accurately  
35 represent space limitations. The significance of representing manual manpower  
36 density limitations in a schedule is that it limits the schedule progress that can be  
37 accomplished within any given time period. In the absence of density limitations,  
38 unrealistic, unlimited progress can be assumed to be accomplished. The absence of  
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1 this density consideration is a serious flaw in OCA witness O'Brien's analysis.

2  
3 Q. WHAT ASSUMPTION DOES OCA WITNESS O'BRIEN MAKE REGARDING  
4  
5 MANPOWER DENSITY LIMITATIONS?  
6

7 A. OCA witness O'Brien has, in his schedule presented in OCA Statement 1, Exhibit  
8  
9 JJO'B-13, inherently assumed that manual manpower densities for critical path  
10  
11 activities, such as in the containment drywell, can increase without limit.  
12

13 Q. HOW HAS THE PECO/BECHTEL ANALYSIS ACCOUNTED FOR THE POTENTIAL  
14  
15 USE OF MORE THAN A SINGLE SHIFT FOR MANUAL MANPOWER STAFFING IN  
16  
17 THE MANPOWER DENSITY LIMITED CONTAINMENT DRYWELL?  
18

19 A. Although the durations for the activities in the original June 1974, MSCS schedule  
20  
21 model run used in both the PECO/Bechtel and OCA witness O'Brien's schedules were  
22  
23 based on single shifting only, PECO/Bechtel conservatively used a double shift  
24  
25 (equivalent to 2/3 of the first shift) for the full duration of containment drywell  
26  
27 mechanical and electrical work.  
28

29 Q. WHAT IMPACT DOES THE PECO/BECHTEL ASSUMPTION OF DOUBLE SHIFTING  
30  
31 HAVE ON THEIR SCHEDULE ANALYSIS?  
32

33 A. Double shifting of drywell critical path activities for their full duration would shorten  
34  
35 the schedule, and is therefore a conservative assumption by PECO/Bechtel which  
36  
37 serves to accelerate Limerick's completion date.  
38

39 Q. WHAT ROLE DOES PROJECT FUNDING CONSTRAINTS PLAY IN BOTH  
40  
41 PECO/BECHTEL'S SCHEDULE ANALYSIS AND OCA WITNESS O'BRIEN'S  
42  
43 ANALYSIS?  
44

45 A. Because of the manual manpower density limitations in the containment drywell, a key  
46  
47 critical path area at Limerick, the impact of funding constraints is less than one might  
48  
49 expect. For example, once the drywell critical path activities were fully manloaded in  
50

1 accordance with the density limitations and known scope, additional available funds  
2 would be expended on non-drywell and non-critical path activities and would not result  
3 in a shorter overall schedule. OCA witness O'Brien, on the other hand, has incorrectly  
4 assumed that the rate of drywell critical path activity progress was directly  
5 proportional to increased project funding, thus failing to consider maximum manpower  
6 density and multiple shifting limitations.  
7  
8  
9

10  
11  
12  
13 Q. HAS TB&A PERFORMED ANY INDEPENDENT VERIFICATIONS TO CONFIRM THE  
14 ANALYSIS AND RESULTS PRESENTED BY PECO AND BECHTEL IN THEIR  
15 SCHEDULE ANALYSIS?  
16  
17

18  
19 A. Yes, several such verifications have been performed. Our previous work in our  
20 retrospective review of the Limerick project and our compilation of an "as-built"  
21 model for Limerick 1 and Common provided us with the necessary knowledge and tools  
22 to perform an independent verification. TB&A's verification efforts can be  
23 summarized into two areas; one, dealing with the methodology, inputs and  
24 assumptions/judgments and second, a separate assessment of the reasonableness of the  
25 results.  
26  
27  
28  
29  
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32

33 Q. WHAT ARE THE DETAILS AND RESULTS OF YOUR VERIFICATION EFFORTS?  
34

35 A. TB&A's verification efforts for the methodology, inputs and assumptions/judgments  
36 included:  
37

- 38 • Confirmation that actual total manual manhours represented actual quantities  
39 and unit rates.
- 40 • Confirmation that the critical path and near-critical path schedule activities  
41 which were modelled represented the actual critical and near-critical path  
42 activities as determined from TB&A's "as-built" schedule.
- 43 • Confirmation that the modifications made to the 1974 MSCS schedule  
44  
45  
46  
47  
48  
49  
50

1 appropriately represented the case conditions imposed on the project, i.e., pre-  
2 May 1976 cashflow constraints, manual manpower density limitations, and use of  
3 multiple shifts. This confirmation included review of actually experienced  
4 conditions and, for hypothetical scenarios, portraying conditions as they would  
5 have occurred given the contemporaneous project situation.  
6  
7  
8  
9  
10

11 Q. WHAT OTHER ANALYSIS HAS TB&A PERFORMED WHICH SUPPORTS OR  
12 CONFIRMS THE CONCLUSION REACHED BY PECO AND BECHTEL?  
13

14 A. TB&A performed a relatively straight-forward analysis of the actual critical path  
15 activities which supports the reasonableness of the PECO/Bechtel fuel load date of  
16 July 1984 for Case 3, as compared to the July 1982 date put forth by OCA witness  
17 O'Brien.  
18

19 Q. WHAT IS THE NATURE OF THIS ANALYSIS?  
20

21 A. For this analysis, TB&A utilized the actual critical path activities as determined in  
22 our "as-built" schedule and segmented these critical path activities, for convenience,  
23 into the following time periods:  
24

- 25 • June 1974 through May, 1976.
- 26 • June 1976 to RPV set.
- 27 • RPV set to start of drywell mechanical and electrical activities.
- 28 • Drywell mechanical and electrical activities.
- 29 • Start-up testing (up until fuel load).

30 Each of these segments were then modified as required to reflect the Case 3  
31 conditions, and separately analyzed.  
32

33 Q. WHAT ARE THE CASE 3 CONDITIONS THAT WERE USED TO MODIFY YOUR "AS-  
34 BUILT" CRITICAL PATH?  
35

36 A. Three conditions which were the basis of Case 3 required consideration, those being; 1)  
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1 utilization of actual cash flows through June 1, 1976, 2) unrestrained cash availability,  
2 as contemporaneously projected for the period from June 1976 through June 1980, and  
3  
4 3) double shifting the critical path drywell activities.  
5

6  
7 Q. WHAT ARE THE DETAILS OF YOUR ANALYSIS?  
8

9 A. The analysis of each of the above identified critical path segments is analyzed below  
10 and summarized in Schedule 9.  
11  
12

13  
14  
15 Segment 1 - June 1974 through May 1976  
16

17 Project funding during this period was in accordance with the 1974 announced  
18 cashflow restrictions (effective October, 1974) and has been accepted by the PPUC  
19 and OCA witness O'Brien as reasonable (OCA Statement No. 1, page 12). Thus actual  
20 progress through May 1976 was herein adopted as the postulated progress under the  
21 Case 3 conditions of this analysis.  
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27  
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29 Segment 2 - June 1976 to RPV Set  
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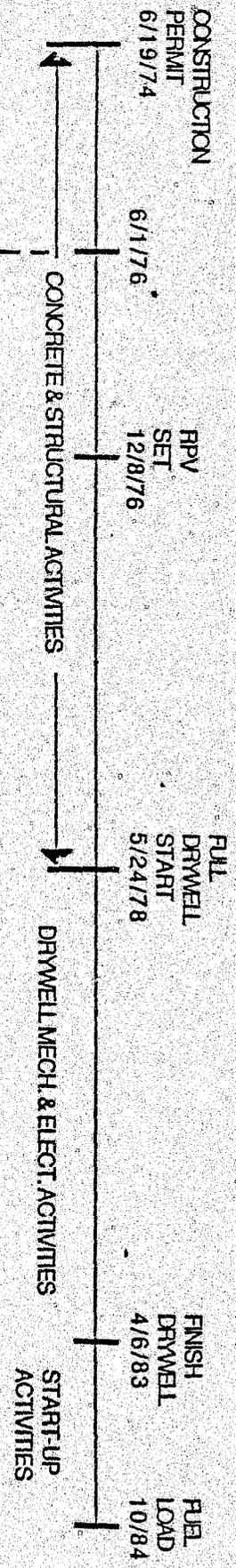
31 The period following May 1976, as it actually occurred, was one of further  
32 funding limitations. However, the Case 3 conditions assume that funding is not  
33 restricted to that which actually occurred, but is in accordance with the project's  
34 contemporaneous perceptions of the funding required to maintain an earlier fuel load  
35 date.  
36  
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39

40 For the purpose of this analysis, it was assumed that the duration of construction  
41 activities leading up to RPV set occurred as scheduled prior to the additional cash  
42 flow constraints that were imposed on the project as of June 1976.  
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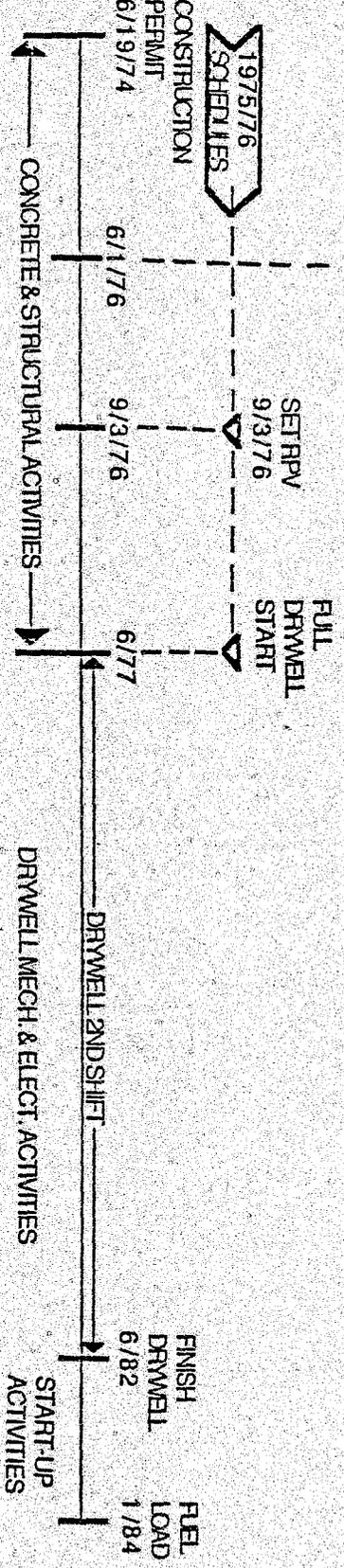
45 Therefore the projected RPV set date of September 3, 1976 (as scheduled in  
46 April 1976) was assumed under the Case 3 conditions of this analysis.  
47  
48  
49  
50

**TB&A CRITICAL PATH ANALYSIS FOR PECO/BECHTEL CASE 3 SANITY CHECK**

**"AS-BUILT" CRITICAL PATH**



**MODIFIED "AS-BUILT" FOR PECO/BECHTEL CASE 3 SANITY CHECK**



\* BEGINNING OF ADDITIONAL CASHFLOW RESTRICTIONS IMPOSED IN 1976.

SOURCE: TB&A "AS-BUILT" SCHEDULE  
PROJECT STATUS REPORT, 4/29/76  
MSCS REV. 8, 12/75

1  
2  
3 Segment 3 - RPV Set to Start of Drywell Mechanical and Electrical Activities  
4

5 The critical path activities from RPV set which include RPV nuclear insulation,  
6 set reactor shield, complete reactor shield welding, and containment structural steel  
7 at elevations 272' and 288', were scheduled in early 1976 to result in the full start of  
8 drywell mechanical and electrical activities in June 1977.  
9

10  
11 Carrying through the logic from Segment 2 above, the projected full start of  
12 drywell activities in June 1977 as scheduled in early 1976 (as compared to the actual  
13 full start of this work in May 1978) was assumed as under the Case 3 conditions.  
14  
15  
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20  
21 Segment 4 - Drywell Mechanical and Electrical Activities  
22

23 Although this activity as scheduled in early 1976 was expected to be completed  
24 in early 1979, the commodities, unit rates and manual manhours actually required  
25 would have prevented this even under cash unrestrained circumstances. In addition,  
26 drywell manual manpower density limitations must be respected.  
27  
28  
29

30 To account for the postulated-higher-than actual funding in Case 3, this analysis  
31 assumes that double shifting (with the second shift equal to 2/3 of the first shift) was  
32 implemented for the full duration of drywell activities. This conservative assumption,  
33 of a step increase (overnight) to two shifts, results in a drywell duration of 260.7  
34 weeks, and the completion of drywell activities in June 1982. The supporting  
35 calculation is presented in Appendix B.  
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44  
45 Segment 5 - Start-Up Testing to Fuel Load  
46

47 The unrestrained funding in the 1982-1984 period and the actual duration of the  
48 start-up testing phase of the project justifies use of the "as-built" logic and durations  
49  
50

1 for these activities which extend from completion of drywell work until fuel load. The  
2 startup testing period, based on using the actual duration for punchlisting, blue tag  
3 testing and system testing subsequent to completion of drywell mechanical and  
4 electrical work, adds 80.7 weeks (as shown in Schedule 8) from the completion of  
5 drywell activities to receipt of the fuel load license.  
6  
7  
8  
9

10  
11 Thus, for the postulated conditions, this analysis yields a completion of start-up  
12 activities and fuel load date of January 1984.  
13  
14  
15

16  
17 Q. HOW DOES THIS RESULT COMPARE TO THE FUEL LOAD DATE DETERMINED IN  
18 THE PECO/BECHTEL ANALYSIS?  
19

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21 A. The results are within 6 months, i.e., January 1984 versus PECO/Bechtel's comparable  
22 Case 3 result of July 1984.  
23  
24

25 As an additional comparison, the difference of 9 months between the January  
26 1984 fuel load date and the actual fuel load date of October 1984 can be attributed to  
27 the simplifying assumptions adopted in the analysis presented herein. For example,  
28 our double shifting assumption has tended to overstaff the drywell activities.  
29  
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31  
32 Q. SHOULD THE RESULT FROM YOUR SIMPLIFIED ANALYSIS BE INTERPRETED AS  
33 A PROBABLE FUEL LOAD DATE?  
34

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36  
37 A. No. Considering the simplifying assumptions that were implemented, our analysis can  
38 be best characterized as one which provides a sanity check against which to evaluate  
39 overall more detailed schedule analyses presented by others.  
40  
41

42  
43 Q. WHAT THEN IS YOUR ASSESSMENT OF THE RESULTS OF BOTH PECO/BECHTEL'S  
44 SCHEDULE ANALYSIS RESULTS, AND THOSE PRESENTED BY OCA WITNESS  
45 O'BRIEN?  
46  
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49 A. From the perspective of our analysis presented herein, which has examined the  
50

1 conditions of PECO/Bechtel Case 3, and which attempts to realistically represent the  
2 actual project conditions (as compared to the conditions considered in the OCA  
3 witness O'Brien schedule JJO'B-13), our assessment is that the PECO/Bechtel result of  
4 July 1984 represents a much more realistic fuel load date than the July 1982 date put  
5 forth by OCA Witness O'Brien.  
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11 V. SUMMARY OF OCA AND STAFF ERRORS OF FACT, CONCEPT OR  
12 ASSUMPTION  
13

14 A. IMPROPER IMPRUDENCE ALLEGATIONS  
15

16 Q. TB&A HAS EXPLAINED IN SOME DETAIL THE NECESSITY OF IDENTIFYING AND  
17 QUANTIFYING, TO AS SPECIFIC A DEGREE AS POSSIBLE, ALLEGED ACTS OF  
18 MANAGEMENT IMPRUDENCE. DO THE TESTIMONIES OF OCA WITNESSES  
19 O'BRIEN AND HANAUER AND STAFF WITNESS DOUGHERTY MEET THIS  
20 REQUIREMENT?  
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26 A. No.  
27

28 Q. PLEASE EXPLAIN WHY NOT.  
29

30 A. Careful Review of OCA witness O'Brien's testimony has failed to reveal explicitly  
31 what he considers to have been PECO Management's imprudent actions or omissions  
32 regarding the construction of Limerick. He states in his testimony that,  
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35

36 "...if prudent construction management practices had been followed, Limerick 1  
37 could have loaded fuel by July, 1982 or 27 months earlier than it was actually  
38 achieved..." (OCA Statement No. 1, pg. 4)  
39

40 and further that,  
41

42 "...the primary task of OKA's analysis became the determination of when Unit 1  
43 could have been completed, had PECO not delayed the project unnecessarily...."  
44 (OCA Statement No. 1, pg. 6)  
45

46 yet fails to note what prudent construction management practices were not followed  
47 or how the project was unnecessarily delayed. OCA witness Hanauer's testimony is  
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1 similarly absent of any specific evidence of PECO or General Electric imprudence  
2 regarding the Mark II containment design. And, as previously discussed, without the  
3 specific identification of imprudent actions nor even an agreement on how to judge  
4 imprudence between OCA witnesses Hanauer and O'Brien, the credibility of their  
5 quantification exercise is severely strained.  
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10 Additionally, Staff witness Dougherty's quantification of alleged imprudence  
11 exceeds the bounds of credibility by assuming that Limerick Unit 1 could have been  
12 completed by April 1981 - a completion date not achieved by any Limerick  
13 contemporary BWR and not factually supported by his own analysis, the PPUC nor  
14 other Staff or OCA witnesses.  
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21 Q. WHY ISN'T OCA AND STAFF WITNESSES' APPARENT RELIANCE ON THE  
22 PENNSYLVANIA PUC'S ORDER OF MAY 7, 1982, WHICH FOUND THAT THE 1976  
23 AND 1978 LIMERICK SCHEDULE DEFERRALS ANNOUNCED BY PECO DID NOT  
24 MEET THEIR REASONABLE MAN STANDARD, A SUFFICIENT AND SOUND BASIS  
25 FOR QUANTIFICATION EFFORTS?  
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30  
31 A. Even if one assumes that the PPUC were correct in their ruling and that their Order  
32 does in fact contain a ruling, the decision was not explicit in its identification of  
33 specific imprudent management actions, notwithstanding the assertion that PECO did  
34 not adequately consider or address ratepayer interest when making its decision to  
35 implement funding reductions on the Limerick project. Implicit in the ruling, of  
36 course, is the sentiment that because PECO reduced then-scheduled funding levels,  
37 schedule delays and increased project costs resulted. Although intuitively credible,  
38 this assumption is not necessarily correct and, even if it were correct, it is encumbent  
39 upon the analysts (PECO, OCA, Staff, consultants, etc.) to perform a thorough review  
40 of all relevant contemporaneous circumstances to determine to what degree, if any,  
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1 funding restrictions or other alleged imprudent actions affected cost and schedule.

