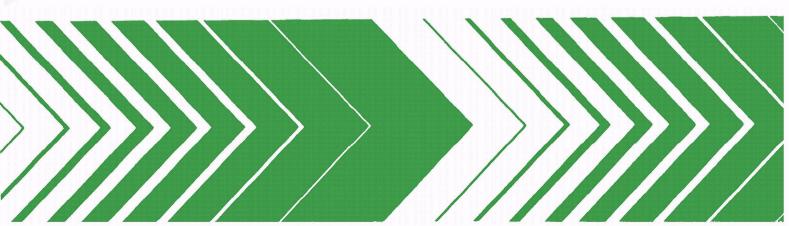
United States Environmental Protection Agency Industrial Environmental Research Laboratory Research Triangle Park NC 27711 EPA-600/2-79-185 August 1979

Research and Development



Cost Effectiveness Model for Pollution Control at Coking Facilities



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Cost Effectiveness Model for Pollution Control at Coking Facilities

by

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Contract No. 68-02-2603, Task No. 44 and Contract No. 68-02-3074, Task No. 6 Program Element No. 1AB604

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Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY Office of Research and Development Washington, DC 20460

DISCLAIMER

This report is furnished to the Environmental Protection Agency by PEDCo Environmental, Inc., Cincinnati, Ohio, in fulfillment of EPA Contract No. 68-02-2603, Task No. 44 and EPA contract No. 68-02-3074, Task 6. It describes the initial development and use of a cost optimization model for control of emissions from coke ovens. The cost model has been developed so that it will accommodate new information that becomes available on control cost, control systems, and emission levels. The data presented in this report and now used in the model are considered to be the best currently available. Because some areas of knowledge are continually developing, however, some engineering estimates are used to facilitate the development and refinement of the model.

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Mr. William Kemner served as Project Director, and Dr. Terrance Briggs as Project Manager. Ms. Beth Fairbairn and Mr. Steve Tomes of PEDCo did the computer programming and Mr. Gary Saunders conducted much of the data development effort.

SECTION 1

INTRODUCTION

The characterization and control of coke oven emissions have been of intense interest and study for some 10 years. Originally, focus was directed primarily toward visible emissions because most coke oven emissions are fugitive in nature. additional data became available on the complex chemical structure and health effects of both the particulate and gaseous emissions, however, attention shifted to the organic components contained therein. Because the environmental control of the coke oven process and its associated operations requires the evaluation of numerous options and because technology and new information are continually developing, the Environmental Protection Agency (EPA) contracted PEDCo Environmental, Inc., to develop a computer model that could calculate the cost and emission levels for any combination of controls. Even more important, the model should be able to calculate the lowest-cost mix of controls for the various sources to meet a given overall level of emissions. The model should also answer the reverse problem by calculating the lowest overall emission level that can be attained at a given total cost. The model may be used to optimize, i.e., minimize, either annualized cost or total capital costs.

Intended to be an engineering tool for evaluating various control strategies on a continuing basis, the model is designed to operate on the EPA computer at the National Computer Center in Research Triangle Park, North Carolina. It accommodates data on four key pollutants: particulate matter (defined herein as front-half--Method 5), benzene soluble organics (BSO), benzo-apyrene (BaP), and benzene. The model includes the coke oven

battery, the coal storage and preparation steps, the quenching and coke screening operations, and the byproduct plant. It addresses both conventional batteries and preheated coal batteries. Various studies are under way to characterize the emissions from the byproduct operations, but the model now contains very limited information regarding this source.

The model utilizes three distinct types of data, referred to as "datasets." Each dataset can be updated and manipulated separately. Dataset 1 covers the uncontrolled emission rates for each pollutant, Dataset 2, capital and annualized costs and the control efficiency of various controls, and Dataset 3, the population of the coke oven batteries (e.g., battery height, capacity, and number of ovens).

Although a precise definition of the coke oven population was not a prime objective of this project, the definition provided by Dataset 3 is sufficiently comprehensive to be representative of both the metallurgical and foundry coke segments of the industry.

The model includes an auxiliary computer program that can update costs to account for such factors as inflation, changing utility rates, and changing labor costs.

The reader of this report is assumed to have a relatively comprehensive knowledge of coking operations and the concomitant emission problems and control schemes. The references at the end of this section are recommended reading for those who desire such background material.

REFERENCES FOR SECTION 1

- 1. Draft of Standards Support and Environmental Impact State-ment, Volume I: Proposed National Emission Standards By-product Coke Oven Wet-coal Charging and Topside Leaks. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina. June 1978.
- 2. Arthur D. Little, Inc. Steel and the Environment. A Cost Impact Analysis. May 1975.
- 3. Kemner, W., et al. Control of Emissions from Dry Coal Charging at Coke Batteries. Prepared for U.S. EPA under Contract 68-02-2603, Task 28, January 1979.
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- 5. Barnes, T.M., H.W. Lownie, Jr., and J. Varga. Summary Report on Control of Coke Oven Emissions to the American Iron and Steel Institute. Batelle Columbus Laboratories. December 31, 1973.

SECTION 2

MODEL STRUCTURE

As shown in Figure 1, the coke model has four essential elements:

- 1. The data management element reads the required information, determines the mode of operation, and translates the input data into the proper format for the optimization element.
- 2. The optimization element calculates the lowest cost for achieving a given level of emissions or the lowest level of emissions that can be achieved at a given cost. Note that optimization is on one pollutant at a time; however, the results for other pollutants are calculated in each case.
- 3. The deterministic mode element calculates specific cases without regard to optimization, e.g., the total cost to industry for putting ESP's on all coke oven stacks.
- 4. The print element prints the output reports in the desired format.

It will be noted that the optimization model is built around the standard 80-column punched card. Although this approach is somewhat outdated by today's computer technology standards, it offers certain advantages at this stage of model development. The main advantage is that the user can actually keep the data cards in his posession and keep track of the data as they are changed. The entire system can later be converted to real time operation from a remote terminal.

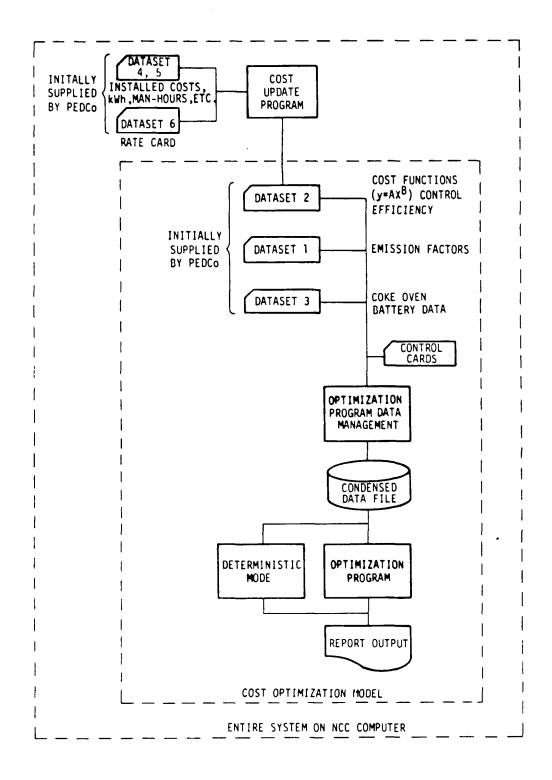


Figure 1. Schematic diagram of overall computing scheme.

2.1 DATA REQUIREMENTS

Emission Factors (Dataset 1)

Fourteen air emission sources and four pollutants are presently considered. A total of 64 uncontrolled emission factors are required because two sources have alternate factors. The emission factors used are shown in Table 1. It should be noted that data for coke oven emissions are very sparse for most sources and the factors shown in Table 1 represent only a starting point used for the purpose of proceeding with model development. The reliability of many of the factors is very low and is discussed more fully in Section 3. The term "uncontrolled" is not easily defined in the case of coke ovens, but for purposes of this project, it represents the conditions existing at the majority of batteries in the late 1960's. Although this definition still leaves much room for judgment, it eliminates totally uncontrolled conditions that could prevail if a coking process were operated with no concern whatever for emissions.

Because estimates of many of the emission factors have been based on limited data, provision has been made for easy updating to accommodate future refinements by use of the card format shown in Figure 2. The 16 cards (i.e., 14 sources, 2 with alternate factors) representing the emission factors comprise Dataset 1 input to the model (Figure 1). These emission factor cards also contain the space to write the name for the source for convenient identification. (The alphabetic names for new sources and control options that appear on the computer output must be entered into the computer using cards identified in the users' manual.) The derivation of emission factors is discussed in detail in Section 3.

Cost Functions (Dataset 2)

All cost functions are expressed as $Y = AX^B$, where Y is annualized cost in dollars and X is tons of coke capacity. Total capital cost is also provided as a function $Y = AX^B$. Capital and

TABLE 1. SUMMARY OF UNCONTROLLED EMISSION FACTORS (1b/ton of coal)

(See Section 3 for discussion of each factor)

Source			Polluta	int	
code No.	Emission source	TSPª	B S0	BaP	Benzene
1	Larry car charge (wet coal)	1.0 ^b	1.15	0.002 ^c	0.5
2	Coke pushing ^e	2.0 ^f	0.08 ^f	4×10 ^{-5 f}	0.006 ^f
3	Quench, clean water	1.7 ^{f,g}	1.7x10 ^{-3b}	1.4x10 ^{-4b}	3x10 ^{-5 c}
4	Doors	0.46	0.5 ^b	0.003 ^b	0.02 ^b
5	Topside leaks	0.2 ^d	0.25 d	0.001 d	0.005 ^d
6	Combustion stack (old) ^h	1.3 ^d	0.006 ^d	6x10 ^{-5 d}	0 ^d
7	Coke handling	1.0 ^d	Od	0 d	od
' ક	Coal preheat	7.05 ^b	1.05 ^b	3.9x10 ^{-4 c}	0.014 ^c
9	Coal preparation	υ.5 ^d	o ^d	o ^d	o ^d
10	Coal storage	0.15 ^d	0 d	0 d	Od
13	Pipeline charge (dry coal)	0.016 ^d	0.019 ^d	3.5x10 ^{-5 d}	0.008 ^d
12	Redler conveyor (dry coal)	0.010 d	0.006 d	1.1x10 ⁻⁵ d	0.0049 d
13	Hot larry car (dry coal)	0.017 ^d	0.019 ^d	3.5x10 ^{-5 d}	0.008 ^d
14	Byproduct	o ^c	0.3 ^c	o ^c	0.2 ^c
15 -	Combustion stack (new) h	0.13 ^d	6x10 ^{-4 d}	6x10 ^{-6 d}	o d
16	Quench, dirty water	3.2 ^{f,g}	6.4x10 ^{-3b}	3.1x10 ^{-4b}	2.6×10 ⁻⁴

^a All TSP values derived from the front half of Method 5 or an equivalent method.

 $^{^{\}mbox{\scriptsize b}}$ One or more tests conducted, moderate confidence in accuracy.

^C Test data available but inconclusive, low confidence in accuracy.

^d No test data available. Emission factor calculated from other sources, very low confidence in accuracy.

 $^{^{\}mathbf{e}}$ For dry coal charging, lower values may be appropriate (see text).

 $^{^{}m f}$ Several tests conducted, good correlation between data, good confidence in numerical accuracy.

 $^{^{9}}$ Two cases are considered: "clean" water and "dirty" water. Existing data are used to select the appropriate emission factor.

h Emissions depend on the maintenance history and age of the battery. The term "new" designates a well maintained battery with effective patching and maintenance programs. The term "old" designates the opposite. The population is subdivided on the assumption that batteries under 15 years old are new and over 15 years old are old. This approach is questionable, but in the absence of site-specific data, it is a starting point. Sensitivity analysis can be used to investigate the significance of various assumptions.

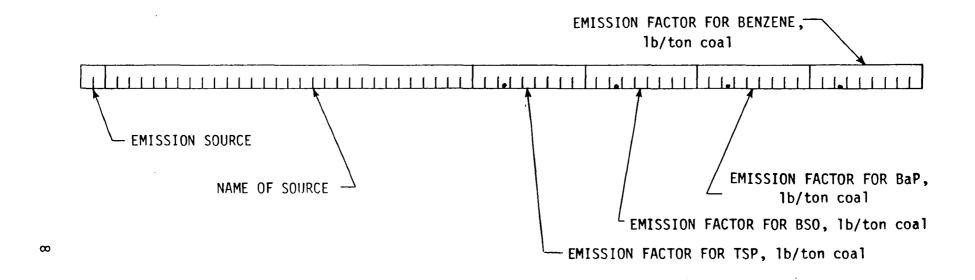


Figure 2. Card format for emission factors--Dataset 1.

annualized cost functions are provided for both new and retrofit installations.

The cost function matrix has the following dimensions:

Sources - Maximum of 20 (16 presently assigned)

Alternative control options--A maximum of nine per source, including uncontrolled

Table 2 lists the control options by source. The efficiencies shown are initial estimates only and are subject to The model provides for up to eight total control options for each source, but only a total of 41 are considered at this time. Although control efficiency is discrete in some cases and continuous in others, discrete levels have been used in the model for simplification. The total control option matrix capability is therefore 20 x 9, which produces a potential maximum of 180 "A" values and 180 "B" values for annualized and capital cost for both new and retrofit installations. Figure 3 shows the card format for A and B values. These cards are introduced as Dataset 2 (see Figure 1). As new control options are added or existing ones modified, the appropriate cost functions are added to Dataset 2. Most of the cost functions now in the model were calculated by PEDCo, using a separate computer program that is not part of the optimization model for coking facilities. calculation of costs is discussed in detail in Sections 4 and 5.

Coke Oven Battery Data (Dataset 3)

This dataset contains the coke capacity, physical size, and existing control equipment information for each individual battery. It is described more fully in Section 6.

Cost Update Program

The cost update program is separate from the optimization model. Its purpose is to enable the user to recalculate annualized and capital costs by using different utility rates, labor rates, and overhead factors and accounting for inflation.

TABLE 2. CONTROL OPTIONS BY SOURCE

		Control		7	TSP,			BSO, iciency		% off	RaP, iciency			Benzene, fficienc	·	
Source No.	Source	No.a	Control option				capture		total	capture	removal	total				Remarks
01	Larry car charging	01 02	Uncontrolled Modified car, steam, boot	80.0	NA	0.0 80.0	80.0	NA	0.0 80.0	80.0	NA	0.0 80.0	80.0	NA	0.0	
		03	New car, steam, boot	99.0	NA	99.0										
		04	Retrofit second main + option 03	99.5	NA	99.5										
02	Coke pushing	01 02	Uncontrolled Controlled coking	60.0	NA	0.0 60.0	19.0 h avg. coking time vs. 17.5 h base. Not appl. for									
		03	Shed + ESP 95%	90.0	95.0	85.5	90.0	50.0	45.0	90.0	50.0	45.0	90.0	50.0	45.0	foundry batteries Shed options include 90% capture of one- half of door
		04	Shed + scrubber		95.0	85.5	90.0	55.0	49.5	90.0	55.0	49.5	90.0	55.0	49.5	emissions
		05 06 07	95% - 30 in.AF Enclosed car Shed + ESP 99% Shed + scrubber 99% - 50 in.AF	90.0 90.0 90.0	98.0 99.0 99.0	88.2 89.1 89.1	90.0 90.0 90.0	60.0 50.0 60.0	54.0 45.0 54.0	90.0 90.0 90.0	40.0 50.0 60.0	36.0 45.0 54.0	90.0 90.0 90.0	60.0 50.0 60.0	54.0 45.0 54.0	
03	Quenching clean water	01 02 03	Uncontrolled Baffles Diverted flow baffles	100.0	70.0 90.0	0.0 70.0 90.0	100.0 100.0	70.0 90.0	0.0 70.0 90.0	100.0	70.0 90.0	0.0 70.0 90.0	100.0 100.0	0.0 0.0	0.0 0.0 0.0	
		04	Dry quenching	100.0	98.0	98.0	100.0	99.0	99.0	100.0	99.0	99.0	100.0	99.0	99.0	Includes option 5 on source 2
04	Doors	01 02	Uncontrolled Cleaning and maintenance	60.0	NA.	0.0	60.0	NA	0.0	60.0	NA.	0.0 60.0	60.0	NA	0.0 60.0	
		03	High pressure	80.0	NA	80.0	Includes door									
		04	Door hood and scrubber - 30 in. AP +	75.0	95.0	88.5	75.0	60.0	78.0	75.0	60.0	78.0	75.0	50.0	65.0	Option 6 is same as 4 but 1 side only
		05	02 Door hood + scrubber - 60 in. AP + 02	85.0	98.0	93.3	85.0	70.0	83.8	85.0	70.0	83.8	85.0	60.0	72.0	Option 7 is same as 5 but 1 side only
05	Topside	01 02	Uncontrolled Luting and	90.0	NA	0.0 90.0	90.0	NA	0.0	90.0	NA.	0.0 90.0	90.0	NA	0.0 90.0	Not applicable to pipeline
		03	cleaning Luting and	95.0	NA	95.0	95.0	NA	95.0	95.0	NA	95.0	95.0	NA.	95.0	batteries that
		04	maintenance New lids and castings + 02	97.0	NA	97.0	separately									

NA - Not applicable.

TABLE 2 (continued)

Source		Control option	i	\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \	TSP, efficienc	: y	% eff	BSO, iciency		% eff	BaP, iciency			enzene, ficienc	y	
No.	Source	No.a	Control option	capture	removal	total	capture	removal	total			total	capture			Remarks
06	Combustion stack -old	01 02 03 04 05	Uncontrolled Oven patching Dry ESP 90% Dry ESP 98% Baghouse 98%	100.0 100.0 100.0 100.0	90.0 98.0	0.0 80.0 90.0 98.0 98.0	100.0 100.0 100.0 100.0	80.0 50.0 60.0 50.0	0.0 80.0 50.0 60.0 50.0	100.0 100.0 100.0 100.0	80.0 50.0 60.0 50.0	0.0 80.0 50.0 60.0 50.0	100.0 100.0 100.0 100.0	80.0 50.0 60.0 50.0	0.0 80.0 50.0 60.0 50.0	
07	Coke handling	01 02	Uncontrolled Enclosures + baghouse 997	90.0	99.0	0.0 89.1	NA.	NA	0.0 NA	NA NA	NA NA	0.0 NA	NA	NA	0.0 NA	
80	Coal preheater	01 02 03 04 05	Uncontrolled Scrubber-15 in. Dry ESP 95% Scrubber-30 in. Dry ESP 99%	100.0 100.0 100.0 100.0	95.0 98.0	0.0 95.0 95.0 98.0 99.0	100.0 100.0 100.0 100.0	60.0 45.0 60.0 50.0	0.0 60.0 45.0 60.0 50.0	100.0 100.0 100.0 100.0	60.0 45.0 60.0 50.0	0.0 60.0 45.0 60.0 50.0	100.0 100.0 100.0 100.0	50.0 45.0 50.0 50.0	0.0 50.0 45.0 50.0 50.0	
09	Coal preparation	01 02	Uncontrolled Enclosure and baghouse-99%	98.0	99.0	0.0 97.0	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	
10	Coal storage yard	01 02 03	Uncontrolled Water truck Unload sprays & water truck	0.0 60.0 75.0	NA NA NA	0.0 60.0 75.0	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	
		04	Coal pile sprays	90.0	NA NA	90.0	NA	NA	NA	NA	NA	NA	NA NA	NA NA	NA	
11	Pipeline charg- ing	01 02	Uncontrolled Operation and maintenance	90.0	NA	0.0 99.0	99.0	NA	0.0 99.0	99.0	NA NA	0.0 99.0	99.0	NA	0.0 99.0	
12	Redler charging	01 02	Uncontrolled Operation and maintenance	99.0	NA.	0.0 99.0	99.0	NA	0.0 99.0	99.0	NA.	0.0 99.0	99.0	NA.	0.0 99.0	
13	Hot larry car charging	01 02	Uncontrolled Operation and maintenance	99.0	NA	0.0 99.0	99.0	NA	0.0 99.0	99.0	NA	0.0 99.0	99.0	NA	0.0 99.0	
14	Byproduct plant	01 02	Uncontrolled Maintenance	NA	NA.	0.0 NA	80.0	NA.	0.0	80.0	NA.	0.0 80.0	80.0	NA.	0.0	
15	Combustion stack -new	01 02	Uncontrolled Oven patching	80.0	NA NA	0.0 80.0	80.0	NA	0.0 80.0	80.0	NA.	0.0 80.0	80.0	NA.	0.0	
16	Quenching - dirty water	01 02 03 04	Uncontrolled Baffles Clean water + 02 Diverted flow baffles +	100.0 100.0 100.0	85.0	0.0 70.0 85.0 95.0	100.0 100.0 100.0	35.0 75.0 85.0	0.0 35.0 75.0 85.0	100.0 100.0 100.0	80.0	0.0 35.0 80.0 85.0	100.0 100.0 100.0	0.0 75.0 75.0	0.0 0.0 75.0 75.0	
		05	clean water Dry quenching ^c	NA	99.0	99.0	NA	99.0	99.0	NA	99.0	99.0	NA	99.0	99.0	Includes options on Source 2.

These code numbers are also used to indicate existing control in columns 21-60 of the load card for data set 3 shown in Figure 4.

b Options 6 and 7 are used by the model when a shed is selected to avoid double accounting for capture of coke-side door emissions.

C The cost for this option in this case also includes the cost of water treatment for the water that otherwise would be used for quenching.

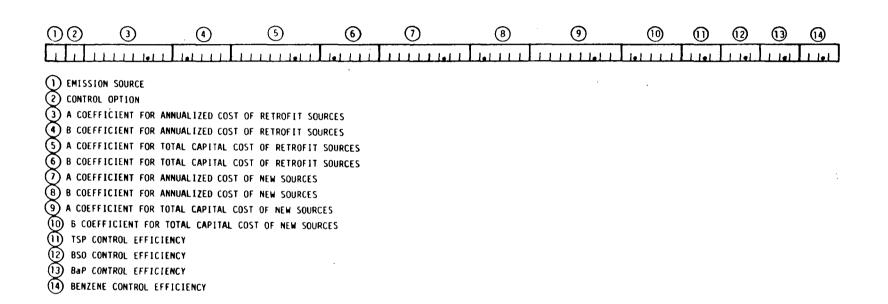


Figure 3. Card format for cost function coefficients and efficiency.

The input to the cost update program consists of the capital cost and utility and labor requirements for three sizes of batteries (or plants as applicable). A rate card contains the various rates and factors that can vary. The program will extend rates, calculate overhead expenses and capital recovery, and finally, calculate regression equations for capital and annualized cost as a function of capacity, according to equations of the form:

$$Y = AX^B$$

This program is run only if new rates are needed. Figure 4 shows the card formats for the Datasets 4, 5, and 6 which are the input data to the cost update program. Appendix B contains an example run of the cost update program. The output cards of the cost update program represent the input cost function cards for the optimization model.

2.2 CONTROL CARDS

The model has three basic modes of operation:

- 1. Deterministic
- 2. Optimized cost, fixed emissions
- 3. Optimized emissions, fixed cost

The control cards serve as the interface between the user's "questions" and the model structure.

Mode 1 is the most straightforward. Its objective is to calculate the cost of a given strategy without regard to optimization. A control efficiency and a control option are specified for each source (or for one source). Figure 5 shows the output. The only reason the quenching and combustion stack sources appear twice is because two different uncontrolled emission factors are used for each in the model as described earlier. The costs and emissions for these sources are additive. Figure 6 shows the formats of the control cards. (Not all columns of the Number 1 card are necessary for Mode 1.)

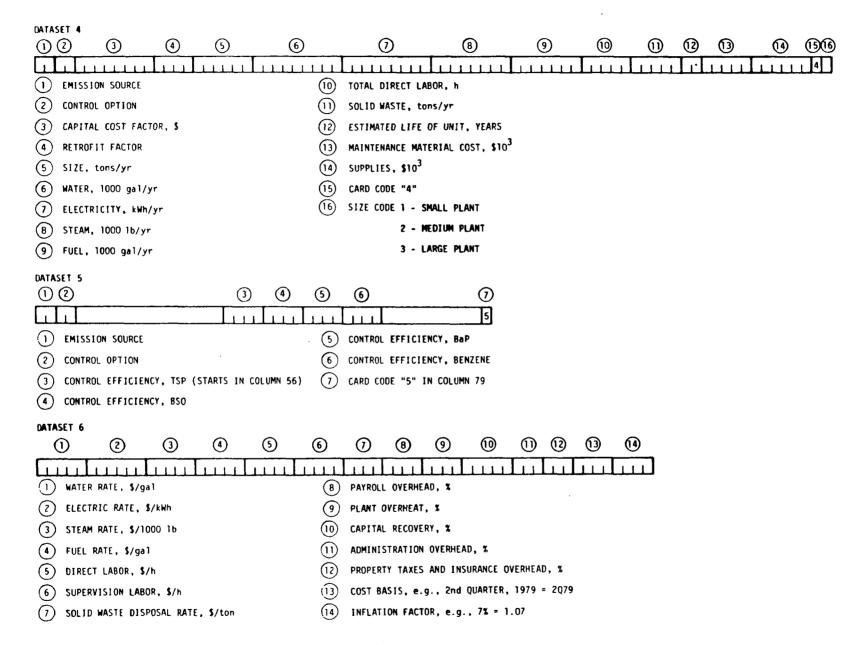


Figure 4. Card formats for Datasets 4, 5, and 6.

COKE OVEN OPTIMIZATION

B NOT IN OPTIMIZATION

OBJECTIVE COST CALCULATION, NO OPTIMIZATION 75.1 % OVERALL EFFICIENCY POLLUTANT: BAP BASE YEAR 1979 BASELINE: COST ADJUSTED FOR EXISTING CONTROLS

		(LBS/T	CONTRO ON COAL		MISSION	S (TONS/	rear)			CONTROLLED COST (MILLION BOLLARS)		
SOURCE	TSP	BSO	BAP	BEN	TSP	BSO	BAP	BEN	CONTROL SCHEME	CAPITAL	ANNUALIZED	
LARRY CAR CHARGING	.01	.0110	.0000	.0050	496	545	0	248	NEW CAR, STEAM, BOOT	303.6	164.7	
COKE PUSHING	02.00	.0800	.0000	.0060	109463	4378	2	328	UNCONTROLLED	.0	.0	
QUENCHING - CLEAN WATER	81.70	.0017	.0001	.0000	41049	41	3	0	UNCONTROLLED	.0	.0	
DOORS	# .16	.2000	.0012	.0080	8757	10946	65	437	CLEANING & MAINT.	.0	173.8	
TOPSIDE	.02	.0250	.0001	.0005	1094	1368	5	27	LUTING & CLEANING	.0	57.2	
COMBUSTION STACK - OLD	#1.30	.0060	.0001	.0000	48840	225	2	0	UNCONTROLLED	.0	.0	
COKE HANDLING	01.00	.0000	.0000	.0000	54731	0	0	0	UNCONTROLLED	.0	.0	
COAL PREHEATER	87.05	1.0500	.0004	.0140	35925	5350	1	71	UNCONTROLLEB	.0	.0	
COAL PREPARATION	● .50	.0000	.0000	.0000	27365	0	0	0	UNCONTROLLED	.0	.0	
COAL STORAGE YARD	W .15	.0000	.0000	.0000	8209	0	0	0	UNCONTROLLED	.0	.0	
PIPELINE CHARGING	.02	.0190	.0000	.0080	49	59	0	24	UNCONTROLLED	.0	.0	
REDLER CHARGING	.01	.0060	.0000	.0049	13	7	0	6	UNCONTROLLED	.0	.0	
MOT LARRY CAR CHARGING	● .02	.0190	.0000	.0080	10	12	0	5	UNCONTROLLED	.0	.0	
BY-PRODUCTS PLANT	.00	.0600	.0000	.0400	0	3283	0	2189	MAINTENANCE	.0	17.4	
COMBUSTION STACK - NEW	■ .13	.0006	.0000	.0000	2231	10	0	0	UNCONTROLLED	.0	.0	
QUENCHING - DIRTY WATER	● .48	.0016	.0001	.0001	14680	48	1	1	CLEAN WATER & BAFFLES	278.1	168.1	
TOTAL UNC.	0 1	2.235	.006	181	508238	122149	337	37577				
EXISTING CONTROL	7.3	2.233	.006	.000	388402		254	17656		297.5	197.1	
EXISTING EFFICIENCY					23.6	37.7	24.6	53.0		277.3	177.1	
DASELINE CONTROL					508237		337	37577		.0	.0	
BASELINE EFFICIENCY					.0	.0	.0	.0		. •	. •	
TOTAL CONTROLLED					352920	26278	B4	3341		581.7	581.2	
PERCENT CONTROLLED					30.6		75.1	91.1		301.7	301.2	
TENDENT CONTROLLED					30.0	70.5	, , , , ,	,				
EXISTI		TOTAL	UILNE 1	2221	,	TOTAL BA		NEW S 0	TOTAL OVENS O			
TOTAL BATTERIES	216	IGINE	DVENS 1	2221	,	UINC BE	CK1E	3 V	IDINE UVENJ V			
TOTAL CAPACITY	109494	267 TO	NS COAL		1	TOTAL CA	PACITY		O TONS COAL			
	76623	1000 TO	NS COKE						O TONS COKE			

Figure 5. Sample output report of coke oven optimization model.

4 MODE: 1=DETERMINISTIC; B BASE YEAR OF DATA

2=MINIMUM ANNUALIZED COST, RESTRICT EMISSIONS
3=MINIMUM EMISSIONS, RESTRICT ANNUALIZED COST
4=MINIMUM CAPITAL COST, RESTRICT EMISSIONS
5=MINIMUM EMISSIONS, RESTRICT CAPITAL COST

CONTROL CARD 2



1) THROUGH (20) FIXED CONTROL OPTION FOR EMISSION SOURCES 1 THROUGH 20

CONTROL CARD 3



- 1 BASELINE CODE
- (2) THROUGH (21) BASELINE CONTROL OPTION FOR SOURCES 1 THROUGH 20 RESPECTIVELY

Figure 6. Format for the control cards.

In Mode 2, the optimization routine is called into use. The user first specifies the sources that are to be fixed at a control level (i.e., as in Mode 1); the remaining sources will be optimized. A total control level expressed as percent efficiency for a given pollutant is specified and the lowest cost (either capital or annualized) combination that will meet that level is calculated. If some sources are specified to be uncontrolled and not included in the optimization, the user must take these emissions into account by lowering the total control efficiency. Otherwise, an infeasible solution can result because the remaining controlled sources may not meet the total allowable level. The output is similar to that in Figure 5. A symbol (#) appears by each source that was fixed, and these do not enter into the optimization.

In both modes the number two control card can be used to set a control level for any given source equal to uncontrolled, in which case the cost is zero. In effect, this enables certain sources to be removed from the optimization analysis.

The base year specified on Control Card 1 is merely a reference date to be printed on the output report. If, for example, the run is a projection for 1985 and projected new batteries have been added to the battery data base, the base year will be 1985. Presently, no new batteries are included in the battery data base and the base year is 1979.

Mode 3 is the opposite of Mode 2. A cost limitation (either capital or annualized) is entered, and the optimization program determines the lowest emission rate for the specified pollutant. It is probably necessary to run Mode 1 and Mode 2 before running Mode 3 to have some idea of what constitutes a reasonable total cost.

The comments portion of the printout will contain messages indicating unreasonable conditions, input errors, or solutions beyond the bounds of the program. For example, if the emission restriction (Mode 2) cannot be achieved by the control systems

available to the program, the printout will give a message to that effect.

Control Card 3 controls the baseline used for most calculations. The baseline codes are as follows:

Code	Baseline
1	Uncontrolled; i.e., all costs are calculated with no regard to existing controls or existing State Implementation Plan (SIP) requirements.
2	Existing control; costs are adjusted by not counting the cost of controls already installed.
3	SIP; i.e., costs are adjusted by not counting the cost of controls required by SIP whether they are actually installed or not. No account is taken for existing controls which exceed SIP requirements.
4	Average SIP; this option is the same as Option 3, but for convenience of data preparation only one SIP definition is used and applied to every plant; whereas as in Option 3 the specific SIP must be entered on each battery card depending on the state in which the battery is located.
5	This is a combination of 2 and 3. The costs are adjusted by not counting the cost of controls already installed or the cost of controls required by SIP whichever is greater.
6	Average SIP and existing; this option is the same as Option 5 but only one SIP definition is used and applied to every plant.

Note that no entries are required beyond field one for the baseline Options 1 and 2 because no distinction is made between sources in these options. For baseline Options 3 and 5, the control option codes corresponding to SIP must be entered on the coke oven battery data cards rather than using Control Card 3.

Currently the model does not attempt to account for costs of tear-out. If, for example, the optimum alternative differs from that already installed in a given plant, no tear-out costs are included. Nor does the model address incremental costs for moving

from one control scheme to a higher-cost scheme. If, for example, existing control is a shed and scrubber and the optimum alternative is a shed and ESP, the full cost of the optimum alternative is included rather than just the cost of the ESP.

In Figure 5, line 1 displays the total weighted uncontrolled emissions expressed in lbs/ton of coal and total tons. Lines 2 and 3 display the total tons of emissions and percent efficiency respectively for existing controls. Lines 4 and 5 display the total tons of emissions and percent efficiency respectively for the baseline controls which are in the optimum solution. Lines 6 and 7 display the total tons of emissions and percent efficiency for the optimum solution. The costs shown on line 2 represent the value of existing controls. The costs shown on line 4 represent the cost of the controls contained in the optimum solution which are already installed or assumed to be installed as designated by the baseline.

The costs shown on line 6 represent the cost of the controls in the optimum solution which exceed the baseline control level. The sum of these two lines therefore represents the total value of the controls in the solution.

SECTION 3

EMISSION FACTORS

For the 16 emission sources identified, emission factors were developed for each of the four pollutants: particulates, BSO, BaP, and benzene. To the extent possible, results from emission tests were used to establish these emission factors. When explicit data were unavailable, an attempt was made to derive an emission rate from other available information and assumptions. If an emission factor could not be developed by either of these approaches, an engineering estimate was made as accurately as possible. All the matrix numbers had to be provided (even if estimated) so that initial runs of the model could be completed. As new data become available, the values in the matrix (Table 1) can be updated to reflect more accurately the nature of emissions from byproduct coke ovens. If estimates have a broad confidence range, model runs can be made for various values to examine sensitivity.

Data were obtained from PEDCo's files, EPA reports, articles in various journals, and emission test reports. A literature search provided considerable information on coke oven emission sources and methods of reducing emissions; however, little actual test data or emission factors were available in comparison with the total number of potential emission sources. When actual numerical values were reported, they were used. The level of precision used in reported results was retained herein, but this does not imply that the value is precise when used as a general emission factor for all batteries. This is not surprising because it is difficult to sample these emission sources, most of which are fugitive in nature. Nevertheless, the literature did

provide considerable information on control techniques and what could be expected from them.

Because most emissions from the 16 sources are fugitive in nature, they do not lend themselves readily to Method 5 sampling techniques. Two commonly used techniques are single-point sampling with a Method 5 sampling train and sampling a fugitive plume with a High-Vol sampler. Sampling is sometimes attempted at isokinetic conditions, even though it often is difficult to achieve. Generally sample results are merely corrected to reflect isokinetic sampling. These methodologies appear to yield as reliable data as can be expected.

Using test data to develop emission factors requires several assumptions. The first is that the results of the test are representative of the emissions found at the entire battery (e.g., charging emissions do not differ significantly from one oven to another if the same sampling procedures are followed). In the case of door emission tests, one notable exception would be if test results were obtained on only one door; the fact that the one door tested was leaking does not indicate that all the doors leak. Another exception would be the sampling results from a single green push; one push does not necessarily represent all the coke pushes of that battery.

The second assumption is that the emissions from the battery tested are representative of the industry as a whole. Although it would be ideal to have test results from various plants for confirmation, it must be assumed that the values from the test used are the best currently available and are representative of battery emissions within the entire industry.

Several problems are unresolved. One is the matter of equivalency of two different sampling methodologies. Although some difference can be expected between the results of the Method 5 train and the Hi-Vol method (depending on the parameters of the emission stream sampled), they are similar enough to be considered equivalent methods. Another problem is the definition of TSP. Generally, a reference to a particulate catch means the

front half of a Method 5 train (or its equivalent). Total suspended particulate (or TSP), however, implies both the front half and back half of a Method 5 train particulate catch (or the equivalent). Because the definition of particulate matter is generally a function of temperature, emission factors derived on the basis of a front-half catch and those derived from both a front- and back-half catch would differ significantly. definition would tend to affect the predicted control efficiencies, particularly when discussing TSP. It is likely that many of the control devices on the optional control systems would not "see" the particulate captured in the back half of the sampling train because it would be gaseous in form as it passed through the control device and would condense some time later. another problem concerns the different methods used to test the various organic species to determine emission rates. Nevertheless, the variability between samples appears to have a greater effect than the differences in sensitivities and biases of the analytical methods because the different analytical methods are believed to yield essentially the same results.

The nature and magnitude of the biases on test results for each of the identified emission sources are discussed. Also discussed are the specific assumptions and references used to arrive at each emission factor. The general assumptions and comments just covered apply to nearly all the emission sources. For ease in predicting control efficiencies, particulate emission factors are given either as the front-half or equivalent value.

3.1 SOURCE 1--LARRY CAR CHARGING (WET COAL)

Particulates

A baseline of emissions must be established when referring to larry car charging. For the purposes of discussion, "uncontrolled" is assumed to mean that a minimal amount of control is applied during charging and minimal effort is expended to reduce emissions from wet coal charging. (This generally reflects the situation in the industry about 10 years ago.) On this premise, an uncontrolled emission factor of 1 lb particulate/ton of coal charged has been estimated by EPA in the draft Standard Support and Environmental Impact Statement (SSEIS) for charging. It is not known whether this number represents what could be expected to be captured by the total Method 5 train or just the front-half particulate catch. If this factor represents only the front half, actual total uncontrolled particulate is likely to be 1.96 lb/ton coal because it is assumed that the ratio of particles collected in the front half and back half of a train are about equal. This was the case in the testing of an experimental larry car during a joint project between the American Iron and Steel Institute (AISI) and the EPA. The back half proved to be approximately 0.96 of the mass of the front half.

The results of four tests revealed a controlled emission rate of 0.017 lb/ton coal (front half) for stage charging. It should be noted that these four tests were conducted anisokinetically, then corrected to reflect isokinetic conditions. A total particulate factor, calculated on the basis of the front-half catch, is 0.033 lb/ton coal. 2,3

A standard Wilputte larry car tested as part of the AISI/EPA program was found to have an emission level of 0.14 lb/ton coal (front-half, 10-test average) when tested by the same method as the experimental larry car. The test values could be in error as much as an order of magnitude, but less error is expected because of the sample size of ten. These latter tests were used as a guide in assigning a control efficiency for conventional stage charging.

Benzene Soluble Organics

The AISI/EPA particulate test revealed that BSO comprised 57 percent of the front-half catch and 60 percent of the back-half, and it can generally be assumed that BSO comprises 55 to 60 percent of the total particulate catch without significant

chance of error. 1,2,4 With the use of the BSO/particulate ratios above, the calculated emission factors from the AISI/EPA test are as follows:

Uncontrolled 1.1 lb/ton coal
AISI/EPA larry car 0.019 lb/ton coal

Benzo-a-Pyrene

A significant variation in the levels of BaP was detected in the samples tested. Although the number of samples tested was not statistically large enough to derive a highly reliable emission factor, the AISI samples in which BaP was observed indicated an "average" of 2 x 10⁻⁵ lb/ton coal.^{1,2} An emission factor for BaP of 0.002 lb/ton coal has been calculated on the basis of ambient data and the ratio of BaP and BSO.^{1,4,5} This latter value is considered more reliable because of the large sample size and is used in the model.

Benzene

No explicit data on the magnitude of benzene emissions were found in the references noted above; however, an emission factor was calculated on the basis of the results of two tests of cokeside shed emissions and a test on coke-oven door emissions. 6-9

These tests indicate that benzene emissions are equivalent to 25 to 50 percent of the front-half particulate emission rate. (This is not to say benzene is captured in the front-half.) Assuming an emission rate for benzene equivalent to 50 percent of the front-half catch, the following emission factors are calculated:

Uncontrolled 0.5 lb/ton coal

AISI/EPA larry car 0.008 lb/ton coal
These rates are highly variable for door emissions, however, and
using these estimates to derive an emission factor for charging
emissions provides a low-confidence estimate.

3.2 SOURCE 2--COKE PUSHING OPERATIONS

Particulates

Several data sources were available to use in the calculation of an emission factor for coke pushing operations. 6,7,8,10,11 The magnitude of pushing emissions varies, depending on test methodology and "greenness" of the push. The sources used were a report on tests using Hi-Vol samplers suspended in the plume and one on sampling isokinetically. 12-14 Results from tests using a Method 5 sampling train or sampling the stack of a cokeside shed appeared somewhat low and biased (a certain amount of dilution could bias the results on the low side). The two coke pushing operations tested were in close agreement. One of the batteries used an enclosed push car with hooding to capture the particulate. 13-15 The enclosed car was controlled by a scrubber; and a standard Method 5 sampling train was used to sample the scrubber inlet and outlet. A Hi-Vol sampler was placed above the hood to capture the fugitive emissions. The total emission rate of particulate was estimated by combining the results of the Hi-Vol sampler and the scrubber inlet.

The emission rate from pushes that were moderately green averaged approximately 2.0 lb particulate/ton coal. Because little condensible matter was found in proportion to the particulate captured (i.e., back-half vs. front-half), a separate emission factor for a front-half and back-half TSP need not be calculated. For clean pushes an emission factor of 0.7 lb particulate/ton coal appears appropriate.

The significance of the clean push emission factor involves two separate items. First, the use of dry coal charging appears to provide uniform coking while reducing coking time. When running this optimization model it may be appropriate for the coke pushing emission factor to be selected on the basis of whether wet coal or dry coal methods are employed. Second, an often discussed alternative or control option is to increase the average coking time and establish some minimum coking time before

pushing takes place. Such an option might reduce emissions in cases where battery operators otherwise would cut short the coking time, but indications are that the greenness of the push is more closely related to the oven characteristics and heating integrity than to coking time. ¹² Although further study is needed, it is conceivable that some ovens in need of maintenance could not thoroughly "coke-out" the coal charge regardless of coking time. The greenness of the push after some specified minimum coking time might therefore be used as an indicator that an oven needs maintenance.

Benzene Soluble Organics

An emission factor for BSO as condensibles in the coke pushing operations was based on a test of the hooded coke car used in the Ford/Koppers demonstration project. 13,14 The emission rate was determined to be 0.08 lb BSO/ton coal for pushes that were moderately green, and a BSO emission factor of 0.03 lb BSO/ton coal was determined for clean pushes. These rates are based on the assumption that most of the condensible material captured is BSO. Although tests of coke-side sheds indicate that the amount of BSO generated is somewhat higher than these rates, it is believed that other factors (such as door leaks) biased the results. 4,6,7,8 Results of another test for coke pushing emissions, which will be available in several months, may confirm the stated emission factors.

Benzo-a-Pyrene

Emissions of BaP were detected by sampling with cyclohexane and analyzing by GC/MS. An emission rate of 4×10^{-5} lb BaP/ton coal was established. It should be noted that the emissions of BaP were not reduced by passage through the venturi scrubber used at the plant, even though the emission level is very low. Although door leaks tend to interfere with the results, tests of the coke-side shed confirm the relatively low level of emissions. 4,6,7,8

Benzene

The tests of the Ford/Koppers scrubber-controlled quench car showed a small amount of benzene released during coke pushing operations. The average of six tests was 0.008 lb ${\rm C_6H_6/ton}$ coal (actually benzene and homologues). The actual rate of benzene only is expected to be in the range of 0.006 to 0.008 lb/ton coal. For clean pushes, benzene emissions could be as low as 0.0005 lb/ton, but they are expected to average 0.001 lb/ton coal. These factors are based on tests of the Ford/Koppers system. 13,14

3.3 SOURCE 3--QUENCH TOWERS WITH CLEAN H₂O; SOURCE 16--WITHOUT CLEAN H₂O

Particulates

Considerable data have become available on the magnitude and nature of coke quench tower emissions. 17-21 Besides the interest in the various types of control options, considerable interest has developed in quenching with clean versus dirty water. Emission factors for quenching with both clean and dirty water are discussed.

The development of an emission factor for particulate from quench towers is based primarily on the work of Edlund et al., 18,19 and on a data comparison from a recent report by Midwest Research Institute (MRI). The results of the various tests vary widely; however, a data comparison was made primarily between Method 5 tests and Hi-Vol sampling techniques. It is difficult to maintain isokinetic sampling rates in the gas stream because the moisture content varies widely, but isokinetic sampling may be maintained "over the average." The difference in quench tower designs and other variables make it difficult to quantify the bias. Uncontrolled emissions from quench towers refer to the use of natural draft towers without baffles or other control devices to capture the emissions from wet quenching. The following particulate emission factors (to be used in the model) are based

on Edlund et al.: 18,19 1.7 lb particulate/ton coal (clean $^{\rm H}_2{}^{\rm O}$) 3.2 lb particulate/ton coal (dirty H₂O). These numbers are slightly higher than the averages from MRI, but they are well documented and fall well within the range of variation observed for the various tests. There appears to be no direct correlation between particulate emissions from quenching and the greenness of a push.

Benzene Soluble Organics

Many of the tests performed were also for the purpose of quantifying emissions of organic materials. Again, variations were similar to those observed for particulate emissions. example, some test results from "clean" water quenches showed higher emission rates than results from "dirty" water quenches. 20 The emission factors shown below, however, are based on recent test 17,21 results from a quench tower where the concentration of BSO in the gas stream was found to be about 1000 times less than the concentration of particulate matter during clean water quenches. Furthermore, dirty water quenches showed a concentration of BSO four times higher than that found in clean water quenches. 17,21 Based on these ratios, the emission factors for BSO to be used in the model are:

1.7 x 10^{-3} lb BSO/ton coal (clean $\mathrm{H}_2\mathrm{O}$) 6.4 x 10^{-3} lb BSO/ton coal (dirty $\mathrm{H}_2\mathrm{O}$)

Benzo-a-Pyrene

Several tests made of the emissions of BaP showed some variations, but the absolute variation was small. The appearance of these variations may be due to the low levels of BaP present, which approach the detection limits of the sampling methodology. On the other hand, the data appeared to be consistent with the particulate data because dirty water quenches had about twice the level of pollutant emission as clean water quenches. 17,21 following emission factors were indicated:

1.4 x 10^{-4} lb BaP/ton coal (clean H_2O)
3.1 x 10^{-4} lb BaP/ton coal (dirty H_2O)

Emissions of BaP, which are not found in every sample, appear to be related somewhat to the greenness of the push.

Benzene

Data are limited regarding benzene emissions. Only two grab samples are available, and the data do not explicitly indicate whether these samples were taken during clean or dirty water quenches. Although the reliability of these values is extremely poor, they are used with the assumption that a higher level of benzene will be found in dirty water quenches:

 3×10^{-5} lb/ton coal (clean H_2O) 2.6 $\times 10^{-4}$ lb/ton coal (dirty H_2O)

3.4 SOURCE 4--DOOR EMISSIONS

Particulates

Considerable data are available on emissions from doors during the coking cycle. 6-10,22,23 It can normally be assumed that any door emissions that occur will be greatest during and immediately after oven charging. 5,9 One test indicated that most emissions occur within the first 8 hours of the coking cycle. a discussion of door emissions, it is difficult to define "uncontrolled" emissions. Two methods might be used to determine uncontrolled emissions. First, uncontrolled door emissions may be defined as emissions occurring because of failure to clean the oven doors thoroughly after each cycle. Such failure results in improperly sealed doors. Uncontrolled emissions might also result from failure to immediately remove damaged and warped doors from service for repairs at the end of a cycle. A second definition of uncontrolled emissions might be based on the number of doors leaking (e.g., no more than 40%). Thus, "uncontrolled" is not necessarily a measure of effort, but rather of results. A series of two tests were performed using an enclosure hood around the door and a Hi-Vol sampler. An emission rate of 0.025 to 0.04 lb/ton coal can be calculated from these data, 9 but this value

seems low in view of available data from tests of coke-side sheds and door emission sheds with prototype gas cleaning equipment. 23 These latter data produced an uncontrolled emission factor of 0.4 lb/ton coal, which will be used in the model. This factor is based on the assumption that emissions from both sides of the battery are essentially the same and that approximately 40 percent of the doors leak when "uncontrolled."

Benzene Soluble Organics

A considerable portion of the door emissions is BSO; the BSO may actually exceed the front-half particulate emissions. The data from most of the tests indicate a factor of 0.25 lb BSO/ton coal may be appropriate for emissions from the doors on one side of a battery. This value is supported both by tests on a single door and by tests of continuous background emissions in a coke-side shed. The values obtained from the shed are more significant in that they consider the average of all leaks from one side of the battery. Again, it is assumed that the emission rates from both sides of the battery are equal, resulting in a total emission rate of 0.5 lb BSO/ton coal.

Benzo-a-Pyrene

Based on most of the data available from stack tests and comments from EPA, an BaP emission factor of 0.003 lb BaP/ton coal appears appropriate, although some data indicate a lower level of emissions is possible. $^{1,4,6-9}$ If 40 percent of the coke battery doors are leaking, it is believed that the emissions from doors would be equal to or greater than that for "uncontrolled" larry car charging.

Benzene

Emissions of benzene can represent a significant portion of the condensible particulate matter during the initial portion of the coking cycle, but these emissions appear to decrease rapidly over the first 2 to 3 hours. Averaged over the entire coking cycle and from several ovens, benzene emissions appear large at first, then decrease considerably in magnitude. ⁹ The results from both an individual door test and tests of a coke-side shed indicate an emission factor of 0.01 lb C_6H_6 /ton coal for one side of the battery. ⁶⁻⁹ For both sides (assuming both emit equally) the emission factor is 0.02 lb C_6H_6 /ton coal.

3.5 SOURCE 5--TOPSIDE LEAKS

Although no test data are available for reliable quantification of topside emissions, it is likely that they are similar in composition to door emissions. It is also likely that such emissions are less than half those from door leaks. 1,4 The rationale for this assumption is that the area through which topside emissions may escape is roughly half that of the doors, oven pressure is generally lower, and the emissions are more easily controlled (e.g., by luting or replacement of warped lids). Emissions occur primarily from charging lids and standpipe caps. 1,4 The following emission factors will be used for the model:

Particulate 0.2 lb/ton coal
BSO 0.25 lb/ton coal
BaP 0.001 lb/ton coal
Benzene 0.005 lb/ton coal

These uncontrolled emission factors are based on the assumption that a minimal amount of manpower is devoted to topside maintenance.

3.6 SOURCE 6--OLD COMBUSTION STACK; SOURCE 15--NEW COMBUSTION STACK

Particulates

Although data are available for calculating emission factors for combustion stacks, they are currently considered confidential and cannot be used in this study. Enough information was provided to estimate the level of emissions, however. When use of the data is permitted, they should be incorporated into the matrix of emission factors.

An average particulate emission factor for all combustion stacks is estimated to be 0.7 lb/ton coal. The range of values is wide, however, with old battery stacks showing higher emissions because of oven cracks and subsequent leakage into the flues. Nevertheless, the values are expected to be well within the range of 1.3 lb/ton coal for the old stack and 0.13 lb/ton coal for the new stack. The values are known to be about an order of magnitude apart.

Benzene Soluble Organics

Emissions of BSO are expected to be small from combustion stacks: 0.006 lb/ton coal from old stacks, and 0.0006 lb/ton coal from new stacks.

Benzo-a-Pyrene, Benzene

Emissions of BaP range from 6×10^{-5} lb/ton coal from old stacks to 6×10^{-6} lb/ton coal from new stacks. Very little benzene is believed to be emitted because it is probably combusted. Therefore, benzene emissions are considered to be zero.

3.7 SOURCE 7--COKE HANDLING

Particulates

No explicit data were found on which to quantify emissions from coke handling, but it is assumed that the coke is cooled sufficiently to prevent hydrocarbon emissions. Further, it is expected that larger particulate matter from sizing and screening operations would contribute greatly to the total particulate mass. Therefore, an emission factor of 1.0 lb/ton coal has been estimated. This value is twice that found for coal preparation.

3.8 SOURCE 8--COAL PREHEAT

Particulates

Data from several tests of coal preheating systems are used to indicate the level of emissions to be expected from the preheater. 25,26 More data are needed to improve the data base and should be added as they become available.

The particulate emission factor is based on the results of two series of emissions tests in which production rates and drying temperatures varied. Particulate emissions appear to relate primarily to the rate of coal drying, and there is a slight correlation between emissions and gas temperatures. An average uncontrolled emission rate was developed over six test runs with the various production/temperature combinations and was determined to be 7.05 lb particulate/ton coal. The relationship between production rate and emissions/ton coal appears to be inversely proportional. "Uncontrolled emissions" refers to the use of no control device after initial separation of the preheated coal from the gas stream.

Benzene Soluble Organics

The level of organic emissions (taken as BSO) was also tested during the particulate tests and average emissions were determined to be 1.05 lb/ton coal for six tests. More recent data indicate a slightly higher emission rate, but this factor will be used until more information becomes available. Although not enough data are available to define accurately the relationship between gas temperature and the rate of organic emissions, the emission rate appears to increase exponentially with higher production rates. Organic emissions also appear to increase with gas temperature.

Benzo-a-Pyrene

Recent data on BaP emissions indicate that emissions from the preheater scrubber outlet are approximately 2.0 x $10^{-4}\ 1b$

BaP/ton coal. 26 Based on an assumed scrubber efficiency of 50 percent for BaP, the uncontrolled emission rate would be 3.9 x 10^{-4} lb BaP/ton coal. Although the absolute variation of the emission rates tends to be small, the percentage variation is quite high.

Benzene

Data concerning benzene emissions are confusing at best. 26 Recent data indicate benzene emissions to be higher at the scrubber outlet than at the inlet, which would indicate a "negative" efficiency for benzene scrubbing, but no other source for benzene has been found that would clarify this. The outlet values will be used to determine an emission factor for the model. These values should be considered of low reliability, however, until the results are explained. One possible explanation is that the data sets might be reversed. Because insufficient data were provided to calculate a benzene emission factor directly, the known ratio between benzene and BSO had to be used. Based on the ratio between benzene and BSO hydrocarbons from this test (factor = 0.0130 x BSO), benzene emissions are estimated to be 0.014 lb $C_6H_6/\text{ton coal}$.

3.9 SOURCE 9--COAL PREPARATION

Particulates

Coal preparation is generally defined as the crushing, screening, and sizing of coal prior to charging of the ovens. Included are the emissions from handling and material transfer points. Coal dust is the predominant particulate emission. Normally no hydrocarbons are emitted because insufficient heat is supplied to cause any carbonization of the coal. It is assumed that the coal has been washed and separated from the burden material at the coal mine prior to its transport to the coke battery. Two sources indicate that with minimal controls (i.e.

hooding, water sprays), the expected particulate level is approximately 0.5 lb particulate/ton coal. This includes all transfer and crushing points. 27,28 Uncontrolled emissions have the potential to be as high as 10 lb particulate/ton coal.

