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DP-1007

AEC RESEARCH AND DEVELOPMENT REPORT

A COMPUTER PROGRAM FOR THE OPTIMIZATION OF ORGANIC-COOLED D_2O REACTORS

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Reactor Technology
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A COMPUTER PROGRAM FOR THE OPTIMIZATION OF ORGANIC-COOLED D_2O REACTORS

by

James W. Wade

April 1966

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ABSTRACT

The portion of the Cost Optimization Program, COP, that is used to design and calculate costs for organic-cooled, heavy-water-moderated power reactor plants is coded in FORTRAN II for an IBM 704 computer. The code is applicable for power reactor plants with electrical outputs of 300, 500, or 1000 MWe. The main features of the code include: (1) an automatic design of concentric fuel tubes of either UO_2 or UC including the calculation of the operating conditions of the fuel assembly and a determination of the reactivity parameters for a unit cell, (2) the determination of the number of fuel positions and an estimate of the fuel life for several fuel charging strategies, (3) an evaluation of the fuel fabrication costs for the specific fuel assembly design and reactor throughput, (4) the design and cost determination for the major reactor equipment, the building structures, and the reactor auxiliary facilities, (5) an automatic optimization of the turbine plant conditions and of the steam generator design, and (6) a final editing of the reactor plant conditions, and the capital, fuel, and operating components of the total electrical power costs.

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ACKNOWLEDGMENTS

As mentioned in the report, Sargent & Lundy, Engineers, under contract with the Atomic Energy Commission, developed the design and cost information required for the reactor plant auxiliary systems, the building structures, and the turbine plant. The Du Pont Engineering Department, under the coordination of H. J. Kamack, developed the design and cost information for the reactor core and primary coolant system. The steam generator design was developed by J. S. Neill, while the programming and some of the optimization methods were developed by J. J. Bugg and J. G. Melvin (while on loan from AECL). The design of the computer code, the programming and much of the checkout were provided by J. C. Jensen. The collection of data and reduction to fitted polynomials, etc., was done by C. R. Tharin. R. R. Hood and L. Isakoff studied the organic reactor technology as developed by others and made recommendations on design criteria, material choices, etc. R. T. Huntoon collected data and developed the cost information on the uranium carbide fuel. D. S. St. John provided much of the direction and coordination for the code development as well as the overall studies of D_2O reactor concepts.

A COMPUTER PROGRAM FOR THE OPTIMIZATION OF ORGANIC-COOLED D_2O REACTORS

INTRODUCTION

As part of the design and economics studies of heavy water power reactors, a computer program has been written in conjunction with Sargent and Lundy, Engineers, for performing the lengthy design and cost calculations required to determine the energy cost from a power plant. This computer code was originally written[1] for systems producing 300 MWe with reactors cooled by pressurized liquid D_2O or by boiling D_2O.

The original program was written for an IBM 650 computer with six tape units. Subsequently the code was rewritten in FORTRAN II language for an IBM 704 computer, and expanded to include organic cooling and 500- and 1000-MWe plants. Thus a code has been developed for handling liquid D_2O, boiling D_2O, or organic coolants at discrete plant sizes of 300, 500, and 1000 MWe.

Development work and design studies that were reported in 1962[2] indicated that the organic-cooled, heavy water system offered potential for low cost nuclear power. At that time, the major development programs pertaining to the organic-D_2O concept were being carried out by Euratom as part of their ORGEL program, by AECL and Canadian General Electric within the Canadian program, and by Atomics International as part of the U. S. OMR program. Much of the coolant technology and plant design has been obtained through the courtesy of Atomics International and of AECL.

The design and costs for the turbine plants, reactor building structures, and reactor auxiliary facilities were developed by Sargent and Lundy[3,4,5]. Summary descriptions of these parts of the plant have been included in this report along with the expressions for the costs; the reader is referred to the original Sargent and Lundy reports for more complete details.

Cost relationships for equipment and building structures were developed to express the variation in costs as a function of reactor size, coolant temperatures, steam pressures, etc, so that the reactor plant could be optimized. Cost equations were developed in terms of mass of material, volume of equipment, pumping or motor requirements, number of tubes, shield penetrations, etc, times appropriate unit costs. Therefore, equipment costs do not exhibit discontinuities as a function of size, facilitating optimization of plant designs. Unit costs are intended to be representative of a mature nuclear industry rather than

for a first-generation plant and thus are indicative of the potential of the reactor concept.

The objective of this report is to provide a companion report to DP-707[1] which covers D_2O-cooled systems. The numerous features of the program, which are common to both the D_2O and organic-cooled designs and are described in DP-707, will only be mentioned briefly.

DISCUSSION

1. Description of the Power Reactor Plant

The plant design for the organic reactor is based on a Sargent and Lundy design[6,7,8] that was updated on the basis of coolant technology supplied by Atomics International. The process flow diagram is shown in Figure 1.1.

The building arrangement and locations of the major pieces of equipment within the building are shown in Figure 1.2 for the 300-MWe design*. For the 1000-MWe designs, the building arrangement was modified to accommodate an increased number of steam generators.

A sketch of the reactor core is shown in Figure 1.3. The organic coolant enters the reactor core through a ring header and pigtail arrangement, passes up through the reactor and out through an outlet header to the steam generators. The moderator is contained in a calandria that is pierced by pressure tubes through which the hot organic flows.

The organic coolant that has been chosen is "Santowax"** R, with an equilibrium high boiler concentration of 10%. Reference 9 reports the properties of this organic as a function of high boiler concentration.

The computer program has been set up to allow the use of UO_2 or UC fuel material, clad with SAP (sintered aluminum powder).

The turbine plant consists of a single-turbine generator unit with the associated condensers, circulating water system, feedwater heaters, booster feed pumps, condensate pumps, piping, filters, and turbine building.

Discrete turbine plant designs have been developed by Sargent and Lundy for 325, 525, and 1050 gross electric megawatts. These designs include throttle conditions from 400 to 1500 psia with from 0 to 500°F of superheat and one to seven stages of feedwater heating.

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* The 500-MWe design had the same general arrangement as the 300-MWe plant.

** "Santowax" is trademark of Monsanto Chemical Co.

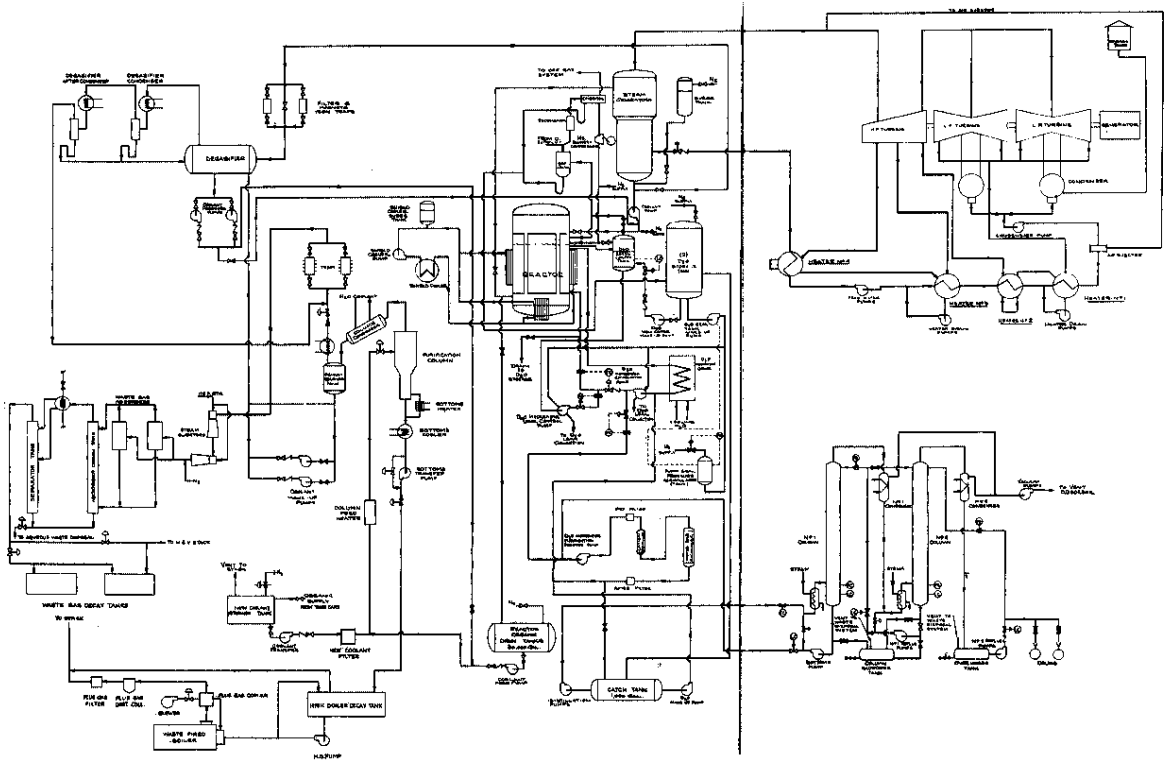
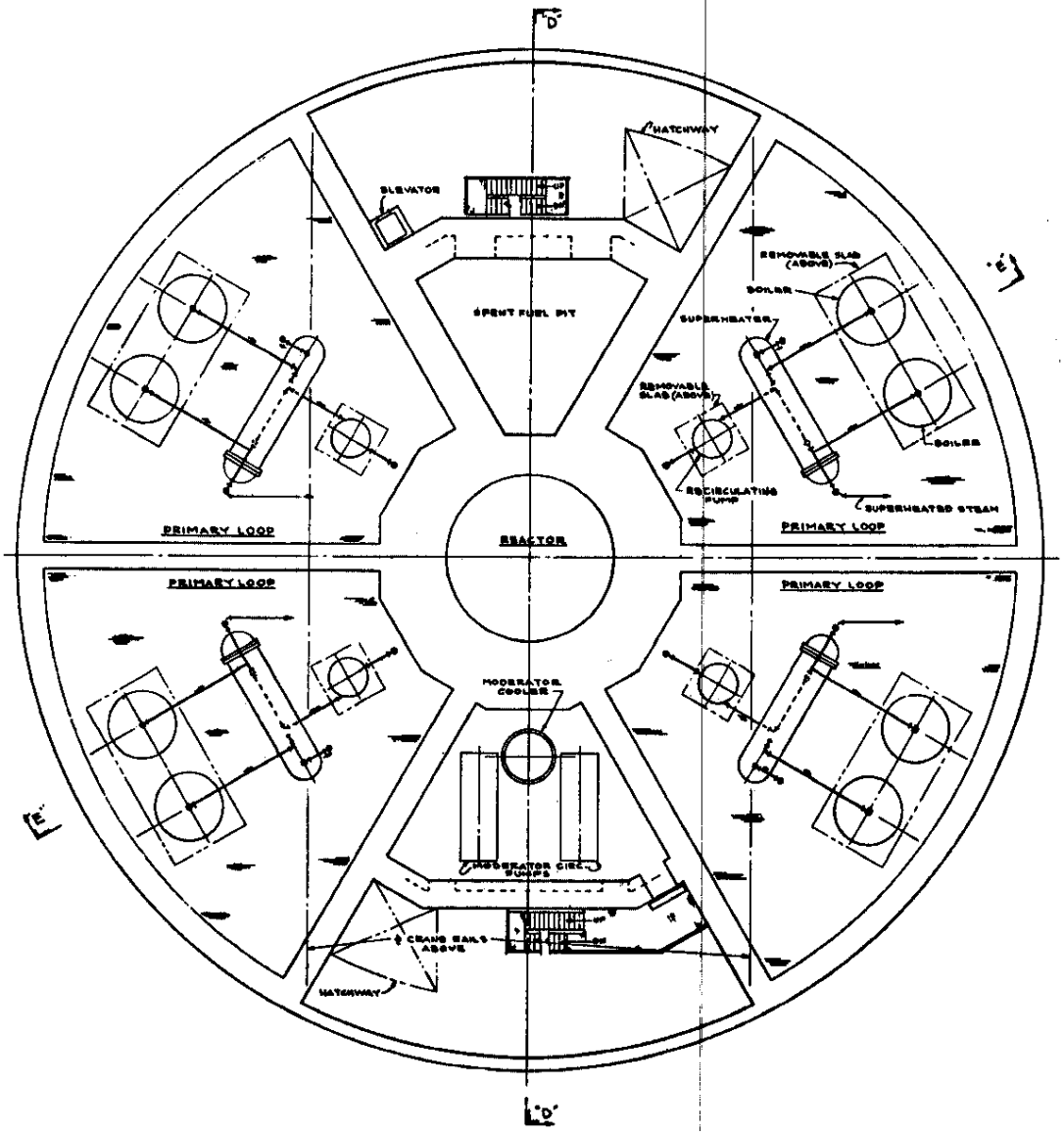


FIG. 1.1 FLOWSHEET OF ORGANIC-COOLED SYSTEM



PLAN A-A

FIG. 1.2 EQUIPMENT LAYOUT FOR 300-MWe PLANT

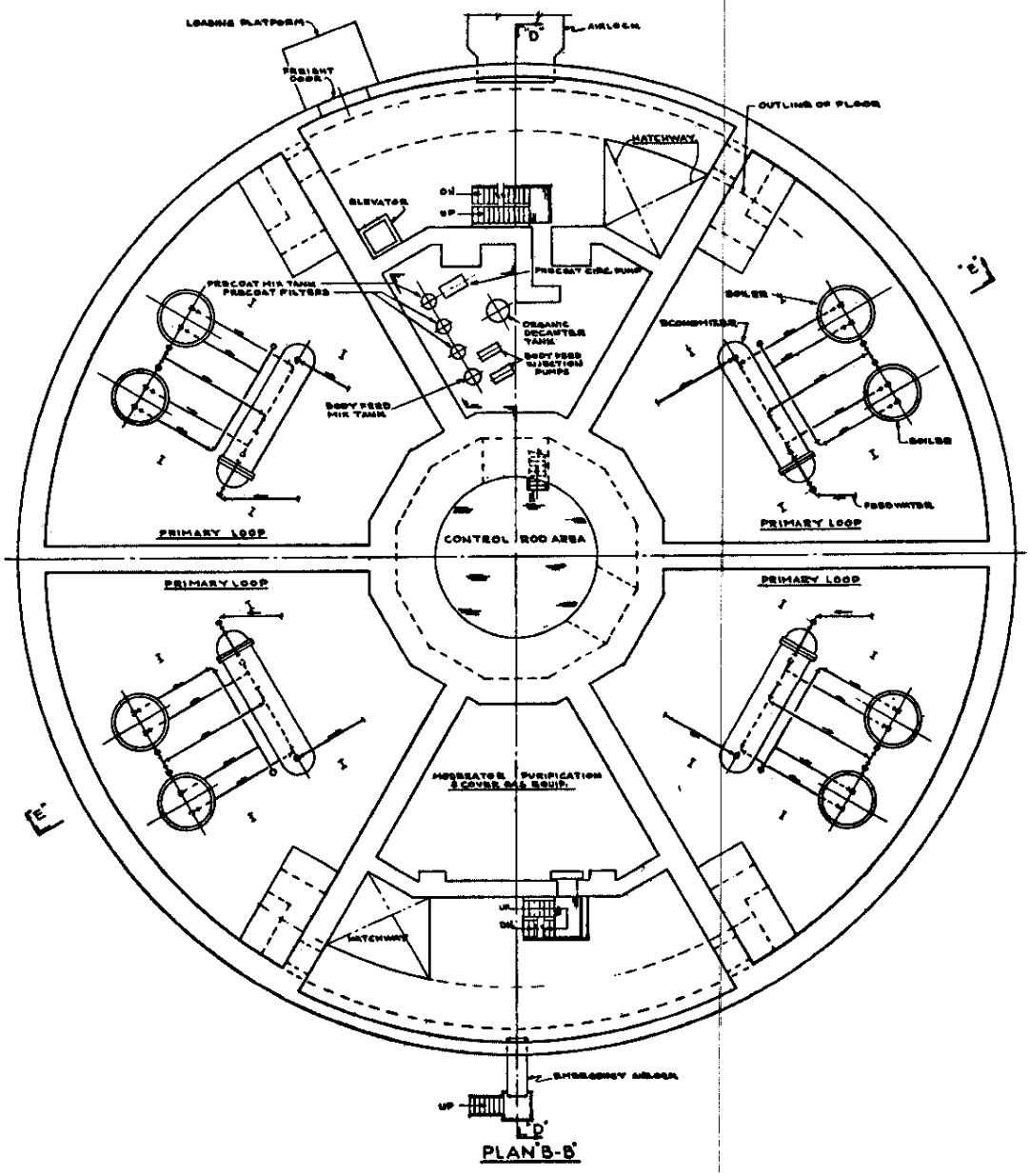
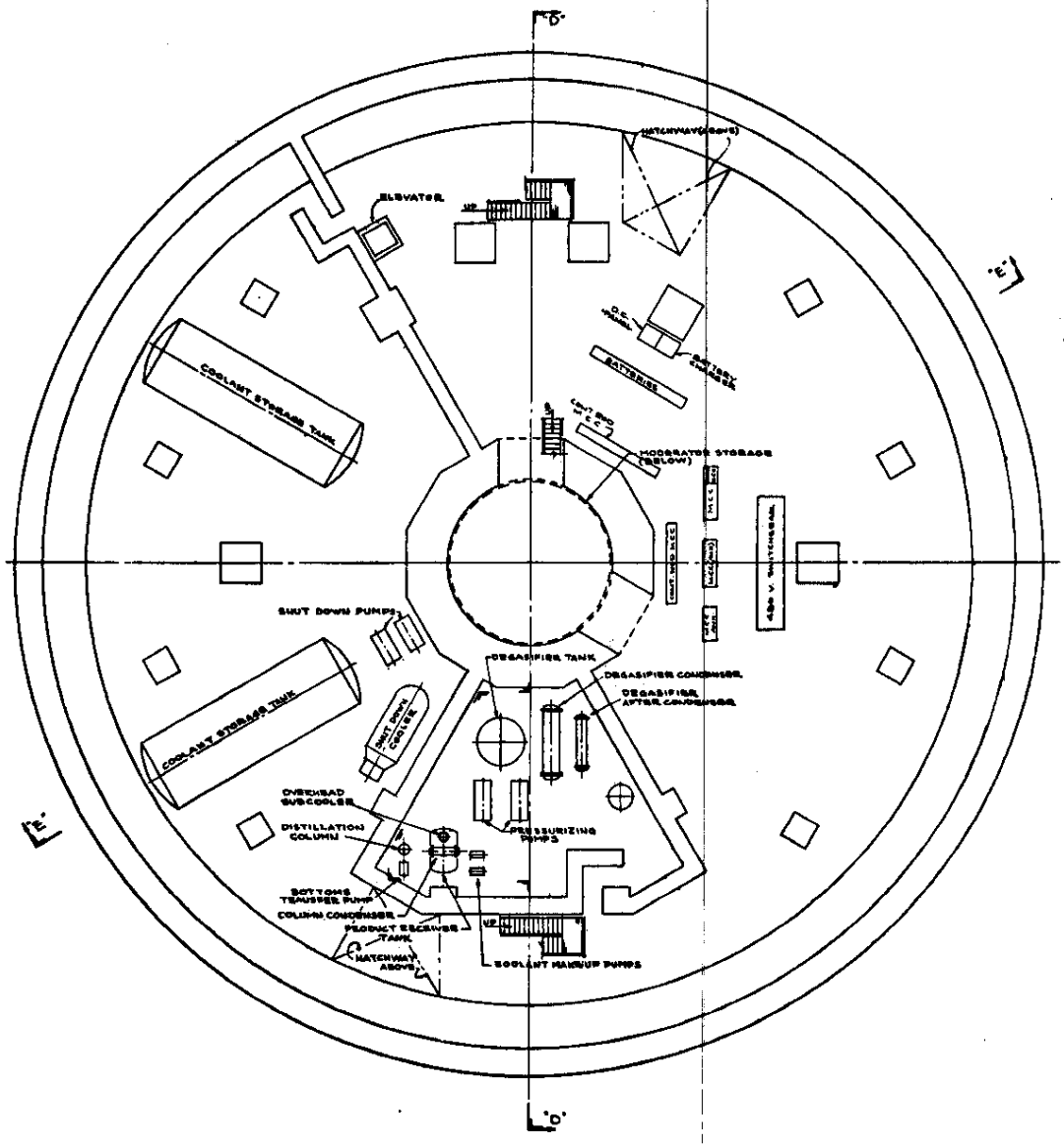
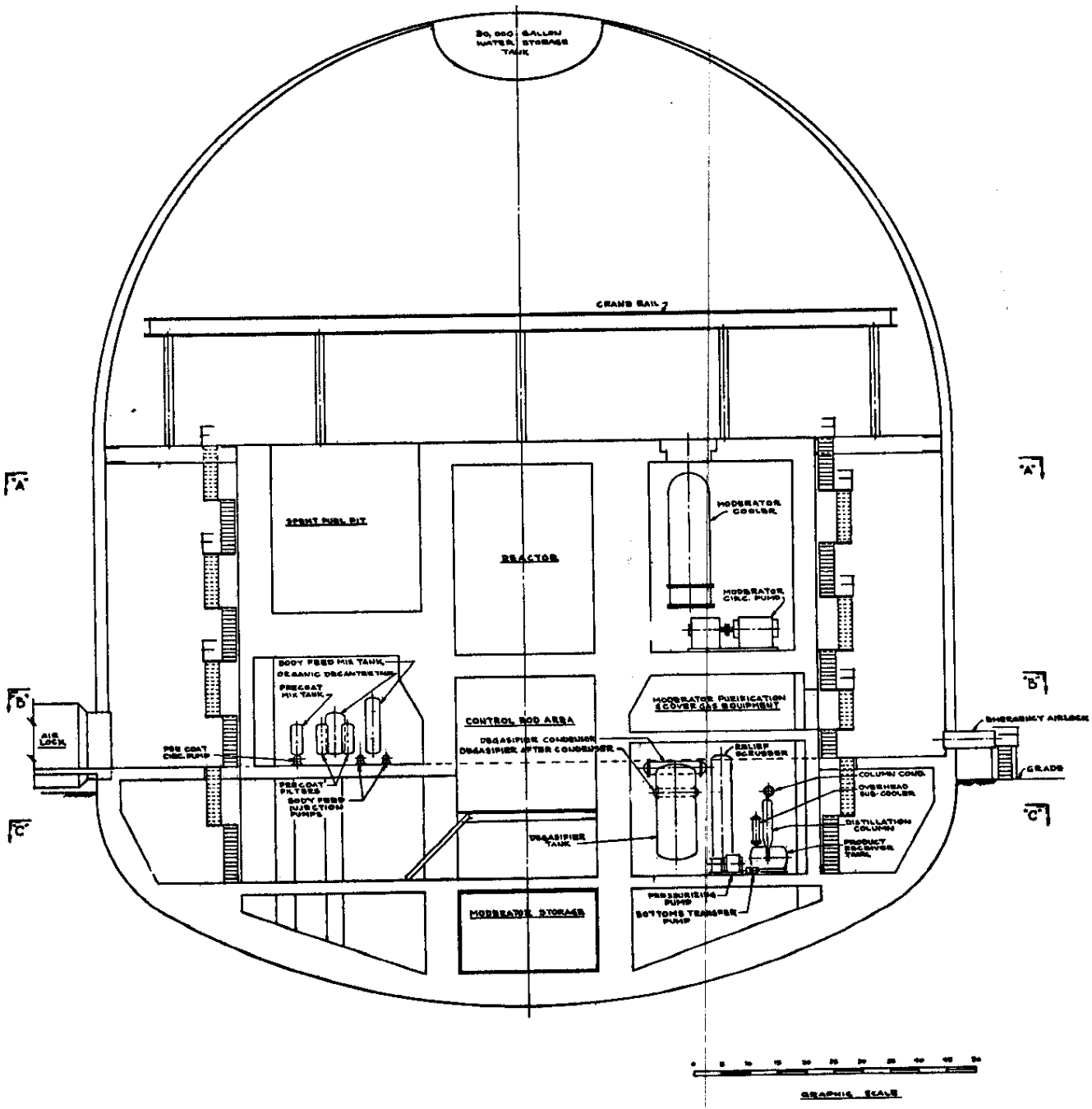


FIG. 1.2 (Continued)



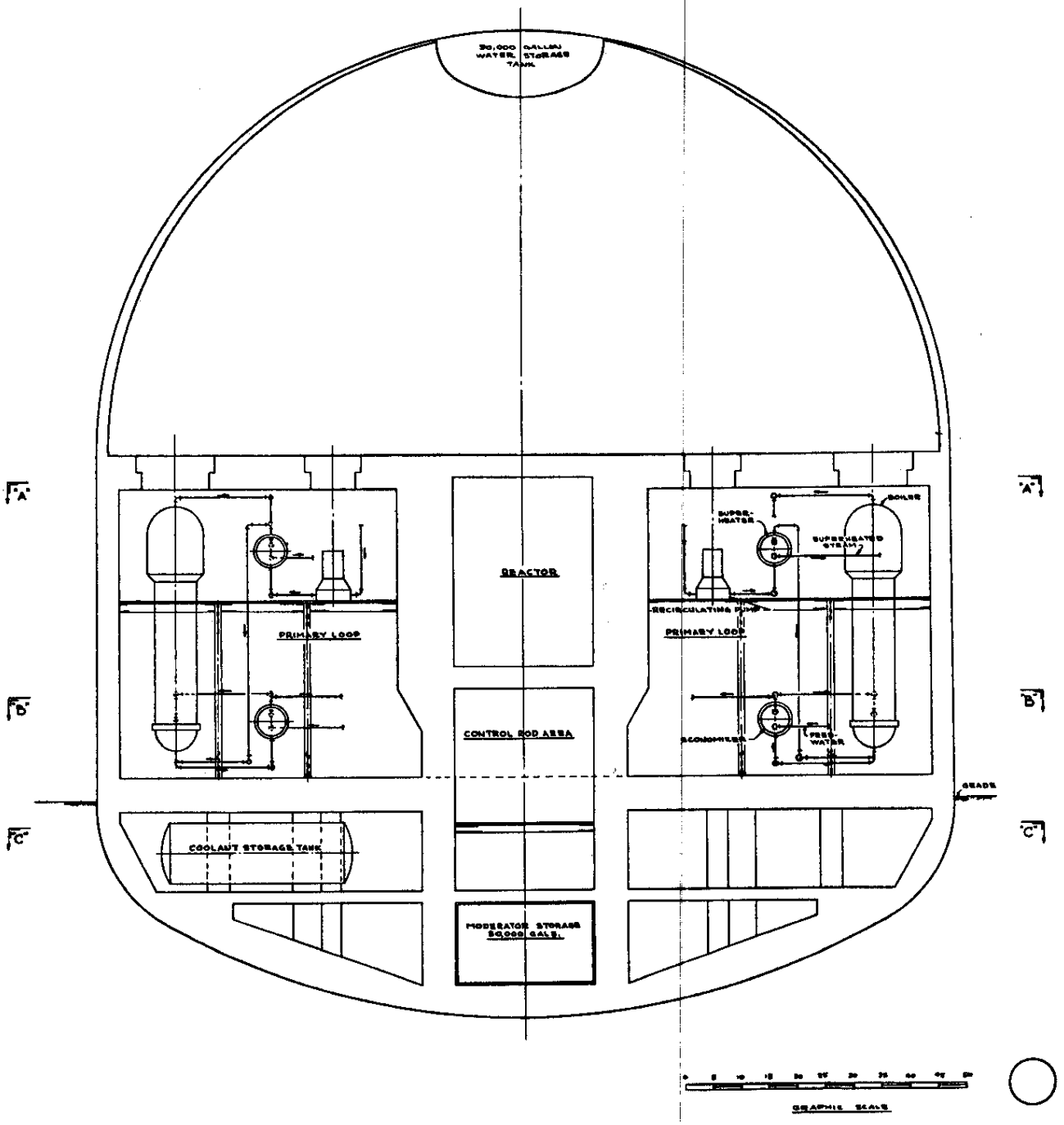
PLAN "C-C"

FIG. 1.2 (Continued)



General Cross Section "D-D"

FIG. 1.2 (Continued)



General Cross Section "E-E"

FIG. 1.2 (Continued)

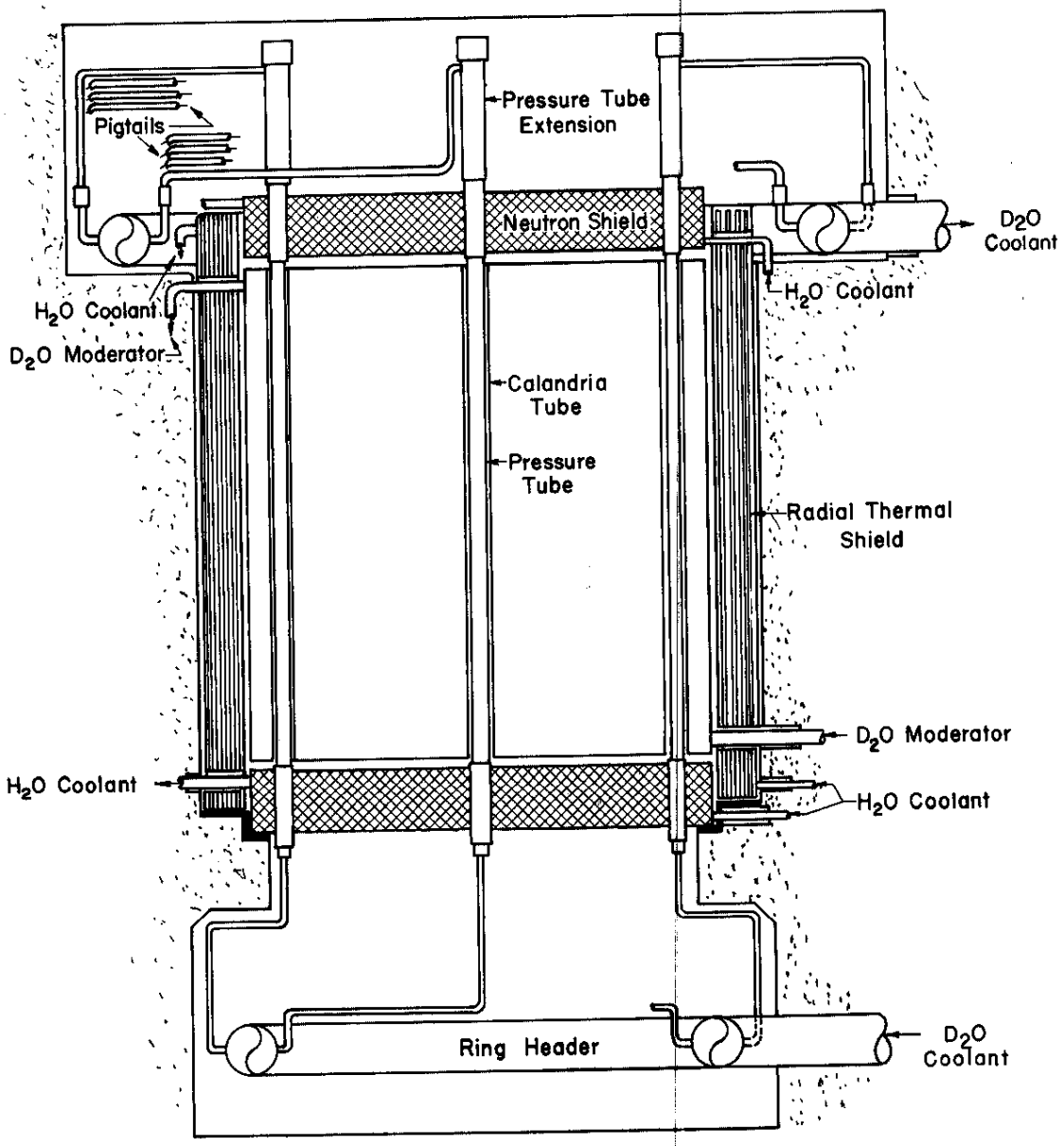


FIG. 1.3 ORGANIC REACTOR CALANDRIA DESIGN

2. Computer Program

The computer program consists of eight major "blocks." A simplified flow diagram of the code is shown in Figure 2.1, and a brief description of each function is given below.

(1) Input

Input parameters are supplied for each problem, including fuel and cladding material, pressure tube material, number of fuel tubes per assembly, mass of fuel per foot of length, coolant temperatures, thermal power, and engineering limits.

(2) Fuel Design

The dimensions and maximum power of a fuel assembly are calculated from input parameters and a set of engineering criteria.

(3) Lattice Physics

Reactivity parameters of the infinite lattice are calculated from the dimensions and materials of the fuel assembly, the lattice pitch, and the operating temperatures of the fuel, coolant, and moderator.

(4) Core Design

The number of fuel positions in the reactor core are computed from the required thermal power and power output of a fuel assembly as computed in the fuel design. Fuel exposure and spent fuel assays are calculated on the basis of one of the fuel charging schemes and the reactivity calculated in the lattice physics block.

(5) Fuel Fabrication

Fuel fabrication cost and fuel cycle costs are computed from the dimensions, materials, and exposures of the fuel assembly.

(6) Reactor

Major pieces of equipment in the reactor and primary coolant system are designed from the coolant flow rates and reactor core size as calculated in the core design. An estimate of the cost of each piece of equipment is made on the basis of its design.

(7) Auxiliaries and Building Structures

Designs and cost estimates are obtained for the various auxiliary facilities required in the reactor plant, and for the containment shell and building structures included in the reactor plant.

(8) Turbine Plant

Turbine plant design and cost are obtained for each problem by determining the turbine plant conditions that give the minimum over-all energy costs. These conditions depend upon the reactor coolant temperatures and the sum of all of the capital and operating costs, and are optimized by calculating the energy costs for a number of turbine plant designs in order to find the optimum.

(9) Final Accounting

Energy costs for the plant are computed from economic ground rules specified as part of the problem.

(10) "Fixed Fuel Design"

The fuel design and lattice physics routines can be bypassed by supplying fuel assembly lattice physics properties and having the code compute the reactor design and costs for the specified fuel assembly. In this way it is possible to study fuel assembly designs other than the annular fuel geometry, such as rod or plate-type fuel clusters.

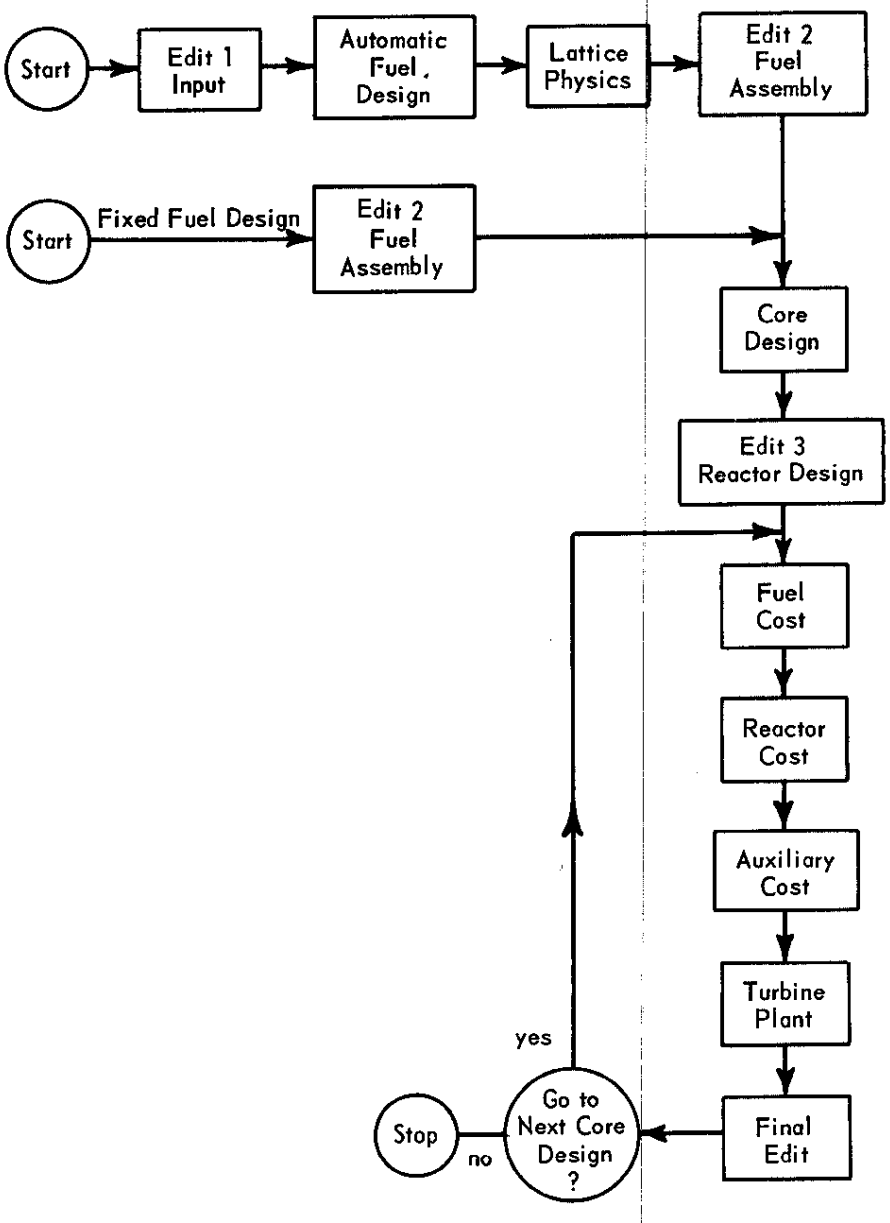


FIG. 2.1 FLOWSHEET FOR COMPUTER STUDIES

3. Input Parameters

Major design variables are included in the list of input required for each problem. Other variable parameters may be read into the code from a library tape. Thus, in the use of the code it is necessary to specify the library file required for each problem; with the use of a series of library files, a parameter on the library file may be varied and its effect studied. The effects of capital charge rates, the price of plutonium, reprocessing costs, and design stress of zirconium as a function of temperatures can be studied in this way.

The list of input required for each problem is given below. The input sheets for a typical problem are shown in Appendix A.

Fuel Assembly

Fuel material, UO_2 or U metal
Fuel length, in.
Mass of fuel (UO_2 or U metal) per unit length, lb/ft
Number of concentric tubes
Cladding material, Zr, Al, or SS
Fuel density (for UO_2 only), % of theoretical
^{235}U content in fuel, atom %
Thickness of outer coolant channel, mils
Insulating liner or calandria tube material, Zr or Al
Space between the pressure tube and liner (or calandria tube), mils
Inner housing tube, yes or no
Length of reactor core, in.
Number of fuel pieces in the reactor length
Cladding thickness, mils
Pressure tube material, Zr or Al

Design Limits

Maximum surface temperature of cladding, °C
Minimum burnout safety factor
Maximum central fuel temperature, °C

Reactor Core

Coolant inlet temperature, °C
Coolant outlet temperature, °C
Moderator temperature, °C
H_2O in moderator, %
Axial reflector thickness, in.
Radial reflector thickness, in.
Number of control rods
Number of safety rods
Reactivity held in control rods (k_{eff})
Lattice pitch, in.
Lattice pattern, hexagonal or square
Degree of flattening

Reactor System

Load factor
Thermal power removed by coolant, MW
Reactor discharge time, days

4. Fuel Design

4.1 Automatic Fuel Design

The fuel design block is for fuel assemblies that consist of two or three concentric tubes of fuel clad with SAP (sintered aluminum powder). Dimensions and power output are computed so that a maximum power can be obtained from the assembly and so that the temperatures and pressure drops are consistent with the design criteria. The design criteria that must be satisfied are: (1) equal pressures along the subchannels, (2) equal coolant temperatures along each subchannel, and (3) equal maximum surface temperatures on each fuel tube. The power is progressively increased in the calculations until one of the design limits is reached. The limits specified in the input to each problem are (1) maximum fuel temperature, (2) maximum surface temperature, and (3) minimum safety factor on heat transfer burnout.

This block of the code, which was originally written for use with liquid D_2O cooling, is described in detail in DP-784[10].

The liquid D_2O code has been modified for organic coolant by making the appropriate changes in the coolant, cladding, and fuel properties. The coolant properties[9] of "Santowax" R were substituted for the properties of pressurized D_2O. The equation for the burnout heat flux is given by

$$(Q/A)_{BO} = 552 T_s V^{2/3} + 85{,}000$$

where

$(Q/A)_{BO}$ = heat flux at burnout, pcu/(hr)(ft^2)

T_s = subcooling at burnout site, °C
= saturation temperature minus the local bulk temperature

V = coolant velocity, ft/sec

As with the liquid D_2O cooled case, the heat transfer coefficient, h, is computed from

$$h = \alpha(T_o) \frac{V^{0.8}}{D_e^{0.2}} [1 + 0.005(T_s + T_B)]$$

where

V = coolant velocity, ft/sec

D_e = hydraulic diameter of the coolant annulus, in.

T_s = surface temperature of the fuel, °C

T_B = bulk temperature of the coolant, °C

$\alpha(T_o)$ = fitted parameter that is a function of the coolant outlet temperature

4.2 Pressure Tube Design

The pressure tube thickness is computed from

$$t = \frac{p_d D}{2S}$$

where

t = thickness of the pressure tube, in.

p_d = design pressure of reactor, psia

D = inner diameter of the pressure tube, in.

S = design stress of the pressure tube material at the design temperature, psia

and the design temperature is taken to be the outlet temperature from the fuel assembly.

4.3 Heat Conduction to the Moderator

Heat is conducted from the outer coolant channel through the pressure tube to the moderator surrounding the fuel assemblies. The heat flux is computed from

$$(q/A) = \Delta T \left(\frac{1}{h_g} + \frac{t}{k_p} + \frac{1}{h_m} \right)^{-1}$$

where

q/A = heat flux through the pressure tube, pcu/(hr)(ft^2)

ΔT = average temperature difference between the coolant and moderator, °C

$$\Delta T = \left(\frac{T_o + T_i}{2} - T_m \right)$$

where

T_o, T_i = reactor outlet and inlet temperatures, °C

T_m = average moderator temperature, °C

h_m = heat transfer coefficient of the moderator interface, pcu/(hr)(ft²)(°C)

h_g = heat transfer coefficient across the insulating gap, pcu/(hr)(ft²)(°C)

k_p = thermal conductivity of the pressure tube material, pcu/(hr)(ft)(°C)

t = pressure tube thickness, ft

For the pressure tube designs where the insulating gap is inside the pressure tube, the value of h_g is the heat transfer coefficient across the insulating material, whereas for the calandria designs, h_g is the heat transfer coefficient across the gas gap.

5. Lattice Physics

Lattice physics parameters for the infinite cell are computed from the fuel dimensions and temperatures of the fuel assembly. All of these parameters are either specified in the original input to the code or are computed in the fuel design portion of the code. The values of η, ϵ, p, f, L^2, τ, and B^2 are computed by a method developed at SRL[11], and has been adjusted by comparison with a large number of experiments to give accurate reactivity calculations over a large range of heavy water lattices. The majority of the comparisons between experiments and calculations have been made with D_2O-cooled lattices. Only about a dozen experiments with hydrogenous coolant are available for comparison with calculations, and it has been found that the normalization required to fit these experiments is the same as for the D_2O-cooled case.

6. Core Design

The core design block uses the results of the fuel design and lattice physics portions to compute the reactor dimensions, power output, and fuel life for several fuel charging strategies. Three fuel charging strategies are considered with each problem. The core designs do not differ in the core dimensions or number of fuel assemblies, but only in the assumed fuel handling procedure and the degree of power flattening that results. A detailed description of the method of calculations are given in the Appendix of DP-707[1]. The three fuel handling schemes are as follows:

Case 1 - Batch Refueling

Case 1 is the base case. The core dimensions and number of fuel assemblies are determined so that this reactor produces the required power (an input parameter) for an assumed power distribution of a chopped J_o-cosine. The fuel life for this case is obtained for a simple batch discharging scheme. The entire core is discharged when the reactivity falls below the minimum value, Δk_c, that is required for xenon override and flux trimming.

Case 2 - Continuous Countercurrent Refueling

Case 2 is characterized by a continuous charging scheme in which each bit of fuel receives the same exposure. The chopped J_o-cosine power distribution for Case 1 is maintained, but a longer exposure of the fuel is achieved by balancing the fuel elements of high exposure with fuel material of adjacent lattice positions. In this procedure the power distribution remains constant and the reactor power is the same as in Case 1.

Case 3 - Graded Two-Zone Refueling

Case 3 is characterized by a continuous two-zone refueling scheme. The power distribution is flattened by charging fresh full-length fuel assemblies into the central zone at a rate such that the mean radial buckling is zero. Assemblies are charged in the outer zone at a rate required to maintain criticality and compensate for the low reactivity of the central zone. In this procedure, reactivity or core life is sacrificed to gain improved power distribution. Because of this better power distribution, the total power is higher than in Case 1 or Case 2. The degree of flattening or the total thermal power is at the discretion of the user of the code.

The input for the core design block is obtained from the initial input or from the output from the fuel design and lattice physics blocks and includes the following:

Initial Input

Lattice pitch
Lattice pattern
Length of fuel assembly
Weight of fuel
Enrichment of fuel
Number of safety rod positions
Minimum amount of reactivity required for control
Radial reflector thickness
Vertical reflector thickness
Time required to replace spent fuel in Case 1
Degree of flattening in Case 3
Total power sent to steam plant in Case 1 and Case 2

Input from Fuel Design

Power removed by coolant in central assembly
Total power generated in central assembly
Coolant flow in central assembly

Input from Lattice Physics

Initial hot clean buckling of the lattice cell
Migration area
Resonance escape probability

The amount of reactivity desired for operational control is an input parameter, and the amount of reactivity lost to xenon-samarium is computed from the average power. The reactivity lost to Doppler broadening is computed from the average temperature of the central fuel assemblies as computed in the fuel design block.

The number of fuel assemblies in the core is adjusted to give the desired thermal power of the reactor for Case 1, which establishes the size of the core and the over-all reactor dimensions. For Case 3, the amount of power flattening is automatically adjusted to give the desired thermal output for Case 3.

An expression for reactivity change as a function of the exposure and resonance escape probability has been standardized in the form of the following polynomial:

$$\Delta k = \sum_i a_i E^{n_i} p^{m_i}$$

where E is the exposure, and p is the resonance escape probability. The coefficients a_i are computed separately in part by side studies and in part, internally in the code. The method for computing the a_i's and some of the results of the side studies are described in DP-707[1]. The reactivity loss due to temperature, leakage, control, and xenon-samarium is first subtracted from the initial hot reactivity of the lattice. The remainder of the available reactivity determines the core life of the fuel. The exposure at discharge is then computed from the root of the polynomial.

Included in the output from the core design block are the exposures, throughput, fuel inventory, and the assays of the spent fuel in the inner and outer regions of the reactor. These quantities are required primarily for the fuel cycle costs. The thermal flux of the core reflector interface is computed for use in the shield design calculations. Also, the total coolant flow, the D_2O in the reactor core and reflector, and the heat load on the moderator are computed for use in the determination of the reactor building and equipment costs.

7. Fuel Cycle Costs

7.1 Fuel Cost Subroutine

In this subroutine the charges associated with the fuel cycle are computed by one of two alternative cost accounting procedures. The two procedures correspond to two methods of handling the spent fuel. One procedure essentially follows the AEC method as outlined in the Cost Evaluation Handbook[12]. This AEC charge schedule has been modified so that \$0.15/kg U and \$2.50/kg U are taken for the shipping charges for new and spent fuel. The alternative procedure assumes that spent fuel is stored at the reactor site and not processed.

The input required for the determination of the fuel cycle costs includes dimensions of the fuel assembly, initial enrichment of the fuel, isotopic assays of the plutonium and uranium-235 in the spent fuel, exposure of the fuel, throughput of the fuel, and the inventory of fuel in the reactor. These input parameters are determined in preceding blocks of the program.

The output from the fuel cycle cost subroutine lists the following charges for both the outer (buckled) zone and central (flat) zone fuel:

Exposure, MWD/tonne

Throughput, tonnes/yr

Fabrication cost, \$/kg U

Manufacturing cost, which includes the fuel preparation cost, fabrication cost, and the cost of shipping new fuel, \$/kg U

Fuel burnup cost, which includes the net credit of plutonium and ^{235}U, \$/kg U

Use charges, \$/kg U

Fuel cost, \$/kg U

For each of the fuel charging schemes, the following charges are listed:

Annual reactor fuel cost, \$/yr

Annual throughput, kg/yr

Average exposures, MWD/tonne

Reactor fuel cycle cost, mills/kwh

7.2 Fabrication Cost

The fuel fabrication cost has been estimated by assuming that a separate plant will be constructed to furnish fuel elements that are required by the reactor design. Estimates have been made of the capital outlay and operating expenses required to build and operate a fuel fabrication plant for this purpose. Fabrication costs have been developed for the manufacture of UO_2 tubes by mechanical compaction and for the manufacture of uranium carbide tubes by a skull casting process. The manufacturing costs for uranium oxide tubes clad in Zircaloy have been published previously[13], and the fabrication costs for the uranium carbide tubes are described below.

The cost of manufactured uranium carbide has been developed by analyzing the investment and operating costs of a plant to produce about 300 kg of uranium carbide per shift. The process consists of skull melting and casting for the manufacture of uranium carbide. The cast uranium carbide tubes are then assembled in SAP sheaths, and nickel-plated end plugs are attached by an aluminum eutectic braze. These operations were developed by Atomics International. The costs have been developed so that it is possible to estimate the effect of plant throughput and fuel assembly dimensions on the unit cost of the fuel.

The variable costs include the cost of materials (not including the cost of components), the cost of laboratory analyses, direct labor, and distributives which include supervision, services, maintenance, and miscellaneous supplies. These variable costs have been divided into those that depend upon the mass of fuel processed and those which depend upon the number of tubes processed. The variable costs that depend upon the mass of fuel processed are \$1293/shift, or \$4.65/kg of U. The costs that depend upon the number of tubes processed are \$1183/shift or

$$\frac{14,800}{(b^2 - c^2)L}, \$/kg\ U$$

where

b and c = OD and ID of the uranium carbide core, cm

L = length of the core, cm

The fixed costs are made up of the following:

(1) Indirect plant costs, including depreciation, taxes, and insurance

(2) Overhead

(3) Management expense

(4) Inventory charge

These charges total \$114/tube, or,

$$\frac{12,700}{(b^2 - c^2)L} \text{ , \$/kg U}$$

In addition, a component of the fixed charge costs can be expressed as a unit cost of \$115/T, where T is the throughput in tonnes U/year.

The cost of the end plugs is calculated from the weight of the end plugs, which are assumed to be 6 inches long, cost \$6/lb and have a machining cost of about \$20/pair. The assumed rejection rate is 15%. The expression for the end plug cost is then

$$\frac{50}{L} + \frac{23.3}{(b^2 - c^2)L} \text{ , \$/kg U}$$

The cost of the SAP sheaths is computed from the mass of the material and an assumed cost of \$12/lb of SAP. The sheath cost, SHC, is given by

$$SHC = \left[\frac{\pi}{4}\frac{(a^2 - b^2 + c^2 - d^2)}{(2.54)^2} + 0.060\right]\left[\frac{L}{2.54} + 2.0\right]\left[\frac{1}{1 - r_1}\right]\left[\frac{1}{1 - r_2}\right]\left[\rho_a C_a\right]$$

where

a and d = OD of the outer sheath and the ID of the inner sheath, respectively, cm

rib area = 0.060 in^2

r_1 = rejection rate of the SAP sheaths during receiving and inspection = 0.20

r_2 = rejection rate during inspection of the finished fuel elements = 0.15

ρ_a = density of the SAP, lb/in^3

C_a = unit cost of the SAP = \$12/lb

These component costs are then combined to give the Equation 4b listed in Table 7.1.

TABLE 7.1

Equations for Fuel Cycle Cost

Cost	Equation Number			
	AEC Accounting Procedure		Throwaway Accounting Procedure	
	Natural Uranium	Enriched Uranium	Natural Uranium	Enriched Uranium
Uranium	1a	1b	1a	1b
Fuel preparation				
Fused UO_2	2a	2c	2a	2c
Uranium carbide	2b	2b	2b	2b
Losses in fuel preparation	3	3	3	3
Fuel fabrication				
UO_2 tubes	4a	4a	4a	4a
Uranium carbide tubes	4b	4b	4b	4b
Losses in fabrication	5	5	5	5
Shipping new fuel	6	6	6	6
Shipping spent fuel	7	7	-	-
Storing spent fuel	-	-	8	8
Depleted fuel price	9	9	-	-
Uranium recovery	10	10	-	-
Reprocessing	11	11	-	-
Plutonium recovery	12	12	-	-
Fuel burnup	13a	13a	13b	13b
Use charges	-	14a	-	14b
Summary costs				
Manufacturing	15	15	15	15
Total fuel	16a	16b	16a	16b
Fuel cycle	17	17	17	17

TABLE 7.1 (Continued)

Equations

Number	Equation
1a	$A = 21.0$
1b	$A = f(\alpha)$ where $f(\alpha)$ is the cost of uranium as a function of enrichment
2a	$N = 6.25 \left(1 + \frac{\beta + \delta + \gamma}{100}\right)$
2b	$N = 3.64 \left(1 + \frac{\beta + \delta + \gamma}{100}\right)$
2c	$N = (6.1 + 2.2\alpha) \left(1 + \frac{\beta + \delta + \gamma}{100}\right)$
3	$P = A \frac{\gamma}{100} \left(1 + \frac{\beta + \delta + \gamma}{100}\right)$
4a	$C_i = \frac{138.5}{\rho_{UO_2}(b_i - c_i)L(1 - R_i)} \left[\frac{32.8}{\pi} \frac{(F_i + \epsilon_i)}{(b_i + c_i)} + 0.215(L + L_i)tC_{Z_i}\right]$
	$\omega_i = b_i^2 - c_i^2$
	$R = \frac{\sum_i \omega_i C_i}{\sum_i \omega_i}$
4b	$C_i = 4.65 \frac{27,500}{(b_i^2 - c_i^2)L} + \frac{50}{L} + \frac{115}{T} + \frac{170}{(b_i^2 - c_i^2)L} 0.122(a^2 - b^2 + c^2 - d^2) + 0.060\left(\frac{L}{2.54} + 2\right)$
5	$S = \frac{A\delta}{100} \left(1 + \frac{\beta + \delta}{100}\right)$
6	$U_1 = 0.15$
7	$U_2 = 2.50$
8	$SS = 2.50$
9	$B = f(\alpha')$

TABLE 7.1 (Continued)

Number	Equation
10	$DD = a_4\ a_5\ a_6$
11	$CC = a_2 \dfrac{[TT + F/G]}{F}$
12	$EE = a_7\ a_8\ a_9 (g_1 + g_2 + g_3)$
13a	$PP = XX + [U_2 + CC - r_j(g_1 + g_2 + g_3) + EE]$
	where $XX = A$ if $B - DD \leq 0$
	and $XX = A - B + DD$ if $B - DD > 0$
13b	$PP = A + SS$
14a	$Q = a_1 \dfrac{A\theta}{12} \left(1 + \dfrac{\beta + \delta + \gamma}{100}\right)$
	$T = a_1 A \dfrac{\lambda}{12} \left(1 + \dfrac{\beta + \delta}{100}\right)$
	$W = a_1 A \dfrac{\mu}{12}$
	$Y = a_1 A \dfrac{Je}{\tau}$
	$Z = a_1 \dfrac{e}{2\tau} [A + B]$
	$AA = a_1 B \left(\dfrac{F}{\tau} + \dfrac{1}{365} \left[\dfrac{F}{G} + \dfrac{F}{1000} + a_3\right]\right)$
	$WW = Q + T + W + Y + Z + AA$
14b	$WW = Q + T + W + Y + Z$
15	$V = N + P + R + S + U_1$
16a	$F_c = V + PP$
16b	$F_c = V + PP + WW$
17	$E_c = \dfrac{F_c(10^5)}{24\ \eta \overline{E}}$

TABLE 7.1 (Continued)

Symbols in Equations

Symbol	Value	Description
a_1	-	OD of clad tube, cm
a_1	0.0475	use charge rate
a_2	17,500	reprocessing cost, $/day
a_3	35	holdup time in reprocessing, days
a_4	5.6	nitrate conversion cost, $/kg U
a_5	0.99	separation efficiency of nitrate conversion
a_6	0.997	conversion efficiency of nitrate conversion
a_7	1.5	cost of plutonium reduction, $/g Pu
a_8	0.99	separation efficiency
a_9	0.99	conversion efficiency
a_{10}	3.0	tube length beyond core, ft
A	-	cost of uranium, $/kg
AA	-	use charge associated with the fuel during reprocessing, $/kg
b_1	-	OD of core, cm
B	-	price of the uranium in the spent fuel, $/kg
c_1	-	ID of core, cm
C_1	-	fuel fabrication cost per fuel element, $/kg
C_{Z_1}	99.0	Zircaloy-2 cost in UO_2 tubes, $/kg Zircaloy
CC	-	fuel processing cost, $/kg
d_1	-	ID of clad tube, cm
DD	5.60	cost of uranium recovery, $/kg
e	-	fuel inventory in the core, kg
$\bar{E}$	-	exposure of the fuel, MWD/tonne
E_c	-	fuel cycle cost, mills/kwh
EE	-	plutonium recovery cost, $/kg
F	25,000	reprocessing batch size, kg
F_c	-	total fuel cost, $/kg
F_1	154	fixed and variable costs of UO_2 tubes, $/element

TABLE 7.1 (Continued)

Symbol	Value	Description
g_1	-	^{239}Pu concentration in spent fuel, g/kg
g_2	-	^{240}Pu concentration in spent fuel, g/kg
g_3	-	^{241}Pu concentration in spent fuel, g/kg
G	1000	reprocessing rate, kg/day
J	0.5	fraction of core in spare fuel
L	-	length of fuel in core, cm
L_1	2.5	trimming loss of Zr in UO_2 tubes, cm
N	-	cost of fuel preparation, $/kg
P	-	cost of fuel material lost in fuel fabrication, $/kg
PP	-	fuel burnup cost, $/kg
Q	-	use charge associated with the fuel during fuel conversion, $/kg
r_j	9.50	Pu price, $/g
R	-	fuel fabrication cost per fuel assembly, $/kg
R_1	0.15	fraction of UO_2 tubes rejected
S	-	fuel material lost in fuel fabrication, $/kg
SS	2.50	storage cost of irradiated fuel, $/kg
t	-	cladding thickness, cm
T	-	use charge associated with the fuel during fuel fabrication, $/kg
TT	8	turnaround time, days
U_1	0.15	shipping cost for new fuel, $/kg
U_2	2.50	shipping cost for spent fuel, $/kg
V	-	manufacturing cost, $/kg
W	-	use charge associated with the fuel during storage, $/kg
WW	-	total use charges, $/kg
Y	-	use charge associated with the spare fuel, $/kg
Z	-	use charge associated with the fuel during irradiation, $/kg
α	-	initial ^{235}U enrichment, wt %
α'	-	final ^{235}U enrichment, wt %

TABLE 7.1 (Continued)

Symbol	Value	Description
β	10	recoverable scrap, %
γ	0.8	nonrecoverable loss in preparation, %
δ	1.2	nonrecoverable loss in fabrication, %
ϵ_1	50	cost of end plugs of UO_2 tubes, \$/element
η	-	over-all plant efficiency, %
θ	1.0	fuel preparation time, months
λ	3.0	fabrication time, months
μ	3.2	new fuel shipping time, months
ρ_Z	6.4	density of zirconium, g/cm^3
ρ_{UO_2}	-	density of UO_2, g/cm^3
τ	-	throughput, kg/yr

8. Reactor Design and Costs

The reactor consists of a cylindrical calandria tank containing D_2O moderator that is pierced by coolant tubes of either SAP or zirconium alloy. The coolant tubes are connected to plenum chambers above and below the reactor. The organic coolant passes from the reactor and outlet plenums through either four or eight parallel loops to the steam generator complex which consists of a superheater, two boilers, and an economizer in each loop. The superheated steam from each of the loops is combined in header piping and is sent to the turbine plant.

Much of the technology associated with this reactor system has been established by Atomics International in their work on the OMR systems. This work provided a basis for formulating much of the design criteria of this system. The general design and cost philosophy has been kept the same as in the D_2O-cooled studies whenever possible so that in these aspects the systems would be comparable.

8.1 Reactor Shields

Three types of shields are considered: (1) the radial thermal shield consisting of 50% H_2O and 50% stainless steel, (2) the radial biological shield of concrete, and (3) the axial shield consisting of 40% H_2O and 60% stainless steel.

A study was made to determine the required shield thicknesses as a function of the reflector thickness and the neutron flux at the core-reflector interface. The results of this study were then fitted to polynomials for use in the computer code. Similar expressions were obtained for the heat generation in the radial and axial shields for determination of the shield cooling requirements.

8.1.1 Radial Thermal Shield

The radial thermal shield is designed so that it reduces the maximum energy flux that is incident on the concrete biological shield to less than 30 Btu/(hr)(ft^2) during reactor operation. This shield consists of an annular tank of stainless steel containing stainless steel plates that are cooled with H_2O. The thickness of the radial shield,

$$t_{rs} = \sum_{i,j} a_{ij} (\ln \phi_1)^i t_r^j \qquad \begin{matrix} i = 0,1,2 \\ j = 0,1,2 \end{matrix}$$

where

t_{rs} = thickness of radial shield, cm

t_r = thickness of radial reflector, cm

ϕ_1 = thermal flux at the core-reflector interface at the reactor midplane, $n/(cm^2)(sec)$

a_{ij} = coefficients of polynomial given in Table 8.1

The heat generation in the shield,

$$q_{rs} = C_1 H R_s \phi_1 \sum_{i,j} b_{ij} t_r^i t_{rs}^j \qquad \begin{matrix} i = 0,1,2 \\ j = 0,1,2 \end{matrix}$$

where

q_{rs} = heat load on the side shield, Btu/hr

R_s = inner radius of shield, cm

H = height of reactor core and reflector, cm

$C_1 = 17.5 \times 10^{-13}$

b_{ij} = coefficients of polynomial given in Table 8.1

The cost of the radial shield, RTS, is expressed as a function of the weight of the shield times the unit cost of steel, which includes the cost of the material, fabrication, and installation.

$$RTS = \left[(d_c + 2t_r + 2t_{rs})^2 - (d_c + 2t_r)^2\right] \frac{\pi}{4} (h_c + 12) v_1 \rho_1 C_2$$

where

d_c = diameter of the reactor core, in.

v_1 = volume fraction of the stainless steel = 0.5

C_2 = installed cost, \$/lb = 1.80

t_{rs} = thickness of the radial shield, in.

t_r = radial reflector thickness, in.

ρ_1 = density of stainless steel = 0.28 lb/in^3

h_c = height of the reactor core, in.

8.1.2 Axial Shield

The top and bottom shields are designed so the radiation level after shutdown due to cobalt activation in the shield is less than 1 mr/hr and the maximum neutron leakage in the area above the shield is less than 10^5 n/(cm^2)(sec) during reactor operation. The neutron leakage criteria are the more restrictive. The thickness of the axial shield is

$$t_{ts} = t_{bs} = \sum_{i,j} d_{ij} (\ln \phi_2)^i t_{ar}^j \qquad \begin{matrix} i = 0,1,2 \\ j = 0,1,2 \end{matrix}$$

where

t_{ts}, t_{bs} = top and bottom shield thicknesses, cm

t_{ar} = axial reflector thickness, cm

ϕ_2 = maximum thermal flux at the core-reflector interface, n/(cm^2)(sec)

d_{ij} = coefficients of the fitted polynomial and are given in Table 8.1

The heat generation in the axial shields is given by the following expression:

$$\begin{bmatrix} q_{bs} \\ q_{ts} \end{bmatrix} = C_3 R_c^2 \phi_2 \sum_{i,j} e_{ij} t_{ar}^i \begin{bmatrix} t_{bs}^j \\ t_{ts}^j \end{bmatrix} \qquad \begin{matrix} i = 0,1,2 \\ j = 0,1,2 \end{matrix}$$

where

q_{ts}, q_{bs} = heat generated in the top and bottom shields, Btu/hr

R_c = radius of the reactor core, cm

$C_3 = 5.5 \times 10^{-13}$

e_{ij} = coefficients of the polynomial given in Table 8.1

The axial shields consist of plate and tube shields with particulate filler of stainless steel. The construction of the shield permits recirculation of the cooling H_2O. The cost is expressed in terms of the gross weight and the number of tubes that pierce the shield.

$$\begin{bmatrix} USH \\ LSH \end{bmatrix} = (d_c + 2t_r + 2t_{rs})^2 \frac{\pi}{4} \begin{bmatrix} t_{ts} \\ t_{bs} \end{bmatrix} v_4 \rho_1 C_4 + \begin{bmatrix} n_f + n_c \\ n_f \end{bmatrix} C_5 + \begin{bmatrix} n_s \\ 0 \end{bmatrix} C_6$$

where

USH, LSH = cost of the upper and lower shields

t_{ts} and t_{bs} = thickness of the upper and lower neutron shields, in.

v_2 = volume fraction of stainless steel = 0.60

C_4 = general fabrication and installation cost, \$/lb = 2.0

C_5 = cost per lattice position, \$200

C_6 = cost per safety rod position, \$150

n_f = number of fuel positions

n_c = number of control positions

n_s = number of safety rod positions

8.1.3 Radial Biological Shield

The concrete biological shield is designed to reduce the maximum radiation level during reactor operation to 1 mr/hr for which the required thickness is 9.5 ft. The cost of the biological shield, RBS, is expressed in terms of the volume of concrete surface area of the shield and the mass of reinforcing steel.

$$RBS = (d_c + 2t_r + 2t_{rs} + t_s)(h_c + 2t_{ar} + t_{ts} + t_{bs} + t_1) \times \left[\pi t_s \frac{C_7}{(36)^3} + \frac{2\pi}{144}(a_1 C_8 + C_9) \right]$$

where

t_s = thickness of the biological shield, in.

t_1 = height of the biological shield above the moderator tank, in.

C_7 = cost of concrete, \$/yd^3 = 25

a_1 = amount of reinforcing steel, \$/ft^2 = 4.0

C_8 = cost of reinforcing steel, \$/lb = 0.2

C_9 = cost of the forms, \$/ft^2 = 3.50

8.2 Primary Coolant System

The primary coolant system consists of pressure tubes, insulating liners, inner housing tubes within the pressure tube, pressure tube hardware and extensions, plenum chambers, main piping, pumps, motors, and steam generators. In subsequent sections, expressions are given for the equipment cost, the D_2O inventory, and the pressure drop for the 300-, 500-, and 1000-MWe reactor plants.

8.2.1 Pressure Tubes

The pressure tube material may consist of either sintered aluminum product (SAP) or zirconium-niobium alloy pressure tubes to which stainless steel extensions are connected. The zirconium-alloy tubes are joined to a stainless steel transition joint by a metallurgical bond. This transition joint is then welded to the stainless steel extension, which in turn, is connected by pigtails to the coolant distributors.

The cost of the zirconium-niobium tubes, PT, is given in terms of the weight of the tubes, the cost of the metallurgical bond and welding, and the weight of the stainless steel fittings. The cost relation is

$$PT = (d_{opt}^2 - d_{ipt}^2)\frac{\pi}{4}(h_c + 2t_{ar})\rho_2 C_{12} n_f + 2n_f(d_{opt}C_{13} + C_{14})$$

$$+ n_f(d_{opt}^2 - d_{ipt}^2)\frac{\pi}{4}(t_{ts} + t_{bs} + t_2)\rho_1 C_{15}$$

where

d_{opt}, d_{ipt} = OD and ID of the pressure tube, in.

h_c = height of the reactor core, in.

t_{ar} = axial reflector thickness, in.

n_f = number of fuel positions

t_{ts}, t_{bs} = thickness of top and bottom shields, in.

ρ_1 = density of stainless steel, lb/in^3

ρ_2 = density of zirconium-niobium, lb/in^3

C_{12} = cost of the zirconium-niobium, \$/lb = 50

C_{13} = cost of the metallurgical bond and welding, \$/in. of dia. = 75

C_{14} = cost of the metallurgical bond and welding, \$/tube = 350

t_2 = length of the stainless steel fitting, in.

C_{15} = cost of the stainless steel fitting, \$/lb = 5

The pressure tubes of sintered aluminum product (SAP) are connected to SAP end fittings by flash welding or some other bonding method. The end fittings are machined for mechanical joint with the plenum tubes. The cost of the tube is given in terms of the weight of SAP, the cost of fittings and installation, and a cost for shop and field tooling, etc. The cost relation is

$$PT = [(d_{opt}^2 - d_{ipt}^2)\frac{\pi}{4}(h_c + 2t_{ar} + t_{ts} + t_{bs} + t_2)\rho_s C_{16} n_f]$$

$$+ n_f(50d_{opt} + 175) + C_{17}$$

where

d_{opt}, d_{ipt} = OD and ID of the pressure tube, in.

h_c = height of the reactor core, in.

t_{ar} = axial reflector thickness, in.

n_f = number of fuel positions

t_{ts}, t_{bs} = thickness of top and bottom shields, in.

ρ_s = density of SAP, $lb/in^3 = 0.098$

C_{16} = cost of the SAP tube including testing, etc, \$/lb = 8.0

C_{17} = cost for shop and field tooling, \$35,000

8.2.2 Pressure Tube Hardware and Extensions

The pressure tube hardware and extensions include access plugs, shield plugs, fuel extension fittings, fuel supports, hold-down mechanisms, etc. The costs of the various pieces of the hardware were obtained in terms of the weight of the hardware and the perimeter of the tube plus a constant cost. The cost of the hardware for the SAP pressure tube is:

$$PTH = n_f [C_{18} d_{ipt}^2 + C_{19} d_{ipt} + C_{20}]$$

where

n_f = number of fuel positions

d_{ipt} = ID of the pressure tube, in.

C_{18} = unit cost, $\$/in^2 = 6.0$

C_{19} = unit cost, \$/in. = 27

C_{20} = constant cost, \$125

For the zirconium pressure tube, the expression for the cost of the pressure tube hardware is similar to the above expression with unit costs to reflect the more expensive material.

$$PTH = n_f [C_{18} d_{ipt}^2 + C_{19} d_{ipt} + C_{20}]$$

where

C_{18} = unit cost, \$/in^2 = 9.0

C_{19} = unit cost, \$/in. = 40

C_{20} = constant cost, \$185

The extension of the pressure tube for the SAP tube is a continuation of the SAP tube out of the core to a height about 36 inches above and below the axial shields and the cost of this extension is contained in equation for the pressure tube cost.

For the zirconium pressure tube, the extension consists of a stainless steel sleeve that is welded to the pressure tube assembly. The cost of the extension, PTE, is expressed in terms of the weight where the total weight equals about 5/3 of the weight of the top extension.

$$PTE = \pi(d_{opt} + t_3) t_4 t_5 \rho_1 a_2 n_f C_{21}$$

where

d_{opt} = OD of the pressure tube, in.

$d_{opt} + t_3$ = mean diameter of pressure tube extension

t_3 = 5/16 in.

t_4 = wall thickness = 3/8 in.

t_5 = length of extension = 65 in.

ρ_1 = density of the stainless steel = 0.28 lb/in^3

a_2 = ratio of the total weight to the weight of the extension = 1.67

C_{21} = fabrication and installation cost, \$/lb = 4.0

The organic inventory and the pressure tube extension, I-PTE, include the fluid in the pressure tubes and extension pieces from the outer edge of the axial reflector to the plenum chambers so that

$$\text{I-PTE} = n_f d_{ipt}^2 \frac{\pi}{4} a_3 t_8 \frac{\rho_4}{1728}$$

where

a_3 = the fraction of the extension filled with organic = 0.5

t_8 = combined length of top and bottom extension tubes = 132 in.

