**COST ANALYSIS
OF
MULTIPLE POWER REACTOR SITING
AT HANFORD**

by

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This study was suggested and conducted by Battelle-Northwest as a contribution to orderly regional growth and development. It was presented to a meeting of the Tri-City Nuclear Industrial Council on October 28, 1970, at Richland, Washington.

TABLE OF CONTENTS

SUMMARY	1
BACKGROUND	2
DETAILS OF THE STUDY	3
Basic Assumptions	3
Base Case	3
DUPLEX Case	3
ADJACENT Case	4
Method of Calculation	7
RESULTS	8
First Reactor	9
Base Case	10
DUPLEX Case	10
ADJACENT Case	13
Effect of Delays	14
Effect of Timing	15
ACKNOWLEDGEMENT	17
APPENDIX	18
Table A-1 - Industry Survey	19
Table A-2 - Breakdown of Capital Cost Savings	23

SUMMARY

Significant capital cost savings can be made in the construction of nuclear power plants if two reactors are built at a common site. Since considerable interest is being shown in locating commercial power plants at Hanford, Battelle-Northwest studied the savings which might be made by building two reactors on a single Hanford site.

The most significant conclusions from this study are:

- Capital cost savings of \$32 million can be realized by building a DUPLEX -- two nuclear power plants constructed in a fully coordinated sequence and sharing a common control room, turbine gallery, service area, river pump house and cooling pond.
- Savings of \$15 million are possible on ADJACENT construction of the two plants where construction is fully coordinated but only a river pump house and cooling pond are shared.

The savings indicated in either of these two cases will be reduced significantly if the need for power and the construction schedule are not optimized. For example, if the DUPLEX is contracted for 1977 and 1978 completion and the time schedule for the project stretches out an additional year, the total costs will increase by about \$41 million. This increase is caused about half by escalation and the other half by increased interest-during-construction costs.

If the demand for power is such that the capacity of both reactors could be used in 1977, there is a large incentive, because of escalation, to step up the construction schedule to bring both reactors on line as quickly as possible. If demand has been overestimated, though, and the extra capacity is built before it is needed, the fixed charges on the second reactor will rapidly consume the savings.

BACKGROUND

Power generation in the Northwest has been almost exclusively hydro-electric. However, additional suitable dam sites are almost nonexistent. Other means of generating electrical power must be found. Nuclear reactors are prime candidates for producing this power.

Nuclear power plant siting has received considerable study in the Northwest. A number of potentially suitable sites have been identified. Because public acceptance, or the lack of it, can cause crippling construction delays, a great deal of attention has been given recently to a Hanford site. As a result, during October 1970, the Washington Public Power Supply System (WPPSS) announced their intention to build a 1100 MWe nuclear power plant at Hanford for a September 1977 startup date. Other Northwest utilities have also indicated an interest in a Hanford site.

Many of the nearly 100 reactors now being built or in the design stage in the U.S. are part of complexes involving more than one reactor. As part of the study reported here, a survey was made of multiple reactors scheduled for a common site in this decade. As is shown in Table A-1, over 60 percent of the reactors scheduled for startup between 1970 and 1977 will share a site with at least one other reactor power plant. Savings of construction costs and time necessary for site approval are prime reasons for these multiple reactor complexes.

Considering the above, Battelle-Northwest felt that to assist orderly regional growth and development it was important to investigate the cost savings that could be achieved by building more than one reactor at a Hanford site. It should be understood that cost savings can be achieved at sites other than Hanford by fully coordinating the design and construction of dual reactors. The Hanford site was chosen as an example because of current projections of Northwest power needs and the presently indicated plans for building nuclear power plants.

DETAILS OF THE STUDY

Basic Assumptions

Determination of the advantages from multiple reactor construction requires establishment of a realistic set of basic assumptions and study cases. In particular, it is desirable to have the results representative of not only the Hanford Plant, but also of other similar sites. At the same time, the number of cases studied was kept small because of time and financial limitations.

Three cases were selected as best accomplishing the objectives of the study:

Base Case. Construction of two nuclear power plants at separate sites with no coordination of siting, construction or engineering.