2  
3 Q. WHY IS STAFF WITNESS DOUGHERTY'S USE OF AN APRIL 1981 SERVICE DATE  
4 FOR LIMERICK UNIT 1 INCONSISTENT WITH FACTUAL EVIDENCE PRESENTED IN  
5 THIS PROCEEDING?  
6  
7

8  
9 A. Staff witness Dougherty presents no analysis to support the possibility of Limerick  
10 achieving an April 1981 completion date, and the reality of post-TMI, BWR completion  
11 dates demonstrates that such a completion date is impossible. Further, Staff witness  
12 Dougherty's assumption, utilized in his quantification analysis, that Limerick's in-  
13 service date would be equivalent to its construction completion date has no basis in  
14 reality. In fact, during cross examination he reversed his position and agreed that  
15 there is a substantial period of time between construction completion (fuel load) and  
16 commercial operation. (Tr. pgs. 2674-2676)  
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25 Given the fact that the Commission's Order does not provide a foundation for  
26 quantification of alleged delays in Limerick's construction (by supplying a probable  
27 completion date), as well as additional errors inherent in his quantification (discussed  
28 later), Staff witness Dougherty's testimony should be rejected.  
29  
30  
31

32  
33 Q. WHAT ERRORS OTHER THAN THOSE DESCRIBED PREVIOUSLY WERE REVEALED  
34 BY TB&A'S REVIEW OF OCA WITNESS O'BRIEN'S TESTIMONY?  
35  
36

37 A. Factually, it appears that he has based his assessment of the prudence of PECO  
38 management in part on information supplied by OCA witness Hanauer which has been  
39 found to be incorrect and misleading. In his testimony, when asked if it would have  
40 been reasonably possible for PECO to have constructed Limerick on the same schedule  
41 as Susquehanna and LaSalle (OCA Statement No. 1, pg. 25), OCA witness O'Brien  
42 replied,  
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49 "Yes, Structural Concrete started at Limerick two months earlier than at  
50 Susquehanna, despite the fact that Susquehanna got its Construction Permit (CP)

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7 months earlier (see Hanauer Exhibit SHH-3). Likewise, Large Pipe installation started at Limerick 10 months earlier than at LaSalle which received its CP 9 months ahead of Limerick; Large Pipe Hanger installation started over 3 years before LaSalle and over 1 1/2 years before Susquehanna (Ibid.). Given these facts, I firmly believe that, but for PECO's deliberate decision to stretch out construction, Limerick could have been completed in the same time frame...." (OCA Statement No. 1, p. 26)

OCA witness O'Brien has referenced Hanauer Exhibit SHH-3, which he stated is based on nuclear project milestone data contained in the NRC Yellow Book (NUREG-0030), as the source of his factual assertions. TB&A considers use of this data source as support for the purported achievable Limerick schedule to be seriously deficient. In any event, review of the NRC Yellow Book, as shown in Schedule 10, reveals that Hanauer Exhibit SHH-3 has incorrectly cited certain milestone dates on which OCA witness O'Brien relies and further, that OCA witness O'Brien fails to note that in general Limerick Unit 1 lags Susquehanna Unit 1 in the installation of almost all commodities.

Q. WHY DOES TB&A CONSIDER DATA FROM THE NRC YELLOW BOOK TO BE DEFICIENT WHEN USED AS SUPPORT FOR OCA WITNESS O'BRIEN'S SCHEDULE ANALYSIS?

A. There are two reasons. First, an implicit suggestion in his schedule analysis is that because installation of certain commodities started earlier at Limerick than at Susquehanna or LaSalle, Limerick's schedule progress was comparable to or better than those units at those points in time. That condition is true only if the start of those activities was on the projects' critical paths. If the start of the activities was not on the critical path, then schedule comparisons utilizing these dates are meaningless. For example, if the start of small bore pipe installation is not a critical activity, and small bore pipe installation began at Limerick one year before installation began at Susquehanna and LaSalle, this does not mean that Limerick's

LIMERICK 1 CONSTRUCTION STATUS REPORT  
 NUCLEAR POWER PLANTS

PAGE NO: 2-061  
 STATUS AS OF: 06-30-82

CONSTRUCTION STATUS:

APPLICANT'S CURRENT ESTIMATED FUEL LOADING DATE: 10-00-86  
 APPLICANT'S PREVIOUS ESTIMATED FUEL LOADING DATE: 10-00-83  
 APPLICANT'S ESTIMATED FUEL LOADING DATE AT CP ISSUANCE: 01-00-79  
 APPLICANT'S CURRENT ESTIMATED COMMERCIAL OPERATION DATE: 04-01-85

APPLICANT'S CONSTRUCTION COMPLETION ESTIMATE AS  
 DEFINED IN CP: (EARLIEST) 10-00-83  
 (LATEST) 10-00-85

CURRENT ESTIMATED PERCENT CONSTRUCTION COMPLETE: 76%

COMMENTS REGARDING CURRENT CONSTRUCTION STATUS: WE CONTINUE TO REPORT THE OVERALL COMPLETION PERCENTAGES BASED ON  
 ON TOTAL SCOPE AND MANHOURLY EXPENDITURES.

	ESTIMATED START	ACTUAL START	ESTIMATED COMPLETION	ACTUAL COMPLETION	ESTIMATED % COMPLETE
MOBILIZE AND PREPARE SITE:	05-00-70	05-00-70	09-00-74	09-00-74	100%
PLACE STRUCTURAL CONCRETE:	07-00-74	07-00-74	11-00-80	11-00-80	100%
INSTALL REACTOR PRESSURE VESSEL:	10-00-76	11-00-76	12-00-76	12-00-76	100%
INSTALL LARGE BORE PROCESS PIPE:	01-00-76	01-00-76	02-00-83		97%
INSTALL LARGE BORE PIPE HANGERS, RESTRAINTS AND SHROUDS:	01-00-76	01-00-76	04-00-83		79%
INSTALL SMALL BORE PIPE:	01-00-77	01-00-77	06-00-83		80%
INSTALL CABLE TRAY:	01-00-76	01-00-76	02-00-83	04-00-82	100%
INSTALL EXPOSED METAL CONDUIT:	02-00-76	02-00-76	11-00-83		75%
INSTALL POWER, CONTROL, INSTRUMENTATION AND SECURITY CABLE:	01-00-81	01-00-81	01-00-84		50%
INSTALL ELECTRICAL TERMINATIONS:	01-00-81	01-00-81	03-00-84		44%
CONDUCT REACTOR COLD HYDROSTATIC TEST:	09-00-83		09-00-83		0%
CONDUCT HOT FUNCTIONAL TEST:	N/A	N/A	N/A	N/A	N/A
CONDUCT PREOP AND ACCEPTANCE TESTS NECESSARY FOR FUEL LOAD:	07-00-82	05-00-82	10-00-84		0%

SOURCE: NUREG-0030 VOL. 6, NO. 2  
 Nuclear Power Plants  
 Construction Status Report Data as of 6/30/82  
 United States Nuclear Regulatory Commission.

CONSTRUCTION STATUS:

APPLICANT'S CURRENT ESTIMATED FUEL LOADING DATE: 07-15-82  
 APPLICANT'S PREVIOUS ESTIMATED FUEL LOADING DATE: 07-01-82  
 APPLICANT'S ESTIMATED FUEL LOADING DATE AT CP ISSUANCE: 05-01-79  
 APPLICANT'S CURRENT ESTIMATED COMMERCIAL OPERATION DATE: 05-15-83

APPLICANT'S CONSTRUCTION COMPLETION ESTIMATE AS  
 DEFINED IN CP: (EARLIEST) 05-01-79  
 (LATEST) 12-31-82

CURRENT ESTIMATED PERCENT CONSTRUCTION COMPLETE: 97%  
 COMMENTS REGARDING CURRENT CONSTRUCTION STATUS:

	ESTIMATED START	ACTUAL START	ESTIMATED COMPLETION	ACTUAL COMPLETION	ESTIMATED % COMPLETE
MOBILIZE AND PREPARE SITE:					
PLACE STRUCTURAL CONCRETE:		09-00-74		08-00-78	100%
INSTALL REACTOR PRESSURE VESSEL:		02-00-76		10-00-76	100%
INSTALL LARGE BORE PROCESS PIPE:		08-00-74		04-00-82	100%
INSTALL LARGE BORE PIPE HANGERS RESTRAINTS AND SHUBBERS:		08-00-75		05-00-82	100%
INSTALL SMALL BORE PIPE:		08-00-75		03-00-82	100%
INSTALL CABLE TRAY:		09-00-75		03-00-82	100%
INSTALL EXPOSED METAL CONDUIT:		04-00-76		04-00-82	100%
INSTALL POWER, CONTROL, INSTRUMENTATION AND SECURITY CABLE:		01-00-78		03-00-82	100%
INSTALL ELECTRICAL TERMINATIONS:		01-00-78		04-00-82	100%
CONDUCT REACTOR COLD HYDROSTATIC TEST:		01-00-78		07-00-82	98%
CONDUCT HOT FUNCTIONAL TEST:	N/A	12-00-79		10-00-80	100%
CONDUCT PREOP AND ACCEPTANCE TESTS NECESSARY FOR FUEL LOAD:	N/A	12-00-79		N/A	N/A
					98%

SOURCE: NUREG-0030 VOL. 6, NO. 2

Nuclear Power Plants  
 Construction Status Report Data as of 6/30/82  
 United States Nuclear Regulatory Commission.

1 progress was one year ahead of those units. It simply indicates that for that particular  
2 commodity, installation at Limerick started earlier than at the other units. It says  
3 nothing about comparable overall schedule status.  
4  
5

6  
7 The second reason that the NRC Yellow Book milestone data is deficient when  
8 used by OCA witness O'Brien is 'definitional' in nature. That is, the definition of when  
9 a particular activity starts may vary from utility to utility. For example, one utility  
10 might use a literal interpretation and define the start of large bore (over 2 1/2 inches  
11 in diameter) pipe installation as beginning when the very first spool of large bore  
12 drainage pipe is installed, while another may report the start only when the first spool  
13 of large bore process or power pipe is installed, ignoring the start of drainage pipe  
14 installation. These definitional problems are common in the industry, as OCA witness  
15 O'Brien admitted during cross examination:  
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24  
25 "Q. Do you know, Mr. O'Brien, whether the Yellow Book data,  
26 when it gives the start date for a particular commodity,  
27 such as large pipe hangers or large pipe or what-have-you  
28 for individual utilities, does the date reported always consist  
29 of the same thing for each utility? In other words, are  
30 utilities consistent in their reporting of start dates?  
31

32 A. I don't know. I wouldn't be surprised if they were  
33 inconsistent.  
34

35 Q. If you know, is it the case at nuclear construction projects  
36 that particular commodities may, because of a special  
37 problem or a special reason, be started at an unusually early  
38 or late time --  
39

40 A. Yes.

41 Q. -- on a specific plant?  
42

43 A. Yes.  
44

45 Q. And, thus, those individual commodities really may not be  
46 indicative of where the total construction at the plant  
47 stands at that particular time?  
48

49 A. That's true." (Tr. pgs. 3180-3181)  
50

1 Absent any analysis from OCA witness O'Brien indicating that the definition of  
2 the reported installation start dates for certain commodities at Limerick, Susquehanna  
3 and LaSalle are similar, and that these start dates were also on the project's critical  
4 paths, his assertion that Limerick could have been completed in the same time frame  
5 as Susquehanna and LaSalle is baseless. In addition, OCA witness O'Brien further  
6 compounds his inaccuracy by utilizing incorrect milestone information from the NRC  
7 Yellow Book.  
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15 Q. WHAT MILESTONE DATES WERE INCORRECTLY CITED BY OCA WITNESS  
16 HANAUER AND SUBSEQUENTLY INCORPORATED INTO OCA WITNESS O'BRIEN'S  
17 ANALYSIS?  
18  
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20

21 A. OCA witness Hanauer, in Exhibit SHH-3, cites large bore pipe hanger installation  
22 beginning in August 1977 at Susquehanna Unit 1 and April 1979 at LaSalle Unit 1.  
23 According to the NRC Yellow Book, (3-31-82 revision) installation began at  
24 Susquehanna Unit 1 in August 1975, five months before Limerick and not one and one  
25 half years after Limerick as indicated by OCA witness O'Brien in his testimony.  
26 Further, the NRC Yellow Book indicates that large bore pipe hanger installation began  
27 at LaSalle Unit 1 in March 1976, 2 months after Limerick and not over 3 years after  
28 Limerick as indicated in his testimony.  
29  
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37 Additionally, while citing Limerick's alleged 10 month lead over LaSalle Unit 1 in  
38 the installation of large bore pipe, OCA witness O'Brien fails to mention that  
39 according to the NRC Yellow Book, Limerick Unit 1 reportedly started large bore pipe  
40 installation 17 months after Susquehanna Unit 1.  
41  
42  
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45 TB&A can only conclude that OCA witness O'Brien's assertion that PECO could  
46 have been reasonably expected to complete the Limerick project in the same time  
47 frame as Susquehanna or LaSalle, due to Limerick's purported head start in the  
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1 installation of the noted commodities, is factually in error and, therefore, is not a  
2 reasonable basis for quantification efforts.  
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5 Q. WHAT OTHER ERRORS ARE INCORPORATED INTO OCA WITNESS O'BRIEN'S  
6 TESTIMONY?  
7

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9 A. Although admitting that he did not evaluate PECO's financial condition (IR-PECO-  
10 OCA-3-15), OCA witness O'Brien assumed that the increased funding necessitated by  
11 his adjusted Limerick schedule would have been available to PECO. This position is  
12 untenable and is in fact not supported by the PPUC's contested ruling in the Limerick  
13 investigation of 1982. The PPUC ruled that PECO did not meet their reasonable man  
14 standard and did not adequately address ratepayer interests. They did not conclude  
15 that PECO could have raised the substantial additional funds that OCA witness  
16 O'Brien indicates would have been required to meet his schedule. It was incumbent  
17 upon him or other OCA or Staff witnesses to demonstrate that those funding levels  
18 could have been achieved. Absent such analysis, his schedule analysis is purely  
19 speculative and not supportable given the financial realities of the mid-to-late 1970's.  
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31 Further, and more importantly, OCA witness O'Brien did not address other  
32 factors that may have had a direct influence on the schedule, with or without  
33 announced schedule deferrals. For example, as discussed previously, manpower  
34 density levels (the maximum number of men that can be physically accommodated in a  
35 given area without adversely effecting production) can be a limiting factor in  
36 construction progress, yet he includes no such analysis in his testimony. Also, he  
37 includes no review of probable licensing and regulatory impacts, other than  
38 referencing OCA witness Hanauer's implausible and undocumented contention that  
39 Limerick specific licensing concerns, such as the PRA, ATWS, Mechanical equipment  
40 qualification, etc., would not have prevented fuel load by mid-1982.  
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1 It was also a mischaracterization for OCA witness O'Brien to state, as previously  
2 cited, that, "... but for PECO's deliberate decision to stretch out construction,  
3 Limerick could have been completed in the same time frame...." as Susquehanna Unit  
4  
5  
6  
7 1 and LaSalle Unit 1, given the following facts;

8  
9 •PECO's use of construction target schedules to maintain  
10 progress toward the earliest possible completion date  
11 regardless of a publicly announced delay.