ρ_4 = density of coolant at a temperature midway between reactor inlet and outlet temperatures, lb/ft^3

The expression for the pressure drop in the pressure tubes outside of the core includes the friction drop along the length of the tubes plus two velocity heads so that

$$\Delta\text{P-PTE} = \frac{4 f_1 t_7 a_4 W_a^2}{\left(\frac{d_{ipt}}{48}\right)(2)(32.2)\rho_4^2 (d_{ipt})^4} + \frac{2 a_4 W_a^2}{2(32.2)\rho_4^2 (d_{ipt})^4}$$

where

f_1 = friction factor = 0.006

t_7 = total length of the pressure tube outside of the core = 7 ft

a_4 = conversion constant = 0.0104

ρ_4 = density of coolant at the temperature midway between the reactor inlet and outlet temperatures, lb/ft^3

W_a = maximum flow per fuel assembly, lb/hr

8.2.3 Inner Housing Tube and Insulating Liners

For fuel assemblies with an inner housing tube of SAP, the cost expression, IHT, is given by

$$\text{IHT} = \frac{\pi}{4}(d_o^2 - d_i^2)(h_c + 2t_{ar} + t_8) n_f \rho_3 C_{22}$$

where

d_o, d_i = OD and ID of the inner housing tube, in.

h_c = height of the reactor core, in.

t_{ar} = thickness of the axial reflector, in.

t_8 = length of the inner housing tube above and below the reflectors, in.

n_f = number of fuel positions

ρ_s = density of SAP, lb/ft^3 = 0.098

C_{22} = cost of SAP, \$/lb = 8.0

One of the pressure tube options includes the use of an insulating liner inside the pressure tube. This liner can be made from SAP or zirconium. The cost of such a liner, INL, is given by

$$INL = \pi D_l(h_c + 2t_{ar} + t_{ts} + t_{bs} + t_9)n_f t_{lo}\rho C_{23}$$

where

D_l = mean diameter of the liner, in.

t_{ts}, t_{bs} = thickness of the top and bottom shields, in.

t_9 = length beyond the shield of the liner = 24 in.

t_{lo} = thickness of the liner, in.

ρ = density of the liner material

C_{23} = unit cost of the liner material, \$/lb = 8 for SAP; = 50 for zirconium

8.2.4 Plenum Chambers

The inlet and outlet plenum chambers consist of right circular cylinders of carbon steel to which the coolant piping is connected. The cost of the plenum chambers is expressed in terms of the weight of carbon steel, the number of fuel, control, and safety rods and nozzles that are attached to the chambers. The expression for the cost, PLCH, is written so that five terms represent the cost of plates, shells, tubes, nozzles, and constant cost, respectively.

$$PLCH = 2[2(d_c + 24)^2 \frac{\pi}{4} t_{11}\rho_1 C_{24}] + 2[(d_c + 24)\pi t_{12} p_d \frac{(d_c + 24)}{S_d} \rho_1 C_{24}]$$

$$+ 2[(n_f + n_c)C_{25} + n_s C_{26}] + 2N_l C_{27} + 2C_{28}$$

where

$d_c + 24$ = diameter of the plenums, in.

t_{11} = thickness of the top and bottom plates = 1 in.

ρ_1 = density of carbon steel = 0.28 lb/in^3

C_{24} = material and fabrication cost = \$1.5/lb

t_{12} = depth of the plenum chambers = 24 in.

p_d = design pressure of the primary coolant system, psi

n_f, n_c, n_s = number of fuel, control, and safety rod positions

C_{25} = unit cost for the fuel and control cluster tubes, $/assembly

C_{26} = unit cost for the safety rod tubes, $/tube

N_1 = number of primary coolant loops
= 4 (300 and 500 MWe)
= 8 (1000 MWe)

C_{27} = unit cost of the nozzles = $3,500

C_{28} = constant cost = $30,000

The organic inventory in the plenum chambers is given by

$$\text{I-PLCH} = 2\,\frac{\pi}{4}\,(d_c + 24)^2\,\frac{t_{12}\bar{\rho}}{1728}$$

The pressure drop through the plenums is based on a combination of empirical and theoretical considerations and is given by

$$\Delta\text{P-PLCH} = \frac{(1.9 \times 10^{-11})(W_1^2)(n_f + n_c)^{0.5}}{\bar{\rho}^2(l_s - d_{opt} - 0.75)^2} + \frac{(1.6 \times 10^{-10})(W_1^2)}{\bar{\rho}^2}$$

where

P-PLCH = pressure drop through one plenum, ft

W_1 = flow per loop, lb/hour

$\bar{\rho}$ = density of coolant in the plenum chamber, lb/ft^3

l_s = lattice spacing, in.

$d_{opt} + 0.75$ = OD of the fuel tube inside of the plenum, in.

8.2.5 Primary Coolant Piping

The primary coolant piping consists of carbon steel piping, fittings, valves, steam tracing, and thermal insulation. The pressure rating on the valve and flanges is 300 psi and schedule 20 pipe was assumed for the main piping.

The diameter of the piping is optimized within the computer program by computing the annual costs associated with (a) the construction cost of the piping, (b) the organic inventory, and (c) the pressure

drop through the piping. These costs are computed for seven pipe sizes covering a sevenfold range of flow velocities from approximately 45 to 6 feet per second. The optimum pipe size is then chosen to be that which produces the lowest annual cost.

The cost of the piping is given in the table below:

Pipe Size, in.	Capital Cost of Piping, $		
	300 MWe	500 MWe	1000 MWe
16	320,000	350,000	800,000
18	360,000	400,000	900,000
20	410,000	450,000	1,050,000
24	480,000	530,000	1,200,000
30	580,000	640,000	1,450,000
36	710,000	780,000	1,950,000
42	860,000	950,000	2,350,000

The annual costs associated with the organic inventory are given by the following equation:

$$\$/yr = C_o I_p (C_n + Y)$$

where

C_o = cost of organic = 0.17 \$/lb

I_p = inventory of organic in the piping, lb

C_n = fixed charges on nondepreciable investment

Y = fraction of organic lost per year by decomposition

The inventory in the pipes is given in the table below for the three reactor sizes.

Pipe Size, in.	Organic Inventory, lb
16	$1.29\ \alpha\ \rho_4$
18	$1.65\ \alpha\ \rho_4$
20	$2.02\ \alpha\ \rho_4$
24	$2.95\ \alpha\ \rho_4$
30	$4.59\ \alpha\ \rho_4$
36	$6.68\ \alpha\ \rho_4$
42	$9.06\ \alpha\ \rho_4$

where

α = equivalent length of pipe (788, 866, and 1970 ft for the 300-, 500-, and 1000-MWe plants, respectively)

ρ_4 = average organic density in coolant systems, lb/ft^3

The pressure drop, ΔP_f, due to frictional loss in the piping is given by the following empirical expression, which takes into account the effect of the roughness to diameter ratio on the friction factor.

$$\Delta P_f = \frac{2.39\ 10^{-11} L W_1^2}{\rho_4^2 D^{5.1}}$$

where

L = applicable length of the pipe = 208, 230, 310 ft for the 300-, 500-, and 1000-MWe systems

W_1 = flow per pipe, lb/hr

ρ_4 = average organic density, lb/ft^3

D = inside diameter of pipe, ft

Expansion and contraction losses equivalent to 9.5 velocity heads are produced by fittings, valves, entrance, and exit losses to the reactor, superheater, boilers, and economizers. Therefore, the total head loss in pipe and fittings is expressed by the following equation:

$$\Delta P = \frac{2.39\ 10^{-11} L W_1^2}{\rho_4^2 D^{5.1}} + \frac{1.84\ 10^{-8} W_1^2}{\rho^2 D^4}$$

For the optimization of the pipe size, the pumping power, BHP, is expressed by the following equation assuming 85% pump efficiency:

$$BHP = \frac{N_1 W_1 \Delta P}{(550)(3600)(0.85)}$$

where

N = number of loops
= 4 for 300- and 500-MWe plants
= 8 for the 1000-MWe plant

Thus, the annual cost of pumping through the pipes and fittings is equal to $C_b BHP$.

The incremental cost of pumping the organic coolant C_b, is made up of three components: (a) incremental cost of pumps, motors, and backup facilities, (b) cost of plant facilities to produce incremental power, and (c) the fuel cycle cost for the incremental power. The values assumed for each of these three components are \$56/bhp for the pump and \$50/bhp for the motor and backup. The incremental cost of

plant facilities to produce incremental power is \$78/bhp, equivalent to \$100 per electrical kw. At a fuel cycle cost of 1.5 mills/kwh, the fuel cycle component is equivalent to \$8.25/bhp-yr. Thus,

$$C_b = C_d(106 + 78) + 8.25$$

where

C_d = annual charge on depreciable investment

8.2.6 Pumps and Motors

The primary coolant pumps and motors include carbon steel centrifugal pumps, their bases, flywheels, motors, and electrical auxiliaries. An empirical expression for the pump costs was derived from a combination of theory and available price quotations. The cost of the motors is expressed in terms of the cost per hp. The combined cost for the pumps and motors, PCPM, is given by the expression below where the first term applies to the cost of the motors, and the following two terms are associated with the costs of the pump.

$$PCPM = \frac{C_{29} N_l W_l \Delta H_T}{(550)(3600)(0.85)} + C_{so}(P_d)^{0.8}\left(\frac{0.124\ W_l}{\rho_5}\right) + C_{s1}$$

where

C_{29} = cost of the motors, \$/ehp = 35

N_l = number of primary coolant loops (motors)

W_l = coolant flow per loop, lb/hr

ΔH_T = total head loss in the system, ft

C_{so} = unit cost of the pumps, \$13.50

P_d = design pressure of the reactor system, psig

ρ_5 = organic density at the reactor inlet temperature, lb/ft^3

C_{s1} = fixed cost = \$40,000

The organic inventory in the pumps, I-PCPM, was assumed proportional to the pump capacity as given by the following expression:

$$I\text{-}PCPM = N_l(0.124\ W_l)a_5$$

where

a_5 = pump volume per unit pump capacity, $ft^3/gpm = 1.1 \times 10^{-3}$

8.2.7 Steam Generators

The design parameters of the steam generator complex are automatically optimized within the code for each computer run. The details of this optimization are described in Section 11.

Connected to each loop of the reactor system is a superheater, two boilers, and an economizer. The superheater is a horizontal U-tube heat exchanger with organic on the shell side. Carbon steel tubes, 5/8 in. x 16 BWG are used and a coolant design pressure of 300 psig is assumed for the shell design. The boiler units are vertical U-tube heat exchangers with organic coolant in the tubes. Carbon steel tubes, 5/8 in. OD x 14 BWG, are used with steam on the shell side. As in the superheater, the design pressure of the organic is assumed to be 300 psig. The economizer consists of a horizontal U-tube heat exchanger with carbon steel 5/8 in. OD x 16 BWG tubes. The organic coolant with an assumed design pressure of 300 psig is on the shell side of the unit.

An empirical relation has been developed for the unit cost of these heat exchanger units in terms of the total area per shell, the total length of each U-tube, and the steam pressure developed in the boiler. This unit cost, $\$/ft^2$, includes the costs of the tube material, connection of the tubes to the tube sheath, tube sheath materials, tube sheath fabrication, shell fabrication, moisture separation equipment, assembly and handling, and field work. Listed below are the expressions for the unit cost of the superheater, boiler, and economizer, respectively.

$$CSH = 10.4 \frac{0.27\ A_s^{0.5}}{\ell^{1.5}} + \frac{55.8}{\ell} + \frac{0.0283\ p_s^{0.5}\ A_s^{0.5}}{\ell^{1.5}} + \frac{11.2^{0.5}}{A_s^{0.5}} + \beta_1 + \frac{23{,}000}{A_s}$$

$$CB = 11.0 + \frac{0.50\ A_s^{0.5}}{\ell^{1.5}} + \frac{58.2}{\ell} + \frac{0.00061\ p_s\ A_s^{0.5}}{\ell^{1.5}} + \beta_2 + \frac{35{,}000}{A_s} + \frac{0.078\ p_s}{\ell} + 0.0039\ p_s$$

$$CEC = CSH$$

$$\beta_1 = 0.075\ (\ell - 30) \quad \ell > 30$$

$$\beta_2 = 0.10\ (\ell - 30) \quad \ell > 30$$

$$\beta_1 = \beta_2 = 0 \quad \ell \leq 30$$

where

A_s = required heat exchange area, ft^2

ℓ = total length of each U-tube, ft

p_s = steam pressure in the boiler, psig

The above parameters are optimized in the steam generator optimization portion of the program described in Section 11.

8.3 Reactor Tank

The reactor tank consists of a calandria tank in which the pressure tubes are mechanically independent from the moderator tank. For the calandria tank the tube sheaths and shell are made of aluminum, and the cost of the tank was determined from the number of tube connections and the weight of the material in the tube sheaths, shell, and tubes. The cost expression, CAL, is given by

$$\begin{aligned} CAL = {} & [2(d_c + 2t_r)^2 \frac{\pi}{4} (2)(C_{34})] \\ & + [(d_c + 2t_r)\pi(h_c + t_{ar})\rho_e C_{35}] \\ & + [(n_s + n_c)(d_{opt} + 0.75)(h_c + 2t_{ar})\pi t_r \rho_e C_{38}] \\ & + \left\{2(n_f + n_c)[C_{37} + C_{38}(d_{opt} + 0.75)]\right\} \end{aligned}$$

where

d_c = diameter of the core, in.

t_r = radial reflector, in.

h_c = height of the reactor core, in.

t_{ar} = axial reflector thickness, in.

d_{opt} = diameter of the pressure tube, in.

n_f, n_c = number of fuel and control positions

t_{13} = thickness of the calandria tube = 0.050 in.

ρ_e = density of the aluminum = 0.098 lb/in^3

C_{34}, C_{35}, C_{38} = unit costs of the tube sheet, shell, and tubes, \$/lb = 3.50, 3.50, and 2.00

C_{37} = cost per connection, \$/tube = 75

C_{38} = connection cost, \$/in. of diameter = 25

8.4 Moderator and Shield Cooling Systems

The moderator system consists of two loops, each containing a heat exchanger, a storage tank, and the associated pumps and piping. The design of this system for the organic-cooled D_2O reactor is similar to that for the liquid D_2O-cooled reactor as described in DP-707[1].

8.4.1 Moderator Heat Exchanger

The cost of the heat exchanger is given in terms of the required heat transfer area. In the calculation of the required heat transfer area, the D_2O velocity in the tubes is assumed to be 40 ft/sec, the outlet temperature of moderator to be 190°F (87.8°C), and the inlet temperature of the H_2O to be 75°F (24°C). The inlet temperature of the moderator, T_1, is given by

$$T_1 = 2\overline{T} - 190$$

where $\overline{T}$ is the average temperature of the moderators and the outlet temperature of the H_2O cooling water. The outlet temperature of the H_2O cooling water, T_o, is given by

$$T_o = T_1 - 10$$

or 140°F, whichever is smaller.

Also, the over-all heat transfer coefficient, U, was assumed to be 300 Btu/(hr)(ft^2)(°F). The required heat transfer area, A, is then computed from the equation,

$$A = p_m \frac{(3.413)(10^6)}{U\ \theta_m}$$

where

$$\theta_m = \frac{(190 - t_o) - (T_1 - 75)}{\ln \dfrac{(190 - t_o)}{(T_1 - 75)}} = \text{log mean temperature difference in the heat exchanger}$$

p_m = power to the moderator, MW

The cost of the heat exchangers, MDHX, is then given by

$$MDHX = C_{39}A + C_{40}$$

where

C_{39} = unit cost, \$/ft^2 = 15.0

C_{40} = constant cost that is applicable to the entire moderator cooling system, \$50,000

8.4.2 Moderator Piping

The cost of the moderator piping, MDPP, is expressed in terms of the weight of the steel in the piping as follows:

$$MDPP = 2C_{41}\left[0.101\left(\frac{f_m}{2}\right)^{1/2} + 2t_{14}\right]\pi\rho_1 t_{14} L_1$$

where

f_m = moderator flow rate, gpm

L_1 = total length of moderator piping, in. = 1200, 1800, and 2400 for 300-, 500-, and 1000-MWe plants

t_{14} = wall thickness of piping, in. = 0.25

ρ_1 = density of steel, lb/in^3

C_{41} = unit cost, \$/lb = 7.00

The flow rate, f_m, is

$$f_m = \frac{6.27(10^3)}{380 - 2\,\overline{T}}\,p_m$$

8.4.3 Moderator Pumps and Motors

The cost of the moderator pumps, MDPM, is given in terms of the required horsepower for the pumps and motors and the flow rate in the system.

$$MDPM = \frac{C_{42} f_m \Delta P_1 \rho_7}{a_6 a_7} + f_m C_{43} + C_{44}$$

where

C_{42} = unit cost, \$/lb = 15.0

C_{43} = unit cost, \$/gpm = 2.0

C_{44} = constant, \$3150

ρ_7 = density of D_2O, lb/gal

a_8 = pump efficiency = 0.85

a_7 = conversion factor = 33,000

ΔP_1 = pressure drop in the moderator system, ft

The pressure drop is obtained by the following equation:

$$\Delta P_1 = \frac{4a_8 L_2 (1600)}{a_9 \left(\frac{f_m}{2}\right)^{1/2} 64.4} + N_1 \left(\frac{1600}{64.4}\right)$$

where

a_8 = friction factor = 0.003

L_2 = equivalent length of piping in one of the moderator loops, ft = 100

a_9 = conversion factor = 0.101/12

N_1 = number of velocity heads

8.4.4 D_2O Inventory

The D_2O inventory in the moderator cooling system is computed from the volume of the heat exchanger and the piping by assuming a fluid velocity of 40 ft/sec in the piping and a 1/2-inch diameter for the heat exchanger tubes. The expression for the inventory, I-MODS, is then:

$$\text{I-MODS} = \frac{\pi}{4}\left[(0.101)^2 \frac{f_m}{2}\right] L_1 \rho_7' + 18\rho_7' A$$

where

A = heat transfer area, ft^2

ρ_7' = density of D_2O, lb/in^3

L_1 = total length of moderator piping, in. = 1200, 1800, and 2400 for 300-, 500-, and 1000-MWe plants

8.4.5 Storage Tanks

The cost of the moderator storage tanks, MDST, is given in terms of the D_2O inventory in the moderator, I_m, as follows:

$$MDST = C_{45} I_m + C_{46}$$

where

C_{45} = unit cost, \$/lb = 0.114

C_{46} = constant, \$1000

8.4.6 Shield Cooling System

The shield cooling system consists of an H_2O circulating system for removing the heat from the shields. This system consists of a pump, cooler, surge tank, and stainless steel piping. The cost of the shield cooling system, SCS-C, is expressed as a function of the shield heat load plus a constant.

$$SCS\text{-}C = C_{47} Q_{rs}^{0.8} + C_{48}$$

where

Q_{rs} = heat load on the radial, top and bottom shields, Btu/hr

C_{47} = constant = 6.2

C_{48} = constant cost, \$45,000

8.5 Control and Safety Rods

The control rods are clusters of individual rods that are top mounted, mechanically actuated rods, and are positioned on the lattice positions. The system includes clusters of individual rods, control rod drives, thimbles, controls, and cooling facilities. The cost of the various items has been broken down so that the cost of the system is expressed as a function of the number of individual rods and the rod length. The equation for the cost of control rods, CR, is

$$CR = a_{10} n_c [C_{51} + C_{52}/(h_c + 2t_{ar})] + C_{53}$$

where

a_{10} = number of control rods per control position

C_{51} = control rod cost, \$/rod = 11,500

C_{52} = control rod cost, \$/ft = 28

C_{53} = fixed cost = \$50,000

n_c = number of control rod positions

h_c = height of the reactor core, in.

t_{ar} = axial reflector thickness, in.

The safety rods are also top mounted and placed in interstitial lattice positions. They are mechanically driven with gravity fall. The cost, SR, is expressed as a function of the number of rods and the length of the rods as follows:

$$SR = n_s[C_{54} + C_{55}/(h_c + 2t_{ar})] + C_{56}$$

where

SR = cost of the safety rod system, \$

n_s = number of safety rod positions

C_{54} = safety rod cost, \$/rod = 8,500

C_{55} = safety rod cost, \$/ft = 25

C_{56} = fixed cost, \$30,000

8.6 Instrumentation and Monitoring

The coolant monitoring instrumentation consists of the devices for measuring the flow, temperature, and radioactivity in each of the coolant outlet pipes. The cost of such a system is expressed as the cost per fuel position plus a fixed cost.

$$CMI = n_f C_{59} + C_{60}$$

where

n_f = number of fuel positions

C_{59} = unit cost, \$/position = 3,380

C_{60} = fixed cost, \$285,000

The nuclear instrumentation consists of two startup channels, two log n - period channels, three flux level safety channels, and one linear level control channel. Also, an allowance has been made for internal flux and temperature instrumentation. The cost of such a system is estimated at \$100,000.

The instrumentation for the primary cooling system includes pressure and temperature measuring facilities throughout the cooling circuits. Also, a level measurement and control, pressurizer, remote controls for the primary valves and pumps, and a central control room facility are included. The cost of this instrumentation is assumed to be constant and equal to about $600,000. The functional requirements of these instruments are similar to those for the D_2O liquid-cooled system[1] and the costs are assumed to be increased arbitrarily about 50% for the organic because of the necessity for tracing the sensing leads and providing a barrier between the sensing and receiving instruments.

8.7 Reactor Enclosure and Fuel Charging Equipment

The reactor enclosure and support is a concrete "silo" extending above and below the reactor and is similar to the structure described for the liquid-cooled case given in DP-707[1]. The cost of this structure, RE, is expressed in terms of the volume of concrete, the surface area of the forms, and the mass of the reinforcing steel.

$$RE = (d_c + 2t_r + 2t_{rs} + 2t_s)\pi\, t_{16}\left[\frac{t_{15}C_{63}}{(36)^3} + \frac{2(a_{11}C_{64} + C_{65})}{144}\right]$$

where

d_c = diameter of the reactor core, in.

t_r = radial reflector thickness, in.

t_{rs} = thickness of the radial thermal shield, in.

t_s = thickness of the biological shield, in.

t_{15} = average thickness of the concrete, in.

t_{16} = height of enclosure, in.

C_{63} = cost of the concrete, $\$/yd^3$ = 20

a_{11} = amount of reinforcing steel, lb/ft^2 = 4

C_{64} = cost of reinforcing steel, \$/lb = 0.15

C_{65} = cost of the forms, $\$/ft^2$ = 2.25

Thermal insulation is placed on the inner walls of the rooms containing the pigtails and the headers. The cost of this insulation, TI, is expressed in terms of the area of the walls as follows:

$$TI = \frac{\pi}{144} (d_c + 2t_r + 2t_{17})(2t_{18} + d_c + 2t_r + 2t_{17})C_{es}$$

where

t_{17} = room radius minus the reactor radius, in.

t_{18} = room height, ft

C_{es} = installed cost, \$/ft^2 = 3.50

The fuel charging equipment includes the machinery and controls required to transfer fuel and other components into and out of the reactor while it is shut down. It does not include the facilities involved in moving fuel from the reactor building to the storage basin. The cost of such machinery is estimated to be \$1.1, \$1.3, and \$1.6 x 10^6 for 300-, 500-, and 1000-MWe systems.

TABLE 8.1

COEFFICIENTS IN SHIELD EQUATIONS

i / j	0 / 0	1 / 0	2 / 0	0 / 1	1 / 1	2 / 1	0 / 2	1 / 2	2 / 2
a_{ij}	27.0	-6.92	0.240	-0.394	0.0259	-0.00111	0.0483	-0.00294	5.05×10^{-5}
b_{ij}	0.629	-0.0170	1.516×10^{-4}	-5.39×10^{-3}	3.34×10^{-5}	5.29×10^{-7}	1.30×10^{-5}	6.33×10^{-7}	-1.19×10^{-8}
c_{ij}	-132.3	9.004	-0.00705	-0.932	-0.0244	6.13×10^{-4}	7.46×10^{-3}	-1.58×10^{-4}	-3.46×10^{-6}
d_{ij}	45.85	-4.207	0.1989	-2.452	0.1607	-0.00426	0.0343	-0.00269	5.96×10^{-5}
e_{ij}	0.632	-0.0170	1.516×10^{-4}	-5.39×10^{-3}	3.34×10^{-5}	5.29×10^{-7}	1.30×10^{-5}	6.33×10^{-7}	-1.19×10^{-8}

$$t_{rs} = \sum_{i,j} a_{ij} (\ln \phi_1)^i t_r^j$$

$$q_{rs} = C_1 H R_s \phi_1 \sum_{i,j} b_{ij} t_r^i t_{rs}^j$$

$$t_{ts} = t_{bs} = \sum_{i,j} c_{ij} (\ln \phi_2)^i t_{ar}^j \quad \text{- noncalandria}$$

$$t_{ts} = t_{bs} = \sum_{i,j} d_{ij} (\ln \phi_2)^i t_{ar}^j \quad \text{- calandria}$$

$$q_{bs} = C_2 R_c^2 \phi_2 \sum_{i,j} e_{ij} t_{ar}^i t_{bs}^j$$

$$q_{ts} = C_2 R_c^2 \phi_2 \sum_{i,j} e_{ij} t_{ar}^i t_{ts}^j$$

9. Reactor Building Structures and Auxiliary Reactor Systems

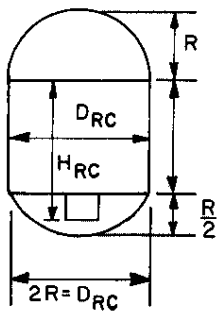
9.1 Containment Structures

The reactor containment building consists of a carbon steel cylinder with a hemispherical dome and hemiellipsoidal bottom, and is designed to completely contain a spill equivalent to the inventory in the reactor and one primary loop together with the secondary H_2O in one steam generator complex. Preliminary plant arrangements showed that a minimum size structure is governed by the space required for equipment, rather than by the pressure buildup requirements. A minimum thickness for the dome of 0.5 inch was established for the building based on structural stability, and similarly, a thickness of 0.625 inch was stipulated for the cylindrical wall section. Numerous examples of hypothetical organic and H_2O releases into the free volume of the reactor building were examined and were found to be consistent with the above criteria for determining the size of the containment building[14,15]. None of the conditions were shown to exceed the maximum allowable pressure for these minimum wall thicknesses.

The building dimensions determined in accordance with the space requirement for equipment were coupled with appropriate unit costs to yield total building costs including the steel vessel, substructure, external treatment, shadow shielding, and all internal structures. The procedures for computing these costs are given in the following paragraphs.

9.1.1 Containment Vessel

The cost of the reactor containment vessel includes the cost of the containment shell including air locks, equipment hatches, and the cost of erection and testing. The height, H_{RC}, and the radius, R_{RC}, for the reactor building are shown schematically in the sketch below. The cost of the containment building, CTV, is given by the following expressions.



$$CTV = (\text{Vessel weight})(C_1') + C_2'$$

$$\text{Vessel weight} = (1.194R_{RC}^2 + 2\pi R_{RC}H_{RC})\rho_1\frac{t_w}{12} + 2\pi R_{RC}^2\rho_1\frac{t_d}{12}$$

$$R_{RC} = \sqrt{2}\left(\frac{D_R}{2} + t_s + L_1 + r_s + 32\right)$$

$$H_{RC} = \left(\frac{R_{RC}}{2} + h_s + 20\right)$$

where

D_R = diameter of reactor and radial reflector, ft

t_s = thickness of the biological shield, ft

L_1 = center distance between the primary pumps and boiler, ft

r_s = radius of the boiler shell, ft

R_{RC} = containment building radius, ft

h_s = over-all height of the boiler, ft

H_{RC} = height of the containment vessel, ft

ρ_1 = density of steel, lb/ft^3

t_w = containment vessel wall thickness = 0.625 in.

t_d = containment vessel dome thickness = 0.5 in.

C_1' = unit cost, \$/lb = 0.40

C_2' = constant cost, \$100,000

9.1.2 Containment Vessel Substructure

The cost of the containment vessel substructure includes the cost of excavation, backfill, and below-grade surface treatment for the containment vessel. The cost, CTVS, is expressed in terms of the volume of the excavation, volume of the concrete fill, and the surface volume of the bottom head.

$$CTVS = C_3'\frac{\pi}{3}\frac{(R_{RC} + 4)^3}{27} + C_4'\frac{\pi}{3}\frac{(R_{RC} + 4)^3}{27} - R_{RC}^3 + C_5'(4.336R_{RC}^2)$$

where

C_3' = cost of excavation = \$20/yd^3

C_4' = cost of fill = \$40/yd^3

C_5' = cost of surface treatment = \$0.2/ft^2

9.1.3 Containment Vessel External Treatment

The cost of the containment vessel external treatment, CTVE, includes the cost of the external insulation and treatment of the containment vessel and is expressed in terms of the surface area of the vessel.

$$CTVE = 2\pi R_{RC} C'_e \left(\frac{R_{RC}}{2} + 4 + H_{RC} \right)$$

where

C'_e = external treatment cost = \$3.0/ft^2

9.1.4 Shadow Shielding

Concrete shadow shielding 2 ft thick along the side walls and 1 ft thick along the top head is provided on the inside surface of the containment vessel above grade. The cost of this shielding, CTSS, is expressed in terms of the volume of the concrete as follows:

$$CTSS = \frac{C'_7}{27} \left[2\pi (R_{RC} - 0.5)^2 (1.0) + 4\pi (H_{RC} - \frac{R_{RC}}{2})(R_{RC} - 1) \right]$$

where

C'_7 = unit cost of concrete, \$/yd^3 = 80

9.1.5 Internal Structures

The internal structures, that is, structures that are inside the containment vessel, consist of four concrete floors and miscellaneous iron and steel structures exclusive of the shadow shields and the reactor biological shield. The cost of these structures, INT, is expressed in terms of the volume of concrete.

$$INT = C'_s V_{ic} + C'_9$$

where

$$V_{ic} = \frac{1}{27} [64(L_1 + r_s + 22)(h_s + 20) + 40(\frac{D_R}{2} + t_s)(h_s + 28)$$
$$+ 2(2R_{RC} - 4 - \frac{D_R}{2} - t_s)$$
$$+ 16(\frac{D_R}{2} + t_s + L_1 + r_s + 22)(L_1 + r_s + 22)]$$

C_s' = cost of concrete, \$/yd^3 = 75

C_e' = constant cost = \$750,000, \$980,000, and \$1,430,000 for the 300-, 500-, and 1000-MWe plants, respectively

where

L_1 = centerline distance between the primary pumps and the boiler, ft

r_s = radius of the boiler shell, ft

R_{RC} = radius of the containment building, ft

h_s = over-all height of the boiler, ft

D_R = diameter of the reactor and reflector, ft

t_s = thickness of the biological shield, ft

9.2 Other Plant Structures

9.2.1 Land and Land Rights

The cost of land and land rights has been based on the AEC standard site criteria and a value of 1,200 acres at \$300/acre has been used to give a total of \$360,000.

9.2.2 Access Roads and Improvements

The costs of permanent access roads, general site improvements, and rail interconnections are assumed to be \$480,000, \$510,000, and \$550,000 for the 300-, 500-, and 1000-MWe plants, respectively.

9.2.3 Fuel Handling Building

The costs of the fuel handling structure and equipment for new and spent fuel that is located external to the reactor containment building are \$1,421,000, \$1,600,000, and \$2,200,000 for the 300-, 500-, and 1000-MWe plants, respectively.

9.2.4 Reactor Building Crane

The cost of the reactor building crane, RBC, is expressed as follows:

$$RBC = C'_{12}\frac{(2R_{RC} - L_2)}{12} + C'_{13}$$

where

C'_{12} = unit cost of the crane, \$/ft of span = 100

C'_{13} = constant cost = \$100,000

L_2 = over-all clearance between the bridge span and the containment vessel, in.

9.2.5 Miscellaneous Structures

The costs of miscellaneous structures, including the gatehouse, warehouse, and oil pumphouse, are assumed to cost \$190,000, \$265,000, and \$470,000 for the 300-, 500-, and 1000-MWe plants, respectively. This cost item has been combined with "miscellaneous systems" described in Section 9.3.

9.3 Coolant System Auxiliaries

9.3.1 Coolant Makeup System

This system includes the equipment for the transfer of coolant from storage to maintain the operating level of the organic in the primary systems. The costs assumed for this system were \$20,000, \$32,000, and \$55,000 for the 300-, 500-, and 1000-MWe reactor plants, respectively.

9.3.2 Coolant Purification System

This system includes the equipment required to remove the high boilers that are formed in the organic coolant during operation. The system consists of a flash distillation column, heaters, condensers, pumps, and storage tanks. All of the new coolant enters the primary system through the purification system. The cost of this system is assumed to be proportional to the capacity of the heaters for the flash distillation column. The flow through the purification system, g, is given by

$$g = 100 \frac{H_B}{H^o} + H_B \text{ , lb/hr} \quad (1)$$

where

H_B = high boiler formation rate, lb/hr

H^o = equilibrium high boiler concentration, %

The capacity of the heater for the column, p_h, is given by

$$p_h = \frac{gC_p\Delta T_p}{3413} \text{ , kw} \quad (2)$$

where

C_p = specific heat of the organic, Btu/(lb)(^oF)

ΔT_p = temperature rise across the heater, ^oF

The cost of the system, CPS, is given by

$$CPS = C'_{14}p_h + C'_{15} \quad (3)$$

where

C'_{14} = unit cost for the column heater = \$25/kw

C'_{15} = constant cost = \$17,300, \$23,000, and \$36,000 for the 300-, 500-, and 1000-MWe plants, respectively

9.3.3 Coolant Storage Tanks, Vents, and Drains

The system includes the tanks and piping for storage of the primary coolant when drained from the system. The cost of this system, CST, is given by

$$CST = C'_{16}I_p + C'_{17} \quad (4)$$

where

I_p = coolant inventory in the primary system, gal

C'_{16} = unit cost = \$0.5/gal

C'_{17} = constant cost = \$65,000, \$88,000, and \$135,000 for the 300-, 500-, and 1000-MWe plants, respectively

9.3.4 Coolant Particulate Removal System

Included in this item is a system of precoat filters and the auxiliaries that are required to remove the corrosion and erosion products from the primary coolant. The cost of the system is assumed to be directly proportional to the total area of the precoat filters. The filtration system is designed to maintain a design quality of about 1 part per million solid impurities in the coolant.

The flow rate through the filtration system, g_f, is given by

$$g_f = \frac{100 R_f A_s}{7.3E \times 10^{-6}} \text{ , gpm} \qquad (5)$$

where

R_f = corrosion rate of the steam generators heat exchange surface in contact with the organic coolant = $0.05 \text{ mg/cm}^2\text{/mo} = 2.38 \times 10^{-9} \text{ lb/(min)(ft}^2\text{)}$

A_s = steam generator heat exchange surface area, ft^2

E = removal efficiency for the filtration system = 75%

The system consists of two filters operating at 1/2 capacity with a nominal capacity of 2 gpm/ft^2. Thus the required filter area is given by

$$A_T = \frac{1}{2} g_f = \frac{1}{2}\left(\frac{100 \times 2.38 \times 10^{-9}}{7.3 \times 75 \times 10^{-6}}\right) A_S = 2.2 \times 10^{-4} A_S \qquad (6)$$

The cost of the system, CPRS, is given by

$$CPRS = C'_{1a} A_T + C'_{1g} \qquad (7)$$

where

C'_{1a} = unit cost of the filters = $\$150/\text{ft}^2$

C'_{1g} = constant cost = \$36,000, \$48,000, and \$75,000 for the 300-, 500-, and 1000-MWe reactor plants, respectively

9.3.5 Steam Tracing System

This system consists of 1/2- and 3/8-inch carbon steel steam tracing lines and maintains all the organic systems except the primary loop at a minimum of 375°F. The system uses 300 psig saturated steam. The cost of this system is assumed to equal \$50,000, \$72,000, and \$110,000 for the 300-, 500-, and 1000-MWe plants, respectively.

9.4 Off-Gas and Waste Disposal Systems

9.4.1 D_2O Distillation System

The cost of this system includes the cost of the distillation equipment and structures and is assumed to be \$150,000 for a single unit for the 300- and 500-MWe plants and \$310,000 for two such units that would be required for the 1000-MWe plant.

9.4.2 Waste Disposal for Aqueous Systems

This item includes the aqueous waste disposal system, its equipment and structures, and is assumed to be a constant cost equal to \$400,000, \$500,000, and \$800,000 for the 300-, 500-, and 1000-MWe plants.

9.4.3 Waste Disposal for Organic Systems

This system consists of transfer pumps, decay storage tanks, a waste-fired boiler, and flue gas filtering apparatus to dispose of the high boiler organic wastes that are extracted from the coolant in the coolant purification system. The high boilers are discharged to storage tanks for a 6-day holdup after being removed from the coolant. Following this, the product is then burned in a fire-tube boiler which generates 300 psig steam to supply the steam tracing system. An auxiliary oil supply is used to fire the waste-fired boiler when the supply of organic high boilers is insufficient to produce sufficient steam as demanded by the tracing system.

The cost of this system is determined by the high boiler formation rate which equals the coolant makeup rate. The cost of the system is expressed as a function of the volume of the holdup tanks and a constant cost. The volume of the holdup tanks is

$$V_t = \frac{24 t_d H_b}{7.5}$$

so that the cost expression for the waste disposal system is given by

$$OWDS = V_t C'_{23} + C'_{24}$$

where

t_d = decay time for the high boilers = 6 days

H_b = high boiler formation rate, lb/hr

C'_{23} = unit cost of the decay tanks = \$1/gal

C'_{24} = constant cost = \$35,000, \$47,000, and \$72,000 for the 300-, 500-, and 1000-MWe plants, respectively

9.4.4 Waste Gas Handling System

This system is required to process the waste gases that are formed as a result of pyrolytic and radiolytic decomposition of the organic. Also, this system will handle any fission product gases that are released in the event of a fuel element failure. The system consists of steam jet ejectors, charcoal adsorbers, waste gas decay tanks, and the necessary piping and instrumentation. The cost of the system is a function of the size of the adsorber vessels and the volume of charcoal adsorbent that is required. The waste gas decay tank consists of two banks of 11 tanks, each 17 ft long with a wall thickness of 1 inch, and with the tank diameter designed to provide the required system capacity. The volume of the decay tanks was based on 7.1 ft^3/SCFH of hydrogen gas evolved. Thus, the diameter and the weight of the decay tanks are given by the following

$$d = 1.87\sqrt{F}$$

$$WDT = 3700\sqrt{F}$$

and the cost of the waste gas handling system, WGH, is given by

$$WGH = C'_{25}(3700\sqrt{F}) + C'_{26}(7.1F) + C'_{27}$$

where

WDT = weight of the decay tanks, lb

F = gas flow rate, SCFH (hydrogen)

d = adsorber vessel, diameter, in.

C'_{25} = unit cost of the adsorber vessels = \$0.60/lb

C'_{26} = unit cost of the charcoal adsorbent = \$20/ft^3

C'_{27} = constant cost = \$38,000, \$50,000, and \$76,000 for the 300-, 500-, and 1000-MWe reactor plants, respectively

9.4.5 Off-Gas System for the Moderator

This includes the system for venting radiolytic gases that are vented from the moderator systems. The cost of this system is assumed to be constant equal to $182,000, $270,000, and $500,000 for the 300-, 500-, and 1000-MWe reactor plants.

A helium blanket is maintained over the D_2O moderator in the calandria. This blanket serves to collect the dissociated D_2O and other gases which are evolved. The gas mixture is circulated through a catalytic recombiner which is followed by condensation and drying apparatus to recover the D_2O vapor. The noncondensable gases are vented to the waste disposal system.

The estimated cost of this system is $182,000, $270,000, and $500,000 for the 300-, 500-, and 1000-MWe plants, respectively.

9.4.6 Organic Degasification and Pressurizing System

A common system was provided to maintain the operating pressure of the primary loop and to degasify the coolant. Two full-capacity circulating pumps furnish continuous circulation of organic through the system and also serve to maintain reactor coolant pressure.

The primary coolant flows from the reactor to a combination degasifier and surge tank, where the H_2O and noncondensable vapors are removed. This tank has a surge volume equivalent to the volume change that results from a temperature change equal to the difference between the reactor inlet and outlet temperature. The pressurizing pumps are connected to the bottom of the degasifier surge tank and have a capability for compensating for this volume change in a period of two minutes. Larger volume changes in the organic coolant associated with startup, etc., would be accommodated by a separate surge tank.

The cost of this system is determined by the primary coolant system inventory, the coolant temperature difference across the reactor, and the primary system operating pressure. The system cost includes the cost of the tank, the two circulating pumps and motors, and the pipe. The tank weight, TW, is

$$TW = \left[\frac{\pi dht}{12} + \frac{2\pi d^2 t}{(4)(12)}\right]\rho_1$$

where

d = degasifier tank diameter, ft

h = degasifier tank height, ft

ρ_1 = density of steel, lb/ft^3 = 500

t = degasifier tank wall thickness, inches = 1.0

The diameter of the tank is obtained from the surge volume requirement and is given by the expression below, assuming an overall height of 17 ft and a height of 7 ft for the surge volume at the lower coolant temperature

$$d^2 = (2I_c\gamma\Delta T_r)/(5\pi\rho_c)$$

where

I_c = primary coolant system inventory, lb

γ = volume expansion coefficient for organic, $ft^3/^oC$

ΔT_r = reactor coolant outlet temperature minus the inlet temperature, ^oC

ρ_c = density of the organic coolant, lb/ft^3

The cost of the pressurizer pump depends upon the flow rate, which is determined from the makeup rate requirement. Thus,

$$f_1 = \frac{7.48V_s}{2}$$

where

f_1 = pressurizer pump flow rate, gpm

V_s = surge volume in the surge tank and equals $\frac{I_c\gamma\Delta T_r}{\rho_c}$, ft^3

The required brake horsepower for the pumps is

$$BHP = \frac{(f_1)(\Delta P_p)(144)(\rho_c)}{(0.8)(33{,}000 \times 7.48)}$$

where

ΔP_p = primary system operating pressure, psia

The unit costs of the pumps and motors are $2.0/gpm plus $1500 for each pump and $2200/bhp plus $100 for each motor. Thus, the cost expression is

$$DEGAS = C'_{28} TW + 2(1600 + 2.0f_1 + 22BHP) + C'_{29}$$

where

C'_{28} = unit cost of the degasifier tank = $0.4/lb

C'_{29} = cost of the piping, control, and instrumentation = $66,000, $89,000, and $137,000 for the 300-, 500-, and 1000-MWe plants, respectively

10. Operating and Maintenance Costs

The cost of operating and maintaining the plant has been included in accordance with the AEC Cost Evaluation Handbook[12]. The operating and maintenance costs for the reactor plant include the operating payroll, maintenance, labor and material, supplies, nuclear insurance, D_2O losses, and organic makeup. The table below lists the annual costs for the operating payroll, maintenance, labor and materials, and supplies for the 300-, 500-, and 1000-MWe plants, respectively.

Item	300 MWe	500 MWe	1000 MWe
Operating payroll	$ 715,000	$ 800,000	$ 950,000
Maintenance, labor, and material	510,000	650,000	900,000
Supplies	175,000	200,000	280,000
Subtotal	1,400,000	1,650,000	2,130,000

The costs of nuclear insurance, D_2O losses, and organic makeup are given by

$$NI = 260{,}000 + 30\ Q_R$$

$$DL = a_1\ C_1''\ I_M$$

$$OMP = 8760\ C_2''\ l_f\ H_B$$

where

NI = nuclear insurance, $/yr

DL = D_2O losses, $/yr

OMP = organic makeup, $/yr

Q_R = reactor thermal power, MW

I_M = D_2O inventory, lb

a_1 = D_2O loss rate = 0.005 fraction/year

C_1'' = cost of D_2O = $20/lb

H_B = organic coolant makeup rate, lb/hr

l_f = load factor

C_2'' = cost of organic = $0.17/lb

10.1 Organic Makeup

The degradation of organic coolant results from pyrolytic and radiolytic decomposition, and the resultant high boilers which are formed are then removed by the coolant purification system. The degradation rate is computed from empirical relations that have been developed in connection with organic studies at other sites.

The expression used for the pyrolytic decomposition rate[16] is

$$Y = 87.6\ l_f\ e^{(0.25T - 84.4)}$$

where

Y = fraction of organic lost/year by pyrolytic decomposition

T = average temperature of the coolant in the reactor system, $^{\circ}R$

l_f = load factor

The expression used for the radiolytic decomposition rate[17] is

$$HB_R = c_1 P_{CL}(G_n E_n + G_\gamma E_\gamma), \quad lb/hr$$

where

P_{CL} = total reactor power, MW

G_n = number of molecules of organic destroyed per 100 ev neutron energy absorbed = 0.3

G_γ = number of molecules of organic coolant destroyed per 100 ev gamma energy absorbed = 0.09

E_n = energy deposited in the coolant by neutrons, MW/MW

E_γ = energy deposited in the coolant by gammas, MW/MW

c_1 = conversion factor = 1.89×10^2

The energy deposited in the coolant is

$$E_n = 2.12 \times 10^{-5}\ A_c \bar{\rho} \qquad MW/MW$$

$$E_\rho = 1.27 \times 10^{-5}\ A_c \bar{\rho} \qquad MW/MW$$

where

A_c = area of organic in the fuel assembly, in^2

$\bar{\rho}$ = average density of organic in the reactor, lb/ft^2

11. Steam Generator Optimization

11.1 Method of Optimization

In the optimization of the turbine plant described in Section 12, the throttle pressure, P_t, the throttle temperature, T_t, and the temperature of the final feedwater returning from the turbine plant, T_f, are varied in order to minimize the over-all cost of the plant. For each set of P_t, T_t, and T_f, it is necessary to determine an optimum steam generator design. The steam generator optimization program consists of four blocks, one each for the design of the (a) steam transfer pipe, (b) superheater, (c) boiler, and (d) economizer sections of the steam generator unit. A schematic of the subroutine flow chart is shown in Figure 11.1.[18]

The temperature and pressure profiles in the steam generator are shown in Figure 11.2.[18] As previously noted, the values of the feedwater temperature, T_f, throttle temperature, T_t, and the throttle pressure, T_p, which are used as input in this routine are obtained from the turbine plant optimization.

In the steam generator subroutines the properties of the various fluids, superheated steam, organic, liquid H_2O, and saturated steam, are required frequently during the calculations. The following properties are required in the calculations, and side studies were made in order to reduce these functions to table look-ups or curves that could be fitted with polynomials.

Superheated Steam	
Specific volume	$v\ (t,p)$
Viscosity	$\mu\ (t,p)$
Temperature	$t\ (t,H)$
Steam property	$\phi\ (t,p) = \frac{k^{0.2} c^{0.33}}{\mu^{0.47}}$
Enthalpy	$H\ (t,p)$
Organic	
Density	$\rho\ (t)$
Viscosity	$\mu\ (t)$
Property function	$\phi\ (t)$
Property	$\lambda\ (N_{re}) = N_{st}\ N_{pr}^{2/3}$

where N_{re}, N_{st}, and N_{pr} are the Reynolds, Strouhal, and Prandtl numbers.

Liquid H_2O

Water property function	ϕ (t)
Heat capacity	c (t)
Viscosity	μ (t)
Density	ρ (t)

Saturated Steam

Temperature	t (p)
Pressure	p (t)
Enthalpy	H (t)
Enthalpy of vaporization	H_{fg} (t)

where t, p, and H are the temperature, pressure, and enthalpy of the fluids.

11.2 Steam Generator Subroutines

11.2.1 Input

The input to the steam generator subroutine comes from the preceding parts of the code and from the turbine optimization routine.

P_t = steam pressure at the turbine throttle, psia

T_t = temperature of the steam at the turbine throttle, ^oC

T_f = temperature of the water returning from the final feedwater heater, ^oC

T_o = outlet temperature of the organic leaving the reactor, ^oC

T_i = inlet temperature of the organic into the reactor, ^oC

M = total power transferred in the steam generators, MW

N_p = number of primary coolant loops in the reactor complex

11.2.2 Steam Pipe

The steam pipe leading from the steam generator units to the turbine consists of individual leads from the superheaters to a header. A single pipe then leads from headers on either side of the reactor to the turbine plant; the piping then divides into two legs leading into the turbine units.

The equations for the effective length of the three steam pipe leads are:

$$L_p = 17 + 188\ d_2$$

$$= 129 + 106\ d_o$$

$$= 92 + 50\ d_1$$

where

D_p = effective diameter of the single main stream line, ft

$d_2 = D_p/2$

$d_o = D_p$

$d_1 = D_p/\sqrt{2}$

A simplified flow diagram of the steam pipe subroutine is shown in Figure 11.3. The pressure drop is given by

$$\Delta P_{sp} = \alpha(P_B - P_t)$$

where

P_B = boiler pressure, psia

Side studies have shown that α is fairly constant over the range of coolant temperatures of interest and is equal to approximately 0.4.

An initial value for the mass flow rate of G_t is chosen, and an initial value of the diameter of the steam pipes is then given by

$$D_p = \sqrt{\frac{4W}{G_t}}$$

where W is the total flow of steam from the steam generator and is computed from the total heat transferred in the steam generator and the initial and final enthalpies of the secondary fluid. The values of G_t and thus D_p are systematically adjusted to satisfy the pressure drop equation

$$\Delta P_{pipe} = \frac{G_t^2}{144\ g}\ \Delta v + \frac{2 v_{av}}{D_p}\ f_p L_p$$

where

Δv = change in specific volume over the length of the steam pipe

v_{av} = average specific volume for the steam

and the product $f_p L_p$ for the system of pipes leading from the superheater to the turbine plant is given by the following expression in which the friction factor is taken to be 0.00235 plus the quantity 0.0009 divided by the diameter of the pipe lead.

$$f_p L_p = (0.00235 + \frac{0.0009}{D_p})(129 + 106\ D_p)$$

$$+ (0.00235 + \frac{0.0009}{D_p/2})(17 + 92\ D_p)2$$

$$+ (0.00235 + \frac{0.0009}{D_p/\sqrt{2}})(92 + 34.7\ D_p)\sqrt{2}$$

The annual cost for the steam pipe I_{sp} is given by the following expression

$$I_{sp} = a_2 (c_1 D_p t_w + c_2)$$

where

a_2 = annual charges on capital investment

t_w = pipe wall thickness, inches

For steam temperatures less than 775°F, the pipe material is assumed to be A106 Grade B and c_1 = 5,200 and c_2 = \$10,000. For temperatures greater than 775°F, the pipe material is assumed to be A335, P-11 and c_1 = 5,700 and c_2 = \$80,000.

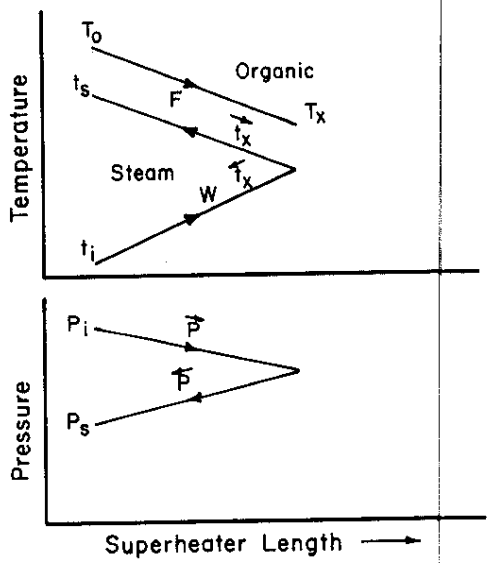
11.2.3 Superheater

The superheater unit is a horizontal U-tube design with the organic on the shell side. The temperature and pressure profiles are illustrated in the following sketch.

The lattice dimensions and characteristics of the superheater are:

Tube ID, D_1 = 0.0413 ft
Tube OD, D_2 = 0.0521 ft
Web, D_c = 0.0281 ft

The tube wall resistance for heat transfer, $1/h_w$, is 0.000231. The fouling resistance for the inside and outside of the tubes, $1/h_{fi} + 1/h_{fo}$ = 0.0010 + 0.0003.



A simplified flow diagram for the subroutine is given in Figure 11.4 which is a continuation of the steam pipe program given in the preceding section. An initial value for the number of tubes, n_{sh}, is chosen, and then the heat transfer, the temperatures, and pressures are computed over a short length along the superheater shell, ΔL. The quantities Δ_p and Δ_t are computed at the end of each interval ΔL.

$$\Delta_p = \overrightarrow{P}_x - \overleftarrow{P}_x$$

$$\Delta_t = \overrightarrow{t}_x - \overleftarrow{t}_x$$

These values must become zero simultaneously after a sufficient number of ΔL intervals. This simultaneous conversion is achieved by appropriate choice of the number of tubes, n_{sh}. The temperature of the steam along the length of the tubes, t_x, is obtained from the steam tables as a function of the pressure and the enthalpy where the pressure and the enthalpy at the end of the intervals are computed from the following set of equations:

$$\Delta\overrightarrow{q} = \frac{\overrightarrow{U}(T - \overrightarrow{t})(\pi D_2 n_{sh} N_p)\Delta L}{W}$$

$$\Delta\overleftarrow{q} = \frac{\overleftarrow{U}(T - \overleftarrow{t})(\pi D_2 n_{sh} N_p)\Delta L}{W}$$

where

U = the over-all heat transfer coefficient and is computed from the film temperatures

T = organic temperature

N_p = number of primary coolant loops in the reactor complex

The change in enthalpy for the integral ΔL is given by

$$\Delta\vec{H} = \Delta\vec{q} - \frac{G_i^2 \vec{v}_{av} \Delta v}{Jg}$$

$$\Delta\overleftarrow{H} = \Delta\overleftarrow{q} - \frac{G_i^2 \overleftarrow{v}_{av} \Delta v}{Jg}$$

where

$v_{av}, \Delta v$ = average and change in specific steam volume along the interval ΔL

G_i = mass velocity of steam in the tubes of the superheater

Δq = incremental heat transfer per lb of steam flowing

J = 1400 ft-lb/pcu

The enthalpy at the end of the interval, H_x, then equals

$$\vec{H}_x = \vec{H} + \Delta\vec{H}$$

$$\overleftarrow{H}_x = \overleftarrow{H} + \Delta\overleftarrow{H}$$

and the steam temperature at the end of the interval is

$$\vec{t}_x = f\,(\vec{P}_x, \vec{H}_x)$$

$$\overleftarrow{t}_x = f\,(\overleftarrow{P}_x, \overleftarrow{H}_x)$$

The values of P_x for these expressions are obtained from the following equations:

$$\Delta\vec{P} = \frac{G_i^2}{144\ g}\left(\frac{2\vec{f}(\Delta L)\vec{v}_{av}}{D_1} + \Delta\vec{v}\right)$$

$$\Delta\overleftarrow{P} = \frac{G_i^2}{144\ g}\left(\frac{2\overleftarrow{f}(\Delta L)\overleftarrow{v}_{av}}{D_1} + \Delta\overleftarrow{v}\right)$$

where the friction factor,

$$\overleftrightarrow{f} = (0.046)/(\overleftrightarrow{N}_{Re})^{0.2}$$

where N_{Re} = the Reynolds number for the steam flowing inside the tube

The number of tubes, n_{sh}, is then varied in order to meet the criteria that Δ_p and Δ_t are simultaneously equal to zero. The design description of the superheater is then edited. This includes calculations of the pressure drop, the organic inventory, the heat exchange area, the tube and shell length, the pumping power, and the annual cost.

The annual cost, I_{sh}, is computed from the following expression:

$$I_{sh} = C_{sh}A_{sh} + C_oB_{sh}$$

where

C_{sh} = annual cost of the superheater surface area, \$/yr/ft^2

A_{sh} = required heat exchange area in the superheater, ft^2

C_o = cost of pumping the organic through the superheater, \$/bhp/yr

B_{sh} = brake horsepower or the shell side of the superheater, bhp

The annual cost of the superheater surface area, C_{sh} includes (1) fixed charges on equipment, (2) fixed charges on the coolant inventory (nondepreciable), (3) annual loss of coolant by pyrolytic decomposition, and (4) the fixed charges on incremental containment costs.

$$C_{sh} = a_2(CSH + 6.0) + \alpha_1 c_o(a_3 + Y_{cool})$$

where

CSH = cost of the heat exchange area, \$/ft, as computed from the equation in Section 8.2.7

6.0 = an estimate of the incremental containment costs

α_1 = organic inventory in the superheater, lb/ft^2 of heat transfer area = 1.2

c_o = cost of organic = \$0.17/lb

a_3 = charge rate on nondepreciable investment

a_2 = charge rate on depreciable investment

Y_{cool} = fraction of coolant lost per year by pyrolytic decomposition

The cost of pumping organic coolant C_o includes (1) incremental cost of pumps, motors, and backup equipment, (2) the cost of plant facilities to produce incremental power, and (3) the fuel cycle cost for the incremental power. Values that were assumed for each of these three components are:

(1) Pump cost = \$56/bhp; motors and backup = \$50/bhp

(2) Incremental power cost of \$100/kw = 78.2 bhp

(3) Fuel cost of 1.5 mills/kwh = \$8.25/bhp/yr

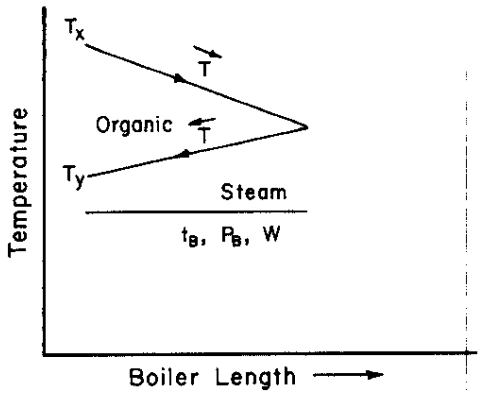
Therefore, $C_o = 184.2a_2 + \$8.25/bhp/yr$.

11.2.4 Boiler

The boiler units are vertical U-tube heat exchangers with carbon steel tubes and shells. The organic coolant passes through the tubes and the steam is produced on the shell side. The lattice dimensions for the boiler are:

Tube ID	$D_1 = 0.0383$ ft
Tube OD	$D_2 = 0.0521$ ft
Web	$D_c = 0.0208$ ft

The tube wall resistance to heat transfer, $1/h_w$, is 0.000308. The fouling resistance for the internal and external surfaces are equal to 0.0010 and 0.0003, as in the superheater. The temperature profile along the length of the boiler is shown in the sketch below.



A simplified schematic for the boiler subroutine is shown in Figure 11.5. In a manner analogous to the superheater routine, an initial value of the number of tubes n_B is chosen and the temperature change of the organic along the length of the tubes is computed over small intervals ΔL. The values of $\vec{T}$ and $\overleftarrow{T}$ are computed after each interval until the difference is zero. Then the annual cost associated with the boiler is computed and the value of n_B is then systematically varied to minimize the annual cost of the boiler.

The change in the organic temperature ΔT along the interval, ΔL, is computed from the following expression:

$$\Delta\vec{T} = \frac{\vec{U}(\vec{T} - t_b)(D_2 n_B 2N_p)\Delta L}{\vec{F}c}$$

$$\Delta\overleftarrow{T} = \frac{\overleftarrow{U}(\overleftarrow{T} - t_b)(D_2 n_B 2N_p)\Delta L}{\overleftarrow{F}c}$$

where

U = over-all heat transfer coefficient and is computed from the film temperatures at each interval

n_B = number of heat exchanger tubes in the boiler unit

N_p = number of primary coolant loops in the reactor complex

F = total flow of organic coolant, lb/hr

c = specific heat of the organic coolant in the interval ΔL, Btu/(lb)(^oF)

The organic temperature at the end of the interval is then

$$\vec{T}_y = \vec{T} - \Delta\vec{T} = T_y - \sum_i(\Delta\vec{T})$$

$$\overleftarrow{T}_y = \overleftarrow{T} - \Delta\overleftarrow{T} = T_y + \sum_i(\Delta\overleftarrow{T})$$

$$\vec{T}_y - \overleftarrow{T}_y = \Delta$$

The calculation proceeds to the next interval of shell length, ΔL, until the difference, Δ, becomes zero.

The annual cost for the boiler as given by

$$I_B = C_B A_B + C_o B_B$$

where

C_B = annual cost of the boiler heat transfer area, \$/ft^2/yr

A_B = required heat transfer area for the boiler, ft^2

C_o = annual cost of pumping the organic through the boiler and is the same as the value of C_o in the superheater subroutine, \$/bhp/yr

B_B = required brake horsepower for pumping the organic, bhp

The annual cost of steam generator surface area, C_B, includes (a) fixed charges on equipment, (b) fixed charges on coolant inventory, (c) annual loss of coolant by pyrolytic decomposition, and (d) fixed charges on incremental containment costs. The expression for C_B is

$$C_B = a_2(CB + 2.7) + 0.54c_o(a_3 + Y_{cool})$$

where the organic inventory is assumed to equal 0.54 lb/ft^2 of heat transfer area, and CB is the cost of heat transfer area in the boiler and is given by the equation in Section 8.2.7.

The incremental containment costs are estimated to be \$2.7/ft^2; a_2 and a_3 are the annual charge rates on depreciable and nondepreciable capital; c_o is the cost of the organic, \$/lb; and Y_{cool} is the fraction of coolant lost per year by pyrolytic decomposition.

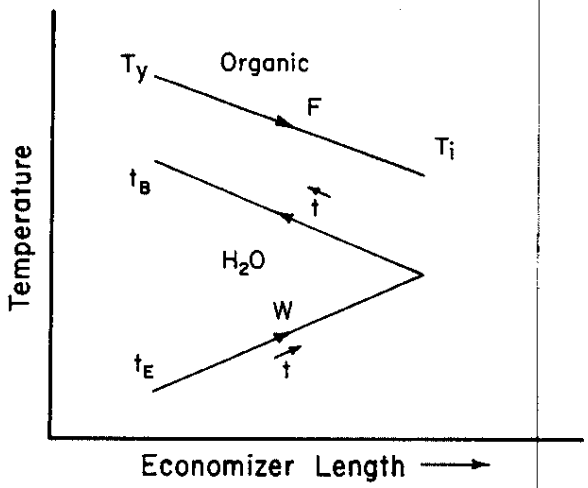
Within the subroutine the value of n_B, the number of tubes, is varied until the annual charge, I_B, reaches a minimum.

11.2.5 Economizer

The economizer is a carbon steel U-tube heat exchanger with the organic coolant on the shell side. The lattice dimensions for the economizer are:

Tube ID	D_1 = 0.0413 ft
Tube OD	D_2 = 0.0521 ft
Web	D_c = 0.0208 ft

The tube wall resistance to heat transfer, $1/h_w$, is 0.000231. The fouling resistances for the internal and external surfaces are assumed to be equal to 0.0010 and 0.0010, respectively. The temperature profile along the length of the economizer is illustrated in the following sketch.



A simplified schematic for the economizer subroutine is shown in Figure 11.6. The method of calculation is analogous to the boiler subroutine in that the number of heat exchanger tubes are varied to minimize the annual cost associated with the economizer unit. An initial value for the number of tubes, n_e, is chosen and then the liquid H_2O temperatures are calculated at the end of intervals, ΔL, along the shell length. The liquid H_2O temperature, t_z, is computed from the following equations:

$$\vec{t}_z = \vec{t} + \frac{\vec{U}(T - \vec{t})(\pi D_2 n_e N_p)\Delta L}{\vec{W}\vec{c}}$$

$$\overleftarrow{t}_z = \overleftarrow{t} - \frac{\overleftarrow{U}(T - \overleftarrow{t})(\pi D_2 n_e N_p)\Delta L}{\overleftarrow{W}\overleftarrow{c}}$$

$$\Delta = \overleftarrow{t}_z - \vec{t}_z$$

where

U = over-all heat transfer coefficient evaluated in the interval ΔL (The values of the film temperature are iterated on to be consistent with the computed value of U.)

N_p = number of primary coolant loops in the reactor

W = mass flow rate of H_2O through the economizer

c = heat capacity of the liquid H_2O at the start of the interval, ΔL

The difference between $\vec{t}_z$ and $\overleftarrow{t}_z$ are computed after each interval and the calculation is continued for successive intervals, ΔL, until this difference, Δ, reaches zero.

The annual cost of the economizer, I_e, is then computed and the number of tubes, n_e, is systematically varied to minimize the annual cost.

$$I_e = C_e A_e + C_w B_w + C_o B_o$$

where

C_e = annual cost of the economizer heat transfer area, \$/ft^2/yr

A_e = required heat transfer area for the economizer, ft^2

C_w = annual cost of pumping the liquid water through the economizer, \$/bhp/yr

B_w = required brake horsepower for pumping the water

C_o = annual cost of pumping the organic through the boiler and is the same as the value of C_o in the superheater and boiler subroutines

B_o = required brake horsepower for pumping the organic

The annual cost of economizer surface area, C_e, includes (a) fixed charges on equipment, (b) fixed charges on coolant inventory, (c) annual loss of coolant by pyrolytic decomposition, and (d) fixed charges on incremental containment costs. The expression for C_e is given below and is identical to the expression for the analogous cost in the superheater subroutine

$$C_e = a_2(CEC + 6.0) + 1.2a_1(a_s + Y_{cool})$$

where CEC is the cost of heat transfer area in the economizer and is given by the equation in Section 8.2.7.

11.2.6 Optimization of Boiler Pressure

A schematic flow diagram of the steps involved in the optimization of the over-all steam generator complex is shown in Figure 11.7. The total annual cost, I_{sg}, is computed from the annual costs of the steam pipe, superheater, boiler, and economizer sections.

$$I_{sg} = I_{sp} + I_{sh} + I_B + I_e$$

Then the boiler pressure, P_B, is systematically changed until the value I_{sg} reaches a minimum. At this point the program returns to the turbine optimization for the next choice of throttle conditions, P_t and T_t.