DUPLEX Case. Construction of two nuclear power plants built as a single reactor complex with maximum coordination of siting, construction and engineering. Both reactors and associated facilities would be located in the same building. Other facilities, such as the river pump houses, cooling ponds, recirculating water systems, etc., would be combined into single facilities with ample capacity for the entire complex. (See Figure 1.)

ADJACENT Case. Construction of two nuclear power plants built as separate plants but located a few hundred yards apart. It implies maximum coordination of siting, construction, and engineering and the two reactors would use a common river pump house and cooling pond. (See Figure 2.)

The typical site for a reactor complex at Hanford is assumed to be just east of the standby 100-D Area on the adjacent high ground. The heat would be dissipated in a cooling pond built further east in the low flatlands between 100-D and the former White Bluffs townsite. Preliminary analysis indicated that a cooling pond would be both technically and economically attractive. Preliminary groundwater studies also indicate that there should be no detrimental effects on the Hanford Plant operations since the ponds would be confined to plant regions recently designated as being available for unlimited release of water to the ground.

The reactors are assumed to be 1180 MWe pressurized water reactors (PWRs) of current standard design. The six year construction period for the first reactor is assumed to start early in 1971 and result in a reactor startup in 1977. The second reactor in each case would start up one year later. Construction of the second reactor nominally would start in 1972, but it must be realized that full coordination of construction of the two plants actually results in an essentially simultaneous start on many of the major structures for both plants.

Land is assumed to cost \$100 per acre, a reasonable cost for the Hanford Project. It is assumed that the reactors are sited on the alluvium typical of the Hanford production reactor sites. The land requirements are 300 acres for each reactor site plus 1200 acres for the adjacent cooling pond. Nominal sealing of the cooling pond may be necessary to control washing of the riverbank, temperatures of seepage

FIGURE 1.
Hanford Duplex Reactor Site

FIGURE 2.
Hanford Adjacent Reactor Site

water going to the river or excessive makeup water pumping costs. This sealing might be accomplished by adding clay to the pond water or by construction of a slurry trench adjacent to the retaining dike.

The construction costs were escalated by assuming continuation of the average escalation rates of the past six years. These were 4.5 percent per year for factory equipment, 10.5 percent for site labor and 4.0 percent for site materials. These result in an overall average escalation rate for direct construction costs of about 6.0 percent. Since indirect construction costs are based on total direct costs, the indirect costs also escalate at this 6.0 percent rate. Because the average escalation varies in accordance with the mix of equipment, labor and materials, these costs were escalated separately for each case studied.

The interest rate during construction was assumed to be 6.5 percent.

Method of Calculation

Determining the construction costs for a nuclear power plant requires estimating the costs for thousands of material and labor items. As a simplification, systems of standard cost accounts have been established for the various cost activities and centers. The definitions of these accounts have been chosen such that correlation of the costs with plant type and size is possible. The cost estimation, however, still is complex because there are eleven main accounts and a total of approximately 150 subaccounts.

Enough nuclear power plant construction costs have become available to allow detailed analysis by size, type and location of the plant. These costs have been correlated and computerized with two codes, the CAPCOST¹ code of Battelle-Northwest

¹BNWL-882, CAPCOST: A Program to Calculate Escalated Nuclear Power Plant Capital Costs, T. A. Shank, E. L. Kelley, Jr. and J. B. Burnham, Jr., July 1968.

and the CONCEPT¹ code of the Computer Technology Center and the Oak Ridge National Laboratory. Both codes estimate the escalated total costs for nuclear power plants at various locations in the United States.

The CAPCOST code estimates the total escalated cost for a nuclear power plant on the basis of correlations of historical construction costs. Included is a breakdown of the costs into total direct and indirect costs plus construction labor, factory labor and materials. These costs are calculated for any of 75 typical locations throughout the United States and are escalated to represent actual costs for the selected reactor startup year.