3.10 SOURCE 10--COAL STORAGE

Particulates

The only pollutant of concern from this source is particulate because it is assumed that the other pollutants either do not occur or are below detectable levels. The amount of particulate emissions from coal storage piles is usually a function of the size and shape of the storage pile, the wind speed, and the amount of material movement on the pile. 29 Thus a site-specific value would need to be assigned for the storage pile at each plant. PEDCo has performed several surveys on emissions from storage piles. 29,30 Based on the assumption that the storage pile will be relatively inactive and that wind erosion is the primary cause of fugitive emissions, the emission factor would be 0.10 to 0.15 lb/ton coal. If loading onto the storage pile, traffic around the pile, and loadout of material are considered, the emission factor would be in the range of 0.4 to 0.5 lb/ton coal. The former value will be used in the model. If the total activity on or around the piles is applicable, the higher value can be used.

3.11 SOURCE 11--PIPELINE CHARGING (PREHEATED DRY COAL)

Particulates

Theoretically, emissions from pipeline charging could be near zero. In most cases, however, theoretical and actual values differ significantly at the batteries observed to date. In most pipeline charging operations, both operation and maintenance practices and engineering design factors have contributed to the level of emissions that have been observed. 16

No formal tests have been made of emissions caused by pipeline charging. The charging hole lids and standpipe elbow covers are the major emission points. (Door leaks can also be a significant source of pollutants; these are discussed under Source 4.) The emission factors presented below are arrived at by relating a mass/time emission factor to visible emissions, using a mass/time constant of 0.0015 lb particulate/second of observed emissions. This factor is based on observation of the AISI/EPA larry car emissions. 2,3,16 Based on this factor, an average of approximately 0.55 lb/charge was observed at the "worst case" battery. It is assumed here that the characteristics of charging emissions are the same as those observed for the AISI/EPA larry car charg-If the quantity of coal charged to the oven is assumed to be equivalent to 35 tons of wet coal, the emission factor is calculated to be 0.016 lb/ton coal. 16 This value would be equivalent to that captured by the front half of a Method 5 sampling train. A total particulate emission factor of 0.031 lb/ton coal can be developed for a front and back half if it is assumed that characteristics are the same as those for the emissions of the AISI/EPA larry car charging. The assumptions used for calculating emission factors for dry coal charging are broad, and the results derived must be considered tenuous. The computations show that emission factors for pipeline charging and the AISI/EPA larry car charging are comparable. Informal observations also show that pushes from batteries using dry coal tend to be cleaner (i.e., the coal is more completely "coked") than those from batteries using wet coal. This factor has not been quantified in the model.

Benzene Soluble Organics

If it is assumed that emission characteristics are similar for BSO from both wet and dry coal charging and that BSO comprises 60 percent of the total particulate emissions, the calculated emission factor would be 0.019 lb BSO/ton coal. The assumed value of 60 percent is slightly higher than that observed

at the AISI/EPA test; however, the preheated coal may produce more volatile organic compounds during charging because of its higher temperature.

Benzo-a-Pyrene

Because both the emission factors and the assumed emission characteristics are similar to those of the AISI/EPA larry car, the BaP/BSO ratio for wet coal charging is used to derive an emission factor of 3.5×10^{-5} lb BaP/ton coal.

Benzene

For similar reasons, the benzene emission factor to be used in the model is 0.008 lb $C_6H_6/{\rm ton}$ coal.

3.12 SOURCE 12--REDLER CONVEYOR (PREHEATED COAL) CHARGING

No formal emission tests have been performed on the Redler conveyor system. An emission factor has been developed, however, on the basis of several visible emission observations. Based on seconds of observed emissions, the emission factor is estimated to be 0.35 lb/ton charge. Assuming an equivalent 35 tons of wet coal/charge, the emission factor is 0.01 lb/ton coal. 16

Particulate emissions were observed primarily from the charging ports and from the conveyor/chute junction. Emissions from the charging ports are not expected to differ significantly from those produced by the AISI/EPA larry car. ¹⁶ Emissions from the conveyor/chute junction, however, appear to be mostly relatively large coal particles which could increase the weight of total particulate emissions. ¹⁶ These emissions should not increase the emission factor above 0.03 lb/ton coal.

An emission factor based on total particulate emissions (front- and back-half) is expected to range from 0.0148 to 0.0168 lb/ton coal, primarily because of condensible emissions from the charging ports. (This is assuming that $\sim 1/2$ of the total emissions are from the charging ports, that the back-half emissions

would be 96 percent of the mass of the front-half, and that the total of any other emission sources is added.)

Benzene Soluble Organics

Emissions of BSO are expected to be less than those from pipeline and larry-car charging because the ratio of BSO to total front-half and back-half particulate is lower. The change in this ratio is due to the relative short periods of visible emissions that have been observed from the charging ports where the BSO is assumed to originate. Charging port emissions represent 0.0098 lb/ton (estimated) of particulate; if 60 percent of the particulate fraction is assumed to be due to BSO, emissions are calculated to be 0.006 lb BSO/ton coal.

Benzo-a-Pyrene

Because of the small quantity of BSO emitted, emissions of BaP are expected to be less than half that expected for the worst case for wet-coal larry car charging, or 0.0005 lb BaP/ton coal; and they could average as low as 1.1×10^{-5} lb BaP/ton coal. The latter value will be used in the model because it is believed to be more representative of actual emissions.

Benzene

Emissions of benzene are difficult to quantify. Based on the assumption that benzene emissions originate from the charging port and that the emission factor is 25 percent of that for total particulate emissions from the charging port (0.0098), the emission factor becomes 0.0025 lb $C_6H_6/\text{ton coal}$. At 50 percent of the total particulate from the charging port, the emission factor becomes 0.0049 lb $C_6H_6/\text{ton coal}$. This higher value will be used in the model.

The preceding emission factors are only estimates; there are no test data to substantiate them. Dry coal charging should improve the level of pushing emissions because of the greater number of "clean" pushes resulting from more complete coking; it

should also provide the potential for lower levels of charging emissions.

3.13 SOURCE 13--HOT-LARRY-CAR CHARGING (PREHEATED DRY COAL)

Although no data are available on which to base emission factors for any of the four pollutants, these emissions are not expected to be significantly higher than those from wet-coal charging. Because the equipment will be new, the hot larry car should perform as well or better than the AISI/EPA larry car. ¹⁶ Therefore, the following emission factors are to be used:

- 0.017 lb particulate/ton coal
- 0.033 lb total particulate/ton coal
- 0.019 lb BSO/ton coal
- 3.5×10^{-5} lb BaP/ton coal
- 0.008 lb $C_6H_6/\text{ton coal}$

The value for total particulate emissions is not used in the model, but it is shown for general information.

3.14 SOURCE 14--BYPRODUCT RECOVERY PLANTS

It is difficult to quantify the emissions from coke-oven by-product-recovery plants. The main difficulties are the numerous fugitive sources and the significant differences in the type of byproduct recovery practiced from plant to plant. The approach taken to quantification of emissions was to select a plant that appeared to be representative of a majority of the byproduct recovery plants. Because not all sources of emissions have been tested and reliable emission data are not readily available, the estimates presented here are rough, and represent only the summation of estimates for various areas in a typical byproduct plant. The pront-half Method 5 particulate emissions are believed to be zero.

The primary pollutants appear to be organics, but no useful data are available except on benzene. During processing, the coke-oven gas is cooled to a sufficiently low temperature to

condense the various hydrocarbons that make up the benzene soluble organics. Therefore only those with relatively high volatility should be emitted as fugitive emissions. Based on test data and estimates, benzene emission are calculated to be at least 0.2 lb/ton coal. It is possible some constituents of BSO (such as naphthalene) are emitted at very high levels and contribute at least 0.3 lb BSO/ton coal. This value will be used in the model until more specific data become available. Although BaP levels are unknown, they should be relatively low because of the condensation effect mentioned above. For the purposes of the model, BaP emissions will be considered zero.

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SECTION 4

COST METHODOLOGY

4.1 STANDARDS AND ASSUMPTIONS

Cost Standards

Three basic costs have been determined: (1) total installed capital cost, (2) annual operating cost, and (3) annualized cost. These costs reflect 4th quarter 1978 dollars. The procedures for calculating installed capital costs for control equipment are presented in Section 4.2, as are the details of the capital recovery factor, the items included in the cost estimates, unit prices for labor, and other such information.

Process Standards

The flow diagram of a typical coke plant (Figure 7) and the corresponding flow diagram of a byproduct plant (Figure 8) indicate the scope of the processes included in the model.

The following constants are used the control cost calculations:

Useful life of battery	40 years
Days in year	365
Hours in day	24
Coke oven gas/ton wet coal	11,500 ft ³
Bulk density of wet coal	50 lb/ft ³
Bulk density of dry coal	44 lb/ft ³
Coking time	17.5 h for furnace coke 24.0 h for foundry coke 12.5 for preheated coal

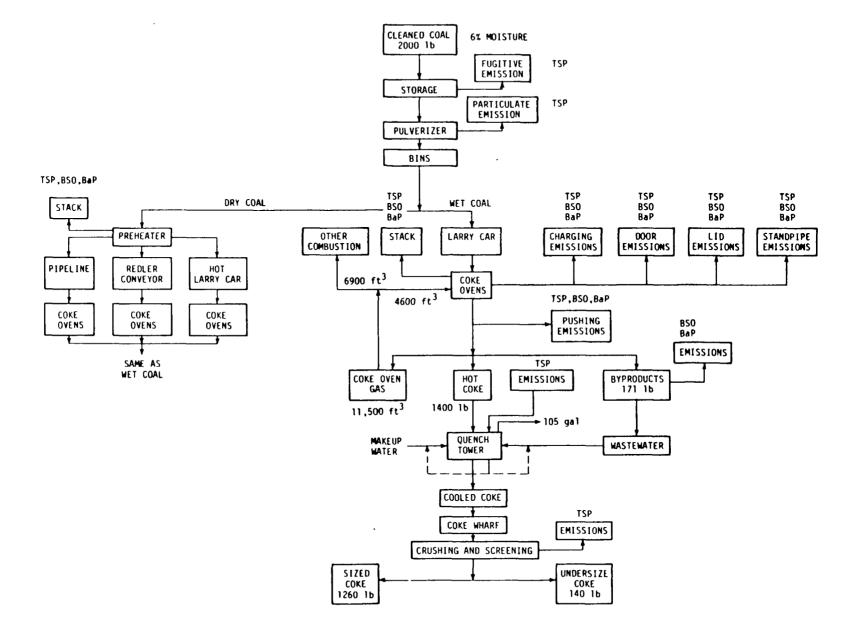
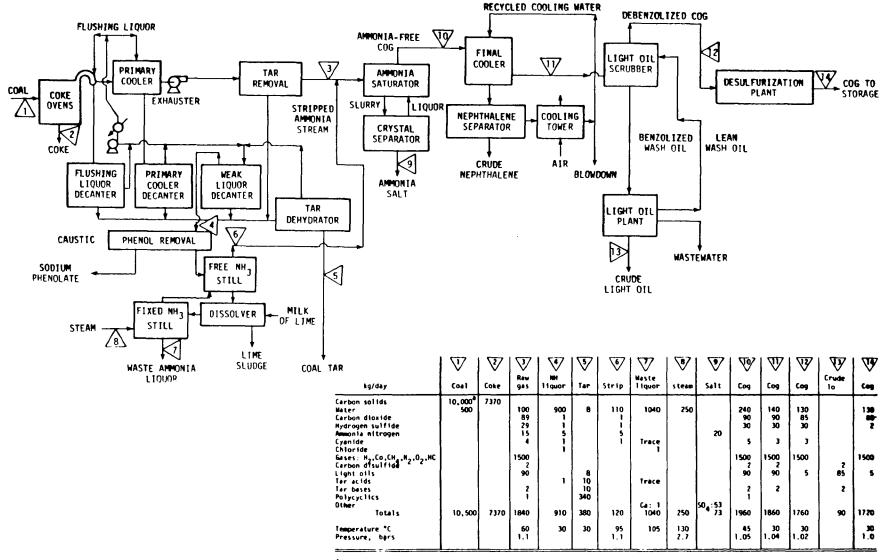


Figure 7. Relationship of emission sources in a typical byproduct coke plant.



Basis: the scale factor to Dunlop and McMichael (36) is 550

Figure 8. Flow plan and material balance of a representative coke byproduct recovery plant.

Rounded

	Doors	Self-sealing (no luted doors)	
	Wet coal moisture	6 percent	
	Excess flushing liquor	45 gal/ton wet coal	
	Quench water requirement	150 gal/ton coke	
	Coke/coal yield	70 percent	
	Percent of gas used for underfire	40 percent	
Flow	rates:		
	Enclosed hot car, acfm	75,000	
	Enclosed shed, acfm	(0.67) x volume	
	Volume of shed	35.6 ft ³ /ft of length per ton of coke pushed (T)	
	Length of shed (L)	4 ft x (No. of ovens) + 20 ft	
	Wet quenching, acfm	30,800 x T	
	Dry quenching, acfm	88 x (tons of coke/day)	
	Combustion stack, acfm	59 x (tons of coal/day) at 450°F @ 100% excess air	
	Coal preheater stack, acfm	$16,900 \times (10^6 \text{ tons of coal/year})$	

Temperatures:

The exhaust temperatures used are as follows:

Source	Temperature,	٥F
Charging	180	
Pushing	300	
Quenching	200	
Doors	120	
Topside	120	
Combustion stack	450	
Coal preheater	180	

Table 3 shows the relationship between key oven parameters used to translate capacity data into the physical size data needed to determine certain costs. For example, oven volume is the key parameter for sizing larry-car hoppers, tons of coke per push is the key parameter for sizing an enclosed hot car, and oven height is a key parameter for determining shed cost. These

TABLE 3. RELATIONSHIPS OF SIZE AND OTHER PARAMETERS, COKE OVEN BATTERY
Basis: 50 ovens

Oven height, m	3	4	6
Oven volume, ft ³	540	720	1390
Tons coke/push	8.5	12.0	25.0
Without preheat			
Coking time, h	17.5	17.5	17.5
Pushes/day	68.6	68.6	68.6
Tons coke/yr ^a	213,000	300,000	626,000
With preheat			
Coking time, h	12.5	12.5	12.5
Pushes/day	96	96	96
Tons coke/yr ^a	296,000	420,000	876,000

 $^{^{\}rm a}{\rm Directly}$ proportional to number of ovens and inversely proportional to coking time.

relationships were used in calculating the cost functions for model input. For convenience the cost equations are expressed as a function of capacity. Because most batteries fall into one of the three categories shown in Table 3, the use of capacity as the cost variable is reasonable.

Two "interactions" are recognized in the model. An interaction is defined as a control of one source that effects control of another source. The interactions are as follows:

- The use of shed control on the pushing source effects control of coke-side door emissions. The removal efficiency is the same as that for pushing emissions except that only the coke-side door emissions are captured.
- The use of dry quenching on the quenching source effects control of pushing emissions because dry quenching utilizes an enclosed hot car. The cost of dry quenching also includes the cost of water treatment at those plants that would otherwise use dirty water for quenching.

4.2 PROCEDURE FOR COST ESTIMATING

Estimates for coke making systems are divided into two major categories, capital costs and annualized costs. Capital costs include such things as basic equipment and installation costs, contractors' fees, and taxes. Estimates are sometimes obtained directly from vendors and published information, or they may be based on engineering experience and judgment. Some elements of annualized costs also can be obtained from published information or other documented sources, whereas other elements (e.g., annualized overhead) must be calculated because they are dependent on capital costs.

The direct operating cost estimates in this report are based on engineering judgment unless otherwise noted. They reflect 4th quarter 1978 dollars based on the Chemical Engineering Plant Cost Index.

Capital Costs

Capital costs represent the total investment required to install a new control system. General factors that must be considered for any type of control device are total equipment cost, piping and ductwork, insulation, painting, and the like. Table 4 lists typical items included in investment costs of air pollution control systems.

System-specific factors affecting costs must also be considered. For coke oven systems these are capture method, temperature, effect on byproduct quality (if applicable), fuel storage (if applicable), and construction interest charges. Not included are production losses due to control equipment installation and startup and research and development costs.

The worksheet presented as Figure 9 organizes all capital investment cost factors for control systems into direct and indirect costs. Factors for the components in each group are calculated either as a function of the basic cost of the equipment or material (obtained from vendor quotations) or calculated specifically from engineering estimates (e.g., cubic yards of concrete required for foundations).

Annualized Costs

Total annualized costs include direct operating costs, capital charges, and overhead charges.

Direct operating costs include such items as utilities (fuel oil, natural gas, electricity, process water, etc.), operating labor (both direct and supervisory), maintenance and supplies (labor and material), and solid waste disposal.

Capital charges include depreciation, interest, administrative overhead, property taxes, and insurance. Depreciation and interest are computed from the total capital cost by using a Capital Recovery Factor (CRF), the value of which depends on the

TABLE 4. TYPICAL ITEMS INCLUDED IN INVESTMENT COSTS FOR CONTROL DEVICES

Total equipment cost, f.o.b. site

Device control instrumentation

Piping and duct work

Electrical equipment (motors, starters, conduits, etc.)

Insulation

Painting

Concrete and steel for foundations and support structures

Labor for equipment installation and materials application

Site preparation and building modifications

Construction management and supervision (contractor's fees)

Contingencies

Engineering and inspection

Startup

Freight charges for equipment and materials

Taxes and insurance

SUMMARY

PEDCO ENVIRONMENTAL DESCRIPTION DATE					
PROJECT NOBY					
DESCR	RIPTION	DETAIL SHEET	MATERIAL	LABOR	TOTAL
DIREC	T COSTS				
1.	Equipment				
2.	Instrumentation				
3.	Piping				
4.	Electrical				
5.	Foundations				
6.	Structural				
7.	Sitework				
8.	Insulation				
9.	Painting				
10.	Buildings				-
11.					
12.					
15.	DIRECT SUBTOTAL				
	ECT COSTS				
21.	Field Overhead				
22.	Contractor's Fee		1		
23.	Engineering				
24.	Freight				
25.	Offsite				
26.	Taxes (5% x material)			<u> </u>	
27.	Allowance For Shakedown				
28.	Spares	İ			
29.					
30.	TAND I DECOME CULTUMORY				
31.	INDIRECT SUBTOTAL	,			<u>-</u>
35.	SUBTOTAL (20% of line 25)				
41.	Contingency (20% of line 35)				
42.	Interest During Construction (10% of line 35)				
<u></u>					
45.	TOTAL				

Figure 9. Worksheet for estimating capital costs.

operating life of the system and on the interest rate.* For example, a CRF of 13.2 percent per year of the total capital costs is allowed for a system with a 15-year life expectancy and an interest rate of 10 percent. Property taxes and insurance are fixed together at 2.0 percent of the total capital cost per year. Administrative overhead charges are also fixed at 2.0 percent of the total capital cost.

Table 5 presents annualized operating cost factors used for control systems. Table 6 lists the specific rates used for computing the annualized costs for this particular study.

Modified/Reconstructed Facilities

The cost of installing a control system in an existing plant that has been modified, reconstructed, or expanded (given the same exhaust gas parameters) is greater than in a new plant because of special design considerations, more complex piping requirements, etc. It is difficult to estimate additional installation costs or retrofit penalty because many things are peculiar to an individual plant. Such factors as lack of space, additional ducting, and additional engineering have been considered here.

The location of the control system is governed by the configuration of the existing equipment. Long ducting runs from ground level to the control device and to the stack are sometimes required, depending on the location of the process or stack. Placing the control equipment above ground, which often requires steel structural support, may increase costs. Other cost components that may be increased because of space restrictions and plant configuration are contractor's fees and engineering fees. Under normal conditions these fees are estimated at 15 percent and 10 percent, but they can be expected to increase to 20 percent and 15 percent for a retrofit. Fees vary according to

^{*} CFR = $\frac{i(1+i)^n}{(1+i)n-1}$ where i = interest rate (decimal factor) and n = economic life of asset (No. years)

TABLE 5. ANNUALIZED OPERATING COST FACTORS FOR CONTROL SYSTEMS

```
Direct operating costs
 Utilities:
    Fuel oil
    Coal
    Natural gas
    Electricity
 Operating labor:
    Direct and supervisory (assume X shifts/day and X days/year to calcu-
     late hours/day)
 Maintenance:
    Labor
    Materials
 Supplies:
    Labor
    Materials
 Solid waste disposal
 Water treatment costs
Capital charges
  Depreciation and interest
 Administrative overhead
  Property taxes
  Insurance
Recovery credit adjustments
```

TABLE 6. RATES USED IN THE COST MODEL

Item	4th Quarter, 1978 dollars	Source
Water	0.161/1000 gal	a
Electricity	0.0266/kWh	a
Steam	4.13/M 1b	b
No. 2 oil	0.42/gal	b
Natural gas	2.80/1000 ft ³	. р
Coke oven gas	1.39/ 1000 ft ³	Ь
Direct labor	15.22/h	a
Supervisory labor	18.26/h	b
Compound MR dust control	3.69/gal	С
Bag cost (Lt 275°F)	0.28/ft ²	d
Bag cost (Gt 275°F)	0.44/ft ²	d
Sodium hydroxide	360/ton (100% basis)	е
Polyelectrolyte	2.48/gal	f
Solid waste disposal	8.25/ton	d
Payroll overhead	20% of payroll	d
Plant overhead	50% of labor and supplies	d
Interest rate	10%	d
Administration overhead	2% of installed cost	d
Property taxes and insurance overhead	2% of installed cost	d

^aTBS (Reference 2).

^bCalculated by PEDCo from rates in Reference 2.

^CPEDCo Fugitive Dust Report. EPA-450/3-77-010. Reference 3.

 $^{^{\}rm d}$ Estimated by PEDCo.

e_{Reference 4.}

f_{Reference 5.}

locale, difficulty of the job, the risks involved, and current economic conditions. PEDCo estimated the fees cited.

The required additional ducting varies considerably with plant configuration, but for purposes of this study, it is estimated that approximately 50 percent more ducting is required for a retrofitted control system.

Additional labor will be required to tie the system into the process, probably at premium-time wage rates (assumed to be double the straight-time pay).

When these additional cost factors are applied, the cost of retrofit installations generally runs about 20 percent higher than the cost of new installations; specific retrofit penalties are estimated individually for each module in the PEDCo cost model. Retrofit is not feasible in some plants, and these cases must be treated on a site-specific basis. The systems which are the most difficult to deal with as retrofits are dry coal charging and dry quenching. In the case of dry coal charging, there is the additional problem of apportioning cost between pollution control and increased production capability. Dry coal charging systems are included in the model only if they already are installed; retrofits to existing batteries are not included. Dry quenching is included with the provision that it may be not feasible for all plants.

Annualized Cost of Control Systems

The annualized costs of control systems for modified/re-constructed facilities are calculated in a manner similar to that for new facilities. The cost components that are based on capital costs are about 10 to 20 percent higher than those for new facilities.

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SECTION 5

CONTROL SYSTEMS

This section provides a general description of each control option listed in Section 2 (Table 2). Further details such as exhaust temperature, duct diameter, and flow rate for each size of battery and plant are presented in the computer printouts for each control option in Appendix A. This section also provides a summary of capital and annualized costs for each option.

The cost estimates presented are based on engineering estimates by PEDCo, unless otherwise noted. Where applicable, the procedures described in Section 4.2 are used to derive the costs. For those control options that involve additional manpower or changes in operation and maintenance (rather than equipment), costs represent estimates of additional manhours required (sometimes based on related work previously performed by PEDCo).

5.1 GENERAL SPECIFICATIONS

Source 1--Larry Car Charging

Control Option 2: Modified Car, Steam, and Smoke Boot--

Modification costs are based on a standard four-hopper larry car. The basic modifications are the addition of a gooseneck cleaner, hydraulics for independent drop sleeve operation, a suction pipe (U-tube), stainless steel cones for hoppers, heat shields, new hopper discharge assemblies allowing independent operation, and a fume pipe for ventilation from the U-tube on Port 4 to Port 1. Costs also include all necessary engineering,

assembly, and installation. Estimates are based on the assumption that the existing car is relatively new and that modifications are feasible. It is also assumed that headroom at the coal bunker is adequate. Estimates do not consider OSHA requirements for filtered air supply.

The steam supply considered in this option consists of a pressure regulating station, a 4-inch header along the battery, 1-inch takeoffs at each standpipe, and steam injection jets and the attendant miscellaneous piping, insulation, and installation.

Although the baseline for "uncontrolled" probably represents a battery already supplied with steam, it is assumed that the supply is not adequate to provide the quantity, pressure control, or the reliability necessary for good stage charging.

The final portion of this option involves a smoke seal for the leveling bar. The operating costs cover one additional lidman per shift (to insure timely lid replacement and luting) and one pipefitter on day shift to provide preventive maintenance for steam nozzle and liquor spray. Steam requirement is estimated at 24 lb/ton coke.

Control Option 3: New Car, Steam, Smoke Boot--

The new car included in Option 3 controls affords greater control because it is more reliable, and includes such design improvements as a gravity feed butterfly valve (Carbotek), and "two ovens-away drafting."

The car basically consists of four hoppers with flow control valves and drop sleeves, fume pipes between Ports 1 and 4 and Port 4 two ovens away, hydraulic slide gates, and gooseneck cleaner.

The battery steam supply and smoke boot are also included.

Many site-specific details of design will increase or decrease the cost from plant to plant. Furthermore, site-specific problems such as three-hole batteries, coal bunker clearance, warped battery tops, and off-battery-limit steam supply problems are not considered in the cost estimates.

The operating costs include the same additional manpower as described for Option 2. The additional costs for treating the condensed steam are not included, nor are potential losses due to deleterious effects of steam on tar quality (these should be addressed later in the refining of the fully developed model).

Control Option 4: Retrofit of Second Collecting Main Plus Option 3--

This option applies only to batteries with one collecting main, and includes the same features as Option 3 plus the retrofit of a second main. The estimate for the latter is based on the cost data in Reference 1. The reference does not indicate specifically what is included, but it is assumed that the second collecting main includes standpipes and goosenecks, collecting main, crossover mains across the battery top, steam and liquor spray systems, and a pressure regulating system. Such an installation is probably not feasible for batteries nearing the end of their useful life.

An additional refinement of the model could restrict usage of this option for older batteries because battery age is included in the battery data base. The model should also account for the probable decrease in door emissions afforded by a double collecting main, but presently this factor is ignored.

Source 2--Pushing

Control Option 2: Controlled Coking--

This option involves no capital cost--only annual operating costs. These include one additional man per shift for monitoring flue temperature and coking time. The major portion of the costs is based on an increase in average coking time of 17.5 to 19 hours. This represents an 8 percent loss in capacity (given that demand is at capacity). Lost production is valued at \$110/ton of coke. For a battery with a capacity of 400,000 tons/year, the cost is $(0.08) \times (400,000) \times (\$110)$, or \$3,520,000. At capacity utilization ratios below 92 percent, the cost thus calculated is

theoretically zero, but periodic need for maximum output would still entail some lost production.

Control Options 3 and 6: Shed and Electrostatic Precipitator (ESP); Control Options 4 and 7: Shed and Scrubber--

The control efficiencies of the ESP are translated into cost by the relationship between efficiency and collection area shown below: ²

	Plate area,			
Efficiency, %	Plate area, $ft^2/1000$ acfm of gas flow			
99.9	385			
99.0	240			
95.0	188			

The larger the plate area, the higher the control efficiency and the greater the control cost.

Aside from this factor, the general specifications for both of the shed ESP systems are identical as described here. The length of the shed is 4 feet per oven plus 20 feet of overhang. The exhaust volume is calculated according to the equation:

Exhaust volume in acfm = 1.67 (shed volume)

shed volume = 35.6 (L)(T)

where

L = length of shed and

T = tons of coke per push

The shed includes foundations, columns, sheeting, internal lighting, and exhaust main along the length of the shed and under the exhaust main, an access walkway through shed. Figure 10 is a simplified cross section of the shed.

The shed system includes the shed, the ESP, the fan and drive, connecting duct work, the exhaust stack, and control dampers at the fans. As is the case for all air-moving systems, fan redundancy is 100 percent for fans smaller than 500 bhp and 50 percent over 500 bhp. For example, if the total horsepower required is 400 bhp, two 400 bhp fans are provided. For a total requirement of 1000 bhp, three 500 bhp fans are provided. Fan drive horsepower is based on standard air density of 0.075 lb/ft³ to allow for cold starts.

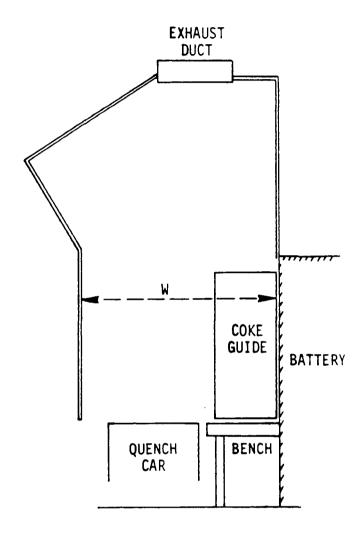


Figure 10. Cross section of coke-side shed.

The redundancy of the ESP is 20 percent of the plate area required. The ESP's are insulated and covered and include dust-handling hoppers and conveyors. Duct diameters are based on a duct velocity of 4000 ft/min. Stack diameters are based on a stack velocity of 3000 ft/min. The 300 ft of duct work for the shed is unlined and uninsulated carbon steel, as is the 100-ft stack. Fans are induced-draft and centrifugal with radial-tipped blades, and are rated for material handling (MH). The totally enclosed motors are drip-proof and have oil-cooled bearings as required. The fan electrical system includes motor starters, louver operators, annunciators and related switches, and wiring. No allowance is made for additional substations or increasing plant electrical capacity.

The only difference in the scrubber systems is that the ESP is substituted with an unlined stainless steel venturi scrubber and mist eliminator. Total system pressure drop is 50 in. $\rm H_2O$ for a 99 percent TSP collection efficiency and 30 in. $\rm H_2O$ for a 95 percent collection efficiency. (These are initial estimates only and can be refined later.) The L/G ratio of the scrubbing liquor is 7.9. Wastewater is recycled through a treatment system, which includes a clarifier-vacuum filter section, a wastewater recirculating pump, and a makeup water pump. It is assumed that this system will have a 5 percent blowdown rate to an existing water treatment system for removal of dissolved compounds such as phenol and cyanide.

The shed systems are assumed to capture coke-side door emissions in addition to 90 percent of the pushing emissions. Coke-side door emissions are assumed to be 50 percent of total door emissions.

Control Option 5: Enclosed Hot Car--

The enclosed hot car used in this option is described in the literature and in Reference 2. Equipment costs are based on a rough quote by Chemico; indirect costs were added by PEDCo. No separate allowance is made for reenforcement or modification of

the bench or for modification of the quench tower or wharf except as they might be included in a gross estimate represented by the retrofit factor. The Chemico car was chosen from a variety of designs to represent this general class of control. Additional variations can be added to the model if desired.

Source 3--Quenching Clean Water

Control Option 2: Wooden Baffles--

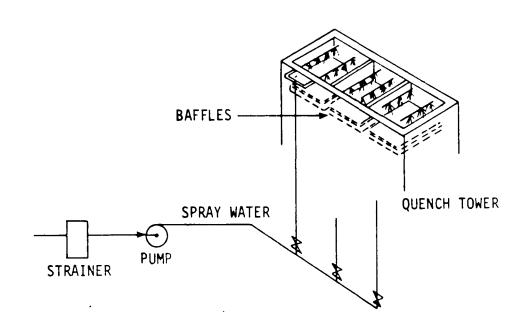
The cost of quench tower controls is a function of the number of quench towers in the plant rather than of coking capacity. Because specific data are not available on the number of quench towers required, it is assumed that one quench tower can handle up to 900,000 tons/yr of coke production. Figure 11 shows the scope of this option.

Control Option 3: Diverted Flow Baffles--

The total installed capital cost of a diverted-flow, baffled quench tower was estimated by PEDCo based on a brochure from Firma Carl Still. The estimate includes baffles, water system, and quench tower extension. It does not include dismantling of an existing tower and total replacement by a new quench tower. Operating costs are calculated to be about 10 percent of the total capital cost. The number of quench towers required is calculated as indicated under Option 2.

Control Option 4: Dry Quenching--

Costs are based on a system such as that shown in simplified form in Figure 12, which was derived from a brochure by American Wagner Biro Company. This system includes enclosed pushing hardware, which is accounted for in the model; i.e., when dry quenching is used, pushing control is put at level 5. Because no U.S. plants use dry quenching and the steam generated might not be useful to the plant, the potential steam credit is not considered here. If it were, the annualized cost would become negative, which would complicate the optimization model. If desired, however, the cost update program can be used to generate





TYPICAL BAFFLE ARRANGEMENT

Figure 11. Conventional quench tower baffles.

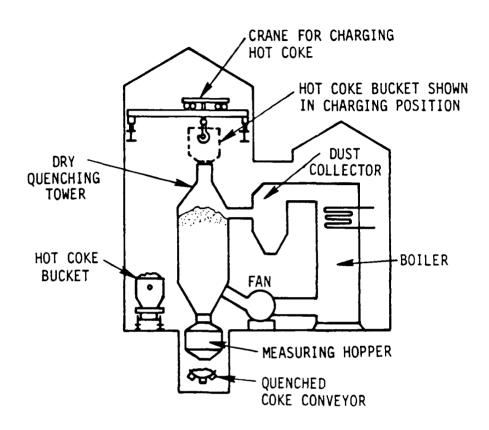


Figure 12. Simplified pictorial diagram of a dry quenching system.

revised cost functions for dry quenching, which do account for steam credit. There are some relatively small plants (less than 100,000 tons of coke per year) in the data base for which dry quenching is probably not feasible. It is also questionable whether the present cost function is applicable in this small range. These issues can be further investigated as a later refinement.

Source 4--Doors

Control Option 2: Cleaning and Maintenance--

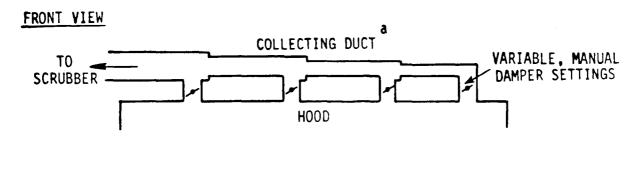
This option involves no capital cost. The annual operating cost is based on the addition of two men/shift for cleaning, door inspection, and repair. Maintenance costs also include the cost of door replacement at a rate of 10 percent per year.

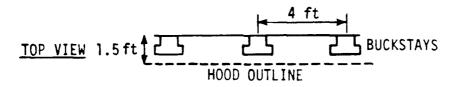
Control Option 3: High Pressure Water Cleaning--

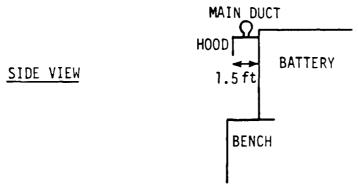
This option entails the installation of two (one per side) high-pressure water-cleaning machines, either on the existing pusher and door machines or on a separate car. Costs are based on a rough quote by Industrial High Pressure Systems, Inc. It is assumed that the existing pusher and door machine operators will operate the cleaning units. The option requires the addition of one man/shift for troubleshooting and inspection. Cost of replacement doors is the same as for control Option 2.

Control Options 4 and 5: Door Hood and Scrubber --

The scrubber, duct work, fans, and auxiliaries used in this control option are generally of the same specification as previously described. An unlined stainless steel venturi is used with a mist eliminator. The scrubber efficiency at 30 in. $\rm H_2O$ pressure drop is estimated to be 95 percent; at 60 in. $\rm H_2O$, 98 percent. The water treatment system is the same as described under Source 2. The duct length included is 150 ft plus the length of ducts along both sides of the battery calculated as four feet per oven per side. Stack height is 100 feet. Both are constructed of unlined, uninsulated, carbon steel. Figure 13 presents a sketch of the system and indicates the required flow







DOOR FACE AREA = (1.5 ft) \times (4 ft) = 6 ft² NUMBER OF OVENS EXHAUSTED AT ANY GIVEN TIME = 6 FACE VELOCITY = 200 ft/min FOR 75% CAPTURE FACE VELOCITY = 250 ft/min FOR 85% CAPTURE FLOW RATE (ONE SIDE) = (6 ft²) \times (6) \times (200 ft/min) = 7200 acfm

TEMPERATURE = 100°F
FLOW RATE = 6800 scfm
FLOW RATE (BOTH SIDES) = 13,600 scfm FOR 75% CAPTURE
= 17,000 scfm FOR 85% CAPTURE

Figure 13. Door hood arrangement.

a IN ACTUAL PRACTICE, DUCT WOULD BE OF VARYING DIAMETER AND REQUIRE SOME DAMPER ARRANGEMENT TO DISTRIBUTE FLOW ALONG LENGTH OF BATTERY. THE COST ESTIMATE IS NOT OF SUFFICIENT DETAIL TO RECOGNIZE SUCH DETAILS. DUCT COST THEREFORE IS BASED ON A CONSTANT DIAMETER.

rate. Also included in the cost of this option are the costs described under Option 2.

Source 5--Topside

supplies.

Control Options 2 and 3: Luting, Cleaning and Maintenance—
These two control options entail no capital costs and differ only in degree. Option 2 includes one additional man/shift for inspection and luting of lids and standpipes (in addition to the lidman and larry car operator). For Option 3, additional maintenance hours are added for grouting lid seats and standpipe bases and replacing faulty lids and caps. The cost estimate is

based on an additional 1000 hours/year of labor plus the cost of

Control Option 4: New Lids and Seats--

The cost of this option includes one additional man/shift for inspection and luting of lids and standpipes plus an additional capital cost for new lids and seats at a rate of four lids per oven. This option is not applicable to preheated coal batteries.

Source 6--Combustion Stack (Old)

Control Option 2: Oven Patching--

The arbitrary definition of "old" combustion stack is based on a battery age of 15 years or older. This option involves the cost of 5900 maintenance hours per year for oven spraying and patching on a regular basis and one additional man around the clock for inspection and adjustments to the heating system. No capital costs are included.

Control Options 3 and 4: Dry ESP--

The control efficiencies of ESP's are related to cost in that higher efficiencies require larger collection areas, as shown below: 2

	<pre>Plate area,</pre>
Efficiency, %	Plate area, ft ² /1000 acfm of gas flow
90.0	232
98.0	450

General ESP specifications are the same as those described under Source 2. The length of duct allowed is 150 ft; duct work is brick lined carbon steel. In the case of retrofits, it is assumed that the duct is tied into the existing flue and the existing stack is used. A booster fan with a total static pressure capacity of 6 in. H₂O is added. The flow rate for this source is calculated as:

acfm = 59 x tons coal/day

with an exhaust temperature of 450°F. This flow is based on a stoichiometric calculation for coke oven gas with 100 percent excess air. Costs for flue gas conditioning are not included. A separate ESP system is provided for each battery although, in specific cases, it might be feasible to use a common ESP for adjacent batteries. Because of space limitations and problems with duct tie-in, the retrofit of an ESP to underfire stacks may not always be possible. The ability to shut the gas off to an existing battery long enough to accomplish tie-in without damaging oven refractories is a site-specific problem and is not addressed in this study.

Control Option 5: Baghouse --

This option is the same as Options 3 and 4 except that a fabric filter is substituted for the ESP. Temperature to the baghouse is limited by increasing the rate of air flow sufficiently to reduce the temperature from 450° to 275°F. The resulting flow rate is about 1.85 times that flow used for Options 3 and 4. The air-to-cloth ratio used is 3.0.

Source 7--Coke Handling

Control Option 2: Enclosures and Baghouse--

Specific details of this control system for emissions from coke handling will vary from plant to plant. The generalized

system used in the model consists of a plain carbon steel hood over the primary screen and five conveyor transfer point enclosures vented to a fabric filter having an air-to-cloth ratio of 6.0. Duct work is unlined, uninsulated, plain carbon steel of variable length depending on plant size. The average length is 75 ft. An exhaust fan with a static pressure rating of 8 in. H₂O is included. Flow rate is based on standard ventilation formulas for hoods and appropriate conveyor belt widths. The control system is rated to accommodate the total coking capacity of a plant and is based on the assumption that a common coke-handling station serves all batteries. This is a safe assumption because only a few plants have widely separated groups of batteries and more than one handling and loadout station. The system does not include controls at the coke wharf.

Source 8--Coal Preheater

Control Options 2 and 4: Wet Scrubber --

The control options for this source are applicable only to those few batteries that have coal preheating systems. The two scrubber options are identical except in pressure drop requirement and concomitant fan capacity. Both scrubbers are stainless steel and contain corrugated-baffle mist eliminators. Both options include 100 ft of carbon steel duct work and a 100-ft stack. Flow rate (in acfm) is calculated according to the following formula:

$$acfm = 16,900 \times (\frac{tons of coal/year}{1,000,000})$$

Control Options 3 and 5: Dry ESP--

These options are similar to the scrubber options except they call for ESP's rather than wet scrubbers. No data are available on the collection area required for coal preheater exhaust. Based on the assumption that preheater particulate emissions are similar to underfire stack emissions, the following values are used: ²

	Plate area
Efficiency, %	$ft^2/1000$ acfm of gas flow
95.0	324
99.0	538

Source 9--Coal Preparation

Control Option 2: Enclosures and Baghouse--

The sources of coal preparation emissions are the crushing, mixing, and transfer steps that occur between the initial coal-receiving station and the coal storage bunkers at the battery. The size of the control system is determined by the coal capacity of the plant. The system includes six conveyor transfer-point hoods vented to a fabric filter having an air-to-cloth ratio of 6.0. Duct length varies with plant size, but the average is 250 ft. The system also includes an exhaust fan with a static pressure capacity of 8 in. H₂O.

Source 10--Coal Storage Yard

Control Option 2: Spray Truck--

This option consists of a standard tractor trailer outfitted with a spray system and water storage tank. The estimated efficiency rating is 60 percent, but little data are available on dust control of coal storage piles. It is assumed that the truck would be used during periods of dry weather or windy conditions to suppress emissions at these most critical times. Operating costs include driver time, dust suppressant chemicals, and truck maintenance.

Control Option 3: Unloading Sprays and Spray Truck--

In addition to a spray truck, control Option 3 includes a spray system at the car dumper (or barge unloading station). The system is shown in Figure 14. Control efficiency should be increased from 60 to 75 percent with the application of option. This increase is based not only on the suppression of emissions during dumping, but also on the assumption that application of a dust suppressant provides more thorough and longer lasting control than water spraying alone.

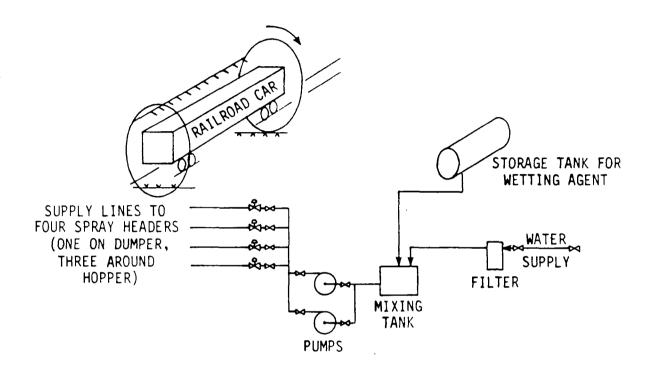


Figure 14. Dust-supression spray system at car dumper.

Source 10--Coal Storage

Control Option 4: Coal Pile Sprays--

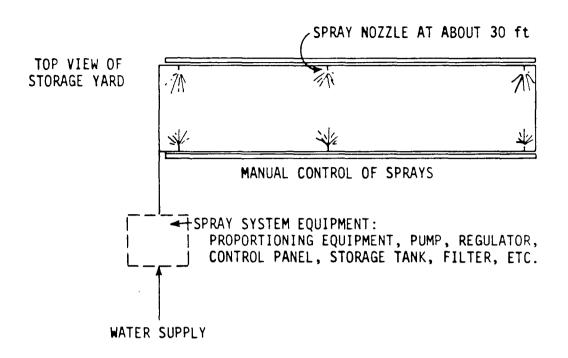
This control option (shown in Figure 15) is much more expensive than Options 2 and 3. It consists of permanently installed spray stanchions around the perimeter of the coal piles. These stanchions can be regulated at a central pump house. The lines are insulated and heated for winter operation. The size of the system is based on the amount of storage area required (based on a coal pile storage density of 0.28 ton/ft²). The control options for Source 10 are based on total plant capacity. Cost estimates are independent of battery characteristics.

Source 11--Pipeline Charging; Source 12--Redler Conveyor Charging; and Source 13--Hot Larry Car Charging

Control Option 2: Operation and Maintenance--

Information concerning controls for dry-coal charging systems (Sources 11, 12, and 13) is limited. These sources represent topside emissions from batteries charged with dry coal. Emission controls for such sources as doors and stacks are the same as those in conventional batteries. The control of emissions from hot larry car loading at the coal bunker is not considered because there is only one such battery and controls were included in its design.

A recent study of pipeline-charged batteries and Redler-charged batteries suggests such controls as additional steam aspiration, better seals at discharge ports, and slower charging rates. Because specific controls have not been selected, however, a capital cost cannot be determined. Cost estimates present only an annual operating cost based on the addition of one topside worker for inspection, luting, and minor maintenance of lids, standpipes, and the pipeline or conveyor.



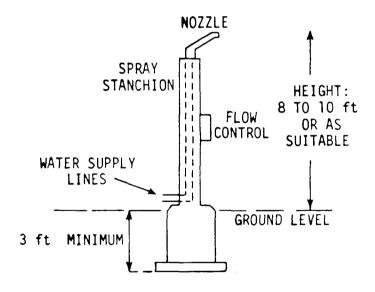


Figure 15. Permanently installed spray stanchions around perimeter of coal piles.

Source 14 - Byproducts Plant

Control Option 2: Maintenance--

No control systems or procedures have yet been developed for the control of air emissions from byproduct plants. So that a working model recognizing this potential emission source could be provided, a control option consisting of 8760 hours/year of inspection and maintenance has been used. This includes valve packing, tank patching, and repair of pipe leaks, and should produce a control efficiency of 80 percent. These data are artificial data, however, and are used only to provide a complete dataset for the model.

Source 15--Combustion Stack (New)

Control Option 2: Oven Patching--

The designation of a battery stack as "old" or "new" is arbitrary and is used only to help explain broad variations in uncontrolled emissions. If site-specific data classifying each stack according to emission level were available, the designation of age as a parameter could be eliminated. Oven patching is the same as the control option described for old battery stacks, and it is the only control option used for new stacks because more extensive measures are not necessary.

Source 16--Quenching With Dirty Water

Control Option 2: Wooden Baffles--

This option is identical to that shown in Figure 11 (for Source 3, Option 2).

Control Option 3: Clean Water and the Use of Baffles--

The most definitive study available on the subject of emissions from quenching is by Edlund. ⁵ The study addresses only particulate emissions. Figure 16 illustrates the relationship between emissions and dissolved solids in the quench water. Determining the total dissolved solids for each plant is beyond

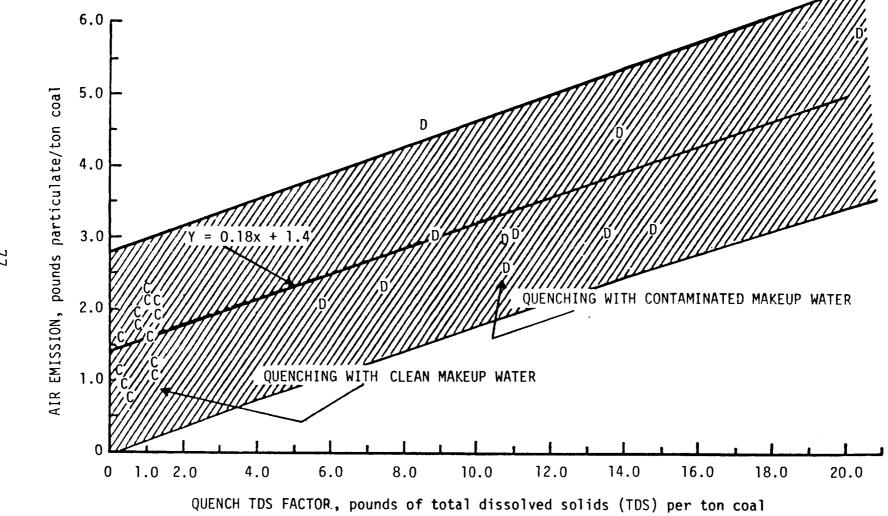


Figure 16. Total particulate emissions from coke quenching. 5

the scope of this project, but it is known that the composition of process water varies from plant to plant, as does the ratio of process water to quench water. The total amount of process water also varies. Table 7 (extracted from a preliminary summary of Effluent Guidelines 308 Questionnaire Data) shows these variations.

The variations in quench water composition and the many different water treatment methods used require some assumptions for simplification:

- 1. Plants are designated as using either clean water or dirty water for quenching. The particulate emission rates are assumed to be 1.7 lb/ton of coal for clean water and 3.2 lb/ton of coal for dirty water.
- 2. The control scheme for treating dirty water (instead of using it for quenching) is an ammonia distillation column using caustic soda, a bio-oxidation plant with 3-day retention time, and activated carbon filters for polishing. An incinerator is included for incinerating the ammonia vapors, although these could be recovered and converted to useful byproduct. A flow sheet of this system is presented in Figure 17. It is assumed that water thus treated becomes acceptable effluent and that river water (i.e., clean water) is used for quenching.
- 3. The quantity of water to be treated is assumed to be 150 gal/ton of coke. (It should be noted that the control option of dry quenching must include the treatment of the dirty water that would otherwise have been used for quenching). The plant is sized for 50 percent excess capacity to enable recovery from outages.
- 4. When dry quenching and wastewater treatment are used in combination, it is assumed the steam generated by the dry quenching system is used to displace the steam requirement of the water treatment system.

Although these are significant assumptions that could affect the usefulness of the model, they are necessary to establish a starting point. More detailed data and additional control schemes can be factored into the model at some later date.

The other control options for quenching have already been described.

TABLE 7. COKE PLANTS USING PROCESS WATER FOR QUENCHING

Reference No.	Company	Location	lxcess NH ₃ liquor	Benzol plant	Final cooler	Barometric Fundenser	Desulfur- izer	Other ^a	Total, gal/min	Process wastewater as % of total quench volume	Process wastewater in gal/tor
0012A	Alabama B.P.	Tarrant, Ala.			145				145	11,1	93
01128	Bethlehem	Lackawanna, N.Y.			120	100		5	225	5.6	50
0112C(Rose)	Bethlehem	Johnstown, Pa.	18	14	5			5	42	12.9	60
0112C(Frank)	Bethlehem	Johnstown, Pa.	58	64	10		=	28	160	11.1	74
01120	Bethlehem	Chesterton, Ind.			505	230	765	270	1770	53.9	493
0256٤	Cyclops-FMP DET.	Portsmouth, Ohio	110						110	98.1	139
02 808	Philadelphia Coke	Philadelphia, Pa.			70				70	18.3	121
0384(#2)	Inland	E. Chicago, Ind.		295	125			10	430	16.7	100
0384(#3)	Inland	E. Chicago, Ind.						100	100	13,8	90
0432A	J&L	Aliquippa, Pa.	166	104	125	28		70	493	64.5	323
0448A	Kaiser	Fontana, Calif.	97	42	1				140	43.8	49
0464E	Koppers	Bessemer, Ala.			150				150	57.6	144
05 84C	National	Granite City, 111.	52		10				62	7,1	51
0584F(Main)	National	Weirton, W. Va.		32.5	29				61.5	22.1	39
0684A	Republic	Youngstown, Ohio	100	20	5			30	155	11.1	81
0684B	Republic	Warren, Ohio	50	50	10			20	130	16.3	146
0684F(1)	Republic .	Cleveland, Ohio		209					209	62.1	93
0684F(2)	Republic	Cleveland, Ohio		56		·		ĺ	56	28.3	42
0732A	Shenango	Neville Island, Pa.			80				80	16.2	73
0856F	USS	Fairless Mills, Pa.			2.5	5		100	107.5	10.3	52
0856N	uss	Lorain, Ohio	167	73		71		1	311	72.8	103
0860B	USS	Gary, Ind.	278		174	, ,			452	7.6	65
0.464	USS	Geneva, Utah	90	75	100				265	70.7	106
0948A	YS&T	Campbell, Ohio	90	61	175				326	92.2	123

^a includes larry car scrubber wastewaters, shed scrubbers, gas holder seals, preheater condensates, designs and seals on gas mains, and miscellaneous floor drains.

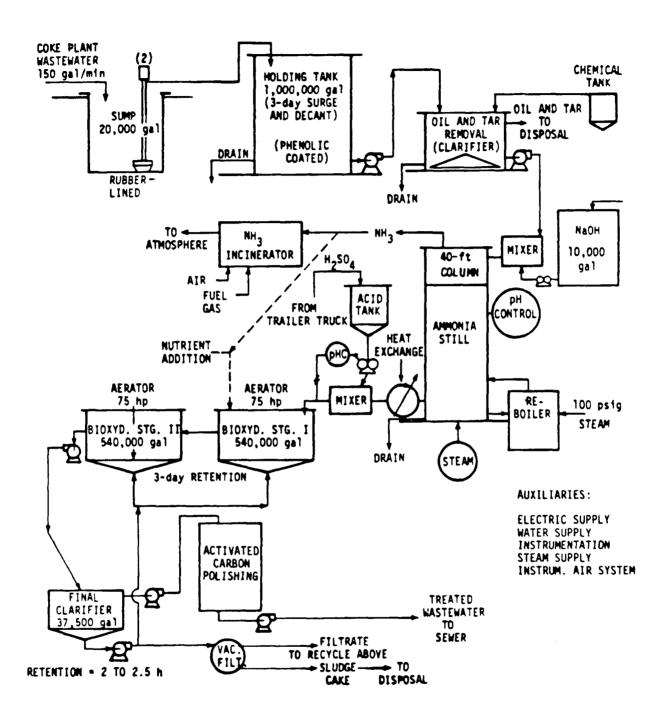


Figure 17. Coke plant wastewater treatment system.

REFERENCES FOR SECTION 5

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- 2. Development of Air Pollution Control Cost Functions for the Integrated Iron and Steel Industry. (Draft) Prepared by PEDCo Environmental, Inc., Cincinnati, Ohio, for the U.S. EPA, Office of Air Quality Planning and Standards, Washington, D.C., under Contract No. 68-01-4600. September 1978.
- 3. Midwest Research Institute. Study of Coke Oven Battery Stack Emission Control Technology Volume II, Control Methods. Prepared for Emission Standards and Engineering Division. U.S. EPA Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. EPA Contract 68-02-2609, Task 5. March 1979.
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- 5. Edlund, Carl, A.H. Laube, and J. Jeffrey. Effects of Water Quality on Coke Quench Towers Particulate Emissions.
- 6. Personal communication with Mr. Bernie Bloom, DSSE, Washington, D.C. to W. Kemner, PEDCo. September 14, 1978.

SECTION 6

BATTERY DATA BASE (DATASET 3)

This dataset provides a record of the following for each battery in the United States:

Company location code

Date installed or date of last major rebuilding

Number of ovens

Capacity, tons of coke/year

Type of charging used

Oven height

Number of collecting mains

Control equipment in place

These data are used as input to the model to determine total coke industry emissions and the costs to control them.

The data base for coke oven batteries was assembled from a variety of documents, some of which provide conflicting information. 1-6 Most of the capacity data is from Reference 1. Where given data conflicted, PEDCo used its own expertise and knowledge of the industry to select data values for use in the model. For most of the foundry coke batteries, the main data source was Reference 6.

The scope of this project does not cover the development of a detailed data base for the U.S. coking industry, but it was necessary to prepare a reasonably accurate census to estimate control costs.