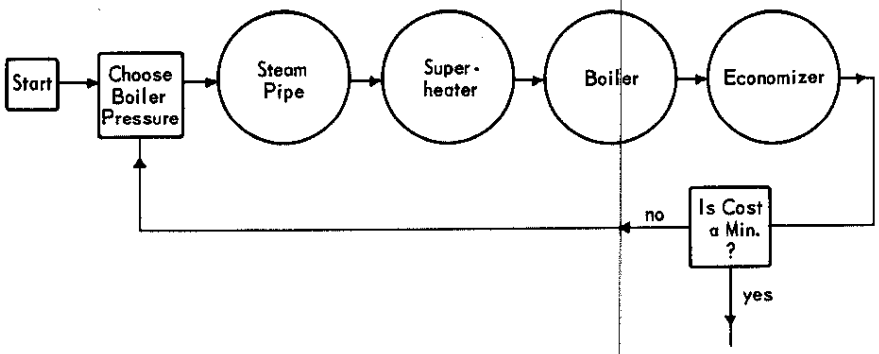


FIG. 11.1 FLOW DIAGRAM OF STEAM GENERATOR SUBROUTINE FOR ORGANIC-COOLED REACTOR DESIGN

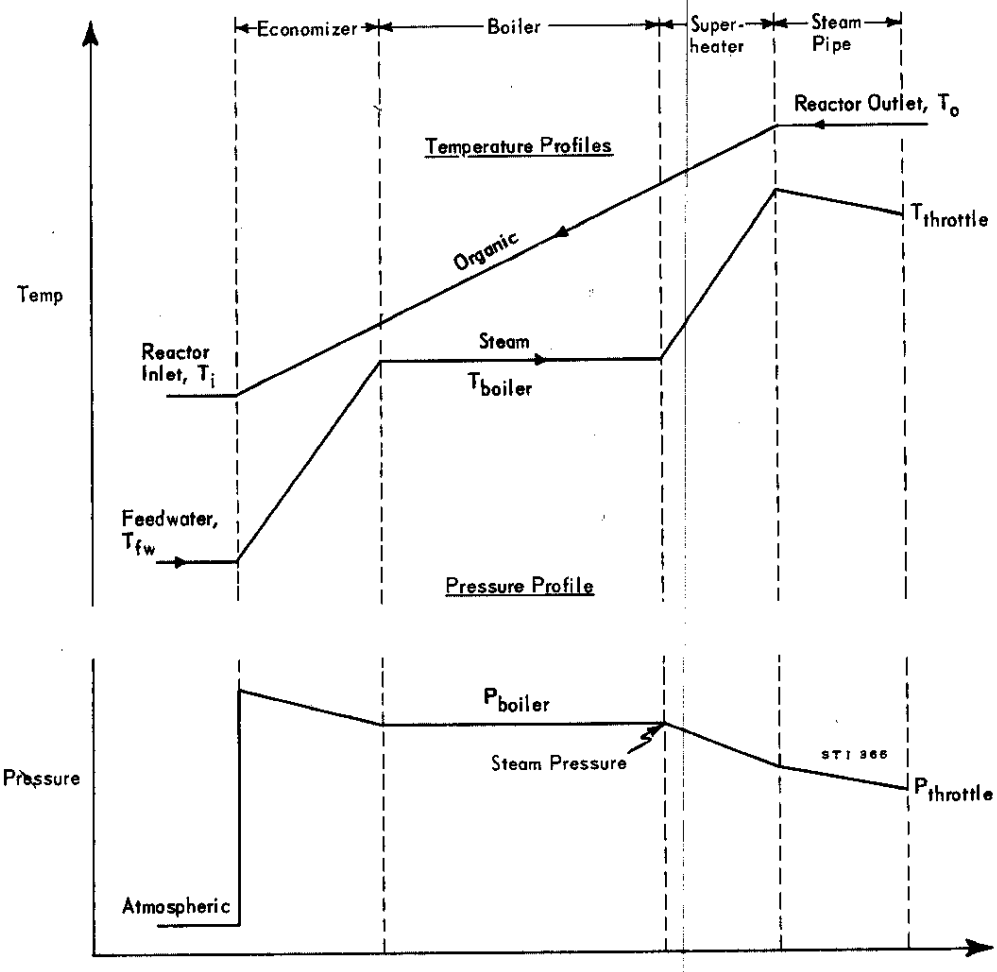


FIG. 11.2 TEMPERATURE AND PRESSURE PROFILES IN STEAM GENERATORS FOR ORGANIC-COOLED D_2O-MODERATED POWER REACTORS

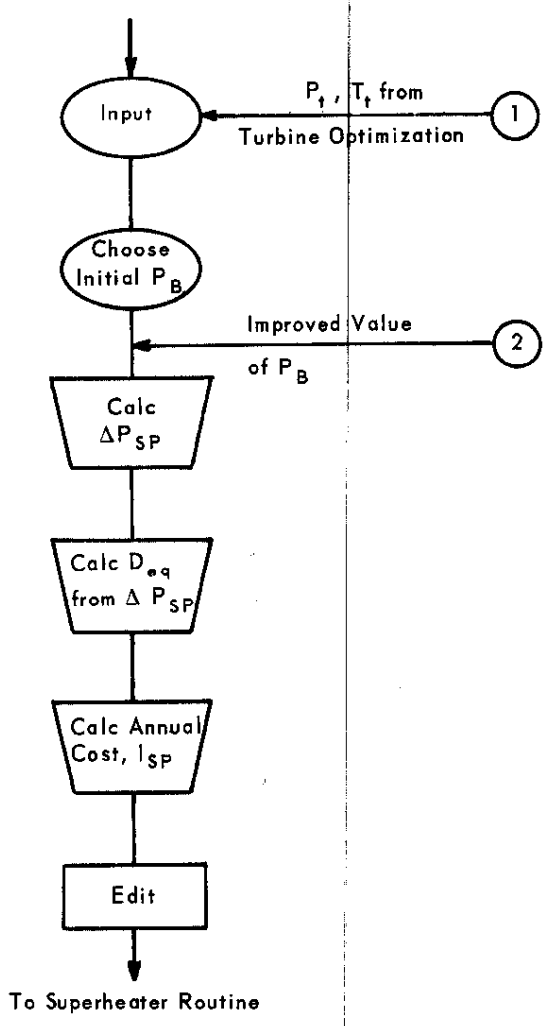


FIG. 11.3 STEAM GENERATOR OPTIMIZATION - STEAM PIPING SUBROUTINE

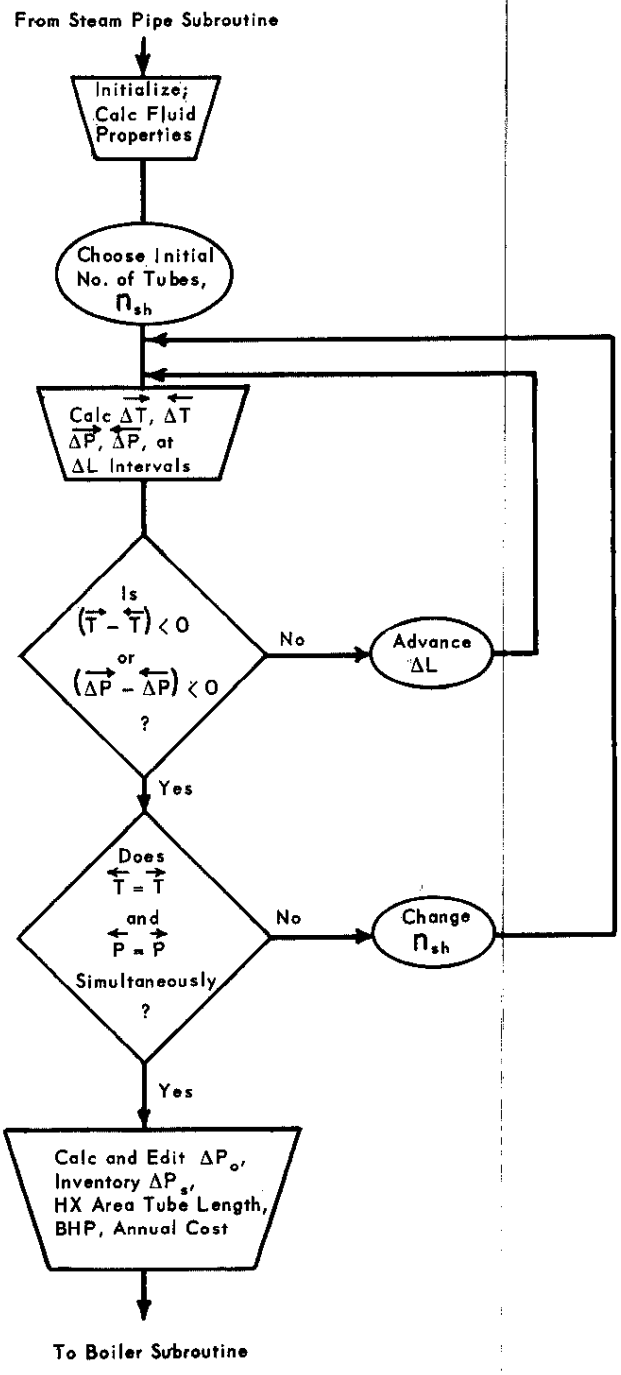


FIG. 11.4 STEAM GENERATOR OPTIMIZATION - SUPERHEATER SUBROUTINE

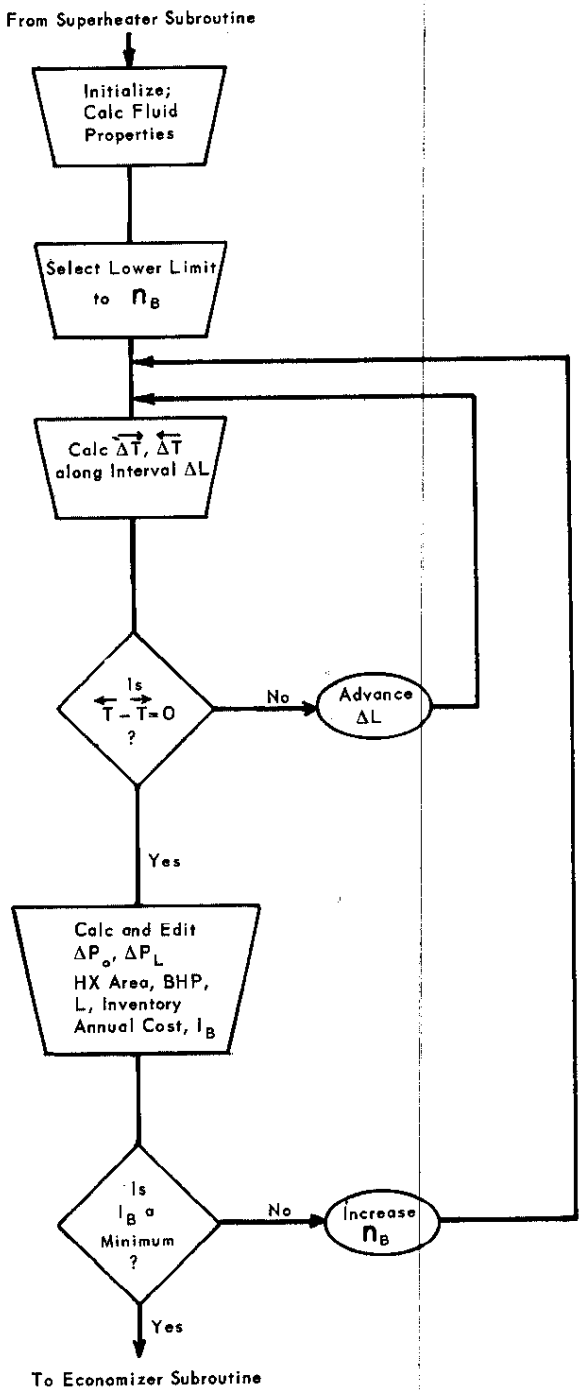


FIG. 11.5 STEAM GENERATOR OPTIMIZATION - BOILER SUBROUTINE

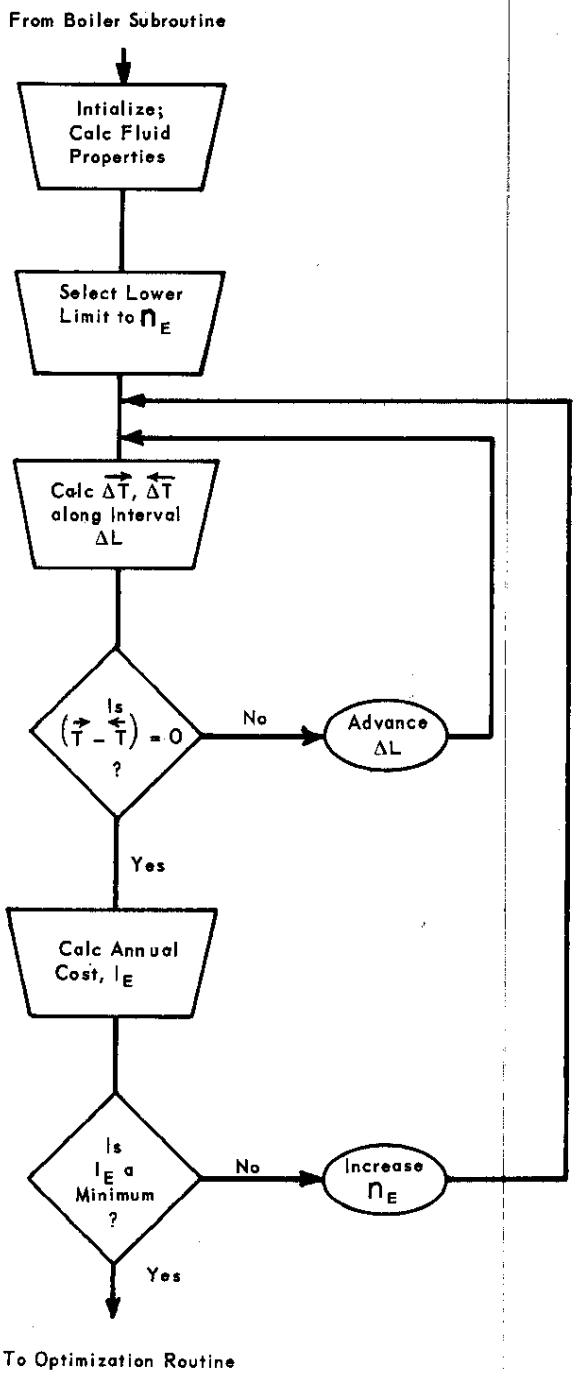


FIG. 11.6 STEAM GENERATOR OPTIMIZATION - ECONOMIZER SUBROUTINE

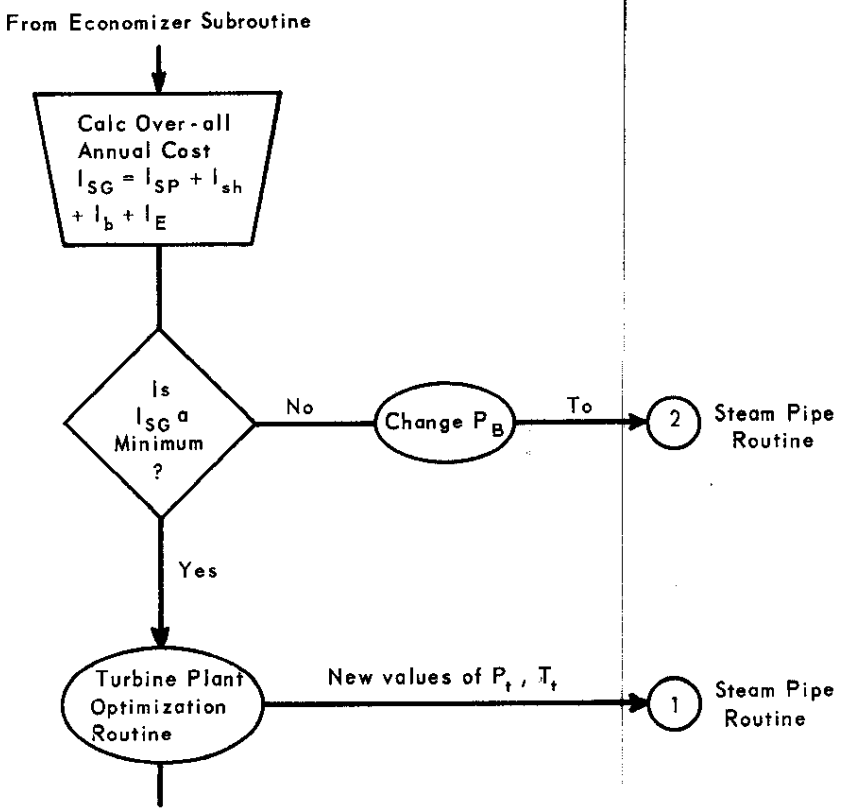


FIG. 11.7 STEAM GENERATOR OPTIMIZATION - OPTIMIZATION SUBROUTINE

12. Turbine Plant

12.1 Turbine Plant Design

All of the information associated with the turbine plant design and cost was developed by Sargent and Lundy, Engineers; a summary of their work on turbine plants for the organic-cooled reactor concept is given in SL-2008[4]. In the development of the information necessary for turbine plant optimization, a wide range of turbine plant steam and feedwater conditions were considered. Eight steam pressures (165, 400, 600, 800, 1000, 1200, 1400, and 1500 psia) were used and for each of these, five temperature conditions were selected in order to span the range from the saturation temperature to approximately 1000°F. The number of feedwater heating stages varied from 1 to 7 to provide a range of final feedwater temperatures from 150-515°F. These parameters were considered for 300-, 500-, and 1000-MWe plant capacities.

Gross turbine cycle efficiency curves were developed as a function of the final feedwater temperature on the basis of a 1.5-inch H_gA condenser pressure. A practical minimum pressure of 400 psia was selected for superheating; therefore saturated steam only was considered for the 165 psia unit.

Cycle efficiency curves were developed by calculating the turbine heat rate for a fixed final feedwater temperature as set with an optimum number of feedwater heaters at each throttle pressure. The feedwater heaters were placed in the cycle so that an approximately equal feedwater temperature rise occurs across each heater. New heat rates were determined for lower final feedwater temperatures by successively removing heaters until a nonextraction heat rate was determined for the throttle pressure considered. The optimum number of feedwater heaters and the outlet temperature from the final feedwater stage are listed in Table 12.1[4].

Major mechanical equipment associated with each turbine cycle was sized in accordance with the capacities, pressures, and temperatures developed in calculating the turbine cycle efficiency. In sizing the equipment, certain assumptions were made that would reflect cost changes representative of those found in conventional plants. For example, the selection of turbine exhaust flow limits which dictate the particular machine to be used can vary over a limited range. The break point in changing condenser tube lengths also varies slightly among designers and manufacturers. Where such limits existed, a particular value was chosen on the basis of conventional plant experience and by limited consultation with major equipment manufacturers.

The cost of the turbine generator, condenser, condensate pumps, feedwater pumps, feedwater heaters, the piping system, circulating water pumps, purification systems, traveling screens, and auxiliary electrical equipment are all functions of the throttle pressure and feedwater temperature. The remaining equipment in a turbine plant does not vary appreciably with the throttle steam conditions.

The turbine plant structures include the turbine building and circulating water system structures. The turbine building houses the turbine plant equipment and the control room, machine shop, store room, office space, and personnel accommodations for the plant. These facilities are independent of the throttle steam pressure. The dimensions of the turbine hall are governed primarily by the turbine dimensions and the auxiliary equipment. The structures for the circulating water system vary appreciably with the turbine throttle pressure.

12.2 300-MWe Plants

The gross turbine efficiency and total turbine plant costs are given in Table 12.2[4] for 201 turbine plant designs over a wide range of temperatures, pressures, and number of feedwater heaters.

Table 12.3 presents the cost summary for 201 discrete 300-MWe steam turbine plants. Data are given for each major component of the variable cost in Items 1 through 11. The other components of the turbine plant cost which do not vary are included as a constant factor. Also included is the cost of the feedwater piping within the reactor building.

12.3 500-MWe Plants

Gross turbine cycle efficiency and total costs are given in Table 12.4[4] for 500-MWe plants at exhaust pressures of 1.5 in. H_gA. The cycle efficiency data were prepared with data for a nominal 525,000 kw, 1800 rpm, cross compound turbine unit. These data cover the range in steam pressure from 400 to 1500 psia and steam temperatures from the saturation temperature to 1000°F.

Table 12.5[4] presents the cost summary for 205 discrete 500-MWe turbine plants in the same format as given for the 300-MWe plants in the section above.

12.4 1000-MWe Plants

As with the 300- and 500-MWe plants, gross turbine cycle efficiency and total costs are given in Table 12.6 at exhaust pressures of 1.5 in. H_gA. These data were prepared for the following pressures: 1500, 1400, 1000, 800, and 600 psi. At each pressure the effects of superheating to 1000°F were determined.

For the present program, it was necessary to establish a lower pressure limit for a single 1000-MWe machine. There was some variation among turbine generator manufacturers as to the limitation of units having a capacity of 1000 MWe. For the present program, 600 psia saturated steam turbine represented the lower pressure limit. This meant that below 600 psia would require the use of two 500-MWe turbine generator units operating in parallel.

A detailed cost summary for the 1000-MWe turbine plants is given in Table 12.7 where the data for the 400 psia plant correspond to the use of two 500-MWe turbine generators.

12.5 Turbine Efficiency Calculations

The gross turbine cycle efficiency data for the turbine plants given in Tables 12.2, 12.4, and 12.6 have been fit to a series of polynomials which are then used in the code to calculate the turbine efficiency. A polynomial fit as a function of the throttle pressure and final feedwater temperature, T_f, has been developed for the following degrees of superheat: 0, 100, 200, 300, 400, and 500°F. The polynomial fits are given by the following equation:

$$\eta_{\Delta T} = \sum a_{ij} T_f^i P_t^j$$

where

$\eta_{\Delta T}$ = gross turbine cycle efficiency with the degree of superheat equal to ΔT

T_f = final feedwater temperature, °F

P_t = turbine throttle pressure, psia

a_{ij} = coefficients used in the polynomial fit and are listed in Table 12.8 for the 300-, 500-, and 1000-MWe plants, respectively

12.6 Turbine Plant Cost Calculations

The turbine plant cost data[4] given in Tables 12.3, 12.5, and 12.7 have been grouped into three major categories: (1) the cost of the turbine plant not including the turbine generator unit, (2) the turbine generator cost for saturated steam cycle, and (3) a correction for the turbine generator unit due to the effect of superheat. The data have been broken down in this fashion in order to effectively smooth the data and eliminate the discontinuities that result when one plots the cost vs pressure or degree of superheat. The cost of the turbine plant, C_t, is then given by

$$C_t = C_1 + C_s + \Delta C_s$$

where

C_1 = cost of the turbine plant, exclusive of the turbine generator unit and is a function of final feedwater temperature, T_f, the degree of superheat, t_s, and the throttle pressure, P_t

C_s = cost of a turbine generator unit for saturated steam cycle and is a function of the turbine exhaust flow, F_1, and the throttle pressure, P_t

ΔC_s = difference between the unit for saturated steam and for superheated steam and is a function of degree of superheat, t_s, and the pressure, P_t

A correlation has been obtained for the ratio, R, of the turbine exhaust flow to the throttle flow, as a function of the pressure, final feedwater temperature, and degree of superheat. Then the turbine exhaust flow, F_1, is given by $F_1 = R \cdot W$, where W is the turbine throttle flow obtained from the steam generator subroutine. It was found necessary to fit this correlation in two parts: (1) in the pressure range 1000 to 1500 psi and (2) in a range from 400 to 1000 psi. Table 12.9 lists the equations for the exhaust flow and the various components of the turbine plant cost. The subsequent tables, 12.10 through 12.12 give the coefficients of the polynomial fits for the various functions in Table 12.9.

12.7 Turbine Plant Optimization

The turbine plant conditions are chosen so that the over-all energy cost including the contribution of the turbine plant itself are minimized. The code first computes the design and cost of the reactor core and primary coolant systems, excluding the steam generators, and the fuel cycle costs. Thus, the input parameters for the turbine plant optimization consist of the inlet and outlet coolant temperatures, the fuel cycle costs, and the reactor costs.

The turbine plant efficiency and costs have been expressed in terms of the throttle pressure, P_t, the throttle temperature, T_t, and the temperature of the final feedwater returning from the turbine plant, T_f. For each reactor design, T_t, P_t, and T_f are systematically varied to determine the minimum energy cost. For each set of turbine conditions an optimum steam generator is computed as described in Section 11. Studies have shown that the optimum value of the final feedwater temperature is always the maximum value for any given value of P_t and T_t. Therefore the minimum cost is determined with respect to P_t and T_t. To determine this minimum, six sets of values for P_t and T_t are chosen and the total energy cost is computed for each of these six sets. These six sets are chosen within the following criteria: (1) the throttle pressure is greater than 400 psi, (2) the throttle steam temperature must be greater than 2°C lower than the reactor outlet temperature, and (3) the minimum temperature difference (the pinch point) between the organic and the steam-water mixture in the boiler must be greater than 8°C. These six points then define a surface which can be approximated by

$$C = a_o + a_1 P_t + a_2 P_t^2 + a_3 T_t + a_4 T_t^2 + a_5 T_t P_t$$

where C is the energy cost in mills/kwh and the a_i's are the coefficients that are evaluated from the six values of the cost. The values of P_t and T_t that give the minimum cost are determined from this equation, and the final energy cost is then recomputed.

TABLE 12.1 (SL-2008, p 56)

Heater Outlet Temperatures
Saturated and Superheated Steam Cycle Analysis

Throttle Press., Psia	Heater Outlet Temperature, °F						
	Htr. #1	Htr. #2	Htr. #3	Htr. #4	Htr. #5	Htr. #6	Htr. #7
165	160	255	305	-	-	-	-
400	160	236	308	365	-	-	-
600	165	226	286	346	406	-	-
800	150	210	260	320	379	439	-
1000	160	220	280	340	405	465	-
1200	160	220	290	360	425	496	-
1400	150	200	260	320	380	442	505
1500	160	210	270	330	390	450	515

TABLE 12.2 (SI-2008, p. 3)

SUMMARY OF 300 MWe H_2O TURBINE PLANT CHARACTERISTICS
Efficiency in %, Cost in millions of dollars

No. of Feed-water Heaters			7		6		5		4		3		2		1	
Pressure Psia	Degrees F Superheat	Act. Steam Temp. °F	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost
	SAT.	596	36.4	-	36.0	-	35.5	-	34.8	-	33.9	-	32.8	-	31.8	-
	100	696	37.4	19.79	37.0	19.55	36.5	19.30	37.7	19.17	34.9	19.16	34.0	19.07	32.9	19.11
1500	200	796	38.5	18.45	38.1	18.17	37.6	18.66	36.8	18.54	35.9	18.44	35.0	18.39	33.8	18.41
	300	896	39.8	18.16	39.3	17.95	38.7	17.83	37.9	17.70	37.0	17.62	35.9	18.20	34.6	18.24
	400	996	40.8	18.20	40.4	17.99	39.8	17.88	38.8	17.76	37.8	17.70	36.7	17.62	35.4	18.28
	SAT.	587	36.0	20.44	35.7	20.02	35.2	19.81	34.5	19.70	33.6	19.65	32.6	19.66	31.4	19.76
	100	687	36.9	19.79	36.6	19.50	36.2	19.32	35.5	19.19	34.7	19.13	33.6	19.12	32.6	19.20
1400	200	787	38.1	18.39	37.8	18.20	37.3	18.65	36.6	18.54	35.7	18.47	34.6	18.42	33.4	18.46
	300	887	39.3	18.17	39.0	17.95	38.4	17.79	37.6	17.70	36.7	18.29	35.4	18.28	34.2	18.32
	400	987	40.4	18.21	40.1	18.03	39.4	17.91	38.6	17.79	37.6	17.75	36.4	18.36	35.1	18.40
	SAT.	567			35.2	20.15	34.9	19.92	34.4	19.73	33.6	19.64	32.6	19.63	31.4	19.71
	100	667			36.4	19.58	36.0	19.37	35.4	19.18	34.7	19.11	33.6	19.04	32.4	19.12
1200	200	767			37.4	18.88	37.1	18.70	36.6	18.55	35.8	18.45	34.6	18.37	33.3	18.40
	300	867			38.6	18.00	38.3	17.86	37.7	17.72	36.9	18.27	35.7	18.20	34.2	18.23
	400	967			39.7	18.06	39.4	17.93	38.8	17.80	37.9	17.68	36.6	17.62	35.1	18.28
	SAT.	545			34.3	20.07	34.0	19.93	33.5	19.76	32.8	19.70	31.9	19.65	30.7	19.76
	100	645			35.4	19.52	35.2	19.34	34.6	19.23	33.8	19.17	32.9	19.10	31.7	19.12
1000	200	745			36.6	18.81	36.4	18.65	35.7	18.51	34.9	18.46	33.9	18.41	32.6	18.40
	300	845			37.8	18.62	37.6	18.50	36.9	18.37	36.0	18.29	34.9	18.24	33.5	18.24
	400	945			38.9	17.87	38.7	17.76	37.9	17.63	37.1	17.59	35.9	18.15	34.4	18.13
	SAT.	518			33.3	21.43	33.0	21.29	32.4	21.12	31.6	21.05	30.9	21.04	29.7	21.10
	100	618			34.3	19.43	34.2	19.29	33.6	19.12	32.8	19.09	32.0	20.43	30.7	20.52
800	200	718			35.6	19.20	35.3	19.02	34.7	18.81	33.9	18.86	32.9	18.80	31.6	19.86
	300	818			36.8	18.60	36.5	18.46	35.9	18.31	34.9	18.26	33.9	18.19	32.4	18.21
	500	1018			38.9	17.92	38.7	17.82	38.0	17.67	36.9	18.27	35.7	18.17	34.1	18.20
	SAT.	486					31.9	21.18	31.5	21.09	30.9	20.99	30.1	20.93	29.0	20.93
	100	586					32.9	18.87	32.6	18.75	32.0	18.68	31.2	20.45	30.0	20.43
600	200	686					34.1	18.06	33.8	17.94	33.1	17.86	32.2	17.84	30.9	19.89
	400	886					36.3	17.82	36.0	17.74	35.4	17.66	34.4	17.61	32.7	17.57
	500	986					37.4	17.90	37.7	17.79	36.5	17.75	35.4	17.65	33.6	17.60
	SAT.	445							29.3	21.88	29.0	21.77	28.3	21.67	27.2	21.66
	100	545							30.7	20.84	30.3	20.70	29.4	20.59	28.1	21.16
400	200	645							31.9	18.31	31.6	20.45	30.6	20.34	29.1	20.32
	400	845							34.4	17.75	34.2	17.64	33.0	17.57	31.0	17.57
	500	945							35.4	17.87	35.3	17.77	34.0	17.67	32.0	17.66
165	SAT.	365									25.1	23.61	24.7	23.54	23.6	23.60

TABLE 12.3 (SL-2008, pp 57-91)

SUMMARY OF COST DATA
1500 PSIA, 696 F THROTTLE STEAM
(100 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	7	6	5	4	3	2	1
1. Turbine Generator And Accessories							
a. Turbine generator unit	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←			Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers							
a. Shells and accessories)	786,500	786,500	800,000	813,500	854,000	894,500	962,000
b. Dry vacuum pumps)							
c. Tubes	442,500	442,500	450,000	457,500	480,000	502,500	540,000
d. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
e. Erection	134,000	134,000	136,000	138,000	142,000	148,000	158,000
f. Deaeration - hot well of cond.	None	←					→ 43,300
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System							
A - Structures							
a. Crib house)							
a'. Substructure)							
b'. Superstructure)	475,000	477,000	482,000	489,000	500,000	517,000	541,000
c'. Steel)							
d'. Miscellaneous)							
b. Dredging)							
c. Intake flume or forebay)							
d. Seal well)							
e. Discharge flume)							
f. Outfall)							
B - Crib House Equipment (erected)							
a. Traveling screens)							
b. Screen wash pumps)	129,000	129,000	132,000	134,000	139,000	146,000	156,000
c. Screen wash piping)							
d. Chlorination equipment)							
e. Chlorine handling)							
C - Circulating water piping	479,000	480,000	484,000	489,000	497,000	508,000	525,000
D - Circulating water pumps							
a. Pumps	186,000	187,000	191,000	195,000	202,000	214,000	228,000
b. Motors	143,000	144,000	145,500	148,000	151,500	157,000	165,000
c. Erection	18,300	18,400	18,600	18,800	19,300	20,000	21,000
4. Feed Water Heaters							
A - L-P Closed Heaters	136,000	137,000	87,000	87,500	44,000	45,000	-
B - H-P Closed Heaters	338,500	200,000	194,000	94,000	85,000	-	89,500
C - Deaerating Heater	117,500	114,500	111,500	109,000	107,500	106,000	-
D - Insulation							
a. Closed heaters	8,750	5,650	4,000	1,900	1,000	-	-
b. Deaerating	8,700	8,400	8,200	8,000	7,900	7,800	-
E - Structural Work							
a. For closed heaters	24,500	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	25,500	24,300	23,500	23,000	22,500	22,200	-
5. Boiler Feed Pumps							
a. Pumps and base plate	183,000	180,500	176,500	176,000	173,500	173,000	172,000
b. Fluid drive	185,100	185,100	121,500	121,265	121,500	121,500	96,000
c. Motors	311,000	294,000	268,000	254,000	250,500	232,500	225,500
d. Erection	15,700	13,600	13,500	12,900	12,300	11,900	11,500
e. Foundations for pumps	4,650	4,450	4,000	4,050	3,900	3,800	3,700
6. Condensate Pumps							
a. Pumps	51,000	50,600	33,000	33,900	26,500	27,000	-
b. Motors	29,400	29,000	17,400	17,800	11,700	12,200	-
c. Erection	5,400	5,400	5,100	5,200	5,000	5,100	-
7. Piping And Insulation							
a. Extraction steam)	244,200	206,000	178,300	150,200	133,200	89,000	49,200
b. Heater vents and drains)							
c. Boiler feed piping	188,500	160,000	118,100	109,000	109,000	64,700	133,000
d. Condensate piping)	69,900	69,900	61,500	61,500	56,700	56,700	-
a'. From condensate pumps)							
through L-P heaters)							
b'. For D.C. heater and)							
B.F. pump suction)							
e. Main steam	15,200	15,200	15,200	15,200	13,500	13,500	13,500
8. Demineralizing Equipment And Condensate Storage Tanks	188,000	181,000	172,000	167,000	160,000	158,000	153,000
9. Electrical	138,400	138,400	129,700	126,300	125,500	121,900	105,700
10. Turbine Room Building							
a. Building	-	-	-	-	-	-	-
b. Turbine generator sub-base	-	-	-	-	-	-	-
11. Condenser Pit-Size Increment	-	-	-	400	1,400	2,500	4,200
TOTAL ITEMS 1-11	14,598,450	14,355,150	14,109,600	13,982,415	13,968,400	13,875,800	13,918,100
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	19,789,950	19,546,650	19,301,100	19,173,915	19,159,900	19,067,300	19,109,600
12. Piping In Containment Vessel	476,100	322,100	322,100	319,900	317,600	317,600	319,800
GRAND TOTAL	20,266,050	19,868,750	19,623,200	19,493,815	19,477,500	19,384,900	19,429,400

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1500 PSIA, 796 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
a. Turbine generator unit	7,810,000	7,810,000	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←			Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers							
a. Shells and accessories b. Dry vacuum pumps	732,500	746,000	759,500	773,000	800,000	840,500	894,500
c. Tubes	412,500	420,000	427,500	435,000	450,000	472,500	502,500
d. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
e. Erection	126,000	128,000	130,000	132,000	136,000	140,000	148,000
f. Deaeration - hot well of cond.	None						40,100
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System							
A - Structures							
a. Crib house a'. Substructure b'. Superstructure c'. Steel d'. Miscellaneous b. Dredging c. Intake flume or forebay d. Seal well e. Discharge flume f. Outfall	460,000	462,000	467,000	474,000	484,000	499,000	518,000
B - Crib House Equipment (erected)							
a. Traveling screens b. Screen wash pumps c. Screen wash piping d. Chlorination equipment e. Chlorine handling	122,000	123,000	125,000	128,000	132,000	138,000	146,000
C - Circulating Water Piping	468,000	470,000	473,000	478,000	485,000	495,000	509,000
D - Circulating Water Pumps							
a. Pumps	176,000	178,000	181,000	185,000	192,000	202,000	214,000
b. Motors	138,000	139,000	140,500	143,000	146,000	151,000	157,500
c. Erection	17,600	17,700	17,900	18,200	18,600	19,300	20,000
4. Feed Water Heaters							
A - L-P closed heaters	129,500	129,500	83,500	84,000	42,500	43,500	
B - H-P closed heaters	320,000	191,000	186,000	90,500	74,000	-	86,500
C - Deaerating heater	112,500	108,500	106,000	104,000	103,000	102,000	
D - Insulation							
a. Closed heaters	7,700	5,500	3,700	1,800	1,000	-	-
b. Deaerating	8,200	8,000	7,800	7,700	7,600	7,500	-
E - Structural Work							
a. For closed heaters	24,500	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	23,300	22,700	22,200	21,800	21,500	21,200	-
5. Boiler Feed Pumps							
a. Pumps and base plate	178,000	176,000	173,000	172,500	171,000	170,500	170,000
b. Fluid drive	185,100	121,500	121,500	121,500	96,000	96,000	96,000
c. Motors	275,500	253,500	240,500	229,000	219,000	212,000	206,500
d. Erection	14,100	13,300	12,300	11,900	11,300	11,100	10,700
e. Foundations for pumps	4,300	4,100	3,900	3,800	3,700	3,600	3,550
6. Condensate Pumps							
a. Pumps	46,400	46,200	30,400	31,200	24,700	25,000	-
b. Motors	27,100	26,800	16,300	16,600	11,000	11,500	-
c. Erection	5,000	5,000	4,800	4,900	4,700	4,900	-
7. Piping and Insulation							
a. Extraction steam b. Heater vents and drains	244,200	202,900	178,300	150,000	121,100	89,000	49,200
c. Boiler feed piping	188,500	160,000	118,100	109,000	109,000	64,700	133,000
d. Condensate piping a'. From condensate pumps thru L-P heaters b'. For D-C heater and B.F. pump suction	69,900	69,900	61,500	61,500	52,200	52,200	-
e. Main steam	38,800	38,800	38,800	38,800	29,600	29,600	29,600
8. Demineralizing Equipment and Condensate Storage Tanks	176,000	168,000	161,000	157,000	152,000	150,000	146,00
9. Electrical	126,000	122,600	125,900	122,700	121,900	118,400	97,400
10. Turbine Room Building							
a. Building	-6,400	-6,400	-	-	-	-	-
b. Turbine generator sub-base	-1,000	-1,000	-	-	-	-	-
11. Condenser Pit-Size Increment	-	-	-	-	-	1,100	2,500
TOTAL ITEMS 1 - 11	13,256,050	12,974,050	13,465,400	13,347,900	13,251,900	13,195,600	13,222,550
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,447,550	18,165,550	18,656,900	18,539,400	18,443,400	18,387,100	18,414,050
12. Piping in Containment Vessel	532,100	378,100	378,100	375,900	366,300	366,300	366,300
GRAND TOTAL	18,979,650	18,543,650	19,035,000	18,915,300	18,809,700	18,753,400	18,780,350

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1500 PSIA, 896 F THROTTLE STEAM
(300 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
a. Turbine generator unit	7,810,000	7,810,000	7,810,000	7,810,000	7,810,000	8,440,000	8,440,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←			Constant	→		
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers							
a. Shells and accessories	692,000	692,000	719,000	732,500	746,000	786,500	840,500
b. Dry vacuum pumps							
c. Tubes	390,000	390,000	405,000	412,500	420,000	442,500	472,500
d. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
e. Erection	120,000	120,000	124,000	126,000	128,000	134,000	140,000
f. Deaeration - hot well of cond.	None	←				→	37,800
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System							
A - Structures							
a. Crib house							
a'. Substructure							
b'. Superstructure	444,000	446,000	452,000	457,000	464,000	475,000	495,000
c'. Steel							
d'. Miscellaneous							
b. Dredging							
c. Intake flume or forebay							
d. Seal well							
e. Discharge flume							
f. Outfall							
B - Crib House Equipment (erected)							
a. Traveling screens							
b. Screen wash pumps	116,000	116,000	119,000	121,000	124,000	129,000	137,000
c. Screen wash piping							
d. Chlorination equipment							
e. Chlorine handling							
C - Circulating Water Piping	457,000	458,000	462,000	466,000	471,000	479,000	493,000
D - Circulating Water Pumps							
a. Pumps	165,000	167,000	171,000	174,000	179,000	186,000	199,000
b. Motors	133,000	133,500	135,500	137,500	139,500	143,500	149,500
c. Erection	17,000	17,000	17,300	17,500	17,800	18,300	19,100
4. Feed Water Heaters							
A - L-P Closed Heaters	124,500	124,500	81,000	82,000	41,000	42,000	-
B - H-P Closed Heaters	306,000	189,000	179,500	87,500	73,000	-	84,500
C - Deaerating Heater	107,000	104,000	102,000	100,500	99,000	98,500	-
D - Insulation							
a. Closed heaters	7,200	4,900	3,500	1,700	950	-	-
b. Deaerating	7,900	7,700	7,500	7,400	7,400	7,300	-
E - Structural Work							
a. For closed heaters	24,500	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	22,500	21,700	21,300	20,900	20,600	20,500	-
5. Boiler Feed Pumps							
a. Pumps and base plate	175,000	173,500	171,000	170,500	169,500	169,000	168,000
b. Fluid drive	121,500	121,500	96,000	96,000	96,000	96,000	96,000
c. Motors	249,000	230,000	219,500	210,000	201,500	196,000	192,000
d. Erection	12,900	12,200	11,400	11,100	10,600	10,400	10,100
e. Foundations for pumps	4,050	3,900	3,700	3,600	3,500	3,500	3,400
6. Condensate Pumps							
a. Pumps	42,500	42,400	28,200	28,900	21,000	23,100	-
b. Motors	24,800	24,800	15,200	15,500	10,400	10,800	-
c. Erection	4,700	4,700	4,600	4,600	4,500	4,600	-
7. Piping and Insulation							
a. Extraction steam	237,200	202,900	178,300	148,900	119,700	87,700	49,200
b. Heater vents and drains							
c. Boiler feed piping	152,800	140,000	118,100	109,000	109,000	64,700	133,000
d. Condensate piping							
a'. From condensate pumps thru L-P heaters	69,900	69,900	61,500	55,400	50,600	50,600	-
b'. For D.C. heater and B.F. pump suction							
e. Main steam	49,700	49,700	44,700	44,700	44,700	44,700	44,700
8. Demineralizing Equipment and Condensate Storage Tanks	166,000	159,000	155,000	148,000	145,000	144,000	141,000
9. Electrical	122,200	118,600	117,400	113,900	113,100	118,400	97,400
10. Turbine Room Building							
a. Building	-6,400	-6,400	-6,400	-6,400	-6,400	-	-
b. Turbine generator sub-base	-1,000	-1,000	-1,000	-1,000	-1,000	-	-
11. Condenser Pit-Size Increment	-	-	-	-	-	-	1,100
TOTAL ITEMS 1 - 11	12,964,700	12,760,750	12,635,300	12,508,200	12,424,450	13,010,100	13,045,800
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,156,200	17,952,250	17,826,800	17,699,700	17,615,950	18,201,600	18,237,300
12. Piping in Containment Vessel	442,600	397,200	395,300	393,100	393,100	393,100	393,100
GRAND TOTAL	18,598,800	18,349,450	18,221,100	18,092,800	18,009,050	18,594,700	18,630,400

TABLE 12.3 (Continued)

1500 PSIA, 996 F THROTTLE STEAM
(400 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
a. Turbine generator unit	8,050,000	8,050,000	8,050,000	8,050,000	8,050,000	8,050,000	8,680,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	← Constant →						
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers							
a. Shells and accessories)	651,500	651,500	665,000	678,500	705,500	732,500	773,000
b. Dry vacuum pumps)							
c. Tubes	367,500	367,500	375,000	382,500	397,500	412,500	435,000
d. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
e. Erection	114,000	114,000	116,000	118,000	122,000	126,000	132,000
f. Deaeration - hot well of cond.	None	→					34,800
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System							
A - Structures							
a. Crib house)							
a'. Substructure)							
b'. Superstructure)							
c'. Steel)							
d'. Miscellaneous)	429,000	431,000	435,000	441,000	446,000	457,000	474,000
b. Dredging)							
c. Intake flume or forebay)							
d. Seal well)							
e. Discharge flume)							
f. Outfall)							
B - Crib House Equipment (erected)							
a. Traveling screens)							
b. Screen wash pumps)							
c. Screen wash piping)	110,000	110,000	112,000	114,000	117,000	121,000	128,000
d. Chlorination equipment)							
e. Chlorine handling)							
C - Circulating Water Piping	447,000	448,000	451,000	455,000	459,000	466,000	478,000
D - Circulating Water Pumps							
a. Pumps	156,000	158,000	160,000	164,000	167,000	174,000	185,000
b. Motors	128,000	128,500	130,000	132,000	133,500	137,500	143,000
c. Erection	16,400	16,400	16,600	16,800	17,100	17,500	18,200
4. Feed Water Heaters							
A - L-P Closed Heaters	121,000	121,000	79,000	79,000	40,000	41,000	-
B - H-P Closed Heaters	295,000	181,000	175,000	85,000	71,500	-	82,500
C - Deaerating Heater	103,000	99,500	98,500	97,000	96,000	95,500	-
D - Insulation							
a. Closed heaters	6,800	4,800	3,300	1,600	950	-	-
b. Deaerating	7,600	7,400	7,300	7,200	7,200	7,100	-
E - Structural Work							
a. For closed heaters	24,500	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	21,500	20,900	20,500	20,200	20,000	19,800	-
5. Boiler Feed Pumps							
a. Pumps and base plate	173,000	171,000	170,500	168,500	168,000	167,000	166,000
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	228,000	211,500	202,300	195,000	188,000	183,000	179,000
d. Erection	12,000	11,300	10,600	10,400	10,000	9,800	9,500
e. Foundations for pumps	3,850	3,700	3,550	3,500	3,400	3,350	3,300
6. Condensate Pumps							
a. Pumps	39,400	39,200	26,200	26,900	20,600	21,600	-
b. Motors	23,200	23,100	14,300	14,600	9,800	10,200	-
c. Erection	4,500	4,500	4,300	4,400	4,300	4,400	-
7. Piping and Insulation							
a. Extraction steam)	237,200	198,100	178,300	148,900	119,700	87,700	49,200
b. Heater vents and drains)							
c. Boiler feed piping	152,800	140,000	118,100	104,100	104,100	64,700	133,000
d. Condensate piping)							
a'. From condensate pumps)							
through L-P heaters)	65,300	65,300	55,400	55,400	50,600	50,600	-
b'. For D.C. heater and)							
B.F. pump suction)							
e. Main steam	60,300	55,900	55,900	55,900	55,900	55,900	55,900
8. Demineralizing Equipment and Condensate Storage Tanks	157,000	152,000	146,000	144,000	140,000	138,000	136,000
9. Electrical	116,700	113,200	112,000	110,900	109,600	109,600	93,900
10. Turbine Room Building							
a. Building	-6,400	-6,400	-6,400	-6,400	-6,400	-6,400	-
b. Turbine generator sub-base	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000	-
11. Condenser Pit-Size Increment	-	-	-	-	-	-	-
TOTAL ITEMS 1 - 11	13,006,700	12,800,650	12,684,950	12,573,400	12,510,350	12,432,350	13,087,300
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,198,400	17,992,150	17,876,450	17,764,900	17,701,850	17,623,850	18,278,800
12. Piping in Containment Vessel	506,700	451,800	451,800	449,600	449,600	449,600	449,600
GRAND TOTAL	18,705,100	18,443,950	18,328,250	18,214,500	18,151,450	18,073,450	18,728,400

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 587 F THROTTLE STEAM (SATURATED STEAM)
300 MWe INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.	4,530,000	4,123,000	3,781,000	3,505,000	3,255,000	3,057,000	3,180,000
HEATER ARRANGEMENT	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
a. Turbine generator unit	9,240,000	9,240,000	9,240,000	9,240,000	9,240,000	9,240,000	9,240,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	Constant						
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers							
a. Shells and accessories	840,500	840,500	854,000	881,000	935,000	1,002,500	1,080,000
b. Dry vacuum pumps	472,500	472,500	480,000	495,000	525,000	562,500	774,000
c. Tubes	19,250	19,250	17,500	17,500	17,500	17,500	33,250
d. Steam jet air equipment	140,000	140,000	142,000	146,000	154,000	164,000	167,000
e. Erection	-	-	-	-	-	-	45,000
f. Deseration - hot well of cond.	20,000	20,000	20,000	20,000	10,000	10,000	10,000
g. L-P htrs. in exhaust stacks							
3. Circulating Water System							
A. - Structures							
a. Crib house							
a'. Substructure							
b'. Superstructure							
c'. Steel							
d'. Miscellaneous	499,000	500,000	504,000	514,000	534,500	558,000	543,000
b. Dredging							
c. Intake flume							
d. Seal well							
e. Discharge flume							
f. Outfall							
B - Crib House Equipment (Erected)							
a. Traveling screens							
b. Screen wash pumps	138,000	138,500	140,000	144,000	152,300	162,000	156,000
c. Screen wash piping							
d. Chlorination equipment							
e. Chlorine handling							
C - Circulating Water Piping	492,000	492,500	496,000	503,000	517,000	535,000	524,000
D - Circulating Water Pumps							
a. Pumps	199,975	200,450	203,300	209,950	223,500	238,925	224,130
b. Motors	150,345	150,520	152,105	155,625	162,400	170,760	175,160
c. Erection	19,130	19,160	19,340	19,920	20,600	21,590	20,960
4. Feed Water Heaters							
A - L-P closed heaters	146,000	145,500	91,000	91,500	46,000	47,000	-
B - H-P closed heaters	460,000	217,000	203,500	96,500	75,000	-	90,000
C - Deaerating heater	129,000	124,000	118,000	115,000	112,000	108,000	-
D - Insulation							
a. Closed heaters	8,550	6,350	4,350	2,050	1,100	-	-
b. Deaerating	9,600	9,100	8,700	8,400	8,100	7,900	-
E - Structural Work							
a. For closed heaters	24,500	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	28,500	27,000	25,500	24,500	23,500	23,000	-
5. Boiler Feed Pumps							
a. Pumps and base plate	180,000	175,500	171,000	169,500	166,500	165,000	165,000
b. Fluid drive	185,100	121,500	121,500	121,500	96,000	96,000	96,000
c. Motors	305,280	274,630	253,465	233,400	213,330	198,780	186,430
d. Erection	27,000	25,200	23,100	21,900	20,400	19,500	19,800
e. Foundations for pumps	5,250	4,950	4,500	4,350	4,050	3,900	3,900
6. Condensate Pumps							
a. Pumps	57,750	57,450	36,300	36,900	28,200	28,800	-
b. Motors	31,090	30,820	18,130	18,400	13,270	13,810	-
c. Erection	5,900	5,900	5,450	5,500	5,200	5,400	-
7. Piping and Insulation							
a. Extraction steam	243,400	210,600	183,600	151,900	119,400	83,900	49,200
b. Heater vents and drains							
c. Boiler feed piping	179,300	163,400	113,600	104,700	104,700	59,800	123,500
d. Condensate piping							
a'. From condensate pumps through L-P heaters	82,400	82,400	75,500	75,500	68,800	68,000	-
b'. For D-C heater and B.F. pump suction							
e. Main steam	20,000	20,000	20,000	20,000	15,000	15,000	15,000
8. Demineralizing Equipment and Condensate Storage Tanks	198,500	187,000	177,500	169,500	162,500	157,000	160,500
9. Electrical	138,400	131,450	126,600	123,900	120,700	119,000	99,000
10. Turbine Room Building	Base						
11. Condenser Pit-Size Increment	1,050	1,050	1,400	2,100	3,500	5,250	10,500
TOTAL ITEMS 1 - 11	15,248,970	14,828,380	14,621,640	14,506,695	14,462,750	14,464,515	14,568,030
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	20,440,470	20,019,880	19,813,140	19,698,195	19,654,250	19,656,015	19,759,530
12. PIPING IN CONTAINMENT VESSEL	436,000	390,000	350,000	326,000	310,000	306,000	300,000
GRAND TOTAL	20,876,470	20,409,880	20,163,140	20,024,195	19,964,250	19,962,015	20,059,530

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 687 F THROTTLE STEAM
(100 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
a. Turbine generator unit	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter				Constant			
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers							
a. Shells and accessories)	800,000	800,000	813,500	827,000	867,500	921,500	989,000
b. Dry vacuum pumps)							
c. Tubes	450,000	450,000	457,500	465,000	487,500	517,500	555,000
d. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
e. Erection	136,000	136,000	138,000	139,000	144,000	152,000	162,000
f. Deaeration - hot well of cond.	None	→	→	→	→	→	44,500
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System							
A - Structures							
a. Crib house)							
a'. Substructure)							
b'. Superstructure)	480,000	481,000	485,000	492,000	506,000	527,000	553,000
c'. Steel)							
d'. Miscellaneous)							
b. Dredging)							
c. Intake flume or forebay)							
d. Seal well)							
e. Discharge flume)							
f. Outfall)							
B - Crib House Equipment (erected)							
a. Traveling screens)							
b. Screen wash pumps)	131,000	131,000	133,000	135,000	141,000	150,000	161,000
c. Screen wash piping)							
d. Chlorination equipment)							
e. Chlorine handling)							
C - Circulating Water Piping	482,000	483,000	486,000	491,000	500,000	515,000	546,000
D - Circulating Water Pumps							
a. Pumps	189,500	190,000	193,000	197,000	208,000	220,000	232,000
b. Motors	145,100	145,200	147,700	148,800	153,500	160,600	169,400
c. Erection	18,500	18,500	18,700	18,900	19,500	20,400	21,500
4. Feed Water Heaters							
A - L-P Closed Heaters	136,000	136,500	86,500	87,500	44,000	45,000	-
B - H-P Closed Heaters	329,000	202,500	189,500	92,000	74,500	-	87,500
C - Deaerating Heater	118,000	117,000	111,500	109,000	107,000	106,000	-
D - Insulation							
a. Closed heaters	8,400	5,600	3,950	1,900	1,050	-	-
b. Deaerating	8,700	8,400	8,200	8,000	7,900	7,800	-
E - Structural Work							
a. For closed heaters	24,500	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	25,400	24,200	23,500	22,900	22,500	22,200	-
5. Boiler Feed Pumps							
a. Pumps and base plate	173,000	171,000	167,500	166,500	164,500	164,000	163,000
b. Fluid drive	185,100	121,500	121,500	121,500	96,000	96,000	96,000
c. Motors	293,000	273,000	259,500	247,000	235,000	228,000	225,000
d. Erection	23,700	22,500	21,000	20,500	19,500	19,000	18,500
e. Foundations for pumps	4,600	4,400	4,200	4,100	3,900	3,800	3,700
6. Condensate Pumps							
a. Pumps	51,300	51,000	33,600	34,200	26,100	27,300	-
b. Motors	27,700	27,500	16,700	17,000	12,600	13,400	-
c. Erection	5,400	5,400	5,100	5,200	5,000	5,200	-
7. Piping and Insulation							
a. Extraction steam)	243,400	210,600	183,600	151,900	119,400	83,900	49,200
b. Heater vents and drains)							
c. Boiler feed piping	179,000	160,000	118,100	109,000	109,000	64,400	133,000
d. Condensate piping)							
a'. From condensate pumps)							
thru L-P heaters)	69,900	69,900	61,500	61,500	56,700	56,700	-
b'. For D.C. heater and)							
B.F. pump suction)							
e. Main steam	18,100	14,200	14,200	14,200	14,200	11,400	11,400
8. Demineralizing Equipment and Condensate Storage Tanks	189,000	180,000	170,000	165,000	160,000	157,000	154,000
9. Electrical	138,400	130,900	126,300	126,300	121,900	121,900	105,700
10. Turbine Room Building							
a. Building	-	-	-	-	-	-	-
b. Turbine generator sub-base	-	-	-	-	-	-	-
11. Condenser Pit-Size Increment	-	-	400	700	1,800	3,200	4,900
TOTAL ITEMS 1 - 11	14,599,950	14,304,550	14,127,250	14,001,100	13,941,050	13,924,700	14,005,550
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	19,791,450	19,496,050	19,318,750	19,192,600	19,132,550	19,116,200	19,197,050
12. Piping in Containment Vessel	421,100	295,100	295,100	295,100	295,100	288,500	288,500
GRAND TOTAL	20,212,550	19,791,150	19,613,850	19,487,700	19,427,650	19,404,700	19,485,550

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 787 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
a. Turbine generator unit	7,810,000	7,810,000	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	← Constant →						
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers							
a. Shells and accessories)	746,000	759,500	773,000	786,500	813,500	854,000	908,000
b. Dry vacuum pumps)							
c. Tubes	420,000	427,500	435,000	442,500	457,500	480,000	510,000
d. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
e. Erection	128,000	130,000	132,000	134,000	138,000	142,000	150,000
f. Deaeration - hot well of cond.	None	→					41,000
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System							
A - Structures							
a. Crib house)							
a'. Substructure)							
b'. Superstructure)							
c'. Steel)							
d'. Miscellaneous)	463,000	466,000	470,000	478,000	486,000	503,000	524,000
b. Dredging)							
c. Intake flume or forebay)							
d. Seal well)							
e. Discharge flume)							
f. Outfall)							
B - Crib House Equipment (erected)							
a. Traveling screens)							
b. Screen wash pumps)							
c. Screen wash piping)	123,000	125,000	127,000	130,000	133,000	140,000	149,000
d. Chlorination equipment)							
e. Chlorine handling)							
C - Circulating Water Piping	470,000	473,000	475,000	481,000	487,000	498,000	513,000
D - Circulating Water Pumps							
a. Pumps	178,000	181,500	184,000	188,000	193,000	204,000	218,000
b. Motors	139,200	140,400	141,800	144,300	147,900	154,500	158,400
c. Erection	17,700	17,900	18,100	18,400	18,700	19,700	20,300
4. Feed Water Heaters							
A - L-P Closed Heaters	130,000	132,000	83,500	84,800	42,700	44,000	-
B - H-P Closed Heaters	312,000	192,000	181,500	88,500	72,200	-	84,500
C - Deaerating Heater	112,000	108,500	106,000	104,500	102,500	102,000	-
D - Insulation							
a. Closed heaters	7,700	5,200	3,700	1,800	1,000	-	-
b. Deaerating	8,200	8,000	7,800	7,600	7,600	7,500	-
E - Structural Work							
a. For closed heaters	24,500	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	23,700	22,800	22,200	21,800	21,400	21,200	-
5. Boiler Feed Pumps							
a. Pumps and base plate	168,500	167,000	164,000	163,500	162,000	161,500	161,000
b. Fluid drive	121,500	121,500	96,000	96,000	96,000	96,000	96,000
c. Motors	265,500	246,000	235,500	225,000	213,000	208,000	208,000
d. Erection	21,700	20,700	19,500	19,000	18,200	18,000	17,600
e. Foundations for pumps	4,300	4,100	3,900	3,800	3,700	3,600	3,500
6. Condensate Pumps							
a. Pumps	47,100	46,800	31,200	31,500	24,300	25,500	-
b. Motors	25,400	25,300	15,500	15,900	11,800	12,400	-
c. Erection	5,000	5,000	4,800	4,900	4,700	4,700	-
7. Piping and Insulation							
a. Extraction steam)	242,300	210,600	179,900	149,200	119,400	83,900	49,200
b. Heater vents and drains)							
c. Boiler feed piping	179,000	160,000	118,100	109,000	109,000	64,400	133,000
d. Condensate piping)							
a'. From condensate pumps)							
through L-P heaters)	69,900	69,900	61,500	61,500	52,200	52,200	-
b'. For D.C. heater and)							
B.F. pump suction)							
e. Main steam	42,900	38,800	38,800	38,800	38,800	38,800	38,800
8. Demineralizing Equipment and Condensate Storage Tanks	175,000	168,000	160,000	157,000	152,000	150,000	147,000
9. Electrical	127,500	122,600	122,300	122,300	118,400	118,400	97,400
10. Turbine Room Building							
a. Building	-6,400	-6,400	-	-	-	-	-
b. Turbine generator sub-base	-1,000	-1,000	-	-	-	-	-
11. Condenser Pit-Size Increment	-	-	-	-	400	1,400	2,800
TOTAL ITEMS 1 - 11	13,197,450	13,011,950	13,460,100	13,350,600	13,277,400	13,233,200	13,270,750
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,388,950	18,203,450	18,651,600	18,542,100	18,468,900	18,424,700	18,462,250
12. Piping in Containment Vessel	473,600	378,100	378,100	378,100	378,100	375,900	375,900
GRAND TOTAL	18,862,550	18,581,550	19,029,700	18,920,200	18,847,000	18,800,600	18,838,150

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 887 F THROTTLE STEAM
(300 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	7	6	5	4	3	2	1
1. Turbine Generator And Accessories							
a. Turbine generator unit	7,810,000	7,810,000	7,810,000	7,810,000	8,440,000	8,440,000	8,440,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←			Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers							
a. Shells and accessories)	705,500	705,500	705,500	732,500	759,500	813,500	867,500
b. Dry vacuum pumps)							
c. Tubes	397,500	397,500	397,500	412,500	427,500	457,500	487,500
d. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
e. Erection	122,000	122,000	122,000	126,000	130,000	138,000	144,000
f. Deaeration - hot well of cond.	None	←					→ 39,000
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System							
A - Structures							
a. Crib house)							
a'. Substructure)							
b'. Superstructure)	447,000	448,000	450,000	458,000	470,000	489,000	509,000
c'. Steel)							
d'. Miscellaneous)							
b. Dredging)							
c. Intake flume or forebay)							
d. Seal well)							
e. Discharge flume)							
f. Outfall)							
B - Crib House Equipment (erected)							
a. Traveling screens)							
b. Screen wash pumps)	117,000	117,000	118,000	122,000	127,000	134,000	142,000
c. Screen wash piping)							
d. Chlorination equipment)							
e. Chlorine handling)							
C - Circulating Water Piping	459,000	460,000	462,000	467,000	475,000	489,000	502,000
D - Circulating Water Pumps							
a. Pumps	167,500	168,000	170,000	175,000	183,000	195,000	208,000
b. Motors	133,800	134,100	135,000	137,700	141,600	147,900	154,500
c. Erection	17,100	17,100	17,200	17,600	18,100	18,800	19,600
4. Feed Water Heaters							
A - L-P Closed Heaters	125,500	125,000	81,000	82,000	41,500	42,500	-
B - H-P Closed Heaters	299,500	186,500	175,500	85,500	71,000	-	82,500
C - Deaerating Heater	107,000	104,000	102,000	100,500	99,500	99,000	-
D - Insulation							
a. Closed heaters	7,200	4,900	3,500	1,650	950	-	-
b. Deaerating	7,900	7,700	7,500	7,400	7,400	7,300	-
E - Structural Work							
a. For closed heaters	24,500	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	22,500	21,700	21,200	20,900	20,600	20,500	-
5. Boiler Feed Pumps							
a. Pumps and base plate	166,000	164,500	162,000	161,500	160,500	160,000	159,000
b. Fluid drive	121,500	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	243,000	225,000	216,000	207,000	198,000	193,500	193,500
d. Erection	20,200	19,300	18,300	18,000	17,200	17,100	16,800
e. Foundations for pumps	4,000	3,900	3,700	3,600	3,500	3,400	3,400
6. Condensate Pumps							
a. Pumps	44,100	43,800	29,100	30,000	23,100	24,000	-
b. Motors	23,500	23,400	14,500	14,800	11,200	11,800	-
c. Erection	5,000	5,000	4,800	4,900	4,700	4,900	-
7. Piping And Insulation							
a. Extraction steam)	238,700	204,200	178,700	147,900	117,700	83,900	49,200
b. Heater vents and drains)							
c. Boiler feed piping	144,700	140,000	118,100	109,000	109,000	64,400	133,000
d. Condensate piping)							
a'. From condensate pumps)							
through L-P heaters)	69,900	69,900	61,500	55,400	50,600	50,600	-
b'. For D.C. heater and)							
B.F. pump suction)							
e. Main steam	52,900	48,700	44,700	44,700	44,700	44,700	44,700
8. Demineralizing Equipment And Condensate Storage Tanks	165,000	159,000	152,000	150,000	145,000	144,000	141,000
9. Electrical	118,600	118,600	117,400	113,900	114,900	114,900	93,900
10. Turbine Room Building							
a. Building	-6,400	-6,400	-6,400	-6,400	-	-	-
b. Turbine generator sub-base	-1,000	-1,000	-1,000	-1,000			
11. Condenser Pit-Size Increment	-	-	-	-	-	400	1,800
TOTAL ITEMS 1-11	12,976,450	12,756,650	12,595,800	12,507,050	13,100,250	13,090,140	13,128,150
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,167,950	17,948,150	17,787,300	17,698,550	18,291,750	18,281,640	18,319,650
12. Piping In Containment Vessel	442,600	397,200	395,300	393,100	393,100	393,100	393,100
GRAND TOTAL	18,610,550	18,345,350	18,182,600	18,091,650	18,684,850	18,674,740	18,712,750

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 987 F THROTTLE STEAM
(400 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
a. Turbine generator unit	8,050,000	8,050,000	8,050,000	8,050,000	8,050,000	8,680,000	8,680,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←			Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers							
a. Shells and accessories	665,000	665,000	678,500	692,000	719,000	759,500	813,500
b. Dry vacuum pumps	375,000	375,000	382,500	390,000	405,000	427,500	457,500
c. Tubes	19,250	19,250	17,500	17,500	17,500	17,500	33,250
d. Steam jet air equipment	116,000	116,000	118,000	120,000	124,000	130,000	138,000
e. Erection	None						36,500
f. Deaeration - hot well of cond.	20,000	20,000	20,000	20,000	10,000	10,000	10,000
g. L-P htrs. in exhaust stacks							
3. Circulating Water System							
A - Structures							
a. Crib house							
a'. Substructure							
b'. Superstructure							
c'. Steel							
d'. Miscellaneous	432,000	433,000	436,000	443,000	455,000	470,000	489,000
b. Dredging							
c. Intake flume or forebay							
d. Seal well							
e. Discharge flume							
f. Outfall							
B - Crib House Equipment (erected)							
a. Traveling screens							
b. Screen wash pumps	111,000	111,000	113,000	115,000	120,000	127,000	134,000
c. Screen wash piping							
d. Chlorination equipment							
e. Chlorine handling							
C - Circulating Water Piping	449,000	449,000	452,000	456,000	465,000	475,000	489,000
D - Circulating Water Pumps							
a. Pumps	158,000	158,500	161,000	165,500	173,000	183,000	195,500
b. Motors	129,000	129,200	130,500	132,900	136,400	141,500	147,900
c. Erection	16,500	16,500	16,700	16,900	17,400	18,100	18,800
4. Feed Water Heaters							
A - L-P Closed Heaters	111,000	121,500	80,000	80,000	40,500	41,500	-
B - H-P Closed Heaters	289,500	179,000	171,500	84,500	70,500	-	80,500
C - Deaerating Heater	103,000	100,000	98,500	97,000	96,000	95,500	-
D - Insulation							
a. Closed heaters	6,750	4,700	3,300	1,600	900	-	-
b. Deaerating	7,600	7,600	7,300	7,200	7,100	7,100	-
E - Structural Work							
a. For closed heaters	24,500	17,500	14,000	7,000	7,000	-	-
b. For deaerating heaters	21,500	20,900	20,500	20,100	20,000	19,800	-
5. Boiler Feed Pumps							
a. Pumps and base plate	164,000	162,000	161,500	159,500	159,000	158,500	157,500
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	225,000	208,000	201,000	192,000	184,500	180,000	180,000
d. Erection	19,100	18,300	17,400	17,100	16,500	16,300	16,000
e. Foundations for pumps	3,900	3,700	3,600	3,500	3,400	3,300	3,300
6. Condensate Pumps							
a. Pumps	42,000	41,700	27,600	28,200	22,200	22,800	-
b. Motors	21,600	21,500	13,700	14,000	10,600	11,100	-
c. Erection	4,800	4,700	4,500	4,600	4,500	4,700	-
7. Piping and Insulation							
a. Extraction steam	238,700	204,200	178,700	147,900	117,700	83,900	49,200
b. Heater vents and drains	144,700	140,000	118,100	104,100	104,100	64,400	133,000
c. Boiler feed piping							
d. Condensate piping							
a'. From condensate pumps thru L-P heaters	65,300	65,300	55,400	55,400	50,600	50,600	-
b'. For D.C. heater and B.F. pump suction							
e. Main steam	59,800	59,800	59,800	59,800	59,800	59,800	59,800
8. Demineralizing Equipment and Condensate Storage Tanks	157,000	151,000	145,000	144,000	140,000	139,000	137,000
9. Electrical	118,200	114,700	113,900	110,400	109,600	114,900	93,900
10. Turbine Room Building							
a. Building	-6,400	-6,400	-6,400	-6,400	-6,400	-	-
b. Turbine generator sub-base	-1,000	-1,000	-1,000	-1,000	-1,000	-	-
11. Condenser Pit-Size Increment	Base	-	-	-	-	-	400
TOTAL ITEMS 1 - 11	13,014,300	12,834,150	12,716,600	12,603,300	12,562,400	13,165,300	13,206,550
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,205,800	18,025,650	17,908,100	17,794,800	17,753,900	18,356,800	18,398,050
12. Piping in Containment Vessel	506,700	451,800	451,800	449,600	449,600	449,600	449,600
GRAND TOTAL	18,712,500	18,477,450	18,359,900	18,244,400	18,203,500	18,806,400	18,847,650

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 567 F THROTTLE STEAM (SATURATED STEAM)
300 MWe INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.	4,418,000	4,065,000	3,724,000	3,431,000	3,249,000	3,204,000
HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	9,240,000	9,240,000	9,240,000	9,240,000	9,240,000	9,240,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	Constant					
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories	867,500	881,000	908,000	935,000	1,002,500	1,068,000
b. Dry vacuum pumps						
c. Tubes	487,500	495,000	510,000	525,000	562,500	765,400
d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	33,250
e. Erection	144,000	146,000	150,000	154,000	164,000	165,500
f. Deaeration - hot well of cond.	-	-	-	-	-	44,500
g. L-P htrs. in exhaust stacks	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A. - Structures						
a. Crib house						
a'. Substructure						
b'. Superstructure						
c'. Steel						
d'. Miscellaneous	511,000	513,000	523,600	532,000	555,000	541,000
b. Dredging						
c. Intake flume						
d. Seal well						
e. Discharge flume						
f. Outfall						
B. Crib House Equipment (Erected)						
a. Traveling screens						
b. Screen wash pumps						
c. Screen wash piping	143,000	144,000	147,950	151,000	161,000	155,000
d. Chlorination equipment						
e. Chlorine handling						
C. Circulating Water Piping	501,000	502,000	509,600	515,000	532,000	522,000
D. Circulating Water Pumps						
a. Pumps	208,050	209,000	216,000	221,350	237,025	222,735
b. Motors	154,480	154,920	158,000	161,345	169,440	174,545
c. Erection	19,640	19,700	20,150	20,480	21,470	20,870
4. Feed Water Heaters						
A - L-P closed heaters	157,500	102,500	103,000	50,500	52,500	-
B - H-P closed heaters	235,500	217,500	104,500	92,000	-	92,500
C - Deaerating heater	127,000	122,000	118,000	114,000	112,000	-
D - Insulation						
a. Closed heaters	7,100	5,100	2,450	2,100	-	-
b. Deaerating	9,400	9,000	8,700	8,400	8,200	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	28,000	26,500	25,000	24,500	23,500	-
5. Boiler Feed Pumps						
a. Pumps and base plate	165,000	159,000	156,000	153,000	151,500	150,000
b. Fluid drive	121,500	96,000	96,000	96,000	96,000	96,000
c. Motors	248,830	236,705	214,875	197,235	184,890	184,005
d. Erection	22,500	20,700	19,500	18,300	17,700	17,400
e. Foundations for pumps	5,250	4,800	4,500	4,200	4,050	3,900
6. Condensate Pumps						
a. Pumps	69,750	38,250	37,200	28,050	29,550	-
b. Motors	43,780	22,450	22,450	13,540	14,080	
c. Erection	6,100	5,650	5,700	5,300	5,550	-
7. Piping and Insulation						
a. Extraction steam	201,000	178,800	147,000	127,200	81,000	47,900
b. Heater vents and drains	163,400	163,400	98,200	98,200	59,400	115,100
c. Boiler feed piping						
d. Condensate piping						
a'. From condensate pumps through L-P heaters	107,500	75,500	75,500	68,800	68,800	--
b'. For D-C heater and B.F. pump suction						
e. Main steam	19,000	19,000	17,100	17,100	17,100	17,100
8. Demineralizing Equipment and Condensate Storage Tanks	195,500	185,500	176,000	167,500	162,000	161,000
9. Electrical	130,300	124,200	121,000	117,200	121,000	100,000
10. Turbine Room Building	Base					
11. Condenser Pit-Size Increment	1,750	2,100	2,450	3,500	5,250	10,100
TOTAL ITEMS 1 - 11	14,955,280	14,729,225	14,541,375	14,453,000	14,443,205	14,514,550
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	20,146,780	19,920,725	19,732,875	19,644,500	19,634,705	19,706,050
12. Piping in Containment Vessel	408,000	358,000	330,000	308,000	296,000	294,000
GRAND TOTAL	20,554,780	20,278,725	20,062,875	19,952,500	19,930,705	20,000,050

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 667 F THROTTLE STEAM
(100 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←		Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories)	813,500	827,000	840,500	857,500	908,000	989,000
b. Dry vacuum pumps)						
c. Tubes	457,500	465,000	472,500	487,500	510,000	555,000
d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	33,250
e. Erection	138,000	139,000	140,000	144,000	150,000	162,000
f. Deaeration - hot well of cond.	-	-	-	-	-	44,500
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house)						
a'. Substructure)						
b'. Superstructure)						
c'. Steel)						
d'. Miscellaneous)	490,000	492,000	498,000	506,000	523,000	549,000
b. Dredging)						
c. Intake flume or forebay)						
d. Seal well)						
e. Discharge flume)						
f. Outfall)						
B - Crib House Equipment (erected						
a. Traveling screens)						
b. Screen wash pumps)						
c. Screen wash piping)	134,500	135,500	138,000	141,000	148,000	159,000
d. Chlorination equipment)						
e. Chlorine handling)						
C - Circulating Water Piping	489,000	491,000	495,000	500,000	512,000	530,500
D - Circulating Water Pumps						
a. Pumps	196,000	197,000	201,000	206,000	217,000	234,000
b. Motors	148,000	149,000	151,000	153,500	159,000	168,000
c. Erection	18,900	19,000	19,200	19,500	20,200	21,300
4. Feed Water Heaters						
A - L-P Closed Heaters	153,500	96,500	97,500	48,500	50,000	-
B - H-P Closed Heaters	217,500	202,000	98,500	88,500	-	89,500
C - Deaerating Heater	118,000	114,000	111,000	108,500	107,000	-
D - Insulation						
a. Closed heaters	6,350	4,550	2,200	1,550	-	-
b. Deaerating	8,700	8,350	8,200	8,000	7,900	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	25,200	24,300	23,500	22,800	22,500	-
5. Boiler Feed Pumps						
a. Pumps and base plate	158,500	154,500	153,000	150,500	149,500	148,000
b. Fluid drive	121,500	96,000	96,000	96,000	96,000	96,000
c. Motors	249,000	230,000	221,000	208,000	199,500	196,500
d. Erection	20,200	18,800	18,200	17,300	17,000	16,500
e. Foundations for pumps	4,650	4,350	4,200	3,950	3,900	3,750
6. Condensate Pumps						
a. Pumps	61,200	34,400	35,100	26,000	27,600	-
b. Motors	38,800	20,400	20,700	12,700	13,300	-
c. Erection	5,600	5,200	5,300	5,000	5,300	-
7. Piping and Insulation						
a. Extraction steam)	201,000	178,800	147,000	127,200	81,000	47,900
b. Heater vents and drains)						
c. Boiler feed piping	161,200	161,200	102,600	102,600	64,100	124,200
d. Condensate piping)						
a'. From condensate pumps)						
through L-P heaters)	72,600	61,500	61,500	61,700	61,700	-
b'. For D.C. heater and)						
B.F. pump suction)						
e. Main steam	21,800	21,800	12,000	12,000	12,000	12,000
8. Demineralizing Equipment and Condensate Storage Tanks	191,000	178,000	171,000	163,000	160,000	155,000
9. Electrical	129,500	123,100	123,100	118,400	118,400	102,200
10. Turbine Room Building						
a. Building	-	-	-	-	-	-
b. Turbine generator sub-base	-	-	-	-	-	-
11. Condenser Pit-Size Increment	400	700	1,100	1,800	2,800	4,900
TOTAL ITEMS 1 - 11	14,385,350	14,183,200	13,991,150	13,920,500	13,851,200	13,929,000
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	19,576,850	19,374,700	19,182,650	19,112,000	19,042,700	19,120,500
12. Piping in Containment Vessel	271,500	271,500	279,200	279,200	279,200	278,700
GRAND TOTAL	19,848,350	19,646,200	19,461,850	19,391,200	19,321,900	19,399,200

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 767 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator And Accessories						
a. Turbine generator unit	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←		Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories)	773,000	786,500	800,000	813,500	854,000	908,000
b. Dry vacuum pumps)						
c. Tubes	435,000	442,500	450,000	457,500	480,000	510,000
d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	33,250
e. Erection	132,000	134,000	136,000	138,000	142,000	150,000
f. Deaeration - hot well of cond.	None	←			→	41,000
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house)						
a'. Substructure)						
b'. Superstructure)	472,000	476,000	481,000	486,000	500,000	524,000
c'. Steel)						
d'. Miscellaneous)						
b. Dredging)						
c. Intake flume or forebay)						
d. Seal well)						
e. Discharge flume)						
f. Outfall)						
B - Crib House Equipment (erected)						
a. Traveling screens)						
b. Screen wash pumps)	127,500	129,000	131,000	133,000	139,000	148,500
c. Screen wash piping)						
d. Chlorination equipment)						
e. Chlorine handling)						
C - Circulating Water Piping	477,000	479,500	483,000	486,500	496,000	513,000
D - Circulating Water Pumps						
a. Pumps	184,000	187,000	190,000	193,000	202,000	218,000
b. Motors	142,000	143,500	145,000	147,000	151,500	159,500
c. Erection	18,100	18,300	18,500	18,700	19,300	20,300
4. Feed Water Heaters						
A - L-P Closed Heaters	145,500	93,000	93,000	46,000	47,500	-
B - H-P Closed Heaters	210,500	192,000	95,500	84,500	-	86,500
C - Deaerating Heater	112,000	108,500	106,000	102,500	102,500	-
D - Insulation						
a. Closed heaters	6,000	4,200	2,100	1,500	-	-
b. Deaerating	8,200	8,000	7,800	7,700	7,400	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	23,700	22,800	22,200	21,700	21,400	-
5. Boiler Feed Pumps						
a. Pumps and base plate	154,500	151,500	150,000	147,500	147,000	146,000
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	222,000	213,000	199,500	189,000	181,500	180,500
d. Erection	18,800	17,700	17,100	16,400	16,200	15,700
e. Foundations for pumps	4,350	4,050	3,900	3,750	3,700	3,600
6. Condensate Pumps						
a. Pumps	55,600	31,700	32,200	24,000	25,300	-
b. Motors	35,500	18,900	19,200	11,900	12,400	-
c. Erection	5,200	4,900	5,000	4,800	5,000	-
7. Piping And Insulation						
a. Extraction steam)						
b. Heater vents and drains)	201,000	177,500	147,000	127,200	81,000	47,900
c. Boiler feed piping	161,200	129,900	102,600	102,600	64,100	124,200
d. Condensate piping)						
a'. From condensate pumps)						
through L-P heaters)	72,600	61,500	61,500	61,700	61,700	-
b'. For D.C. heater and)						
B.F. pump suction)						
e. Main steam	41,200	41,200	36,900	34,100	34,100	34,100
8. Demineralizing Equipment And Condensate Storage Tanks	178,000	166,000	161,000	155,000	151,000	148,000
9. Electrical	125,000	122,700	119,200	114,900	114,900	93,900
10. Turbine Room Building						
a. Building	-	-	-	-	-	-
b. Turbine Generator sub-base	-	-	-	-	-	-
11. Condenser Pit-Size Increment	-	-	-	400	1,400	2,800
TOTAL ITEMS 1 - 11	13,691,300	13,511,600	13,355,450	13,257,850	13,182,400	13,211,750
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,882,800	18,703,100	18,546,950	18,449,350	18,373,900	18,403,250
12. Piping In Containment Vessel	365,100	402,600	332,700	328,500	328,500	328,000
GRAND TOTAL	19,247,900	19,105,700	18,879,650	18,777,850	18,702,400	18,731,250

