MASTER

CHEM
SYSTEMS INC.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

COMPARATIVE COST ESTIMATES OF
FIVE COAL UTILIZATION PROCESSES

Report prepared by:

Chem Systems Inc.
747 Third Avenue
New York, NY 10017

under subcontract number 7384 for

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tenn 37830
operated by
UNION CARBIDE CORPORATION
for the
DEPARTMENT OF ENERGY
Contract No. W-7405-eng-26

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

January, 1979

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

WDM

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the Energy Research and Development Administration nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

ABSTRACT

Detailed capital and operating cost estimates were prepared for the generation of electric power in a new, net 500 MW (e), coal-burning facility by five alternative processes: conventional boiler with no control of SO_2 emissions, atmospheric fluidized bed steam generator (AFB), conventional boiler equipped with a limestone FGD system, conventional boiler equipped with magnesia FGD system, and coal beneficiation followed by a conventional boiler equipped with limestone FGD for part of the flue gas stream. For a coal containing 3.5% sulfur, meeting SO_2 emission limits of 1.2 pounds per million Btu fired was most economical with the limestone FGD system. This result was unchanged for a coal containing 5% sulfur; however, for 2% sulfur, limestone FGD and AFB were competitive methods of controlling SO_2 emissions. Brief consideration of 90% reduction of SO_2 emissions led to the choice of limestone FGD as the most economical method. Byproduct credit for the sulfuric acid produced in regenerating the magnesia could make that system competitive with the limestone FGD system, depending upon local markets. The cost of sludge fixation and disposal would make limestone FGD noneconomic in many situations, if these steps are necessary.

TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION	1
II. SUMMARY	3
III. TECHNICAL AND ECONOMIC CRITERIA	8
A. Technical Criteria	8
B. Economic Criteria	13
IV. PROCESS DESCRIPTIONS	17
A. Base Case - Conventional Plant	17
B. Atmospheric Fluidized Bed Steam Generator	21
C. Limestone Slurry Scrubbing	27
D. Magnesia Slurry Scrubbing	32
E. Coal Cleaning/Limestone FGD	38
V. COST ESTIMATES AND COMPARISONS	43
A. Capital Cost Estimates and Comparisons	43
B. Operating Cost Estimates and Comparisons	49
C. Sensitivity Analyses	57
1. Level of SO ₂ Emissions	57
2. Level of Sulfur in the Coal	59
3. Byproduct Credit for Sulfuric Acid	61
4. Sludge Disposal and Fixation	62
VI. APPENDICES	65
A. Description of COST System	65
B. Typical COST Output Detail	83
C. Capital Cost Estimate - Conventional Plant	89
D. Capital Cost Estimate - Atmospheric Fluidized Bed Steam Generator	113
E. Capital Cost Estimate - Limestone Slurry Scrubbing	150
F. Capital Cost Estimate - Magnesia Slurry Scrubbing	176
G. Capital Cost Estimate - Coal Cleaning	210
H. Site Development Cost Summary	247
I. Bibliography	251

I. INTRODUCTION

The Office of Program Planning and Analysis now succeeded by the Division of Systems Analysis at the Department of Energy (DOE) has a broad charter to evaluate the on-going programs of the Division. These include major programs to develop and demonstrate new technology that will permit the conversion of high-sulfur coal into clean gaseous and liquid fuels. An alternative that is also being pursued within the DOE is the development of a process, such as fluidized bed boilers, that permits simultaneous combustion and entrapment of the pollutants that are released from the coal. Finally, outside DOE, the Environmental Protection Agency (EPA) has pursued the development of a number of flue gas desulfurization systems that allow sulfur emissions to be scrubbed from the flue gas after high-sulfur coal has been burned in a conventional boiler. All of these programs are aimed at allowing coal, our most abundant fossil resource, to be utilized in compliance with environmental regulations.

The Office of Program Planning and Analysis, through subcontract No. 7384 to Chem Systems Inc. from Union Carbide, the operators of the Oak Ridge National Laboratories, retained Chem Systems to perform an economic comparison of five of these alternatives. This comparison was intended to place on a common basis a number of studies that had been performed separately.

The most recently published comparisons of flue gas desulfurization (FGD) processes have been by the Tennessee Valley Authority (TVA) for EPA (1,2). This work was used as a basis here for the design of the limestone and magnesium oxide (MgO) flue gas desulfurization (FGD) systems downstream of a conventional pulverized coal boiler.

An atmospheric fluidized-bed (AFB) combustion case was based on the Energy Conversion Alternative Studies (ECAS) by General Electric for NASA's Lewis Research Center⁽³⁾.

The base case for a coal-fired power plant with no sulfur oxide control system was derived largely from the ECAS studies⁽⁴⁾.

The fifth case combined mechanical cleaning of the coal and scrubbing of part of the flue gas by the limestone scrubbing process. The design of the coal cleaning plant and the purchased cost of major equipment for it were supplied (under a subcontract to Chem Systems) by Powell Construction.

Chem Systems has evaluated these five processes on a consistent basis. A new, 500-MW plant at a Midwestern location was chosen. Reasonable parameters for the site and the coal to be used in the plant were developed. The process flow sheets and descriptions were derived from the sources named above. Equipment lists, where available, were taken from the same sources. Chem Systems reviewed the published information for consistency and developed independent capital cost estimates on a common basis. These capital cost estimates were then used to estimate annual fixed charges for each of the five cases. The total annual operating costs were estimated using Chem Systems' independent review of raw materials and labor requirements given in the earlier studies.

This report presents Chem Systems' capital and operating cost estimates for the five cases.

II. SUMMARY

This report by Chem Systems for the Department of Energy under subcontract No. 7384 to Oak Ridge National Laboratories (operated by Union Carbide) presents the results of an economic comparison of five alternative processes for coal utilization. The cases considered here are based on the net generation of 500 megawatts (MW) of electric power at a new, pulverized coal facility located in the Midwest, designed to meet New Source Performance Standards of 1.2 pounds of SO_2 per million Btu of coal.

The pertinent characteristics of the site and the coal used are shown in Table II-1. The factors that most significantly affect the capital cost are the load-bearing capacity of the soil, the accessibility of the site by rail and barge for delivery of equipment and materials during construction, and the BTU content and sulfur content of the coal. The parameters assumed for the site are typical for Midwestern locations as it was felt that such parameters would be representative of future power plant sites. The characteristics of the coal are those typical of a Southern Illinois No. 6 coal, a likely fuel for a plant in this location. The economic impact of coals with different sulfur contents was also considered in the sensitivity analyses.

The capital costs for each of the five cases are summarized in Table II-2. The base case - a pulverized coal-fired unit with no SO_2 emission controls - is based upon the design in the ECAS work⁽⁴⁾. The fluidized bed combustion system is also based upon an ECAS design⁽³⁾. The design bases for the limestone scrubbing and magnesium oxide scrubbing systems are taken from earlier work by the TVA^(1,2). For these four cases, sufficient detail was available to perform fully independent capital cost estimates, which are the values shown in the table. The last case in Table II-2 combines mechanical cleaning and limestone scrubbing. For this case, the cleaning plant design was verified by Powell Engineering, which also supplied an equipment list and an estimate of the purchased cost of the equipment. Chem Systems developed the cost estimate for the installation of the cleaning plant.

The capital cost for the limestone scrubber in this last case was derived by Chem Systems.

The incremental capital costs for control of SO₂ emissions shown in Table II-2 includes the cost for the control system, the cost of additional generating capacity to maintain a net 500 MW output, and costs for support systems, land, contingencies, etc. The regeneration section of the MgO FGD system and the coal cleaning plant are relatively capital - intensive. Thus, these two cases require higher incremental investment than the limestone FGD and AFB.

TABLE II-1

KEY CHARACTERISTICS OF THE PLANT SITE AND COAL

Site Characteristics

- River front location
- Soil load-bearing: 4,000 psf
- Depth of footings: 36 inches

Coal Characteristics

- Washed and sized before delivery
- Sulfur content: 3.5 percent
 - inorganic: 2.1 percent
 - organic: 1.4 percent
- Higher heating value: 12,000 Btu/lb

TABLE II-2

SUMMARY OF CAPITAL COST ESTIMATES
(\$ million)

<u>Case</u>	<u>Total Plant Cost</u>	<u>Increment for SO₂ Emissions Control</u>
Base Case	244	-
AFB	286	42
Limestone FGD	293	49
MgO FGD	307	63
Coal Cleaning & Limestone FGD	311	67

The summary of operating costs, including fixed charges, for the five cases are tabulated in Table II-3. These costs include no sludge disposal charges for either of the limestone slurry cases. Also, the cost for the magnesia slurry case does not reflect any credit for the byproduct, sulfuric acid. If these assumptions are made, there is no incentive for cleaning the coal before burning it, as this would become the most expensive method. The limestone FGD system is the lowest cost SO₂ emission control alternative.

TABLE II-3
SUMMARY OF OPERATING COST ESTIMATES

<u>Case</u>	Total Operating Cost Annual (\$ Million)	Unit (mil/kwh)	Increment for SO ₂ Emission Control (mil/kwh)
Base case	97	27.8	-
AFB	121	34.5	6.7
Limestone FGD	118	33.8	6.0
MgO FGD	120	34.4	6.6
Coal Cleaning & Limestone FGD	125	35.7	7.9

In addition to the basic estimates of capital and operating costs, some consideration was given to sensitivity of the costs to the following parameters.

- Level of SO₂ Emissions - Increasing the SO₂ removal capability to achieve 90 percent reduction adds about \$900,000 to the capital cost and 0.3 mil per kilowatt - hour to the operating cost for limestone FGD. For MgO FGD, the cost increments are \$2,800,000 for capital and 0.8 mil per kilowatt - hour for operation.
- Level of Sulfur in the Coal - For New Source Performance Standards, coal at 2 percent or 5 percent sulfur would have an appreciable effect on both capital and operating costs, as shown

in Tables II-4 and II-5. The relatively capital-intensive MgO FGD and coal cleaning systems show high sensitivity to coal sulfur level in their capital requirements. The inefficient use of limestone in the AFB becomes significant in its operating cost at the higher level of sulfur.

TABLE II-4

TOTAL PLANT INVESTMENT FOR THREE LEVELS OF SULFUR IN COAL
(\$ Millions)

Sulfur level in coal, %	2	3.5	5.0
Base case	243.9	243.9	243.9
Atmospheric fluidized bed	281.7	285.5	288.4
Limestone FGD	289.4	292.6	295.3
Magnesia FGD	298.4	307.1	321.1
Coal cleaning & Limestone FGD	-	311.3	317.4

TABLE II-5

OPERATING COST ESTIMATES FOR THREE LEVELS OF SULFUR IN COAL
(mil per kilowatt - hour)

Sulfur level in coal, %	2.0	3.5	5.0
Base case	27.8	27.8	27.8
Atmospheric fluidized bed	33.0	34.5	35.9
Limestone FGD	33.0	33.8	34.6
Magnesia FGD	33.7	34.4	35.6
Coal cleaning & Limestone FGD	-	35.7	36.7

- By-product Credit for Sulfuric Acid - If a net credit of \$18 per ton of acid can be obtained, the MgO FGD system becomes competitive with the limestone FGD system at the design basis conditions. A recent TVA study (5) shows that such credits might be possible.

- Sludge Disposal and Fixation - Landfill disposal of the dewatered sludge with fixation by the IUCS Poz-o-Tec process adds about \$4.1 million to the investment cost and 0.8 mil per kilowatt - hour to the operating cost for the limestone FGD alternative. The effect of these costs is to make both the MgO FGD and the AFB alternatives relatively more attractive.

III. TECHNICAL AND ECONOMIC CRITERIA

A. Technical Criteria

Plant designs were developed from criteria used in the NASA Lewis ECAS reports, the TVA's report for EPA, information supplied by Powell Construction and Chem Systems' prior experience. These criteria included coal data, site location, material and heat balances, process equipment requirements and general plant requirements. These are consistent for all cases treated in this study.

The site for the plant is non-specific; we assumed it to be adjacent to the Ohio River or one of its tributaries, west of Cincinnati, Ohio and east of Peoria, Illinois. Table III-1 shows pertinent conditions for the site. We assumed the site was free from major impediments with no demolition of buildings, rights-of-way for pipelines, overhead wires, roads or heavy brush. As some of these are usually encountered at any location, this assumption is optimistic.

TABLE III-1

SITE CONDITIONS

Location: West of Cincinnati, Ohio and east of
Peoria, Illinois. River access.

Design ambient temperatures:

Summer dry bulb	88°F
Summer wet bulb	75°F
Winter dry bulb	0°F

Civil Design Data:

Soil Type	Sand plus dry clay
Soil Density	85 lb/cu ft
Soil Bearing Capacity	4000 lb/sq ft
Footings	36 in

TABLE III-2CHARACTERISTICS OF COAL RECEIVED AT POWER PLANT SITE

Type	Illinois No. 6
Ash Content, %	12.0
Sulfur content, %	3.5
Inorganic, %	2.1
Organic, %	1.4
Higher heating value, Btu/lb	12,000
Coal size as received	1-1/2" x 0
Delivery	Rail

Table III-2 gives the characteristics of the Illinois No. 6 coal used for this study. A location at the mouth of a mine was not assumed. The coal was assumed to be washed and sized, then delivered by train. Thus, coal handling requirements were reduced for all cases except that of coal cleaning/partial scrubbing.

For all cases, equipment was sized to achieve a net 500 MW of electric power from the plant. A balanced draft boiler design along with the following combustion emission parameters were selected for the four cases which use a conventional boiler:

- Combustion of pulverized coal
- 20 percent excess air to the boiler
- 13 percent additional air leakage at the air heater(s)
- 75 percent of ash present in the coal emitted as fly ash
- 92 percent of entering sulfur emitted as SO_2

Net plant products were restricted to flue gas, electricity and sulfur or waste streams containing sulfur compounds. Ash disposal was not considered. It would be common cost for the four cases which use a conventional boiler. Ash plus spent limestone must be disposed of from the atmospheric fluidized bed boiler. Table III-3 shows the estimated flue gas composition for the base case power plant without an emission control facility.

TABLE III-3ESTIMATED FLUE GAS COMPOSITION FOR A POWER PLANT
WITHOUT AN EMISSION CONTROL FACILITY*

Flue gas composition, vol. %	
Nitrogen	74.55
Carbon dioxide	12.55
Oxygen	4.86
Water	7.76
Sulfur dioxide	0.22
Nitrogen dioxide	0.06
Fly ash loading,	
Grain/SCF (dry)	4.11
Grain/SCF (wet)	3.79
Gas flow at 310°F, ACFM	1,540,000
Equivalent SO ₂ emission rate to SO ₂ recovery system, lb/hr	22,760

*Fuel containing 3.5 percent sulfur.

Process and equipment design for the four alternatives for control of SO₂ emissions will meet the following standards (the standard for particulates was also applied to the base case):

- Particulates: 0.1 pounds per million Btu heat input
- Sulfur dioxide: 1.2 pounds per million Btu heat input

For the design basis coal (Table III-2), these standards require that 98.7 percent of the particulate matter and 76.3 percent of the SO₂ be removed. The particulate removal systems all have 99.0 percent removal efficiency and the design for the FGD systems provides for either 90 percent SO₂ removal or meeting the emissions standard. The SO₂ emission level of the AFB and the coal washing/limestone FGD were adjusted to the 1.2 pounds per million Btu level.

Reheat to restore buoyancy to the plume after aqueous scrubbing is generally required. The degree of reheat depends upon site - specific conditions. For the non-specific site of this study (Table III-1), reheat to 1750°F is provided for the cases involving FGD processes.

Because the plant is a grass roots installation, it will be self-supporting, including fuel, steam and electric power at the

necessary conditions for start-up and emergency situations. In addition to the specific equipment described in Section IV, the following facilities are provided and included in the cost estimate for each case:

- Power recovery
- Cooling tower
- Plant and instrument air
- Potable and utility water
- Fuel gas and nitrogen systems
- Fire water
- Effluent water treating
- Electrical substation and distribution
- Buildings
- Maintenance
- Laboratory
- Rail
- Roads
- Fencing
- Temporary unloading dock for barge-delivered items

Generally, the process equipment is commercially available. Advanced equipment designs are incorporated where:

- the equipment is expected to be commercially available in the near future;
- the equipment is viewed as a logical, economical extension of the present state of the art.

Since the site includes a temporary unloading dock, mechanical design data are based on delivery by barge of larger-than-normal, shop-fabricated equipment (Table III-4).

Table III-4 also indicates the limits used for shop fabrication of piping, rather than field fabrication, and the design values for wind loadings.

TABLE III-4
MECHANICAL DESIGN DATA

Shop fabrication envelope	
Diameter, ft	18
Length, ft	120
Weight, tons	250
Remote shop fabrication for piping:	
Diameter (min), in.....	2.5
Diameter (max), in.....	30.0
Length, ft	28
Wind loading	
Wind speed, mph	80
Loading, lb/sq ft	16

Redundant equipment or systems are provided where failure would jeopardize a substantial fraction of plant capacity. Major equipment is not spared where experience indicates minimal probability of failure or where multiple trains are provided that limit the impact of a failure should it occur. In addition, redundancy is not provided where intermediate storage permits bypass of equipment for a sufficient period of time to accomplish reasonable maintenance and repair. The sparing provided is noted in the plant description section for each case and on the process flow diagrams. The degree of redundancy is compatible with a 90 percent onstream factor in the early years of plant life. The plant designs depicted here are intended to represent what is possible when all of the technology is fully established and does not reflect the approach to be taken on a "first-of-a-kind" plant.

B. Economic Criteria

A set of criteria for estimating capital requirements and costs of services was supplied by Chem Systems. These criteria are summarized in Tables III-5 and III-6.

The proprietary COST program of Icarus Corporation was used to develop the capital costs for each of the five cases. A detailed discussion of the COST program is presented in Appendix A. The program develops cost estimates from detailed component designs to form the basis of the unit operation cost. This cost development includes parameters such as material and labor cost indexes, capability of shop fabrication and site conditions.

The Marshall-Swift Index value of 530 was used. Construction costs were based on the Engineering News Record construction index of 2705. These values of the material and labor indexes can be adjusted to fit other cases, as desired.

The cost do not include inflation or loan interest during construction and start-up.

TABLE III-5CAPITAL INVESTMENT BASIS

<u>Item</u>	<u>Basis</u>
Total plant investment	First quarter of 1978 dollars with no escalation during construction and start-up. Riverside location between Cincinnati, Ohio and Peoria, Illinois. Clear and level site.
Total plant investment definition	<p>The sum of:</p> <p>(a) Process (or onsite) plant investment costs.</p> <p>(b) General facilities (or offsites) investment costs.</p> <p>(c) Contingencies.</p> <p>These items are discussed below:</p>
Process plant investment	Total constructed cost of all onsite processing units including all direct and indirect construction costs. No sales and/or use taxes are included.
General facilities	The capital cost of the offsite facilities is accounted for explicitly. Offsite facilities include roads, building, railroad loading and unloading systems, electrical distribution and substations, cooling water systems, inerting systems, effluent water treatment facilities, etc. No sales and/or use taxes are included.
Project contingency (in the first quarter of 1978)	This factor is intended to cover additional equipment that would result from a more detailed design of a definitive project at an actual site. An allowance of 10 percent of the bare plant cost is used.
Process contingency	This contingency factor is to be applied to unproven technology in an effort to quantify the uncertainty in the design, performance and cost of the commercial-scale equipment. The process contingency allowance for each such operational unit is 7.0 percent of the equipment cost.

TABLE III-5 (continued)CAPITAL INVESTMENT BASIS

<u>Item</u>	<u>Basis</u>
Total capital requirement	The total capital requirement includes the capital necessary to complete the entire project: a) Total facility cost b) Land plus site preparation c) Start-up plus modification. <u>Not</u> included are: a) Royalties b) Construction loan interest.
Land plus site preparation	Land cost at \$30,000 per acre plus a computer-generated site preparation cost of \$2,000,000. (This is likely to be a minimum preparation cost due to the optimism of the site specifications given in Section III-A.)
Start-up plus modification	The minimum preproduction cost is 8 percent of total facility cost, with a sliding basis up to 12 percent for unproven technologies.
Royalties	Royalties are not included
Construction loan interest	No construction loan interest is included.

TABLE III-6

COST OF SERVICES BASIS

<u>Item</u>	<u>Basis</u>
Direct Costs	
Operating factor, %	
Fossil fuel power unit	80
SO ₂ recovery processer	90
Cost of coal delivered, \$/ton	27.00
Cost of lime delivered, \$/ton	47.00
Cost of limestone delivered, \$/ton	29.00
Cost of magnesium oxide delivered, \$/ton	204.00
Cost of coke delivered, \$/ton	25.00
Cost of magnetitie delivered, \$/lb	0.03
Cost of fuel oil delivered, \$/gal	0.348
Cooling water \$/1,000 gal	0.041
Treated water \$/1,000 gal	0.90
Electricity, \$/kwh	0.021
By-product heat credit, \$/10 ⁶ Btu	0.98
Ash disposal, \$/ton	1.00
Operating supervision, \$/hr	14.00*
Operating labor, \$/hr	10.00**
Maintenance labor and materials	Varies with the uncertainty of the process. A minimum of 2 mil/kw was used.
Analyses	\$500,000 for power plant plus \$250,000 for additional sampling for SO ₂ monitoring.
Indirect costs	
Average capital charge	18.5 percent of total capital
Overhead	
Plant	20.0 percent of conversion costs (direct costs minus raw material costs)
Administrative	4.0 percent of conversion costs.

*This labor rate corresponds to a direct labor charge of \$10.35 per hour plus a 35 percent payroll burden.

**This labor rate corresponds to a direct labor charge of \$7.40 per hour plus a 35 percent payroll burden.

IV. PROCESS DESCRIPTIONS

A. Base Case - Conventional Plant

The base case consists of a conventional steam-electric plant burning pulverized coal. The flow sheet is shown as Figure IV-1 while the material balance is presented as Table IV-1. The plant design is based in part on the ECAS design (4). This case was scaled down and adjusted for the coal used in this study. No treatment is included for removal of SO_2 from either the coal or the stack gas. This case provides a basis for comparing the costs of the four alternative SO_2 removal systems.

Coal, received from the mines (properties as shown in Table III-2) is off loaded by a rotary car dumper system (Figure IV-1). This system is capable of handling twenty (20) 100-ton hopper cars per hour. Through a series of three (3) 3000-ton per hour unloading conveyors, CO-107 through 109, the coal is fed to the stacker boom for eventual distribution onto the live storage pile. Adjacent to the live pile is an additional 362,000 tons of dead coal storage, approximately a 60-day supply.

The coal feed system provides transportation by reclaim conveyors, CO-119 and 120, to the five coal silos, VT-101 through 105, each of which holds 10,430 cubic feet of coal. Tramp iron is removed during this transfer operation.

Each of the filled silos holds an eight-hour supply for the boiler at full output. Each silo feeds a single coal pulverizer gravimetrically. Coal conveyance to the burners is by hot primary air. For start-up and warm-up, an oil-fired system that burns no. 2 oil and a 100,000 gallon fuel storage tank are provided.

The steam generation unit and its auxiliary equipment are included in Section 400. There are five ball mill pulverizers, CR-401 A through E,

TABLE IV-1
MATERIAL BALANCE FOR
BASE CASE
CONVENTIONAL STEAM PLANT

[illegible]

which are located at the steam generation base elevation. Coal from the pulverizers, along with hot primary air from the primary air fans, FN 402 A-E, enters the burners. The burners are arranged on opposing sides of the radiant furnace section. Combustion gas flows upward over and across the superheater sections, then downward through the reheater and primary superheater, and finally emerges from the superheater.

The heat to steam for this super critical boiler is 87.1346 percent of the higher heating value. The boiler is a balanced draft, net 500 MW unit. The steam cycle output will generate 548.7 MW, with 48.7 MW required to run to auxiliary equipment.

The main superheater steam is supplied to the steam turbine plant at 3600 psig and 1000°F while the reheated steam is supplied at 710 psig and 1000°F.

The induced draft fans, FN-403 A through C, are downstream of the electrostatic precipitators, DC-401 A through C. Combustion air to the boiler is supplied by forced draft fans, FN-401 A through C. Between 15 and 20 percent of the total combustion air is heated to 633°F in the hottest section of the air preheaters, HE-400, A through C.

The electrostatic precipitators are included in the base case. These units, which have an efficiency of 98.6 percent, collect almost 75 percent of the total ash. The remaining 25 percent is collected from the bottom of the main furnace chamber. The collected fly ash is stored in dry silos for shipment off-site. The main plant boiler stack is included in the base case.

Not shown but based on information in (4), the steam turbine comprises four shells, including a high-pressure turbine, preheat turbine, and two double-flow, low-pressure condensing turbines arranged in tandem with the single generator. The purchased cost information, based on (4), is shown in Section 500 of the computer printout.

Section 600, not shown in Figure IV-1, includes the feed water system with its seven feedwater heaters and its pumping system.

B. Atmospheric Fluidized Bed Steam Generator

The atmospheric fluidized-bed steam generator (AFB) cost estimate is based on information contained in the ECAS report (3). Coal and limestone are mechanically blended and injected into a series of combustion chambers where the coal is burned and the heat released is used to generate steam. The limestone reacts with sulfur dioxide (formed during combustion) to form calcium sulfate. Substituting the AFB for a conventional steam generator eliminates the need for downstream desulfurization of the flue gas. The material balance is presented as Table IV-2, while the flow diagram is shown in Figures IV-2 through IV-4.

In Figure IV-2, coal is offloaded by a rotary car dumper system identical to the system explained in Section IV-A and transferred to the live pile as described in Section IV-A. The coal feed system provides transportation by belt conveyor, CO-119 and CO-120, to the five transfer coal silos, VT-101 through 105, each of which holds 10,430 cubic feet of coal. The filled silos feed three coal dryers, VT-106 through 108, after removal of tramp iron. The coal is dried by counter-current contact with a portion of the hot gases leaving the solids cooler, VT-406 A-C. It is then crushed in CR-101-103 and conveyed to the coal/limestone blending section.

A similar system that provides for the unloading and handling of limestone, Section 200, is also shown in Figure IV-2. After it is dried, the limestone is conveyed to the coal/limestone blending section.

In Section 300 (Figure IV-3), coal is combined with limestone and conveyed to the AFB main cells.

As shown in Figure IV-4, primary air assists the coal/limestone flow down through the many injection needles or tubes into the beds. A portion of the limestone fed from VT-302 goes directly to the carbon burnup cell. The three atmospheric fluidized-bed modules, WTS-401 A through C, each

TABLE IV-2
MATERIAL BALANCE FOR
ATMOSPHERIC FLUIDIZED BED PROCESS

[illegible]

CHEM SYSTEMS INC. 747 THIRD AVENUE NEW YORK, N. Y. 10017	
AFB SYSTEM COAL AND LIMESTONE HANDLING SECTIONS	
DRAWN BY _____ APPROVED BY _____	DATE _____ NO. 304

FIGURE IV-3

	CHEM SYSTEMS INC.	
	747 THIRD AVENUE	
	NEW YORK, N. Y. 10017	
	TITLE	
A F B SYSTEM		
COAL / LIMESTONE		
FEED SECTION		
DRAWN BY _____		DATE _____
APPROVED BY _____		DATE _____
		NO. 4

FIGURE IV-4

CHEM SYSTEMS INC.
747 THIRD AVENUE
NEW YORK, N. Y. 10017

AFB SYSTEM
FURNACE SECTION

DRAWN BY _____ DATE _____
APPROVED BY _____ DATE _____ NO. 304

consist of six main cells (MBC), stacked on top of the carbon burnup cell (CBC). Ducts for air and flue gas taper from top to bottom in proportion to the local gas flow. The system described in the ECAS report included four modules of a 814.3 MW unit. A three module unit was designed by scaling down each module by 18 percent.

C. Limestone Slurry Scrubbing

The design of the limestone slurry scrubbing system used here for control of SO_2 emissions is based on information included in EPA-600/2-75-006 (1). The balance of power plant is on the same basis as the base case described in Section IV-A. The process flow diagram is shown as Figures IV-5 and IV-6. The material balance is presented in Table IV-3. SO_2 is removed by contacting the stack gas in a multi-bed absorber with a recirculating aqueous slurry of ground limestone and reactor product.

As shown in Figure IV-5, limestone is first received by rail at the power plant as 0 x 1.5 inch material and is conveyed by CO-102, to a 30-day storage pile. The limestone is next reduced in size to 0 x 3/4 inch by gyratory crushers, CR-201 A and B, wet ground to 70 percent -200 mesh in two parallel ball mills, M-201 A and B, and stored as a 60 percent by weight aqueous slurry in the feed tank, VT-201, which has an eight-hour capacity.

The limestone slurry is pumped via CP-201 A or B to the slurry effluent hold tank(s), VT-401 A-C, (Figure IV-6). There it is combined with effluent slurry from the scrubbers and reclaimed water from the thickeners and filters to maintain a 10 percent by weight solids slurry. Next, 30,300 gallons per minute are pumped to the SO_2 absorbers, TW-401 A, B and C. The SO_2 absorption system consists of three parallel trains. (The original four-train EPA design was modified so that the four SO_2 emissions control systems could be compared on an equivalent basis.)

A 6,500 gallon per minute bleed stream of slurry overflows VT-401 A through C, and is circulated through the venturi scrubbers, VT-302 A, B and C, to remove fly ash.

The spent slurry, consisting of calcium compounds and fly ash, is pumped via CP-601 A and B to the thickeners, T-601 A and B. Underflow from the thickeners is pumped through the vacuum filters, F-601 A and B; the

TABLE IV-3

MATERIAL BALANCE FOR

LIMESTONE SLURRY SCRUBBING

28

★★ $M = 1000$

+ One of two similar streams

FIGURE IV-5

CHEM SYSTEMS INC.
747 THIRD AVENUE
NEW YORK, N. Y. 10017

LIMESTONE SLURRY PROCESS
LIMESTONE RECEIVING
& SLURRYING

DRAWN BY _____ DATE _____ NO. 304
APPROVED BY _____ DATE _____

resulting cake, which contains 50 percent solids, is disposed of offsite. Overflows from the thickeners are recycled to the wet ball mills and to the SO_2 absorber hold tanks.

The stack gas leaving the scrubbers is reheated from 137°F to 175°F by the indirect steam (500 psig) tubular heat exchangers, HE-401 A, B and C, constructed within each exit flue gas duct upstream of the fans. The half of the tube bank on the scrubber side is made of Inconel 625 and the half on the fan side of Cor-Ten.

A total of 60 soot blowers are provided for periodic cleaning of the scrubbers, TW-401 A, B and C, and the reheaters, HE-401 A, B and C. The induced draft (ID) fans, FN-401 A, B and C, are designed to accomodate a pressure drop of 39 inch of H_2O . As this is greater than the base case pressure drop of 24 inches, a cost penalty is incurred.

D. Magnesia Slurry Scrubbing

The design of the magnesia slurry scrubbing system used in this case to control SO_2 emissions is based on information included in EPA-600/2-75-006 (1). The balance of the power plant is on the same basis as the base case described in Section IV-A. The process flow diagram is shown as Figures IV-7 through IV-9, while the material balance is presented as Table IV-4. SO_2 is removed by contacting the power plant stack gas with an aqueous slurry of magnesium oxide (MgO) absorbant.

In Figure IV-7, the process flow begins with fresh make-up MgO being unloaded from covered hopper cars by a pneumatic conveying system and stored in the makeup MgO storage silo, VT-103. The fresh MgO is then fed along with regenerated MgO to the slurry tank, VT-104. Here the combined MgO is slurried with a bleed stream of recycle liquor from the SO_2 absorbers and recycled to the SO_2 absorption system.

Flue gas enters the particulate scrubbers, VT-201 A through D (Figure IV-8). The particulate scrubbers operate in a closed loop by recycling slurry from the flyash pond. The flyash slurry is neutralized with slaked lime and returned to the power plant ash disposal pond. The flue gas entering the SO_2 absorption flows into the SO_2 absorbers, VT-301 A through D. The SO_2 absorbers are rubber-lined venturi scrubbers with stainless steel, chevron-vane entrainment separators. The combined recycle liquor - fresh make-up MgO removes SO_2 from the flue gas by forming magnesium sulfite/sulfate in the scrubber. The stack gas leaving the scrubbers is reheated to 175°F by 500 psig steam in four tubular heat exchangers, HE-301 A through D. The heated gas then passes through the ID fans and up the stack.

The spent liquid from the SO_2 absorbers is combined with part of the recycle MgO and pumped to the wet screens, VS-501 A through D (Figure IV-7), for thickening from 10 to 40 percent solids. The $\text{MgSO}_3 \cdot 6\text{H}_2\text{O}$ in the slurry is thermally converted to $\text{MgSO}_3 \cdot 3\text{H}_2\text{O}$ in the

33

FIGURE IV-7

CHEM SYSTEMS INC. 747 THIRD AVENUE NEW YORK, N. Y. 10017	
TITLE MAGNESIA SLURRY : REGENERATION PROCESS RAW MATERIAL RECEIVING & CONCENTRATION	
DRAWN BY _____ APPROVED BY _____	DATE _____ DATE _____
NO. 700 4

FIGURE IV - 8

	CHEM SYSTEMS INC. 747 THIRD AVENUE NEW YORK, N. Y. 10017	
	TITLE MAGNESIA SLURRY- REGENERATION PROCESS SO₂ ABSORPTION	
DRAWN BY _____ DATE _____		NO. 304
APPROVED BY _____ DATE _____

FIGURE IV-9

CHEM SYSTEMS INC. 747 THIRD AVENUE NEW YORK, N. Y. 10017		
MAGNESIA SLURRY- REGENERATION PROCESS CONVERSION & RECOVERY		
TITLE MAGNESIA SLURRY- REGENERATION PROCESS CONVERSION & RECOVERY	DRAWN BY _____ DATE _____ APPROVED BY _____ DATE _____	NO. 04

conversion tank, VT-502, which combines the flow from the four trains in the absorption section. The $\text{MgSO}_3 \cdot 3\text{H}_2\text{O}$ slurry is pumped, CP-503 A or B, to two parallel centrifuges, CT-501 A and B, where the solids are separated from the liquor. Filtrate and underflow from the wet screens, VS-501 A through D, are recycled to the SO_2 absorption loop via the liquor tank, VT-501.

The centrifuge cakes are dried in a oil-fired, single-stage fluid-bed dryer, HT-601. Dryer off-gas is cleaned in a cyclone/fabric dust collector system. A portion of the gas is recycled to the dryer dust collection unit for temperature control. The remainder partially reheats the main stack gas stream.

The collected MgSO_3 solids are conveyed to an in-process storage silo with a live bottom, VT-603 (Figure IV-9). The solids are then fed along with coke from VT-102 to the oil-fired fluid bed calciner, VT-701. MgSO_3 is calcined by direct combustion with coke and (in the upper stage) with fuel oil to form MgO and SO_2 . The MgO is drained from the lower, cooled section of the calciner and returned to the slurry preparation area, VT-703 (Figure IV-7).

Off-gas from the calciner is partially cleaned in a cyclone, cooled to 700°F in a waste heat boiler and eventually fed to the sulfuric acid plant, Section 800 (Figure IV-8).

A complete 400 ton per day, conventional, contact sulfuric acid unit is provided for production of 98 percent acid. Three 500,000-gallon product storage tanks (30 days production) are included in the plant. The sulfuric acid plant is treated as a package unit in the capital cost estimate.

E. Coal Cleaning/FGD

Case E consists of a combined coal cleaning/limestone FGD system. The coal cleaning facility was designed by Powell Construction under a subcontract to Chem Systems. Powell also supplied the estimated purchased equipment costs for this part of the system. The coal feed, which contains 3.5 percent sulfur, is washed first with water and then with heavy media solution containing magnetite to reduce the sulfur in the fired coal to about 2 percent. This lower sulfur content means that only two of the three limestone scrubbing trains described in Section III-C are required to achieve a SO_2 emissions level of 1.2 pounds per million Btu of fired coal. As in the other cases, the balance of the power plant is as described in Section IV-A.

The coal washing system operates 1,500 hours per year. (This corresponds to current practice in the industry. Economies are possible with higher utilization factors.) It processes 1,200 tons per hour of coal. Of the 144 tons per hour of ash entering with the coal, 78 TPH is rejected to refuse. The fuel stream is then reduced in ash from 12 to 7 percent. The material balance is given in Table IV-5.

The raw coal is transported to the rotary dump by rail car (Figure IV-10). The rail car is rotary dumped and fed onto the raw coal storage belt for conveying to the 25,000-ton open storage pile. The coal is reclaimed at a maximum rate of 1,200 tons per hour and fed onto the reclaim belt for transfer onto the plant feed belt after removal of tramp iron. The tonnage rate is monitored and controlled by the plant feed belt scale, which insures a constant feed rate. The current feed rate as well as totals are recorded here.

The raw coal is fed onto the raw coal screens, VS-201 A through F where the plus 4 inch fraction (less than 1 percent of the total) is scalped off for reject. A 1 1/4 inch size classification is made on the bottom deck and the plus 1 1/4 inch material is crushed in a double roll crusher, CR-201 and returned to the minus 1 1/4 inch fraction.