Input of the battery data is arranged so that it can be updated easily as additional data become available. Although some of the data are estimated and some may be outdated, most of

the industry is correctly represented in the census, and the aggregate costs calculated from the current data base should be representative.

Table 8 represents the data base provided to the model. Figure 18 shows the data coding form used to change or update the data base. Table 9 presents the plant ID codes used for the data coding form.

Total industry cost for a given control option and efficiency are calculated generally as:

Industry cost =
$$\sum_{i=1}^{n} A \cdot X_{i}^{B}$$

where A and B = cost coefficients from the cost model

X; = capacity (tons coke/year) for battery i

n = total number of batteries

Company names are used only for convenience in coding and keeping track of the data. This study is not source-specific, and company names will not appear in the model printout.

In this model, plant capacity has generally been used as the variable in determining control costs. Certain costs, however, are not strictly a function of capacity. Shed cost, for example, is a function of oven height and number of ovens. In the case of quench towers, on the other hand, cost is proportional to the size and number of towers. The slight inaccuracies introduced by the use of capacity as the cost variable, however, are not of major concern in this stage of model development. In the case of quench tower baffles, it is assumed that one quench tower can handle up to 2500 tons of coke per day. For coal yards, coal preparation, coke processing, and byproduct plants, the model calculates costs for entire plants rather than individual batteries (i.e., X_i becomes the total capacity of all batteries in a plant).

Certain other site-specific factors could affect cost. For example, the economy of scale gained by combining two or more adjacent batteries under a common control device to control

TABLE 8. COKE OVEN MODEL BATTERY DATA BASE

PLANT	lnst.	NU.	CUKE Capacity	CHARGING	HEIGHT	PuSn	QUENCH	NO. COLL.
NU	DATE	UVENS	HYVENUT		(METERS)	CUNTHOL	WATER	MAINS
1	1966	 >>	220000.	LAKHY CAR	3	NONE	CLEAN	1
1	1967	55	\$50000.	LARHY CAR	3	NONE	CLEAN	ī
5	1750	15	80000.	LARRY CAR	4	NONE	CLEAN	1
2	1441	25	130000.	LARHY CAN	4	NONE	· CLEAN	ŧ
2	1941	25	130000.	LAHHY CAH	4	NONE	CLEAN	8
2	1952	76	540000.	LARHY CAH	4	NONE	CLEAN	, 2
2	1401	45	240000.	LARRY CAR	4	NONE	CLEAN	1
2	1976	57	670000.	LAHRY CAH	•	ENCLUSED CAR	CLEAN	. 2
5	1477	57	670000.	LAHNY CAR	•	ENCLUSED CAR	GLEAN	2
•	1942	47	190000.	LANNY CAR	•	SHED	CLEAN	1
•	1953	15	190000.	LAHHY CAK	4	SHED	CLEAN	1
5	1941	51	400000.	LARRY CAR	3	NONE	OIRTY	1
5	1942	51	400000.	LANKY CAN	3	NUNE	DINTY	1
5	1953	60	440000.	LARRY CAN	4	NONE	DIRTY	1
5	1976	80	890000.	LARRY CAR	•	OTHER	DINTA	5
6	1915	63	260000.	LARRY CAR	3	NONE	CLEAM	1
•	1418	6.3	260000.	LARKY CAR	3	NONE	CLEAN	ì
•	1450	6.3	260000.	LARRY CAR	3	NONE	CLEAN	1
•	1955	6.5	260000.	LAHRY CAR	3	NONE	CLEAN	1
•	1454	63	250000.	LARRY CAR	3	NONE	CLEAN	1,
•	1936	60	560000 .	LARRY CAR	3	NONE	CLEAN	1
•	1941	61	310000.	LAKKY CAR	•	NONE	CLEAN	1
•	1948	61	310000.	LARRY CAR	•	NONE	CLEAN	3
•	1950	65	350000.	LAHRY CAR	•	NONE	CLEAN	2
•	1952	65	350000.	LARRY CAR	•	NONE	CLEAN	3
•	1955	65	350000.	LARRY CAR	•	NONE	CLEAN	S
•	1457	65	350000.	LARHY CAR	•	NONE	CLEAM	2
7	1941	76	450000.	LANNY CAN	•	NONE	DINTY	1
7	1943	76	450000.	LARHY CAN	•	NONE	DINTY	, i
7	1943	. 57	300000.	LARRY CAR	4	NONE	DIRTY	1
7	1944	57	300000.	LARRY CAR	•	NONE	DIRTY	1
7	1425	76	495000.	LANRY CAR	•	NONE	DINTY	
7	1965	76	495000.	LANKY CAR	•	NONE	DIRTY	3
7	1970	76	900000.	LARMY CAN	•	MONE	DIRTY	1
•	1946	74	420000.	LARNY CAN	4	NONE	DIRTY	1
•	1969	62	1170000.	LARRY CAR	•	OTHER	DIRTY	1
4	1472	85	1270000.	LARRY CAR	•	OTHER	DIRTY	2
10	1400	51	150000.	LAHRY CAN	•	NONE	DIRTY	3
10	197€	65	580000.	LANKT CAN	4	NONE	DIKTA	2
10	1974	47	290000.	LARRY CAR	4	NONE	OIRTY	\$
11	1947	21	80000.	LARRY CAR	5	NONE	CLEAN	1

(continued)

TABLE 8 (continued)

PLANT	INST.	NU.	CURE Capacity Tuns/yr	CHARGING	HEIGHT	PUSH	OUENCH	NO. COLL
NU 	UATE	uvtns			(METERS)	COMTHOL	MATER	BAIAN
11	1946	•3	250000.	LANNY CAN	3	NONE	CLEAN	1
11	1955	3.0	120000.	LAHRY CAM	3	NONE	CLEAM	i
15	1964	70	420000.	LANNY CAR	•	HOME	DIRTY	1
13	1962	•1	460000.	LANNY CAN	•	OTHER	CLEAM	1
13	1405	61	460000.	LARHY CAR	•	OTHER	CLEAN	. 1
13	1963	52	200000.	LARHY CAR	•	OTHER	CLEAN	1
13	1964	45	340000.	LAHRY CAN	•	OTHER	CLEAM .	1
13	1972	-13	100000.	LARRY CAR	•	OTHER	CLEAM	1
14	1949	49	440000.	LARRY CAR	•	OTHER	DINTY	1
14	1953	21	240000.	LAHRY CAH	•	DTHER	DINIA	1 .
14	1961	•1	280000.	LARHY CAR	•	OTHER	DIHTY	1
15	1957	7 u	430000.	LARRY CAN	•	OTHER	DINTY	1
15	1957	78	450000.	LARRY CAM	4	OTHER	DISTY	1
15	1970	85	1060000.	LARRY CAR	•	UTHER	DIRTY	1
16	1950	•5	320000.	LAHRY CAR	•	NONE	PTRIO	1
16	1456	#7	460000.	LANRY CAN	•	NONE	DIRTY	1
16	1958	67	460000.	LAHHY CAN	•	NONE	DIRTY	1
10	1458	67	460000.	LANRY CAR	•	NONE	DIRTY	2
10	1970	51	550000.	LAHHY CAR	•	NUNE	DIHTY	1
16	1474	56	910000.	PIPELINE	•	BHED	DINTY	1
16	1978	69	1100000.	PIPELINE	•	ENCLOSED CAR	DIRTY	2
17	1455	57	500000.	LANNY CAN	•	OTHER	CLEAN	1
17	1956	50	320000.	LAHRY CAH	4	NONE	CLEAN	1
17	1457	50	320000.	LARHY CAH	•	NUNE	CLEAN	1
10	1953	79	470000.	LARRY CAR	•	NONE	CLEAN .	1
1.0	1460	59	370000.	LAHNY CAN	•	NONE	CLEAM	. 1
16	1461	59	370000.	LAKHY CAR	4	NONE	CLEAN	1
10	1961	. 59	370000.	LAHRY CAH	•	NUNE	CLEAN	1
10	1461	59	370000.	FUHHA CAH	•	NONE	CLEAN	1.
19	1945	106	590000.	LAHRT CAN	•	NUNE	DIATY	1
19	1446	146	590000.	LANNT CAN	4	NONE	PIRTY	1
19	1451	54	320000.	LANNY CAN	4	NONE	DIHIA	1
19	1476	56	1040000.	PIPELINE	6	SHLD	DINTA	1
٤١	1446	45	<10000.	LARRY CAR	4	NUNE	DIRTY	š
51	1942	45	210000.	LANKY CAN	•	NUNE	DINTY	S
41	1444	45	210000.	LANKY CAK	4	NUNE	DIRTY	Š
51	1453	45	210006.	LANNY CAN	•	NUNE	DINTY	5
\$1	1953	45	210000.	LANNY CAN	•	NUNE	DIRTY	2
51	1460	45	210000.	LARRY CAR	4	NUNE NUNE	DINTA	5
ς I	1460	45	210000.	LANNY CAN	•	NUNE	O I M I I	•
	1444	34	~~~~~~	LANNY CAN	4	NUNE	CLEAN	1

(continued)

PLANT NU	UATE	NU. OVENS	CUKE CAPACITY TUNB/YH	CHANGING	HEIGHT	PUBH CONTROL	QUENCH WATER	MO. COLL Mains
26 	1447	39	220000.	LAHRY CAN	•	NONE	CLEAM	1
	1944 .	40	340000.	LANKY CAN	•	NUNE	DINTY	1
24	1949	30	50000.	LARRY CAR	•	NUNE	DIATY	3
24 24	1950	40	340000.	LAHRY CAR	4	NUNE	· DINTA	1
24	1450	65	440000.	LAHRY CAR	•	NUNE	DIRTY	1
24	1960	59	400000.	LARRY CAR	4	NONE	DIRTY	2
64		•	•				0.024	2
25	1952	6.3	440000.	LARRY CAR	4	NONE	DIRTY .	5
52	1952	6.5	440000.	LARRY CAR	4	NONE	DIKTY	5
52	1957	51	350000.	LAHRY CAH	4	NONE	DIATY	2
52	1958	51	350000.	LARHT CAR	4	NONE	DINTY	ā
52	1950	51	350000.	LARRY CAN	4	NONE	DIRTY	•
26	1976	51	350000.	LARRY CAN	•	NONE	DIRTY	2
21	1955	31	210000.	LARRY CAR	•	NONE	DIHTY	1
	-	15	500000.	LAHRY CAN	•	SHED	CLEAN	1
20	1945	75	300000					
30	1943	65	430000.	LARHY CAR	4	NONE	CLEAM	
54	1952	65	390000.	LARRY CAN	4	NONE	CLEAN	1
29	1965	65	430000.	LARHY CAR	4	NONE	CLEAN	1
E V	,,,,,		•				A1474	2
51	1951	67	550000.	LARRY CAH	•	NONE	DINTY	į
31	1951	87	550000.	LARMY CAR	4	NUNE	DIRTY	•
-•	• • • •				_	NONE	CLEAN	2
35	1924	61	270000.	LANKY CAR	•	NONE	CLEAN	ž
52	1924	61	270000.	LARRY CAR	•	NONE	CLEAN	Ž
35	1450	61	270000.	LAHHY CAR	•	NONE	CLEAN	ā
32	1948	85	360000.	LARRY CAR	3	NONE	CLEAN	Ž
32	1450	61	270000.	LAHHY CAR	•	NONE	CLEAM	Ž.
35	1950	61	270000.	LANNY CAN	•	NONE	CLEAN	Š
35	1454	64	340000.	LANRY CAR		NONE	CLEAN	2
36	1454	. 64	340000.	LAHRY CAR	7	NONE	CLEAN	2
32	1454	64	340000.	LAHRY CAN		NUNE	CLEAN	2
32	1955	64	340000.	LANNY CAN		NONE	CLEAN	2
32	1955	64	340000.	LANNY CAN		NUNE	CLEAN	2
56	1455	64	540000.	LARRY CAR	3	NUNE	CLEAN	5
35	1957	64	340000.	LANKY CAN	7	NONE	CLEAN	2
35	1457	64	340000.	LAHRY CAN	7	NONE	CLEAN	2
32	1450	64	340000.	LANNY CAN	7	NUNE	CLEAN	2
32	1415	67	630000.	LARRY CAR	7	SHED	CLEAN	5
32	1973	67	640000.	LARRY CAR		NUNE	CLEAN	5
52	1976	67	630000.	LANKY CAN		NONE	CLEAN	2
52	1477	67	650000.	LARMY CAR	•			_
		L O	250000.	LANNY CAN	5	NUNE	DINTY	1
5.5	1947	59	230000.	LANNY CAR	3	NUNE	DIRTY	1
5.5	1447	59		LANNY CAN	_	NONE	ALMID	1
3.5	1947	59	230000 •	ERNNI CAN	•	•		

TABLE 8 (continued)

			CURE					
PLANT NU	INST.	NU. UVĖNS	CAPACITY Tuns/YR	CHANGING	HEIGHT (METERS)	PUSH CUNTHOL	QUENCH WATER	MO. COLL. Mains
53	1955		250000.	LANKY CAN	3	NONE	DIRTY	1
33	1955	59	230000.	LANNY CAN	š	NOHE	DINTY	i
33	1956	59	230000.	LANNY CAN	š	NUNE	DINTY	:
33	1957	59	230000.	LANNY CAN	3	NUNE	DINTY	ż
							•	
36	1949	77	350000.	LANNY CAN	5	NUNE	DIRTY	5
36	1951	77	320000.	LAHRY CAR	3	NONE	DIHTY	2
36	1951	77	250000.	LARKY CAR	3	NONE	DIRTY	i
36	1954	77	\$20000.	LAHHY CAR	3	NUNE	DIMIA .	1
36	1454	17	320000.	LAHRY CAR	3	NUNE	DINIA	1
36	1970	85	900000.	LAHHY CAR	•	NONE	DINTA	1
36	1975	57	430000.	REULEA	•	ENCLOSED CAR	DINTA	3
36	1976	51	930000.	HEDLER	•	ENCLUSED CAN	DIRTY	5
19	1952	11	400000	LAHNY CAN		NUNE	CLEAN	•
34	1952	"	400000.	LANNY CAN	ì	NONE	CLEAN	i
39	1950	6.5	400000.	LANNY CAN		NUNE	CLEAM	•
39	1978	57	900000.	HOT L.C.		OTHER	CLEAN	ż
34	1770	31	700000	NOT L.C.	•	UTHER	CLEAN	•
40	1450	6.3	320000.	LARHY CAR	4	NONE	DIRTY	2
40	1950	6.5	320000.	LAHRY CAR	•	NUNE	DINTY	2
40	1950	63	320000.	LANKY CAR	4	NONE	DIRTY	2
40	1950	6.5	320000.	LANNY CAR	•	NONE	DINTA	2
41	1947	53	350000.	LARRY CAR	4	NONE	DIRTY	1
41	1447	53	350000.	LARRY CAR	i i	NONE	DINTY	i
41	1951	61	400000.	LAHHY CAR	T T	NONE	DINTY	i
41	1454	91	∠70000.	LAHHT CAH		NUNE	DINTY	i
41	1956	i	270000.	LARHY CAR		NUNE	DINTY	i
41	1973	•7	1350000.	LAHHY CAR	•	OTHER	CLEAN	į
-			•	_				•
42	1946	53	250000.	LARHY CAR	4	NONE	CLEAN	1
42	1925	6.5	300000.	LANKY CAN	•	NONE	CLEAN	
42	1951	47	180000.	LANNY CAN	3	NONE	CLEAN	3
42	1955	47	180000.	LAHHY CAH	5	NUNE	CLEAN	3
42	1964	51	190000.	LARRY CAR	5	NUNE	CLEAN	i i
42	1976	79	800000.	LARRY CAR	•	NUNE	CLEAN	2
45	1445	74	550000.	LARMY CAN	•	NONE	CLEAN	1
43	1956	19	140000.	LARHY CAN	•	NUNE	CLEAN	1
					a	845B	01474	1
44	1400	45	570000.	LANNY CAN	5	SHED	DINTA	•
45	1454	76	460000.	LANNY CAN	4	NONE	DIRTY	5
45	1455	7 0	460000.	LAHHY CAR	•	NUNE	DINTY	2
45	1958	76	460000.	LAHRY CAR	4	NONE	DIHTY	2
	1452	75	460000.	LANNY CAN	A	NUNE	CLEAN	1
46	1956	75	460000.	FARKA CAN	7	NUNE	CLEAN	i
46		67	-	_		NONE	CLEAN	i
46	1461	01	535000.	LAHHY CAH	-	HUNE	CECAN	•

(continued)

TABLE 8 (continued)

PLANT	1831.	NU.	CURE CAPACITY	CHANGING	HE IGHT	PUSH	QUENCH	NO. COLL
NU	DAIF	UVENS	TUNS/TR		(METENS)	CONTROL	Hatan	BHIAM
45	1473	30	75000.	LARNT CAN	•	NUNE	CLEAN	1
48	1973	50	75000.	LARRY CAR	•	NONE	CLEAN	i
49	1917	••	254000.	LARHY CAR	4	NUME	CLEAN	
49	1941	76	548000.	LAHHY CAH	•	NONE	CLEAN	1
49	1455	24	145000.	PIPELINE	•	NONE	CLEAN	1
50	1443	55	185000.	LANKY CAN	4	OTHER	CLEAN .	1
50	1952	23	120000.	LARHY CAN	•	OTHEN	CLEAN	1
65	1950	35	250000.	LARHY CAR	•	NONE	DIRTY	a a
65	1952	35	250000.	LARHY CAN	•	NUNE	DIATA	S
65	1958	35	250000.	LARHY CAN	•	NONE	DINTY	3
77	1916	24	50000.	LANNY CAN	3	NUNE	DIRTY	1
17	1941	50	56000.	LAHRY CAR	3	NONE	DIRTY	1
61	1962	••	326000.	LARHY CAR	4	NONE	CLEAN	1
45	1953	76	469000.	LARKY CAR	4	NONE	CLEAN	. 1
45	1967	70	797000.	LARRY CAR	5	NONE	CLEAM	1
86	1972	23	82000.	LANNY CAN	4	NUNE	DINTY	1
**	1912	53	82000.	LAHRY CAR	4	NONE	DIRTY	1
87	1950	74	340000.	LARRY CAR	•	NONE	DIRTY	1
••	1408	70	674000.	PIPELINE	•	NONE	CLEAN	1
49	1926	40	119000.	LAHRY CAH	4	NONE	CLEAN	1
••	1429	40	119000,	LARRY CAR	4	NONE	CLEAN	1
44	1941	41	121000.	LAHHY CAH	4	NONE	CLEAN	1
49	1946	. 47	140000.	LAHRY CAN	•	NONE	CLEAN	1
70	1974	40	117000.	LARHY CAN	5	OTHER	DIRTY	1
90	1974	. ••	175000.	LAHRY CAR	3	OTHEN	DIRTY	1
91	1951	51	316000.	LARRY CAR	•	NONE	CLEAN	1
91	1964	50	316000.	LANKY CAN	4	NONE	CLEAN	1
41	1967	50	316000.	LANNY CAN	•	NONE	CLEAN	1
92	1952	U	360000.	LANKY CAR	0	NUNE	DIRTY	1
92	1961	95	56600v.	LARMY CAN	3	BHED	CLEAN	1
95	1919	65 -	192000.	LAHRY CAH	3	NONE	CLEAN	1
94	1956	20	44000.	LAHRY CAR	3	NONE	CLEAN	1
94	1956	40	88000.	LAHHY CAR	3	NONE	CLEAN	1
	1920	17	48000.	LARRY CAR	4	NONE	DINTY	1

(continuea)

TABLE 8 (continued)

PLAN1 NU	INSI. Date	NU.	CURE CAPACITY TUNS/YR	CHARGING	HEIGHT	PUSH CUNTHOL	QUENCH WATER	NO. COLL. Mains
		••••••			**********			***********
45	1450	25	150000.	LAHRY CAH	4	NUNE	DINTY	1
95	1452	25	7900u.	LANNY CAN	4	NONE	DINTY	1
95	1944	20	95000.	LANNY CAN	•	NUNE	DIKTA	1
95	1944	30	102000.	LANKY CAR	4	NONE	DIHTY	3
95	1425	30	120000.	LANKY CAN	4	NONE	· DIRTY	1
45	1969	38	153000.	LARRY CAR	4	NUNE	DINTY	1
96	1956	••	234000.	LANNY CAN	3	NUNE	DIRTY	1
97	1420	60	232000.	LANNY CAN	4	NONE	CLEAN	1
97	1450	6 0	232000.	LARRY CAR	4	NUNE	CLEAN	1
97	1450	50	116000.	LANKY CAN	•	NONE	CLEAN	1
97	1955	30	116000.	LARRY CAR	•	NUNE	CLEAN	1
47	1957	60	232000.	LANNY CAN	4	NUNE	CLEAM	1
98	1951	58	287000.	LARRY CAR	3	NONE	DIATY	1
90	1452	57	282000.	LARRY CAN	3	NONE	DIRIA	1
99	1941	₹5	110000.	LANRY CAN	4	NONE	DIRTY	1
99	1951	29	128000.	LANNY CAR	•	NONE	DIRTY	1
99	1452	25	64000.	LARRY CAR	3	NONE	DINTY	1
••	1964	78	500000.	PIPELINE	•	NONE	DIRTY	1

TOTAL PLANTS 59
TOTAL BATTERIES 216
TOTAL UVENS 12221.
TOTAL CAPACITY 76625.E+03

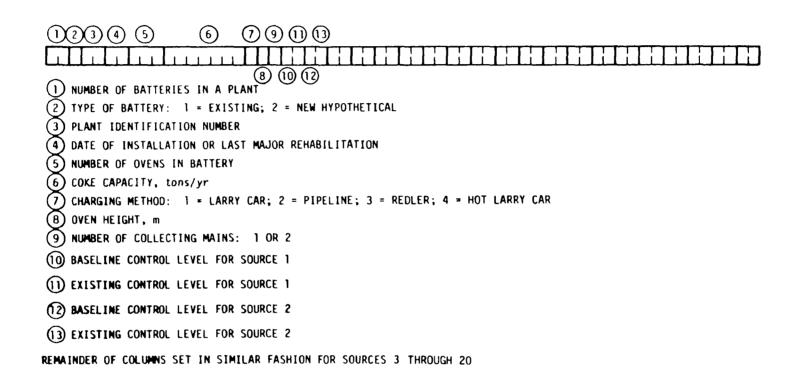


Figure 18. Battery data card format.

TABLE 9. PLANT ID CODES

Plant ID ^a	Company
01	Keystone Coke, Conshohocken, Pa.
02	Armco, Middletown, Ohio
04	Armco, Houston, Tex.
05	Bethlehem, Bethlehem, Pa.
06	Bethlehem, Sparrows Point, Md.
07	Bethlehem, Lackawanna, N.Y.
08	Bethlehem, Johnstown, Pa.
09	Bethlehem, Burns Harbor, Ind.
10	CFI, Pueblo, Colo.
11	Crucible, Midland, Pa.
12	Empire Detroit, Portsmouth, Ohio
13	Ford, Rouge Works, Detroit, Mich.
14	Granite City, Granite City, Ill.
15	Great Lakes Steel, Detroit, Mich.
16	Inland, East Chicago, Ind.
17	Interlake, South Chicago, Ill.
18	J & L, Pittsburgh, Pa.
19	J & L, Aliquippa, Pa.
21	Kaiser, Fontana, Calif.
22	Lonestar Steel, Texas
24	Republic, Mahoning Valley Dist., Ohio
25	Republic, Cleveland, Ohio
27	Republic, Central Alloy Dist., Ohio
28	Republic, South Chicago, Ill.
29	Republic, Gulfsteel, Ala.
31	USS, Fairless Hills, Pa.
32	USS, Homestead Clairton, Pa.
33	USS, Lorain, Cuyahoga, Ohio
36	USS, Gary, Ind.
39	USS, Fairfield, Ala.
40	USS, Geneva, Utah
(continued)	
	• •

TABLE 9 (continued)

Plant ID ^a	Company
41	Weirton Steel, Weirton, W. Va.
42	Wheeling Pitt, Steubenville, Ohio
43	Wheeling Pitt, Monesson, Pa.
44	Wisconsin, South Chicago, Ill.
45	YST, Campbell, Youngstown, Ohio
46	YST, East Chicago, Ind.
48	Indiana Gas, Terre Haute, Ind.
49	Allied, Ironton, Ohio
50	Koppers, Erie, Pa.
65	Shenango, Neville Island, Pa.
77	Chatanooga Coke & Chem., Tenn.
81	Allied, Buffalo, N.Y.
85	Allied, Ashland, Ky.
86	Diamond Shamrock, Painesville, Ohio
87	Eastern Fuel Assoc. Philadelphia, Pa.
88	Allied Chemical, Detroit, Mich.
89	Citizens Gas, Indianapolis, Ind.
90	Milwaukee Solvay, Milwaukee, Wis.
91	Donnar Hanna, Buffalo, N.Y.
92	Missouri Coke, St. Louis, Mo.
93	Koppers, St. Paul, Minn.
94	Empire Coke, Holt, Ala.
95	Koppers, Bessemer, Ala.
96	Sharon, Fairmont, W. Va.
97	Jim Walter, Birmingham, Ala.
98	USS Duluth, Minn.
99	ABC, Tarrant, Ala.

 $^{^{\}rm a}$ Plant ID numbers are not sequential.

battery stacks has not been considered. Also, the number of spare hot cars required in a multibattery plant is less in proportion to capacity than the number at an isolated plant having one battery. Such site-specifics are not considered in this project.

New Versus Existing Batteries

To evaluate projected growth (or decline) in the industry, the user may add battery data cards corresponding to the projected growth, or delete the battery cards for projected retirements.

New battery cards must be filled out even though the data may be speculative. It is not sufficient just to enter simply 10 percent growth; the user must decide, for example, that there will be 10 new batteries by 1985, that they will be 60-oven batteries 6 meters high and that they will be equipped with some specific controls. Only if specific plans for a given plant are known is the plant ID entered. In the case of retirements the user simply removes the battery card from the card deck.

The primary distinction between "new" and "existing" in the model is the use of new or retrofit cost functions.

Existing Installed Equipment

Columns 21 to 60 of the battery data card (Figure 18) are 20 two-digit fields corresponding to the twenty sources considered. Only 16 are now used. The code numbers to be entered in these fields correspond to the control option codes. The first column of each two digit field contains the desired baseline code and the second column contains the existing control code.

Because the control level (control efficiency and exact control equipment) of a given plant may not be the same as those designated in the options used, the user must be careful to select the code for the control option that most closely corresponds to the existing equipment or control program.

In the computer program, the code is used for one of two purposes:

- 1. To correct total industry cost (or total cost for any given industry subset) by eliminating the cost of a control option for those plants where the option is already in use.
- 2. To allow the use of a control baseline (e.g., SIP) whereby only costs above this baseline are considered. The same baseline can be used for every battery. A single card for all batteries can be used to avoid having to enter the same codes on each of the more than 200 battery cards. This card is designated as Control Card 3, described in Section 2.

As an example of the first purpose, assume Battery 1 has already installed a new larry car for stage charging and has good stage charging practice. The card for this battery would then contain a Code 3 in the charging columns (Column 22). Consequently, in the program to determine the cost of charging controls for this plant, the only costs calculated will be those for controls achieving control levels greater than level 3. "Tearout" costs (i.e., for removal of existing controls) are not considered in the present model.

A more complicated example arises when the existing controls achieve an efficiency close to that described in the options but are represented by different hardware. If a battery already has a shed and scrubber, for example, it is probably better to consider this comparable in achieving a given level of control rather than equivalent to the specific hardware configuration. For this reason, the control options are ordered according to degree of efficiency. This permits the user to select the option that achieves the highest level he considers appropriate. The computer will disregard the cost of all options equal to or less than the option selected for the given battery.

The approach in the second purpose is similar, but the concept is different. In this case the user establishes a baseline of control below which control costs are not considered whether installed or not. For example, if the baseline for

charging control is modified larry cars for stage charging, no costs will be calculated for control options achieving control levels below those of larry car modification. The battery card in this case would contain a Code 2 in the charging columns (Column 21). In the extreme, if the highest control option were selected as the baseline for every source, no costs would be calculated. If the user wanted costs for inspection only, they could be obtained by making a computer run with "uncontrolled" as the baseline.

REFERENCES FOR SECTION 6

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SECTION 7

MODEL FORMULATION

The first step in the model is the calculation of total industry control costs. In the discussion of this calculation, mathematical nomenclature has been defined as follows:

i = the emission sou	rce	(i =	1	•	•	•	I)
----------------------	-----	------	---	---	---	---	---	---

$$j = the pollutant$$
 ($j = 1 . . . J$)

$$n = the specific battery$$
 $(n = 1 . . . N)$

E = the annual emissions, in tons/year

C = the annualized cost (or capital cost)

e_{iik} = the control efficiency

 X_n = the capacity of battery n in tons coke/year

 $\text{U}_{\text{ij}} = \text{the uncontrolled emission factor in lbs/ton coal}$ Note that for some sources such as coke handling, X_{n} actually represents capacity for all batteries in a given plant.

Then $C_{\mbox{ijkn}}$ represents a specific dollar value calculated from the general cost function:

$$C_{ijkn} = A_{ijk} X_n^B ijk$$

where A = y intercept, B = slope

Note that
$$C_{ilkn} = C_{i2kn} = C_{i4kn}$$

i.e., the cost of a specific control system does not vary by pollutant.

Similarly,
$$E_{ijkn} = \left[\frac{(100 - e_{ijk})}{100} (U_{ij}) (X_n/.7)\right] / 2000$$

but,
$$E_{i1kn} \neq E_{i2kn} \neq E_{i3kn} \neq E_{i4kn}$$

The C and E matrices are calculated from the input datasets. Note that k=1 will represent no additional control. Therefore, $C_{\mbox{ijln}}=\mbox{zero}$ by definition and

$$E_{iiln} = [(U_{ii})(X_n/.7)] \div 2000$$

The total emission restriction (Mode 2) is entered as an overall percent efficiency, represented by R_j. This will be converted to ρ_j , an annual quantity, by the equation:

$$\rho_{j} = (1 - \frac{R_{j}}{100}) \quad (\sum_{n=1}^{N} \sum_{i=1}^{I} E_{ijn, k = 1})$$

The total cost restriction (Mode 3) will be entered as a total dollar amount, T.

Finally, note that not all i exist for every n. Therefore, the C and E matrices are not full.

The next step is to compress the total C and E matrices to a total industry basis, i.e., eliminate the n dimension. Let C' and E' represent the total industry:

$$C'_{ijk} = \sum_{n=1}^{N} C_{ijkn}$$

Again noting that $C'_{i1k} = C'_{i2k} = C'_{i3k} = C'_{i4k}$

Similarly,

$$E'_{ijk} = \sum_{n=1}^{N} E_{ijkn}$$

and
$$E'_{ijk} \neq E'_{i2k} \neq E'_{i3k} = E'_{i4k}$$

Furthermore, E' can be treated as four separate matrices, E'_{ik} for j = 1, E'_{ik} for j = 2, etc.

The data is now reduced to two simple matrices:

C_{ik} and E_{ik} for each j

To find the optimum combination of controls, consider Mode 2, the restriction being total emissions, ρ_j , and the objective being to find lowest cost. Another matrix, Y, must now be introduced. The values of Y will be either one or zero. A one will indicate that a control option, k, is selected and a zero will indicate that the control option is not selected. The Y matrix is a mathematical device to solve the optimization and has no significance from an engineering standpoint. For example,

let
$$Y_{ik} = Y_{14} = 1$$

this means Control Option 4 on Emission Source 1 is part of the optimum solution.

If this is so, then by definition, all other Y's for source l are zero:

$$Y_{11} = Y_{12} = Y_{13} = Y_{15} = Y_{16} = Y_{1k} = 0$$

That is, a source can only be controlled by one option at a time.

The statement of the problem in matrix form is therefore:

Minimize ΣCY for a given j subject to $\Sigma Y = 1$ for all i and $\Sigma EY \stackrel{\leq}{\circ} \rho$ for a given j and $Y \stackrel{\geqslant}{\circ} 0$ for all i

In expanded form:

minimize
$$C_{11}Y_{11} + C_{12}Y_{12} + \dots + C_{1k}Y_{1k} + C_{21}Y_{21} + \dots + C_{2k}Y_{2k} + \dots + C_{ik}Y_{ik}$$

subject to
$$Y_{11} + Y_{12} + Y_{13} + \dots + Y_{1k} = 1$$

 $Y_{21} + Y_{22} + Y_{23} + \dots + Y_{2k} = 1$, etc. for each i

and:
$$E_{11}^{Y}_{11} + E_{12}^{Y}_{12} + \cdots + E_{1k}^{Y}_{1k} + E_{21}^{Y}_{21} + \cdots + E_{2k}^{Y}_{2k} + \cdots + E_{ik}^{Y}_{ik} \stackrel{\leq}{\sim} \rho_{j}$$

and $Y_{ik} \geqslant 0$ for every i and k

The optimal solution to this problem will be determination of the Y matrix. The Y matrix in turn will define a k value for each i (i.e., a control option for each emission source that will result in the overall minimum cost for meeting a total emission restriction). Note that any given k may equal 1, i.e., no control. In general, the program will select those alternatives which reduce emissions the most and cost the least.

After the optimum solution is found, the Y matrix will be superimposed onto the E matrices for the other pollutants to determine the emissions of the pollutants that were not restricted. To the optimum totals the program will add the costs and emissions for those sources previously excluded from the optimization (by using the No. 2 cards described in Section 1) to get total industry costs and emissions.

The statement for Mode 3 is very similar:

Minimize ΣEY subject to: $\Sigma CY \le T$ and $\Sigma Y = 1$ and $Y \ge 0$

The same approach as described above is used in this case also. Operation of the model in Modes 2 and 3 is identical regardless of whether annualized cost or capital cost is the subject of optimization.

The greatest value of the model is its ability to supply rapid answers to "what if" questions. The model has great flexibility, and its user can easily examine its sensitivity to variations in the emission factors and control costs by simply changing the input data.

Controls for any given emission source can be fixed at a predetermined level and the source can thus be removed from the optimization procedure. The battery data base can be set up to represent all batteries or any subset of batteries. For example, furnace coke producers can be separated from foundry coke producers.

SECTION 8

RESULTS

The function of the model is to calculate emissions and emission control costs and to select a set of controls that will meet a given emission restriction at the lowest cost. Conceptually, this is as if the "bubble concept" were applied to all the coke plants in the United States. Section 2 describes the many variations of the basic scheme.

An example best illustrates the logic of the model. The data base for this example consists of the 216 coke oven batteries presented in Section 6, the uncontrolled emission factors presented in Table 1, and the control options and their efficiencies presented in Table 2. Annualized and capital cost functions associated with the control options are shown in Appendix A.

Figure 19 is a graphic presentation of the capital cost functions for the three control options applicable to Source 1, wet coal charging. These values are based on tons of coke capacity for a 60-oven battery. An increase in the number of ovens would increase the cost because certain elements of the capital cost (e.g., steam lines and number of standpipes) are directly proportional to the number of ovens. Every cost function represented in Appendix A could be plotted as shown on Figure 19.

Figure 20 shows the annualized cost per pound of particulate removed for the same three options. The spacing of the curves is related to both the relative costs of the options and the relative efficiencies. Although Option 3 is more costly than Option 2, the curves are very close because the efficiency of

Option 3 is 99 percent compared with only 80 percent for Option 2. The 99.5 percent efficiency of Option 4, on the other hand, represents an improvement of only 0.5 percent over Option 3, but the cost is much higher. Each option for each source could be analyzed in a similar manner.

Table 10 presents the capital and annualized cost matrix calculated for the present data base. Table 11 presents the uncontrolled emissions matrix. These matrices and the appropriate control efficiencies could be used to generate curves like those in Figures 19 and 20 for each source.

The function of the optimization model is to analyze all such curves and find the lowest cost combinations. In this section, the examples deal with minimizing annualized cost, but the approach is identical for capital cost. Table 12 is the model output for a case of no control on any source. This provides a convenient frame of reference for uncontrolled emission quantities. The table shows that pushing is the largest single source of uncontrolled particulate emissions, although the total of quenching (with clean water and with dirty water) is slightly larger. Charging is by far the largest single source of both BSO and benzene emissions.

Table 13 is the model output to meet a restriction calling for an overall particulate control at least 95 percent efficiency, which requires the highest possible control level on every source except dry coal charging and the byproducts plant. The latter two are excluded from the solution by the model because their contributions to particulate emissions are very low; in fact, particulate emissions from the byproducts plant are zero. Total annualized costs for the industry are \$1,396,000,000 and total capital costs (retrofit) are \$2,887,000,000. It should be noted that the model seeks to minimize annualized costs in the examples presented in this section. In this example the costs do not take into account any control that may already exist, as indicated by the baseline notation in the tables. That is, the costs are theoretical costs based on no controls on any battery.

TABLE 10. TOTAL CAPITAL AND ANNUALIZED COSTS FOR CONTROL OPTIONS (in millions of dollars)

Source/control option	Total capital cost	Total annualized cost
Wet coal charging		
Modified larry car	91	124
New larry car	304	165
New larry car and second main	649	254
Coke pushing		
Controlled coking	0	99 3
Shed + ESP with 95% eff.	905	295
Shed + scrubber with 95% eff.	1277	4 89
Enclosed hot car	1164	314
Shed + ESP with 99% eff.	973	307
Shed + scrubber with 99% eff.	1330	538
Quenching, clean water		
Conventional baffles	7	2.4
Diverted flow baffles	53	14
Dry quenching	424	111
Doors		
Cleaning and maintenance	0	174
High pressure water cleaning	90	189
Hoods + scrubber with 95% eff.	386	464
Hoods + scrubber with 98% eff.	439	481
Topside		
Luting and cleaning	0	57
Luting, cleaning, and maintenance	0	109
New lids	22	63
Combustion stack, old		
Oven patching	0	89
Dry ESP with 90. eff.	411	153
Dry ESP with 98, eff.	544	176
Fabric filter with 98% eff.	32 3	112

(continued)

TABLE 10 (continued)

Source/control option	Total capital cost	Total annualized cost
Coke handling Enclosures + fabric filter	40	17
Coal preheater Scrubber with 95% eff. Dry ESP with 95% eff. Scrubber with 98% eff. Dry ESP with 99% eff.	11.7 10.5 12.1 12.7	9 5 10 6
Coal preparation Enclosures + fabric filter	29	13
Coal storage Water spray truck Unloading sprays + spray truck Coal pile sprays	17 30 148	8 11 69
Pipeline charging Operating and maintenance program	o	3
Redler charging Operating and maintenance program	0	0.7
Hot larry car charging Operating and maintenance program	0	0.3
Byproduct plant Maintenance program	0	17
Combustion stack, new Oven patching	0	20
Quenching, dirty water Conventional baffles Clean water + conventional baffles Clean water + diverted flow baffles Dry quenching	9 278 341 800	3.5 168 184 251

105

TABLE 11. TOTAL UNCONTROLLED EMISSIONS (tons/year)

	Pollutant Pollutant									
Emission source	Particulates	BSO	BaP	Benzene						
Wet coal charging	49,600	54,600	100	24,800						
Coke pushing	109,500	4,400	2	330						
Quenching with clean water	41,000	41	3	1						
Doors	21,900	27,400	164	1,100						
Topside	10,900	13,700	55	274						
Combustion stack, old	43,800	225	2	0						
Coke handling	54,700	0	0	0						
Coal preheater	35,900	5,400	2	71						
Coal preparation	27,400	0	0	0						
Coal storage	3,200	0	0	0						
Pipeline charging	50	60	a	25						
Redler charging	13	8	a	7						
Hot larry car charging	11	12	a	5						
Byproducts plant	0	16,400	0	10,900						
Combustion stack, new	2,200	10	a	0						
Quenching with dirty water	97,900	196	10	8						

aLess than one ton per year.

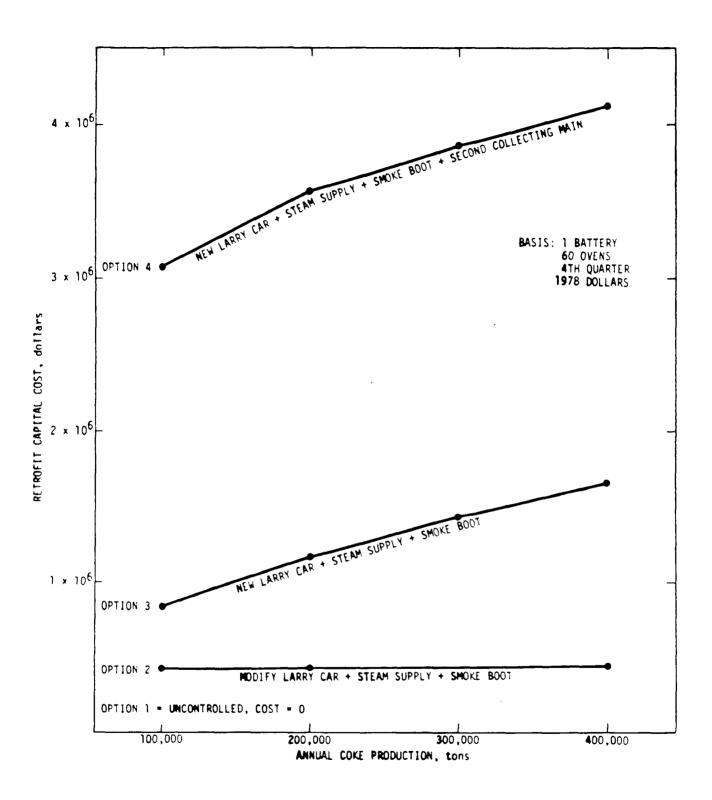


Figure 19. Capital cost of control options for wet coal charging.

Figure 20. Cost per pound of particulate removal for control options for wet coal charging.

TABLE 12. MODEL OUTPUT FOR BASELINE OF NO CONTROL

COKE OVEN OPTIMIZATION

OBJECTIVE: MINIMUM ANNUALIZED COST RESTRICTION: .02 OVERALL EFFICIENCY POLLUTANT: BSO BASE YEAR 1979
BASELINE: ASSUMING NO SIP OR EXISTING CONTROLS

	CONTROLLED EMISSION (LDS/TOW COAL)				HISSIONS	3 (TOMB/Y	EAR)			CONTROLLED COST (MILLION DOLLARS)		
SOURCE	TSP	BSO	BAP	DEN	TSP	BSO	BAP	BEN	CONTROL SCHEME	CAPITAL	ANNUAL I ZED	
LARRY CAR CHARGING	41'.00	1.1000	.0020	.5000	49635	34599	99	24817	UNCONTROLLED	.0	.0	
COKE PUSHING	₩2.00	.0800	.0000	.0060	109463	4378	2	328	UNCONTROLLED	.0	.0	
QUENCHING - CLEAN WATER	#1.70	.0017	.0001	.0000	41049	41	3	0	UNCONTROLLED	.0	.0	
DOORS	■ .40	.5000	.0030	.0200	21892	27365	164	1094	UNCONTROLLED	.0	.0	
TOPSIDE	.20	.2500	.0010	.0050	10946	13682	54	273	UNCONTROLLED	.0	-0	
COMBUSTION STACK - OLD	81.30	.0060	.0001	.0000	48840	225	2	0	UNCONTROLLED	.0	.0	
COKE HANDLING	#1.00	.0000	.0000	.0000	54731	0	0	0	UNCONTROLLED	.0	.0	
COAL PREHEATER	#7.05	1.0500	.0004	.0140	35925	5350	1	71	UNCONTROLLED	.0	.0	
COAL PREPARATION	₩ .50	.0000	.0000	.0000	27365	0	0	0	UNCONTROLLED	.0	.0	
COAL STORAGE YARD	.15	.0000	.0000	.0000	8209	0	0	0	UNCONTROLLED	.0	.0	
PIPELINE CHARGING	● .02	.0190	.0000	.0080	49	59	0	24	UNCONTROLLED	.0	.0	
REDLER CHARGING	.01	.0060	.0000	.0049	13	7	0	6	UNCONTROLLED	.0	.0	
HOT LARRY CAR CHARGING	₽ .02	.0190	.0000	.0080	10	12	0	5	UNCONTROLLED	.0	.0	
BY-PRODUCTS PLANT	■ .00	.3000	.0000	.2000	0	16419	0	10946	UNCONTROLLED	.0	.0	
CONBUSTION STACK - NEW	.13	.0006	.0000	.0000	2231	10	0	0	UNCONTROLLED	.0	.0	
QUENCHING - DIRTY WATER	#3.20	.0064	.0003	.0003	97871	195	9	7	UNCONTROLLED	.0	.0	
*****				4 n 4	F00070	100740	777	11511				
TOTAL UNC.	7.3	2.235	.006	.000	509238 388402	76172	33 <i>7</i> 254	37577 17656		297.5	197.1	
EXISTING CONTROL						37.7		53.0		277.3	177.1	
EXISTING EFFICIENCY					23.6		24.6 337	37577			•	
BASELINE CONTROL					508237		.0			0	.0	
BASELINE EFFICIENCY					.0 508238	122740		.0 37577		.0	.0	
TOTAL CONTROLLED							337 .0	3/3//		.0	٠,٧	
PERCENT CONTROLLED					.0	.0	.0	.0				

EXISTING
TOTAL BATTERIES 216 TOTAL OVENS 12221 TOTAL BATTERIES O TOTAL OVENS
TOTAL CAPACITY 109494267 TONS COAL

76623000 TONS COKE

NEW
TOTAL CAPACITY O TOTAL OVENS COAL
TOTAL CAPACITY O TONS COAL
O TONS COKE

N NOT IN OPTIMIZATION

TABLE 13. MODEL OUTPUT FOR 95 PERCENT OVERALL PARTICULATE REDUCTION

COKE OVEN OPTIMIZATION

OBJECTIVE: NININUM ANNUALIZED COST RESTRICTION: 95.0% OVERALL EFFICIENCY POLLUTANT: TSP

BASE YEAR 1979
BASELINE: ASSUMING NO SIP OR EXISTING CONTROLS

		(LBS/T	CONTRO ON COAL		HISSIONS (TONS/YEAR)					COMTROLLED COST (MILLION DOLLARS)		
SOURCE	TSP	990	BAP	DEN	TSP	990	BAP	DEN	CONTROL SCHEME	CAPITAL	ANNUALIZED	
LARRY CAR CHARGING	.01	.0055	.0000	.0025	248	272	0	124	NEW CAR, SECOND MAIN	649.3	253.6	
COKE PUSHINB	.22	.0440	.0000	.0033	11931	2408	1	180	ENCLOSED HOT CAR	.0	.0	
QUENCHING - CLEAN WATER	.03	.0000	.0000	.0000	820	0	0	0	DRY QUENCHING	423.9	111.4	
DOORS	.03	.0810	.0005	.0056	1466	4433	26	306	DOOR HOOD, SCRUBBER 98%	439.1	481.1	
TOPSIDE	.01	.0075	.0000	.0002	328	410	1	8	NEW LIDS & CASTINGS	21.8	63.0	
COMBUSTION STACK - OLD	.03	.0030	.0000	.0000	976	112	1	0	BAGHOUSE, 98%	323.2	111.6	
COKE HANDLING	.11	.0000	.0000	.0000	5965	0	0	0	ENCLOSURES + BAGHOUSE	40.0	16.5	
COAL PREHEATER	.07	.5250	.0002	.0070	359	2675	. 0	35	ESP 99%	12.7	5.8	
COAL PREPARATION	.02	.0000	.0000	.0000	820	0	0	0	ENCLOSURE + BAGHOUSE - 99%	29.1	12.7	
COAL STORAGE YARD	.02	.0000	.0000	.0000	820	0	0	0	COAL PILE BPRAYS	147.9	68.6	
PIPELINE CHARBING	.02	.0190	.0000	.0080	49	59	0	24	UNCONTROLLED	.0	.0	
REDLER CHARGING	.01	.0060	.0000	.0049	13	7	0	6	UNCONTROLLED	.0	.0	
NOT LARRY CAR CHARBINS	.02	.0190	.0000	.0080	10	12	0	5	UNCONTROLLED	.0	.0	
BY-PRODUCTS PLANT	.00	.3000	.0000	.2000	0	16419	0	10946	UNCONTROLLED	.0	.0	
COMBUSTION STACK - NEW	.03	.0001	.0000	.0000	446	2	0	0	OVEN PATCHING	.0	20.1	
QUENCHING - DIRTY WATER	.03	.0001	.0000	.0000	978	1	0	0	DRY QUENCHING	799.5	251.4	
TOTAL UNC. Existing Control	9.3	2.235	.006	.686		76172	337 254	37577 17656		297.5	197.1	
EXISTING EFFICIENCY					23.6	37.7	24.6	53.0				
DASELINE CONTROL						122348	337	37577		.0	.0	
BASELINE EFFICIENCY					.0	.0	.0	.0		2004 4	4705 8	
TOTAL CONTROLLED					25238		32	11638		2886.6	1395.8	
PERCENT CONTROLLEB					95.0	78.1	90.5	69.0				

EXISTING	NEU						
TOTAL BATTERIES 216 TOTAL OVENS 12221	TOTAL BATTERIES 0	TOTAL OVENS	0				
TOTAL CAPACITY 109494267 TONS COAL	TOTAL CAPACITY	O TOWS COAL					
76623000 TONS COKE		O TONS COKE					

NOT IN OPTIMIZATION

When dry quenching is selected as the control for quenching emissions, no cost is assigned to the enclosed car option for pushing emissions because the equivalent of an enclosed car is included in the cost of the dry quenching system. For small batteries (less than 100,000 tons of coke per year) further examination of the cost functions for dry quenching is required because they are not necessarily applicable in this small size range. If a shed is selected as the control option for pushing emissions, the cost of door hoods is reduced to the extent that they are not used on the coke-side doors. Otherwise there would be a double accounting of the control cost for coke-side doors.

Cost is overstated when the options selected include a scrubber and wastewater recirculation. This occurs because each battery is treated independently. An example would be a plant with four batteries, on which both door hoods and a wastewater recirculation system are provided for each battery. In such a scheme it is likely that one common water system could be installed to serve all four batteries for less than the cost of four separate water systems. Similarly, if a shed and scrubber were installed for control of pushing emissions and coke-side door emissions and a hood system was installed for pusher-side doors, the water system (and perhaps the scrubber itself) could be designed to handle both sources.

Although the existing model could be modified to address these issues, specific assumptions would be required.

Tables 14, 15, and 16 represent the model output for the same kind of problem except that the control efficiency restrictions are set at 80, 85, and 90 percent, respectively. In these cases, certain sources can use lower-level control schemes, and the total cost is decreased. Figure 21 shows total cost as a function of efficiency, based on the results shown on Tables 13 through 16.