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 867 F THROTTLE STEAM
(300 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	7,810,000	7,810,000	7,810,000	8,440,000	8,440,000	8,440,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←		Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories	719,000	732,500	746,000	759,500	800,000	854,000
b. Dry vacuum pumps						
c. Tubes	405,000	412,500	420,000	427,500	450,000	480,000
d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	33,250
e. Erection	124,000	126,000	128,000	130,000	136,000	142,000
f. Deaeration - hot well of cond.	None	←				→ 38,500
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house						
a'. Substructure						
b'. Superstructure	455,000	458,000	461,000	469,000	481,000	501,500
c'. Steel						
d'. Miscellaneous						
b. Dredging						
c. Intake flume or forebay						
d. Seal well						
e. Discharge flume						
f. Outfall						
B - Crib House Equipment (erected)						
a. Traveling screens						
b. Screen wash pumps	120,000	121,500	123,000	126,000	131,000	139,500
c. Screen wash piping						
d. Chlorination equipment						
e. Chlorine handling						
C - Circulating Water Piping	464,500	467,000	469,000	474,500	483,000	497,500
D - Circulating Water Pumps						
a. Pumps	173,000	175,000	177,000	182,000	190,000	203,000
b. Motors	142,000	143,500	145,000	147,000	151,500	159,500
c. Erection	17,400	17,500	17,700	18,000	18,500	19,300
4. Feed Water Heaters						
A - L-P Closed Heaters	140,000	88,700	89,000	44,500	46,000	-
B - H-P Closed Heaters	197,500	184,500	94,000	82,000	-	84,000
C - Deaerating Heater	107,000	104,000	102,000	100,000	99,000	-
D - Insulation						
a. Closed heaters	5,500	3,900	1,900	1,400	-	-
b. Deaerating	7,900	7,700	7,500	7,400	7,300	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	22,500	21,800	21,300	20,900	20,600	-
5. Boiler Feed Pumps						
a. Pumps and base plate	151,500	149,000	147,500	145,500	145,000	144,000
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	202,000	194,000	182,500	173,500	168,000	167,000
d. Erection	17,800	16,800	16,300	15,700	15,500	15,100
e. Foundations for pumps	4,100	3,850	3,700	3,550	3,500	3,450
6. Condensate Pumps						
a. Pumps	51,100	29,200	29,900	22,400	23,500	-
b. Motors	32,800	17,600	17,900	11,200	11,700	-
c. Erection	4,900	4,700	4,700	4,500	4,700	-
7. Piping and Insulation						
a. Extraction steam	200,600	171,900	147,000	111,500	76,300	47,900
b. Heater vents and drains						
c. Boiler feed piping	129,900	129,900	102,600	102,600	64,100	124,200
d. Condensate piping						
a'. From condensate pumps thru L-P heaters	72,600	61,500	61,500	57,200	55,600	-
b'. For D.C. heater and B.F. pump suction						
e. Main steam	47,200	47,200	47,200	47,200	47,200	47,200
8. Demineralizing Equipment and Condensate Storage Tanks	168,000	158,000	153,000	148,000	145,000	142,000
9. Electrical	116,700	114,300	110,800	114,900	114,900	90,300
10. Turbine Room Building						
a. Building	-6,400	-6,400	-6,400	-	-	-
b. Turbine generator sub-base	-1,000	-1,000	-1,0000	-	-	-
11. Condenser Pit-Size Increment	-	-	-	-	-	2,500
TOTAL ITEMS 1 - 11	12,811,850	12,670,900	12,528,850	13,074,950	13,009,400	13,038,700
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,003,350	17,862,400	17,720,350	18,266,450	18,200,900	18,230,200
12. Piping in Containment Vessel	384,500	384,500	381,900	381,900	381,900	381,400
GRAND TOTAL	18,387,850	18,246,900	18,102,250	18,648,350	18,582,800	18,611,600

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 967 F THROTTLE STEAM
(400 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	8,050,000	8,050,000	8,050,000	8,050,000	8,050,000	8,680,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←			Constant		→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories	678,500	692,000	705,500	705,500	746,000	800,000
b. Dry vacuum pumps						
c. Tubes	382,500	390,000	397,500	397,500	420,000	450,000
d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	17,500
e. Erection	118,000	120,000	122,000	122,000	128,000	136,000
f. Deaeration - hot well of cond.	None	→				36,000
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house						
a'. Substructure						
b'. Superstructure	439,000	442,000	446,000	450,000	463,000	484,000
c'. Steel						
d'. Miscellaneous						
b. Dredging						
c. Intake flume or forebay						
d. Seal well						
e. Discharge flume						
f. Outfall						
B - Crib House Equipment (erected)						
a. Traveling screens						
b. Screen wash pumps	113,500	115,000	116,500	118,500	123,500	132,000
c. Screen wash piping						
d. Chlorination equipment						
e. Chlorine handling						
C - Circulating Water Piping	453,500	455,500	458,500	461,500	470,000	485,000
D - Circulating Water Pumps						
a. Pumps	162,000	164,000	167,000	170,000	178,000	192,000
b. Motors	131,000	132,000	133,500	135,000	139,000	146,000
c. Erection	16,800	16,900	17,100	17,200	17,700	18,600
4. Feed Water Heaters						
A - L-P Closed Heaters	133,000	85,500	86,000	43,000	44,500	-
B - H-P Closed Heaters	190,000	178,000	87,500	80,000	-	81,500
C - Deaerating Heater	103,000	100,500	98,500	97,000	96,000	-
D - Insulation						
a. Closed heaters	5,150	3,700	1,800	1,300	-	-
b. Deaerating	7,600	7,400	7,300	7,200	7,200	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	21,500	20,900	20,500	20,200	20,000	-
5. Boiler Feed Pumps						
a. Pumps and base plate	149,000	146,500	145,500	144,000	143,500	142,500
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	185,000	178,500	169,000	161,000	156,500	156,000
d. Erection	16,900	16,000	15,600	15,100	14,900	14,600
e. Foundations for pumps	3,850	3,650	3,550	3,450	3,400	3,300
6. Condensate Pumps						
a. Pumps	47,300	27,200	27,700	20,900	22,000	-
b. Motors	30,500	16,500	16,800	10,600	11,000	-
c. Erection	4,600	4,500	4,500	4,300	4,500	-
7. Piping and Insulation						
a. Extraction steam						
b. Heater vents and drains	198,400	171,400	147,000	111,500	76,300	47,900
c. Boiler feed piping	129,900	129,900	102,600	102,600	64,100	124,200
d. Condensate piping						
a'. From condensate pumps thru L-P heaters						
b'. For D.C. heater and B.F. pump suction	68,000	57,000	55,600	55,600	55,600	-
e. Main steam	55,200	55,200	55,200	55,200	55,200	55,200
8. Demineralizing Equipment and Condensate Storage Tanks	159,000	150,000	147,000	142,000	140,000	137,000
9. Electrical	112,400	110,800	110,800	106,000	106,400	90,300
10. Turbine Plant Building						
a. Building	-6,400	-6,400	-6,400	-6,400	-6,400	-
b. Turbine generator sub-base	-1,000	-1,000	-1,000	-1,000	-1,000	-
11. Condenser Pit-Size Increment	-	-	-	-	-	-
TOTAL ITEMS 1 - 11	12,867,450	12,739,400	12,607,900	12,488,250	12,429,400	13,092,600
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,058,950	17,930,900	17,799,400	17,679,750	17,620,900	18,284,100
12. Piping in Containment Vessel	404,700	404,700	402,100	402,100	402,100	401,600
GRAND TOTAL	18,463,650	18,335,600	18,201,500	18,081,850	18,023,000	18,685,700

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 545 F THROTTLE STEAM (SATURATED STEAM)
300 MWe INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.	4,337,000	4,014,000	3,708,000	3,471,000	3,316,000	3,060,000
HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	9,240,000	9,240,000	9,240,000	9,240,000	9,240,000	9,240,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	Constant					
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories)	908,000	921,500	948,500	975,500	1,029,000	1,116,000
b. Dry vacuum pumps)						
c. Tubes	510,000	517,500	532,500	547,500	577,500	800,800
d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	31,500
e. Erection	150,000	152,000	156,000	160,000	168,000	171,500
f. Deaeration - hotwell of cond.	-	-	-	-	-	46,500
g. L.P. htrs. in exhaust stacks	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house)						
a'. Substructure)						
b'. Superstructure)						
c'. Steel)						
d'. Miscellaneous)	524,000	528,000	535,000	547,000	570,500	556,000
b. Dredging)						
c. Intake flume)						
d. Seal well)						
e. Discharge flume)						
f. Outfall)						
B - Crib House Equipment (Erected)						
a. Traveling screens)						
b. Screen wash pumps)						
c. Screen wash piping)	148,000	150,000	153,000	157,000	166,800	161,000
d. Chlorination equipment)						
e. Chlorine handling)						
C - Circulating Water Piping	510,000	513,000	518,000	526,000	543,500	533,000
D - Circulating Water Pumps						
a. Pumps	216,125	218,975	223,725	231,325	247,000	235,500
b. Motors	158,705	160,200	162,665	166,360	174,200	180,000
c. Erection	20,150	20,330	20,630	21,110	22,000	21,500
4. Feed Water Heaters						
A - L-P closed heaters	148,000	103,500	104,000	51,500	53,500	-
B - H-P closed heaters	216,000	197,000	91,500	83,000	-	87,500
C - Deaerating heater	126,000	122,000	118,000	114,000	112,000	-
D - Insulation						
a. Closed heaters	6,600	4,800	2,150	1,500	-	-
b. Deaerating	9,300	9,000	8,700	8,400	8,200	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	27,500	26,500	25,500	24,500	23,500	-
5. Boiler Feed Pumps						
a. Pumps and base plate	150,000	145,500	142,500	139,500	138,000	135,000
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	209,365	199,440	182,460	169,875	160,410	150,930
d. Erection	19,500	18,300	17,400	16,500	17,400	15,000
e. Foundations for pumps	5,100	4,800	4,500	4,200	4,050	3,900
6. Condensate Pumps						
a. Pumps	53,250	39,000	39,300	28,800	30,300	-
b. Motors	32,710	21,370	21,640	13,810	14,350	-
c. Erection	5,500	5,750	5,750	5,450	5,650	-
7. Piping and Insulation						
a. Extraction steam)						
b. Heater vents and drains)	192,700	170,400	138,700	127,200	81,000	43,200
c. Boiler feed piping	132,100	132,100	83,500	83,500	53,000	98,200
d. Condensate piping						
a'. From condensate pumps thru)						
L.P. heaters)	107,500	75,500	75,000	68,800	68,800	-
b'. For D.C. heater and B.F.)						
pump suction)						
e. Main steam	23,500	22,600	20,700	19,000	19,000	19,000
8. Demineralizing Equipment and Condensate Storage Tanks	193,000	184,000	175,000	168,500	164,000	157,000
9. Electrical	123,400	121,700	118,700	114,700	116,400	91,700
10. Turbine Room Building	Base					
11. Condenser Pit-Size Increment	2,800	3,150	3,850	4,550	5,600	11,500
TOTAL ITEMS 1 - 11	14,878,255	14,733,865	14,567,820	14,506,280	14,455,710	14,568,930
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	20,069,755	19,925,365	19,759,320	19,697,780	19,647,210	19,760,430
12. Piping in Containment Vessel	316,000	276,000	256,000	252,000	250,000	252,000
GRAND TOTAL	20,385,755	20,201,365	20,015,320	19,949,780	19,897,210	20,012,430

TABLE 12.3 (Continued)

1000 PSIA, 645 F THROTTLE STEAM
(100 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000	8,920,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	← Constant →					
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories)	854,000	854,000	881,000	908,000	935,000	1,016,000
b. Dry vacuum pumps)						
c. Tubes	480,000	480,000	495,000	510,000	525,000	570,000
d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	31,500
e. Erection	142,000	142,000	146,000	150,000	154,000	166,000
f. Deaeration - hot well of cond.	None	→				45,600
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house)						
a'. Substructure)						
b'. Superstructure)						
c'. Steel)	502,000	504,000	510,000	520,000	534,000	560,000
d'. Miscellaneous)						
b. Dredging)						
c. Intake flume or forebay)						
d. Seal well)						
e. Discharge flume)						
f. Outfall)						
B - Crib House Equipment (erected)						
a. Traveling screens)						
b. Screen wash pumps)	140,000	140,000	143,000	147,000	153,000	163,000
c. Screen wash piping)						
d. Chlorination equipment)						
e. Chlorine handling)						
C - Circulating Water Piping	498,000	499,000	503,000	510,000	520,000	538,000
D - Circulating Water Pumps						
a. Pumps	204,000	205,000	209,000	215,000	224,000	241,000
b. Motors	152,500	143,000	155,000	158,000	163,000	171,500
c. Erection	19,350	19,450	19,700	20,100	20,700	21,700
4. Feed Water Heaters						
A - L-P Closed Heaters	148,000	97,500	98,500	49,000	50,700	-
B - H-P Closed Heaters	201,000	184,000	87,500	80,500	-	87,000
C - Deaerating Heater	117,500	114,000	111,000	109,000	108,000	-
D - Insulation						
a. Closed heaters	6,100	4,300	2,000	1,400	-	-
b. Deaerating	8,600	8,400	8,200	8,000	7,900	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	25,100	24,200	23,500	23,000	22,600	-
5. Boiler Feed Pumps						
a. Pumps and base plate	144,000	140,500	139,000	137,000	136,000	134,500
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	222,000	206,500	193,000	184,000	176,500	175,500
d. Erection	17,800	16,800	16,300	15,700	15,400	15,000
e. Foundations for pumps	4,600	4,300	4,150	4,000	3,950	3,800
6. Condensate Pumps						
a. Pumps	46,200	34,900	35,550	27,000	28,400	-
b. Motors	33,700	19,500	19,800	13,000	13,600	-
c. Erection	5,600	5,300	5,400	5,200	5,300	-
7. Piping and Insulation						
a. Extraction steam)	192,700	170,400	138,700	127,200	81,000	43,200
b. Heater vents and drains)						
c. Boiler feed piping	135,000	135,000	102,600	87,700	64,100	105,000
d. Condensate piping)						
a'. From condensate pumps thru)						
L-P heaters)	72,600	61,500	61,500	61,700	61,700	-
b'. For D.C. heater and)						
B.F. pump suction)						
e. Main steam	16,100	15,000	15,000	15,000	15,000	15,000
8. Demineralizing Equipment and Condensate Storage Tanks	188,000	176,000	171,000	164,000	161,000	157,000
9. Electrical	125,100	119,600	119,600	114,900	119,700	98,700
10. Turbine Room Building						
a. Building	Base	Base	Base	Base	Base	Base
b. Turbine generator sub-base	Base	Base	Base	Base	Base	Base
11. Condenser Pit-Size Increment	1,400	1,400	2,100	2,800	3,500	5,600
TOTAL ITEMS 1 - 11	14,332,700	14,151,800	14,035,350	13,975,700	13,903,550	13,932,600
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	19,524,200	19,343,300	19,226,850	19,167,200	19,095,050	19,124,100
12. Piping in Containment Vessel	269,600	256,400	291,300	291,300	291,300	240,400
GRAND TOTAL	19,793,800	19,599,700	19,518,150	19,458,500	19,386,350	19,364,500

TABLE 12.3 (Continued)

1000 PSIA, 745 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator And Accessories						
a. Turbine generator unit	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	← Constant →					
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories)	800,000	800,000	813,500	840,500	881,000	935,000
b. Dry vacuum pumps)						
c. Tubes	450,000	450,000	457,500	472,500	495,000	525,000
d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	31,500
e. Erection	136,000	136,000	138,000	140,000	146,000	154,000
f. Deaeration - hot well of cond.	None	→				42,100
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house)						
a'. Substructure)						
b'. Superstructure)	482,000	485,000	489,000	499,000	512,000	532,000
c'. Steel)						
d'. Miscellaneous)						
b. Dredging)						
c. Intake flume or forebay)						
d. Seal well)						
e. Discharge flume)						
f. Outfall)						
B - Crib House Equipment (erected)						
a. Traveling screens)						
b. Screen wash pumps)	131,000	132,000	134,000	138,000	144,000	152,000
c. Screen wash piping)						
d. Chlorination equipment)						
e. Chlorine handling)						
C - Circulating Water Piping	484,000	486,000	489,000	496,000	504,000	519,000
D - Circulating Water Pumps						
a. Pumps	190,000	192,000	195,000	202,000	210,000	225,000
b. Motors	145,500	146,000	148,000	151,500	155,500	162,500
c. Erection	18,050	18,650	18,850	19,250	19,800	20,600
4. Feed Water Heaters						
A - L-P Closed Heaters	139,500	93,000	93,500	47,000	49,000	-
B - H-P Closed Heaters	190,000	175,500	83,200	77,500	-	86,500
C - Deaerating Heater	112,000	108,700	106,500	105,000	104,000	-
D - Insulation						
a. Closed heaters	5,600	4,000	1,800	1,300	-	-
d. Deaerating	8,200	8,000	7,800	7,700	7,600	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	23,600	22,900	22,900	21,900	21,600	-
5. Boiler Feed Pumps						
a. Pumps and base plate	140,500	137,500	136,000	134,500	133,500	132,500
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	199,000	186,000	174,500	167,500	162,000	161,500
d. Erection	16,700	15,800	15,400	14,900	14,700	14,300
e. Foundations for pumps	4,300	4,050	3,950	3,800	3,750	3,650
6. Condensate Pumps						
a. Pumps	42,000	32,100	32,600	25,000	26,200	-
b. Motors	30,800	18,100	18,400	12,200	12,700	-
c. Erection	5,200	5,000	5,000	4,900	5,000	-
7. Piping And Insulation						
a. Extraction Steam)						
b. Heater vents and drains)	192,600	161,800	138,200	127,100	81,000	43,200
c. Boiler feed piping	135,000	135,000	102,600	87,700	64,100	105,000
d. Condensate piping)						
a'. From condensate pumps)						
through L-P heaters)	72,600	61,500	61,500	61,700	61,700	-
b'. For D.C. heater and)						
B.F. pump suction)						
e. Main steam	16,100	15,000	15,000	15,000	15,000	15,000
8. Demineralizing Equipment And Condensate Storage Tanks	176,000	166,000	161,000	155,000	153,000	150,000
9. Electrical	121,600	115,700	115,700	114,900	111,300	90,300
10. Turbine Room Building						
a. Building	Base	Base	Base	Base	Base	Base
b. Turbine generator sub-base	Base	Base	Base	Base	Base	Base
11. Condenser Pit-Size Increment	Base	Base	400	1,100	2,100	3,500
TOTAL ITEMS 1 - 11	13,617,600	13,457,550	13,318,050	13,271,950	13,216,050	13,207,150
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,809,100	18,649,050	18,509,550	18,463,450	18,407,550	18,398,650
12. Piping In Containment Vessel	294,500	277,400	312,300	312,300	312,300	261,400
GRAND TOTAL	19,103,600	18,926,450	18,841,850	18,775,750	18,719,850	18,660,050

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 845 F THROTTLE STEAM
(300 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000	8,440,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←		Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories	746,000	759,500	773,000	786,500	827,000	881,000
b. Dry vacuum pumps						
c. Tubes	420,000	427,500	435,000	442,500	465,000	495,000
d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	31,500
e. Erection	128,000	130,000	132,000	134,000	139,000	146,000
f. Deaeration - hot well of cond.	None	←				→ 39,700
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house						
a'. Substructure						
b'. Superstructure						
c'. Steel						
d'. Miscellaneous	465,000	466,000	472,000	480,000	490,000	512,000
b. Dredging						
c. Intake flume or forebay						
d. Seal well						
e. Discharge flume						
f. Outfall						
B - Crib House Equipment (erected)						
a. Traveling screens						
b. Screen wash pumps						
c. Screen wash piping	124,000	125,000	127,000	130,000	135,000	144,000
d. Chlorination equipment						
e. Chlorine handling						
C - Circulating Water Piping	472,000	473,000	477,000	482,000	490,000	504,000
D - Circulating Water Pumps						
a. Pumps	180,000	181,000	184,000	189,000	196,000	210,000
b. Motors	140,000	140,500	142,500	144,500	148,500	155,500
c. Erection	17,850	17,900	18,150	18,450	18,900	19,800
4. Feed Water Heaters						
A - L-P Closed Heaters	136,000	89,500	90,000	45,500	46,500	-
B - H-P Closed Heaters	182,500	169,500	80,500	75,800	-	81,800
C - Deaerating Heater	107,000	104,400	102,000	101,000	00,000	-
D - Insulation						
a. Closed heaters	5,300	3,700	1,700	1,300	-	-
b. Deaerating	7,900	7,600	7,500	7,500	7,400	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	22,500	21,800	21,400	21,000	20,800	-
5. Boiler Feed Pumps						
a. Pumps and base plate	137,500	135,000	133,500	132,500	132,000	131,000
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	181,000	170,000	160,500	154,500	150,000	150,500
d. Erection	15,800	15,100	14,700	14,300	14,100	13,800
e. Foundation for pumps	4,050	3,850	3,750	3,600	3,550	3,500
6. Condensate Pumps						
a. Pumps	38,700	29,700	30,200	23,200	24,400	-
b. Motors	28,500	16,900	17,200	11,500	11,900	-
c. Erection	5,000	4,700	4,800	4,600	4,800	-
7. Piping and Insulation						
a. Extraction steam	187,400	161,300	135,400	122,500	80,500	43,200
b. Heater vents and drains						
c. Boiler feed piping	129,900	129,900	102,600	87,700	64,100	105,000
d. Condensate piping						
a'. From condensate pumps through L-P heaters	72,600	61,500	61,500	57,200	57,200	-
b'. For D.C. heater and B.F. pump suction						
e. Main steam	44,300	44,300	41,200	41,200	41,200	41,200
8. Demineralizing Equipment and Condensate Storage Tanks	166,000	158,000	154,000	149,000	147,000	144,000
9. Electrical	112,400	110,800	112,100	111,300	111,300	90,300
10. Turbine Room Building						
a. Building	Base	Base	Base	Base	Base	Base
b. Turbine generator sub-base	Base	Base	Base	Base	Base	Base
11. Condenser Pit-Size Increment	Base	Base	Base	Base	700	2,100
TOTAL ITEMS 1 - 11	13,426,950	13,304,200	13,174,450	13,099,650	13,047,350	13,047,900
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,618,450	18,495,700	18,365,950	18,291,150	18,238,850	18,239,400
12. Piping in Containment Vessel	405,700	368,200	400,000	400,000	400,000	349,100
GRAND TOTAL	19,024,150	18,863,900	18,765,950	18,691,150	18,638,850	18,588,500

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 945 F THROTTLE STEAM
(400 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	7,890,000	7,890,000	7,890,000	7,890,000	8,519,700	8,519,700
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←		Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories	692,000	705,500	719,000	746,000	773,000	827,000
b. Dry vacuum pumps						
c. Tubes	390,000	397,500	405,000	420,000	435,000	465,000
d. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	17,500
e. Erection	120,000	122,000	124,000	128,000	132,000	139,000
f. Deaeration - hot well of cond	None	←			→	37,200
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house						
a'. Substructure						
b'. Superstructure	447,000	450,000	455,000	461,000	471,000	490,000
c'. Steel						
d'. Miscellaneous						
b. Dredging						
c. Intake flume or forebay						
d. Seal well						
e. Discharge flume						
f. Outfall						
B - Crib House Equipment (erected)						
a. Traveling screens						
b. Screen wash pumps	117,000	118,000	120,000	123,000	127,000	135,000
c. Screen wash piping						
d. Chlorination equipment						
e. Chlorine handling						
C - Circulating Water Piping	460,000	461,000	465,000	469,000	476,000	490,000
D - Circulating Water Pumps						
a. Pumps	163,000	165,000	173,000	177,000	183,000	196,000
b. Motors	134,000	135,000	136,500	138,500	142,000	148,000
c. Erection	17,100	17,200	17,400	17,700	18,100	18,900
4. Feed Water Heaters	132,000	87,000	85,000	44,000	45,000	-
A - L-P Closed Heaters	176,500	163,700	78,500	74,000	-	80,000
B - H-P Closed Heaters	103,000	101,000	99,000	98,000	97,000	-
C - Deaerating Heater						
D - Insulation						
a. Closed heaters	5,000	3,500	1,650	1,200	-	-
b. Deaerating	7,600	7,500	7,300	7,300	7,200	
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	21,500	21,000	20,500	20,400	20,200	-
5. Boiler Feed Pumps						
a. Pumps and base plate	135,000	133,000	132,000	130,500	130,000	129,500
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	166,500	157,000	148,500	144,500	139,500	140,500
d. Erection	15,100	14,400	14,100	13,800	13,700	13,400
e. Foundations for pumps	3,850	3,650	3,550	3,450	3,450	3,350
6. Condensate Pumps						
a. Pumps	35,800	27,800	28,000	21,800	22,600	-
b. Motors	26,600	16,000	16,100	10,900	11,300	-
c. Erection	4,700	4,500	4,600	4,400	4,600	-
7. Piping and Insulation						
a. Extraction steam						
b. Heater vents and drains	187,400	161,300	135,400	122,500	80,500	43,200
c. Boiler feed piping	129,900	129,900	102,600	87,700	64,100	105,000
d. Condensate piping						
a'. From condensate pumps thru L-P heaters	68,000	57,000	57,000	55,600	55,600	-
b'. For D.C. heater and B.F. pump suction						
e. Main steam	57,400	57,400	57,400	57,400	57,400	50,800
8. Demineralizing Equipment and Condensate Storage Tanks	158,000	151,000	148,000	144,000	142,000	139,000
9. Electrical	108,400	106,800	106,800	102,900	107,800	86,800
10. Turbine Room Building						
a. Building	-6,400	-6,400	-6,400	-6,400	-	-
b. Turbine generator sub-base	-1,000	-1,000	-1,000	-1,000	-	-
11. Condenser Pit-Size Increment	-	-	-	-	-	700
TOTAL ITEMS 1 - 11	12,674,700	12,563,500	12,442,750	12,959,250	12,959,250	12,938,550
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	17,866,200	17,755,000	17,634,250	17,586,150	18,150,750	18,130,050
12. Piping in Containment Vessel	453,800	416,300	451,200	451,200	451,200	391,700
GRAND TOTAL	18,320,000	18,171,300	18,085,450	18,037,350	18,601,950	18,521,750

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
800 PSIA, 518 F THROTTLE STEAM (SATURATED STEAM)
300 MWe INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.	4,267,000	3,979,000	3,712,000	3,498,000	3,352,000	3,372,000
HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	10,445,000	10,445,000	10,445,000	10,445,000	10,445,000	10,445,000
b. Turbine generator erection	419,000	419,000	419,000	419,000	419,000	419,000
c. Reserve exciter	Constant					
d. Turbine foundation	190,000	190,000	190,000	190,000	190,000	190,000
2. Condensers						
a. Shells and accessories)	948,500	962,000	975,500	1,016,000	1,056,500	1,140,000
b. Dry vacuum pumps)						
c. Tubes	532,500	540,000	547,500	570,000	592,500	817,000
d. Steam jet air equipment	19,250	17,500	17,500	17,500	17,500	28,000
e. Erection	156,000	158,000	160,000	166,000	172,000	174,500
f. Deaeration - hotwell of cond.	-	-	-	-	-	47,500
g. L-P htrs. in exhaust stacks	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house)						
a'. Substructure)						
b'. Superstructure)						
c'. Steel)						
d'. Miscellaneous)	540,000	544,000	549,000	561,000	577,000	560,000
b. Dredging)						
c. Intake flume)						
d. Seal well)						
e. Discharge flume)						
f. Outfall)						
B - Crib House Equipment (erected)						
a. Traveling screens)						
b. Screen wash pumps)						
c. Screen wash piping)	155,000	156,000	158,000	163,000	169,000	163,000
d. Chlorination equipment)						
e. Chlorine handling)						
C - Circulating Water Piping	522,000	524,000	528,000	537,000	548,000	536,000
D - Circulating Water Pumps						
a. Pumps	227,050	229,425	233,225	240,825	251,275	235,290
b. Motors	164,160	165,305	167,505	171,200	176,745	181,585
c. Erection	20,840	20,990	21,230	21,720	22,370	21,680
4. Feed Water Heaters						
A - L-P closed heaters	152,000	100,000	100,000	47,500	49,000	-
B - H-P closed heaters	188,500	176,500	84,500	64,000	-	78,500
C - Deaerating heater	125,000	121,000	118,000	114,000	113,000	-
D - Insulation						
a. Closed heaters	6,300	4,600	2,200	1,100	-	-
b. Deaerating	9,200	8,900	8,700	8,400	8,300	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	27,500	26,000	25,000	24,500	24,000	-
5. Boiler Feed Pumps						
a. Pumps and base plate	135,000	129,000	126,000	123,000	121,500	120,000
b. Fluid drive	96,000	96,000	96,000	71,100	71,100	71,100
c. Motors	169,670	163,060	150,050	141,010	133,730	137,480
d. Erection	17,100	16,200	15,600	15,000	14,700	14,100
e. Foundations for pumps	3,950	4,650	4,350	4,200	4,200	4,050
6. Condensate Pumps						
a. Pumps	61,500	39,750	40,050	29,550	30,900	-
b. Motors	32,710	19,480	19,750	14,080	14,620	-
c. Erection	6,200	5,800	5,850	5,550	5,750	-
7. Piping and Insulation						
a. Extraction steam)	213,100	186,500	153,700	127,800	104,600	49,300
b. Heater vents and drains)						
c. Boiler feed piping	116,900	116,900	72,000	72,000	49,300	87,500
d. Condensate piping)						
a'. From condensate pumps)						
through L-P heaters)	82,400	75,500	75,500	68,800	68,800	-
b'. For D-C heater and)						
B-F pump suction)						
e. Main steam	23,600	23,000	22,500	21,700	21,500	21,100
8. Demineralizing Equipment and Condensate Storage Tanks	191,000	183,000	175,500	169,000	165,000	165,500
9. Electrical	117,900	119,300	112,300	112,300	113,800	93,400
10. Turbine Room Building						
a. Building	70,000	70,000	70,000	70,000	70,000	70,000
b. Turbine generator sub-base	11,000	11,000	11,000	11,000	11,000	11,000
11. Condenser Pit-Size Increment	3,850	4,200	4,550	5,600	6,650	12,200
TOTAL ITEMS 1 - 11	16,236,780	16,101,860	15,931,560	15,856,435	15,848,340	15,903,785
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	21,428,280	21,293,360	21,123,060	21,047,935	21,039,840	21,095,285
12. Piping in Containment Vessel	304,000	274,000	258,000	250,000	250,000	244,000
GRAND TOTAL	21,732,280	21,567,360	21,381,060	21,297,935	21,289,840	21,339,285

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
800 PSIA, 618 F THROTTLE STEAM
(100 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	8,820,000	8,820,000	8,820,000	8,820,000	10,125,000	10,125,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	419,000	419,000
c. Reserve exciter	←		Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	190,000	190,000
2. Condensers						
a. Shells and accessories)	894,500	894,500	908,000	948,500	975,500	1,056,500
b. Dry vacuum pumps)						
c. Tubes	502,500	502,500	510,000	532,500	547,500	592,500
d. Steam jet air equipment	19,250	17,500	17,500	17,500	17,500	28,000
e. Erection	148,000	148,000	150,000	156,000	160,000	172,000
f. Deaeration - hot well of cond.	None	←				→ 47,500
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house)						
a'. Substructure)						
b'. Superstructure)	517,000	519,000	524,000	535,000	547,000	575,000
c'. Steel)						
d'. Miscellaneous)						
b. Dredging)						
c. Intake flume or forebay)						
d. Seal well)						
e. Discharge flume)						
f. Outfall)						
B - Crib House Equipment (erected)						
a. Traveling screens)	146,000	147,000	149,000	153,000	158,000	170,000
b. Screen wash pumps)						
c. Screen wash piping)						
d. Chlorination equipment)						
e. Chlorine handling)						
C - Circulating Water Piping	508,000	510,000	513,000	521,000	529,000	549,000
D - Circulating Water Pumps						
a. Pumps	213,000	215,000	218,000	225,000	233,000	251,000
b. Motors	157,000	158,000	159,500	163,000	167,500	176,500
c. Erection	20,000	20,100	20,300	20,700	21,300	22,400
4. Feed Water Heaters						
A - L-P Closed Heaters	144,500	94,000	95,000	46,000	47,000	-
B - H-P Closed Heaters	175,000	175,500	80,000	62,800	-	75,500
C - Deaerating Heater	117,500	114,000	112,000	110,000	109,000	-
D - Insulation						
a. Closed heaters	5,700	4,100	2,000	1,100	-	-
b. Deaerating	8,600	8,300	8,200	8,100	8,000	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	25,100	24,200	23,500	23,100	22,900	-
5. Boiler Feed Pumps						
a. Pumps and base plate	100,500	99,000	98,500	98,000	97,500	97,000
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	185,000	176,500	166,000	159,000	153,500	154,500
d. Erection	15,900	15,000	14,600	14,200	14,000	13,600
e. Foundations for pumps	4,600	4,300	4,150	4,000	3,950	3,850
6. Condensate Pumps						
a. Pumps	55,100	35,100	36,600	27,800	29,000	-
b. Motors	29,700	17,900	18,200	13,400	13,900	-
c. Erection	5,700	5,400	5,500	5,300	5,500	-
7. Piping and Insulation						
a. Extraction steam)	213,100	186,500	153,700	127,800	104,600	49,300
b. Heater vents and drains)						
c. Boiler feed piping	126,000	126,000	78,200	78,200	49,300	96,500
d. Condensate piping)						
a'. From condensate pumps)						
thru L-P heaters)	72,600	61,500	61,500	61,700	61,700	-
b'. For D.C. heater and)						
B.F. pump suction)						
e. Main steam	15,700	15,700	14,100	14,100	14,100	14,100
8. Demineralizing Equipment and Condensate Storage Tanks	187,000	175,000	171,000	165,000	163,000	159,000
9. Electrical	117,300	115,700	112,100	111,300	116,500	95,100
10. Turbine Room Building						
a. Building	-	-	-	-	70,000	70,000
b. Turbine generator sub-base	-	-	-	-	11,000	11,000
11. Condenser Pit-Size Increment	2,500	2,500	2,800	3,900	4,600	6,600
TOTAL ITEMS 1 - 11	14,242,850	14,094,800	13,926,950	13,897,000	15,233,650	15,326,450
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	19,434,350	19,286,300	19,118,450	19,088,500	20,425,150	20,517,950
12. Piping in Containment Vessel	342,600	342,600	230,900	230,900	230,900	229,100
GRAND TOTAL	19,776,950	19,628,900	19,349,350	19,319,400	20,656,050	20,747,050

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
800 PSIA, 718 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	8,820,000	8,820,000	8,820,000	8,820,000	8,820,000	9,725,000
b. Turbine generator eraction	390,000	390,000	390,000	390,000	390,000	419,000
c. Reserve exciter	←		Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	190,000
2. Condensers						
a. Shells and accessories)	840,500	840,500	854,000	881,000	908,000	975,500
b. Dry vacuum pumps)						
c. Tubes	472,500	472,500	480,000	495,000	510,000	547,500
d. Steam jet air equipment	19,250	17,500	17,500	17,500	17,500	28,000
e. Erection	140,000	140,000	142,000	146,000	150,000	160,000
f. Deaeration - hotwell of cond.	None	←			→	43,900
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house)						
a'. Substructure)						
b'. Superstructure)						
c'. Steel)						
d'. Miscellaneous)	486,000	498,000	503,000	512,000	523,000	547,000
b. Dredging)						
c. Intake flume or forebay)						
d. Seal well)						
e. Discherge flume)						
f. Outfall)						
B - Crib House Equipment (erected)						
a. Traveling screens)						
b. Screen wash pumps)						
c. Screen wash piping)	137,000	138,000	140,000	144,000	148,000	158,000
d. Chlorination equipment)						
e. Chlorine handling)						
C - Circulating Water Piping	494,000	495,000	498,000	504,000	512,000	529,000
D - Circulating Water Pumps						
a. Pumps	200,000	201,000	204,000	210,000	217,000	233,000
b. Motors	150,500	151,000	152,500	155,500	159,000	167,500
c. Erection	19,100	19,200	19,400	19,800	20,200	21,200
4. Feed Water Heaters						
A - L-P Closed Heaters	135,000	90,000	91,000	44,000	45,000	-
B - H-P Closed Heaters	167,500	158,000	76,500	61,000	-	73,000
C - Deaerating Heater	112,000	109,000	107,000	106,000	105,000	-
D - Insulation						
a. Closed heaters	5,300	3,800	1,900	1,000	-	-
b. Deaerating	8,200	8,000	7,900	7,800	7,700	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	23,700	23,000	22,500	22,100	21,800	-
5. Boiler Feed Pumps						
a. Pumps and base plate	99,000	98,000	97,500	97,000	96,500	96,000
b. Fluid drive	96,000	96,000	96,000	96,000	96,000	96,000
c. Motors	166,500	160,000	151,000	145,500	141,000	142,500
d. Erection	14,900	14,200	13,900	13,500	13,400	13,100
e. Foundations for pumps	4,250	4,050	3,950	3,800	3,800	3,700
6. Condensate Pumps						
a. Pumps	50,400	33,000	33,600	25,600	26,800	-
b. Motors	27,300	16,600	16,900	12,500	12,000	-
c. Erection	5,300	5,100	5,200	5,000	5,200	-
7. Piping and Insulation						
a. Extraction steam)	205,700	176,800	147,400	125,700	89,200	49,300
b. Heater vents and drains)						
c. Boiler feed piping	126,000	98,000	78,200	78,200	49,300	96,500
d. Condensate piping)						
a'. From condensate pumps)						
through L-P heaters)	72,600	61,500	61,500	61,700	61,700	-
b'. For D.C. heater and)						
B.F. pump suction)						
e. Main steam	15,700	15,700	14,100	14,100	14,100	14,100
8. Demineralizing Equipment and Condensate Storage Tanks	175,000	166,000	162,000	157,000	155,000	152,000
9. Electrical	113,300	111,700	112,100	111,300	107,800	91,600
10. Turbine Room Building						
a. Building	-	-	-	-	-	70,000
b. Turbine generator sub-base	-	-	-	-	-	11,000
11. Condenser Pit-Size Increment	1,100	1,100	1,400	2,100	2,800	4,600
TOTAL ITEMS 1 - 11	14,008,100	13,833,250	13,619,650	13,669,700	13,605,800	14,668,000
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	19,199,600	19,023,750	18,811,150	18,861,200	18,797,300	19,859,500
12. Piping in Containment Vessel	342,600	294,000	230,900	230,900	230,900	229,100
GRAND TOTAL	19,542,200	19,317,750	19,042,050	19,092,100	19,028,200	20,088,600

TABLE 12.3 (Continued)

800 PSIA, 818 F THROTTLE STEAM
(300 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	8,420,000	8,420,000	8,420,000	8,420,000	8,420,000	8,420,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←		Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories)	786,500	786,500	800,000	827,000	854,000	908,000
b. Dry vacuum pumps)						
c. Tubes	442,500	442,500	450,000	465,000	480,000	510,000
d. Steam jet air equipment	19,250	17,500	17,500	17,500	17,500	28,000
e. Erection	134,000	134,000	136,000	139,000	142,000	150,000
f. Deaeration - hot well of cond.	None	←			→	40,900
g. L-P htrs. in exhaust stack	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house)						
a'. Substructure)						
b'. Superstructure)	477,000	480,000	482,000	492,000	501,000	524,000
c'. Steel)						
d'. Miscellaneous)						
b. Dredging)						
c. Intake flume or forebay)						
d. Seal well)						
e. Discharge flume)						
f. Outfall)						
B - Crib House Equipment (erected)						
a. Traveling screens)						
b. Screen wash pumps)	129,000	130,000	132,000	136,000	139,000	149,000
c. Screen wash piping)						
d. Chlorination equipment)						
e. Chlorine handling)						
C - Circulating Water Piping	480,000	482,000	484,000	491,000	497,000	513,000
D - Circulating Water Pumps						
a. Pumps	187,000	189,000	191,000	197,000	203,000	218,000
b. Motors	144,000	144,500	145,500	149,000	152,000	159,500
c. Erection	18,300	18,400	18,600	19,000	19,300	20,300
4. Feed Water Heaters						
A - L-P Closed Heaters	130,000	87,000	87,500	43,000	43,500	-
B - H-P Closed Heaters	161,000	152,500	74,000	59,500	-	71,000
C - Deaerating Heater	107,500	105,000	103,000	102,000	101,000	-
D - Insulation						
a. Closed heaters	5,000	3,600	1,800	1,000	-	-
b. Deaerating	7,900	7,700	7,600	7,500	7,500	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	22,500	22,000	21,500	21,200	21,100	-
5. Boiler Feed Pumps						
a. Pumps and base plate	98,000	97,000	96,500	96,000	96,000	95,500
b. Fluid drive	96,000	96,000	71,100	71,100	71,100	71,100
c. Motors	152,000	146,500	139,000	134,000	131,000	133,500
d. Erection	14,200	13,500	13,300	13,000	12,900	12,600
e. Foundations for pumps	4,050	3,850	3,750	3,650	3,600	3,550
6. Condensate Pumps						
a. Pumps	46,300	30,700	31,000	24,900	25,800	-
b. Motors	25,300	15,600	15,800	11,800	12,200	-
c. Erection	5,000	4,800	4,900	4,800	4,900	-
7. Piping and Insulation						
a. Extraction steam)	205,700	173,400	139,000	116,400	88,800	49,300
b. Heater vents and drains)						
c. Boiler feed piping	98,000	98,000	78,200	78,200	49,300	96,500
d. Condensate piping)						
a'. From condensate pumps)						
thru L-P heaters)	72,600	61,500	61,500	57,200	57,200	-
b'. For D.C. heater and)						
B.F. pump suction)						
e. Main steam	44,500	44,100	44,100	41,100	41,100	41,100
8. Demineralizing Equipment and Condensate Storage Tanks	166,000	157,000	154,000	150,000	149,000	146,000
9. Electrical	113,300	111,700	108,200	107,800	87,800	86,800
10. Turbine Room Building						
a. Building	-	-	-	-	-	-
b. Turbine generator sub-base	-	-	-	-	-	-
11. Condenser Pit-Size Increment	-	-	-	700	1,400	2,800
TOTAL ITEMS 1 - 11	13,406,900	13,266,850	13,116,350	13,071,350	12,997,000	13,017,450
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,598,400	18,458,350	18,307,850	18,262,850	18,188,500	18,208,950
12. Piping in Containment Vessel	303,500	294,000	292,300	283,200	283,200	281,400
GRAND TOTAL	18,901,900	18,752,350	18,600,150	18,546,050	18,471,700	18,490,350

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
800 PSIA, 1000 F THROTTLE STEAM
(500 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	6	5	4	3	2	1
1. Turbine Generator and Accessories						
a. Turbine generator unit	8,110,000	8,110,000	8,110,000	8,740,000	8,740,000	8,740,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←		Constant			→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000	167,000
2. Condensers						
a. Shells and accessories)	692,000	705,500	705,500	732,500	746,000	800,000
b. Dry vacuum pumps)						
c. Tubes	390,000	397,500	397,500	412,500	420,000	450,000
d. Steam jet air equipment	19,250	17,500	17,500	17,500	17,500	28,000
e. Erection	120,000	122,000	122,000	126,000	128,000	136,000
f. Deaeration - hot well of cond.	None	←				→ 36,000
g. L-P htrs. in exhaust stacks	20,000	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System						
A - Structures						
a. Crib house)						
a'. Substructure)						
b'. Superstructure)						
c'. Steel)						
d'. Miscellaneous)	443,000	447,000	447,000	456,000	463,000	482,000
b. Dredging)						
c. Intake flume or forebay)						
d. Seal well)						
e. Discharge flume)						
f. Outfall)						
B - Crib House Equipment (erected)						
a. Traveling screens)						
b. Screen wash pumps)						
c. Screen wash piping)	115,000	117,000	117,000	121,000	124,000	132,000
d. Chlorination equipment)						
e. Chlorine handling)						
C - Circulating Water Piping	456,000	459,000	460,000	466,000	470,000	484,000
D - Circulating Water Pumps						
a. Pumps	165,000	168,000	171,000	174,000	178,000	191,000
b. Motors	133,500	134,000	134,000	137,000	139,000	145,500
c. Erection	16,900	17,100	17,100	17,500	17,700	18,600
4. Feed Water Heaters						
A - L-P Closed Heaters	121,500	82,000	82,500	40,500	41,000	-
B - H-P Closed Heaters	150,000	143,000	69,500	58,500	-	67,500
C - Deaerating Heater	100,000	98,000	96,500	96,000	95,500	-
D - Insulation						
a. Closed heaters	4,500	3,200	1,600	950	-	-
b. Deaerating	7,400	7,300	7,200	7,100	7,100	-
E - Structural Work						
a. For closed heaters	17,500	14,000	7,000	7,000	-	-
b. For deaerating heater	20,900	20,400	20,000	19,900	19,800	-
5. Boiler Feed Pumps						
a. Pumps and base plate	96,000	95,500	95,000	94,500	94,500	94,500
b. Fluid drive	71,100	71,100	71,100	71,100	71,100	71,100
c. Motors	130,000	125,500	120,000	117,000	114,500	117,500
d. Erection	13,000	12,500	12,300	12,100	12,100	11,900
e. Foundations for pumps	3,650	3,500	3,450	3,350	3,350	3,300
6. Condensate Pumps						
a. Pumps	40,000	26,600	27,000	20,900	21,800	-
b. Motors	22,100	13,800	14,000	10,600	11,000	-
c. Erection	4,600	4,400	4,400	4,400	4,500	-
7. Piping and Insulation						
a. Extraction steam)	197,900	167,700	131,300	116,400	77,800	49,300
b. Heater vents and drains)						
c. Boiler feed piping	98,000	98,000	78,200	78,200	49,300	96,500
d. Condensate piping)						
a'. From condensate pumps)						
through L-P heaters)	68,000	55,400	55,400	45,600	45,600	-
b'. For D.C. heater and)						
B.F. pump suction)						
e. Main steam	66,900	66,900	66,900	66,900	66,900	66,900
8. Demineralizing Equipment and Condensate Storage Tanks	151,000	145,000	142,000	139,000	138,000	136,000
9. Electrical	104,500	103,300	99,800	99,000	99,400	83,300
10. Turbine Room Building						
a. Building	-	-	-	-	-	-
b. Turbine generator sub-base	-	-	-	-	-	-
11. Condenser Pit-Size Increment	-	-	-	-	-	-
TOTAL ITEMS 1 - 11	12,726,200	12,628,700	12,480,750	13,076,600	12,983,450	13,007,900
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	17,917,700	17,820,200	17,672,250	18,267,500	18,174,950	18,199,400
12. Piping in Containment Vessel	417,000	417,000	415,400	415,400	415,400	413,600
GRAND TOTAL	18,334,700	18,237,200	18,087,650	18,682,900	18,590,350	18,613,000

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
600 PSIA, 486 F THROTTLE STEAM (SATURATED STEAM)
300 MWe INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.	4,245,000	3,982,000	3,743,000	3,561,000	3,480,000
HEATER ARRANGEMENT	5	4	3	2	1
1. Turbine Generator and Accessories					
a. Turbine generator unit	10,275,000	10,275,000	10,275,000	10,275,000	10,275,000
b. Turbine generator erection	419,000	419,000	419,000	419,000	419,000
c. Reserve exciter	Constant Factor				
d. Turbine foundation	190,000	190,000	190,000	190,000	190,000
2. Condensers					
a. Shells and accessories)	1,016,000	1,043,000	1,056,000	1,092,000	1,164,000
b. Dry vacuum pumps)					
c. Tubes	570,000	585,000	756,800	782,600	834,200
d. Steam jet air equipment	15,750	15,750	14,000	14,000	21,000
e. Erection	166,000	170,000	164,000	168,500	177,500
f. Deaeration - hot well of cond.	-	-	-	-	48,500
g. L-P heaters in exhaust stacks	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System					
A - Structures					
a. Crib house)					
a'. Substructure)					
b'. Superstructure)					
c'. Steel)					
d'. Miscellaneous)	562,000	570,000	534,000	547,000	570,500
b. Dredging)					
c. Intake flume)					
d. Seal well)					
e. Discharge flume)					
f. Outfall)					
B - Crib House Equipment (Erected)					
a. Traveling screens)					
b. Screen wash pumps)					
c. Screen wash piping)	164,000	166,000	152,000	157,000	167,000
d. Chlorination equipment)					
e. Chlorine handling)					
C - Circulating Water Piping	538,000	543,000	517,000	527,000	543,500
D - Circulating Water Pumps					
a. Pumps	241,775	246,525	218,085	226,920	241,800
b. Motors	171,905	174,105	171,640	176,745	185,280
c. Erection	21,770	22,070	20,570	21,140	22,100
4. Feed Water Heaters					
A - L-P closed heaters	112,000	113,500	57,500	59,000	-
B - H-P closed heaters	162,500	76,000	71,000	-	78,000
C - Deaerating heater	124,000	121,000	118,000	116,000	-
D - Insulation					
a. Closed heaters	4,800	2,300	1,700	-	-
b. Deaerating	9,200	8,900	8,700	8,500	-
E - Structural Work					
a. For closed heaters	14,000	7,000	7,000	-	-
b. For deaerating heater	27,000	26,000	25,000	24,500	-
5. Boiler Feed Pumps					
a. Pumps and base plate	105,000	100,500	96,000	91,500	90,000
b. Fluid drive	71,100	71,100	71,100	71,100	71,100
c. Motors	135,715	124,250	119,620	111,680	114,110
d. Erection	15,000	14,400	13,500	13,200	12,600
e. Foundations for pumps	4,950	4,800	4,500	4,350	4,200
6. Condensate Pumps					
a. Pumps	42,000	42,750	31,500	32,550	-
b. Motors	23,530	24,070	14,890	15,430	-
c. Erection	6,050	6,100	5,800	6,000	-
7. Piping and Insulation					
a. Extraction steam)	161,300	132,700	119,000	72,300	34,500
b. Heater vents and drains)					
c. Boiler feed piping	104,400	96,800	66,500	40,600	84,300
d. Condensate piping					
a'. From condensate pumps through)					
L-P heaters)	75,500	75,500	68,800	68,800	-
b'. For D-C heater and B.F. pump)					
suction)					
e. Main steam	28,400	27,600	26,800	26,000	26,000
8. Demineralizing Equipment and Condensate Storage Tanks	190,500	183,000	176,000	171,000	169,000
9. Electrical	114,000	111,000	109,300	110,400	90,700
10. Turbine Room Building					
a. Building	70,000	70,000	70,000	70,000	70,000
b. Turbine-generator sub-base	11,000	11,000	11,000	11,000	11,000
11. Condenser Pit Size Increment	5,600	6,300	9,800	10,700	12,950
TOTAL ITEMS 1 - 11	15,988,745	15,896,020	15,801,105	15,741,515	15,737,840
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	21,180,245	21,087,520	20,992,605	20,933,015	20,929,340
12. Piping in Containment Vessel	288,000	254,000	236,000	230,000	226,000
GRAND TOTAL	21,468,245	21,341,520	21,228,605	21,163,015	21,155,340

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
600 PSIA, 586 F THROTTLE STEAM
(100 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	5	4	3	2	1
1. Turbine Generator And Accessories					
a. Turbine generator unit	8,090,000	8,090,000	8,090,000	10,035,000	10,035,000
b. Turbine generator erection	390,000	390,000	390,000	419,000	419,000
c. Reserve exciter	←		Constant		→
d. Turbine foundation	390,000	390,000	390,000	190,000	190,000
2. Condensers					
a. Shells and accessories)	948,500	962,000	989,000	1,016,000	1,068,000
b. Dry vacuum pumps)					
c. Tubes	532,500	540,000	555,000	570,000	765,000
d. Steam jet air equipment	15,750	15,750	14,000	14,000	21,000
e. Erection	156,000	158,000	162,000	166,000	164,500
f. Deaeration - hot well of cond.	None			→	48,000
g. L-P htrs. in exhaust stack	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System					
A - Structures					
a. Crib house)					
a'. Substructure)					
b'. Superstructure)	535,000	541,000	550,000	563,000	539,000
c'. Steel)					
d'. Miscellaneous)					
b. Dredging)					
c. Intake flume or forebay)					
d. Seal well)					
e. Discharge flume)					
f. Outfall)					
B - Crib House Equipment (erected)					
a. Traveling screens)	153,000	156,000	159,000	165,000	155,000
b. Screen wash pumps)					
c. Screen wash piping)					
d. Chlorination equipment)					
e. Chlorine handling)					
C - Circulating Water Piping	521,000	525,000	531,000	540,000	523,000
D - Circulating Water Pumps					
a. Pumps	226,000	229,000	235,000	243,000	228,000
b. Motors	163,000	165,000	168,000	172,500	174,500
c. Erection	20,700	21,000	21,300	21,900	20,900
4. Feed Water Heaters					
A - L-P Closed Heaters	110,000	106,000	54,300	55,700	-
B - H-P Closed Heaters	151,000	71,700	67,800	-	75,500
C - Deaerating Heater	118,000	115,000	112,500	111,000	-
D - Insulation					
a. Closed heaters	4,400	2,100	1,550	-	-
b. Deaerating	8,600	8,400	8,300	8,100	-
E - Structural Work					
a. For closed heaters	14,000	7,000	7,000	-	-
b. For deaerating heater	25,100	24,400	23,800	23,400	-
5. Boiler Feed Pumps					
a. Pumps and base plate	97,500	94,500	91,000	89,500	87,000
b. Fluid drive	96,000	96,000	71,100	71,100	71,100
c. Motors	155,500	144,500	139,000	133,000	134,500
d. Erection	13,700	13,200	12,600	12,400	11,900
e. Foundations for pumps	4,550	4,350	4,150	4,100	3,950
6. Condensate Pumps					
a. Pumps	38,200	38,600	29,100	30,000	-
b. Motors	21,700	21,900	13,900	14,400	-
c. Erection	5,600	5,700	5,500	5,600	-
7. Piping and Insulation					
a. Extraction steam)					
b. Heater vents and drains)	161,300	132,700	119,000	72,300	34,500
c. Boiler feed piping	115,000	86,500	86,500	45,300	91,900
d. Condensate piping					
a'. From condensate pumps) through L-P heaters)					
b'. For D.C. heater and) B.F. pump suction)	61,500	61,500	61,700	61,700	-
e. Main steam	23,500	23,500	23,500	23,500	23,500
8. Demineralizing Equipment and Condensate Storage Tanks	180,000	178,000	171,000	168,000	162,000
9. Electrical	112,600	113,800	113,000	113,000	91,600
10. Turbine Room Building					
a. Building	-	-	-	70,000	70,000
b. Turbine generator sub-base	-	-	-	11,000	11,000
11. Condenser Pit-Size Increment	3,900	4,200	4,900	5,600	10,000
TOTAL ITEMS 1 - 11	13,683,100	13,556,300	13,485,500	15,254,100	15,239,350
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,874,600	18,747,800	18,677,000	20,445,600	20,430,850
12. Piping In Containment Vessel	268,800	222,200	222,500	222,500	222,500
GRAND TOTAL	19,143,400	18,970,000	18,899,500	20,668,100	20,653,350

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
600 PSIA, 686 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	5	4	3	2	1
1. Turbine Generator and Accessories					
a. Turbine generator unit	7,770,000	7,770,000	7,770,000	7,770,000	9,715,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	419,000
c. Reserve exciter	←		Constant	→	
d. Turbine foundation	167,000	167,000	167,000	167,000	190,000
2. Condensers					
a. Shells and accessories)	881,000	894,500	908,000	948,500	1,016,000
b. Dry vacuum pumps)					
c. Tubes	495,000	502,500	510,000	532,500	570,000
d. Steam jet air equipment	15,750	15,750	14,000	14,000	21,000
e. Erection	146,000	148,000	150,000	156,000	166,000
f. Deaeration - hot well of cond.	None			→	45,600
g. L-P htrs. in exhaust stack	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System					
A - Structures					
a. Crib house)					
a'. Substructure)					
b'. Superstructure)	514,000	518,000	523,000	536,000	560,000
c'. Steel)					
d'. Miscellaneous)					
b. Dredging)					
c. Intake flume or forebay)					
d. Seal well)					
e. Discharge flume)					
f. Outfall)					
B - Crib House Equipment (erected)					
a. Traveling screens)					
b. Screen wash pumps)	144,000	146,000	148,000	154,000	163,000
c. Screen wash piping)					
d. Chlorination equipment)					
e. Chlorine handling)					
C - Circulating Water Piping	506,000	508,000	513,000	521,000	538,000
D - Circulating Water Pumps					
a. Pumps	212,000	214,000	218,000	226,000	242,000
b. Motors	156,000	157,500	159,500	163,500	171,500
c. Erection	19,900	20,000	20,200	20,800	21,900
4. Feed Water Heaters					
A - L-P Closed Heaters	100,000	100,500	51,500	52,900	-
B - H-P Closed Heaters	142,000	67,700	64,000	-	70,600
C - Deaerating Heater	112,500	110,000	108,000	107,000	-
D - Insulation					
a. Closed heaters	4,050	1,950	1,450	-	-
b. Deaerating	8,250	8,050	7,900	7,800	-
E - Structural Work					
a. For closed heaters	14,000	7,000	7,000	-	-
b. For deaerating heater	23,800	23,100	22,700	22,400	-
5. Boiler Feed Pumps					
a. Pumps and base plate	92,500	89,500	86,500	85,500	83,500
b. Fluid drive	71,100	71,100	71,100	71,100	71,100
c. Motors	141,000	131,000	127,500	122,500	125,500
d. Erection	12,900	12,400	11,900	11,700	11,400
e. Foundations for pumps	4,250	4,100	3,950	3,900	3,750
6. Condensate Pumps					
a. Pumps	35,100	35,400	26,700	27,900	-
b. Motors	20,100	20,300	13,000	13,500	-
c. Erection	5,300	5,400	5,200	5,300	-
7. Piping and Insulation					
a. Extraction steam					
b. Heater vents and drains	158,700	130,100	115,900	69,200	34,500
c. Boiler feed piping	115,000	86,500	86,500	85,300	91,900
d. Condensate piping)					
a'. From condensate pumps)					
thru L-P heaters)	61,500	61,500	61,700	61,700	-
b'. For D.C. heater and)					
B.F. pump suction)					
e. Main steam	28,700	28,700	23,500	23,500	23,500
8. Demineralizing Equipment and Condensate Storage Tanks	174,000	169,000	162,000	160,000	155,000
9. Electrical	109,000	109,000	107,800	107,800	91,600
10. Turbine Room Building					
a. Building	-	-	-	-	70,000
b. Turbine generator sub-base	-	-	-	-	11,000
11. Condenser Pit-Size Increment	2,100	2,500	2,800	3,900	5,600
TOTAL ITEMS 1 - 11	12,872,500	12,746,050	12,669,300	12,652,200	14,697,950
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,064,000	17,937,550	17,860,800	17,843,700	19,889,450
12. Piping in Containment Vessel	282,600	236,000	221,700	221,700	221,700
GRAND TOTAL	18,346,600	18,173,550	18,082,500	18,065,400	20,111,150

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
600 PSIA, 886 F THROTTLE STEAM
(400 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	5	4	3	2	1
1. Turbine Generator and Accessories					
a. Turbine generator unit	7,930,000	7,930,000	7,930,000	7,930,000	7,930,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←		Constant		→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000
2. Condensers					
a. Shells and accessories)	773,000	786,500	800,000	840,500	881,000
b. Dry vacuum pumps)					
c. Tubes	435,000	442,500	450,000	472,500	495,000
d. Steam jet air equipment	19,250	19,250	17,500	17,500	22,750
e. Erection	132,000	134,000	136,000	140,000	146,000
f. Deaeration - hot well of cond.	None	←		→	39,700
g. L-P htrs. in exhaust stack	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System					
A - Structures					
a. Crib house)					
a'. Substructure)					
b'. Superstructure)					
c'. Steel)	474,000	478,000	485,000	495,000	514,000
d'. Miscellaneous)					
b. Dredging)					
c. Intake flume or forebay)					
d. Seal well)					
e. Discharge flume)					
f. Outfall)					
B - Crib House Equipment (erected)					
a. Traveling screens)					
b. Screen wash pumps)	128,000	130,000	132,000	137,000	144,000
c. Screen wash piping)					
d. Chlorination equipment)					
e. Chlorine handling)					
C - Circulating Water Piping	478,000	481,000	486,000	493,000	506,000
D - Circulating Water Pumps					
a. Pumps	186,000	188,000	192,000	199,000	212,000
b. Motors	143,000	144,500	146,000	150,000	157,500
c. Erection	18,300	18,400	18,700	19,100	19,900
4. Feed Water Heaters					
A - L-P Closed Heaters	93,000	96,700	47,500	48,500	-
B - H-P Closed Heaters	130,000	64,800	60,000	-	66,000
C - Deaerating Heater	104,000	102,000	100,500	99,700	-
D - Insulation					
a. Closed heaters	3,600	1,750	1,350	-	-
b. Deaerating	7,700	7,500	7,400	7,350	-
E - Structural Work					
a. For closed heaters	14,000	7,000	7,000	-	-
b. For deaerating heater	21,800	21,200	20,900	20,700	-
5. Boiler Feed Pumps					
a. Pumps and base plate	84,500	82,500	80,000	79,500	78,000
b. Fluid drive	71,100	71,100	71,100	71,100	71,100
c. Motors	119,500	111,500	109,000	105,000	108,000
d. Erection	11,600	11,200	10,800	10,700	10,500
e. Foundations for pumps	3,850	3,700	3,600	3,550	3,500
6. Condensate Pumps					
a. Pumps	30,200	30,500	23,200	24,200	-
b. Motors	17,600	17,700	11,600	11,900	-
c. Erection	4,800	4,800	4,700	4,800	-
7. Piping and Insulation					
a. Extraction steam)	149,400	120,800	99,900	59,800	34,500
b. Heater vents and drains)					
c. Boiler feed piping	91,200	86,500	86,500	45,300	91,900
d. Condensate piping)					
a'. From condensate pumps)					
thru L-P heaters)	61,500	61,500	57,200	57,200	-
b'. For D.C. heater and B.F.)					
pump suction)					
e. Main steam	56,800	56,800	56,800	56,800	56,800
8. Demineralizing Equipment and Condensate Storage Tanks	158,000	153,000	148,000	147,000	144,000
9. Electrical	105,100	105,100	102,500	102,500	81,500
10. Turbine Room Building					
a. Building	-	-	-	-	-
b. Turbine generator sub-base	-	-	-	-	-
11. Condenser Pit-Size Increment	-	-	-	1,100	2,100
TOTAL ITEMS 1 - 11	12,632,800	12,546,800	12,468,750	12,417,300	12,382,750
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	17,824,300	17,738,300	17,660,250	17,608,800	17,574,250
12. Piping in Containment Vessel	302,500	301,100	301,100	301,100	255,500
GRAND TOTAL	18,126,800	18,039,400	17,961,350	17,909,900	17,829,750

TABLE 12.3 (Continued)

600 PSIA, 986 F THROTTLE STEAM
(500 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	5	4	3	2	1
1. Turbine Generator and Accessories					
a. Turbine generator unit	8,170,000	8,170,000	8,170,000	8,170,000	8,170,000
b. Turbine generator erection	390,000	390,000	390,000	390,000	390,000
c. Reserve exciter	←		Constant		→
d. Turbine foundation	167,000	167,000	167,000	167,000	167,000
2. Condensers					
a. Shells and accessories)	732,500	732,500	759,500	773,000	800,000
b. Dry vacuum pumps)					
c. Tubes	412,500	412,500	427,500	435,000	450,000
d. Steam jet air equipment	19,250	19,250	17,500	17,500	22,750
e. Erection	126,000	126,000	130,000	132,000	136,000
f. Deaeration - hot well of cond.	None			→	36,000
g. L-P htrs. in exhaust stack	20,000	20,000	10,000	10,000	10,000
3. Circulating Water System					
A - Structures					
a. Crib house)					
a'. Substructure)					
b'. Superstructure)					
c'. Steel)	457,000	460,000	466,000	474,000	493,000
d'. Miscellaneous)					
b. Dredging)					
c. Intake flume or forebay)					
d. Seal well)					
e. Discharge flume)					
f. Outfall)					
B - Crib House Equipment (Erected)					
a. Traveling screens)					
b. Screen wash pumps)	121,000	122,000	125,000	128,000	136,000
c. Screen wash piping)					
d. Chlorination equipment)					
e. Chlorine handling)					
C - Circulating Water Piping	466,000	468,000	472,000	478,000	492,000
D - Circulating Water Pumps					
a. Pumps	175,000	177,000	180,000	186,000	198,000
b. Motors	137,000	138,000	140,000	143,000	149,500
c. Erection	17,500	17,500	17,900	18,200	19,000
4. Feed Water Heaters					
A - L-P Closed Heaters	89,000	89,500	45,800	46,500	-
B - H-P Closed Heaters	125,000	60,000	58,800	-	63,900
C - Deaerating Heater	101,000	99,000	97,500	97,000	-
D - Insulation					
a. Closed heaters	3,400	1,650	1,300	-	-
b. Deaerating	7,450	7,300	7,200	7,200	-
E - Structural Work					
a. For closed heaters	14,000	7,000	7,000	-	-
b. For deaerating heater	21,000	20,500	20,300	20,100	-
5. Boiler Feed Pumps					
a. Pumps and base plate	81,500	79,500	77,500	77,000	76,000
b. Fluid drive	71,100	71,100	71,100	71,100	71,100
c. Motors	111,000	103,500	101,500	98,000	101,500
d. Erection	11,000	10,700	10,400	10,300	10,100
e. Foundations for pumps	3,650	3,550	3,450	3,400	3,350
6. Condensate Pumps					
a. Pumps	28,200	28,400	21,700	22,000	-
b. Motors	16,600	16,700	11,000	11,300	-
c. Erection	4,600	4,600	4,500	4,600	-
7. Piping and Insulation					
a. Extraction steam)	149,400	120,800	99,900	59,800	34,500
b. Heater vents and drains)					
c. Boiler feed piping	91,200	86,500	86,500	45,300	91,900
d. Condensate piping)					
a'. From condensate pumps)					
thru L-P heaters)	57,000	57,000	55,600	55,600	-
b'. For D.C. heater and B.F.)					
pump suction)					
e. Main steam	65,700	65,700	65,700	65,700	65,700
8. Demineralizing Equipment and Condensate Storage Tanks	150,000	147,000	143,000	141,000	139,000
9. Electrical	100,200	98,400	97,600	102,500	81,500
10. Turbine Room Building					
a. Building	-	-	-	-	-
b. Turbine generator sub-base	-	-	-	-	-
11. Condenser Pit-Size Increment	-	-	-	-	-
TOTAL ITEMS 1 - 11	12,712,750	12,598,150	12,559,750	12,460,100	12,407,800
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	17,904,250	17,789,650	17,751,250	17,651,600	17,599,300
12. Piping in Containment Vessel	424,900	423,500	423,500	423,500	423,500
GRAND TOTAL	18,329,150	18,213,150	18,174,750	18,075,100	18,022,800

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
400 PSIA, 445 F THROTTLE STEAM (SATURATED STEAM)
300 MWe INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.	4,366,000	4,134,000	3,930,000	3,833,000
HEATER ARRANGEMENT	4	3	2	1
1. Turbine Generator and Accessories				
a. Turbine generator unit	10,785,000	10,785,000	10,785,000	10,785,000
b. Turbine generator erection	422,000	422,000	422,000	422,000
c. Reserve exciter	(Constant Factor)			
d. Turbine foundation	195,000	195,000	195,000	195,000
2. Condensers				
a. Shells and accessories b. Dry vacuum pumps	1,128,000	1,140,000	1,176,000	1,260,000
c. Tubes	808,400	817,000	842,800	903,000
d. Steam jet air equipment	15,750	14,000	14,000	17,500
e. Erection	173,000	174,500	179,000	190,000
f. Deaeration - hotwell of cond	-	-	-	-
g. L.P. htrs. in exhaust stacks	20,000	10,000	10,000	10,000
3. Circulating Water System				
A - Structures				
a. Crib house a'. Substructure b'. Superstructure c'. Steel d'. Miscellaneous b. Dredging c. Intake flume d. Seal well e. Discharge flume f. Outfall	559,000	563,000	574,000	601,000
B - Crib House Equipment (Erected)				
a. Traveling screens b. Screen wash pumps c. Screen wash piping d. Chlorination equipment e. Chlorine handling	162,000	164,000	168,000	179,000
C - Circulating Water Piping	535,000	538,000	546,000	565,000
D - Circulating Water Pumps				
a. Pumps	234,360	236,685	243,660	261,330
b. Motors	181,145	182,465	186,425	191,880
c. Erection	21,620	21,770	22,220	23,360
4. Feed Water Heaters				
A - L-P closed heaters	128,000	57,500	59,000	-
B - H-P closed heaters	70,000	76,000	-	67,000
C - Deaerating heater	126,000	123,000	121,000	-
D - Insulation				
a. Closed heaters	2,400	2,650	-	-
b. Deaerating	9,300	9,100	8,800	-
E - Structural Work				
a. For closed heaters	7,000	7,000	-	-
b. For deaerating heater	28,000	27,000	26,000	-
5. Boiler Feed Pumps				
a. Pumps and base plate	75,000	67,500	64,500	60,000
b. Fluid drive	60,000	60,000	60,000	60,000
c. Motors	94,700	96,025	87,205	93,820
d. Erection	13,500	12,000	11,700	10,500
e. Foundations for pumps	5,100	4,800	4,650	4,350
6. Condensate Pumps				
a. Pumps	56,700	34,200	35,400	-
b. Motors	30,550	16,780	17,320	
c. Erection	6,550	6,200	6,350	
7. Piping and Insulation				
a. Extraction steam b. Heater vents and drains	137,100	135,900	82,100	49,200
c. Boiler feed piping	70,000	70,000	26,700	58,600
d. Condensate piping a'. From condensate pumps thru L.P. heaters b'. For D.C. heater and B.F. pump suction	79,700	68,800	72,800	-
e. Main steam	35,700	34,000	32,700	32,700
8. Demineralizing Equipment and Condensate Storage Tanks	194,000	187,500	181,500	179,000
9. Electrical	109,700	107,900	107,900	89,300
10. Turbine Room Building				
a. Building	83,000	83,000	83,000	83,000
b. Turbine generator sub-base	13,000	13,000	13,000	13,000
11. Condenser Pit-Size Increment	11,900	12,250	13,300	15,750
TOTAL ITEMS 1 - 11	16,687,175	16,575,525	16,478,030	16,472,790
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	21,878,675	21,767,025	21,669,530	21,664,290
12. Piping in Containment Vessel	297,000	280,000	262,000	253,000
GRAND TOTAL	22,175,675	22,047,025	21,931,560	21,917,290

TABLE 12.3 (Continued)