12  
13 •PECO attempts, subsequent to the 1978 deferral  
14 announcement, to maintain the October 1982 scheduled fuel  
15 load date by supplying funds in addition to those budgeted.

16  
17 •The unconstrained funding, starting in the early 1980's,  
18 provided by PECO in support of Limerick completion.

19  
20 •PECO's successful efforts to expedite its startup schedule.

21  
22 •The increased commodities of Limerick compared to  
23 Susquehanna

24  
25 •The intensive licensing scrutiny of Limerick because of its  
26 high population density site location

27  
28 •PECO's ability to successfully complete the regulatory  
29 requirements added late in the Limerick Schedule, such as  
30 PRA, ATWS, RMMS and others.

31  
32 Q. YOU MENTIONED THAT PECO'S DECISIONS TO PUBLICLY ANNOUNCE  
33 DEFERRALS OF LIMERICK IN 1976 AND 1978 WERE MISCHARACTERIZED BY OCA  
34 WITNESS O'BRIEN. WERE THE VARIOUS PROJECT COMPLETION DATES  
35 PUBLICLY ANNOUNCED BY THE COMPANY REPRESENTATIVE OF ACTUAL  
36 CONSTRUCTION TARGET SCHEDULES?  
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41  
42 A. No. TB&A's review of project documentation has indicated that construction target  
43 schedules, i.e., the schedules which actually drove construction efforts at Limerick,  
44 were almost always significantly shorter than those publicly announced. In fact,  
45 construction target schedules projected fuel load up to two years in advance of  
46 publicly announced fuel load dates. OCA witness O'Brien acknowledges this when he  
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50

1 states,  
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4 "PECO's public announcements and its monthly schedule forecasts  
5 were not the same...By May of 1978, the Fuel Load date was slipped  
6 to October of 1982 and it was held there until June 1980 - two full  
7 years..." (OCA Statement 1, pgs. 14-15)  
8

9 The publicly announced fuel load date during the period (May 1978 to June 1980)  
10 cited above was October 1984, a full two years later than construction's target  
11 schedule.  
12

13  
14 Q. DOES IT MAKE A DIFFERENCE THAT, PRIOR TO MID-1980, THE LIMERICK  
15 CONSTRUCTION FORCES WERE ALMOST ALWAYS WORKING TOWARDS A  
16 TARGET COMPLETION DATE THAT WAS EARLIER THAN THAT PUBLICLY  
17 ANNOUNCED?  
18  
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20  
21  
22 A. Yes, from a variety of viewpoints. First, the deferral announcements notwithstanding,  
23 PECO's aggressive construction schedules indicated that the Company continued to  
24 seek early fuel load dates for the Limerick units. As stated in TB&A's direct  
25 testimony,  
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30 "PECO's decision to announce a deferral publicly but work internally  
31 toward more aggressive goals was the result of several factors. Its  
32 poor financial condition and lower than anticipated load growth  
33 dictated a cautious position with regard to both its near-term  
34 capacity needs given projected increasing reserve margins.  
35 However, by supplying funds on a year-to-year basis sufficient to  
36 maintain the more advanced completion dates, PECO could  
37 effectively protect its options given changes in either its financial  
38 position or projected capacity needs." (PECO Statement No. 8, pgs.  
39 282-283).  
40

41 Clearly, PECO continued to seek early project completion and made legitimate  
42 efforts, as documented in direct testimony, to meet those construction target  
43 schedules, being hindered in their attempts only by the influence of events which were  
44 beyond the control of management.  
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47

48 Second, use of early target schedules demonstrated PECO's proactive posture  
49  
50

1 with regard to keeping the involved parties, i.e., Bechtel, sub-contractors, vendors and  
2 PECO personnel themselves, working at a high level of intensity so as to maximize  
3 progress from the limited funds available.  
4  
5

6  
7 Q. DOES THE FACT THAT LIMERICK UNIT 1 COULD NOT MEET ANY OF ITS PRE-  
8 1980 CONSTRUCTION TARGET FUEL LOAD DATES MEAN THAT PECO  
9 MANAGEMENT OVERSIGHT WAS LACKING?  
10  
11

12  
13 A. Definitely not. TB&A found PECO management oversight of Limerick was intensive  
14 and that it facilitated plant completion. It is very unusual that a contemporary  
15 nuclear power plant was able to meet a construction completion target (October 1984)  
16 set more than four years in advance, as PECO did for Limerick Unit 1 and Common.  
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21 B. IMPROPER QUANTIFICATION OF ALLEGED IMPRUDENCE  
22

23 Q. DID OCA WITNESS O'BRIEN AND STAFF WITNESS DOUGHERTY ALSO  
24 INCORPORATE ERRORS INTO THEIR QUANTIFICATION OF COSTS ASSOCIATED  
25 WITH ALLEGED PECO IMPRUDENCE?  
26  
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28  
29 A. Yes. When calculating AFUDC costs associated with their purported achievable  
30 schedules, OCA witness O'Brien and Staff witness Dougherty failed to include an  
31 estimate of the certain rise in AFUDC rates that would have occurred had PECO  
32 raised additional external funds during the periods in which they adjusted funding  
33 levels. Excluding this significant impact on AFUDC rates from their quantifications  
34 obviously understates their estimates of the final cost of the project.  
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39  
40 Staff witness Dougherty has also erred in his quantification. As previously  
41 noted, he has assumed for quantification purposes that the April 1981 in-service date  
42 for Limerick Unit 1 and Common would be the same as its construction completion  
43 date. Incorporating into Staff witness Dougherty's "4/81 completion date" Limerick's  
44 actually experienced 15 month duration (October 26, 1984 to February 1, 1986) from  
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1 fuel load to commercial operation, leads to a hypothetical Limerick fuel load in  
2  
3 January 1980; over two years before LaSalle Unit 1's fuel load in April 1982, and prior  
4  
5 to the necessary resolution of many technical, regulatory and licensing issues, e.g.,  
6  
7 Mark II, ATWS, TMI, etc. This is an obvious impossibility, particularly in view of the  
8  
9 post-TMI licensing moratorium which extended beyond January 1980.

10  
11 Further, Staff witness Dougherty has provided no analyses demonstrating that  
12  
13 the additional manpower and funds necessary to complete Limerick Unit 1 and  
14  
15 Common by April 1981 would have been available, nor has he supplied any studies  
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17 demonstrating how Limerick could have obtained the requisite NRC environmental and  
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19 safety approvals in a timely fashion.

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21 In summary, Staff witness Dougherty's quantification provides the Commission  
22  
23 absolutely no basis from which to quantify alleged PECO imprudence on the Limerick  
24  
25 project.

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27 Q. WHAT ADDITIONAL ERRORS WERE INCORPORATED INTO OCA WITNESS  
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29 O'BRIEN'S QUANTIFICATION EFFORTS?

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31 A. OCA witness O'Brien did not attempt to calculate the incremental cost increase  
32  
33 associated with the alleged imprudence in the Mark II containment design. Attributing  
34  
35 all costs associated with the Mark II fixes to imprudent management, without  
36  
37 recognizing that some, if not all of those costs would have been incurred no matter  
38  
39 when the problem had been discovered, is obviously incorrect.

40  
41 Further, when OCA witness O'Brien accepts the PPUC ruling that PECO was  
42  
43 imprudent regarding the 1976 and 1978 announced delays, he must, conversely, accept  
44  
45 the ruling that PECO actions up through May 1976 (the month the 1976 delay was  
46  
47 announced) were prudent. Given this constraint, actual cash flows up through May  
48  
49 1976 should not have been subject to adjustment. In his analysis however, he does  
50

1 adjust funding levels in the period prior to May 1976, thereby violating a condition of  
2 his own argument.  
3  
4

5 In summary, the analyses of OCA witnesses O'Brien and Hanauer, as well as Staff  
6 witness Dougherty, contain all of the typical errors described in Section II of this  
7 testimony. In TB&A's opinion, Susquehanna's and LaSalle's achievement of early fuel  
8 load dates is not sufficient proof, as seems to be suggested, that similar progress could  
9 have been reasonably expected of Limerick, and does not obviate OCA or Staff  
10 witnesses of the responsibility to examine all pertinent factors that were Limerick  
11 specific and could be expected to influence the project's cost and schedule. OCA and  
12 Staff analyses and subsequent quantification efforts are negligent in this regard.  
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21 Q. DOES THIS CONCLUDE YOUR TESTIMONY?  
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23 A. Yes.  
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## APPENDIX A

### RESULTS OF TB&A'S "AS-BUILT" SCHEDULE ANALYSIS

- Description of Critical Path for Limerick Unit 1 & Common
- "As-Built" Critical Path Activities
- Critical Path Gantt Chart
- 900 Activity Report

## APPENDIX A

### DESCRIPTION OF CRITICAL PATH FOR 'LIMERICK UNIT 1 & COMMON

Following receipt of the construction permit in June 1974, concrete and steel activities comprised the initial critical path. Within the period from June 1974 through late 1976, two concurrent events (first, an operating engineers strike and second, a two month construction hold on containment activities due to the Mark II new loads problem) interrupted critical path activities.

In December 1976, a major construction milestone on the critical path, the setting of the Reactor Pressure Vessel (RPV) was accomplished. Subsequent to the RPV set, the project developed two parallel critical paths, one through the containment drywell and the other through the fuel pool girders and elevation 283' in the reactor enclosure. The mechanical and electrical work in the containment drywell which began in December 1977, was comprised of numerous activities including installation of large bore pipe, large pipe hangers, small bore pipe, cable tray, conduit, and wire and cable. However only limited progress could be made until May 1978 when the concurrent critical path activity of erecting drywell structural steel at elevations 272' and 286' was completed. In August 1978, similar mechanical and electrical work began in elevation 283' of the reactor enclosure.

Installation of mechanical and electrical commodities in both the Containment Drywell and Reactor Enclosure elevation 283' continued through early 1983, when the "systems" (a collection of mechanical and electrical commodities and equipment which together perform a specific function in the plant, e.g. the Feedwater system) in those areas were first completed and "turned-over" from construction to startup for

preoperational testing. Startup tests for systems in the Containment Drywell and on elevation 283' of the Reactor Enclosure took place from 1983 through October 1984, culminating with the loading of fuel which began on October 26, 1984.

APPENDIX ALIMERICK UNIT 1 AND COMMON  
"AS-BUILT" CRITICAL PATH ACTIVITIES

<u>ACTIVITIES</u>	<u>DURATION (WEEKS)</u>	<u>START DATE</u>	<u>END DATE</u>
Form, Reinforce and Pour Basemat	6	June 19, 1974	July 31, 1974
Radwaste Drains in Basemat	6	June 19, 1974	July 31, 1974
CB&I Out of Hole Work	15	June 19, 1974	October 2, 1974
Area 12 and 16 Footing at Elevation 177'	3	July 31, 1974	August 21, 1974
Area 11 Footing at Elevation 177'	3	July 31, 1974	August 21, 1974
Exterior and Partial Interior Walls to Elevation 201'	16	August 21, 1974	December 11, 1974
CB&I Unit 2 Restraint	27	October 2, 1974	April 9, 1975
Cure Slab and Set Cranes	7	December 11, 1974	January 29, 1975
Suppression Pool Rebar 30%	3	January 29, 1975	February 19, 1975
Suppression Pool Rebar 60%	3	February 19, 1975	March 12, 1975
Suppression Pool Rebar 100%	4	March 12, 1975	April 9, 1975
Mark II-Related Containment Hold	7	April 9, 1975	May 28, 1975
Prefabricate and Fit New Rebar	6	May 28, 1975	July 9, 1975
Suppression Pool Walls Lifts 1-3	4	July 9, 1975	August 6, 1975
Suppression Pool Lifts 4 and 5	2	August 6, 1975	August 20, 1975
Drywell Rebar to Elevation 258'	18	August 20, 1975	December 24, 1975

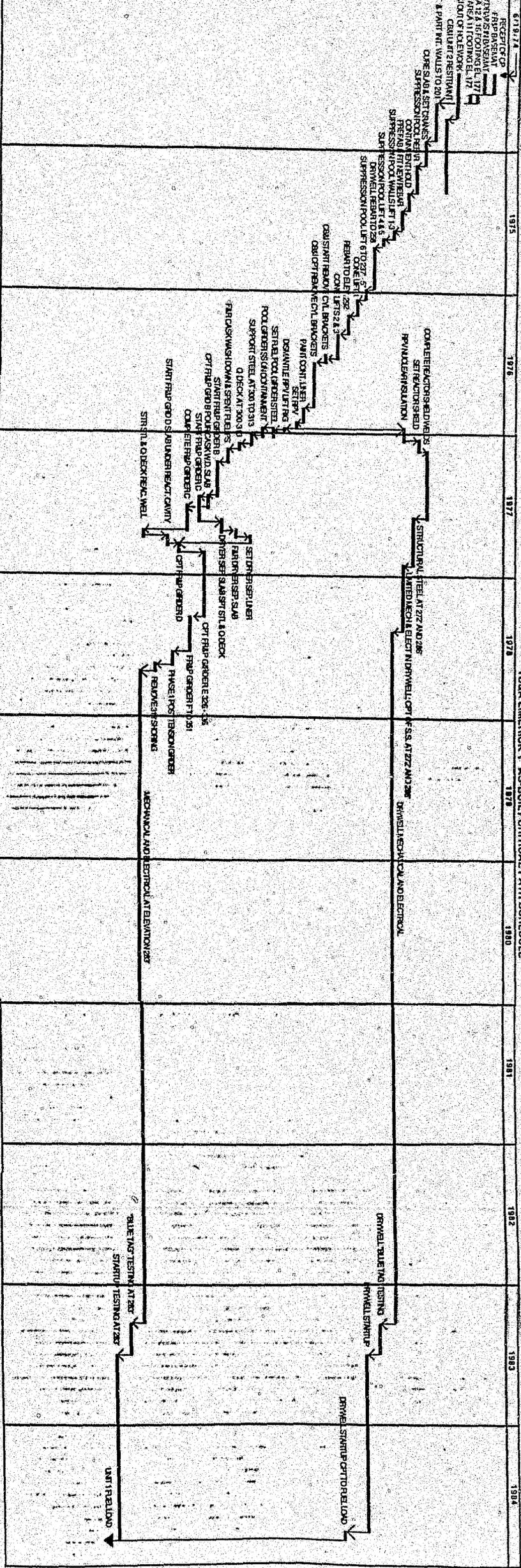
<u>ACTIVITIES</u>	<u>DURATION (WEEKS)</u>	<u>START DATE</u>	<u>END DATE</u>
Suppression Pool Lift 6 to Elevation 237'-5"	3	December 24, 1975	January 14, 1976
Cone Lift 1	6	January 14, 1975	February 25, 1976
Rebar to Elevation 292'	8	February 25, 1976	April 21, 1976
Cone Lifts 2 and 3	9	April 21, 1976	June 23, 1976
CB&I Start Removal Cylinder Brackets	2	June 23, 1976	July 7, 1976
CB&I Complete Removal Cylinder Brackets	15	July 7, 1976	October 20, 1976
Paint Containment Liner	6	October 20, 1976	December 1, 1976
Set RPV	1	December 1, 1976	December 8, 1976
RPV Nuclear Insulation	2	December 8, 1976	December 22, 1976
Dismantle RPV Lift Rig	1	December 8, 1976	December 15, 1976
Set Fuel Pool Girder Steel	3	December 15, 1976	January 5, 1977
Fuel Pool Girder Steel on Containment	3	December 15, 1976	January 12, 1977
Set Reactor Shield	3	December 22, 1976	January 12, 1977
Support Steel at Elevation 300' to 313'	4	January 5, 1977	February 2, 1977
Complete Reactor Shield Welds	23	January 12, 1977	June 22, 1977
Q-Deck at Elevation 300' to 313'	2	February 2, 1977	February 16, 1977
Form and Reinforce Cask Wash Dn. and Spent Fuel Pool	4	February 16, 1977	March 16, 1977
Start Forming, Reinforcing and Pouring Girder B	12	March 16, 1977	June 8, 1977
Complete Forming, Reinforc- ing and Pouring Girder B, Pour Cask W.D. Slab	4	June 8, 1977	July 6, 1977