TABLE 14. MODEL OUTPUT FOR 80 PERCENT OVERALL PARTICULATE REDUCTION

COKE OVEN OPTIMIZATION

OBJECTIVE: MINIMUM ANNUALIZED COST RESTRICTION: 80.0% OVERALL EFFICIENCY POLLUTANT: TSP BASE YEAR 1979
BASELINE: ASSUMING NO SIP OR EXISTING CONTROLS

		/1 BC /T	CONTRO		HISSION				CONTROLLED COST (MILLION DOLLARS)		
		(185/1	UM LUAL	,		(TOMS/Y	EAKI			(MILEIU	M DOCLARS)
SOURCE	TSP	BSO	BAP	BEN	TSP	390	BAP	BEN	CONTROL SCHEME	CAPITAL	ANNUALIZED
LARRY CAR CHARGING	. 20	.2200	.0004	.1000	9927	10919	19	4963	MODIFIED CAR, STEAM, BOOT	90.6	124.0
COKE PUSHING	.22	.0440	.0000	.0033	11931	2408	1	180	SHED + ESP 99%	972.9	307.0
QUENCHING - CLEAN WATER	.17	.0002	.0000	.0000	4104	4	0	0	DIVERTED FLOW BAFFLES	58.0	14.0
900RS	.40	.5000	.0030	.0200	21892	27365	164	1094	UNCONTROLLED	.0	.0
TOPSIDE	.20	.2500	.0010	.0050	10946	13682	54	273	UNCONTROLLED	.0	.0
COMBUSTION STACK - OLD	.03	.0030	.0000	.0000	976	112	•	0	BAGHOUSE, 98%	323.2	111.6
COKE HANDLING	.11	.0000	.0000	.0000	5965	0	0		ENCLOSURES + BABHOUSE	40.0	16.5
COAL PREHEATER	.07	.5250	.0002	.0070	359	2675	0	35	ESP 991	12.7	5.0
COAL PREPARATION	.02	.0000	.0000	.0000	820	0	0	0	ENCLOSURE + BAGHOUSE - 99%	29.1	12.7
COAL STORAGE YARD	.04	.0000	.0000	.0000	2052	0	0	0	UNLOAD SPRAYS + WATER TRUCK	29.6	11.4
PIPELINE CHARGING	.02	.0190	.0000	.0080	49	59	0	24	UNCONTROLLED	.0	.0
REDLER CHARGING	.01	.0060	.0000	.0049	13	7	0	6	UNCONTROLLED	.0	.0
HOT LARRY CAR CHARGING	.02	.0190	.0000	.0080	10	12	0	5	UNCONTROLLED	.0	.0
BY-PRODUCTS PLANT	.00	.3000	.0000	.2000	0	16419	0	10946	UNCONTROLLED	.0	.0
COMBUSTION STACK - NEW	.13	.0006	.0000	.0000	2231	10	0	0	UNCONTROLLED	.0	.0
QUENCHING - DIRTY WATER	.96	.0019	.0001	.0003	29361	58	2	7	BAFFLES	7.3	3.5
707AL 11M6		0 376	001	404	FADO70	422340	•••	7			
TOTAL UNC.	y.3	2.235	.006	. 686	509238		337	37577		207 6	467 (
EXISTING CONTROL					388402		254	17656		297.5	197.1
EXISTING EFFICIENCY					23.6	37.7	24.6	53.0			•
BASELINE CONTROL						122348	337	37577		.0	.0
BASELINE EFFICIENCY					0.	.0	.0	.0		1848 -	404 5
TOTAL CONTROLLED					100644	73737	245	17539		1565.3	606.5
PERCENT CONTROLLED					80.2	39.7	27.3	53.3			

EXISTING	NEU						
TOTAL BATTERIES 216 TOTAL OVENS 12221	TOTAL BATTERIES O TOTAL	OVENS 0					
TOTAL CAPACITY 109494267 TOMS COAL	TOTAL CAPACITY 0 T	ONS COAL					
76623000 TONS COKE	0 т	ONS COKE					

N NOT IN OPTIMIZATION

TABLE 15. MODEL OUTPUT FOR 85 PERCENT OVERALL PARTICULATE REDUCTION

COKE OVEN OPTIMIZATION

ODJECTIVE: MINIMUM ANNUALIZED COST RESTRICTION: 85.0% OVERALL EFFICIENCY POLLUTANT: TSP

BASE YEAR 1979
BASELINE: ASSUMING NO SIP OR EXISTING CONTROLS

			CONTRO	LLED E	MISSION	S				CONTROLLED COST			
		(LBS/T	ON COAL			(TOMS/)	(EAR)				M DOLLARS)		
SOURCE	TSP	BSO	BAP	BEN	TSP	350	BAP	BEN	CONTROL SCHEME	CAPITAL	ANNUALIZED		
LARRY CAR CHARBING	. 20	.2200	.0004	.1000	9927	10919	19	4963	MODIFIED CAR, STEAM, BOOT	90.6	124.0		
COKE PUSHING	.22	.0440	.0000	.0033	11931	2408	1		SHED + ESP 99%	972.9	307.0		
QUENCHING - CLEAN WATER	.17	.0002	.0000	.0000	4104	4	0	0	DIVERTED FLOW BAFFLES	58.0	14.0		
DOORS	.40	.5000	.0030	.0200	21892	27365	164	1094	UNCONTROLLED	.0	.0		
TOPSIDE	.20	.2500	.0010	.0050	10946	13682	54	273	UNCONTROLLED	.0	.0		
COMBUSTION STACK - OLD	.03	.0030	.0000	.0000	976	112	1	0	DAGHOUSE, 98%	323.2	111.6		
COKE HANDLING	.11	.0000	.0000	.0000	5965	0	0	0	ENCLOSURES + BAGHOUSE	40.0	16.5		
COAL PREHEATER	.07	.5250	.0002	.0070	359	2675	0	35	ESP 99%	12.7	5.8		
COAL PREPARATION	.02	.0000	.0000	.0000	820	0	0	0	ENCLOSURE + BAGHOUSE - 99%	29.1	12.7		
COAL STORAGE YARD	.04	.0000	.0000	.0000	2052	0	0	0	UNLOAD SPRAYS + WATER TRUCK	29.6	11.4		
PIPELINE CHARGING	.02	.0190	.0000	.0080	49	59	0	24	UNCONTROLLED	.0	.0		
REDLER CHARGING	.01	.0060	.0000	.0049	13	7	0	6	UNCONTROLLED	.0	.0		
NOT LARRY CAR CHARBING	.02	.0190	.0000	.0080	10	12	0	5	UNCONTROLLED	.0	.0		
BY-PRODUCTS PLANT	.00	.3000	.0000	.2000	0	16419	0	10946	UNCONTROLLED	.0	.0		
COMBUSTION STACK - NEW	.13	.0006	.0000	.0000	2231	10	0	0	UNCONTROLLED	.0	.0		
QUENCHING - DIRTY WATER	.16	.0010	.0000	1000.	4893	29	1	1	CLEAN WATER, BIV. FLOW BAFFLES	341.1	183.6		
••••			•••		500070	400740		****					
TOTAL UNC.	9.3	2.235	.006	. 686	508238		337	37377		207 5			
EXISTING CONTROL					388402		254	17656		297.5	197.1		
EXISTING EFFICIENCY					23.6	37.7	24.6	53.0			•		
BASELINE CONTROL						122348	337	37577		.0	.0		
BASELINE EFFICIENCY					.0	.0	.0	.0			30/ /		
TOTAL CONTROLLED					76176	73707	244	17533		1897.1	786.6		
PERCENT CONTROLLED					85.0	39.8	27.6	53.3					

EXISTING	NEU						
TOTAL BATTERIES 216 TOTAL OVERS 12221	TOTAL BATTERIES 0	TOTAL OVENS	0				
TOTAL CAPACITY 109494267 TOWS COAL	TOTAL CAPACITY	O TONS COAL					
76623000 TONS COKE		O TONS COKE					

N NOT IN OPTIMIZATION

TABLE 16. MODEL OUTPUT FOR 90 PERCENT OVERALL PARTICULATE REDUCTION

COKE OVEN OPTIMIZATION

OBJECTIVE: MINIMUM ANNUALIZED COST RESTRICTION: 90.0% OVERALL EFFICIENCY POLLUTANT: TSP

BASE YEAR 1979
BASELINE: ASSUMING NO SIP OR EXISTING CONTROLS

			CONTRO	LLED E	MISSION	S				CONTROLLED COST		
		(LBS/T	ON COAL	.)		(TOMS/)	(EAR)				N BOLLARS)	
SOURCE	TSP	BSO	BAP	BEN	TSP	890	BAP	BEN	CONTROL SCHEME	CAPITAL	ANNUALIZED	
LARRY CAR CHARGING	.01	.0110	.0000	.0050	496	545	0	248	NEW CAR, STEAM, BOOT	303.6	164.7	
COKE PUSHING	.23	.0408	.0000	.0031	12366	2234	1	167	ENCLOSED HOT CAR	429.2	135.4	
QUENCHING - CLEAN WATER	.17	.0002	.0000	.0000	4104	4	0	0	DIVERTED FLOW BAFFLES	58.0	14.0	
DOORS	.40	.5000	.0030	.0200	21892	27365	164	1094	UNCONTROLLED	.0	.0	
TOPSIDE	.01	.0075	.0000	.0002	328	410	1	8	NEW LIDS & CASTINGS	21.8	63.0	
COMBUSTION STACK - OLD	.03	.0030	.0000	.0000	976	112	1	0	BAGHOUSE, 98%	323.2	111.6	
COKE HANDLING	.11	.0000	.0000	.0000	5965	0	0	0	ENCLOSURES + DAGHOUSE	40.0	16.5	
COAL PREHEATER	.07	.5250	.0002	.0070	359	2675	0	35	ESP 99%	12.7	5.8	
COAL PREPARATION	.02	.0000	.0000	.0000	820	0	0	0	ENCLOSURE + BAGHOUSE - 99%	29.1	12.7	
COAL STORAGE YARD	.04	.0000	.0000	.0000	2052	0	0	0	UNLOAD SPRAYS + WATER TRUCK	29.6	11.4	
PIPELINE CHARGINB	.02	.0190	.0000	.0080	49	59	0	24	UNCONTROLLED	.0	.0	
REDLER CHARGING	.01	.0060	.0000	.0049	13	7	0	6	UNCONTROLLED	.0	.0	
HOT LARRY CAR CHARGING	.02	.0190	.0000	.0080	10	12	0	5	UNCONTROLLED	.0	.0	
BY-PRODUCTS PLANT	.00	.3000	.0000	.2000	0	16419	0	10946	UNCONTROLLED	.0	.0	
COMBUSTION STACK - NEW	.03	.0001	.0000	.0000	446	2	0	0	OVEN PATCHING	.0	20.1	
QUENCHING - DIRTY WATER	.03	.0001	.0000	.0000	978	1	0	0	DRY QUENCHING	799.5	251.4	
**************************************		2 215	221	404	E00270	122740		17877				
TOTAL UNC.	7.3	2.235	.006	.000	508238		337	37577		207 €	407.4	
EXISTING CONTROL						76172 37.7	254	17656		297.5	197.1	
EXISTING EFFICIENCY					23.6		24.6	53.0		•		
DASELINE CONTROL						122348	337	37577		.0	.0	
BASELINE EFFICIENCY					.0 50862	.0 49851	.0 170	.0 12538		. 2046.8	004 4	
TOTAL CONTROLLED					90.0	59.3				, 2V40.8	806.6	
PERCENT CONTROLLED					70.0	JY.3	49.6	66.6				

EXISTINO	NEU						
TOTAL BATTERIES 216 TOTAL OVENS 12221	TOTAL BATTERIES 0 TOTAL OVENS	0					
TOTAL CAPACITY 109494267 TOMS COAL	TOTAL CAPACITY 0 TONS COAL						
76623000 TOWS COKE	O TOWS COKE						

NOT IN OPTIMIZATION

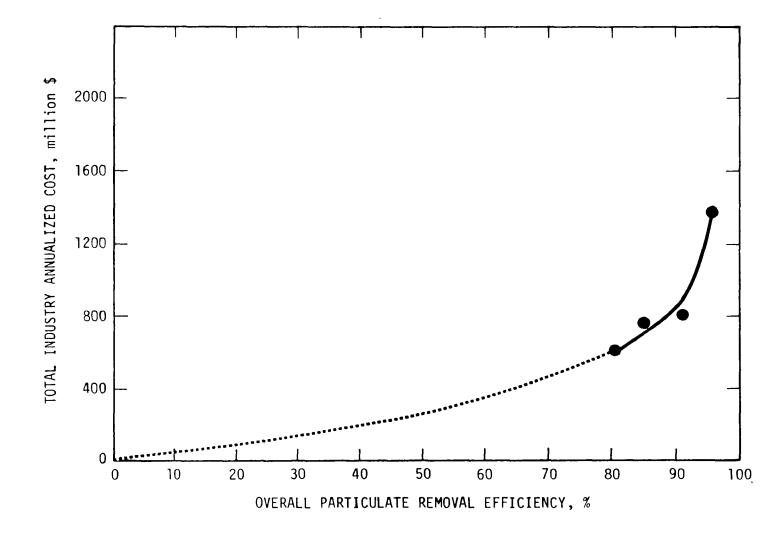


Figure 21. Total annualized cost as a function of overall efficiency.

Clearly these examples represent only a few of the cases that can be evaluated. Furthermore, the results for other pollutants and emission factors, control cost functions, and battery subsets have not been examined. These are among the many possibilities that remain for the users of the model.

APPENDIX A

EXAMPLE COMPUTER PRINTOUTS FOR COST FUNCTIONS PRESENTLY INCLUDED IN MODEL

Complete and detailed printouts for each control option have been provided to the Project Officer as data supplements for the three plant sizes. Table A-l is a summary of all the cost functions. This appendix also includes summary pages for each control option for the large plant. Each set of pages is arranged in ascending order according to source number and control option number (as indicated at the top of every page). The first page contains general information and the second page describes the control system. The third page summarizes the capital cost (if applicable) and the fourth page summarizes the annualized cost.

TABLE A-1. COST FUNCTION COEFFICIENTS FOR CONTROL OPTIONS^a (cost in fourth quarter 1978 dollars)

				<u>stallation</u> ,				stallation	
Source control option	Basis	Capital	cost	Annualize		Capita		Annualize	
fi X vi				coefficient		coefficient		coefficient	
- 	X value	Α	В	A	В	A	В	A	В
Wet coal charging	Battery		i						
Modified larry car	1	290,539.2	0.0250	227,751.9	0.0762	319,187.0	0.0251	230,194.8	0.0761
New larry car		2,784.7	0.4882	68,022.8	0.1934	3,064.5	0.4882	63,015.2	0.2014
New larry car & second main	1	326,894.4	0.1935	341,620.2	0.1117	293,877.1	0.2046	320,512.5	0.1178
Coke pushing	Battery				ļ				
Controlled coking		l 0	1 0	25.7	0.9593	0	0	25.7	0.9593
Shed and ESP, 95%		17,498.8	0.4228	3,177.5	0.4737	22,052.2	0.4141	3,659.2	0.4670
Shed and scrubber, 95%		25,028.5	0.4223	7,752.5	0.4439	30,128.9	0.4166	8,519.4	0.4403
Enclosed hot car		423,778.8	0.1938	70,214.2	0.2354	466,163.3	0.1938	76,212.7	0.2332
Shed and ESP, 99%	i	14,710.7	0.4422	2,907.6	0.4836	18,452.7	0.4337	3,345.8	0.4771
Shed and scrubber, 99%		23,357.7	0.4310	5,243.8	0.4823	28,061.2	0.4254	5,825.5	0.4776
Quenching, clean water	Plant						 .		
Conventional baffles	1	1.7	0.8412	0.4	0.8750	2.1	0.8412	0.4	0.8707
Diverted flow baffles	i	82.6	0.7119	9.5	0.7714	107.5	0.7119	12.7	0.7621
Dry quenching ^b		771.8	0.7065	87.6	0.7683	848.9	0.7065	96.8	0.7651
• ,	\	/ //	0.7003	, 07.0	0.7003) 040.3	0.7003	, ,,,,	0.7031
loors .	Battery	1	l	}		ì	1		i
Cleaning and maintenance	l	0	0	804,801.2	0	0	0	804,801.2	0
High pressure water cleaning		414,499.8	0	876,701.5	0	414,499.8	0	876,701.5	0
Door hoods, scrubber, 95,	1	18,558.0	0.3453	954,615.0	0.0624	21,613.0	0.3487	880,426.2	0.0708
Door hoods, scrubber, 98%	1	21,562.1	0.3441	879,789.9	0.0715	25,298.2	0.3465	812,304.1	0.0800
Door hoods, scrubber, 95 one side		13,431.0	0.3409	106,371.0	0.0431	15,000.0	0.3443	998,158.0	0.0496
Door hoods, scrubber, 98, one side	1	11,682.0	0.3620	863,212.0	0.0614	13,625.0	0.3638	808,202.0	0.0682
opside	Battery					ļ			
Luting and cleaning	1	0	0	264,900.1	0	0	0	264,900.1	0
Luting, cleaning, and maintenance	1	0	0	503,300.4	0	0	0	503,300.4	0
New lids, luting, and cleaning		81,100.0	0	300,799.9	0	105,399.9	0	304,299.8	0
ombustion stack, old	Battery					}			}
Oven patching	1	0	0	503,300.4	0	0	0	503,300.4	0
Dry ESP, 90%	I	2,534.3	0.5283	5,373.4	0.3994	2,976.1	0.5306	5,061.8	0.4101
Dry ESP, 98%	l	2,609.3	0.5484	3,989.6	0.4333	3,085.1	0.5500	3,800.7	0.4440
Fabric filter, 98%	1	418.3	0.6518	551.5	0.5543	515.9	0.6504	546.8	0.5616

(continued)

TABLE A-1 (continued)

				stallation				stallation	
Source control option	Basis			Annualized cost coefficient		Capital cost coefficient		Annualiz	
	for X value		T R	COETTI	Clent B	Coeff11	Cient B	coeffi A	cient B
			 						В
Coke handling Enclosures and fabric filters	Plant	196.0	0.5789	111.2	0.5612	207.7	0.5823	112.9	0.5629
Coal preheater Scrubber, 95% Dry ESP, 95% Scrubber, 98% Dry ESP, 99%	Battery	2,083.4 1,869.5 2,051.3 1,944.9	0.4691 0.4688 0.4724 0.4799	131,626.3 52,969.1 102,188.8 41,863.8	0.1515 0.1785 0.1719 0.2006	2,244.9 2,007.5 2,211.2 2,095.3	0.4704 0.4702 0.4737 0.4811	123,839.7 49,467.6 96,494.4 38,805.0	0.1574 0.1855 0.1755 0.2084
Coal preparation Enclosures and fabric filter	Plant	682.6	0.4686	2,893.9	0.3108	693.2	0.4746	2,710.6	0.3180
Coal storage Water spray truck Water spray truck and unloading sprays Coal pile sprays	Plant	159,450.1 314,191.3 42.5	0.0341 0.0245 0.7780	76,052.9 101,422.0 13.4	0.0428 0.0443 0.8097	179,919.7 372,093.4 53.3	0.0336 0.0231 0.7695	79,334.9 110,347.1 14.8	0.0422 0.0424 0.8055
Pipeline charging Operating and maintenance program	Battery	0	0	539,800.0	0	0	0	593,800.0	0
Redler charging Operating and maintenance program	Battery	0	0	358,100.3	0	0	0	358,100.3	0
Hot larry car charging Operating and maintenance program	Battery	0	0	264,900.1	0	0	0	264,900.1	0
Byproducts plant Maintenance program	Plant	0	0	300,000.0	0	0	0	300,000.0	0
Combustion stack, new oven patching	Battery	0	0	503,300.4	0	0	0	503,300.4	0
Quenching, dirty water Conventional baffles Conventional baffles and clean water	Plant	1.7	0.8412	0.3	0.8944	2.1	0.8412	0.4	0.8888 0.6724
water Diverted flow baffles and clean water Dry quenching ^C		11,753.1	0.4319	348.3 352.8 838.3	0.6848 0.6894 0.6503	21,656.8 13,599.2	0.4328	436.3 440.6 967.5	0.6724 0.6779 0.6448

a Cost = AXB; X = tons of coke/year.
 b Annualized cost does not account for potential steam credit.
 c Annualized cost does not account for potential steam credit except for steam used in water treatment.

INDEX TO COST SHEETS

Source	<u>Option</u>	Page
Larry car charging	2 3	A-5 A-9
Coke pushing	4 2 3 4 5 6	A-13 A-17 A-20 A-24 A-28 A-32
Quenching, clean water	7	A-36 A-40 A-44 A-48
Doors	2 3 4 2 3 4 5	A-52 A-55 A-59 A-63 A-67
Topside	7 2 3 4 2 3	A-71 A-75 A-78 A-81
Combustion stack, old	4	A-85 A-88 A-92 A-96
Coke handling Coal preheater	5 2 2 3 4 5 2 2 3	A-100 A-104 A-108 A-112
Coal preparation Coal storage	5 2 2 3 4	A-116 A-120 A-124 A-128 A-132
Pipeline charging Redler charging Hot larry car charging Byproducts plant Combustion stack, new Quenching, dirty water	2 2 2 2 2 2 2 3 4 5	A-136 A-139 A-142 A-145 A-148 A-151 A-154 A-158 A-162

					TION
PPSES:	501.	LARRY CAR	CHARGING	COKE	5
CAPACII	Υ:	.708	MILLION TUNS/	YEAR	
PARTICL	LATE				
		1.000000	LBS/TON COAL		
			LBS/TON CUAL		80.02
			LBS/HR		
BS 0	······································				
	DAD IN:	1.100000	LBS/TON COAL		
AL	LOWABLE	000005. :	LBS/TON COAL	EFFICIENCY:	80.0%
		25.41			
BAP					
LC	AD IN:	.002000	LBS/TON COAL		
AL	LOWABLE	: .000400	LBS/TON COAL	EFFICIENCY:	80.0%
		.05	LBS/HK		
BENZENE					
			LBS/TON COAL		
AL	LOWABLE		LBS/TON COAL LBS/HR	EFFICIENCY:	80.0%
DUST CO	LLECTED	PER DAY:	1.1 TONS	DRY)	
TEMP ()	T OF PR	DCESS:	180. F		
		ATURE:	180. F		
	.OW:		70. F		
ACFM FL	.Ow:	0. AT	180. F		
L/G RAT	10:		. 0		
	· -	FLOW:			
	WATER	-	0. GPM		
SUSPEND	ED SULI	DS OUT:	0. MG/L	%SOLIDS:	.0
				•	
· · · · · · · · · · · · · · · · · · ·					

A-5

PPSES: 501. LARRY CAR CHA	RGING COKE 2
	·
CONTRUL SYSTEM CONFIGURATION	ı:
LARRY CAR LEVELING BAR SMOKE SEAL	
STEAM SUPPLY	
FEET OF ADDITIONAL DUCT:	0. DIAMETER: 0.
TOTAL PRESSURE DROP: 0 FANS & 0. HP EACH	0. INCHES
O FANS & O. HP EACH	SPARE FAN CAPACITY: 0.%
OPERATING HOURS AT FULL HP: OPERATING HOURS AT REDUCED H	
STACK HEIGHT:	IP: 0. 0. DIAMETER: 0.
NO. OF OVENS	60.
OVEN HEIGHT	6.0 METERS
OVEN VOLUME	1348. CUBIC FEET
TONS COKE/PUSH AVG. COKING TIME, HRS.	24. 17.5
NU. CYCLES/DAY	82.
	50. LBS/CUBIC FT.
YIELD	.70
TUNS COAL/YEAR	1011967.
	•
<u> </u>	

CAPITAL CUST:

			OPTION			
PPSES: 501. LARRY CAR CHARGING	COI	KE	5			
CAPACITY:	S/YEAR					
TOTAL COST (COST BASIS IS 110.00)	X OF JUNE	1977	DOLLARS	FOR	4078	COS
CATEGORY	COST IN	DOLL	ARS	************	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
*** DIRECT COST ***						
EQUIPMENT OR MATERIAL	110500.					
INSTRUMENTATION	0.					
PIPING	15000.					
ELECTRICAL	7500.					
FOUNDATIONS	0.					
STRUCTURAL						
SITE WORK	0.					
INSULATION	18100.					
PROTECTIVE CUATING BUILDINGS	400.					
EQUIPMENT/MATERIAL LABOR						
DIRECT COST SUBTOTAL			4200.			
			7.5.7.4			
*** INDIRECT CUST ***						
FIELD OVERHEAD	30400.					
CONTRACTORS FEE	17900.					
ENGINEERING	51600.					
FREIGHT			 			
OFFSITE WORK	0.					
TAXES	8200.					
SHAKEDUWN	4600.					
SPARES	5600.					
CONTINGENCY INDIRECT COST SUBTOTAL	65200.		5900.			
INDIAELI COSI SUBIDIAL			27VX		·	
INTEREST DURING INSTALLATION	DN	1	6700.			
TOTAL COST		40	6800.			
TOTAL COST WITH RETROFIT		44	7500.			
					· · · · · · · · · · · · · · · · · · ·	_
						
				-		

		UNITS OPTION	
PPSES: 501. LA	RRY CAR CHARGING	COKE 5	
CAPACITY:	.708 MILLION TOP	NS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST
	*** UTILI	IES ***	
WATER	0. MGAL/YR	\$.1595/1000 GAL	
ELECTRICITY	O. KWH/YR	\$.0266/KWH	0.
STEAM	17001. MLBS/YR	5 4.0920/MLBS	69600.
FUEL	U. GAL/YR	\$.4180/GAL	0.
	*** OPERATING	LABOR ***	
DIRECT	8760. HRS/YR	\$14.34/HR	125700. (
SUPERVISION	1752. HRS/YR	\$17.20/HR	30100. (
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	5200. HRS/YR		74600. (
SUPERVISION	1040. HRS/YR	\$17.20/HR	17900. (
MATERIALS			36700. (
SUPPLIES			19400. (
WATER TREATMENT SOLID WASTE			0.
DISPOSAL	O TONZYP	\$ 8.25/TON	0.
DISTOOKL	V. 1017 TR	3 0 E 37 TON	V •
DIRECT OPERAT	ING COST		374000.
PAYROLL OVERH	EAD =20.0% OF A+B+0	;+D	49700.
PLANT UVERHEA	D =50.0% OF A+B+C+C)+E+F	152200.
TOTAL OPERATI			5 75900.
	T IN DOLLARS PER TO		.81
		ON OF DUST COLLECTED	1422.72
	T AS PERCENT OF CAR	PITAL COST	128.7
	TIME IN WEEKS E OF SYSTEM IN YEAF		<u>52.</u> 25.
KWH PER TON		(3	•0
	ERY (11.02% OF TUTA	LI CAPITAL)	49300.
	N OVERHEAD (2.0%		9000.
	S & INS. (2.0% OF		9000.
	ZED COST - RETROFIT		643200.
	- NEW		636900.

				UNITS OF	
PPSES:	501.	LARRY CAR	CHARGING	COKE	3
CAPACI	TY:	.708	MILLION TONS/	YEAR	
DADTIC	ATE				
PARTIC		1 000000	LBS/TON COAL		
			LBS/TON COAL		:00 07
•	FEOMMOLE		LBS/HR	EFFICIENCY.	77,04
			L DO7 1110		
BS 0					
			LBS/TON COAL		
A	LLOWABLE		LBS/TON COAL	EFFICIENCY:	99.0%
		1.27	LBS/HR		
BAP					
	OAD IN:	0002000	LBS/TON COAL		
			LBS/TON" COAL		99.0%
			LBS/HR		
	_				
BENZEN		FAAAA	. 5.5.47.54: 60.43		
			LBS/TON COAL		00 08
^	LLUMADLE		LBS/TON COAL LBS/HR	EFFICIENCY:	99.0%
		• • • •	2507		
*540 O	of oo	0.0000	400 #		
	<u>ut of Pr</u> t temper		180. F 180. F		
	T TEMPER	ATURE:	180. F		
EXHAUS SCFM F	T TEMPER	ATURE:	180. F		·
SCFM F	T TEMPER LOW: LOW:	ATURE: O. AT	180. F 70. F 180. F		
SCFM F ACFM F L/G RA	T TEMPER LOW: LOW: TIO:	ATURE: O. AT O. AT	180. F 70. F 180. F		
SCFM F ACFM F L/G RA PROCES	T TEMPER LOW: LOW: TIO:	O. AT O. AT FLOW:	180. F 70. F 180. F .0 0. GPM	,	
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F		.0
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		.0
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		.0
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		•0
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		.0
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		. 0
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		•
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		.0
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		.0
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		
SCFM F ACFM F L/G RA PROCES COOLIN	T TEMPER LOW: LOW: TIO: S WATER G WATER	O. AT O. AT FLOW: FLOW:	180. F 70. F 180. F 0. GPM 0. GPM		

CAPITAL COST: UNITS OPTION PPSES: 501. LARRY CAR CHARGING COKE 3 CAPACITY: .708 MILLION TONS/YEAR (COST BASIS IS 110.00% OF JUNE 1977 DOLLARS FOR 4078 COST TOTAL COST CATEGORY COST IN DOLLARS *** DIRECT COST *** EQUIPMENT OR MATERIAL 1222600. INSTRUMENTATION 0. 0. PIPING ELECTRICAL 0. FOUNDATIONS 0. STRUCTURAL 0. SITE WORK 0. 17000-INSULATION PROTECTIVE COATING BUILDINGS EQUIPMENT/MATERIAL LABOR 117700. 1357300. DIRECT COST SUBTOTAL *** INDIRECT COST *** FIELD OVERHEAD 39100. CONTRACTORS FEE 19100. ENGINEERING 14500. FREIGHT 18000. OFFSITE WORK 0. 57000. TAXES SHAKEDOWN 6100. 57100. SPARES CONTINGENCY 297200. INDIRECT COST SUBTOTAL 508100. INTEREST DURING INSTALLATION 136600. TOTAL COST 2002000. TOTAL COST WITH RETROFIT 2202200.

GENERAL INFORMATION: UNITS OPTION PPSES: 501. LARRY CAR CHARGING 3 COKE CONTROL SYSTEM CONFIGURATION: LARRY CAR LEVELING BAR SMOKE SEAL STEAM SUPPLY FEET OF ADDITIONAL DUCT: O. DIAMETER: O. TOTAL PRESSURE DROP: 0. INCHES 0. HP EACH O FANS @ SPARE FAN CAPACITY: OPERATING HOURS AT FULL HP: 8760. OPERATING HOURS AT REDUCED HP: STACK HEIGHT: 0. DIAMETER: 0. NO. OF OVENS 60. OVEN HEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. CUKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. .70 YIELD TONS COAL/YEAR 1011967. A-11

OPERATING COST:

CAPACITY: .708 CATEGORY QUA NATER ELECTRICITY STEAM 1700	CHARGING MILLION TOP NTITY *** UTILIT O. MGAL/YR O. KWH/YR	RATE	3	ANNUAL COST
CATEGORY QUA	*** UTILI1	RATE		ANNUAL COST (
NATER ELECTRICITY STEAM 1700	*** UTILI1	TIES ***		ANNUAL COST
ELECTRICITY STEAM 1700	O. MGAL/YR			
ELECTRICITY STEAM 1700	-			
STEAM 1700	O. KWH/YR	\$.1595/10	OO GAL	0.
		\$.0266/KW	Н	0.
FUEL	1. MLBS/YR			69600.
	O. GAL/YR	\$ _4180/GA		0
	** OPERATING	LABOR ***		
DIRECT 876	O. HRS/YR	\$14.34/HR		125700. (/
_	2. HRS/YR	\$17.20/HR		30100. (8
***	MAINTENANCE	& SUPPLIES **	<u> </u>	
DIRECT LABOR 620	O. HRS/YR	\$14.34/HR		88900. ((
	O. HRS/YR	\$17.20/HR		21300. (
MATERIALS				43900. (8
SUPPLIES				23100. (
WATER TREATMENT				0.
SOLID WASTE				_
DISPOSAL	O. TON/YR	\$ 8.25/TON		0.
DIRECT OPERATING COS	7			402600.
PAYROLL OVERHEAD =20	.02 OF A+B+0	C+D		53200.
PLANT OVERHEAD =50.0	% OF A+B+C+D)+E+F		166500.
TOTAL OPERATING COST				622300.
OPERATING COST IN DO				.88
OPERATING COST IN DO			LECTED	1242.31
OPERATING COST AS PE		FIAL CUST		28.3 80
ESTIMATED LIFE OF SY		96		25.
KWH PER TON CAPAC		``		.0
CAPITAL RECOVERY (11		AL CAPITAL)		242600.
ADMINISTRATION OVERH			AL)	44000.
PROPERTY TAXES & INS		•		44000.
TOTAL ANNUALIZED COS		<u> </u>		952900.
	- NEW			922900.

GENERAL INFURMATION: UNIIS OPTION PPSES: 501. LARRY CAR CHARGING CUKE CAPACITY: .708 MILLION TONS/YEAR PARTICULATE LOAD IN: 1.000000 LBS/TON COAL ALLOWABLE: .005000 LBS/TON COAL EFFICIENCY: 99.5% .58 LBS/HR **BS**0 LOAD IN: 1.100000 LBS/TON COAL ALLOWABLE: .005500 LBS/IUN COAL EFFICIENCY: 99.5% .64 LBS/HR HAP LUAD IN: .UUZUUU LBS/TUN COAL ALLUWABLE: .000010 LBS/TON COAL EFFICIENCY: 99.5% .UU LBS/HR BENZENE LOAD IN: .500000 LESTION COAL ALLUWABLE: .002500 LBS/TON COAL EFFICIENCY: 99.5% .29 LBS/HR DUST COLLECTED PER DAY: 1.4 TONS(DRY) TEMP OUT OF PROCESS: 180. F EXHAUST TEMPERATURE: 180. F U. AT 70. F SCFM FLUW: ACFM FLUW: U. AT 180. F L/G HATID: __0__ PRUCESS WATER FLUW: U. GPM COULING WATER FLOW: 0. GPM SUSPENDED SULIDS OUT: 0. MG/L XSOLIDS: .0

PPSES: 501. LARRY CAR CHARG	ING	CUKE	OPTION
Trocov Solia Entri on Charle	2.00	OUNE	~
CONTROL SYSTEM CONFIGURATION:			·
LARRY CAR			
LEVELING BAR SMUKE SEAL			
SECOND COLLECTING MAIN			
FEET OF ADDITIONAL DUCT:	0.	DIAMETER:	0.
TOTAL PRESSURE DROP:	0. IN		
O FANS & U. HP EACH S		CAPACITY:	0,2
OPERATING HOURS AT FULL HP: OPERATING HOURS AT REDUCED HP:	•		
STACK HEIGHT:		DIAMETER:	0 -
NO. OF OVENS	60.		
OVEN HEIGHT	6.0 M	ETERS	
OVEN VOLUME		UBIC FEET	
TONS COKE/PUSH	24.		
AVG. CUKING TIME, HRS.	17.5		
NO. CYCLES/DAY BULK DENSITY	82.	BS/CUBIC F	
YIELD	.70	POLCOBIC L	•
	11967.		
		 	
	· · · · · · · · · · · · · · · · · · ·		

CAPITAL CUST:

	UNITS OPTION
PPSES: 501. LARRY CAR CHARGING	COKE 4
CAPACITY: .708 MILLION YON	S/YEAR
TOTAL COST (COST BASIS IS 110.00	% OF JUNE 1977 DULLARS FOR 4078
CATEGORY	COST IN DULLARS
*** DIRECT COST ***	
EQUIPMENT OR MATERIAL	2410600.
INSTRUMENTATION	0.
PIPING	
ELECTRICAL	0.
FDUNDATIONS	0.
STRUCTURAL	· ·
SITE WORK INSULATION	0. 17000.
	0.
BUILDINGS	v .
EQUIPMENT/MATERIAL LABOR	
DIRECT COST SUBTUIAL	2545300.
*** INDIRECT CUST ***	
	158300.
CUNTRACTURS FEE	138300.
ENGINEERING	252900.
FREIGHT	
OFFSITE WORK	19900.
	116600. 125300.
	116700.
CONTINGENCY	690500.
INDIRECT COST SUBTOTAL	1696100.
INTEREST DURING INSTALLATI	ON 196000.
TUTAL CUST	4437400.
TOTAL COST WITH RETROET	4637600.
	•
A-15	

OPERATING CUST:

RRY CAR CHARGING 708 MILLION TOP	CUKE 4	
.708 MILLION TO		
	NS/YEAR	
GUANTITY	RATÉ	ANNUAL COST
*** UTILI	TIES ***	
O MCALZYR	\$ 1595/1000 CAL	
•	• • • • • • • •	υ.
	-	69600.
U. GAL/YR	\$.4180/GAL	0.
		•
*** OPERATING	G LABOR ***	
8760. HRS/YR	\$14.34/HR	125700.
1752. HRS/YR	\$17.20/HR	30100.
*** MAINTENANCE	& SUPPLIES ***	
11600 MEC/VD	61/1 3/1/40	166400.
	- ·	39900
	<u> </u>	82600.
		43300.
U. TON/YR	\$ 8.25/TUN	0.
ING COST		557600.
FAD =20.01 DF A+B+1	C+D	72400
		244000.
NG COST		874000.
IN DULLARS PER TO	ON PRODUCTION	1.2
		1736.0
		18.5
		80.
	₹5	25.
	AL CAPITAL)	510900.
		92800.
		92800.
		1570500.
- NEW		1540300.
	U. MGAL/YR U. KWH/YR 170U1. MLBS/YR U. GAL/YR *** OPERATING 876U. HRS/YR 1752. HRS/YR 1160U. HRS/YR 232U. HRS/YR 232U. HRS/YR U. TUN/YR ING CUST EAD =20.02 OF A+B+C+C NG CUST IN DULLARS PER TO IN DULLARS PER TO I AS PERCENT UF CAN I IN DULLARS PER TO I IN DULLARS PER TO I IN DULLARS PER TO I AS PERCENT UF CAN I IN DULLARS PER TO I IN DULLARS PER TO I AS PERCENT UF CAN I IN DULLARS PER TO I IN DULLARS	17001. MLBS/YR \$ 4.0920/MLBS U. GAL/YR \$.4180/GAL *** OPERATING LABOR *** 6760. HRS/YR \$14.34/HR 1752. HRS/YR \$17.20/HR *** MAINTENANCE & SUPPLIES *** 11600. HRS/YR \$14.34/HR 2320. HRS/YR \$17.20/HK U. TON/YR \$14.34/HR 2320. HRS/YR \$17.20/HK O. TON/YR \$1.00/HK ING COST EAD =20.02 OF A+B+C+D D =50.02 OF A+B+C+D+E+F NG COST I IN DOLLARS PER TON OF DUST CULLECTED I AS PERCENT OF CAPITAL COST IME IN WEEKS E UF SYSTEM IN YEARS CAPACITY ERY (11.022 UF TOTAL CAPITAL) N OVERHEAD (2.02 OF TOTAL CAPITAL) N OVERHEAD (2.02 OF TOTAL CAPITAL) N OVERHEAD (2.02 OF TOTAL CAPITAL) NED COST = RETHOFIT

PPSES: 502.	COKE PUSH	ING	UNITS OP COKE	
., 0201	3 5 KZ , 55 K		CONE	•
CAPACITY:	.708	MILLION TONS/	YEAR	
BARTICIN ATC				
PARTICULATE LUAD IN:	2.000000	IRS/TON COAL		
		LBS/TON COAL	EFFICIENCY:	60.01
	92.42	-		
BSO				
		LBS/TON COAL	FFF101FN04.	/ /\
ALLUMABLE		LBS/TON COAL LBS/HR	EFFICIENCY:	60,0%
	3.10	FD3/UK		
BAP				
LUAD IN:		LBS/TON COAL		
ALLUWABLE		LBS/TON COAL	EFFICIENCY:	60.0%
	.00	LBS/HR		·
BENZENE				
	.006000	LBS/TON CUAL		
		LBS/TON COAL	EFFICIENCY:	60.0%
		LBS/HR		
DUST COLLECTED	PER DAY:	1.7 TONS (DRY)	
TEMP OUT OF PRO	aress.	700 F		
EXHAUST TEMPERA				
SCFM FLOW:		70. F		
ACFM FLUW:	U. AT	3 00. F		
		•		
L/G RATIO:				
PROCESS WATER FLOW: COOLING WATER FLOW:		O. GPM		
SUSPENDED SOLIC		U. MG/L	*SOLIDS:	• 0
•				
				•
		•		

GENERAL INFORMATION:

PPSES: 502. COKE PUSHING	UNITS OPTION
Fraca. Suc. Cure Puanting	COKE 5
CONTROL SYSTEM CONFIGURATION:	
CONTROLLED COKING	
FEET OF ADDITIONAL DUCT: TOTAL PRESSURE DROP:	O. DIAMETER: O.
TOTAL PRESSURE DROP: 0 FANS 0 0. HP EACH SP	O. INCHES PARE FAN CAPACITY: 0.7
OPERATING HOURS AT FULL HP:	8760.
OPERATING HOURS AT REDUCED HP:	
STACK HEIGHT: NU. OF OVENS	60.
OVEN HEIGHT	6.0 METERS
OVEN VOLUME	
	24. 17.5
NO. CYCLES/DAY	82.
BULK DENSITY	50. LBS/CUBIC FT. .70
YIELD TONS CUAL/YEAR 10:	11967.
	·
	•

PPSES: 502. C	OKE PUSHING	COKE 2	
CAPACITY:	.708 MILLION TON	IC/VEAU	
LBEALLIII	A TVO PILLIUN TUN	SZIEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST
	*** UTILIT	IES ***	
WATER	Û. MGAL/YK	\$.1595/1000 GAL	0
ELECTRICITY	O. KWH/YR	\$.0266/KWH	0.
STEAM	U. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	0. GAL/YR	\$.4180/GAL	<u> </u>
	*** OPERATING	LABOR ***	
DIRECT	6760. HRS/YR	\$14.34/HR	125700.
SUPERVISION	1752. HRS/YR	\$17.20/HR	30100.
	*** MAINTENANCE	8 SUPPLIES ***	
DIRECT LABOR	U. HRS/YR	\$14.34/HR	0.
SUPERVISION	U. HRS/YR	\$17,20/HR	<u>0 •</u> _
MATERIALS			0.
SUPPLIES			6857100.
WATER TREATMENT			
SULID WASTE	A TON 245	F B 35 (TON	0
DISPOSAL	0. TON/YR	\$ 8.25/TON	0.
DIRECT OPERA	TING COST		7012900.
PAYRULL OVER	31200.		
PLANT OVERHE	3506500.		
TOTAL OPERAT	10550600.		
	ST IN DOLLARS PER TO		14,8
		N OF DUST COLLECTED	17376.3
	ST AS PERCENT OF CAP	ITAL CUST	• (
	TIME IN WEEKS FE OF SYSTEM IN YEAR) c	8.
KWH PER TON	CAPACITY	(5	99.
	VERY (10.00% OF TOTA	LI CAPITAL)	0.
	ON OVERHEAD (2.0% O		0.
	ES & INS. (2.0% OF	· · · · · · · · · · · · · · · · · · ·	0.
	IZED COST - RETROFIT	- ·	10550600.
	- NEW		10550600.

PPSES: 502.	COKE PUSH	ING		UNITS OF	3
APACITY:	.798	MILLION	TONS/	YEAR	
ARTICULATE					•
	2.000000	LBS/TON	COAL		
ALLOWABLE	290000	LBS/TON	COAL	EFFICIENCY:	85.5%
	35.26	LBS/HR			,
\$ 0					
	.080000	LBS/TON	COAL		
				EFFICIENCY:	45.0%
	5.35	LBS/HR			
AP					
	.000040	LBS/TON	COAL		
ALLOWABLE		_	COAL	EFFICIENCY:	45.0%
	.00	LBS/HR			
ENZENE					
LOAD IN:					·
ALLOWABLE			CUAL	EFFICIENCY:	45.0%
	.40	LBS/HR			
UST COLLECTED	PER DAY:	2.4	TONS	DRY)	
EMP OUT OF PR	OCESS:	300.	5		
XHAUST TEMPER		150.			
CFM FLOW: 31	7000- AT	70.	•		
CFM FLOW: 36	5000. AT				***************************************
/G RATIO:		0			
ROCESS WATER OOLING WATER		0. (
USPENDED SOLI			GPM MG/L	*SOLIDS:	• 0
<u> </u>	. <u> </u>		10/		
					- <u></u>
				•	
					

	P /- >	Anus minimus			OPTION	
PPSES:	502.	COKE PUSHING		COKE	3	
CONTROL	SYSTEM	1 CONFIGURATION	v :			
ES	Ρ			 		
	KE OVEN	SHED				
	N AND D					
ÐU	CTWORK					
	ACK					
		LING HUPPER &	CONVEYORS			
	MPERS					
FA	N AND E	RIVE ELECTRICA	NL .			
664. 18	0	TOTAL PLATE	ADEAD	22000 60 5	7 2 20% 6840	C. C. L. C.
		DNAL DUCT:				
TOTAL P	RESSURE	DROP:	12.			
		HP EACH			50.1	
		S AT FULL HP:				
		S AT REDUCED H				
STACK H	EIGHT:	_	100.	DIAMETER	: 12.	
			60.			
OVEN HE	IGHT		6.0	METERS		
OVEN VO				CUBIC FEET		
		ME, HRS.	17.5			
NO. CYC			82. 50		ET	
AIETD			.70		F 1 •	
TONS CO		}	1011967.	•		

				·	•	
				· · · · · · · · · · · · · · · · · · ·		

CAPITAL CUST:	UNI	TS (PTION			
PPSES: 502. COKE PUSHING	COI	KE	3			
CAPACITY: .708 MILLION TO	NS/YEAR					
TOTAL COST (COST BASIS IS 110.0	00% OF JUNE	1977	DOLLARS	FOR	4078	cos
CATEGORY	COST IN	DOLL	ARS			
*** DIRECT COST ***			 			
EQUIPMENT OR MATERIAL						
INSTRUMENTATION	0.					
PIPING						
ELECTRICAL	71900.					
FOUNDATIONS	15500.					
SIRUCTURAL	7900.					
SITE WORK Insulation	59900.					
PROTECTIVE COATING	9600					
PROTECTIVE COATING BUILDINGS	8800.					
EQUIPMENT/MATERIAL LABOR						
DIRECT COST SUBTOTAL	· · ·		0500.			
DIRECT COST SOCIOTAL						
*** INDIRECT COST **	: *					
FIELD OVERHEAD						
	261400.		·····			
	237100.					
FREIGHT						•
OFFSITE WURK	48100.			- <u>-</u>		
TAXES	98000.					
SHAKEDUWN	95000.					
SPARES	89200.					
CONTINGENCY	829900.					
INDIRECT COST SUBIOTAL		210	1200.			
INTEREST DURING INSTALLAT	TION	42	9600.			
TUTAL COST		521	1300.			
TOTAL COST WITH RETROFIT		584	0000.			
——————————————————————————————————————				·		
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PPSES: 502. CO	OKE PUSHING	UNITS OPTION COKE 3	
CAPACITY:	.708 MILLION TON	IS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST
	*** UTILIT	IES ***	
WATER	O. MGAL/YR	\$.1595/1000 GAL	0.
ELECTRICITY	8677492. KWH/YR		231000.
STEAM	0. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	U. GAL/YR	\$.4180/GAL	0,
	*** OPERATING	LABOR ***	
DIRECT	8760. HRS/YR	\$14.34/HR	125700.
SUPERVISION	1752. HRS/YR	\$17.20/HR	30100.
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	11867. HRS/YR	-	170200.
SUPERVISION	2373, HRS/YR	\$17.20/HR	40800,
MATERIALS			86800.
SUPPLIES TOTALMENT			44700.
WATER TREATMENT SOLID WASTE			0
DISPUSAL	865. TON/YR	\$ 8.25/TON	7100.
DIRECT OPERAT	TING CUST		736400.
PAYROLL OVER	1EAD =20.0% OF A+B+C	;+D	73400.
PLANT OVERHER	AD =50.0% OF A+B+C+D)+E+F	249200.
	ING COST		1059000.
	BT IN DOLLARS PER TO		1,4
		N OF DUST COLLECTED	1223.9
	ST AS PERCENT OF CAP	PITAL COST	18.1
	TIME IN WEEKS		130.
ESTIMATED LIF	FE OF SYSTEM IN YEAR	(5	20.
	CAPACITY /ERY (11.75% OF TOTA	I CARITAL)	12.2
	ON OVERHEAD (2.0% O		686000. 116800.
	ES & INS. (2.0% OF		116800.
	ZED COST - RETROFIT	• •	1978600.
	- NEW		1879500.

DDEF		502	COKE	DIIGH	TNG		UNITS COKE		A A
PPSE	.5 •	306.	LUNE	PUSH	IND		LUNE		•
CAPA	CII	Y:	<u> </u>	.708	MILLID	N TONS	YEAR		
•••									
		LATE	2 00	0000	LBS/TO	N COAL			
					L83/10			r V z	45.51
					LB8/HR		21140201		~23407
BSO						 			
	LO	AD IN:	.08	0000	LBS/TO	N COAL			
	AL	LOWABL					EFFICIEN	CY:	49.5%
			4	.91	LBS/HR				
BAP								_	
					LBS/TO				
	AL	LOWABL	_				EFFICIEN	CY:	49.5%
				•00	LBS/HR				
BENZ			_			_			
					LBS/TO		PPF-4-5	• •	A.O. F.:-
	AL	LUMABL					EFFICIEN	UY:	44.5%
			•	• 3 (LBS/HR				
DUST	CO	LLECTE	D PER D	AY:	2.	4 TONS	DRY)		
TEMP	OH	T OF P	ROCESS:		30.0 _	F			
					100.				
	_								
SCFM	FL	DW: 3	45000,	<u> </u>	70,	<u>F</u>			
AUFM	FL	OM: 3	65000.	AI	100.	۲			
L/G	RAT	10:			7.	9			
PROC	ESS	WATER	FLOW:		2738.	GPM			
		WATER				6PM			
SUSP	END	ED SOL	IDS OUT	:	124.	MG/L	*SOLIDS	ŧ	0
									· · · · · · · · · · · · · · · · · · ·
		· · · · · · · · · · · · · · · · · · ·							
									
									,

	UNITS OPTION
PPSES: 502. COKE PUSHING	COKE 4
CONTROL SYSTEM CONFIGURATION	:
· VENTURI SCRUBBER	
COKE OVEN SHED	
MIST ELIMINATOR	
FAN AND DRIVE	
DUCTWORK	
STACK WASTEWATER RECYCLE SYST	FM
DAMPERS	
WASTE WATER RETURN SYST	EM
WATER PUMPING SYSTEM	
FAN AND DRIVE ELECTRICA	L
FEET OF ADDITIONAL DUCT:	
TOTAL PRESSURE DROP:	30. INCHES
3 FANS @ 1436. HP EACH	
OPERATING HOURS AT FULL HP: OPERATING HOURS AT REDUCED H	
STACK HEIGHT:	100. DIAMETER: 12.
NO. OF OVENS	60.
	6.0 METERS
OVEN VOLUME	1346. CUBIC FEET
TONS COKE/PUSH AVG. COKING TIME, HRS.	24.
NO. CYCLES/DAY	17.5 82.
BULK DENSITY	50. LBS/CUBIC FT.
YIELD	
TONS COAL/YEAR	1011967.
	•

							OPTION			
PPSES: 502.	COKE PUSHI	iG .			CO	KE	4			
CAPACITY:	.708	ILLI	ON TONS	/YEA	\R				1	
TOTAL COST	(COST BASIS	IS	110.002	OF	JUNE	1977	DOLLARS	FOR	4078	COST
CATEGORY				CUS	51 1N	DOLL	AKS			
	REA DIRECT									
	OR MATERIAL	•			500.					
INSTRUME					900.					
										
ELECTRICA					500.					
FOUNDATIO	JNS AL				500.					
					-					
SITE WORK Insulation	\			11	000.					
PROTECTION	ON VE COATING			20	3400					
BUILDING	E LUATING			7.0	600.					
	, T/MATERIAL L/	ane.								
	CT COST SUB						9200			
#AN		UIAL					7EVV			
	*** INDIRECT	CO	ST ***							
FIELD OVE	RHEAD			457	700.					
	ORS FEE				400.					
ENGINEER	ING			396	500.					
FREIGHT				91	800.					
OFFSITE W	ORK			72	800.					
TAXES				145	800.					
SHAKEDOWN	<u> </u>			136	400.					
SPARES					400.					
CONTINGER	IC Y			1131	000.					
INDI	RECT COST SI	BIDI	AL			279	7800.			
INTE	EREST DURING	INST	ALLATIO	N		56	3500.	•		
TOTA	L COST				· · · · · · · · · · · · · · · · · · ·	741	0500.			
701/	L COST WITH	REIR	OFIT			825	9100.			
						· 			·	·
						· ·				
	· · · · · · · · · · · · · · · · · · ·						•			
						·	_			
*** **********************************				<u>-</u>						
	· = -									

ERATING COST:			
PPSES: 502.	COKE PUSHING	UNITS OPTION COKE 4	
CAPACITY:	.708 MILLION TON	IS/YEAR	
CATEGORY	DUANTITY	RATE	ANNUAL COST (S
	*** UTILIT	IES ***	
WATER	273402. MGAL/YR	8 .1595/1000 GAL	43600
ELECTRICITY	18980168. KWH/YR	\$.0266/KWH	505300.
STEAM	O. MLBS/YR	_	0.
FUEL	O. GAL/YR		0,
·	*** OPERATING	LABOR ***	
DIRECT	8760. HRS/YR	\$14.34/HR	125700. (A)
SUPERVISION	1752. HRS/YR	\$17.20/HR	30100. (B)
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	17163. HRS/YR	\$14.34/HR	246200. (C)
SUPERVISION	3433, HRS/YR	\$17.20/HR	59100, (0)
MATERIALS			191100. (E)
SUPPLIES			110200. (F)
MATER TREATMENT			
SOLID WASTE			
DISPOSAL	1730. TON/YR	\$ 8.25/TON	14300.
DIRECT OPER	ATING COST		1325600.
PAYROLL OVE	RHEAD =20.0% OF A+B+C	+D	92200.
_	EAD =50.0% OF A+B+C+D)+E+F	381200.
TOTAL OPERA	-		1799000.
	OST IN DOLLARS PER TO		2,54
	OST IN DOLLARS PER TO		2079.21
	OST AS PERCENT OF CAP	TITAL COST	21.8
	Y TIME IN WEEKS		130
KWH PER TON	IFE OF SYSTEM IN YEAR Capacity		15. 2 6.8
	DVERY (13.15% OF TOTA	I CAPTTAL T	1085900.
	ION OVERHEAD (2.0% O		165200.
	KES & INS. (2.0% OF		165200.
	IZED COST - RETROFIT		3215300
	- NEW		3069700.

GENERAL INFORMATION: UNITS OPTION PPSES: 502. COKE PUSHING COKE CAPACITY: .708 MILLION TONS/YEAR PARTICULATE LOAD IN: 2.000000 LBS/TON COAL EFFICIENCY: *88.2% ALLOWABLE: .236000 LBS/TON COAL 88.45 LBS/HR B\$0 LOAD IN: .080000 LBS/TON COAL ALLOWABLE: .036800 LBS/TON COAL EFFICIENCY: 54.0% 13.79 LBS/HR BAP .000040 LBS/TON COAL LOAD IN: ALLOWABLE: .000026 LBS/TON COAL EFFICIENCY: 36.0% .01 LBS/HR BENZENE -006000 LBS/TON COAL LOAD IN: .002760 LBS/TON COAL EFFICIENCY: 54.0% ALLOWABLE: 1.03 LBS/HR DUST COLLECTED PER DAY: 2.4 TONS(DRY) TEMP OUT OF PROCESS: 300. F 100. F EXHAUST TEMPERATURE: SCFM FLOW: 71000. AT 70, F ACFM FLOW: 75000. AT 100. F ACFM FLOW: L/G RATIO: .0_ 0. GPM PROCESS WATER FLOW: 0. GPM COOLING WATER FLOW: 0. MG/L SUSPENDED SOLIDS OUT: XSOLIDS: .0

GENERAL INFORMATION: UNITS OPTION PPSES: 502. COKE PUSHING COKE 5 CONTROL SYSTEM CONFIGURATION: ENCLOSED HOT CAR FEET OF ADDITIONAL DUCT: DIAMETER: 5. 0. TOTAL PRESSURE DROP: 0. INCHES O FANS @ O. HP EACH SPARE FAN CAPACITY: 0.X OPERATING HOURS AT FULL HP: 2700. OPERATING HOURS AT REDUCED HP: 5900. STACK HEIGHT: O. DIAMETER: O. NO. OF OVENS 60. OVEN HEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. 17.5 AVG. COKING TIME, HRS. NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. .70 YIELD TONS COAL/YEAR 1011967. A-29

CAPITAL COST:

TPITAL COST.					OPTION			
PPSES: 502.	COKE PUSHING		COI	KE	5			
CAPACITY:	.708 MIL	LION TONS	YEAR					
TOTAL COST	(COST BASIS 1	S 110.00%	OF JUNE	1977	DOLLARS	FOR	4078	COST
CATEGORY			COST IN	ווחת	ARS			
				JULE.				
	*** DIRECT C							
	OR MATERIAL	•	3841700.					
INSTRUMENT			0.					
ELECTRICAL			0.					
FOUNDATION	•		0.					
-								
SITE WORK		***************************************	0.					· · · · · · · · · · · · · · · · · · ·
INSULATION			0.					
	COATING							
BUILDINGS			0.					
- -	MATERIAL LABO)R						
	T COST SUBTOT		_	386	4800.			
	** INDIRECT	•						
	RHEAD							
CONTRACTOR			3800.					
ENGINEERIN			55000.					
						 		
