

## COST ESTIMATES FOR ALTERNATIVE BASE-LOAD GENERATION SYSTEMS

The computer program CONCEPT<sup>1</sup> has been used to rough check the applicant's capital cost estimate for the proposed nuclear power station and to estimate the costs for fossil-fired alternative generation systems.

This computer program was developed as part of the nuclear assessment activities of the Department of Energy, and the work was performed in the Engineering Technology Division at the Oak Ridge National Laboratory. The code was designed primarily for use in examining average trends in costs, determining sensitivity to technical and economic factors, and providing reasonable long-range projections of costs. Although cost estimates produced by the CONCEPT code are not intended as substitutes for detailed engineering cost estimates for specific projects, the code has been organized to facilitate modifications to the cost models so that costs can be tailored to a particular project. Use of the computer provides a rapid means of estimating future capital costs of a project with various assumed sets of economic and technical ground rules.

### DESCRIPTION OF THE CONCEPT CODE

The procedures used in the CONCEPT code are based on the premise that any central station power plant involves approximately the same major cost components regardless of location or date of initial operation. Therefore, if the trends of these major cost components can be established as a function of plant type, size, location, and interest and escalation rates, then a cost estimate for a reference case can be adjusted to fit the case of interest. The application of this approach requires a detailed cost model for each plant type at a reference condition and the determination of the cost trend relationships. The generation of these data has comprised a large effort in the development of the CONCEPT code. Detailed investment cost studies by an architect-engineering firm have provided basic cost model data for light water reactor nuclear plants and for coal-fired plants.<sup>2-7</sup>

Each cost model is based on a detailed cost estimate for a reference plant at a designated location and a specified date. This estimate includes a breakdown of each cost account into costs for factory equipment, site labor, and site materials. A typical cost model consists of a large number of individual cost accounts, each of which can be altered by input at the user's option. The DOE (formerly AEC) system of cost accounts<sup>3</sup> is used in CONCEPT.

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To generate a cost estimate under specific conditions, the user specifies the following input: plant type, location, net capacity, beginning date for construction, beginning date for commercial operation, and rate of interest during construction. If the specified plant size is different from the reference plant size, the cost for each account is adjusted by scaling functions which define the cost as a function of plant size. This initial step gives an estimate of the cost for a plant of the specified type and size at the reference date and location.

The code has access to cost index data files for 20 major cities in the United States. These files contain data on wage rates for 16 construction crafts and unit costs for 7 site-related materials as reported by a trade publication over the past 15 years.<sup>9</sup> These files also contain U. S. average cost index data for factory equipment as reported by the U. S. Department of Labor.<sup>10,11</sup> These data are used to determine historical trends in costs of factory equipment, site labor, and site materials, providing a basis for projecting future costs. These cost data can be overridden by user input if data for the particular project are available.

This technique of separating the plant cost into individual components, applying appropriate scaling functions and location-dependent cost adjustments, and escalating to different dates is the heart of the computerized approach used in CONCEPT. The procedure is illustrated schematically in Fig. 1.

#### ESTIMATED CAPITAL COSTS

The assumptions used in the CONCEPT calculations for this project are listed in Table 1. The total plant capital investment cost estimates are summarized in Table 2.