TABLE IV-5
MATERIAL BALANCE FOR
COAL CLEANING

39

FIGURE IV-10

CHEM SYSTEMS INC.
747 THIRD AVENUE
NEW YORK, N. Y. 10017

COAL WASHING/FGD COMBINATION
COAL RECEIVING/
PRIMARY SEPARATION

DESIGNED BY _____ DATE _____
APPROVED BY _____ DATE _____

NO 304

The minus 1 1/4 inch raw coal is pulped in the raw coal sumps, VT-201 A through C, and pumped to the desliming sieves and screens, where a 28 mesh size classification is made. The minus 28 mesh coal is pumped to the hydrocyclones, DC-202 A-L, where a gravity separation is made. The refuse is sent to the thickener (Figure IV-11), and the clean coal is pumped to classifying cyclones, where it is size classified at 100 mesh. The minus 100 mesh is discarded to the thickener. The 28 mesh by 100 mesh material is partially dewatered on vibrating screens in preparation for the final dewatering in centrifugal dryers before reporting to the clean coal belt.

The plus 28 mesh fraction from the desliming sieves and screens passes by gravity through the primary heavy media cyclones and by pumping through the secondary heavy media cyclones, where the required gravity separation is made (Figure IV-11). The two products are drained of magnetite and rinsed. The reject is dried in a centrifuge and conveyed by the refuse belt to a refuse bin for loading onto trucks. The clean coal product is dried in a centrifuge and conveyed by the clean coal belt to the 10,000-ton clean coal silo. The secondary heavy media cyclones can be by-passed when required.

The reject minus 28 mesh settled in the thickeners, T-201 A and B, is pumped to refuse filters for dewatering and then reports to the refuse belt. The clarified water from the thickeners is recirculated to the plant for reuse.

Auxiliary equipment and facilities consist of automatic feed rate control, automatic specific gravity control with common dilute circuit for magnetite recovery, automatic sump level control, by-pass arrangements for secondary heavy media cyclones, automatic sampling system, automatic underflow diversion for filter feed for uninterrupted pump operation, semiautomatic flocculent facilities, automatic floor clean-up sump system, and a 200,000-gallon water storage tank.

Downstream equipment is similar to that previously described in Sections III-A and III-C.

FIGURE IX-11

CHEM SYSTEMS INC. 747 THIRD AVENUE NEW YORK, N. Y. 10017	
COAL WASHING / F G D COMBINATION HEAVY MEDIUM SEPARATION	
DRAWN BY	DATE
APPROVED BY	DATE
NO 304	

V. COST ESTIMATES AND COMPARISONS

The capital and operating cost estimates for the five cases in Section IV were developed by Chem Systems using the assumptions and bases presented in Section III. The capital costs were estimated using the COST system of Icarus Corporation. This system, described in Appendix A, is a computer-based, detailed estimating technique that follows the same procedures used by equipment vendors and engineering construction firms. A typical detailed cost output, in this instance for a pump, is given in Appendix B. The capital costs are discussed and tabulated in Section V-A and the operating cost estimates are presented in Section V-B. The sensitivity of the operating costs to sulfur content in the coal, to sulfuric acid by-product credit, and to sludge disposal and fixation costs are discussed in Section V-C. The impact of sulfur removal requirements is also considered in Section V-C.

A. Capital Cost Estimates and Comparisons

Table V-1 summarizes the results of the capital cost estimates. The areas shown in the Table represent the major operating units of these power plants. The costs for the SO₂ emissions control cases are based on the limit of 1.2 pounds of SO₂ per million Btu of coal fired. The cost for 90 percent removal of SO₂ is briefly considered in Section V-C.

For the base case, Chem Systems developed purchased cost information from design parameters by using the COST system. There were two major exceptions to this procedure: the steam generator and the electrical turbine systems. These costs were developed from reference (4). Fan costs were developed from information supplied by American Blower. Also, the cost of the rotary car dumper was supplied directly by Icarus, not computed.

Bulk cost items which include amounts for equipment setting, civil, piping, electrical, painting, instrumentation and insulation were developed by Chem Systems, using the COST program. Bulk accounts for the

TABLE V-1
SUMMARY OF CAPITAL COST ESTIMATES
(\$ 1,000)

	I	II	III	IV	V
		Atmospheric Fluidized Bed	Limestone Scrubbing	Magnesia Slurry Scrubbing	Coal Washing with Partial Limestone Scrubbing + Base Case
<u>Operational Unit</u>	<u>Base Case</u>	<u>System</u>	<u>+ Base Case</u>	<u>+ Base Case</u>	
1. Coal Handling	4,220	4,220	4,490	4,460	4,560
2. Absorbant Receiving and Preparation	-	3,110	1,440	2,180	1,440
3. Fuel Preparation	-	8,710	-	-	16,860
4. Steam Generation	66,190	70,010	69,530	69,040	67,900
5. Electric Generation and Main Water Systems	84,720	84,720	84,920	84,920	84,920
6. Scrubbing	-	-	15,990	16,220	10,060
7. Absorbent Removal/Regeneration	-	-	3,080	11,040	2,550
8. Auxiliary Equipment	<u>12,440</u>	<u>16,240</u>	<u>13,940</u>	<u>14,960</u>	<u>14,180</u>
Total Field Cost	167,570	187,010	193,390	202,820	202,470

TABLE V-1 (Continued)
SUMMARY OF CAPITAL COST ESTIMATES
(\$ 1,000)

	I	II	III	IV	V
		Atmospheric Fluidized Bed	Limestone Scrubbing	Magnesia Slurry Scrubbing	Coal Washing with Partial Limestone
	<u>Base Case</u>	<u>System</u>	<u>+ Base Case</u>	<u>+ Base Case</u>	<u>Scrubbing + Base Case</u>
Total Field Cost	167,570	187,010	193,390	202,820	202,470
Engineering	10,500	12,000	12,680	13,400	14,680
Construction Overhead	13,640	17,910	16,540	17,900	19,640
Bare Plant Cost	191,710	216,920	222,610	234,120	236,790
Contingencies	19,170	21,690	22,260	23,410	23,680
Contractor Fee + Special Charges	8,490	9,570	9,670	10,150	10,370
Total Facility Cost	219,370	248,180	254,540	267,680	270,840
Land + Site Preparation	6,950	7,550	7,550	7,250	8,000
Start-up Plus Modifications	17,550	29,780	30,550	32,122	32,500
Total Plant Cost	243,870	285,510	292,640	307,050	311,340

steam generation section were scaled-up from the largest steam generator size (2.2 million pounds per hour) that could be selected on the COST system. Some other items of equipment were outside the limits of the COST program due to their size or type. Capital costs for these items were developed from known purchased costs. Installation costs were estimated by the COST system using such known equipment parameters as weight, horsepower and envelope dimensions for similar equipment types.

The steam generator was enclosed in an unheated steel structure. The structures for the other plant sections are listed, along with their sizes in the individual section listings in Appendix C, as are the rest of the results of the COST system estimate for the base case conventional boiler. The costs for the coal handling, steam generation, turbines, and main feedwater systems developed for the base case were also used in those cases with scrubbing systems for control of SO_2 emissions.

For the atmospheric fluid bed (AFB) combustion system, purchased equipment costs for the three fluidized bed systems and the turbine costs were adjusted from the ECAS work (4) using scale factors to account for the reduced size of this unit. Each AFB unit was housed in a separate shell. The results are shown in Appendix D.

The limestone FGD case, as well as the magnesia FGD case, reflect Chem Systems' estimates using the COST system (with the exception of the costs for certain Sections (power generation) which were duplicates of those found in the base case. The limestone scrubbing capital cost estimate is presented in detail in Appendix E and that for the magnesia scrubbing case capital cost estimate is given in Appendix F.

The coal cleaning/limestone FGD case is based on coal washing to remove some sulfur and ash prior to combustion followed by limestone scrubbing of part of the flue gas to remove SO_2 formed from combustion of the residual sulfur. Purchased equipment costs for the coal preparation section were based in part on information supplied by Powell Construction. The COST program was then used by Chem Systems to generate

installation costs for the individual items. This information is shown in Appendix G. The limestone scrubbing sections and main plant sections were estimated as described above for the limestone only case.

The site preparation costs are presented in Appendix H. The total preparation cost represents a minimum, as defined in Section III. Higher costs can be expected with selection of a less than optimum site, i.e., existing structures requiring dismantling, a heavily wooded area, marshland, pipeline rights-of-way, etc.

In Table V-1 the total field cost for the base case power station is \$167,570,000. Providing an SO₂ emissions control system increases the field cost to \$187,010,000 for the atmospheric fluidized bed system. The other emissions control alternatives had higher field costs, ranging up to \$202,820,000 for the MgO FGD case.

The fuel preparation section cost of \$7,900,000 for the AFB case shows the increment for the limestone drying and crushing equipment over the coal pulverization and handling for the base case and the two FGD cases. The fuel preparation section cost of \$16,860,000 for case V is the estimated cost of the coal cleaning plant.

The steam generation sections for the conventional boiler cases differ in cost due to the use of three (3) smaller ID fans for the FGD cases and due to the reduced requirements for the electrostatic precipitator, pulverizers and ash handling system for the coal cleaning case. The cost of this section for the AFB case reflects the higher cost of that type of steam generator.

To the total field costs shown in the table, engineering and construction overhead are added to give the base plant cost.

Further allowance must be made for contingencies, contractor's fee, freight and other special charges to arrive at the total facility cost estimates.

In estimating the base case, 165 acres was assumed to be required for the plant site at a cost of \$30,000 per acre. For the base case start-up and modifications, 8% of the total facility cost was provided. Thus, the total plant cost for the base case was estimated to be \$243,870,000.

For the AFB and limestone scrubbing cases, we estimated that an additional 20 acres would be required for these systems and their limestone storage and preparation facilities. The start-up and modification of these two systems would entail more time and risk than the base plant. Hence, a 12% allowance was made, resulting in total plant cost estimates of \$285,510,000 and \$292,640,000 for the AFB and limestone scrubbing cases, respectively.

The magnesia scrubbing system was estimated to require only an additional 10 acres of land over the base case and a 12% allowance for start-up, leading to the total plant cost estimate of \$307,050,000.

The coal beneficiation plant and its storage and waste disposal areas added to the land required for case V. We estimated that 200 acres would be necessary (an increase of 35 acres over the base case). The start-up allowance was only 10% for this case, as the coal preparation plant is based on established technology. The total plant cost of \$311,340,000 for this combined beneficiation/limestone scrubbing is the highest for the five cases studied.

B. Operating Cost Estimates and Comparisons

The total annual operating cost (Table V-2) for the base case of nearly \$97,500,000 (27.8 mil per kilowatt hour) is composed largely of the cost of coal and the capital charges. Changes in the cost of coal, interest charges or in construction costs would have the most significant impact on the cost of electric power generation.

The operating costs for the SO₂ emissions control cases are all based on the limit of 1.2 pounds of SO₂ per million Btu of coal fired.

The annual operating costs for the atmospheric fluidized bed are shown in Table V-3. Again, coal and capital charges are the major cost items. The total annual cost of about \$121 million translates to a cost of 34.5 mil per kilowatt hour. The higher capital investment is reflected in the higher capital charges, and there is a substantial additional cost for limestone. Of the four systems that control SO₂ emissions, this costs the least to install; however, the poor limestone utilization attained in this process leads to high operating costs.

The annual operating costs of a limestone slurry scrubbing unit for flue gas desulfurization are given in Table V-4. Again, coal and capital charges dominate. The lower efficiency of the unit is reflected by the greater amount of coal needed to achieve a net output of 500 MW. The limestone costs are lower than in the AFB case, since the limestone is much more effectively utilized in this system. The annualized cost of 33.8 mil per kilowatt hour is the lowest of the four SO₂ control alternatives. When the cost of sludge disposal and/or fixation is added to this, the cost of limestone scrubbing increases substantially (Section V-C).

The magnesium oxide slurry flue gas desulfurization case is shown in Table V-5. Here the higher capital and maintenance charges offset the somewhat improved operating efficiency, with the result that annual costs are 34.4 mil per kilowatt hour. However, when credit is allowed for the

TABLE V-2

OPERATING COSTS FOR BASE CASE - NO SO₂ REMOVAL

Basis: Location: Ohio Valley
 Capacity: 500 MW/Hour
 On Stream Time: 7000 Hours/Year

Capital Investment: \$243,900,000
 Time: January, 1978

<u>Direct Costs</u>	<u>Annual Quantity</u>	<u>Unit Cost, \$</u>	<u>Total Annual Cost, \$Million</u>
Delivered Raw Materials			
Coal, tons	1,440,000	27.00	38.880
Chemicals			.800
Subtotal Raw Materials			<u>39.680</u>
<u>Conversion Costs</u>			
Utilities			
Fuel Oil, gal	300,000	.348	.104
Treated Water, thousand gal	101,000	0.90	.909
Electricity, MWh	340,538	0.0	
Operating			
Supervision, hr	26,300	14.00	.368
Labor, hr	131,400	10.00	1.314
Maintenance Labor & Materials (2 mil/kwh)			7.000
Analyses			.500
Subtotal Conversion Costs			<u>10.195</u>
Subtotal Direct Costs			49.875
<u>Indirect Costs</u>			
Average Capital Charge @ 18.5% of Total Capital			45.121
Overhead: Plant: 20% of Conversion Costs			2.039
Administrative: 4% of Conversion Costs			0.408
Subtotal Indirect Costs			<u>47.568</u>
<u>Total Annual Operating Costs</u>			97.443
<u>Annualized Costs (mil/kwh)</u>			27.8

TABLE V-3

OPERATING COSTS FOR THE ATMOSPHERIC FLUIDIZED BED CASE

Basis: Location: Ohio Valley
 Capacity: 500 MW/Hour
 On Stream Time: 7000 Hours/Year

Capital Investment: \$285,500,000
 Time: January, 1978

<u>Direct Costs</u>	<u>Annual Quantity</u>	<u>Unit Cost, \$</u>	<u>Total Annual Cost, \$Million</u>
Delivered Raw Materials			
Coal, tons	1,417,000	27.00	38.259
Limestone, tons	363,900	29.00	10.553
Chemicals			1.000
Subtotal Raw Materials			49.812
<u>Conversion Costs</u>			
Utilities			
Fuel Oil, gal	600,000	.348	.209
Treated Water, thousand gal	101,000	0.90	.909
Electricity, MWh	276,820	0.00	
Operating			
Supervision, hr	35,040	14.00	.491
Labor, hr	183,960	10.00	1.840
Maintenance Labor & Materials (3 mil/kwh)			10.500
Analyses			.750
Subtotal Conversion Costs			14.699
Subtotal Direct Costs			64.511
<u>Indirect Costs</u>			
Average Capital Charge @ 18.5% of Total Capital			52.818
Overhead: Plant: 20% of Conversion Costs			2.940
Administrative: 4% of Conversion Costs			.588
Subtotal Indirect Costs			56.346
<u>Total Annual Operating Costs</u>			120.857
<u>Annualized Costs (mil/kwh)</u>			34.5

TABLE V-4

OPERATING COSTS FOR THE LIMESTONE SLURRY SCRUBBING CASE

Basis: Location: Ohio Valley
 Capacity: 500 MW/Hour
 On Stream Time: 7000 Hours/Year

Capital Investment: \$292,600,000
 Time: January, 1978

<u>Direct Costs</u>	<u>Annual Quantity</u>	<u>Unit Cost, \$</u>	<u>Total Annual Cost, \$Million</u>
<u>Delivered Raw Materials</u>			
Coal, tons	1,477,000	27.00	39.879
Limestone, tons	167,000	29.00	4.843
Chemicals			1.000
Subtotal Raw Materials			45.722
<u>Conversion Costs</u>			
<u>Utilities</u>			
Fuel Oil, gal	300,000	.348	.052
Cooling Water, million gal	224,300	.041	.009
Treated Water, thousand gal	101,000	0.90	.909
Electricity, MWh	378,200	0.00	
<u>Operating</u>			
Supervision, hr	35,040	14.00	.491
Labor, hr	183,960	10.00	1.840
Maintenance Labor & Materials (8% of increment plus 2 mil/kwh)			10.899
Analyses			.750
Subtotal Conversion Costs			14.950
Subtotal Direct Costs			60.672
<u>Indirect Costs</u>			
Average Capital Charge @ 18.5% of Total Capital			54.131
Overhead: Plant: 20% of Conversion Costs			2.990
Administrative: 4% of Conversion Costs			.598
Subtotal Indirect Costs			57.719
<u>Total Annual Operating Costs</u>			118.391
<u>Annualized Costs (mil/kwh)</u>			33.8

TABLE V-5

OPERATING COSTS FOR THE MAGNESIA SLURRY SCRUBBING CASE

Basis: Location: Ohio Valley
 Capacity: 500 MW/Hour
 On Stream Time: 7000 Hours/Year

Capital Investment: \$307,050,000
 Time: January, 1978

<u>Direct Costs</u>	<u>Annual Quantity</u>	<u>Unit Cost, \$</u>	<u>Total Annual Cost, \$Million</u>
<u>Delivered Raw Materials</u>			
Coal, tons	1,472,000	27	39.744
Lime, tons	150	47	.007
Magnesium Oxide, tons	1,000	204	.204
Coke, tons	725	29	.021
Catalyst & Chemicals			1.000
Subtotal Raw Materials			40.976
<u>Conversion Costs</u>			
<u>Utilities</u>			
Fuel Oil, gal	5,656,000	.348	1.968
Cooling Water, million gal	2,207,500	.041	.090
Treated Water, thousand gal	101,000	.90	.909
Electricity, MWh	370,366	0.00	
Heat Credit, MM Btu	20,300	.98	.020
<u>Operating</u>			
Supervision, hr	35,040	14.00	.491
Labor, hr	201,480	10.00	2.015
Maintenance Labor & Materials (8% of increment plus 2 mil/kwh)			12.052
Analyses			.750
Subtotal Conversion Costs			18.295
Subtotal Direct Costs			59.271
<u>Indirect Costs</u>			
Average Capital Charge @ 18.5% of Total Capital			56.804
Overhead: Plant: 20% of Conversion Costs			3.659
Administrative: 4% of Conversion Costs			.732
Subtotal Indirect Costs			61.195
<u>Total Annual Operating Costs</u>			120.466
<u>Annualized Costs (mil/kwh)</u>			34.4

sulfuric acid, this process becomes attractive compared to the limestone scrubbing process. The comparison is particularly favorable to the magnesium oxide scrubbing, if sludge disposal with fixation is required for the limestone scrubbing (Section V-C).

The cost of coal washing alone is shown separately in Table V-6. Here, the capital investment is for the coal preparation plant only. The operating costs are 14.4 mil per kilowatt hour for the cleaning plant itself. About 2.5 mil per kilowatt hour is the net cost of coal preparation, less the cost of the raw coal feed. This is \$8,807,000 on an annual cost basis. Costs of a coal preparation plant integrated with the power generating facility, followed by limestone scrubbing of about 70 percent of the flue gas are shown in Table V-7. The 35.7 mil per kilowatt hour annual operating cost is the highest of any of these cases. However, the cost of sludge disposal and fixation for limestone scrubbing impacts less heavily here than for limestone scrubbing alone, since less limestone is consumed and less sludge is produced (Section V-C).

TABLE V-6

OPERATING COSTS FOR UPGRADING COAL BY WASHING

Basis: Location: Ohio Valley
 Capacity: 500 MW/Hour
 On Stream Time: 7000 Hours/Year

Capital Investment: \$26,020,000
 Time: January, 1978

<u>Direct Costs</u>	<u>Annual Quantity</u>	<u>Unit Cost, \$</u>	<u>Total Annual Cost, \$Million</u>
<u>Delivered Raw Materials</u>			
Coal, tons	1,534,000	27.00	41.418
Chemicals - Magnetite, lb	2,149,000	.030	.064
- Others			.085
Subtotal Raw Materials			41.567
<u>Conversion Costs</u>			
Utilities			
Electricity, MWh	17,400	0.00	
Operating			
Supervision, hr	12,000	14.00	.168
Labor, hr	35,040	10.00	.350
Maintenance Labor & Materials (8% of Capital Investment)			2.082
Analyses			.500
Subtotal Conversion Costs			3.100
Subtotal Direct Costs			44.667
<u>Indirect Costs</u>			
Average Capital Charge @ 18.5% of Total Capital			4.814
Overhead: Plant: 20% of Conversion Costs			.620
Administrative: 4% of Conversion Costs			.124
Subtotal Indirect Costs			5.558
<u>Total Annual Operating Costs</u>			50.225
<u>Annualized Costs (mil/kwh)</u>			14.4

TABLE V-7

OPERATING COSTS FOR THE COAL WASHING/FGD CASE

Basis: Location: Ohio Valley
 Capacity: 500 MW/Hour
 On Stream Time: 7000 Hours/Year

Capital Investment: \$285,320,000
 Time: January, 1978

<u>Direct Costs</u>	<u>Annual Quantity</u>	<u>Unit Cost, \$</u>	<u>Total Annual Cost, \$Million</u>
Delivered Raw Materials			
Coal- Washed			50.225
Limestone, tons	117,000	29.00	3.393
Chemicals			.900
Subtotal Raw Materials			54.518
<u>Conversion Costs</u>			
Utilities			
Fuel Oil, gal	300,000	.348	.052
Cooling Water, million gal	188,500	.041	.007
Treated Water, thousand gal	101,000	.90	.909
Electricity, MWh	365,400	0.00	
Steam (credited as coal)			
Operating			
Supervision, hr	35,040	14.00	.491
Labor, hr	175,200	10.00	1.752
Maintenance Labor & Materials (8% of increment + 2 mil/kwh)			10.314
Analyses			.750
Subtotal Conversion Costs			14.275
Subtotal Direct Costs			68.793
<u>Indirect Costs</u>			
Average Capital Charge @ 18.5% of Total Capital			52.784
Overhead: Plant: 20% of Conversion Costs			2.855
Administrative: 4% of Conversion Costs			.571
Subtotal Indirect Costs			56.210
<u>Total Annual Operating Costs</u>			125.003
<u>Annualized Costs (mil/kwh)</u>			35.7

C. Sensitivity Analyses

The scope of work for this study only included the tasks leading to the development of capital and operating cost estimates for the five cases presented in Sections V-A and V-B. As these cases were developed, several additional tasks were suggested by the DOE Project Officer. Chem Systems has provided only brief consideration of these, due to budget constraints.

1. Level of SO₂ Emissions

During the course of this study, the United States Environmental Protection Agency evolved new limits on SO₂ (and other pollutants), as a consequence of the 1977 amendments to the Clean Air Act. It seems likely that future electric power generating stations will be limited to SO₂ emissions consistent with 90 percent removal of sulfur from the raw coal.

In considering the impact of 90 percent removal on the SO₂ emissions control systems studied here, Chem Systems judged that the AFB was not likely to be effective enough to meet this more stringent limit. Further, deeper cleaning of coal seemed likely to be more costly than higher efficiency scrubbing. Hence, we estimated the costs for 90 percent reduction of SO₂ emissions for the two FGD cases, where it was most likely to be technically and economically feasible.

The results of increasing the capacity of the limestone FGD system to achieve 90 percent reduction of SO₂ are summarized in Table V-8. The additional equipment adds about \$700,000 to the field cost. The largest increase is for the thickeners and filters in Section 600 of the plant (see Section IV-C). The total capital cost for the FGD system increases by just over \$900 thousand. This increases the capital cost for the generating station to about \$234 million. The higher capital charges and increased limestone requirements combine to raise the operating cost for 90 percent reduction of SO₂ to 34.1 mil per kilowatt-hour, an increase

of 0.3 mil over the cost of meeting the limit of 1.2 pound of SO_2 per million Btu.

TABLE V-8
CAPITAL COST COMPARISON FOR LIMESTONE FGD AT TWO SO_2
REDUCTION LEVELS
(\$1,000)

	<u>90%</u>	<u>NSPS*</u>
Section 100 Material Handling	529	529
200 Feed Preparation	1,008	913
300 Particulate Scrubbing	3,199	3,050
400 SO_2 Scrubbing	12,949	12,939
600 Solids Disposal	3,392	3,075
700 Auxiliary & Piping	1,625	1,497
Total Field Cost	<u>22,702</u>	<u>22,003</u>
Engineering	2,180	2,180
Construction	2,993	2,901
Bare Plant Cost	27,875	27,084
Contingencies	2,788	2,708
Contractors Fee	836	813
Special Changes	380	368
Total Facility Cost	<u>31,879</u>	<u>30,973</u>

*NSPS corresponds to New Sound Performance Standards of 1.2 lb SO_2 per million Btu.

The results of increasing the capacity of the MgO FGD system to achieve 90 percent reduction of SO_2 are shown in Table V-9. The additional equipment adds about \$2.1 million to the field cost. The largest increases are in the regeneration sections of the plant, especially the sulfuric acid production unit. The total capital cost for the FGD system increases by almost \$2.8 million. This increases the capital cost for the generating station to about \$310 million. The higher capital charges and increased operating costs to reduce the SO_2 emissions by 90 percent combine to raise the cost of electricity to 35.2 mil per kilowatt-hour from 34.4 mil for the 1.2 pound of SO_2 basis given in Section V-B.

TABLE V-9

CAPITAL COST COMPARISON FOR MAGNESIA SLURRY FGD
AT TWO SO₂ REDUCTION LEVELS
 (\$1,000)

	<u>90%</u>	<u>NSPS*</u>
Section 100 Raw Material Handling	619	570
200 Particulate Scrubbing	4,686	4,468
300 SO ₂ Scrubbing	11,970	11,751
500 Slurry Processing	1,800	1,605
600 Cake Drying	1,468	1,309
700 Mg SO ₃ Calcination	1,484	1,323
800 H ₂ SO ₄ Production	9,281	8,412
900 Auxiliary & Storage	<u>2,783</u>	<u>2,522</u>
Total Field Cost	34,092	31,960
Engineering	2,900	2,900
Construction Overhead	4,546	4,262
Bare Plant Cost	41,538	39,122
Contingencies	4,154	3,912
Contractors Fee	1,246	1,174
Special Changes	<u>516</u>	<u>484</u>
Total Facility Cost	47,454	44,692

*NSPS corresponds to New Source Performance Standards of 1.2 lb SO₂ per million Btu.

2. Level of Sulfur in the Coal

The capacity required for the emissions control system changes with the sulfur content of the coal. For an emissions level of 1.2 pounds of SO₂ per million Btu fired, the capital costs for the five cases studied here were adjusted from the basis level of 3.5 percent sulfur to 2 and 5 percent. The results for total plant costs are shown in Table V-10. As the heating value and ash content of the coal were assumed to remain constant, the base case did not vary. The AFB and limestone FGD systems show small effects on total plant cost for their capacity changes with

somewhat greater savings at the lower sulfur level than penalties at the higher. The magnesia FGD system investment cost is both more sensitive to capacity and increases in cost faster as the coal sulfur level rises. This is due to cost changes for the capital-intensive regeneration sections, especially the sulfuric acid production unit. For coal cleaning, total scrubbing would be required at the higher sulfur level, although at a lower removal efficiency than for limestone FGD alone. This raises the cost by a substantial amount. As it is not likely that coal cleaning would be used for low sulfur coal, no estimate was made. (At the same relative sulfur rejection ratio during mechanical cleaning, the 2 percent sulfur coal would still require scrubbing after cleaning).

TABLE V-10

TOTAL PLANT COST ESTIMATES FOR THREE LEVELS OF SULFUR IN COAL
(\$ Million)

<u>Sulfur Level in Coal, %</u>	<u>2.0</u>	<u>3.5</u>	<u>5.0</u>
Base Case	243.9	243.9	243.9
Atmospheric Fluidized Bed	281.7	285.5	288.4
Limestone FGD + Base Case	289.4	292.6	295.3
Magnesia FGD + Base Case	298.4	307.1	321.1
Coal Cleaning/Partial Limestone FGD + Base Case	-	311.3	317.4

The effect of sulfur level in the coal on operating cost is shown in Table V-11. The AFB is less efficient in converting limestone than the FGD system. Hence, its operating cost increases more than that for the FGD system at the 5 percent level of sulfur in the coal. The higher capital cost of the MgO FGD system relative to limestone, due to the larger regeneration sections, also makes this system less competitive at the high sulfur level. The coal cleaning/partial scrubbing case remains the most costly at the higher sulfur level.

For coal with 2 percent sulfur, the AFB becomes competitive with the limestone FGD system (Table V-11).

TABLE V-11
OPERATING COST ESTIMATES FOR THREE LEVELS OF
SULFUR IN COAL
 (Mil per kilowatt-hour)

<u>Sulfur Level in Coal, %</u>	<u>2.0</u>	<u>3.5</u>	<u>5.0</u>
Base Case	27.8	27.8	27.8
Atmospheric Fluidized Bed	33.0	34.5	35.9
Limestone FGD + Base Case	33.0	33.8	34.6
Magnesia FGD + Base Case	33.7	34.4	35.6
Coal Cleaning/Partial Limestone FGD			
+ Base Case	-	35.7	36.7

3. Byproduct Credit for Sulfuric Acid

A recent study by the TVA for the EPA (5) has shown that there could be a substantial market for byproduct sulfuric acid in the southeastern U.S. The value of the byproduct acid and the volume which could be sold depend upon demand, transportation, and competition factors. While a detailed analysis was not possible for this study, it did seem likely that prospective MgO FGD installations in that region would be favored by the sales value for the sulfuric acid produced.

The effect of the byproduct value on the cost of electricity for the basis MgO FGD case (3.5 percent sulfur in the coal, SO₂ reduction to 1.2 pounds per million Btu) is substantial. In this case, about 113 thousand tons per year of sulfuric acid are recovered. At a net byproduct credit of \$18 per ton, the cost of electricity is reduced by 0.6 mil per kilowatt-hour, bringing the cost for the MgO FGD case down to that for limestone FGD. The TVA study showed that net byproduct credits as high as \$40 per ton might be reached in some circumstances (5). Thus, the potential effect on the economics of MgO FGD systems of byproduct credit value for the sulfuric acid is significant.

4. Sludge Disposal and Fixation

Lime and limestone FGD systems produce a waste stream of water and calcium sulfite, sulfate, and carbonate in the form of a sludge. The methods and costs for the ultimate disposal of this sludge, while complying with the emissions requirements for solid and liquid wastes, have been the subject of intense study by the EPA. Chem Systems believes that in the future, new users of lime/limestone FGD systems will be required to dewater the sludge and employ landfill disposal, rather than ponding the dilute material. It seems likely that fixation of the dewatered sludge to improve its stability under load will also be strongly preferred, if not actually required. Accordingly, thickeners and filters were provided in the limestone FGD system described in Section IV-C. The capital and operating costs for this equipment are included in the cost estimates presented earlier.

Two recent studies of sludge disposal and fixation costs (6,7) have shown that there is wide variability in costs among the commercial processes and that site - specific variables such as hauling distance, presence of flyash in the sludge, land availability and cost, and use of fixation additives are all significant. The following specific choices were made to estimate the cost of disposal and fixation for the limestone FGD system used in this study:

- IUCS Poz-O-Tec Process for fixation
- Landfill disposal
- Optimum land available (255 acres required, including perimeter buffer zone)
- Hauling distance of 5 miles
- Lime and flyash additives mixed with the dewatered sludge at the level of 4 percent of the dry calcium containing solids

The capital cost estimate for the sludge disposal and fixation system is shown in Table V-12. The additive handling and mixing equipment is not as significant as the cost of acquiring and preparing the landfill site. The cost of land was set at \$3,000 per acre at a distance of five miles from the power plant.

TABLE V-12

CAPITAL COST ESTIMATE FOR SLUDGE FIXATION
AND DISPOSAL, LIMESTONE FGD
(\$1,000)

Additives Handling and Mixing	550
Trucks and Earthmoving Equipment	680
Subtotal Field Cost	1,230
Engineering	123
Construction Overhead	308
Subtotal Base Plant Cost	1,661
Contingencies	340
Contractor's Fee	100
Special Charges	37
Total Facility Cost	2,138
Disposal Site Acquisition and Preparation	1,265
Working Capital	697
Total Capital Investment	4,100

The total capital cost for sludge fixation and disposal is estimated to be \$4,100,000. This brings the total investment for the limestone FGD case to \$297 million.

The operating cost estimate for sludge disposal and fixation is shown in Table V-13. Fixed charges, operating costs for the landfill, and additive costs are all significant. The unit cost of 0.8 mil per kilowatt-hour is in addition to the basis cost of 33.8 mil (Table V-4). The total cost of 34.6 mil per kilowatt-hour makes limestone FGD with sludge disposal and fixation more costly than either the AFB or the MgO FGD alternatives.

TABLE V-13

OPERATING COST ESTIMATE FOR SLUDGE FIXATION AND
DISPOSAL, LIMESTONE FGD
(\$1,000)

Basis: Location - Ohio Valley
Capacity - 500 MW/Hour
On Stream Time: 7,000 Hour/Year

Capital Investment: \$4,100
Time: Jan, 1978

<u>Direct Costs</u>	<u>Annual Quantity</u>	<u>Unit Cost</u> \$	<u>Total Annual</u> <u>Cost</u>
Delivered Raw Materials			
Lime, ton	7,525	47	354
Subtotal Raw Materials			354
<u>Conversion Costs</u>			
Electricity, MWh	7,000	21	147
Operating Plant			
Plant Supervision, hr	1,460	14	20
Plant Labor, hr	9,760	10	98
Disposal Supervision, hr	8,760	15	131
Disposal Labor, hr	48,180	12	578
Maintenance Labor & Materials (4% of fixed investment)			86
Landfill Operation			
Land preparation			7
Trucks (fuel and maintenance)	441,000 tons	0.20	88
Earthmoving equipment (fuel and maintenance)	441,000 tons	0.16	71
Subtotal Conversion Costs			1,226
<u>Indirect Costs</u>			
Average Capital Charge @ 18.5% of Total Capital Overhead			759
Plant - 20% of Conversion Costs			245
Administrative - 4% of Conversion Costs			49
Subtotal Indirect Costs			1,053
<u>Total Annual Operating Costs</u>			2,633
<u>Annualized Cost (mil/kwh)</u>			0.8

Appendix A

Description of CØST System

CHAPTER 1

COMPUTER-AIDED DESIGN AND ESTIMATING

Today's high cost of investment capital makes it mandatory to evaluate the economics of new processing facilities at the earliest possible time. Many companies now examine proposed plant investment during the infancy of the process design phase of research and development, which requires rapid economic evaluation of the process at a point in time when the cost engineer has only minimum data.

Until recently, cost engineers had to rely on manual estimating techniques to provide these evaluations. Now, however, there are two basic categories of estimating methods available: manual and computer-aided.

MANUAL ESTIMATING METHODS

Manual estimating methods in the past have been divided into two basic categories: the factored (preliminary) estimate and the definitive (material takeoff) estimate.

FACTORED METHOD

In the factored estimating method, equipment item costs are developed, factors for installing the equipment determined, and selection of appropriate factors for the indirect costs (prime contractor engineering and construction overhead costs) are chosen (Figure 1- 1).

Equipment costs can be obtained from various sources: The process or cost engineer may obtain quotations from equipment vendors, utilize cost versus capacity charts, or use recent data from his own personal or company files. Since the preliminary estimate is for a processing facility that will be constructed some time in the future, equipment costs must be escalated into the future to the point in time that the equipment will be ordered for the facility.

Figure 1- 1. Estimating Systems

When applying factors for estimating the cost of installing equipment for a new process, the process engineer can only estimate the effects of the economy of scale (for example, reuse factors on forms, concrete overpour quantities) and the other cost engineering relationships which are, in some cases, complex functions of the process equipment mix. The engineer, after selecting factors for the installation accounts (equipment setting, piping, civil, steel, instrumentation, electrical, insulation, and paint), applies these factors separately to the escalated equipment costs to obtain the direct field material and labor costs. Sometimes, the use of these generalized factors for the separate installation accounts introduces errors which can result in these bulk accounts being off by more than an order of magnitude. For example, a particular factor used for piping around pumps may yield low piping costs if these pumps are associated with large field-erected vessels requiring long lead and return lines. On the other hand, this same factor for these pumps may yield high

piping costs if these pumps are associated with agitated reactors located near the pumps and if these pumps are being used as recycle pumps with very short lines.

In the factored estimating method, the direct field cost is obtained by adding the direct field material and labor costs to the escalated equipment costs.

Factors are selected for prime contractor engineering and construction overhead costs and are applied to the direct plant cost to obtain the indirect costs. When selecting these indirect cost factors, the engineer must be extremely careful because the prime contractor's engineering costs are associated primarily with the equipment and field material accounts, while the construction overhead costs are associated primarily with the field labor activities.

Adding the equipment level, installation level, and indirect level costs together, the bare plant cost is obtained. A value judgment is made concerning the estimated contingencies

for construction of the facility and is applied to the bare plant cost (direct prime contractor cost).

A contractor's fee is applied to the sum of the bare plant cost plus contingencies to arrive at a factored estimated cost of the required fixed capital for the proposed facility (Contingencies selected for factored estimates are usually quite high because of the manner in which the estimate is prepared.) The contractor's fee selected is usually an average fee that the engineer feels is appropriate for the type and size of the job.

When preparing the factored estimate, the process engineer or cost engineer spends most of this time on the equipment account, which represents at most only a small fraction (10% to 30%) of the total fixed capital cost. The bulk cost items (including direct labor, field materials, and indirect costs) are handled by factors.