OFFSITE WO) RK		0.					
TAXES			192400.					
			192400.		· · · · · · · · · · · · · · · · · · ·			
SPARES Contingen(• •		38500.					
	RECT COST SUBT	OTAL	877500.	1 7 7 1	3800.			
ABUIT	CL (LUS SUD)	VIAL			<u> </u>			
INTER	REST DURING IN	ISTALLATIO!	V	524	4400.			
TOTAL	COST			5768	3000.			
TOTAL	COST WITH RE	TROFIT		6344	1800.			.
			·					
				*				
· · · · · · · · · · · · · · · · · · ·								
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			PTION
PPSES: 502. C	OKE PUSHING	COKE	5
CAPACITY:	.708 MILLION TO	NS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST
	*** UTILI1	TIES ***	
WATER	6375 MGAL/YR	s .1595/1000	GAL 1000.
ELECTRICITY	4173. KWH/YR	\$.0266/KWH	100.
STEAM	0. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	672958 GAL/YR	\$,4180/GAL	281300.
	*** OPERATING	LABOR ***	
DIRECT	0. HRS/YR	\$14.34/HR	0. (
SUPERVISION	O. HRS/YR	\$17.20/HR	0. (
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	8000. HRS/YR	\$14.34/HR	114800. (
SUPERVISION	1600. HRS/YR	\$17,20/HR	27500. (
MATERIALS			114800. (
SUPPLIES			38600. (
WATER TREATMENT			
SOLID WASTE			
DISPOSAL	1785. TON/YR	\$ 8.25/TON	14700.
DIRECT OPERA	TING COST		592800.
	HEAD =20.0% OF A+B+C		28500.
and the second s	AD =50.0% OF A+B+C+D)+E+F	147900.
TOTAL OPERAT			769200.
	ST IN DOLLARS PER TO		
	ST IN DOLLARS PER TO		
	ST AS PERCENT OF CAP	PITAL CUST	12.1
	TIME IN WEEKS FE OF SYSTEM IN YEAR) e	104.
KWH PER TON		(3	20. 41.8
	VERY (11.75% OF TOTA	AL CARTTAL Y	745300.
	ON OVERHEAD (2.0% (
	ES & INS. (2.0% OF		
	IZED COST - RETROFI		
		· · · · · · · · · · · · · · · · · · ·	

			· · · · · · · · · · · · · · · · · · ·	UNITS OP	TION
PPSES: 502.	COKE PUSH	ING		COKE	6
CAPACITY:	.708	MILLION	TONS/	YEAR	
					•
PARTICULATE	3 000000	LDC/TON	CO.A.)		
	2.000000			EFFICIENCY:	80 17
MELUMADEC		LBS/HR	CUAL	CFF 161ENG1+	07.14
350	<u> </u>				
	.080000	LRS/TON	COAL		
	•			EFFICIENCY:	45.07
<u> </u>		LBS/HR	<u> </u>		
IAP					
	.000040	LBS/TON	CUAL		
ALLOWABLE		LBS/TON		EFFICIENCY:	45.0%
		LBS/HR	-		
BENZENE					
	.006000				
ALLOWABLE		LBS/TON LBS/HR	COAL	EFFICIENCY:	45.0%
UST COLLECTED	DED DAY.	2 5	TONS (NDV1	
			•		
EMP OUT OF PR		300.			· · · · · · · · · · · · · · · · · · ·
XHAUST TEMPER	ATURE:	150.	F		
CFM FLOW: 31					· · · · · · · · · · · · · · · · · · ·
CFM FLOW: 36	5000. AT	150.	F		
/G RATIO:		0			
PROCESS WATER	FLOW:	0.			
COOLING WATER	FLOW:	0.	6PM		
SUSPENDED SOLI	DS OUT:	0,	MG/L	XSOLIDS:	0
· <u></u>				•	
				:	

PPSES: 502. COKE PUSI	UNITS OPTION HING COKE 6
•	
CONTROL SYSTEM CONFIGURA	ATION:
ESP	
COKE OVEN SHED	
•	
DUCTWORK	
STACK	
DUST HANDLING HUPPE	ER & CONVEYORS
DAMPERS	
FAN AND DRIVE ELECT	TRICAL
SCA: 240. TOTAL (PLATE AREA: 105000. SQ.FT. @ 20% SPARE CA
FEET OF ADDITIONAL DUCT	: 300, DIAMETER: 11.
TOTAL PRESSURE DROP:	12. INCHES
3 FANS @ 575. HP EACH	SPARE FAN CAPACITY: 50.%
	HP: 8322,
OPERATING HOURS AT REDUC	
	100. DIAMETER: 12.
NO. OF OVENS OVEN HEIGHT	6.0 METERS
OVEN VOLUME	1348. CUBIC FEET
	24
AVG. COKING TIME, HRS.	
NO. CYCLES/DAY	62.
BULK DENSITY	50. LBS/CUBIC FT.
YIELD	.70
TUNS COAL/YEAR	1011967.
	4-14-14-14-14-14-14-14-14-14-14-14-14-14
	·

CAPITAL COST:

CAPITAL COST:		UNIT	S	OPTION			
PPSES: 502. COKE PUSHING		COK	E	6			
CAPACITY: .708 MILLION TON	S/YEAR						
TOTAL COST (COST BASIS IS 110.00	x OF J	UNE	1977	DOLLARS	FOR	4078	COS
CATEGORY	COST	IN	DOLL	ARS			
*** DIRECT COST ***							
EQUIPMENT OR MATERIAL	18761	00.					
INSTRUMENTATION		0.					
PIPING		0.					
ELECTRICAL	8110						
FOUNDATIONS	1620	00.					
STRUCTURAL	8121	00.					
SITE WURK	910	00.					
INSULATION	6890	00.					
PROTECTIVE CUATING	1050						
BUILDINGS	101						
EQUIPMENT/MATERIAL LABOR	7540						
DIRECT COST SUBTOTAL			290	7200.			
				•			
*** INDIRECT COST ***							
FIELD OVERHEAD							
CONTRACTORS FEE	28746						
ENGINEERING	25930	-					
FREIGHT							
OFFSITE WORK	548						
TAXES	10540						
SHAKEDUWN SPARES	10620						
CONTINGENCY	10040 90070						
INDIRECT COST SUBTOTAL			230	1000.			
INTEREST DURING INSTALLATI	ION		47	2100.			
TOTAL COST		BT14	568	0300.	· · · · · · · · · · · · · · · · · · ·		
TOTAL COST WITH RETROFIT			635	5900.			
		<u></u>	 				
			•				
				 			
							
A-34							

CAPACITY: CATEGORY WATER ELECTRICITY STEAM	QUANTITY	NS/YEAR RATE	ANNUAL COST (
WATER ELECTRICITY		RATE	ANNUAL COST (
WATER ELECTRICITY	*** UTILI		
ELECTRICITY	WAK DITET	7750	
ELECTRICITY		ITES MAN	
	U. MGAL/YR	\$.1595/1000 GA	L0
STEAM	9151822. KWH/YR	\$.0266/KWH	243600.
	U. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	U, GAL/YR	\$,4180/GAL	0.
	*** OPERATING	LABOR ***	
DIRECT	8760. HRS/YR	\$14.34/HR	125700. (A
SUPERVISION	1752. HRS/YR	\$17.20/HR	30100. (B
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	11867. HRS/YR	\$14.34/HR	170200. (C
SUPERVISION	2373. HRS/YR	\$17.20/HR	40800. (D
MATERIALS			86800. (E
SUPPLIES			44700. (F
NATER TREATMENT			0.
SULID WASTE			
DISPOSAL	902. TON/YR	\$ 8.25/TUN	7400.
DIRECT OPERA	TING COST		749300.
PAYHOLL OVER	HEAD =20.0% OF A+B+0	C+D	73400.
	AD =50.0% UF A+B+C+0	D+E+F	249200.
TOTAL OPERAT			1071900.
	ST IN DOLLARS PER TO		1.51
	ST IN DOLLARS PER TO		
	ST AS PERCENT OF CAR	PITAL CUST	16.9
	TIME IN WEEKS FE OF SYSTEM IN YEAR	D 6	130. 20.
KWH PER TUN		13	12.9
	VERY (11.75% OF TOTA	AL CAPITAL)	746600.
	ON OVERHEAD (2.0% (127100.
	ES & INS. (2.0% OF		127100.
	IZED COST - RETROFT		2072700.
	- NEW		1966300.

GENERAL INFORMATION: UNITS OPTION PPSES: 502. COKE PUSHING COKE 7 CAPACITY: .708 MILLION TONS/YEAR PARTICULATE LOAD IN: 2.000000 LBS/TON COAL ALLOWABLE: .218000 LBS/TON COAL EFFICIENCY: 89.1% 26.51 LBS/HR B50 LOAD IN: .080000 LBS/TON COAL ALLOWABLE: .036800 LBS/TON COAL EFFICIENCY: 54.0% 4.47 LBS/HR BAP LOAD IN: .000040 LBS/TON COAL .000018 LBS/TON COAL EFFICIENCY: 54.0% ALLOWABLE: .00 LBS/HR BENZENE LOAD IN: .006000 LBS/TON COAL ALLOWABLE: .002760 LBS/TON COAL EFFICIENCY: 54.0% . .34 LBS/HR DUST COLLECTED PER DAY: 2.5 TONS (DRY) 300. F TEMP OUT OF PROCESS: 100. F EXHAUST TEMPERATURE: SCFM FLOW: 345000, AT 70, F ACFM FLOW: 365000. AT 100. F L/G RATIO: 7.9 PROCESS WATER FLOW: 2738. GPM COULING WATER FLOW: 0. GPM SUSPENDED SOLIDS OUT: 124. MG/L %SOLIDS: .0

GENERAL INFORMATION: OPTION UNITS PPSES: 502. COKE PUSHING COKE 7 CONTROL SYSTEM CONFIGURATION: VENTURI SCRUBBER COKE OVEN SHED MIST FLIMINATOR FAN AND DRIVE DUCTWORK STACK WASTEWATER RECYCLE SYSTEM DAMPERS WASTE WATER RETURN SYSTEM WATER PUMPING SYSTEM FAN AND DRIVE ELECTRICAL FEET OF ADDITIONAL DUCT: 300. DIAMETER: 11. 50. INCHES TOTAL PRESSURE DROP: SPARE FAN CAPACITY: 50.7 3 FANS @ 2394. HP EACH OPERATING HOURS AT FULL HP: 8322. OPERATING HOURS AT REDUCED HP: 0. 100. STACK HEIGHT: DIAMETER: 12. NO. OF OVENS 60. OVEN HEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. .70 YIELD TONS COAL/YEAR 1011967.

CAPITAL COST: UNITS OPTION PPSES: 502. COKE PUSHING COKE 7 CAPACITY: .708 MILLION TONS/YEAR (COST BASIS IS 110.00% OF JUNE 1977 DOLLARS FOR 4078 COST .-TOTAL COST CATEGORY COST IN DOLLARS *** DIRECT COST *** EQUIPMENT OR MATERIAL 2727900. INSTRUMENTATION 51900. PIPING 235000. ELECTRICAL 316500. FOUNDATIONS 95800. STRUCTURAL 126200. SITE WORK 11000. INSULATION 23400. PROTECTIVE COATING .00585 BUILDINGS 38600. EQUIPMENT/MATERIAL LABOR 628400. DIRECT COST SUBTOTAL 4282900. *** INDIRECT COST *** FIELD OVERHEAD 462200. CONTRACTORS FEE 250700. ENGINEERING 396500. FREIGHT 92400 OFFSITE WORK 73300. TAXES 157500. 148900. SHAKEDOWN SPARES 119300. CONTINGENCY 1185700. 2886500. INDIRECT COST SUBTOTAL INTEREST DURING INSTALLATION 604600. TOTAL COST 7774000. TOTAL COST WITH RETROFIT 8658900.

PPSES: 502. (OKE PUSHING	UNITS OPTION COKE 7	
CAPACITY:	.708 MILLION TON	IS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST
	*** UTILIT	IES ***	
WATER	273402. MGAL/YR	\$.1595/1000 GAL	43600
ELECTRICITY	31514320 KWH/YR	\$.0266/KWH	838900.
STEAM	0. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	O. GAL/YR	\$.4180/GAL	0
	*** OPERATING	LABOR ***	
DIRECT	8760. HRS/YR	\$14.34/HR	125700. (4
SUPERVISION	1752, HRS/YR	\$17.20/HR	30100. (E
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	17763. HRS/YR	\$14.34/HR	254800. (0
SUPERVISION	3553 HRS/YR		61100. (
MATERIALS			197600. (E
SUPPLIES			112800. (F
WATER TREATMENT			0.
SOLID WASTE			
DISPOSAL	1803. TON/YR	\$ 8.25/TON	14900.
DIRECT OPERA	TING COST		1679500.
	HEAD =20.0% OF A+B+C		94300.
	AD = 50.02 OF A+B+C+D)+E+F	391100.
TOTAL OPERAT			2164900.
	ST IN DOLLARS PER TO		3,06
	IST IN DOLLARS PER TO IST AS PERCENT OF CAP		2401.01
	TIME IN WEEKS	TIME COST	25.0 130.
	FE OF SYSTEM IN YEAR	98	15.
KWH PER TON	CAPACITY	. 0	44.5
· · · · · ·	VERY (13.15% OF TOTA	L CAPITAL)	1138400.
	ON OVERHEAD (2.0% 0		173200.
PROPERTY TAX	ES & INS. (2.0% OF	TOTAL CAPITAL)	173200.
TOTAL ANNUAL	IZED COST - REJROFIT		3649700
	- NEW		3498000.

PPSES: 503.	DUENCHING	- PIEAN	WATED	UNITS OP	2 110N
PP3E3: 303.	DUENCHING	- LLEAN	MAIER	LUNE	2
CAPACITY:	2.834	MILLION	TONS	/EAR	
PARTICULATE					
	1.700000	LBS/TON	COAL		
ALLOWABLE	.510000	LBS/TON	COAL	EFFICIENCY:	70.0%
	235.66	LBS/HR			
BS 0		- 			
LOAD IN:	.001700	LBS/TON	COAL		
ALLOWABLE	.000510		COAL	EFFICIENCY:	70.0%
	.24	LB\$/HR			
BAP					
LOAD IN:		LBS/TON			
ALLOWABLE	_		COAL	EFFICIENCY:	70.0%
		LBS/HR			
BENZENE					
	.000030				
ALLOWABLE		LBS/TON LBS/HR	COAL	EFFICIENCY:	.0%
DUST COLLECTED	PER DAY:	6.6	TONS (ORY)	
TEMP OUT OF PRI	OCESS:	200.	E		
EXHAUST TEMPER	ATURE:	200.	F		
SCFM FLOW: 56	5000 AT	70.	F		
ACFM FLOW: 70					
L/G RATIO:					
PROCESS WATER I	FLOW:	0.	GPM		
COOLING WATER I		0.			
SUSPENDED SOLI	S OUT:	0.1	4G/L	%SOLIDS:	. 0
		. 			····
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GENERAL INFORMATION: UNITS OPTION PPSES: 503. QUENCHING - CLEAN WATER COKE 2 CONTROL SYSTEM CONFIGURATION: QUENCH TOWER BAFFLES FEET OF ADDITIONAL DUCT: DIAMETER: 15. TOTAL PRESSURE DROP: 0. INCHES O. HP EACH O FANS a SPARE FAN CAPACITY: 0.7 OPERATING HOURS AT FULL HP: 8760. OPERATING HOURS AT REDUCED HP: 0. O. DIAMETER: O. STACK HEIGHT: 60. NO. OF OVENS 6.0 METERS OVEN HEIGHT OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. 50. LBS/CUBIC FT. BULK DENSITY .70 YIELD 4047868, TONS COAL/YEAR

PPSES: 503. QUENCHING - CLEAN W.	UNITS OPTION ATER COKE 2
PPSES. 303. GUENCHING - CLEAN W.	TIEN CONE E
CAPACITY: 2.834 MILLION T	INS/YEAR
TOTAL COST (COST BASIS IS 110.	00% OF JUNE 1977 DOLLARS FOR 4
CATEGORY	COST IN DOLLARS
*** DIRECT COST **	·
EQUIPMENT OR MATERIAL	114100.
INSTRUMENTATION	0.
PIPING	30800.
ELECTRICAL	6200.
FOUNDATIONS	900.
STRUCTURAL	0.
SITE WORK	600.
INSULATION	0.
PROTECTIVE COATING	900.
BUILDINGS	0.
EQUIPMENT/MATERIAL LABOR	80300.
DIRECT COST SUBTOTAL	233800.
*** INDIRECT COST *	
FIELD OVERHEAD	45400.
CONTRACTORS FEE	27900.
ENGINEERING	35100.
FREIGHT OFFSITE WORK	4400.
TAXES	0. 5700.
	1300.
SHAKEDOWN SPARES	3500.
CONTINGENCY	71400.
INDIRECT COST SUBTOTAL	194700.
INTEREST DURING INSTALLA	TION 10700.
TOTAL COST	439200.
TOTAL POST WITH DETROFT	571000.
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PPSES: 503. QU	JENCHING - CLEAN WAS	UNITS OPTION TER COKE 2	
CAPACITY:	2.834 MILLION TO	NS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (
	*** UTILIT	TIES ***	
WATER	O. MGAL/YR	3 .1595/1000 GAL	0.
ELECTRICITY	O. KWH/YR	S .0266/KWH	0.
STEAM	U. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	O. GAL/YR	\$ 4180/GAL	0.
	*** OPERATING	LABOR ***	
DIRECT	0. HRS/YR	\$14.34/HR	0. (4
SUPERVISION	0. HR\$/YR	\$17.20/HR	0. (8
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	1200. HRS/YR	\$14.34/HR	17200. ((
SUPERVISION	240. HRS/YR	\$17.20/HR	4100. ([
MATERIALS			8600. (8
SUPPLIES			4500. (F
WATER TREATMENT			<u>0.</u>
SOLID WASTE DISPOSAL	4817. TON/YR	\$ 8.25/TON	39700.
DIRECT OPERAT	ING COST		74100.
PAYROLL OVER	1EAD =20.0% DF A+B+C	C+D	4300.
	D =50.0% OF A+B+C+D		17200.
TOTAL OPERATI	ING COST		95600.
	ST IN DOLLARS PER TO		
•		ON OF DUST COLLECTED	39.69
	ST AS PERCENT OF CAP	PITAL COST	16.7
	TIME IN WEEKS E OF SYSTEM IN YEAR) c	<u> 26.</u> 20.
KWH PER TON		(3	.0
	ERY (11.75% OF TOTA	N CAPITAL)	67100.
	N OVERHEAD (2.0% C		11400.
	S & INS. (2.0% OF		11400.
TOTAL ANNUAL	ZED COST - RETROFI		185500.
	- NEW		164800.
		<u> </u>	

GENERA	L INF	ORMATION	v:					
PP	SES:	503.	QUENCHING	- CLEAN		UNITS OF		
UA	PAUL!			MILLIUN		EAR		
PA	RTICU	JLATE						
	L0	DAD IN:	1.700000	LBS/TON	COAL	EEETCTENCV.		
•	AL	LOWABLE		COOLIGIA	COAL	EFFICIENCY:	90.0%	
			78.55	LBS/HR				
88	<u> </u>							
		AD IN:	.001700	LBS/TON	COAL			
					_	EFFICIENCY:	90,0%	
			.08	LBS/HR				
D.A.	_							
BA		AD THE	.000140	L D C / TON				
	A:	LOWARLE:	.000140	LBS/TON	COAL	EFFICIENCY:	90.07	
arrandina ya				_ _				· · · · ·
	NZENE							
	LO	DAD IN:	,000030	LBS/TON	COAL			
	AL	LOWABLE:			CUAL	EFFICIENCY:	.02	
			• 0 1	LBS/HR				
UQ	ST CO	LLECTED	PER DAY:	8.5	TONS (D	RY)		
						, .		
			CESS:					
EX	HAUST	TEMPERA	TURE:	150.	F			
ور	EM FI	Ow: 566	.000 AT	7.0	c			
AC AC	FM FL	.OW: 651	TAAT	150.	r F			•
		, , , , , , , , , , , , , , , , , , , ,	,,,,					
L/	G RAT	10:		0				
			LOW:					
		WATER F		907		%SOLIDS:	•	
30	SECIMI	LU JULII	73 001+	70,1 •	MU/L	*30[103+	, • A .	• •
						<u> </u>		
							•	
			- · · · · · - · - · - · - · - · - · - ·					
		· · · · · · · · · · · · · · · · · · ·						
					·			

A-44

	DDCEC.	 507	DIENCHTAG	CLEAN WATER	UNITS _	OPTION
	PPSES.	202.	ANEWCHING -	LLEAN WATER	LUKE	3
	CONTROL	SYSTEM	CONFIGURATI	ON:		
	QU	ENCH TO	MER BAFFLES			
				0. 0. IN		: 14.
	OPERATI	NG HOUR	HP EACH S AT FULL HP S AT REDUCED	8760.	CAPACITY:	
· <u>-</u> -	STACK H	EIGHT: OVENS		60.		: _0
	OVEN HE OVEN VO TONS CO	LUME	<u></u>	6.0 M 1348. C		and the second s
	AVG. CO NOCYC	KING TII LES/DAY	ME, HRS.	17.5		
	BULK DE YIELD TONS CO	NSITY AL/YEAR		50. LI .70 .4047868.	BS/CUBIC F	•
						
		- · ·				
					·	
. <u>.</u>						
						2 2 2 2
				<u></u>	· .	
		· · · · · · · · · · · · · · · · · · ·				

PRESS: 503. QUENCHING - CLEAN WATER CUKE 3 CAPACITY: 2.834 MILLIUN TUNS/YEAR TOTAL COST (COST BASIS IS 110.00% OF JUNE 1977 DOLLARS FOR 4078 COST CATEGORY COST IN DOLLARS *** DIRECT LOST *** EQUIPMENT OR MATERIAL 928400. INSTRUMENTATION 30840. PIPING 13240. ELECTRICAL 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,	CAPITAL CUST:		UNIT	S OPTION	
TOTAL COST (COST BASIS IS 110.00% OF JUNE 1977 DOLLARS FOR 4078 COST ***.DIRECT. COST *** EQUIPMENT OR MATERIAL 928400. INSTRUMENTATION 30800. PIPING 132404. ELECIRICAL 0. FOUNDATIONS U. SITE WORK 8800. INSULATION 7900. PROTECTIVE COATING 3500. BUILDINGS 0. EQUIPMENT/MATERIAL LABOR 654700. DIRECT COST SUBIOTAL 1647300. *** INDIRECT COST *** FIELD OVERHEAD 0. CONTRACTORS FEE 338600. EMGINEERING 244200. FREIGHT 0. OFFSITE WORK 48400. SPARES 48400. SPARES 48400. SPARES 48400. SPARES 48400. INTEREST DURING INSTALLATION 155100. TOTAL COST WITH RETKOFIT 4233600.	PPSES: 503. QU	ENCHING - CLEAN	WATER CUK	3	
CATEGORY COST IN DOLLARS	CAPACITY:	2.834 MILLION	TUNS/YEAR		
### DIRECT COST *** EQUIPMENT OR MATERIAL 928400. INSTRUMENTATION 30800. PIPING 13200. ELECTRICAL 0. FOUNDATIONS 0. SITRUCTURAL 0. SITE WUPK 8800. INSULATION 7900. PROTECTIVE COATING 3500. BUILDINGS 0. EQUIPMENT/MATERIAL LABOR 654700. DIRECT COST_SUBTOTAL 1647300. *** INDIRECT CUST *** FIELD OVERHEAD 70400. CONTRACTORS FEE 338800. ENGINEETING 244200. FREIGHT 0. OFFSITE WUPK 44000. SPARES 44000. SPARES 44000. SPARES 44000. INDIRECT COST_SUBTOTAL 155100. TOTAL COST_WITH NETROFIT 4233600.	TOTAL COST (C	OST BASIS IS 11	0.00% OF JUNE	1977 DOLLARS	FOR 4078 COST
EQUIPMENT OR MATERIAL 928400. INSTRUMENTATION 30800. PIPING 13200. ELECTRICAL 0. FOUNDATIONS 0. SIRUCTURAL 0. SITE WURK 8800. INSULATION 7900. PROTECTIVE COATING 3500. BUILDINGS 0. EQUIPMENT/MATERIAL LABUR 654700. DIRECT COST. SUBTOTAL 1647300. *** INDIRECT COST *** FIELD OVERHEAD 70400. CONTRACTORS FEE 358800. ENGINEERING 244200. FREIGHT 0. OFFSITE WORK 44000. TAXES 48000. SHAKEDOWN 26400. SPARES 44000. CUNTINGENCY 638000. INDIRECT COST SUBTOTAL 1454200. INTEREST DURING INSTALLATION 155100. TOTAL COST WITH RETRUFIT 4233660.	CATEGORY	·	COST IN	DOLLARS	
EQUIPMENT OR MATERIAL 928800. INSTRUMENTATION 30800. PIPING 13200. ELECTRICAL 0. FOUNDATIONS 0. SIRUCTURAL 0. SITE WORK 8800. INSULATION 7900. PROTECTIVE COATING 3500. BUILDINGS 0. EQUIPMENT/MATERIAL LABUR 654700. DIRECT COST *** FIELD OVERHEAD 70400. CONTRACTORS FEE 38800. ENGINEERING 244200. FREIGHT 0. OFFSITE WORK 44000. TAXES 48400. SHAREDOWN 26400. SHAREDOWN 26400. SHAREDOWN 638000. INDIRECT COST SUBTOTAL 195100. TOTAL COST SUBTOTAL 195100.	**	* DIRECT_COST_	* * *		
INSTRUMENTATION 30800 PIPING 13200 ELECTRICAL 0 0 0 0 0 0 0 0 0	EQUIPMENT OR	MATERIAL	928400.		ı
PIPING	TNSTRUMENTAT	TON	30800		
ELECTRICAL FOUNDATIONS 0. STRUCTURAL 0. SITE WURK 8800. INSULATION PROTECTIVE COATING BUILDINGS 0. EQUIPMENT/MATERIAL LABUR DIRECT COST_SUBTOTAL EX** INDIRECT COST *** FIELD OVERHEAD CONTRACTORS FEE 338800. ENGINEERING ENGINEERING OFFSITE WURK 44000. TAXES 48400. SHAKEDOWN SPARES CUNTINGENCY INDIRECT COST_SUBTOTAL INTEREST DURING INSTALLATION TOTAL COST_WITH RETRUFIT 4233600.					
FOUNDATIONS					- ·
STRUCTURAL 0 SITE WURK			· · · · · · · · · · · · · · · · · · ·		
SITE WURK	-		-		
INSULATION 7900. PROTECTIVE COATING 3500. BUILDINGS 0. EQUIPMENT/MATERIAL LABUR 654700. DIRECT COST SUBJOTAL 1647300. *** INDIRECT COST *** FIELD OVERHEAD 70400. CONTRACTORS FEE 338800. ENGINEEPING 244200. FREIGHT 0. OFFSITE WURK 44000. TAXES 48400. SHAKEDOWN 26400. SPARES 44000. CONTINGENCY 638000. INDIRECT COST SUBTOTAL 1454200. INTEREST DURING INSTALLATION 155100. TOTAL COST WITH RETRUFIT 4233600.	- /				•
## PROTECTIVE COATING ## 3500. ## BUILDINGS			=		
BUILDINGS EQUIPMENT/MATERIAL LABUR DIRECT COST SUBTOTAL *** INDIRECT COST *** FIELD OVERHEAD CONTRACTORS FEE 338800. ENGINEERING ENGINEERING OFFSITE WURK TAXES A8400. SHAKEDOWN SPARES CUNTINGENCY INDIRECT COST SUBTOTAL INTEREST DURING INSTALLATION TOTAL COST WITH RETROFIT 4233600.					
### INDIRECT COST *** FIELD OVERHEAD 70400. CONTRACTORS FEE 358800. ENGINEERING 244200. FREIGHT 0. OFFSITE WORK 44000. TAXES 48400. SPARES 44000. CONTINGENCY 638000. INDIRECT COST SUBTOJAL 1454200. TOTAL COST WITH RETRUFIT 4233600.		OATING _	3500.		
### INDIRECT COST ### FIELD OVERHEAD 70400. CONTRACTORS FEE 338800. ENGINEERING 244200. FREIGHT 0. OFFSITE WORK 44000. TAXES 48400. SHAKEDOWN 26400. SPARES 44000. CONTINGENCY 638000. INDIRECT COST SUBTOTAL 1454200. TOTAL COST 3256600. TOTAL COST WITH RETRUFIT 4233600.			0.		
### INDIRECT COST ### FIELD OVERHEAD 70400. CONTRACTORS FEE 338800. ENGINEERING 244200. FREIGHT 0. OFFSITE WORK 44000. TAXES 48400. SHAKEDOWN 26400. SPARES 44000. CONTINGENCY 638000. INDIRECT COST SUBTOTAL 1454200. TOTAL COST 3256600. TOTAL COST WITH RETRUFIT 4233600.	EQUIPMENT/MA	TERIAL LABOR	654700.		
### INDIRECT COST ### FIELD OVERHEAD 70400. CONTRACTORS FEE 338800. ENGINEERING 244200. FREIGHT 0. OFFSITE WORK 44000. TAXES 48400. SHAKEDOWN 26400. SPARES 44000. CONTINGENCY 638000. INDIRECT COST SUBTOTAL 1454200. INTEREST DURING INSTALLATION 155100. TOTAL COST 3256600. TOTAL COST WITH RETRUFIT 4233600.	DIRECT	COST_SUBTOTAL		1647300.	
FIELD OVERHEAD CONTRACTORS FEE 338800. ENGINEERING PREIGHT 0. OFFSITE WURK 44000. TAXES 48400. SHAKEDOWN SPARES 44000. CONTINGENCY INDIRECT COST SUBTOTAL INTEREST DURING INSTALLATION TOTAL COST TOTAL COST WITH RETROFIT 4233600.					
FIELD OVERHEAD 70400. CONTRACTORS FEE 338800. ENGINEERING 244200. FREIGHT 0. OFFSITE WURK 44000. TAXES 48400. SHAKEDOWN 26400. SPARES 44000. CONTINGENCY 638000. INDIRECT COST SUBTOTAL 1454200. INTEREST DURING INSTALLATION 155100. TOTAL COST 3256600. TOTAL COST WITH RETROFIT 4233600.	***	INDIRECT COST	***		
CONTRACTORS FEE 338800. ENGINEERING 244200. FREIGHT 0. OFFSITE WURK 44000. TAKES 48400. SPARES 44000. CONTINGENCY 638000. INDIRECT COST SUBTOJAL 1454200. INTEREST DURING INSTALLATION 155100. TOTAL COST 3256600. TOTAL COST WITH RETROFIT 4233600.					
ENGINEERING 244200. FREIGHT 0. OFFSITE WURK 44000. TAXES 48400. SHAKEDOWN 26400. SPARES 44000. CONTINGENCY 638000. INDIRECT COST SUBTOTAL 1454200. INTEREST DURING INSTALLATION 155100. TOTAL COST 3256600. TOTAL COST WITH RETRUFIT 4233600.	CONTRACTORS	EEE			
FREIGHT 0. OFFSITE WURK 44000. TAXES 48400. SHAKEDOWN 26400. SPARES 44000. CUNTINGENCY 638000. INDIRECT COST SUBTOJAL 1454200. INTEREST DURING INSTALLATION 155100. TOTAL COST 3256600. TOTAL COST WITH RETKOFIT 4233600.		ree			
OFFSITE WURK TAXES 48400. SHAKEDOWN 2-6400. SPARES 44000. CUNTINGENCY 638000. INDIRECT COST SUBTOJAL 1454200. INTEREST DURING INSTALLATION 155100. TOTAL COST 3256600. TOTAL COST WITH RETROFIT 4233600.					
TAXES SHAKEDOWN SPARES CONTINGENCY CONTINGENCY INDIRECT COST SUBTOJAL INTEREST DURING INSTALLATION TOTAL COST TOTAL COST TOTAL COST WITH RETROFIT 4233600.					
SHAKEDOWN SPARES 44000. CONTINGENCY 638000. INDIRECT COST SUBTOTAL 1454200. INTEREST DURING INSTALLATION 155100. TOTAL COST 3256600. TOTAL COST WITH RETRUFIT 4233600.			•		
SPARES CONTINGENCY 1NDIRECT COST SUBTOTAL 1454200. INTEREST DURING INSTALLATION 155100. TOTAL COST 3256600. TOTAL COST WITH RETRUFIT 4233600.					
CONTINGENCY INDIRECT COST SUBTOJAL INTEREST DURING INSTALLATION TOTAL COST TOTAL COST WITH RETRUFIT 4233600.					**
INTEREST DURING INSTALLATION 155100. TOTAL COST 3256600. TOTAL COST WITH RETROFIT 4233600.					
INTEREST DURING INSTALLATION 155100. TOTAL COST WITH RETROFIT 4233600.	CONTINGENCY		638000.		
INTEREST DURING INSTALLATION 155100. TOTAL COST 3256600. TOTAL COST WITH RETROFIT 4233600.	INDIREC	T COST SUBTOTAL		1454200.	
TOTAL COST WITH RETRUFIT 4233600.					
TOTAL COST WITH RETRUFIT 4233600.	INTERES	T DURING INSTAL		155100.	
	TOTAL C	OST		3256600.	
	TOTAL C	OST WITH RETRUF	IT .	4233600.	
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				and the second discussion when the second of	
	<u> </u>				

PPSES: 503. Q	UENCHING - CLEAN WA	TER COKE 3	· - -
CAPACITY:	2.834 MILLION TO	NS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST
•	*** UTILI	TIES ***	
	0. MGAL/YR	\$1595/1000 GAL	
ELECTRICITY		\$.0266/KWH	0.
STEAM		\$ 4.0920/MLBS	
FUEL	0, GAL/YR	\$4180/GAL	0
. <u> </u>	*** OPERATING	G LABOR ***	
0.1050.1		- A	
DIRECT	U. HRS/YR	\$14.34/HR	Ů. (<i>l</i>
SUPERVISION	U. HRS/YR	\$17 <u>.</u> 20/HR	O• (F
	*** MAINTENANCE	&_SUPPLIES ***	
DIRECT LABOR	4000 HRS/YR	\$14.34/HR	57400. ((
SUPERVISION_	BOU. HRS/YR	\$17.20/HR	13800. (
MATERIALS			114800. (6
SUPPLIES			27900. (1
WATER TREATMENT			
SULID WASTE			
	6193. TON/YR	\$ 8,25/1UN	51100.
DIRECT OPERA	TING CUST		265000.
PAYROLL OVER	HEAD = 20.0% OF A+B+	C+D	14200.
PLANT UVERHE	AD =50.0% OF A+B+C+1	D+E+F	107000.
TOTAL OPERAT	-		386200.
	ST IN DOLLARS PER TO		• 1 4
	ST IN DOLLARS PER TO		
	ST AS PERCENT OF CAR	PITAL COST	9.1
· ·	TIME IN WEEKS		52.
KWH PER TON	FE OF SYSTEM IN YEAR CAPACITY	4.5	20.
	VERY (11.75% OF TOTA	AL CADITAL)	.0 497300.
	ON OVERHEAD (2.0%		
	ES & INS. (2.0% OF		
	IZED COST - RETROFT		The state of the s
	- NEW	······································	898900.
	<u>.</u>		 : -

						UNITS	
PPS	s:	503.	DUENCHING	- CLEAN	WATER	COKE	4
CAP	CII	y:	2.834	MILLION	TONS/	EAR	
DADI	T T C 11	LATE					
			1.700000	LRS/TON	COAL		
						EFFICIENCY	: 98.07
	~_		15.71		0042	21,1312,131	
B\$ 0							
500	ιn	AD TN:	.001700	LBS/TON	COAL		
						EFFICIENCY	: 99.01
				LBS/HR			
BAP							
		AD IN:	.000140	LBS/TON	COAL		
						EFFICIENCY	: 99.0%
	···			LBS/HR			
BENZ	ZENE						
			.000030				
	AL	LOWABLE			COAL	EFFICIENCY	: 99.0%
			. •00	LBS/HR			
DUST	CO	LLECTED	PER DAY:	9.2	TONS (RY)	
TEME		T 05 800	CESS:	200 1	•		
			TURE:				
E A III	,001	TEM EN	· · O · · E ·	2000			
SCF	1 FL	OW: 549	000. AT	70. 1	:		
ACF	1 FL	OW: 683	5000. AT	200.			
L/G	RAT	10:		0			
			LOW:				
		WATER F		0.			
SUSF	PEND	ED SOLI	S OUT:	0,	4G/L	XSOLIDS:	. 0
	· · · · · · · · · · · · · · · · · · ·				***************************************		
					<u>-</u>		
•							
			<u> </u>				
					- 4.2		
				····			

PPSES	503.	QUENCHING	- CLEAN WA	TER	COKE	OPTION 4	
	SYSTEM	CONFIGURAT	ION:				
DR	Y BUENCH	IING					
PEET UP	AUUIIII	DROP:	0). Thick	IAMETER:	15.	
O FAME	TESSURE	HP EACH	SDADE	FAN CA	ES Pactty:	0. *	
		AT FULL H			PACITI	U . A	
		AT REDUCE					
STACK MI	FIGHT:	A NEDOCE	111111111111111111111111111111111111111) n	TAMETED.	0	
NO. OF (60		AND LEN.		
A			6	O MET	FRS		
DVEN VOI	UME		1348	CUA	IC FEFT	······································	
TONS CO	(E/PUSH		24	i .	<u> </u>	······································	
AVG. CO				7.5			
BULK DE			50	LBS	/CUBIC F	Τ.	
YIELD						_	
	AL/YEAR		4047868	3.			
							
				· · · · · · · · · · · · · · · · · · ·			
						•	
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						•	

	UNITS OPTION
PPSES: 503. QUENCHING - CLEAN WA	TER COKE 4
CAPACITY: 2.834 MILLION TO	NS/YEAR
TOTAL COST (COST BASIS IS 110.0	0x OF JUNE 1977 DOLLARS FOR 4078 CO
CATEGORY	COST IN DOLLARS
*** DIRECT COST ***	
EQUIPMENT OR MATERIAL	9365400.
INSTRUMENTATION	0.
PIPING	0.
ELECTRICAL	0.
FOUNDATIONS	0.
STRUCTURAL	0.
SITE WORK	0.
INSULATION	0.
PROTECTIVE COATING	0.
BUILDINGS	0.
EQUIPMENT/MATERIAL LABOR	
DIRECT COST SUBTOTAL	13860700.
*** INDIRECT COST **	
FIELD OVERHEAD	2409500.
CONTRACTORS FEE	1591300.
ENGINEERING	476500.
FREIGHT	0.
OFFSITE WORK	404600.
TAXES	449500.
	674300.
SPARES	71900.
CONTINGENCY	4890900.
INDIRECT COST SUBTOTAL	10968500.
INTEREST DURING INSTALLAT	ION 3103700.
TOTAL COST	27932900.
TOTAL COST WITH RETROFIT	30726200.
JUINE DES MILITIME INSTITUTE OF THE PROPERTY O	
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PPSES: 503.	QUENCHING - CLEAN WA	UNITS OPTION TER COKE 4	-
CAPACITY:	2.834 MILLION TO	NS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (
	*** UTILI	TIES ***	
WATER	O. MGAL/YR	\$.1595/1000 GAL	0.
ELECTRICITY	22668064. KWH/YR	\$.0266/KWH	603400.
STEAM	0. MLBS/YR	- '	0.
FUEL	0. GAL/YR	\$.4180/GAL	0.
	*** OPERATIN	G LABOR ***	
DIRECT	8760. HRS/YR	\$14.34/HR	125700. (A
SUPERVISION	1752. HRS/YR	\$17.20/HR	30100. (8
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	62337. HRS/YR	\$14.34/HR	894200. (0
SUPERVISION	12467 . HRS/YR	\$17.20/HR	214500. (D
MATERIALS			447100. (E
SUPPLIES			233400. (F
WATER TREATMEN	T		0.
SOLID WASTE			
DISPOSAL	3372. TON/YR	\$ 8.25/TON	27800.
DIRECT OPE	RATING COST		2576200.
PAYROLL OV	252900.		
PLANT OVER	972500.		
TOTAL OPER	3801600.		
<u>OPERATING</u>	1.34		
OPERATING	1127.44		
OPERATING	12.4		
	ON TIME IN WEEKS		130.
	LIFE OF SYSTEM IN YEAR N CAPACITY	RS	25.
KWH PER TO	8.0		
CAPITAL RE	3385000.		
ADMINISTRA PROPERTY T	614500.		
	614500. 8415600.		
JUIAL ANNU	ALIZED COST - RETROFI' - NEW		7996300.

DDCCC	• En#	DOOPS			S IION
rrses	504.	UUUKS		COKE	C
CAPAC	ITY:	.708	MILLION TONS	YEAR	
	. .				•
_	CULATE	E0000	I DE /TON COA		
	ALLOWABLE		LBS/TON COAL	EFFICIENCY:	40 08
	ALLUMADLE	•	LBS/HR	EFFILIENCIA	60.0A
BSO					
	LOAD TN:	-500000	LBS/TON COAL		
				EFFICIENCY:	60.07
	TILLY INVEST		LBS/HR		
BAP.					
	LOAD IN:	.003000	LBS/TUN COAL		
				EFFICIENCY:	60.0%
			LBS/HR		
BENZE	NE				
	LOAD IN:		LBS/TON COAL		
	ALLOWABLE			EFFICIENCY:	60.0%
		.46	LBS/HR		
DUST	COLLECTED	PER DAY:	.4 TONS	DRY)	
		DCESS:	120. F		
EXHAU	ST TEMPER	A I UKE :	120. F		
	FLOW:		70. F		
		O. AT	120. F		
ACFM	FLOW:				
			.0		
L/G R	FLOW: ATIO: SS WATER	FLOW:	0. GPM		
L/G R PROCE COOLI	ATIO: SS WATER ING WATER	FLOW:	0. GPM 0. GPM		
L/G R PROCE COOLI	FLOW: ATIO: SS WATER	FLOW:	0. GPM	*SOLIDS:	• 0
L/G R PROCE COOLI	ATIO: SS WATER ING WATER	FLOW:	0. GPM 0. GPM	%SOLIDS:	• 0
L/G R PROCE COOLI	ATIO: SS WATER ING WATER	FLOW:	0. GPM 0. GPM	%SOLIDS:	• 0
L/G R PROCE COOLI	ATIO: SS WATER ING WATER	FLOW:	0. GPM 0. GPM	%SOLIDS:	• 0
L/G R PROCE COOLI	ATIO: SS WATER ING WATER	FLOW:	0. GPM 0. GPM	%SOLIDS:	• 0
L/G R PROCE COOLI	ATIO: SS WATER ING WATER	FLOW:	0. GPM 0. GPM	XSOLIDS:	.0
L/G R PROCE COOLI	ATIO: SS WATER ING WATER	FLOW:	0. GPM 0. GPM	*SOLIDS:	.0
L/G R PROCE COOLI	ATIO: SS WATER ING WATER	FLOW:	0. GPM 0. GPM	%SOLIDS:	• 0
L/G R PROCE COOLI	ATIO: SS WATER ING WATER	FLOW:	0. GPM 0. GPM	%SOLIDS:	• 0
L/G R PROCE COOLI	ATIO: SS WATER ING WATER	FLOW:	0. GPM 0. GPM	%SOLIDS:	.0
L/G R PROCE COOLI	ATIO: SS WATER ING WATER	FLOW:	0. GPM 0. GPM	XSOLIDS:	.0

GENERAL INFORMATION: UNITS OPTION PPSES: 504. DOORS COKE 2 CONTROL SYSTEM CONFIGURATION: COKE OVEN DOOR CLEAN & MAINT FEET OF ADDITIONAL DUCT: DIAMETER: 0. INCHES TOTAL PRESSURE DROP: O FANS D O. HP EACH SPARE FAN CAPACITY: 0,X OPERATING HOURS AT FULL HP: 8760. OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: O. DIAMETER: O. NO. OF OVENS 60. OVEN HEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82.__ BULK DENSITY 50. LBS/CUBIC FT. .70 YIELD 1011967. TONS COAL/YEAR A-53

PPSES: 504.			
CAPACITY:	.708 MILLION TOP	NS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (
	*** UTILI	TIES ***	· · · · · · · · · · · · · · · · · · ·
WATER	O. MGAL/YR	\$.1595/1000 GAL	0.
ELECTRICITY	O. KWH/YR	\$.0266/KWH	0.
STEAM	0. MLBS/YR		0.
FUEL	Q. GAL/YR	\$.4180/GAL	0.
	*** OPERATING	S LABOR ***	
DIRECT	0. HRS/YR	\$14.34/HR	0. (/
SUPERVISION	0. HRS/YR	\$17.20/HR	0. (6
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	17520. HRS/YR	*10 70/UD	251300. (c
SUPERVISION	3504. HRS/YR	\$14.34/HR \$17.20/HR	60300. ([
MATERIALS.	3304. HR3/1R	\$17,EU/HK	125400. (6
SUPPLIES			58000. (F
WATER TREATMENT			
SOLID WASTE			
DISPOSAL	O. TON/YR	\$ 8.25/TON	0.
DIRECT OPERA	ATING COST		495000.
PAYROLL OVER	62300.		
PLANT OVERHE	247500.		
TOTAL OPERAT	804800.		
OPERATING CO	1.14		
OPERATING CO	5301.89		
OPERATING CO	• 0		
	99.		
KWH PER TON	FE OF SYSTEM IN YEAR CAPACITY		• 0
	OVERY (10.00% OF TOTA	AL CAPITAL)	0.
ADMINISTRATI	0.		
PROPERTY TAX	0.		
TOTAL ANNUAL	804800.		
IVIAL_AUIUVI	- NEW		804800.

GENERAL INFORMATION: UNITS OPTIUN PPSES: 504. DOORS COKE CAPACITY: .708 MILLION TONS/YEAR PARTICULATE LOAD IN: .500000 LBS/TON COAL ALLOWABLE: .100000 LBS/TON COAL EFFICIENCY: 80.0% 11.55 LBS/HR BSO .500000 LBS/TON COAL LOAD IN: ALLOWABLE: .100000 LBS/TON COAL EFFICIENCY: 80.0% 11.55 LBS/HR BAP. LOAU IN: .003000 LBS/TON COAL ALLOWABLE: .000600 LBS/TON COAL EFFICIENCY: 80.0% .07 LBS/HR BENZENE .010000 LBS/TON COAL LOAD IN: .002000 LBS/TON COAL ALLOWABLE: EFFICIENCY: 80.0% .23 LBS/HR DUST COLLECTED PER DAY: .6 TONS (DRY) TEMP OUT OF PROCESS: 120. F EXHAUST TEMPERATURE: 120. F SCFM FLOW: U. AT 70. F 120. F ACFM FLOW: .0 L/G RATIO: 0. GPM PROCESS WATER FLOW: CUULING WATER FLOW: 0. GPM SUSPENDED SOLIDS OUT: 0. MG/L XSOLIDS: .0

GENERAL INFORMATION: UNITS OPTION PPSES: 504. DOURS COKE CONTROL SYSTEM CONFIGURATION: COKE OVEN DOOR CLEAN & MAINT FEET UF ADDITIONAL DUCT: DIAMETER: 0. TOTAL PRESSURE DROP: 0. INCHES 0 FANS & 0. HP EACH SPARE FAN CAPACITY: 0.X OPERATING HOURS AT FULL HP: 8760. OPERATING HOURS AT REDUCED HP: 0. DIAMETER: 0. STACK HEIGHT: 0.__ NO. OF OVENS 60. OVEN HEIGHT 6.0 METERS 1348. CUBIC FEET OVEN VOLUME TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. .70 YIELD TUNS COAL/YEAR 1011967.

CAPITAL CUST:

	UNITS OPTION
PPSES: 504. DOORS	COKE 3
CAPACITY:	IONS/YEAR
TOTAL 2007 (2007 01070 70 110	
TOTAL COST (COST BASIS IS 110.	.00% OF JUNE 1977 DOLLARS FOR 4078 CUST
CATEGORY	COST IN DOLLARS
*** DIRECT COST **	nt d
EQUIPMENT OR MATERIAL	251900.
INSTRUMENTATION	0.
PIPING	<u> </u>
ELECTRICAL	0.
FOUNDATIONS	0.
STRUCTURAL	
SITE WORK	0.
INSULATION	0.
PROTECTIVE COATING	
BUILDINGS EQUIPMENT/MATERIAL LABUR	0.
DIRECT COST SUBTOTAL	
DANEET EGGT GODTOTAL	
*** INDIRECT COST	R ft ft
FIELD OVERHEAD	7000.
CONTRACTORS FEE	3000.
ENGINEERING	17500.
FREIGHT	
OFFSITE WORK	0.
TAXES	12500.
SHAKEDOWN	2300.
SPARES	12000. 63900.
CONTINGENCY	119700.
INDIRECT COST SUBJUIRE	4171VV
INTERES! DURING INSTALL	ATION 29600.
TUTAL COST	414500.
TOTAL COST WITH RETROFIT	414500.
JUINE GOOT HATTI NETRO! I	717277
A-57	
h -37	

PPSES: 504. DC	ORS	UNITS OPTION COKE 3	
-PADACITY+	708 MILLION TO	NC /VEAD	
CAPACITY:	708 MILLION TO	S/IEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST
	*** UTILI	ILES ***	
WATER	U. MGAL/YR	\$.1595/1000 GAL	0.
ELECTRICITY	U. KWH/YR	\$.0266/KWH	0.
STEAM	0. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	O. GAL/YR	\$.4180/GAL	0.
	*** OPERATING	S LABOR_**	
DIRECT	17520. HRS/YR	\$14.34/HR	251300.
SUPERVISION	3504, HRS/YR	\$17,20/HR	60300.
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	4500. HRS/YR	\$14.34/HR	64500.
SUPERVISION	90U. HRS/YR	\$17.20/HR	15500.
MATERIALS			82300.
SUPPLIES			16800.
WATER TREATMENT			0.
SOLID WASTE			
DISPUSAL	U. TON/YR	\$ 8.25/TON	0.
DIRECT OPERAT	ING COST		490700.
PAYHOLL OVERH	EAD =20.0% OF A+8+1	C+0	78300,
PLANT OVERHEA	D =50.0% OF A+6+C+1)+E+F	245400.
TOTAL OPERATI			814400.
	T IN DOLLARS PER TO		1.
		ON OF DUST COLLECTED	4023.
	T AS PERCENT OF CAL	·	196.
	TIME IN WEEKS E OF SYSTEM IN YEAR		80. 25.
KWH PER TON		***	£5.
	ERY (11.02% OF TOTA	AL CAPITAL)	45700.
	N OVERHEAD (2.0%)		8300.
	S & INS. (2.0% OF		8300.
	ZED COST - RETROFI		876700.
	- NEW		876700.

GENERAL INFORMATION: UNITS OPTION COKE PPSES: 504. DOORS 4 --CAPACITY: .708 -MILLION TONS/YEAR -- -- -- -----PARTICULATE ___LOAD IN: -.500000 -LBS/TON COAL ALLOWABLE: .057500 LBS/TON COAL EFFICIENCY: 88.5% 6.99 LBS/HR BSO .500000 LBS/TON COAL LOAD IN: ALLOWABLE: -110000 LBS/TON COAL EFFICIENCY: --78.0% 13.38 LBS/HR BAP LOAD IN: .003000 LBS/TON COAL ALLOWABLE: .000660 LBS/TON COAL EFFICIENCY: 78.0% -.08 LBS/HR --BENZENE -010000 LBS/TON COAL LOAD IN: ALLOWABLE: .003500 LBS/TON COAL EFFICIENCY: 65.0% .43 LBS/HR DUST COLLECTED PER DAY: .6 TONS(DRY) TEMP OUT OF PRUCESS: -120. F EXHAUST TEMPERATURE: 100. F SCFM FLOW: TA ..0000S 70. F ACFM FLOW: 22000. AT 100. F L/G RATIO: PROCESS WATER FLOW: 160. GPM COOLING WATER FLOW: 0. GPM SUSPENDED SOLIDS OUT: 532. MG/L XSOLIDS: .1

GENERAL I	NFORMA	TI	ON:
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PPSES: 504. DOORS

COKE

CONTROL SYSTEM CONFIGURATION:

The state of the s

VENTURI SCRUBBER MIST ELIMINATOR FAN AND DRIVE -- --- ... DUCTWORK STACK - --- CANOPY -HOOD --- WASTEWATER RECYCLE SYSTEM DAMPERS - WASTE WATER RETURN SYSTEM WATER PUMPING SYSTEM FAN AND DRIVE ELECTRICAL

- -- COKE -OVEN DOOR CLEAN -8 -MAINT

FEET-OF-ADDITIONAL-DUCT: -----630. ---DIAMETER: -3.-----TOTAL PRESSURE DROP: 35. INCHES 2 FANS @ 202. HP EACH SPARE FAN CAPAC SPARE FAN CAPACITY: 100.2 DPERATING HOURS AT FULL HP: - 8322. OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 100. - NO. OF OVENS HOOD SIZE: 16. SQ.FT. OVEN HEIGHT 6.0 METERS -1348. --CUBIC FEET --- ... TONS COKE/PUSH AVG. COKING TIME, HRS. 17.5 --- NO. CYCLES/DAY 82. . . BULK DENSITY 50. LBS/CUBIC FT. YIELD .70 TONS COAL/YEAR 1011967.

A-60

	04. DOORS					rs(<e< th=""><th></th><th></th><th></th><th></th></e<>				
CAPACITY:		,708 MILL	ION TONS	YEAR	?					-
TOTAL COS	T (COST	BASIS IS					DOLLARS	FOR	4078	cos
CATE	GORY	<u>.</u>		COST		DOLL	ARS			•
						<u>-</u>				
EGUI	PMENT OR MAT	TERIAL		4414	100.					
TNST	RUMENTATION			519						
DIPI	NG		<u></u>	-						
		•	· · · · · ·		-			•		
	TRICAL			99.0	_					
	DATIONS			556						
STRU	CTURAL	•		836	00.	•		÷	-	
SITE	WORK			38	00.					
INSU	LATION			77	00.					
	ECTIVE COATI									
	DINGS			108						
	PMENT/MATER]									
	DIRECT -COST	SUBTUTAL	• • • • • • • • • • • • • • • • • • • •			457	7500			
		IRECT CO								
FIEL	D OVERHEAD .			1381	00.					
CONT	RACTORS FEE			669	00.					
	NEERING			1383	-					
	GHT			419	000 -					
	ITE WORK			204						
TAXE				380						
	EDOWN							•	•	
SPAR				345	•					
CONT	INGENCY			3332						
_	INDIRECT CO	ST SUBTO	TAL		•	849	000.			
	INTEREST DU	JRING INS				131	900.			
	TOTAL COST					1938	9400.			

	PPSES: 504.	DOORS	COKE 4	
		708 MILLION TON	S/YEAR	
	CATEGORY	QUANTITY	RATE	ANNUAL COST (
		*** UTILIT	IES ***	
	WATER	15978. MGAL/YR		2500.
	ELECTRICITY	1332553. KWH/YR	\$.0266/KWH	35500.
	STEAM	0. MLBS/YR	\$ 4.0920/MLBS	0.
	FUEL	1332553. KWH/YR 0. MLBS/YR	\$4180/GAL	······································
			-LABOR -***	
	DIRECT	8760. HRS/YR	\$14.34/HR	125700. (4
		1752. HRS/YR		
•			& -SUPPLIES -***	
	DIRECT LABOR	33977. HRS/YR 6795. HRS/YR	\$14.34/HR	487400. (C
	SUPERVISION	6795. HRS/YR	\$17.20/HR	116900. (D
	MATERIALS		•	236400. (E
	SUPPLIES			128300. (F
	- WATER TREATMENT			0.
	SOLID WASTE			• •
	DISPOSAL	448. TON/YR	\$ 8.25/TON	3700.
	DIRECT OPER	ATING COST		1166500.
	PAYROLL -OVE	RHEAD =20.0% OF A+B+C	+D	152000.
	PLANT OVERH	EAD =50.0% OF A+B+C+0	+E+F	562400.
	TOTAL OPERA	TING COST		1880900.
	OPERATING C	OST IN DOLLARS PER TO	N PRODUCTION	2.66
		OST IN DOLLARS PER TO		8400.71
		OST AS PERCENT OF CAP		79.6
	INSTALLATIO	N TIME IN WEEKS		104.
		IFE OF SYSTEM IN YEAR		15.
	KWH PER TON		•	1.9
		OVERY (13.15% OF TOTA	L CAPITAL)	310700.
		ION OVERHEAD (2.0% O		47300.
		XES & INS. (2.0% OF		47300.
		LIZED COST - RETROFIT		~2286200 .

PPSE	s: 504.	DOORS			COKE	5
CAPA	CITY:		MILLION	-TONS/	YEAR	
PART	ICULATE				·	
	ALLOWABLE		LBS/TON LBS/HR	COAL	EFFICIENCY:	93.3
BS 0			<u> </u>	·····		
		.500000	I BS/TON	COAL		
					-EFFICIENCY:	-83.8
			LBS/HR			
BAP						
		.003000				
					EFFICIENCY:	
		06	FB3/HK			
BENZ						
		-				
	ALLOWABLE		LBS/TON LBS/HR	COAL	EFFICIENCY:	72.0
DUST		_			DRY)	
0001	COLLECTED	TEN DATE	••	10110		
		OCESS:				
EXHA	UST TEMPER	ATURE:	100. F	•		
SCFM	FLOW: 2	6000. AT	70. F	•		
ACFM	FLOW: 2	6000. AT 7000. AT	100. F	•		
	RATIO:		~8 • 0			. •
	ESS WATER		208. 0			
	ING WATER Ended Soli		0. (409.)		Y COL TOC .	• 0
auar	といいたり うりにす	03 -001+	409. 4	46/L	*SOLIDS:	- 17

GENERAL INFORMATION:	UNITSOPTION
 PPSES: 504. DOORS	COKE 5
 CONTROL SYSTEM CONFIG	
 VENTURI SCRUBBER	
MIST ELIMINATOR	
DUCTWORK	
STACK	
CANOPYHOOD	
WASTEWATER RECYC	LE SYSTEM
DAMPERS	
-WASTE WATER RETU	
WATER PUMPING SY	
FAN AND DRIVE EL	
 COKE OVEN DOOR .C	LEAN -6 MAIN!
	CT:630DIAMETER:3.
TOTAL PRESSURE DROP:	
	H SPARE FAN CAPACITY: 100.%
	LL HP:8322.
OPERATING HOURS AT RE	
STACK HEIGHT:	100. DIAMETER: 3.
NO. OF OVENS	
HOOD SIZE:	16. SQ.FT.
OVEN HEIGHT	6.0 METERS
DVEN VOLUME TONS COKE/PUSH	.1348. CUBIC FEET
AVG. COKING TIME, HRS.	24. 17.5
NO. CYCLES/DAY	
BULK DENSITY	50. LBS/CUBIC FT.
YIELD	•70
TONS COAL/YEAR	1011967.