The CONCEPT code makes a detailed calculation of the capital costs broken down into factory equipment, site labor and site material costs for each of the capital cost accounts. The account structure and definitions are based on the NUS-531² guide, a standard reference document for the USAEC. At present, the CONCEPT code can calculate the total capital cost for a plant constructed at any one of twenty-four typical central cities throughout the United States and Canada. The resultant capital costs are escalated to the year that construction starts. The capability to escalate during the construction period is currently being added to the code. This correction was hand calculated for this study.

RESULTS

The reactor complex capital costs were determined by starting with the basic construction account costs provided by the computer codes, correcting these

¹CTC-18, CONCEPT (Phase I): Computerized Nominal Cost Estimates for PWR-Type Power Plants, R. C. DeLozier, L. D. Reynolds and H. I. Bowers (The Computer Technology Center and Oak Ridge National Laboratories--to be published).

²NUS-531, "Guide for Economic Evaluation of Nuclear Reactor Plant Designs", NUS Corporation, January 1969.

for differences in plant design and then escalating as appropriate for the assumed construction period. A stepwise approach was taken. The costs were first determined for a single reactor complex; these basic costs were adjusted to obtain the cost of the second reactor for each case.

A summary of these capital costs appears in Table I. A detailed breakdown of the costs by accounts is presented in Table A-2 of the Appendix. A discussion of each reactor complex and the reasons for cost differences is presented below.

First Reactor

The basic cost data obtained by computer calculations represent the costs for building a PWR with once-through river water cooling, good foundation conditions requiring no bedrock excavation and a forty-hour work week with Seattle, Washington, labor costs. Most of the account costs would be the same for a Hanford reactor complex as for the typical Seattle-area reactor. The primary differences are as follows:

Labor Items. Site labor rates were increased by five percent to represent current travel allowance at Hanford and to accommodate a nominal amount of overtime work.

Land and Land Rights. Assumed purchase of 1500 acres of land at \$100 per acre.

Relocation. Assumed \$1,000,000 for relocation of utilities, etc.

Intake and Discharge Structures. Added a 200,000 gpm river pump house for makeup water to the cooling pond.

Other Buildings. Added a \$500,000 visitors center.

Shipping. Added \$500,000 for extra equipment shipping costs.

Heat Removal System. Added an 1100 acre pond (1200 acres of land are required) and the equipment in the river pump house.

TABLE I

Summarized Construction Costs
Hanford Power Reactors

<u>Case</u>	<u>Total Capital Costs</u>	<u>Total Cost Savings</u>
First Reactor (1977)	\$293,760,000	-----
Second Reactor (1978)		
Base Construction	311,440,000	-----
DUPLEX Construction	279,550,000	31,890,000
ADJACENT Construction	296,280,000	15,160,000

Base Case

This second reactor would be built with no coordination of siting, engineering or construction. The costs were obtained by assuming that construction would start one year after the first reactor. The second reactor was calculated to cost \$311,440,000. The cost of this second reactor becomes the basis for the determination of savings for the other two cases.

DUPLEX Case

DUPLEX construction (described earlier) assumes maximum coordination of planning and use of common facilities.

The cost of the second reactor in this case is calculated to be \$279,550,000. Compared to the base case, this is a savings of \$31,890,000 or 10.2 percent. The

details of these savings are shown in Table II. The reasons for these differences are as follows:

Site Improvements and Facilities. Most of the site preparation costs for the first plant would also be adequate for the second. Both reactors could be served by the same roads, railroads, etc. with only minor cost increases.

Buildings. Common construction of the one large main building permits both economies of scale plus the elimination of duplicate facilities. Offsetting some of these advantages are the problems associated with more phases of construction occurring at the same time and the isolation of the first reactor systems during startup preparations while major construction is continuing in the second reactor system.

Construction of Heat Removal System. Common construction of the recirculating water and river pump houses plus the intake and discharge conduits results in economies of scale. Construction of a single 2200 acre cooling pond saves some diking expenses.

Reactor Plant Equipment. Construction of a second identical reactor plant is expected to reduce the site labor costs for this account by about four percent because of better work scheduling and improved construction labor training.