400 PSIA, 545 F THROTTLE STEAM
(100 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	4	3	2	1
1. Turbine Generator and Accessories				
a. Turbine generator unit	9,995,000	9,995,000	9,995,000	10,545,000
b. Turbine generator erection	419,000	419,000	419,000	419,000
c. Reserve exciter	←		Constant	→
d. Turbine foundation	190,000	190,000	190,000	190,000
2. Condensers				
a. Shells and accessories b. Dry vacuum pumps	1,056,500	1,056,500	1,080,000	1,165,000
c. Tubes	592,500	592,500	774,000	835,000
d. Steam jet air equipment	15,750	14,000	14,000	17,500
e. Erection	172,000	172,000	166,000	177,000
f. Deaeration - hot well of cond.	None	→	→	52,400
g. L-P htrs. in exhaust stack	20,000	10,000	10,000	10,000
3. Circulating Water System				
A - Structures				
a. Crib house a'. Substructure b'. Superstructure c'. Steel d'. Miscellaneous b. Dredging c. Intake flume or forebay d. Seal well e. Discharge flume f. Outfall	574,000	577,000	539,000	566,000
B - Crib House Equipment (Erected)				
a. Traveling screens b. Screen wash pumps c. Screen wash piping d. Chlorination equipment e. Chlorine handling	169,000	170,000	155,000	166,000
C - Circulating Water Piping	548,000	550,000	524,000	543,000
D - Circulating Water Pumps				
a. Pumps	250,000	252,000	228,000	246,000
b. Motors	176,000	177,000	175,000	184,500
c. Erection	22,300	22,400	20,900	22,000
4. Feed Water Heaters				
A - L-P Closed Heaters	118,100	56,700	55,400	-
B - H-P Closed Heaters	63,200	69,200	-	63,000
C - Deaerating Heater	119,500	117,000	115,000	-
D - Insulation				
a. Closed heaters	2,150	1,950	-	-
b. Deaerating	8,750	8,550	8,400	-
E - Structural Work				
a. For closed heaters	7,000	7,000	-	-
b. For deaerating heater	25,600	25,000	24,400	
5. Boiler Feed Pumps				
a. Pumps and base plate	65,000	59,000	56,500	52,000
b. Fluid drive	71,100	71,100	71,100	71,100
c. Motors	121,500	119,500	112,500	115,000
d. Erection	11,700	10,500	10,000	9,200
e. Foundations for pumps	4,650	4,400	4,300	4,100
6. Condensate Pumps				
a. Pumps	51,200	31,400	32,500	-
b. Motors	27,600	15,500	15,900	-
c. Erection	6,100	5,800	5,900	-
7. Piping and Insulation				
a. Extraction steam b. Heater vents and drains	137,100	135,000	82,100	49,200
c. Boiler feed piping	90,900	90,900	40,900	84,800
d. Condensate piping a'. From condensate pumps through L-P heaters b'. For D.C. heater and B.F. pump suction	69,600	62,700	62,700	-
e. Main steam	20,800	20,800	20,800	20,800
8. Demineralizing Equipment and Condensate Storage Tanks	190,000	180,000	175,000	168,000
9. Electrical	147,000	127,700	127,700	88,300
10. Turbine Room Building				
a. Building	70,000	70,000	70,000	83,000
b. Turbine generator sub-base	11,000	11,000	11,000	13,000
11. Condenser Pit-Size Increment	6,600	6,600	10,300	13,000
TOTAL ITEMS 1 - 11	15,646,200	15,504,700	15,402,300	15,972,900
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	20,837,700	20,696,200	20,593,800	21,164,400
12. Piping in Containment Vessel	250,700	244,000	203,600	203,600
GRAND TOTAL	21,088,400	20,940,200	20,797,400	21,368,000

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
400 PSIA, 645 F THROTTLE STEAM
(200 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	4	3	2	1
1. Turbine-Generator And Accessories				
a. Turbine generator unit	7,890,000	9,995,000	9,995,000	9,995,000
b. Turbine generator erection	390,000	419,000	419,000	419,000
c. Reserve exciter	←		Constant	→
d. Turbine foundation	167,000	190,000	190,000	190,000
2. Condensers				
a. Shells and accessories	975,500	989,000	1,016,000	1,080,000
b. Dry vacuum pumps				
c. Tubes	547,500	555,000	570,000	774,000
d. Steam jet air equipment	15,750	14,000	14,000	17,500
e. Erection	160,000	162,000	166,000	166,000
f. Deaeration - hot well of cond.	None	←		→ 48,600
g. L-P. htrs. in exhaust stack	20,000	10,000	10,000	10,000
3. Circulating Water System				
A - Structures				
a. Crib house				
a'. Substructure				
b'. Superstructure				
c'. Steel				
d'. Miscellaneous	546,000	552,000	558,000	539,000
b. Dredging				
c. Intake flume or forebay				
d. Seal well				
e. Discharge flume				
f. Outfall				
B - Crib House Equipment (erected)				
a. Traveling screens				
b. Screen wash pump				
c. Screen wash piping	158,000	160,000	163,000	155,000
d. Chlorination Equipment				
e. Chlorine handling				
C - Circulating Water Piping	528,000	532,000	537,000	524,000
D - Circulating Water Pumps				
a. Pumps	232,000	236,000	240,000	228,000
b. Motors	167,000	169,000	171,000	174,500
c. Erection	21,200	21,400	21,700	20,900
4. Feed Water Heaters				
A - L-P Closed Heaters	111,000	52,100	52,400	-
B - H-P Closed Heaters	52,800	64,200	-	59,500
C - Deaerating Heater	114,000	112,000	110,000	-
D - Insulation				
a. Closed heaters	1,750	1,800	-	-
b. Deaerating	8,350	8,200	8,050	-
E - Structural Work				
a. For closed heaters	7,000	7,000	-	-
b. For deaerating heater	24,300	23,600	23,200	-
5. Boiler Feed Pumps				
a. Pumps and base plate	58,500	53,000	51,000	47,500
b. Fluid drive	71,100	71,100	71,100	71,100
c. Motors	110,000	109,000	103,000	106,500
d. Erection	10,400	9,400	8,900	8,300
e. Foundations for pumps	4,350	4,150	4,050	3,900
6. Condensate Pumps				
a. Pumps	46,800	29,000	29,800	-
b. Motors	25,400	14,500	14,800	-
c. Erection	5,700	5,500	5,600	-
7. Piping And Insulation				
a. Extraction steam				
b. Heater vents and drains	136,000	135,000	80,000	49,200
c. Boiler feed piping	90,900	90,900	40,900	84,800
d. Condensate piping				
a'. From condensate pumps through L-P heaters	69,600	62,700	62,700	-
b'. For D.C. heater and B.F. pump suction				
e. Main steam	20,800	20,800	20,800	20,800
8. Demineralizing Equipment And Condensate Storage Tanks	179,000	170,000	167,000	160,000
9. Electrical	143,700	123,700	123,700	86,300
10. Turbine Room Building				
a. Building	-	70,000	70,000	70,000
b. Turbine generator sub-base	-	11,000	11,000	11,000
11. Condenser Pit-Size Increment	4,600	4,900	5,600	10,300
TOTAL ITEM 1 - 11	13,114,000	15,258,750	15,144,300	15,130,700
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	18,305,500	20,450,250	20,335,800	20,322,200
12. Piping In Containment Vessel	250,700	250,700	203,600	203,600
GRAND TOTAL	18,556,200	20,700,950	20,539,400	20,525,800

TABLE 12.3 (Continued)

400 PSIA, 845 F THROTTLE STEAM
(400 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	4	3	2	1
1. Turbine Generator and Accessories				
a. Turbine generator unit	8,050,000	8,050,000	8,050,000	8,050,000
b. Turbine generator erection	167,000	167,000	167,000	167,000
c. Reserve exciter	←		Constant	→
d. Turbine foundation	167,000	167,000	167,000	167,000
2. Condensers				
a. Shells and accessories)	840,500	854,000	881,000	948,500
b. Dry vacuum pumps)				
c. Tubes	472,500	480,000	495,000	532,500
d. Steam jet air equipment	19,250	17,500	17,500	21,000
e. Erection	140,000	142,000	146,000	156,000
f. Deaeration - hot well of cond.	None	→		42,600
g. L-P htrs. in exhaust stack	20,000	10,000	10,000	10,000
3. Circulating Water System				
A - Structures				
a. Crib house)				
a'. Substructure)				
b'. Superstructure)	499,000	503,000	512,000	536,000
c'. Steel)				
d'. Miscellaneous)				
b. Dredging)				
c. Intake flume or forebay)				
d. Seal well)				
e. Discharge flume)				
f. Outfall)				
B - Crib House Equipment (erected)				
a. Traveling screens)				
b. Screen wash pumps)	138,000	140,000	144,000	154,000
c. Screen wash piping)				
d. Chlorination equipment)				
e. Chlorine handling)				
C - Circulating Water Piping	496,000	498,000	504,000	522,000
D - Circulating Water Pumps				
a. Pumps	202,000	204,000	210,000	226,000
b. Motors	151,000	152,500	155,500	164,000
c. Erection	19,300	19,400	19,900	20,800
4. Feed Water Heaters				
A - L-P Closed Heaters	100,000	46,900	48,000	-
B - H-P Closed Heaters	53,500	47,500	-	54,500
C - Deaerating Heater	106,000	104,000	102,500	-
D - Insulation				
a. Closed heaters	1,750	1,600	-	-
b. Deaerating	7,700	7,600	7,600	-
E - Structural Work				
a. For closed heaters	7,000	7,000	-	-
b. For deaerating heater	22,100	21,600	21,300	-
5. Boiler Feed Pumps				
a. Pumps and base plate	47,500	43,500	42,000	39,500
b. Fluid drive	60,000	60,000	60,000	60,000
c. Motors	93,500	92,500	88,000	92,500
d. Erection	8,400	7,500	7,300	6,800
e. Foundations for pumps	3,900	3,750	3,700	3,600
6. Condensate Pumps				
a. Pumps	39,800	24,800	25,600	-
b. Motors	22,000	12,700	13,100	-
c. Erection	5,100	4,900	5,000	-
7. Piping and Insulation				
a. Extraction steam)				
b. Heater vents and drains)	132,600	114,700	69,300	49,200
c. Boiler feed piping	76,100	76,100	40,900	84,800
d. Condensate piping)				
a'. From condensate pumps)				
thru L-P heaters)	61,500	61,700	61,700	-
b'. For D.C. heater and)				
B.F. pump suction)				
e. Main steam	37,800	37,200	37,200	37,200
8. Demineralizing Equipment and Condensate Storage Tanks	161,000	155,000	152,000	147,000
9. Electrical	128,200	116,200	116,200	84,600
10. Turbine Room Building				
a. Building	-	-	-	-
b. Turbine generator sub-base	-	-	-	-
11. Condenser Pit-Size Increment	1,100	1,400	2,100	3,900
TOTAL ITEMS 1 - 11	12,558,100	12,452,550	12,382,300	12,381,000
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	17,749,600	17,644,050	17,573,800	17,572,500
12. Piping in Containment Vessel	357,200	287,200	286,200	286,200
GRAND TOTAL	18,106,800	17,931,250	17,860,000	17,858,700

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
400 PSIA, 945 F THROTTLE STEAM
(500 F SUPERHEAT)
300 MWe INDIRECT CYCLE TURBINE PLANT

HEATER ARRANGEMENT	4	3	2	1
1. Turbine Generator and Accessories				
a. Turbine generator unit	8,130,000	8,130,000	8,130,000	8,130,000
b. Turbine generator erection	390,000	390,000	390,000	390,000
c. Reserve exciter	← Constant →			
d. Turbine foundation	167,000	167,000	167,000	167,000
2. Condensers				
a. Shells and accessories) b. Dry vacuum pumps)	786,500	800,000	813,500	881,000
c. Tubes	442,500	450,000	457,500	495,000
d. Steam jet air equipment	19,250	17,500	17,500	21,000
e. Erection	134,000	136,000	138,000	146,000
f. Deaeration - hot well of cond.	None	→	→	39,700
g. L-P htrs. in exhaust stack	20,000	10,000	10,000	10,000
3. Circulating Water System				
A - Structures				
a. Crib house) a'. Substructure) b'. Superstructure) c'. Steel) d'. Miscellaneous) b. Dredging) c. Intake flume or forebay) d. Seal well) e. Discharge flume) f. Outfall)	480,000	482,000	489,000	513,000
B - Crib House Equipment (erected)				
a. Traveling screens) b. Screen wash pumps) c. Screen wash piping) d. Chlorination equipment) e. Chlorine handling)	130,000	132,000	134,000	144,000
C - Circulating Water Piping	482,000	484,000	489,000	505,000
D - Circulating Water Pumps				
a. Pumps	189,000	191,000	196,000	211,000
b. Motors	145,000	145,500	148,000	156,000
c. Erection	18,400	18,600	18,800	19,800
4. Feed Water Heaters				
A - L-P Closed Heaters	96,000	45,500	46,000	-
B - H-P Closed Heaters	52,200	55,000	-	52,500
C - Deaerating Heater	102,000	100,000	99,000	-
D - Insulation				
a. Closed heaters	1,700	1,500	-	-
b. Deaerating	7,500	7,400	7,000	-
E - Structural Work				
a. For closed heaters	7,000	7,000	-	-
b. For deaerating heater	21,300	20,800	20,600	-
5. Boiler Feed Pumps				
a. Pumps and base plate	43,500	39,500	38,500	36,500
b. Fluid drive	60,000	60,000	60,000	60,000
c. Motors	89,000	86,000	82,000	86,500
d. Erection	7,600	6,800	6,600	6,200
e. Foundations for pumps	3,750	3,600	3,550	3,450
6. Condensate Pumps				
a. Pumps	37,000	23,100	23,800	-
b. Motors	20,600	12,000	12,300	-
c. Erection	4,800	4,600	4,700	-
7. Piping and Insulation				
a. Extraction steam) b. Heater vents and drains)	132,600	114,700	69,300	49,200
c. Boiler feed piping	76,100	76,100	40,900	84,800
d. Condensate piping) a'. From condensate pumps) thru L-P heaters) b'. For D.C. heaters and B.F. pump suction)	61,500	61,700	61,700	-
e. Main Steam	42,100	42,100	39,300	39,300
8. Demineralizing Equipment and Condensate Storage Tanks	155,000	148,000	146,000	143,000
9. Electrical	128,200	112,400	114,400	79,000
10. Turbine Room Building				
a. Building	-	-	-	-
b. Turbine generator sub-base	-	-	-	-
11. Condenser Pit-Size Increment	-	-	400	2,100
TOTAL ITEMS 1 - 11	12,683,100	12,581,400	12,474,350	12,471,050
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	17,874,600	17,772,900	17,665,850	17,662,550
12. Piping in Containment Vessel	380,600	380,600	299,400	299,400
GRAND TOTAL	18,255,200	18,153,500	17,965,250	17,961,950

TABLE 12.3 (Continued)

SUMMARY OF COST DATA
165 PSIA, 366 F THROTTLE STEAM (SATURATED STEAM)
300 MWe INDIRECT CYCLE TURBINE PLANT

THROTTLE FLOW, #/HR.	4,802,000	4,631,000	4,456,000
HEATER ARRANGEMENT	3	2	1
1. Turbine Generator and Accessories			
a. Turbine generator unit	11,965,000	11,965,000	11,965,000
b. Turbine generator erection	430,000	430,000	430,000
c. Reserve exciter	Constant		
d. Turbine foundation	200,000	200,000	200,000
2. Condensers			
a. Shells and accessories	1,356,000	1,380,000	1,488,000
b. Dry vacuum pumps			
c. Tubes	971,800	989,000	1,066,400
d. Steam jet air equipment	14,000	14,000	15,750
e. Erection	203,000	206,500	220,000
f. Deaeration - hot well of cond.	-	-	62,000
g. L-P htrs. in exhaust stacks	10,000	10,000	10,000
3. Circulating Water System			
A - Structures			
a. Crib house			
a'. Substructure			
b'. Superstructure			
c'. Steel			
d'. Miscellaneous	633,000	640,000	673,000
b. Dredging			
c. Intake flume			
d. Seal well			
e. Discharge flume			
f. Outfall			
B - Crib House Equipment (Erected)			
a. Traveling screens			
b. Screen wash pumps			
c. Screen wash piping	192,000	195,000	208,000
d. Chlorination equipment			
e. Chlorine handling			
C - Circulating Water Piping	589,000	593,000	617,000
D - Circulating Water Pumps			
a. Pumps	282,255	286,440	307,830
b. Motors	208,160	210,625	222,680
c. Erection	24,710	24,980	26,360
4. Feed Water Heaters			
A - L-P closed heaters	65,500	67,000	-
B - H-P closed heaters	59,000	-	71,000
C - Deaerating heater	132,000	130,000	-
D - Insulation			
a. Closed heaters	2,200	-	-
b. Deaerating	9,800	9,600	-
E - Structural Work			
a. For closed heaters	7,000	-	-
b. For deaerating heater	29,500	28,500	-
5. Boiler Feed Pumps			
a. Pumps and base plate	75,000	75,000	75,000
b. Fluid drive	42,900	42,900	60,000
c. Motors	61,410	55,455	71,550
d. Erection	12,000	10,400	10,400
e. Foundations for pumps	5,250	5,100	5,100
6. Condensate Pumps			
a. Pumps	51,600	53,400	-
b. Motors	21,530	22,180	-
c. Erection	5,950	6,100	-
7. Piping and Insulation			
a. Extraction steam	128,800	90,100	49,200
b. Heater vents and drains			
c. Boiler feed piping	64,800	39,400	87,600
d. Condensate piping			
a'. From condensate pumps thru L-P heaters	72,800	72,800	-
b'. For D-C heater and B.F. pump suction			
e. Main steam	53,000	51,700	50,400
8. Demineralizing Equipment and Condensate Storage Tanks	206,000	201,500	196,500
9. Electrical	108,300	108,800	91,100
10. Turbine Room Building			
a. Building	96,000	96,000	96,000
b. Turbine generator sub-base	15,000	15,000	15,000
11. Condenser Pit-Size Increment	18,600	19,300	22,400
TOTAL ITEMS 1 - 11	18,421,865	18,344,780	18,413,270
TOTAL CONSTANT COST	5,191,500	5,191,500	5,191,500
TOTAL TURBINE PLANT COST	23,613,365	23,536,280	23,604,770
12. PIPING IN CONTAINMENT VESSEL	410,000	408,000	404,000
GRAND TOTAL	24,023,365	23,944,280	24,008,770

TABLE 12.4 (SI-2008, p 5)

Summary of 500-MWe H_2O Turbine Plant Characteristics

Efficiency in %, Cost in Millions of Dollars

No. of Feed-Water Heaters			7		6		5		4		3		2		1	
Pressure Psia	Degrees F Superheat	Act. Steam Temp. °F	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost
1500	SAT.	596	36.3	30.56	35.9	29.86	35.4	29.51	34.7	29.22	33.8	29.05	32.7	28.96	31.7	28.93
	100	696	37.1	29.64	36.8	29.02	36.4	28.64	35.7	28.43	34.8	28.19	33.8	28.03	32.8	28.06
	200	796	38.4	28.64	38.1	28.02	37.6	27.66	36.8	27.47	35.9	27.30	34.9	27.20	33.7	27.20
	300	896	39.7	27.98	39.2	27.68	38.6	27.45	37.8	27.26	36.8	27.10	35.6	26.98	34.4	27.00
	400	996	40.7	28.27	40.3	27.90	39.7	27.64	38.8	27.45	37.7	27.32	36.6	27.20	35.3	27.21
1400	SAT.	587	35.9	30.44	35.6	29.93	35.1	29.53	34.4	29.25	33.5	29.08	32.4	29.02	31.3	29.03
	100	687	36.8	29.53	36.5	28.94	36.0	28.65	35.4	28.44	34.6	28.20	33.5	28.09	32.4	28.20
	200	787	38.1	28.48	37.8	28.06	37.2	27.70	36.6	27.52	35.7	27.34	34.5	27.14	33.3	27.30
	300	887	39.2	28.07	38.9	27.72	38.3	27.45	37.5	27.27	36.6	27.13	35.4	27.03	34.1	27.11
	400	987	40.3	28.27	40.1	27.89	39.4	27.68	38.5	27.50	37.5	27.36	36.3	27.28	35.0	27.32
1200	SAT.	567			35.1	31.24	34.8	30.80	34.3	30.48	33.5	30.28	32.4	30.07	31.2	30.03
	100	667			36.2	29.09	35.9	28.30	35.3	28.51	34.5	28.33	33.4	28.12	32.2	28.08
	200	767			37.3	28.20	37.1	27.89	36.5	27.53	35.7	27.40	34.5	27.25	33.2	27.24
	300	867			38.5	27.80	38.2	27.58	37.7	27.37	36.8	27.21	35.6	27.07	34.1	27.06
	400	967			39.6	27.92	39.4	27.71	38.8	27.51	37.8	27.39	36.5	27.23	35.0	27.16
1000	SAT.	545			34.1	30.98	33.9	30.64	33.4	30.33	32.6	30.20	31.7	30.08	30.5	30.02
	100	645			35.3	28.78	35.1	28.66	34.4	28.47	33.7	28.34	32.8	28.12	31.6	28.06
	200	745			36.5	27.67	36.3	27.43	35.6	27.18	34.8	27.05	33.8	26.93	32.5	26.86
	300	845			37.6	27.48	37.4	27.22	36.8	27.06	35.9	26.93	34.8	26.80	33.4	26.69
	400	945			38.8	27.68	38.6	27.44	37.9	27.29	37.0	27.17	35.8	27.04	34.2	26.88
800	SAT.	518			33.1	30.79	32.8	30.54	32.3	30.28	31.6	30.12	30.8	30.10	29.5	30.02
	100	618			34.2	30.05	33.9	29.81	33.4	29.40	32.6	29.26	31.8	29.17	30.5	29.10
	200	718			35.4	27.64	35.2	27.31	34.6	27.01	33.7	26.88	32.8	26.78	31.3	26.79
	300	818			36.6	27.31	36.4	27.10	35.7	26.94	34.8	26.81	33.8	26.74	32.2	26.76
	500	1018			38.8	27.79	38.6	27.41	37.9	27.14	36.8	27.27	35.6	27.27	33.9	27.22
600	SAT.	486					31.6	30.48	31.3	30.25	30.7	30.06	29.9	29.82	28.8	29.85
	100	586					32.8	29.69	32.4	29.43	31.8	29.32	31.0	29.17	29.8	29.04
	200	686					33.9	28.88	33.6	28.69	32.9	28.34	32.0	28.19	30.7	28.13
	400	886					36.1	27.14	35.9	27.00	35.3	26.89	34.3	26.76	32.6	26.66
	500	986					37.3	27.40	37.1	27.29	36.4	27.16	35.3	27.05	33.5	26.99
400	SAT.	445							29.1	30.48	28.7	30.30	28.1	30.05	27.0	29.93
	100	545							30.5	29.54	30.2	29.37	29.2	29.15	27.9	29.01
	200	645							31.7	29.15	31.4	29.03	30.4	28.82	28.9	28.77
	400	845							34.2	28.75	34.0	28.52	32.8	28.40	30.8	28.46
	500	945							35.3	27.33	35.2	27.21	33.9	26.97	31.8	27.02

TABLE 12.5 (SL-2008, pp 114-148)

SUMMARY OF COST DATA
1500 PSIA, 596 THROTTLE STEAM
(SATURATED STEAM)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	13,480,000	13,480,000	13,480,000	13,480,000	13,480,000	13,480,000	13,480,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	←			CONSTANT	→		
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessories B. Dry vacuum pumps	1,326,000	1,326,000	1,330,000	1,340,000	1,370,000	1,440,000	1,550,000
C. Tubes	945,000	945,000	950,000	956,000	975,000	1,020,000	1,097,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
E. Erection	222,000	222,000	223,000	225,000	228,000	237,000	252,000
F. Deaeration - hot well of cond.	NONE	←				→	69,700
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System							
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall	667,000	667,000	668,000	670,000	674,000	684,000	699,000
B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	137,000	137,000	137,000	138,000	139,000	142,000	147,000
C. Circulating water piping	656,000	656,000	657,000	659,000	667,000	683,000	710,000
D. Circulating water pumps							
1. Pumps	319,000	319,000	320,000	323,000	330,000	346,000	372,000
2. Motors	183,000	183,000	184,000	185,000	189,000	198,000	214,000
3. Erection	25,100	25,100	25,100	25,300	25,600	26,200	27,300
4. Feed Water Heaters							
A. L-P closed heaters	230,500	227,500	138,500	141,000	70,000	75,000	----
B. H-P closed heaters	511,500	296,500	268,500	128,000	104,000	-----	128,000
C. Deaerating heater	235,000	225,000	218,400	213,200	209,800	206,600	----
D. Insulation							
1. Closed heaters	16,200	11,100	8,200	4,900	1,800	----	----
2. Deaerators	17,300	16,500	16,100	15,700	15,400	15,300	----
E. Structural work							
1. For closed heaters	28,000	21,000	14,000	7,000	7,000	-----	----
2. For deaerators	50,400	47,600	45,800	44,600	43,600	43,000	----
5. Boiler Feed Pumps							
A. Pumps and base plates	408,000	380,000	351,000	338,000	320,000	314,000	302,000
B. Fluid drive	222,000	222,000	222,000	161,000	161,000	161,000	161,000
C. Motors	472,000	427,000	400,000	378,000	360,000	355,000	342,000
D. Erection	37,300	35,000	32,600	31,400	30,100	29,600	28,700
E. Foundation for pumps	7,400	7,000	6,500	6,200	6,000	5,800	5,700
6. Condensate Pumps							
A. Pumps	83,000	82,000	63,000	65,000	48,000	52,000	----
B. Motors	52,900	44,700	32,000	32,700	22,100	23,600	----
C. Erection	8,200	8,100	7,500	7,600	7,000	7,500	----
7. Piping and Insulation							
A. Extraction steam B. Heater vents and drains	400,300	340,000	294,000	248,000	220,000	146,000	81,200
C. Feed water piping	283,500	225,100	170,400	157,000	157,000	90,000	185,200
D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deaerator and B.F. pump suction	123,600	123,600	113,300	113,300	103,200	103,200	----
E. Main steam	30,000	30,000	30,000	30,000	22,500	22,500	22,500
8. Demineralizing Equipment and Condensate Storage Tanks	236,000	219,000	208,000	200,000	194,000	190,000	188,000
9. Electrical	217,800	208,400	200,100	195,600	191,200	192,300	164,100
10. Turbine Room Building	89,000	89,000	89,000	89,000	89,000	89,000	89,000
Total Items 1-10	22,607,250	22,133,450	21,788,500	21,494,000	21,331,800	21,749,100	21,204,400
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	29,849,750	29,375,950	29,031,000	28,736,500	28,574,300	28,491,600	28,446,900
11. Piping In Containment Vessel	714,000	483,500	483,000	479,000	475,000	470,000	478,500
Grand Total	30,563,750	29,859,450	29,514,000	29,215,500	29,049,300	28,961,600	28,925,400

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1500 PSIA, 696 THROTTLE STEAM
(100 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	13,000,000	13,000,000	13,000,000	13,000,000	13,000,000	13,000,000	13,000,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessories	1,260,000	1,262,000	1,270,000	1,280,000	1,300,000	1,340,000	1,420,000
B. Dry vacuum pumps							
C. Tubes	897,000	899,000	907,000	917,000	927,000	956,000	1,015,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
E. Erection	213,000	214,000	215,000	216,000	218,000	225,000	235,000
F. Deaeration - hot well of cond.	None	←					63,900
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	658,000	658,000	659,000	661,000	664,000	670,000	682,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	134,000	134,000	134,000	135,000	136,000	138,000	142,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	640,000	640,000	642,000	644,000	650,000	659,000	681,000
D. Circulating water pumps							
1. Pumps	303,000	304,000	306,000	308,000	313,000	323,000	342,000
2. Motors	174,000	174,000	175,000	177,000	180,000	186,000	197,000
3. Erection	24,400	24,400	24,500	24,600	24,900	25,300	26,100
4. Feed Water Heaters							
A. L-P closed heaters	206,500	205,000	128,000	129,500	65,000	68,000	----
B. H-P closed heaters	457,500	269,500	246,000	118,000	98,000	------	119,000
C. Deaerating heater	217,000	209,600	204,000	200,600	133,300	131,800	----
D. Insulation							
1. Closed heaters	14,700	9,900	7,400	4,400	1,600	------	----
2. Deaerators	16,000	15,400	15,100	14,800	9,900	9,800	----
E. Structural work							
1. For closed heaters	28,000	21,000	14,000	7,000	7,000	------	----
2. For deaerators	45,500	43,500	42,200	41,200	29,800	29,300	----
5. Boiler Feed Pumps.							
A. Pumps and base plates	356,000	335,000	313,000	302,000	289,000	284,000	275,000
B. Fluid drive	222,000	222,000	161,000	161,000	161,000	161,000	161,000
C. Motors	447,000	410,000	388,000	368,000	352,000	340,000	336,000
D. Erection	33,100	31,300	29,500	28,700	27,700	27,300	26,500
E. Foundation for pumps	6,600	6,200	5,800	5,700	5,400	5,300	5,200
6. Condensate Pumps							
A. Pumps	73,500	73,000	56,500	58,000	44,000	46,500	----
B. Motors	46,900	46,500	29,100	29,600	20,500	21,500	----
C. Erection	7,400	7,300	6,800	6,900	6,500	6,800	----
7. Piping and Insulation							
A. Extraction steam							
B. Heater vents and drains	400,300	340,000	294,000	248,000	220,000	146,800	81,200
C. Feed water piping	282,700	240,000	177,100	163,500	163,500	97,000	199,500
D. Condensate piping							
1. From condensate pumps through L-P heaters.	104,800	104,000	92,200	92,200	78,300	78,300	----
2. To deaerator and B.F. pump suction							
E. Main steam	22,800	22,800	22,800	22,800	19,700	19,700	19,700
8. Demineralizing Equipment and Condensate Storage Tanks	206,000	194,000	186,000	180,000	176,000	173,000	171,000
9. Electrical	209,900	202,300	185,000	191,300	187,200	186,200	159,300
10. Turbine Room Building	89,000	89,000	89,000	89,000	89,000	89,000	89,000
Total Items 1-10	21,683,850	21,293,950	20,910,500	20,710,300	20,468,800	20,315,100	20,335,400
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	28,926,350	28,536,450	28,153,000	27,952,800	27,711,300	27,557,600	27,577,900
11. Piping In Containment Vessel	714,000	483,500	483,000	479,000	475,000	470,000	478,500
Grand Total	29,640,350	29,019,950	28,636,000	28,431,800	28,186,300	28,027,600	28,056,400

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1500 PSIA, 796 F THROTTLE STEAM
(200 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	12,280,000	12,280,000	12,280,000	12,280,000	12,280,000	12,280,000	12,280,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	← CONSTANT →						
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessories	1,186,000	1,194,000	1,206,000	1,214,000	1,240,000	1,310,000	1,360,000
B. Dry vacuum pumps							
C. Tubes	840,000	850,000	857,000	866,000	885,000	915,000	973,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
E. Erection	203,000	205,000	206,000	208,000	213,000	217,000	227,000
F. Deaeration - hot well of cond.	None	→					61,200
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	646,000	648,000	650,000	652,000	656,000	662,000	673,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	130,000	131,000	131,000	132,000	133,000	135,000	139,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	620,000	623,000	626,000	629,000	637,000	646,000	665,000
D. Circulating water pumps							
1. Pumps	284,000	287,000	290,000	293,000	299,000	309,000	328,000
2. Motors	163,000	165,000	166,000	168,000	172,000	178,000	188,000
3. Erection	23,600	23,800	23,900	24,000	24,300	24,700	25,500
4. Feed Water Heaters							
A. L-P closed heaters	190,500	191,000	120,500	121,500	61,500	64,000	----
B. H-P closed heaters	425,500	252,500	232,000	112,000	94,000	----	114,000
C. Deaerating heater	205,600	199,400	131,700	129,300	127,400	125,100	----
D. Insulation							
1. Closed heaters	12,800	9,000	6,800	4,100	1,500	-----	----
2. Deaerators	15,200	14,700	9,800	9,600	9,400	9,300	----
E. Structural work							
1. For closed heaters	28,000	21,000	14,000	7,000	7,000	-----	----
2. For deaerators	42,600	41,000	29,300	28,500	27,900	27,500	----
5. Boiler Feed Pumps							
A. Pumps and base plates	325,000	308,000	289,000	281,000	270,000	266,000	259,000
B. Fluid drive	222,000	161,000	161,000	161,000	161,000	161,000	161,000
C. Motors	397,000	368,000	350,000	335,000	320,000	312,000	310,000
D. Erection	30,500	29,200	27,700	27,000	26,100	25,800	25,200
E. Foundation for pumps	6,000	5,700	5,400	5,300	5,100	5,000	4,900
6. Condensate Pumps							
A. Pumps	66,500	66,000	53,000	53,500	41,500	43,500	----
B. Motors	42,700	42,500	27,000	27,500	19,400	20,300	----
C. Erection	6,800	6,700	6,400	6,500	6,200	6,400	----
7. Piping and Insulation							
A. Extraction steam							
B. Heater vents and drains	400,300	335,000	294,000	247,700	200,000	146,800	81,200
C. Feed water piping	282,700	240,000	177,100	163,500	163,500	97,000	199,500
D. Condensate piping							
1. From condensate pumps through L-P heaters.	104,800	104,800	92,200	92,200	78,300	78,300	----
2. To deaerator and B.F. pump suction							
E. Main steam	58,200	58,200	58,200	58,200	44,400	44,400	44,400
8. Demineralizing Equipment and Condensate Storage Tanks	188,000	179,000	173,000	168,000	164,000	162,000	161,000
9. Electrical	196,600	190,700	184,800	182,000	178,900	178,300	151,900
10. Turbine Room Building	89,000	89,000	89,000	89,000	89,000	89,000	89,000
Total Items 1-10	20,599,150	20,206,450	19,853,300	19,660,900	19,506,900	19,409,900	19,409,800
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,841,650	27,448,950	27,095,800	26,903,400	26,749,400	26,652,400	26,652,300
11. Piping In Containment Vessel	798,500	567,000	567,000	563,500	549,500	549,500	549,500
Grand Total	28,640,150	28,015,950	27,662,800	27,466,900	27,298,900	27,201,900	27,201,800

TABLE 12.5 (Continued)

1500 PSIA, 896 F THROTTLE STEAM
(300 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	12,280,000	12,280,000	12,280,000	12,280,000	12,280,000	12,280,000	12,280,000
B. Turbine generator erection	540,000	540,000	540,000	540,000	540,000	540,000	540,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessories B. Dry vacuum pumps	1,110,000	1,108,000	1,120,000	1,130,000	1,156,000	1,200,000	1,270,000
C. Tubes	788,000	791,000	800,000	808,000	825,000	855,000	905,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
E. Erection	193,000	194,000	195,000	196,000	201,000	206,000	215,000
F. Deaeration - hot well of cond.	None	←				→	57,200
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System							
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall	635,000	636,000	638,000	640,000	643,000	650,000	659,000
B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	126,000	127,000	127,000	128,000	129,000	131,000	134,000
C. Circulating water piping	601,000	603,000	606,000	608,000	614,000	625,000	642,000
D. Circulating water pumps							
1. Pumps	264,000	267,000	270,000	273,000	278,000	289,000	306,000
2. Motors	152,000	153,000	155,000	157,000	160,000	166,000	175,000
3. Erection	22,900	23,000	23,100	23,200	23,400	23,900	24,500
4. Feed Water Heaters							
A. L-P closed heaters	182,500	182,500	114,000	115,500	58,000	60,000	-----
B. H-P closed heaters	401,500	240,000	222,500	107,500	91,500	-----	110,000
C. Deaerating heater	133,000	129,200	126,400	124,400	122,900	121,900	-----
D. Insulation							
1. Closed heaters	11,800	8,400	6,300	3,800	1,400	-----	-----
2. Deaerators	9,900	9,600	9,300	9,200	9,100	9,000	-----
E. Structural work							
1. For closed heaters	28,000	21,000	14,000	7,000	7,000	-------	-----
2. For deaerators	29,700	28,500	27,700	27,100	26,600	26,500	-----
5. Boiler Feed Pumps							
A. Pumps and base plates	301,000	287,000	272,000	266,000	257,000	253,000	247,000
B. Fluid drive	161,000	161,000	161,000	161,000	128,000	128,000	128,000
C. Motors	361,000	337,000	322,000	310,000	300,000	292,000	290,000
D. Erection	28,600	27,400	26,300	25,700	25,000	24,700	24,300
E. Foundation for pumps	5,600	5,400	5,100	5,000	4,900	4,800	4,700
6. Condensate Pumps							
A. Pumps	62,000	61,500	49,500	50,000	39,000	41,000	-----
B. Motors	39,400	39,300	25,400	25,700	18,200	19,100	-----
C. Erection	6,300	6,300	6,000	6,100	5,800	6,100	-----
7. Piping and Insulation							
A. Extraction steam B. Heater vents and drains	391,500	335,000	294,000	245,500	197,500	144,500	81,200
C. Feed water piping	229,200	210,000	177,100	163,500	163,500	97,000	199,500
D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deaerator and B.F. pump suction	104,800	104,800	92,200	92,200	75,900	75,900	-----
E. Main steam	74,500	74,500	67,000	67,000	67,000	67,000	67,000
8. Demineralizing Equipment and Condensate Storage Tanks	175,000	168,000	162,000	158,000	156,000	155,000	154,000
9. Electrical	186,100	181,300	176,400	174,200	171,400	171,600	145,100
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	20,139,550	19,844,950	19,613,800	19,431,100	19,264,600	19,157,500	19,165,500
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,382,050	27,087,450	26,856,300	26,673,600	26,507,100	26,395,000	26,408,000
11. Piping In Containment Vessel	664,000	595,000	592,000	589,500	589,500	589,500	589,500
Grand Total	27,979,650	27,682,450	27,448,300	27,263,100	27,096,600	26,984,500	26,997,500

TABLE 12.5 (Continued)

1500 PSIA, 996 F THROTTLE STEAM
(400 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	12,640,000	12,640,000	12,640,000	12,640,000	12,640,000	12,640,000	12,640,000
B. Turbine generator erection	540,000	540,000	540,000	540,000	540,000	540,000	540,000
C. Reserve exciter	←		CONSTANT				→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessories	1,060,000	1,062,000	1,064,000	1,074,000	1,090,000	1,130,000	1,194,000
B. Dry vacuum pumps							
C. Tubes	753,000	755,000	760,000	766,000	780,000	805,000	850,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	35,000
E. Erection	185,000	186,000	187,000	188,000	192,000	196,000	205,000
F. Deaeration - hot well of cond.	NONE	←					→ 53,700
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	628,000	629,000	630,000	631,000	634,000	639,000	648,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	124,000	124,000	125,000	125,000	126,000	128,000	131,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	588,000	590,000	592,000	593,00	598,000	608,000	624,000
D. Circulating water pumps							
1. Pumps	252,000	254,000	256,000	258,000	262,000	272,000	287,000
2. Motors	145,000	146,000	147,000	148,000	151,000	156,000	165,000
3. Erection	22,400	22,400	22,500	22,600	22,800	23,200	23,800
4. Feed Water Heaters							
A. L-P closed heaters	172,000	172,000	109,000	110,500	55,500	58,500	------
B. H-P closed heaters	384,500	230,500	214,000	104,000	88,500	-------	106,500
C. Deaerating heater	128,000	124,200	121,800	120,000	118,700	117,700	-------
D. Insulation							
1. Closed heaters	9,000	7,900	6,000	3,600	1,400	-------	-------
2. Deaerators	9,400	9,100	9,000	8,800	8,700	8,700	-------
E. Structural work							
1. For closed heaters	28,000	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	28,100	27,000	26,300	25,800	25,400	25,200	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	284,000	272,000	258,000	252,000	244,000	242,000	236,000
B. Fluid drive	161,000	161,000	128,000	128,000	128,000	128,000	128,000
C. Motors	333,000	311,000	300,000	290,000	281,000	275,000	273,000
D. Erection	27,200	26,300	25,200	24,700	24,000	23,800	23,400
E. Foundation for pumps	5,300	5,100	4,900	4,800	4,700	4,600	4,500
6. Condensate Pumps							
A. Pumps	58,500	58,000	46,500	47,500	37,500	39,000	-------
B. Motors	36,900	36,800	23,800	24,300	17,300	18,100	-------
C. Erection	5,900	5,900	5,600	5,700	5,500	5,700	-------
7. Piping and Insulation							
A. Extraction steam							
B. Heater vents and drains	391,500	327,000	294,000	245,500	197,500	144,500	81,200
C. Feed water piping	229,200	210,000	177,100	156,100	156,100	97,000	199,500
D. Condensate piping							
1. From condensate pumps through L-P heaters.	98,000	98,000	83,100	83,100	75,900	75,900	------
2. To deaerator and B.F. pump suction							
E. Main steam	90,500	83,800	83,800	83,800	83,800	83,800	83,800
8. Demineralizing Equipment and Condensate Storage Tanks	165,000	159,000	154,000	151,000	149,000	148,000	147,000
9. Electrical	178,200	174,100	169,800	167,700	165,300	165,300	139,200
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	20,265,850	19,973,350	19,720,900	19,533,000	19,400,100	19,287,500	19,290,600
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,508,350	27,215,850	26,963,400	26,775,500	26,642,600	26,530,000	26,533,100
11. Piping In Containment Vessel	761,000	678,500	678,500	674,000	674,000	674,000	674,000
Grand Total	28,269,350	27,894,350	27,641,900	27,449,500	27,316,600	27,204,000	27,207,100

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 587 F THROTTLE STEAM
(SATURATED STEAM)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	13,530,000	13,530,000	13,530,000	13,530,000	13,530,000	13,530,000	13,530,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessories	1,342,000	1,344,000	1,347,000	1,350,000	1,400,000	1,485,000	1,595,000
B. Dry vacuum pumps							
C. Tubes	958,000	963,000	970,000	980,000	1,000,000	1,041,000	1,140,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
E. Erection	225,000	226,000	228,000	229,000	232,000	241,000	259,000
F. Deaeration - hot well of cond.	NONE	→					71,800
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	671,000	671,000	673,000	675,000	679,000	688,000	707,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	138,000	138,000	139,000	139,000	141,000	144,000	150,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	661,000	662,000	665,000	667,000	675,000	691,000	724,000
D. Circulating water pumps							
1. Pumps	324,000	325,000	328,000	331,000	338,000	354,000	386,000
2. Motors	186,000	187,000	188,000	190,000	194,000	203,000	222,000
3. Erection	25,300	25,400	25,400	25,600	25,900	26,500	27,900
4. Feed Water Heaters							
A. L-P closed heaters	210,000	208,500	125,500	127,000	60,000	63,000	------
B. H-P closed heaters	473,000	280,000	259,000	123,500	90,000	------	114,000
C. Deaerating heater	233,600	223,200	217,400	212,200	208,800	205,600	--------
D. Insulation							
1. Closed heaters	15,900	10,900	8,100	4,800	1,500	------	--------
2. Deaerators	17,200	16,500	16,000	15,600	15,400	15,200	--------
E. Structural work							
1. For closed heaters	28,000	21,000	14,000	7,000	7,000	------	---------
2. For deaerators	50,000	47,200	45,600	44,200	43,400	42,800	--------
5. Boiler Feed Pumps							
A. Pumps and base plates	373,000	348,000	323,000	310,000	295,000	290,000	281,000
B. Fluid drive	222,000	222,000	161,000	161,000	161,000	161,000	161,000
C. Motors	437,000	397,000	374,000	354,000	336,000	324,000	323,000
D. Erection	36,700	34,500	32,400	31,200	29,900	29,400	28,700
E. Foundation for pumps	7,300	6,800	6,400	6,200	5,900	5,800	5,600
6. Condensate Pumps							
A. Pumps	83,000	82,500	52,000	53,000	48,500	52,500	--------
B. Motors	49,600	49,000	30,600	31,200	23,500	25,000	--------
C. Erection	8,200	8,100	7,500	7,600	7,100	7,500	--------
7. Piping and Insulation							
A. Extraction steam							
B. Heater vents and drains	401,000	348,000	302,000	250,000	197,000	138,000	81,200
C. Feed water piping	269,000	225,100	170,400	157,000	157,000	89,700	185,200
D. Condensate piping							
1. From condensate pumps through L-P heaters.	123,600	123,600	113,300	113,300	103,200	103,200	--------
2. To deaerator and B.F. pump suction							
E. Main steam	30,000	30,000	30,000	30,000	22,500	22,500	22,500
8. Demineralizing Equipment and Condensate Storage Tanks	233,000	217,000	207,000	199,000	193,000	190,000	188,000
9. Electrical	210,800	202,400	195,100	191,200	187,000	186,800	161,900
10. Turbine Room Building	89,000	89,000	89,000	89,000	89,000	89,000	89,000
Total Items 1-10	22,548,450	22,148,950	21,758,200	21,520,100	21,368,100	21,316,000	21,341,050
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	29,790,950	29,391,450	29,000,700	28,762,600	28,610,600	28,558,500	28,583,550
11. Piping In Containment Vessel	654,000	542,000	525,000	489,000	465,000	459,000	450,000
Grand Total	30,444,950	29,933,450	29,525,700	29,251,600	29,075,600	29,017,500	29,033,550

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 687 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	13,050,000	13,050,000	13,050,000	13,050,000	13,050,000	13,050,000	13,050,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessories	1,275,000	1,277,000	1,300,000	1,310,000	1,330,000	1,380,000	1,493,000
B. Dry vacuum pumps							
C. Tubes	909,000	915,000	923,000	930,000	945,000	981,000	1,067,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
E. Erection	216,000	217,000	218,000	220,000	223,000	230,000	244,000
F. Deaeration - hot well of cond.	NONE	←				→	67,200
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	660,000	661,000	662,000	665,000	668,000	675,000	690,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	135,000	135,000	135,000	136,000	137,000	140,000	145,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	644,000	645,000	647,000	651,000	656,000	669,000	697,000
D. Circulating water pumps							
1. Pumps	307,000	309,000	310,000	314,000	320,000	332,000	360,000
2. Motors	175,000	177,000	178,000	180,000	184,000	190,000	206,000
3. Erection	24,600	24,000	24,700	24,900	25,100	25,600	26,700
4. Feed Water Heaters							
A. L-P closed heaters	193,500	193,500	118,000	120,000	57,000	59,500	-------
B. H-P closed heaters	427,000	256,000	238,000	114,000	85,000	-------	107,000
C. Deaerating heater	216,400	208,800	204,000	200,000	133,200	131,700	-------
D. Insulation							
1. Closed heaters	13,900	9,700	7,300	4,300	1,300	-------	-------
2. Deaerators	15,900	15,400	15,000	14,800	9,900	9,800	-------
E. Structural work							
1. For closed heaters	28,000	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	45,200	43,400	42,200	41,000	29,800	29,300	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	326,000	309,000	289,000	280,000	268,000	264,000	257,000
B. Fluid drive	222,000	161,000	161,000	161,000	161,000	161,000	161,000
C. Motors	420,000	387,000	367,000	348,000	332,000	322,000	320,000
D. Erection	32,700	31,200	29,400	28,600	27,500	27,200	26,500
E. Foundation for pumps	6,500	6,100	5,800	5,600	5,400	5,300	5,200
6. Condensate Pumps							
A. Pumps	73,500	73,000	47,000	48,000	44,500	47,000	--------
B. Motors	44,100	43,800	27,900	28,400	21,800	22,900	--------
C. Erection	7,400	7,300	6,900	7,000	6,600	6,900	--------
7. Piping and Insulation							
A. Extraction steam							
B. Heater vents and drains	401,000	348,000	302,500	250,000	197,000	138,300	81,200
C. Feed water piping	268,500	240,000	177,100	163,500	163,500	96,600	199,500
D. Condensate piping							
1. From condensate pumps through L-P heaters.	104,800	104,800	92,200	92,200	85,000	85,000	-------
2. To deaerator and B.F. pump suction							
E. Main steam	27,100	21,300	21,300	21,300	21,300	17,100	17,100
8. Demineralizing Equipment and Condensate Storage Tanks	205,000	194,000	186,000	179,000	175,000	173,000	172,000
9. Electrical	204,600	197,800	190,700	187,800	184,000	183,500	158,200
10. Turbine Room Building	89,000	89,000	89,000	89,000	89,000	89,000	89,000
Total Items 1-10	21,654,950	21,258,350	20,964,500	20,756,900	20,514,400	20,413,200	20,526,850
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	28,897,450	28,500,850	28,207,000	27,999,400	27,756,900	27,655,700	27,769,350
11. Piping In Containment Vessel	631,000	442,500	442,500	442,500	442,500	433,000	433,000
Grand Total	29,528,450	28,943,350	28,649,500	28,441,900	28,199,400	28,088,700	28,202,350

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 787 F THROTTLE STEAM
(200 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessories	1,200,000	1,210,000	1,220,000	1,240,000	1,260,000	1,310,000	1,400,000
B. Dry vacuum pumps							
C. Tubes	855,000	865,000	873,000	883,000	901,000	931,000	997,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
E. Erection	206,000	207,000	209,000	211,000	213,000	220,000	232,000
F. Deaeration - hot well of cond.	NONE	→					63,000
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	649,000	652,000	653,000	655,000	659,000	665,000	678,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	131,000	132,000	132,000	133,000	134,000	136,000	140,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	625,000	629,000	631,000	635,000	641,000	652,000	674,000
D. Circulating water pumps							
1. Pumps	288,000	292,000	294,000	298,000	304,000	315,000	337,000
2. Motors	165,000	167,000	169,000	171,000	175,000	181,000	193,000
3. Erection	23,800	24,000	24,100	24,200	24,500	24,900	25,900
4. Feed Water Heaters							
A. L-P closed heaters	177,500	177,500	112,500	111,000	54,500	56,500	--------
B. H-P closed heaters	396,000	239,500	224,500	108,500	82,500	-------	102,500
C. Deaerating heater	205,000	199,600	131,500	129,200	127,300	126,200	--------
D. Insulation							
1. Closed heaters	12,600	9,000	6,700	4,000	1,300	-------	--------
2. Deaerators	15,200	14,700	9,800	9,600	9,400	9,300	--------
E. Structural work							
1. For closed heaters	28,000	21,000	14,000	7,000	7,000	-------	--------
2. For deaerators	41,600	41,000	29,200	28,500	27,900	27,700	--------
5. Boiler Feed Pumps							
A. Pumps and base plates	299,000	285,000	268,000	260,000	251,000	248,000	242,000
B. Fluid drive	161,000	161,000	161,000	161,000	128,000	128,000	128,000
C. Motors	375,000	349,000	332,000	317,000	303,000	296,000	297,000
D. Erection	30,300	29,000	27,500	26,900	26,000	25,700	25,300
E. Foundation for pumps	6,000	5,800	5,400	5,300	5,100	5,000	4,900
6. Condensate Pumps							
A. Pumps	67,000	67,000	43,500	44,000	42,000	44,000	--------
B. Motors	40,400	40,300	26,000	26,400	20,600	21,500	--------
C. Erection	6,800	6,800	6,400	6,500	6,200	6,500	--------
7. Piping and Insulation							
A. Extraction steam							
B. Heater vents and drains	400,000	348,000	296,500	246,000	197,000	138,300	81,200
C. Feed water piping	268,500	240,000	177,100	163,500	163,500	96,600	199,500
D. Condensate piping							
1. From condensate pumps through L-P heaters.	104,800	104,800	92,200	92,200	78,300	78,300	--------
2. To deaerator and B.F. pump suction							
E. Main steam	64,300	58,200	58,200	58,200	58,200	58,200	58,200
8. Demineralizing Equipment and Condensate Storage Tanks	188,000	179,000	173,000	168,000	164,000	162,000	161,000
9. Electrical	192,300	186,900	181,500	179,000	176,000	175,700	150,300
10. Turbine Room Building	89,000	89,000	89,000	89,000	89,000	89,000	89,000
Total Items 1-10	20,528,350	20,247,350	19,886,100	19,706,500	19,530,800	19,332,300	19,496,050
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,770,850	27,489,850	27,128,600	26,949,000	26,773,300	26,574,800	26,738,550
11. Piping In Containment Vessel	710,000	566,500	566,500	566,500	566,500	563,500	563,500
Grand Total	28,480,850	28,056,350	27,695,100	27,515,500	27,339,800	27,138,300	27,302,050

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 887 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000
B. Turbine generator erection	540,000	540,000	540,000	540,000	540,000	540,000	540,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessories	1,130,000	1,130,000	1,140,000	1,157,000	1,175,000	1,215,000	1,313,000
B. Dry vacuum pumps							
C. Tubes	806,000	807,000	814,000	823,000	835,000	866,000	935,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
E. Erection	196,000	196,000	197,000	200,000	202,000	207,000	220,000
F. Deaeration - hot well of cond.	NONE	←					→ 59,200
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	639,000	639,000	641,000	642,000	645,000	652,000	666,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	128,000	128,000	128,000	129,000	130,000	132,000	136,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	607,000	607,000	610,000	612,000	618,000	630,000	652,000
D. Circulating water pumps							
1. Pumps	271,000	272,000	274,000	276,000	282,000	292,000	316,000
2. Motors	156,000	156,000	157,000	159,000	162,000	168,000	181,000
3. Erection	23,100	23,200	23,200	23,400	23,600	24,000	25,000
4. Feed Water Heaters							
A. L-P closed heaters	171,500	171,500	107,000	108,000	52,000	53,500	-------
B. H-P closed heaters	374,000	228,000	215,000	104,000	80,500	-------	98,500
C. Deaerating heater	133,000	129,200	126,400	124,300	122,900	121,900	-------
D. Insulation							
1. Closed heaters	11,800	8,400	6,400	3,800	1,200	-------	-------
2. Deaerators	9,900	9,600	9,300	9,000	9,100	9,000	-------
E. Structural work							
1. For closed heaters	28,000	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	29,700	28,500	27,700	27,000	26,600	26,300	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	279,000	266,000	252,000	247,000	238,000	236,000	229,000
B. Fluid drive	161,000	161,000	128,000	128,000	128,000	128,000	128,000
C. Motors	344,000	320,000	307,000	294,000	283,000	277,000	274,000
D. Erection	28,500	27,300	26,200	25,700	25,000	24,700	24,000
E. Foundation for pumps	5,600	5,400	5,100	5,000	4,900	4,800	4,700
6. Condensate Pumps							
A. Pumps	62,500	62,000	40,500	41,000	39,500	41,000	-------
B. Motors	37,400	37,200	24,300	24,700	19,300	20,200	-------
C. Erection	6,300	5,900	5,700	5,800	5,500	5,800	-------
7. Piping and Insulation							
A. Extraction steam							
B. Heater vents and drains	394,000	337,000	294,500	244,000	194,000	138,300	81,200
C. Feed water piping	217,000	210,000	177,100	163,500	163,500	96,600	199,500
D. Condensate piping							
1. From condensate pumps through L-P heaters.	104,800	104,800	92,200	83,100	75,900	75,900	-------
2. To deaerator and B.F. pump suction							
E. Main steam	79,300	73,000	67,000	67,000	67,000	67,000	67,000
8. Demineralizing Equipment and Condensate Storage Tanks	175,000	167,000	162,000	158,000	156,000	155,000	153,000
9. Electrical	182,900	177,900	173,300	171,300	168,700	168,800	142,800
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	20,166,550	19,884,150	19,618,400	19,436,100	19,299,700	19,195,300	19,280,150
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,409,050	27,126,650	26,860,900	26,678,600	26,542,200	26,437,800	26,522,650
11. Piping In Containment Vessel	664,000	595,500	592,500	589,500	589,500	589,500	589,500
Grand Total	28,073,050	27,722,150	27,453,400	27,263,100	27,131,700	27,027,300	27,112,150

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 987 F THROTTLE STEAM
(400 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	12,690,000	12,690,000	12,690,000	12,690,000	12,690,000	12,690,000	12,690,000
B. Turbine generator erection	540,000	540,000	540,000	540,000	540,000	540,000	540,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers							
A. Shells and accessories	1,070,000	1,070,000	1,078,000	1,090,000	1,108,000	1,157,000	1,225,000
B. Dry vacuum pumps							
C. Tubes	764,000	765,000	772,000	780,000	789,000	822,000	875,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	17,500	17,500	33,250
E. Erection	187,000	187,000	188,000	191,000	194,000	199,000	209,000
F. Deaeration - hot well of cond.	NONE	←					→ 55,100
G. L-P heaters in exhaust stack	28,000	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	630,000	630,000	632,000	634,000	636,000	642,000	653,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	125,000	125,000	125,000	126,000	127,000	129,000	132,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	592,000	592,000	595,000	597,000	603,000	612,000	631,000
D. Circulating water pumps							
1. Pumps	256,000	257,000	259,000	262,000	266,000	276,000	296,000
2. Motors	147,000	147,000	149,000	150,000	153,000	158,000	170,000
3. Erection	22,500	22,500	22,600	22,800	23,000	23,400	24,100
4. Feed Water Heaters							
A. L-P closed heaters	163,500	163,500	103,000	104,500	50,000	51,500	-------
B. H-P closed heaters	359,000	219,000	207,000	100,000	78,500	-------	96,500
C. Deaerating heater	128,000	124,100	121,800	120,000	118,500	117,800	-------
D. Insulation							
1. Closed heaters	11,100	8,000	5,900	3,600	1,100	-------	-------
2. Deaerators	9,400	9,100	9,000	8,800	8,700	8,700	-------
E. Structural work							
1. For closed heaters	28,000	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	28,100	27,000	26,300	25,800	25,400	24,800	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	262,000	252,000	240,000	235,000	228,000	225,000	222,000
B. Fluid drive	161,000	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	318,000	297,000	284,000	276,000	265,000	261,000	262,000
D. Erection	27,000	26,000	25,000	24,700	24,000	23,800	23,400
E. Foundation for pumps	5,300	5,100	5,000	4,800	4,700	4,600	4,500
6. Condensate Pumps							
A. Pumps	58,500	58,000	38,000	39,000	37,500	39,000	--------
B. Motors	35,000	34,800	22,900	23,300	18,400	19,100	--------
C. Erection	6,000	5,900	5,700	5,800	5,500	5,800	--------
7. Piping and Insulation							
A. Extraction steam							
B. Heater vents and drains	394,000	337,000	294,500	244,000	194,000	138,300	81,200
C. Feed water piping	217,000	210,000	177,100	156,100	156,100	96,600	199,500
D. Condensate piping							
1. From condensate pumps through L-P heaters.	98,000	98,000	83,100	83,100	75,900	75,900	-------
2. To deaerator and B.F. pump suction							
E. Main steam	89,700	89,700	89,700	89,700	89,700	89,700	89,700
8. Demineralizing Equipment and Condensate Storage Tanks	165,000	158,000	154,000	151,000	149,000	148,000	148,000
9. Electrical	175,000	170,700	166,900	165,200	162,800	162,900	137,800
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	20,267,350	19,972,650	19,755,000	19,581,700	19,446,300	19,358,400	19,398,050
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,509,850	27,215,150	26,997,500	26,824,200	26,688,800	26,600,900	26,640,550
11. Piping In Containment Vessel	760,500	678,500	678,500	674,500	674,500	674,500	674,500
Grand Total	28,270,350	27,893,650	27,676,000	27,498,700	27,363,300	27,275,400	27,315,050

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 567 F THROTTLE STEAM
(SATURATED STEAM)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit.	14,530,000	14,530,000	14,530,000	14,530,000	14,530,000	14,530,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	← CONSTANT →					
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers						
A. Shells and accessories B. Dry vacuum pumps	1,400,000	1,402,000	1,410,000	1,450,000	1,490,000	1,610,000
C. Tubes	995,000	1,000,000	1,012,000	1,031,000	1,070,000	1,144,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	33,250
E. Erection	232,000	233,000	235,000	238,000	246,000	262,000
F. Deaeration - hot well of cond.	NONE →					72,500
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall	678,000	679,000	681,000	685,000	693,000	709,000
B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	140,000	141,000	142,000	143,000	145,000	150,000
C. Circulating water piping	674,000	676,000	680,000	686,000	700,000	726,000
D. Circulating water pumps						
1. Pumps	337,000	339,000	342,000	349,000	362,000	388,000
2. Motors	193,000	195,000	197,000	200,000	208,000	223,000
3. Erection	25,800	25,900	26,100	26,300	26,900	28,000
4. Feed Water Heaters						
A. L-P closed heaters	256,000	152,500	154,000	71,500	75,000	-------
B. H-P closed heaters	312,500	280,500	136,000	118,000	-------	119,000
C. Deaerating heater	231,000	222,600	216,200	210,800	205,600	-------
D. Insulation						
1. Closed heaters	12,700	9,600	5,600	2,400	-------	-------
2. Deaerators	17,000	16,400	15,900	15,500	15,300	-------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	49,200	47,000	45,200	43,800	43,000	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	345,000	313,000	297,000	277,000	269,000	257,000
B. Fluid drive	161,000	161,000	161,000	128,000	128,000	128,000
C. Motors	363,000	346,000	322,000	304,000	290,000	287,000
D. Erection	31,100	28,800	27,500	25,900	25,300	24,400
E. Foundation for pumps	7,300	6,700	6,400	6,000	5,800	5,600
6. Condensate Pumps						
A. Pumps	99,000	66,500	67,000	50,000	53,000	-------
B. Motors	67,200	36,900	37,500	24,100	25,300	-------
C. Erection	8,500	7,800	7,900	7,300	7,600	-------
7. Piping and Insulation						
A. Extraction steam B. Heater vents and drains	332,000	295,000	242,000	210,000	133,500	79,000
C. Feed water piping	225,100	222,500	147,300	147,300	89,100	172,600
D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deaerator and B.F. pump suction	161,300	113,300	113,300	103,200	103,200	-------
E. Main steam	28,500	28,500	25,600	25,600	25,600	25,600
8. Demineralizing Equipment and Condensate Storage Tanks	229,000	216,000	205,000	196,000	190,000	188,000
9. Electrical	199,600	191,800	187,200	181,800	180,800	154,600
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	23,427,050	23,062,550	22,746,950	22,543,000	22,385,500	22,348,550
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	30,669,550	30,305,050	29,989,450	29,785,500	29,628,000	29,591,050
11. Piping In Containment Vessel	566,500	492,500	495,000	495,000	444,000	443,000
Grand Total	31,236,050	30,797,550	30,484,450	30,280,500	30,072,000	30,034,050

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 667 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	13,050,000	13,050,000	13,050,000	13,050,000	13,050,000	13,050,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	← CONSTANT →					
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers						
A. Shells and accessories B. Dry vacuum pumps	1,320,000	1,323,000	1,342,000	1,370,000	1,407,000	1,490,000
C. Tubes	940,000	945,000	957,000	975,000	999,000	1,045,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	33,250
E. Erection	220,000	221,000	225,000	227,000	232,000	245,000
F. Deaeration - hot well of cond.	NONE →					67,100
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall	666,000	668,000	670,000	674,000	680,000	693,000
B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	137,000	137,000	138,000	139,000	141,000	145,000
C. Circulating water piping	653,000	656,000	660,000	666,000	676,000	699,000
D. Circulating water pumps						
1. Pumps	317,000	319,000	323,000	329,000	340,000	362,000
2. Motors	182,000	183,000	185,000	189,000	195,000	208,000
3. Erection	25,000	25,100	25,300	25,500	26,000	26,900
4. Feed Water Heaters						
A. L-P closed heaters	228,500	139,000	140,000	66,000	69,000	--------
B. H-P closed heaters	287,000	259,000	125,000	110,000	--------	119,000
C. Deaerating heater	215,000	208,800	203,800	199,800	132,400	--------
D. Insulation						
1. Closed heaters	11,200	9,300	5,100	2,200	--------	--------
2. Deaerators	15,800	15,400	15,000	14,700	9,800	--------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	------	--------
2. For deaerators	45,000	43,400	42,000	41,000	29,500	--------
5. Boiler Feed Pumps						
A. Pumps and base plates	304,000	279,000	268,000	252,000	245,000	236,000
B. Fluid drive	161,000	161,000	161,000	128,000	128,000	128,000
C. Motors	362,000	346,000	325,000	308,000	293,000	292,000
D. Erection	28,000	26,000	25,200	24,000	23,300	22,800
E. Foundation for pumps	6,500	6,100	5,800	5,500	5,400	5,200
6. Condensate Pumps						
A. Pumps	87,500	59,000	60,500	46,000	48,000	--------
B. Motors	60,100	33,500	34,000	22,300	23,200	--------
C. Erection	7,700	7,100	7,200	6,700	7,000	--------
7. Piping and Insulation						
A. Extraction steam B. Heater vents and drains	332,000	295,000	242,000	210,000	133,500	79,000
C. Feed water piping	241,800	241,800	153,900	153,900	96,100	186,300
D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deaerator and B.P. pump suction	108,900	92,200	92,200	92,500	92,500	--------
E. Main steam	32,700	32,700	18,000	18,000	18,000	18,000
8. Demineralizing Equipment and Condensate Storage Tanks	203,000	199,000	185,000	180,000	175,000	173,000
9. Electrical	196,000	188,700	184,800	180,200	178,700	152,400
10. Turbine Room Building	89,000	89,000	89,000	89,000	89,000	89,000
Total Items 1-10	21,435,950	21,153,350	20,852,050	20,672,800	20,413,900	20,418,950
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	28,678,450	28,395,850	28,094,550	27,915,300	27,656,400	27,661,450
11. Piping In Containment Vessel	407,000	407,000	418,500	418,500	418,500	418,000
Grand Total	29,085,450	28,802,850	28,513,050	28,333,800	28,074,900	28,079,450

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 767 F THROTTLE STEAM
(200 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000
B. Turbine generator erection	500,000	500,000	500,000	500,000	500,000	500,000
C. Reserve exciter	← CONSTANT →					
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000	230,000
2. Condensers						
A. Shells and accessories	1,243,000	1,250,000	1,275,000	1,300,000	1,340,000	1,418,000
B. Dry vacuum pumps						
C. Tubes	884,000	895,000	906,000	929,000	956,000	1,008,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	33,250
E. Erection	211,000	213,000	215,000	219,000	225,000	234,000
F. Deaeration - hot well of cond.	NONE				→	63,000
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel	655,000	657,000	660,000	664,000	670,000	680,000
d. Miscellaneous						
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps						
3. Screen wash piping	133,000	134,000	135,000	136,000	138,000	141,000
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	635,000	638,000	643,000	650,000	660,000	678,000
D. Circulating water pumps						
1. Pumps	298,000	302,000	306,000	313,000	323,000	341,000
2. Motors	171,000	173,000	176,000	180,000	185,000	196,000
3. Erection	242,000	244,000	246,000	249,000	253,000	260,000
4. Feed Water Heaters						
A. L-P closed heaters	213,000	130,000	131,000	62,500	65,000	--------
B. H-P closed heaters	267,000	244,000	118,000	105,000	-------	106,500
C. Deaerating heater	205,000	199,800	131,700	129,200	127,300	--------
D. Insulation						
1. Closed heaters	10,400	7,800	4,800	2,000	-------	--------
2. Deaerators	15,100	14,900	9,800	9,600	9,400	--------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	42,400	41,000	29,300	28,500	27,900	--------
5. Boiler Feed Pumps						
A. Pumps and base plates	279,000	257,000	249,000	235,000	231,000	223,000
B. Fluid drive	161,000	161,000	128,000	128,000	128,000	128,000
C. Motors	326,000	314,000	296,000	282,000	273,000	271,000
D. Erection	26,000	24,500	23,700	22,700	22,300	21,800
E. Foundation for pumps	6,000	5,600	5,500	5,200	5,100	5,000
6. Condensate Pumps						
A. Pumps	79,000	55,500	56,000	43,500	45,000	--------
B. Motors	54,900	31,100	31,500	21,100	21,900	--------
C. Erection	7,100	6,600	6,700	6,400	6,600	--------
7. Piping and Insulation						
A. Extraction steam	332,000	292,500	242,000	210,000	133,500	79,000
B. Heater vents and drains						
C. Feed water piping	241,800	194,800	153,900	153,900	96,100	186,300
D. Condensate piping						
1. From condensate pumps through L-P heaters.	108,900	92,200	92,200	92,500	92,500	--------
2. To deaerator and B.F. pump suction						
E. Main steam	61,800	61,800	55,300	51,100	51,100	51,100
8. Demineralizing Equipment and Condensate Storage Tanks	188,000	180,000	173,000	168,000	165,000	163,000
9. Electrical	185,300	179,400	176,200	172,500	171,900	145,300
10. Turbine Room Building	-------	-------	-------	-------	-------	-------
Total Items 1-10	20,409,950	20,120,750	19,789,850	19,667,200	19,514,100	19,506,250
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,652,450	27,363,250	27,032,350	26,909,700	26,756,600	26,748,750
11. Piping In Containment Vessel	547,000	525,000	499,500	493,000	493,000	493,000
Grand Total	28,199,450	27,888,250	27,531,850	27,402,700	27,249,600	27,241,750

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 867 F THROTTLE STEAM
(300 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000
B. Turbine generator erection	540,000	540,000	540,000	540,000	540,000	540,000
C. Reserve exciter	←			CONSTANT		→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers						
A. Shells and accessories	1,163,000	1,180,000	1,195,000	1,210,000	1,250,000	1,314,000
B. Dry vacuum pumps						
C. Tubes	830,000	840,000	850,000	864,000	895,00	942,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	33,500
E. Erection	201,000	203,000	205,000	207,000	211,000	222,000
F. Deaeration - hot well of cond.	NONE				→	59,200
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	644,000	646,000	648,000	652,000	657,000	667,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	129,000	130,000	131,000	132,000	134,000	137,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	616,000	619,000	623,000	629,000	638,000	656,000
D. Circulating water pumps						
1. Pumps	280,000	283,000	286,000	292,000	302,000	318,000
2. Motors	161,000	162,000	164,000	168,000	173,000	183,000
3. Erection	23,500	23,700	23,800	24,000	24,400	25,100
4. Feed Water Heaters						
A. L-P closed heaters	199,500	122,500	123,500	59,000	61,000	-------
B. H-P closed heaters	247,500	231,000	112,500	100,500	-------	102,500
C. Deaerating heater	133,000	129,400	126,600	124,100	122,800	-------
D. Insulation						
1. Closed heaters	9,500	7,500	4,500	1,900	-------	-------
2. Deaerators	9,900	9,600	9,300	9,100	9,000	-------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	30,000	28,500	27,700	27,000	26,500	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	260,000	242,000	233,000	221,000	219,000	212,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	298,000	288,000	274,000	262,000	253,000	252,000
D. Erection	24,600	23,200	22,500	21,600	21,400	20,900
E. Foundation for pumps	5,700	5,300	5,200	4,900	4,900	4,800
6. Condensate Pumps						
A. Pumps	73,500	51,500	52,000	40,200	42,000	-------
B. Motors	50,800	29,000	29,400	21,800	20,500	-------
C. Erection	6,600	6,200	6,300	6,000	6,200	-------
7. Piping and Insulation						
A. Extraction steam	331,000	283,500	242,000	184,000	125,900	79,000
B. Heater vents and drains						
C. Feed water piping	194,800	194,800	153,900	153,900	96,100	186,300
D. Condensate piping						
1. From condensate pumps through L-P heaters.	108,900	92,200	92,200	85,800	83,400	-------
2. To deaerator and B.F. pump suction						
E. Main steam	70,800	70,800	70,800	70,800	70,800	70,800
8. Demineralizing Equipment and Condensate Storage Tanks	175,000	169,000	162,000	158,000	156,000	155,000
9. Electrical	176,800	171,400	168,800	165,900	165,100	136,200
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	19,977,650	19,759,350	19,552,250	19,390,000	19,255,500	19,246,300
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,220,150	27,001,850	26,794,750	26,632,500	26,498,000	26,488,800
11. Piping In Containment Vessel	576,500	576,500	572,500	572,500	572,500	572,500
Grand Total	27,796,650	27,578,350	27,367,250	27,205,000	27,070,500	27,061,300