PPSES: 504	4. DOORS				COI	< E	5			
CAPACITYS -		708 MI	LL-ION-TONS	/YE#	\R					
TOTAL COST	(COST (BASIS	15 110.002	OF	JUNE	1977	DOLLARS	FOR	4078	cos
CATEGO	DRY			cos	ST IN	DOLL	ARS			
		RECT	COST-+++							
	MENT OR MATE				400.					
	JMENTATION	_			900.					
PIPING										
	RICAL		•		300.					
	ATIONS									
	TURAL		and the state of t	A 7	900.					
	VORK				.005					
	ATION				600.					
		иc								
BUILDI		10			5500					
	MENT/MATERIA									
	TENIZMATERIZ Storet Port	SUDTO	UK Tai	1//	900.	445				
	HELT-LUST	-50510	†- M [1-1-00			
	*** IND	TRECT	COST ***							
· · · · FIELD	OVERHEAD -			-154	800.					
	CTORS FEE				700.					
ENGINE	ERING			148	900.					
FREIGH	ERING			46	100.					
OFFSIT	E WORK				3200.					
TAXES		'.			800.					
SHAKED	OWN			43	1900					
SPARES					000.					
CONTIN	GENCY				400.					
		ST -SUB	TOTAL			95	3800			
1	INTEREST DUF	RING I	NSTALLATIO	N		15	0100.			
T	TOTAL COST					222	5000.			
_							-			
	TOTAL COST V	VITH -R	ETROFIT	•		-5690	6700.	-		
				• •						
NAME OF THE PROPERTY OF THE PR										
			•							
			and the secondary supporting a supply							
		·	and the same of th	==						

PPSES: 504.			COKE 5	
CAPACITY:		HOT HOL	5/YEAR	
CATEGORY	QUANTITY		RATE	ANNUAL CO
	* * *	UTILIT	IES ***	
WATER	20772MG	AL/YR	6 1 595/ 10 00- 6 AL	3300
ELECTRICITY	3026942. KW	H/YR		80600
STEAM	0. ML	BS/YR	\$ 4.0920/MLBS	(
FUEL	O,GA	L/4R	\$ 4.0920/MLBS -\$ -4180/GAL	
	***- 0 P	ERATING	-LABOR -+++	
DIRECT	8760 HR	S/YR	\$14.34/HR	125700
SUPERVISION	1752HR	S/YR	\$17.20/HR	30100
	MATAIT	ENANCE 1	-SUPPLIES-***	
			\$14,34/HR	487400
	6795 . _HR	S/YR		116900
MATERIALS				236400
SUPPLIES				128800
WATER TREATMEN				
SOLID WASTE				
DISPOSAL	472. TO	N/YR	\$ 8.25/TON	
	RATING COST			1213100
-PAYROLL OVE	C. XO. 05= DA3HR	F -A+B+C	D	152000
PLANT OVER	EAD =50.0% OF	A+B+C+D-	∙E+F	562700
TOTAL OPERA				1927800
OPERATING (OST IN DOLLARS	PER TO	N PRODUCTION	
OPERATING (COST IN DOLLARS	PER TO	N OF DUST COLLECTED	8167
OPERATING (OST AS PERCENT	OF CAP	ITAL COST	71
	IFE OF SYSTEM	IN YEAR	5	15
	V CAPACITY			4
			CAPITAL)	
ADMINISTRA	TION OVERHEAD (2.0% 0	TOTAL CAPITAL)	53900.
			TOTAL CAPITAL)	
	- N	EW		2309300.

Ancres For	2000			IIUN
PPSES: 504. [DOORS		COKE	6
CAPACITY:	708	MILLION TONS/	YEAR	
DAGTTO				
PARTICULATE	500000	LBS/TON COAL		
·		LBS/TUN COAL		88.5%
ne connocut		LBS/HK	Livioience	00.54
BSU				
LUAD IN:	.500000	LBS/TON CUAL		
ALLUWABLE:		LBS/TUN COAL	EFFICIENCY:	78.0%
	13.38	LBS/HR		
BAP		LBS/TON COAL		
ALLOWABLE:		LBS/TUN COAL	EFFICIENCY:	78.0%
SELZCAL				
BENZENE	010000	LUCITON COAL		
		LBS/TON COAL LBS/TON COAL		45 09
ALLUMANTE.		LBS/HK	EFFICIENCY;	65.04
DUST COLLECTED F	PER DAY:	.6 TONS (I	DRY)	
TEMP OUT OF PRUC				
EXHAUST TEMPERA	IURE .	100. F		
SCFM FLOW: 10	TA CUC	70. F		
ACEM FLOW: 110	000. AT	100. F		
L/G RATIO:		8.0		
PROCESS WATER FL	_UN:	80. GPM		
COULING WATER FL		U. GPM		
SUSPENDED SULTOS	5 001:	1064. MG/L	%50LIDS:	•1
				
			·	

PPSES: 504. DOORS	COKE 6
CONTROL SYSTEM CONFIGURAT	IUN:
VENTURI SCRUBBER	
MIST ELIMINATUR	
FAN AND DRIVE	
DUCTWORK	
STACK	
CANOPY HOUD	
WASTEWATER RECYCLE S'	YSTEM
DAMPERS	
WASTE WATER RETURN S'	YSTEM
WATER PUMPING SYSTEM	
FAN AND DRIVE ELECTR	ICAL
CUKE UVEN DOOR CLEAN	& MAINT
	350. DIAMETER: 2.
TOTAL PRESSURE DROP:	
	SPARE FAN CAPACITY: 100.X
UPERATING HOURS AT FULL HE	
UPERATING HOURS AT REDUCE!	
STACK HEIGHT:	100. DIAMETER: 2.
NO. OF OVENS	60.
HOUD SIZE: OVEN HEIGHT	16. SQ.FT.
OVEN VOLUME	6.0 METERS 1348. CUBIC FEET
TONS CUKE/PUSH	24.
AVG. CUKING TIME, HRS.	17.5
NO. CYCLES/DAY	
BULK DENSITY	50. LBS/CUBIC FT.
	.70
YIELD	1011967.

CATEGORY QUANTITY RATE ANNUAL COST *** UTILITIES *** MATER 7989, MGAL/YR \$.1595/1000 GAL 1500, ELECTRICITY 666276, KWH/YR \$.0266/KWH 17700, STEAM 0. MLBS/YR \$ 4.0920/MLBS 0, FUEL 0. GAL/YR \$.4180/GAL 0, FUEL 0. GAL/YR \$.4180/GAL 0, *** OPERAIING LABOR *** DIRECT 8760, HRS/YR \$14.34/HR 125700, SUPERVISION 1752, HRS/YR \$17.20/HR 30100, *** MAINJENANCE & SUPPLIES *** DIRECT LABUR 29937, HRS/YR \$17.20/HR 103000, MATERIALS 209100, SUPPLIES 112500, MATERIALS 209100, SUPPLIES 112500, WAIER THEATHENI 0. FOLIO WASTE 0. DIRECT UPERATING COST 1032300. PAYROLL OVERHEAD =20.0% OF A+8+C+D 137600, PLANT OVERHEAD =50.0% UP A+8+C+D+E+F 504800, TIOTAL OPERATING COST 1052300. PAYROLL OVERHEAD =50.0% UP A+8+C+D+E+F 504800, TIOTAL OPERATING COST 1052300. PAYROLL OVERHEAD =50.0% UP A+8+C+D+E+F 504800, TIOTAL OPERATING COST 1052300. OPERATING COST IN DOLLARS PER TON PRODUCTION 2. OPERATING COST IN DOLLARS PER TON PRODUCTION 2. OPERATING COST AS PERCENT OF CAPITAL COST 1053. UNSTALLATION TIME IN WEEKS 104. LSTIMATED LIFE OF SYSTEM IN YEARS 15. KWH PER TON CAPACITY 104. CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.	PPSES: 504. DO	DRS		COKE	6		
### UTILITIES ### MATER 7989. MGAL/YR \$.1595/1000 GAL 1300. ELECTRICITY 666276. KWH/YR \$.0266/KWH 17700. STEAM U. MLBS/YR \$ 4.0920/MLBS U. FUEL U. GAL/YR \$.4180/GAL U. DIRECT 8760. HRS/YR \$ 14.34/HR 125700. SUPERVISION 1752. HRS/YR \$17.20/HR 30100. ### MAINJENANCE & SUPPLIES ### DIRECT LABUR 29937. HRS/YR \$17.20/HR 103000. MATERIALS 209100. SUPERVISION 5987. HRS/YR \$17.20/HR 103000. MATERIALS 209100. SUPERVISION 5987. HRS/YR \$17.20/HR 103000. MATERIALS 209100. SUPERVISION 5987. HRS/YR \$17.20/HR 103000. DIRECT UPERATING COST 1032300. PAYROLL OVERHEAD =20.02 OF A+B+C+D 137600. PLANT OVERHEAD =50.02 OF A+B+C+D 504800. TOTAL OPERATING COST 1050LARS PER TON PRODUCTION 2. OPERATING COST IN DOLLARS PER TON PRODUCTION 2. OPERATING COST IN DOLLARS PER TON PRODUCTION 2. OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 7479. UPERATING COST AS PERCENT OF CAPITAL COST 105.81 INSTALLATION TIME IN MEEKS 15. KWH PER TON CAPACITY 2.	CAPACITY:	.708 M	ILLION TON	NS/YEAR			
### MAINTENANCE & SUPPLIES *** DIRECT LABUR 2937. HRS/YR \$14.34/HR 125700. SUPERVISION 5987. HRS/YR \$17.20/HR 30100. ### MAINTENANCE & SUPPLIES *** DIRECT B760. HRS/YR \$14.34/HR 125700. SUPERVISION 1752. HRS/YR \$17.20/HR 30100. *** MAINTENANCE & SUPPLIES *** DIRECT LABUR 2937. HRS/YR \$17.20/HR 103000. ### MAINTENANCE & SUPPLIES *** DIRECT LABUR 2937. HRS/YR \$17.20/HR 103000. ### MAINTENANCE & SUPPLIES *** DIRECT LABUR 2937. HRS/YR \$17.20/HR 103000. ### MAINTENANCE & SUPPLIES *** DIRECT LABUR 2937. HRS/YR \$17.20/HR 103000. ### MAINTENANCE & SUPPLIES *** DIRECT UPERATING COST 103000. ### MAINTENANCE & SUPPLIES *** DIRECT UPERATING COST 1032300. ### DISPUSAL 448. TUN/YR \$8.25/TON 3700. DIRECT UPERATING COST 1032300. ### PAYROLL OVERHEAD =20.02 OF A+8+C+D	CATEGORY	QUANT	ITY	RATE	ANNUA	L COS	ſ
ELECTRICITY 666276. KWH/YR \$.0266/KWH 17700. STEAM 0. MLBS/YR \$ 4.0920/MLBS 0. FUEL 0. GAL/YR \$.4180/GAL 0. *** OPERATING LABOR *** DIRECT 8760. HRS/YR \$14.34/HR 125700. SUPERVISION 1752. HRS/YR \$17.20/HR 30100. *** MAINTENANCE & SUPPLIES *** DIRECT LABUR 29937. HRS/YR \$14.34/HR 429400. SUPFRVISION 5987. HRS/YR \$17.20/HR 103000. MATERIALS 209100. SUPPLIES 112300. WAIER THEATMENT 0. SOLID WASTE DISPUSAL 448. TUN/YR \$ 8.25/TUN 3700. DIRECT OPERATING COST 1032300. PAYROLL DVERHEAD =20.0% OF A+8+C+D 137600. PLANI OVERHEAD =50.0% OF A+8+C+D+F+ 504800. OPERATING COST 10 DOLLARS PER TON PRODUCTION 2. OPERATING COST 1N DOLLARS PER TON PRODUCTION 2. OPERATING COST AS PERCENT OF CAPITAL COST 105. INSTALLATION TIME IN WEEKS 15. KWH PER TON CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.			*** UTILI1	TIES ***			
ELECTRICITY	WATER	7989.	MGAL/YR	\$.1595/100	OO GAL	1300_	
STEAM							
### OPERATING LABOR ### DIRECT 8760. HRS/YR \$14.34/HR 125700. SUPERVISION 1752. HRS/YR \$17.20/HR 30100. ### MAINTENANCE & SUPPLIES ### DIRECT LABUR 29937. HRS/YR \$14.34/HR 429400. SUPERVISION 5987. HRS/YR \$17.20/HR 103000, MATERIALS 209100. SUPPLIES 112300. WATER TREATMENT 0.50LID WASTE DISPUSAL 448. TUN/YR \$8.25/TON 3700. DIRECT UPERATING COST 1032300. PAYROLL OVERHEAD =20.0% OF A+8+C+D 137600. PLANT OVERHEAD =50.0% OF A+8+C+D+F+ 504800. TOTAL OPERATING COST 1674700. OPERATING COST 10 DOLLARS PER TON PRUDUCTION 2. OPERATING COST 10 DOLLARS PER TON OF DUST COLLECTED 7479. OPERATING COST 10 DOLLARS PER TON OF DUST COLLECTED 7479. OPERATING COST AS PERCENT OF CAPITAL COST 105.8 INSTALLATION TIME IN WEEKS 104. ESTIMATED LIFE OF SYSTEM IN YEARS 15. KWH PER TON CAPACITY 208100.						-	
DIRECT	FUEL						
SUPERVISION 1752. HRS/YR \$17.20/HR 30100. *** MAINJENANCE & SUPPLIES *** DIRECT LABUR 29937. HRS/YR \$14.34/HR 429400. SUPERVISION 5987. HRS/YR \$17.20/HR 103000. MATERIALS 209100. SUPPLIES 112300. WAIER THEATMENT 0. SOLID WASTE DISPUSAL 448. TUN/YR \$8.25/TON 3700. DIRECT UPERATING COST 1032300. PAYROLL OVERHEAD =20.02 OF A+B+C+D 137600. PLANT OVERHEAD =50.02 UF A+B+C+D+E+F 504800. TOTAL OPERATING COST 100LLARS PER TON PRODUCTION 2. OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 7479. UPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 7479. UPERATING COST AS PERCENT OF CAPITAL COST 105.8 INSTALLATION TIME IN WEEKS 104. ESTIMATED LIFE OF SYSTEM IN YEARS 15. KWH PER TON CAPACITY 208100.		**	_OPERATING	LABOR ***			
SUPERVISION 1752. HRS/YR \$17.20/HR 30100. *** MAINJENANCE & SUPPLIES *** DIRECT LABUR 29937. HRS/YR \$14.34/HR 429400. SUPERVISION 5987. HRS/YR \$17.20/HR 103000. MATERIALS 209100. SUPPLIES 112300. WAIER THEATMENT 0. SOLID WASTE DISPUSAL 448. TUN/YR \$8.25/TON 3700. DIRECT UPERATING COST 1032300. PAYROLL DVERHEAD =20.02 OF A+B+C+D 137600. PLANT OVERHEAD =50.02 UF A+B+C+D+E+F 504800. TOTAL OPERATING CUST 1050LARS PER TON 0F DUST COLLECTED 7479. OPERATING CUST IN DOLLARS PER TON 0F DUST COLLECTED 7479. UPERATING COST IN DOLLARS PER TON 0F DUST COLLECTED 7479. UPERATING CUST AS PERCENT OF CAPITAL CUST 105.8 INSTALLATION TIME IN WEEKS 104. ESTIMATED LIFE OF SYSTEM IN YEARS 15. KWH PER 10N CAPACITY 208100.	DIRECT	8760	HDS/YD	\$14 3 4/HP	1 2	570n	(
DIRECT LABUR 29937. HRS/YR \$14.34/HR 429400. SUPERVISION 5987. HRS/YR \$17.20/HR 103000. MATERIALS 209100. SUPPLIES 209100. WAIER TREATHENT 0. SOLID WASTE DISPUSAL 448. TUN/YR \$8.25/TON 3700. DIRECT OPERATING COST 1032300. PAYROLL OVERHEAD =20.0% OF A+B+C+D 504800. TOTAL OPERATING CUST 1074700. OPERATING CUST 1001LARS PER TON PRODUCTION 2. OPERATING CUST 1N DOLLARS PER TON OF DUST COLLECTED 7479. OPERATING CUST AS PERCENT OF CAPITAL CUST 105.8 INSTALLATION TIME IN WEEKS 1.04. ESTIMATED LIFE OF SYSTEM IN YEARS 1.5. KWH PER TON CAPACITY 208100.				•			
DIRECT LABUR 29937. HRS/YR \$14.34/HR 429400. SUPERVISION 5987, HRS/YR \$17.20/HR 103000, MATERIALS 209100. SUPPLIES 112300. WAIER THEATMENT 0. SOLID WASTE DISPUSAL 448. TUN/YR \$8.25/TON 3700. DIRECT UPERATING COST 1032300. PAYROLL OVERHEAD =20.0% OF A+B+C+D 137600. PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 504800. TOTAL OPERATING CUST 1674700. OPERATING CUST 1674700. OPERATING CUST 100LLARS PER TON PRUDUCTION 2. OPERATING CUST 105.8 INSTALLATION TIME IN WEEKS 104. ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY 2.98100.						<u> </u>	`
SUPERVISION 5987. HRS/YR \$17.20/HR 103000, MATERIALS 209100. SUPPLIES 112300. WAIER TREATMENT 0. SOLID WASTE DISPOSAL 448. TON/YR \$ 8.25/TON 3700. DIRECT OPERATING COST 1032300. PAYROLL OVERHEAD =20.0% OF A+B+C+D 504800. TOTAL OPERATING COST 504800. OPERATING COST 1050LARS PER TON PRODUCTION 2. OPERATING COST 10 DOLLARS PER TON OF DUST COLLECTED 7479.7 OPERATING COST AS PERCENT OF CAPITAL COST 105.8 INSTALLATION TIME IN WEEKS 104. ESTIMATED LIFE OF SYSTEM IN YEARS 15. KWH PER TON CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.		*** MA	INTENANCE	& SUPPLIES ***			
MATERIALS SUPPLIES MATER TREATMENT SOLID WASTE DISPUSAL DIRECT OPERATING COST PAYROLL OVERHEAD =20.0% OF A+B+C+D TOTAL OPERATING COST OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST OPERATING COST TOPERATING COST TOPER				\$14.34/HR	42	9400.	(
SUPPLIES WATER TREATMENT SOLID WASTE DISPUSAL ### A 448. TON/YR ### \$ 8.25/TON DIRECT OPERATING COST PAYROLL OVERHEAD =20.0% OF A+B+C+D PLANT OVERHEAD =50.0% OF A+B+C+D+E+F TOTAL OPERATING COST OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS LSTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.		5987.	HRS/YR	\$17.20/HR			
WATER TREATMENT SOLID WASTE DISPUSAL 448. TUN/YR \$ 8.25/TON 3700. DIRECT UPERATING COST PAYROLL OVERHEAD =20.0% OF A+B+C+D PLANT OVERHEAD =50.0% OF A+B+C+D+E+F TOTAL OPERATING CUST OPERATING CUST IN DOLLARS PER TON PRUDUCTION OPERATING COST IN DOLLARS PER TON UP DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL CUST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.							
SOLID WASTE DISPOSAL 448. TON/YR \$ 8.25/TON 3700. DIRECT OPERATING COST 1032300. PAYROLL OVERHEAD =20.0% OF A+B+C+D 137600. PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 504800. TOTAL OPERATING COST 10 DOLLARS PER TON PRODUCTION 2.1 OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 7479.7 OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 7479.7 OPERATING COST AS PERCENT OF CAPITAL COST 105.8 INSTALLATION TIME IN WEEKS 104. ESTIMATED LIFE OF SYSTEM IN YEARS 15. KWH PER TON CAPACITY 208100.					11		
DISPUSAL 448. TUN/YR \$ 8.25/TON 3700. DIRECT OPERATING COST 1032300. PAYROLL OVERHEAD =20.0% OF A+B+C+D 137600. PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 504800. TOTAL OPERATING COST 1000LLARS PER TON PRODUCTION 2.0 OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 7479.7 OPERATING COST AS PERCENT OF CAPITAL COST 105.8 INSTALLATION TIME IN WEEKS 104. ESTIMATED LIFE OF SYSTEM IN YEARS 15. KWH PER TON CAPACITY 208100.						0	
DIRECT OPERATING COST PAYROLL OVERHEAD =20.0% OF A+B+C+D PLANT OVERHEAD =50.0% OF A+B+C+D+E+F TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS LSTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.		448	TONZYE	€ 8 25/TON		77 00	
PAYROLL OVERHEAD =20.0% OF A+B+C+D PLANT OVERHEAD =50.0% OF A+B+C+D+E+F TOTAL OPERATING CUST OPERATING CUST IN DOLLARS PER TON PRODUCTION OPERATING CUST IN DOLLARS PER TON OF DUST COLLECTED OPERATING CUST AS PERCENT OF CAPITAL CUST INSTALLATION TIME IN WEEKS LSTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 137600. 137600. 137600.							.
PLANT OVERHEAD =50.0% OF A+B+C+D+E+F TOTAL OPERATING CUST OPERATING CUST IN DOLLARS PER TON PRODUCTION OPERATING CUST IN DOLLARS PER TON OF DUST COLLECTED OPERATING CUST AS PERCENT OF CAPITAL CUST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.	DIRECT OPERAT	ING COST			103	2300.	
TOTAL OPERATING CUST OPERATING CUST IN DOLLARS PER TON PRODUCTION OPERATING CUST IN DOLLARS PER TON OF DUST COLLECTED OPERATING CUST AS PERCENT OF CAPITAL CUST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER ION CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 1674700. 1674700. 1674700. 1674700. 1674700. 1674700. 208100.							
OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS LSTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 2.2			UF A+B+C+D)+E+F			
OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 7479.TOPERATING COST AS PERCENT OF CAPITAL COST 105.8 INSTALLATION TIME IN WEEKS 104. ESTIMATED LIFE OF SYSTEM IN YEARS 15. KWH PER TON CAPACITY 208100.			. 0 0				
OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS LSTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.							
INSTALLATION TIME IN WEEKS 104. ESTIMATED LIFE OF SYSTEM IN YEARS 15. KWH PER ION CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.					ECTED		
ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.				TIAL COST			
KWH PER TON CAPACITY CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.				26			
CAPITAL RECOVERY (13.15% OF TOTAL CAPITAL) 208100.				``			
				AL CAPTIAL)	208		
ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) 31700.							
PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) 31700.			-				
TOTAL ANNUALIZED COST - RETROFIT 1946200.						-	
- NEW 1901000.		1	- NEW		1901	000.	

GENERAL INFORMATION: UNITS OPTION PPSES: 504. DOORS COKE CAPACITY: .708 MILLION TONS/YEAR PARTICULATE LUAD IN: .500000 LBS/TON COAL ALLOWABLE: .033500 LBS/TON COAL EFFICIENCY: 93.3% 4.07 LBS/HR BSU LOAD IN: .500000 LBS/TON COAL ALLOWABLE: .081000 LBS/TON COAL EFFICIENCY: 83.8% 9.85 LBS/HR BAP .003000 LBS/TON COAL LUAD IN: ALLUWABLE: .000486 LBS/TON COAL EFFICIENCY: 83.8% .06 LBS/HR BENZENE LOAD IN: .010000 LBS/TON COAL .002800 LBS/TON COAL EFFICIENCY: 72.0% ALLOWABLE: .34 LBS/HR .6 TONS (DRY) DUST COLLECTED PER DAY: TEMP OUT OF PROCESS: 120. F EXHAUST TEMPERATURE: 100. F SCFM FLUN: 13000. AT 70. F 100. F ACFM FLOW: 14000. AT L/G RATIU: 8.0__ PROCESS WATER FLOW: 104. GPM COOLING WATER FLOW: 0. GPM SUSPENDED SOLIDS OUT: 818. MG/L %SOLIDS: .1 A-71

GENERAL INFORMATION:	UNITS UPIION
PPSES: 504. DOURS	COKE 7
CUNTPUL SYSTEM CONFIGURATION	:
VENTURI SCRUBBER	
MIST ELIMINATOR	
FAN AND DRIVE	
DUCTWORK	
STACK	
CANUPY HOUD	P A4
WASTEWATER RECYCLE SYSTI	EM .
DAMPERS WASTE WATER RETURN: SYSTE	EM
WATER PUMPING SYSTEM	
FAU AND DRIVE ELECTRICAL	L
	MAINT
	350. DIAMETER: 2.
TOTAL PRESSURE DROP:	65. INCHES
2 FANS & 239. HP EACH OPERATING HOURS AT FULL HP:	
DPERATING HOURS AT REDUCED HI	
STACK HEIGHT:	100. DIAMETER: 2.
IND. OF DYENS	· · · · · · · · · · · · · · · · · · ·
HOOD SIZE:	16. SQ.FT.
OVEN HEIGHT	6.0 METERS
OVEN VOLUME	1348. CUBJC FEET
TONS COKE/PUSH	24. 17.5
AVG. CUKING TIME, HRS. NO. CYCLES/DAY	
BULK DENSITY	50. LBS/CUBIC FT.
YIELD	.70
TUNS CUAL/YEAR	1011967.

PPSES: 504. DOORS	UNITS OPTION COKE 7
CAPACITY: .708 MII	LION TONS/YEAR
TUTAL COST (COST BASIS	IS 110.00% OF JUNE 1977 DULLARS FOR 4
CATEGORY	COST IN DOLLARS
*** DIRECT (COST ***
EQUIPMENT OR MATERIAL	340000.
INSTRUMENTATION	51900.
PIPING	54600.
ELECTRICAL	82800.
FOUNDATIONS	19700.
STRUCTURAL	51400.
SITE WORK	3200.
INSULATION	6500.
PROTECTIVE COATING	9000.
BUILDINGS	8900.
EQUIPMENT/MATERIAL LABO	DR 115700.
DIRECT CUST SUBTO	TAL 743700.
*** INDIRECT	CUST ***
FIELD OVERHEAD	106500.
CONTRACTORS FEE	52300.
ENGINEERING	123000.
FREIGHT	27600.
OFFSITE WURK	17000.
TAXES	29300.
SHAKEDUWN	32800.
SPARES	29200.
CONTINGENCY	254300.
INDIRECT COST SUB	
INTEREST DURING I	NSTALLATION 107300.
TOTAL COST	1523000.
TOTAL COST WITH R	TROFIT 1818400.

		OORS		CUKE	7		
	CAPACITY:	-708 M	ILLION IO	NS/YEAR			
						:	
	CATEGORY	GUANT] T Y	RATE		ANNUAL COST	
		:	*** UTILIT	TIES ***			
·· ···	WATER	-		\$.1595/10	OO GAL	1700.	
	ELECTRICITY	-	KWH/YR			41800.	
	STEAM	_	MLBS/YR			0.	
	<u> FUEL </u>	υ.	GAL/YR	5 4180/GA	L		
		<u>**</u> *	OPERATING	LABUR ***			-
	OTRECT	8760_	HRS/YR	\$14.34/HR		125700.	(
	SUPERVISIUM		HRS/YR	\$17.20/HR		30100.	
		*** MA	INTENANCE	& SUPPLIES **	*		
	DIRECT LABOR	_	HRS/YR			432300.	
	SUPERVISION	6027.	HRS/YR	\$17.20/HR		103700.	
	MATERIALS					211300.	
	SUPPLIES					113500.	
·· -	WATER TREATMENT					0	
	SOLIU WASTE	473	TONAVO	6 0 35 / 7 0 1/		7000	
	DISPUSAL	472.	TON/YR	\$ 8.25/TUN		3900.	
	DIRECT OPERA	TING COST				1064000.	• • • •
	PAYROLL OVER					138400.	
	PLANT UVERHE	40 =50.0% (OF A+B+C+D)+E+F		508300.	
	TOTAL OPERAT:					1710700.	
				N PRODUCTIO		2.4	
				IN OF DUST COL	LECTED	7247.4	
	OPERATING COS			PITAL COST		94.1	
	INSTALLATION					104.	
	ESTIMATED LIF			(3)		15.	1
	CAPITAL RECOV			U CAPITAL)		2.2 239100.	
				OF TOTAL CAPIT	ΔΙΊ	36400.	
			-	TOTAL CAPITAL		36400.	
	TAL ANNUAL				•	2022600	
			- NEW			1971900.	-
						<u> </u>	

BBSE	C. EAF	TORETOR			TION
PPSE	s: 505.	1075106		COKE	5
CAPA	CITY:	.708	MILLION TONS/	YEAR	
DADT	7614 A 75				
PARI.	ICULATE	200000	LRR/TON COAL		
	ALLOWABLE		LBS/TON COAL LBS/TON COAL	EFFICIENCY:	
	MELOWADEE	*	LBS/HR	ELLICIENCI.	70,02
BSO					
	LOAD IN:	-250000	LBS/TON COAL		
				EFFICIENCY:	90.02
			LBS/HR		
BAP					
	LOAD IN:	.001000	LBS/TON COAL		
	ALLOWABLE	: .000100	LBS/TON COAL	EFFICIENCY:	90.0%
		.01	LBS/HR		App. Elif
BENZI	ENE				
			LBS/TON COAL		
	ALLOWABLE		LBS/TON COAL LBS/HR	EFFICIENCY:	90.0%
		• 00	LDS/HK		
DUST	COLLECTED	PER DAY:	.2 TONS (DRY)	
		_			
	OUT OF PR		120. F		
EXHA	UST TEMPER	ATURE:	120. F		
SCFM	FLOW:	0. AT	70. F		
ACFM	FLOW:	0. AT	120. F		
L/G I	RATIO:		0		
	ESS WATER		0. GPM		
	ING WATER		O. GPM		•
SUSPI	ENDED SOLI	DS OUT:	0. MG/L	#SOLIDS:	.0
					<u> </u>
<u></u> .		····			<u> </u>
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· w > ia .					
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NERAL INFORMATION:	INITE OPTION
PPSES: 505. TOPSIDE	UNITS OPTION
PPSES: 3V3. TUPSIDE	COKE 5
	· · · · · · · · · · · · · · · · · · ·
CONTROL SYSTEM CONFIGURATION	ON:
TOPSIDE MAINTENANCE -	LEVEL 1
•	
FEET OF ADDITIONAL DUCT:	0. DIAMETER: 0.
TOTAL PRESSURE DROP:	0. INCHES
	SPARE FAN CAPACITY: 0.X
OPERATING HOURS AT FULL HP	
OPERATING HOURS AT REDUCED	
STACK HEIGHT: NO. OF OVENS	0. DIAMETER: 0.
OVEN HEIGHT	6.0 METERS
OVEN VOLUME	1348. CUBIC FEET
TONS COKE/PUSH	24.
AVG. COKING TIME, HRS.	17.5
ND. CYCLES/DAY	82.
BULK DENSITY	50. LBS/CUBIC FT.
YIELD .	•70
TONS COAL/YEAR	1011967.
i	,
	*
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•	

000001 500 700	erne	UNITS OPTION	
PPSES: 505. TOP	SIDE	COKE 5	
CAPACITY:	.708 MILLION TON	S/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (
	*** UTILIT	IES ***	
MATER	O. MGAL/YR	\$.1595/1000 GAL	0.
ELECTRICITY	O. KWH/YR	\$.0266/KWH	0.
STEAM	O. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	0. GAL/YR	\$.4180/GAL	0.
	*** OPERATING	LABOR ***	
DIRECT	8760. HRS/YR	\$14.34/HR	125700. (A
SUPERVISION	1752. HRS/YR	\$17.20/HR_	30100. (B
SUPERVISION	1/JE, HROVIR	#110EV/HR	30100. (1
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	0. HRS/YR	\$14.34/HR	0. (0
SUPERVISION	0. HRS/YR	\$17.20/HR	0. (D
MATERIALS			0. (E
SUPPLIES			0. (F
WATER TREATMENT	· · · · · · · · · · · · · · · · · · ·		<u> </u>
SOLID WASTE	0 T0N/YD	c a 35/70N	•
DISPOSAL	O. TON/YR	\$ 8.25/TON	0.
DIRECT OPERATI	NG COST		155800.
	AD =20.0% OF A+8+C		31200.
	=50.0% OF A+B+C+D	+E+F	77900.
TOTAL OPERATIN	-		264900.
	IN DOLLARS PER TO		37
		N OF DUST COLLECTED	2908.53
INSTALLATION T	AS PERCENT OF CAP	TIAL CUST	. 0
	OF SYSTEM IN YEAR	8	99.
KWH PER TON	CAPACITY	•	• 0
	RY (10.00% OF TOTA	L CAPITAL)	0.
	OVERHEAD (2.0% 0		0.
	8 INS. (2.0% OF		0.
TOTAL ANNUALIZ	ED COST - RETROFIT	· · · · · · · · · · · · · · · · · · ·	264900.
	- NEW		264900.
TOTAL ANNUALIZ			

PPS			N: 	No F. V. Brance			TION
•	ES:	5 05.	TOPSIDE			COKE	-3
CAP	ACII	Y:	.708	MILLION	TONS/	YEAR	
PAR	_	LATE	20000				
			200000			CEETCIENCY.	×-45:-44
	AL	LUMADLE		LBS/HR		EFFICIENCY:	SANTA SA Santa Santa S
,,	ς.		1.10	FB0/HK		• • • • • • • • • • • • • • • • • • • •	· · · · · · · · ·
880							
	L0	AD IN:	.250000	LBS/TON	COAL		
	AL	LOWABLE				EFFICIENCY:	95.0%
			1.44	LBS/HR			
BAP							
DAP		AD TN:	.001000	LBS/TON	COAL		
						EFFICIENCY:	95.0%
	. • •			LBS/HR			
	ZENE		****				
			_005000				05 A¥
	AL	LUMABLE		LBS/HR	LUAL	EFFICIENCY:	42.0%
			•03	FB3) HK			
DUS	T CO	LLECTED	PER DAY:	.3	TONS (DRY)	
			•				
			OCESS:	120.			
EXH.	AUST	TEMPER	ATURE:	120.	F		
SCE	M FL	Ow:	0. AT	70.	E		
		Ow:	O. AT				
ACF	M FL	UH •	-				
L/G	RAT	10:					
L/G PRO	RAT	IO: WATER I	FLOW:	0.	GPM		
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	YSOL TOS.	
L/6 PRO C00	RAT CESS LING	IO: WATER I	FLOW:	0.	GPM	%SOLIDS:	• 0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	%SOLIDS:	• 0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	%SOLIDS:	• 0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	%SOLIDS:	.0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	%SOLIDS:	• 0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	%SOLIDS:	.0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	%SOLIDS:	.0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	%SOLIDS:	• 0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	%SOLIDS:	.0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	%SOLIDS:	.0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	#SOLIDS:	• 0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	%SOLIDS:	.0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	#SOLIDS:	.0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	%SOLIDS:	.0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	XSOLIDS:	.0
L/6 PRO C00	RAT CESS LING	IO: WATER (FLOW:	0.	GPM GPM	#SOLIDS:	.0

	UNITS OPTION
PPSES: 505. TOPSIDE	COKE 3
CONTROL SYSTEM CONFIGURATIO	IN:
TOPSIDE MAINTENANCE -	FEAET 5
PPCT OF ADDITIONAL BUCCA	A
FEET OF ADDITIONAL DUCT: TOTAL PRESSURE DROP:	0. INCHES
	SPARE FAN CAPACITY: 0.2
OPERATING HOURS AT FULL HP:	
OPERATING HOURS AT REDUCED	HP: 0. 0. DIAMETER: 0.
NO. OF OVENS	60.
OVEN HEIGHT	6.0 METERS
OVEN VOLUME	1348. CUBIC FEET
TONS COKE/PUSH	24.
AVG. COKING TIME, HRS.	17.5
NO. CYCLES/DAY	82.
BULK DENSITY YIELD	50. LBS/CUBIC FT
	1011967.
TONO CONETTEN	
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	·
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	5 1 35

CAPACI CATEGOR CATEGOR WATER ELECTR STEAM FUEL DIRECT SUPERV MATERIA SUPPLIE NATER SOLID IN DISPO	IY: RY ICITY ISION LABOR ISION ALS	TOPSIDE .708 MILLION TO QUANTITY *** UTILI O. MGAL/YR O. KWH/YR O. MLBS/YR O. GAL/YR 8760. HRS/YR 1752. HRS/YR *** MAINTENANCE 5900. HRS/YR	RATE TIES *** \$.1595/1000 GAL \$.0266/KWH \$ 4.0920/MLBS \$.4180/GAL	ANNUAL COST (3 0. 0. 0. 0. 0. 0. 25700. (A 30100. (B
DIRECT SUPERV MATER DIRECT SUPERV MATERIA SUPPLIE WATER SOLID IN DISPO	ISION LABOR ISION ALS	QUANTITY ### UTILI Q. MGAL/YR Q. KWH/YR Q. MLBS/YR Q. GAL/YR ### OPERATIA 8760. HRS/YR 1752. HRS/YR ### MAINTENANCE	RATE S. 1595/1000 GAL S. 0266/KWH S. 4.0920/MLBS S. 4180/GAL MG. LABOR *** \$14.34/HR \$17.20/HR E. SUPPLIES ***	0. 0. 0. 0. 0. 125700. (A 30100. (B
DIRECT SUPERV MATERIA SUPPLIE MATERIA SOLID IN DISPO	ICITY ISION LABOR ISION ALS	### UTILI Q. MGAL/YR Q. KWH/YR Q. KWH/YR Q. MLBS/YR Q. GAL/YR ### OPERATIN 8760. HRS/YR 1752. HRS/YR ### MAINTENANCE 5900. HRS/YR	\$.1595/1000 GAL \$.0266/KWH \$ 4.0920/MLBS \$.4180/GAL NG LABOR *** \$14.34/HR \$17.20/HR	0. 0. 0. 0. 0. 125700. (A 30100. (B
DIRECT SUPERV DIRECT SUPERV MATERIA SUPPLIE NATER SOLID I	LABOR ISION ALS	O. MGAL/YR O. KWH/YR O. MLBS/YR O. GAL/YR 8760. HRS/YR 1752. HRS/YR *** MAINTENANCE	\$.1595/1000 GAL \$.0266/KWH \$ 4.0920/MLBS \$.4180/GAL NG LABOR *** \$14.34/HR \$17.20/HR \$ SUPPLIES *** \$14.34/HR	0. 0. 0. 0. 0. 125700. (A 30100. (B
DIRECT SUPERV MATERIA SUPPLIE MATERIA SOLID I DISPO	LABOR ISION ALS	0. KWH/YR 0. MLBS/YR 0. GAL/YR *** OPERATION 8760. HRS/YR 1752. HRS/YR *** MAINTENANCE 5900. HRS/YR	\$.0266/KWH \$ 4.0920/MLBS \$.4180/GAL NG LABOR *** \$14.34/HR \$17.20/HR \$ SUPPLIES *** \$14.34/HR	125700. (A 30100. (B
DIRECT SUPERV MATERIA SUPLIA WATER SOLID O	LABOR ISION ALS	0. KWH/YR 0. MLBS/YR 0. GAL/YR *** OPERATION 8760. HRS/YR 1752. HRS/YR *** MAINTENANCE 5900. HRS/YR	\$.0266/KWH \$ 4.0920/MLBS \$.4180/GAL NG LABOR *** \$14.34/HR \$17.20/HR \$ SUPPLIES *** \$14.34/HR	0. 0. 0. 0. 125700. (A 30100. (B
DIRECT SUPERV MATERIA SUPPLIE WATER SOLID I	LABOR ISION ALS	0. MLBS/YR 0. GAL/YR *** OPERATION 8760. HRS/YR 1752. HRS/YR *** MAINTENANCE 5900. HRS/YR	\$ 4.0920/MLBS \$ _4180/GAL NG LABOR *** \$14.34/HR \$17.20/HR E SUPPLIES *** \$14.34/HR	0. 0. 125700. (A 30100. (B
DIRECT SUPERVI MATERIA SUPPLIE WATER SOLID I	LABOR ISION ALS	0. GAL/YR *** OPERATION 8760. HRS/YR 1752. HRS/YR *** MAINTENANCE 5900. HRS/YR	\$.4180/GAL NG LABOR *** \$14.34/HR \$17.20/HR E & SUPPLIES *** \$14.34/HR	0. 125700. (A 30100. (B
DIRECT SUPERVI MATERIA SUPPLIE WATER SOLID O	LABOR ISION ALS	8760. HRS/YR 1752. HRS/YR *** MAINTENANCE 5900. HRS/YR	\$14.34/HR \$17.20/HR 8 SUPPLIES ***	30100. (8 84600. (C
DIRECT SUPERVI MATERIA SUPPLIE WATER SOLID O	LABOR ISION ALS	8760. HRS/YR 1752. HRS/YR *** MAINTENANCE 5900. HRS/YR	\$14.34/HR \$17.20/HR 8 SUPPLIES ***	30100. (8 84600. (C
DIRECT SUPERVI MATERIA SUPPLIE WATER SOLID O	LABOR ISION ALS	1752. HRS/YR *** MAINTENANCE 5900. HRS/YR	\$17.20/HR 8 SUPPLIES *** \$14.34/HR	30100. (8 84600. (C
DIRECT SUPERVI MATERIA SUPPLIA WATER SOLID O	LABOR ISION ALS	*** MAINTENANCE 5900. HRS/YR	S14.34/HR	84600. (C
SUPERVI MATERIA SUPPLIA WATER SOLID A DISPO	ISION ALS	5900. HRS/YR	\$14.34/HR	
SUPERVI MATERIA SUPPLIA WATER SOLID O DISPO	ISION ALS	-	· · · · · · · · · · · · · · · · · · ·	
SUPERVI MATERIA SUPPLIA WATER SOLID A DISPO	ISION ALS	-	· · · · · · · · · · · · · · · · · · ·	
MATERIA SUPPLIA NATER SOLID DISPO	ALS	110V HK3/TK	31/.EU/HR	20300. (0
SUPPLIE MATER SOLID DISPO				21200. (E
SOLID DISPO				18900. (F
SOLID O		T		0-
DISPO				
		0. TON/YR	\$ 8.25/TON	0.
DI	RECT OPE	RATING COST		300800.
PA	YROLL DV	ERHEAD =20.0% OF A+B+	-C+D	52100
		HEAD =50.0% OF A+B+C+		150400.
		ATING COST		503300.
OPI	ERATING	COST IN DOLLARS PER T	ON PRODUCTION	.71
		COST IN DOLLARS PER T		5235.24
	-	COST AS PERCENT OF CA	PITAL COST	• 0
		ON TIME IN WEEKS		8,
		LIFE OF SYSTEM IN YEA	ARS	99.
	H PER TO			•0
		COVERY (10,00% OF TOT TION OVERHEAD (2.0%		0.
		AXES & INS. (2.0% OF		0. 0.
		ALIZED COST - RETROFI		503300
	LAL HIJIE	- NEW		503300.
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DDCF	S:	505	TOPSIDE		UNITS O	4	
FFOC	•	JV J 4	IOFSIDE		LUNE	7	
CAPA	CIL	!	708	MILLION TONS	/YEAR		
		. = =					
PART			30000	L DC /T/M COAL			
				LBS/TON COAL			
٠٣.	*L!	UNADLE		LBS/HR	EFFICIENCY	3 1 1 7 1 4 V X	374.
*			•07	LDOTTIN			
BSO							
	LOA	D IN:	.250000	LBS/TON COAL			
	ALL	OWABLE	: .007500	LBS/TON COAL	EFFICIENCY	97.0%	
			.87	LBS/HR			
212							
BAP	104	D TN:	001000	LBS/TON COAL			
		OWABLE:		LBS/TON COAL		97.07	
	-7 % 6			LBS/HR			
BENZE							
	_	-		LBS/TON COAL			
	ALL	OWABLE:	_	LBS/TON COAL	EFFICIENCY	77.0%	
			•05	LBS/HR			
DUST	COL	LECTED	PER DAY:	.3 TONS	(nPY)	*······	
D O O .			I Pro Chia				
					•	_	
TEMP	נעם	OF PR	OCESS:	120. F			
			OCESS:	120. F 120. F		-	
EXHAL	UST	TEMPER	ATURE:	120. F		·	
EXHAL SCFM	UST Fl	TEMPER	ATURE:	120. F			
EXHAL	UST Fl	TEMPER	ATURE:	120. F			
SCFM ACFM	FLC FLC	TEMPER)W:)W:	ATURE:	120. F			
SCFM ACFM L/G I	FLC FLC RATI	TEMPER)W:)W:	O. AT O. AT	120. F 70. F 120. F			
SCFM ACFM L/G I PROCE COOL:	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F			
SCFM ACFM L/G I PROCE COOL:	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F	%SOLIDS:	• 0	
SCFM ACFM L/G I PROCE COOL:	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		.0	
SCFM ACFM L/G I PROCE COOL:	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		.0	
SCFM ACFM L/G I PROCE COOL:	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		• 0	
SCFM ACFM L/G I PROCE COOL:	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		• 0	
SCFM ACFM L/G I PROCE COOL:	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		.0	
SCFM ACFM L/G I PROCE COOL:	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		.0	
SCFM ACFM L/G I PROCE COOL:	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		• 0	
SCFM ACFM L/G I PROCE COUL: SUSPE	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		.0	
SCFM ACFM L/G I PROCE COUL: SUSPE	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		.0	
SCFM ACFM L/G I PROCE COUL: SUSPE	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		•0	•
SCFM ACFM L/G I PROCE COUL: SUSPE	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		.0	
SCFM ACFM L/G I PROCE COUL: SUSPE	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		• 0	
SCFM ACFM L/G I PROCE COUL: SUSPE	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		.0	
SCFM ACFM L/G I PROCE COUL: SUSPE	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		• 0	
SCFM ACFM L/G I PROCE COUL: SUSPE	FLC FLC RATI ESS ING	TEMPER	O. AT O. AT FLOW:	120. F 70. F 120. F .0 0. GPM 0. GPM		• 0	

GENERAL INFORMATION:

	UNITS	OPTION	
PPSES: 505. TOPSIDE	COKE	4	
	•		
CONTROL CYCTCH CONTROL TOWN			
CONTROL SYSTEM CONFIGURATION:			· ·
TOPSIDE MAINTENANCE - LEVEL 1		and the second of the second o	7.
NEW LIDS AND CASTINGS		All water to the control of the cont	
		_	
FEET OF ADDITIONAL DUCT: 0.	DIAMETER:	0.	
TOTAL PRESSURE DROP: 0. I		0.1	
O FANS 8 0. HP EACH SPARE FAN	CAPACITY:	U . X	
OPERATING HOURS AT FULL HP: 8760. OPERATING HOURS AT REDUCED HP: 0.			
	DIAMETER	: 0.	
NO. OF OVENS 60.	ATMMETER	• •	
OVEN HEIGHT 6.0	METERS		
	CUBIC FEET		
TONS COKE/PUSH 24.			
AVG. COKING TIME, HRS. 17.5			
NO. CYCLES/DAY 82.			
— ·	LBS/CUBIC F	7.	
YIELD ,70			
TONS COAL/YEAR 1011967.			
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PITAL							1			DPTION	···		
PPSE	ES:	505.	TOPSI	DE				COP	(E				
CAP	CII	Y:		.708 M	ILLI	ON TONS	/YEAR						
TOT	AL C	OST	(cost	BASIS	IS	110.00%	OF J	JNE	1977	DOLLARS	FOR	4978	COST
	CA	TEGORY	·· ···· ·				COST	IN	DOLL	AR8			
			***	IRFCT	COS	T ###							
	EQ	UIPMEN'	T OR MA	TERIAL			5520	00.					
	_		NTATION	1				0.					
		PING						<u> </u>					
		ECTRIC/ Undation						0.					
	_		AL					0.					
		TE WORL	_					0.	·· —··				
		SULATIO						0.					
	PR	OTECTI	VE COAT	ING				0.					
		ILDING						0.					
	ΕQ		TIMATER					٥.	-				
-		DIK	ECT COS	SUBI	U LAL		:			5200.			
			*** TN	DIRECT	CO	ST ***							
	FI	ELD OVE	-					0.					
			ORS FEE				430	00.					
		GINEER					500						
		EIGHT					380			·_·	· · · · · ·		
		FSITE I XES	WORK				0.0	0.					
		AKEDOW!	N				71	0.					
		ARES					180					· · · · · · · · · · · · · · · · · · ·	
	CO	NTINGE	NCY				1220						
		IND	IRECT C	OST SU	TOT	AL			2	5000.			
		INT	EREST D	URING	INST	ALLATIO	N			900.			
		TOTA	AL COST						8	1100.			
		TOT	AL COST	WITH !	REIR	OFIT			10	5400.	<u>.</u>		
	······									· · · · · · · · · · · · · · · · · · ·	::- 		
							<u> </u>			<u> </u>	•	·	

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						A-83			•				

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PPSES: 505. TO	PSIDE	UNITS OPTION COKE 4	
FF000 3436 10	77 0102	CONC	
CAPACITY:	.708 MILLION TO	NS/YEAR	
CATEGORY	DUANTITY	RATE	ANNUAL COST
	*** UTILI1	IES ***	
WATER	O. MGAL/YR	\$.1595/1000 GAL	0.
ELECTRICITY	O. KWH/YR	\$.0266/KWH	0.
STEAM	O. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	U. GAL/YR	\$.4180/GAL	0.
	*** OPERATING	* ! ABOD AAA	
	WAR UPERALING	LADUR WAR	
DIRECT	8760. HRS/YR	\$14.34/HR	125700. (
SUPERVISION	1752. HRS/YR	\$17,20/HR	30100. (
	*** MAINTENANCE	# 81500 TEC 444	٠
	NAM MAINICHANCE	B SUPPLIES XXX	
DIRECT LABOR	600. HRS/YR	\$14.34/HR	8600. (
SUPERVISION	120. HRS/YR	\$17,20/HR	2100. (
MATERIALS			2200. (
SUPPLIES			1900. (
WATER TREATMENT			0.
SOLID WASTE	4 		
DISPOSAL	0. TON/YR	\$ 8.25/TON	0.
DIRECT OPERAT	ING COST		170600.
PAYROLL OVERH	EAD #20.0% OF A+B+C	;+D	33300.
	D =50.0% OF A+B+C+D)+E+F	85300.
TOTAL OPERATI			289200.
	T IN DOLLARS PER TO		.41
		N OF DUST COLLECTED	2946.19
	T AS PERCENT OF CAP	PITAL COST	274.4
	TIME IN WEEKS 'E OF SYSTEM IN YEAR	0.0	12. 35.
KWH PER TON	CAPACITY	(3	•0
	ERY (10.37% OF TOTA	LI CAPITAL)	10900.
	N OVERHEAD (2.0% C		2100.
	S & INS. (2.0% OF	• -	2100.
	ZED COST - RETROFIT		304300
	- NEW	,	300800.
		•	

			UNITS OF	TION	
PPSES: 506.	COMBUSTIO	N STACK - OLD	COKE	5	
CAPACITY:	708	MILLION TONS	/VEAD		
LACALITI	100	MILLIUN IUNS	/ IEAK		
PARTICULATE					
	1.300000	LBS/TON COAL			
ALLOWABLE			EFFICIENCY:	80.0x	
		LBS/HR			रें
					
BSO	00/000	1.00 (70)			
LOAD IN:		LBS/TON COAL		•••	
ALLUMADLE		LBS/TON COAL	EFFICIENCY:	80,0%	
	. 14	LBS/HR			
BAP					
LOAD IN:	.000060	LBS/TON COAL			
ALLOWABLE	\$100001	LBS/TON COAL	EFFICIENCY:	80.0%	
	.00	LBS/HR			
DUST COLLECTED	DED DAY:	1.4 TONS	(npv)		
DOG! COLLECTED	PER DATE	1.4 19113			
TEMP OUT OF PR	OCESS:	450. F			
EXHAUST TEMPER	RATURE:	450. F			
SCFM FLOW: 6	7000. AT	70. F			
ACFM FLOW: 11	-	· · · ·			
L/G RATIO:		• 0			
PROCESS WATER	FI OW:	0. GPM			
COOLING WATER		0. GPM			
SUSPENDED SOLI		0. MG/L	XSOLIDS:	•0	
				•	

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The work of the second					·
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		UNITS		
PPSES: 506. COMBUSTION S'	TACK - OLD	COKE	5	
CONTROL SYSTEM CONFIGURATION	1:			
HEATING CONTROL AND PA	CHING	, , , , , , , , , , , , , , , , , , , 		
	•		S. J. W. J. W.	
FEET OF ADDITIONAL DUCT:	0. D	TAMETED.	6.	···
TOTAL PRESSURE DROP:			0.	
O FANS @ O. HP EACH			0.2	
OPERATING HOURS AT FULL HP:				
OPERATING HOURS AT REDUCED !				
STACK HEIGHT:	0. D	IAMETER:	0.	
NO. OF OVENS	60.			
OVEN HEIGHT	6.0 MET			
OVEN VOLUME	1348. CUB	IC FEET		
TONS COKE/PUSH	24.			
AVG. COKING TIME, HRS.	17.5 82.			
BULK DENSITY	50. LBS	/CURTO E	T	<u></u>
YIELD	.70	COBIC P	•	
	1011967.			
		.4		

PPSES: 506. CO	MBUSTION STACK - OL	D COKE 2	····
CAPACITY:	.708 MILLION TON	IS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (
	*** UTILIT	IES ***	
WATER	O_ MGAL/YR	\$.1595/1000 GAL	0.
ELECTRICITY	0. KWH/YR	\$.0266/KWH	0.
STEAM	0. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	0. GAL/YR	\$.4180/GAL	
	*** OPERATING	S LABOR ***	
AIDEAI	. 63 40 H064M0	e44 7440	425700 (4
DIRECT	8760. HRS/YR	\$14.34/HR	125700. (A 30100. (B
SUPERVISION	1752, HRS/YR	\$17,20/HR	30100. (8
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	5900. HRS/YR	\$14.34/HR	84600. (C
SUPERVISION	1180, HRS/YR	\$17,20/HR	20300. (D
MATERIALS			21200. (E
SUPPLIES			18900. (F
WATER TREATMENT			<u> </u>
SOLID WASTE			
DISPOSAL	O. TON/YR	\$ 8.25/TON	0.
DIRECT OPERAT	ING COST		300800.
PAYROLL OVERH	EAD =20.0% OF A+B+0	C+D	52100.
PLANT OVERHEA	D =50.0% OF A+B+C+D)+E+F	150400.
TOTAL OPERATI	NG COST		503300.
	T IN DOLLARS PER TO		.71
_		IN OF DUST COLLECTED	956.44
	T AS PERCENT OF CAP	TAL COST	• 0
	TIME IN WEEKS		<u>8.</u>
	E OF SYSTEM IN YEAR	85	99.
KWH PER TON	CAPACITY	L CARTTAL N	.0
	ERY (10,00% OF TOTAL		0.
	N OVERHEAD (2.0% OF S & INS. (2.0% OF		0.
	ZED COST - RETROFIT	-	503300.
IVIAL ARMUALI	- NEW		503300.
			- · · · ·

PPSES: 506. COMBUSTION STA	UNITS OPTION CK - OLD COKE 3
CAPACITY: 708 MILE	JUN TUNS/YEAR
PARTICULATE LUAD IN: 1.300000 LBS/ ALLUMABLE: .130000 LBS/ 15.02 LBS/	TUN CUAL EFFICIENCY: 90.0%
BS 0	
LUAD 11: .006000 LBS/ ALLUWABLE: .003000 LBS/ .35 LbS/	TUN LUAL EFFICIENCY: 50.0%
BAP LOAD IN:	TUN CUAR
	TON CUAL EFFICIENCY: 50.0%
DUST CULLECTED PER DAY:	1.6 TUNS (DRY)
1EMP UUT OF PROCESS: 45 EXHAUST TEMPERATURE: 45	
SCFM FLUN: 107000. AT 7 ACFM FLUN: 184000. AT 45	
L/G RATIO: PRUCESS WATER FLOW:	0. GPM
CUOLING WATER FLUN:	0. GPM 0. MG/L %SULIDS: .0
<u></u>	
	· · · · · · · · · · · · · · · · · · ·
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	n-00

		DUB.	COMBUSTION S	TACK - ULL		0PT10N 3_:	
CU	INTRUL	SYSIEM	CUNF IGUKATIU		i ti, yan tin sasanikaan sab ii aan kiista maa		
	£ c	r)					
	ES FA	N AND DI					
		CTWURK					300
	u U	ST HAND	LING HOPPER &	CONVEYORS	<u> </u>		
		MPERS					
	F A	N AND D	KIVE ELECTRIC	AL			
FE	ET UF	LITIOUAL	TOTAL PLAT	250.	DIAMETER		
10	TAL P	KESSUKE	ひれしてい	6.	INCHES		
			HP EACH				
UP.	FRAIT	MP HOOK	S AT FULL HP: S AT REDUCED	8/6U.			
		L16H1:	S AT REDUCED		DIAMETER	: 0.	
			Angel ye has regulated a set of the commence of				
ŲV	EN HE	IHHI		6.0) MÉTERS		
	EN VU				CUBIC FEET		
10		KE/PUSH	ME, HKS.	<u>24.</u> 17.5			
		LES/DAY		.58			
						E1.	
Y 1	LLυ			. 7			
10	INS CU	AL/YEAK		1011967.			
. 4. 44. 44. 44. 44. 44. 44. 44. 44. 44							
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505600.	1349900.		
	242600.		
	3136000.		
	158900. 141700. 73200. 36000. 55600. 66800. 505600.	158900. 141700. 73200. 36000. 55600. 66800. 505600. 242600. 3136000.	158900. 141700. 73200. 36000. 55600. 66800. 505600. 1349900. 242600.