<u>ACTIVITIES</u>	<u>DURATION (WEEKS)</u>	<u>START DATE</u>	<u>END DATE</u>
Start Forming Reinforcing and Pouring Girder C	9	June 8, 1977	August 10, 1977
Structural Steel at Elevation 272' and 286'	24	June 22, 1977	December 7, 1977
Complete Forming, Reinforcing and Pouring Girder C	9	July 7, 1977	September 7, 1977
Dryer Separation Slab, Support Steel and Q-Deck	4	August 10, 1977	September 7, 1977
Structural Steel and Q-Deck Reactor Well	3	September 7, 1977	September 28, 1977
Form and Reinforce Dryer Separation Slab	3	September 7, 1977	September 28, 1977
Start Forming, Reinforcing and Pouring Girder D Slab Under Reactor Cavity	2	September 28, 1977	October 12, 1977
Set Dryer Separation Liner	2	September 28, 1977	October 12, 1977
Complete Forming, Reinforcing and Pouring Girder D	3	October 12, 1977	November 2, 1977
Complete Forming, Reinforcing and Pouring Girder E 326' to 336'	23	November 2, 1977	April 12, 1978
Limited Mechanical and Electrical in the Containment Drywell, and Completion of Structural Steel at Elevation 272' and 286'	24	December 7, 1977	May 24, 1978
Form, Reinforce and Pour Girder F to Elevation 351'	13	April 12, 1978	July 12, 1978
Mechanical and Electrical in the Containment Drywell	254	May 24, 1978	April 6, 1983

<u>ACTIVITIES</u>	<u>DURATION (WEEKS)</u>	<u>START DATE</u>	<u>END DATE</u>
Phase I Post Tension Girder	5	July 12, 1978	August 16, 1978
Remove Elevation 313' Shoring	2	August 16, 1978	August 30, 1978
Mechanical and Electrical at Elevation 283'	240	August 30, 1978	April 6, 1983
"Blue Tag" Testing at Elevation 283'	12	April 6, 1983	June 29, 1983
"Blue Tag" Testing in Containment Drywell	12	April 6, 1983	June 29, 1983
Startup Activities in Containment Drywell	67	June 29, 1983	October 10, 1984
Startup Activities in Elevation 283'	69	June 29, 1983	October 24, 1984
Drywell Startup Completion to Fuel Load	2	October 10, 1984	October, 24, 1984

- Note:
1. Activity durations rounded to nearest whole number for the basis of this analysis.
  2. Dates may not be exact due to rounding within each calendar week.

18A LIMERICK 1 - AS-BUILT CRITICAL PATH SCHEDULE



ACTIVITY REPORT

Task Number and Description	#Wks	Earliest Start	Earliest Finish	Latest Start	
A000 RECEIPT OF CONSTRUCTION PERMIT	0	06/19/74	06/19/74	06/19/74	0
A008 FR&P BASEMAT	6	06/19/74	07/31/74	06/19/74	0
A009 RW DRAINS IN BASEMAT	6	06/19/74	07/31/74	06/19/74	0
A010 OUT OF HOLE CONCRETE	278	07/31/74	11/28/79	11/09/77	0
A011 CB&I OUT OF HOLE WORK	15	06/19/74	10/02/74	06/19/74	1
A012 CB&I CYL. 1-3	2	10/02/74	10/16/74	03/26/75	0
A013 CB&I UNIT 2 RESTRAINT	27	10/02/74	04/09/75	10/02/74	0
A014 S.S. COLUMNS	2	10/02/74	10/16/74	03/12/75	0
A015 CB&I CYL. 4-6	2	10/16/74	10/30/74	04/09/75	0
A016 CB&I COURSE	6	10/30/74	12/11/74	04/23/75	0
A017 INSTALL BOTTOM LINER	6	10/16/74	11/27/74	03/26/75	0
A018 RPV PED. BELOW 238	4	11/27/74	12/25/74	05/07/75	0
A019 SET PIPE	1	12/25/74	01/01/75	06/04/75	0
A020 SET TANKS	1	12/25/74	01/01/75	06/04/75	0
A021 CPT. S. S. & DOWNCOMERS	3	01/01/75	01/22/75	06/11/75	0
A022 SUPPRESSION POOL M&E	227	01/22/75	05/30/79	07/18/79	1
A023 CB&I CONES 1-3	2	01/22/75	02/05/75	07/02/75	0
A024 SUPPRESSION POOL S/C	212	01/01/75	01/24/79	10/31/79	1
A025 RW DRAINS EL. 177	20	06/19/74	11/06/74	07/24/74	1
A026 AREA 12 & 16 FOOTING EL. 177	3	07/31/74	08/21/74	07/31/74	0
A027 AREA 11 FOOTING EL. 177	3	07/31/74	08/21/74	07/31/74	0
A029 EMBEDDED CONDUIT - EL. 177	7	06/19/74	08/07/74	10/23/74	1
A030 FR&P EL. 177 BASEMAT AND EMBEDS	7	07/31/74	09/18/74	10/23/74	1
A031 CB&I INSERTS 1-4	3	02/05/75	02/26/75	07/30/75	0
A032 EXT. & PART INT. WALLS TO 201'	16	08/21/74	12/11/74	08/21/74	1
A033 INSTALL REBAR, Q-DECK, DIAPH, SLAB	4	01/22/75	02/19/75	02/18/76	0
A034 CB&I CONES 4-6	2	02/05/75	02/19/75	07/16/75	0
A035 23-LINE WALL EL. 177 - 201'	10	08/21/74	10/30/74	10/02/74	1
A036 RW DRAINS IN DIAPHRAM SLAB	5	01/22/75	02/26/75	02/18/76	0
A037 CB&I INSERTS 5-6	4	02/26/75	03/26/75	02/11/76	0
A038 CURE SLAB & SET CRANES	7	12/11/74	01/29/75	12/11/74	0
A039 SUPPRESSION POOL REBAR 30 %	3	01/29/75	02/19/75	01/29/75	0
A040 CB&I CONES 7-9	20	02/19/75	07/09/75	07/30/75	1
A041 CB&I CONES 10-11	22	07/09/75	12/10/75	12/17/75	0
A042 CB&I INSERTS 7-10	10	03/26/75	06/04/75	03/10/76	0
A043 SUPPRESSION POOL REBAR 60 %	3	02/19/75	03/12/75	02/19/75	0
A044 SUPPRESSION POOL REBAR 100 %	4	03/12/75	04/09/75	03/12/75	0
A045 SET 9 STEEL COLUMNS	3	01/29/75	02/19/75	06/18/75	0
A046 PREFAB & FIT NEW REBAR	6	05/28/75	07/09/75	05/28/75	0
A047 SUPPRESSION POOL WALLS LIFT 1-3	4	07/09/75	08/06/75	07/09/75	0
A048 SUPPORT STEEL	3	02/19/75	03/12/75	07/09/75	0
A049 SET PIPE AT EL. 177'	1	12/11/74	12/18/74	05/31/78	0
A050 SUPPRESSION POOL LIFT 4&5	2	08/06/75	08/20/75	08/06/75	0
A051 Q-DECK	1	03/12/75	03/19/75	07/30/75	0
A052 EXT. & PART INT. WALLS TO 217	12	12/11/74	03/05/75	05/14/75	0
A053 CB&I LINER MANPOWER	76	06/19/74	12/03/75	05/07/75	1
A054 QUAD CRANES TO 253'	2	03/19/75	04/02/75	08/06/75	0
A055 BACKFILL D-LINE	2	03/05/75	03/19/75	08/25/76	0
A056 DRYWELL REBAR TO 258	18	08/20/75	12/24/75	08/20/75	1
A057 SUPPRESSION POOL LIFT 6 TO 237' - 5"	3	12/24/75	01/14/76	12/24/75	0
A058 LIFT 6 CURE	1	01/14/76	01/21/76	03/17/76	0

## ACTIVITY REPORT

Task Number and Description	#Wks	Earliest Start	Earliest Finish	Latest Start
A059 POUR DIAPHRAGM SLAB	1	01/21/76	01/28/76	03/24/76
A060 INST PIPE HGRS RESTR. TO CONT	2	01/28/76	02/11/76	06/23/76
A061 FR&P LIFT RIG FOUNDATION	5	03/19/75	04/23/75	09/08/76
A062 JUMP CRANE TO 316	2	04/02/75	04/16/75	01/21/76
A063 RPY RIG TRANSPORT	2	06/19/74	07/03/74	10/20/76
A064 CONE LIFT 1	6	01/14/76	02/25/76	01/14/76
A065 FRP RPY PEDST ABOVE DIAPH SLAB	14	01/28/76	05/05/76	03/31/76
A066 SET OUTSIDE LEGS LIFT RIG	4	04/23/75	05/21/75	10/13/76
A067 PLATFORM AT 253	15	05/05/76	08/18/76	07/07/76
A068 REBAR TO ELEV. 292	8	02/25/76	04/21/76	02/25/76
A069 INSERVICE INSPECTION	3	07/03/74	07/24/74	11/03/76
A070 CONE LIFTS 2 & 3	9	04/21/76	06/23/76	04/21/76
A071 REBAR TO FLANGE 322' - 4"	5	04/21/76	05/26/76	05/19/76
A072 CB&I START REMOVE CYL. BRACKETS	2	06/23/76	07/07/76	06/23/76
A073 COMPLETE LIFT RIG	2	05/26/76	06/09/76	11/10/76
A074 CB&I DIAPH SLAB LINER PLATE	8	05/05/76	06/30/76	08/25/76
A075 PLACE NUC INSUL FOR BOTTOM HEAD	1	07/24/74	07/31/74	11/24/76
A076 TEST RIG	1	06/09/76	06/16/76	11/24/76
A077 SET RPY RING GIRDER	8	05/05/76	06/30/76	08/25/76
A078 CB&I CPT REMOVE CYL. BRACKETS	15	07/07/76	10/20/76	07/07/76
A079 PAINT CONT. LINER	6	10/20/76	12/01/76	10/20/76
A081 COMPLETE INT. WALLS EL. 177-201'	8	08/06/75	10/01/75	03/02/77
A083 SET RPY	1	12/01/76	12/08/76	12/01/76
A084 OUT OF HOLE CONC CONTAINMENT	107	06/19/74	07/07/76	06/16/82
A085 CPT INT WALLS 217'	3	10/01/75	10/22/75	04/27/77
A086 SUB ASSEMBLY REAC SHIELD	16	06/19/74	10/09/74	08/18/76
A087 RPY NUCLEAR INSULATION	2	12/08/76	12/22/76	12/08/76
A088 EMBEDDED CONDUIT EL. 201'	4	03/19/75	04/16/75	04/13/77
A089 FR&P 201 SLAB	15	03/19/75	07/02/75	01/26/77
A090 OUT OF HOLE PAINT REAC. SHIELD	2	10/09/74	10/23/74	12/08/76
A091 S.S. 201-217&COLS TO EXT WALLS	3	03/19/75	04/09/75	10/29/75
A092 POUR SHIELD	13	07/07/76	10/06/76	07/04/84
A093 SET REACTOR SHIELD	3	12/22/76	01/12/77	12/22/76
A094 CPT REACT SHIELD WELD	23	01/12/77	06/22/77	01/12/77
A095 Q-DECK 217	2	04/09/75	04/23/75	11/19/75
A096 RW DRAINS EL. 201'	4	03/19/75	04/16/75	04/13/77
A097 WELD SHIELD CAP	2	10/06/76	10/20/76	10/03/84
A098 CPT SS EL. 201'	2	10/01/75	10/15/75	03/08/78
A099 START SS AT 217-253 EXT WLS-COLS	9	04/23/75	06/25/75	12/03/75
A100 CPT PAINT REAC SHIELD	1	10/20/76	10/27/76	10/17/84
A101 SET PIPE EL. 201'	1	10/01/75	10/08/75	05/11/77
A102 CPT. Q-DECK 217'	4	10/22/75	11/19/75	05/18/77
A103 S/C EL. 177'	264	10/15/75	11/05/80	10/11/78
A104 RW DRAINS @ 217	6	04/23/75	06/04/75	06/15/77
A105 PART Q-DECK @253 EXT WALLS TO COLS	1	06/25/75	07/02/75	02/04/76
A106 START REBAR WALLS 217-253	3	04/23/75	05/14/75	12/24/75
A107 S.S. EL. 217' COLS. TO CONT	1	10/22/75	10/29/75	06/08/77
A108 CPT FR&P EL. 217 SLABCOLS. TO CONT	6	11/19/75	12/31/75	06/15/77
A109 MECH & ELECT 177'	260	10/15/75	10/08/80	06/07/78
A110 START FORMS CPT RBR WALS 217-253	4	05/14/75	06/11/75	01/14/76
A111 PRECAST 217-253	2	07/02/75	07/16/75	02/25/76

## ACTIVITY REPORT

Task Number and Description	*Wks	Earliest Start	Earliest Finish	Latest Start
A112 FR&P PART SLAB 217 EXT WALLS TO COL	6	04/23/75	06/04/75	06/15/77
A113 DISMANTLE RPY LIFT RIG	1	12/08/76	12/15/76	12/08/76
A115 EMBED CONDUIT @ 217'	6	10/29/75	12/10/75	06/15/77
A116 CONT FR&P WALLS ELEV 217-253	4	07/02/75	07/30/75	02/11/76
A117 CPT. FR&P WALLS ELEV 217-253	9	07/30/75	10/01/75	03/10/76
A118 MECH & ELEC 201'	262	12/31/75	01/07/81	05/24/78
A119 CPT INT WALLS 217-253 CON-COLS	14	02/25/76	06/02/76	07/27/77
A120 S/C AT 201'	239	12/31/75	07/30/80	04/04/79
A121 Q-DECK 241	1	06/23/76	06/30/76	03/15/78
A123 FRAME STEEL @ 253 - 313	2	10/01/75	10/15/75	05/12/76
A124 FR&P SLAB AT 241 STEAM VENT AREA	2	06/30/76	07/14/76	03/22/78
A125 CPT. Q-DECK 253	15	06/23/76	10/06/76	11/02/77
A126 STEAMCHASE MECH & ELEC	219	10/01/75	12/12/79	03/14/79
A128 FR&P WALLS 241-253 STEAM VENT AREA	1	07/14/76	07/21/76	04/05/78
A129 S/C IN STEAM CHASE	12	10/01/75	12/24/75	09/01/82
A130 START FR&P 253 SLAB EXT WAL-COL	4	10/01/75	10/29/75	03/15/78
A131 RW DRAINS @ 253'	19	07/02/75	11/12/75	11/30/77
A132 CPT FR&P 253 SLAB COLS TO CONT	23	10/06/76	03/16/77	04/12/78
A133 START EXT. WALLS 253-283	4	10/15/75	11/12/75	06/02/76
A134 283 EXT WALLS TO COLS FLOOR SUPPORT	3	10/15/75	11/05/75	05/26/76
A135 Q-DECK	1	11/05/75	11/12/75	06/16/76
A136 S/C 217'	209	11/12/75	11/14/79	10/31/79
A137 CPT SS 253-283 COLS TO CONT	2	06/23/76	07/07/76	02/15/78
A138 MECH & ELEC 217'	284	11/12/75	04/22/81	12/21/77
A139 CPT Q-DECK 283	1	07/07/76	07/14/76	03/01/78
A141 CPT FR&P SLAB @ 283'	28	07/14/76	01/26/77	03/08/78
A142 RW DRAINS @ 283'	36	11/12/75	07/21/76	01/11/78
A143 START PRECAST PNLS 253-283	1	11/12/75	11/19/75	06/23/76
A144 CONT. WALLS 253-283	15	11/19/75	03/03/76	06/30/76
A145 EMBEDDED CONDUIT @ 283	55	11/12/75	12/01/76	08/31/77
A146 CPT PRECAST PANELS 253-283	2	11/19/75	12/03/75	09/29/76
A147 EMBEDDED CONDUIT 253	31	10/06/76	05/11/77	02/15/78
A148 CONT. WALLS 253-283	5	03/03/76	04/07/76	10/13/76
A149 CPT. WALLS 253-283	3	04/07/76	04/28/76	11/17/76
A150 CONE LIFTS 4-5	15	05/26/76	09/08/76	09/01/76
A151 START FR&P SLAB AT 283	6	11/12/75	12/24/75	10/27/76
A152 SET TEMP COLS AT 283 FOR	1	04/28/76	05/05/76	12/08/76
A153 SET FUEL POOL GIRDER	3	12/15/76	01/05/77	12/15/76
A154 BECHTEL SUPT REACT SHIELD	0	06/19/74	06/19/74	06/22/77
A155 POOL GIRDER SS ON	3	12/15/76	01/05/77	12/15/76
A156 SUPPORT STEEL AT 300	4	01/05/77	02/02/77	01/05/77
A157 CRD MODULES	196	05/11/77	02/11/81	07/04/79
A158 Q-DECK AT 300-313	2	02/02/77	02/16/77	02/02/77
A159 S/C 253	236	05/11/77	11/18/81	04/25/79
A160 SS AT 272' & 286'	24	06/22/77	12/07/77	06/22/77
A161 CRD PIPE OUTSIDE	16	05/11/77	08/31/77	12/15/82
A162 INSTALL CRD PIPE	144	12/06/78	09/09/81	07/02/80
A163 START FUEL POOL LINER OUT OF HOLE	10	06/19/74	08/28/74	01/05/77
A164 F&R CASK WASH DN &	4	02/16/77	03/16/77	02/16/77
A165 MECH & ELEC 253	256	05/11/77	04/07/82	09/20/78
A166 START PRECAST TO 313	1	02/16/77	02/23/77	05/18/77