DEFINITIVE METHOD

The procedure for preparing definitive estimates is quite different from factored estimating procedures. In the definitive estimating method, drawings are prepared for the equipment items, foundations, buildings and structures, piping runs and other items required to definitively scope the work (Figure 1-1).

Material takeoffs are prepared from scale drawings, and accurate counts are tabulated for piping (for example, elbows, tees, valves, couplings), concrete (for example, square feet of forms, pounds of reinforcement), instrumentation (for example, pressure indicators, temperature indicators, flow recording controllers, pressure indicating controllers), and all of the other field material accounts.

Unit costs from up-to-date vendor catalogs and current price lists (including appropriate discounts) are used to determine actual field material costs.

The contractor's cost analysis group analyzes return field costs to determine labor productivity, crew mixes, and production rates for performing the various field labor tasks which must be accomplished to assemble the field materials and install the equipment. A tabulation of field material quantities is made from the material takeoff and the field labor and construction equipment rental

requirements are determined for each individual material component and labor activity.

Direct field material cost and associated labor man-hours are thereby determined.

Equipment vendors are contacted for firm prices and delivery times for the equipment items.

Prime contractor engineering is estimated as a function of the job size, equipment items and equipment mix, process complexity, and field material costs. Construction overhead costs are estimated as a function of the field labor activities.

Summarizing the equipment level, direct level, and indirect level costs, the bare plant cost is obtained.

Contingencies are applied to the bare plant cost, and a contractor's fee to the contingencies plus bare plant cost. Contingencies for the definitive estimate are usually much lower than the factored estimate because all of the major equipment items are defined. The contractor's fee is based on job size, status of the economy, status of the contractor's shop, and negotiations with the client or operating company.

The definitive material takeoff estimating technique is the most accurate estimating method, but it has its limitations. Site conditions may vary considerably during construction of the facility, and labor productivity may change during the actual construction phase. Definitive estimating is also expensive and time consuming. As the result of these drawbacks, the definitive estimate is usually only prepared once, and just for those projects that have a prior go-ahead from management.

COMPUTER-AIDED ESTIMATING METHOD

Computer-aided estimating develops costs (equipment, materials, labor, direct and indirect) for the proposed facility by simulating contractor costing processes.

A computer model of the facility generates a material quantity take-off of material and labor man-hours. The take-off is based upon a detailed design of the equipment components and associated installation materials as specified by the user or determined by the estimating System. The resulting quantities (e.g., cubic yards of concrete, tons of steel) are related to the field labor required to install specific units of materials by work items. These work items relate

field labor to direct (bulk) quantities at a specific production rate for each specific labor task.

Indirect costs are simulated by examination of the material costs and resulting field labor man-hours.

Prime contractor engineering costs are determined by the same method used by most contractors to compute engineering, procurement, drafting and other associated home office charges.

Construction overhead costs are calculated as a function of field labor as determined by the System.

The System builds a comprehensive cost estimate for the proposed project similar to a quantity take-off. The difference is that the computer-aided estimating system can do this type of quantity survey as a part of the decision-making process in the preliminary stage, using only the minimum of information and in a fraction of the time normally required for a detailed estimate. The System achieves this advantage because its data base contains cost models, volumetric models, equipment sizing algorithms, and mathematical models for design and costing of the many facility components.

SYSTEM STRUCTURE

The System utilizes a contractor-type logic to estimate and assemble costs; it is a non-factored estimating system. Contractors arrive at their prices by determining equipment costs, field labor costs, construction overhead costs, contingencies, internal engineering costs, and by choosing a competitive fee or negotiating a fee with the owner. The System simulates this process by applying the same logic to arrive at an estimate.

INPUT DATA

A specific process scheme for a specific production capacity will be associated with a specific equipment list. The input to the System primarily consists of data derived from this equipment list. Each equipment item shown on the equipment list must be described to the System.

Preparation of input data to the System is straightforward and rapid. Using this manual, the process or cost engineer can rapidly prepare the System input data for a process he is examining.

LEVELS OF INPUT

The System allows for three levels of input data for each equipment item: minimum design, maximum design, and known cost.

Minimum design input for an equipment item is the specification of the material of construction for the item and its key-size parameter. For example, some key-size parameters are the area for a heat exchanger, the diameter and number of trays for a tray tower, the capacity of a centrifugal pump, and the capacity of a storage vessel.

Maximum design input for each equipment item allows the process engineer to specify up to 35 size parameters for that item. This allows the engineer to specify not only the material of construction, diameter and number of trays for the tray tower, but in addition, the skirt height, number of manholes, tray spacing, cladding material, cladding thickness, design pressure, design temperature, and other variables, including (if desired) the actual thickness he may require for the tray tower.

Known cost input allows the engineer to specify the actual cost, material of construction, and key-size parameters for an equipment item which is not among those in the System. Specifying the material and size parameters for the equipment item allows the System to build-up material quantities required for field installation of the item (for example, cubic yards of concrete derived from weight, area, shape, and height; instrumentation derived from its generic type and the equipment mix in the unit process or unit operation where the item is located) as though the System designed the item. These material quantities derived for each equipment item are obtained using volumetric models covered in a following section of this chapter.

EQUIPMENT COST MODELS

The equipment cost model is a series of equations, including all cost engineering and fabrication labor/material relationships, used to define all equipment sizes through a mechanical design. This model generates an equipment component takeoff for the various equipment item quantities; calculates costs of these component quantities; fabricates, tests, and performs all vendor fabrication labor activities to obtain a manufactured equipment item cost; and calculates estimated shop overhead, general and administrative expenses, machine burdens, and vendor

profit. Overlaid on each equipment item cost model is either a vendor cost structure or subcontractor cost structure. These vendor cost structures determine the proper cost engineering relationships of fabrication labor to material, shop overhead, general and administrative expenses, and profit for each equipment item type. For example, a simplified diagram of the material and fabrication labor cost engineering relationships for a centrifugal pump is shown in Figure 1- 2.

By a computerized simulation of vendor definitive job costing procedures, the equipment cost model determines the estimated equipment cost. By determining equipment specifications, it also determines the sizes and field material quantities required for the installation accounts. For example, weight, area, and height have been determined in the equipment cost model for calculation of concrete quantities; equipment item type, design conditions, and industry type for instrumentation; and motor horsepower and type have been determined for electrical material.

VOLUMETRIC MODELS

Following the flow of data sequentially, the equipment cost model determines all equipment specifications, and volumetric models determine the mathematical relationship of these equipment specifications to field material (bulk) quantities. A volumetric tray tower model is shown in Figure 1- 3. The volumetric models generate the internal material takeoff for equipment handling and setting, piping, civil, structural steel, instrumentation, electrical, insulation, and paint materials. For example, the pipe material would be a function of the diameter, height, pressure, temperature, number of trays, and estimated flowrates for the tower.

FIELD LABOR COSTS

Field labor costs are determined by the System by computing the installation of all internally-derived material quantities by work items that relate material to the various field labor craft production rates. Work items in the System's data base simulate contractor procedures for estimating field labor productivity including costs and schedules. The labor cost is derived from work item productivity and wage rates. To complete the estimate the System uses the derived field labor cost to determine construction overhead costs such as fringe benefits, insurance and payroll burdens for the project.

* CALCULATED ELSEWHERE IN COST MODEL

Figure 1- 2. Single Stage Centrifugal Pump Cost Model

Figure 1- 3. Typical Tray Tower Volumetric Model.

Note: For other models see Appendix V.

WAGE RATE AND PRODUCTIVITY LOGIC

If the Wage Rate Coding Form is used and no value is entered for a particular craft, the following logic is used by the System to determine wage rates and productivity values omitted by the user.

For all values of productivity omitted, a value of 100% is used. If a wage rate is omitted, the wage rate used is the product of the leftmost user-specified wage rate in the craft series multiplied by the ratio of the System's wage rate for the unspecified craft and divided by the System's wage rate for the leftmost user-specified wage rate. If no wage rate is entered for a series, the System updates its value of the wage rates by the value of the user-specified ENR Index divided by the base ENR Index.

PRODUCTIVITY

The user may estimate field labor productivity by using the productivity element table (Table 8- 2). Productivity may be estimated for each craft separately or may be determined for the composite craft mix, then inserted for each craft or as a single value on the Wage Rate Coding Form (Card W1). The user when inputting productivity on the Wage Rate Coding Form, in effect adjusts the actual units of scheduled work attained by each craft.

The productivity element table enables the user to determine productivity for proposed plant facilities over a wide range of working conditions and local restrictions. Productivity is arbitrarily classified into three basic ranges: low, average, and high. Low productivity indicates a field labor efficiency of 50% to 85%; average productivity indicates an efficiency of 85% to 115%; and high productivity indicates an efficiency of 115% to 140%. These percentages are based on the amount of work a typical construction worker can perform under a given set of conditions. Given ideal circumstances, such a field labor crew may achieve an approximation of 140% efficiency. In actual estimating, the user should not count on this high degree of productivity unless the operations in the project are highly mechanized. In manual operations such as bricklaying, pipe fitting and insulating, for example, the scheduling of high-range

productivity may mean that the prime contractor will have to push field labor crews for maximum production during the entire course of the project.

In general, the field labor productivity is a function of two major factors: the present national economy and the specific local conditions under which the work is to be accomplished for the project.

The first major factor (present economy) affects field labor productivity in the following manner: no matter what his trade may be, the individual construction worker is directly influenced by the general state of the economy. In good times, when construction jobs are plentiful and labor scarce, his productivity usually decreases, resulting in increasing field labor costs. In normal times, average productivity and costs are the rules. During depressions, recessions or slumps in the economy, field labor becomes plentiful and more productive; consequently, field labor costs decline. The productivity element table (Table 8- 2) has been designed to reflect all these conditions.

The second major factor (local conditions) affecting field labor productivity relates more directly to the project and consists of the many variables that influence all field labor construction activity, such as the character of the job site, volume of work to be performed, quality of available field labor, and other such unusual conditions as tight or loose plot plans, etc. Each of these variables (productivity elements) is listed in the Productivity Element Table (Table 8- 2). The user must study these variables keeping in mind both the existing and foreseeable conditions that will affect the proposed construction project being input into the System. At the same time, the user must make an evaluation of the prime contractor as a productive unit to determine his potential performance under a given set of circumstances. A graph of working minutes per hour versus productivity in percent is shown in Figure 8- 2.

Table 8- 2. Productivity Element Table

Productivity Element	Productivity (%)				
	Low	Average	High		
	50	85	100	115	140
General Economy	Prosperous	Normal	Hard Times		
Local business trend	Stimulated	Normal	Depressed		
Construction volume	High	Normal	Low		
Unemployment	Low	Normal	High		
Amount of Work	Limited	Average	Extensive		
Site complexity	Tight	Average	Loose		
Manual operations	Limited	Average	Extensive		
Mechanized operations	Limited	Average	Extensive		
Field Labor	Poor	Average	Good		
Training	Poor	Average	Good		
Wages	Low	Average	High		
Supply	Scarce	Normal	Surplus		
Field Labor Supervision	Poor	Average	Good		
Training	Poor	Average	Good		
Wages	Low	Average	High		
Supply	Scarce	Normal	Surplus		
Job Conditions	Poor	Average	Good		
Management	Poor	Average	Good		
Materials and site	Unfavorable	Average	Favorable		
Required workmanship	First rate	Regular	Passable		
Length of operations	Short	Average	Long		
Weather	Bad	Fair	Good		
Precipitation	Much	Some	Occassional		
Cold	Bitter	Moderate	Occassional		
Heat	Oppressive	Moderate	Occassional		
Construction Equipment	Poor	Normal	Good		
Applicability	Poor	Normal	Good		
Condition	Poor	Fair	Good		
Maintenance and repairs	Slow	Average	Quick		
Delays	Numerous	Some	Minimum		
Job flexibility	Poor	Average	Good		
Equipment delivery	Slow	Normal	Prompt		
Expediting	Poor	Average	Good		

To determine the overall productivity of any project, group of crafts, or individual craft, the user must develop a percentage value for each of the eight productivity elements shown in the productivity element table. The overall productivity is then obtained by averaging the eight values. For example, after studying a proposed project the user made the following evaluation of the productivity elements:

Item	Productivity Element	Percent
1	General economy	90
2	Amount of work	100
3	Field labor	75
4	Field labor supervision	100
5	Job conditions	110
6	Weather	90
7	Construction equipment	100
8	Delays	100
	Total	765

The average value for productivity is the total divided by eight.

$$\text{Productivity} = \frac{765}{8} = 95.6\%$$

For large projects (See Figure 8- 3) and revamps this productivity should be further adjusted. It is recommended that revamps have a base productivity of 50% (0.5). If a project is large and a revamp these adjustments should be compounded (e.g. productivity per Productivity Element Table x Job Size Productivity x Revamp Productivity = .956 x .9 x .5 = 0.43 (43% productivity)).

WORK ITEM CONCEPT

The work item cost engineering technique used by the System provides a method of determining material costs and norm labor man-hours associated with each equipment's volumetric model. The craft mix (that is, a unit relating the crafts required for a specific task or work item and their respective percentages thereof) is applied to the man-hour relationships and the norm or unadjusted man-hours for each craft result. Values of the field labor productivity for each craft are then assigned, and the adjusted man-hours are obtained. It should be noted that because the

foreman must be on hand to supervise the crew whether the job requires 10 man-hours or 40 man-hours, the foreman's man-hours are taken as a percentage of the adjusted man-hours and not as a percentage of the norm man-hours. From the total adjusted man-hours, the costs for each craft are derived, and the total cost of the specified task or work item is computed. A graphical representation of typical civil tasks and work items is shown in Figure 8- 4.

Field labor models exist for each equipment installation account (equipment setting, piping, civil, steel, instrumentation electrical insulation, and paint). Each direct field labor model (for a typical equipment item) is composed of several work items, the composition of which varies as a function of equipment type, size, weight, horsepower, electrical class and division, material type, and other similar identifying variables. A typical work item found in the civil account is shown in Figure 8- 5.

Figure 8- 2. Productivity Versus Working Minutes Per Hour

Table 9-2. System Engineering Accounts

Account	Account Description
Basic Engineering	<p>Includes all engineering and drafting expenses for the following items:</p> <ul style="list-style-type: none"> Process Flow Diagrams Heat and Material Balances Equipment Process Data Sheets Equipment Lists Piping and Instrumentation Diagrams Interconnecting Piping Diagrams Utility Process Flow Diagrams Utility Balances Utility Piping and Instrumentation Diagrams Electrical One-Line Diagrams Electrical System Distribution Equipment Specifications Job Specifications Overall Facilities Plot Plans Site Location Plot Plans Area Equipment Arrangements Fire Protection and Safety Systems Building and Enclosure Requirements Comparative Economic Evaluations Documentation Cost Estimation
Detail Engineering	<p>Includes all engineering and drafting expenses for the following detail engineering items:</p> <ul style="list-style-type: none"> Equipment Design <u>Piping</u> <ul style="list-style-type: none"> Piping Arrangements Piping Isometrics Pipe Support <u>Instrumentation</u> <ul style="list-style-type: none"> Instrumentation Mechanical Location Drawings Tubing and/or Cable Distribution Plans and Elevations Control Panel Design <u>Electrical</u> <ul style="list-style-type: none"> Interlock and Wiring Diagrams Electrical Equipment Location Drawings Switchgear and MCC Details Power and Lighting Conduit Distribution Plans and Elevations Area Classification Drawings <u>Civil</u> <ul style="list-style-type: none"> Equipment Foundation Location Drawings Foundation Details Structural Steel Plans and Elevations Ladder and Platform Details <u>Building and Enclosures</u> <ul style="list-style-type: none"> Building Arrangement Plans Roof Plans and Elevations Architectural Details <u>General Facility Requirements</u> <ul style="list-style-type: none"> Facility Plot Plan Details Area Equipment Arrangement Details Site Preparation Details <u>Other Job Requirements</u> <ul style="list-style-type: none"> Cost Estimation Material Take-Offs Plant Operations and Start-Up Manual Engineering Planning & Scheduling

08/01/77

Table 9-2. System Engineering Accounts - Continued.

Account	Account Description
Procurement	Includes all purchasing, all requisition, inspection and expediting as well as international purchasing and trafficking costs.
Home Office Construction Services	Includes all costs for construction management, cost control, construction planning & scheduling, labor relations and administration, and sub-contract administration.
Field Office Construction Supervision	Includes costs for project superintendant, field superintendants, field engineering and material controls supervision, field cost engineering and and field drafting.
Support Personnel	Includes costs for Secretarial, Clerical, Administrative and Accounting Support in each engineering category.
Indirects	Includes rent, heat, and electricity, and other operating expenses not specifically covered in other accounts in each engineering category.
Payroll Burdens	Includes mandatory contributions to vacations, holidays, workman's compensation, social security, and unemployment insurance in each engineering category.
Engineering and Miscellaneous Expenses	Includes cost of reproduction, communication (telephone, telegraph, and postage), travel, and computer services in each engineering category.
Plant Start-Up	Includes costs for Instrument calibration, plant commissioning, start-up, as well as guarantees and performance tests.

08/01/77

Table 10-3. System Prime Contractors Construction Overhead Accounts.

Account	Account Description
Construction Equipment Rental	Construction equipment rental costs.
Field Services	Includes medical, first aid, transportation, welder tests, equipment services, welding supplies and other consumables.
Fringe Benefits	Prime contractor's contribution to union funds for health and welfare, vacations, holidays, sick leave, and retirement.
Labor Burdens	Prime contractor's mandatory contributions for Federal Social Security (FICA), Federal Unemployment Insurance (FUI), Workmens Compensation, and State Unemployment Insurance (SUI).
Miscellaneous (Ins., Safety, etc.)	Includes job cleanup costs, watchmen, construction equipment servicing and handling, public liability, public damage, automobile, and all-risk insurance, warehousing, and nonproductive labor.
Consumables/Small Tools	Includes cost of small tools and consumable materials.
Temporary Construction and Utilities	Cost of temporary sanitary and shelter facilities, roadways, riggings, utilities and fencing. Also includes travel and scaffolding costs unless specified separately by user.
Mobilization/Demobilization	Cost of construction equipment handling and transport to and from jobsite.
Catering/Accommodation	Includes all catering and accommodation for all field labor crews at the site.
Travel	Includes all travel and subsistence when required.
Scaffolding	Includes all scaffolding, except as required for assembly and/or field erection by vendor.
Vendor Representatives	Includes travel and subsistence as well as average rates for vendor field representatives.

08/01/77

Reproduced by permission of ICARUS Corporation

STANDARD INSTRUMENTATION

CODING INSTRUCTIONS:

EQUIP. ITEM SYMBOL	EQUIPMENT ITEM TYPE SYMBOL
APT	ALL TYPES
AOT	

REVISIONS		
NO.	DATE	DESCRIPTION

AGITATED TANK

79

APT, APT

Reproduced by permission of ICARUS Corporation

CODING INSTRUCTIONS:

EQUIP. ITEM SYMBOL	EQUIPMENT ITEM TYPE SYMBOL	REMARKS
CP	ALL EXCEPT IN-LINE	

REVISIONS		
NO.	DATE	DESCRIPTION

Reproduced by permission of ICARUS Corporation

CODING INSTRUCTIONS:

EQUIP. ITEM SYMBOL	EQUIPMENT ITEM TYPE SYMBOL	REMARKS
HE	FIXED-T-S	
	FLAT-HEAD	
	U-TUBE	

REVISIONS		
NO.	DATE	DESCRIPTION

Reproduced by permission of ICARUS Corporation

CODING INSTRUCTIONS:

EQUIP. ITEM SYMBOL	EQUIPMENT ITEM TYPE SYMBOL	REMARKS
HT	ALL TYPES	

REVISIONS		
NO.	DATE	DESCRIPTION

Appendix B

Typical Detailed Output from COST System

46	CP -312	CENTRIFUGAL PUMPS	EQUIPMENT & SETTING	1 ITEM(S)	2700	39	492
			2,000 HP 507 LBS				
226	CP -312	LINE 1 REDUCERS	304P 2 IN DIA SCH 10	1 EACH	13	0	0
228	CP -312	GLOBE VALVES	304P 2 IN DIA 150 POUND	1 EACH	357	0	0
			47 LBS				
530	CP -312	CONTROL VALVES	304P 2 IN DIA 150 POUND	1 EACH	2350	0	0
			54 LBS				
232	CP -312	GATE VALVES	304P 2 IN DIA 150 POUND	3 EACH	880	0	0
			174 LBS				
233	CP -312	CHECK VALVES	304P 2 IN DIA 150 POUND	1 EACH	332	0	0
			38 LBS				
234	CP -312	TEES	304P 2 IN DIA SCH 10	2 EACH	67	0	0
			5 LBS				
257	CP -312	THREADOLETS	304P	1 EACH	14	0	0
204	CP -312	PIPE	304P 2 IN DIA SCH 10	29 FEET	150	0	0
			78 LBS				
239	CP -312	CUT&THRU PIPE-FIELD SHOP		20 JOINTS	0	26	364
240	CP -312	BENDING PIPE -FIELD SHOP		9 BENDS	0	20	271
257	CP -312	THREADOLETS		1 EACH	0	3	44
204	CP -312	PIPE	ERECTION	29 FT LG	0	22	302

IC	CODE	ORIGIN	ID	ITEM	MATERIAL	DESCRIPTION	QUANT.	UNITS	MAT'L COST (\$)	LABOR MH	LABOR COST (\$)
205	CP	-312		VALVES		ERECTION	6	EACH	0	7	96
214	CP	-312		PIPING SYSTEM TESTING	304P	2 IN DIA SCH 10	29	FT LG	0	1	9
208	CP	-312		PIPE SUPPORTS	A 36	FABRICATION	1	EACH	4	2	29
						7 LBS					
208	CP	-312		PIPE SUPPORTS		ERECTION	1	EACH	0	2	24
221	CP	-312	LINE 2	90 DEGREE ELBOWS	304P	3 IN DIA SCH 10	3	EACH	0	0	0
222	CP	-312		FLANGES	304P	3 IN DIA 150 POUND	3	EACH	0	0	0
226	CP	-312		REDUCERS	304P	3 IN DIA SCH 10	1	EACH	0	0	0
232	CP	-312		GATE VALVES	304P	3 IN DIA 150 POUND	1	EACH	456	0	0
						88 LBS					
260	CP	-312		STRAINER	304P	3 IN DIA 150 POUND	1	EACH	489	0	0
						20 LBS					
203	CP	-312		PREFABRICATED PIPING	304P	3 IN DIA SCH 10	169	LBS	1580	0	0
						29 FT LG 2 SECTION					
204	CP	-312		PIPE		ERECTION	29	FT LG	0	25	352
247	CP	-312		FIELD FABRICATION		1 CUTS	0		0	1	13
247	CP	-312		FIELD FABRICATION		1 BEVELS	0		0	1	15
247	CP	-312		FIELD FABRICATION	304P	2 WELDS	0		0	6	84
205	CP	-312		VALVES		ERECTION	1	EACH	0	3	39
247	CP	-312		FIELD FABRICATION		BOLT UP CONNECTIONS	3	EACH	0	6	82
214	CP	-312		PIPING SYSTEM TESTING	304P	3 IN DIA SCH 10	29	FT LG	0	1	10
208	CP	-312		PIPE SUPPORTS	A 36	FABRICATION	1	EACH	7	4	49
						15 LBS					
209	CP	-312		PIPE SUPPORTS		ERECTION	1	EACH	0	3	41
232	CP	-312	DRAINS	GATE VALVES	CS	0.750 IN DIA 150 POUND	3	EACH	183	0	0
						24 LBS					
204	CP	-312		PIPE	A 106	0.750 IN DIA SCH XS	30	FEET	41	0	0
						49 LBS					
239	CP	-312		CUT&THRUD PIPE-FIELD SHOP		10 JOINTS	0		0	5	74
240	CP	-312		BENDING PIPE -FIELD SHOP		9 BENDS	0		0	15	213
204	CP	-312		PIPE		30 FT LG	0		0	17	229
205	CP	-312		VALVES		ERECTION	3	EACH	0	1	20
214	CP	-312		PIPING SYSTEM TESTING	A 106	0.750 IN DIA SCH XS	30	FT LG	0	1	11
208	CP	-312		PIPE SUPPORTS		ERECTION	2	EACH	5	4	60
311	CP	-312	TYPE 5	HAND EXCAVATION		1 CU YD	0		0	5	48
308	CP	-312		CEMENT		7 SACKS	21		0	0	0
310	CP	-312		SAND		0.6 CU YD	4		0	0	0
307	CP	-312		AGGREGATE	STONE	0.9 CU YD	7		0	0	0
316	CP	-312		CONCRETE POUR AND FINISH		1 CU YD	0		0	5	58
317	CP	-312		FORMWORK-CONTACT SURFACE	WOOD	1/2 INCH	27	SQ FT	7	0	0
318	CP	-312		FORMWORK-BACK-UP LUMBER	WOOD	2 X 4	27	BOUF	2	0	0
321	CP	-312		FIELD FABRICATE FORMWORK		27 SQ FT	0		0	8	96

IC U D E	ORIGIN	I D	ITEM	IPAT	DESCRIPTION	QUANT.	UNITS	MAT'L COST (\$)	LABOR MH	COST (\$)
I M - L										
512	CP -312		INSTRUMENT PIPING	BRASS	1/4 GLOBE VALVE THD 150#	1	EACH	10	1	10
512	CP -312		INSTRUMENT PIPING	CS	1/4 PLUG 3000#	1	EACH	0.65	1	9
512	CP -312		INSTRUMENT PIPING	CS	1/4 TEE 3000#	1	EACH	1.77	1	9
512	CP -312		INSTRUMENT PIPING	BRASS	1/4 CONNECT. COMP M NPT	4	EACH	4	4	50
512	CP -312		INSTRUMENT PIPING	BRASS	FILTER/REGULATOR AIR SET	1	EACH	30	3	48
512	CP -312		INSTRUMENT PIPING	BRASS	BLKHD FITTING COMP.	1	EACH	0.98	2	25
503	CP -312	HP-C P	FLOW INSTRUMENTS	FIC	FIELD MOUNTED	1	EACH	0	48	559
610	CP -312	MOTOR	WIRE PULLED IN CONDUIT		12 AWG 600 VOLTS	240	FEET	30	4	63
					TYPE THW COPPER					
617	CP -312		CONDUIT		1.000 IN DIA	70	FEET	101	14	175
606	CP -312		CONDUIT FITTINGS		1.000 IN DIA	1	EACH	2	0	3
606	CP -312		CONDUIT FITTINGS		1.000 IN DIA	5	EACH	21	13	156
606	CP -312		CONDUIT FITTINGS		1.000 IN DIA	4	EACH	19	4	55
606	CP -312		CONDUIT FITTINGS		1.000 IN DIA	3	EACH	13	3	39
606	CP -312		CONDUIT FITTINGS		1.000 IN DIA	3	EACH	8	2	21
610	CP -312		WIRE PULLED IN CONDUIT		14 AWG 600 VOLTS	240	FEET	20	3	52
					TYPE THW COPPER					
616	-		MOTOR CONTROL CENTER		440 VOLTS	2	SPACES	435	4	62
613	CP -312		MOTOR STARTER		440 VOLTS 1 SIZE	1	EACH	118	4	57
					2.000 HP					
619	CP -312		ELECTRICAL CIRCUIT TESTING			1	CIRCUIT	0	3	51
622	CP -312		PUSH BUTTON STATION			2	EACH	67	4	62
621	CP -312		PILOT LIGHT			2	EACH	44	9	125
812	CP -312		SURFACE PREP - PIPING		COMMERCIAL SAND BLAST	8	50 FT	0	0	0
801	CP -312		OTHER PAINT ITEMS		SAND	0.0	CU YD	0	0	0
806	CP -312		PAINT - PIPING			8	50 FT	0	0	0
46	CP -313		CENTRIFUGAL PUMPS		EQUIPMENT & SETTING	1	ITEM(S)	2700	39	492
					2.000 HP 507 LBS					
226	CP -313	LINE 1	REDUCERS	304P	2 IN DIA SCH 10	1	EACH	13	0	0
232	CP -313		GATE VALVES	304P	2 IN DIA 150 POUND	1	EACH	293	0	0
					50 LBS					
233	CP -313		CHECK VALVES	304P	2 IN DIA 150 POUND	1	EACH	332	0	0
					38 LBS					
257	CP -313		THREDOLETS	304P		1	EACH	14	0	0
204	CP -313		PIPE	304P	2 IN DIA SCH 10	10	FEET	52	0	0
					26 LBS					
239	CP -313		CUT&THRU PIPE-FIELD SHOP			6	JOINTS	0	8	109
240	CP -313		BENDING PIPE -FIELD SHOP			2	BENDS	0	4	60
257	CP -313		THREDOLETS			1	EACH	0	3	44
204	CP -313		PIPE		ERECTION	10	FT LG	0	8	104
205	CP -313		VALVES		ERECTION	2	EACH	0	2	32
214	CP -313		PIPING SYSTEM TESTING	304P	2 IN DIA SCH 10	10	FT LG	0	0	3

=====									
IC O D E	ORIGIN	I D	ITEM	PAI L	DESCRIPTION	QUANT.	UNITS	MAT'L COST (\$)	LABOR COST (\$)
=====									
221	CP -313	LINE 2	90 DEGREE ELBOWS	304P	3 IN DIA SCH 10	2 EACH		0	0
222	CP -313		FLANGES	304P	3 IN DIA 150 POUND	3 EACH		0	0
226	CP -313		REDUCERS	304P	3 IN DIA SCH 10	1 EACH		0	0
232	CP -313		GATE VALVES	304P	3 IN DIA 150 POUND	1 EACH		456	0
260	CP -313		STRAINER	304P	3 IN DIA 150 POUND	1 EACH		489	0
203	CP -313		PREFABRICATED PIPING	304P	3 IN DIA SCH 10 10 FT LG 1 SECTION	82 LBS		1200	0
204	CP -313		PIPE		ERECTION	10 FT LG		0	9
247	CP -313		FIELD FABRICATION			1 CUTS		0	1
247	CP -313		FIELD FABRICATION			1 BEVELS		0	1
247	CP -313		FIELD FABRICATION	304P		1 WELDS		0	3
205	CP -313		VALVES		ERECTION	1 EACH		0	3
247	CP -313		FIELD FABRICATION		BOLT UP CONNECTIONS	3 EACH		0	6
214	CP -313		PIPING SYSTEM TESTING	304P	3 IN DIA SCH 10	10 FT LG		0	0
232	CP -313	DRAINS	GATE VALVES	CS	0.750 IN DIA 150 POUND	3 EACH		183	0
204	CP -313		PIPE		A 106 0.750 IN DIA SCH XS 49 LBS	30 FEET		41	0
239	CP -313		CUT/THRD PIPE-FIELD SHOP			10 JOINTS		0	5
240	CP -313		BENDING PIPE -FIELD SHOP			9 BENDS		0	15
204	CP -313		PIPE		ERECTION	30 FT LG		0	17
205	CP -313		VALVES		ERECTION	3 EACH		0	1
214	CP -313		PIPING SYSTEM TESTING	A 106	0.750 IN DIA SCH XS	30 FT LG		0	1
208	CP -313		PIPE SUPPORTS		ERECTION	2 EACH		5	4
311	CP -313	TYPE 5	HAND EXCAVATION			1 CU YD		0	5
308	CP -313		CEMENT			7 SACKS		21	0
310	CP -313		SAND			0.6 CU YD		4	0
307	CP -313		AGGREGATE	STONE		0.9 CU YD		7	0
316	CP -313		CONCRETE POUR AND FINISH			1 CU YD		0	5
317	CP -313		FORMWORK-CONTACT SURFACE	WOOD	1/2 INCH	27 SQ FT		7	0
318	CP -313		FORMWORK-BACK-UP LUMBER	WOOD	2 X 4	27 BUUF		2	0
321	CP -313		FIELD FABRICATE FORMWORK			27 SQ FT		0	8
322	CP -313		INSTALL STRIP & CLEAN FW			27 SQ FT		0	8
320	CP -313		ACCESSORIES			1 SET		8	0
319	CP -313		REBAR	A 36		0.0 TONS		12	0
326	CP -313		INSTALL REINFORCEMENT			0.0 TONS		0	2
339	CP -313		GROUT			0.0 CU YD		1.08	2
610	CP -313	MOTOR	WIRE PULLED IN CONDUIT		12 AWG 600 VOLTS	240 FEET		30	4
617	CP -313		CONDUIT		TYPE THW COPPER 1.000 IN DIA	70 FEET		101	14
=====									

173-00000-0000-0000

173-00000-0000-0000

87

IC	ODE	ORIGIN	ID	ITEM	MAT'L	DESCRIPTION	QUANT.	UNITS	MAT'L COST (\$)	LABOR MH	LABOR COST (\$)
M	L										
606	CP	-313		CONDUIT FITTINGS	1.000	IN DIA ELBOWS	1	EACH	2	0	3
606	CP	-313		CONDUIT FITTINGS	1.000	IN DIA FITTINGS	5	EACH	21	13	156
606	CP	-313		CONDUIT FITTINGS	1.000	IN DIA UNIONS	4	EACH	19	4	55
606	CP	-313		CONDUIT FITTINGS	1.000	IN DIA SEALS	3	EACH	13	3	39
606	CP	-313		CONDUIT FITTINGS	1.000	IN DIA COUPLNG	3	EACH	8	2	21
610	CP	-313		WIRE PULLED IN CONDUIT	14	AWG 600 VOLTS	240	FEET	20	3	52
615	-			MOTOR CONTROL CENTER	TYPE THW COPPER	440 VOLTS	2	SPACES	435	4	62
613	CP	-313		MOTOR STARTER	440 VOLTS	1 SIZE	1	EACH	118	4	57
					2.000	HP					
619	CP	-313		ELECTRICAL CIRCUIT TSTNG			1	CIRCUIT	0	3	51
622	CP	-313		PUSH BUTTON STATION			2	EACH	67	4	62
621	CP	-313		PILOT LIGHT			2	EACH	44	9	125
812	CP	-313		SURFACE PREP - PIPING	COMMERCIAL SAND BLAST		8	SQ FT	0	0	0
801	CP	-313		OTHER PAINT ITEMS	SAND		0.0	CU YD	0	0	0
806	CP	-313		PAINT - PIPING			8	SQ FT	0	0	0
				EQUIPMENT & SETTING			1	ITEM(S)	14500	44	570

Appendix C

Capital Cost Estimate
Conventional Plant

CONVENTIONAL STEAM BOILER

12/01/77

```

          //          //          (R)
CCCCCCCCC 00000000// SSSSSSS// TTTTTTTTTT
CCCCCCCCC 0000000//0 SSSSSSS//SS TTTTTTTTTT
CCC      CCC 000 //000 SS // TT
CC      CC 00 // 00 SS // TT
CC      CC 00 // 00 SSSS//SSS TT
CC      CC 00 // 00 SS//SSSSS TT
CC      CC 00 // 00 // SS TT
CCC      CCC 00// 000 // SS TT
CCCCCCCCC //00000000 S//SSSSSSS TT
CCCCCCCCC //00000000 //SSSSSSS TT
          //          //

```

06

(COST ORIENTED SYSTEMS TECHNIQUE)

VERSION 8.1E
NOVEMBER 14, 1977

12/30/77 11:23:07

(R) COST IS A SERVICE MARK OF

ICARUS CORPORATION
ONE CENTRAL PLAZA
11300 ROCKVILLE PIKE
ROCKVILLE, MD 20852
(301) 881-9350

REGISTERED WITH THE UNITED STATES PATENT OFFICE

TABLE V-A-1
CAPITAL COST SUMMARY

HASE CASE - STEAM PLANT - 500 MW - NO SO2 REMOVAL SYSTEM

NO.	I T E M	-----D I R E C T C O S T S-----			SURCONTRACTS	AMOUNT	PERCENT OF PURCHASED EQUIPMENT	PERCENT OF TOTAL COST
		MATERIAL M-\$	LABOR MANHOURS	LABOR M-\$		\$		
1.	PURCHASED EQUIPMENT	105416.1	-	-	3347.0	108763100.	100.0	51.8
2.	EQUIPMENT SETTING	-	442734	4666.6	-	4666600.00	4.2	2.2
3.	PIPING	9320.4	383400	4577.7	0.0	13898000.0	12.8	6.6
4.	CIVIL	4644.1	1042740	9952.9	12630.7	27227696.0	24.7	13.0
5.	STEEL	750.3	35326	370.6	0.0	1120900.00	1.0	0.5
6.	INSTRUMENTATION	2118.2	49973	553.8	0.0	2672000.00	2.4	1.3
7.	ELECTRICAL	5433.6	219294	2391.6	0.0	7825200.00	7.1	3.7
8.	INSULATION	16.0	1100	13.1	458.3	487400.00	0.4	0.2
9.	PAINT	30.6	12061	110.8	771.2	912600.00	0.8	0.4
10.	TOTAL FIELD COST	121729.3	2186628	22637.0	17207.2	167513500.	154.1	79.8
11.	ENGINEERING					2175600.00	2.0	1.0
12.	CONSTRUCTION OVERHEAD					13639000.0	12.4	6.5
13.	BARE PLANT COST					183388100	168.6	87.3
14.	CONTINGENCIES					18339000.0	16.9	8.7
15.	CONTRACTOR'S FEE					5501600.00	5.1	2.6
16.	SPECIAL CHARGES					2736300.00	2.5	1.3
17.	TOTAL FACILITY COST					209965000.	193.0	100.0