Miscellaneous Plant Equipment. Use of a common turbine gallery permits elimination of one overhead crane. Economies of scale are realized in the air and water service systems, communications systems, furnishings, etc.

TABLE II

Significant Capital Cost Reductions
Multiple Reactor Construction

<u>Account Number</u>		<u>Cost Savings in Comparison to Base Case</u>	
		DUPLEX	ADJACENT
211	Improvements & Facilities	2,090,000	1,250,000
212, 213, 214, 215	Buildings	8,170,000	1,530,000
232	Heat Removal Systems	3,460,000	1,850,000
	Other Direct	<u>2,420,000</u>	<u>900,000</u>
	Total Direct	<u>16,140,000</u>	<u>5,530,000</u>
92	Engineering	6,020,000	6,020,000
94	Interest during Construction	4,890,000	2,330,000
	Other Indirect	<u>4,840,000</u>	<u>1,280,000</u>
	Total Indirect	<u>15,750,000</u>	<u>9,630,000</u>
	Combined Total	<u>31,890,000</u>	<u>15,160,000</u>
	Percent Savings	10.2	4.9

Reactor Engineering. Most of the engineering for the first reactor plant would be applicable to the second plant. Examples are site selection, design, environmental studies, subsurface investigations, procurement, preparation of test and startup procedures, and inspection. Other activities would be reduced in scope because of reduction of the total amount of construction (field inspection, preparation of as-built drawings, etc.).

Interest During Construction. Interest during construction is proportional to the total plant costs and the construction period. It was conservatively assumed that the total construction period for both reactors would be six years, even though one could advance substantial arguments for a shorter construction period for the second reactor in a duplex facility.

ADJACENT Case

ADJACENT construction assumes maximum coordination of planning and construction, but with the two reactor complexes built separately a few hundred yards apart. The only common facilities would be the cooling pond, the river pump house and temporary construction facilities. The cost of the second reactor in this case was calculated to be \$296,280,000 for a savings of \$15,160,000 -- or a 4.9 percent reduction.

The cost savings would be realized primarily from coordination of construction activities and construction of the common cooling pond. The primary savings

in construction costs are summarized in Table II. The reasons for the cost differences between the ADJACENT and DUPLEX cases are as follows:

Site Improvements and Facilities. More site preparation is required because of the larger construction area. All roads, railroads, etc. must be longer.

Buildings. The advantages of common buildings and elimination of duplicate facilities no longer are realized.

Construction of Heat Removal System. Construction of two recirculating water systems is more costly than construction of one larger system.

Miscellaneous. The advantages of common cranes and facilities are not realized.

Interest During Construction. The interest during construction would be higher because of the higher direct costs.

Effect of Delays

Delays can occur during a large construction project at any time and for any of several reasons. Typical causes are labor difficulties, interventions, licensing and equipment delays.

The delays may increase the total construction cost in the following manner:

1. Increased interest during construction.
2. Increased salary costs for management during delays.
3. Increased labor costs because of work inefficiencies related to preparing for and recovering from the delay periods.
4. Overtime expenses to recover lost time.
5. Increased salary and equipment costs due to escalation.

Obviously, the total extra cost due to a particular delay will depend on the cause and the nature of the delay. A complete shutdown of a job because of a strike will have a different effect than late delivery of a major equipment item such as the reactor vessel.

In this particular analysis the effect of delays will be illustrated by assuming that the delay is a complete stretchout of the entire DUPLEX project such that the total construction time is increased by one year. It also is assumed that there is no significant increase in total work performed or quantity of materials used. In that case the total cost increase is due primarily to the effects of escalation and increased interest during construction.

The total extra cost of a one-year stretchout would be \$40,700,000 -- an increase of 6.7 percent.

Effect of Timing

Realization of maximum savings from coordinated construction of a two reactor complex requires precise planning of the reactor construction schedule. Important factors that must be considered are:

1. Demand for electricity.
2. Scheduling of construction activities.
3. Escalation of construction costs.

Maximum benefit from coordinated construction activities is realized by reactor startups from six to eighteen months apart. A shorter period between startups results in a reduction of efficiency. Longer periods between startups result in the disbanding of experienced crews and the need to restart activities.