## ACTIVITY REPORT

Task Number and Description	#Wks	Earliest Start	Earliest Finish	Latest Start
A167 DRYWELL S/C	216	12/07/77	01/27/82	09/03/80
A168 DRYWELL MECH & ELEC	254	05/24/78	04/06/83	05/24/78
A169 START EXT WALLS TO 283	2	02/23/77	03/09/77	05/25/77
A170 SHORE 313 SLAB	4	02/02/77	03/02/77	11/16/77
A171 SET SPENT FUEL POOL LINER	2	03/16/77	03/30/77	05/11/77
A172 CPT 313 PRECAST	2	02/23/77	03/09/77	05/25/77
A173 START FR&P GIRDER B	12	03/16/77	06/08/77	03/16/77
A176 COMPLETE EXT WALLS 283 TO	18	03/09/77	07/13/77	06/08/77
A177 SET CASK WASHDOWN LINER	2	03/30/77	04/13/77	05/25/77
A178 CPT FR&P GRD B POUR	4	06/08/77	07/06/77	06/08/77
A179 START FR&P GIRDER C	9	06/08/77	08/10/77	06/08/77
A180 F&R 313 SLAB D-F	9	07/13/77	09/14/77	10/12/77
A181 FRAME STEEL 313 TO 352	2	07/13/77	07/27/77	10/19/77
A183 POUR SOUTH 313 SLAB	3	09/14/77	10/05/77	12/14/77
A184 COMPLETE FR&P GIRDER C	9	07/06/77	09/07/77	07/06/77
A185 DRYER SEP. SLAB SPT	4	08/10/77	09/07/77	08/10/77
A186 CPT SUPPORT STEEL @ 331	15	07/27/77	11/09/77	11/02/77
A187 STR STL & Q-DECK	3	09/07/77	09/28/77	09/07/77
A188 F&R DRYER SEP SLAB	3	09/07/77	09/28/77	09/07/77
A189 START FR&P GRD D	2	09/28/77	10/12/77	09/28/77
A190 RW DRAINS @ 313	87	07/13/77	03/14/79	10/28/81
A191 Q-DECK @ 331	3	11/09/77	11/30/77	02/15/78
A192 EXT START WALLS 313-331	7	11/30/77	01/18/78	03/08/78
A193 START F&R GIRDER E	3	09/28/77	10/19/77	10/12/77
A194 SET DRYER SEP LINER	2	09/28/77	10/12/77	09/28/77
A195 CPT FR&P GIRDER D	3	10/12/77	11/02/77	10/12/77
A196 FR&P SOUTH INT WALLS TO	8	10/05/77	11/30/77	01/04/78
A197 PRECAST TO 331	2	01/18/78	02/01/78	04/26/78
A198 CPT FUEL POOL LINER OUT OF	89	03/16/77	11/29/78	12/24/80
A199 CPT EXT WALLS 313 & 331	3	02/01/78	02/22/78	05/10/78
A200 CPT FR&P GIRDER E	23	11/02/77	04/12/78	11/02/77
A201 REMOVE COLS 283	2	11/02/77	11/16/77	03/15/78
A202 FR&P 331 SLAB	13	11/30/77	03/01/78	03/01/78
A204 SET REACTOR CAVITY LINER	2	11/16/77	11/30/77	03/29/78
A205 CONSTRUCTION RESTRAINT	2	11/30/77	12/14/77	10/13/82
A206 PRECAST TO 352	5	03/01/78	04/05/78	06/28/78
A207 CPT 313 & 352 CONSTRUCTION	2	12/14/77	12/28/77	10/27/82
A208 BECHTEL SUP PRV INTERNALS	184	12/07/77	06/17/81	12/12/79
A209 REMOVE QUAD CRANES	3	11/30/77	12/21/77	10/18/78
A210 FR&P EXT. & INT. WALLS TO	9	03/01/78	05/03/78	05/31/78
A211 FR&P GIRDER F TO 351	13	04/12/78	07/12/78	04/12/78
A212 TOP HAT COLS TO 23 LINE	15	05/03/78	08/16/78	08/02/78
A213 SET HVAC FILTR PLENUMS @	4	05/03/78	05/31/78	10/11/78
A214 STR STL Q-DECK @ 352	1	07/12/78	07/19/78	11/08/78
A215 CPT Q-DECK	16	08/16/78	12/06/78	03/10/82
A216 RF GIRDER (EXCEPT 21.5	8	08/16/78	10/11/78	11/15/78
A217 OPERATING ENGINEERS STRIKE	5	04/09/75	05/14/75	04/23/75
A217 R.B. BRIDGE CRANE (RIG IN)	5	10/11/78	11/15/78	02/27/80
A218 PHASE 1 POST TENSTION	5	07/12/78	08/16/78	07/12/78
A219 REBAR EXT WALLS 352-410	9	12/06/78	02/07/79	07/21/82
A220 PLACE CNSTR SEPARATION	2	12/28/77	01/11/78	11/10/82

ACTIVITY REPORT

Task Number and Description	#Wks	Earliest Start	Earliest Finish	Latest Start
A221 PRECAST 2 LIFTS NOT OVER	35	12/06/78	08/08/79	06/30/82
A223 FR&P INT WALLS 283' - 313'	45	11/16/77	09/27/78	06/23/82
A224 CPT NEW FUEL STORAGE	13	04/12/78	07/12/78	04/26/78
A225 TEST CRANE	2	11/15/78	11/29/78	04/02/80
A226 PRECAST FPG 14.1 LINE	2	08/08/79	08/22/79	03/02/83
A227 FR&P 300' SLAB	8	09/27/78	11/22/78	05/04/83
A228 PLACE EXT. WALLS ALL LIFTS	27	02/07/79	08/15/79	09/22/82
A229 FR&P WALLS & ROOF OF ELEV	15	01/11/78	04/26/78	11/24/82
A230 CURE F	3	07/12/78	08/02/78	07/26/78
A231 352 SLAB & NEW FUEL	20	08/16/78	01/03/79	03/10/82
A232 PRECAST THIRD LIFT	2	08/22/79	09/05/79	03/16/83
A233 PRV INTRNLS UPTO & INCLUDING JET PUMP	70	11/29/78	04/02/80	04/16/80
A234 MECH & ELECT 313	261	07/12/78	07/13/83	11/01/78
A235 INCORE INSTRUMENTS	24	12/07/77	05/24/78	01/05/83
A238 S/C 313	222	07/12/78	10/13/82	08/01/79
A239 POUR DRYER SEP &	34	08/16/78	04/11/79	12/02/81
A240 COMP. INTRNL UPTO COLD HYDRO	96	04/02/80	02/03/82	08/19/81
A241 BECH CPT RPY INTERNAL	5	02/03/82	03/10/82	06/22/83
A242 PLACE ROOF	11	09/05/79	11/21/79	03/30/83
A243 S/C 352	235	10/11/78	04/13/83	05/02/79
A246 MECH & ELECT 352	230	10/11/78	03/09/83	01/10/79
A247 SPECIAL COATING	4	11/21/79	12/19/79	06/15/83
A248 RW DRAINS @ 352'	15	08/16/78	11/29/78	04/14/82
A249 CPT FR&P REST OF 313 SLAB	13	08/16/78	11/15/78	04/28/82
A250 SPECIAL COATING @ 331	2	04/05/78	04/19/78	07/14/82
A252 PHASE II POST TENSION	6	04/11/79	05/23/79	07/28/82
A253 MOVE IN D.W. HEAD	4	12/19/79	01/16/80	07/13/83
A254 TOPPING SLABS & LINER BASE	13	05/23/79	08/22/79	09/08/82
A255 REMOVE 313' SHORING	2	08/16/78	08/30/78	08/16/78
A256 CRANE ON ROOF	2	11/21/79	12/05/79	11/02/83
A257 S/C 283	236	11/16/77	05/26/82	04/25/79
A258 CHECK RPY HEAD FIT.	4	01/16/80	02/13/80	08/10/83
A259 REAC. WELL LINER FINISH	13	08/22/79	11/21/79	12/08/82
A260 MECH & ELECT 283	240	08/30/78	04/06/83	08/30/78
A262 PDM, LINERS & GATE & STOP	31	11/28/79	07/02/80	03/09/83
A263 N,W, & S PRECAST STACKS	6	12/05/79	01/16/80	11/16/83
A264 INSTALL RPY HEAD, BELLOWS	5	02/13/80	03/19/80	09/07/83
A265 PDM HYDRO	3	07/02/80	07/23/80	10/12/83
A266 INSTALL ROOFING	6	01/16/80	02/27/80	12/28/83
A267 FUEL POOL RACKS & EQUIP	18	07/23/80	11/26/80	11/02/83
A270 EXC. D-LINE PIPE TUNNEL	4	06/19/74	07/17/74	06/28/78
A271 INSTALL R/W DRAIN PIPE	4	07/17/74	08/14/74	07/26/78
A272 FR&P TUNNEL BASE SLAB &	30	08/14/74	03/12/75	08/23/78
A273 FR&P TUNNEL ROOF	13	03/12/75	06/11/75	03/21/79
A274 WEATHER ALLOWANCE	0	06/11/75	06/11/75	06/20/79
A275 MECHANICAL & ELECTRICAL	205	06/11/75	05/16/79	06/20/79
A279 REDESIGN OF CRD SYS. BY	52	12/07/77	12/06/78	07/04/79
A280 CONTAINMENT HOLD	7	04/09/75	05/28/75	04/09/75
A281 LIMITED DRYWELL MECH & ELECTRICAL	24	12/07/77	05/24/78	12/07/77
A282 "BLUE TAG" TESTING	12	04/06/83	06/29/83	04/06/83
A283 DRYWELL "BLUE TAG" TESTING	12	04/06/83	06/29/83	04/06/83

ACTIVITY REPORT

Task Number and Description	*Wks	Earliest Start	Earliest Finish	Latest Start
A284 DRYWELL STARTUP; CORESPRAY	67	06/29/83	10/10/84	06/29/83
A285 EL. 283 STARTUP; CORESPRAY	69	06/29/83	10/24/84	06/29/83
A286 LICENSE DELAY DRYWELL STARTUP COMPLETION TO FUEL LC	2	10/10/84	10/24/84	10/10/84
A287 COMPLETE ATWS MODIFICATIONS	0	09/01/84	09/01/84	10/24/84
A288 TUNNEL STARTUP TESTING	62	07/15/82	09/22/83	08/17/83
A289 STEAM CHASE STARTUP	74	12/12/79	05/13/81	05/25/83
C001 FR&P TURBINE FOUNDATNS	9	11/20/74	01/22/75	02/25/76
C002 CIRC WATER PIPE ENV.	5	06/19/74	07/24/74	03/17/76
C003 SITE PREPARATION	5	06/19/74	07/24/74	12/17/75
C004 FR&P TURBINE BASE	9	01/22/75	03/26/75	04/28/76
C005 MUD MAT	8	07/24/74	09/18/74	01/21/76
C006 SERVICE WATER PIPE	4	07/24/74	08/21/74	06/02/76
C007 FRP FOOTINGS & GROUND BEAMS	10	07/24/74	10/02/74	04/21/76
C008 UTILITY PIPE & DRAINS	24	09/18/74	03/05/75	04/07/76
C009 BACKFILL CONCRETE	13	11/20/74	02/19/75	06/23/76
C010 ELEC DUCT BNKS BELOW 217 SLB	7	03/26/75	05/14/75	10/27/76
C011 ENCASE ELEC DUCT BANK	2	05/14/75	05/28/75	12/15/76
C012 FR&P TUNNEL	43	11/20/74	09/17/75	03/17/76
C013 FR&P BASE SLAB	12	10/02/74	12/25/74	06/30/76
C014 CIRC WATER CONC. ENV.	2	08/21/74	09/04/74	06/30/76
C015 CPT FRP FDN WALLS	10	01/22/75	04/02/75	07/14/76
C016 FRP STRUCT WALLS	14	04/02/75	07/09/75	09/22/76
C017 FR&P INT WALLS TO 239	5	07/09/75	08/13/75	12/29/76
C018 FR&P INT WALLS TO 253	12	08/13/75	11/05/75	03/16/77
C019 CONDENSER OUTSIDE EREC	66	04/02/75	07/07/76	07/25/79
C020 FR&P PEDESTAL LEGS	14	03/26/75	07/02/75	06/30/76
C021 RW DRAINS @ 239	11	08/13/75	10/29/75	03/23/77
C022 FR&P SLAB AT 239	10	08/13/75	10/22/75	03/30/77
C023 CURE SLAB	3	10/22/75	11/12/75	05/28/80
C024 MECH & ELEC AREA 03A 200 217	105	11/12/75	11/16/77	01/07/81
C025 EMBEDDED CONDUIT @ 239	2	08/13/75	08/27/75	05/25/77
C026 FR&P INT WALLS TO 269	50	11/05/75	10/20/76	04/27/83
C027 STR. STL. INST. PED. CAP	4	07/02/75	07/30/75	10/06/76
C028 TUNNEL S/C	4	07/09/75	08/06/75	06/29/83
C029 FR&P SLAB @ 217	5	09/17/75	10/22/75	01/12/77
C030 RW DRAINS @ 217	5	07/09/75	08/13/75	01/12/77
C031 S/C AREA 03A 200' 217'	154	11/12/75	10/25/78	06/18/80
C032 TUNNEL MECH & ELEC	271	07/09/75	09/17/80	05/17/78
C033 START CONDENSER INSIDE ERECT.	67	07/07/76	10/19/77	10/29/80
C034 FR&P SLAB AT 253'	8	11/05/75	12/31/75	06/08/77
C035 CURE SLAB	4	12/31/75	01/28/76	08/03/77
C036 EMB CONDUIT 217	5	09/17/75	10/22/75	01/12/77
C037 S/C AREA 01B 239'	70	12/31/75	05/04/77	01/27/82
C038 217 - 269 STRUC STEEL BECH.	10	10/22/75	12/31/75	03/30/77
C039 FRP PED CAP	15	07/30/75	11/12/75	11/03/76
C040 S/C AREA 01A 200' 217'	154	08/13/75	07/26/78	06/18/80
C041 MECH & ELEC AREA 01B 239'	117	12/31/75	03/29/78	09/10/80
C042 FR&P INT WALLS @ 269	10	10/20/76	12/29/76	04/11/84
C043 MVSS STRUCT STEEL	16	12/10/75	03/31/76	02/16/77
C044 OUT OF HOLE CONCRETE	132	06/19/74	12/29/76	12/09/81
C045 FR&P SLAB @ 269	30	08/13/75	03/10/76	02/02/77