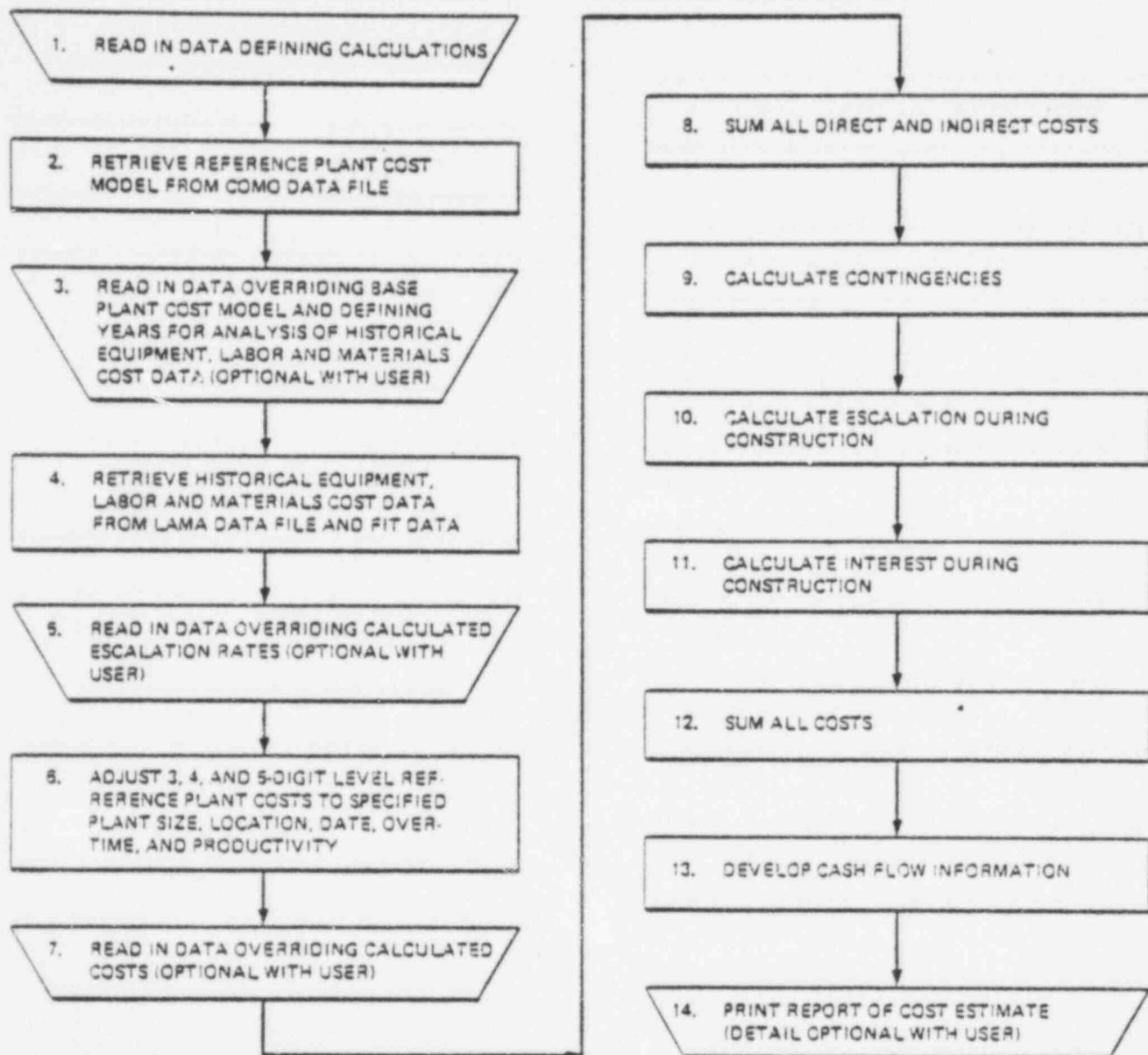


Fig. 1. USE OF THE CONCEPT PROGRAM FOR ESTIMATING CAPITAL COSTS.

Table 1. Assumptions used in CONCEPT calculations for  
the Pebble Springs Nuclear Power Project

(Revised September 21, 1979)

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Plant type	Two-unit PWR			
Alternate plant types	Four-unit coal			
Unit size	1240 MWe, net, each unit (nuclear) 630 MWe, net, each unit (coal)			
Plant location				
Actual	Arlington, Oregon			
CONCEPT calculations	Seattle, Washington			
Site labor requirements	7.9 mh/kWe (nuclear) 7.6 mh/kWe (coal with scrubbers) 6.1 mh/kWe (coal without scrubbers)			
Escalation during construction				
Purchased equipment	8%/year			
Site labor	8%/year			
Site materials	8%/year			
Interest during construction	10.8%/year, compound			
Start of construction date:				
	<u>Unit 1</u>	<u>Unit 2</u>	<u>Unit 3</u>	<u>Unit 4</u>
Nuclear	Jul 1981	Jul 1983		
Coal	Mar 1983	Nov 1984	Mar 1986	Nov 1986
Start of commercial operation date:				
	<u>Unit 1</u>	<u>Unit 2</u>	<u>Unit 3</u>	<u>Unit 4</u>
Nuclear	Nov 1988	Nov 1990		
Coal	Mar 1988	Nov 1988	Mar 1990	Nov 1990

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Table 2. Total plant capital investment summaries for  
a two-unit (2480 MWe) pressurized water reactor nuclear power plant  
and for four-unit (2520 MWe) coal-fired plants as alternatives  
to the Pebble Springs Power Project

(Revised September 21, 1979)

	PWR	Coal with Scrubbers	Coal without Scrubbers
<u>Direct Costs (millions of dollars)*</u>			
Land and land rights	2	2	2
Structures and improvements	230	146	152
Reactor/boiler plant equipment	325	492	340
Turbine plant equipment	285	252	250
Electric plant equipment	92	108	90
Miscellaneous plant equipment	28	28	28
Main heat rejection system	<u>48</u>	<u>46</u>	<u>46</u>
Subtotal (direct costs)	1010	1074	908
<u>Indirect Costs (millions of dollars)*</u>			
Construction services	128	118	90
Home office engineering and services	134	36	30
Field office engineering and services	57	36	30
Owner's costs	<u>84</u>	<u>108</u>	<u>108</u>
Subtotal (indirect costs)	403	298	258
Direct and indirect costs	1413	1372	1166
Contingency allowance	142	136	116
<u>Total Costs (millions of dollars)</u>			
Total direct and indirect costs*	1555	1508	1282
Allowance for escalation	934	1188	1012
Allowance for interest	1546	963	818
Plant capital cost at commercial operation			
Millions of dollars	4033	3659	3112
Dollars per kilowatt	1627	1452	1235

\* In 1979 dollars

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## REFERENCES

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