Escalation reduces the savings in direct proportion to the time between startups. Delays could eliminate all savings. We must be careful though, in talking about reductions in savings due to escalation. If the second reactor of a DUPLEX design is delayed no longer than the other independent reactor to which it is being compared, they would both escalate at the same rate and the effects of escalation would cancel out. A more detailed study of this effect must include the relative probability of delay at each of the sites being compared. (It is logical to assume that delays in the second reactor of a DUPLEX are less likely than in an independent site.)

The effects of these three parameters are illustrated in Figure 3 for the DUPLEX case with the second reactor being required one year after the first. This highly qualitative curve is typical of the ones that utility executives frequently must evaluate. Such curves are only as accurate as the general forecasts of future power demand.

FIGURE 3.

Estimated Capital Cost Savings Duplex Reactor Construction

While Figure 3 is only qualitative, it illustrates the factors which effect the planning. The solid portion of the curve is based on assumed startup of the second reactor one year after the first reactor to satisfy the forecast demand. Delay of the second reactor startup beyond one year is illustrated by the solid curve to the right. This curve slopes downward because of decreased construction efficiency, increased interest during construction and cost escalation. As mentioned earlier, a different point of view could mitigate the effects of escalation and make the curve flatter. If the cost of replacement power (hardly a capital cost) were included, the curve would be steeper.

If the demand for power is such that the second reactor's capacity can be used earlier than the indicated 12-month delay, there is a significant further savings to be realized as indicated by the dotted line sloping upwards. These cost savings arise from less escalation and interest during construction; they are partially offset by a reduction in construction work efficiency.

The other dashed part of the curve, sloping downward to zero savings, illustrates the problem of miscalculation of demand. If the demand is overestimated and the second reactor is completed too soon, the fixed charges on the idle capacity rapidly erode the savings.

ACKNOWLEDGEMENT

Appreciation is expressed for the cooperation of Messrs. H. I. Bowers and M. L. Myers of the Oak Ridge National Laboratory in providing basic economic data, multiple reactor cost relationships and the escalation factors used in this analysis.

APPENDIX**TABULATED DATA**

Table A-1 Results of Industry Survey

Table A-2 Detailed Breakdown of Capital Cost Savings

TABLE A-1

MULTIPLE REACTORS ORDERED FOR COMMON SITE

<u>Reactor/Location</u>	<u>Owner/Operator</u>	<u>Year of Operation & Net MWe of Reactor</u>									
		<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
DRESDEN STATION Morris, Illinois (Kankakee and Des Plaines R.)	Commonwealth Ed. Do	715 715									
CORDOVA STATION (QUAD CITIES) Cordova, Illinois (Mississippi R.)	Commonwealth Ed. Illinois C&E	715 715									
BROWN'S FERRY STA. Brown's Ferry, Ala. (Wheeler Reservoir, Tennessee River)	Tennessee Valley Authority TVA		1075	1075 1075							
PEACH BOTTOM 2,3 Peach Bottom, PA (Conowingo Dam)	Delaware Valley Utilities (Atlantic City Electric, Phila. Electric.)		1065		1065						
BRUNSWICK STATION Near Wilmington, S. Carolina (Estuary, Cape Fear River)	Carolina P & L					800		800			
EDWIN I. HATCH STA. Baxley, Ga. (Altamaha River)	Georgia Power Co. (Member Southern Company System)				800			800			