ACTIVITY REPORT

Task Number and Description	*Wks	Earliest Start	Earliest Finish	Latest Start
C046 MECH & ELEC AREA 01A 200 217	107	08/13/75	08/31/77	12/24/80
C047 INSTALL OVERHEAD CRANE	15	03/31/76	07/14/76	06/27/79
C048 CONT. COND. INSIDE ERECT.	42	10/19/77	08/09/78	02/10/82
C049 INSTALL PRECAST PANELS	131	03/31/76	10/04/78	06/10/81
C050 DUMMY	0	03/10/76	03/10/76	08/31/77
C051 RW DRAINS @ 269	22	08/13/75	01/14/76	03/30/77
C052 COMP COND. INSIDE ERECT.	1	08/09/78	08/16/78	12/01/82
C053 DUMMY	0	10/04/78	10/04/78	12/14/83
C054 FRP EXT. WALLS	27	10/04/78	04/11/79	12/14/83
C055 DUMMY	0	01/28/76	01/28/76	08/31/77
C056 CLEAN & HYDROTEST CONDENSER	10	08/16/78	10/25/78	12/08/82
C057 PERMANENT ROOFING	18	04/11/79	08/15/79	06/20/84
C058 MECH & ELEC 269	165	07/14/76	09/12/79	01/09/80
C059 S/C AREA 01C 200' 217' 239'	17	03/31/76	07/28/76	02/02/83
C060 METAL DECK	6	03/31/76	05/12/76	06/08/77
C061 MECH & ELEC AREA 01C 200 217 239	171	03/31/76	07/11/79	01/30/80
C062 TEMPORARY ROOFING	6	05/12/76	06/23/76	07/20/77
C063 S/C 269	190	07/14/76	03/05/80	10/10/79
C064 S/C AREA 03C 239'	103	06/23/76	06/14/78	06/10/81
C065 MECH & ELEC 02A 200 217 239	278	06/23/76	10/21/81	08/23/78
C066 MECH & ELEC AREA 03C 239'	137	06/23/76	02/07/79	07/23/80
C067 S/C 02A 200' 217' 239'	39	06/23/76	03/23/77	09/01/82
C068 S/C 03B 200 217	77	06/23/76	12/14/77	12/09/81
C069 MECH & ELEC 02B 200 217 239	297	06/23/76	03/03/82	08/31/77
C070 S/C 02B 200' 217' 239'	60	06/23/76	08/17/77	04/07/82
C071 MECH & ELEC 03B 200' 217'	185	06/23/76	01/09/80	05/09/79
D001 DRAINAGE	9	06/19/74	08/21/74	02/19/75
D002 MUD MAT	3	08/21/74	09/11/74	04/23/75
D003 OUT OF HOLE CONCRETE	243	06/19/74	02/14/79	04/25/79
D004 FR&P FDN SLABS FTGS & WALLS	6	09/11/74	10/23/74	06/25/75
D005 FR&P WALLS TO 200	4	10/23/74	11/20/74	08/06/75
D006 STRUC. STEEL TO 200	1	11/20/74	11/27/74	09/03/75
D007 FR&P SLAB 182	3	10/23/74	11/13/74	08/20/75
D008 RW DRAINS @ 180	17	09/11/74	01/08/75	05/14/75
D009 FR&P WALLS TO 217	6	11/27/74	01/08/75	09/17/75
D010 FR&P SLAB - 200	7	01/08/75	02/26/75	09/10/75
D011 STRUCTURAL STEEL TO 217	2	02/26/75	03/12/75	10/29/75
D012 FR&P SLAB - 217	4	03/12/75	04/09/75	11/19/75
D012 FR&P SLAB - 217	4	07/02/75	07/30/75	05/24/78
D013 RW DRAINS @ 200	7	02/26/75	04/16/75	11/30/77
D014 TUNNEL MECH & ELEC	60	04/16/75	06/09/76	06/02/82
D015 MECH & ELECT 180	103	04/16/75	04/06/77	08/05/81
D016 S/C 180	288	04/16/75	10/22/80	01/18/78
D017 EMBED CONDUIT @ 217	3	03/12/75	04/02/75	11/26/75
D020 RW DRAINS @ 217	5	03/12/75	04/16/75	11/12/75
D021 FR&P WALLS TO 239	9	04/16/75	06/18/75	12/17/75
D022 SUPPORT STEEL 239	2	06/18/75	07/02/75	02/18/76
D023 FR&P WALLS TO 254	12	07/02/75	09/24/75	03/03/76
D024 SUPPORT STEEL 254'	2	09/24/75	10/08/75	05/26/76
D025 FR&P J LINE WALL TO 351	15	08/25/76	12/08/76	04/27/77
D026 FR&P WALLS TO 269'	13	10/08/75	01/07/76	06/09/76

ACTIVITY REPORT

Task Number and Description	#Wks	Earliest Start	Earliest Finish	Latest Start
D027 SUPPORT STEEL 269'	5	01/07/76	02/11/76	09/08/76
D028 FR&P WALLS TO 289	17	02/11/76	06/09/76	10/13/76
D029 289' SUPPORT STEEL	4	06/09/76	07/07/76	02/09/77
D030 FR&P WALLS TO 304	7	07/07/76	08/25/76	03/09/77
D031 MECH & ELEC 200	95	04/16/75	02/09/77	02/24/82
D033 EMBED CONDUIT @ 239	7	07/02/75	08/20/75	05/03/78
D034 S/C 200	192	04/09/75	12/13/78	04/16/80
D035 EMBED CONDUIT @ 254	3	10/08/75	10/29/75	06/17/81
D036 FR&P SLAB @ 254	3	10/08/75	10/29/75	06/17/81
D038 FR&P SLAB @ 269	20	02/11/76	06/30/76	01/12/77
D039 RW DRAINS @ 269	1	02/11/76	02/18/76	05/25/77
D040 S/C 217	267	08/20/75	10/01/80	06/21/78
D041 MECH & ELEC 217	129	08/20/75	02/08/78	02/11/81
D042 FR&P 26.6 & 19.4 WALL TO 324'	15	08/25/76	12/08/76	04/27/77
D043 EMBED CONDUIT @ 289	4	07/07/76	08/04/76	03/28/79
D044 MECH & ELEC 239	108	10/29/75	11/23/77	07/08/81
D045 S/C 239	90	10/29/75	07/20/77	11/11/81
D046 MECH & ELEC 254	148	06/30/76	05/02/79	10/01/80
D047 STRUCTURAL STEEL TO ROOF	10	12/08/76	02/16/77	08/10/77
D049 S/C 254	322	06/30/76	09/01/82	06/01/77
D050 304' SUPPORT STEEL	6	08/25/76	10/06/75	06/29/77
D051 FR&P SLAB 289	4	07/07/76	08/04/76	03/28/79
D053 RW DRAINS @ 304	10	10/06/76	12/15/76	08/10/77
D054 RW DRAINS @ 289	4	07/07/76	08/04/76	03/28/79
D056 EMBED CONDUIT @ 304	10	10/06/76	12/15/76	08/10/77
D057 FR&P SLAB @ 304	10	10/06/76	12/15/76	08/10/77
D058 F&R 26.6 LINE TO ROOF	30	02/16/77	09/14/77	10/19/77
D059 PRECAST PANELS TO ROOF	14	09/14/77	12/21/77	05/17/78
D060 MECH & ELEC 269	143	08/04/76	05/02/79	11/05/80
D061 S/C 269	223	08/04/76	11/12/80	04/25/79
D062 F&P WALLS TO 332	7	12/21/77	02/08/78	08/23/78
D063 S/C 289	250	12/15/76	09/30/81	10/18/78
D064 MECH & ELEC 289	134	12/15/76	07/11/79	01/07/81
D065 F & P WALLS TO 366	40	02/08/78	11/15/78	10/11/78
D066 FR&P ROOF SLAB	40	11/15/78	08/22/79	07/18/79
D067 FR&P SLABS 332 & 350	31	02/08/78	09/13/78	08/08/79
D069 RW DRAINS 332 & 350	31	02/08/78	09/13/78	08/08/79
D071 DUMMY	0	08/22/79	08/22/79	04/23/80
D072 ROOFING	3	08/22/79	09/12/79	10/03/84
D073 S/C 304	177	09/13/78	02/03/82	03/12/80
D074 MECH & ELEC 304	97	09/13/78	07/23/80	09/23/81
D075 MECH & ELEC 360	12	08/22/79	11/14/79	10/29/80
D076 MECH & ELEC 332	167	08/22/79	11/03/82	05/21/80
D077 S/C 332	171	08/22/79	12/01/82	04/23/80
E002 BACKFILL & MUDMAT	7	06/19/74	08/07/74	04/07/76
E003 TRENCH EXCAVATION	4	06/19/74	07/17/74	06/09/76
E004 WATER PROOFING	6	08/07/74	09/18/74	05/26/76
E005 START DRAINAGE PIPING	7	09/18/74	11/06/74	07/07/76
E006 FR&P SLAB 162'	3	11/06/74	11/27/74	05/25/77
E007 RW DRAINS @ 162	42	11/06/74	08/27/75	08/25/76
E008 START WATERPROOFING WALLS TO 174	2	08/27/75	09/10/75	06/15/77

ACTIVITY REPORT

Task Number and Description	#Wks	Earliest Start	Earliest Finish	Latest Start
E009 185 FRP WALLS & COLS	16	09/10/75	12/31/75	06/29/77
E010 PHASE SEPARATORS	29	08/27/75	03/17/76	07/13/77
E011 COMPLETE WATERPRFG TO 174'	2	12/31/75	01/14/76	10/19/77
E012 WATERPROOF -ING 185 WALLS	2	12/31/75	01/14/76	06/06/79
E013 CPT. STRUCT. STEEL TO 191	5	01/14/76	02/18/76	11/02/77
E014 FRP WALLS & COLS TO 191	8	02/18/76	04/14/76	12/07/77
E015 F&R SLAB SOUTH OF CD	5	04/14/76	05/19/76	02/15/78
E016 191' -217' ERECT STRUC.STEEL	8	05/19/76	07/14/76	03/22/78
E017 RW DRAINS @ 191	19	04/14/76	08/25/76	02/01/78
E018 COMPLETE LIGHTING	9	02/18/76	04/21/76	04/12/78
E019 EXCAVATE MUDMAT	15	08/27/75	12/10/75	07/19/78
E020 WALLS TO 217 SOUTH OF CD	8	07/14/76	09/08/76	05/17/78
E021 F&R SLAB NORTH OF CD	6	05/19/76	06/30/76	05/03/78
E022 RW DRAINS @ 217	10	09/08/76	11/17/76	09/20/78
E023 WALLS TO 217' NORTH OF CD	5	09/08/76	10/13/76	07/12/78
E024 WATERPROOF MUDMAT	27	08/25/76	03/02/77	11/01/78
E025 ERECT TANKS@ 191	9	08/25/76	10/27/76	06/14/78
E026 MECH & ELEC 162	155	08/25/76	08/15/79	10/08/80
E027 FRP COLDBOX BASE SLAB 181'	6	03/02/77	04/13/77	05/09/79
E028 FRP 217' SLAB NORTH OF CD	15	10/27/76	02/09/77	08/16/78
E029 RW DRAINS @ 189	6	03/02/77	04/13/77	05/09/79
E030 STRUCT STL 217 - 237	4	02/09/77	03/09/77	11/29/78
E031 FR&P BLOCKOUTS	4	02/09/77	03/09/77	08/08/84
E032 S/C 162	270	08/25/76	10/28/81	07/26/78
E033 189 MUDMAT	3	04/13/77	05/04/77	09/12/79
E035 STRUCT STEEL 237 - 257	4	03/09/77	04/06/77	12/27/78
E036 PRECAST TO 237	7	03/09/77	04/27/77	08/08/79
E037 PRECAST TO 257	1	04/06/77	04/13/77	01/24/79
E038 FINE GRADE & BACKFILL	7	03/09/77	04/27/77	09/05/84
E039 WATERPROOF MUDMAT	2	05/04/77	05/18/77	10/03/79
E040 FRP WALLS TO 185'	6	04/13/77	05/25/77	06/20/79
E042 COLUMNS & FRAMING TO 279	4	04/06/77	05/04/77	04/16/80
E043 FRP WALLS TO 237	22	04/27/77	09/28/77	09/26/79
E044 PRECAST TO 275	4	05/04/77	06/01/77	05/14/80
E045 FRP WALLS TO 257	24	04/13/77	09/28/77	01/31/79
E046 RW DRAINS 257	1	09/28/77	10/05/77	08/22/79
E047 OUT OF HOLE CON- CRETE	194	06/19/74	03/08/78	12/01/76
E048 FRP PIPEWAY SLAB	8	05/25/77	07/20/77	10/17/79
E049 FRP 217 SOUTH OF CD	7	09/08/76	10/27/76	04/30/80
E050 FR&P-WALLS TO 195' SLAB	19	05/25/77	10/05/77	08/01/79
E051 FRP ROOF SLAB	4	05/04/77	06/01/77	07/23/80
E052 WTRPRF & BACKFILL SW CORNR OF RW	6	10/27/76	12/08/76	06/18/80
E053 FRP SLAB @228 & 237	6	09/28/77	11/09/77	02/27/80
E054 FLOOR SUPPORT STL 195-217	3	10/05/77	10/26/77	07/09/80
E055 FRP 257' SLAB	6	09/28/77	11/09/77	07/18/79
E056 RW DRAINS 228 & 237	6	09/28/77	11/09/77	02/27/80
E057 FRP WALLS TO 275	10	06/01/77	08/10/77	06/11/80
E058 POUR PART 195 SLAB	7	10/05/77	11/23/77	12/12/79
E059 TUNNEL MECH & ELEC	13	10/05/77	01/04/78	04/30/80
E060 DUMMY	0	11/09/77	11/09/77	04/09/80
E061 DUMMY	0	12/20/78	12/20/78	09/23/81

ACTIVITY REPORT

Task Number and Description	#Wks	Earliest Start	Earliest Finish	Latest Start
E062 CURE	5	11/09/77	12/14/77	07/16/80
E063 S/C 191	183	02/09/77	08/13/80	03/26/80
E064 ROOFING	3	03/08/78	03/29/78	09/12/84
E065 CPT FRB 195 SLAB BACKFIL	4	11/23/77	12/21/77	01/30/80
E066 WALLS TO 217	22	12/21/77	05/24/78	02/27/80
E067 MECH & ELEC. 191	147	02/09/77	12/05/79	12/03/80
E068 MECH & ELEC 237	138	11/09/77	07/02/80	03/11/81
E069 FRP SLABS 217	30	05/24/78	12/20/78	07/30/80
E070. PRECAST PLUGS	10	03/08/78	05/17/78	08/20/80
E071 S/C 217	178	11/09/77	04/08/81	04/09/80
E072 MECH & ELEC 217	137	11/09/77	06/25/80	01/21/81
E073 DUMMY	0	11/09/77	11/09/77	08/29/79
E074 DUMMY	0	03/29/78	03/29/78	10/03/84
E075 S/C 257	128	05/17/78	10/29/80	03/25/81
E076 S/C 237	218	11/09/77	01/13/82	08/29/79
E077 CIVIL REWORK	30	12/20/78	07/18/79	02/25/81
E078 MECH & ELECT 257	149	05/17/78	03/25/81	10/29/80
E079 RADIATION COATING	3	03/29/78	04/19/78	10/03/84
E080 FR&P PARAPET WALLS	10	07/18/79	09/26/79	08/15/84
E081 OFF GAS MECH & ELEC	96	07/18/79	05/20/81	09/23/81
E082 S/C OFF GAS	39	07/18/79	04/16/80	10/27/82
F001 EXCAVATE	12	06/19/74	09/11/74	05/17/78
F002 CONCRETE BACKFILL	4	06/11/75	07/09/75	06/16/82
F003 S/C DGS	26	07/09/75	01/07/76	06/08/83
F004 EXCAVATE	2	06/19/74	07/03/74	08/12/81
F005 MOBILIZE	8	09/11/74	11/06/74	08/09/78
F006 PIPE TRENCH TO COOLING	45	07/03/74	05/14/75	02/03/82
F008 FOUNDATIONS & DRAINS	22	07/09/75	12/10/75	07/13/83
F009 U.G. PIPE & DRAINS	3	07/03/74	07/24/74	08/26/81
F010 ROCK ANCHORS & SUBPLINTHS	9	11/06/74	01/08/75	11/29/78
F011 MECH & ELEC DGS	73	07/09/75	12/01/76	07/14/82
F012 LIGHTING GROUNDING AIRCRFT LGHTS	11	01/08/75	03/26/75	01/27/82
F013 CPT SP. IN TRENCH	4	05/14/75	06/11/75	12/15/82
F014 STRUCTURAL STEEL	4	12/10/75	01/07/76	02/01/84
F015 FOUNDATIONS SLABS &	4	07/24/74	08/21/74	09/16/81
F016 EMBEDDED CONDUIT	4	07/24/74	08/21/74	09/16/81
F017 PRECAST COLUMNS	9	01/08/75	03/12/75	01/31/79
F018 INTERIOR WALLS	39	12/10/75	09/08/76	12/14/83
F019 UNDERGROUND PIPE	65	11/06/74	02/04/76	05/07/80
F020 EQUIPMENT	2	08/21/74	09/04/74	10/14/81
F021 ERECT PRECAST WALLS	7	01/07/76	02/25/76	02/29/84
F022 PLINTHS & BACK PROP PADS	38	11/06/74	07/30/75	10/04/78
F023 PRECAST WALLS & ROOF	4	09/04/74	10/02/74	10/28/81
F024 EXTERIOR WALLS	21	02/25/76	07/21/76	04/18/84
F025 ERECT COLUMNS	12	03/12/75	06/04/75	04/04/79
F026 OUT OF HOLE CONCRETE	13	06/11/75	09/10/75	06/13/84
F027 INNER BASIN	49	07/30/75	07/07/76	06/27/79
F028 ROOFINGS & SHEET METAL	2	09/08/76	09/22/76	09/12/84
F029 MECH & ELEC YARD	59	10/02/74	11/19/75	11/25/81
F030 ROOFING	2	10/02/74	10/16/74	12/29/82
F031 CAISSONS & BENTS	33	07/30/75	03/17/76	12/17/80