PPSES:	506. C	JMBUSTIUN	STACK - UL	.D COK	E 3		
CAPACI	1 Y :	.708 M	ILLIUN TON	IS/YEAK			
CATEGO	κΥ	TNAUU	11 A	HAIE		ANNUAL CUST	(\$
	<u>.</u>		<u>*</u> ** UljL1T	<u>1ES ***</u>		······································	
WATER		U,	MGAL/YR	\$.1595	/1000 GAL	· ·	
						64100.	_
STEAM				\$ 4.0920		U.	
FUEL			GAL/YK	5 .4180	/GAL	0.	
		***	UPERATING	LABUR ***	,		
DIRECT		 σ/6υ .	HK\$/YK	\$14.34/H		125700.	(A)
SUPERV	18100					30100.	
		*** MA	INTENANCE	& SUPPLIES	***		
 D1RECT	LABOR	1045.	HKS/YE	\$14.34/H	IR	101000.	(C)
	ISTUM					24200.	
MATERI	ALS					59100.	
SUPPLI	£5					27700.	(F)
	TREATMENT RASTE					v.	
D15F	USAL	596.	101v/YR	\$ 8.25/1	ON	4960.	
<u> </u>	RECT OFERA	11 No CUST				436800.	
PΔ	YRULL OVER	サムレーニンりょり	ን በF ልቀዘ+ቦ	` + f)		56200.	
	ANT UVERHE					183900	
	TAL UPERAT					676900.	
υF	ERATING CU	ST IN DULL	ARS PER TU	IN PRODUC	TIUN	• (96
					CULLECTED		
	ERATING CU			TTAL CUST		17.6	
-	STALLATION	_	-			104.	
	H PER TUN			L9		20. 3.6	
	PITAL RECU			I CAPITAL)		445700.	•
						75900.	
	UPERTY TAX					75900.	
1.	TAL ANNUAL	IZED CUST	- RETRUFIT	Ī	·	1274400.	
			- NEW			<u> 1170700.</u>	

PESES:	506.	COMBUSTION	STACK	• Oi 6	UNITS COKE	OPTIUN 4	
CAPACI		.708				7	
PARTIC		1.300000	1 4 5 / 1 (4)	CGAL			
					EFFICIENC	Y: 98,0%	
		3.00		_			
<u> 8</u> \$0		<u></u>					
	UAD IN:	•006000	LBS/TUN	CUAL			
Á					EFFICIENC		
		<u></u> €€Ω	Postik i	***************************************			
HAP	() a () T •			C 13 A 1			
		.000060			EFFICIENC	V• 60 07	
^	ee		FR2/44	COAL	LIVICILING	.1. 00.0%	
DUST C	OLLECTED	PER DAY:	1.8	1 UNS (ÚRY)		· -·-
TEMP U	of OF Pki	CESS:	450. 1	<u>.</u>			
		TUKE:					
SC+% +	LUM: 107	UUU. AT	70. 1	:			
ALFM F	LUW: 164	OUD. AT	450. 1		,		
L/G KA	110:		. 0_				
		LON:					
		LUN: S OUT:	0. (34M 46/L	46 01 lns		
3031	700 300 10	73 001.		107L	% SUL105:	. 0	
			•				
						· · · · · · · · · · · · · · · · · · ·	
							

PPSES: 506. COMMUNITURE STACK - OLD CORE 4 CONTRUL SYSTEM CONFIGURATION: ESP FAN AND DRIVE DUCTIONEN DUST HANDLING HOPPER & EUNVEYDRS DAMPERS FAN AND UNIVE ELECTRICAL SCA: 450. [UTAL PLATE AREA: 99000. SU.FT. & 202 SPARE CAPAL FEET UP ADDITIONAL DUCT: 250. DIAMETER: 8. 101AL PRESSURE ORUP: 6. INCRES 2 FARS & 290. HP EACH SPARE FAN CAPACITY: 100.2 UPERATING HOURS AT REDUCED HP: 0. UPERATING HOURS AT REDUCED HP: 0. STACE HEIGHT 6. DETERM UVEN HEIGHT 6.0 METERS UVEN HEIGHT 548. COBIC FEET LONS COLKED IME, HRS. 17.5 NU. CYCLESYDAY 82. BULK DEWSITY 50. LBS/COBIC FT. TOTOLS COME/VENA 10011967.	PPSES: 506. COMBUSTION S	STACK - OLD COKE A
CONTROL SYSTEM CONFIGURATION: ESP FAN AND DRIVE DUCTWORK DUST HANDLING HOPPER & CONVEYORS DAMPERS FAN AND DRIVE ELECTRICAL SCA: 450. TOTAL PLATE AREA: 99000. SU.FT. & 20% SPARE CAPACE EET OF ADDITIONAL DUCT: 250. DIAMETER: 8. TOTAL PRESSURE DRUP: 6. INCHES 2 FANS & 290. HP EACH SPARE FAN CAPACITY: 100.% OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. NU. OF OVENS 60. OVEN HEIGHT 6.0 METERS TONS CONTROL TIME, HRS. 17.5 NU. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. YIELD		ZIACN - DEL/
FAN AND DRIVE DUCTWORK DUST HANDLING HOPPER & CONVEYORS DAMPERS FAN AND URIVE ELECTRICAL SCA: 450. TOTAL PLATE AREA: 99000. SU.FT. & 20% SPARE CAPACE ELET UP ADDITIONAL DUCT: 250. DIAMETER: 8. TOTAL PRESSURE DRUP: 6. INCRES 2 FANS & 290. HP EACH SPARE FAN CAPACTY: 100.% OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT 6. NU. OF OVENS OVEN HEIGHT 6.0 METERS TONS CORETON 4. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CORIC FT. YTELD	CUNTRUL SYSTEM CONFIGURATIO	
FAN AND DRIVE DUCTWORK DUST HANDLING HOPPER & CONVEYORS DAMPERS FAN AND URIVE ELECTRICAL SCA: 450. TOTAL PLATE AREA: 99000. SU.FT. & 20% SPARE CAPACE ELET UP ADDITIONAL DUCT: 250. DIAMETER: 8. TOTAL PRESSURE DRUP: 6. INCRES 2 FANS & 290. HP EACH SPARE FAN CAPACTY: 100.% OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT 6. NU. OF OVENS OVEN HEIGHT 6.0 METERS TONS CORETON 4. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CORIC FT. YTELD		
DUCTWORK DUST HANDLING HOPPER & CONVEYORS DAMPERS FAN AND DRIVE ELECTRICAL SCA: 450. TOTAL PLATE AREA: 99000. SU.FT. © 20% SPARE CAPACE FOR THE PRESSURE DUCT: 250. DIAMETER: 8. TOTAL PRESSURE DRUP: 6. INCHES 2 FANS © 290. HP EACH SPARE FAN CAPACITY: 100.% OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. NO. OF UVENS 60. OVEN HEIGHT 6.0 METERS UVEN VOLUME 1348. CUBIC FEET TONS CUREFPUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. YTELD	ESP	
DUST HANDLING HOPPER & CONVEYORS DAMPERS FAN AND DRIVE ELECTRICAL SCA: 450. TOTAL PLATE AREA: 99000. SU.FT. & 20% SPARE CAPACE FEET DF ADDITIONAL DUCT: 250. DIAMETER: 8. TOTAL PRESSURE DRUP: 6. INCHES 2 FANS & 290. HP EACH SPARE FAN CAPACITY: 100.% OPERATING HOUNS AT FULL HP: 8760. OPERATING HOUNS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. NU. OF UVENS 60. OVEN HEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKING TIME, HRS. 17.5 NU. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. YTELD .70		·
DAMPERS FAN AND UNIVE ELECTRICAL SCA: 450. TOTAL PLATE AREA: 99000. SU.FT. @ 20% SPARE CAPACE ELET UP ADDITIONAL DUCT: 250. DIAMETER: 8. TOTAL PRESSURE DRUP: 6. INCHES 2 FANS @ 290. HP EACH SPARE FAN CAPACTIY: 100.% (PERALING HOURS AT REDUCED HP: 0. UPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. NO. OF OVEN HEIGHT 6.0 METERS OVEN HEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. YTELD .70		COMMINGUE
SCA: 450. TOTAL PLATE AREA: 99000. SU.FT. @ 20% SPARE CAPACE FET DF ADDITIONAL DUCT: 250. DIAMETER: 8. TOTAL PRESSURE DRUP: 6. INCRES 2 FANS @ 290. HP EACH SPARE FAN CAPACITY: 100.% OPERATING HOURS AT FOLL HP: 6760. OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. NO. OF OVEN HEIGHT 6.0 METERS OVEN HEIGHT 6.0 METERS OVEN VOLUME 1548. CUBIC FEET TONS COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/COBIC FT. YIELD		LUIVE LUND
SCA: 450. TUTAL PLATE AREA: 99000. SU.FT. & 20% SPARE CAPACE FEET OF ADDITIONAL DUCT: 250. DIAMETER: 8. TUTAL PRESSURE DRUP: 6. INCHES 2 FANS & 290. HP EACH SPARE FAN CAPACITY: 100.% OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. NU. OF UVENS 60. OVEN HEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKING TIME, HRS. 17.5 NU. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. YTELD		
TUTAL PRESSURE DRUP: 2 FANS & 290. HP EACH SPARE FAN CAPACITY: 100.2 UPERATING HOURS AT REDUCED HP: OUBLATING HOURS AT REDUCED HP: OUBLATER: OUBLATER	SCA: 450. TUTAL PLAT	
2 FARS 0 290. HP EACH SPARE FAR CAPACITY: 100.2 UPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. NO. OF OVERS OVER VOLUME 1548. CUBIC FEET TONS CUKE/FUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/COBIC FT. YIELD .70	FEET OF ADDITIONAL DUCT:	250. DIAMETER: 8.
UPERATING HOURS AT REDUCED HP: STACK HEIGHT: O. DIAMETER: O. NO. OF OVERS OVER VOLUME TONS CUKEZPUSH AVG. COKING TIME, HRS. BULK DENSITY YIELD O. DIAMETER: O. DIAMET		
OPERATING HOURS AT REDUCED HP: STACK HEIGHT: O. DIAMETER: O. OVEN HEIGHT 6.0 METERS OVEN VULUME 1348. CUBIC FEET TONS CUKE/PUSH AVG. CUKING TIME, HRS. NO. CYCLES/DAY BULK DENSITY 70		
STACK HEIGHT: NU. UF UVENS OVEN HEIGHT O. DIAMETER: O. OUNTER: OUNTER: O. OUNTER: OUNTER: O. OUNTER: OUNTER		
NU. OF UVENS 60. OVEN HEIGHT 6.0 METERS OVEN VULHME 1348. CUBIC FEET TONS CUKE/PUSH 24. AVG. CUKING TIME, HRS. 17.5 NU. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. YTELD .70		
OVEN HEIGHT 6.0 METERS OVEN VULTIME 1348. CUBIC FEET TONS CUKEZPUSH 24. AVG. COKING TIME, HRS. 17.5 NU. CYCLESZDAY 82. BULK DENSITY 50. LBSZCUBIC FT. YTELD .70		
OVER VULTIME1348. CUBIC FEETTONS CUREZPUSH24.AVG. COKING TIME, HRS.17.5NU. CYCLES/DAY82.BULK DENSITY50. LBS/CUBIC FT.YIELD.70		
TONS CORE/PUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/COBIC FT. YIELD .70		
AVG. CUKING TIME, HRS. 17.5 NU. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. YIELD .70	· · · · · · · · · · · · · · · · ·	
NU. CYCLES/DAY BULK DENSITY YIELD 50. LBS/CUBIC FT. 70		
BULK DENSITY 50, LBS/CUBIC FT. Y1ELD .70		
Y1ELU .70		
TONS COAL/YEAR 1011967.		
	TUNS COAL/YEAR	1011967.
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		Part

CAPITAL CUSI: UNITS OPTION PPSES: 506. COMBUSTION STACK - OLD COKE 4 CAPACITY: .708 MILLIUN TUNS/YEAR TUTAL CUST LCUST BASIS IS 110.00% OF JUNE 1977 DOLLARS FOR 4078 CUST CATEGURY CUST IN DULLARS *** DIRECT COST *** EQUIPMENT OR MATERIAL 1232700. INSTRUMENTALION PIPING ELECTRICAL 78700. FUUNDATIONS 10500. STRUCTURAL 77500. STIF WURK 8800. INSULATIUN 66600. PRUTECTIVE CUALING 9300. BUILDINGS 9800. EUUIPMENI/MATERIAL LABUR 570700. DIRECT COST SUBTOTAL 2064600. *** INDIRECT CUST *** FIELD UVERMEAD 328700. CUNTRACTURS FEE 219500. ENGINEERING 193100. FRE16H1 89700. UFFSITE WURK 51700. IAXES 72600. SHAKEDUMIN 95500. CUNTINGENCY 93000. 669700. INDIKECT CUST SUBTOTAL 1813300. INTEREST DURING INSTALLATION 340900. 101AL CUSI 4216600. TUTAL CUST WITH RETRUFIT 5093900.

GENE	RAL I	VEURMATTUN	:					
	PPSES	506.	CUMBUSIJUI	N STACK	<u>- ULD</u>		OPTION5	
	CAPAU	ITY:	./08	MILLIUN	10N5/Y	/EAR		
	t	CULATE LUAD IN: ALLÜWABLE:		LHS/TUN		<u>EFFICIEN</u> C	Y: 98.0%	
	BSU		-					
			.003000	LB5/1UN	CUAL	EFFICIENC	CY: 50.0%	
	BAP							
		LUAD IN: ALLUMABLE:	.000050			EFFICIEN(CY: 50.0%	
	DUST (COLLECTED	PER DAY:	1.8	10NS ([SRY)		
		JUT_UF_PRO ST_TEMPERA				 .		
	SCFM F	-Lun: 198 -Luw: 275	υυυ. <u>Δ]</u> υυυ. ΑΤ	7u. 1	F			·
	PRUCE:	SS WATER FI	LUW: LOw:	0.	etti etti		• 0	
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		URMAT].			UNITS		
	PPSES:	506.	CUMBUSTION S	TACK - ULD	CUKĖ	5	
	CONTRUL	SYSTEM	CUNFIGURATIU				
	BAL	MOUSE N AND L	16 1 V F				
		JTWURK) N 1 V C				
	DAI	MPERS _					
	FAI	V ARD L	OINTUBLE EVENTRIC	AL			
		5 . U	TUTAL CLUT		000. SU.FT		RE CAPACITY
	FEFT UF	AUDITI	LUNAL DUCT:	250.	DIAMETER:	9.	C CALACIT
- · · ·	TUTAL PH	RESSURE	. DKUP:	10. IN	CHES	4	
			HP EACH		CAPACITY:	50.%	
			RS AT FULL HP: RS AT REDUCED				
	STACK HE				DIAMETER:	U .	
	NO. UF U	JVENS		60.		·	
	OVEN ME.						
	OVEN VUL TUHS CO			1348. L	NRIC FEEL		
	AVIS CO	NEZPOST CING 11	i LmE, ndS.	24. 17.5		* ***	
	NU. EYEL	LS/DAY		be.	e i moramente mora de la manda		
	BULK DE	VSIIY		50. E	BS/CUBIC F	١.	
	YIELD			.70			
	Tuics Lui	ALZYEAR	(1011967.			
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CALLIAL	cusi:			UNIT	s (PTION			
PPS	5: 506.	CUMBUSTIUN SIAC	K - OLD	_					
CAP	ACITY:	.708 MILLI	ON TONS/YE	AR					
TUT	AL CUST	(COST BASIS IS	110.00% OF	JUNE	1977	DULLARS	FOR	4078	CUS
	CATEGURY	······································	CU	ST IN	DULL	\ks			· · · · · · · · · · · · · · · · · · ·
		*** DIRECT CUS	7					** **	
	FHHTPMEN	T OR MATERIAL		4500					
		NTATION		5900.					
	PIFING	WIRITON		1500.					
	FIFCIRIC	AL	1	2000					
	FUUNDATI			5900.					
	STRUCTUR			1900.					
		K							
	INSULATI			U .					
		VE CUATING	1						
		5	31						
		I/MATERIAL LABUR		0200.					
		ECT COST SUBTUTAL			145	300.			
		*** INDIRECT CO	SI ***		· · · · · · · · · · · · · · · · · · ·				
	FIELD OV	ÊKHE AD	17	4700.					
	CONTRACT	URS FEE	12	7900.					
	ENGINEER	ING	11	8900.					
	FRE1GHT		4	6900.					
	UFFSITE	WORK	2	7500.					
	TAXES		5	4500.					
	SHAKEDUM	N	5	8100.					
.	SPARES			3900.					
	CONTINGE	NU Y	44	5800.					
	INU	THECT COST SORTOT	AL		1108	.005			
	T T	EREST DURING INST	ALLATIUN		164				
	. 1101								
		AL CUST			2/3	0600.			

OPERATING CUSI:

CAPACITY:	.706 MILLIUN TON	S/YEAR	
CATEGURY	UUANTITY	RATE	ANNUAL CUST (S
	*** UTILIT	IES ***	
WATER	U. MGAL/YK	\$.1595/1000 GAL	0
ELECTRICITY	3985249. KWH/YR	\$.U266/KWH	106100
STEAM	U. MLBS/YR	\$ 4.0920/MLBS	U.
FUEL	U. GAL/YR	5 .416U/GAL	0.
	*** OPERATING	LABOR ***	
DIRECT	29eu. HRS/YR	\$14.34/HK	41900. (A
SUPERVISION	564. HKS/YK	\$1/.2U/HR	10000. (B
	*** MAINTENANCE	& SUPPLIES ***	
DIKECT LABUR	6017. HK5/YK	\$14.34/HK	97800. (C
SUPERVISIUN	1363. HRS/YR	\$17.20/HR	23500. (D
MATERIALS			58600. (E
SUPPLIES			33300. (F
WATER TREATMENT			V •
SULIU WASTE DISPUSAL	645. TUN/YR	\$ 8.25/1UN	5300.
DIRECT OPERA	TING COST		376500.
PAYROLL OVER	HEAD =20.0% OF A+B+C	+ 0	34600.
	AU =50.0% UF A+B+C+U		132600.
TUTAL OPERAT		· · · · · · · · · · · · · · · · · · ·	543700.
_	ST IN DULLARS PER TU	N PRODUCTION	•77
		N OF DUST CULLECTED	
	ST AS PERCENT OF CAP		16.5
	TIME IN WEEKS		83.
		<u> </u>	
KWH PER TUN			5.6
	VERY (11.75% OF TUTA		387900.
		F TOTAL CAPITAL)	
	ES & INS. (2.0% OF IZED CUST - RETROFIT		66100.
TOTAL KINDAL	- ACH	•	1063800.

GENERAL :	INFORMATIO	N:		= = 0	08 ***0N	
		5045	21.0		_OPTION	
PPSES	5: 507.	COKE HANDL	ING	COKE	5	
CAPA	-11Y:	2.A34	MILLION TONS	/YEAD		
WAI.AI						
PART	ICULATE				•	•
			LBS/TON COAL			<u>:</u>
	ALLOWABLE	: .109000	LBS/TON COAL	EFFICIENC	Y: 89.1%	75
		53.02	LBS/HR			
			* 0 *0.00	(-5.4)		
busi	COLLECTED	PER DAT:	4.9 TONS	(DRY)		
TEMP	OUT OF PR	nress:	70. F			
	JST TEMPER		70. F	<u> </u>		
	, , , , , , , , , , , , , , , , , , , ,		, ,			
SCFM	FLOW: 9	0000 AT	70. F			
ACFM	FLOW: 9	0000. AT	70. F			
			•			
	RATIO:		. 0			
	ESS WATER		O. GPM			
	ING WATER ENDED SOLI		0. 6PM	XSOLIDS:		
	THUED BULL	<u> </u>	V. FIB/I	ASUL IUS	· · · · · · · · · · · · · · · · · · ·	
					· · · · · · · · · · · · · · · · · · ·	
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			A-100			

					OPTION
PPSES:	507.	COKE HANDLING		COKE	2
w.)				•	
CONTROL	SYSTE	CONFIGURATION:	;		
BAG	HOUSE				
Jan FAN	AND I	DRIVE			
DITC					
-	OPY HO				
	PERS	TRANS PT. HOOD			
		RIVE ELECTRICAL			
			•		
A/C: 6		TOTAL CLOTH	AREA:	18000. SQ.F1	. a 20% SPARE CAPACITY
FEET OF	ADDIT	IONAL DUCT:	200.	DIAMETER	5.
TOTAL PR	ESSURE	DROP: HP EACH	8.	INCHES	
2 FANS a	189,	, HP EACH	SPARE FAI	N CAPACITY:	100.2
		RS AT FULL HP: RS AT REDUCED HE			
STACK HE		S AT REVULEU HE		DIAMETER	. 0
NO. OF O			60.	O I AME I EN	
				SQ.FT.	
OVEN HEI	GHT			METERS	
OVEN VOL				CUBIC FEET	
TONS COK			17.5	4/	
NO. CYCL			82.		
BULK DEN			·	LBS/CUBIC F	T
YIELD			p7(
TONS COA	L/YEAR	₹ 4	1047868.		
		··· ··································			
No. 45 Angeles and a service and a					•
					
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					\$ v v v v v v v v v v v v v v v v v v v
				· · · · · · · · · · · · · · · · · · ·	
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CAPITAL COST: UNITS OPTION PPSES: 507. COKE HANDLING COKE 5 2.834 MILLION TONS/YEAR CAPACITY: (COST BASIS IS 110.00% OF JUNE 1977 DOLLARS FOR 4078 COST.) TOTAL COST CATEGORY COST IN DOLLARS *** DIRECT COST *** EQUIPMENT OR MATERIAL 396800. INSTRUMENTATION 4000. PIPING_ 400. 12600. ELECTRICAL FOUNDATIONS 12300. STRUCTURAL 46900. 1800. SITE WORK INSULATION 0. 18800. PROTECTIVE COATING 9000. BUILDINGS EQUIPMENT/MATERIAL LABOR 99900. DIRECT COST SUBTOTAL 607000.

*** INDIRECT COST *** FIELD OVERHEAD 71500. CONTRACTORS FEE 51800. 63800. ENGINEERING FREIGHT 20100. 7600. OFFSITE WURK TAXES 24200. 22700. SHAKEDOWN SPARES 20300. CONTINGENCY 219100. INDIRECT COST SUBTOTAL 501100. INTEREST DURING INSTALLATION 60000.

TOTAL COST WITH RETROFIT 1299200.

UPERATING CUST:		UNITS OPTION	
PPSES: 507. COK	E HANDLING	COKE 5	
CAPACITYI	2.834 MILLION TO	NS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (S
	*** UTILI	TIES ***	2 172
WATER	O. MGAL/YR	\$.1595/1000 GAL	0 -
ELECTRICITY	1375802. KWH/YR	\$.0266/KWH	36600.
STEAM	U. MLBS/YR	_	0.
FUEL	U. GAL/YR	\$.4180/GAL	0.
	*** OPERATIN	S LABOR ***	
DIRECT	2920. HRS/YR	\$14.34/HR	41900. (A)
SUPERVISION	584. HRS/YR	\$17,20/HR	10000. (B)
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	4100. HRS/YR	\$14.34/HR	58800. (C)
SUPERVISION	820. HRS/YR	\$17.20/HR	14100. (D)
MATERIALS			28700. (E)
SUPPLIES			16300. (F)
WATER TREATMENT			0
SOLID WASTE			
DISPOSAL	1803. TON/YR	\$ 8.25/TON	14900.
DIRECT OPERATI	NG COST		221300.
PAYROLL OVERHE	AD =20.0% OF A+B+	C+D	25000.
PLANT OVERHEAD	=50.0% OF A+B+C+	D+E+F	84900.
TOTAL OPERATIN	G COST		331200.
	IN DOLLARS PER T		.12
		ON OF DUST COLLECTED	183.66
	AS PERCENT OF CA	PITAL COST	25.5
INSTALLATION T			83.
	OF SYSTEM IN YEA CAPACITY	K 9	20.
KWH PER TON	•5 •5		
	RY (11.75% OF TOT OVERHEAD (2.0%		152600. 26000.
	& INS. (2.0% OF		5 6000.
	ED COST - RETROFT		535800.
	- NEW		515200.
•			•

		Manager Manager 1				OPTION	
PPSES	5: 508.	COAL PREH	EATER		COKE	2	
CAPAC	ITY:	.992	MILLION	TONS/Y	EAR		
	. 						
PARTI	CULATE	7 050000	L DC /TON	COAL			
		7,050000 E: .352500			FEETCIENC	V: 45 NY	
	MECOUNCE		LBS/HR	· COME	LIV ZOZENO	70 7500	
<u> </u>							
BS 0							
		1.050000					
	ALLOWABL	E: .420000		COAL	EFFICIENC	Y: 60.0%	
		11.30	LBS/HR				
BAP							
	LOAD IN	.000390	LBS/TON	COAL			
	ALLOWABL	E: .000156	LBS/TON	_	EFFICIENC	Y: 60.0%	•
			LBS/HR				
D F N 3 F							
BENZE		.014000	1 20/TON	COAL			
	ALLOWABL		LBS/TON		EFFICIENC	Y: 50-07	
		:	LBS/HR		L. 1 20 2 E 140	, - 30,00	
DUST	COLLECTE	D PER DAY:	13.0	TONS (D	RY)		
* * * * * * * * * *	0117 0	1000500	4.6.5	-			
		PROCESS:	180.				
EANAL	IOI IEMPE	RMIUNE .	100.	r			
SCFM	FLOW:	17000. AT	70.	F			
		TA .00005					
, ,= =							
	ATID:	S ELOW*	6.5				
	SS WATER		111.	ЬРМ С р м			
		IDS OUT:	15206.		%SOLIDS:	1.5	
				· · · ·			
					•		

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						water and the second	
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			A-	104			

GENERAL INFORMATION: UNITS OPTION PPSES: 508. COAL PREHEATER COKE 2 CONTROL SYSTEM CONFIGURATION: VENTURI SCRUBBER MIST ELIMINATOR FAN AND DRIVE DUCTWORK WASTEWATER RECYCLE SYSTEM DAMPERS WASTE WATER RETURN SYSTEM WATER PUMPING SYSTEM FAN AND DRIVE ELECTRICAL FEET OF ADDITIONAL DUCT: 100. DIAMETER: 3. TOTAL PRESSURE DROP: 18. INCHES 2 FANS @ 94. HP EACH SPARE FAN CAPACITY: 100.7 OPERATING HOURS AT FULL HP: 8322. OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. NO. OF OVENS 60. 6.0 METERS OVEN HEIGHT OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 12.5 115. NO. CYCLES/DAY BULK DENSITY 50. LBS/CUBIC FT. .70 YIELD TONS COAL/YEAR 1416755.

A-105

										OPTION		·	
PPSES	5 :	508.	COAL	PREHEA	TER			CO	KE	2			
CAPAC		/:	, <u>.</u>	992 M	ILL:	ION TONS	/YEA	.R					
TOTAL	_ C(OST	(COST	BASIS	IS	110.00%	OF	JUNE	1977	DOLLARS	FOR	4078	COST
 ,	CA	TEGORY					cos	TIN	DOLL	ARS			;
			*** D	IRECT	_co:	SI ***							**
	EQ	JIPMEN'	T OR MA		_		280	800.					
	IN	STRUME	NOITATION				51	600.					
								700.					
	EL	ECTRICA	AL				84	800.					
		JNDATI						500.					
	-	-	AL					100.					
		TE WORK						400.					
		SULATIO		_				600.					
			VE COAT	ING				100.					
		ILDING						300.					
	ED		T/MATER				100	300.					
		DIR	ECT_COS	SUBT	LLAI				54	8200.			
			TAI	10501	c	DST ***							
	ETI	ELD OVS	ERHEAD	_	_	J31 ===	97	500.					
			DRS FEE					400.					
		SINEER						800.					
		IGHT						800					
		SITE	NORK					300.					
		KES						600.					
	SH	KEDOWI	V					400.					
	SP	RES		•			29	200.					
	COI	NTINGER	VC Y				217	900.					
		IND	RECT C	ST SU	STO	TAL			59	3900.			
		INTE	EREST DI	JRING	INS	TALLATIO	N		10	1000.			
		TOTA	AL COST						134	3100.			
·		707	u rnet	WTTL I) F 7 C	ROFIT			147	4200			
			L LUSI	<u> </u>	XI.J.I	KUP 1.1			197	<u>4200</u>			
							••••		<u>-</u>				
									•				
-													
		·					-						

PPSES: 508. CO	AL BOCHEATED	UNITS OPTION	
PP5E5: 308. CU	AL PREHEATER	COKE 5	
CAPACITY:	.992 MILLION TO	IS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (
	*** UTIL11	IES ***	
WATER	11035. MGAL/YR	8 _1595/1000 GAL	1800.
ELECTRICITY	548080. KWH/YR	\$.0266/KWH	14600.
STEAM	0. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	O. GAL/YR	\$.4180/GAL	0.
	*** OPERATING	LABOR ***	
DIRECT	8760. HRS/YR	\$14.34/HR	125700. (A
SUPERVISION	1752. HRS/YR	\$17.20/HR	30100. (B
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	8567. HRS/YR	\$14.34/HR	122900. (c
SUPERVISION	1713. HRS/YR	\$17.20/HR	29500. (D
MATERIALS			104800. (E
SUPPLIES			40200. (F
WATER TREATMENT			0.
SOLID WASTE			
DISPOSAL	9489. TON/YR	\$ 8.25/TON	78300.
DIRECT OPERAT	ING COST		547900.
PAYROLL OVERH	EAD =20.0% OF A+B+0	:+D	61600.
PLANT OVERHEA	D =50.0% OF A+B+C+D)+E+F	226600.
TOTAL OPERATI		•	836100.
	T IN DOLLARS PER TO		.84
		N OF DUST COLLECTED	176.23
	T AS PERCENT OF CAP	TITAL COST	56.7
	TIME IN WEEKS E OF SYSTEM IN YEAR	i e	104.
KWH PER TON		.5	15.
	ERY (13.15% OF TOTA	LI CAPITAL)	.6 193800.
	N OVERHEAD (2.0% C		29500.
	S & INS. (2.0% OF		29500.
	ZED COST - RETROFIT		1088900
	- NEW		1066500.
		1.11	
		in the second of	

0005	S: 508.	COAL PREH	CATED			TION	
PPSE	S: 500.	SUAL PREH	EAIEK		COKE	3	
CAPA	CIIY:	.992	MILLION	TONS/	YEAR		
PART	ICULATE						
, ,,,,,,	_	7,050000	LBS/TON	COAL			
		: .352500				95.0%	
Ž.	, <u>, , , , , , , , , , , , , , , , , , </u>		LBS/HR		2.1.2022.11011	. , , , , , , , , , , , , , , , , , , ,	
BSO							
	LOAD IN:	1.050000	LBS/TON	COAL			
					EFFICIENCY:	45.0%	
			LBS/HR				
BAP							
	LOAD IN:	.000390	LBS/TON	COAL			
	ALLOWABLE	: .000214	LBS/TON	COAL	EFFICIENCY:	45.0%	
· · · · · · · · · · · · · · · · · · ·		.04	LBS/HR				
BENZ	ENE						
		.014000	LBS/TON	COAL			
	ALLOWABLE	• • • • •		COAL	EFFICIENCY:	45.0%	
		1.31	LBS/HR				
DUST	COLLECTED	PER DAY:	13.0	TONS (DRY)		·
TEMB	OUT OF BE	000000	100				
	OUT OF PRUST TEMPER		180. I				 -
EARM	USI TEMPEN	FIUNE.	100, 1				
SCFM	FLOW: 1	7000. AT	70.	•			
	FLOW: 2						
L/6_	RATIO:		0				
PROC	ESS WATER	FLOW:	0.	SPM			
COOL	ING WATER	FLOW:	0. (PM			
SUSP	ENDED SOLI	DS OUT:	0, 1	1G/L	XSOLIDS:	.0	 -
					1942-762-7		
8 1							
···							
	·	<u> </u>				*	

					UNITS	OPTION	
PPSES:	508.	COAL PREHE	ATER		COKE	3	
							
CONTROL	SYSTEM	CONFIGURAT	ION:				
	P	DIVE					2. U.S.
DUI	CTWORK _						·
	ST HAND MPERS	LING HOPPER	& CONVEYO	ORS			
FA	Q. AND .	RIVE ELECTR	ICAL				
3CA: 32	4	TOTAL PL	ATE AREA:	80	00. SQ.F	1. a 20% S	PARE CAPACI
FEET OF TOTAL PI	ADDITI RESSURE	ONAL DUCT: DROP:	100). 4. Inc	DIAMETER: Hes	3.	
		HP EACH			APACITY:	100.2	
_		S AT FULL H					
STACK H	EIGHT:) .	DIAMETER	0	
NO. OF OVEN HE), :	TEDE		
OVEN HE		•		S.O ME	IERS BIC FEET		
TONS CO			54		UAG I EL		······································
AVG. CO				2.5			
NO. CYC			115	5			
AIEFD BRFK DEI				.70	S/CUBIC F	FT.	
TONS CO	AL/YEAR		1416755	<u> </u>			
				<u> </u>			

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			TS OPTION	
PPSES: 508.	COAL PREHEATER	CO	KE 3	
CAPACITY:	.992 MILLIO	N TONS/YEAR	· · · · · · · · · · · · · · · · · · ·	
TOTAL COST	COST BASIS IS 1	10.00% OF JUNE	1977 DOLLARS	FOR 407
CATEGORY		COST IN	DOLLARS	
	*** DIRECT COST	***		
	OR MATERIAL	328700.		
INSTRUMEN	TATION	0.		
PIPING		0.		
ELECTRICA	L	26600.		
FOUNDATIO	NS	4400.		
STRUCTURA		37200.		
SITE WORK		2100.		
INSULATIO		16000.		
	E COATING	5000.		
BUILDINGS		2400.		
_	/MATERIAL LABOR CT COST SUBTOTAL	143700.	566100.	
CONTRACTO	_	59200.		
ENGINEERI	NG	75000.		
FREIGHT		18900.		
OFFSITE W	ORK	12500.		
		22100.		
TAXES		30300.	/=	
SHAKEDOWN		30360		
SHAKEDOWN Spares	rv	29700.		
SHAKEDOWN SPARES CONTINGEN		200900.	542900.	
SHAKEDOWN SPARES CONTINGEN INDI	RECT COST SUBTOTAL	200900.		
SHAKEDOWN SPARES CONTINGEN INDI	RECT COST SUBTOTAL	200900.	89200.	
SHAKEDOWN SPARES CONTINGEN INDI	RECT COST SUBTOTAL	200900.		
SHAKEDOWN SPARES CONTINGEN INDI INTE	RECT COST SUBTOTAL	200900.	89200.	
SHAKEDOWN SPARES CONTINGEN INDI INTE TOTA	RECT COST SUBTOTAL REST DURING INSTAL L COST	200900.	89200. 1198200. 1311600.	

PPSES: 508. C	DAL PREHEA	TED	UNITS COKE	OPTION 3		
	OAL PACILA	, LN	LUNE	3		
CAPACITY:	.992 M	ILLION TOA	IS/YEAR			
CATEGORY	QUANT	ITY	RATE		ANNUAL COST	(
	,	*** UTILIT	IES ***		. 7 (4)	
MATER	0	MGAL/YR	3.1595/10	00 641	0 -	
ELECTRICITY	-	KWH/YR	\$.0566\KM		9700.	
STEAM		MLBS/YR			0.	
FUEL		GAL/YR	\$.4180/GA		0.	
	***	OPERATING	LABOR ***			
		_	_			
DIRECT		HRS/YR	\$14.34/HR		125700.	
SUPERVISION	1752.	HRS/YR	\$17.20/HR		30100.	<u>_</u> E
	*** MA	INTENANCE	& SUPPLIES **	*	<u> </u>	
DIRECT LABOR	2517	HRS/YR	\$14.34/HR		36100.	"
SUPERVISION	-	HRS/YR	\$17.20/HR		8700	
MATERIALS		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	V 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		19700.	
SUPPLIES					9700.	
WATER TREATMENT						
SOLID WASTE						
DISPOSAL	4744.	TON/YR	\$ 8.25/TON		39100.	
DIRECT OPERA	TING COST				278800.	
PAYROLL OVER	HEAD =20.0	K OF A+B+C	:+D		40100	
PLANT OVERHE					115000.	
TOTAL OPERAT	ING COST				433900.	
			N PRODUCTIO			
			N OF DUST COL	LECTED	91.4	
OPERATING CO			PITAL COST		33.1	
INSTALLATION						
ESTIMATED LI			(5		20.	,
KWH PER TON			LI CADITAL N		.4 .154100	
CAPITAL RECO			F TOTAL CAPIT	AL Y	26200.	
			TOTAL CAPITAL		2 6200.	
TOTAL ANNUAL		-		•	640400	
		- NEW			622600.	
V. 201						
			•	WV 1		

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PI	PSES:	508.	, C	DAL	PREH	EATER		COKE	4	
	BACT	T V •			002	MILLIO	N TONE	VEAD		
	RPALI	11ă			.772	wirrin.	N IUNS/	ICAR		
P	ARTIC	ULATE								
	L	DAD IN	1:	7.05	0000	LBS/TO	N COAL			
. ××:	: Al	LLOWAB	LE:	.14	1000	LBS/TO	N COAL	EFFICIENCY	98.0%)) ''
				24	.00	LBS/HR				
5 3	50	DAD TK	1 •,	1 05	0000	LBS/TO	N COAL			
						_		EFFICIENCY:	60.07	
					-	LBS/HR				
B/	NP								<u></u>	··
						LBS/TO				
	ΑI	LLOMAB	LE	.00		-		EFFICIENCY:	60.0%	
					<u>, v 3</u>	LBS/HR			······································	
Al	ENZENI	Ε								
			1:	.01	4000	LBS/TO	N COAL			
								EFFICIENCY:	50.0%	
				1	.19	LBS/HR				
							* TO NO (·····
Dt	JS1 C1	JLLEUI	EU P	FK D	ATI	13.	4 1UNS	נאט		
TE	EMP O	UT OF	PROC	FSS:		180.	F			
		T TEMP				180.				
91						70.				
		_UW:	200	00.	AI	180.	F			
	CFM FL						_			
AC						6.4	5			
AC L/	G RAT	TIO: S WATE	R FL	Ow:		111.				
L /	G RATROCESS	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM		<u> </u>	
L /	G RATROCESS	TID: S WATE	RFL	OW:		111.	GPM GPM	%SOLIDS:	1.5	
L /	G RATROCESS	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM	%SOLIDS:	1.5	
L /	G RATROCESS	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM	*SOLIDS:	1.5	
L /	G RATROCESS	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM	%SOLIDS:	1.5	
L /	G RATROCESS	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM	*SOLIDS:	1.5	
L /	G RATROCESS	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM	%SOLIDS:	1.5	
L /	G RATROCESS	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM	#SOLIDS:	1.5	
PF CC St	G RAT ROCESS DOLING JSPEND	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM	*SOLIDS:		
L /	G RAT ROCESS DOLING JSPEND	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM	%SOLIDS:		
PF CC St	G RAT ROCESS DOLING JSPEND	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM	%SOLIDS:		
PF CC St	G RAT ROCESS DOLING JSPEND	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM	%SOLIDS:		
PF CC St	G RAT ROCESS DOLING JSPEND	TIO: S WATE G WATE	RFL	OW:		111.	GPM GPM	#SOLIDS:		
PF CC St	G RAT ROCESS DOLING JSPEND	TIO: S WATE G WATE DED SO	RFL	OW:		111.	GPM GPM	%SOLIDS:		
PF CC St	G RAT ROCESS DOLING JSPEND	TIO: S WATE G WATE DED SO	RFL	OW:		111.	GPM GPM	%SOLIDS:		
PF CC St	G RAT ROCESS DOLING JSPEND	TIO: S WATE G WATE DED SO	RFL	OW:		111.	GPM GPM	#SOLIDS:		
PF CC St	G RAT ROCESS DOLING JSPEND	TIO: S WATE G WATE DED SO	RFL	OW:		111.	GPM GPM	%SOLIDS:		

		UNITS OPTI	
PPSES: 508. COAL PREHE	ATER	COKE 4	
•		•	
CONTROL SYSTEM CONFIGURAT:	[ON:		
VENTURI SCRUBBER			Ş
MIST ELIMINATOR			
FAN AND DRIVE			
DUCTWORK	40 7 514		
WASTEWATER RECYCLE S'	ISIEM		
DAMPERS WASTE WATER RETURN S'	/STEM		
WATER PUMPING SYSTEM	SIEM		
FAN AND DRIVE ELECTRY	rca:		
JAN AND DRIVE LEEDIN			
FFFT OF ADDITIONAL BURTA	4.0.0	N. T. M. T. C. T.	
FEET OF ADDITIONAL DUCT: TOTAL PRESSURE DROP:	100. 33. INC		
2 FANS @ 173. HP EACH			
OPERATING HOURS AT FULL HE			
OPERATING HOURS AT REDUCE!			
STACK HEIGHT:		DIAMETER: 0.	
NO. OF OVENS	60,		
OVEN HEIGHT	6.0 ME	TERS	•
OVEN VOLUME	1348. CU		
TONS COKE/PUSH	24.		
AVG. COKING TIME, HRS.	12.5		
NO. CYCLES/DAY	115.		
BULK DENSITY		S/CUBIC FT.	
YIELD	.70		
TONS COAL/YEAR	1416755.		
		•	
	•		
		·	

CAPITAL COST:

DDeci									OPTION			
PFJE	508.	COAL	PREHEA'	TER			C	KE	4			
CAPA	ITY:		992 M	ILLI	ON TO	NS/YE	A R					
TOTAL	. COST	(cost	BASIS	IS	110.0	0% OF	JUNE	1977	DOLLARS	FOR	4078	COS
	CATEGORY	 				CO	ST TA	DOLL	ARS			 -
	••	_					.				į	•
	FOUTOMENT						4700					
	EQUIPMENT INSTRUMEN		_				1700.					
	PIPING						1600.					
	ELECTRICA						4800.					-
	FOUNDATIO						9500.					
	SIRUCTURA											
	SITE WORK						3400					
	INSULATIO						6600					
	PROTECTIV		ING									
	BUILDINGS						9300.					
	EQUIPMENT.		IAL LA	30R								
									0400.			
		*** IN										
	FIELD OVE											
	CONTRACTO						7600.					
	ENGINEERI						3500.					
	FREIGHT			<u>-</u>								
	OFFSITE W	IORK					7800.					
	TAXES	_					6300.					
	SHAKEDOWA	<u> </u>							······			
	SPARES						0050					
	CONTINGEN		NET 644				4800.					
	1001	RECT C	<u> 181 801</u>	3101	AL			61	0200.			
	INTE	REST DI	URING :	INST	ALLAT	ION		10	4600.			
	TOTA	L COST						138	5200.			
	TOTA	L COST	WITH I	REIR	OFIT			152	0500.			
÷. «												
* 9 . 2						 						<u></u>
*				•					3.5			٠,

PPSES: 508. C	DAL PREHEATER	UNITS COKE	OPTION 4		
7,020. 300. 0			•		
CAPACITY:	MOT NOTILIM SPP.	IS/YEAR		······································	
CATEGORY	QUANTITY	RATE		ANNUAL COST	(
· · ·	*** UTILIT	IES ***	<u>.</u>		
WATER	11035. MGAL/YR	\$.1595/10	OO GAL	1800.	
ELECTRICITY	998794. KWH/YR	5 .0266/KM	νН	26600.	
STEAM	0. MLBS/YR	\$ 4.0920/ML	BS	0.	
FUEL	U. GAL/YR	\$.4180/G/	\L	0.	
	*** OPERATING	LABOR ***			
DIRECT	8760. HRS/YR	<u> </u>		125700.	
SUPERVISION	1752. HRS/YR	\$17.20/HR		30100.	Œ
	*** MAINTENANCE	& SUPPLIES *	<u>.</u>		<u> </u>
DIRECT LABOR	8767. HRS/YR	\$14.34/HR		125700.	"
SUPERVISION	1753. HRS/YR	\$17.20/HR		30200.	
MATERIALS				107000.	
SUPPLIES				41000.	
WATER TREATMENT				0.	
SOLID WASTE					
DISPOSAL	9788. TON/YR	\$ 8.25/TON		80800.	
DIRECT OPERA	TING COST		***************************************	568900.	
PAYROLL OVER	HEAD =20.0% OF A+B+C	:+D		62300.	
	AD =50.0% OF A+B+C+D)+E+F		229900.	
TOTAL OPERAT				861100.	
	ST IN DOLLARS PER TO			.8	
	ST IN DOLLARS PER TO		LECTED	175.9	
	ST AS PERCENT OF CAP Time in Weeks	TIAL CUST		56.6	
	FE OF SYSTEM IN YEAR			104. 15.	
KWH PER TON				1.0	
	VERY (13.15% OF TOTA	L CAPITAL)		199900	
	ON OVERHEAD (2.0% O		AL)	30400.	
PROPERTY TAX		30400.			
TOTAL ANNUAL		1121800.			
	- NEW			1098600.	
			· · · · · · · · · · · · · · · · · · ·		

		UNITS OP	TION	
PPSES: 508. COAL PREHE	ATER	COKE	5	
CAPACITY: .992	MILLION TONS/	YEAR		_
BADTICIII ATE				
PARTICULATE LOAD IN: 7.050000	IRS/TON COAL			
ALLOWABLE: .070500		FFFTCTFNCY:	-99.02	-
12.00	-			
BSO				
LOAD IN: 1.050000	LBS/TON COAL			
ALLOWABLE: .525000		EFFICIENCY:	50.0%	
89.38				
BAP				
LOAD IN: .000390	LBS/TON COAL			
ALLOWABLE: .000195		EFFICIENCY:	50.0%	
.03	LB\$/HR			
BENZENE				
LOAD IN: .014000				_
ALLOWABLE: .007000	LBS/TON COAL LBS/HR	EFFICIENCY:	50.0%	
DUST COLLECTED PER DAY:	13.5 TONS(DRY)		
TEMP OUT OF PROCESS:	· -			
EXHAUST TEMPERATURE:	180. F			
SCFM FLOW: 17000. AT	70. F			
ACFM FLOW: 20000. AT	180. F			
L/G RATIO:	0			
PROCESS WATER FLOW:	O. GPM			
COOLING WATER FLOW:	0. GPM			
SUSPENDED SOLIDS OUT:	0. MG/L	XSOLIDS:	0	
	· · · · · · · · · · · · · · · · · · ·			_

GENERAL INFORMATION: UNITS OPTION PPSES: 508. COAL PREHEATER COKE 5 CONTROL SYSTEM CONFIGURATION: ESP FAN AND DRIVE DUCTWORK DUST HANDLING HOPPER & CONVEYORS DAMPERS FAN AND DRIVE ELECTRICAL < SCA: 538. TOTAL PLATE AREA: 13000 SO FT. 20% SPARE CAPACITY NAL DUCT: 100. DIAMETER: 3. FEET OF ADDITIONAL DUCT: 4. INCHES TOTAL PRESSURE DROP: 2 FANS 2 21. HP EACH SPARE FAN CAPACITY: 100.2 OPERATING HOURS AT FULL HP: 8322. OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: O. DIAMETER: O. NO. OF OVENS 60. 6.0 METERS OVEN HEIGHT OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 12.5 NO. CYCLES/DAY 115. BULK DENSITY 50. LBS/CUBIC FT. .70 YIELD 1416755. TONS COAL/YEAR

CAPITAL COST:

CAPACITY: .992 MILLION TON TOTAL COST (COST BASIS IS 110.00 CATEGORY *** DIRECT COST *** EQUIPMENT OR MATERIAL			5	·		
TOTAL COST (COST BASIS IS 110.00 CATEGORY *** DIRECT COST ***	Z OF JUNE	1977				
CATEGORY *** DIRECT COST ***		1977				
*** DIRECT COST ***	COST IN		DOLLARS	FOR	4978	COST.
*** DIKECI COSI ***		DOLL	ARS			- <u> </u>
	397400.					
INSTRUMENTATION	0.					
PIPING	0.					
ELECTRICAL	31900.	7		-		
FOUNDATIONS	4800.					
STRUCTURAL	42400.					
SITE WORK	2800.					
INSULATION	21100.					
PROTECTIVE COATING	5500.					
BUILDINGS	3100.					
EQUIPMENT/MATERIAL LABOR	177500.		/ FAA			
DIRECT COST SUBTOTAL			6500.			
*** INDIRECT COST ***						
FIELD OVERHEAD	115400.					
CONTRACTORS FEE	74000.					
ENGINEERING	87700.					
FREIGHT	23000.	<u> </u>				
OFFSITE WORK	16300.					
TAXES	26200.					
SHAKEDOWN	36700.					
SPARES	36100.					
CONTINGENCY INDIRECT COST SUBTOTAL	241300.	ia e	6700	,		
INVIRELI LUSI SUBTUIAL			6/UV •			
INTEREST DURING INSTALLATI	ON	11	2500.			
TOTAL COST		145	5700.			
TOTAL COST WITH RETROFIT		159	4900.			
						