TABLE V-A-II

OPERATIONAL UNIT SUMMARY

OPERATIONAL UNIT	INSTALLED EQUIPMENT	PIPING	CIVIL	STEEL	INSTRU- MENTATION	ELEC- TRICAL	INSULATION	PAINT	TOTAL
	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$
SECTION 100 COAL HANDLING	2995.5	217.5	408.4	245.1	31.0	204.0	0.0	115.8	4217.2
SECT 400 STEAM GENERATOR & AUX	45324.6	6648.5	11225.1	279.3	747.7	1188.1	268.8	510.4	66192.6
SECT 500 ELECTRIC GENERATION	50335.7	2365.4	9906.2	437.6	509.4	4353.2	11.0	14.2	67932.8
SECT 600 WATER PROCESSING SYST	11386.7	2920.3	815.7	28.8	838.6	502.8	179.2	116.4	16788.4
SECTION 700 AUXILIARY EQUIP.	3387.2	1746.3	4872.3	130.2	545.3	1577.1	28.3	155.8	12442.5
TOTAL	113429.6	13898.0	27227.7	1120.9	2672.0	7825.2	487.4	912.6	167573.5

* REVISED

LIST OF EQUIPMENT
BY
UNIT OPERATION OR PROCESS

SECTION 100 COAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====						
ROTARY CAR DUMP SYSTEM FOR COKE-100 TONS CAPACITY CAR						
ROTARY CAR DUMPER SYSTEM -100						1000000.00
	EDI-101			R-CON EXCAVATED	1 SECTION - RECTANGLE 24.00 FT LENGTH 23.00 FT DEPTH 58.50 FT WIDTH	(207900.00)*
ELECTRICAL FOR DUMP SYSTEM						
POSITIONER MOTOR SUPPLIED						
POSITIONER \$=0.	MOT-	250.00 HP		ENCLOSED	3600.00 RPM 2620 LBS (TOTAL WT.)	0.00
DUMPER MOTOR SUPPLIED						
DUMPER MOT \$=0.	MOT-	140.00 HP		ENCLOSED	3600.00 RPM 1740 LBS (TOTAL WT.)	0.00
COAL CAR UNLOADING VIBRATING FEEDERS CO-101-106						
(6) ITEMS CO-101-106	CO -101	375.00 TPH	CS	VIBRATING	120.00 FT LONG 20.00 HP 36.00 INCH PAN WIDTH	133800.00
COAL UNLOADING CONVEYOR CO -107						
		3000.00 TPH	CS	OPEN BELT	344.00 FT LG 60.00 IN W 200.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 45700 LBS (TOTAL WT.)	190000.00
COAL UNLOADING CONVEYOR CO -108						
		3000.00 TPH	CS	OPEN BELT	575.00 FT LG 60.00 IN W 300.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 70900 LBS (TOTAL WT.)	363000.00

SECTION 100 COAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
COAL UNLOADING CONVEYOR	CO -109	3000.00 TPH	CS	OPEN BELT	190.00 FT LG 60.00 IN W 125.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 28500 LBS (TOTAL WT.)	101000.00	
STACKER ROOM	-ST	CO -110	3000.00 TPH	CS	OPEN BELT	110.00 FT LG 60.00 IN W 75.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 19200 LBS (TOTAL WT.)	59800.00
RECLAIM FEEDERS CO-111-118							
(8) ITEMS CO-111-118	CO -111	200.00 TPH	CS	VIBRATING	60.00 FT LONG 7.50 HP 36.00 INCH PAN WIDTH	95200.00	
RECLAIM CONVEYOR	CO -119	280.00 TPH	CS	OPEN BELT	1000.00 FT LG 26.00 IN W 60.00 HP 1750.00 RPM 300.00 FT/MIN 1 SECT'N 63400 LBS (TOTAL WT.)	199000.00	
RECLAIM CONVEYOR	CO -120	280.00 TPH	CS	OPEN BELT	610.00 FT LG 26.00 IN W 40.00 HP 1750.00 RPM 300.00 FT/MIN 1 SECT'N 40300 LBS (TOTAL WT.)	124000.00	
MAGNETIC COAL CLEANER, TOTAL INSTALLED COST FOR 3 ITEMS							
MAGNETIC COAL CLEANER	-100					44800.00	
ELECTRICAL FOR MAGNETIC COAL CLEANER MOT-100 A-C							
(3) ITEMS \$=0.	MOT-100	7.50 HP	ENCLOSED	3600.00 RPM 164 LBS (TOTAL WT.)		0.00	

SECTION 100 COAL HANDLING
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
PULVERIZER FEEDERS CO-121 A-E (5) ITEMS	CO -121	56.00 TPH	CS	VIBRATING	40.00 FT LONG 1.00 HP 24.00 INCH PAN WIDTH		33000.00
PULVERIZER COAL FEED PIPE CCP-101 A-E (5) ITEMS	CCP-101		A 53	YARD PIPE	50.00 FT LG 24.00 IN DIA 50.00 PSIG 125.00 DEG F	(25700.00)*	
BURNER FEED LINES CCP-102 A-E (20) ITEMS	CCP-102	5 ELBOWS	A 53	YARD PIPE	100.00 FT LG 10.00 IN DIA 50.00 PSIG 125.00 DEG F	(121600.00)*	
COAL UNLOADING BELT SCALE S -101		3000.00 TPH		BELT	60.00 IN W		6900.00
COAL SILO VT-101-105 (5) ITEMS	VT -101	78000.00 GAL	A285C	CONE BTM	25.00 FT DIA 18.00 FT HT 0.050 PSIG 125.00 DEG F 0.25 INCHES THICK 70400 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR		310500.00
HOPPERS UNDER PILES (5) ITEMS VT-106-110	VT -106	575.00 GAL	A285C	CONE BTM	4.00 FT DIA 5.30 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 1740 LBS (TOTAL WT.)		18000.00

FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SECTION 100 COAL HANDLING

- OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/STRUCTURE NO.	SYMBOL	DESCRIPTION	SIZE			E: FOUND	ROOF	SERVICES		F: MATERIAL	LABOR		TOTAL COST
			LENGTH	WIDTH	HEIGHT			A: C + E	L: R		(M-)	(MH)	
			(FT)	(FT)	(FT)	S:							
RL	PAI		100	100				M: - L - - -		16.6	2631	25.8	42.5
PR		PIPE RACK	150	30	20					10.8	1445	14.8	25.6
1		CLOSED BOOM HOUSE	20	20	10			M: - M M M M		3.4	586	6.6	13.0
2		OPEN BOOM HOUSE	20	20	100			M: - M - - -		19.6	1383	14.1	33.7

SUPPLEMENTAL BULK ADJUSTMENT DATA

NO.	ACCOUNT	DESCRIPTION	COST CODE		MATERIAL COST (\$)	LABOR MANHOURS	LABOR COST (\$)	MODE	TOTAL COST (\$)
1.	STEEL	ADD'L STEEL FOR STR BM	403	403	10698.00	914.0	9585.00	DIRECT	20283.00

SECT 400 STEAM GENERATOR & AUX
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
STATIONARY STEAM GENERATOR, PURCHASED EQUIPMENT COST							
INCLUDES PURCHASED EQUIPMENT COST FOR PULVERIZERS							
	STEAM GENERATOR	-401					32470000.00
AIR PREHEATER PURCHASED EQUIPMENT COST							
	AIR PREHEATER (3) ITEMS	-400					1941000.00
(3)	ITEMS AIR HEATR MUTOR	MOT-400	25.00 HP		ENCLOSED	3600.00 RPM 421 LBS (TOTAL WT.)	2600.00
(5)	ITEMS PULVERIZER A-E	CR-401	700.00 HP	CS	PULVERIZER	300000 POUNDS 112000 LB/HR	0.00
	DUST COLLECTOR	DC -401		CS	ELC-H-VOLT		4120000.00
(7)	ITEMS FEEDERS	FE -401		CS	ROTARY	4 IN SIZE 498 LBS (TOTAL WT.)	10100.00
FORCED DRAFT FAN FN-401 A-C							
(3)-ITEMS		FN -401	420000.0 ACFM	CS	CENTRIF	2900.00 HP	875000.00
PRIMARY AIR FAN FN-402 A-E							
(5) ITEMS		FN -402	44000.00 CFM	CS	CENTRIF	520.00 HP 1800.00 RPM 6480 LBS (TOTAL WT.)	151500.00
INDUCED DRAFT FAN FN-403 A-C							
(3) ITEMS		FN -403		CS	CENTRIF	1500.00 HP	720000.00

* REVISED

SECT 400 STEAM GENERATOR & AUX
EQUIPMENT LIST *

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
DUCTING							
MAIN STEAM		CCP-401	20 ELBOWS	A335C	YARD PIPE	1000.00 FT LG 3600.00 PSIG	12.5 IN DIA 900.00 DEG F (221600.00)*
BOILER FEED WATER		CCP-402	15 ELBOWS	A 53	YARD PIPE	1000.00 FT LG 3600.00 PSIG	21.7 IN DIA 400.00 DEG F (285400.00)*
COLD REHEAT		CCP-403	15 ELBOWS	A 53	YARD PIPE	1000.00 FT LG 800.00 PSIG	26.62 IN DIA 640.00 DEG F (166900.00)*
HOT REHEAT		CCP-404	15 ELBOWS	A335C	YARD PIPE	1000.00 FT LG 720.00 PSIG	14.80 IN DIA 900.00 DEG F (97300.00)*
BOTTOM ASH REMVL CONVEYOR	CO -401		60.00 TPH	CS	VIBRATING	40.00 FT LONG 1.50 HP 36.00 INCH PAN WIDTH	8300.00
BOTTOM ASH REMVL CONVEYOR	CO -402		60.00 TPH	CS	CLOSED-BLT	1500.00 FT LG 20.00 HP 25.00 FT/MIN 294000 LBS (TOTAL WT.)	36.00 IN W 1750.00 RPM 1 SECT'N 482000.00
BOTTOM ASH HOPPER	VT -401		48700.00 GAL	A285C	CONE BTM	18.00 FT DIA 0.050 PSIG 0.25 INCHES THICK 30100 LBS (TOTAL WT.)	10.00 FT HT 600.00 DEG F 23000.00

* REVISED

SECT 400 STEAM GENERATOR & AUX
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
LINING FOR VT-401		LIN-401	3650.00 SQ FT	9.0FB			70800.00
ASH STORAGE SILO (3) ITEMS STORAGE		VT -402	1735400 GAL	A285C	STORAGE	60.00 FT DIA 82.06 FT HT 0.050 PSIG 125.00 DEG F 0.25 IN THICK (TOP) 0.88 IN THICK (BOT'M) 561000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	1329000.00

* FIELD FAHRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SECT 400 STEAM GENERATOR & AUX - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC:STRUC NO. SYMBOL	DESCRIPTION	SIZE			FOUND	ROOF	SERVICES		FIMATERIAL	LABOR		TOTAL
		LENGTH	WIDTH	HEIGHT			A/C	E L		COST	COST	
		(FT)	(FT)	(FT)	S:					(M-\$)	(MH)	(M-\$)
BL	PAD	160	160				M	-	-	53.1	7763	76.7
PR	PIPE RACK	800	30	20	1					52.0	6442	65.8
1	CLOSED BOILER HOUSE	150	110	302	6	NORMAL	FLAT	M	-	2942.2	270197	2828.1
2	CONTRL CONTROL ROOM SECT 400	50	100	10	1	NORMAL	FLAT	M	H	85.5	16709	186.3

* REVISED

SECT 500 ELECTRIC GENERATION
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
STEAM TURBINE GENERATOR		-500					*****
ELECTRIC GENERATOR		GC -501	200000.0 CFM	CS	CENTRIF	650.00 PSIG IN3500.00 PSIG 670000 HP 2492.00 RPM 6 STAGES 1560 TONS (TOTAL WT.) INCLUDES TURBINE DRIVER	XXXXXXXXXX *

XXXXXXXXXX-INCLUDED IN SUMMARY

* REVISED

SECT 500 ELECTRIC GENERATION - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC NO. /SYMBOL/	DESCRIPTION	SIZE			FOUND	ROOF	SERVICES		MATERIAL COST	LABOR		TOTAL COST
		LENGTH	WIDTH	HEIGHT			A/C	E/L		(M-H)	(M-S)	
		(FT)	(FT)	(FT)	S							
RL : NONE		10	10		1		M	-	0.0	0	0.0	0.0
PR : PIPE RACK		600	30	20	1				39.2	4921	50.3	89.5
1 : CLOSED TURBINE BLDG	SECT 500	200	120	100	1	NORMAL	FLAT	H	1222.8	88444	878.6	2731.8

SUPPLEMENTAL BULK ADJUSTMENT DATA

NO.	ACCOUNT	DESCRIPTION	COST CODE		MATERIAL COST (\$)	LABOR MANHOURS	LABOR COST (\$)	MODE	TOTAL COST (\$)
			MAT'L	LABOR					
1.	STEEL:	TURBINE HAUL CRANE H0501	499	499	330000.00	3000.0	31461.00	DIRECT	361461.00
2.	ELECTRICAL:	TURBINE GENERATOR INST	620	620	790000.00	86000.0	943651.00	DIRECT	1733650.00
3.		MAIN TRANSFORMERS SEC500	632	632	1490000.00	2460.0	26993.00	DIRECT	1516992.00
4.		MAIN BUS SECT 500	634	634	480000.00	5200.0	57058.00	DIRECT	537058.00

SECT 600 WATER PROCESSING SYST
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
MAIN CONDENSER PUMPS CP-601							
(2) ITEMS		CP -601	3100.00 GPM	CS	CENTRIF-M	410.00 FT HD 120.00 DEG F 400.00 HP 1800.00 RPM 11500 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	89600.00
SPARE CP-601		CP -601	3100.00 GPM	CS	CENTRIF-M	410.00 FT HD 120.00 DEG F 400.00 HP 1800.00 RPM 11500 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	44800.00
BOOSTER PUMPS CP-602							
(2) ITEMS		CP -602	4500.00 GPM	CS	CENTRIF-M	1510.00 FT HD 120.00 DEG F 2250.00 HP 3600.00 RPM 26100 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	296000.00
SPARE CP-601		CP -602	4500.00 GPM	CS	CENTRIF-M	1510.00 FT HD 120.00 DEG F 2250.00 HP 3600.00 RPM 26100 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	148000.00
MAIN BOILER FEED PUMPS WITH TURBINE DRIVE CP-603							
(9) ITEMS		CP -603	3000.00 GPM	CS	CENTRIF-T	2800.00 FT HD 120.00 DEG F 3000.00 HP 3600.00 RPM 39200 LBS (TOTAL WT.) INCLUDES TURBINE DRIVER	1962000.00

SECT 600 WATER PROCESSING SYST
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
MAIN CIRCULATING WATER PUMPS							
(3) ITEMS	CP -604	53700.00 GPM	CS	CENTRIF-M	75.00 FT HD	1500.00 HP	652500.00
(3) ITEMS	AIR HEATER MOTR MOT-	25.00 HP		ENCLOSED	3600.00 RPM		2600.00
					421 LBS (TOTAL WT.)		
MAIN CONDENSER	HE -601			CA443	FIXED-T-S	173R35 SQ FT PER SHELL 3 SHELLS A285C SHELL MATERIAL BEM TEMA TYPE 50.00 PSIG SHELL PRESS 650.00 DEG F SHELL TEMP 192.00 IN DIA 40.00 FT LG 50.00 PSIG TUBE PRESS 400.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 40.00 FEET TUBE LENGTH 1045 TONS (TOTAL WT.)	6160000.00
LP #1 FEED H2O HEATER	HE -602			A 179	FIXED-T-S	5190 SQ FT PER SHELL 2 SHELLS A285C SHELL MATERIAL BEM TEMA TYPE 50.00 PSIG SHELL PRESS 185.00 DEG F SHELL TEMP 43.00 IN DIA 20.00 FT LG 225.00 PSIG TUBE PRESS 185.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 52800 LBS (TOTAL WT.)	109000.00

SECT 600 WATER PROCESSING SYST
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
LP #2	FEED H2O HEATER	HE -603		A 179 FIXED-T-S	4893 SQ FT PER SHELL 2 SHELLS A285C SHELL MATERIAL BEM TEMA TYPE 50.00 PSIG SHELL PRESS 215.00 DEG F SHELL TEMP 42.00 IN DIA 20.00 FT LG 225.00 PSIG TUBE PRESS 215.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 50200 LBS (TOTAL WT.)	103000.00
LP #3	FEED H2O HEATER	HE -604		A 179 FIXED-T-S	4953 SQ FT PER SHELL 2 SHELLS A285C SHELL MATERIAL BEM TEMA TYPE 50.00 PSIG SHELL PRESS 250.00 DEG F SHELL TEMP 42.00 IN DIA 20.00 FT LG 225.00 PSIG TUBE PRESS 250.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 50800 LBS (TOTAL WT.)	104000.00
LP #4	FEED WATER HEATER	HE -605		A 179 FIXED-T-S	4444 SQ FT PER SHELL 3 SHELLS A285C SHELL MATERIAL BEM TEMA TYPE 80.00 PSIG SHELL PRESS 320.00 DEG F SHELL TEMP 40.00 IN DIA 20.00 FT LG 225.00 PSIG TUBE PRESS 320.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 71400 LBS (TOTAL WT.)	144000.00

SECT 500 WATER PROCESSING SYST
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====
HP FEED WATER HEATER	HE -606			A 179 FIXED-T-S	6194 SQ FT PER SHELL 3 SHELLS A285C SHELL MATERIAL HEM TEMA TYPE 310.00 PSIG SHELL PRESS 435.00 DEG F SHELL TEMP 47.00 IN DIA 20.00 FT LG 1055.00 PSIG TUBE PRESS 435.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 141600 LBS (TOTAL WT.)	285000.00
HP FEED WATER HEATER	HE -607			A 179 FIXED-T-S	6180 SQ FT PER SHELL 3 SHELLS A285C SHELL MATERIAL HEM TEMA TYPE 760.00 PSIG SHELL PRESS 540.00 DEG F SHELL TEMP 47.00 IN DIA 20.00 FT LG 1055.00 PSIG TUBE PRESS 540.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 183600 LBS (TOTAL WT.)	346000.00
DEAERATOR -I	VT -601	3000.00 GAL		A285C CYLINDER	8.00 FT DIA 7.98 FT HT 200.00 PSIG 385.00 DEG F 0.88 INCHES THICK 12700 LBS (TOTAL WT.)	13900.00

SECT 600 WATER PROCESSING SYST - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/		DESCRIPTION	SIZE			L	E:FOUND	ROOF	SERVICES		F:MATERIAL	LABOR		TOTAL	
STRUC:STRUC	NO.		LENGTH	WIDTH	HEIGHT				V: TYPE	TYPE		A: C + E	L I: R		COST
	SYMBOL		(FT)	(FT)	(FT)	S				T M E: B		(M-\$)	(MH)	(M-\$)	(M-\$)
BL	PAD		200	50											
PR		PIPE RACK	200	20	20	1						19.7	2918	28.8	48.5
												12.8	1655	16.9	29.7
1	SHELL		200	50	40	1	NORMAL	FLAT		M1- M L L M: -		155.8	19927	213.0	428.5

SECTION 700 AUXILIARY EQUIP.
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
(2) ITEMS INSTR AIR COMPR	AC -701	500.00 CFM	CS	SINGLE 1-S	150.00 PSIG 7170 LBS (TOTAL WT.)	75.00 HP	58100.00
(2) ITEMS PLANT AIR COMPR	AC -702	1500.00 CFM	CS	CENTRIF-M	115.00 PSIG 14100 LBS (TOTAL WT.)	300.00 HP	212800.00
(2) ITEMS INSTR AIR DRYER	AD -701	500.00 CFM	CS				25200.00
INSTRUMENT AIR LINE	CCP-705	30 ELBOWS	A 53	YARD PIPE	4000.00 FT LG 100.00 PSIG	3.00 IN DIA 100.00 DEG F	(62400.00)*
FIRE WATER LOOP	CCP-706	30 ELBOWS	A 53	YARD PIPE	6000.00 FT LG 100.00 PSIG	12.00 IN DIA 100.00 DEG F	(300400.00)*
CITY WATER	CCP-707	20 ELBOWS	PVC	YARD PIPE	6000.00 FT LG 150.00 PSIG	3.00 IN DIA 60.00 DEG F	(63800.00)*
FIREWATER SUPPLY	CP -701	15000.00 GPM	A 283	CENTRIF-T	75.00 FT HD 350.00 HP 6920 LBS (TOTAL WT.) INCLUDES TURBINE DRIVER	120.00 DEG F 3600.00 RPM	37600.00
FIREWATER SUPPLY	CP -702	15000.00 GPM	A 283	CENTRIF-M	75.00 FT HD 350.00 HP 7960 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	120.00 DEG F 1800.00 RPM	39600.00

SECTION 700 AUXILIARY EQUIP.
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
ELECTRIC GENERATOR	EG -701	800.00 KW	CS	PORTABLE		227000.00	
FUEL OIL HEAT EXCHANGER	HE -701		CS	HEATER-STM	40.00 SQ FT	595.00	
WAREHOUSE CRANE	HO -701	12.00 TONS	CS	HOIST		17800.00	
SHOP CRANE	HO -702	12.00 TONS	CS	HOIST		17800.00	
(2) ITEMS NITROGEN SUPPLY	HT -701	5000.00 GAL	304L	ASME CODE	7.00 FT DIA 17.37 FT LG 300.00 PSIG 400.00 DEG F 1.25 INCHES THICK 26400 LBS (TOTAL WT.)	139400.00	
INSTRUMENT AIR SURGE POT	HT -702	570.00 GAL	A285C	ASME CODE	4.00 FT DIA 6.06 FT LG 15.00 PSIG 400.00 DEG F 0.31 INCHES THICK 1930 LBS (TOTAL WT.)	2400.00	
PLANT AIR SURGE POT	HT -703	1000.00 GAL	A285C	ASME CODE	4.00 FT DIA 10.64 FT LG 150.00 PSIG 170.00 DEG F 0.44 INCHES THICK 3550 LBS (TOTAL WT.)	4100.00	
(2) ITEMS FUEL OIL PUMPS	P -703	20.00 GPM	CS	RECIP-MOTR	1000.00 FT HD 7.50 HP 1800.00 RPM 868 LBS (TOTAL WT.)	11500.00	
FUEL OIL TANK	VT -701	100000.0 GAL	A285C	CONE ROOF	35.00 FT DIA 13.90 FT HT 0.050 PSIG 68.00 DEG F 0.19 IN THICK (TOP) 0.25 IN THICK (BOT'M) 51900 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	57500.00	

SECTION 700 AUXILIARY EQUIP.
E Q U I P M E N T L I S T

ITEM NAME	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
(4) ITEMS DEMINERALIZER	WTS-701	15000.00 GPH	A285C DEMINERAL	PACKAGED SYSTEM 18400 LBS (TOTAL WT.)	220400.00
COOLING TOWER	WTS-702	157200.0 GPM	A285C COOLING	30.00 DEG F RANGE 18.70 DEG APPROACH 60.00 DEG F WET BULB 125.00 HP/FAN 21 FANS 1000.00 HP/PUMP 3 PUMPS 416000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	1650000.00
WATER TREATMENT SYSTEM, TOTAL INSTALLED COST					
WATER TREATMENT SYSTEM	-700				40000.00
TOOLS	-700				200000.00
LAB EQUIPMENT	-700				150000.00

* FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SECTION 700 AUXILIARY EQUIP. - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/STRUC NO.	BLDG/STRUC SYMBOL	DESCRIPTION	SIZE			FOUND	TYPE	ROOF TYPE	SERVICES		MATERIAL COST	LABOR		TOTAL COST
			LENGTH	WIDTH	HEIGHT				LA	HP		(M-H)	(M-S)	
			(FT)	(FT)	(FT)						(M-\$)	(MH)	(M-\$)	(M-\$)
BL	IPAD		200	200					MI	M	71.7	11082	109.1	180.8
PR	PIPE RACK		1000	30	20						64.9	7946	81.1	146.0
1	WARE	WAREHOUSE SECT 700	75	100	40	2	NORMAL	FLAT	MI	L	119.3	10774	113.8	303.1
2	SHOP	MAINTAINANCE BLDG SEC 700	60	100	20	1	NORMAL	FLAT	MI	M	52.3	7347	82.4	175.1
3	SANTRY	CHANGE HOUSE SECT 700	50	80	20	1	NORMAL	FLAT	MI	V	60.1	12709	143.9	265.2
4	OFFICE	ADMINISTRATION BLDG 700	75	150	10	1	NORMAL	FLAT	MI	M	295.6	33526	371.5	867.2
5	SHELL	GUARD HOUSE SECT 700	15	15	10	1	NORMAL	FLAT	MI	M	2.0	339	3.8	6.3
6	GARAGE	GARAGE SECT 700	70	100	30	1	NORMAL	FLAT	MI	L	58.3	4813	49.6	140.3
7	SHELL	MCC BUILDINGS SECT 700	30	20	10	1	NORMAL	FLAT	MI	M	5.2	904	10.0	16.7
8	SHELL	MCC BUILDINGS SECT 700	30	20	10	1	NORMAL	FLAT	MI	M	5.2	904	10.0	16.7
9	SHELL	MCC BUILDINGS SECT 700	30	20	10	1	NORMAL	FLAT	MI	M	5.2	904	10.0	16.7

SUPPLEMENTAL BULK ADJUSTMENT DATA

NO.	ACCOUNT	DESCRIPTION	COST CODE		MATERIAL COST (\$)	LABOR MANHOURS	LABOR COST (\$)	MODE	TOTAL COST (\$)
			399	399					
1.	CIVIL	STACKS SECT 700	399	399	1340000.00	73000.0	695632.00	DIRECT	2035631.00

Appendix D

Capital Cost Estimate
Atmospheric Fluidized Bed Steam Generator

ATMOSPHERIC FLUIDIZED BED STEAM GENERATOR

12/01/77

```

                //      //
CCCCCCCCC      0000000//  SSSSSS//
CCCCCCCCC      .0000000//0 SSSSSS//SS
CCC          CCC 000    //000  SS    //
CC           00    // 00  SS    //
CC           00    // 00  SSSS//SSS
CC           00    // 00  SS//SSSS
CC           00    // 00    //    SS
CCC          CCC 00//    000    //    SS
CCCCCCCCC      //0000000  S//SSSSSSS
CCCCCCCCC      //0000000  //SSSSSSS
                //      //
    
```

(R)

(COST ORIENTED SYSTEMS TECHNIQUE)

VERSION 8.1E
NOVEMBER 14, 1977

12/29/77 16:02:09

(R)
COST IS A SERVICE MARK OF

ICARUS CORPORATION
ONE CENTRAL PLAZA
11300 ROCKVILLE PIKE
ROCKVILLE, MD 20852
(301) 881-9350

REGISTERED WITH THE UNITED STATES PATENT OFFICE

TABLE 11-B-1

M A S T E R S U M M A R Y *

NO.	I T E M	-----D I R E C T C O S T S-----			SUBCONTRACTS TOTAL M-\$	AMOUNT \$	PERCENT OF PURCHASED EQUIPMENT	PERCENT OF TOTAL COST
		MATERIAL M-\$	LABOR MANHOURS	LABOR M-\$				
1.	PURCHASED EQUIPMENT	112896.6	-	-	5238.8	118135400.0	100.0	50.4
2.	EQUIPMENT SETTING	-	535125	5636.8	-	5636800.00	4.7	2.4
3.	PIPING	10599.9	597472	7217.4	0.0	17817300.0	15.1	7.5
4.	CIVIL	5174.0	1176677	10043.1	10771.6	25988700.0	22.0	10.9
5.	STEEL	1380.9	91518	962.5	0.0	2343400.00	2.0	1.0
6.	INSTRUMENTATION	2227.7	66011	721.9	0.0	2949600.0	2.5	1.2
7.	ELECTRICAL	6711.8	405941	4322.9	0.0	11034700.0	9.3	4.6
8.	INSULATION	16.0	1100	13.1	648.7	677800.00	0.6	0.3
9.	PAINT	10.0	1700	15.6	2397.9	2423500.00	2.0	1.0
10.	TOTAL FIELD COST	139016.9	2875544	28933.3	19057.1	187007200.	158.3	78.6
11.	ENGINEERING					2927400.00	2.4	1.2
12.	CONSTRUCTION OVERHEAD					17910400.0	15.0	7.5
13.	BARE PLANT COST					207845000.0	175.9	87.4
14.	CONTINGENCIES					20785000.0	17.6	8.7
15.	CONTRACTOR'S FEE					6235000.0	5.3	2.6
16.	SPECIAL CHARGES					3058800.00	2.6	1.3
17.	TOTAL FACILITY COST					237923800	201.4	100.0

* REVISED

TABLE 11-B-2

OPERATIONAL UNIT SUMMARY *

OPERATIONAL UNIT	INSTALLED EQUIPMENT	PIPING	CIVIL	STEEL	INSTRU- MENTATION	ELEC- TRICAL	INSULATION	PAINT	TOTAL
	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$
SECTION 100 COAL HANDLING	5411.4	271.3	604.2	420.3	101.7	1963.4	27.1	382.7	9182.2
SECTION 200 LIMESTONE HANDLG	1994.9	66.6	187.9	439.4	49.1	893.6	16.9	261.2	3909.6
SECTION 300 FUEL FEED	1826.1	234.5	122.3	172.8	24.2	381.8	44.6	134.0	2940.4
SECT 400 BOILER	46217.0	10048.9	9346.2	703.6	856.9	1236.0	363.5	1244.3	70014.3
SECT 500 ELECTRIC GENERATION	50335.7	2365.4	9906.2	437.6	509.4	4353.2	11.0	14.2	67932.8
SECT 600 MAIN WATER SYSTEM	11382.8	2920.3	815.7	28.8	838.6	502.8	179.2	116.4	16788.4
SECTION 700 AUXILIARY EQUIP.	6606.4	1910.1	5006.3	140.9	569.5	1704.0	35.5	270.6	16243.3
TOTAL	123772.2	17817.3	25988.7	2343.4	2949.4	11034.7	677.8	2423.5	187004.2

* REVISED

LIST OF EQUIPMENT
BY
UNIT OPERATION OR PROCESS

SECTION 100 COAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
COAL CAR UNLOADING VIBRATING FEEDERS CO-101-106							
(6) ITEMS	CO-101-106	CO -101	375.00 TPH	CS	VIBRATING	120.00 FT LONG 20.00 HP 36.00 INCH PAN WIDTH	134400.00
COAL UNLOADING CONVEYOR		CO -107	3000.00 TPH	CS	OPEN BELT	344.00 FT LG 60.00 IN W 200.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 45700 LBS (TOTAL WT.)	190000.00
COAL UNLOADING CONVEYOR		CO -10E	3000.00 TPH	CS	OPEN BELT	575.00 FT LG 60.00 IN W 300.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 70900 LBS (TOTAL WT.)	366000.00
COAL UNLOADING CONVEYOR		CO -109	3000.00 TPH	CS	OPEN BELT	190.00 FT LG 60.00 IN W 125.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 28500 LBS (TOTAL WT.)	101000.00
STACKER BOOM	-ST	CO -110	3000.00 TPH	CS	OPEN BELT	110.00 FT LG 60.00 IN W 75.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 19200 LBS (TOTAL WT.)	59900.00
RECLAIM FEEDERS CO-111-118							
(8) ITEMS	CO-111-118	CO -111	200.00 TPH	CS	VIBRATING	60.00 FT LONG 7.50 HP 36.00 INCH PAN WIDTH	96000.00

SECTION 100 COAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
RECLAIM CONVEYOR		CO -119	350.00 TPH	CS	OPEN BELT	1000.00 FT LG 30.00 IN W 75.00 HP 1750.00 RPM 270.00 FT/MIN 1 SECT'N 69200 LBS (TOTAL WT.)	235000.00
RECLAIM CONVEYOR		CO -120	350.00 TPH	CS	OPEN BELT	610.00 FT LG 30.00 IN W 40.00 HP 1750.00 RPM 270.00 FT/MIN 1 SECT'N 43600 LBS (TOTAL WT.)	124000.00
COAL DRYER FEED CONVEYORS CO-121-122							
(2) ITEMS	CO-121-122	CO -121	130.00 TPH	CS	OPEN BELT	540.00 FT LG 36.00 IN W 15.00 HP 1750.00 RPM 68.00 FT/MIN 1 SECT'N 41400 LBS (TOTAL WT.)	380000.00
COAL DRYER FEED CONVEYORS CO-123-125							
(3) ITEMS	CO-123-125	CO -123	130.00 TPH	CS	OPEN BELT	170.00 FT LG 36.00 IN W 5.00 HP 1750.00 RPM 68.00 FT/MIN 1 SECT'N 14400 LBS (TOTAL WT.)	120300.00
COAL DRYER FEED CONVEYORS CO-126-129							
(4) ITEMS	CO-126-129	CO -126	130.00 TPH	CS	OPEN BELT	30.00 FT LG 36.00 IN W 2.00 HP 1750.00 RPM 68.00 FT/MIN 1 SECT'N 4680 LBS (TOTAL WT.)	48000.00
COAL CRUSHER FEED CONVEYORS CO-130-132							
(3) ITEMS	CO-130-132	CO -130	130.00 TPH	CS	OPEN BELT	30.00 FT LG 36.00 IN W 2.00 HP 1750.00 RPM 68.00 FT/MIN 1 SECT'N 4680 LBS (TOTAL WT.)	36000.00

SECTION 100 COAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====							
CRUSHED COAL FEED CONVEYOR CO-133-135							
(3)	ITEMS CO-133-135	CO -133	130.00 TPH	CS	OPEN BELT	30.00 FT LG 36.00 IN W 2.00 HP 1750.00 RPM 68.00 FT/MIN 1 SECT'N 4680 LBS (TOTAL WT.)	36000.00
COAL FEED VIBRATING CONVEYORS CO-136-138 A&B							
(6)	ITEMS CO-136-138 A&B	CO -136	130.00 TPH	CS	VIBRATING	30.00 FT LONG 2.00 HP 36.00 INCH PAN WIDTH	38800.00
COAL FEED CONVEYORS CO-139-141 A&B							
(6)	ITEMS CO-139-141 A&B	CO -139	130.00 TPH	CS	OPEN BELT	60.00 FT LG 36.00 IN W 3.00 HP 1750.00 RPM 68.00 FT/MIN 1 SECT'N 6440 LBS (TOTAL WT.)	104400.00
COAL FEED-BUCKET ELEVATOR TYPE CO-142-156							
(15)	ITEMS CO-142-156	CO -142	130.00 TPH	CS	CENT-BKT-L	60.00 FT LONG 20.00 HP 16X8 IN BUCKET SIZE 80.00 LBS/CU FT 10000 LBS (TOTAL WT.)	169500.00
COAL CRUSHERS CR-101-103							
(3)	ITEMS CR-101-103	CR -101		CS	ROLL	30X50 SIZE 60.00 HP 1200.00 RPM 22600 LBS (TOTAL WT.)	97800.00
COAL DRYER CYCLONES DC-101-109							
(9)	ITEMS DC-101-109	DC -101	22000.00 CFM	CS	CYCLONE	56.00 IN DIA 2.50 IN H2O 3630 LBS (TOTAL WT.)	70100.00

SECTION 100 COAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====							
COAL FEEDERS FE-101-120							
(20) ITEMS FE-101-120	FE -101			CS	ROTARY	24 IN SIZE 4700 LBS (TOTAL WT.)	554000.00
COAL DRYER EXHAUST FANS FN-101-103							
(3) ITEMS FN-101-103	FN -101	72000.00 CFM		CS	CENTRIF	250.00 HP 1800.00 RPM 4670 LBS (TOTAL WT.)	71100.00
SPARE FN-101	FN -101	72000.00 CFM		CS	CENTRIF	250.00 HP 1800.00 RPM 4670 LBS (TOTAL WT.)	23700.00
COAL UNLOADING BELT SCALE S -101			3000.00 TPH		BELT	60.00 IN W	6900.00
RAW COAL SCREEN VS-101-103							
(3) ITEMS VS-101-103	VS -101			CS	TWO DECK	100.00 SQ FT 20.00 HP 13400 LBS (TOTAL WT.)	43800.00
CRUSHED COAL SCREEN VS-104-106							
(3) ITEMS VS-104-106	VS -104			CS	TWO DECK	100.00 SQ FT 20.00 HP 13400 LBS (TOTAL WT.)	43800.00
COAL SILOS VT-101-105							
(5) ITEMS VT-101-105	VT -101	78000.00 GAL		A285C	CONE BTM	25.00 FT DIA 18.00 FT HT 0.050 PSIG 125.00 DEG F 0.25 INCHES THICK 70400 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	310500.00