ACTIVITY REPORT

Task Number and Description	*Wks	Earliest Start	Earliest Finish	Latest Start
F032 TOWER CRANE	61	07/07/76	09/07/77	06/04/80
F033 DUMMY	0	09/22/76	09/22/76	09/26/84
F034 ERECT SHELL	36	09/07/77	05/17/78	08/05/81
F034 INTERIOR FINISH	4	09/22/76	10/20/76	09/26/84
F035 INTERIOR FINISH	2	11/19/75	12/03/75	01/12/83
F037 LAG	16	05/17/78	09/06/78	04/14/82
F038 SMALL PIPE	1	09/06/78	09/13/78	09/21/83
F039 RISERS & COLD WATER OUTLETS	27	09/06/78	03/14/79	08/04/82
F040 OUTER BASIN & WALLS	18	03/14/79	07/18/79	02/09/83
F042 MISC APPURTENANCE	15	07/18/79	10/31/79	06/15/83
F043 ERECT FILL STRUCTURE	33	09/06/78	04/25/79	02/09/83
F044 INSTRUMENTS	2	09/06/78	09/20/78	09/14/83
F045 FUNCT. TEST S/U SYSTEM 42	56	10/31/79	11/26/80	09/28/83
F046 CLEAN UP	4	10/31/79	11/28/79	09/26/84
G001 EXCAVATE	2	06/19/74	07/03/74	04/25/79
G002 EXCAVATION	3	06/19/74	07/10/74	11/09/83
G003 EXCAVATION	7	06/19/74	08/07/74	10/18/78
G005 MARINE WORK	7	06/19/74	08/07/74	11/24/82
G006 FR&P SLAB	2	07/03/74	07/17/74	05/09/79
G007 U/G PIPE	2	07/10/74	07/24/74	02/22/84
G008 U.G. PIPE CONDUIT GROUNDING	16	08/07/74	11/27/74	09/19/79
G009 FR&P WALLS TO 217'	16	08/07/74	11/27/74	12/06/78
G010 ERECT TANKS	2	07/17/74	07/31/74	05/23/79
G011 FRP TANKS & SLAB	16	07/10/74	10/30/74	11/30/83
G012 START INTAKE & PUMPHOUSE	32	08/07/74	03/19/75	01/12/83
G013 MECHANICAL EQUIPMENT	30	03/19/75	10/15/75	08/24/83
G014 U/G CONDUIT & GROUND	2	07/24/74	08/07/74	03/07/84
G015 MUDMAT	2	11/27/74	12/11/74	09/26/79
G016 DEWATER	37	08/07/74	04/23/75	08/31/83
G017 BACKFILL CONCRETE	57	11/27/74	12/31/75	03/28/79
G018 ELECTRICAL EQUIPMENT	14	03/19/75	06/25/75	11/02/83
G019 MECH & ELECTRICAL HYDROGEN	112	07/31/74	09/22/76	06/06/79
G020 LARGE PIPE	24	03/19/75	09/03/75	08/24/83
G021 TEMPORARY OUTFALL PIPE	4	10/30/74	11/27/74	05/09/84
G022 COMPLETE INTAKE &	5	04/23/75	05/28/75	05/16/84
G023 SLABS	13	12/11/74	03/12/75	10/10/79
G024 MISC STEEL	11	03/19/75	06/04/75	03/21/84
G025 ERECT SHELTER	4	09/22/76	10/20/76	09/21/83
G026 BEGIN PIPING	3	10/30/74	11/20/74	03/21/84
G027 START ELECTRICAL WORK	17	09/03/75	12/31/75	02/08/84
G028 S/C HYDROGEN	116	09/22/76	12/13/78	07/29/81
G029 PRECAST PANELS	1	10/30/74	11/06/74	09/19/84
G030 INSTALL MECH EQUIPMENT &	3	10/30/74	11/20/74	03/21/84
G031 SMALL PIPE	6	09/03/75	10/15/75	04/25/84
G032 ROOF	1	05/28/75	06/04/75	06/20/84
G033 MISC S/C PIPING	36	03/19/75	11/26/75	11/02/83
G034 FR&P N. WALLS TO ELEV 263	16	03/12/75	07/02/75	01/09/80
G035 PERMANENT EFFLUENT PIPE	5	11/27/74	01/01/75	06/06/84
G036 MISC. STEEL	15	10/30/74	02/12/75	07/11/84
G037 ELECTRICAL EQUIPMENT	15	11/20/74	03/05/75	05/16/84
G038 PAINT	2	12/13/78	12/27/78	10/19/83

ACTIVITY REPORT

Task Number and Description	*Wks	Earliest Start	Earliest Finish	Latest Start
G039 ROOFING	1	11/06/74	11/13/74	09/26/84
G040 COMPLETE PIPING	20	11/20/74	04/09/75	04/11/84
G041 INSTRUMENTS	11	10/15/75	12/31/75	03/21/84
G042 STRUCTURAL STEEL	4	12/31/75	01/28/76	04/30/80
G043 MISC STEEL	10	07/02/75	09/10/75	04/08/81
G044 DUMMY	0	06/04/75	06/04/75	06/27/84
G045 FR&P WEST RETAINING WALL	5	12/31/75	02/04/76	06/04/80
G046 HVAC	3	09/03/75	09/24/75	06/20/84
G047 FR&P CW PUMP PADS	2	12/11/74	12/25/74	06/25/80
G048 INSULATION	1	04/09/75	04/16/75	10/17/84
G049 HEADWALL	15	01/01/75	04/16/75	07/11/84
G051 ELECTRICAL BULKS	8	04/09/75	06/04/75	08/29/84
G052 O.H. CRANE	6	01/28/76	03/10/76	05/28/80
G053 CPT YARD & INTERIOR	2	06/04/75	06/18/75	06/27/84
G054 FR&P SW FIRE WTR DIES TANK	1	03/10/76	03/17/76	03/18/81
G055 PLUMBING	2	11/13/74	11/27/74	10/03/84
G056 INSTALL PIPELINE	43	06/19/74	04/16/75	09/14/83
G057 SET PUMPS, FIRE & SUMP &	49	03/10/76	02/16/77	07/09/80
G058 INSULATION	2	12/31/75	01/14/76	06/27/84
G059 INSTALL CHLORINATION	12	03/17/76	06/09/76	03/25/81
G060 ARCHITECTURE FINISH	1	11/27/74	12/04/74	10/17/84
G061 PRECAST WALL PANELS & RF	4	03/10/76	04/07/76	05/20/81
G063 COMPLETE ELECTRICAL WORK	3	12/31/75	01/21/76	06/20/84
G064 DUMMY	0	04/07/76	04/07/76	06/17/81
G065 S/C CWP	98	02/16/77	01/03/79	06/17/81
G066 ARCHITECTURAL FINISHES	5	12/31/75	02/04/76	06/06/84
G068 CONCRETE	12	06/19/74	09/11/74	02/08/84
G069 CONCRETE	15	06/19/74	10/02/74	08/19/81
G071 U.G. PIPE	3	06/19/74	07/10/74	11/11/81
G072 U.G. PIPE	3	06/19/74	07/10/74	04/11/84
G073 PRECAST PANELS	1	10/02/74	10/09/74	12/02/81
G074 PRECAST PANELS	1	09/11/74	09/18/74	05/02/84
G075 ROOFING	1	10/09/74	10/16/74	01/11/84
G076 ROOFING	1	09/18/74	09/25/74	06/20/84
G077 MECH & ELECTRICAL FOH	110	10/09/74	11/17/76	12/09/81
G078 MECH & ELECTRICAL LOE	7	09/18/74	11/06/74	05/09/84
G079 DUMMY	0	10/16/74	10/16/74	01/18/84
G004 GROUNDING	2	07/03/74	07/17/74	05/09/79
H001 SITE CLEARING & ACCESS RD	4	06/19/74	07/17/74	02/13/80
H002 EXCAVATE TOWER	3	06/19/74	07/10/74	07/02/80
H003 EXCAVATE WAREHOUSE	4	06/19/74	07/17/74	06/09/82
H004 CONDUIT GROUNDING & BACKFILL	40	07/17/74	04/23/75	05/19/82
H005 INTAKE COFFERDAM	21	07/17/74	12/11/74	03/12/80
H006 FRP SLABS & WALLS TO 217'	23	07/10/74	12/18/74	07/23/80
H007 CIVIL RIVERWORK & BLOW-DOWN	51	07/17/74	07/09/75	05/12/82
H008 FRP SLAB & WALLS TO 217'	6	07/17/74	08/28/74	07/07/82
H009 INSTALL OVERHEAD CRANE	9	08/28/74	10/30/74	09/01/82
H010 MANHOLE 91 92, 93 & BACKFILL	49	07/17/74	06/25/75	03/17/82
H011 CLEAN UP RIVER WORK	5	07/09/75	08/13/75	05/04/83
H012 SS & Q-DECK @ 217'	22	12/18/74	05/21/75	12/31/80
H013 ERECT STRUC STL & FRP SLB	11	08/28/74	11/13/74	08/18/82

ACTIVITY REPORT

Task Number and Description	#Wks	Earliest Start	Earliest Finish	Latest Start
H014 U/G PIPE	4	06/19/74	07/17/74	12/03/80
H015 EREC.SS & INSTL PRECAST PANELS	12	05/21/75	08/13/75	05/12/82
H016 EXCAVATE	8	12/11/74	02/05/75	11/12/80
H017 INSTALL PRECAST PANELS	8	08/28/74	10/23/74	09/08/82
H018 INSTALL M-U PIPE MNFLD&BACKFILL	30	07/17/74	02/12/75	11/10/82
H019 R & P SLABS @ 217'	16	05/21/75	09/10/75	06/03/81
H020 FRP & EMBDS	14	11/13/74	02/19/75	11/03/82
H021 INSTALL ROOF	11	11/13/74	01/29/75	11/24/82
H022 PULL WIRE DUCT BANKS	15	06/25/75	10/08/75	02/23/83
H023 MECH & ELEC GDS	64	12/17/75	03/09/77	08/03/83
H024 START STR STEEL ABOVE 217'	4	09/10/75	10/08/75	09/23/81
H025 INSTALL ROOF	18	08/13/75	12/17/75	08/04/82
H026 FR&P FOOTINGS	5	02/05/75	03/12/75	01/07/81
H027 INSTALL MULLIONS & GLASS	4	11/13/74	12/11/74	01/12/83
H029 S/C WAREHOUSE	78	02/19/75	08/18/76	04/27/83
H030 TRASH RACK & RAKE	8	03/12/75	05/07/75	05/18/83
H031 CPT STRUCT & Q-DECK TO ROOF	4	10/08/75	11/05/75	10/21/81
H032 CLEAN UP	5	10/12/77	11/16/77	06/08/83
H033 ROOFING	6	08/25/76	10/06/76	04/27/83
H034 FIRE PROOFING	9	11/05/75	01/07/76	07/04/84
H035 INTERIOR S/C GDS	98	12/17/75	11/02/77	12/08/82
H036 FRP COLS 137 SLAB & INTER WALL	29	03/12/75	10/01/75	07/01/81
H037 INTERIOR WALLS & FINISHES	29	02/19/75	09/10/75	01/04/84
H038 FRP RETAINING WALLS	49	03/12/75	02/18/76	02/11/81
H039 MISC CONCRETE	54	02/05/75	02/18/76	04/08/81
H040 PRECAST PANELS	14	11/05/75	02/11/76	03/30/83
H041 BACKFILL WALLS&FINE GRADE	33	06/19/74	02/05/75	10/20/82
H042 MECH & ELEC WAREHOUSE	89	02/19/75	11/03/76	02/09/83
H043 INSTALL SECURITY SYSTEM	55	12/17/75	01/05/77	10/05/83
H044 BLOCKWALLS	12	11/05/75	01/28/76	10/12/83
H045 R&P SLAB ABOVE 217' TO ROOF	85	11/05/75	06/22/77	11/18/81
H046 SS & PANELS TO ROOF	8	02/18/76	04/14/76	01/20/82
H047 DEWATER	89	12/11/74	08/25/76	08/06/80
H049 CLEAN UP	13	09/10/75	12/10/75	07/25/84
H051 FRP ROOF SLAB	5	04/14/76	05/19/76	03/17/82
H052 SIDING	9	12/10/75	02/11/76	05/04/83
H053 TRAVELING SCREENS	12	02/18/76	05/12/76	01/27/82
H054 INTERIOR WALL FRAMING	35	06/22/77	02/22/78	01/04/84
H055 MULLIONS	22	06/22/77	11/23/77	07/06/83
H056 MECH & ELEC ADB	54	11/05/75	11/17/76	08/24/83
H057 FIELD PAINTING	13	02/18/76	05/19/76	01/20/82
H058 GLASS	28	11/23/77	06/07/78	02/22/84
H059 TEMPORARY CLOSE IN	29	11/23/77	06/14/78	02/15/84
H060 COMPLETE FIREPROOFING	7	06/14/78	08/02/78	09/05/84
H061 ROOFING	30	05/21/75	12/17/75	08/11/82
H062 REMOVE COFFERDAM	11	08/25/76	11/10/76	03/23/83
H063 S/C SRP H63	59	08/25/76	10/12/77	04/21/82
H064 S/C ADB	46	11/23/77	10/11/78	12/07/83
H065 CLEAN UP	13	12/17/75	03/17/76	07/25/84
H067 MOVE MATERIAL TO NEW AREA	10	06/19/74	08/28/74	02/25/81
H068 COMMON EXCAVATION	2	06/19/74	07/03/74	08/27/80