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 967 F THROTTLE STEAM
(400 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	12,690,000	12,690,000	12,690,000	12,690,000	12,690,000	12,690,000
B. Turbine generator erection	540,000	540,000	540,000	540,000	540,000	540,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers						
A. Shells and accessories B. Dry vacuum pumps	1,100,000	1,113,000	1,130,000	1,158,000	1,180,000	1,245,000
C. Tubes	782,000	790,000	800,000	820,000	845,000	840,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	17,500
E. Erection	193,000	194,000	195,000	199,000	203,000	212,000
F. Deaeration - hot well of cond.	NONE	←				→ 56,000
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall	634,000	636,000	638,000	642,000	647,000	656,000
B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	126,000	127,000	128,000	128,000	130,000	133,000
C. Circulating water piping	598,000	602,000	607,000	611,000	621,000	636,000
D. Circulating water pumps						
1. Pumps	263,000	266,000	270,000	275,000	284,000	300,000
2. Motors	151,000	153,000	155,000	158,000	163,000	172,000
3. Erection	22,800	22,900	23,100	23,300	23,700	24,300
4. Feed Water Heaters						
A. L-P closed heaters	187,000	117,000	118,000	56,500	58,500	-------
B. H-P closed heaters	239,000	221,000	108,000	96,500	-------	99,500
C. Deaerating heater	128,000	124,500	121,900	119,800	118,700	-------
D. Insulation						
1. Closed heaters	8,900	6,900	4,200	1,800	-------	-------
2. Deaerators	9,500	9,200	9,000	8,800	8,700	-------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	28,100	27,100	26,300	25,800	25,400	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	244,000	229,000	221,000	212,000	208,000	203,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	277,000	268,000	255,000	243,000	237,000	236,000
D. Erection	23,400	22,200	21,600	20,900	20,600	20,200
E. Foundation for pumps	5,400	5,100	4,900	4,700	4,700	4,600
6. Condensate Pumps						
A. Pumps	68,000	48,500	48,500	42,000	39,500	-------
B. Motors	41,400	27,200	27,600	18,800	19,500	-------
C. Erection	6,100	5,800	5,900	5,700	5,900	-------
7. Piping and Insulation						
A. Extraction steam B. Heater vents and drains	327,500	283,000	242,000	184,000	125,900	79,000
C. Feed water piping	194,800	194,800	153,900	153,900	96,100	186,300
D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deaerator and B.F. pump suction	102,000	85,500	83,400	83,400	83,400	-------
E. Main steam	82,800	82,800	82,800	82,800	82,800	82,800
8. Demineralizing Equipment and Condensate Storage Tanks	166,000	159,000	155,000	151,000	149,000	148,000
9. Electrical	168,400	164,800	162,700	159,700	159,600	133,500
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	20,061,350	19,862,550	19,668,050	19,539,900	19,387,500	19,313,900
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,303,850	27,105,050	26,910,550	26,782,400	26,630,000	26,556,400
11. Piping In Containment Vessel	606,500	606,500	603,500	603,500	603,500	602,500
Grand Total	27,910,350	27,711,550	27,514,050	27,385,900	27,233,500	27,158,900

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 545 F THROTTLE STEAM
(SATURATED STEAM)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	14,530,000	14,530,000	14,530,000	14,530,000	14,530,000	14,530,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers						
A. Shells and accessories B. Dry vacuum pumps	1,455,000	1,475,000	1,500,000	1,530,000	1,576,000	1,690,000
C. Tubes	1,035,000	1,049,000	1,066,000	1,087,000	1,118,000	1,205,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	31,500
E. Erection	238,000	242,000	245,000	249,000	256,000	270,000
F. Deaeration - hot well of cond.	NONE				→	76,100
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal wall 5. Discharge flume 6. Outfall	686,000	689,000	692,000	697,000	704,000	720,000
B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	143,000	144,000	145,000	146,000	149,000	154,000
C. Circulating water piping	688,000	692,000	698,000	706,000	718,000	745,000
D. Circulating water pumps						
1. Pumps	350,000	355,000	360,000	368,000	380,000	406,000
2. Motors	201,000	204,000	207,000	212,000	218,000	234,000
3. Erection	26,400	26,500	26,800	27,100	27,600	28,700
4. Feed Water Heaters						
A. L-P closed heaters	251,000	156,000	158,000	75,000	79,000	-------
B. H-P closed heaters	290,500	259,000	118,000	104,500	-------	118,000
C. Deaerating heater	229,400	221,800	215,000	210,600	209,000	-------
D. Insulation						
1. Closed heaters	12,200	9,200	5,300	2,100	-------	-------
2. Deaerators	16,900	16,300	15,800	15,500	15,400	-------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	48,800	46,800	45,000	43,800	43,400	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	209,000	194,000	180,000	176,000	173,000	165,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	308,000	296,000	275,000	265,000	255,000	252,000
D. Erection	26,900	25,000	24,000	23,000	22,600	21,600
E. Foundation for pumps	7,100	6,600	6,300	6,000	5,900	5,800
6. Condensate Pumps						
A. Pumps	100,000	67,500	68,000	51,500	55,500	-------
B. Motors	59,100	35,500	35,900	24,700	26,100	-------
C. Erection	8,600	7,900	8,000	7,500	7,900	-------
7. Piping and Insulation						
A. Extraction steam B. Heater vents and drains	318,000	281,500	228,500	210,000	133,500	71,400
C. Feed water piping	198,100	198,100	125,200	125,200	79,500	147,300
D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deaerator and B.F. pump suction	161,300	113,300	113,300	103,200	103,200	-------
E. Main steam	35,200	33,900	31,000	28,500	28,500	28,500
8. Demineralizing Equipment and Condensate Storage Tanks	226,000	214,000	203,000	196,000	194,000	189,000
9. Electrical	188,700	182,900	179,200	176,300	176,100	149,600
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	23,261,450	22,979,050	22,704,550	22,581,000	22,461,700	22,398,500
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	30,503,950	30,221,550	29,947,050	29,823,500	29,704,200	29,641,000
11. Piping In Containment Vessel	474,000	414,000	384,000	378,000	375,000	378,000
Grand Total	30,977,950	30,635,550	30,331,050	30,201,500	30,079,200	30,019,000

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 645 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	13,050,000	13,050,000	13,050,000	13,050,000	13,050,000	13,050,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers						
A. Shells and accessories	1,370,000	1,380,000	1,395,000	1,420,000	1,460,000	1,563,000
B. Dry vacuum pumps						
C. Tubes	975,000	978,000	992,000	1,012,000	1,035,000	1,112,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	31,500
E. Erection	228,000	230,000	231,000	234,000	240,000	254,000
F. Deaeration - hot well of cond.	NONE	←				→ 70,400
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	674,000	675,000	678,000	681,000	687,000	702,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps						
3. Screen wash piping	139,000	139,000	140,000	141,000	143,000	148,000
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	667,000	669,000	673,000	679,000	688,000	714,000
D. Circulating water pumps						
1. Pumps	330,000	332,000	336,000	342,000	351,000	377,000
2. Motors	189,000	191,000	193,000	196,000	202,000	216,000
3. Erection	25,600	25,700	25,800	26,000	26,400	27,500
4. Feed Water Heaters						
A. L-P closed heaters	227,000	143,500	145,000	69,000	71,500	-------
B. H-P closed heaters	263,500	236,500	109,500	98,500	-------	109,000
C. Deaerating heater	215,000	208,600	203,800	200,400	134,000	-------
D. Insulation						
1. Closed heaters	10,900	8,700	4,800	1,900	-------	-------
2. Deaerators	15,800	15,400	15,000	14,800	10,000	-------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	45,000	43,400	42,200	41,400	30,000	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	188,000	176,000	169,000	162,000	159,000	152,000
B. Fluid drive	161,000	128,000	128,000	128,000	128,000	128,000
C. Motors	319,000	305,000	288,000	276,000	266,000	260,000
D. Erection	24,500	23,000	22,200	21,300	21,000	20,000
E. Foundation for pumps	6,500	5,900	5,800	5,600	5,500	5,200
6. Condensate Pumps						
A. Pumps	88,500	61,000	61,500	47,000	49,500	-------
B. Motors	53,000	32,300	32,700	22,900	23,800	-------
C. Erection	7,700	7,200	7,300	6,900	7,200	-------
7. Piping and Insulation						
A. Extraction steam	318,400	281,500	228,500	210,000	133,500	71,
B. Heater vents and drains						
C. Feed water piping	202,500	202,500	153,900	131,500	96,100	157,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	108,900	92,200	92,200	92,500	92,500	-------
2. To deaerator and B.F. pump suction						
E. Main steam	24,100	22,500	22,500	22,500	22,500	22,500
8. Demineralizing Equipment and Condensate Storage Tanks	20,300	193,000	185,000	181,000	177,000	173,000
9. Electrical	187,500	181,600	178,400	175,100	174,300	147,600
10. Turbine Room Building	89,000	89,000	89,000	89,000	89,000	89,000
Total Items 1-10	21,131,950	21,027,750	20,792,350	20,656,800	20,444,300	20,454,600
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	28,374,450	28,270,250	28,034,850	27,899,300	27,686,800	27,697,100
11. Piping In Containment Vessel	404,500	385,000	436,500	436,500	436,500	360,500
Grand Total	28,778,950	28,655,250	28,471,350	28,335,800	28,123,300	28,057,600

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 745 F THROTTLE STEAM
(200 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000
B. Turbine generator erection	500,000	500,000	500,000	500,000	500,000	500,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000	230,000
2. Condensers						
A. Shells and accessories	1,280,000	1,300,000	1,310,000	1,335,000	1,368,000	1,465,000
B. Dry vacuum pumps						
C. Tubes	911,000	924,000	933,000	944,000	974,000	1,040,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	31,000
E. Erection	217,000	219,000	220,000	222,000	227,000	240,000
F. Deaeration - hot well of cond.	NONE	←				→ 66,000
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	661,000	663,000	665,000	668,000	673,000	687,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps						
3. Screen wash piping	135,000	135,000	136,000	137,000	139,000	143,000
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	645,000	647,000	652,000	656,000	666,000	690,000
D. Circulating water pumps						
1. Pumps	308,000	311,000	315,000	320,000	328,000	352,000
2. Motors	177,000	178,000	181,000	184,000	189,000	202,000
3. Erection	24,500	24,800	24,900	25,100	25,500	26,400
4. Feed Water Heaters						
A. L-P closed heaters	209,500	133,500	135,000	64,000	67,000	-------
B. H-P closed heaters	245,500	222,500	103,500	93,500	-------	105,000
C. Deaerating heater	205,000	199,600	132,100	130,100	128,800	-------
D. Insulation						
1. Closed heaters	10,000	7,500	4,400	1,800	-------	-------
2. Deaerators	15,100	14,800	9,800	9,600	9,500	-------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	42,400	41,000	29,400	28,800	28,400	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	175,000	164,000	158,000	153,000	150,000	146,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	290,000	279,000	262,000	254,000	245,000	244,000
D. Erection	22,800	21,500	20,900	20,200	19,900	19,400
E. Foundation for pumps	6,000	5,600	5,400	5,200	5,300	5,000
6. Condensate Pumps						
A. Pumps	80,500	56,000	56,500	44,000	46,000	-------
B. Motors	48,500	30,000	30,300	21,400	22,200	-------
C. Erection	7,100	6,700	6,800	6,500	6,700	-------
7. Piping and Insulation						
A. Extraction steam	318,200	268,500	228,000	210,000	133,500	71,400
B. Heater vents and drains						
C. Feed water piping	202,500	202,500	153,900	131,500	96,100	157,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	108,900	92,200	92,200	92,500	92,500	-------
2. To deaerator and B.F. pump suction						
E. Main steam	24,100	22,500	22,500	22,500	22,500	22,500
8. Demineralizing Equipment and Condensate Storage Tanks	187,000	180,000	173,000	170,000	167,000	165,000
9. Electrical	177,800	172,900	170,200	167,500	167,100	141,500
10. Turbine Room Building	-------	-------	-------	-------	-------	-------
Total Items 1-10	19,990,650	19,771,350	19,473,050	19,343,700	19,216,500	19,221,700
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,233,150	27,013,850	26,715,550	26,586,200	26,459,000	26,464,200
11. Piping In Containment Vessel	441,500	416,000	468,500	468,500	468,500	392,000
Grand Total	27,674,650	27,429,850	27,184,050	27,054,700	26,927,500	26,856,200

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 845 F THROTTLE STEAM
(300 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000	12,330,000
B. Turbine generator erection	500,000	500,000	500,000	500,000	500,000	500,000
C. Reserve exciter	←			CONSTANT		→
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000	230,000
2. Condensers						
A. Shells and accessories	1,200,000	1,210,000	1,227,000	1,250,000	1,276,000	1,356,000
B. Dry vacuum pumps						
C. Tubes	860,000	866,000	876,000	890,000	910,000	964,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	31,500
E. Erection	206,000	207,000	209,000	212,000	216,000	226,000
F. Deaeration - hot well of cond.	NONE	←				→ 61,000
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	651,000	652,000	653,000	656,000	661,000	672,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps						
3. Screen wash piping	131,000	132,000	132,000	133,000	135,000	138,000
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	626,000	630,000	631,000	637,000	644,000	663,000
D. Circulating water pumps						
1. Pumps	290,000	292,000	295,000	300,000	308,000	326,000
2. Motors	167,000	168,000	170,000	172,000	177,000	187,000
3. Erection	23,900	24,000	24,100	24,300	24,600	25,400
4. Feed Water Heaters						
A. L-P closed heaters	197,000	126,000	127,000	61,000	63,000	--------
B. H-P closed heaters	233,000	211,000	99,000	90,000	--------	101,000
C. Deaerating heater	133,100	129,800	127,000	125,200	124,100	--------
D. Insulation						
1. Closed heaters	9,300	7,000	4,200	1,700	--------	--------
2. Deaerators	9,900	9,600	9,400	9,200	9,100	--------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	--------	--------
2. For deaerators	29,800	28,600	27,800	27,300	27,000	--------
5. Boiler Feed Pumps						
A. Pumps and base plates	164,000	155,000	150,000	145,000	143,000	140,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	266,000	255,000	243,000	234,000	226,000	227,000
D. Erection	21,600	20,400	19,900	19,300	19,000	18,600
E. Foundation for pumps	5,600	5,300	5,200	5,000	4,900	4,800
6. Condensate Pumps						
A. Pumps	74,500	52,500	53,000	41,000	43,000	--------
B. Motors	44,900	28,000	28,300	20,200	20,900	--------
C. Erection	6,700	6,300	6,400	6,100	6,300	--------
7. Piping and Insulation						
A. Extraction steam	309,500	268,000	223,500	206,000	132,300	71,400
B. Heater vents and drains						
C. Feed water piping	194,800	194,800	153,900	131,500	96,100	157,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	108,900	92,200	92,200	85,800	85,800	--------
2. To deaerator and B.F. pump suction						
E. Main steam	66,500	66,500	61,800	61,800	61,800	61,800
8. Demineralizing Equipment and Condensate Storage Tanks	176,000	170,000	164,000	160,000	158,000	157,000
9. Electrical	170,200	165,800	163,600	161,200	161,100	135,100
10. Turbine Room Building	--------	--------	--------	--------	--------	--------
Total Items 1-10	19,632,450	19,422,050	19,218,550	19,092,100	18,952,500	18,926,100
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	26,874,950	26,664,550	26,461,050	26,334,600	26,195,000	26,168,600
11. Piping In Containment Vessel	608,500	553,000	600,000	600,000	600,000	523,500
Grand Total	27,483,450	27,217,550	27,061,050	26,934,600	26,795,000	26,692,100

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 945 F THROTTLE STEAM
(400 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	12,450,000	12,450,000	12,450,000	12,450,000	12,450,000	12,450,000
B. Turbine generator erection	540,000	540,000	540,000	540,000	540,000	540,000
C. Reserve exciter	←	—	—	CONSTANT	—	→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers						
A. Shells and accessories B. Dry vacuum pumps	1,136,000	1,155,000	1,158,000	1,175,000	1,204,000	1,271,000
C. Tubes	808,000	815,000	825,000	837,000	857,000	906,000
D. Steam jet air equipment	19,250	19,250	19,250	17,500	17,500	17,500
E. Erection	196,000	198,000	200,000	202,000	206,000	214,000
F. Deaeration - hot well of cond.	NONE	—	—	—	→	57,200
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	640,000	641,000	643,000	645,000	650,000	659,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps						
3. Screen wash piping	128,000	128,000	129,000	130,000	131,000	134,000
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	608,000	610,000	614,000	618,000	626,000	642,000
D. Circulating water pumps						
1. Pumps	272,000	274,000	277,000	282,000	290,000	305,000
2. Motors	156,000	158,000	159,000	162,000	166,000	175,000
3. Erection	23,200	23,300	23,400	23,600	23,900	24,500
4. Feed Water Heaters						
A. L-P closed heaters	185,000	119,500	121,500	58,000	60,000	-------
B. H-P closed heaters	221,500	202,000	95,000	86,500	-------	97,000
C. Deaerating heater	128,200	124,900	122,400	119,900	119,900	-------
D. Insulation						
1. Closed heaters	8,800	6,600	3,600	1,600	-------	-------
2. Deaerators	9,500	9,200	9,000	8,800	8,800	-------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	28,200	27,200	26,500	25,800	25,800	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	155,000	147,000	143,000	139,000	137,000	134,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	245,000	236,000	225,000	217,000	212,000	213,000
D. Erection	20,500	19,500	19,000	18,500	18,300	18,000
E. Foundation for pumps	5,300	5,100	4,900	4,800	4,700	4,600
6. Condensate Pumps						
A. Pumps	69,000	49,000	50,000	39,000	40,500	-------
B. Motors	41,800	26,300	26,600	19,100	19,800	-------
C. Erection	6,300	5,900	6,000	5,800	6,000	-------
7. Piping and Insulation						
A. Extraction steam B. Heater vents and drains	309,500	268,000	223,500	206,000	132,300	71,400
C. Feed water piping	194,800	194,800	153,900	131,500	96,100	157,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	102,000	85,500	85,500	83,400	83,400	-------
2. To deaerator and B.F. pump suction						
E. Main steam	86,100	86,100	86,100	86,100	86,100	76,200
8. Demineralizing Equipment and Condensate Storage Tanks	166,000	160,000	156,000	153,000	152,000	151,000
9. Electrical	163,500	159,700	157,800	155,700	155,600	129,800
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	19,757,450	19,571,850	19,373,950	19,248,600	19,119,700	19,047,700
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	26,999,950	26,814,350	26,616,450	26,491,100	26,362,200	26,290,200
11. Piping In Containment Vessel	681,000	625,000	676,000	676,000	676,000	586,500
Grand Total	27,680,950	27,439,350	27,292,450	27,167,100	27,038,200	26,876,700

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
800 PSIA, 518 F THROTTLE STEAM
(SATURATED STEAM)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	14,380,000	14,380,000	14,380,000	14,380,000	14,380,000	14,380,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	← CONSTANT →					
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers						
A. Shells and accessories	1,535,000	1,555,000	1,570,000	1,600,000	1,657,000	1,776,000
B. Dry vacuum pumps	1,080,000	1,100,000	1,115,000	1,140,000	1,190,000	1,280,000
C. Tubes	19,250	17,500	17,500	17,500	17,500	28,000
D. Steam jet air equipment	248,000	252,000	255,000	258,000	266,000	281,000
E. Erection	NONE	←			→	80,000
F. Deaeration - hot well of cond.	28,000	28,000	28,000	14,000	14,000	14,000
G. L-P heaters in exhaust stack						
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	697,000	699,000	703,000	707,000	714,000	733,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps						
3. Screen wash piping	146,000	147,000	148,000	150,000	152,000	158,000
4. Chlorination equipment						
5. Chlorine handling	705,000	710,000	716,000	724,000	735,000	767,000
C. Circulating water piping	368,000	372,000	378,000	386,000	397,000	429,000
D. Circulating water pumps	213,000	214,000	218,000	222,000	228,000	247,000
1. Pumps	27,100	27,300	27,500	27,900	28,300	29,700
2. Motors						
3. Erection						
4. Feed Water Heaters	229,000	148,500	150,000	67,000	70,000	-------
A. L-P closed heaters	253,000	231,000	110,000	77,500	-------	101,000
B. H-P closed heaters	227,600	220,800	216,000	211,800	209,800	-------
C. Deaerating heater						
D. Insulation	11,400	8,800	5,300	1,500	-------	-------
1. Closed heaters	16,800	16,200	15,900	15,600	15,400	-------
2. Deaerators						
E. Structural work	21,000	14,000	7,000	7,000	-------	-------
1. For closed heaters	48,300	46,500	45,100	44,000	43,500	-------
2. For deaerators						
5. Boiler Feed Pumps	176,000	164,000	158,000	151,000	148,000	143,000
A. Pumps and base plates	128,000	128,000	128,000	128,000	128,000	128,000
B. Fluid drive	257,000	247,000	231,000	221,000	211,000	214,000
C. Motors	23,600	22,000	21,300	20,400	20,100	19,500
D. Erection	7,000	6,500	6,300	6,100	5,900	5,700
E. Foundation for pumps						
6. Condensate Pumps	84,000	56,500	58,000	53,000	56,000	-------
A. Pumps	52,200	32,900	33,400	25,400	26,600	-------
B. Motors	8,600	8,000	8,100	7,800	8,000	-------
C. Erection						
7. Piping and Insulation						
A. Extraction steam	357,000	308,000	253,500	210,500	172,500	81,400
B. Heater vents and drains	175,300	175,300	108,000	108,000	74,000	131,200
C. Feed water piping						
D. Condensate piping						
1. From condensate pumps through L-P heaters.	123,600	113,300	113,300	103,200	103,200	-------
2. To deaerator and B.F. pump suction	35,400	34,500	33,800	32,600	32,200	31,600
E. Main steam						
8. Demineralizing Equipment and Condensate Storage Tanks	223,000	212,000	205,000	198,000	195,000	192,000
9. Electrical	179,100	174,700	172,500	170,200	170,100	145,600
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	23,096,250	22,888,300	22,653,500	22,504,000	22,486,100	22,413,700
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	30,338,750	30,130,800	29,896,000	29,746,500	29,728,600	29,656,200
11. Piping In Containment Vessel	455,500	411,000	387,000	375,000	375,000	366,000
Grand Total	30,794,250	30,541,800	30,283,000	30,121,500	30,103,600	30,022,200

TABLE 12.5 (Continued)

800 PSIA, 618 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	13,900,000	13,900,000	13,900,000	13,900,000	13,900,000	13,900,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000	280,000
2. Condensers						
A. Shells and accessories	1,439,000	1,450,000	1,465,000	1,487,000	1,520,000	1,635,000
B. Dry vacuum pumps	1,024,000	1,031,000	1,040,000	1,060,000	1,081,000	1,155,000
C. Tubes						
D. Steam jet air equipment	19,250	17,500	17,500	17,500	17,500	28,000
E. Erection	236,000	238,000	240,000	243,000	248,000	262,000
F. Deaeration - hot well of cond.	NONE					73,600
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	683,000	685,000	687,000	691,000	696,000	712,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps						
3. Screen wash piping	142,000	142,000	143,000	144,000	146,000	151,000
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	683,000	686,000	690,000	697,000	704,000	731,000
D. Circulating water pumps						
1. Pumps	346,000	348,000	352,000	358,000	366,000	394,000
2. Motors	197,000	199,000	201,000	204,000	209,000	225,000
3. Erection	26,200	26,300	26,400	26,700	27,000	28,200
4. Feed Water Heaters						
A. L-P closed heaters	209,500	136,500	138,000	62,000	64,000	-------
B. H-P closed heaters	231,500	214,000	102,500	74,000	-------	95,000
C. Deaerating heater	215,000	208,800	204,600	201,800	200,000	-------
D. Insulation						
1. Closed heaters	10,300	7,900	4,900	1,400	-------	-------
2. Deaerators	15,800	15,400	15,100	14,900	14,800	-------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	45,000	43,400	42,400	41,600	41,000	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	160,000	150,000	145,000	139,000	137,000	133,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	277,000	266,000	252,000	241,000	232,000	235,000
D. Erection	21,600	20,300	19,700	19,000	18,800	18,300
E. Foundation for pumps	6,400	6,000	5,800	5,600	5,500	5,400
6. Condensate Pumps						
A. Pumps	79,500	51,000	51,500	48,000	50,500	-------
B. Motors	47,300	30,100	30,500	23,500	24,400	-------
C. Erection	7,900	7,400	7,500	7,100	7,400	-------
7. Piping and Insulation						
A. Extraction steam	352,000	308,000	253,500	210,500	172,500	81,400
B. Heater vents and drains						
C. Feed water piping	189,000	189,000	117,300	117,300	74,000	144,700
D. Condensate piping						
1. From condensate pumps through L-P heaters.	108,900	92,200	92,200	92,500	92,500	-------
2. To deaerator and B.F. pump suction						
E. Main steam	23,500	23,500	21,100	21,100	21,100	21,100
8. Demineralizing Equipment and Condensate Storage Tanks	203,000	194,000	187,000	182,000	180,000	178,000
9. Electrical	179,800	175,000	172,600	170,300	169,700	144,800
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	22,273,450	22,049,300	21,806,100	21,667,800	21,579,700	21,511,500
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	29,515,950	29,291,800	29,048,600	28,910,300	28,822,200	28,754,000
11. Piping In Containment Vessel	513,500	513,500	346,500	346,500	346,500	343,500
Grand Total	30,029,450	29,805,300	29,395,100	29,256,800	29,168,700	29,097,500

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
800 PSIA, 718 F THROTTLE STEAM
(200 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	12,180,000	12,180,000	12,180,000	12,180,000	12,180,000	12,180,000
B. Turbine generator erection	500,000	500,000	500,000	500,000	500,000	500,000
C. Reserve exciter	← CONSTANT →					
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000	230,000
2. Condensers	1,340,000	1,350,000	1,399,000	1,408,000	1,440,000	1,540,000
A. Shells and accessories	956,000	963,000	987,000	1,000,000	1,025,000	1,095,000
B. Dry vacuum pumps	19,250	17,500	17,500	17,500	17,500	28,000
C. Tubes	225,000	227,000	229,000	233,000	237,000	251,000
D. Steam jet air equipment	NONE					69,300
E. Erection						
F. Deaeration - hot well of cond.	28,000	28,000	28,000	14,000	14,000	14,000
G. L-P heaters in exhaust stack						
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	671,000	672,000	674,000	679,000	684,000	695,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps						
3. Screen wash piping						
4. Chlorination equipment	138,000	138,000	139,000	141,000	142,000	147,000
5. Chlorine handling						
C. Circulating water piping	661,000	662,000	667,000	675,000	684,000	709,000
D. Circulating water pumps	324,000	325,000	333,000	338,000	346,000	372,000
1. Pumps	185,000	186,000	189,000	193,000	198,000	212,000
2. Motors	25,300	25,400	25,600	25,900	26,200	27,300
3. Erection						
4. Feed Water Heaters	194,500	128,500	129,500	59,000	60,500	-------
A. L-P closed heaters	216,500	201,500	96,500	71,500	-------	91,000
B. H-P closed heaters	205,200	200,200	132,900	131,000	130,100	-------
C. Deaerating heater						
D. Insulation	9,500	7,300	4,500	1,300	-------	-------
1. Closed heaters	15,100	14,800	9,900	9,700	9,600	-------
2. Deaerators						
E. Structural work	21,000	14,000	7,000	7,000	-------	-------
1. For closed heaters	42,400	41,200	29,700	29,000	28,800	-------
2. For deaerators						
5. Boiler Feed Pumps	148,000	140,000	136,000	131,000	130,000	126,000
A. Pumps and base plates	128,000	128,000	128,000	128,000	128,000	128,000
B. Fluid drive	252,000	242,000	229,000	220,000	213,000	215,000
C. Motors	20,200	19,100	18,600	18,100	17,900	17,400
D. Erection	6,000	5,600	5,500	5,300	5,200	5,100
E. Foundation for pumps						
6. Condensate Pumps	73,000	47,000	47,500	45,500	47,500	-------
A. Pumps	43,500	28,000	28,300	22,100	23,000	-------
B. Motors	7,300	6,900	7,000	6,700	6,900	-------
C. Erection						
7. Piping and Insulation	339,000	291,500	243,000	207,000	147,000	81,400
A. Extraction steam	189,000	147,000	117,300	117,300	74,000	144,700
B. Heater vents and drains						
C. Feed water piping						
D. Condensate piping	108,900	92,200	92,200	92,500	92,500	-------
1. From condensate pumps through L-P heaters.						
2. To deaerator and B.F. pump suction	23,500	23,500	21,100	21,100	21,100	21,100
E. Main steam						
8. Demineralizing Equipment and Condensate Storage Tanks	188,000	180,000	175,000	172,000	170,000	169,000
	171,300	167,100	165,300	163,600	163,600	138,700
9. Electrical	-------	-------	-------	-------	-------	-------
10. Turbine Room Building	19,884,450	19,629,300	19,421,900	19,293,100	19,192,400	19,207,000
Total Items 1-10	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Constant Cost	27,126,950	26,871,800	26,664,400	26,535,600	26,434,900	26,449,500
Total Turbine Plant Cost	513,500	441,000	346,500	346,500	346,500	343,500
11. Piping In Containment Vessel	27,640,450	27,312,800	27,010,900	26,882,100	26,781,400	26,793,000
Grand Total						

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
800 PSIA, 818 F THROTTLE STEAM
(300 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	12,300,000	12,300,000	12,300,000	12,300,000	12,300,000	12,300,000
B. Turbine generator erection	500,000	500,000	500,000	500,000	500,000	500,000
C. Reserve exciter	←			CONSTANT		→
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000	230,000
2. Condensers						
A. Shells and accessories	1,260,000	1,272,000	1,294,000	1,320,000	1,360,000	1,450,000
B. Dry vacuum pumps	900,000	907,000	923,000	940,000	963,000	1,034,000
C. Tubes	19,250	17,500	17,500	17,500	17,500	28,000
D. Steam jet air equipment	214,000	215,000	217,000	221,000	227,000	238,000
E. Erection	NONE	←				→ 65,300
F. Deaeration - hot well of cond.	28,000	28,000	28,000	14,000	14,000	14,000
G. L-P heaters in exhaust stack						
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	658,000	660,000	663,000	667,000	672,000	686,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	134,000	134,000	135,000	137,000	138,000	143,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	640,000	643,000	647,000	654,000	662,000	686,000
D. Circulating water pumps						
1. Pumps	303,000	306,000	310,000	317,000	326,000	349,000
2. Motors	173,000	175,000	177,000	181,000	186,000	200,000
3. Erection	24,500	24,600	24,800	25,000	25,400	26,300
4. Feed Water Heaters						
A. L-P closed heaters	183,500	121,500	122,500	56,000	57,500	-------
B. H-P closed heaters	205,500	191,500	92,000	69,500	-------	88,000
C. Deaerating heater	133,300	130,200	128,000	126,400	125,800	-------
D. Insulation						
1. Closed heaters	8,900	6,800	4,200	1,200	-------	-------
2. Deaerators	9,900	9,700	9,500	9,300	9,200	-------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	29,800	28,800	28,100	27,600	27,400	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	140,000	132,000	129,000	125,000	124,000	121,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000	128,000
C. Motors	230,000	222,000	211,000	203,000	198,000	203,000
D. Erection	19,000	18,100	17,700	17,300	17,100	16,800
E. Foundation for pumps	5,600	5,300	5,200	5,100	5,000	4,900
6. Condensate Pumps						
A. Pumps	67,000	44,000	44,500	43,000	44,500	-------
B. Motors	40,300	26,200	26,500	20,900	21,600	-------
C. Erection	6,800	6,500	6,500	6,300	6,500	-------
7. Piping and Insulation						
A. Extraction steam	339,000	286,000	229,000	192,000	146,500	81,400
B. Heater vents and drains	147,000	147,000	117,300	117,300	74,000	144,700
C. Feed water piping						
D. Condensate piping						
1. From condensate pumps through L-P heaters.	108,900	92,200	92,200	85,800	85,800	-------
2. To deaerator and B.F. pump suction						
E. Main steam	66,800	66,200	66,200	61,700	61,700	61,700
8. Demineralizing Equipment and Condensate Storage Tanks	176,000	170,000	165,000	162,000	161,000	161,000
9. Electrical	164,300	160,700	159,100	157,500	157,900	133,300
10. Turbine Room Building	-------	-------	-------	-------	-------	-------
Total Items 1-10	19,614,350	19,418,800	19,254,800	19,145,400	19,072,400	19,093,400
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	26,856,850	26,661,300	26,497,300	26,387,900	26,314,900	26,335,900
11. Piping In Containment Vessel	455,000	441,000	438,500	424,500	424,500	422,000
Grand Total	27,311,850	27,102,300	26,935,800	26,812,400	26,739,400	26,757,900

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
800 PSIA, 1000 F THROTTLE STEAM
(500 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	13,140,000	13,140,000	13,140,000	13,140,000	13,140,000	13,140,000
B. Turbine generator erection	500,000	500,000	500,000	500,000	500,000	500,000
C. Reserve exciter	← CONSTANT →					
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000	230,000
2. Condensers						
A. Shells and accessories	1,108,000	1,130,000	1,150,000	1,172,000	1,203,000	1,298,000
B. Dry vacuum pumps						
C. Tubes	795,000	806,000	816,000	835,000	865,000	925,000
D. Steam jet air equipment	19,250	17,500	17,500	17,500	17,500	28,000
E. Erection	194,000	196,000	198,000	202,000	206,000	218,000
F. Deaeration - hot well of cond.	NONE	→				68,000
G. L-P heaters in exhaust stack	28,000	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	637,000	639,000	641,000	645,000	651,000	663,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	127,000	128,000	128,000	130,000	131,000	136,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	603,000	607,000	611,000	618,000	626,000	649,000
D. Circulating water pumps						
1. Pumps	267,000	271,000	275,000	282,000	290,000	312,000
2. Motors	152,000	155,000	157,000	161,000	166,000	176,000
3. Erection	23,000	23,100	23,300	23,600	23,900	24,800
4. Feed Water Heaters						
A. L-P closed heaters	166,500	111,000	112,000	51,500	53,000	-------
B. H-P closed heaters	188,000	176,500	85,500	66,500	-------	82,500
C. Deaerating heater	124,000	121,100	119,000	118,300	117,800	-------
D. Insulation						
1. Closed heaters	7,900	6,100	3,800	1,100	-------	-------
2. Deaerators	9,100	8,900	8,800	8,700	8,600	-------
E. Structural work						
1. For closed heaters	21,000	14,000	7,000	7,000	-------	-------
2. For deaerators	26,900	26,100	25,600	25,300	25,700	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	126,000	120,000	117,000	115,000	114,000	112,000
B. Fluid drive	128,000	94,000	94,000	94,000	94,000	94,000
C. Motors	197,000	191,000	182,000	177,000	174,000	178,000
D. Erection	17,400	16,600	16,300	16,000	15,900	15,600
E. Foundation for pumps	5,000	4,900	4,800	4,700	4,600	4,600
6. Condensate Pumps						
A. Pumps	59,000	39,000	39,500	38,500	39,500	-------
B. Motors	35,200	23,300	23,600	19,300	19,500	-------
C. Erection	6,000	5,800	5,800	5,700	5,900	-------
7. Piping and Insulation						
A. Extraction steam	326,700	276,500	216,500	192,000	128,400	81,400
B. Heater vents and drains						
C. Feed water piping	147,000	147,000	117,300	117,300	74,000	144,700
D. Condensate piping						
1. From condensate pumps through L-P heaters.	102,000	83,100	83,100	68,400	68,400	-------
2. To deaerator and B.F. pump suction						
E. Main steam	100,300	100,300	100,300	100,300	100,300	100,300
8. Demineralizing Equipment and Condensate Storage Tanks	158,000	153,000	150,000	148,000	147,000	147,000
9. Electrical	152,500	150,100	148,900	148,200	148,600	124,100
10. Turbine Room Building	-------	-------	-------	-------	-------	-------
Total Items 1-10	19,926,750	19,738,900	19,575,600	19,408,300	19,402,100	19,462,000
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	27,169,250	26,981,400	26,818,100	26,650,800	26,644,600	26,704,500
11. Piping In Containment Vessel	425,500	425,500	623,500	623,500	623,500	620,000
Grand Total	27,594,750	27,406,200	27,441,600	27,274,300	27,268,100	27,324,500

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
600 PSIA, 486 F THROTTLE STEAM
(SATURATED STEAM)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories					
A. Turbine generator unit	14,110,000	14,110,000	14,110,000	14,110,000	14,110,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	←		CONSTANT		→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000
2. Condensers					
A. Shells and accessories	1,630,000	1,665,000	1,703,000	1,730,000	1,863,000
B. Dry vacuum pumps					
C. Tubes	1,180,000	1,200,000	1,220,000	1,260,000	1,340,000
D. Steam jet air equipment	15,750	15,750	14,000	14,000	21,000
E. Erection	263,000	267,000	272,000	279,000	293,000
F. Deaeration - hot well of cond.	NONE	←			→ 84,000
G. L-P heaters in exhaust stack	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel	711,000	716,000	722,000	729,000	745,000
d. Miscellaneous					
2. Dredging					
3. Intake flume or forebay					
4. Seal well					
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)					
1. Traveling screens					
2. Screen wash pumps	151,000	153,000	154,000	157,000	162,000
3. Screen wash piping					
4. Chlorination equipment					
5. Chlorine handling					
C. Circulating water piping	731,000	738,000	748,000	761,000	787,000
D. Circulating water pumps					
1. Pumps	393,000	401,000	410,000	423,000	449,000
2. Motors	226,000	230,000	235,000	242,000	258,000
3. Erection	28,200	28,400	28,800	29,400	30,400
4. Feed Water Heaters					
A. L-P closed heaters	175,000	178,000	87,500	91,500	-------
B. H-P closed heaters	232,500	107,000	99,000	-------	116,500
C. Deaerating heater	227,000	220,600	216,400	212,800	-------
D. Insulation					
1. Closed heaters	9,300	5,600	2,400	-------	-------
2. Deaerators	16,700	16,200	15,900	15,700	-------
E. Structural work					
1. For closed heaters	14,000	7,000	7,000	-------	-------
2. For deaerators	48,000	46,600	45,200	44,400	-------
5. Boiler Feed Pumps					
A. Pumps and base plates	148,000	141,000	133,000	130,000	123,000
B. Fluid drive	128,000	94,000	94,000	94,000	94,000
C. Motors	205,000	190,000	185,000	174,000	178,000
D. Erection	20,500	19,600	18,700	18,300	17,500
E. Foundation for pumps	6,900	6,600	6,300	6,100	5,900
6. Condensate Pumps					
A. Pumps	73,500	74,000	56,600	59,500	-------
B. Motors	39,400	39,900	26,700	27,700	-------
C. Erection	8,400	8,600	8,000	8,400	-------
7. Piping and Insulation					
A. Extraction steam	266,000	218,500	196,300	119,000	57,000
B. Heater vents and drains					
C. Feed water piping	156,600	145,200	99,700	61,000	126,400
D. Condensate piping					
1. From condensate pumps through L-P heaters.	113,300	113,300	103,200	103,200	-------
2. To deaerator and B.F. pump suction					
E. Main steam	42,600	41,400	40,200	39,000	39,000
8. Demineralizing Equipment and Condensate Storage Tanks	222,000	212,000	205,000	200,000	197,000
9. Electrical	170,500	168,500	166,700	166,400	141,100
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	22,808,150	22,623,750	22,461,600	22,337,400	22,269,800
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	30,050,650	29,866,250	29,704,100	29,579,900	29,512,300
11. Piping In Containment Vessel	432,000	381,000	354,000	345,000	339,000
Grand Total	30,482,650	30,247,250	30,058,100	29,924,900	29,851,300

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
600 PSIA, 586 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories					
A. Turbine generator unit	13,750,000	13,750,000	13,750,000	13,750,000	13,750,000
B. Turbine generator erection	560,000	560,000	560,000	560,000	560,000
C. Reserve exciter	←		CONSTANT		→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000
2. Condensers					
A. Shells and accessories	1,520,000	1,542,000	1,570,000	1,607,000	1,690,000
B. Dry vacuum pumps					
C. Tubes	1,080,000	1,095,000	1,115,000	1,145,000	1,205,000
D. Steam jet air equipment	15,750	15,750	14,000	14,000	21,000
E. Erection	247,000	250,000	255,000	259,000	271,000
F. Deaeration - hot well of cond.	NONE	←			→ 76,000
G. L-P heaters in exhaust stack	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel	695,000	698,000	702,000	708,000	721,000
d. Miscellaneous					
2. Dredging					
3. Intake flume or forebay					
4. Seal well					
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)					
1. Traveling screens					
2. Screen wash pumps	146,000	147,000	148,000	150,000	154,000
3. Screen wash piping					
4. Chlorination equipment					
5. Chlorine handling					
C. Circulating water piping	703,000	708,000	715,000	725,000	747,000
D. Circulating water pumps					
1. Pumps	365,000	371,000	375,000	387,000	408,000
2. Motors	210,000	213,000	217,000	223,000	234,000
3. Erection	27,000	27,200	27,500	27,900	28,700
4. Feed Water Heaters					
A. L-P closed heaters	160,500	162,000	81,500	83,000	-------
B. H-P closed heaters	210,000	97,500	91,000	-------	104,000
C. Deaerating heater	215,200	210,000	206,000	203,600	-------
D. Insulation					
1. Closed heaters	8,300	5,100	2,200	-------	-------
2. Deaerators	15,800	15,500	15,200	15,000	-------
E. Structural work					
1. For closed heaters	14,000	7,000	7,000	-------	-------
2. For deaerators	45,000	43,600	42,600	42,000	-------
5. Boiler Feed Pumps					
A. Pumps and base plates	135,000	129,000	123,000	120,000	115,000
B. Fluid drive	128,000	128,000	128,000	128,000	128,000
C. Motors	235,000	219,000	211,000	202,000	204,000
D. Erection	19,500	18,200	17,400	17,000	16,500
E. Foundation for pumps	6,300	6,100	5,800	5,700	5,500
6. Condensate Pumps					
A. Pumps	66,000	67,000	52,500	53,000	-------
B. Motors	36,000	36,400	25,000	25,400	-------
C. Erection	7,800	7,800	7,500	7,700	-------
7. Piping and Insulation					
A. Extraction steam	266,000	218,500	196,300	119,000	57,000
B. Heater vents and drains					
C. Feed water piping	172,500	129,700	129,700	68,000	137,000
D. Condensate piping					
1. From condensate pumps through L-P heaters.	92,200	92,200	92,500	92,500	-------
2. To deaerator and B.F. pump suction					
E. Main steam	35,200	35,200	35,200	35,200	35,200
8. Demineralizing Equipment and Condensate Storage Tanks	203,000	196,000	189,000	185,000	183,000
9. Electrical	172,200	169,700	167,400	166,900	141,000
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	22,048,250	21,856,450	21,746,300	21,596,900	21,463,900
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	29,290,750	29,098,950	28,988,800	28,839,400	28,706,400
11. Piping In Containment Vessel	403,500	333,300	333,500	333,500	333,500
Grand Total	29,694,250	29,432,250	29,322,300	29,172,900	29,039,900

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
600 PSIA, 686 F THROTTLE STEAM
(200 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories					
A. Turbine generator unit	13,270,000	13,270,000	13,270,000	13,270,000	13,270,000
B. Turbine generator erection	540,000	540,000	540,000	540,000	540,000
C. Reserve exciter	←		CONSTANT		→
D. Turbine foundation	280,000	280,000	280,000	280,000	280,000
2. Condensers					
A. Shells and accessories	1,430,000	1,440,000	1,460,000	1,490,000	1,574,000
B. Dry vacuum pumps					
C. Tubes	1,017,000	1,025,000	1,040,000	1,065,000	1,115,000
D. Steam jet air equipment	15,750	15,750	14,000	14,000	21,000
E. Erection	235,000	237,000	240,000	244,000	255,000
F. Deaeration - hot well of cond.	NONE	←			→ 70,800
G. L-P heaters in exhaust stack	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel					
d. Miscellaneous	682,000	684,000	687,000	692,000	703,000
2. Dredging					
3. Inteke flume or forebay					
4. Seal well					
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)					
1. Traveling screens					
2. Screen wash pumps	142,000	142,000	143,000	145,000	148,000
3. Screen wash piping					
4. Chlorination equipment					
5. Chlorine handling					
C. Circulating water piping	681,000	685,000	690,000	697,000	716,000
D. Circulating water pumps					
1. Pumps	343,000	347,000	352,000	360,000	378,000
2. Motors	197,000	199,000	202,000	207,000	217,000
3. Erection	26,100	26,300	26,500	26.800	27,600
4. Feed Water Heaters					
A. L-P closed heaters	149,500	150,000	74,500	77,000	-------
B. H-P closed heaters	194,500	90,500	85,000	-------	97,500
C. Deaerating heater	206,000	201,600	134,000	132,700	-------
D. Insulation					
1. Closed heaters	7,800	4,700	2,100	-------	-------
2. Deaerators	15,200	14,900	10,000	9,900	-------
E. Structural work					
1. For closed heaters	14,000	7,000	7,000	-------	-------
2. For deaerators	42,800	41,600	30,000	29,600	-------
5. Boiler Feed Pumps					
A. Pumps and base plates	125,000	120,000	115,000	113,000	109,000
B. Fluid drive	128,000	128,000	94,000	94,000	94,000
C. Motors	214,000	199,000	193,000	186,000	189,000
D. Erection	17,700	17,100	16,400	16,200	15,700
E. Foundation for pumps	5,900	5,700	5,500	5,400	5,200
6. Condensate Pumps					
A. Pumps	61,000	61,500	47,500	49,500	-------
B. Motors	33,500	33,700	23,000	23,800	-------
C. Erection	7,300	7,300	6,900	7,200	-------
7. Piping and Insulation					
A. Extraction steam	262,000	214,000	191,000	114,200	57,000
B. Heater vents and drains					
C. Feed water piping	172,500	129,700	129,700	68,000	137,800
D. Condensate piping					
1. From condensate pumps through L-P heaters.	92,200	92,200	92,500	92,500	-------
2. To deaerator and B.F. pump suction					
E. Main steam	43,000	43,000	35,200	35,200	35,200
8. Demineralizing Equipment and Condensate Storage Tanks	190,000	182,000	177,000	175,000	174,000
9. Electrical	164,900	162,800	160,600	160,300	134,400
10. Turbine Room Building	178,000	178,000	178,000	178,000	178,000
Total Items 1-10	21,211,650	21,003,350	20,766,400	20,612,300	20,556,200
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	28,454,150	28,245,850	28,008,900	27,854,800	27,798,700
11. Piping In Containment Vessel	424,000	346,000	332,500	332,500	332,500
Grand Total	28,878,150	28,591,850	28,341,400	28,187,300	28,131,200

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
600 PSIA, 886 F THROTTLE STEAM
(400 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories					
A. Turbine generator unit	12,510,000	12,510,000	12,510,000	12,510,000	12,510,000
B. Turbine generator erection	500,000	500,000	500,000	500,000	500,000
C. Reserve exciter	←		CONSTANT		→
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000
2. Condensers					
A. Shells and accessories	1,250,000	1,270,000	1,296,000	1,325,000	1,397,000
B. Dry vacuum pumps	890,000	905,000	920,000	942,000	995,000
C. Tubes	19,250	19,250	17,500	17,500	22,750
D. Steam jet air equipment	213,000	215,000	217,000	221,000	231,000
E. Erection	NONE	←			→ 62,800
F. Deaeration - hot well of cond.	28,000	28,000	14,000	14,000	14,000
G. L-P heaters in exhaust stack					
3. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel					
d. Miscellaneous	657,000	659,000	662,000	667,000	678,000
2. Dredging					
3. Intake flume or forebay					
4. Seal well					
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)					
1. Traveling screens					
2. Screen wash pumps	133,000	134,000	135,000	137,000	140,000
3. Screen wash piping					
4. Chlorination equipment					
5. Chlorine handling					
C. Circulating water piping	637,000	641,000	646,000	656,000	673,000
D. Circulating water pumps					
1. Pumps	301,000	305,000	310,000	318,000	336,000
2. Motors	173,000	175,000	178,000	183,000	193,000
3. Erection	24,400	24,500	24,700	25,100	25,800
4. Feed Water Heaters					
A. L-P closed heaters	132,000	133,500	66,000	68,000	-------
B. H-P closed heaters	172,500	81,000	76,500	-------	88,000
C. Deaerating heater	129,800	126,800	124,700	123,400	-------
D. Insulation					
1. Closed heaters	6,800	4,200	1,800	-------	-------
2. Deaerators	9,600	9,400	9,200	9,100	-------
E. Structural work					
1. For closed heaters	14,000	7,000	7,000	-------	-------
2. For deaerators	28,700	27,700	27,100	26,800	-------
5. Boiler Feed Pumps					
A. Pumps and base plates	111,000	107,000	103,000	102,000	99,000
B. Fluid drive	94,000	94,000	94,000	94,000	94,000
C. Motors	182,000	170,000	165,000	160,000	164,000
D. Erection	16,000	15,500	14,900	14,700	14,400
E. Foundation for pumps	5,300	5,200	5,000	4,900	4,800
6. Condensate Pumps					
A. Pumps	53,000	53,500	42,000	43,500	-------
B. Motors	29,300	29,500	20,500	21,100	-------
C. Erection	6,400	6,400	6,200	6,400	-------
7. Piping and Insulation					
A. Extraction steam	246,300	199,000	164,800	98,600	57,000
B. Heater vents and drains					
C. Feed water piping	136,800	129,700	129,700	68,000	137,800
D. Condensate piping					
1. From condensate pumps through L-P heaters.	92,200	92,200	85,800	85,800	-------
2. To deaerator and B.F. pump suction					
E. Main steam	85,200	85,200	85,200	85,20	85,200
8. Demineralizing Equipment and Condensate Storage Tanks	169,000	163,000	160,000	157,000	158,000
9. Electrical	153,000	151,400	149,800	149,500	124,600
10. Turbine Room Building	-------	-------	-------	-------	-------
Total Items 1-10	19,438,550	19,306,050	19,198,400	19,063,600	19,035,150
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	26,681,050	26,548,550	26,440,900	26,306,100	26,277,650
11 Piping In Containment Vessel	454,000	451,500	451,500	451,500	383,000
Grand Total	27,135,050	27,000,050	26,892,400	26,757,600	26,660,650

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
600 PSIA, 986 F THROTTLE STEAM
(500 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories					
A. Turbine generator unit	12,870,000	12,870,000	12,870,000	12,870,000	12,870,000
B. Turbine generator erection	500,000	500,000	500,000	500,000	500,000
C. Reserve exciter	←		CONSTANT		→
D. Turbine foundation	230,000	230,000	230,000	230,000	230,000
2. Condensers					
A. Shells and accessories	1,149,000	1,197,000	1,200,000	1,239,000	1,300,000
B. Dry vacuum pumps					
C. Tubes	839,000	850,000	861,000	881,000	925,000
D. Steam jet air equipment	19,250	19,250	17,500	17,500	22,750
E. Erection	202,000	204,000	206,000	210,000	219,000
F. Deaeration - hot well of cond.	NONE				58,500
G. L-P heaters in exhaust stack	28,000	28,000	14,000	14,000	14,000
3. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel					
d. Miscellaneous	646,000	648,000	650,000	655,000	664,000
2. Dredging					
3. Intake flume or forebay					
4. Seal well					
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)					
1. Traveling screens					
2. Screen wash pumps	130,000	131,000	131,000	133,000	136,000
3. Screen wash piping					
4. Chlorination equipment					
5. Chlorine handling					
C. Circulating water piping	618,000	622,000	626,000	638,000	650,000
D. Circulating water pumps					
1. Pumps	282,000	286,000	290,000	297,000	313,000
2. Motors	162,000	164,000	166,000	171,000	180,000
3. Erection	23,600	23,800	23,900	24,200	24,900
4. Feed Water Heaters					
A. L-P closed heaters	125,000	126,500	62,000	64,500	-------
B. H-P closed heaters	164,000	77,000	73,000	--------	84,000
C. Deaerating heater	125,100	122,200	120,300	119,300	-------
D. Insulation					
1. Closed heaters	6,500	3,900	1,700	-------	-------
2. Deaerators	9,200	9,000	8,900	9,800	-------
E. Structural work					
1. For closed heaters	14,000	7,000	7,000	-------	-------
2. For deaerators	27,300	26,400	25,900	25,700	-------
5. Boiler Feed Pumps					
A. Pumps and base plates	105,000	102,000	98,000	97,000	95,000
B. Fluid drive	94,000	94,000	94,000	94,000	94,000
C. Motors	168,000	157,000	153,000	149,000	153,000
D. Erection	15,200	14,800	14,300	14,200	13,900
E. Foundation for pumps	5,100	4,900	4,800	4,700	4,600
6. Condensate Pumps					
A. Pumps	50,000	50,500	39,500	41,000	-------
B. Motors	27,500	27,700	19,300	19,900	-------
C. Erection	6,000	6,100	5,800	6,000	-------
7. Piping and Insulation					
A. Extraction steam	246,300	199,000	164,800	98,600	57,000
B. Heater vents and drains					
C. Feed water piping	136,800	129,700	129,700	68,000	137,800
D. Condensate piping					
1. From condensate pumps through L-P heaters.	85,500	85,500	83,400	83,400	-------
2. To deaerator and B.F. pump suction					
E. Main steam	98,500	98,500	98,500	98,500	98,500
8. Demineralizing Equipment and Condensate Storage Tanks	160,000	155,000	152,000	150,000	151,000
9. Electrical	147,900	146,500	145,000	145,000	119,800
10. Turbine Room Building	-------	-------	-------	-------	-------
Total Items 1-10	19,515,750	19,416,250	19,286,300	19,168,300	19,115,750
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	26,758,250	26,658,750	26,528,800	26,410,800	26,358,250
11. Piping In Containment Vessel	637,500	635,000	635,000	635,000	635,000
Grand Total	27,395,750	27,293,750	27,163,800	27,045,800	26,993,250

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
400 PSIA, 445 F THROTTLE STEAM
(SATURATED STEAM)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
1. Turbine Generator and Accessories				
A. Turbine generator unit	14,050,000	14,050,000	14,050,000	14,050,000
B. Turbine generator erection	520,000	520,000	520,000	520,000
C. Reserve exciter	← CONSTANT →			
D. Turbine foundation	230,000	230,000	230,000	230,000
2. Condensers				
A. Shells and accessories	1,840,000	1,860,000	1,895,000	2,020,000
B. Dry vacuum pumps				
C. Tubes	1,360,000	1,385,000	1,390,000	1,470,000
D. Steam jet air equipment	15,750	14,000	14,000	17,500
E. Erection	290,000	292,000	296,000	314,000
F. Deaeration - hot well of cond.	NONE	→		90,000
G. L-P heaters in exhaust stack	28,000	14,000	14,000	14,000
3. Circulating Water System				
A. Structures				
1. Crib house				
a. Substructure				
b. Superstructure				
c. Steel	741,000	743,000	749,000	767,000
d. Miscellaneous				
2. Dredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume				
6. Outfall				
B. Crib house equipment (erected)				
1. Traveling screens				
2. Screen wash pumps	161,000	161,000	163,000	169,000
3. Screen wash piping				
4. Chlorination equipment				
5. Chlorine handling				
C. Circulating water piping	781,000	785,000	794,000	825,000
D. Circulating water pumps				
1. Pumps	442,000	446,000	455,000	486,000
2. Motors	254,000	256,000	262,000	279,900
3. Erection	30,200	30,300	30,700	32,000
4. Feed Water Heaters				
A. L-P closed heaters	208,000	87,500	90,000	-------
B. H-P closed heaters	106,000	120,500	-------	103,000
C. Deaerating heater	230,000	224,400	219,600	-------
D. Insulation				
1. Closed heaters	6,400	3,100	-------	-------
2. Deaerators	16,900	16,500	16,100	-------
E. Structural work				
1. For closed heaters	7,000	7,000	-------	-------
2. For deaerators	49,000	47,600	46,000	-------
5. Boiler Feed Pumps				
A. Pumps and base plates	126,000	117,000	112,000	105,000
B. Fluid drive	94,000	94,000	94,000	94,000
C. Motors	144,000	145,000	134,000	142,000
D. Erection	18,800	17,600	17,000	16,100
E. Foundation for pumps	7,100	6,700	6,400	6,100
6. Condensate Pumps				
A. Pumps	82,000	62,000	64,000	-------
B. Motors	49,500	29,700	30,500	-------
C. Erection	9,300	8,700	8,900	-------
7. Piping and Insulation				
A. Extraction steam				
B. Heater vents and drains	226,000	222,500	135,300	81,200
C. Feed water piping	105,000	105,000	40,000	88,000
D. Condensate piping				
1. From condensate pumps through L-P heaters.	119,500	103,200	109,400	-------
2. To deaerator and B.F. pump suction				
E. Main steam	53,500	51,000	49,000	49,000
8. Demineralizing Equipment and Condensate Storage Tanks	222,000	218,000	211,000	206,000
9. Electrical	167,000	164,700	163,900	138,000
10. Turbine Room Building	-------	-------	-------	-------
Total Items 1-10	22,790,050	22,638,00	22,409,800	22,311,900
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	30,032,550	29,880,500	29,652,300	29,554,400
11. Piping In Containment Vessel	445,000	420,000	393,000	379,500
Grand Total	30,477,550	30,300,500	30,045,300	29,933,900

TABLE 12.5 (Continued)

400 PSIA, 545 F THROTTLE STEAM
(100 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
1. Turbine Generator and Accessories				
A. Turbine generator unit	13,690,000	13,690,000	13,690,000	13,690,000
B. Turbine generator erection	500,000	500,000	500,000	500,000
C. Reserve exciter	←	CONSTANT	→	
D. Turbine foundation	230,000	230,000	230,000	230,000
2. Condensers				
A. Shells and accessories	1,690,000	1,700,000	1,754,000	1,775,000
B. Dry vacuum pumps	1,220,000	1,230,000	1,265,000	1,380,000
C. Tubes	15,750	14,000	14,000	17,500
D. Steam jet air equipment	270,000	272,000	277,000	293,000
E. Erection	NONE			80,000
F. Deaeration - hot well of cond.				
G. L-P heaters in exhaust stack	28,000	14,000	14,000	14,000
3. Circulating Water System				
A. Structures				
1. Crib house				
a. Substructure				
b. Superstructure				
c. Steel				
d. Miscellaneous	721,000	722,000	728,000	745,000
2. Dredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume				
6. Outfall				
B. Crib house equipment (erected)				
1. Traveling screens				
2. Screen wash pumps				
3. Screen wash piping	154,000	154,000	156,000	162,000
4. Chlorination equipment				
5. Chlorine handling				
C. Circulating water piping	745,000	748,000	759,000	787,000
D. Circulating water pumps				
1. Pumps	402,000	410,000	420,000	448,000
2. Motors	234,000	235,000	242,000	258,000
3. Erection	28,700	28,800	29,300	30,400
4. Feed Water Heaters				
A. L-P closed heaters	187,000	80,000	82,000	-------
B. H-P closed heaters	95,500	107,500	-------	94,500
C. Deaerating heater	218,000	213,600	210,000	-------
D. Insulation				
1. Closed heaters	5,800	2,800	-------	-------
2. Deaerators	16,000	15,700	15,500	-------
E. Structural work				
1. For closed heaters	7,000	7,000	-------	-------
2. For deaerators	45,700	44,600	43,600	-------
5. Boiler Feed Pumps				
A. Pumps and base plates	114,000	106,000	103,000	97,000
B. Fluid drive	94,000	94,000	94,000	94,000
C. Motors	184,000	182,000	172,000	175,000
D. Erection	17,300	16,300	15,800	15,100
E. Foundation for pumps	6,500	6,200	6,000	5,700
6. Condensate Pumps				
A. Pumps	73,500	56,000	58,000	-------
B. Motors	44,800	27,200	28,100	-------
C. Erection	8,500	8,000	8,200	-------
7. Piping and Insulation				
A. Extraction steam	226,000	222,500	135,300	81,200
B. Heater vents and drains				
C. Feed water piping	136,300	136,300	61,300	127,200
D. Condensate piping				
1. From condensate pumps through L-P heaters.	104,400	94,000	94,000	-------
2. To deaerator and B.F. pump suction				
E. Main steam	31,200	31,200	31,200	31,200
8. Demineralizing Equipment and Condensate Storage Tanks	207,000	201,000	195,000	192,000
9. Electrical	169,300	166,400	165,700	140,600
10. Turbine Room Building	-------	-------	-------	-------
Total Items 1-10	21,920,250	21,766,100	21,597,000	21,463,400
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	29,162,750	29,008,600	28,839,500	28,705,900
11. Piping In Containment Vessel	376,500	366,000	305,500	305,500
Grand Total	29,539,250	29,374,600	29,145,000	29,011,400

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
400 PSIA, 645 F THROTTLE STEAM
(200 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
1. Turbine Generator and Accessories				
A. Turbine generator unit	13,450,000	13,450,000	13,450,000	13,450,000
B. Turbine generator erection	540,000	540,000	540,000	540,000
C. Reserve exciter	← CONSTANT →			
D. Turbine foundation	280,000	280,000	280,000	280,000
2. Condensers				
A. Shells and accessories	1,578,000	1,600,000	1,655,000	1,770,000
B. Dry vacuum pumps				
C. Tubes	1,117,000	1,134,000	1,170,000	1,281,000
D. Steam jet air equipment	15,750	14,000	14,000	17,500
E. Erection	255,000	257,000	265,000	281,000
F. Deaeration - hot well of cond.	NONE →			79,700
G. L-P heaters in exhaust stack	28,000	14,000	14,000	14,000
3. Circulating Water System				
A. Structures				
1. Crib house				
a. Substructure				
b. Superstructure				
c. Steel	703,000	706,000	714,000	731,000
d. Miscellaneous				
2. Dredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume				
6. Outfall				
B. Crib house equipment (erected)				
1. Traveling screens				
2. Screen wash pumps	148,000	149,000	152,000	157,000
3. Screen wash piping				
4. Chlorination equipment				
5. Chlorine handling				
C. Circulating water piping	716,000	722,000	735,000	768,000
D. Circulating water pumps				
1. Pumps	378,000	384,000	397,000	425,000
2. Motors	217,000	220,000	228,000	244,000
3. Erection	27,500	27,800	28,300	29,500
4. Feed Water Heaters				
A. L-P closed heaters	172,000	74,500	77,000	-------
B. H-P closed heaters	87,500	91,500	-------	83,000
C. Deaerating heater	209,000	204,800	202,000	-------
D. Insulation				
1. Closed heaters	5,400	2,500	-------	-------
2. Deaerators	15,400	15,100	14,900	-------
E. Structural work				
1. For closed heaters	7,000	7,000	-------	-------
2. For deaerators	43,400	42,400	41,600	-------
5. Boiler Feed Pumps				
A. Pumps and base plates	105,000	98,000	95,000	86,000
B. Fluid drive	94,000	94,000	94,000	94,000
C. Motors	168,000	165,000	157,000	152,000
D. Erection	16,200	15,200	14,900	13,800
E. Foundation for pumps	6,100	5,800	5,700	5,200
6. Condensate Pumps				
A Pumps	67,000	51,500	53,500	-------
B. Motors	41,300	25,500	26,300	-------
C. Erection	7,800	7,400	7,700	-------
7. Piping and Insulation				
A. Extraction steam	225,000	222,500	132,000	81,000
B. Heater vents and drains				
C. Feed water piping	136,300	136,300	61,300	127,200
D. Condensate piping				
1. From condensate pumps through L-P heaters.	104,400	94,000	94,000	-------
2. To deaerator and B.F. pump suction				
E. Main steam	31,200	31,200	31,200	31,200
8. Demineralizing Equipment and Condensate Storage Tanks	194,000	187,000	183,000	174,000
9. Electrical	162,000	159,800	160,000	133,300
10. Turbine Room Building	178,000	178,000	178,000	178,000
Total Items 1-10	21,529,250	21,406,800	21,048,400	21,226,400
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	28,771,750	28,649,300	28,513,900	28,468,900
11. Piping In Containment Vessel	376,500	376,500	305,500	305,500
Grand Total	29,148,250	29,025,800	28,819,400	28,774,400

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
400 PSIA, 845 F THROTTLE STEAM
(400 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
1. Turbine Generator and Accessories				
A. Turbine generator unit	13,690,000	13,690,000	13,690,000	13,690,000
B. Turbine generator erection	540,000	540,000	540,000	540,000
C. Reserve exciter	← CONSTANT →			
D. Turbine foundation	280,000	280,000	280,000	280,000
2. Condensers				
A. Shells and accessories	1,360,000	1,380,000	1,420,000	1,535,000
B. Dry vacuum pumps	971,000	980,000	1,013,000	1,088,000
C. Tubes	19,250	17,500	17,500	21,000
D. Steam jet air equipment	228,000	230,000	235,000	248,000
E. Erection	NONE →			69,000
F. Deaeration - hot well of cond.				
G. L-P heaters in exhaust stack	28,000	14,000	14,000	14,000
3. Circulating Water System				
A. Structures				
1. Crib house				
a. Substructure				
b. Superstructure				
c. Steel	673,000	675,000	681,000	697,000
d. Miscellaneous				
2. Dredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume				
6. Outfall				
B. Crib house equipment (erected)				
1. Traveling screens				
2. Screen wash pumps	139,000	139,000	141,000	146,000
3. Screen wash piping				
4. Chlorination equipment				
5. Chlorine handling				
C. Circulating water piping	665,000	668,000	680,000	706,000
D. Circulating water pumps				
1. Pumps	328,000	332,000	342,000	368,000
2. Motors	188,000	190,000	197,000	215,000
3. Erection	25,500	25,600	26,100	27,100
Feed Water Heaters				
A. L-P closed heaters	150,000	65,000	67,000	-------
B. H-P closed heaters	76,000	84,000	-------	77,500
C. Deaerating heater	131,200	128,800	127,100	-------
D. Insulation				
1. Closed heaters	4,700	2,300	-------	-------
2. Deaerators	9,700	9,500	9,400	-------
E. Structural work				
1. For closed heaters	7,000	7,000	-------	-------
2. For deaerators	29,100	28,300	27,800	-------
5. Boiler Feed Pumps				
A. Pumps and base plates	91,000	85,000	83,000	80,000
B. Fluid drive	94,000	94,000	94,000	94,000
C. Motors	142,000	141,000	135,000	141,000
D. Erection	14,400	13,700	13,500	13,100
E. Foundation for pumps	5,500	5,200	5,100	5,000
6. Condensate Pumps				
A. Pumps	57,000	44,000	46,000	-------
B. Motors	35,700	22,300	23,000	-------
C. Erection	6,800	6,500	6,700	-------
7. Piping and Insulation				
A. Extraction steam	218,500	189,000	114,400	81,200
B. Heater vents and drains	114,100	114,100	61,300	127,200
C. Feed water piping				
D. Condensate piping				
1. From condensate pumps through L-P heaters.	92,200	92,500	92,500	-------
2. To deaerator and B.F. pump suction				
E. Main steam	56,700	56,700	56,700	56,700
8. Demineralizing Equipment and Condensate Storage Tanks	172,000	167,000	163,000	164,000
9. Electrical	150,000	148,200	148,400	124,200
10. Turbine Room Building	178,000	178,000	178,000	178,000
Total Items 1-10	20,970,350	20,843,200	20,728,500	20,786,000
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	28,212,850	28,085,700	27,971,000	28,028,500
11. Piping In Containment Vessel	535,000	433,000	433,500	431,500
Grand Total	28,747,850	28,518,700	28,404,500	28,460,000

TABLE 12.5 (Continued)

SUMMARY OF COST DATA
400 PSIA, 945 F THROTTLE STEAM
(500 F SUPERHEAT)
500 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
1. Turbine Generator and Accessories				
A. Turbine generator unit	12,810,000	12,810,000	12,810,000	12,810,000
B. Turbine generator erection	500,000	500,000	500,000	500,000
C. Reserve exciter	← CONSTANT →			
D. Turbine foundation	230,000	230,000	230,000	230,000
2. Condensers				
A. Shells and accessories	1,275,000	1,292,000	1,330,000	1,434,000
B. Dry vacuum pumps	907,000	916,000	948,000	1,024,000
C. Tubes	19,250	17,500	17,500	21,000
D. Steam jet air equipment	215,000	217,000	223,000	237,000
E. Erection	NONE →			64,000
F. Deaeration - hot well of cond.	28,000	14,000	14,000	14,000
G. L-P heaters in exhaust stack				
3. Circulating Water System				
A. Structures				
1. Crib house				
a. Substructure				
b. Superstructure				
c. Steel	660,000	662,000	668,000	683,000
d. Miscellaneous				
2. Dredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume				
6. Outfall				
B. Crib house equipment (erected)				
1. Traveling screens				
2. Screen wash pumps	134,000	135,000	137,000	142,000
3. Screen wash piping				
4. Chlorination equipment				
5. Chlorine handling				
C. Circulating water piping	642,000	647,000	657,000	682,000
D. Circulating water pumps				
1. Pumps	306,000	310,000	320,000	344,000
2. Motors	176,000	178,000	184,000	198,000
3. Erection	24,600	24,700	25,200	26,200
4. Feed Water Heaters				
A. L-P closed heaters	138,500	61,500	63,000	-------
B. H-P closed heaters	72,000	79,000	-------	73,000
C. Deaerating heater	126,800	124,100	122,800	-------
D. Insulation				
1. Closed heaters	4,500	2,100	-------	-------
2. Deaerators	9,400	9,100	9,000	-------
E. Structural work				
1. For closed heaters	7,000	7,000	-------	-------
2. For deaerators	27,700	27,000	26,500	-------
5. Boiler Feed Pumps				
A. Pumps and base plates	85,000	80,000	78,000	76,000
B. Fluid drive	80,000	80,000	80,000	80,000
C. Motors	132,000	130,000	124,000	131,000
D. Erection	13,700	13,100	12,900	12,600
E. Foundation for pumps	5,200	5,000	4,900	4,800
6. Condensate Pumps				
A. Pumps	53,500	42,000	43,500	-------
B. Motors	33,400	21,000	21,700	-------
C. Erection	6,400	6,200	6,300	-------
7. Piping and Insulation				
A. Extraction steam	218,500	189,000	114,400	81,200
B. Heater vents and drains	114,100	114,100	61,300	127,200
C. Feed water piping				
D. Condensate piping				
1. From condensate pumps through L-P heaters.	92,200	92,500	92,500	-------
2. To deaerator and B.F. pump suction				
E. Main steam	63,100	63,100	59,000	59,000
8. Demineralizing Equipment and Condensate Storage Tanks	163,000	158,000	155,000	157,000
9. Electrical	145,100	143,500	143,700	119,600
10. Turbine Room Building	-------	-------	-------	-------
Total Items 1-10	19,517,950	19,400,500	19,282,200	19,330,600
Total Constant Cost	7,242,500	7,242,500	7,242,500	7,242,500
Total Turbine Plant Cost	26,760,450	26,643,000	26,524,700	26,573,100
11. Piping In Containment Vessel	570,500	570,500	449,000	449,000
Grand Total	27,330,950	27,213,500	26,973,700	27,022,100

SUMMARY OF 1,000 MWe H_2O TURBINE PLANT CHARACTERISTICS
EFFICIENCY IN %, COST IN MILLIONS OF DOLLARS

No. of Feed-water Heaters			7		6		5		4		3		2		1	
Pressure Psia	Degrees F Superheat	Act. Steam Temp. °F	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost
	SAT.	596	35.8	54.21	35.4	53.02	34.8	52.18	34.2	51.79	33.3	51.49	32.1	51.51	30.8	51.65
	100	696	36.6	52.00	36.3	51.16	35.9	50.61	35.2	50.25	34.4	49.95	33.3	49.92	32.1	50.12
1500	200	796	38.0	50.82	37.7	49.87	37.2	49.31	36.4	48.97	35.5	48.60	34.4	48.57	33.1	48.76
	300	896	39.4	49.81	38.9	49.25	38.3	48.74	37.4	48.43	36.4	48.18	35.2	48.13	33.9	48.32
	400	996	40.6	49.59	40.1	48.92	39.4	48.58	38.5	48.30	37.5	48.06	36.2	47.95	34.8	48.09
	SAT.	587	35.3	54.13	35.0	53.05	34.5	52.37	33.8	51.93	33.0	51.54	31.8	51.64	30.5	51.90
	100	687	36.3	52.35	36.0	51.17	35.5	50.59	34.9	50.25	34.0	49.93	33.0	49.78	31.7	50.21
1400	200	787	37.7	50.70	37.3	49.97	36.8	49.37	36.1	49.00	35.2	48.75	34.0	48.72	32.7	49.07
	300	887	38.9	49.90	38.6	49.35	37.9	48.80	37.1	48.52	36.2	48.30	35.0	48.36	33.5	48.51
	400	987	40.0	49.60	39.8	49.06	39.1	48.66	38.2	48.34	37.2	48.13	35.9	48.04	34.4	48.27
	SAT.	567			34.5	52.95	34.2	52.18	33.7	51.40	32.9	51.02	31.8	50.78	30.4	50.88
	100	667			35.7	51.52	35.3	51.04	34.8	50.49	34.0	50.12	32.9	49.79	31.5	50.05
1200	200	767			36.9	50.22	36.5	49.72	36.0	49.03	35.1	48.75	34.0	48.57	32.5	48.79
	300	867			38.1	49.46	37.8	49.06	37.2	48.67	36.3	48.37	35.1	48.21	33.5	48.44
	400	967			39.3	49.10	39.0	48.75	38.4	48.35	37.5	48.07	36.1	47.93	34.4	48.02
	SAT.	545			33.5	53.08	33.2	52.42	32.7	51.85	31.9	51.60	31.0	51.44	29.7	51.54
	100	645			34.7	51.23	34.4	50.75	33.8	50.38	33.1	50.13	32.2	50.03	30.8	50.00
1000	200	745			36.0	49.73	35.7	49.25	35.1	48.89	34.3	48.63	33.3	48.51	31.8	48.52
	300	845			37.2	49.42	36.9	48.90	36.3	48.64	35.4	48.43	34.3	48.29	32.7	48.12
	400	945			38.4	49.07	38.2	48.61	37.4	48.37	36.6	48.19	35.4	48.00	33.7	47.90
	SAT.	518			32.4	52.01	32.0	51.58	31.5	51.14	30.7	50.91	29.9	50.96	28.6	51.02
	100	618			33.5	50.82	33.2	50.39	32.7	49.61	31.9	49.42	31.1	49.47	29.6	49.56
800	200	718			34.8	49.22	34.5	48.65	33.9	48.09	33.1	47.95	32.2	47.86	30.6	48.08
	300	818			36.1	48.46	35.8	47.99	35.2	47.70	34.2	47.48	33.2	47.50	31.5	47.62
	500	1018			38.4	47.87	38.2	47.61	37.5	47.34	36.3	47.16	35.2	47.07	33.3	47.20
	SAT.	486					30.7	49.54	30.4	49.21	29.8	49.00	29.0	48.89	27.9	48.87
	100	586					32.0	48.25	31.6	47.78	31.0	47.63	30.2	47.45	28.9	47.50
600	200	686					33.2	46.89	32.9	46.44	32.2	46.20	31.3	45.93	29.9	46.05
	400	886					35.6	45.87	35.3	45.63	34.8	45.46	33.7	45.27	31.8	45.28
	500	986					36.8	46.15	36.6	45.88	35.9	45.67	34.8	45.51	32.8	45.61
	SAT.	445							29.1	58.61	28.7	58.26	28.1	57.64	27.0	57.53
	100	545							30.5	56.73	30.2	56.40	29.2	55.83	27.9	55.68
400	200	645							31.7	55.90	31.4	55.65	30.4	55.24	28.9	55.14
	400	845							34.2	55.08	34.0	54.62	32.8	54.19	30.8	54.50
	500	945							35.3	52.30	35.2	52.06	33.9	51.58	31.8	51.68