SECTION 100 COAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====						
COAL DRYERS VT-106-108 (3) ITEMS VT-106-108	VT -106	24000.00 GAL	A285C CONE BTM	13.50 FT DIA 0.050 PSIG 0.25 INCHES THICK 21600 LBS (TOTAL WT.)	19.00 FT HT 150.00 DEG F	50100.00
COAL FEED SILOS VT-109-112 (4) ITEMS VT-109-112	VT -109	2330.00 CU FT	A285C LIVE BTM	10.00 FT DIA 3.00 HP 19500 LBS (TOTAL WT.)	26.97 FT HT 68.00 DEG F	104400.00
HOPPERS UNDER PILES (5) ITEMS VT-113-117	VT -113	575.00 GAL	A285C CONE BTM	4.00 FT DIA 0.050 PSIG 0.25 INCHES THICK 1740 LBS (TOTAL WT.)	5.30 FT HT 68.00 DEG F	18000.00
CO2 FIRE PROTECTION SYST	-100					150000.00
ROTARY CAR DUMPER SYSTEM FOR COAL AND LIMESTONE TOTAL INSTALLED COST 100 TONS CAPACITY CAR	-100					1000000.00
POSITIONER MOTOR SUPPLIED \$=0.	MOT-	250.00 HP	ENCLOSED	3600.00 RPM 2620 LBS (TOTAL WT.)		0.00
DUMPER MOTOR SUPPLIED \$=0.	MOT-	140.00 HP	ENCLOSED	3600.00 RPM 1740 LBS (TOTAL WT.)		0.00

SECTION 100 COAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
		EDI-101		R-CON	EXCAVATED	1 SECTION - RECTANGLE 24.00 FT LENGTH 23.00 FT DEPTH 58.50 FT WIDTH	(207900.00)*
MAGNETIC COAL CLEANER, TOTAL INSTALLED COST FOR 3 ITEMS							
	MAGNETIC COAL CLEANER	-100					44800.00
ELECTRICAL FOR MAGNETIC COAL CLEANER MOT-100 A-C							
(3) ITEMS \$=0.		MOT-100	7.50 HP	ENCLOSED	3600.00 RPM 164 LBS (TOTAL WT.)		0.00
COAL & LIMESTONE DUST CONTROL SYSTEM *							
		DC -100	7500.00 CFM	CS	CLOTH BAG 1000 SQ FT 7.50 AIR/MEDIA RATIO 6130 LBS (TOTAL WT.)		9300.00

* FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

* REVISED

SECTION 100 COAL HANDLING

- OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/STRUC NO.	BLDG/STRUC SYMBOL	DESCRIPTION	SIZE			FOUND TYPE E SYMBOL	ROOF TYPE SYMBOL	SERVICES		MATERIAL COST E L R A U R N T M E	LABOR COST (MH)	TOTAL COST (M-\$)	
			LENGTH	WIDTH	HEIGHT			A/C	ELECTRICAL				
(FT)	(FT)	(FT)	S			(M-\$)	(MH)	(M-\$)	(M-\$)				
BL	IPAD		100	100				MI	L	16.6	2631	42.5	
PR		PIPE RACK	150	30	20					10.8	1445	25.6	
1	CLOSED	BOOM HOUSE	20	20	10	NORMAL	FLAT	MI	M M M M	3.4	586	13.0	
2	OPEN	BOOM HOUSE	20	20	100			MI	M	19.6	1363	33.5	

SUPPLEMENTAL BULK ADJUSTMENT DATA

NO.	ACCOUNT	DESCRIPTION	COST CODE		MATERIAL COST (\$)	LABOR MANHOURS	LABOR COST (\$)	MODE	TOTAL COST (\$)
			MAT'L	LABOR					
1.	STEEL	ADD'L STEEL FOR STKR BM	403	403	10698.00	914.0	9585.00	DIRECT	20283.00

SECTION 200 LIMESTONE HANDLG
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST	
=====								
CO-201-203 IS PART OF SECT 100 COAL HANDLING FACILITY								
LIMESTONE UNLOADING CONV	CO -204	3000.00 TPH	CS	OPEN BELT	1000.00 FT LG 500.00 HP 420.00 FT/MIN 117000 LBS (TOTAL WT.)	60.00 IN W 1750.00 RPM 1 SECT'N	647000.00	
STACKER BOOM	-ST	CO -205	3000.00 TPH	CS	OPEN BELT	100.00 FT LG 75.00 HP 420.00 FT/MIN 18200 LBS (TOTAL WT.)	60.00 IN W 1750.00 RPM 1 SECT'N	58700.00
LIMESTONE RECLAIM FEEDER	CO-206-210							
(5) ITEMS CO-206-210	CO -206	80.00 TPH	CS	VIBRATING	60.00 FT LONG 3.00 HP 24.00 INCH PAN WIDTH		47500.00	
LIMESTONE RECLAIM CONVEYR	CO -211	62.00 TPH	CS	OPEN BELT	1000.00 FT LG 15.00 HP 75.00 FT/MIN 54900 LBS (TOTAL WT.)	22.00 IN W 1750.00 RPM 1 SECT'N	169000.00	
LIMESTONE RECLAIM CONVEYR	CO -212	62.00 TPH	CS	OPEN BELT	800.00 FT LG 10.00 HP 75.00 FT/MIN 44000 LBS (TOTAL WT.)	22.00 IN W 1750.00 RPM 1 SECT'N	131000.00	
LIMESTONE DRYER FEED CONVEYORS	CO-213-214							
(2) ITEMS CO-213-214	CO -213	24.00 TPH	CS	OPEN BELT	540.00 FT LG 3.00 HP 44.00 FT/MIN 26800 LBS (TOTAL WT.)	18.00 IN W 1750.00 RPM 1 SECT'N	142600.00	

SECTION 200 LIMESTONE HANDLG
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
LIMESTONE DRYER FEED CONVEYORS CO-215-217							
(3)	ITEMS CO-215-217	CO -215	24.00 TPH	CS	OPEN BELT	140.00 FT LG 18.00 IN W 1.00 HP 1750.00 RPM 44.00 FT/MIN 1 SECT'N 8040 LBS (TOTAL WT.)	50700.00
LIMESTONE DRYER FEED CONVEYORS CO-218-220							
(3)	ITEMS CO-218-220	CO -218	24.00 TPH	CS	OPEN BELT	30.00 FT LG 18.00 IN W 0.50 HP 1750.00 RPM 44.00 FT/MIN 1 SECT'N 3110 LBS (TOTAL WT.)	20900.00
LIMESTONE CRUSHER FEED CONVEYOR CO-221-223							
(3)	ITEMS CO-221-223	CO -221	24.00 TPH	CS	OPEN BELT	30.00 FT LG 18.00 IN W 0.50 HP 1750.00 RPM 44.00 FT/MIN 1 SECT'N 3110 LBS (TOTAL WT.)	20900.00
CRUSHED LIMESTONE FEED CONVEYOR CO-224-226							
(3)	ITEMS CO-224-226	CO -224	24.00 TPH	CS	OPEN BELT	30.00 FT LG 18.00 IN W 0.50 HP 1750.00 RPM 44.00 FT/MIN 1 SECT'N 3110 LBS (TOTAL WT.)	20900.00
LIMESTONE FEED VIBRATING CONVEYOR CO-227-228 A&B							
(4)	ITEMS CO-227-228 A&B	CO -227	24.00 TPH	CS	VIBRATING	30.00 FT LONG 0.33 HP 24.00 INCH PAN WIDTH	20400.00
LIMESTONE FEED CONVEYOR CO-229-230 A&B							
(4)	ITEMS CO-229-230 A&B	CO -229	24.00 TPH	CS	OPEN BELT	60.00 FT LG 18.00 IN W 0.50 HP 1750.00 RPM 44.00 FT/MIN 1 SECT'N 4200 LBS (TOTAL WT.)	35400.00

SECTION 200 LIMESTONE HANDLG
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
LIMESTONE FEED BUCKET ELEVATORS CO-231-245							
(15)	ITEMS CO-231-245	CO -231	22.00 TPH	CS	CENT-BKT-L	60.00 FT LONG 5.00 HP 8X5 IN BUCKET SIZE 5080 LBS (TOTAL WT.)	112200.00
LIMESTONE CRUSHERS CR-201-203							
(3)	ITEMS CR-201-203	CR -201		CS	ROLL	30X50 SIZE 20.00 HP 1200.00 RPM 21900 LBS (TOTAL WT.)	92400.00
LIMESTONE DRYER CYLONES DC-201-203							
(3)	ITEMS DC-201-203	DC -201	3100.00 CFM	CS	CYCLONE	22.00 IN DIA 2.50 IN H20 371 LBS (TOTAL WT.)	5300.00
LIME STONE FEEDERS, FE-201-216							
(16)	ITEMS FE-201-216	FE -201		CS	ROTARY	8 IN SIZE 823 LBS (TOTAL WT.)	42800.00
LIMESTON UNLOAD BELT SCAL S -201 3000.00 TPH							
					BELT	60.00 IN W	6900.00
RAW LIMESTONE SCREEN VS-201-203							
(3)	ITEMS VS-201-203	VS -201		CS	TWO DECK	30.00 SQ FT 3.00 HP 2460 LBS (TOTAL WT.)	15400.00
CRUSHED LIMESTONE SCREEN VS-204-206							
(3)	ITEMS VS-204-206	VS -204		CS	TWO DECK	30.00 SQ FT 3.00 HP 2460 LBS (TOTAL WT.)	15400.00

SECTION 200 LIMESTONE HANDLG
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====						
LIMESTONE SILO VT-201-202						
(2) ITEMS VT-201-202	VT -201	48600.00 GAL	A285C CONE BTM	17.00 FT DIA 0.050 PSIG 0.25 INCHES THICK 36700 LBS (TOTAL WT.)	25.00 FT HT 68.00 DEG F	52600.00
LIMESTONE DRYERS VT-203-205						
(3) ITEMS VT-203-205	VT -203	4500.00 GAL	A285C CONE BTM	9.00 FT DIA 0.050 PSIG 0.25 INCHES THICK 5880 LBS (TOTAL WT.)	8.20 FT HT 150.00 DEG F	18400.00
LIMESTONE FEED SILO VT-206-207						
(2) ITEMS VT-206-207	VT -206	460.00 CU FT	A285C LIVE BTM	5.00 FT DIA 1.50 HP 6070 LBS (TOTAL WT.)	21.30 FT HT 68.00 DEG F	24000.00
HOPPERS UNDER PILES						
(3) ITEMS VT-208-210	VT -208	575.00 GAL	A285C CONE BTM	4.00 FT DIA 0.050 PSIG 0.25 INCHES THICK 1740 LBS (TOTAL WT.)	5.30 FT HT 68.00 DEG F	10800.00
MAGNETIC LIMESTONE CLEANER, TOTAL INSTALLED COST FOR 3 ITEMS						
MAGNETIC LIMESTONE CLEANR -200						44800.00
ELECTRICAL FOR MAGNETIC LIMESTONE CLEANER						
(3) ITEMS S=0.	MOT-	7.50 HP	ENCLOSED	3600.00 RPM 164 LBS (TOTAL WT.)		0.00

SECTION 200 LIMESTONE HANDLG - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC NO. /SYMBOL	DESCRIPTION	SIZE			L FOUND V E L S	ROOF TYPE SYMBOL	SERVICES		FIMATERIAL COST	LABOR		TOTAL COST
		LENGTH	WIDTH	HEIGHT			AIC + E L I R	E A U R I N		COST	COST	
		(FT)	(FT)	(FT)					(M-\$)	(MH)	(M-\$)	(M-\$)
BL	NONE	200	200				MI- L		16.9	1539	15.9	32.8
PR	PIPE RACK	200	20	20					12.8	1641	16.7	29.5
1	CLOSED BOOM HOUSE	20	20	10		NORMAL	FLAT MI- M		3.4	586	6.6	13.0
2	OPEN BOOM HOUSE	20	20	100	5		MI- M		35.7	2481	25.3	61.0

SUPPLEMENTAL BULK ADJUSTMENT DATA

NO.	ACCOUNT	DESCRIPTION	COST CODE		MATERIAL COST (\$)	LABOR MANHOURS	LABOR COST (\$)	MODE	TOTAL COST (\$)
			IMAT'L	LABOR					
1.	STEEL	ADD'L STEEL FOR STKR HM	403	403	9757.00	825.0	8652.00	DIRECT	18409.00

* REVISED

SECTION 300 FUEL FEED
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
(3) ITEMS	BLENDER A,B&C	BL -301	450.00 CU FT	CS		120.00 LB MAT'L/CU FT 75.00 HP 50.00 RPM 37600 LBS (TOTAL WT.)	259500.00
(3) ITEMS	COAL/LIMESTONE CONVEYOR CO-301 A,B&C	CO -301	151.00 TPH	CS	OPEN BELT	140.00 FT LG 36.00 IN W 5.00 HP 1750.00 RPM 53.00 FT/MIN 1 SECTION 12700 LBS (TOTAL WT.)	113700.00
(3) ITEMS	BLENDED FEED CONVEYORS CO-302 A,B&C	CO -302	151.00 TPH	CS	OPEN BELT	300.00 FT LG 36.00 IN W 10.00 HP 1750.00 RPM 53.00 FT/MIN 1 SECTION 24800 LBS (TOTAL WT.)	297300.00
(21) ITEMS	FUEL FEED VIBRATING CONVEYORS CO-303-309 A,B&C	CO -303	22.00 TPH	CS	VIBRATING	30.00 FT LONG 0.33 HP 18.00 INCH PAN WIDTH	71400.00
(3) ITEMS	CRC LIMESTONE FEED CO-310 A,B&C	CO -310	5.00 TPH	CS	VIBRATING	15.00 FT LONG 0.13 HP 12.00 INCH PAN WIDTH	4500.00
(3) ITEMS	CRC LIMESTONE CONVEYORS CO-311 A,B&C	CO -311	5.00 TPH	CS	OPEN BELT	140.00 FT LG 12.00 IN W 0.25 HP 1750.00 RPM 18.00 FT/MIN 1 SECTION 6360 LBS (TOTAL WT.)	42900.00

SECTION 300 FUEL FEED
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====							
FEEDERS FE-301-321 (21) ITEMS		FE -301		CS	ROTARY	4 IN SIZE 498 LBS (TOTAL WT.)	30300.00
FEEDERS FE- 322-333 (12) ITEMS		FE -322		CS	ROTARY	4 IN SIZE 498 LBS (TOTAL WT.)	17300.00
COAL WEIGH BELT SCALE S-301 A&B&C (3) ITEMS		S -301	25.00 TPH		BELT	36.00 IN W	20200.00
LIMESTONE WEIGH BELT SCALE S-302 A&B&C (3) ITEMS		S -302	26.00 TPH		BELT	22.00 IN W	19900.00
COAL SURGE BINS VT-301 A&B (2) ITEMS		VT -301	70000.00 GAL	A285C	CONE BTM	25.00 FT DIA 17.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 69500 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	122400.00
LIMESTONE SURGE BINS VT-302 A&B (2) ITEMS		VT -302	73000.00 GAL	A285C	CONE BTM	25.00 FT DIA 17.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 69500 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	122400.00

SECTION 300 FUEL FEED
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E		PURCHASED EQUIPMENT COST
=====							
SURGE BIN VT-303 A&B							
(2) ITEMS		VT -303	8000.00 GAL	A285C CONE BTM	10.00 FT DIA	12.00 FT HT	15000.00
					0.050 PSIG	68.00 DEG F	
					0.25 INCHES THICK		
					8290 LBS	(TOTAL WT.)	
AIR FUEL FEED SYSTEM CCP-301-307 A,B&C							
(21) ITEMS		CCP-301	6 ELBOWS A 53	YARD PIPE	250.00 FT LG	6.00 IN DIA	(181400.00)*
					50.00 PSIG	150.00 DEG F	
SOLIDS HANDLING CONTROL SYSTEM, TOTAL INSTALLED COST							
SOLIDS HAND CONTR SYST -300							540000.00

* FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SECTION 300 FUEL FEED

- OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/ STRUC NO.	BLDG/ STRUC SYMBOL	DESCRIPTION	SIZE			L E S YMBOL	FOUND TYPE SYMBOL	ROOF TYPE SYMBOL	SERVICES		F MATERIAL COST	LABOR		TOTAL COST
			LENGTH	WIDTH	HEIGHT				A/C + E L	R		COST	(M-H)	(M-\$)
			(FT)	(FT)	(FT)	S			B		(M-\$)	(MH)	(M-\$)	(M-\$)
EL	NONE		400	200		1			M	L	29.4	2685	27.7	57.1
PR		PIPE RACK	400	20	20	1					24.8	3090	31.5	56.4

SECT 400 BOILER
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
(6) ITEMS	SOLIDS REINJECTION SYSTEM CO-401-A-F	CO -401	11.10 TPH	SS304	PNEUMATIC	1000.00 FT LG 20.00 HP 4.00 IN LINE SIZE 60.00 LBS/CU FT	141600.00
(3) ITEMS	FINES CONVEYOR CO-402-A,B&C	CO -402	27.00 TPH	CS	CLOSED-BLT	400.00 FT LG 20.00 IN W 3.00 HP 1750.00 RPM 40.00 FT/MIN 1 SECT'N 65900 LBS (TOTAL WT.)	243600.00
(2) ITEMS	FINES DISPOSAL CONVEYOR CO-403 A&B	CO -403	77.00 TPH	CS	OPEN BELT	100.00 FT LG 26.00 IN W 2.00 HP 1750.00 RPM 65.00 FT/MIN 1 SECT'N 7670 LBS (TOTAL WT.)	35200.00
	FINES DISPOSAL CONVEYOR	CO -404	154.00 TPH	CS	OPEN BELT	1500.00 FT LG 52.00 IN W 40.00 HP 1750.00 RPM 30.00 FT/MIN 1 SECT'N 145000 LBS (TOTAL WT.)	589000.00
	FINES DISPOSAL CONVEYOR	CO -405	154.00 TPH	CS	OPEN BELT	200.00 FT LG 52.00 IN W 7.50 HP 1750.00 RPM 30.00 FT/MIN 1 SECT'N 21800 LBS (TOTAL WT.)	95400.00
(3) ITEMS	BOTTOMS CONVEYOR CO-406 A-C	CO -406	14.00 TPH	CS	VIBRATING	30.00 FT LONG 0.25 HP 12.00 INCH PAN WIDTH	7500.00

SECT 400 BOILER
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
BOTTOMS CONVEYOR CO-407 A-C							
(3) ITEMS		CO -407	14.00 TPH	CS	CLOSED-BLT	80.00 FT LG 30.00 IN W 0.33 HP 1750.00 RPM 8.70 FT/MIN 1 SECT'N 15900 LBS (TOTAL WT.)	57300.00
CBC-BED CYCLONE UNITS DC-401 A-C							
(9) ITEMS		DC -401	31000.00 CFM	CS	CYCLONE	52.00 IN DIA 6.00 IN H2O 3160 LBS (TOTAL WT.)	63400.00
MBC-BED CYCLONE UNITS DC-402							
(54) ITEMS		DC -402	40000.00 CFM	CS	CYCLONE	60.00 IN DIA 6.00 IN H2O 4210 LBS (TOTAL WT.)	477400.00
ELECTROSTATIC PRECIPITATORS DC-403 A-F							
(6) ITEMS		DC -403	411000.0 ACFM	CS	ELC-H-VOLT		3497999.36
(4) ITEMS	DC-404 A-D	DC -404	6900.00 CFM	CS	CYCLONE	36.00 IN DIA 2.50 IN H2O 1180 LBS (TOTAL WT.)	13000.00
FEEDERS (54) ITEMS		FE -401		CS	ROTARY	3 IN SIZE 405 LBS (TOTAL WT.)	60500.00
FEEDERS (23) ITEMS		FE -402		CS	ROTARY	4 IN SIZE 498 LBS (TOTAL WT.)	33200.00
FORCED DRAFT FAN FN-401 A-C							
(3) ITEMS		FN -401	420000.0 ACFM	CS	CENTRIF	6000.00 HP	2550000.00

SECT 400 BOILER
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
PRIMARY AIR FAN FN-402 A-C							
(3) ITEMS	FN -402	60100.00 CFM	CS	CENTRIF	150.00 HP 3430 LBS	1800.00 RPM (TOTAL WT.)	26500.00
INDUCED DRAFT FAN FN-403 A-C							
(3) ITEMS	FN -403	564000.0 ACFM	CS	CENTRIF	1500.00 HP		720000.00
FLUIDIZED BED BOILER, PURCHASED EQUIPMENT COST							
(3) ITEMS	-401						33000000.00
PURCHASED EQUIPMENT FOR AIR HEATERS							
AIR PREHEATER (3) ITEMS	-						1941000.00
(3) ITEMS AIR HEATER MOTR MOT-		25.00 HP		ENCLOSED	3600.00 RPM 421 LBS	(TOTAL WT.)	2600.00
FINES COOLER RD-401-A-C							
(3) ITEMS	RD -401	54000.00 LBS/HR	CS	DIRECT	615.00 SQ FT 30.00 HP F-GAS HEATING MEDIUM		232200.00
CBC FINES SURGE BIN VT-401 A-C							
(3) ITEMS	VT -401	2600.00 GAL	A387C	CONE BTM	5.00 FT DIA 15.00 PSIG 0.25 INCHES THICK 3830 LBS	15.00 FT HT 830.00 DEG F (TOTAL WT.)	18300.00

REVISIED

SECT 400 BOILER
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====						
MBC FINES SURGE BIN	VT-402 A-C					
(3) ITEMS	VT -402	3520.00 GAL	A387C CONE BTM	6.00 FT DIA 14.00 FT HT 15.00 PSIG 830.00 DEG F 0.25 INCHES THICK 4440 LBS (TOTAL WT.)		21400.00
BOILER BOTTOMS TANK	VT-406 A-C					
(3) ITEMS	VT -406	48700.00 GAL	9.0FB CONE BTM	18.00 FT DIA 10.00 FT HT 0.050 PSIG 600.00 DEG F 0.25 INCHES THICK 30100 LBS (TOTAL WT.)		150900.00
LINING FOR VT-406 A-C						
(3) ITEMS	LIN-401	3650.00 SQ FT	9.0FB			212400.00
MAIN STEAM	CCP-401	20 ELBOWS	A335C YARD PIPE	1000.00 FT LG 12.50 IN DIA 3600.00 PSIG 900.00 DEG F		(221600.00)*
BOILER FEED WATER	CCP-402	15 ELBOWS	A 53 YARD PIPE	1000.00 FT LG 21.70 IN DIA 3600.00 PSIG 400.00 DEG F		(285400.00)*
COLD REHEAT	CCP-403	15 ELBOWS	A 53 YARD PIPE	1000.00 FT LG 26.62 IN DIA 800.00 PSIG 640.00 DEG F		(166900.00)*
HOT REHEAT	CCP-404	15 ELBOWS	A335C YARD PIPE	1000.00 FT LG 14.80 IN DIA 720.00 PSIG 900.00 DEG F		(97300.00)*
DUCTING						(2850000.00)*

* FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

REVISED

SECT 400 BOILER

- OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/STRUC NO.	BLDG/STRUC SYMBOL	DESCRIPTION	SIZE			LI SYMBOL	FOUND TYPE	ROOF TYPE	SERVICES			FIMATERIAL RI	COST	LABOR			TOTAL COST
			LENGTH	WIDTH	HEIGHT				AL	HP	F						
			(FT)	(FT)	(FT)				ME	UR	NI			(M-\$)	(MH)	(M-\$)	
									B								
BL	PAD		800	200					ME	M	-	-	154.9	31924	308.1		463.0
PR		PIPE RACK	800	30	20	11							52.0	6442	65.8		117.8
1		CONTRL:CONTROL ROOM SECT 400	50	100	10	11	NORMAL	FLAT	M	H	H	M	85.5	16709	186.3		353.3
2		CLOSED:AFB HOUSE A	96	53	198	61	NORMAL	FLAT	M	-	M	M	692.9	70562	750.5		1876.5
3		CLOSED:AFB HOUSE B	96	53	198	61	NORMAL	FLAT	M	-	M	M	692.9	70562	750.5		1876.5
4		CLOSED:AFB HOUSE C	96	53	198	61	NORMAL	FLAT	M	-	M	M	692.9	70562	750.5		1876.5

SUPPLEMENTAL BULK ADJUSTMENT DATA

NO.	ACCOUNT	DESCRIPTION	COST CODE		MATERIAL COST (\$)	LABOR MANHOURS	LABOR COST (\$)	MODE	TOTAL COST (\$)
1.	PIPING:	FLUID BED PIPING	299	299	200000.00	16441.0	198082.00	DIRECT	2198082.00
2.	CIVIL:	FLUID BED CIVIL	399	399	13060.00	294.0	2802.00	DIRECT	15862.00
3.		ADD'L CIVIL FOR AIR PREH	301	301	22500.00	4200.0	40023.00	DIRECT	62523.00
4.	INSTRUMENTATION:	FLUID BED INSTRUMENTS	599	599	280000.00	13000.0	143033.00	DIRECT	423033.00
5.	ELECTRICAL:	FLUID BEDELECTRIC	699	699	120090.00	2176.0	23877.00	DIRECT	143967.00
6.	INSULATION:	FLUID BED INSULATION	799	799	16000.00	1100.0	13103.00	DIRECT	29103.00
7.	PAINT:	FLUID BED PAINTING	899	899	10000.00	1700.0	15579.00	DIRECT	25579.00

SECT 500 ELECTRIC GENERATION
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
TURBINE		GC -501	200000.0 CFM	CS	CENTRIF	650.00 PSIG IN 3500.00 PSIG 670000 HP 2492.00 RPM 6 STAGES 1560 TONS (TOTAL WT.) INCLUDES TURBINE DRIVER	XXXXXXXXXX

PURCHASED EQUIPMENT COST
STEAM TURBINE GENERATOR -500

XXXXXXXXXX - INCLUDED IN SUMMARY

REVISED

SECT 500 ELECTRIC GENERATION - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/STRUC NO.	BLDG/STRUC SYMBOL	DESCRIPTION	SIZE			L I	E I	FOUND	ROOF	SERVICES		F I	MATERIAL	LABOR	TOTAL							
			LENGTH	WIDTH	HEIGHT					V I	TYPE					TYPE	A I	C + E L I R I	COST	COST	COST	COST
			(FT)	(FT)	(FT)	S I						(M-\$)	(MH)	(M-\$)	(M-\$)							
BL	NONE		10	10						M I - M - - - -			0.0	0	0.0	0.0						
PR		PIPE RACK	600	30	20								39.2	4921	50.3	89.5						
1	CLOSED	TURBINE BLDG SECT 500	200	120	100					M I - H H - - -			1222.8	88444	878.6	2731.8						

SUPPLEMENTAL BULK ADJUSTMENT DATA

NO.	ACCOUNT	DESCRIPTION	COST CODE		MATERIAL COST (\$)	LABOR MANHOURS	LABOR COST (\$)	MODE	TOTAL COST (\$)
			MAT'L	LABOR					
1.	STEEL	TURBINE HAUL CRANE H0501	499	499	330000.00	3000.0	31461.00	DIRECT	361461.00
2.	ELECTRICAL	TURBINE GENERATOR INST	620	620	790000.00	86000.0	943651.00	DIRECT	1733650.00
3.		MAIN TRANSFORMERS SEC500	632	632	1490000.00	2460.0	26993.00	DIRECT	1516992.00
4.		MAIN BUS SECT 500	634	634	480000.00	5200.0	57058.00	DIRECT	537058.00

SECT 600 MAIN WATER SYSTEM
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
MAIN CONDENSER PUMPS CP-601							
(2) ITEMS		CP -601	3100.00 GPM	CS	CENTRIF-M	410.00 FT HD 120.00 DEG F 400.00 HP 1800.00 RPM 11500 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	89600.00
SPARE CP-601		CP -601	3100.00 GPM	CS	CENTRIF-M	410.00 FT HD 120.00 DEG F 400.00 HP 1800.00 RPM 11500 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	44800.00
BOOSTER PUMPS CP-602							
(2) ITEMS		CP -602	4500.00 GPM	CS	CENTRIF-M	1510.00 FT HD 120.00 DEG F 2250.00 HP 3600.00 RPM 26100 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	296000.00
SPARE CP-601		CP -602	4500.00 GPM	CS	CENTRIF-M	1510.00 FT HD 120.00 DEG F 2250.00 HP 3600.00 RPM 26100 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	148000.00
MAIN BOILER FEED PUMPS WITH TURBINE DRIVE CP-603							
(9) ITEMS		CP -603	3000.00 GPM	CS	CENTRIF-T	2800.00 FT HD 120.00 DEG F 3000.00 HP 3600.00 RPM 39200 LBS (TOTAL WT.) INCLUDES TURBINE DRIVER	1962000.00

SECT 600 MAIN WATER SYSTEM
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
MAIN CIRCULATING WATER PUMPS							
(3) ITEMS		CP -604	53700.00 GPM	CS	CENTRIF-M	75.00 FT HD 1500.00 HP	652500.00
MAIN CONDENSER		HE -601		CA443	FIXED-T-S	173835 SQ FT PER SHELL 3 SHELLS A285C SHELL MATERIAL BEM TENA TYPE 50.00 PSIG SHELL PRESS 650.00 DEG F SHELL TEMP 192.00 IN DIA 40.00 FT LG 50.00 PSIG TUBE PRESS 400.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 40.00 FEET TUBE LENGTH 1045 TONS (TOTAL WT.)	6160000.00
LP #1 FEED H2O HEATER		HE -602		A 179	FIXED-T-S	5190 SQ FT PER SHELL 2 SHELLS A285C SHELL MATERIAL BEM TENA TYPE 50.00 PSIG SHELL PRESS 185.00 DEG F SHELL TEMP 43.00 IN DIA 20.00 FT LG 225.00 PSIG TUBE PRESS 185.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 52800 LBS (TOTAL WT.)	109000.00
LP #2 FEED H2O HEATER		HE -603		A 179	FIXED-T-S	4893 SQ FT PER SHELL 2 SHELLS A285C SHELL MATERIAL BEM TENA TYPE 50.00 PSIG SHELL PRESS 215.00 DEG F SHELL TEMP 42.00 IN DIA 20.00 FT LG 225.00 PSIG TUBE PRESS 215.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 50200 LBS (TOTAL WT.)	103000.00

SECT 600 MAIN WATER SYSTEM
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
LP #3	FEED H2O HEATER	HE -604		A 179 FIXED-T-S	4953 SQ FT PER SHELL 2 SHELLS A285C SHELL MATERIAL BEM TEMA TYPE 50.00 PSIG SHELL PRESS 250.00 DEG F SHELL TEMP 42.00 IN DIA 20.00 FT LG 225.00 PSIG TUBE PRESS 250.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 50800 LBS (TOTAL WT.)	104000.00
LP #4	FEED WATER HEATER	HE -605		A 179 FIXED-T-S	4444 SQ FT PER SHELL 3 SHELLS A285C SHELL MATERIAL BEM TEMA TYPE 80.00 PSIG SHELL PRESS 320.00 DEG F SHELL TEMP 40.00 IN DIA 20.00 FT LG 225.00 PSIG TUBE PRESS 320.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 71400 LBS (TOTAL WT.)	144000.00
HP	FEED WATER HEATER	HE -606		A 179 FIXED-T-S	6194 SQ FT PER SHELL 3 SHELLS A285C SHELL MATERIAL BEM TEMA TYPE 310.00 PSIG SHELL PRESS 435.00 DEG F SHELL TEMP 47.00 IN DIA 20.00 FT LG 1055.00 PSIG TUBE PRESS 435.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 141600 LBS (TOTAL WT.)	285000.00

SECT 600 MAIN WATER SYSTEM
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====
HP FEED WATER HEATER	HE -607			A 179 FIXED-T-S	6180 SQ FT PER SHELL 3 SHELLS A285C SHELL MATERIAL 8EM TEMA TYPE 760.00 PSIG SHELL PRESS 540.00 DEG F SHELL TEMP 47.00 IN DIA 20.00 FT LG 1055.00 PSIG TUBE PRESS 540.00 DEG F TUBE TEMP 1.00 INCH TUBE OD 20.00 FEET TUBE LENGTH 183600 LBS (TOTAL WT.)	346000.00
DEAERATOR -I	VT -601	3000.00 GAL	A285C CYLINDER	8.00 FT DIA 7.98 FT HT 200.00 PSIG 385.00 DEG F 0.88 INCHES THICK 12700 LBS (TOTAL WT.)	13900.00	

SECT 600 WATER PROCESSING SYST - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/ STRUC NO.	BLDG/ STRUC SYMBOL	DESCRIPTION	SIZE			FOUND TYPE SYMBOL	ROOF TYPE SYMBOL	SERVICES		MATERIAL COST	LABOR			TOTAL COST
			LENGTH	WIDTH	HEIGHT			A/C	EL					
			(FT)	(FT)	(FT)									
BL	PAD		200	50				M	M	19.7	2918	28.8		48.5
PR		PIPE RACK	200	20	20					12.8	1655	16.9		29.7
1	SHELL		200	50	40	NORMAL	FLAT	M	M L L M	155.8	19927	213.0		428.5

SECTION 700 AUXILIARY EQUIP.
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
(2)	ITEMS INSTR AIR COMPR	AC -701	500.00 CFM	CS	SINGLE 1-S	150.00 PSIG 75.00 HP 7170 LBS (TOTAL WT.)	58100.00
(2)	ITEMS PLANT AIR COMPR	AC -702	1500.00 CFM	CS	CENTRIF-M	115.00 PSIG 300.00 HP 14100 LBS (TOTAL WT.)	212800.00
(2)	ITEMS INSTR AIR DRYER	AD -701	500.00 CFM	CS			25200.00
	INSTRUMENT AIR LINE	CCP-705	30 ELBOWS	A 53	YARD PIPE	4000.00 FT LG 3.00 IN DIA 100.00 PSIG 100.00 DEG F	(62400.00)*
	FIRE WATER LOOP	CCP-706	30 ELBOWS	A 53	YARD PIPE	6000.00 FT LG 12.00 IN DIA 100.00 PSIG 100.00 DEG F	(300400.00)*
	CITY WATER	CCP-707	20 ELBOWS	PVC	YARD PIPE	6000.00 FT LG 3.00 IN DIA 150.00 PSIG 68.00 DEG F	(63800.00)*
	FIREWATER SUPPLY	CP -701	15000.00 GPM	A 283	CENTRIF-T	75.00 FT HD 120.00 DEG F 350.00 HP 3600.00 RPM 6920 LBS (TOTAL WT.) INCLUDES TURBINE DRIVER	37600.00
	FIREWATER SUPPLY	CP -702	15000.00 GPM	A 283	CENTRIF-M	75.00 FT HD 120.00 DEG F 350.00 HP 1800.00 RPM 7960 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	39600.00

SECTION 700 AUXILIARY EQUIP.
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
ELECTRIC GENERATOR	EG -701	800.00 KW	CS	PORTABLE		227000.00	
FUEL OIL HEAT EXCHANGER	HE -701		CS	HEATER-STM	40.00 SQ FT	595.00	
WAREHOUSE CRANE	HO -701	12.00 TONS	CS	HOIST		17800.00	
SHOP CRANE	HO -702	12.00 TONS	CS	HOIST		17800.00	
(2) ITEMS NITROGEN SUPPLY	HT -701	5000.00 GAL	304L	ASME CODE	7.00 FT DIA 17.37 FT LG 300.00 PSIG 400.00 DEG F 1.25 INCHES THICK 26400 LBS (TOTAL WT.)	139400.00	
INSTRUMENT AIR SURGE POT	HT -702	570.00 GAL	A285C	ASME CODE	4.00 FT DIA 6.06 FT LG 15.00 PSIG 400.00 DEG F 0.31 INCHES THICK 1930 LBS (TOTAL WT.)	2400.00	
PLANT AIR SURGE POT	HT -703	1000.00 GAL	A285C	ASME CODE	4.00 FT DIA 10.64 FT LG 150.00 PSIG 170.00 DEG F 0.44 INCHES THICK 3550 LBS (TOTAL WT.)	4100.00	
(2) ITEMS FUEL OIL PUMPS	P -703	20.00 GPM	CS	RECIP-MOTR	1000.00 FT HD 7.50 HP 1800.00 RPM 868 LBS (TOTAL WT.)	11500.00	
FUEL OIL TANK	VT -701	100000.0 GAL	A285C	CONE ROOF	35.00 FT DIA 13.90 FT HT 0.050 PSIG 68.00 DEG F 0.19 IN THICK (TOP) 0.25 IN THICK (BOT'M) 51900 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	57500.00	

SECTION 700 AUXILIARY EQUIP.
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
(4) ITEMS	DEMINERALIZER	WTS-701	15000.00 GPM	A285C DEMINERAL	PACKAGED SYSTEM. 18400 LBS (TOTAL WT.)	220400.00
WATER TREATMENT SYSTEM, TOTAL INSTALLED COST						
COOLING TOWER		WTS-601	157200.0 GPM	A285C COOLING	30.00 DEG F RANGE 18.70 DEG APPROACH 60.00 DEG F WET BULB 125.00 HP/FAN 21 FANS 1000.00 HP/PUMP 3 PUMPS 416000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	1650000.00
WATER TREATMENT SYSTEM		-700				40000.00
TOOLS		-700				200000.00
LAB EQUIPMENT		-700				150000.00
FINES DISPOSAL HOPPER VT-701 & VT-702						
(2) ITEMS		VT -701	1000.00 CU FT	CS LIVE BTM	8.00 FT DIA 18.09 FT HT 3.00 HP 250.00 DEG F 9800 LBS (TOTAL WT.)	31800.00
ASH STORAGE SILOS VT-703 A-F						
(6) ITEMS -I		VT -703	1900000 GAL	A285C CONE ROOF	60.00 FT DIA 88.57 FT HT 0.050 PSIG 125.00 DEG F 0.25 IN THICK (TOP) 0.94 IN THICK (BOT'M) 633000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	2976000.00

FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SECTION 700 AUXILIARY EQUIP. - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC NO. SYMBOL	DESCRIPTION	SIZE			L V E L S	FOUND TYPE SYMBOL	ROOF TYPE SYMBOL	SERVICES		MATERIAL COST RI	LABOR			TOTAL COST
		LENGTH	WIDTH	HEIGHT				A L H P F	U					
		(FT)	(FT)	(FT)				E A U R	N					
										(M-S)	(MH)	(M-S)	(M-S)	
BL	IPAD	200	200					MI- M	- - -	71.8	11090	109.1		181.0
PR	PIPE RACK	1000	30	20	1					64.9	7946	81.1		146.0
1	WAREHOUSE SECT 700	75	100	40	2	NORMAL	FLAT	MI- L	- - MI	119.3	10774	113.8		303.1
2	SHOP MAINTAINANCE BLG SEC 700	60	100	20	1	NORMAL	FLAT	MI- M M L	MI	52.3	7347	82.4		175.1
3	SANTRY CHANGE HOUSE SECT 700	50	80	20	1	NORMAL	FLAT	MI- V M H V	MI	60.1	12709	143.9		265.2
4	OFFICE ADMINISTRATION BLG 700	75	150	10	1	NORMAL	FLAT	MI- M H M M	MI	295.6	33526	371.5		867.2
5	SHELL GUARD HOUSE SECT 700	15	15	10	1	NORMAL	FLAT	MI- M L L	MI	2.0	339	3.8		6.3
6	GARAGE GARAGE SECT 700	70	100	30	1	NORMAL	FLAT	MI- L	- - MI	58.3	4813	49.6		140.3
7	SHELL IMCC BUILDINGS SECT 700	30	20	10	1	NORMAL	FLAT	MI- M L L	MI	5.2	904	10.0		16.7
8	SHELL IMCC BUILDINGS SECT 700	30	20	10	1	NORMAL	FLAT	MI- M L L	MI	5.2	904	10.0		16.7
9	SHELL IMCC BUILDINGS SECT 700	30	20	10	1	NORMAL	FLAT	MI- M L L	MI	5.2	904	10.0		16.7

SUPPLEMENTAL BULK ADJUSTMENT DATA

NO.	ACCOUNT	DESCRIPTION	COST CODE		MATERIAL COST (\$)	LABOR MANHOURS	LABOR COST (\$)	MODE	TOTAL COST (\$)
			MAT	L					
1.	CIVIL	STACKS SECT 700	399	399	1340000.00	73000.0	695632.00	DIRECT	2035631.00

Appendix E

Capital Cost Estimate
Limestone Slurry Scrubbing

LIMESTONE SLURRY PROCESS

12/01/77

```

          CCCCCCCCCC      00000000//      SSSSSSSS//      TTTTTTTTTTTT (R)
          CCCCCCCCCCCC      00000000//0      SSSSSSSS//SS      TTTTTTTTTTTT
          CCC          CCC      000      //000      SS      //      TT
          CC          CC      00      // 00      SS      //      TT
          CC          CC      00      // 00      SSSS//SSS      TT
          CC          CC      00      // 00      SS//SSSSS      TT
          CC          CC      00      // 00      //      SS      TT
          CCC          CCC      00//      000      //      SS      TT
          CCCCCCCCCCCC      //000000000      S//SSSSSSSS      TT
          CCCCCCCCCC      //000000000      //SSSSSSSS      TT
          //      //
    
```

(COST ORIENTED SYSTEMS TECHNIQUE)

VERSION 8.1E
NOVEMBER 14, 1977

12/28/77 15:55:21

(R)
COST IS A SERVICE MARK OF

ICARUS CORPORATION
ONE CENTRAL PLAZA
11300 ROCKVILLE PIKE
ROCKVILLE, MD 20852
(301) 881-9350

REGISTERED WITH THE UNITED STATES PATENT OFFICE

M A S T E R S U M M A R Y *

NO.	I T E M	----D I R E C T C O S T S-----			SUBCONTRACTS		AMOUNT	PERCENT	PERCENT
		MATERIAL M-\$	LABOR MANHOURS	LABOR M-\$	TOTAL M-\$		\$	OF PURCHASED EQUIPMENT	OF TOTAL COST
1.	PURCHASED EQUIPMENT	5394.1	-	-	4857.8		10251900.0	100.0	33.5
2.	EQUIPMENT SETTING	-	19959	210.5	-		210500.00	1.6	0.7
3.	PIPING	3850.5	183342	2175.3	0.0		6026100.00	58.8	19.7
4.	CIVIL	214.8	82786	786.3	766.2		1767200.00	13.7	5.6
5.	STEEL	225.4	18287	192.3	0.0		417700.00	3.2	1.3
6.	INSTRUMENTATION	927.1	15753	178.2	0.0		1105300.00	8.6	3.5
7.	ELECTRICAL	1305.1	53059	560.0	0.0		1365200.00	14.5	6.0
8.	INSULATION	0.0	0	0.0	621.8		521800.00	4.8	2.0
9.	PAINT	0.0	0	0.0	436.7		436700.00	3.4	1.4
10.	TOTAL FIELD COST	11917.3	373186	4102.5	6682.5		22702200.0	221.4	74.1
11.	ENGINEERING						1088000.00	8.5	3.5
12.	CONSTRUCTION OVERHEAD						2992800.00	23.3	9.6
13.	BARE PLANT COST						26783000.00	261.2	87.4
14.	CONTINGENCIES						2678000.00	26.1	8.7
15.	CONTRACTOR'S FEE						803500.00	7.8	2.6
16.	SPECIAL CHARGES						380200.00	3.0	1.2
17.	TOTAL FACILITY COST						30644500.0	298.9	100.0

* REVISED

O P E R A T I O N A L U N I T S U M M A R Y *

OPERATIONAL UNIT	INSTALLED EQUIPMENT	PIPING	CIVIL	STEEL	INSTRU- MENTATION	FLEC- TRICAL	INSULATION	PAINT	TOTAL
	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$
SECT 100 MATERIAL HANDLING	181.7	38.5	50.0	52.3	32.4	142.6	0.0	31.5	528.9
SECT 200 FEED PREPARATION	603.8	74.8	81.7	28.7	31.7	163.4	4.9	18.8	1007.9
SECT 300 PARTICULATE SCRUBBING	1812.1	680.7	123.0	31.1	157.5	248.5	108.3	38.2	3199.3
SECT 400 SO2 SCRUBBING	5950.7	4526.4	418.0	86.8	699.3	650.2	447.8	170.3	12949.4
SECT 600 SOLIDS DISPOSAL	1914.2	277.4	822.1	35.1	82.8	170.9	12.1	77.3	3391.8
SEC 700 AUXILIARY & PIPING	0.0	428.3	272.5	183.6	101.6	489.7	48.7	100.6	1625.0
TOTAL	10462.4	6026.1	1767.2	417.7	1105.3	1865.2	621.8	436.7	22702.4

* REVISED

LIST OF EQUIPMENT
BY
UNIT OPERATION OR PROCESS

SECT 100 MATERIAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
CONVEYOR #1		CO -101	210.00 TPH	CS	OPEN BELT	10.00 FT LG 24.00 IN W 5.00 HP 1750.00 RPM 210.00 FT/MIN 1 SECT'N 3350 LBS (TOTAL WT.)	9800.00
CONVEYOR #2		CO -102	210.00 TPH	CS	OPEN BELT	172.00 FT LG 24.00 IN W 10.00 HP 1750.00 RPM 210.00 FT/MIN 1 SECT'N 11900 LBS (TOTAL WT.)	34300.00
CONVEYOR #3		CO -103	100.00 TPH	CS	OPEN BELT	135.00 FT LG 18.00 IN W 5.00 HP 1750.00 RPM 190.00 FT/MIN 1 SECT'N 8240 LBS (TOTAL WT.)	16900.00
ELEVATOR #1		CO -104	100.00 TPH	CS	CENT-BKT-L	70.00 FT LONG 20.00 HP 16X8 IN BUCKET SIZE 100.00 LBS/CU FT 11100 LBS (TOTAL WT.)	12500.00
TUNNEL SUMP PUMPS CP-101 A&B . MAT'L IS NEOPRENE LINED CARBON STEEL							
(2) ITEMS \$=1200.		CP -101	5.00 GPM	CS	AVS-MEDIUM	10.00 FT HD 120.00 DEG F 0.50 HP 1750.00 RPM 471 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	2400.00
INERTIAL SEPARATOR-A		DC -101	2000.00 CFM	CS	CENTRF-PRE	10.00 HP 1530 LBS (TOTAL WT.)	4900.00

* REVISED

SECT 100 MATERIAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
INERTIAL SEPARATOR-B	DC -102	6000.00 CFM	CS	CENTRF-PRE	30.00 HP 3480 LBS (TOTAL WT.)		9600.00
FABRIC DUST COLLECTOR	DC -103	8000.00 CFM	CS	CLOTH BAY	1000 SQ FT 8.00 AIR/MEDIA RATIO 6130 LBS (TOTAL WT.)		9300.00
LIMESTONE FEEDER #1	FE -101	210.00 TPH	CS	VIBRATING	5.00 FT LG 42.00 IN W 2.50 HP 2670 LBS (TOTAL WT.)		4300.00
LIMESTONE FEEDERS #2 (3) ITEMS	FE-102 A,B&C FE -102	100.00 TPH	CS	VIBRATING	5.00 FT LG 18.00 IN W 1.00 HP 1250 LBS (TOTAL WT.)		6200.00
CAR SHAKER FE-103 FE-103	TOTAL INSTALLED COST -103						15000.00
UNLOADING HOPPER #1	VT -101	700.00 GAL	A285C	CONE BTM	3.50 FT DIA 8.33 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 1940 LBS (TOTAL WT.)		3700.00
HOPPERS UNDER PILE (3) ITEMS	VT -102	575.00 GAL	A285C	CONE BTM	7.00 FT DIA 1.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 1930 LBS (TOTAL WT.)		10800.00

SECT 100 MATERIAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L EQUIPMNT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
BIN		VT -103	37000.00 GAL	A285C CONE RTM	14.00 FT DIA 28.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 29100 LBS (TOTAL WT.)	21200.00

SECT 100 MATERIAL HANDLING - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUCSTRUC NO. ISYMBOL	DESCRIPTION	SIZE			FOUND	ROOF	SERVICES		MATERIAL	LABOR		TOTAL
		LENGTH	WIDTH	HEIGHT			AL	HP		COST	COST	
		(FT)	(FT)	(FT)	SI					(M-\$)	(MH)	(M-\$)
RL	NONE	25	250									
PR	PIPE RACK	100	20	20								

SECT 200 FEED PREPARATION
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
ELEVATOR #2 (2) ITEMS		CO -201	12.50 TPH	CS	CENT-BKT-L	40.00 FT LONG 1.50 HP 6X4 IN BUCKET SIZE 100.00 LBS/CU FT 2870 LBS (TOTAL WT.)	13700.00
MILLS PRODUCT TANK PUMPS CP-201 A&B , MAT'L IS NEOPRENE LINED CARBON STEEL PRICE QUOTE FROM GALIGHER PUMP VIA ARGO INDUSTRIAL							
(2) ITEMS \$=2500.		CP -201	96.00 GPM	CS	AVS-MEDIUM	58.00 FT HD 120.00 DEG F 3.00 HP 1750.00 RPM 564 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	5000.00
SLURRY FEED TANK PUMPS CP-202 A&B , MAT'L IS NEOPRENE LINED CARBON STEEL PRICE QUOTE FROM GALIGHER PUMP VIA ARGO INDUSTRIAL							
(2) ITEMS \$=2500.		CP -202	96.00 GPM	CS	AVS-MEDIUM	58.00 FT HD 120.00 DEG F 3.00 HP 1750.00 RPM 564 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	5000.00
CRUSHER CR-201 A&B (2) ITEMS		CR -201	12.50 TPH	CS	CONE	2 FEET 25.00 HP	51600.00
INERTIAL SEPARATOR		DC -201	8000.00 CFM	CS	CENTRF-PRE	50.00 HP 4570 LBS (TOTAL WT.)	11900.00
FABRIC DUST COLLECTOR		DC -202	8000.00 CFM	CS	CLOTH BAY	1000 SQ FT 8.00 AIR/MEDIA RATIO 6130 LBS (TOTAL WT.)	9300.00

SECT 200 FEED PREPARATION
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
BIN DISCHARGE FEEDERS (2) ITEMS	FE-201 A&B FE -201		12.50 TPH	CS	VIBRATING	5.00 FT LG 12.00 IN W 0.50 HP 905 LBS (TOTAL WT.)	2900.00
HOIST	HO -201		5.00 TONS	CS	HOIST		9900.00
WET BALL MILL (2) ITEMS	M-201 A&B M -201		300.00 TPD	CS	BALL	9X7 SIZE 450.00 HP 200 MESH PRODUCT *	336000.00
SLURRY FEED TANK AGITATOR AGITATOR	MX-201 MX -201				MAT'L IS NEOPRENE LINED CARBON STEEL SS FIXED PROP	10.00 HP 1800.00 RPM 1120 LBS (TOTAL WT.)	7500.00
(2) ITEMS WEIGH FEEDER	S -201		12.50 TPH		BELT	18.00 IN W	13300.00
MILLS PRODUCT TANK MILLS PRODUCT TANK	VT-201 VT -201		1920.00 GAL		MAT'L IS NEOPRENE LINED CARBON STEEL 3/16R OPEN TOP	8.00 FT DIA 5.11 FT HT 250.00 DEG F 0.19 INCHES THICK 2990 LBS (TOTAL WT.)	6700.00
MAT'L FOR AG-201 IS NEOPRENE COATED AGITATOR FOR VT-201	AG -201				RURCV DIRECT	1.00 HP 84 LBS (TOTAL WT.)	1500.00
SLURRY FEED TANK SLURRY FEED TANK	VT-202 VT -202		46080.00 GAL		MAT'L IS NEOPRENE LINED CARBON STEEL 3/16R CONE ROOF	17.33 FT DIA 26.12 FT HT 0.050 PSIG 68.00 DEG F 0.19 INCHES THICK 22600 LBS (TOTAL WT.)	34400.00

* REVISED

SECT 200 FEED PREPARATION

- OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC NO. SYMBOL	DESCRIPTION	SIZE			L	E	FOUND	ROOF	SERVICES		F	MATERIAL	LABOR		TOTAL
		LENGTH	WIDTH	HEIGHT					A	L			COST	COST	
		(FT)	(FT)	(FT)	S				C	E	L	R			
BL	PAD	80	80						M	-	-	-	13.5	1961	32.91
PR	PIPE RACK	150	20	20									10.1	1316	23.61

*
 SECT 300 PARTICULATE SCRUBBING
 E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
SLURRY RECYCLE PUMPS CP-301 A-E , MAT'L IS NEOPRENE LINED CARBON STEEL							
(3) ITEMS	\$=21000.	CP -301	6500.00 GPM	CS	CENTRIF-M	144.00 FT HD 120.00 DEG F 400.00 HP 1800.00 RPM 4880 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	63000.00
(2) ITEMS	\$=21000. SPARE	CP -301	6500.00 GPM	CS	CENTRIF-M	144.00 FT HD 120.00 DEG F 400.00 HP 1800.00 RPM 4880 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	42000.00
EFFLUENT HOLD TANK AGITATOR MX-301 A-C , MAT'L IS NEOPRENE COATED CARBON STEEL							
(3) ITEMS		MX -301		SS	FIXED PROP	5.00 HP 1800.00 RPM 774 LBS (TOTAL WT.)	17300.00
PARTICULATE SCRUBBER, EFFLUENT HOLD TANK VT-301 A-C, MAT'L IS NEOPRENE LINED CS							
(3) ITEMS		VT -301	34200.00 GAL	3/16R	CONE ROOF	13.00 FT DIA 34.45 FT HT 0.050 PSIG 68.00 DEG F 0.19 INCHES THICK 18600 LBS (TOTAL WT.)	90000.00
PARTICULATE SCRUBBER VT-302 A-C , NEOPRENE LINED CARBON STEEL							
(3) ITEMS	\$=1400000.	VT -302	111000.0 GAL	A285C	CYLINDER	26.00 FT DIA 28.00 FT HT 15.00 PSIG 400.00 DEG F 0.56 INCHES THICK 104000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	4200000.00
SCRUBBER VT-502 A&B, MAT'L IS NEOPRENE LINED CARBON STEEL							
(3) ITEMS	KO \$=446700.	VT -502	36000.00 GAL	3/16R	CYLINDER	17.50 FT DIA 20.00 FT HT 15.00 PSIG 400.00 DEG F 0.31 INCHES THICK 31000 LBS (TOTAL WT.)	1340000.00

* REVISED

SECT 300 PARTICULATE SCRUBBING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====
	PARTICULATE SOOT BLOWERS	15 FT LONG				
	(20) ITEMS	-301				122000.00
	DIAMOND POWER					
	PIPING FOR SOOT BLOWERS	CCP-301		A 106 YARD PIPE	1000.00 FT LG 2.00 IN DIA 150.00 PSIG 300.00 DEG F	(12000.00)*
	ELECTRICAL FOR PARTICULATE SOOT BLOWERS					
	\$=0.	MOT-301	90.00 HP	OPEN	3600.00 RPM 1260 LBS (TOTAL WT.)	0.00

* FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SECT 300 PARTICULATE SCRUBBING - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/STRUC NO.	BLDG/STRUC SYMBOL	DESCRIPTION	SIZE			L VI	FOUND TYPE	RCOF TYPE	SERVICES		F U	MATERIAL COST	LABOR		TOTAL COST
			LENGTH	WIDTH	HEIGHT				A L H P	E L					
			(FT)	(FT)	(FT)	S						(M-\$)	(MH)	(M-\$)	(M-\$)
BL	IPAD		200	100					M	M	-	27.6	4747	46.3	73.9
PR		PIPE RACK	200	30	20	1						13.6	1796	18.4	32.0

SECT 400 SO2 SCRUBBING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====							
SO2 ABSORBER RECYCLE SLURRY PUMPS CP-401 A-H, NEOPRENE LINED CARBON STEEL							
PRICE QUOTE IS FROM ENVIROTECH A-S-H PUMPS							
(B) ITEMS \$=30000.	CP -401	11500.00 GPM	CS	CENTRIF-M	75.00 FT HD 120.00 DEG F 450.00 HP 1800.00 RPM 7510 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER		240000.00
MAKE-UP WATER PUMP	CP -402	1240.00 GPM	CS	TURBINE	150.00 FT HD 120.00 DEG F 60.00 HP 1750.00 RPM 1480 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER		4300.00
SPARE CP-402	CP -402	1240.00 GPM	CS	TURBINE	150.00 FT HD 120.00 DEG F 60.00 HP 1750.00 RPM 1480 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER		4300.00
GAS REHEATER HE 401 A-C							
GAS REHEATER HE-401 HAS	HE -401	HALF 1825 TUBES & HALF CORTEN TUBES	CS	FIN TUBE	2700.00 SQ FT A285C SHELL 12.00 FOOT TUBE LENGTH		219600.00
\$=73200. (3) ITEMS							
(3) ITEMS I.D. FANS	FN -401	441000.0 ACFM	CS	CENTRIF	4000.00 HP		900000.00
GAS DUCTING							(2000000.00)

* REVISED

SECT 400 SO2 SCRUBBING
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====
	ABSORBER SOOT BLOWERS, 15 FT LONG					
(40) ITEMS	-401					244000.00
	DIAMOND POWER					
PIPING FOR SOOT BLOWERS	CCP-401			A 106 YARD PIPE	1500.00 FT LG 2.00 IN DIA 150.00 PSIG 300.00 DEG F	(18000.00)*
ELECTRICAL FOR SCRUBBER SOOT BLOWERS						
(2) ITEMS \$=0.	MOT-401	90.00 HP	OPEN	3600.00 RPM 1260 LBS (TOTAL WT.)		0.00
REHEATER SOOT BLOWERS, 15.0 FT LONG						
(20) ITEMS	-402					120000.00
	DIAMOND POWER					
PIPING FOR SOOT BLOWERS	CCP-402			A 106 YARD PIPE	1000.00 FT LG 2.00 IN DIA 150.00 PSIG 300.00 DEG F	(12000.00)*
ELECTRICAL FOR REHEATER SOOT BLOWERS						
\$=0.	MOT-402	90.00 HP	OPEN	3600.00 RPM 1260 LBS (TOTAL WT.)		0.00
SO2 ABSORBER 1W-401 A-C, MAT'L IS NEOPRENE LINED CARBON STEEL						
(3) ITEMS SO2 ABSORBERS	TW -E01			A 515 PACKED	30.00 FT DIA 41.00 FT HT 15.00 PSIG 400.00 DEG F 2.0PPH PACKING TYPE 30.00 FT PACKING HT 0.63 INCHES THICK 253000 LBS (TOTAL WT. LESS PACKING) INCLUDES FIELD ERECTION BY VENDOR	3200000
LINING FOR SO2 ABSORBER						
(3) ITEMS LIN FOR 1W-401	LIN-401	5300.00 SQ FT	3/16R			142800.00

SECT 400 SO2 SCRUBBING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====						
ABSORBER EFFLUENT HOLD TANK (3) ITEMS	VI-401 A-C	VI-401	320000.0 GAL	MAT'L IS NEOPRENE LINED CARBON STEEL 3/16R OPEN TOP	46.00 FT DIA 25.74 FT HT 250.00 DEG F 0.19 INCHES THICK 53300 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	330000.00
ABSORBER HOLD TANK MIXERS (3) ITEMS	MX-401-A-C	MX -401		NEOPRENE COATED CARBON STEEL SS FIXED PROP	75.00 HP 1800.00 RPM 4600 LBS (TOTAL WT.)	80700.00

* FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

* REVISED

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC NO. /SYMBOL/	DESCRIPTION	SIZE			E: FOUND V: TYPE E: SYMROL L: S	ROOF TYPE SYMROL S	SERVICES		F: MATERIAL C + E L A U R B	COST	LABOR		TOTAL COST
		LENGTH	WIDTH	HEIGHT			IA	HP			(M-\$)	(MH)	
BL	IPAD	200	90				M	M	-	29.7	4733	46.4	76.2
PR	PIPE RACK	300	30	20						20.0	2593	26.5	46.5

SECT 600 SOLIDS DISPOSAL
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
CONVEYOR-A		CO -601	21.00 TPH	CS	OPEN BELT	40.00 FT LG 14.00 IN W 0.50 HP 1750.00 RPM 67.00 FT/MIN 1 SECT'N 3070 LBS (TOTAL WT.)	6900.00
CONVEYOR-B		CO -602	21.00 TPH	CS	OPEN BELT	70.00 FT LG 14.00 IN W 0.50 HP 1750.00 RPM 67.00 FT/MIN 1 SECT'N 4140 LBS (TOTAL WT.)	9000.00
THICKENER FEED PUMP CP-601 A&SPARE, NEOPRENE LINED CARBON STEEL PRICE QUOTE IS FROM GALIGHER PUMP VIA ARGO INDUSTRIAL \$=3000.							
		CP -601	1000.00 GPM	CS	AVS-MEDIUM	65.00 FT HD 120.00 DEG F 25.00 HP 1750.00 RPM 1160 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	3000.00
SPARE CP-601 \$=3000.		CP -601	1000.00 GPM	CS	AVS-MEDIUM	65.00 FT HD 120.00 DEG F 25.00 HP 1750.00 RPM 1160 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	3000.00
OVERFLOW RETURN PUMP		CP -602	566.00 GPM	CS	AVS-MEDIUM	50.00 FT HD 120.00 DEG F 10.00 HP 1750.00 RPM 778 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	2400.00
SPARE CP-602		CP -602	566.00 GPM	CS	AVS-MEDIUM	50.00 FT HD 120.00 DEG F 10.00 HP 1750.00 RPM 778 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	2400.00

SECT 600 SOLIDS DISPOSAL
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
UNDERFLOW PUMPS CP-603 A&B SPARE, NEOPRENE LINED CARBON STEEL							
PRICE QUOTE IS FROM GALIGHIER PUMP VIA ARGO INDUSTRIAL							
(2) ITEMS \$=2300.	CP -603	210.00 GPM	CS	AVS-MEDIUM	75.00 FT HD 3.00 HP 641 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	120.00 DEG F 1750.00 RPM	4600.00
SPARE CP-603 \$=2300.	CP -603	210.00 GPM	CS	AVS-MEDIUM	75.00 FT HD 3.00 HP 641 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	120.00 DEG F 1750.00 RPM	2300.00
FILTRATE RECYCLE PUMPS CP-604 A&B	CP -604	210.00 GPM	CS	AVS-MEDIUM	100.00 FT HD 10.00 HP 801 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	120.00 DEG F 1750.00 RPM	4900.00
VACUUM FILTERS (2) ITEMS F -601			CS	ROTY-DRUM	680.00 SQ FT 7.50 HP 31800 LBS (TOTAL WT.)	1800.00 RPM	151200.00
AGITATOR MX-601, NEOPRENE COATED CARBON STEEL	MX -601		SS	FIXED PROP	7.50 HP 961 LBS (TOTAL WT.)	1800.00 RPM	6700.00
THICKENER (2) ITEMS	-601		CS	SINGLE	15393.8 SQ FT 15.00 HP 140.00 FT DIA 370000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	0.057 RPM 14.00 FT HT	956000.00

* REVISED

SECT 600 SOLIDS DISPOSAL
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
LINING FOR T-601							
(2) ITEMS		LIN-601	22700.00 SQ FT	3/16R			394000.00
THICKENER FEED TANK VT-601, NEOPRENE LINED CARBON STEEL							
THICKENER FEED TANK		VT -601	63000.00 GAL	3/16R	OPEN TOP	21.00 FT DIA 24.32 FT HT 250.00 DEG F 0.19 INCHES THICK 20100 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	44300.00
OVERFLOW TANK		VT -602	1920.00 GAL	A285C	OPEN TOP	5.50 FT DIA 10.80 FT HT 68.00 DEG F 0.19 INCHES THICK 2840 LBS (TOTAL WT.)	4200.00
RECEIVER (2) ITEMS		VT -603	1000.00 GAL	A285C	OPEN TOP	4.50 FT DIA 8.41 FT HT 68.00 DEG F 0.19 INCHES THICK 2030 LBS (TOTAL WT.)	7300.00
CAKE SILO-TOP		VT -604	160000.0 GAL	A285C	CONE RTM	18.00 FT DIA 73.00 FT HT 0.050 PSIG 68.00 DEG F 0.31 IN THICK (AVG) 98700 LBS (TOTAL WT.)	61900.00
CAKE SILO-BOTTOM		VT -605	100.00 CU FT	CS	LIVE RTM	4.00 FT DIA 7.23 FT HT 1.50 HP 68.00 DEG F 2470 LBS (TOTAL WT.)	8300.00

SECT 600 SOLIDS DISPOSAL
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E		PURCHASED EQUIPMENT COST
VACUUM PUMPS (2) ITEMS	VP -601	3800.00 CFM	CS	WATER-SEAL	150.00 HP	1800.00 RPM	82800.00	
					16700 LBS	(TOTAL WT.)		

SECT 600 SOLIDS DISPOSAL

- OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC/ NO. SYMBOL	DESCRIPTION	SIZE			E: FOUND V: TYPE E: SYMROL L: S	ROOF TYPE SYMROL	SERVICES		F: MATERIAL COST	LABOR			TOTAL COST
		LENGTH	WIDTH	HEIGHT			A: L H P F C + E L I R E A U R N T M E B	(M-\$)		(MH)	(M-\$)	(M-\$)	
BL	IPAD	200	100				1M	- M - -	27.6	4751	46.4	74.0	
PR	PIPE RACK	200	20	20	1				12.8	1641	16.7	29.5	
1	CLOSED SECT 600 BUILDING	80	80	40	2	PIERS	FLAT	1M - M M M M	154.0	21459	237.2	508.6	

SEC 700 AUXILIARY & PIPING
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
STEAM DISTRIBUTION	CCP-701	20 ELBOWS	A 53	YARD PIPE	1500.00 FT LG 650.00 PSIG	10.00 IN DIA 650.00 DEG F	(72300.00)*
INSTRUMENT AIR LINE	CCP-702	20 ELBOWS	A 53	YARD PIPE	1300.00 FT LG 100.00 PSIG	3.00 IN DIA 100.00 DEG F	(22000.00)*
PLANT AIR LINE	CCP-703	10 ELBOWS	A 106	YARD PIPE	1000.00 FT LG 100.00 PSIG	2.00 IN DIA 100.00 DEG F	(12300.00)*
PROCESS WATER LINE	CCP-704	15 ELBOWS	A 53	YARD PIPE	1500.00 FT LG 50.00 PSIG	6.00 IN DIA 100.00 DEG F	(46500.00)*
FIRE WATER LOOP	CCP-705	20 ELBOWS	A 53	YARD PIPE	2400.00 FT LG 100.00 PSIG	12.00 IN DIA 100.00 DEG F	(123900.00)*
(2) ITEMS PROCESS TIE-IN	CCP-706	20 ELBOWS	A 106	YARD PIPE	1000.00 FT LG 200.00 PSIG	2.00 IN DIA 100.00 DEG F	(25200.00)*
(3) ITEMS PROCESS TIE-IN	CCP-707	20 ELBOWS	A 53	YARD PIPE	800.00 FT LG 200.00 PSIG	10.00 IN DIA 100.00 DEG F	(126500.00)*

*
FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SEC 700 AUXILIARY & PIPING - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC NO. /SYMBOL/	DESCRIPTION	SIZE			L V E L S	FOUND TYPE SYMBOL	ROOF TYPE SYMBOL	SERVICES			MATERIAL COST	LABOR		TOTAL COST
		LENGTH	WIDTH	HEIGHT				A L H P F U	E L	E A U R N I				
		(FT)	(FT)	(FT)							(M-\$)	(MH)	(M-\$)	(M-\$)
BL	NONE	100	500					M	L	- - - -	69.2	6416	66.3	135.5
PR	PIPE RACK	1500	30	20							96.9	11647	118.9	215.8
1	CONTRL GENERAL SERVICE BUILDING	40	100	10		NORMAL	FLAT	M	M	H H M M V	64.4	11998	133.7	257.6

Appendix F

Capital Cost Estimate
Magnesia Slurry Scrubbing

MAGNESIA SLURRY-REGENERATION PROCESS

12/01/77

```

                //      //
CCCCCCCCC      0000000//  SSSSSS//
CCCCCCCCC      0000000//0  SSSSSS//SS
CCC          CCC 000  //000  SS  //
CC           00  // 00  SS  //
CC           00  // 00  SSSS//SSS
CC           00  // 00  SS//SSSS
CC           00  // 00  //  SS
CCC          CCC 00// 000  //  SS
CCCCCCCCC      //00000000  S//SSSSSSS
CCCCCCCCC      //00000000  //SSSSSSS
                //      //

```

(R)

```

TTTTTTTTTTT
TTTTTTTTTTT
TT
TT
TT
TT
TT
TT
TT
TT

```

(COST ORIENTED SYSTEMS TECHNIQUE)

VERSION 8.1E
NOVEMBER 14, 1977

12/28/77 16130132

(R)

COST IS A SERVICE MARK OF

ICARUS CORPORATION
ONE CENTRAL PLAZA
11300 ROCKVILLE PIKE
ROCKVILLE, MD 20852
(301) 881-9350

REGISTERED WITH THE UNITED STATES PATENT OFFICE

M A S T E R S U M M A R Y *

NO.	I T E M	-----D I R E C T C O S T S-----			SURCONTRACTS TOTAL M-\$	AMOUNT \$	PERCENT OF PURCHASED EQUIPMENT	PERCENT OF TOTAL COST
		MATERIAL M-\$	LABOR MANHOURS	LABOR M-\$				
1.	PURCHASED EQUIPMENT	9822.4	-	-	10082.0	19904400.0	100.0	43.4
2.	EQUIPMENT SETTING	-	15652	165.6	-	165600.00	0.9	0.4
3.	PIPING	3436.0	357295.	4228.1	0.0	7664100.00	38.5	16.7
4.	CIVIL	241.4	91804	916.4	729.8	1887600.00	9.5	4.1
5.	STEEL	206.5	19118	201.1	0.0	407600.00	2.3	0.9
6.	INSTRUMENTATION	759.0	16935	194.2	0.0	953200.00	5.3	2.2
7.	ELECTRICAL	1270.3	50893	537.4	0.0	1807700.00	10.0	4.2
8.	INSULATION	0.0	0	0.0	816.7	816700.00	4.5	1.9
9.	PAINT	0.0	0	0.0	485.3	485300.00	2.7	1.1
		-----	-----	-----	-----	-----		
10.	TOTAL FIELD COST	15735.6	604276	6242.8	12113.9	34092200.0	173.3	74.4
11.	ENGINEERING					1452200.00	8.0	3.4
12.	CONSTRUCTION OVERHEAD					4545700.00	25.2	10.6
13.	BARE PLANT COST					40090100.0	201.4	87.5
14.	CONTINGENCIES					4009000.0	20.1	8.7
15.	CONTRACTOR'S FEE					1203000.0	6.0	2.6
16.	SPECIAL CHARGES					516200.00	2.9	1.2
17.	TOTAL FACILITY COST					45818300.0	230.2	100.0

* REVISED

MAGNESIA SLURRY

OPERATIONAL UNIT SUMMARY *

OPERATIONAL UNIT	INSTALLED EQUIPMENT	PIPING	CIVIL	STEEL	INSTRU- MENTATION	ELEC- TRICAL	INSULATION	PAINT	TOTAL
	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$
SECT 100 RAW MATERIAL HANDLING	273.7	72.8	69.0	36.3	26.6	112.5	0.0	28.0	618.9
SECT 200 PARTICULATE SCRUBBING	2388.0	1292.4	126.3	33.8	284.3	285.9	218.6	56.9	4686.2
SECT 300 SO2 SCRUBBING	6153.8	4266.5	270.6	45.3	299.0	479.6	332.9	122.7	11970.3
SECT 500 SLURRY PROCESSING	525.8	249.2	766.1	27.9	80.9	136.9	3.3	9.7	1799.8
SECT 600 CAKE DRYING	768.9	287.6	116.3	29.3	45.0	132.2	49.6	39.3	1468.3
SECT 700 MgSO3 CALCINATION SEC	923.3	201.2	69.7	37.5	70.3	104.7	44.4	33.3	1484.3
SECT 800 H2SO4 PRODUCTION	8600.0	600.0	66.0	12.1	0.0	1.2	0.0	2.0	9281.3
SECT 900 AUXILIARY & STORAGE	436.5	694.4	403.7	185.4	147.3	554.7	168.0	193.3	2783.3
TOTAL	23070.0	7664.1	1887.6	407.6	953.2	1807.7	816.7	485.3	34092.2

* REVISED

LIST OF EQUIPMENT
BY
UNIT OPERATION OR PROCESS

SECT 100 FAW MATERIAL HANDLING
EQUIPMENT LIST

ITEM NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====
COKE CONVEYOR-A	CO -101	15.00 TPH	CS	CLOSED-BLT	60.00 FT LG 24.00 IN W 0.33 HP 1750.00 RPM 15.00 FT/MIN 1 SECT'N 11600 LBS (TOTAL WT.)	13600.00
COKE CONVEYOR-B	CO -102	15.00 TPH	CS	CENT-BKT-L	60.00 FT LONG 3.00 HP 8X5 IN BUCKET SIZE 5000 LBS (TOTAL WT.)	8100.00
PNEUMATIC SYSTEM INCLUDES BLGWER PNEUMATIC CONVEYING SYST	CO -103	2.00 TPH	CS	PNEUMATIC	200.00 FT LG 10.00 HP 4.00 IN LINE SIZE	6000.00
MAKE-UP MGO CONVEYOR	CO -104	0.15 TPH	CS	CLOSED-BLT	60.00 FT LG 6.00 IN W 0.13 HP 1750.00 RPM 2.90 FT/MIN 1 SECT'N 8650 LBS (TOTAL WT.)	8700.00
RECYCLE MGO VIR FEEDER	CO -105	149.00 TPH	CS	VIBRATING	20.00 FT LONG 1.50 HP 12.00 INCH PAN WIDTH	2000.00
RECYCLE MGO CONVEYOR	CO -106	8.30 TPH	CS	CLOSED-BLT	60.00 FT LG 14.00 IN W 0.25 HP 1750.00 RPM 26.00 FT/MIN 1 SECT'N 10100 LBS (TOTAL WT.)	10900.00
MGO ELEVATOR	CO -107	8.30 TPH	CS	CENT-BKT-L	60.00 FT LONG 1.50 HP 6X4 IN BUCKET SIZE 3890 LBS (TOTAL WT.)	8100.00