MULTIPLE REACTORS ORDERED FOR COMMON SITE

- Continued -

<u>Reactor/Location</u>	<u>Owner/Operator</u>	<u>Year of Operation & Net MWe of Reactor</u>									
		<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
INDIAN POINT -4, 5 Cortland, N. Y. (Hudson River)	Consolidated Ed.						1115		1115		
LA SALLE COUNTY STA. Seneca, Ill. (Illinois River)	Commonwealth Ed.							1100	1100		
ZIMMER STATION Ohio, Near Moscow (Ohio River)	Cincinnati G&E Columbus & South Ohio Electric, Dayton P & L						840	840			
LIMERICK STA. Near Pottstown, Pa. (Schuylkill River)	Philadelphia Electric						1065		1065		
PP&L STATION Site not announced	Pennsylvania Power & Light								1100		1100
INDIAN POINT STA. Buchanan, N. Y. (Hudson River)	Consolidated Ed. Do.			873	965						
SAN ONOFRE STATION (CAMP PENDLETON) San Clemente, Cal.	S. Calif. Edison, San Diego G & E S. Calif. Ed.						1100	1100			
POINT BEACH STATION Two Creeks, Wis. (Lake Michigan)	Wisconsin Michigan Power Co. WMPCO	455	455								

MULTIPLE REACTORS ORDERED FOR COMMON SITE

- Continued -

<u>Reactor/Location</u>	<u>Owner/Operator</u>	<u>Year of Operation & Net MWe of Reactor</u>									
		<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
TURKEY POINT STA. Turkey Point, Fla. (Biscayne Bay)	Florida P & L		688	688							
OCONEE STATION Lake Keowee, S. Carolina	Duke Power Co.		839	839	847						
SURREY STATION Hog Island, Va. (James River)	Virginia Electric Power Co. VEPCO		783	783							
PRAIRIE ISLAND STA. (RED WING STATION) Red Wing, Minn. (Mississippi R.)	Northern States Power			550		550					
DIABLO CANYON STA. San Luis Obispo County, Calif. (Pacific Ocean)	Pacific G & E				1060	1060					
SEQUOYAH STATION Chickamauga Lake, Tennessee	Tennessee Valley Authority				1175	1175					
COOK STATION Bridgman, Mich. (Lake Michigan)	American Electric Power (Indiana & Mich. Electric Co.)			1060	1060						

MULTIPLE REACTORS ORDERED FOR COMMON SITE

- Continued -

<u>Reactor/Location</u>	<u>Owner/Operator</u>	<u>Year of Operation & Net MWe of Reactor</u>									
		<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
CALVERT CLIFFS STA. Maryland (Chesapeake Bay)	Baltimore G & E				800		800				
NORTH ANNA STATION North Anna River, Va.	Virginia Electric Power Co.					783	783				
LAKE NORMAN STA. Lake Norman (near Davidson), N. C. Artificial Lake	Duke Power Co. Contract award November 1969							1100	1100		
THREE MILE ISLAND Near Harrisburg, Pa. (Susquehanna R.)	Metropolitan Ed., Reading, Pa.										
WATTS BAR DAM Decatur, Tenn. (Tennessee River)	Tennessee Valley Authority							1180	1180		
TVA STATION (Site not announced)	Tennessee Valley Authority								1230	1230	
Total		3315	5745	6943	8562	4368	4603	6970	8990	1230	1100
Single Plants		2280	2357	5815	8695	3835	5620	2700			
Total Capacity Added		6195	8102	12758	17257	8203	10223	9670	8990	1230	1100

1970 - 1977

Multiple Reactors, Common Site
Single Reactors
Total Net MWe

51,776
31,902
83,678

Multiple Reactors - 61.9 percent of total.

TABLE A-2

HANFORD POWER REACTOR COSTS
MULTIPLE REACTOR CONSTRUCTION

Basis: 1971 start, six year construction period, one year between reactor startups

<u>Account Number</u>	<u>Account Title</u>	<u>First Reactor Cost (\$000)</u>	<u>Second Reactor Cost (\$000)</u>		
			<u>Base Case (Separate Construction)</u>	<u>Duplex Design</u>	<u>Adjacent Design</u>
20	Land & Land Rights				
201	Land & Privilege Acq.	150	159	127	127
202	Relocation of Bldgs., Utilities, etc.	<u>1,000</u>	<u>1,060</u>	<u>1,060</u>	<u>1,060</u>
	<u>Account Total</u>	1,150	1,219	1,187	1,187
21	Structures & Facilities				
211	Site Improvements & Facilities	2,160	2,334	350	1,167
212	Reactor Building	13,321	14,389	13,650	14,389
213	Turbine Building	10,405	11,158	10,600	11,158
214	Intake & Discharge Structures	2,214	2,371	1,223	1,534
215	Reactor Auxiliaries Bldg.	4,313	4,650	2,398	4,650
218	Other	3,262	3,495	700	2,967
	Contingency	2,764	3,002	2,220	2,754
	Spare Parts	<u>81</u>	<u>84</u>	<u>62</u>	<u>80</u>
	<u>Account Total</u>	38,520	41,463	31,203	38,679