TABLE 12.6 (SL-2008, p 7)

TABLE 12.7 (SL-2008, pp 171-204)

SUMMARY OF COST DATA
1500 PSIA, 696 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers							
A. Shells and accessories	2,367,000	2,550,000	2,565,000	2,577,000	2,640,000	2,790,000	3,027,000
B. Dry vacuum pumps							
C. Tubes	1,660,000	1,805,000	1,820,000	1,835,000	1,880,000	1,988,000	2,145,000
D. Steam jet air equipment	28,875	28,875	26,250	26,250	26,250	26,250	52,500
E. Erection	368,000	402,000	406,000	408,000	417,000	442,000	477,000
F. Deaeration - hot well of cond.	NONE	←					→ 136,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	858,000	894,000	899,000	902,000	912,000	939,000	979,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps							
3. Screen wash piping	193,000	209,000	211,000	212,000	218,000	227,000	245,000
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	1,154,000	1,206,000	1,212,000	1,218,000	1,231,000	1,269,000	1,324,000
D. Circulating water pumps							
1. Pumps	563,000	613,000	618,000	623,000	637,000	673,000	727,000
2. Motors	346,000	365,000	367,000	369,000	374,000	388,000	408,000
3. Erection	40,700	42,700	42,800	43,000	43,600	44,900	46,900
4. Feed Water Heaters							
A. L-P closed heaters	384,000	392,500	242,500	246,500	127,500	135,000	-------
B. H-P closed heaters	739,500	430,000	396,500	188,500	145,500	-------	192,500
C. Deaerating heater	373,000	358,000	348,000	341,000	268,000	266,000	-------
D. Insulation							
1. Closed heaters	34,400	23,800	17,700	10,400	3,700	-------	-------
2. Deaerators	27,500	26,300	25,600	25,100	20,000	19,700	-------
E. Structural work							
1. For closed heaters	42,000	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	81,000	76,800	74,100	72,300	60,000	59,200	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	561,000	528,000	492,000	475,000	454,000	446,000	434,000
B. Fluid drive	663,000	330,000	333,000	333,000	333,000	333,000	333,000
C. Motors	819,000	747,000	704,000	668,000	637,000	618,000	611,000
D. Erection	53,000	50,500	47,700	46,400	44,900	44,300	43,300
E. Foundation for pumps	11,200	10,600	9,900	9,600	9,200	9,100	8,800
6. Condensate Pumps							
A. Pumps	129,000	132,000	104,000	106,000	80,000	86,000	-------
B. Motors	81,100	82,900	50,800	51,800	35,100	37,200	-------
C. Erection	13,300	13,500	12,900	13,000	12,500	13,000	-------
7. Piping and Insulation							
A. Extraction steam	732,600	618,000	534,900	450,600	399,600	267,000	147,600
B. Heater vents and drains							
C. Feed water piping	500,000	431,000	319,000	294,000	294,000	174,700	359,000
D. Condensate piping							
1. From condensate pumps through L-P heaters.	188,700	188,700	166,000	166,000	153,000	153,000	-------
2. To deaerator and B.F. pump suction							
E. Main steam	38,000	38,000	38,000	38,000	33,700	33,700	33,700
8. Demineralizing Equipment and Condensate Storage Tanks	254,000	238,000	227,000	220,000	217,000	210,000	208,000
9. Electrical	373,200	364,200	351,200	343,400	336,800	337,300	282,800
10. Turbine Room Building	-	-	-	-	-	-	-
Total Items 1-10	38,872,075	38,421,875	37,877,850	37,517,350	37,223,850	37,199,350	37,391,100
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	50,746,075	50,295,875	49,751,850	49,391,350	49,097,850	49,073,350	49,265,100
11. Piping In Containment Vessel	1,260,000	862,000	863,000	855,000	849,000	846,000	857,000
Grand Total	52,006,075	51,157,875	50,614,850	50,246,350	49,946,850	49,919,350	50,122,100

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1500 PSIA, 796 F THROTTLE STEAM
(200 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers							
A. Shells and accessories	2,374,000	2,400,000	2,415,000	2,430,000	2,490,000	2,625,000	2,850,000
B. Dry vacuum pumps							
C. Tubes	1,693,000	1,705,000	1,725,000	1,735,000	1,775,000	1,868,000	2,010,000
D. Steam jet air equipment	28,875	28,875	26,250	26,250	26,250	26,250	52,500
E. Erection	377,000	379,000	384,000	386,000	395,000	415,000	447,000
F. Deaeration - hot well of cond.	NONE	←					→ 128,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	866,000	870,000	873,000	877,000	886,000	910,000	946,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	197,000	198,000	200,000	201,000	205,000	214,000	231,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	1,165,000	1,170,000	1,175,000	1,181,000	1,193,000	1,228,000	1,278,000
D. Circulating water pumps							
1. Pumps	569,000	578,000	584,000	588,000	601,000	634,000	683,000
2. Motors	351,000	352,000	354,000	356,000	361,000	372,000	391,000
3. Erection	41,200	41,400	41,600	41,800	42,200	43,500	45,200
4. Feed Water Heaters							
A. L-P closed heaters	363,000	361,000	225,500	227,500	119,000	126,000	-------
B. H-P closed heaters	671,000	395,000	366,500	175,500	137,500	-------	180,500
C. Deaerating heater	351,000	339,000	264,000	260,000	256,000	254,000	-------
D. Insulation							
1. Closed heaters	31,000	21,500	16,100	9,500	3,400	-------	-------
2. Deaerators	25,800	24,900	19,600	19,200	18,960	18,700	-------
E. Structural work							
1. For closed heaters	42,000	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	75,000	71,800	58,800	57,400	56,300	55,600	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	510,000	483,000	453,000	441,000	422,000	417,000	407,000
B. Fluid drive	333,000	333,000	333,000	333,000	241,000	241,000	241,000
C. Motors	721,000	666,000	632,000	602,000	581,000	563,000	560,000
D. Erection	49,100	47,000	44,800	43,800	42,500	42,100	41,300
E. Foundation for pumps	10,200	9,700	9,200	9,000	8,600	8,500	8,300
6. Condensate Pumps							
A. Pumps	121,000	120,000	95,000	97,000	74,000	79,000	-------
B. Motors	76,000	75,500	46,900	47,800	32,800	34,700	-------
C. Erection	12,800	12,800	12,300	12,400	12,000	12,400	-------
7. Piping and Insulation							
A. Extraction steam	732,600	608,700	534,900	450,600	363,300	267,000	147,600
B. Heater vents and drains							
C. Feed water piping	500,000	431,000	319,000	294,000	294,000	174,700	359,000
D. Condensate piping							
1. From condensate pumps through L-P heaters.	188,700	188,700	166,000	166,000	141,000	141,000	-------
2. To deaerator and B.F. pump suction							
E. Main steam	97,000	97,000	97,000	97,000	74,000	74,000	74,000
8. Demineralizing Equipment and Condensate Storage Tanks	230,000	217,000	209,000	202,000	198,000	195,000	195,000
9. Electrical	354,700	343,700	333,500	329,100	322,600	322,000	268,700
10. Turbine Room Building	--------	--------	--------	--------	-------	------	-------
Total Items 1-10	37,551,975	36,995,075	36,429,950	36,101,800	35,752,910	35,731,450	35,914,100
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	49,425,975	48,869,075	48,303,950	47,975,950	47,626,910	47,605,450	47,788,100
11. Piping In Containment Vessel	1,390,000	1,004,000	1,003,000	994,000	974,000	967,000	975,000
Grand Total	50,815,975	49,873,075	49,306,950	48,969,950	48,600,910	48,572,450	48,763,100

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1500 PSIA, 896 F THROTTLE STEAM
(300 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers							
A. Shells and accessories	2,205,000	2,235,000	2,250,000	2,280,000	2,310,000	2,430,000	2,640,000
B. Dry vacuum pumps							
C. Tubes	1,570,000	1,585,000	1,600,000	1,619,000	1,649,000	1,735,000	1,871,000
D. Steam jet air equipment	28,875	28,875	26,250	26,250	26,250	26,250	52,500
E. Erection	349,000	353,000	356,000	360,000	366,000	386,000	417,000
F. Deaeration - hot well of cond.	NONE						118,700
G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	837,000	840,000	844,000	847,000	855,000	877,000	911,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	184,000	185,000	186,000	188,000	192,000	201,000	216,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	1,124,000	1,128,000	1,131,000	1,138,000	1,150,000	1,180,000	1,228,000
D. Circulating water pumps							
1. Pumps	533,000	538,000	543,000	548,000	559,000	589,000	635,000
2. Motors	335,000	337,000	338,000	340,000	345,000	356,000	373,000
3. Erection	39,700	39,800	40,000	40,300	40,700	41,800	43,500
4. Feed Water Heaters							
A. L-P closed heaters	335,000	335,000	211,000	214,500	111,500	118,000	-------
B. H-P closed heaters	626,500	370,000	345,000	166,000	133,500	-------	171,500
C. Deaerating heater	267,000	259,000	254,000	250,000	247,000	245,000	-------
D. Insulation							
1. Closed heaters	28,300	20,900	14,900	8,800	3,200	-------	-------
2. Deaerators	19,800	19,200	18,700	18,400	18,200	18,000	-------
E. Structural work							
1. For closed heaters	42,000	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	59,600	57,200	55,600	54,400	53,600	53,000	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	470,000	449,000	426,000	415,000	401,000	396,000	388,000
B. Fluid drive	333,000	333,000	241,000	241,000	241,000	241,000	241,000
C. Motors	651,000	606,000	580,000	557,000	536,000	524,000	522,000
D. Erection	46,100	44,500	42,700	41,900	40,800	40,500	39,800
E. Foundation for pumps	9,500	9,100	8,700	8,500	8,200	8,100	8,000
6. Condensate Pumps							
A. Pumps	111,000	110,000	88,000	90,000	69,000	74,000	-------
B. Motors	69,500	69,400	43,500	44,400	30,700	32,400	-------
C. Erection	12,200	12,200	11,700	11,900	11,500	11,900	-------
7. Piping and Insulation							
A. Extraction steam	711,600	608,700	534,900	446,700	359,100	263,100	147,600
B. Heater vents and drains							
C. Feed water piping	412,000	378,000	319,000	294,000	294,000	174,700	359,000
D. Condensate piping							
1. From condensate pumps through L-P heaters.	188,700	188,700	166,000	149,500	136,700	136,700	-------
2. To deaerator and B.F. pump suction							
E. Main steam	124,200	124,200	111,700	111,700	111,700	111,700	111,700
8. Demineralizing Equipment and Condensate Storage Tanks	212,000	202,000	195,000	190,000	182,000	180,000	180,000
9. Electrical	333,500	327,500	319,300	315,000	309,800	306,200	256,900
10. Turbine Room Building	-------	-------	-------	-------	-------	-------	-------
Total Items 1-10	36,763,075	36,319,775	35,816,950	35,520,750	35,271,950	35,226,350	35,401,200
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	48,637,075	48,193,775	47,690,950	47,394,750	47,145,950	47,100,350	47,275,200
11. Piping In Containment Vessel	1,172,000	1,052,000	1,045,000	1,038,000	1,038,000	1,030,000	1,042,000
Grand Total	49,809,075	49,245,775	48,735,950	48,432,750	48,183,950	48,130,350	48,317,200

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1500 PSIA, 996 F THROTTLE STEAM
(400 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers							
A. Shells and accessories	2,070,000	2,100,000	2,124,000	2,160,000	2,190,000	2,250,000	2,451,000
B. Dry vacuum pumps							
C. Tubes	1,480,000	1,493,000	1,510,000	1,530,000	1,555,000	1,629,000	1,750,000
D. Steam jet air equipment	28,875	28,875	26,250	26,250	26,250	26,250	52,500
E. Erection	329,000	332,000	336,000	340,000	346,000	362,000	389,000
F. Deaeration - hot well of cond.	NONE	←					→ 110,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	813,000	817,000	821,000	825,000	832,000	851,000	880,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	174,000	176,000	177,000	179,000	182,000	190,000	203,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	1,091,000	1,097,000	1,102,000	1,108,000	1,117,000	1,143,000	1,195,000
D. Circulating water pumps							
1. Pumps	501,000	507,000	512,000	517,000	527,000	563,000	593,000
2. Motors	324,000	326,000	328,000	330,000	333,000	342,000	357,000
3. Erection	38,600	38,800	39,000	39,200	39,500	40,500	41,900
4. Feed Water Heaters							
A. L-P closed heaters	308,500	310,500	198,000	202,000	106,000	111,000	--------
B. H-P closed heaters	588,000	348,500	327,000	157,500	125,500	--------	163,500
C. Deaerating heater	256,400	249,000	244,400	240,400	238,000	237,000	--------
D. Insulation							
1. Closed heaters	25,900	18,400	13,900	8,400	3,000	--------	--------
2. Deaerators	19,200	18,300	18,000	17,700	17,500	17,400	--------
E. Structural work							
1. For closed heaters	42,000	31,500	21,000	10,500	10,500	--------	--------
2. For deaerators	56,200	54,200	52,800	51,800	51,000	50,600	--------
5. Boiler Feed Pumps							
A. Pumps and base plates	441,000	422,000	402,000	393,000	380,000	377,000	369,000
B. Fluid drive	333,000	241,000	241,000	241,000	241,000	241,000	241,000
C. Motors	596,000	557,000	535,000	516,000	498,000	489,000	487,000
D. Erection	43,800	42,500	40,900	40,300	39,300	39,100	38,500
E. Foundation for pumps	9,000	8,600	8,200	8,100	7,800	7,700	7,600
6. Condensate Pumps							
A. Pumps	103,000	103,000	82,000	84,000	65,000	69,000	--------
B. Motors	64,500	64,500	40,800	41,600	28,900	30,500	--------
C. Erection	11,700	11,700	11,300	11,400	11,100	11,500	--------
7. Piping and Insulation							
A. Extraction steam	711,600	594,300	534,900	446,700	359,100	263,100	147,600
B. Heater vents and drains							
C. Feed water piping	412,000	378,000	319,000	281,00	281,000	174,700	359,000
D. Condensate piping							
1. From condensate pumps through L-P heaters.	176,200	176,200	149,500	149,500	136,700	136,700	--------
2. To deaerator and B.F. pump suction							
E. Main steam	150,800	139,700	139,700	139,700	139,700	139,700	139,700
8. Demineralizing Equipment and Condensate Storage Tanks	197,000	189,000	184,000	180,000	176,000	175,000	175,000
9. Electrical	327,000	324,100	316,500	313,000	309,400	311,000	258,500
10. Turbine Room Building							
Total Items 1-10	36,377,275	35,852,675	35,510,150	35,243,050	35,002,250	34,907,750	35,028,800
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	48,251,275	47,726,675	47,384,150	47,117,050	46,876,250	46,781,750	46,902,800
11. Piping In Containment Vessel	1,338,000	1,192,000	1,192,000	1,183,000	1,183,000	1,173,000	1,187,000
Grand Total	49,589,275	48,918,675	48,576,150	48,300,050	48,059,250	47,954,750	48,089,800

TABLE 12.7 (Continued

SUMMARY OF COST DATA
1400 PSIA, 587 F THROTTLE STEAM
(SATURATED STEAM)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	25,000,000	25,000,000	25,000,000	25,000,000	25,000,000	25,000,000	25,000,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers							
A. Shells and accessories	2,724,000	2,730,000	2,790,000	2,820,000	2,865,000	3,150,000	3,390,000
B. Dry vacuum pumps	2,010,000	2,016,000	2,025,000	2,040,000	2,055,000	2,130,000	2,370,000
C. Tubes	28,875	28,875	26,250	26,250	26,250	26,250	49,875
D. Steam jet air equipment	429,000	431,000	435,000	440,000	450,000	474,000	527,000
E. Erection	NONE	←					→ 152,400
F. Deaeration - hot well of cond.	50,000	50,000	50,000	50,000	25,000	25,000	25,000
G. L-P heaters in exhaust stack							
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	927,000	930,000	934,000	940,000	952,000	978,000	1,040,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	223,000	224,000	226,000	228,000	233,000	245,000	271,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	1,251,000	1,255,000	1,261,000	1,269,000	1,285,000	1,323,000	1,409,000
D. Circulating water pumps							
1. Pumps	656,000	661,000	666,000	675,000	690,000	726,000	810,000
2. Motors	382,000	383,000	385,000	388,000	394,000	407,000	438,000
3. Erection	44,300	44,500	44,700	45,000	45,500	46,800	50,000
4. Feed Water Heaters							
A. L-P closed heaters	396,500	400,500	241,000	249,000	121,500	128,500	-------
B. H-P closed heaters	810,000	479,500	437,000	206,500	132,500	-------	188,500
C. Deaerating heater	401,400	385,500	373,500	364,500	357,000	353,400	-------
D. Insulation							
1. Closed heaters	39,100	26,700	20,000	11,600	3,300	-------	-------
2. Deaerators	29,900	28,500	27,600	26,800	26,300	26,000	-------
E. Structural work							
1. For closed heaters	42,000	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	90,000	84,900	81,300	78,600	76,900	75,600	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	587,000	546,000	507,000	488,000	464,000	457,000	445,000
B. Fluid drive	633,000	333,000	333,000	333,000	333,000	333,000	333,000
C. Motors	801,000	722,000	679,000	639,000	606,000	586,000	589,000
D. Erection	58,700	55,300	52,000	50,300	48,400	47,700	46,700
E. Foundation for pumps	12,700	11,800	11,000	10,600	10,100	9,900	9,700
6. Condensate Pumps							
A. Pumps	153,000	152,000	96,000	98,000	90,000	97,000	-------
B. Motors	89,000	88,200	53,900	55,100	40,800	43,700	-------
C. Erection	14,750	10,900	13,800	14,000	13,300	13,900	-------
7. Piping and Insulation							
A. Extraction steam	730,200	631,800	560,800	455,700	358,200	251,700	147,600
B. Heater vents and drains	484,000	441,000	306,500	282,500	282,500	161,500	333,500
C. Feed water piping							
D. Condensate piping							
1. From condensate pumps through L-P heaters.	222,500	222,500	203,500	203,500	185,800	185,800	-------
2. To deaerator and B.F. pump suction							
E. Main steam	50,000	50,000	50,000	50,000	37,500	37,500	37,500
8. Demineralizing Equipment and Condensate Storage Tanks	288,000	270,000	256,000	245,000	237,500	233,000	232,000
9. Electrical	379,600	364,800	352,300	344,500	337,200	336,500	285,000
10. Turbine Room Building							
Total Items 1-10	41,082,525	40,134,775	39,564,150	39,182,950	38,838,050	38,953,750	39,224,775
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	52,956,525	52,008,775	51,438,150	51,056,950	50,712,050	50,827,750	51,098,775
11. Piping In Containment Vessel	1,169,000	1,044,000	934,000	870,000	829,000	814,000	804,000
Grand Total	54,125,525	53,052,775	52,372,150	51,926,950	51,541,050	51,641,750	51,902,775

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 687 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers							
A. Shells and accessories	2,565,000	2,580,000	2,610,000	2,640,000	2,700,000	2,850,000	3,120,000
B. Dry vacuum pumps							
C. Tubes	1,860,000	1,911,000	1,875,000	1,905,000	1,950,000	2,009,000	2,300,000
D. Steam jet air equipment	28,875	28,875	26,250	26,250	26,250	26,250	49,875
E. Erection	411,000	412,000	414,000	417,000	426,000	447,000	492,000
F. Deaeration - hot well of cond.	NONE	→					140,500
G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	902,000	905,000	908,000	912,000	924,000	949,000	998,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	212,000	213,000	214,000	216,000	221,000	232,000	253,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	1,215,000	1,219,000	1,224,000	1,229,000	1,246,000	1,281,000	1,350,000
D. Circulating water pumps							
1. Pumps	618,000	627,000	630,000	635,000	652,000	687,000	753,000
2. Motors	368,000	370,000	372,000	374,000	380,000	393,000	417,000
3. Erection	43,000	43,200	43,300	43,500	44,200	45,400	47,800
4. Feed Water Heaters							
A. L-P closed heaters	377,000	375,000	226,500	230,000	112,500	119,000	-------
B. H-P closed heaters	712,500	425,500	391,500	186,000	122,500	-------	171,000
C. Deaerating heater	371,400	357,600	347,400	340,500	268,000	265,000	-------
D. Insulation							
1. Closed heaters	38,200	23,800	19,600	10,500	3,000	-------	-------
2. Deaerators	27,300	26,300	25,600	25,000	20,000	19,700	-------
E. Structural work							
1. For closed heaters	42,000	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	80,700	76,900	74,100	72,000	60,000	59,200	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	514,000	484,000	454,000	440,000	422,000	415,000	405,000
B. Fluid drive	633,000	333,000	333,000	333,000	333,000	241,000	241,000
C. Motors	770,000	705,000	667,000	632,000	601,000	582,000	583,000
D. Erection	52,600	50,100	47,500	46,300	44,700	44,200	43,900
E. Foundation for pumps	11,100	10,500	9,900	9,600	9,200	9,000	8,800
6. Condensate Pumps							
A. Pumps	134,000	133,000	85,000	87,000	81,000	87,000	-------
B. Motors	78,900	78,300	48,800	49,700	37,500	39,800	-------
C. Erection	13,600	13,600	13,000	13,100	12,600	13,100	-------
7. Piping and Insulation							
A. Extraction steam	730,200	631,800	560,800	455,700	358,200	251,700	147,600
B. Heater vents and drains							
C. Feed water piping	483,000	431,000	319,000	294,000	294,000	174,000	359,000
D. Condensate piping							
1. From condensate pumps through L-P heaters.	188,700	188,700	166,000	166,000	153,000	153,000	-------
2. To deaerator and B.F. pump suction							
E. Main steam	45,200	35,500	35,500	35,500	35,500	28,500	28,500
8. Demineralizing Equipment and Condensate Storage Tanks	253,000	238,000	226,000	220,000	214,000	210,000	208,000
9. Electrical	368,200	356,500	344,700	338,400	331,000	332,000	279,000
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	39,342,475	38,509,675	37,927,450	37,587,550	37,262,650	37,132,850	37,565,975
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	51,216,475	50,383,675	49,801,450	49,461,550	49,136,650	49,006,850	49,439,975
11. Piping In Containment Vessel	1,129,000	789,000	790,000	789,000	789,000	772,000	774,000
Grand Total	52,345,475	51,172,675	50,591,450	50,250,550	49,925,650	49,778,850	50,213,975

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 787 F THROTTLE STEAM
(200 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers							
A. Shells and accessories	2,430,000	2,445,000	2,460,000	2,505,000	2,550,000	2,670,000	2,940,000
B. Dry vacuum pumps							
C. Tubes	1,731,000	1,770,000	1,785,000	1,806,000	1,845,000	1,970,000	2,159,000
D. Steam jet air equipment	28,875	28,875	26,250	26,250	26,250	26,250	49,875
E. Erection	390,000	399,000	400,000	402,000	409,000	421,000	461,000
F. Deaeration - hot well of cond.	NONE	←				→	132,300
G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	875,000	879,000	883,000	889,000	899,000	918,000	963,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	200,000	202,000	204,000	206,000	210,000	219,000	238,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	1,178,000	1,183,000	1,189,000	1,197,000	1,211,000	1,239,000	1,301,000
D. Circulating water pumps							
1. Pumps	586,000	591,000	597,000	605,000	618,000	645,000	705,000
2. Motors	355,000	357,000	359,000	362,000	367,000	377,000	400,000
3. Erection	41,700	41,800	42,100	42,400	42,800	43,800	46,100
4. Feed Water Heaters							
A. L-P closed heaters	347,500	345,000	212,000	215,000	106,000	111,000	-------
B. H-P closed heaters	651,000	392,000	361,500	173,000	116,000	-------	161,000
C. Deaerating heater	350,400	339,000	264,000	259,600	256,400	254,000	-------
D. Insulation							
1. Closed heaters	30,000	20,200	16,100	9,500	2,700	-------	-------
2. Deaerators	25,700	24,900	19,600	19,200	19,000	18,800	-------
E Structural work							
1. For closed heaters	42,000	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	74,900	71,900	58,800	57,400	56,400	55,600	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	469,000	446,000	421,000	409,000	394,000	389,000	382,000
B. Fluid drive	333,000	333,000	333,000	241,000	241,000	241,000	241,000
C. Motors	682,000	631,000	600,000	572,000	542,000	532,000	534,000
D. Erection	48,700	46,800	44,700	43,700	42,400	42,000	41,400
E. Foundation for pumps	10,200	9,700	9,200	8,900	8,600	8,500	8,300
6. Condensate Pumps							
A. Pumps	122,000	121,000	78,000	80,000	76,000	80,000	-------
B. Motors	71,800	71,500	45,200	46,000	35,200	37,000	-------
C. Erection	12,900	12,800	12,400	12,500	12,100	12,500	-------
7. Piping and Insulation							
A. Extraction steam	726,900	631,800	539,700	447,600	358,200	251,700	147,600
B. Heater vents and drains							
C. Feed water piping	483,000	431,000	319,000	294,000	294,000	174,000	359,000
D. Condensate piping							
1. From condensate pumps through L-P heaters.	188,700	188,700	166,000	166,000	141,100	141,100	-------
2. To deaerator and B.F. pump suction							
E. Main steam	107,300	97,000	97,000	97,000	97,000	97,000	97,000
8. Demineralizing Equipment and Condensate Storage Tanks	230,000	217,000	208,000	203,000	198,000	195,000	195,000
9. Electrical	347,200	337,500	328,000	323,000	317,700	317,800	265,800
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	37,564,775	37,090,975	36,494,550	36,123,550	35,872,350	35,857,050	36,197,375
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	49,438,775	48,964,975	48,368,550	47,997,550	47,746,350	47,731,050	48,071,375
11. Piping In Containment Vessel	1,266,000	1,003,000	1,003,000	1,001,000	1,001,000	986,000	997,000
Grand Total	50,704,775	49,967,975	49,371,550	48,998,550	48,747,350	48,717,050	49,068,375

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 887 F THROTTLE STEAM
(300 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers							
A. Shells and accessories	2,265,000	2,280,000	2,310,000	2,325,000	2,400,000	2,520,000	2,715,000
B. Dry vacuum pumps							
C. Tubes	1,640,000	1,650,000	1,665,000	1,715,000	1,710,000	1,855,000	1,956,000
D. Steam jet air equipment	28,875	28,875	26,250	26,250	26,250	26,250	49,875
E. Erection	370,000	372,000	378,000	382,000	384,000	414,000	428,000
F. Deaeration - hot well of cond	NONE	→					121,900
G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	847,000	849,000	851,000	857,000	868,000	891,000	926,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	188,000	189,000	190,000	193,000	198,000	207,000	222,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	1,138,000	1,140,000	1,143,000	1,153,000	1,168,000	1,200,000	1,249,000
D. Circulating water pumps							
1. Pumps	547,000	549,000	553,000	561,000	576,000	608,000	655,000
2. Motors	340,000	341,000	343,000	346,000	352,000	363,000	381,000
3. Erection	40,200	40,300	40,500	40,800	41,300	42,500	44,200
4. Feed Water Heaters							
A. L-P closed heaters	323,000	322,000	198,000	200,000	103,000	104,500	-------
B. H-P closed heaters	607,000	366,500	340,000	163,000	113,500	-------	151,000
C. Deaerating heater	267,000	259,400	254,000	250,000	247,000	245,600	-------
D. Insulation							
1. Closed heaters	28,200	20,000	14,900	8,900	2,600	-------	-------
2. Deaerators	19,900	19,200	18,700	18,400	18,200	18,000	-------
E. Structural work							
1. For closed heaters	42,000	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	59,800	57,300	55,500	54,400	53,400	53,000	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	437,000	417,000	396,000	387,000	374,000	370,000	360,000
B. Fluid drive	333,000	333,000	241,000	241,000	241,000	241,000	241,000
C. Motors	618,000	592,000	549,000	526,000	506,000	494,000	479,000
D. Erection	46,000	44,400	42,600	41,800	40,700	40,000	39,500
E. Foundation for pumps	9,500	9,100	8,600	8,500	8,200	8,100	7,900
6. Condensate Pumps							
A. Pumps	112,000	111,000	72,000	74,000	70,000	75,000	-------
B. Motors	66,100	65,700	41,800	42,700	32,900	34,700	-------
C. Erection	12,250	12,200	11,800	11,900	11,600	12,000	-------
7. Piping and Insulation							
A. Extraction steam	716,100	612,600	536,100	443,700	353,100	251,700	147,600
B. Heater vents and drains							
C. Feed water piping	390,000	378,000	319,000	294,000	294,000	174,000	359,000
D. Condensate piping							
1. From condensate pumps through L-P heaters.	188,700	188,700	166,000	149,500	136,700	136,700	-------
2. To deaerator and B.F. pump suction							
E. Main steam	132,300	121,700	111,700	111,700	111,700	111,700	111,700
8. Demineralizing Equipment and Condensate Storage Tanks	212,000	202,000	195,000	190,000	186,000	185,000	182,000
9. Electrical	330,800	325,500	313,900	310,200	305,800	306,700	252,300
10. Turbine Room Building	-------	-------	-------	-------	-------	-------	-------
Total Items 1-10	36,849,725	36,422,975	35,901,350	35,631,250	35,413,450	35,458,450	35,593,975
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	48,723,725	48,296,975	47,775,350	47,505,250	47,287,450	47,332,450	47,467,975
11. Piping In Containment Vessel	1,172,000	1,050,000	1,020,000	1,012,000	1,012,000	1,027,000	1,041,000
Grand Total	49,895,725	49,346,975	48,795,350	48,517,250	48,299,450	48,359,450	48,508,975

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1400 PSIA, 987 F THROTTLE STEAM
(400 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	7	6	5	4	3	2	1
1. Turbine Generator and Accessories							
A. Turbine generator unit	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←			CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers							
A. Shells and accessories	2,130,000	2,145,000	2,160,000	2,175,000	2,235,000	2,340,000	2,535,000
B. Dry vacuum pumps	1,572,000	1,585,000	1,595,000	1,610,000	1,605,000	1,692,000	1,830,000
C. Tubes	28,875	28,875	26,250	26,250	26,250	26,250	49,875
D. Steam jet air equipment	350,000	353,000	355,000	359,000	366,000	381,000	405,000
E. Erection	NONE						114,000
F. Deaeration - hot well of cond.							
G. L-P heaters in exhaust stack	50,000	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System							
A. Structures							
1. Crib house							
a. Substructure							
b. Superstructure							
c. Steel							
d. Miscellaneous	823,000	826,000	828,000	832,000	841,000	861,000	894,000
2. Dredging							
3. Intake flume or forebay							
4. Seal well							
5. Discharge flume							
6. Outfall							
B. Crib house equipment (erected)							
1. Traveling screens							
2. Screen wash pumps	178,000	179,000	180,000	182,000	185,000	194,000	208,000
3. Screen wash piping							
4. Chlorination equipment							
5. Chlorine handling							
C. Circulating water piping	1,105,000	1,109,000	1,112,000	1,117,000	1,130,000	1,158,000	1,204,000
D. Circulating water pumps							
1. Pumps	515,000	519,000	522,000	527,000	540,000	567,000	612,000
2. Motors	329,000	330,000	331,000	333,000	338,000	348,000	365,000
3. Erection	39,100	39,200	39,300	39,500	40,000	41,000	42,700
4. Feed Water Heaters							
A. L-P closed heaters	297,000	298,500	185,000	189,000	94,000	97,000	-------
B. H-P closed heaters	570,500	346,500	322,000	141,500	107,500	-------	147,000
C. Deaerating heater	256,400	249,600	244,400	240,400	238,000	237,000	-------
D. Insulation							
1. Closed heaters	26,000	18,500	13,900	7,700	2,400	-------	-------
2. Deaerators	19,000	18,400	18,000	17,700	17,500	17,400	-------
E. Structural work							
1. For closed heaters	42,000	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	56,400	54,200	52,800	51,800	51,000	50,600	-------
5. Boiler Feed Pumps							
A. Pumps and base plates	411,000	394,000	375,000	367,000	357,000	354,000	349,000
B. Fluid drive	241,000	241,000	241,000	241,000	241,000	192,000	241,000
C. Motors	567,000	530,000	508,000	489,000	470,000	462,000	466,000
D. Erection	43,800	42,400	40,800	40,200	39,200	39,000	38,600
E. Foundation for pumps	9,000	8,600	8,200	8,000	7,800	7,700	7,600
6. Condensate Pumps							
A. Pumps	104,000	103,000	68,000	69,000	66,000	70,000	-------
B. Motors	61,400	61,200	39,200	40,000	30,900	32,600	-------
C. Erection	11,700	11,700	11,400	11,500	11,200	11,600	-------
7. Piping and Insulation							
A. Extraction steam	716,100	612,600	536,100	443,700	353,100	251,700	147,600
B. Heater vents and drains							
C. Feed water piping	390,000	378,000	319,000	281,000	281,000	174,000	359,000
D. Condensate piping							
1. From condensate pumps through L-P heaters.	176,200	176,200	149,500	149,500	136,700	136,700	-------
2. To deaerator and B.F. pump suction							
E. Main steam	149,500	149,500	149,500	149,500	149,500	149,500	149,500
8. Demineralizing Equipment and Condensate Storage Tanks	199,000	190,000	184,000	180,000	176,000	175,000	176,000
9. Electrical	316,800	309,700	302,600	299,100	295,300	296,300	244,000
10. Turbine Room Building	- - - -	- - - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	36,388,775	35,994,175	35,592,950	35,282,850	35,071,850	34,992,350	35,214,875
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	48,262,775	47,868,175	47,466,950	47,156,850	46,945,850	46,866,350	47,088,875
11. Piping In Containment Vessel	1,337,000	1,191,000	1,189,000	1,180,000	1,180,000	1,170,000	1,182,000
Grand Total	49,599,775	49,059,175	48,655,950	48,336,850	48,125,850	48,036,350	48,270,875

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 567 F THROTTLE STEAM
(SATURATED STEAM)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	25,000,000	25,000,000	25,000,000	25,000,000	25,000,000	25,000,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,205,000	2,235,000	2,250,000	2,280,000	2,380,000	2,550,000
B. Dry vacuum pumps						
C. Tubes	2,052,000	2,064,000	2,070,000	2,130,000	2,214,000	2,424,000
D. Steam jet air equipment	28,875	28,875	28,875	26,250	26,250	49,875
E. Erection	444,000	447,000	453,000	461,000	474,000	513,000
F. Deaeration - hot well of cond.	NONE	←				→ 152,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	948,000	952,000	957,000	967,000	990,000	1,042,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	232,000	234,000	236,000	240,000	250,000	272,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,281,000	1,286,000	1,294,000	1,307,000	1,339,000	1,411,000
D. Circulating water pumps						
1. Pumps	686,000	692,000	699,000	712,000	743,000	813,000
2. Motors	392,000	395,000	397,000	402,000	413,000	440,000
3. Erection	45,400	45,600	45,800	46,300	47,500	50,100
4. Feed Water Heaters						
A. L-P closed heaters	486,500	290,000	296,500	143,000	151,000	-------
B. H-P closed heaters	538,000	503,500	240,500	204,000	-------	207,000
C. Deaerating heater	397,500	384,000	371,400	361,500	354,000	-------
D. Insulation						
1. Closed heaters	31,400	24,000	14,000	6,000	-------	-------
2. Deaerators	29,600	28,400	27,300	26,600	26,100	-------
E. Structural work						
1. For closed heaters	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	88,600	84,100	81,000	77,900	76,200	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	543,000	492,000	467,000	437,000	423,000	408,000
B. Fluid drive	333,000	333,000	241,000	241,000	241,000	241,000
C. Motors	658,000	630,000	582,000	548,000	521,000	520,000
D. Erection	52,300	48,100	46,000	43,400	42,400	41,100
E. Foundation for pumps	12,700	11,600	11,000	10,300	10,000	9,700
6. Condensate Pumps						
A. Pumps	171,000	110,000	114,000	80,000	88,000	-------
B. Motors	155,900	59,400	61,400	36,900	40,400	-------
C. Erection	14,500	13,300	13,600	12,500	13,200	-------
7. Piping and Insulation						
A. Extraction steam	603,000	536,400	441,000	381,600	243,000	143,700
B. Heater vents and drains						
C. Feed water piping	441,000	441,000	265,000	265,000	160,400	311,000
D. Condensate piping	290,200	203,500	203,500	185,800	185,800	-------
1. From condensate pumps through L-P heaters.	290,200	203,500	203,500	185,800	185,800	-------
2. To deaerator and B.F. pump suction						
E. Main steam	47,500	47,500	42,700	42,700	42,700	42,700
8. Demineralizing Equipment and Condensate Storage Tanks	284,000	267,000	254,000	242,000	234,000	233,000
9. Electrical	364,600	344,600	336,200	326,800	325,000	272,400
10. Turbine Room Building	-------	-------	------	------	-------	----
Total Items 1-10	39,983,075	39,346,875	38,645,275	38,324,050	38,123,950	38,216,575
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	51,857,075	51,220,875	50,519,275	50,198,050	49,997,950	50,090,575
11. Piping In Containment Vessel	1,090,000	956,000	879,000	821,000	785,000	785,000
Grand Total	52,947,075	52,176,875	51,398,275	51,019,050	50,782,950	50,875,575

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 667 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,670,000	2,700,000	2,715,000	2,790,000	2,880,000	3,150,000
B. Dry vacuum pumps						
C. Tubes	2,000,000	2,004,000	2,010,000	2,025,000	2,064,000	2,250,000
D. Steam jet air equipment	28,875	28,875	28,875	26,250	26,250	49,875
E. Erection	423,000	426,000	428,000	435,000	447,000	480,000
F. Deaeration - hot well of cond.	NONE				→	142,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	918,000	922,000	926,000	934,000	952,000	999,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	218,000	221,000	223,000	226,000	234,000	254,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,237,000	1,244,000	1,250,000	1,260,000	1,286,000	1,352,000
D. Circulating water pumps						
1. Pumps	645,000	650,000	655,000	666,000	692,000	755,000
2. Motors	377,000	379,000	381,000	385,000	395,000	418,000
3. Erection	43,800	44,000	44,200	44,600	45,500	48,000
4. Feed Water Heaters						
A. L-P closed heaters	452,500	271,000	274,500	131,500	137,500	-------
B. H-P closed heaters	476,000	448,000	216,000	185,000	-------	189,000
C. Deaerating heater	369,000	357,000	347,400	339,600	267,400	-------
D. Insulation						
1. Closed heaters	27,700	21,500	12,600	5,300	-------	-------
2. Deaerators	27,200	26,300	25,500	25,000	19,900	-------
E. Structural work						
1. For closed heaters	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	80,000	76,500	74,000	72,000	59,900	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	478,000	439,000	420,000	396,000	381,000	373,000
B. Fluid drive	333,000	333,000	333,000	241,000	241,000	241,000
C. Motors	657,000	627,000	587,000	555,000	532,000	526,000
D. Erection	46,900	43,600	42,100	40,000	39,200	38,200
E. Foundation for pumps	11,200	10,400	10,000	9,400	9,200	8,900
6. Condensate Pumps						
A. Pumps	163,000	109,000	112,000	83,000	88,000	-------
B. Motors	108,700	59,200	60,100	38,400	40,300	-------
C. Erection	14,000	13,300	13,400	12,800	13,200	-------
7. Piping and Insulation						
A. Extraction steam	603,000	536,400	441,000	381,600	243,000	143,700
B. Heater vents and drains						
C. Feed water piping	435,000	435,000	277,000	277,000	173,200	335,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	196,000	166,000	166,000	165,500	165,500	-------
2. To deaerator and B.F. pump suction						
E. Main steam	54,500	54,500	30,000	30,000	30,000	30,000
8. Demineralizing Equipment and Condensate Storage Tanks	250,000	237,500	227,000	218,000	213,000	212,000
9. Electrical	353,400	340.200	333,200	324,400	322,000	268,800
10. Turbine Room Building	-------	-------	-------	-------	-------	-------
Total Items 1-10	38,923,275	38,439,275	37,868,375	37,502,850	37,167,050	37,433,975
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	50,797,275	50,313,275	49,742,375	49,376,850	49,041,050	49,307,975
11. Piping In Containment Vessel	724,000	724,000	747,000	747,000	744,000	746,000
Grand Total	51,521,275	51,037,275	50,489,375	50,123,850	49,785,050	50,053,975

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 767 F THROTTLE STEAM
(200 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,505,000	2,535,000	2,550,000	2,580,000	2,700,000	2,940,000
B. Dry vacuum pumps	1,806,000	1,830,000	1,845,000	1,875,000	1,950,000	2,115,000
C. Tubes	28,875	28,875	28,875	26,250	26,250	49,875
D. Steam jet air equipment	402,000	405,000	409,000	414,000	426,000	459,000
E. Erection	NONE					132,000
F. Deaeration - hot well of cond.						
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	890,000	894,000	898,000	905,000	923,000	965,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	207,000	209,000	210,000	214,000	211,000	239,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,198,000	1,204,000	1,209,000	1,220,000	1,245,000	1,303,000
D. Circulating water pumps	606,000	612,000	617,000	628,000	652,000	709,000
1. Pumps	362,000	365,000	367,000	370,000	379,000	400,000
2. Motors	42,400	42,600	42,800	43,200	44,100	46,200
3. Erection						
4. Feed Water Heaters						
A. L-P closed heaters	416,000	251,000	254,500	123,000	128,500	--------
B. H-P closed heaters	437,000	413,000	200,000	172,000	--------	177,000
C. Deaerating heater	349,500	339,000	265,000	260,000	256,400	--------
D. Insulation						
1. Closed heaters	25,200	19,200	11,500	4,800	--------	--------
2. Deaerators	25,700	25,000	19,700	19,200	19,000	--------
E. Structural work						
1. For closed heaters	31,500	21,000	10,500	10,500	--------	--------
2. For deaerators	74,700	72,000	59,000	57,300	56,400	--------
5. Boiler Feed Pumps						
A. Pumps and base plates	438,000	405,000	389,000	368,000	361,000	350,000
B. Fluid drive	333,000	241,000	241,000	241,000	241,000	241,000
C. Motors	589,000	566,000	532,000	505,000	487,000	486,000
D. Erection	43,500	40,800	39,500	37,800	37,200	36,300
E. Foundation for pumps	10,300	9,600	9,300	8,800	8,600	8,400
6. Condensate Pumps						
A. Pumps	148,000	100,000	101,000	77,000	81,000	--------
B. Motors	98,900	54,600	55,300	35,800	37,500	--------
C. Erection	13,200	12,700	12,700	12,300	12,600	--------
7. Piping and Insulation						
A. Extraction steam	603,000	532,500	441,000	381,600	243,000	143,700
B. Heater vents and drains	435,000	350,500	277,000	277,000	173,200	335,500
C. Feed water piping						
D. Condensate piping						
1. From condensate pumps through L-P heaters.	196,000	166,000	166,000	166,500	166,500	--------
2. To deaerator and B.F. pump suction						
E. Main steam	103,000	103,000	92,200	85,200	85,200	85,200
8. Demineralizing Equipment and Condensate Storage Tanks	229,000	218,000	210,000	203,000	198,000	197,500
9. Electrical	335,100	324,100	317,900	310,600	309,700	256,100
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	37,376,875	36,784,475	36,275,775	36,001,850	35,828,150	36,044,775
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	49,250,875	48,658,475	48,149,775	47,875,850	47,702,150	47,918,775
11. Piping In Containment Vessel	969,000	1,066,000	880,000	871,000	864,000	872,000
Grand Total	50,219,875	49,724,475	49,029,775	48,746,850	48,566,150	48,790,775

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 867 F THROTTLE STEAM
(300 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,340,000	2,370,000	2,400,000	2,430,000	2,535,000	2,805,000
B. Dry vacuum pumps						
C. Tubes	1,692,000	1,704,000	1,710,000	1,731,000	1,830,000	1,965,000
D. Steam jet air equipment	28,875	28,875	28,875	26,250	26,250	49,875
E. Erection	381,000	383,000	384,000	390,000	405,000	430,000
F. Deaeration - hot well of cond.	NONE	←			→	126,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	861,000	865,000	868,000	875,000	894,000	929,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	195,000	196,000	197,000	200,000	209,000	224,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,158,000	1,163,000	1,167,000	1,178,000	1,205,000	1,254,000
D. Circulating water pumps						
1. Pumps	567,000	571,000	575,000	586,000	612,000	660,000
2. Motors	348,000	350,000	351,000	355,000	365,000	382,000
3. Erection	41,000	41,200	41,300	41,700	42,700	44,400
4. Feed Water Heaters						
A. L-P closed heaters	386,500	235,000	238,000	115,000	120,500	-------
B. H-P closed heaters	408,000	386,000	187,500	162,000	-------	168,000
C. Deaerating heater	267,000	260,000	254,000	249,800	247,000	-------
D. Insulation						
1. Closed heaters	23,100	18,700	10,700	4,500	-------	-------
2. Deaerators	19,900	19,600	18,800	18,400	18,200	-------
E. Structural work						
1. For closed heaters	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	59,800	57,600	55,800	54,200	53,500	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	407,000	378,000	365,000	348,000	342,000	333,000
B. Fluid drive	241,000	241,000	241,000	241,000	192,000	192,000
C. Motors	534,000	516,000	487,000	465,000	449,000	451,000
D. Erection	40,900	38,500	37,500	36,000	35,500	34,800
E. Foundation for pumps	9,700	9,000	8,700	8,400	8,200	8,000
6. Condensate Pumps						
A. Pumps	135,000	92,000	94,000	72,000	75,000	-------
B. Motors	9,900	50,600	51,200	33,500	35,100	-------
C. Erection	12,600	12,100	12,200	11,800	12,100	-------
7. Piping and Insulation						
A. Extraction steam	601,800	515,700	441,000	334,500	228,900	143,700
B. Heater vents and drains						
C. Feed water piping	350,500	350,500	277,000	277,000	173,200	335,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	196,000	166,000	166,000	154,500	150,000	-------
2. To deaerator and B.F. pump suction						
E. Main steam	118,000	118,000	118,000	118,000	118,000	118,000
8. Demineralizing Equipment and Condensate Storage Tanks	212,000	203,000	195,000	190,000	186,000	186,000
9. Electrical	320,400	310,200	305,100	298,800	298,500	245,400
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	36,572,475	36,165,575	35,791,175	35,485,850	35,336,650	35,554,675
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	48,446,475	48,039,575	47,665,175	47,359,850	47,210,650	47,428,675
11. Piping In Containment Vessel	1,017,000	1,017,000	1,008,000	1,008,000	1,000,000	1,008,000
Grand Total	49,463,475	49,056,575	48,673,175	48,367,850	48,210,650	48,436,675

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1200 PSIA, 967 F THROTTLE STEAM
(400 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,205,000	2,235,000	2,250,000	2,280,000	2,380,000	2,550,000
B. Dry vacuum pumps						
C. Tubes	1,584,000	1,605,000	1,620,000	1,650,000	1,707,000	1,845,000
D. Steam jet air equipment	28,875	28,875	28,875	26,250	26,250	26,250
E. Erection	363,000	366,000	369,000	372,000	413,000	409,000
F. Deaeration - hot well of cond.	NONE					115,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	835,000	840,000	844,000	850,000	864,000	898,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	183,000	185,000	187,000	189,000	195,000	210,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,121,000	1,128,000	1,131,000	1,142,000	1,162,000	1,209,000
D. Circulating water pumps						
1. Pumps	531,000	538,000	543,000	551,000	570,000	617,000
2. Motors	335,000	337,000	338,000	342,000	349,000	366,000
3. Erection	39,600	39,800	40,000	40,400	41,100	42,800
4. Feed Water Heaters						
A. L-P closed heaters	355,000	219,000	232,000	109,000	113,000	-------
B. H-P closed heaters	384,500	364,000	177,000	154,000	-------	160,000
C. Deaerating heater	257,000	250,400	247,600	240,400	238,400	-------
D. Insulation						
1. Closed heaters	21,300	16,400	10,000	4,200	-------	-------
2. Deaerators	19,000	18,400	18,000	17,700	17,600	-------
E. Structural work						
1. For closed heaters	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	56,400	54,500	53,000	51,800	51,200	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	382,000	356,000	349,000	330,000	326,000	318,000
B. Fluid drive	241,000	241,000	192,000	192,000	192,000	192,000
C. Motors	492,000	476,000	451,000	432,000	421,000	422,000
D. Erection	38,900	36,800	35,900	34,600	34,200	33,500
E. Foundation for pumps	9,100	8,500	8,300	8,000	7,900	7,700
6. Condensate Pumps						
A. Pumps	125,000	86,000	87,000	68,000	70,000	-------
B. Motors	84,200	47,300	47,900	31,500	32,900	-------
C. Erection	12,000	11,600	11,700	11,300	11,600	-------
7. Piping and Insulation						
A. Extraction steam	595,200	514,200	441,000	334,500	228,900	143,700
B. Heater vents and drains						
C. Feed water piping	350,500	350,500	227,000	277,000	173,200	335,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	183,500	154,000	150,000	150,000	150,000	-------
2. To deaerator and B.F. pump suction						
E. Main steam	138,000	138,000	138,000	138,000	138,000	138,000
8. Demineralizing Equipment and Condensate Storage Tanks	198,000	190,000	184,000	179,000	176,000	177,000
9. Electrical	307,100	298,800	294,800	289,000	288,900	235,700
10. Turbine Room Building	---------	--------	--------	--------	--------	--------
Total Items 1-10	36,161,675	35,810,075	35,421,575	35,135,150	35,008,150	35,081,150
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	48,035,675	47,684,075	47,295,575	47,009,150	46,882,150	46,955,150
11. Piping In Containment Vessel	1,066,000	1,066,000	1,058,000	1,058,000	1,049,000	1,061,000
Grand Total	49,101,675	48,750,075	48,353,575	48,067,150	47,931,150	48,016,150

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 545 F THROTTLE STEAM
(SATURATED STEAM)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	25,000,000	25,000,000	25,000,000	25,000,000	25,000,000	25,000,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,985,000	3,000,000	3,030,000	3,090,000	3,210,000	3,480,000
B. Dry vacuum pumps	2,145,000	2,160,000	2,175,000	2,205,000	2,310,000	2,505,000
C. Tubes	28,875	28,875	28,875	26,250	26,250	47,250
D. Steam jet air equipment	462,000	465,000	470,000	477,000	495,000	528,000
E. Erection	NONE					157,000
F. Deaeration - hot well of cond.	50,000	50,000	50,000	25,000	25,000	25,000
G. L-P heaters in exhaust stack						
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	972,000	975,000	982,000	993,000	1,013,000	1,060,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	242,000	244,000	246,000	251,000	260,000	280,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,314,000	1,319,000	1,328,000	1,343,000	1,372,000	1,437,000
D. Circulating water pumps						
1. Pumps	719,000	722,000	732,000	746,000	775,000	839,000
2. Motors	404,000	406,000	409,000	415,000	425,000	449,000
3. Erection	46,500	46,700	47,000	47,100	47,600	51,000
4. Feed Water Heaters						
A. L-P closed heaters	471,000	298,000	303,500	147,000	154,000	-------
B. H-P closed heaters	504,500	452,500	204,000	176,500	-------	204,500
C. Deaerating heater	395,400	382,500	369,600	361,800	355,800	-------
D. Insulation						
1. Closed heaters	30,000	22,400	12,800	5,100	-------	-------
2. Deaerators	29,400	28,200	27,200	26,600	26,200	-------
E. Structural Work						
1. For closed heaters	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	87,700	83,600	80,100	78,000	76,500	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	328,000	303,000	288,000	274,000	267,000	258,000
B. Fluid drive	241,000	241,000	241,000	241,000	192,000	192,000
C. Motors	558,000	534,000	491,000	472,000	452,000	454,000
D. Erection	45,900	42,500	40,500	38,600	37,700	36,600
E. Foundation for pumps	12,400	11,500	10,900	10,300	10,100	9,700
6. Condensate Pumps						
A. Pumps	187,00	125,000	126,000	96,000	101,000	-------
B. Motors	107,400	63,200	62,600	42,900	45,300	-------
C. Erection	15,300	14,400	14,500	13,800	14,300	-------
7. Piping and Insulation						
A. Extraction steam	578,100	511,200	416,100	381,600	243,000	129,600
B. Heater vents and drains						
C. Feed water piping	356,500	356,500	225,500	225,500	143,100	265,000
D. Condensate piping						
1. From condensate pumps through L-P heaters.	290,200	203,500	202,700	185,800	185,800	-------
2. To deaerator and B.F. pump suction						
E. Main steam	58,700	56,500	51,700	47,500	47,500	47,500
8. Demineralizing Equipment and Condensate Storage Tanks	281,000	265,000	251,000	243,000	236,000	234,000
9. Electrical	340,600	329,500	322,100	316,000	314,700	261,400
10. Turbine Room Building	-------	-------	-------	-------	-------	-------
Total Items 1-10	40,362,975	39,806,575	39,294,175	39,056,850	38,905,850	38,995,550
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	52,236,975	51,680,575	51,168,175	50,930,850	50,779,850	50,869,550
11. Piping In Containment Vessel	844,000	737,000	681,000	671,000	661,000	671,000
Grand Total	53,080,975	52,417,575	51,849,175	51,601,850	51,440,850	51,540,550

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 645 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000	24,100,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories B. Dry vacuum pumps	2,790,000	2,795,000	2,820,000	2,865,000	2,990,000	3,240,000
C. Tubes	2,010,000	2,025,000	2,040,000	2,070,000	2,146,000	2,340,000
D. Steam jet air equipment	28,875	28,875	28,875	26,250	26,250	47,250
E. Erection	438,000	440,000	443,000	450,000	462,000	498,000
F. Deaeration - hot well of cond.	NONE	←			→	146,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures 1. Crib house a. Substructure b. Superstructure c. Steel d. Miscellaneous 2. Dredging 3. Intake flume or forebay 4. Seal well 5. Discharge flume 6. Outfall	939,000	942,000	946,000	954,000	973,000	1,020,000
B. Crib house equipment (erected) 1. Traveling screens 2. Screen wash pumps 3. Screen wash piping 4. Chlorination equipment 5. Chlorine handling	228,000	229,000	231,000	234,000	242,000	263,000
C. Circulating water piping	1,267,000	1,271,000	1,273,000	1,288,000	1,315,000	1,381,000
D. Circulating water pumps						
1. Pumps	673,000	678,000	683,000	694,000	720,000	784,000
2. Motors	388,000	389,000	391,000	395,000	405,000	428,000
3. Erection	44,800	45,100	45,200	45,700	46,600	49,000
4. Feed Water Heaters						
A. L-P closed heaters	438,000	286,500	272,500	135,000	141,500	-------
B. H-P closed heaters	450,000	407,000	186,000	162,000	-------	188,000
C. Deaerating heater	369,000	357,600	348,000	342,600	338,400	-------
D. Insulation						
1. Closed heaters	26,700	20,400	11,600	4,600	-------	-------
2. Deaerators	27,200	26,300	25,600	25,200	24,900	-------
E. Structural Work						
1. For Closed Heaters	31,500	21,000	10,500	10,500	-------	-------
2. For Deaerators	79,900	76,800	74,100	72,500	71,700	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	294,000	275,000	264,000	253,000	248,000	240,000
B. Fluid drive	241,000	241,000	241,000	241,000	241,000	241,000
C. Motors	577,000	551,000	516,000	496,000	477,000	476,000
D. Erection	41,300	38,700	37,300	35,700	35,100	34,100
E. Foundation for pumps	11,000	10,400	10,000	9,500	9,300	9,000
6 Condensate Pumps						
A. Pumps	166,000	117,000	113,000	86,000	91,000	-------
B. Motors	95,600	59,500	57,800	39,500	41,400	-------
C. Erection	14,200	13,800	13,600	13,000	13,400	-------
7. Piping and Insulation						
A. Extraction steam B. Heater vents and drains	578,100	511,200	416,100	381,600	243,000	129,600
C. Feed water piping	364,500	364,500	277,000	236,800	173,200	283,500
D. Condensate piping 1. From condensate pumps through L-P heaters. 2. To deaerator and B.F. pump suction	196,000	166,000	166,000	166,500	166,500	-------
E. Main steam	40,200	37,500	37,500	37,500	37,500	37,500
8. Demineralizing Equipment and Condensate Storage Tanks	250,000	237,500	228,000	222,000	216,000	214,000
9. Electrical	338,300	328,900	321,000	315,200	314,300	261,100
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	38,631,275	38,185,575	37,722,675	37,477,650	37,379,050	37,480,050
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	50,505,275	50,059,575	49,596,675	49,351,650	49,253,050	49,354,050
11. Piping In Containment Vessel	720,000	689,000	779,000	779,000	776,000	642,000
Grand Total	51,225,275	50,748,575	50,375,675	50,130,650	50,029,050	49,996,050

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 745 F THROTTLE STEAM
(200 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000	23,300,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,595,000	2,610,000	2,640,000	2,700,000	2,790,000	3,030,000
B. Dry vacuum pumps						
C. Tubes	1,875,000	1,884,000	1,905,000	1,935,000	2,010,000	2,175,000
D. Steam jet air equipment	28,875	28,875	28,875	26,250	26,250	47,250
E. Erection	414,000	415,000	417,000	426,000	438,000	471,000
F. Deaeration - hot well of cond.	NONE					136,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	905,000	909,000	912,000	922,000	939,000	981,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	213,000	215,000	217,000	211,000	228,000	246,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,220,000	1,225,000	1,230,000	1,244,000	1,267,000	1,326,000
D. Circulating water pumps						
1. Pumps	627,000	632,000	637,000	651,000	673,000	730,000
2. Motors	371,000	372,000	374,000	379,000	388,000	408,000
3. Erection	43,200	43,400	43,600	44,100	44,800	47,000
4. Feed Water Heaters						
A. L-P closed heaters	402,000	255,500	258,500	126,000	132,000	-------
B. H-P closed heaters	414,000	376,000	172,500	152,000	-------	176,500
C. Deaerating heater	349,800	340,500	266,000	262,000	259,600	-------
D. Insulation						
1. Closed heaters	24,300	18,200	10,700	4,200	-------	-------
2. Deaerators	25,800	25,000	19,800	19,400	19,200	-------
E. Structural Work						
1. For Closed Heaters	31,500	21,000	10,500	10,500	-------	-------
2. For Deaerators	75,000	72,000	59,200	58,100	57,200	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	272,000	255,000	247,000	237,000	234,000	228,000
B. Fluid drive	241,000	241,000	241,000	192,000	192,000	192,000
C. Motors	518,000	498,000	469,000	452,000	438,000	439,000
D. Erection	38,300	36,100	35,000	33,700	33,200	32,400
E. Foundation for pumps	10,300	9,600	9,300	8,900	8,800	8,600
6. Condensate Pumps						
A. Pumps	150,000	102,000	103,000	79,000	83,000	-------
B. Motors	87,000	52,600	53,200	36,800	38,500	-------
C. Erection	13,300	12,800	12,900	12,500	12,800	-------
7. Piping and Insulation						
A. Extraction steam						
B. Heater vents and drains	577,800	485,400	414,600	381,300	243,000	129,600
C. Feed water piping	364,500	364,500	277,000	236,800	173,200	283,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	196,000	166,000	166,000	166,500	166,500	-------
2. To deaerator and B.F. pump suction						
E. Main steam	40,200	37,500	37,500	37,500	37,500	37,500
8. Demineralizing Equipment and Condensate Storage Tanks	230,000	218,000	211,000	205,000	202,000	201,000
9. Electrical	321,200	312,200	307,400	302,400	302,200	249,100
10. Turbine Room Building	-------	-------	-------	-------	-------	-------
Total Items 1-10	37,069,075	36,628,175	36,180,575	35,921,950	35,806,750	35,944,450
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	48,943,075	48,502,175	48,054,575	47,795,950	47,680,750	47,818,450
11. Piping In Containment Vessel	788,000	744,000	836,000	836,000	832,000	700,000
Grand Total	49,731,075	49,246,175	48,890,575	48,631,950	48,512,750	48,518,450

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 845 F THROTTLE STEAM
(300 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000	23,400,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,410,000	2,430,000	2,460,000	2,520,000	2,610,000	2,795,000
B. Dry vacuum pumps	1,755,000	1,770,000	1,785,000	1,815,000	1,875,000	1,922,000
C. Tubes	28,875	28,875	28,875	26,250	26,250	47,250
D. Steam jet air equipment	396,000	399,000	400,000	405,000	414,000	440,000
E. Erection	NONE					126,000
F. Deaeration - hot well of cond.						
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	876,000	879,000	884,000	892,000	907,000	942,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	201,000	202,000	204,000	208,000	214,000	229,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,179,000	1,184,000	1,190,000	1,201,000	1,222,000	1,272,000
D. Circulating water pumps						
1. Pumps	587,000	592,000	598,000	608,000	629,000	677,000
2. Motors	351,000	357,000	359,000	363,000	371,000	389,000
3. Erection	41,800	41,900	42,100	42,500	43,300	45,000
4. Feed Water Heaters						
A. L-P closed heaters	374,000	239,500	242,000	118,000	123,000	-------
B. H-P closed heaters	386,500	351,500	162,500	143,500	-------	167,500
C. Deaerating heater	268,000	261,000	256,000	252,000	250,000	-------
D. Insulation						
1. Closed heaters	22,500	16,800	9,900	3,900	-------	-------
2. Deaerators	19,900	19,400	18,900	18,600	18,400	-------
E. Structural Work						
1. For Closed Heaters	31,500	21,000	10,500	10,500	-------	-------
2. For Deaerators	60,000	57,700	56,000	55,000	54,400	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	255,000	240,000	233,000	226,000	223,000	217,000
B. Fluid drive	241,000	192,000	192,000	192,000	192,000	192,000
C. Motors	474,000	456,000	432,000	417,000	406,000	410,000
D. Erection	36,100	34,100	33,200	32,000	31,700	31,000
E. Foundation for pumps	9,600	9,000	8,800	8,500	8,300	8,100
6. Condensate Pumps						
A. Pumps	137,000	95,000	96,000	74,000	77,000	-------
B. Motors	80,200	48,900	49,500	34,400	35,900	-------
C. Erection	12,700	12,200	12,300	12,000	12,300	-------
7. Piping and Insulation						
A. Extraction steam	562,200	483,900	406,200	367,500	241,500	129,600
B. Heater vents and drains						
C. Feed water piping	350,500	350,500	277,000	236,800	173,200	283,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	196,000	166,000	166,000	154,500	154,500	-------
2. To deaerator and B.F. pump suction						
E. Main steam	110,700	110,700	103,000	103,000	103,000	103,000
8. Demineralizing Equipment and Condensate Storage Tanks	213,000	204,000	197,000	193,000	190,000	190,000
9. Electrical	307,700	299,900	296,000	291,600	291,500	238,400
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	36,468,775	36,047,875	35,703,775	35,494,550	35,367,250	35,324,350
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	48,342,775	47,921,875	47,577,775	47,368,550	47,241,250	47,198,350
11. Piping In Containment Vessel	1,075,000	976,000	1,058,000	1,057,000	1,050,000	922,000
Grand Total	49,417,775	48,897,875	48,635,775	48,425,550	48,291,250	48,120,350

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
1000 PSIA, 945 F THROTTLE STEAM
(400 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000	23,560,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,260,000	2,280,000	2,310,000	2,370,000	2,410,000	2,610,000
B. Dry vacuum pumps						
C. Tubes	1,650,000	1,655,000	1,665,000	1,695,000	1,755,000	1,875,000
D. Steam jet air equipment	28,875	28,875	28,875	26,250	26,250	26,250
E. Erection	372,000	375,000	378,000	384,000	396,000	414,000
F. Deaeration - hot well of cond.	NONE					117,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	849,000	851,000	855,000	863,000	876,000	908,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	189,000	190,000	192,000	195,000	201,000	214,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,141,000	1,144,000	1,150,000	1,161,000	1,179,000	1,224,000
D. Circulating water pumps						
1. Pumps	550,000	553,000	558,000	570,000	587,000	630,000
2. Motors	342,000	343,000	345,000	349,000	351,000	372,000
3. Erection	40,400	40,500	40,700	41,100	41,700	43,300
4. Feed Water Heaters						
A. L-P closed heaters	346,500	224,500	227,000	112,000	116,000	-------
B. H-P closed heaters	363,000	331,500	154,000	137,000	-------	159,500
C. Deaerating heater	258,000	251,000	246,000	243,000	241,200	-------
D. Insulation						
1. Closed heaters	20,700	15,700	9,300	3,700	-------	-------
2. Deaerators	19,000	18,500	18,100	17,900	17,800	-------
E. Structural work						
1. For closed heaters	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	56,800	54,800	53,200	52,500	51,900	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	241,000	228,000	222,000	215,000	213,000	208,000
B. Fluid drive	192,000	192,000	192,000	192,000	192,000	192,000
C. Motors	436,000	422,000	401,000	389,000	379,000	383,000
D. Erection	34,200	32,400	31,600	30,600	30,400	29,800
E. Foundation for pumps	9,100	8,600	8,300	8,100	8,000	7,800
6. Condensate Pumps						
A. Pumps	127,000	87,000	88,000	69,000	72,000	-------
B. Motors	74,400	45,600	46,100	32,300	33,700	-------
C. Erection	12,100	11,700	11,800	11,500	11,800	-------
7. Piping and Insulation						
A. Extraction steam	562,200	483,900	406,200	367,500	241,500	129,600
B. Heater vents and drains						
C. Feed water piping	350,500	350,500	277,000	236,800	173,200	283,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	183,500	154,000	154,000	150,000	150,000	-------
2. To deaerator and B.F. pump suction						
E. Main steam	133,500	133,500	133,500	133,500	133,500	127,000
8. Demineralizing Equipment and Condensate Storage Tanks	199,000	192,000	185,000	183,000	180,000	181,000
9. Electrical	296,300	289,500	285,800	282,600	281,900	229,200
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	36,023,575	35,663,075	35,337,975	35,161,850	34,979,850	34,993,950
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	47,897,575	47,537,075	47,211,975	47,035,850	46,853,850	46,867,950
11. Piping In Containment Vessel	1,171,000	1,074,000	1,158,000	1,152,000	1,142,000	1,033,000
Grand Total	49,068,575	48,611,075	48,369,975	48,187,850	47,995,850	47,900,950

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
800 PSIA, 518 F THROTTLE STEAM
(SATURATED STEAM)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	24,000,000	24,000,000	24,000,000	24,000,000	24,000,000	24,000,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	3,120,000	3,165,000	3,210,000	3,300,000	3,420,000	3,720,000
B. Dry vacuum pumps						
C. Tubes	2,244,000	2,274,000	2,310,000	2,370,000	2,460,000	2,670,000
D. Steam jet air equipment	28,875	26,250	26,250	26,250	26,250	42,000
E. Erection	480,000	486,000	495,000	503,000	520,000	560,000
F. Deaeration - hot well of cond.	NONE					167,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	997,000	1,005,000	1,013,000	1,027,000	1,050,000	1,101,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	253,000	256,000	260,000	266,000	276,000	298,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,349,000	1,361,000	1,372,000	1,391,000	1,423,000	1,496,000
D. Circulating water pumps						
1. Pumps	753,000	764,000	775,000	794,000	825,000	895,000
2. Motors	417,000	421,000	425,000	432,000	440,000	470,000
3. Erection	47,800	48,300	48,600	49,300	50,500	53,100
4. Feed Water Heaters						
A. L-P closed heaters	429,000	284,000	290,500	134,000	138,000	-------
B. H-P closed heaters	446,000	406,500	193,000	120,500	-------	174,500
C. Deaerating heater	393,000	381,000	372,000	364,800	360,000	-------
D. Insulation						
1. Closed heaters	28,000	21,700	13,100	3,400	-------	-------
2. Deaerators	29,100	28,100	27,400	26,800	26,500	-------
E. Structural work						
1. For closed heaters	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	87,200	83,400	80,800	78,800	77,600	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	279,000	258,000	249,000	238,000	234,000	226,000
B. Fluid drive	192,000	192,000	192,000	192,000	192,000	192,000
C. Motors	462,000	450,000	417,000	399,000	384,000	392,000
D. Erection	40,600	37,900	36,600	35,000	34,400	33,400
E. Foundation for pumps	12,200	11,300	10,900	10,500	10,200	9,900
6. Condensate Pumps						
A. Pumps	164,000	106,000	107,000	100,000	106,000	-------
B. Motors	94,700	58,500	59,500	44,700	47,000	-------
C. Erection	15,400	14,600	14,700	14,100	14,600	-------
7. Piping and Insulation						
A. Extraction steam	639,300	559,500	461,100	383,400	324,800	147,900
B. Heater vents and drains						
C. Feed water piping	315,500	315,500	194,400	194,400	133,100	236,200
D. Condensate piping						
1. From condensate pumps through L-P heaters.	222,500	203,500	203,500	185,800	185,800	-------
2. To deaerator and B.F. pump suction						
E. Main steam	59,000	57,500	56,200	54,200	53,700	52,700
8. Demineralizing Equipment and Condensate Storage Tanks	278,000	265,000	254,000	246,000	242,000	239,000
9. Electrical	322,300	314,800	310,200	306,100	306,200	254,600
10. Turbine Room Building	-------	--------	--------	--------	-------	---------
Total Items 1-10	39,324,975	38,971,350	38,583,250	38,370,550	38,430,650	38,500,300
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	51,198,975	50,845,350	50,457,250	50,244,550	50,304,650	50,374,300
11. Piping In Containment Vessel	810,000	730,000	685,000	662,000	658,000	650,000
Grand Total	52,008,975	51,575,350	51,142,250	50,906,550	50,962,650	51,024,300