SECT 100 RAW MATERIAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====							
PRICE QUOTE FROM GALIGHER PUMP VIA ARGO INDUSTRIAL							
\$=1200.	SUMP PUMP	CP -101	5.00 GPM	CS	AVS-MEDIUM	10.00 FT HD 120.00 DEG F 0.50 HP 1750.00 RPM 471 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	1200.00
MAT'L FOR CP-102 IS NEOPRENE LINED CARBON STEEL							
PRICE QUOTE FROM GALIGHER PUMP VIA ARGO INDUSTRIAL							
\$=3100.	MGO SLURRY PUMP	CP -102	263.00 GPM	CS	AVS-MEDIUM	180.00 FT HD 120.00 DEG F 25.00 HP 1750.00 RPM 1100 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	3100.00
MAT'L FOR SPARE CP-102 IS NEOPRENE LINED CARBON STEEL							
PRICE QUOTE FROM GALIGHER PUMP VIA ARGO INDUSTRIAL							
\$=3100.	SPARE CP-102	CP -102	263.00 GPM	CS	AVS-MEDIUM	180.00 FT HD 120.00 DEG F 25.00 HP 1750.00 RPM 1100 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	3100.00
CYCLONE		DC -101	530.00 CFM	CS	CYCLONE	12.00 IN DIA 2.50 IN H2O 149 LBS (TOTAL WT.)	1100.00
MAKE-UP MGO VALVE		FE -101		CS	ROTARY	4 IN SIZE 498 LBS (TOTAL WT.)	1500.00
RECYCLE MGO VALVE		FE -102		CS	ROTARY	14 IN SIZE 1520 LBS (TOTAL WT.)	6000.00

SECT 100 RAW MATERIAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
MGO TANK MIXER		HX -101		SS	FIXED PROP	20.00 HP 1800.00 RPM 1620 LBS (TOTAL WT.)	9700.00
RECYCLE MGO WEIGH FEEDER		S -101			BELT	18.00 IN W	6700.00
COKE RECEIVING HOPPER		VT -101	58.00 CU FT	CS	LIVE BTM	3.00 FT DIA 7.46 FT HT 1.00 HP 68.00 DEG F 1730 LBS (TOTAL WT.)	6900.00
COKE STORAGE SILO		VT -102	30900.00 GAL	A285C	CONE BTM	15.00 FT DIA 20.50 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 28000 LBS (TOTAL WT.)	21300.00
MAKE-UP MGO STORAGE SILO		WT -103	57100.00 GAL	A285C	CONE BTM	18.00 FT DIA 27.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 44500 LBS (TOTAL WT.)	31500.00
MAT'L FOR VT-104 IS NEOPRENE LINED CARBON STEEL							
MGO SLURRY TANK		VT -104	105700.0 GAL	3/16R	STORAGE	23.00 FT DIA 34.00 FT HT 0.050 PSIG 68.00 DEG F 0.19 INCHES THICK 36100 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	74500.00

SECT 100 RAW MATERIAL HANDLING - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/ STRUC NO.	BLDG/ STRUC SYMBOL	DESCRIPTION	SIZE			FOUND TYPE	ROOF TYPE	SERVICES		MATERIAL COST	LABOR			TOTAL COST
			LENGTH	WIDTH	HEIGHT			A L H P F	U					
			(FT)	(FT)	(FT)	S					(M-\$)	(MH)	(M-\$)	(M-\$)
BL	IPAD		20	100										
PR		PIPE RACK	100	20	20									

SECT 200 PARTICULATE SCRUBBING
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
RECYCLE PUMPS CP-201 A-F , MAT'L IS NEOPRENE LINED CARBON STEEL							
PRICE QUOTE FROM GALIGHIER PUMP VIA ARGO INDUSTRIAL							
(4) ITEMS \$=17160.	CP -201	4740.00 GPM	CS	CENTRIF-M	130.00 FT HD 120.00 DEG F 300.00 HP 1800.00 RPM 4720 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	68700.00	
(2) ITEMS \$=17160. SPARE	CP -201	4740.00 GPM	CS	CENTRIF-M	130.00 FT HD 120.00 DEG F 300.00 HP 1800.00 RPM 4720 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	34400.00	
UNDERFLOW PUMPS TO POND CP-202 A-F, MAT'L IS NEOPRENE LINED CARBON STEEL							
(4) ITEMS \$=2500.	CP -202	113.00 GPM	CS	AVS-MEDIUM	132.00 FT HD 120.00 DEG F 7.50 HP 1750.00 RPM 773 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	10000.00	
(2) ITEMS \$=2500. SPARE	CP -202	113.00 GPM	CS	AVS-MEDIUM	132.00 FT HD 120.00 DEG F 7.50 HP 1750.00 RPM 773 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	5000.00	
MAKE-UP WATER PUMP-A	CP -203	880.00 GPM	CS	TURBINE	150.00 FT HD 120.00 DEG F 50.00 HP 1750.00 RPM 1310 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	3600.00	

SECT 200 PARTICULATE SCRUBBING
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
SPARE CP-203-B		CP -203	880.00 GPM	CS	TURBINE	150.00 FT HD 120.00 DEG F 50.00 HP 1750.00 RPM 1310 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	3600.00
	PARTICULATE SCRUBBER VT-201 , NEOPRENE LINED CARBON STEEL (4) ITEMS	VT -201	27000.0 GAL	A285C	CYLINDER	28.00 FT DIA 48.50 FT HT 15.00 PSIG 400.00 DEG F 0.63 INCHES THICK 236000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	1490000.00 *
	SURGE TANKS VT-202 A-D, MAT'L IS NEOPRENE LINED CARBON STEEL (4) ITEMS	VT -202	40600.00 GAL	3/16R	STORAGE	24.00 FT DIA 12.00 FT HT 0.050 PSIG 68.00 DEG F 0.19 INCHES THICK 24100 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	194400.00
	SURGE TANK AGITATORS MX-201 A-D (4) ITEMS	MX -201		SS	FIXED PROP	20.00 HP 1800.00 RPM 1620 LBS (TOTAL WT.)	38600.00
	PARTICULATE SOOT BLOWERS, 15 FT LONG (20) ITEMS DIAMOND POWER	-201					122000.00

* REVISED

SECT 200 PARTICULATE SCRUBBING
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====
PIPING FOR SOOT BLOWERS	CCP-201			A 106 YARD PIPE	1000.00 FT LG 150.00 PSIG	2.00 IN DIA (12000.00)* 300.00 DEG F
ELECTRICAL FOR PARTICULATE SOOT BLOWERS						
\$=0.	MOT-201	90.00 HP		OPEN	3600.00 RPM 1260 LBS (TOTAL WT.)	0.00
PH CONTROL SYSTEM INCLUDES NEUT TANK, BASE STOR TANK & CONTROLLER						
TOTAL INSTALLED COST						
PH CONTROL SYSTEM	-200					49000.00

* FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SECT 200 PARTICULATE SCRUBBING - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC NO. SYMBOL	DESCRIPTION	SIZE			L	E	FOUND	ROOF	SERVICES		FIMATERIAL	LABOR		TOTAL
		LENGTH	WIDTH	HEIGHT					A	L		COST	COST	
		(FT)	(FT)	(FT)	S							(M-\$)	(MH)	(M-\$)
BL	IPAD	200	100						M	-		27.6	4744	46.3
PR	PIPE RACK	200	30	20	1							13.6	1796	18.4

SECT 300 SO2 SCRUBBING
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====						
RECYCLE PUMPS CP-301 A-F , MAT'L IS NEOPRENE LINED CARBON STEEL						
PRICE QUOTE FROM GALIGHER PUMP VIA ARGO INDUSTRIAL						
(6) ITEMS \$=17160.	CP -301	6320.00 GPM	CS	CENTRIF-M	100.00 FT HD 120.00 DEG F 300.00 HP 1800.00 RPM 4860 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	103000.00
SO2 ABSORBERS VT-301 A-D , NEOPRENE LINED CARBON STEEL						
(4) ITEMS	VT -301	223000.0 GAL	A2R5C	CYLINDER	28.00 FT DIA 48.50 FT HT 15.00 PSIG 400.00 DEG F 0.63 INCHES THICK 236000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	4050000 *
ABSORBER SOOT BLOWERS, 15 FT LONG						
(20) ITEMS	-301					122000.00
DIAMOND POWER						
PIPING FOR SOOT BLOWERS	CCP-301		A 106 YARD PIPE		1000.00 FT LG 2.00 IN DIA (12000.00)* 150.00 PSIG 300.00 DEG F	
ELECTRICAL FOR ABSORBER SOOT BLOWERS						
\$=0.	MOT-301	90.00 HP		OPEN	3600.00 RPM 1260 LBS (TOTAL WT.)	0.00
REHEATER SOOT BLOWERS, 13.75 FT LONG						
(20) ITEMS	-302					120000.00
DIAMOND POWER						

* REVISED

SECT 300 S02 SCRUBBING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
PIPING FOR SOOT BLOWERS	CCP-302			A 106	YARD PIPE	1000.00 FT LG 150.00 PSIG	2.00 IN DIA 300.00 DEG F (12000.00)*
ELECTRICAL FOR REHEATER SOOT BLOWERS							
\$=0.	MOT-302		90.00 HP		OPEN	3600.00 RPM 1260 LBS (TOTAL WT.)	0.00
GAS REHEATER HE-301 A-D *							
GAS REHEATER HE-301 HAS HALF 1825 TUBES & HALF CORTEN TUBES							
\$=46700. (4) ITEMS	HE -301			CS	FIN TUBE	1658.00 SQ FT 12.00 FOOT TUBE LENGTH	A285C SHELL 186800.00
(4) ITEMS I.D. FANS	FN -301		369000.0 ACFM	CS	CENTRIF	3000.00 HP	1110000.00

GAS DUCTING

(2200000.00)*

* FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

* REVISED

SECT 300 S02 SCRUBBING

- OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC NO. /SYMBOL/	DESCRIPTION	SIZE			FOUND	ROOF	SERVICES		MATERIAL	LABOR		TOTAL
		LENGTH	WIDTH	HEIGHT			A/C	E/L		COST	COST	
		(FT)	(FT)	(FT)	SI					(M-\$)	(MH)	(M-\$)
BL	PAD	180	90				M	-	-	27.5	4331	70.0
PR	PIPE RACK	300	30	20						20.0	2593	46.5

SECT 500 SLURRY PROCESSING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
HORIZONTAL	SCRFW CONVEYOR	CO -501	33.20 TPH	SS316	SCREW	20.00 FT LG 16.00 IN DIA 5.00 HP 100.00 LBS/CU FT 2650 LBS (TOTAL WT.)	15800.00
VERTICAL	SCREW CONVEYOR	CO -502	33.20 TPH	SS316	SCREW	40.00 FT LG 16.00 IN DIA 10.00 HP 100.00 LBS/CU FT 4150 LBS (TOTAL WT.)	28700.00
LIQUOR PUMP CP-501-A ,MAT'L IS NEOPRENE LINED CARBON STEEL PRICE QUOTE FROM GALIGHIER PUMP VIA ARGO INDUSTRIAL							
CP-501-A	\$=4700.	CP -501	1440.00 GPM	CS	CENTRIF-M	75.00 FT HD 120.00 DEG F 50.00 HP 3600.00 RPM 1270 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	4700.00
SPARE LIQUOR PUMP CP-501-B ,MAT'L IS NEOPRENE LINED CARBON STEEL PRICE QUOTE FROM GALIGHIER PUMP VIA ARGO INDUSTRIAL							
SPARE CP-501-B	\$=4700.	CP -501	1440.00 GPM	CS	CENTRIF-M	75.00 FT HD 120.00 DEG F 50.00 HP 3600.00 RPM 1270 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	4700.00
CONDENSATE PUMP		CP -502	25.00 GPM	CS	AVS-HIGH	480.00 FT HD 120.00 DEG F 7.50 HP 3500.00 RPM 603 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	2100.00

SECT 500 SLURRY PROCESSING
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====							
CONVERSION TANK PUMP CP-503-A ,MAT'L IS NEOPRENE LINED CARBON STEEL							
PRICE QUOTE FROM GALIGHER PUMP VIA ARGO INDUSTRIAL							
CP-503-A	\$=2900.	CP -503	340.00 GPM	CS	AVS-LOW	50.00 FT HD 55.00 DEG F 10.00 HP 1150.00 RPM 829 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	2900.00
SPARE CONVERSION TANK PUMP CP-503-B ,MAT'L IS NEOPRENE LINED CARBON STEEL							
PRICE QUOTE FROM GALIGHER PUMP VIA ARGO INDUSTRIAL							
SPARE CP-503-B	\$=2900.	CP -503	340.00 GPM	CS	AVS-LOW	50.00 FT HD 55.00 DEG F 10.00 HP 1150.00 RPM 829 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	2900.00
CENTRIFUGES CT-501 A&B							
\$=180000. 12) ITEMS		CT -501		SS	SOLID BOWL	36.00 IN BOWL DIAMETER 200.00 HP 3.00 CU FT CAPACITY 14200 LBS (TOTAL WT.)	360000.00
STEAM COIL		HE -501		SS	HEATER-STM	1200.00 SQ FT	4300.00
AGITATOR		HX -501		SS	FIXED PROP	20.00 HP 1800.00 RPM 1620 LBS (TOTAL WT.)	9700.00
SCREENS (4) ITEMS 501-A-D VS -501				CS	ONE DECK	20.00 SQ FT 2.00 HP 1650 LBS (TOTAL WT.)	15000.00

SECT 500 SLURRY PROCESSING
E Q U I P M E N T L I S T

I T E M .	N A M E	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====
VT-501	MAT'L IS NEOPRENE LIQUOR TANK	VT -501	5000.00 GAL	3/16R STORAGE	9.00 FT DIA 10.50 FT HT 0.050 PSIG 68.00 DEG F 0.19 INCHES THICK 6210 LBS (TOTAL WT.)	11500.00
CONVERSION TANK		VT -502	6300.00 GAL	SS316 STORAGE	12.00 FT DIA 7.50 FT HT 0.050 PSIG 68.00 DEG F 0.19 INCHES THICK 8110 LBS (TOTAL WT.)	15600.00
CONDENSATE TANK		VT -503	100.00 GAL	A285C CYLINDER	2.00 FT DIA 4.26 FT HT 150.00 PSIG 400.00 DEG F 0.38 INCHES THICK 1020 LBS (TOTAL WT.)	1600.00

SECT 500 SLURRY PROCESSING - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC/ NO. SYMBOL	DESCRIPTION	SIZE			FOUND	ROOF	SERVICES		MATERIAL	LABOR		TOTAL
		LENGTH	WIDTH	HEIGHT			ALHPF	UI		COST		
		(FT)	(FT)	(FT)	TYPE	TYPE	C + E L	R				COST
					SYMBOL	SYMBOL	E A U R	N				
							T M E					
							B		(M-\$)	(MH)	(M-\$)	(M-\$)
BL	PAD	150	60				M - M - -	-	16.3	2498	24.6	40.9
PR	PIPE RACK	150	30	20	1				10.8	1445	14.8	25.6
1	SHELL	150	60	40	2	NORMAL	FLAT	M - M L L M	-	216.3	31343	340.4
2	CLOSED SLURRY PROCESSING BLDG	60	30	40	1	NORMAL	FLAT	M - M M M M	-	27.1	3342	36.5

SECT 600 CAKE DRYING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
CONVEYOR		CO -601	19.70 TPH	CS	CLOSED-BLT	60.00 FT LG 14.00 IN W 0.75 HP 1750.00 RPM 120.00 FT/MIN 1 SECTION 10200 LRS (TOTAL WT.)	10800.00
CONVEYOR-ELEVATOR		CO -602	19.70 TPH	CS	CENT-RKT-L	60.00 FT LONG 3.00 HP 8X5 IN BUCKET SIZE 5040 LRS (TOTAL WT.)	7700.00
DUST COLLECTOR		DC -601	54000.00 CFM	CS	CLOTH BAG	12000 SQ FT 4.50 AIR/MEDIA RATIO 19000 LRS (TOTAL WT.)	50400.00
DISCHARGE FAN		FN -602	54000.00 CFM	CS	CENTRIF	250.00 HP 1800.00 RPM 4130 LRS (TOTAL WT.)	22600.00
FLUID BED DRYER SYSTEM INCLUDES VT-601,VT-602,HT-601,AND FN-601 DRYING SYSTEM PURCHASED EQUIPMENT COST							505000.00
DRYING SYSTEM DORR-OLIVER -600							
BLOWER \$=0.		FN -601	13200.00 CFM	CS	CENTRIF	250.00 HP 1800.00 RPM 2960 LRS (TOTAL WT.)	0.00
COMBUSTION CHAMBER \$=0.		HT -601	9400.00 GAL	REF-2	ASME CODE	10.00 FT DIA 16.00 FT LG 15.00 PSIG 400.00 DEG F 0.25 INCHES THICK 9710 LRS (TOTAL WT.)	0.00

SECT 600 CAKE DRYING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
FLUID BED DRYER	\$=0.	VT -601	76000.00 GAL	REF-2	CYLINDER	18.00 FT DIA 40.00 FT HT 2.00 PSIG 400.00 DEG F 0.38 INCHES THICK 76000 LBS (TOTAL WT.)	0.00
CYCLONE	\$=0.	VT -602	26700.00 GAL	REF-2	CONE RTM	12.00 FT DIA 24.00 FT HT 2.00 PSIG 250.00 DEG F 0.25 INCHES THICK 18200 LBS (TOTAL WT.)	0.00
MGS03-STORAGE SILO-TOP		VT -603	191000.0 GAL	CS	CONE RTM	26.00 FT DIA 43.00 FT HT 0.050 PSIG 63.00 DEG F 0.28 IN THICK (AVG) 120000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	103000.00
MGS03-STORAGE SILO-POTTOM		VT -604	75.00 CU FT	CS	LIVE RTM	4.00 FT DIA 5.43 FT HT 1.50 HP 68.00 DEG F 2170 LBS (TOTAL WT.)	8100.00

SECT 600 CAKE DRYING

- OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/	STRUC/STRUC/	NO.	SYMBOL	DESCRIPTION	SIZE			L	E	FOUND	ROOF	A	L	H	P	F	U	COST	LABOR			TOTAL
					LENGTH	WIDTH	HEIGHT															
					(FT)	(FT)	(FT)															
BL	IPAD				80	160												19.9	3245	31.8		51.7
PR				PIPE RACK	150	20	20	1										10.1	1316	13.4		23.6

SECT 700 MGS03 CALCINATION SEC
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
CONVEYOR-ELEVATOR MGS03 FEEDER TO FLUID BED CALCINER CO-701 & CO-702							
CONVEYOR		CO -701	20.00 TPH	CS	CLOSED-BLT	40.00 FT LG 14.00 IN W 0.50 HP 1750.00 RPM 63.00 FT/MIN 1 SECT'N 7370 LBS (TOTAL WT.)	8800.00
ELEVATOR		CO -702	20.00 TPH	CS	CENT-BKT-L	60.00 FT LONG 3.00 HP 8X5 IN BUCKET SIZE 5040 LBS (TOTAL WT.)	7600.00
CONVEYOR-ELEVATOR CALCINER TO RECYCLE MGO - CO-703 & CO-704							
CONVEYOR		CO -703	20.00 TPH	CS	CLOSED-RLT	40.00 FT LG 14.00 IN W 0.50 HP 1750.00 RPM 63.00 FT/MIN 1 SECT'N 7370 LBS (TOTAL WT.)	8800.00
ELEVATOR		CO -704	20.00 TPH	CS	CENT-BKT-L	60.00 FT LONG 3.00 HP 8X5 IN BUCKET SIZE 5040 LBS (TOTAL WT.)	7600.00
CONVEYR	ELEV DUST COLLETR	CO -705	0.15 TPH	CS	CLOSED-BLT	38.00 FT LG 6.00 IN W 0.13 HP 1750.00 RPM 2.90 FT/MIN 1 SECT'N 5900 LBS (TOTAL WT.)	6900.00
DUST COLLECTOR		DC -701	40000.00 CFM	CS	CLOTH BAG	4000 SQ FT 10.00 AIR/MEDIA RATIO 14100 LBS (TOTAL WT.)	23800.00

SECT 700 MGS03 CALCINATION SEC
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
COKE FEEDER		FE -701		CS	ROTARY	3 IN SIZE 405 LBS (TOTAL WT.)	1200.00
VIBRATING FEEDER FE-702 ,TOTAL INSTALLED COST FE-702 218LBS/HR,1 HP.							
TOTAL INSTALLED COST		-702					4500.00
MGS03 VIBRATING FEEDER		FE -703		CS	VIBRATING	5.00 FT LG 12.00 IN W 0.50 HP 905 LBS (TOTAL WT.)	1500.00
WASTE HEAT ROILER		HE -701	16000.00 LBS/HR	CS	WASTE HEAT	840.00 SQ FT 44000 LBS (TOTAL WT.)	47900.00
WEIGH FEEDER		S -701			BELT	18.00 IN W	6700.00
MGO RECYCLE-STORAGE SILO		VT -703	142000.0 GAL	A285C	CONE BTM	26.00 FT DIA 31.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 94000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	83100.00
FLUID BED CALCINER INCLUDES VT-701,VT-702,AND FN-701. MGS03 CALCINATION SYSTEM, PURCHASED EQUIPMENT COST CALCINATION SYSTEM							
		-700					645000.00
FEED AIR FAN S=0.		FN -701	10100.00 CFM	CS	CENTRIF	400.00 HP 1800.00 RPM 4070 LBS (TOTAL WT.)	0.00

SECT 700 MGS03 CALCINATION SEC
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====
CALCINER \$=0.	VT -701	57000.00 GAL	REF-2 CYLINDER	16.00 FT DIA 38.00 FT HT 15.00 PSIG 400.00 DEG F 0.31 INCHES THICK 53300 LBS (TOTAL WT.)	0.00	
CYCLONE \$=0.	VT -702	26700.00 GAL	REF-2 CONE BTM	12.00 FT DIA 24.00 FT HT 0.050 PSIG 250.00 DEG F 0.25 INCHES THICK 20600 LBS (TOTAL WT.)	0.00	

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/	BLDG/	DESCRIPTION	SIZE			E: FOUND	ROOF	SERVICES		FIMATERIAL	L A B O R	TOTAL
			LENGTH	WIDTH	HEIGHT			V: TYPE	TYPE			
NO.	SYMBOL		(FT)	(FT)	(FT)	S: L				(M-\$)	(MH)	(M-\$)
BL	IPAD		40	80				M - M - -	-	8.7	1162	11.6
PR	PIPE RACK		100	30	20					7.2	982	10.0

SECT 800 H2S04 PRODUCTION
E Q U I P M E N T L I S T

I T E M	N A M E	A P P . N O .	C A P A C I T Y	M A T ' L	E Q U I P M E N T I T E M T Y P E	S I Z E	P U R C H A S E D E Q U I P M E N T C O S T
=====							=====
	H2S04 PLANT TOTAL INSTALLED COST						
	H2S04 PLANT	-800					8600000.00

* REVISED

SECT 800 H2504 PRODUCTION - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC NO. SYMBOL	DESCRIPTION	SIZE			L E S	FOUND TYPE	ROOF TYPE	SERVICES		FIMATERIAL COST	LABOR			TOTAL COST
		LENGTH	WIDTH	HEIGHT				A L H P F	U					
		(FT)	(FT)	(FT)										
BL	IPAD	50	80											
PR	PIPE RACK	80	30	20										

SECT 900 AUXILIARY & STORAGE
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
STEAM DISTRIBUTION	CCP-901	20 ELBOWS	A 53	YARD PIPE	2000.00 FT LG 650.00 PSIG	12.00 IN DIA 650.00 DEG F	(104900.00)*
INSTRUMENT AIR LINE	CCP-902	20 ELBOWS	A 53	YARD PIPE	1500.00 FT LG 100.00 PSIG	3.00 IN DIA 100.00 DEG F	(24800.00)*
PLANT AIR LINE	CCP-903	10 ELBOWS	A 106	YARD PIPE	1500.00 FT LG 100.00 PSIG	2.00 IN DIA 100.00 DEG F	(18300.00)*
PROCESS WATER LINE	CCP-904	15 ELBOWS	A 53	YARD PIPE	1500.00 FT LG 50.00 PSIG	6.00 IN DIA 100.00 DEG F	(46500.00)*
FIRE WATER LOOP	CCP-905	20 ELBOWS	A 53	YARD PIPE	3000.00 FT LG 100.00 PSIG	14.00 IN DIA 100.00 DEG F	(167200.00)*
(2) ITEMS PROCESS TIE-IN	CCP-906	20 ELBOWS	A 106	YARD PIPE	1500.00 FT LG 200.00 PSIG	2.00 IN DIA 100.00 DEG F	(37200.00)*
(3) ITEMS PROCESS TIE-IN	CCP-907	20 ELBOWS	A 53	YARD PIPE	800.00 FT LG 200.00 PSIG	12.00 IN DIA 100.00 DEG F	(143000.00)*

PUMPS (2) ITEMS	CP -901	400.00 GPM	CS	AVS-HIGH	250.00 FT HD 40.00 HP 1120 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	120.00 DEG F 3500.00 RPM	6700.00

* REVISED

SECT 900 AUXILIARY & STORAGE
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
FEED PUMPS (2) ITEMS		GP -901	15.00 GPM	CI		2.00 HP 87.00 RPM 468 LBS (TOTAL WT.)	4400.00
TRANSFER PUMPS (2) ITEMS		GP -902	50.00 GPM	CI		5.00 HP 87.00 RPM 345 LBS (TOTAL WT.)	3900.00
OIL HEATERS HE-901 A&B ,TOTAL INSTALLED COST							
HE-901 A&B (2) ITEMS		-					15000.00
COIL HEATERS (2) ITEMS		HE -902		CS	HEATER-STM	56.00 SQ FT	1400.00
H2S04 STORAGE TANKS VT-901							
(2) ITMES STORAGE		VT -901	500000.0 GAL	A285C	STORAGE	60.00 FT DIA 23.64 FT HT 0.050 PSIG 68.00 DEG F 0.25 IN THICK (TOP) 0.38 IN THICK (BOT'M) 169000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	159000.00
STORAGE TANK		VT -902	560000.0 GAL	A285C	STORAGE	65.00 FT DIA 26.59 FT HT 0.050 PSIG 68.00 DEG F 0.25 IN THICK (TOP) 0.38 IN THICK (BOT'M) 199000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	188000.00

* REVISED

SECT 900 AUXILIARY & STORAGE
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
(2)	ITEMS HOLD TANK STOR	VT -903	24000.00 GAL	A285C STORAGE	13.00 FT DIA 24.17 FT HT 0.050 PSIG 69.00 DEG F 0.19 INCHES THICK 14600 LBS (TOTAL WT.)	25200.00

*
FIELD FABRICATED ITEM. CCST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SECT 900 AUXILIARY & STORAGE
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
(2)	ITEMS HOLD TANK STOR	VT -903	24000.00 GAL	A285C	STORAGE	13.00 FT DIA 24.17 FT HT 0.050 PSIG 68.00 DEG F 0.19 INCHES THICK 14600 LBS (TOTAL WT.)	25200.00

* FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SECT 900 AUXILIARY & STORAGE - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/ STRUC NO.	BLDG/ STRUC SYMBOL	DESCRIPTION	SIZE			E SYMBOL	FOUND TYPE	ROOF TYPE	SERVICES		F MATERIAL	U COST	LABOR		TOTAL COST
			LENGTH	WIDTH	HEIGHT				AIC + E	L					
			(FT)	(FT)	(FT)	S			B		(M-\$)		(MH)	(M-\$)	(M-\$)
BL	NONE		100	500					M	- L - - -		69.3	6440	66.5	135.8
PR		PIPE RACK	1500	30	20							96.9	11647	118.9	215.8
1	CONTRL	GENERAL SERVICE BUILDING	50	100	10		NORMAL	FLAT	M	M H H M M	V	80.4	14989	167.1	321.7

Appendix G

Capital Cost Estimate
Coal Cleaning Plant

COAL WASHING

12/01/77

```

                //          //          (R)
CCCCCCCCC      0000000//  SSSSSS//  TTTTTTTTTT
CCCCCCCCC      0000000//0  SSSSSS//SS TTTTTTTTTT
CCC          CCC 000 //000  SS //      TT
CC          00 // 00  SS //      TT
CC          00 // 00  SSSS//SSS      TT
CC          00 // 00  SS//SSSS      TT
CC          00 // 00  // // SS      TT
CCC          CCC 00// 000 // // SS      TT
CCCCCCCCC      //0000000  S//SSSSSSS      TT
CCCCCCCCC      //0000000  //SSSSSSS      TT
                //          //

```

(COST ORIENTED SYSTEMS TECHNIQUE)

VERSION 8.1F
JANUARY 27, 1978

03/06/78 13158152

(R)

COST IS A SERVICE MARK OF

ICARUS CORPORATION
ONE CENTRAL PLAZA
11300 ROCKVILLE PIKE
ROCKVILLE, MD 20852
(301) 881-9350

REGISTERED WITH THE UNITED STATES PATENT OFFICE

O P E R A T I O N A L U N I T S U M M A R Y

OPERATIONAL UNIT	INSTALLED EQUIPMENT	PIPING	CIVIL	STEEL	INSTRU- MENTATION	ELEC- TRICAL	INSULATION	PAINT	TOTAL
	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$	M-\$
SECTION 100 COAL HANDLING	3493.9	69.5	402.6	259.3	31.0	201.5	0.0	101.1	4559.0
SECT 200 COAL WASHING	5392.0	2754.1	4414.6	266.3	595.0	2975.4	0.0	467.2	16864.5
SECT 300 MATERIAL HANDLING	162.3	35.7	46.0	51.9	32.4	142.4	0.0	29.2	499.8
SECT 400 FEED PREPARATION	645.9	72.0	57.9	28.7	29.8	145.3	4.0	17.4	1001.0
SECT 500 PARTICULATE SCRUBBING	1194.0	445.4	111.6	24.0	74.0	170.4	40.5	22.0	2081.8
SECT 600 SO2 SCRUBBING	2928.6	3479.9	207.6	71.7	448.7	516.2	215.8	105.1	7973.6
SECT 700 SOLIDS DISPOSAL	1262.7	244.3	697.9	31.6	93.5	149.6	11.0	55.3	2545.9
SEC 800 AUXILIARY & PIPING	0.0	460.1	270.6	159.9	157.0	494.8	66.7	127.5	1736.6
TOTAL	15079.4	7561.0	6208.8	893.4	1461.4	4795.6	338.0	924.8	37262.4

* REVISED

LIST OF EQUIPMENT
BY
UNIT OPERATION OR PROCESS

SECTION 100 COAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
ROTARY CAR DUMP SYSTEM FOR COKE-100 TONS CAPACITY CAR							
ROTARY CAR DUMPER SYSTEM		-100					1000000.00
	EDI-101			R-CON	EXCAVATED	1 SECTION - RECTANGLE 24.00 FT LENGTH 23.00 FT DEPTH 58.50 FT WIDTH	(207900.00)*
ELECTRICAL FOR DUMP SYSTEM							
POSITIONER MOTOR SUPPLIED							
POSITIONER	\$=0.	MOT-	250.00 HP		ENCLOSED	3600.00 RPM 2620 LBS (TOTAL WT.)	0.00
DUMPER MOTOR SUPPLIED							
DUMPER MOT	\$=0.	MOT-	140.00 HP		ENCLOSED	3600.00 RPM 1740 LBS (TOTAL WT.)	0.00
COAL CAR UNLOADING VIBRATING FEEDERS CO-101-106							
(6) ITEMS CO-101-106	CO -101		375.00 TPH	CS	VIBRATING	120.00 FT LONG 20.00 HP 36.00 INCH PAN WIDTH	133800.00
COAL UNLOADING CONVEYOR	CO -107		3000.00 TPH	CS	OPEN BELT	344.00 FT LG 60.00 IN W 200.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 45700 LBS (TOTAL WT.)	190000.00
COAL UNLOADING CONVEYOR	CO -108		3000.00 TPH	CS	OPEN BELT	575.00 FT LG 60.00 IN W 300.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 70900 LBS (TOTAL WT.)	363000.00

SECTION 100 COAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
COAL UNLOADING CONVEYOR	CO -109	3000.00 TPH	CS	OPEN BELT	190.00 FT LG 60.00 IN W 125.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 28500 LBS (TOTAL WT.)	101000.00	
STACKER BOOM	-ST CO -110	3000.00 TPH	CS	OPEN BELT	110.00 FT LG 60.00 IN W 75.00 HP 1750.00 RPM 530.00 FT/MIN 1 SECT'N 19200 LBS (TOTAL WT.)	59800.00	
RECLAIM FEEDERS CO-111-118 (8) ITEMS CO-111-118	CO -111	200.00 TPH	CS	VIBRATING	60.00 FT LONG 7.50 HP 36.00 INCH PAN WIDTH	95200.00	
COAL WASHING FEED CONVEYR	CO -119	1200.00 TPH	CS	OPEN BELT	1000.00 FT LG 60.00 IN W 200.00 HP 1750.00 RPM 210.00 FT/MIN 1 SECT'N 114000 LBS (TOTAL WT.)	520000.00	
COAL WASHING FEED CONVEYR	CO -120	1200.00 TPH	CS	OPEN BELT	610.00 FT LG 60.00 IN W 125.00 HP 1750.00 RPM 210.00 FT/MIN 1 SECT'N 72000 LBS (TOTAL WT.)	302000.00	
MAGNETIC COAL CLEANER, TOTAL INSTALLED COST FOR 3 ITEMS MAGNETIC COAL CLEANER	-100					44800.00	
ELECTRICAL FOR MAGNETIC COAL CLEANER MOT-100 A-C (3) ITEMS \$=0.	MOT-100	7.50 HP	ENCLOSED	3600.00 RPM 164 LBS (TOTAL WT.)	0.00		

SECTION 100 COAL HANDLING
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====
COAL UNLOADING BELT	SCALE S -101	3000.00	TPH	BELT	60.00 IN W	6900.00
COAL SILO VT-101-105						
(5) ITEMS	VT -101	78000.00	GAL	A285C CONE BTM	25.00 FT DIA 18.00 FT HT 0.050 PSIG 125.00 DEG F 0.25 INCHES THICK 70400 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	310500.00
HOPPERS UNDER PILES						
(5) ITEMS VT-106-110	VT -105	575.00	GAL	A285C CONE RTM	4.00 FT DIA 5.30 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 1740 LBS (TOTAL WT.)	18000.00

*
FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SECTION 100 COAL HANDLING - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/STRUC NO.	BLDG/STRUC SYMBOL	DESCRIPTION	SIZE			FOUND	ROOF	SERVICES		MATERIAL COST	LABOR		TOTAL COST
			LENGTH	WIDTH	HEIGHT			A/C	E/L		U/R	N	
			(FT)	(FT)	(FT)	S				(M-\$)	(MH)	(M-\$)	(M-\$)
BL	PAD		100	100				M	- L - - -	16.6	2631	25.8	42.5
PR		PIPE RACK	150	30	20	1				10.8	1445	14.8	25.6
1	CLOSED	ROOM HOUSE	20	20	10	1	NORMAL	FLAT	M - M M M M	3.4	586	6.6	13.0
2	OPEN	ROOM HOUSE	20	20	100	1			M - M - - -	19.6	1363	13.9	33.5

SUPPLEMENTAL BULK ADJUSTMENT DATA

NO.	ACCOUNT	DESCRIPTION	COST CODE		MATERIAL COST (\$)	LABOR MANHOURS	LABOR COST (\$)	MODE	TOTAL COST (\$)
			MAT'L	LABOR					
1.	STEEL	ADD'L STEEL FOR STKR BM	403	403	10698.00	914.0	9585.00	DIRECT	20283.00

SECT 200 COAL WASHING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
CLEAN COAL BELT		CO -201	1060.00 TPH	CS	CLOSED-BLT	200.00 FT LG 52.00 IN W 40.00 HP 1750.00 RPM 200.00 FT/MIN 1 SECT'N 50900 LBS (TOTAL WT.)	82300.00
REFUSE BELT		CO -202	140.00 TPH	CS	OPEN BELT	200.00 FT LG 18.00 IN W 7.50 HP 1750.00 RPM 260.00 FT/MIN 1 SECT'N 11400 LBS (TOTAL WT.)	24800.00
PULVERIZER FEEDERS CO-203 A-E (5) ITEMS		CO -203	54.00 TPH	CS	VIBRATING	40.00 FT LONG 1.00 HP 24.00 INCH PAN WIDTH	33200.00
RAW COAL SUMP PUMPS CP-201 A-F, INSTALLATION \$=0. (6) ITEMS		CP -201	4880.00 GPM	CS	CENTRIF-M	75.00 FT HD 120.00 DEG F 75.00 HP 1800.00 RPM 2470 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	0.00
PRIMARY HEAVY MEDIA SUMP PUMPS A-F, INSTALLATION \$=0. (6) ITEMS		CP -202	5980.00 GPM	CS	CENTRIF-M	75.00 FT HD 120.00 DEG F 100.00 HP 1800.00 RPM 3000 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	0.00
SECONDARY HEAVY MEDIA SUMP PUMP CP-203, INSTALLATION \$=0. (2) ITEMS		CP -203	3130.00 GPM	CS	CENTRIF-M	75.00 FT HD 120.00 DEG F 75.00 HP 1800.00 RPM 2070 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	0.00