Account Number	Account Title	First Reactor Cost (\$000)	Second Reactor Cost (\$000)		
			Base Case (Separate Construction)	Duplex Design	Adjacent Design
22	Reactor Plant Equip.				
	<u>Account Total</u>	82,554	87,141	86,277*	86,277*
23	Turbine Plant Equip.				
231	Turbine Generators	45,933	48,147	48,147	48,147
232	Heat Removal Sys.	8,108	8,670	5,410	6,917
233	Condensing Systems	6,565	6,982	6,982	6,982
234	Feed Heating Sys.	8,442	8,981	8,981	8,981
235	Other Turbine Plant Equipment	5,388	5,804	5,804	5,804
236	Instrumentation & Control	1,035	1,106	1,051	1,051
	Contingency	3,234	3,436	3,316	3,405
	Spare Parts	612	639	617	627
	<u>Account Total</u>	79,347	83,765	80,308	81,914
24	Electric Plant Equip.				
241	Switchgear	1,548			
242	Station Service Equip.	2,318			
243	Switchboards	490			
244	Protective Equipment	339			
245	Electrical Structures & Wiring Containers	1,555			
246	Power & Control Wiring	4,574			
	Contingency	786			
	Spare Parts	30			
	<u>Account Total</u>	11,640	12,471	12,471	12,471

*Labor reduction of 4 percent assumed for all accounts.

25.

Account Number	Account Title	First Reactor Cost (\$000)	Second Reactor Cost (\$000)		
			Base Case (Separate Construction)	Duplex Design	Adjacent Design
25	Miscellaneous Plant Equipment				
251	Transportation & Lifting Equipment	600	631	280	
252	Air & Water Service Systems	1,370	1,468	757	
253	Communications Equipment	112	121	62	
254	Furnishings and Fixtures	599	628	324	
	Contingency	175	188	94	
	Spare Parts	<u>18</u>	<u>19</u>	<u>9</u>	
	<u>Account Total</u>	2,874	3,055	1,526	3,055
	TOTAL DIRECT COSTS	<u>216,085</u>	<u>229,114</u>	<u>212,972</u>	<u>223,583</u>
91	Construction Facilities, Equipment & Services				
911	Temporary Facil.	1,389	1,491	298	1,193
912	Construction Equipment	116	121	63	63
913	Construction Services	<u>1,832</u>	<u>1,934</u>	<u>1,382</u>	<u>1,934</u>
	<u>Account Total</u>	3,337	3,546	1,743	3,190
92	Engineering Services				
921	Reactor Engin.	2,050	2,132	1,492	1,492
922	Plant Engineering	<u>10,334</u>	<u>10,749</u>	<u>5,374</u>	<u>5,374</u>
	<u>Account Total</u>	12,384	12,881	6,866	6,866
93	Other Costs				
931	Taxes & Insurance	14,190	15,259	13,862	14,600
932	Staff Training & Plant Startup	1,510	1,600	530	1,333
933	Owners G&A	<u>1,169</u>	<u>1,238</u>	<u>928</u>	<u>1,238</u>
	<u>Account Total</u>	16,869	18,097	15,320	17,171
94	Interest During Construction	45,065	47,798	42,905	45,472
	TOTAL INDIRECT COSTS	<u>77,675</u>	<u>82,322</u>	<u>66,574</u>	<u>72,699</u>
	GRAND TOTAL	<u>293,760</u>	<u>311,436</u>	<u>279,546</u>	<u>296,282</u>