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
800 PSIA, 618 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	23,370,000	23,370,000	23,370,000	23,370,000	23,370,000	23,370,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,940,000	2,955,000	2,985,000	3,030,000	3,150,000	3,435,000
B. Dry vacuum pumps						
C. Tubes	2,115,000	2,124,000	2,145,000	2,175,000	2,265,000	2,460,000
D. Steam jet air equipment	28,875	26,250	26,250	26,250	26,250	42,000
E. Erection	456,000	459,000	462,000	470,000	486,000	520,000
F. Deaeration - hot well of cond.	NONE	→				154,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	964,000	967,000	971,000	981,000	1,001,000	1,052,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	239,000	240,000	242,000	246,000	255,000	277,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,302,000	1,306,000	1,313,000	1,327,000	1,355,000	1,426,000
D. Circulating water pumps						
1. Pumps	708,000	711,000	717,000	731,000	759,000	828,000
2. Motors	400,000	401,000	403,000	409,000	419,000	445,000
3. Erection	46,200	46,300	46,500	47,000	48,000	50,600
4. Feed Water Heaters						
A. L-P closed heaters	404,000	264,000	266,500	122,000	127,500	-------
B. H-P closed heaters	401,000	368,500	114,500	112,000	-------	160,500
C. Deaerating heater	369,000	358,500	351,000	345,000	342,000	-------
D. Insulation						
1. Closed heaters	25,200	19,500	8,900	3,100	-------	-------
2. Deaerators	27,200	26,400	25,800	25,400	25,100	-------
E. Structural work						
1. For closed heaters	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	80,000	77,100	75,000	73,500	72,500	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	252,000	235,000	227,000	218,000	216,000	210,000
B. Fluid drive	192,000	192,000	192,000	192,000	192,000	192,000
C. Motors	499,000	479,000	450,000	432,000	419,000	424,000
D. Erection	37,000	34,600	33,500	32,300	31,900	31,100
E. Foundation for pumps	11,000	10,300	10,000	9,600	9,500	9,200
6. Condensate Pumps						
A. Pumps	146,000	94,000	95,000	90,000	95,000	-------
B. Motors	85,200	53,200	53,800	40,900	42,800	-------
C. Erection	14,300	13,700	13,800	13,300	13,700	-------
7. Piping and Insulation						
A. Extraction steam	639,300	559,500	461,100	383,400	324,800	147,900
B. Heater vents and drains						
C. Feed water piping	340,000	340,000	211,100	211,100	133,100	260,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	196,000	166,000	166,000	166,500	166,500	-------
2. To deaerator and B.F. pump suction						
E. Main steam	38,200	38,200	35,200	35,200	35,200	35,200
8. Demineralizing Equipment and Condensate Storage Tanks	251,000	238,000	230,000	224,000	221,000	220,000
9. Electrical	324,100	315,400	310,600	306,200	306,300	254,900
10. Turbine Room Building	-------	-------	-------	-------	-------	-------
Total Items 1-10	38,027,075	37,604,450	37,117,050	36,928,250	36,978,150	37,074,900
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	49,901,075	49,478,450	48,991,050	48,802,250	48,852,150	48,948,900
11. Piping In Containment Vessel	914,000	914,000	617,000	617,000	614,000	612,000
Grand Total	50,815,075	50,392,450	49,608,050	49,419,250	49,466,150	49,560,900

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
800 PSIA, 718 F THROTTLE STEAM
(200 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	22,570,000	22,570,000	22,570,000	22,570,000	22,570,000	22,570,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,730,000	2,775,000	2,790,000	2,840,000	2,940,000	3,210,000
B. Dry vacuum pumps						
C. Tubes	1,965,000	1,980,000	2,010,000	2,055,000	2,115,000	2,310,000
D. Steam jet air equipment	28,875	26,250	26,250	26,250	26,250	42,000
E. Erection	429,000	432,000	435,000	443,000	456,000	495,000
F. Deaeration - hot well of cond.	NONE	←				→ 144,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	928,000	931,000	934,000	944,000	964,000	1,012,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	223,000	224,000	226,000	230,000	239,000	259,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,253,000	1,256,000	1,261,000	1,274,000	1,303,000	1,370,000
D. Circulating water pumps						
1. Pumps	659,000	662,000	667,000	680,000	708,000	773,000
2. Motors	382,000	383,000	385,000	390,000	400,000	425,000
3. Erection	44,300	44,500	44,700	45,200	46,200	48,500
4. Feed Water Heaters						
A. L-P closed heaters	373,500	244,500	247,000	114,000	119,000	-------
B. H-P closed heaters	370,500	340,500	163,000	106,000	-------	151,000
C. Deaerating heater	351,000	342,000	268,000	264,000	262,400	-------
D. Insulation						
1. Closed heaters	22,800	17,700	10,900	2,900	-------	-------
2. Deaerators	25,800	25,100	20,000	19,600	19,500	-------
E. Structural Work						
1. For Closed Heaters	31,500	21,000	10,500	10,500	-------	-------
2. For Deaerators	75,000	72,500	60,000	58,700	58,200	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	230,000	219,000	213,000	218,000	203,000	198,000
B. Fluid drive	192,000	192,000	192,000	192,000	192,000	192,000
C. Motors	450,000	433,000	412,000	432,000	386,000	393,000
D. Erection	34,300	32,300	31,500	32,300	30,100	29,500
E. Foundation for pumps	10,200	9,600	9,300	9,600	8,900	8,700
6. Condensate Pumps						
A. Pumps	133,000	86,000	87,000	82,000	87,000	-------
B. Motors	77,900	49,000	49,600	38,000	49,600	-------
C. Erection	13,500	13,000	13,100	12,700	13,100	-------
7. Piping and Insulation						
A. Extraction steam	617,100	530,400	442,200	377,100	267,600	147,900
B. Heater vents and drains						
C. Feed water piping	340,000	264,500	211,100	211,100	133,100	260,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	196,000	166,000	166,000	166,500	166,500	-------
2. To deaerator and B.F. pump suction						
E. Main steam	38,200	38,200	35,200	35,200	35,200	35,200
8. Demineralizing Equipment and Condensate Storage Tanks	231,000	220,000	218,000	208,000	206,000	206,000
9. Electrical	309,100	301,700	297,900	301,500	296,600	243,800
10. Turbine Room Building	-------	-------	-------	-------	-------	-------
Total Items 1-10	36,429,575	35,996,750	35,601,250	35,459,150	35,371,250	35,594,100
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	48,303,575	47,870,750	47,475,250	47,333,150	47,245,250	47,468,100
11. Piping In Containment Vessel	915,000	782,000	617,000	617,000	614,000	612,000
Grand Total	49,218,575	48,652,750	48,092,250	47,950,150	47,859,250	48,080,100

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
800 PSIA, 818 F THROTTLE STEAM
(300 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	22,570,000	22,570,000	22,570,000	22,570,000	22,570,000	22,570,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,550,000	2,565,000	2,610,000	2,655,000	2,790,000	3,000,000
B. Dry vacuum pumps	1,845,000	1,860,000	1,875,000	1,920,000	1,995,000	2,150,000
C. Tubes	28,875	26,250	26,250	26,250	26,250	42,000
D. Steam jet air equipment	408,000	411,000	414,000	423,000	435,000	463,000
E. Erection	NONE	→				135,000
F. Deaeration - hot well of cond.						
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	897,000	902,000	907,000	916,000	933,000	974,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	210,000	212,000	214,000	218,000	225,000	243,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,208,000	1,215,000	1,223,000	1,236,000	1,259,000	1,316,000
D. Circulating water pumps						
1. Pumps	616,000	623,000	630,000	642,000	666,000	721,000
2. Motors	366,000	369,000	371,000	376,000	385,000	405,000
3. Erection	42,800	43,000	43,300	43,800	44,600	46,700
4. Feed Water Heaters						
A. L-P closed heaters	347,500	229,500	233,000	107,000	111,500	-------
B. H-P closed heaters	345,500	319,000	153,000	101,000	-------	143,500
C. Deaerating heater	336,000	262,000	258,000	255,000	253,600	-------
D. Insulation						
1. Closed heaters	21,000	16,500	10,000	2,700	-------	-------
2. Deaerators	24,700	19,400	19,000	18,800	18,700	-------
E. Structural work						
1. For closed heaters	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	72,000	58,100	56,800	55,700	55,400	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	218,000	205,000	200,000	195,000	193,000	189,000
B. Fluid drive	192,000	192,000	192,000	192,000	192,000	192,000
C. Motors	412,000	398,000	378,000	366,000	357,000	367,000
D. Erection	32,200	30,600	29,800	29,000	28,700	28,200
E. Foundation for pumps	9,600	9,000	8,800	8,700	8,500	8,300
6. Condensate Pumps						
A. Pumps	122,000	79,000	80,000	77,000	80,000	-------
B. Motors	71,800	45,700	46,200	35,700	37,300	-------
C. Erection	12,900	12,400	12,500	12,200	12,600	-------
7. Piping and Insulation						
A. Extraction steam	617,100	520,200	417,000	349,200	266,700	147,900
B. Heater vents and drains	264,500	264,500	211,100	211,100	133,100	260,500
C. Feed water piping						
D. Condensate piping						
1. From condensate pumps through L-P heaters.	196,000	166,000	166,000	154,500	154,500	-------
2. To deaerator and B.F. pump suction						
E. Main steam	111,200	110,200	110,200	102,700	102,700	102,700
8. Demineralizing Equipment and Condensate Storage Tanks	215,000	205,000	200,000	196,000	194,000	195,000
9. Electrical	297,100	290,700	287,900	285,100	285,800	234,100
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	35,786,275	35,345,050	35,058,350	34,860,950	34,883,950	35,003,900
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	47,660,275	47,219,050	46,932,350	46,734,950	46,757,950	46,877,900
11. Piping In Containment Vessel	800,000	775,000	768,000	744,000	739,000	741,000
Grand Total	48,460,275	47,994,050	47,700,350	47,478,950	47,496,950	47,618,900

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
800 PSIA, 1000 F THROTTLE STEAM
(500 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	6	5	4	3	2	1
1. Turbine Generator and Accessories						
A. Turbine generator unit	22,880,000	22,880,000	22,880,000	22,880,000	22,880,000	22,880,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT			→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000	345,000
2. Condensers						
A. Shells and accessories	2,235,000	2,280,000	2,310,000	2,340,000	2,430,000	2,610,000
B. Dry vacuum pumps						
C. Tubes	1,605,000	1,635,000	1,665,000	1,695,000	1,755,000	1,890,000
D. Steam jet air equipment	28,875	26,250	26,250	26,250	26,250	42,000
E. Erection	366,000	370,000	375,000	381,000	393,000	415,000
F. Deaeration - hot well of cond.	NONE	→				117,000
G. L-P heaters in exhaust stack	50,000	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System						
A. Structures						
1. Crib house						
a. Substructure						
b. Superstructure						
c. Steel						
d. Miscellaneous	841,000	847,000	853,000	861,000	875,000	908,000
2. Dredging						
3. Intake flume or forebay						
4. Seal well						
5. Discharge flume						
6. Outfall						
B. Crib house equipment (erected)						
1. Traveling screens						
2. Screen wash pumps	186,000	188,000	191,000	194,000	200,000	215,000
3. Screen wash piping						
4. Chlorination equipment						
5. Chlorine handling						
C. Circulating water piping	1,130,000	1,138,000	1,147,000	1,158,000	1,176,000	1,225,000
D. Circulating water pumps						
1. Pumps	540,000	548,000	556,000	567,000	586,000	632,000
2. Motors	338,000	341,000	344,000	348,000	355,000	372,000
3. Erection	40,000	40,200	40,600	41,000	41,700	43,400
4. Feed Water Heaters						
A. L-P closed heaters	303,500	204,500	207,500	96,000	99,000	-------
B. H-P closed heaters	308,000	285,500	137,500	93,500	------	131,000
C. Deaerating heater	249,400	243,000	240,000	237,600	237,000	-------
D. Insulation						
1. Closed heaters	17,100	14,400	7,800	2,400	-------	-------
2. Deaerators	18,400	17,900	17,600	17,500	17,400	-------
E. Structural work						
1. For closed heaters	31,500	21,000	10,500	10,500	-------	-------
2. For deaerators	54,200	52,500	51,600	51,000	50,800	-------
5. Boiler Feed Pumps						
A. Pumps and base plates	195,000	185,000	182,000	178,000	177,000	174,000
B. Fluid drive	192,000	192,000	192,000	192,000	192,000	192,000
C. Motors	354,000	344,000	329,000	321,000	315,000	324,000
D. Erection	29,100	27,700	27,200	26,600	26,500	26,100
E. Foundation for pumps	8,600	8,200	8,000	7,800	7,800	7,700
6. Condensate Pumps						
A. Pumps	105,000	69,000	70,000	68,000	71,000	-------
B. Motors	62,100	40,000	40,600	31,700	33,000	-------
C. Erection	11,800	11,500	11,600	11,400	11,700	-------
7. Piping and Insulation						
A. Extraction steam	593,700	503,100	393,900	349,200	233,400	147,900
B. Heater vents and drains						
C. Feed water piping	264,500	264,500	211,100	211,100	133,100	260,500
D. Condensate piping						
1. From condensate pumps through L-P heaters.	183,500	149,500	149,500	123,000	123,000	-------
2. To deaerator and B.F. pump suction						
E. Main steam	167,200	167,200	167,200	167,200	167,200	167,200
8. Demineralizing Equipment and Condensate Storage Tanks	189,000	183,000	178,000	176,000	175,000	176,000
9. Electrical	277,400	272,800	270,900	268,800	269,400	217,800
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	34,899,875	34,644,750	34,386,350	34,201,550	34,127,250	34,243,600
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	46,773,875	46,518,750	46,260,350	46,075,550	46,001,250	46,117,600
11. Piping In Containment Vessel	1,092,000	1,092,000	1,083,000	1,083,000	1,073,000	1,083,000
Grand Total	47,865,875	47,610,750	47,343,350	47,158,550	47,074,250	47,200,600

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
600 PSIA, 486 F THROTTLE STEAM
(SATURATED STEAM)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories					
A. Turbine generator unit	21,500,000	21,500,000	21,500,000	21,500,000	21,500,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT		→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000
2. Condensers					
A. Shells and accessories	3,336,000	3,420,000	3,525,000	3,660,000	3,900,000
B. Dry vacuum pumps					
C. Tubes	2,405,000	2,451,000	2,532,000	2,620,000	2,790,000
D. Steam jet air equipment	23,625	23,625	21,000	21,000	31,500
E. Erection	510,000	513,000	528,000	550,000	580,000
F. Deaeration - hot well of cond.	NONE				175,000
G. L-P heaters in exhaust stack	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel					
d. Miscellaneous	1,038,000	1,049,000	1,068,000	1,090,000	1,130,000
2. Dredging					
3. Intake flume or forebay					
4. Seal well					
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)					
1. Traveling screens					
2. Screen wash pumps	270,000	276,000	284,000	293,000	310,000
3. Screen wash piping					
4. Chlorination equipment					
5. Chlorine handling					
C. Circulating water piping	1,406,000	1,422,000	1,449,000	1,480,000	1,536,000
D. Circulating water pumps					
1. Pumps	808,000	824,000	850,000	879,000	935,000
2. Motors	437,000	443,000	453,000	464,000	485,000
3. Erection	49,800	50,500	51,400	52,500	54,500
4. Feed Water Heaters					
A. L-P closed heaters	337,000	344,000	175,000	182,000	-------
B. H-P closed heaters	434,000	200,000	183,500	-------	212,000
C. Deaerating heater	393,000	382,500	372,600	367,500	-------
D. Insulation					
1. Closed heaters	23,400	13,900	6,000	-------	-------
2. Deaerators	29,100	28,200	27,500	27,100	-------
E. Structural work					
1. For closed heaters	21,000	10,500	10,500	-------	-------
2. For deaerators	87,000	83,800	81,300	79,500	-------
5. Boiler Feed Pumps					
A. Pumps and base plates	233,000	222,000	214,000	209,000	206,000
B. Fluid drive	192,000	192,000	192,000	192,000	192,000
C. Motors	375,000	347,000	346,000	329,000	351,000
D. Erection	36,200	34,700	33,600	32,500	32,300
E. Foundation for pumps	12,000	11,500	11,100	10,800	10,700
6. Condensate Pumps					
A. Pumps	137,000	140,000	107,000	112,000	-------
B. Motors	71,000	72,000	47,300	49,300	-------
C. Erection	15,200	15,300	14,700	15,100	-------
7. Piping and Insulation					
A. Extraction steam	483,900	398,100	357,000	216,900	103,500
B. Heater vents and drains					
C. Feed water piping	281,700	261,300	179,500	109,800	227,500
D. Condensate piping					
1. From condensate pumps through L-P heaters.	203,500	203,500	185,800	185,800	-------
2. To deaerator and B.F. pump suction					
E. Main steam	71,000	69,000	67,000	65,000	65,000
8. Demineralizing Equipment and Condensate Storage Tanks	278,000	266,000	256,000	249,000	245,000
9. Electrical	307,900	302,900	301,200	300,600	250,200
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	36,900,325	36,665,325	36,500,000	36,412,400	36,492,200
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	48,774,325	48,539,325	48,374,000	48,286,400	48,266,200
11. Piping In Containment Vessel	766,000	675,000	624,000	604,000	599,000
Grand Total	49,540,325	49,214,325	48,998,000	48,890,400	48,865,200

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
600 PSIA, 586 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories					
A. Turbine generator unit	21,020,000	21,020,000	21,020,000	21,020,000	21,020,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT		→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000
2. Condensers					
A. Shells and accessories	3,120,000	3,150,000	3,220,000	3,330,000	3,570,000
B. Dry vacuum pumps					
C. Tubes	2,235,000	2,265,000	2,315,000	2,385,000	2,556,000
D. Steam jet air equipment	23,625	23,625	21,000	21,000	31,500
E. Erection	481,000	487,000	496,000	509,000	535,000
F. Deaeration - hot well of cond.	NONE	←			→ 160,000
G. L-P heaters in exhaust stack	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel					
d. Miscellaneous	999,000	1,004,000	1,014,000	1,033,000	1,074,000
2. Dredging					
3. Intake flume or forebay					
4. Seal well					
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)					
1. Traveling screens					
2. Screen wash pumps	252,000	256,000	260,000	268,000	286,000
3. Screen wash piping					
4. Chlorination equipment					
5. Chlorine handling					
C. Circulating water piping	1,346,000	1,359,000	1,373,000	1,400,000	1,458,000
D. Circulating water pumps					
1. Pumps	750,000	762,000	775,000	801,000	859,000
2. Motors	416,000	421,000	426,000	436,000	457,000
3. Erection	47,700	48,200	48,700	49,700	51,700
4. Feed Water Heaters					
A. L-P closed heaters	310,500	314,000	158,000	165,000	-------
B. H-P closed heaters	386,500	180,000	167,000	-------	194,500
C. Deaerating heater	370,500	360,600	354,000	349,500	-------
D. Insulation					
1. Closed heaters	21,000	12,500	5,400	-------	-------
2. Deaerators	27,300	26,500	26,000	25,700	-------
E. Structural work					
1. For closed heaters	21,000	10,500	10,500	-------	-------
2. For deaerators	80,500	77,900	75,800	74,500	-------
5. Boiler Feed Pumps					
A. Pumps and base plates	211,000	202,000	196,000	193,000	191,000
B. Fluid drive	192,000	192,000	192,000	192,000	192,000
C. Motors	424,000	396,000	394,000	377,000	399,000
D. Erection	33,000	31,700	30,800	30,100	29,900
E. Foundation for pumps	11,000	10,500	10,200	10,000	9,900
6. Condensate Pumps					
A. Pumps	123,000	125,000	96,000	100,000	-------
B. Motors	64,000	65,200	43,100	44,800	-------
C. Erection	14,200	14,300	13,800	14,200	-------
7. Piping and Insulation					
A. Extraction steam	483,900	398,100	357,000	216,900	103,500
B. Heater vents and drains					
C. Feed water piping	310,700	233,500	233,500	122,200	248,000
D. Condensate piping					
1. From condensate pumps through L-P heaters.	166,000	166,000	166,500	166,500	-------
2. To deaerator and B.F. pump suction					
E. Main steam	58,700	58,700	58,700	58,700	58,700
8. Demineralizing Equipment and Condensate Storage Tanks	253,000	242,000	234,000	228,000	227,000
9. Electrical	310,600	305,800	303,100	302,600	252,500
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	35,657,725	35,313,625	35,164,100	34,993,400	35,034,200
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	47,531,725	47,187,625	47,038,100	46,867,400	46,908,200
11. Piping In Containment Vessel	716,000	590,000	591,000	585,000	591,000
Grand Total	48,247,725	47,777,625	47,629,100	47,452,400	47,499,200

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
600 PSIA, 686 F THROTTLE STEAM
(200 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories					
A. Turbine generator unit	20,380,000	20,380,000	20,380,000	20,380,000	20,380,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT		→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000
2. Condensers					
A. Shells and accessories	2,900,000	2,940,000	2,985,000	3,060,000	3,300,000
B. Dry vacuum pumps	2,085,000	2,112,000	2,136,000	2,214,000	2,370,000
C. Tubes	23,625	23,625	21,000	21,000	31,500
D. Steam jet air equipment	454,000	459,000	464,000	478,000	505,000
E. Erection	NONE	←		→	148,000
F. Deaeration - hot well of cond.	50,000	50,000	25,000	25,000	25,000
G. L-P heaters in exhaust stack					
3. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel					
d. Miscellaneous	959,000	965,000	976,000	991,000	1,027,000
2. Dredging					
3. Intake flume or forebay					
4. Seal well					
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)					
1. Traveling screens					
2. Screen wash pumps	237,000	239,000	242,000	250,000	266,000
3. Screen wash piping					
4. Chlorination equipment					
5. Chlorine handling					
C. Circulating water piping	1,296,000	1,304,000	1,314,000	1,340,000	1,392,000
D. Circulating water pumps					
1. Pumps	701,000	709,000	719,000	743,000	795,000
2. Motors	398,000	400,000	404,000	414,000	433,000
3. Erection	45,900	46,200	46,600	47,500	49,300
4. Feed Water Heaters					
A. L-P closed heaters	288,500	290,500	147,000	153,000	-------
B. H-P closed heaters	356,000	166,000	154,500	-------	181,000
C. Deaerating heater	353,400	345.000	339,000	268,000	-------
D. Insulation					
1. Closed heaters	19,200	11,500	4,900	-------	-------
2. Deaerators	26,000	25,400	24,900	20,000	-------
E. Structural Work					
1. For Closed Heaters	21,000	10,500	10,500	-------	-------
2. For Deaerators	75,600	73,500	71,900	60,000	-------
5. Boiler Feed Pumps					
A. Pumps and base plates	193,000	188,000	184,000	180,000	180,000
B. Fluid drive	192,000	192,000	192,000	192,000	192,000
C. Motors	387,000	362,000	361,000	348,000	368,000
D. Erection	30,700	29,500	28,800	28,300	28,200
E. Foundation for pumps	10,200	9,800	9,600	9,400	9,400
6. Condensate Pumps					
A. Pumps	112,000	113,000	87,000	92,000	-------
B. Motors	59,500	60,000	39,900	41,600	-------
C. Erection	13,500	13,600	13,100	13,500	-------
7. Piping and Insulation					
A. Extraction steam	476,100	390,900	347,700	207,600	103,500
B. Heater vents and drains					
C. Feed water piping	310,700	233,500	233,500	122,200	248,000
D. Condensate piping					
1. From condensate pumps through L-P heaters.	166,000	166,000	166,500	166,500	-------
2. To deaerator and B.F. pump suction					
E. Main steam	71,700	71,700	58,700	58,700	58,700
8. Demineralizing Equipment and Condensate Storage Tanks	233,000	224,000	217,000	214,000	212,000
9. Electrical	297,800	293,400	291,500	291,100	240,800
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	34,267,425	33,942,625	33,740,600	33,474,400	33,588,400
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	46,141,425	45,816,625	45,614,600	45,348,400	45,462,400
11. Piping In Containment Vessel	753,000	625,000	588,000	583,000	592,000
Grand Total	46,894,425	46,441,625	46,202,600	45,931,400	46,054,400

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
600 PSIA, 886 F THROTTLE STEAM
(400 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories					
A. Turbine generator unit	20,700,000	20,700,000	20,700,000	20,700,000	20,700,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT		→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000
2. Condensers					
A. Shells and accessories	2,525,000	2,550,000	2,610,000	2,700,000	2,900,000
B. Dry vacuum pumps					
C. Tubes	1,821,000	1,842,000	1,878,000	1,964,000	2,080,000
D. Steam jet air equipment	28,875	28,875	26,250	26,250	34,125
E. Erection	407,000	410,000	417,000	428,000	453,000
F. Deaeration - hot well of cond.	NONE				130,000
G. L-P heaters in exhaust stack	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel					
d. Miscellaneous	894,000	900,000	908,000	924,000	957,000
2. Dredging					
3. Intake flume or forebay					
4. Seal well					
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)					
1. Traveling screens					
2. Screen wash pumps	209,000	211,000	214,000	221,000	236,000
3. Screen wash piping					
4. Chlorination equipment					
5. Chlorine handling					
C. Circulating water piping	1,204,000	1,213,000	1,224,000	1,246,000	1,293,000
D. Circulating water pumps					
1. Pumps	612,000	620,000	630,000	653,000	698,000
2. Motors	365,000	367,000	372,000	380,000	397,000
3. Erection	42,600	42,900	43,300	44,200	45,800
4. Feed Water Heaters					
A. L-P closed heaters	252,000	254,500	129,500	134,000	-------
B. H-P closed heaters	309,000	143,000	135,500	-------	160,500
C. Deaerating heater	261,000	255,000	251,000	248,400	-------
D. Insulation					
1. Closed heaters	16,500	10,000	4,300	-------	-------
2. Deaerators	19,400	18,800	18,500	18,300	-------
E. Structural Work					
1. For Closed Heaters	21,000	10,500	10,500	-------	-------
2. For Deaerators	57,800	56,000	54,800	54,200	-------
5. Boiler Feed Pumps					
A. Pumps and base plates	173,000	167,000	161,000	158,000	155,000
B. Fluid drive	192,000	192,000	192,000	141,000	192,000
C. Motors	329,000	310,000	301,000	291,000	301,000
D. Erection	27,200	26,400	25,300	29,000	24,500
E. Foundation for pumps	9,100	8,800	8,400	8,300	8,100
6. Condensate Pumps					
A. Pumps	96,000	97,000	75,000	78,000	-------
B. Motors	51,400	51,800	35,000	36,300	-------
C. Erection	12,300	12,400	12,100	12,400	-------
7. Piping and Insulation					
A. Extraction steam	448,200	362,400	299,700	179,400	103,500
B. Heater vents and drains					
C. Feed water piping	246,000	233,500	233,500	122,200	248,000
D. Condensate piping					
1. From condensate pumps through L-P heaters.	166,000	166,000	154,200	154,200	-------
2. To deaerator and B.F. pump suction					
E. Main steam	140,000	140,000	140,000	140,000	140,000
8. Demineralizing Equipment and Condensate Storage Tanks	204,000	197,000	192,000	188,000	190,000
9. Electrical	277,400	274,400	271,200	271,600	219,400
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	33,211,775	32,966,275	32,797,050	32,620,750	32,735,925
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	45,085,775	44,840,275	44,671,050	44,494,750	44,609,925
11. Piping In Containment Vessel	789,000	785,000	785,000	773,000	667,000
Grand Total	45,874,775	45,625,275	45,456,050	45,267,750	45,276,925

TABLE 12.7 (Continued)

600 PSIA, 986 F THROTTLE STEAM
(500 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	5	4	3	2	1
1. Turbine Generator and Accessories					
A. Turbine generator unit	21,180,000	21,180,000	21,180,000	21,180,000	21,180,000
B. Turbine generator erection	700,000	700,000	700,000	700,000	700,000
C. Reserve exciter	←		CONSTANT		→
D. Turbine foundation	345,000	345,000	345,000	345,000	345,000
2. Condensers					
A. Shells and accessories	2,360,000	2,400,000	2,415,000	2,520,000	2,700,000
B. Dry vacuum pumps					
C. Tubes	1,704,000	1,728,000	1,755,000	1,812,000	1,964,000
D. Steam jet air equipment	28,875	28,875	26,250	26,250	34,125
E. Erection	385,000	390,000	394,000	405,000	428,000
F. Deaeration - hot well of cond.	NONE			→	122,000
G. L-P heaters in exhaust stack	50,000	50,000	25,000	25,000	25,000
3. Circulating Water System					
A. Structures					
1. Crib house					
a. Substructure					
b. Superstructure					
c. Steel					
d. Miscellaneous	865,000	871,000	878,000	892,000	923,000
2. Dredging					
3. Intake flume or forebay					
4. Seal well					
5. Discharge flume					
6. Outfall					
B. Crib house equipment (erected)					
1. Traveling screens					
2. Screen wash pumps	196,000	199,000	202,000	208,000	221,000
3. Screen wash piping					
4. Chlorination equipment					
5. Chlorine handling					
C. Circulating water piping	1,164,000	1,172,000	1,182,000	1,201,000	1,245,000
D. Circulating water pumps					
1. Pumps	572,000	580,000	590,000	608,000	652,000
2. Motors	350,000	353,000	356,000	363,000	380,000
3. Erection	41,200	41,500	41,800	42,500	44,100
4. Feed Water Heaters					
A. L-P closed heaters	238,000	240,000	123,000	127,000	-------
B. H-P closed heaters	290,500	136,000	128,000	-----	152,000
C. Deaerating heater	251,600	246,000	242,400	240,000	-------
D. Insulation					
1. Closed heaters	12,900	9,400	4,000	-------	-------
2. Deaerators	18,500	18,100	17,800	17,600	-------
E. Structural work					
1. For closed heaters	21,000	10,500	10,500	-------	-------
2. For deaerators	55,000	53,400	52,300	51,800	--------
5. Boiler Feed Pumps					
A. Pumps and base plates	164,000	159,000	152,000	151,000	148,000
B. Fluid drive	192,000	141,000	141,000	141,000	141,000
C. Motors	306,000	283,000	270,000	258,000	266,000
D. Erection	25,800	25,100	24,200	23,900	23,500
E. Foundation for pumps	8,600	8,300	8,000	8,000	7,800
6. Condensate Pumps					
A. Pumps	89,000	90,000	70,000	73,000	-------
B. Motors	48,000	48,500	32,900	34,100	-------
C. Erection	11,900	11,900	11,600	11,900	-------
7. Piping and Insulation					
A. Extraction steam	448,200	362,400	299,700	179,400	103,500
B. Heater vents and drains					
C. Feed water piping	246,000	233,500	233,500	122,200	248,000
D. Condensate piping					
1. From condensate pumps through L-P heaters.	154,000	154,000	150,000	150,000	-------
2. To deaerator and B.F. pump suction					
E. Main steam	168,200	168,200	168,200	168,200	168,200
8. Demineralizing Equipment and Condensate Storage Tanks	192,000	186,000	182,000	179,000	181,000
9. Electrical	268,800	266,200	263,500	263,700	211,900
10. Turbine Room Building	- - - -	- - - -	- - - -	- - - -	- - - -
Total Items 1-10	33,151,075	32,888,875	32,674,650	32,527,550	32,614,125
Total Constant Cost	11,874,000	11,874,000	11,874,000	11,874,000	11,874,000
Total Turbine Plant Cost	45,025,075	44,762,875	44,548,650	44,401,500	44,488,125
11. Piping In Containment Vessel	1,121,000	1,118,000	1,118,000	1,108,000	1,118,000
Grand Total	46,146,075	45,880,875	45,666,650	45,509,550	45,606,125

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
400 PSIA, 445 F THROTTLE STEAM
(SATURATED STEAM)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
1. Turbine Generator and Accessories				
A. Turbine generator unit	28,100,000	28,100,000	28,100,000	28,100,000
B. Turbine generator erection	1,040,000	1,040,000	1,040,000	1,040,000
C. Reserve exciter	← CONSTANT →			
D. Turbine foundation	460,000	460,000	460,000	460,000
2. Condensers				
A. Shells and accessories	3,680,000	3,720,000	3,790,000	4,040,000
B. Dry vacuum pumps	2,720,000	2,770,000	2,780,000	2,940,000
C. Tubes	31,500	28,000	28,000	35,000
D. Steam jet air equipment	580,000	584,000	592,000	624,000
E. Erection	NONE →			180,000
F. Deaeration - hot well of cond.	56,000	28,000	28,000	28,000
G. L-P heaters in exhaust stack				
3. Circulating Water System				
A. Structures				
1. Crib house				
a. Substructure				
b. Superstructure				
c. Steel				
d. Miscellaneous	1,093,000	1,100,000	1,112,000	1,157,000
2. Dredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume				
6. Outfall				
B. Crib house equipment (erected)				
1. Traveling screens				
2. Screen wash pumps	295,000	297,000	303,000	324,000
3. Screen wash piping				
4. Chlorination equipment				
5. Chlorine handling				
C. Circulating water piping	1,488,000	1,495,000	1,512,000	1,578,000
D. Circulating water pumps				
1. Pumps	886,000	894,000	911,000	973,000
2. Motors	466,000	470,000	476,000	499,000
3. Erection	52,700	53,000	53,700	56,000
4. Feed Water Heaters				
A. L-P closed heaters	416,000	175,000	180,000	-------
B. H-P closed heaters	212,000	241,000	-------	206,000
C. Deaerating heater	460,000	448,800	439,200	-------
D. Insulation				
1. Closed heaters	12,800	6,200	-------	-------
2. Deaerators	33,800	33,000	32,200	-------
E. Structural Work				
1. For Closed Heaters	14,000	14,000	-------	-------
2. For Deaerators	98,000	95,200	92,000	-------
5. Boiler Feed Pumps				
A. Pumps and base plates	252,000	234,000	224,000	210,000
B. Fluid drive	188,000	188,000	188,000	188,000
C. Motors	288,000	290,000	268,000	284,000
D. Erection	37,600	35,200	34,000	32,200
E. Foundation for pumps	14,200	13,400	12,800	12,200
6. Condensate Pumps				
A. Pumps	164,000	124,000	128,000	-------
B. Motors	99,000	59,400	61,000	-------
C. Erection	18,600	17,400	17,800	-------
7. Piping and Insulation				
A. Extraction steam	452,000	445,000	170,600	162,400
B. Heater vents and drains	210,000	210,000	80,000	176,000
C. Feed water piping				
D. Condensate piping				
1. From condensate pumps through L-P heaters.	239,000	206,400	218,800	-------
2. To deaerator and B.F. pump suction				
E. Main steam	107,000	102,000	98,000	98,000
8. Demineralizing Equipment and Condensate Storage Tanks	444,000	436,000	422,000	412,000
9. Electrical	334,000	329,400	327,800	276,000
10. Turbine Room Building	-------	-------	-------	-------
Total Items 1-10	45,042,200	44,742,400	44,179,900	44,090,800
Total Constant Cost	12,676,000	12,676,000	12,676,000	12,676,000
Total Turbine Plant Cost	57,718,200	57,418,400	56,855,900	56,766,800
11. Piping In Containment Vessel	891,000	840,000	786,000	759,000
Grand Total	58,609,200	58,258,400	57,641,900	57,525,800

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
400 PSIA, 545 F THROTTLE STEAM
(100 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
1. Turbine Generator and Accessories				
A. Turbine generator unit	27,380,000	27,380,000	27,380,000	27,380,000
B. Turbine generator erection	1,000,000	1,000,000	1,000,000	1,000,000
C. Reserve exciter	←	CONSTANT	→	
D. Turbine foundation	460,000	460,000	460,000	460,000
2. Condensers				
A. Shells and accessories	3,380,000	3,400,000	3,508,000	3,550,000
B. Dry vacuum pumps	2,440,000	2,460,000	2,530,000	2,760,000
C. Tubes	31,500	28,000	28,000	35,000
D. Steam jet air equipment	540,000	544,000	554,000	586,000
E. Erection	NONE	←	→	160,000
F. Deaeration - hot well of cond.	56,000	28,000	28,000	28,000
G. L-P heaters in exhaust stack				
3. Circulating Water System				
A. Structures				
1. Crib house				
a. Substructure				
b. Superstructure				
c. Steel				
d. Miscellaneous	1,042,000	1,047,000	1,060,000	1,108,000
2. Dredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume				
6. Outfall				
B. Crib house equipment (erected)				
1. Traveling screens				
2. Screen wash pumps	272,000	274,000	280,000	298,000
3. Screen wash piping				
4. Chlorination equipment				
5. Chlorine handling				
C. Circulating water piping	1,413,000	1,420,000	1,440,000	1,500,000
D. Circulating water pumps				
1. Pumps	813,000	820,000	842,000	899,000
2. Motors	440,000	442,000	450,000	472,000
3. Erection	50,100	50,300	51,100	53,200
4. Feed Water Heaters				
A. L-P closed heaters	374,000	160,000	164,000	-------
B. H-P closed heaters	191,000	215,000	-------	189,000
C. Deaerating heater	436,000	427,200	420,000	-------
D. Insulation				
1. Closed heaters	11,600	5,600	-------	-------
2. Deaerators	32,000	31,400	31,000	-------
E. Structural work				
1. For closed heaters	14,000	14,000	-------	-------
2. For deaerators	91,400	89,200	87,200	-------
5. Boiler Feed Pumps				
A. Pumps and base plates	228,000	212,000	206,000	194,000
B. Fluid drive	188,000	188,000	188,000	188,000
C. Motors	368,000	364,000	342,000	350,000
D. Erection	34,600	32,600	31,600	30,200
E. Foundation for pumps	13,000	12,400	12,000	11,400
6. Condensate Pumps				
A. Pumps	147,000	112,000	116,000	-------
B. Motors	89,600	54,400	56,200	-------
C. Erection	17,000	16,000	16,400	-------
7. Piping and Insulation				
A. Extraction steam	452,000	445,000	170,600	162,400
B. Heater vents and drains	272,600	272,600	122.600	254,400
C. Feed water piping				
D. Condensate piping				
1. From condensate pumps through L-P heaters.	208,800	188,000	188,000	-------
2. To deaerator and B.F. pump suction	62,400	62,400	62,400	62,400
E. Main steam	414,000	402,000	390,000	384,000
8. Demineralizing Equipment and Condensate Storage Tanks	338,600	332,800	331,400	281,200
9. Electrical	-------	-------	-------	-------
10. Turbine Room Building	43,301,200	42,989,900	42,546,500	42,396,200
Total Items 1-10	12,676,000	12,676,000	12,676,000	12,676,000
Total Constant Cost	55,977,200	55,665,900	55,222,500	55,072,200
Total Turbine Plant Cost	752,100	732,000	610,800	610,800
11. Piping In Containment Vessel	56,729,300	56,397,900	55,833,300	55,683,000
Grand Total				

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
400 PSIA, 645 F THROTTLE STEAM
(200 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
1. Turbine Generator and Accessories				
A. Turbine generator unit	26,900,000	26,900,000	26,900,000	26,900,000
B. Turbine generator erection	1,080,000	1,080,000	1,080,000	1,080,000
C. Reserve exciter	←	CONSTANT	→	
D. Turbine foundation	560,000	560,000	560,000	560,000
2. Condensers				
A. Shells and accessories	3,156,000	3,200,000	3,310,000	3,540,000
B. Dry vacuum pumps	2,234,000	2,268,000	2,340,000	2,562,000
C. Tubes	31,500	28,000	28,000	35,000
D. Steam jet air equipment	510,000	514,000	530,000	562,000
E. Erection	NONE	→		159,400
F. Deaeration - hot well of cond.				
G. L-P heaters in exhaust stack	56,000	28,000	28,000	28,000
3. Circulating Water System				
A. Structures				
1. Crib house				
a. Substructure				
b. Superstructure				
c. Steel				
d. Miscellaneous	1,000,000	1,010,000	1,028,000	1,070,000
2. Dredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume				
6. Outfall				
B. Crib house equipment (erected)				
1. Traveling screens				
2. Screen wash pumps	254,000	257,500	266,000	284,000
3. Screen wash piping				
4. Chlorination equipment				
5. Chlorine handling				
C. Circulating water piping	1,353,000	1,366,000	1,394,000	1,450,000
D. Circulating water pumps				
1. Pumps	755,000	768,000	793,000	850,000
2. Motors	418,000	422,000	433,000	454,000
3. Erection	48,000	48,400	49,400	51,500
4. Feed Water Heaters				
A. L-P closed heaters	344,000	149,000	154,000	-------
B. H-P closed heaters	175,000	183,000	-------	166,000
C. Deaerating heater	418,000	409,600	404,000	-------
D. Insulation				
1. Closed heaters	10,800	5,000	-------	-------
2. Deaerators	30,800	30,200	29,800	-------
E. Structural work				
1. For closed heaters	14,000	14,000	-------	-------
2. For deaerators	86,800	84,800	82,200	-------
5. Boiler Feed Pumps				
A. Pumps and base plates	210,000	196,000	190,000	172,000
B. Fluid drive	188,000	188,000	188,000	188,000
C. Motors	336,000	330,000	314,000	304,000
D. Erection	32,800	30,400	29,800	27,600
E. Foundation for pumps	12,200	11,600	11,400	10,400
6. Condensate Pumps				
A. Pumps	134,000	103,000	107,000	-------
B. Motors	82,600	51,000	52,600	-------
C. Erection	15,600	14,800	15,400	-------
7. Piping and Insulation				
A. Extraction steam	450,000	445,000	264,000	162,000
B. Heater vents and drains	272,600	272,600	122,600	254,400
C. Feed water piping				
D. Condensate piping				
1. From condensate pumps through L-P heaters.	208,800	188,000	188,000	-------
2. To deaerator and B.F. pump suction	62,400	62,400	62,400	62,400
E. Main steam				
8. Demineralizing Equipment and Condensate Storage Tanks	388,000	374,000	366,000	348,000
9. Electrical	324,000	319,600	320,000	266,600
10. Turbine Room Building	309,000	309,000	309,000	309,000
Total Items 1-10	42,460,900	42,220,900	41,949,600	41,856,300
Total Constant Cost	12,676,000	12,676,000	12,676,000	12,676,000
Total Turbine Plant Cost	55,136,900	54,896,900	54,625,600	54,532,300
11. Piping In Containment Vessel	752,100	752,100	610,800	610,800
Grand Total	55,889,000	55,649,000	55,236,400	55,143,100

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
400 PSIA, 845 F THROTTLE STEAM
(400 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
1. Turbine Generator and Accessories				
A. Turbine generator unit	27,380,000	27,380,000	27,380,000	27,380,000
B. Turbine generator erection	1,080,000	1,080,000	1,080,000	1,080,000
C. Reserve exciter	← CONSTANT →			→
D. Turbine foundation	560,000	560,000	560,000	560,000
2. Condensers	2,720,000	2,760,000	2,840,000	3,070,000
A. Shells and accessories	1,942,000	1,960,000	2,026,000	2,196,000
B. Dry vacuum pumps	38,500	35,000	35,000	42,000
C. Tubes	456,000	460,000	270,000	496,000
D. Steam jet air equipment	NONE		→	138,000
E. Erection				
F. Deaeration - hot well of cond.	56,000	28.000	28,000	28,000
G. L-P heaters in exhaust stack				
3. Circulating Water System				
A. Structures				
1. Crib house				
a. Substructure				
b. Superstructure				
c. Steel	927,000	932,000	948,000	986,000
d. Miscellaneous				
2. Dredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume				
6. Outfall				
B. Crib house equipment (erected)				
1. Traveling screens	222,000	224,500	231,000	247,000
2. Screen wash pumps				
3. Screen wash piping				
4. Chlorination equipment				
5. Chlorine handling	1,250,000	1,259,000	1,280,000	1,334,000
C. Circulating water piping	654,000	661,000	682,000	735,000
D. Circulating water pumps	381,000	384,000	392,000	411,000
1. Pumps	44,200	44,500	45,300	47,200
2. Motors				
3. Erection			134,000	-------
4. Feed Water Heaters	300,000	130,000	-------	155,000
A. L-P closed heaters	152,000	168,000	254,200	-------
B. H-P closed heaters	262,400	257,600		
C. Deaerating heater			-------	-------
D. Insulation	9,400	4,600	18,800	-------
1. Closed heaters	19,400	19,000		
2. Deaerators			-------	-------
E. Structural work	14,000	14,000	55,600	-------
1. For closed heaters	58,200	56,600		
2. For deaerators			166,000	160,000
5. Boiler Feed Pumps	182,000	170,000	188,000	188,000
A. Pumps and base plates	188,000	188,000	270,000	282,000
B. Fluid drive	284,000	282,000	27,000	26,200
C. Motors	28,800	27,400	10,200	10,000
D. Erection	11,000	10,400		
E. Foundation for pumps			92,000	-------
6. Condensate Pumps	114,000	88,000	46,000	-------
A. Pumps	71,400	44,600	13,400	-------
B. Motors	13,600	13,000		
C. Erection			228,800	162,400
7. Piping and Insulation	437,000	378,000	122,600	254,400
A. Extraction steam	228,200	228,200		
B. Heater vents and drains			185,000	-------
C. Feed water piping	184,400	185,000		
D. Condensate piping			113,400	113,400
1. From condensate pumps through L-P heaters.	113,400	113,400	326,000	328,000
2. To deaerator and B.F. pump suction				
E. Main steam	344,000	334,000	296,800	248,400
8. Demineralizing Equipment and Condensate Storage Tanks	300,000	296,400	309,000	309,000
9. Electrical	309,000	309,000	40,654,100	40,967,000
10. Turbine Room Building	41,334,900	41,085,200	12,676,000	12,676,000
Total Items 1-10	12,676,000	12,676,000	53,330,100	53,643,000
Total Constant Cost	54,010,900	53,761,200	858,600	858,600
Total Turbine Plant Cost	1,071,600	861,600	54,188,700	54,501,600
11. Piping In Containment Vessel	55,082,500	54,622,800		
Grand Total				

TABLE 12.7 (Continued)

SUMMARY OF COST DATA
400 PSIA, 945 F THROTTLE STEAM
(500 F SUPERHEAT)
1000 MWe INDIRECT CYCLE TURBINE PLANT

Heater Arrangement	4	3	2	1
1. Turbine Generator and Accessories				
A. Turbine generator unit	25,620,000	25,620,000	25,620,000	25,620,000
B. Turbine generator erection	1,000,000	1,000,000	1,000,000	1,000,000
C. Reserve exciter	← CONSTANT →			
D. Turbine foundation	460,000	460,000	460,000	460,000
2. Condensers				
A. Shells and accessories	2,550,000	2,584,000	2,660,000	2,868,000
B. Dry vacuum pumps	1,814,000	1,832,000	1,896,000	2,048,000
C. Tubes	38,500	35,000	35,000	42,000
D. Steam jet air equipment	430,000	434,000	446,000	474,000
E. Erection	NONE			128,000
F. Deaeration - hot well of cond.	56,000	28,000	28,000	28,000
G. L-P heaters in exhaust stack				
3. Circulating Water System				
A. Structures				
1. Crib house				
a. Substructure				
b. Superstructure				
c. Steel				
d. Miscellaneous	895,000	900,000	915,000	950,000
2. Dredging				
3. Intake flume or forebay				
4. Seal well				
5. Discharge flume				
6. Outfall				
B. Crib house equipment (erected)				
1. Traveling screens				
2. Screen wash pumps	208,000	211,000	217,000	233,000
3. Screen wash piping				
4. Chlorination equipment				
5. Chlorine handling				
C. Circulating water piping	1,207,000	1,213,000	1,235,000	1,284,000
D. Circulating water pumps				
1. Pumps	610,000	618,000	639,000	688,000
2. Motors	365,000	367,500	375,000	393,000
3. Erection	42,600	43,000	43,600	45,500
4. Feed Water Heaters				
A. L-P closed heaters	277,000	123,000	126,000	-------
B. H-P closed heaters	144,000	158,000	-------	146,000
C. Deaerating heater	253,600	248,200	245,600	-------
D. Insulation				
1. Closed heaters	9,000	4,200	-------	-------
2. Deaerators	18,800	18,200	18,000	-------
E. Structural work				
1. For closed heaters	14,000	14,000	-------	-------
2. For deaerators	55,400	54,000	53,000	-------
5. Boiler Feed Pumps				
A. Pumps and base plates	170,000	160,000	156,000	152,000
B. Fluid drive	160,000	160,000	160,000	160,000
C. Motors	264,000	260,000	248,000	262,000
D. Erection	27,400	26,200	25,800	25,200
E. Foundation for pumps	10,400	10,000	9,800	9,600
6. Condensate Pumps				
A. Pumps	107,000	84,000	87,000	-------
B. Motors	66,800	42,000	43,400	-------
C. Erection	12,800	12,400	12,600	-------
7. Piping and Insulation				
A. Extraction steam	437,000	378,000	228,800	162,400
B. Heater vents and drains	228,200	228,200	122,600	254,400
C. Feed water piping				
D. Condensate piping				
1. From condensate pumps through L-P heaters.	184,400	185,000	185,000	-------
2. To deaerator and B.F. pump suction				
E. Main steam	126,200	126,200	118,000	118,000
8. Demineralizing Equipment and Condensate Storage Tanks	326,000	316,000	310,000	314,000
9. Electrical	290,200	287,000	287,400	239,200
10. Turbine Room Building	-------	-------	-------	-------
Total Items 1-10	38,478,300	38,240,100	38,006,600	38,104,300
Total Constant Cost	12,676,000	12,676,000	12,676,000	12,676,000
Total Turbine Plant Cost	51,154,300	50,916,100	50,682,600	50,780,300
11. Piping In Containment Vessel	1,141,800	1,141,800	898,200	898,200
Grand Total	52,296,100	52,057,900	51,580,800	51,678,500

TABLE 12.8

Coefficients for Turbine Efficiency Calculations

Superheat, °F	i	j	300 MWe	500 MWe	1000 MWe
0	0	0	1.0404E 01	8.9025E 00	2.1419E 01
	1	0	1.1129E-01	1.4525E-01	-5.5988E-02
	2	0	-5.1301E-04	-7.5757E-04	8.6141E-04
	3	0	1.2629E-06	2.1206E-06	-3.8182E-06
	4	0	-1.5539E-09	-2.9949E-09	7.1502E-09
	5	0	7.4627E-13	1.6532E-12	-4.9023E-12
	0	1	2.7301E-02	2.4824E-02	8.2673E-03
	2	1	1.9444E-08	1.5194E-08	1.6540E-08
	3	1	-2.6711E-11	-1.4429E-11	-1.5388E-11
	0	2	-2.1767E-05	-1.8738E-05	-1.5549E-06
	0	4	8.4504E-12	7.0213E-12	-1.0100E-12
	0	5	-3.0096E-15	2.5198E-15	4.3499E-16
100	0	0	1.7821E 01	1.3948E 01	1.6967E 01
	1	0	6.5040E-02	9.4633E-02	1.4907E-01
	2	0	-1.9902E-04	-2.9061E-04	-7.0686E-04
	3	0	3.6786E-07	3.5512E-07	1.9184E-06
	4	0	-3.5274E-10	1.2439E-10	-2.7301E-09
	5	0	7.3249E-14	-5.2277E-13	1.4835E-12
	0	1	9.4377E-03	1.1772E-02	-5.1442E-04
	2	1	-5.2080E-09	-1.6490E-08	-9.8009E-09
	3	1	2.0272E-11	4.9757E-11	3.5349E-11
	0	4	-3.7002E-12	-6.2034E-12	3.9979E-12
	0	5	1.7381E-15	3.0865E-15	-2.1251E-15
200	0	0	1.0676E 01	1.1832E 01	5.7998E 00
	1	0	1.3558E-01	1.3921E-01	1.6956E-01
	2	0	-5.2044E-04	-6.6213E-04	-9.4484E-04
	3	0	8.6497E-07	1.8020E-06	3.1676E-06
	4	0	-2.7717E-10	-2.5176E-09	-5.6240E-09
	5	0	-5.1574E-13	1.3522E-12	4.0167E-12
	0	1	2.3363E-02	1.8945E-02	3.2047E-02
	2	1	7.4909E-09	-4.4374E-09	1.7353E-09
	3	1	9.5050E-12	1.6904E-11	-6.7071E-12
	0	2	-1.7707E-05	-1.1753E-05	-2.5532E-05
	0	4	6.7220E-12	3.4819E-12	1.0811E-11
	0	5	-2.4418E-15	-1.1608E-15	-4.0565E-15

TABLE 12.8 (Continued)

Superheat, °F	i	j	300 MWe	500 MWe	1000 MWe
300	0	0	-1.4070E 01	1.8261E 01	1.2364E 01
	1	0	9.9272E-02	1.2627E-01	2.0583E-01
	2	0	-3.7457E-04	-5.1824E-04	-1.1012E-03
	3	0	9.2703E-07	1.2983E-06	3.1665E-06
	4	0	-1.2482E-09	-1.6844E-09	-4.5487E-09
	5	0	5.7252E-13	7.2766E-13	2.4909E-12
	0	1	1.0585E-01	1.8449E-03	1.0456E-02
	2	1	-2.3193E-08	-3.0401E-08	-2.0408E-09
	3	1	5.7187E-11	7.2605E-11	2.4646E-11
	0	2	-8.8416E-05	4.0336E-06	-6.8872E-06
	0	4	3.2060E-11	-2.1851E-12	3.4282E-12
	0	5	-1.0829E-14	6.5224E-16	-1.4455E-15
400	0	0	1.6991E 01	1.4464E 01	2.2964E 01
	1	0	7.6389E-02	1.1858E-01	1.0767E-01
	2	0	-1.7279E-04	-4.1898E-04	-2.7793E-04
	3	0	1.5587E-07	8.3163E-07	2.3799E-07
	4	0	7.3936E-11	-7.6624E-10	2.9625E-10
	5	0	-2.9397E-13	7.3871E-14	-6.3302E-13
	0	1	1.9180E-02	1.7215E-02	-1.2565E-02
	2	1	-2.2174E-08	-2.7321E-08	-3.1434E-08
	3	1	6.2189E-11	7.0304E-11	8.0475E-11
	0	2	-1.3018E-05	-1.0163E-05	1.7783E-05
	0	4	4.9835E-12	3.2825E-12	-7.8457E-12
	0	5	-1.8833E-15	-1.2177E-15	2.6255E-15
500	0	0	-1.6289E 00	3.1763E 01	3.1763E 01
	1	0	2.2070E-01	1.4307E-01	1.4307E-01
	2	0	-1.2967E-03	-5.9349E-04	-5.9349E-04
	3	0	4.5635E-06	1.4003E-06	1.4003E-06
	4	0	-8.3170E-09	-1.5848E-09	-1.5848E-09
	5	0	5.6286E-12	4.3468E-13	4.3468E-13
	0	1	6.1721E-02	-6.0454E-02	-6.0454E-02
	2	1	-8.1239E-08	-2.0889E-08	-2.0889E-08
	3	1	2.4067E-10	7.3300E-11	7.3300E-11
	0	2	-2.7368E-05	7.2258E-05	7.2258E-05
	0	4	-1.4674E-10	4.2318E-11	4.2318E-11
	0	5	1.5004E-13	-7.6398E-14	-7.6398E-14

TABLE 12.9

Equations for Turbine Cost Calculations

$$R = \Sigma\, a_{ijk}\, t_s^i\, T_f^j\, P_t^k \qquad 1000 < P_t \leqslant 1500 \text{ psia}$$

$$R = \Sigma\, b_{ijk}\, t^i\, T_f^j\, P_t^k \qquad 400 \leqslant P_t \leqslant 1000 \text{ psia}$$

$$F_1 = R \cdot W$$

$$C_s = \Sigma\, c_{ij}\, F_1^i\, P_t^j$$

$$\Delta C_s = \Sigma\, d_{ij}\, t_s^i\, P_t^j$$

$$C_1 = \Sigma\, e_{ijk}\, T_f^i\, t_s^j\, P_t^k$$

$$C_t = C_1 + C_s + \Delta C_s$$

TABLE 12.10a

Coefficients for Turbine Exhaust Flow Calculations, a_{ijk}

$1000 < P_t \leq 1500$ psia

i	j	k	300 MWe	500 MWe	1000 MWe
0	0	0	1.0872E 00	9.1470E-01	5.2228E-01
1	0	0	-6.3556E-05	3.9252E-04	5.5421E-04
2	0	0	-2.6636E-07	-8.0232E-07	-8.3170E-07
3	0	0	0.	0.	0.
0	1	0	-1.4289E-03	-1.0847E-03	-1.2769E-03
0	2	0	8.8793E-07	4.1142E-07	6.9040E-07
0	3	0	0.	0.	0.
0	0	1	3.9065E-05	1.3074E-04	7.2342E-04
0	0	2	-1.4378E-08	-9.0364E-08	-2.8858E-07
0	0	3	0.	0.	0.
1	1	0	8.5400E-07	3.5681E-07	4.0089E-07
1	0	1	8.6662E-08	7.4253E-08	-3.5697E-08
0	1	1	-1.7134E-07	2.3190E-08	-1.6660E-08

TABLE 12.10b

Coefficients for Turbine Exhaust Flow Calculations, b_{ijk}

400 psia $\leq P_t \leq$ 1000 psia

i	j	k	300 MWe	500 MWe	1000 MWe
0	0	0	1.0737E 00	1.1162E 00	1.1493E 00
1	0	0	4.3288E-05	1.5262E-04	1.3479E-04
2	0	0	-2.1754E-07	-3.0396E-07	-3.2886E-07
3	0	0	-0.	-0.	-0.
0	1	0	-1.2006E-03	-1.1892E-03	-1.3524E-03
0	2	0	5.5034E-07	4.3294E-07	6.8091E-07
0	3	0	-0.	-0.	-0.
0	0	1	-5.9594E-07	-1.9225E-04	-1.9076E-04
0	0	2	5.2387E-10	5.1773E-08	4.7746E-08
0	0	3	-0.	-0.	-0.
1	1	0	6.8856E-07	3.9278E-07	4.4331E-07
1	0	1	2.0068E-07	8.5316E-08	1.0013E-07
0	1	1	-1.5707E-07	9.8612E-08	4.7701E-08

TABLE 12.11

Coefficients in Cost of Saturated Steam Turbine Generator, c_{ij}

i	j	300 MWe	500 MWe	1000 MWe
0	0	5.9223E 00	1.0890E 01	1.1846E 01
1	0	7.1604E-01	1.2209E-04	1.2140E-04
2	0	-1.4713E-02	3.6182E-07	4.4817E-07
3	0	-0.	-0.	0.
4	0	-0.	-0.	0.
0	1	3.8569E-04	7.6466E-03	2.1752E-02
1	1	3.8540E-04	-2.2081E-07	1.1026E-07
2	1	-0.	-0.	0.
3	1	-0.	-0.	0.
4	1	-0.	-0.	0.
0	2	1.6262E-07	-3.9865E-06	8.7676E-06

TABLE 12.12

Coefficients for the Correction to the Turbine Cost Due to Superheat, d_{ij}

i	j	300 MWe	500 MWe	1000 MWe
0	0	2.1281E 05	-1.7761E 00	8.0147E-01
1	0	-3.8241E 03	-3.4821E-02	5.8779E-03
2	0	8.2770E 00	6.8718E-05	-1.0139E-05
3	0	-0.	-5.9507E-09	2.2179E-08
4	0	-0.	-0.	0.
0	1	-4.0256E 02	4.4684E-03	-1.9713E-03
1	1	-9.8758E-01	1.5911E-05	-2.8293E-05
2	1	-0.	-3.6277E-08	1.4985E-08
3	1	-0.	-0.	0.
4	1	-0.	-0.	0.
0	2	1.0355E-01	-2.3139E-06	1.0399E-06
1	2	-0.	1.7544E-09	1.1755E-08

TABLE 12.13

Coefficients for Cost of Turbine Plant Exclusive of Turbine Unit, e_{ijk}

i	j	k	300 MWe	500 MWe	1000 MWe
0	0	0	1.1668E 01	1.6537E 01	3.8150E 01
1	0	0	-2.4629E-03	4.0880E-03	-9.4430E-03
2	0	0	0.	-2.3511E-06	-0.
3	0	0	-0.	-0.	-5.5706E-03
0	1	0	-1.3689E-03	-3.0170E-03	0.
0	2	0	4.6191E-06	0.	-0.
0	3	0	-0.	-0.	-2.8624E-02
0	0	1	-8.2634E-04	-5.0569E-03	2.4798E-05
0	0	2	-1.5069E-06	4.4811E-06	-6.9430E-09
0	0	3	1.5669E-09	-1.2197E-09	-0.
1	1	0	-0.	-0.	-0.
1	0	1	-0.	-0.	-0.
0	1	1	-0.	-0.	-0.
2	1	0	-0.	-0.	-0.
2	0	1	-0.	-0.	-0.
1	2	0	-0.	-0.	-0.
0	2	1	-0.	-0.	-0.
0	1	2	-0.	-0.	-0.
1	0	2	-0.	-0.	-0.

13. Cost Accounting

The over-all energy costs include the charges associated with (1) the capital investment which includes the direct labor and material costs, the direct construction costs, and the D_2O inventory charges, (2) the operating expenses which include maintenance, payroll, supplies, D_2O losses, insurance, and organic makeup, and (3) the fuel cycle cost. The charges associated with the capital investment and the operating expenses are determined by the procedure recommended by the AEC and given in the Cost Evaluation Handbook[12]. There are two methods available for computing the fuel cycle costs as described in Section 7. The direct labor and material costs are determined from the expressions given in Sections 8, 9, 11, and 12. The schedule of the indirect construction costs are taken from the Cost Evaluation Handbook and include the following charges: general and administrative, miscellaneous, architecture engineering, design and inspection, nuclear engineering, startup, contingencies, and interest during construction. The AEC handbook lists these charges as a function of the direct labor material costs over a range from \$20 to \$200 million. The ratio of the indirect to the direct costs was fitted by the following expression.

$$C_I/C_D = 0.9567 - 0.01638\ C_D + 0.2045 \times 10^{-3}\ C_D^2 - 0.1096 \times 10^{-5}\ C_D^3 + 0.2098 \times 10^{-8}\ C_D^4$$

where

C_I = indirect construction costs, \$ millions

C_D = direct labor and material costs, \$ millions

The fixed charges on depreciable and nondepreciable investment were 14.5 and 13.0% per year, respectively. The charges on D_2O inventory were based on a cost for D_2O of \$20/lb.

The influence of the cost accounting procedures on the optimization of reactor concept can be determined by changing the various charge rates on the library file.

APPENDIX A

INPUT SHEETS

The input sheets for the code are shown in Figures A-I, A-II, and A-III.

The input data required for the automatic fuel design portion of the code follow the control card 8002 and are listed in Figure A-I.

If the "fixed" fuel design option is used, the characteristics of the fuel assembly are listed on the input sheets shown in Figure A-II and follow the control card 8003.

The input cards required for the plant design and cost portion of code are shown in Figure A-III. These data follow control card 8004 for the D_2O cooled reactor designs or control card 8006 for the organic cooled designs.

FIGURE A-1

POWER REACTOR COST OPTIMIZATION PROGRAM
INPUT DATA FORM - COP1AD

Name*_____ Phone_____ Date_____

8	0	0	2

MO.		DAY		YR.		RUN NO.			10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27

BLOCK	OPTION
10	Lattice geometry: 0 = square; 1 = hexagonal
11	Coolant: 0 = liquid D_2O; 2 = organic
12	1
13	Cladding: 0 = Zr; 1 = SAP
14	Pressure tube: 0 = Zr; 1 = SAP
15	Calandria or liner: 0 = Zr; 1 = SAP
16	Insulating annulus: 0 = inside pressure tube; 1 = outside
17	Fuel: 0 = oxide; 1 = metal; 2 = carbide
18	1
19-20	Number of tubes/assembly
21-22	0
23-25	File number from library tape
26	Library tape number
27	Binary output tape number

DATA CARDS ±

	.						E				Lattice pitch, in.
	.						E				Weight of fuel, lb/ft.
	.						E				Length of fuel, in.
	.						E				Cladding thickness, mils
	.						E				Calandria or liner thickness, mils
	.						E				Insulating annulus thickness, mils
	.						E				Inner housing tube thickness, mils
1	.						E				Outer coolant channel OD, in. Only if inner housing used.
	.						E				Outer coolant channel thickness, mils
	.						E				Fuel density in % theoretical, if oxide
	.						E				U-235 content in fuel, wt %
	.						E				Inlet coolant temperature, °C
	.						E				Outlet coolant temperature, °C
	.						E				Moderator temperature, °C
2	.						E				H_2O in moderator, atom %
	.						E				Maximum surface temperature, °C
	.						E				Maximum fuel temperature, °C
	.						E				Minimum BOSF
3	.						E				System pressure, psia. Only used for organic coolant.

*Punch 1 Hollerith identification card for each batch of COP problems. 1 in Col. 1.

FIGURE A-2

POWER REACTOR COST OPTIMIZATION PROGRAM

INPUT DATA FORM - COP1ID

Page 1

Name* _____ Phone _____ Date _____

MO	DAY	YEAR	RUN NO. 1011 1213 1415 1617 1819 20 21 22 23 24 25 26 27
8	03		

BLOCK	OPTION
10	Lattice geometry: 0=square; 1=hexagonal
11	Coolant: 0=liquid D_2O; 1=boiling D_2O; 2=organic
12	Fuel type: 0=rods; 1=tubes
13	Cladding: 0=Zr; 1=SAP
14	Pressure tube: 0=Zr; 1=SAP
15	Calandria or Liner: 0=Zr; 1=SAP
16	Insulating annulus: 0=inside; 1=outside pressure tube
17	Fuel: 0=oxide; 1=metal; 2=carbide
18	Input Diameters: 0=no; 1=yes
19-20	Number of rods or tubes per assembly
21-22	blank
23-25	File number from library tape
26	Library tape number
27	Binary output tape number

DATA CARDS ±

	. E	Pressure tube OD, in.
	. E	Outer coolant channel OD, in.
	. E	Clad OD, in.
	. E	Fuel OD, in.
	. E	Clad OD, in.
	. E	Coolant OD, in.
1	. E	Clad OD, in.
	. E	Fuel OD, in.
	. E	Clad OD, in.
	. E	Coolant OD, in.
	. E	Clad OD, in; inner housing OD for 2 tubes
	. E	Fuel OD, in.
	. E	Clad OD, in.
2	. E	Coolant OD, in.
	. E	Inner housing OD, in.
	. E	Lattice pitch, in.
	. E	Weight of fuel, lb/ft
	. E	Fuel density, % theoretical if oxide
	. E	Length of fuel, in.
	. E	Pressure tube thickness, mils
3	. E	Liner or calandria thickness, mils

Note: These diameters may be omitted if desired. Block 18 of the control card must then be zero.

* Punch 1 Hollerith identification card for each batch of COP problems. 1 in Col. 1.

FIGURE A-2 (Page 2)

POWER REACTOR COST OPTIMIZATION PROGRAM
INPUT DATA FORM - COP1ID

	±		
	E		Insulating annulus thickness, mils
	E		Inner housing thickness, mils; 0 for no housing
	E		Cladding thickness, mils
	E		Coolant area, sq. in.
	E		U-235 content in fuel, weight %
	E		Moderator temperature, °C
4	E		H_2O in moderator, atom %
	E		Design pressure, psia
	E		Design temperature, °C
	E		System pressure, psia
	E		Inlet coolant temperature, °C
	E		Outlet coolant temperature, °C
	E		Maximum assembly power, MW
5	E		Power conducted to moderator, MW
	E		Maximum assembly flow, gpm at T_{in}
	E		Pressure drop across assembly, psi
	E		Maximum subchannel velocity, ft/sec
	E		Maximum heat flux, pcu/hr-ft^2
	E		Maximum surface temperature, °C
	E		Maximum fuel temperature, °C
6	E		Minimum burnout safety factor
	E		Maximum subchannel coolant temperature, °C*
	E		Fuel fabrication cost (if dia. not specified), $/kg
	E		Eta
	E		Epsilon
	E		Resonance escape probability
	E		Thermal utilization
7	E		K infinity
	E		Diffusion area, cm^2
	E		τ, cm^2
	E		Migration area, cm^2
	E		Buckling, cm^{-2}
	E		Cell Σ_a, cm^{-1}
	E		Disadvantage factor of the fuel
8	E		Average Σ_f of the fuel, cm^{-1}
	E		Axial ϕ_{max}/ϕ_{avg}(assembly)
	E		Radial ϕ_{max}/ϕ_{avg} (assembly)
9	E		Maximum integral of kdθ for the fuel, watts/cm

Note: These are hot, clean lattice parameters.

* For boiling D_2O coolant use steam quality, %

FIGURE A-3

POWER REACTOR COST OPTIMIZATION PROGRAM
INPUT DATA FORM - COP2 AND COP2OR

Name* _____ Phone _____ Date _____

	N
8	0
0	

N = 4 - D_2O Coolant
N = 6 - Organic Coolant

1	2	3	4	5	6	7	8	9

Block	OPTION
1	Pile number to be designed (1,2,3,or 4)
2	Fuel accounting scheme: 0 = AEC; 1 = other; 9 = run through core design only.
3-4	0
5-7	File number from library tape
8	Library tape number
9	Binary input tape number

DATA CARDS ±

	. E	Axial reflector thickness, in.
	. E	Radial reflector thickness, in.
	. E	Thermal power in Pile 1, MW
	. E	Load factor, fraction
	. E	Control rods, number
	. E	Safety rods, number
1	. E	Delta K in control, fraction
	. E	Reactor discharge time, days
	. E	Alpha, fraction, or thermal power for Pile 3, MW
2	. E	Max. allowable exposure, MWD/Tonne
**	. E	0 for turbine plant optimization; 1.0 for card 2A; Boiler pressure for card 2B

D_2O-Cooled System

	. E	Steam temperature, °C
	. E	Feed-water temperature, °F
	. E	Turbine plant efficiency, %
	. E	Turbine plant cost, $
2A	. E	D_2O inventory in turbine plant, lbs

Organic-Cooled System

	. E	Turbine throttle pressure, psia
	. E	Turbine throttle temperature, °C
2B	. E	Feed-water temperature, °C

* Punch 1 Hollerith identification card for each batch of COP problems. 1 in Col. 1.

** Do not insert cards 2A or 2B if this parameter is 0.

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Author: J. W. Wade

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We now have all the releases on DP-1007 (including the one from Sargent and Lundy). I have marked the changes Wade requested and also had Marilea give it a quick look for errors. The yellow marks are hers. You may want to improve some of the questions. I did not put in Print Shop because they were running DP-1066 this week.

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Attached is a letter from Bill Chittenden of S & L, giving his comments on DP-1007. I think we should eliminate the S & L title blocks as he suggests and then release the report.

JWW/jws

Enclosure

17

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June 14, 1966

Mr. J.W. Wade, Research Manager
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E.I. du Pont de Nemours & Company, Inc.
Aiken, South Carolina 29801

Dear Mr. Wade:

We wish to acknowledge receipt of a draft of DP-1007 "A Computer Program for the Optimization of Organic Cooled D_2O Reactors. We appreciate the opportunity of reviewing this draft and wish to advise that we concur in the material, as presented, and have no comments to offer as such. Unless there is a strong desire on your part to attach the Sargent & Lundy title block to the arrangement drawings included in the report, it would seem to us that these title blocks may be appropriately deleted as they do not really add to the presentation of the material and you have been more than generous in crediting Sargent & Lundy in other ways.

If we can be of any further assistance in this matter, please feel free to contact us.

Very truly yours,

SARGENT & LUNDY

BY W A Chittenden

WAChittenden:as
cc: H.B. Rahner

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DP-1007

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Mr. R. G. Erdley, Chief
Patent Branch
Savannah River Operations Office
U. S. Atomic Energy Commission
Post Office Box A
Aiken, South Carolina

May 12, 1966

Dear Mr. Erdley:

REQUEST FOR PATENT REVIEW

Please review for patent matter:

DP-1007, A Computer Program for the Optimization of Organic-Cooled D_2O Reactors, by J. W. Wade

If any technical clarification is needed please call J. E. Beach whose document review is attached.

Please telephone your comments to the TIS Office (Ext. 3402) and notify me by signing and returning to TIS the original of this letter. A copy is provided for your file.

If you decide to pursue a patent on any development covered, I shall be happy to supply additional information required such as appropriate references and the names of persons responsible for the development.

The above item is approved
for release.

R. G. Erdley 5-17-66

R. G. Erdley, Chief Date
Patent Branch
SROO, USAEC

Very truly yours,

C. W. J. Wende, Director
Technical Division

By: J. E. Beach
J. E. Beach

5/12/66
Date

TECHNICAL DIVISION
SAVANNAH RIVER LABORATORY

MEMORANDUM

TO: S. W. O'REAR

FROM: J. E. BEACH JEB

DOCUMENT REVIEW

Document: Report DP-1007

Title: A Computer Program for the Optimization of Organic-Cooled D_2O Reactors

Author: J. W. Wade

Contractual Origin: AT(07-2)-1

Present Classification: Unclassified

References:

No items were noted that, in my opinion, should be called to the attention of the AEC for patent consideration.

Form AEC-426(7-64)
AEC Manual Chapter 3202, Appendix 064a

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Indicate known prior art

Approval (Introduction, Summary, Cover Letter) Richard Denaro 9-14-65 Section Director A. A. Johnson 9/17 Laboratory Director

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