SECT 200 COAL WASHING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
DILUTE MEDIA SUMP PUMPS	CP-204 A&B, INSTALLATION						
\$=0. (2) ITEMS	CP -204	6540.00 GPM	CS	CENTRIF-M	75.00 FT HD 120.00 DEG F 200.00 HP 1800.00 RPM 4080 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER		0.00
HYDRYCLONE SUMP PUMPS	CF-205 A-F, INSTALLATION						
\$=0. (6) ITEMS	CP -205	5130.00 GPM	CS	CENTRIF-M	75.00 FT HD 120.00 DEG F 50.00 HP 1800.00 RPM 2260 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER		0.00
THICKENER OVER FLOW PUMP	CP-206 A-C						
(3) ITEMS	CP -205	12500.00 GPM	CS	CENTRIF-M	75.00 FT HD 120.00 DEG F 600.00 HP 1800.00 RPM 8920 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER		136500.00
THICKENER UNDERFLOW PUMP	CP-207 A&B						
\$=6960. (2) ITEMS	CP -207	740.00 GPM	CS	CENTRIF-M	75.00 FT HD 120.00 DEG F 75.00 HP 3600.00 RPM 1470 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER		14000.00
CLASSIFYING SUMP PUMPS	CF-208 A-F, INSTALLATION						
\$=0. (6) ITEMS	CP -208	5180.00 GPM	CS	CENTRIF-M	75.00 FT HD 120.00 DEG F 75.00 HP 1800.00 RPM 2550 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER		0.00

SECT 200 COAL WASHING
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
FILTRATE PUMPS (4) ITEMS	CP -209	200.00 GPM	CS	AVS-MEDIUM	200.00 FT HD 120.00 DEG F 15.00 HP 1750.00 RPM 947 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	11300.00	
\$=38970; RAW COAL CRUSHER	CR -201	168.00 TPH	CS	ROLL	24X50 SIZE 75.00 HP 1200.00 RPM 14000 LBS (TOTAL WT.)	39000.00	
COARSE COAL DRYERS CT-201 A-H (8) ITEMS CT-201 A-H	CT -201		CS	ATM SUSPEN	50.00 HP	230500.00	
REFUSE DRYERS CT-202 A-C (3) ITEMS CT-202 A-C	CT -202		CS	ATM SUSPEN	50.00 HP	86500.00	
CLEAN COAL DRYERS CT-203 A-C (3) ITEMS	CT -203		CS	ATM SUSPEN	50.00 HP	105300.00	
PRIMARY AND SECONDARY HEAVY MEDIA CYCLONES DC-201 A-N (14) ITEMS \$=9000.	DC -201	4420.00 CFM	CS	CYCLONE	24.00 IN DIA 2.50 IN H2O 440 LBS (TOTAL WT.)	126000.00	
HYDROCYCLONES DC-202 A-L (12) ITEMS \$=2425	DC -202	1510.00 CFM	CS	CYCLONE	14.00 IN DIA 2.50 IN H2O 181 LBS (TOTAL WT.)	29100.00	
CLASSIFYING CYCLONES DC-203 A-R							

SECT 200 COAL WASHING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
(18) ITEMS \$=2425.		DC -203	1510.00 CFM	CS	CYCLONE	14.00 IN DIA 2.50 IN H2O 181 LBS (TOTAL WT.)	43700.00
REFUSE DISK FILTER F-201 A-C \$=95500. (3) ITEMS		F -201		CS	ROTY-DISK	410.00 SQ FT 300.00 HP 0.00 RPM	286500.00
MACHINERY HOIST & TROLLEY HO		-201	12.00 TONS	CS	HOIST		17800.00
\$=20000. BELT SCALE		S -201			BELT	26.00 IN W	20000.00
THICKENERS A&H (2) ITEMS \$=220500.		T -201	1390000 TPD	CS	SINGLE	13273.2 SQ FT 15.00 HP 0.061 RPM 130.00 FT DIA 14.00 FT HT 281000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	441000.00
RAW COAL SCREFFNS VS-201 A-F (6) ITEMS VS-201 A-F		VS -201		CS	TWO DECK	128.00 SQ FT 20.00 HP	135000.00
DESLIMING SEIVE BENDS VS-202 A-L -E (12) ITEMS \$=5110.		VS -202		CS	ONE DECK	35.00 SQ FT 3340 LBS (TOTAL WT.)	61400.00
DESLIMING SCREFFNS VS-203 A-L (12) ITEMS VS-203 A-L		VS -203		CS	ONE DECK	128.00 SQ FT 20.00 HP.	203200.00

SECT 200 COAL WASHING
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
	CLEAN COAL SIEVE BENDS VS-204 A-N						
-E (14) ITEMS \$=4100.	VS -204			CS	ONE DECK	17.50 SQ FT 1470 LBS (TOTAL WT.)	57400.00
	CLEAN COAL D & R SCREENS VS-205 A-N						
(14) ITEMS VS-205 A-N	VS -205			CS	ONE DECK	128.00 SQ FT 20.00 HP	237100.00
	SECONDARY DRAIN SIEVE BENDS VS-206 A-F						
-E (6) ITEMS \$=4100.	VS -206			CS	ONE DECK	12.50 SQ FT 1210 LBS (TOTAL WT.)	24600.00
	SECONDARY DRAIN SIEVE BENDS VS-207 A-F						
-E (6) ITEMS \$=4650.	VS -207			CS	ONE DECK	30.00 SQ FT 1980 LBS (TOTAL WT.)	27900.00
	MIDDINGS D & R SIEVE BENDS VS-208 A AND B						
-E (2) ITEMS \$=4100.	VS -208			CS	ONE DECK	12.50 SQ FT 1210 LBS (TOTAL WT.)	8200.00
	MIDDINGS D & R SCREENS VS-209 A-B						
(2) ITEMS \$=17545.	VS -209			CS	ONE DECK	96.00 SQ FT 7.50 HP 10700 LBS (TOTAL WT.)	35100.00
	REFUSE D & R SIEVE BENDS VS-210 A-C						
-E (3) ITEMS \$=4100	VS -210			CS	ONE DECK	16.00 SQ FT 1390 LBS (TOTAL WT.)	12300.00
	REFUSE D & R SCREENS VS-211 A-C						

SECT 200 COAL WASHING
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
(3) ITEMS	VS-211 A-C	VS -211		CS	ONE DECK	128.00 SQ FT 20.00 HP	50800.00
DERRICK SCREENS VS-212 A-H							
(8) ITEMS	\$=17125.	VS -212		CS	ONE DECK	32.00 SQ FT 1.50 HP 3160 LBS (TOTAL WT.)	137000.00
RAW COAL SUMPS VT-201 A-C, TOTAL PURCHASED COST INCLUDES SUMPS AND 6 PUMPS							
\$=24600. (3) ITEMS		VT -201	33800.00 GAL	A285C	CONE BTM	14.00 FT DIA 26.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 28100 LBS (TOTAL WT.)	73800.00
PRIMARY HEAVY MEDIA SUMPS VT-202 A-C, TOTAL PURCHASED COST INC SUMPS & 6 PUMPS							
\$=13670. (3) ITEMS		VT -202	41400.00 GAL	A285C	CONE BTM	15.00 FT DIA 27.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 31600 LBS (TOTAL WT.)	41100.00
SECONDARY HEAVY MEDIA SUMP VT-203, TOTAL PURCHASED COST INCLUDES SUMP & PUMPS							
\$=8450. VT-203		VT -203	7300.00 GAL	A285C	CONE BTM	8.00 FT DIA 17.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 7840 LBS (TOTAL WT.)	8500.00
DILUTE MEDIA SUMP VT-204, TOTAL PURCHASED COST INCLUDES SUMP & 2 PUMPS							
\$=21660.		VT -204	15100.00 GAL	A285C	CONE BTM	11.00 FT DIA 18.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 15800 LBS (TOTAL WT.)	21700.00

SECT 200 COAL WASHING
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====						
	HYDROCLONE SUMPS VT-205 A-C, TOTAL PURCHASED COST INCLUDES SUMPS & 2 PUMPS					
\$=13310.	(3) ITEMS	VT -205	35500.00 GAL	A285C CONE BTM	14.00 FT DIA 27.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 28600 LBS (TOTAL WT.)	40000.00
\$=954000.	CLEAN COAL SILO VT -206		1496000 GAL	A285C CONE BTM	48.00 FT DIA 96.00 FT HT 0.050 PSIG 68.00 DEG F 0.81 IN THICK (AVG) 605 TONS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	954000.00
	CLASSIFYING CYCLONE VT-208, TOTAL PURCHASED COST INCLUDES SUMP & 6 PUMPS					
\$=26100.	(3) ITEMS	VT -208	40000.00 GAL	A285C CONE BTM	15.00 FT DIA 26.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 31000 LBS (TOTAL WT.)	78300.00
MAGNITITE BIN		VT -209	1000.00 CU FT	CS LIVE BTM	8.00 FT DIA 18.09 FT HT 3.00 HP 68.00 DEG F 9800 LBS (TOTAL WT.)	15900.00
WATER TANK STORAGE		VT -210	200000.0 GAL	A 285 CONE ROOF	25.00 FT DIA 54.47 FT HT 0.050 PSIG 68.00 DEG F 0.19 IN THICK (TOP) 0.38 IN THICK (BOT'M) 77500 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	79500.00

SECT 200 COAL WASHING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							=====
DOUBLE DRUM MAGNETIC SEPARATORS, TOTAL INSTALLED COST							
(6)	ITEMS MAGNETIC SEPARATR	-					134800.00
ELECTRICAL FOR MAGNETIC SEPARATORS							
(6)	ITEMS S=0.	MOT-	5.00 HP		ENCLOSED	3600.00 RPM 120 LBS (TOTAL WT.)	0.00
DEMAGNETIZING COILS, TOTAL INSTALLED COST							
(6)	ITEMS	-					28800.00
FLOCCULATION FACILITIES, TOTAL INSTALLED COST							
							75000.00
4000 TPH AUTOMATIC SAMPLING SYSTEM INSTALLED COST							
SAMPLING SYSTEM							78300.00
MAGNITITE FEEDER		FE -201		CS	VIBRATING	14.00 FT LG 12.00 IN W 0.75 HP 1670 LBS (TOTAL WT.)	2500.00
PULVERIZER COAL FEED PIPE	CCP-201 A-E						
(5)	ITEMS	CCP-201		A 53	YARD PIPE	50.00 FT LG 24.00 IN DIA (25300.00)* 50.00 PSIG 125.00 DEG F	
BURNER FEED LINES	CCP-202 A-E						
(20)	ITEMS	CCP-202	5 ELBOWS	A 53	YARD PIPE	100.00 FT LG 10.00 IN DIA (120200.00)* 50.00 PSIG 125.00 DEG F	

SECT 200 COAL WASHING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
(5) ITEMS		VT -206	74900.00 GAL	A285C	CONE BTM	24.50 FT DIA 18.00 FT HT 0.050 PSIG 125.00 DEG F 0.25 INCHES THICK 67300 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	298500.00

COAL SILO VT-206 A-E

* FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

- OPERATIONAL UNIT DATA SUMMARY

[illegible]

SECT 300 MATERIAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
CONVEYOR #1		CO -301	210.00 TPH	CS	OPEN BELT	10.00 FT LG 24.00 IN W 5.00 HP 1750.00 RPM 210.00 FT/MIN 1 SECT'N 3350 LBS (TOTAL WT.)	9800.00
CONVEYOR #2		CO -302	210.00 TPH	CS	OPEN BELT	150.00 FT LG 24.00 IN W 7.50 HP 1750.00 RPM 210.00 FT/MIN 1 SECT'N 10500 LBS (TOTAL WT.)	27500.00
CONVEYOR #3		CO -303	69.00 TPH	CS	OPEN BELT	110.00 FT LG 18.00 IN W 3.00 HP 1750.00 RPM 300.00 FT/MIN 1 SECT'N 6950 LBS (TOTAL WT.)	14400.00
ELEVATOR #1		CO -304	69.00 TPH	CS	CENT-BKT-L	70.00 FT LONG 15.00 HP 12X7 IN BUCKET SIZE 100.00 LBS/CU FT 8530 LBS (TOTAL WT.)	10100.00
TUNNEL SUMP PUMPS (2) ITEMS \$=1200.	CP-301	A&B, MAT'L IS NEOPRENE LINED CP -301	5.00 GPM	CS	CARRON STEEL AVS-MEDIUM	10.00 FT HD 120.00 DEG F 0.50 HP 1750.00 RPM 471 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	2400.00
INERTIAL SEPARATOR-A		DC -301	1400.00 CFM	CS	CENTRF-PRE	5.00 HP 1530 LBS (TOTAL WT.)	4900.00

SECT 300 MATERIAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
INERTIAL SEPARATOR-R	DC -302	6000.00 CFM	CS	CENTRF-PRE	30.00 HP 3480 LBS (TOTAL WT.)	9600.00	
FABRIC DUST COLLECTOR	DC -303	7400.00 CFM	CS	CLOTH BAY	900 SQ FT 8.22 AIR/MEDIA RATIO 5900 LBS (TOTAL WT.)	8700.00	
LIMESTONE FEEDER #1	FE -301	210.00 TPH	CS	VIBRATING	5.00 FT LG 42.00 IN W 2.50 HP 2670 LBS (TOTAL WT.)	4300.00	
LIMESTONE FEEDERS #2 (3) ITEMS FE-302A,B&C	FE-302 A,B&C FE -302	69.00 TPH	CS	VIBRATING	5.00 FT LG 14.00 IN W 1.00 HP 1250 LBS (TOTAL WT.)	5000.00	
CAR SHAKER FE-303 TOTAL INSTALLED COST FE-303	-303					15000.00	
UNLOADING HOPPER #1	VT -301	700.00 GAL	A285C	CONE BTM	3.50 FT DIA 8.33 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 1940 LBS (TOTAL WT.)	3700.00	
HOPPERS UNDER PILE (3) ITEMS VT-302 A,B&C	VT -302	575.00 GAL	A285C	CONE BTM	7.00 FT DIA 1.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 1930 LBS (TOTAL WT.)	10800.00	

SECT 300 MATERIAL HANDLING
EQUIPMENT LIST

ITEM	NAME	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
BIN		VT -303	25500.00 GAL	A285C	CONE BTM	13.00 FT DIA 22.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 22100 LBS (TOTAL WT.)	17200.00

SECT 300 MATERIAL HANDLING - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC:STRUC NO. :SYMBOL:	DESCRIPTION	SIZE			L: FOUND	TYPE	TYPE	SERVICES		F: MATERIAL	LABOR		TOTAL
		LENGTH	WIDTH	HEIGHT				A: C	E: L		U: COST	COST	
		(FT)	(FT)	(FT)	S:				T: ME	B:	(M-\$)	(MH)	(M-\$)
BL	NONE	25	250		1:			IM	L	-	11.3	1031	22.0
PR	PIPE RACK	100	20	20	1:						6.8	894	15.9

SECT 400 FEED PREPARATION
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
	MAT'L FOR AG-401 IS NEOPRENE COATED CARBON STEEL						
	MILLS PROD TANK AGITATOR	AG -401		RURCV	DIRECT	1.00 HP 84 LBS (TOTAL WT.)	1500.00
(2)	ITEMS ELEVATOR #2 A&B	CO -401	8.60 TPH	CS	CENT-BKT-L	40.00 FT LONG 1.00 HP 6X4 IN BUCKET SIZE 100.00 LBS/CU FT 2830 LBS (TOTAL WT.)	16100.00
MILLS PRODUCT TANK PUMPS CP-401 A&B, MAT'L IS NEOPRENE LINED CARBON STEEL							
(2)	ITEMS \$=2000.	CP -401	65.00 GPM	CS	AVS-MEDIUM	58.00 FT HD 120.00 DEG F 2.00 HP 1750.00 RPM 539 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	4000.00
SLURRY FEED TANK PUMPS CP-402 A&B, MAT'L IS NEOPRENE LINED CARBON STEEL							
(2)	ITEMS \$=2000.	CP -402	65.00 GPM	CS	AVS-MEDIUM	58.00 FT HD 120.00 DEG F 2.00 HP 1750.00 RPM 539 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	4000.00
CRUSHER CR-401 A&B							
(2)	ITEMS CR-401 A&B	CR -401	8.60 TPH	CS	CONE	2 FEET	52000.00
INERTIAL SEPARATOR							
		DC -401	5500.00 CFM	CS	CENTRF-PRE	30.00 HP 3480 LBS (TOTAL WT.)	9600.00

SECT 400 FEED PREPARATION
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
FABRIC DUST COLLECTOR	DC -402	5500.00 CFM	CS	CLOTH BAY	690 SQ FT 7.97 AIR/MEDIA RATIO 5350 LBS (TOTAL WT.)	7300.00	
RIN DISCHARGE FEEDERS FE-401 A&B (2) ITEMS FE-401 A&B	FE -401	8.60 TPH	CS	VIBRATING	5.00 FT LG 12.00 IN W 0.50 HP 905 LBS (TOTAL WT.)	2900.00	
HOIST	HO -401	5.00 TONS	CS	HOIST		9900.00	
WET BALL MILL M-401 A&B (2) ITEMS M-401 A&B	M -401	200.00 TPD	CS	BALL	7X6 SIZE 200.00 HP 200 MESH PRODUCT	382000.00	
SLURRY FEED TANK AGITATOR MX-401, MAT'L IS NEOPRENE LINED CARBON STEEL SLURRY FEED TANK AGITATOR MX -401			SS	FIXED PROP	7.50 HP 1800.00 RPM 961 LBS (TOTAL WT.)	6700.00	
(2) ITEMS WEIGH FEEDER2	S -401	8.60 TPH		BELT	18.00 IN W	13300.00	
MILLS PRODUCT TANK VT-401, MAT'L IS NEOPRENE LINED CARBON STEEL MILLS PRODUCT TANK	VT -401	1320.00 GAL	3/16R	OPEN TOP	5.00 FT DIA 8.99 FT HT 250.00 DEG F 0.19 INCHES THICK 2340 LBS (TOTAL WT.)	5900.00	
SLURRY FEED TANK VT-402, MAT'L IS NEOPRENE LINED CARBON STEEL SLURRY FEED TANK	VT -402	31800.00 GAL	3/16R	CONE ROOF	14.00 FT DIA 27.62 FT HT 0.050 PSIG 68.00 DEG F 0.19 INCHES THICK 17700 LBS (TOTAL WT.)	28200.00	

SECT 400 FEED PREPARATION

- OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/	DESCRIPTION	SIZE			FOUND	ROOF	SERVICES		FIMATERIAL	LABOR		TOTAL
		LENGTH	WIDTH	HEIGHT			TYPE	TYPE		COST	COST	
NO.	SYMBOL				TYPE		SYMBOL	SYMBOL				
		(FT)	(FT)	(FT)	SI					(M-\$)	(MH)	(M-\$)
BL	PAD	75	75									
PR	PIPE RACK	150	20	20								

SECT 500 PARTICULATE SCRUBBING
E Q U I P M E N T L I S T

I T E M	N A M E	A F P . N O .	C A P A C I T Y	M A T ' L	E Q U I P M E N T I T E M T Y P E	S I Z E	P U R C H A S E D E Q U I P M E N T C O S T
=====							
SLURRY RECYCLE PUMPS CP-501 A-C, MAT'L IS NEOPRENE LINED CARBON STEEL							
(3)	ITEMS \$=21000.	CP -501	4900.00 GPM	CS	CENTRIF-M	144.00 FT HD 120.00 DEG F 400.00 HP 1800.00 RPM 5660 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	63000.00
EFFLUENT HOLD TANK AGITATOR MX-501 A&B, MAT'L IS NEOPRENE LINED CARBON STEEL							
(2)	ITEMS MX-501 A&B	MX -501		SS	FIXED PROP	5.00 HP 1800.00 RPM 774 LBS (TOTAL WT.)	11600.00
EFFLUENT HOLD TANK VT-501 A&B, MAT'L IS NEOPRENE LINED CARBON STEEL							
(2)	ITEMS VT-501 A&B	VT -501	34200.00 GAL	3/16R	CONE ROOF	13.00 FT DIA 34.45 FT HT 0.050 PSIG 68.00 DEG F 0.19 INCHES THICK 18600 LBS (TOTAL WT.)	60000.00
SCRUBBER VT-502 A&B, MAT'L IS NEOPRENE LINED CARBON STEEL							
(2)	ITEMS KO \$=446700.	VT -502	36000.00 GAL	3/16R	CYLINDER	17.50 FT DIA 20.00 FT HT 15.00 PSIG 400.00 DEG F 0.31 INCHES THICK 31000 LBS (TOTAL WT.)	893400.00
PARTICULATE SOOT BLOWERS, 15 FT LONG							
(12)	ITEMS	-501					73200.00
DIAMOND POWER							
ELECTRICAL FOR PARTICULATE SOOT BLOWERS							
\$=0.		MOT-501	90.00 HP		OPEN	3600.00 RPM 1260 LBS (TOTAL WT.)	0.00

SECT 500 PARTICULATE SCRUBBING
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
PIPING FOR SOOT BLOWERS	CCP-501		106 ELBOWS	A 106	YARD PIPE	800.00 FT LG 150.00 PSIG	2.00 IN DIA 300.00 DEG F (12800.00)*

*
FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SECT 500 PARTICULATE SCRUBBER - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/STRUC NO.	BLDG/STRUC SYMBOL	DESCRIPTION	SIZE			FOUND	ROOF	SERVICES		FIMATERIAL	LABOR	TOTAL
			LENGTH	WIDTH	HEIGHT			TYPE	TYPE			
			(FT)	(FT)	(FT)							
BL	IPAD		150	100								
PR		PIPE RACK	150	30	20							

SECT. 600 SO2 SCRUBBING
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	SIZE	PURCHASED EQUIPMENT COST
=====							
SO2 ABSORBER RECYCLE SLURRY PUMPS CP-601 A-E, MAT'L IS NEOPRENE LINED CS							
(5) ITEMS \$=30000.	CP -601	11500.00 GPM	CS	CENTRIF-M	75.00 FT HD 450.00 HP 7510 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	120.00 DEG F 1800.00 RPM	150000.00
(2) ITEMS MAKE UP WTR PMP CP -602		855.00 GPM	CS	TURBINE	150.00 FT HD 40.00 HP 1190 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	120.00 DEG F 1750.00 RPM	6500.00
(2) ITEMS I.D. FANS	FN -601	441000.0 ACFM	CS	CENTRIF	4000.00 HP		600000.00
BYPASS FAN	FN -602	441000.0 ACFM	CS	CENTRIF	2500.00 HP		240000.00
ABSORBER EFFLUENT HOLD TANK MIXERS MX-601 A&B, MAT'L IS NEOPRENE COATED CS							
(2) ITEMS	MX -601		SS	FIXED PROP	75.00 HP 4600 LBS (TOTAL WT.)	1800.00 RPM	53800.00
SO2 ABSORBER TW-601 A&B, MAT'L IS NEOPRENE LINED CARBON STEEL							
(2) ITEMS SO2 ABSORBERS	TW -601		A 515	PACKED	30.00 FT DIA 15.00 PSIG 2.0PPR PACKING TYPE 30.00 FT PACKING HT 0.63 INCHES THICK 253000 LBS (TOTAL WT. LESS PACKING) INCLUDES FIELD ERECTION BY VENDOR	41.00 FT HT 400.00 DEG F	1216000.00

* REVISED

SECT 600 SO2 SCRUBBING
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====							
LINING FOR SO2 ABSORBER							
(2)	ITEMS LIN FOR TW-601	LIN-601	5300.00 SQ FT	3/16R			95200.00
ABSORBER EFFLUENT HOLD TANK VT-601 A&B, MAT'L IS NEOPRENE LINED CARBON STEEL							
(2)	ITEMS VT-601 A&B	VT -601	320000.0 GAL	3/16R OPEN TOP	46.00 FT DIA	25.74 FT HT 250.00 DEG F	220000.00
					0.19 INCHES THICK		
					53300 LBS (TOTAL WT.)		
					INCLUDES FIELD		
					ERECTION BY		
					VENDOR		
ABSORBER SOOT BLOWERS, 15 FEET LONG							
(20)	ITEMS SOOT BLOWERZ	-601					122000.00
DIAMOND POWER							
ELECTRICAL FOR ABSORBER SOOT BLOWERS MOT-601							
(20)	ITEMS \$=0.	MOT-601	3.00 HP	ENCLOSED	3600.00 RPM		0.00
					93 LBS (TOTAL WT.)		
PIPING FOR SOOT BLOWERS CCP-501							
				A 106 YARD PIPE	800.00 FT LG	2.00 IN DIA	(9300.00)*
					150.00 PSIG	300.00 DEG F	
DUCT SIMULATION							
							(2000000.00)*

*

FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

* REVISED

SECT 600 502 SCRUBBING

- OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC/ NO. SYMBOL	DESCRIPTION	SIZE			L E S	L I S	SERVICES		F I M A T E R I A L C O S T	LABOR		TOTAL COST
		LENGTH	WIDTH	HEIGHT			FOUND	ROOF				
		(FT)	(FT)	(FT)						(M-)	(M-)	(M-)
BL	PAD	130	100							25.4	3781	62.6
PR	PIPE RACK	300	20	20						18.8	2371	43.0

SECT 700 SOLIDS DISPOSAL
E Q U I P M E N T L I S T

I T E M	N A M E	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
CONVEYOR-A		CO -701	14.50 TPH	CS	OPEN BELT	40.00 FT LG 12.00 IN W 1.00 HP 1750.00 RPM 280.00 FT/MIN 1 SECT'N 2990 LBS (TOTAL WT.)	6400.00
CONVEYOR-B		CO -702	14.50 TPH	CS	OPEN BELT	70.00 FT LG 12.00 IN W 1.00 HP 1750.00 RPM 280.00 FT/MIN 1 SECT'N 3950 LBS (TOTAL WT.)	8200.00
THICKENER FEED PUMP CP-701 A&B, MATERIAL IS NEOPRENE LINED CARBON STEEL							
\$=2200.		CP -701	500.00 GPM	CS	AVS-MEDIUM	65.00 FT HD 120.00 DEG F 15.00 HP 1750.00 RPM 884 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	2200.00
(2) ITEMS OVRFL RETN PUMP CP -702 400.00 GPM CS AVS-MEDIUM							
						50.00 FT HD 120.00 DEG F 7.50 HP 1750.00 RPM 690 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	4300.00
UNDERFLOW PUMPS CP-703 A,B&C, MATERIAL IS NEOPRENE LINED CARBON STEEL							
(3) ITEMS \$=1950.		CP -703	150.00 GPM	CS	AVS-MEDIUM	75.00 FT HD 120.00 DEG F 5.00 HP 1750.00 RPM 652 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	5900.00
FILTRATE RECYCLE PUMPS CP-704 A&B							

SECT 700 SOLIDS DISPOSAL
EQUIPMENT LIST

ITEM	NAME	APP. NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
(2) ITEMS	CP-704 ARR	CP -704	150.00 GPM	CS	AVS-MEDIUM	100.00 FT HD 120.00 DEG F 5.00 HP 1750.00 RPM 700 LBS (TOTAL WT.) INCLUDES MOTOR DRIVER	4400.00
VACUUM FILTERS (2) ITEMS	F -701			CS	ROTY-DRUM	470.00 SQ FT 7.50 HP 1800.00 RPM 23400 LBS (TOTAL WT.)	122600.00
THICKENER FEED TANK AGITATOR	MX-701, MAT'L IS NEOPRENE	MX -701		SS	COATED CARBON STEEL FIXED PROP	5.00 HP 1800.00 RPM 774 LBS (TOTAL WT.)	5800.00
THICKENER (2) ITEMS	T -701		764000.0 TPD	CS	SINGLE	7853.98 SQ FT 10.00 HP 0.080 RPM 100.00 FT DIA 13.00 FT HT 152000 LBS (TOTAL WT.) INCLUDES FIELD ERECTION BY VENDOR	616000.00
LINING FOR THICKENER (2) ITEMS LIN FOR T-701	LIN-701		13000.00 SQ FT	3/16R			228000.00
THICKENER FEED TANK THICKENER FEED TANK	VT-701, MAT'L IS NEOPRENE LINED CARBON STEEL VT -701		42000.00 GAL	3/16R	OPEN TOP	15.50 FT DIA 29.76 FT HT 250.00 DEG F 0.19 INCHES THICK 16600 LBS (TOTAL WT.)	30800.00

SECT 700 SOLIDS DISPOSAL
EQUIPMENT LIST

ITEM NAME	APP.NO.	CAPACITY	MAT'L EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
OVER FLOW TANK	VT -702	1320.00 GAL	A285C OPEN TOP	5.00 FT DIA 8.99 FT HT 68.00 DEG F 0.19 INCHES THICK 2340 LBS (TOTAL WT.)	3800.00
RECEIVER (2) ITEMS	VT -703	650.00 GAL	A235C OPEN TOP	4.00 FT DIA 6.92 FT HT 68.00 DEG F 0.19 INCHES THICK 1650 LBS (TOTAL WT.)	6800.00
CAKE SILO-TOP	VT -704	110000.0 GAL	A285C CONE BTM	18.00 FT DIA 50.00 FT HT 0.050 PSIG 68.00 DEG F 0.25 INCHES THICK 62900 LBS (TOTAL WT.)	42600.00
CAKE SILO-BOTTOM	VT -705	69.00 CU FT	A285C LIVE BTM	3.00 FT DIA 8.87 FT HT 1.00 HP 68.00 DEG F 1900 LBS (TOTAL WT.)	7000.00
VACUUM PUMPS (2) ITEMS	VP -701	2620.00 CFM	CS WATER-SEAL	100.00 HP 1800.00 RPM 10500 LBS (TOTAL WT.)	58300.00

SECT 700 SOLIDS DISPOSAL

- OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

BLDG/BLDG/ STRUC/STRUC/ NO. SYMBOL	DESCRIPTION	SIZE			L V E L S	FOUND TYPE SYMBOL	ROOF TYPE SYMBOL	SERVICES		MATERIAL COST	LABOR		TOTAL COST
		LENGTH	WIDTH	HEIGHT				A L H P F	U		COST		
		(FT)	(FT)	(FT)				E A U R N					
										(M-\$)	(MH)	(M-\$)	(M-\$)
BL	PAD	180	80					M	-	22.9	3701	36.3	59.1
PR	PIPE RACK	200	20	20	1					12.8	1641	16.7	29.5
1	CLOSED SECT 700 BUILDING	80	80	40	2	PIERS	FLAT	M	-	154.0	21459	237.2	508.6

SEC 800 AUXILIARY & PIPING
E Q U I P M E N T L I S T

I T E M	N A M E	APP.NO.	CAPACITY	MAT'L	EQUIPMENT ITEM TYPE	S I Z E	PURCHASED EQUIPMENT COST
=====	=====	=====	=====	=====	=====	=====	=====
STEAM DISTRIBUTION	CCP-801	20 ELBOWS	A 53	YARD PIPE	1500.00 FT LG 650.00 PSIG	3.00 IN DIA 650.00 DEG F	(24200.00)*
INSTRUMENT AIR LINE	CCP-802	20 ELBOWS	A 53	YARD PIPE	1300.00 FT LG 100.00 PSIG	3.00 IN DIA 100.00 DEG F	(21500.00)*
PLANT AIR LINE	CCP-803	10 ELBOWS	A 106	YARD PIPE	1000.00 FT LG 100.00 PSIG	2.00 IN DIA 100.00 DEG F	(12000.00)*
PROCESS WATER LINE	CCP-804	15 ELBOWS	A 53	YARD PIPE	1500.00 FT LG 50.00 PSIG	6.00 IN DIA 100.00 DEG F	(45600.00)*
FIRE WATER LOOP	CCP-805	20 ELBOWS	A 53	YARD PIPE	2400.00 FT LG 100.00 PSIG	12.00 IN DIA 100.00 DEG F	(122000.00)*
(2) ITEMS PROCESS TIE-IN	CCP-806	20 ELBOWS	A 106	YARD PIPE	1000.00 FT LG 200.00 PSIG	2.00 IN DIA 100.00 DEG F	(24500.00)*
(4) ITEMS PROCESS TIE-IN	CCP-807	20 ELBOWS	A 53	YARD PIPE	1000.00 FT LG 200.00 PSIG	4.00 IN DIA 100.00 DEG F	(86000.00)*
(3) ITEMS PROCESS TIE-IN	CCP-808	20 ELBOWS	A 53	YARD PIPE	800.00 FT LG 200.00 PSIG	10.00 IN DIA 100.00 DEG F	(124800.00)*

* FIELD FABRICATED ITEM. COST INCLUDED IN PROPER DIRECT MATERIAL AND LABOR ACCOUNTS.

SEC 800 AUXILIARY & PIPING - OPERATIONAL UNIT DATA SUMMARY

BUILDING / STRUCTURE DATA SHEET

		S I Z E			SERVICES		MATERIAL		L A B O R		TOTAL	
BLDG/	BLDG/	D E S C R I P T I O N			FOUND	ROOF	A L H P F	U	COST		COST	
STRUC	STRUC	LENGTH WIDTH HEIGHT			V	TYPE	TYPE	A	C + E L	R		
NO.	SYMBOL				E	SYMBOL	SYMBOL	E	A U R	N		
		(FT)	(FT)	(FT)	S			B	(M-\$)	(MH)	(M-\$)	(M-\$)
BL	NONE	100	450						61.0	5651	58.4	119.3
PR	PIPE RACK	1300	30	20					84.1	10177	103.9	188.0
1	CONTRL	GENERAL SERVICE BUILDING	40	100	10	NORMAL	FLAT	M H H M M V	64.4	11998	133.7	257.6

Appendix H

Capital Cost Estimate
Site Development

S I T E D E V E L O P M E N T

S I T E D E V E L O P M E N T R E P O R T

D E S C R I P T I O N	S I T E D E V E L O P M E N T S Y M B O L	M A T E R I A L C O S T (\$)	D I R E C T L A B O R M A N H O U R S	D I R E C T L A B O R C O S T (\$)	T O T A L (S U B C O N T R A C T) C O S T (\$)
=====	=====	=====	=====	=====	=====
CATCH BASINS	BASINS	16119.00	1286	9874.00	25993.00
PIPE DRAINAGE	DRAINS	51538.00	3967	43614.00	95152.00
SUMP PITS	SUMP-PIT	54.00	18	139.00	193.00
SEPTIC TANKS	SEPTIC-TNK	18276.00	73	801.00	19077.00
DIKE	DIKE	1605.00	160	1336.00	2941.00
SLOPE PROTECTION	GUNIT	7456.00	263	2267.00	9723.00
TRENCHING	TRENCHING	0.0	4400	44336.00	44336.00
BACKFILL	BACKFILL	0.0	436	3148.00	3148.00
FENCING	CHAIN-LINK	87724.00	1905	14456.00	102180.00
FENCE GATES	GATES	3065.00	381	2891.00	5956.00
SIDEWALKS	SIDEWALKS	731.00	102	784.00	1515.00
ROAD	ASPHALT	152969.00	17316	144054.00	297023.00
PARKING	ASPHALT	169965.00	28860	240091.00	410056.00
AREA PAVING	ASPHALT	20396.00	3463	28811.00	49207.00
SIDING	SIDING	121793.00	6349	49313.00	171106.00
TURNOUTS	TURNOUT	21200.00	1981	15386.00	36586.00
BUMPERS	BUMPER	5848.00	229	1775.00	7623.00
CROSSING	CROSSING	8827.00	235	1825.00	10652.00
RAIL	TURNOUT	21200.00	1981	15386.00	36586.00
RAIL SIDING	SIDING	121793.00	6349	49313.00	171106.00
RAIL	BUMPER	5848.00	229	1775.00	7623.00
RAIL	CROSSING	8443.00	205	1594.00	10037.00
TEMPORARY DOCK	BACKFILL	0.0	57	415.00	415.00
TEMPORARY DOCK	CONC-PAVNG	25099.00	2699	24015.00	49114.00
TEMPORARY DOCK	ASPHALT	6462.00	1353	11258.00	17720.00

[illegible]

NOTE: ABOVE COSTS EXCLUDE RENTED CONSTRUCTION EQUIPMENT.
SEE CONSTRUCTION OVERHEAD REPORT.

Appendix I

Bibliography

1. McGlamery, G.G. et al, Detailed Cost Estimates for Advanced Effluent Desulfurization Processes, EPA-600/2-75-006 January 1975
2. McGlamery, G.G. et al, "Flue Gas Desulfurization Economics" in Proceedings, Symposium on Flue Gas Desulfurization, EPA-600/2-76-136a May 1976
3. Corman, J.C. et al, Energy Conversion Alternatives Study (ECAS) General Electric Phase II Final Report. Volume II- Advanced Energy Conversion Systems, Parts 1 and 2; NASA-CR 134949, Volume II, Parts 1 and 2, SRD-76-064-2
4. Brown, Dale H., op. cit., Supplemental Volume - Conceptual Design and Implementation Assessment of a Utility Steam Plant with Conventional Furnace and Wet Lime Stack Gas Scrubbers, NASA-CR-134950, SRD-76-064-4 December 1976
5. Bucy, J.I. et al, Potential Abatement Production and Marketing of Byproduct Sulfuric Acid in the U.S., EPA-600/7-78-070 April 1978
6. Duvel, W.A., Jr. et al, State-of-the-Art of FGD Sludge Fixation, EPRI FP-671, Research Project 786-1, January 1978
7. Barrier, J.W. et al, Economics of Disposal of Lime/Limestone Scrubbing Wastes: Untreated and Chemically Treated Wastes, EPA-600/7-78-023a February 1978