ACTIVITY REPORT

Task Number and Description	#Wks	Earliest Start	Earliest Finish	Latest Start
H069 EXCAVATE HOT SHOP AREA	6	06/19/74	07/31/74	09/09/81
H070 NEW LAY DWN AREA STRIP	11	06/19/74	09/04/74	02/18/81
H071 EXCAVATE DUCT BANK PWR	5	07/03/74	08/07/74	09/29/82
H072 POND EXCAVATION	20	09/04/74	01/22/75	05/06/81
H073 ERECT STRCT STL & FRP SLAB	16	07/31/74	11/20/74	10/21/81
H074 EXCAVATE ROCK	4	07/03/74	07/31/74	09/10/80
H075 INSTALL DUCT BANKS	10	08/07/74	10/16/74	11/03/82
H076 START ROCK FRACTURE	4	01/22/75	02/19/75	09/23/81
H077 INSTALL INTERMEDIATE SLAB	23	11/20/74	04/30/75	03/03/82
H078 INSTALL PRECAST	26	11/20/74	05/21/75	02/10/82
H079 BACKFILL ACCESS ROAD	2	02/19/75	03/05/75	11/11/81
H080 MUDMAT	2	07/31/74	08/14/74	10/08/80
H081 BACKFILL DUCT BANKS	2	10/16/74	10/30/74	01/12/83
H082 START INSTALLATION OF PIPE	8	02/19/75	04/16/75	10/28/81
H083 CPT ROCK FRACTURE	9	02/19/75	04/23/75	10/21/81
H084 ROOFING	5	11/05/75	12/10/75	03/30/83
H085 FENCING	4	03/05/75	04/02/75	11/25/81
H086 FR&P FDN	5	08/14/74	09/18/74	10/22/80
H087 U.G. PIPE	3	09/18/74	10/09/74	11/26/80
H088 MECH & ELEC HOT SHOP	66	12/17/75	03/23/77	04/27/83
H089 INTERIOR WALLS & FINISHES	13	12/17/75	03/17/76	05/02/84
H090 CPT INSTALLATION OF PIPE	10	04/23/75	07/02/75	12/23/81
H091 S/C HOT SHOP	73	12/17/75	05/11/77	03/09/83
H092 EXCAVATE MAKE-UP PIPE	3	07/02/75	07/23/75	05/23/84
H094 MISC S/C	9	09/18/74	11/20/74	11/24/82
H095 THRUST BLOCKS	10	10/09/74	12/18/74	12/17/80
H096 CLEAN UP	12	05/11/77	08/03/77	08/01/84
H096 FR&P FDN WALLS TO 262'	14	09/18/74	12/25/74	12/31/80
H097 INSTALL MAKE-UP PIPE	4	07/23/75	08/20/75	06/13/84
H098 MECH & ELEC SPA	125	07/02/75	11/23/77	03/03/82
H099 BACKFILL UG PIPE	2	12/18/74	01/01/75	02/25/81
H101 OUT OF HOLE CONCRETE	15	07/31/74	11/13/74	09/15/82
H102 BACKFILL MAKE-UP PIPE	2	08/20/75	09/03/75	07/11/84
H103 BACKFILL STATION	3	01/01/75	01/22/75	04/08/81
H104 BENTONITE LINING	13	11/23/77	02/22/78	07/25/84
H106 FR&P SLAB @ 264'	7	01/01/75	02/19/75	03/11/81
H107 MECH & ELEC SWP	91	02/19/75	11/17/76	04/29/81
H108 EXTERIOR PRECAST TO 287'	5	02/19/75	03/26/75	06/23/82
H109 WL & MISSLE PROTECTION	10	03/26/75	06/04/75	07/28/82
H110 STRUCT & MISC STEEL	6	06/04/75	07/16/75	10/06/82
H111 S/C SWP	0	07/16/75	07/16/75	01/26/83
H112 CONCRETE ROOF DECK	6	07/16/75	08/27/75	11/17/82
H113 ROOFING & SHEET METAL	2	08/27/75	09/10/75	12/29/82
H114 DUMMY	0	09/10/75	09/10/75	01/12/83
H115 INTERIOR FINISH	2	09/10/75	09/24/75	01/12/83
K001 EMBEDDED CONDUIT @200	8	06/19/74	08/14/74	10/01/75
K002 TUNNEL MUDMAT	11	06/19/74	09/04/74	06/23/76
K003 200 FOUNDATION WALLS	11	06/19/74	09/04/74	09/10/75
K004 FR&P WALLS	50	06/19/74	06/04/75	11/19/80
K005 FR&B BASE SLAB	13	06/19/74	09/18/74	08/27/75
K006 RW DRAINS @ 200	11	06/19/74	09/04/74	09/10/75

ACTIVITY REPORT

Task Number and Description	#Wks.	Earliest Start	Earliest Finish	Latest Start
K007 TUNNEL CONCRETE BACKFILL	7	09/04/74	10/23/74	04/27/77
K008 START FR&P WALLS FROM 200-217'	42	09/18/74	07/09/75	11/26/75
K009 FOOTINGS& BEAMSTO201 TUNNEL	40	09/04/74	06/11/75	09/08/76
K010 MECH& ELEC. STEAM CHASE	86	06/04/75	01/26/77	11/04/81
K011 TUNNEL RW DRAINS	6	09/04/74	10/16/74	05/04/77
K012 MVSS STRUC STL TO 217'	4	07/09/75	08/06/75	09/15/76
K013 TUNNEL MECH & ELEC	166	06/11/75	08/16/78	07/23/80
K014 FR&P WALLS 200 - 217	30	08/06/75	03/03/76	12/26/79
K015 FR&P ROOF	4	01/26/77	02/23/77	06/29/83
K016 TUNNEL S/C	89	06/11/75	02/23/77	01/13/82
K017 CPT MVSS STRUCT STEEL	18	08/06/75	12/10/75	10/13/76
K019 FR&P SLAB @217	14	03/03/76	06/09/76	07/23/80
K020 RW DRAINS @ 217	14	03/03/76	06/09/76	07/23/80
K021 BECHTEL SUPPORT TO MVSS	7	08/06/75	09/24/75	02/18/81
K023 EMBEDDED CONDUIT@217	13	03/03/76	06/02/76	07/30/80
K024 PRECAST PANELS	12	06/19/74	09/11/74	09/14/77
K025 METAL ROOF DECK	3	06/09/76	06/30/76	04/08/81
K026 FR&P WALLS TO 239	10	06/19/74	08/28/74	09/28/77
K027 MECH & ELEC 200	147	06/09/76	04/04/79	03/25/81
K028 TURB AUX ENCL HVAC CONTROL	39	06/19/74	03/19/75	09/01/82
K029 S/C 200	135	06/09/76	01/10/79	10/29/80
K030 FR&P WALLS TO 255	12	09/11/74	12/04/74	04/12/78
K031 RW DRAINS @ 239	30	09/11/74	04/09/75	12/07/77
K032 FR&P SLAB @ 239	30	09/11/74	04/09/75	12/07/77
K033 FR&P WALLS TO 269	18	04/09/75	08/13/75	07/05/78
K034 FR&P SLAB @ 255	10	04/09/75	06/18/75	08/30/78
K035 EMBEDDED CONDUIT@269	24	08/13/75	01/28/76	11/08/78
K036 S/C 217	135	04/09/75	11/09/77	10/29/80
K037 TEMPORARY ROOFING	3	06/30/76	07/21/76	04/29/81
K038 S/C 239	104	06/18/75	06/15/77	06/03/81
K039 MECH & ELEC 217	186	04/09/75	11/01/78	10/31/79
K040 FR&P WALLS TO 302	10	08/13/75	10/22/75	02/14/79
K041 FR&P SLAB @ 269	16	08/13/75	12/03/75	01/03/79
K042 RW DRAINS@269	12	06/18/75	09/10/75	01/31/79
K043 MECH & ELEC 239	136	06/18/75	01/25/78	09/17/80
K044 RW DRAINS @ 302	9	01/28/76	03/31/76	04/23/80
K045 EMBEDDED CONDUIT@ 302	61	01/28/76	03/30/77	04/25/79
K046 OUT OF HOLE CONC TURB AUX#1	182	06/19/74	12/14/77	11/23/77
K047 FR&P SLAB @ 302	47	01/28/76	12/22/76	08/01/79
K048 BLOCK WORK @ 269	10	01/28/76	04/07/76	02/16/83
K049 FR&P N LINE WALLS ON 302'	5	12/22/76	01/26/77	03/31/82
K050 SLAB AT 285	4	04/07/76	05/05/76	04/27/83
K051 DUMMY	0	12/22/76	12/22/76	06/25/80
K052 S/C 302	106	12/14/77	12/26/79	05/20/81
K053 S/C 269	153	03/30/77	03/05/80	06/25/80
K054 PERMANENT ROOFING	7	12/14/77	02/01/78	09/05/84
K055 MECH & ELEC 269	97	03/30/77	02/07/79	07/15/81
K056 MECH & ELEC 302	129	12/14/77	06/04/80	05/05/82
X001 FLUSH CRD INSERT LINES	6	09/09/81	10/21/81	04/06/83
X002 GRIND FLGS, CPL WELDS	10	10/21/81	12/30/81	05/18/83
X003 HYDRO RPV, BACKFLUSH	1	03/10/82	03/17/82	07/27/83

ACTIVITY REPORT

Task Number and Description	#Wks	Earliest Start	Earliest Finish	Latest Start	
X004 CPT RPV INT	6	03/17/82	04/28/82	08/03/83	0
X005 SU-34 RX BLDG H&V: P/L, TEST, TRB APPR.	51	07/13/83	07/04/84	11/02/83	1
X006 SU-54 PUNCHLIST	12	05/16/79	08/08/79	05/25/83	0
X008 SU-62 RPV & AUX: TEST, TRB APPR.	58	04/06/83	05/16/84	09/14/83	1
X009 SU-59 CONT. & SUPP.	48	07/15/82	06/16/83	11/23/83	1
X010 SU13 PUNCHLIST	12	02/27/80	05/21/80	02/08/84	0
X013 SU-81 FUEL HAND.: P/L, TEST, TRB APPR.	33	07/15/82	03/03/83	03/07/84	1
X014 SU-14 REAC. BLDG COOL WTR:	72	03/09/83	07/25/84	06/08/83	1
X016 EL. 217 STARTUP	73	04/22/81	09/15/82	06/01/83	1
X017 SU-55 PUNCHLIST	12	04/07/82	06/30/82	08/17/83	1
X018 SU-55 CRD HYD: TEST, TRB APPR.	50	06/30/82	06/15/83	11/09/83	1
X019 UNIT 1 FUEL LOAD	0	10/24/84	10/24/84	10/24/84	1
X020 SU-33 TURB. BLDG. H&V: P/L, TEST, TRB APPR.	73	03/05/80	07/29/81	06/01/83	1
X022 SU-47 FEEDWATER SYS.: P/L, TEST, TRB APPR.	78	01/25/78	07/25/79	04/27/83	1
X023 SU-37 PUNCHLIST	12	04/04/79	06/27/79	01/18/84	0
X024 SU-37 DEMMIN WTR TRANSFER STARTUP	28	06/27/79	01/09/80	04/11/84	1
X025 SU-69 LIQUID RADWASTE: P/L, TEST, TRB APPR.	56	10/28/81	11/24/82	09/28/83	1
X027 SU-99 MISC: P/L, TEST, TRB, APPR.	196	11/14/79	08/17/83	01/21/81	1
X028 SU-30 CONTROL BLDG H&V:	64	12/01/82	02/22/84	08/03/83	1
X030 SU-11 SERVICE WTR: TEST, TRB APPR.	32	01/13/82	08/25/82	03/14/84	1
X032 SU-24 DIESEL GEN: P/L, TEST, TRB APPR.	46	12/01/76	10/19/77	12/07/83	1
X033 SU-9 INTAKE STRUCTURE:	67	11/16/77	02/28/79	07/13/83	1
X034 SU10A: SCRN WASH	62	11/16/77	01/24/79	08/17/83	1
X035 SU-23 FUEL OIL SYS:P/L, TEST, TRB APPR.	40	11/17/76	08/24/77	01/18/84	1
X036 SU-74 N2, H3 & CO2: TEST, TRB APPR.	51	12/27/78	12/19/79	11/02/83	1
X037 SU-40 PUNCHLIST	17	11/06/74	03/05/75	06/27/84	1
X038 SU-42 CIRC WTR SYS: P/L, TEST, TRB APPR.	77	01/03/79	06/25/80	05/04/83	1
X039 SU-10C: SCRN & SCRN WASH	15	02/04/76	05/19/76	07/11/84	1
X040 SU-92 TURBINE STM SEAL: P/L, TEST, TRB, APPR.	76	03/03/82	08/17/83	05/11/83	1
X041 SU-43 PUNCHLIST	12	01/09/80	04/02/80	11/24/82	0
X042 SU-43 CONDENSER & AIR	88	04/02/80	12/09/81	02/16/83	1
X043 SU-93 PUNCHLIST	12	09/12/79	12/05/79	03/09/83	0
X044 SU-93 MAIN TURB: TEST, TRB, APPR.	73	03/05/80	07/29/81	06/01/83	1
X045 SU-18 PUNCHLIST	12	08/31/77	11/23/77	01/12/83	0
X046 SU-18 INST. AIR SYS; TEST, TRB, APPR.	81	11/23/77	06/13/79	04/06/83	1
X047 SU-15 TURB BLDG COOL WTR:	98	03/29/78	02/13/80	12/08/82	1
X048 SU-44 CONDENSATE P/L, TEST, TRB APPR.	93	11/16/77	08/29/79	01/12/83	1
X049 SU-68 RADSOLIDS HANDLING	51	01/13/82	01/05/83	11/02/83	1
X050 SU-65 RADWASTE BLDG H&V	59	04/08/81	05/26/82	09/07/83	1
X051 SU-72 GASEOUS RADWASTE: P/L, TEST, TRB APPR.	65	05/20/81	08/18/82	07/27/83	1
X052 SU-16 RHR SERV. SYSTEM:	21	11/17/76	04/13/77	05/30/84	1
X053 SU-41 COOLING TWRS: TEST, TRB APPR.	91	11/17/76	08/16/78	01/26/83	1
X054 SU-11 PUNCHLIST	12	10/21/81	01/13/82	12/21/83	0
X055 SU-13 FIRE PROT: TEST, TRB APPR.	25	07/15/82	01/06/83	05/02/84	1
X061 SU-53 STDBY LIQ CONTROL:	43	04/07/82	02/02/83	12/28/83	1
Z001 DUMMY	0	11/16/77	11/16/77	07/13/83	0
Z002 DUMMY	0	10/31/79	10/31/79	09/26/84	0
Z003 DUMMY	0	11/26/80	11/26/80	10/24/84	1
Z004 DUMMY	0	02/07/79	02/07/79	05/25/83	0
Z005 DUMMY	0	03/05/80	03/05/80	06/01/83	0
Z006 DUMMY	0	08/16/78	08/16/78	09/28/83	0

# ACTIVITY REPORT

Task Number and Description	*Wks	Earliest Start	Earliest Finish	Latest Start	Lates Finis
Z007 DUMMY	0	10/22/80	10/22/80	07/27/83	07/27/83
Z008 DUMMY	0	02/14/79	02/14/79	12/21/83	12/21/83
Z009 DUMMY	0	08/17/83	08/17/83	10/24/84	10/24/84
Z010 DUMMY	0	02/04/76	02/04/76	07/11/84	07/11/84
Z011 DUMMY	0	02/22/84	02/22/84	10/24/84	10/24/84
Z012 DUMMY	0	11/02/77	11/02/77	10/24/84	10/24/84
Z013 DUMMY	0	10/11/78	10/11/78	10/24/84	10/24/84
Z014 DUMMY	0	11/03/76	11/03/76	10/24/84	10/24/84
Z015 DUMMY	0	11/17/76	11/17/76	01/26/83	01/26/83
Z016 DUMMY	0	02/22/84	02/22/84	10/24/84	10/24/84
Z017 DUMMY	0	12/08/76	12/08/76	03/10/82	03/10/82
Z018 DUMMY	0	12/08/76	12/08/76	03/10/82	03/10/82
Z019 DUMMY	0	06/15/83	06/15/83	10/24/84	10/24/84
Z020 DUMMY	0	09/01/82	09/01/82	08/03/83	08/03/83
Z021 DUMMY	0	10/24/84	10/24/84	10/24/84	10/24/84
Z022 DUMMY	0	10/11/78	10/11/78	01/10/79	01/10/79

APPENDIX B

LIMERICK UNIT 1 COMMON

CALCULATION OF DRYWELL DURATION

FOR PECO/BECHTEL CASE 3 SANITY CHECK

ACTUAL DATA:

Actual Drywell Manual Manhours Expended:

Bechtel	1,790,000.*
Subcontractor	300,000.*
Total	<u>2,090,000.</u>

Maximum Drywell Density: 120 Manuals\*  
(Bechtel & Subcontractor)

Calculated Duration/for Case 3 check:

Double Shift 6/77 - completion (second shift = .67 first shift)\*\*

Duration from 6/77 =

$$\frac{2,090,000 \text{ manhours}}{120 \text{ men} \times 40 \text{ hrs/wk} \times 1.67 \text{ shifts}} = 260.7 \text{ wks.}$$

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\*/ Source: Bechtel

\*\*/ As assumed by PECO/Bechtel