	· <u>·</u>					<i>.</i> 3:

			UNITS		······································
PPSES: 508. C	DAL PREHEA	TER	COKE	5	
CAPACITY:	.992 M	ILLION TO	NS/YEAR		
CATEGORY	QUANT	ITY	RATE		ANNUAL COST (
	.1	*** UTILI	TIES ***		
WATER	0.	MGAL/YR	\$.1595/	1000 GAL	0.
ELECTRICITY		KWH/YR	\$.0266/		12500.
STEAM		MLBS/YR	\$ 4.0920/	-	0.
FUEL	0,	GAL/YR	\$.4180/	GAL	0.
	****	OPERATING	LABOR ***		
DIRECT	8760.	HR\$/YR	\$14.34/HR		125700. (A
SUPERVISION	1752.	HRS/YR	\$17,20/HR		30100, (B
	*** MA	INTENANCE	& SUPPLIES	***	
DIRECT LABOR	2517.	HRS/YR	\$14.34/HR		36100. (C
SUPERVISION	-	HR9/YR	\$17.20/HR		8700. (D
MATERIALS	••				19700. (E
SUPPLIES					9700. (F)
WATER TREATMENT SOLID WASTE			······································		<u> </u>
DISPOSAL	4944.	TON/YR	\$ 8.25/10	N	40800.
DIRECT OPERA	TING COST				283300.
PAYROLL OVER	HEAD =20.0	C OF A+B+0	2+D		40100.
PLANT OVERHE		OF A+B+C+E)+E+F		115000.
TOTAL OPERAT					438400.
OPERATING CO					.44
OPERATING CO				DLLECTED	88.67
OPERATING CO			TIAL CUST		27.5 104.
ESTIMATED LI			?s	<u></u>	20.
KWH PER TON	CAPACITY		. •		•5
CAPITAL RECO	VERY (11.7	5% OF TOT			187300.
ADMINISTRATI					31900.
PROPERTY TAX				AL)	31900.
TOTAL ANNUAL			A SALAN CO.		689500.
	•	- NEW			667600.
	v				N. j. j.
				S 10 70 72 1	· ·

GENERAL INFORMATION:	HATTE ORTION
PPSES: 509. COAL PREPARATION	UNITS OPTION COKE 2
CAPACITY: 2.834 MILLIO	N TONE/VEAD
Later	I IUNOZIERA
PARTICULATE LOAD IN:500000 LBS/TO	N COAL
ALLOWABLE: .015000 LBS/TO	· · · · · · · · · · · · · · · · · · ·
7.30 LB5/HR	
DUST COLLECTED PER DAY: 2.	7 TONS(DRY)
	_
TEMP OUT OF PROCESS: 70. EXHAUST TEMPERATURE: 70.	
•	
SCFM FLOW: 70000. AT 70. ACFM FLOW: 70000. AT 70.	
L/G RATIO: PROCESS WATER FLOW: 0.	0 GPM
COOLING WATER FLOW: 0.	GPM
SUSPENDED SOLIDS OUT: 0.	MG/L %SOLIDS: .0
	·
· CART CA	

	FORMATIO				OPTION	······································
PPSES:	509.	COAL PREPAR	RATION	COKE	2	
	SYSTEM	4 CONFIGURATI	ON:		<u>,, , , , , , , , , , , , , , , , , , ,</u>	
8/	GHOUSE			·		
	AN AND D	RIVE			'	7 AP
C C	NVEYOR Ampers	TRANS PT. HO				
	IN AND D	RIVE ELECTRY	LLAL			
A/C:	6.0	TOTAL CLO	TH AREA: 10	1000_ SD_FT	. a 20% SPAR	E CAPACI
FEET OF	ADDITI	IONAL DUCT:	300.	DIAMETER:		
TOTAL F	RESSURE	DROP:	8. II Spare fan	NCHES	100 *	
		RS AT FULL HE		CAPACITIE	100.4	
) HP: 0.			
				DIAMETER:	0.	
NO. OF			60.			
OVEN HE		•	6.0 1			
	LUME			CUBIC FEET		
	KE/PUSH		24.			
	CLES/DAY	ME,HRS.	17.5 82.			
BULK DE		<u> </u>		BS/CUBIC F	7	
YIELD			.70	.00/0010 /	•	
	AL/YEAR	?	4047868.			
			· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	·	
	 					
Wild Enteret						
A 100 A 10 A 10 A 10 A 10 A 10 A 10 A 1						
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					iger San	
		•				
					<u> </u>	

CAPITAL COST:

ODCEC+ FAC	COAL BREDARISSON		TS OPTION		
PPSES: 509.	COAL PREPARATION	€0	KE 2		
CAPACITY:	2.834 MILLION TO	NS/YEAR			
TOTAL COST	(COST BASIS IS 110.0	0% OF JUNE	1977 DOLLARS	FOR 4978	ÇOST
CATEGORY		COST IN	DOLLARS		
	DIDECT - 6067			'y	•
	<u> *** DIRECT COST ***</u> I or material	252300.	<u> </u>		
INSTRUMEN	· -	4000.			
		500.			
ELECTRICA	\L	9100.			
FOUNDATIO	·	4500.			
STRUCTURA		24100.			
SITE WORK		500.			
INSULATIO		0.			
BUILDINGS	VE COATING	16100.			
	/ //MATERIAL LABOR	0. 73600.			
	ECT COST SUBTOTAL	, 3000.	384700.		
	*** INDIRECT COST **	*			
FIELD OVE	· - · · · · - · · · · · · · · · · · · ·	45900.			
	ORS FEE	27300.			
ENGINEER		35100.			
FREIGHT		23200.			
OFFSITE V	VORK	1000.			
TAXES SHAKEDOWN	. 1	15300. 7400.			
SPARES	Y	7500.			
CONTINGEN	NCY	160000.			
	RECT COST SUBTOTAL		322700.		
INTE	EREST DURING INSTALLAT	ION	26300.		
TOTA	AL COST		733700.		
101/	AL COST WITH RETROFIT		814700.	<u>., </u>	
			*		
			<u> </u>		
	A-1 :	22			

CAPACITY:					
CAPACITY:	3 474 MTL (TON TO)				
	2.834 MILLION TON	STYFAR			
CATEGORY	QUANTITY	RATE		ANNUAL COST	(\$
	*** UTILIT	IES ***		160	
WATER	O. MGAL/YR	\$.1595/100	O GAL	0-	
ELECTRICITY	1016568. KWH/YR	\$.0266/KWH		27100.	
STEAM	0. MLBS/YR	\$ 4.0920/MLB		0.	
FUEL	O. GAL/YR	\$.4180/GAL		0.	
	*** OPERATING	LABOR ***		······································	
DIRECT	500. HRS/YR	\$14.34/HR		7200.	(A)
SUPERVISION	100. HRS/YR	\$17.20/HR		1700.	
	*** MAINTENANCE	& SUPPLIES ***			
DIDECT + ADOD				*****	
DIRECT LABOR SUPERVISION	3000. HRS/YR 600. HKS/YR	\$14.34/HR		43000. 10300.	
MATERIALS	600. HRS/TR	\$17.20/HR		17600.	
SUPPLIES				11400.	
WATER TREATMENT				0.	., ,
SOLID WASTE		· · · · · · · · · · · · · · · · · · ·		······································	
DISPOSAL	982. TON/YR	\$ 8.25/TON		8100.	
DIRECT OPER	ATING COST			126400.	
PAYROLL DVE	RHEAD =20.0X OF A+B+C	:+D		12400.	
PLANT OVERH	45600.				
TOTAL OPERA				184400.	
	OST IN DOLLARS PER TO			• 0.	
	OST IN DOLLARS PER TO		ECTED	187.80	
	OST AS PERCENT OF CAP	TIAL COST		22.6	
	N TIME IN WEEKS IFE OF SYSTEM IN YEAR) c	·····	<u>52.</u> 20.	
KWH PER TON				.4	
	OVERY (11.75% OF TOTA	LI CAPTTAL 1		95700	
	ION OVERHEAD (2.0% O		(I)	16300.	
	XES & INS. (2.0% OF			16300.	
	LIZED COST - RETROFT		•	312700	
	- NEW			300000.	

GENERAL INFORMATION: UNITS OPTION COAL STORAGE YARD PPSES: 510. COKE 2 CAPACITY: 2.834 MILLION TONS/YEAR PARTICULATE .150000 LBS/TON COAL LOAD IN: MALLOWABLE: .060000 LBS/TON COAL EFFICIENCY: \$60.0% 27.73 LBS/HR DUST COLLECTED PER DAY: .5 TONS (DRY) 70. F TEMP OUT OF PROCESS: EXHAUST TEMPERATURE: 70. F 70. F SCFM FLOW: AT ACFM FLOW: AT 0. 70. F L/G RATIO: .0 PROCESS WATER FLOW: 170. GPM 0. GPM COOLING WATER FLOW: XSOLIDS: .0 SUSPENDED SOLIDS OUT: O. MG/L

187 1 **17**₹ -1884-1

GENERAL INFORMATION: UNITS OPTION PPSES: 510. COAL STORAGE YARD COKE 2 CONTROL SYSTEM CONFIGURATION: TRANSFER POINT SPRAY 7 SPRAY TRUCK WATER PUMPING SYSTEM FEET OF ADDITIONAL DUCT: DIAMETER: TOTAL PRESSURE DROP: 0. INCHES 0 FANS a O. HP EACH SPARE FAN CAPACITY: OPERATING HOURS AT FULL HP: 8760 OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. 0. DIAMETER: NO. OF OVENS 60. 6.0 METERS OVEN HEIGHT OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. 50. BULK DENSITY LBS/CUBIC FT. YIELD TONS COAL/YEAR 4047868.

O. O. O. O. O. O.	1977 DOLLI	DOLLAI		R 4Q78	COST.
NE :	DOLLI	ARS TO		R 4Q78	
O. O. O. O. O. O.	DOLLI	ARS TO		R 4078	3
0.					· · · · · · · · · · · · · · · · · · ·
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0.00.00.00.00.00.00.00.00.00.00.00.00.0	16	1400.			
0.00.00.00.00.00.00.00.00.00.00.00.00.0	16	1400.			
0.00.00.00.00.00.00.00.00.00.00.00.00.0	161	1400.			
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	7	7100.			
	265	5400.		·······	
	297	7200.		<u>.</u>	
0) •	26) <u></u>	96900. 7100. 265400.	96900. 7100. 265400.

ERATING CUSI:		UNITS O	PTION
PPSES: 510. C	OAL STORAGE YARD	COKE	5
CAPACITY:	2.834 MILLION TOP	NS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (S
:	*** UTILI	TIES ***	· · · · · · · · · · · · · · · · · · ·
MATER	49870. MGAL/YR	4 1595/1000	
ELECTRICITY	32639. KWH/YR	\$.0266/KWH	900.
STEAM	0. MLBS/YR	• • •	
FUEL	0. GAL/YR	\$ 4180/GAL	_
	*** OPERATING	LABOR ***	
DIRECT	1800. HRS/YR	\$14.34/HR	25800. (A)
SUPERVISION	360. HRS/YH	\$17.20/HR	6200. (B)
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	. 800. HRS/YR	\$14.34/HR	11500. (C)
SUPERVISION	160. HRS/YR	\$17.20/HR	2800. (D)
MATERIALS			6500. (E)
SUPPLIES			-3300. (F)
MATER TREATMENT		· · · · · · · · · · · · · · · · · · ·	
SOLID WASTE			_
DISPOSAL	0. TON/YR	\$ 8.25/TON	0.
DIRECT OPERA	TING COST		65000.
PAYROLL OVER	HEAD \$20.0% OF A+B+0	C+D	9300.
PLANT OVERHE	AD =50.0% OF A+B+C+0)+E+F	28100.
-	ING COST		102400.
	ST IN DOLLARS PER TO		.04
	ST IN DOLLARS PER TO		
	ST AS PERCENT OF CAR	PITAL CUST	34.5
	TIME IN WEEKS FE OF SYSTEM IN YEAR) e	<u>52.</u> 20.
KWH PER TON		(3	•0
	VERY (11.75% OF TOTA	N. CAPTTAL)	34900.
	ON OVERHEAD (2.0%		
DONDEDTY TAY	ES & INS. (2.0% OF		5900.
	IZED COST - RETROFT		149100.
	- NEW		144200.
			3.

			TION	
. COAL STORA	GE YARD	COKE	3	
3 074	MILLIAN TANG	WEAB		
	WIFFINN INVOV	IEAR		
	LBS/TON COAL			· · ·
			75.0%	i de
17.33	LBS/HR			- 15°
TED DED DAY.	4 TONE (NDV)		
IEU PER UNTI	•6 TUNS (נואט		
PROCESS:	70. F			
	70. F			
		<u> </u>		
O. AT	70. F			
	- 0			
ER FLOW:				
	O. MG/L	#SOLIDS:	0	
				
	······································			
<u></u>				
	÷ 5	<u> </u>		
			-	
			· · · · · · · · · · · · · · · · · · ·	
•		*	y i	
<u> </u>				
	2.834 N: .150000 BLE: .037500 17.33 TED PER DAY: PROCESS: PERATURE:	2.834 MILLION TONS/ N: .150000 LBS/TON COAL BLE: .037500 LBS/TON COAL 17.33 LBS/HR TED PER DAY: .6 TONS() PROCESS: 70. F PERATURE: 70. F 0. AT 70. F 0. AT 70. F 0. AT 70. F 0. AT 70. F 0. GPM DLIDS OUT: 0. MG/L	COAL STORAGE YARD 2.834 MILLION TONS/YEAR N: .150000 LBS/TON COAL BLE: .037500 LBS/TON COAL BLE: .037500 LBS/TON COAL T-33 LBS/HR TED PER DAY: .6 TONS(DRY) PROCESS: 70. F PERATURE: 70. F 0. AT 70. F 0. AT 70. F ER FLOW: 254. GPM ER FLOW: 0. GPM DLIDS OUT: 0. MG/L %SOLIDS:	. COAL STORAGE YARD COKE 3 2.834 MILLION TONS/YEAR N: .150000 LBS/TDN COAL BLE: .037500 LBS/TON COAL EFFICIENCY: 75.0X 17.33 LBS/HR TED PER DAY: .6 TONS(DRY) PROCESS: 70. F PERATURE: 70. F 0. AT

GENERAL INFORMATION:	HALTE OPTION
PPSES: 510. COAL STORAGE	UNITS OPTION E YARD COKE 3
CONTROL SYSTEM CONFIGURATIO	ON:
COAL RECEIVING STATION TRANSFER POINT SPRAY SPRAY TRUCK	N SPRAYS
WATER PUMPING SYSTEM	
FEET OF ADDITIONAL DUCT: TOTAL PRESSURE DROP:	0. DIAMETER: 0. 0. INCHES
O FANS D U. HP EACH OPERATING HOURS AT FULL HP: OPERATING HOURS AT REDUCED	
STACK HEIGHT:	0. DIAMETER: 0.
OVEN HEIGHT	6.0 METERS
OVEN VOLUME Tons Coke/Push	1348. CUBIC FEET
AVG. COKING TIME, HRS.	17.5
NO. CYCLES/DAY	82.
BULK DENSITY Yield	50. LBS/CUBIC FT
TONS COAL/YEAR	4047868
	•
<u> </u>	
<u> </u>	

CAFITAL COST.				UNI	TS (OPTION			
PPSES: 510.	COAL STORAGE	YARD		CO	KE	3			
CAPACITY	2.834 MI	LLION TONS	/YEAR						
	40000 0.000								
TOTAL COST	(COST BASIS	15 110.002	OF J	UNE	1977	DOLLARS	FOR	4078	CUST
CATEGORY			COST	IN	DOLL	ARS			3 V 4,
V 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	*** DIRECT	FORT AAA				200-00			د. کې
	OR MATERIAL		1533	00.					
INSTRUMEN			38						
_				00.					
ELECTRICA	L		229	00.					
FOUNDATIO	NS		26	00.					
STRUCTURA	<u>L</u>	· · · · · · · · · · · · · · · · · · ·	44	00.					
SITE WORK			9	00.					
INSULATIO				00.					
	E COATING		4						
BUILDINGS			55	-					
	/MATERIAL LAB		104						
DIRE	CT COST SUBTO)TAL			28	1000.			
	*** INDIRECT		_						
	RHEAD			00.					
CONTRACTO				00.					
ENGINEERI			427	-					
FREIGHT			19		· · ·				
OFFSITE W	UKK		3						
TAXES				00.					
SHAKEDOWN SPARES			16						
CONTINGEN	~ ~			00.					
	RECT COST SUB	TOTAL		_		8200			
INDI	ALLI LUSI SUL					DEVU.			
INTE	REST DURING 1	NSTALLATIO	N		13	3500.			
TOTA	L COST		<u>. </u>		45	2700.	,		
TOTA	COST NITH	RETROFIT			529	5100.			
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		UNITS OPTION	***************************************
PPSES: 510.	COAL STORAGE YARD	COKE 3	
CAPACITY:	2.834 MILLION TOP	NS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (
	*** UTILI1	TIES ***	~ (1)
WATER	74805. MGAL/YR	\$.1595/1000 GAL	11900.
ELECTRICITY	48959. KWH/YR	\$.0266/KWH	1300.
STEAM	0. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	0. GAL/YR	\$.4180/GAL	0.
	*** OPERATING	LABOR ***	
DIRECT	1800. HRS/YR	\$14.34/HR	25800. (A
SUPERVISION	360, HRS/YR	\$17.20/HR	6200. (B
		·	
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	1200. HRS/YR	\$14.34/HR	17200. (C
SUPERVISION	240. HRS/YR	\$17,20/HR	4100. (p
MATERIALS			9300. (E
SUPPLIES	_		4900. (F
WATER TREATMEN			
SOLID WASTE Disposal	O. TON/YR	\$ 8.25/TON	0.
DISPUSAL	V. 10N/1K	9 6.23710N	V•
DIRECT OPE	RATING COST		80700.
PAYROLL OVI	RHEAD =20.0% OF A+8+0	;+D	10700.
PLANT OVER	HEAD =50.0% OF A+B+C+E)+E+F	33800.
TOTAL OPERA			125200.
	COST IN DOLLARS PER TO		.04
	COST IN DOLLARS PER TO		549.86
_	COST AS PERCENT OF CAR	PITAL COST	23.8
	ON TIME IN WEEKS	20	52
KWH PER TO	_IFE OF SYSTEM IN YEAR N CAPACITY	(3	20.
	COVERY (11.75% OF TOTA	AL CAPTTAL)	.0 61700
	TION OVERHEAD (2.0% (10500.
	AXES & INS. (2.0% OF		10500.
	ALIZED COST - RETROFIT		207900
	- NEW		196600.

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GENERAL INFORMATION: UNITS OPTION PPSES: 510. COAL STORAGE YARD COKE CAPACITY: 2.834 MILLION TONS/YEAR PARTICULATE .150000 LBS/TON COAL LOAD IN: ALLOWABLE: .015000 LBS/TON COAL EFFICIENCY: 90.0% 6.93 LBS/HR .7 TONS (DRY) DUST COLLECTED PER DAY: 70. F TEMP OUT OF PROCESS: EXHAUST TEMPERATURE: 70. F 70. F O. AT SCFM FLOW: ACFM FLOW: 0. 70. F L/G RATIO: .0 680. GPM PROCESS WATER FLOW: COOLING WATER FLOW: 0. GPM SUSPENDED SOLIDS OUT: 0. MG/L *SOLIDS:

PPSES: 510. C	OAL STORAGE YAR	D	COKE	OPTION 4	•
CONTROL SYSTEM C	ONFIGURATION:				
COAL RECEIV		AVE	·····		
SPRAY TRUCK COAL PILE P				**	11.50
WATER PUMPI					
FEET OF ADDITION	AL DUCT:	0.		0.	
TOTAL PRESSURE DO FANS & O. H	RUP: PEACH SP	O. I Are fan	NCHES CAPACITY:	0.2	
OPERATING HOURS	AT FULL HP:	8760.			
OPERATING HOURS STACK HEIGHT:			DIAMETER:		
NO. OF OVENS		60.	DIAMETER.	<u> </u>	
OVEN HEIGHT			METERS		
OVEN VOLUME Tons Coke/Push		1 <u>348.</u> 24.	CUBIC FEET		
AVG. COKING TIME	,HRS.	17.5			
NO. CYCLES/DAY		82.			
BULK DENSITY Yield		50.	L83/CUBIC F	Τ•	
TONS COAL/YEAR		7868			- <u></u>
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_		UN	ITS	OPTION	
PPSES: 510.	COAL STORAGE YARD		OKE	4	
CAPACITY:	2.834 MILLION TO	ONS/YEAR			
TOTAL COST	(COST BASIS IS 110.6	00% OF JUN	E 197	7 DOLLARS	FOR 407
CATEGORY		COST I	N DOL	LARS	
	*** DIRECT COST ***	<u> </u>			
EQUIPMENT	OR MATERIAL	1240100	•		
INSTRUMEN	TATION	3800	•		
PIPING		582100	•		
ELECTRICA		78100	•		
FOUNDATIO		20400	-		
STRUCTURA		4400			
SITE WORK		15300	-		
INSULATIO		347000	•		
PROTECTIV		700			
BUILDINGS		96400	-		
	/MATERIAL LABOR CT COST SUBTOTAL	72300	-	60600.	
	*** INDIRECT COST **				
FIELD OVE		389900	~ 	· · · · · · · · · · · · · · · · · · ·	
CONTRACTO: ENGINEERI		239800	-		
FREIGHT	NG	235600	-		
OFFSITE W	nek	13800 68100			
TAXES	VNN	63200	-		
SHAKEDOWN		17500			
SPARES		12700			
CONTINGEN	CY	687500	-		
	RECT COST SUBTOTAL			28100.	
INTE	REST DURING INSTALLAT	TION	3	08700.	
TOTA	COST		44	97400.	
TOTAL	COST WITH RETROFIT		49	74300.	

	Ann. Ann. Ann.	UNITS OPTIO	N
PPSES: 510.	COAL STORAGE YARD	COKE 4	
CAPACITY:	2.834 MILLION TO	NS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (
	*** UTILI	TIES ***	ğ
WATER	200046. MGAL/YR	\$.1595/1000 GAL	31900.
ELECTRICITY	130928. KWH/YR	\$.0266/KWH	3500.
STEAM	0. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	0. GAL/YR	\$.4180/GAL	0.
	*** OPERATIN	G LABOR ***	
DIRECT	40590. HRS/YR	\$14.34/HR	582200. (A
SUPERVISION	8118. HRS/YR	\$17,20/HR	139700, (B
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	6378. HRS/YR	\$14.34/HR	91500. (C
SUPERVISION	1276. HRS/YR	\$17.20/HR	21900. (D
MATERIALS			46500. (E
SUPPLIES			24700. (F
WATER TREATMENT			0.
SOLID WASTE			
DISPOSAL	O. TON/YR	\$ 8.25/TON	0.
DIRECT OPER	ATING COST		941900.
PAYROLL OVE	RHEAD =20.01 OF A+B+	C+D	167100.
	EAD =50.0% OF A+B+C+	D+E+F	453300.
	TING COST		1562300.
	OST IN DOLLARS PER TI		.55
	OST IN DOLLARS PER TO		
	OST AS PERCENT OF CAL	PITAL COST	31.4
	N TIME IN WEEKS	De .	80.
KWH PER TON	IFE OF SYSTEM IN YEAR	N 3	.0 .0
• • • • • • • • • • • • • • • • • • • •	OVERY (11.75% OF TOT	AL CAPTTAL)	584300.
	ION OVERHEAD (2.0%		99500.
	XES & INS. (2.0% DF		99500.
	LIZED COST - RETROFT	· · · • · · · · · · · · · · · · · · · ·	2345600.
	- NEW		2270400.
:		No. 1	

						PTION	
PPSES:	511.	PIPELINE	CHARGING		COKE	2	
CAPACITY	<u>/:</u>	.992	MILLION	TONS/	YEAR		
	. = =						
PARTICUL							4.
		.016000	-			BO 04	<u>=</u>
ALI	OWABLE		LBS/TON LBS/HR	CUAL	EFFICIENCY:	99.02	37.44.4
		• • • •	COOTIN				·
850							
LOA	AD IN:	.019000	LBS/TON	COAL			
ALI	OWABLE			COAL	EFFICIENCY:	99.0%	
		.03	LBS/HR				
BAP							
'	AD IN:	.000035	LBS/TON	COAL			
ALL	OWABLE	.000000	LBS/TON	COAL	EFFICIENCY:	99.0%	
		.00	LB\$/HR				
BENZENE							
	AD IN:	.008000	LBS/TON	COAL			
	OWABLE		LBS/TON		EFFICIENCY:	99.0%	
		.01	LBS/HR				
DUST COL	IECTED	PER DAY:		TONS	n p v)		
000, 001		TEN DATE	• •	1045			
		CESS:	180. F				
EXHAUST	TEMPERA	TURE:	180. F	•			
		0 47	70. F	<u>.</u>			
SCFM FLC)w:	0. AT					
SCFM FLC		0. AT		;			
ACFM FLO)W:		180. F				
ACFM FLO	Ow:		180. F				· · · · · · · · · · · · · · · · · · ·
L/G RAIJ PROCESS COULING	O: Water F Water F	O. AT	180. F	SPM SPM			
ACFM FLO	O: Water F Water F	O. AT	180. F	SPM SPM	%SOLIDS:	• 0	
L/G RAIJ PROCESS COULING	O: Water F Water F	O. AT	180. F	SPM SPM	%SOLIDS:	• 0	
L/G RAIJ PROCESS COULING	O: Water F Water F	O. AT	180. F	SPM SPM	%SOLIDS:	.0	
L/G RAIJ PROCESS COULING	O: Water F Water F	O. AT	180. F	SPM SPM	%SOLIDS:	• 0	
L/G RAIJ PROCESS COULING	O: Water F Water F	O. AT	180. F	SPM SPM	%SOLIDS:	• 0	
L/G RAIJ PROCESS COULING	O: Water F Water F	O. AT	180. F	SPM SPM	%SOLIDS:	.0	
L/G RAIJ PROCESS COULING	O: Water F Water F	O. AT	180. F	SPM SPM	%SOLIDS:	• 0	
ACFM FLO L/G_RATJ PROCESS COOLING SUSPENDE	O: Water F Water F	O. AT	180. F	SPM SPM	%SOLIDS:	. 0	
ACFM FLO L/G_RATJ PROCESS COOLING SUSPENDE	O: Water F Water F	O. AT	180. F	SPM SPM	%SOLIDS:	. 0	
ACFM FLO L/G_RATJ PROCESS COOLING SUSPENDE	O: Water F Water F	O. AT	180. F	SPM SPM	%SOLIDS:	• 0	
ACFM FLO L/G_RATJ PROCESS COOLING SUSPENDE	O: Water F Water F	O. AT	180. F	SPM SPM			
ACFM FLO L/G_RATJ PROCESS COOLING SUSPENDE	O: Water F Water F	O. AT	180. F	SPM SPM			

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	UNITS OPTION	
PPSES: 511. PIPELINE CHAR	GING COKE S	
CONTROL SYSTEM CONFIGURATION	:	
TOPSIDE AND PIPELINE MA	INT.	484
•		3
FEET OF ADDITIONAL DUCT:	0. DIAMETER: 0.	
TOTAL PRESSURE DROP:	0. INCHES	
O FANS & O. HP EACH		
OPERATING HOURS AT FULL HP:		
OPERATING HOURS AT REDUCED H	P: 0.	
STACK HEIGHT:	O. DIAMETER: O.	
NO. OF OVENS	60.	
OVEN HEIGHT	6.0 METERS	
OVEN VOLUME	1346. CUBIC FEET	
TONS COKE/PUSH	24.	
AVG. COKING TIME, HRS.	12.5	
NO. CYCLES/DAY	115.	
BULK DENSITY	50. LBS/CUBIC FT.	
YIELD	.70	
TONS COAL/YEAR	1416755.	

CAPACITY: .992 MILLION TONS/YEAR CATEGORY QUANTITY RATE ANNUAL COS *** UTILITIES *** WATER	PPSES: 511. PIP	ELINE CHARGING	UNITS COKE	S S S S S S S S S S S S S S S S S S S
### UTILITIES *** #ATER	PPSCS. 311. PIPI	TIME CHANGING	LUNE	2
### UTILITIES *** MATER	CAPACITY:	.992 MILLION TO	S/YEAR	
MATER 0. MGAL/YR \$.1595/1000 GAL 0. STEAM 0. MLBS/YR \$.0266/KWH 0. STEAM 0. MLBS/YR \$ 4.0920/MLBS 0. FUEL 0. GAL/YR \$.4180/GAL 0. *** OPERATING LABOR *** DIRECT 8760. HRS/YR \$14.34/HR 125700. SUPERVISION 1752. HRS/YR \$17.20/HR 30100. *** MAINTENANCE & SUPPLIES *** DIRECT LABOR 5900. HRS/YR \$14.34/HR 84600. SUPERVISION 1180. HRS/YR \$17.20/HR 20300. MATERIALS 42300. SUPPLIES 22100. MATER TREATMENT 0. SOLID WASTE 0ISPOSAL 0. TON/YR \$ 8.25/TON 0. DIRECT OPERATING COST 325100. PAYROLL OVERHEAD =20.0% OF A+B+C+D 52100. PAYROLL OVERHEAD =20.0% OF A+B+C+D 539800. OPERATING COST IN DOLLARS PER TON PRODUCTION 0. OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 0. OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 0. OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 0. OPERATING COST AS PERCENT OF CAPITAL COST OPERATING COST AS PERCENT OF CAPITAL CAPITAL) OPERATING COST AS PERCENT OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) OPERATOR CAPITAL OPERATOR	CATEGORY	QUANTITY	RATE	ANNUAL COST
Comparison		*** UTILI	IES ***	
STEAM	WATER	O. MGAL/YR	\$ 1595/100	O GAL O.
STEAM			-	
### OPERATING LABOR *** DIRECT		-		
DIRECT		-		
DIRECT		*** OPERATING	IAROR ***	
### MAINTENANCE & SUPPLIES ### DIRECT LABOR 5900. HRS/YR \$14.34/HR 84600. SUPERVISION 1180. HRS/YR \$14.34/HR 20300. MATERIALS 42300. SUPPLIES 22100. WATER TREATMENT 0. SOLID WASTE DISPOSAL 0. TON/YR \$ 8.25/TON 0. DIRECT OPERATING COST 325100. PAYROLL OVERHEAD #20.0% OF A+B+C+D 52100. PLANT OVERHEAD #50.0% OF A+B+C+D+E+F 162600. TOTAL OPERATING COST 539800. OPERATING COST IN DOLLARS PER TON PRODUCTION 59800. OPERATING COST IN DOLLARS PER TON DF DUST COLLECTED 48107. OPERATING COST IN DELIARS PER TON DF DUST COLLECTED 48107. OPERATING COST IN WEEKS 99. KWH PER TON CAPACITY ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) 0. PROPERTY TAKES & INS. (2.0% OF TOTAL CAPITAL) 0. TOTAL ANNUALIZED COST - RETROFIT 539800.			LAUVIN BAA	
DIRECT LABOR 5900. HRS/YR \$14.34/HR 84600. SUPERVISION 1180. HRS/YR \$17.20/HR 20300. MATERIALS 42300. SUPPLIES 22100. WAIER TREATMENT 0. SOLID WASTE DISPOSAL 0. TON/YR \$8.25/TON 0. DIRECT OPERATING COST 325100. PAYROLL OVERHEAD \$20.00 OF A+B+C+D 52100. PLANT OVERHEAD \$50.00 OF A+B+C+D+E+F 162600. TOTAL OPERATING COST 539800. OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 48107. OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 48107. OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 48107. OPERATING COST IN BEEKS 8. ESTIMATED LIFE OF SYSTEM IN YEARS 99. KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) 0. PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) 0. TOTAL ANNUALIZED COST - RETROFIT 539800.	DIRECT	8760. HRS/YR		125700. (
DIRECT LABOR 5900. HRS/YR \$14.34/HR 84600. SUPERVISION 1180. HRS/YR \$17.20/HR 20300. MATERIALS 42300. SUPPLIES 22100. WATER TREATMENT 0. SOLID WASTE DISPOSAL 0. TON/YR \$8.25/TON 0. DIRECT OPERATING COST 325100. PAYROLL OVERHEAD \$20.0% OF A+B+C+D 52100. PAYROLL OVERHEAD \$50.0% OF A+B+C+D+E+F 162600. TOTAL OPERATING COST 539800. OPERATING COST IN DOLLARS PER TON PRODUCTION 539800. OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 48107. OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN MEEKS 8. ESTIMATED LIFE OF SYSTEM IN YEARS 99. KWH PER TON CAPACITY ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) 0. PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) 0. TOTAL ANNUALIZED COST = RETROFIT 539800. - NEW 539800.	SUPERVISION	1752. HRS/YR	\$17.20/HR	30100. (
DIRECT LABOR 5900. HRS/YR \$14.34/HR 84600. SUPERVISION 1180. HRS/YR \$17.20/HR 20300. MATERIALS 42300. SUPPLIES 22100. WATER TREATMENT 0. SOLID WASTE 0ISPOSAL 0. TON/YR \$8.25/TON 0. DIRECT OPERATING COST 325100. PAYROLL OVERHEAD #20.0% OF A+B+C+D 52100. PLANT OVERHEAD #50.0% OF A+B+C+D+E+F 162600. TOTAL OPERATING COST 539800. OPERATING COST IN DOLLARS PER TON PRODUCTION 539800. OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 48107. OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS 8. ESTIMATED LIFE OF SYSTEM IN YEARS 99. KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) 0. PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) 0. PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) 0. TOTAL ANNUALIZED COST = RETROFIT 539800. - NEW 539800.		*** MAINTENANCE	& SUPPLIES ***	
SUPERVISION 1180, HRS/YR \$17,20/HR 20300, MATERIALS 22100. WATER TREATMENT 22100. WATER TREATMENT 22100 22100. DIRECT OPERATING COST 325100. PAYROLL OVERHEAD #20.0% OF A+B+C+D 52100. PLANT OVERHEAD #50.0% OF A+B+C+D+E+F 162600. TOTAL OPERATING COST 539800. OPERATING COST IN DOLLARS PER TON PRODUCTION 0PERATING COST IN DOLLARS PER TON OF DUST COLLECTED 48107. OPERATING COST IN DULARS PER TON OF DUST COLLECTED 48107. OPERATING COST AS PERCENT OF CAPITAL COST 1NSTALLATION TIME IN WEEKS 8. ESTIMATED LIFE OF SYSTEM IN YEARS 99. KWH PER TON CAPACITY 2. CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) 0. ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) 0. PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) 0. TOTAL ANNUALIZED COST = RETROFIT 539800.				
MATERIALS SUPPLIES MATER TREATMENT SOLID WASTE DISPOSAL DIRECT OPERATING COST PAYROLL OVERHEAD #20.0% OF A+B+C+D PLANT OVERHEAD #50.0% OF A+B+C+D+E+F TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) OPROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST - RETROFIT 539800.		=	- -	84600. (
SUPPLIES MATER TREATMENT SOLID WASTE DISPOSAL DIRECT OPERATING COST PAYROLL OVERHEAD =20.0% OF A+B+C+D PLANT OVERHEAD =50.0% OF A+B+C+D+E+F TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS WHICH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST - RETROFIT S39800.		1180. HRS/YR	\$17,20/HR	20300. (
MATER TREATMENT SOLID WASTE DISPOSAL DIRECT OPERATING COST PAYROLL OVERHEAD \$20.0% OF A+B+C+D PLANT OVERHEAD \$50.0% OF A+B+C+D+E+F 162600. TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST = RETROFIT S39800.				42300. (
SOLID WASTE DISPOSAL O. TON/YR S 8.25/TON O. DIRECT OPERATING COST PAYROLL OVERHEAD \$20.0% OF A+B+C+D PLANT OVERHEAD \$50.0% OF A+B+C+D+E+F 162600. TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) O. TOTAL ANNUALIZED COST = RETROFIT S39800.				22100. (
DISPOSAL DIRECT OPERATING COST DIRECT OPERATING COST PAYROLL OVERHEAD #20.0% OF A+B+C+D PLANT OVERHEAD #50.0% OF A+B+C+D+E+F TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN MEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) O. ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST = RETROFIT 539800.		<u> </u>		
PAYROLL OVERHEAD #20.0% OF A+B+C+D PLANT OVERHEAD #50.0% OF A+B+C+D+E+F 162600. TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST = RETROFIT 539800.		0. TON/YR	\$ 8.25/TON	0.
PLANT OVERHEAD #50.0% OF A+B+C+D+E+F TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST - RETROFIT S39800.	DIRECT OPERATION	NG COST		325100.
PLANT OVERHEAD ±50.0% OF A+B+C+D+E+F TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST - RETROFIT 539800.	PAVDOLL OVERHE.	AD #20 07 OF A+R+0	` ≜ħ	52100
TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST - RETROFIT S39800.				
OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST - RETROFIT 539800.		_		-
OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST - RETROFIT S39800. - NEW 539800.			N PRODUCTION	
INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST - RETROFIT NEW 539800.	OPERATING COST	IN DOLLARS PER TO	IN OF DUST COLL	ECTED 48107.55
ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST - RETROFIT - NEW 539800.			PITAL COST	• 0
KWH PER TON CAPACITY CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST - RETROFIT NEW 539800.				
CAPITAL RECOVERY (10.00% OF TOTAL CAPITAL) ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) TOTAL ANNUALIZED COST - RETROFIT NEW 539800.			RS	
ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) 0. PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) 0. TOTAL ANNUALIZED COST - RETROFIT 539800 NEW 539800.			L CARTTAL Y	•0
PROPERTY TAXES & INS. (2.0% OF TOTAL CAPITAL) 101AL ANNUALIZED COST = RETROFIT 539800. - NEW 539800.				
TOTAL ANNUALIZED COST - RETROFIT 539800. - NEW 539800.				
- NEW 539800.			_ +	-

		MATIO					UNITS	OPTION		
PPSE	S: 5	12.	REDLER	CH	ARGING		COKE	5		
CAPA	CITY:			992	MILLION	TONS/	YEAR			
PART	ICULA	TE In:	010		LBS/TON	COA1				
		WABLE			LBS/TON		EFFICIENC	Y: 99.0	7	
			_		LBS/HR			, , , , , , , , , , , , , , , , , , ,		<u> </u>
880						·····				
	LOAD	IN:	.006	000	LBS/TON	COAL				
	ALLO	WABLE				COAL	EFFICIENC	Y: 99.0	<u> </u>	
			•	01	LBS/HR					
BAP			·		· · · · · · · · · · · · · · · · · · ·	*****	·····	· · · · · · · · · · · · · · · · · · ·		
					LBS/TON					
	ALLO	WABLE			LBS/TON	COAL	EFFICIENC	Y: 99.0	*	
				00	LBS/HR					
BENZ	ENE									
					LBS/TON					
	ALLO	WABLE	-		LBS/TON	COAL	EFFICIENC	Y: 99.0	X	
			· •	01	LBS/HR					
DUST	COLL	ECTED	PER DA	Y:	•0	TONS (DRY)		······································	
TEMO	OUT	NE DD	OCESS:		180. 1	•				
			ATURE:		180.					
SCEM	FLOW	:	0.	AT	70.					
	FLOW		0.	AT						
1.76	RATIO	•			0					
		ATER	FI NW:	·	0. (PM				
		ATER			0.					
			DS OUT:			4G/L	%SOLIDS:	0		
						··				
								****		·····
) 3							# 1 #	•		
			····							
						·				

GENERAL INFORMATION: UNITS OPTION PPSES: 512. REDLER CHARGING COKE 2 CONTROL SYSTEM CONFIGURATION: REDLER SYSTEM MAINT. الماكين المهيية FEET OF ADDITIONAL DUCT: 0. DIAMETER: 0. TOTAL PRESSURE DROP: O. INCHES O FANS a O, HP EACH SPARE FAN CAPACITY: 0.7 OPERATING HOURS AT FULL HP: 8760. OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. NO. OF OVENS 60. OVEN HEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 12.5 115. NO. CYCLES/DAY BULK DENSITY 50. LBS/CUBIC FT. .70 YIELD TONS COAL/YEAR 1416755.

88888 E43 85	DI ED BUILDCENE	UNITS OPTIO	
PPSES: 512. RE	DLER CHARGING	COKE 5	
CAPACITY:	.992 MILLION TON	IS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (
······································	*** UTILIT	IES ***	÷
WATER	O. MGAL/YR	\$.1595/1000 GAL	0.
ELECTRICITY	O. KWH/YR	\$.0266/KWH	0.
STEAM	0. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	0. GAL/YR	\$.4180/GAL	0.
	*** OPERATING	LABOR ***	
DIRECT	8760. HRS/YR	\$14.34/HR	125700. (A
SUPERVISION	1752. HRS/YR	\$17.20/HR	30100. (E
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	2000. HRS/YR	\$14.34/HR	28700. (0
SUPERVISION	400. HRS/YR	\$17.20/HR	6900. ((
MATERIALS			14300. (E
SUPPLIES		•	7500. (f
WATER TREATMENT			0
SOLID WASTE	0. TON/YR	e e 35/70N	^
DISPOSAL	U. TUN/TR	\$ 6.25/TON	0.
DIRECT OPERAT	ING COST		213200.
	EAD =20.0% OF A+B+C		38300.
	D =50.0% OF A+B+C+D)+E+F	106600.
TOTAL OPERATI			358100.
	T IN DOLLARS PER TO		<u>.36</u>
		N OF DUST COLLECTED	
	T AS PERCENT OF CAP Time in weeks	TIME COST	. 0
	E OF SYSTEM IN YEAR	96	99.
KWH PER TON	CAPACITY	. 3	•0
	ERY (10.00% OF TOTA	L CAPITAL)	0.
	N OVERHEAD (2.0% C		0.
PROPERTY TAXE	3 & INS. (2.0% OF	TOTAL CAPITAL)	0.
TOTAL ANNUALI	ZED COST - RETROFT	•	358100.
	- NEW		358100.
		1	

						PTION	
PPSES:	513.	HOT LARRY	CAR CHA	ARGING	COKE	2	
CAPACII	Y:	.992	MILLION	TONS/	YEAR		
	= =						
PARTICU		.017000	LRS/TOR	I COAL			=
	LOWABLE:				EFFICIENCY:	99.02	5 5 7, v
			LBS/HR				-; *
BS 0	- <u></u>			·			_
	DAD IN:	.019000	LBS/TOM	N COAL			
	LOWABLE:				EFFICIENCY:	99.0%	
	,	.03	LBS/HR				
BAP							
L	DAD IN:		_				
AL	LOWABLE:	- • - • - •		COAL	EFFICIENCY:	99.0%	
		.00	LBS/HR				
BENZENE							
		.008000				· · · · · · · · · · · · · · · · · · ·	_
AL	LOWABLE:	- ·		N COAL	EFFICIENCY:	99.0%	
		•01	LBS/HR				
	IT OF PRO		180.	•			
	• • • • • • • • • • • • • • • • • • • •						
	_	_					
SCFM FL	*	0. AT					
	*	0. AT					
SCFM FL ACFM FL L/G RAI	.OW: .IO:	0. AT	180.	F)			
SCFM FL ACFM FL L/G RAI PROCESS	OW: 'IO: B WATER F	O. AT	180.	F) GPM			
SCFM FL ACFM FL L/G RAI PROCESS COOLING	.OW: .IO:	O. AT	180.	F)	%SOLIDS:	• 0	
SCFM FL ACFM FL L/G RAI PROCESS COOLING	OW: IO: WATER F	O. AT	180.	F GPM GPM	%SOLIDS:	.0	
SCFM FL ACFM FL L/G RAI PROCESS COOLING	OW: IO: WATER F	O. AT	180.	F GPM GPM	%SOLIDS:	• 0	
SCFM FL ACFM FL L/G RAI PROCESS COOLING	OW: IO: WATER F	O. AT	180.	F GPM GPM	%SOLIDS:	•0	
SCFM FL ACFM FL L/G RAI PROCESS COOLING	OW: IO: WATER F	O. AT	180.	F GPM GPM	%SOLIDS:	• 0	
SCFM FL ACFM FL L/G RAI PROCESS COOLING	OW: IO: WATER F	O. AT	180.	F GPM GPM	%SOLIDS:	• 0	
SCFM FL ACFM FL L/G RAI PROCESS COOLING SUSPEND	OW: IO: WATER F	O. AT	180.	F GPM GPM		• 0	•
SCFM FL ACFM FL L/G RAI PROCESS COOLING	OW: IO: WATER F	O. AT LOW: LOW: S OUT:	180.	F GPM GPM	%SOLIDS:	.0	
SCFM FL ACFM FL L/G RAI PROCESS COOLING SUSPEND	OW: ID: WATER F WATER F DED SOLID	O. AT LOW: LOW: S OUT:	180.	F GPM GPM		•0	
SCFM FL ACFM FL L/G RAI PROCESS COOLING SUSPEND	OW: ID: WATER F WATER F DED SOLID	O. AT LOW: LOW: S OUT:	180.	F GPM GPM	/ :· •		
SCFM FL ACFM FL L/G RAI PROCESS COOLING SUSPEND	OW: IO: WATER F WATER F DED SOLID	O. AT LOW: LOW: S OUT:	180.	F GPM GPM	/ :· •		
SCFM FL ACFM FL L/G RAI PROCESS COOLING SUSPEND	OW: ID: WATER F WATER F DED SOLID	O. AT LOW: LOW: S OUT:	180.	F GPM GPM	/ :· •	• 0	

		UNITS OPTION	
PPSES: 513. HOT LAR	RY CAR CHARGING	COKE 5	
CONTROL SYSTEM CONFIGU	RATION:		
HOT LARRY CAR -TO	PSIDE		3. 8 80
FEET OF ADDITIONAL DUC		DIAMETER: 0.	
TOTAL PRESSURE DROP: 0 FANS 0 0. HP EACH			
OPERATING HOURS AT FUL		APALITY U.A	
OPERATING HOURS AT RED			
STACK HEIGHT:		DIAMETER: 0.	
NO. OF OVENS	60.		
OVEN HEIGHT	6.0 ME		
OVEN VOLUME TONS COKE/PUSH	1348, CU	RIC FEET	
AVG. COKING TIME, HRS.	24. 12.5		
NO. CYCLES/DAY	115.		
BULK DENSITY		S/CUBIC FT.	<u>-</u> , , , , , , , , , , , , , , , , , , ,
YIELD	.70		
TONS COAL/YEAR	1416755.		
	•		
	- <u></u>		
4		•	
		• •	
•			
			
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			OPTION	
PPSES: 513. H	DT LARRY CAR CHARGIA	IG COKE	.2	
CAPACITY:	.992 MILLION TON	IS/YEAR		
CATEGORY	QUANTITY	RATE	-ANNUAL (COST
	*** UTILIT	IES ***		V 4
(0 -4541 (45			0_
ELECTRICITY	O. MGAL/YR O. KWH/YR			0.
STEAM	0. MLBS/YR	\$.0266/KWH \$ 4.0920/MLB		0.
FUEL	0. GAL/YR	\$.4180/GAL		0.
	*** OPERATING	LABOR ***		
DIRECT	8760. HRS/YR	\$14.34/HR	1257	00. (
SUPERVISION	1752. HRS/YR	\$17.20/HR		00. (
	*** MAINTENANCE	& SUPPLIES ***		
DIRECT LABOR	0. HRS/YR	\$14.34/HR		0. (
SUPERVISION	0. HRS/YR	\$17.20/HR		0. (
MATERIALS			<u> </u>	0. (
SUPPLIES				.0. (
WATER TREATMENT				0.
SOLID WASTE				
DISPOSAL	O. TON/YR	\$ 8.25/TON		0.
DIRECT OPERA	TING COST		15580	00.
PAYROLL OVER	HEAD =20.02 OF A+B+C	`+D	312	00.
	AD =50.0% OF A+B+C+D		7790	
TOTAL OPERAT			2649	
	ST IN DOLLARS PER TO	N PRODUCTION		.27
OPERATING CO	ST IN DOLLARS PER TO	N OF DUST COLL	ECTED 222	19.45
OPERATING CO	ST AS PERCENT OF CAP	TAL COST		.0
	TIME IN WEEKS			8.
	FE OF SYSTEM IN YEAR	RS	•	99.
KWH PER TON	CAPACITY			. 0
	VERY (10,00% OF TOTA			<u> </u>
	ON OVERHEAD (2.0% O).
	ES & INS. (2.0% OF IZED COST - RETROFIT		26490). `
INIAL SURVE	- NEW		264900	
			See The Control of th	
•				
2.73				

GENERAL INFORMATION: UNITS OPTION PPSES: 514. BY-PRODUCTS PLANT COKE 2 CAPACITY: 2.834 MILLION TONS/YEAR BSO LOAD IN: .300000 LBS/TON COAL ALLOWABLE: .060000 LBS/TON CDAL EFFICIENCY: BO.OX 27.73 LBS/HR and the same BENZENE .200000 LBS/TON COAL LOAD IN: ALLOWABLE: .040000 LBS/TON COAL EFFICIENCY: 80.0% 18.48 LBS/HR DUST COLLECTED PER DAY: .0 TONS(DRY) 100. F TEMP OUT OF PROCESS: EXHAUST TEMPERATURE: 100. F SCFM FLOW: 0. AT 70. F 100 F ACFM FLOW: AT .0 L/G RATIO: PROCESS WATER FLOW: O. GPM COOLING WATER FLOW: 0. SPM SUSPENDED SOLIDS OUT: O. MG/L XSOLIDS: .0 **4**

GENERAL INFORMATION:

PPSES: 514. BY-PRODUCTS	UNITS OPTION COKE 2	
CONTROL SYSTEM CONFIGURATI	ON:	·
BY-PRODUCT CONTROLS	A Compensation of the Comp	S. S. S.
FEET OF ADDITIONAL DUCT: Total pressure drop:	0. DIAMETER: 0. 0. INCHES	
O FANS @ O. HP EACH	SPARE FAN CAPACITY: 0.X	
OPERATING HOURS AT FULL HP		
OPERATING HOURS AT REDUCED STACK HEIGHT:		
NO. OF OVENS	O. DIAMETER: O.	
OVEN HEIGHT	6.0 METERS	
OVEN VOLUME	1348. CUBIC FEET	
TONS COKE/PUSH	24.	
AVG. COKING TIME, HRS.	17.5	
NO. CYCLES/DAY	82.	
BULK DENSITY	50. LBS/CUBIC FT.	
YIELD Tons coal/year	.70 4047868.	

		UNITS	OPTION	
PPSES: 514. 8Y-P	PRODUCTS PLANT	COKE	5	
CAPACITY:	2.834 MILLION TON	S/YEAR		
CATEGORY	QUANTITY	RATE	•	ANNUAL COST (
	*** UTILIT	750 444	100m (1000) 1 1	
	AAN DITETI	ICO MAN	The state of the s	
MATER	O. MGAL/YR	1595/	1000 GAL	0.
ELECTRICITY	O. KWH/YR	\$.0266/1		0.
STEAM	0. MLBS/YR	\$ 4.0920/1	4LBS	0.
FUEL	0. GAL/YR	\$ 4180/	GAL	0.
	*** OPERATING	LABOR ***		
DIRECT	O. HRS/YR	\$14.34/HR		0. (A
SUPERVISION	0. HRS/YR	\$17.20/HR		0. (B
	*** MAINTENANCE	& SUPPLIES	***	
DIRECT LABOR	8760. HRS/YR	\$14.34/HR		125700. (C
SUPERVISION	1752. HRS/YR	\$17.20/HR		30100. (D
MATERIALS				0. (E
SUPPLIES				23400. (F
WATER TREATMENT				0.
SOLID WASTE				
DISPOSAL	O. TON/YR	\$ 8.25/10	٧	0.
DIRECT OPERATION	IG COST			179200.
PAYROLL OVERHEA	D =20.0% OF A+B+C	+D		31200
	=50.0% OF A+B+C+D			89600.
TOTAL OPERATING				300000.
OPERATING COST	IN DOLLARS PER TO	N PRODUCT	ION	.11
	IN DOLLARS PER TO		DLLECTED	25163.59
	AS PERCENT OF CAP	ITAL COST		• 0
INSTALLATION TI				
-	OF SYSTEM IN YEAR	S		99.
KWH PER TON	CAPACITY			•0
	CY (10.00% OF TOTA			<u> </u>
	OVERHEAD (2.0% OF			0.
PRUPERTY TAXES	& INS. (2.0% OF		nt/	300000
WIAL ANNUALIAE	- NEW			300000.

GENERAL INFORMATION: OPTION UNITS PPSES: 515. COMBUSTION STACK - NEW COKE 2 CAPACITY: .708 MILLION TONS/YEAR PARTICULATE _130000 LBS/TON COAL LOAD IN: ALLOWABLES .026000 LBS/TON COAL EFFICIENCY: .80.0% 3.00 LBS/HR 850 LOAD IN: .000600 LBS/TON COAL ALLOWABLE: .000120 LBS/TON COAL __EFFICIENCY: 80.0% .01 LBS/HR BAP LOAD IN: .000006 LBS/TON COAL .000001 LBS/TON COAL EFFICIENCY: 80.0% ALLOWABLE: .00 LBS/HR DUST COLLECTED PER DAY: .1 TONS (DRY) TEMP OUT OF PROCESS: 450. F EXHAUST TEMPERATURE: 450. F SCFM FLOW: 67000. AT 70. F ACFM FLOW: 115000. 450. F AT L/G RATIO: .0 PROCESS WATER FLOW: O. GPM O. GPM COOLING WATER FLOW: SUSPENDED SOLIDS OUT: 0. MG/L %SOLIDS: .0

GENERAL INFORMATION: UNITS OPTION PPSES: 515. COMBUSTION STACK - NEW COKE 2 CONTROL SYSTEM CONFIGURATION: HEATING CONTROL AND PATCHING Mary many FEET OF ADDITIONAL DUCT: DIAMETER: 6. 0. INCHES TOTAL PRESSURE DROP: 0 FANS & 0. HP EACH SPARE FAN CAPACITY: 0.X OPERATING HOURS AT FULL HP: 8760. 0. OPERATING HOURS AT REDUCED HP: DIAMETER: 0. STACK HEIGHT: 0_ NO. OF OVENS 60. OVEN HEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. .70 YIELD 1011967. TONS COAL/YEAR

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			OPTION	······································	
PPSES: 515. C	OMBUSTION STACK - NEW	COKE	5		
CAPACITY:	.708 MILLION TONS	/YEAR			
CATEGORY	QUANTITY	RATE		ANNUAL COST	r (
	*** UTILITI	E\$ ***		<u> </u>	
WATER	O. MGAL/YR	\$ -1595/100	0 641	0	
ELECTRICITY	0. KWH/YR	\$.0266/KWH		0.	
STEAM	0. MLBS/YR			0.	
FUEL	0. GAL/YR	\$.4180/GAL		0.	
	*** OPERATING	LABOR ***			
DIRECT	8760. HRS/YR	\$14.34/HR		125700.	(/
SUPERVISION	1752, HRS/YR	\$17.20/HR		30100.	
	*** MAINTENANCE &	SUPPLIES ***	····		
DIRECT LABOR	5900. HRS/YR	\$14.34/HR		84600.	((
SUPERVISION	1180. HRS/YR	\$17.20/HR		20300.	
MATERIALS				21200.	([
SUPPLIES				18900.	(F
WATER TREATMENT				0.	
SOLID WASTE					
DISPOSAL	0. TON/YR	\$ 8.25/TON		0.	
DIRECT OPERA	TING COST			300800.	
	EAD =20.0% OF A+B+C+			52100.	
	AD =50.0% OF A+B+C+D+1	E+F		150400.	
TOTAL OPERAT				503300.	
	T IN DOLLARS PER TON				11_
	ST IN DOLLARS PER TON		ECTED	9564.	
	ST AS PERCENT OF CAPI' TIME IN WEEKS	IAL CUST		• •	,
_	E OF SYSTEM IN YEARS			99.	
KWH PER TON	CAPACITY			. ()
	ERY (10.00% OF TOTAL	CAPITAL)		0.	•
	ON OVERHEAD (2.0% OF		L)	0.	
PROPERTY TAX	S & INS. (2.0% OF TO	DTAL CAPITAL)		0.	
TOTAL ANNUAL	ZED COST - RETROFIT	•		503300.	
	- NEW			503300.	

		241		0115 11				WATED		TS					
PP3E	5:	516.	•	BUEN	HING	- 010	414	WATER	Ci	KE		5			
CAPA	CITY	1			2.834	MILL	LON	TONS/	EAR						
														.,	
PART	ICUL	ATE													
								COAL							
	ALL	OWAB	LE:	-				COAL	EFF1(CIENCY	1	70.0%			54
				44	3.60	LBS/	HR								3
BS 0								·					·		
	LOA	D IN	:	.00	06400	LBS/	TON	COAL							
								COAL	EFFIC	IENCY	(;	70.0%			
						LBS/									
BAP															
DAP	LOA	DIN	:	.00	0310	LBS/	TON	COAL		· · · · · · · · · · · · · · · · · · ·					
		OWAB						COAL	EFFIC	CIENCY	/:	70.0%			
					.04	LBS/	HR								
BENZ	ENE														
DENL		D IN	:	_01	00260	LRSZ	เบพ	CDAL							
		OWAB						COAL	FFFTC	IENCY	/ :	.0%			
		, U II I		•••		LBS/				, , , , , , , , , , , , , , , , , , , ,	•	• • •			
								5 000 (5							
DUST	COL	LECT	ED	PER I	AY:	17	2,4	TONS (RY)						
TEMP							_								
	' DUT	ur:	PKII	CFSS	ĭ .	201	0_	F							
		TEMP		CESS: Ture:			0.						·····	<u> </u>	
EXHA	UST	TEMP		TURE	3	20	0.	F							
EXHA SCFM	UST FLC	TEMP		TURE:	AT	20	0.	F F							
EXHA	UST FLC	TEMP		TURE	3	20	0.	F F							
EXHA SCFM	UST I FLO	TEMP W: W:		TURE:	AT	20	0.	F F							
SCFM ACFM L/G	UST FLO FLO RATI	TEMP W: W:	ERA	0. 0.	AT	200 200	0.	F F							
SCFM ACFM L/G PROC	UST FLO RATI	TEMP	ERA R F	0. 0. Low:	AT	70 200	0.	F F GPM							
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING	TEMP	ERA R F	O. O. LOW: LOW:	AT AT	70 200	0.	F F	%SOL	.IDS:		. 0			
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING	TEMP W: O: WATE WATE	ERA R F	O. O. LOW: LOW:	AT AT	70 200	0.	F F GPM GPM	%SOL	.IDS:		. 0			
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING	TEMP W: O: WATE WATE	ERA R F	O. O. LOW: LOW:	AT AT	70 200	0.	F F GPM GPM	%SOL	.IDS:		. 0			
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING	TEMP W: O: WATE WATE	ERA R F	O. O. LOW: LOW:	AT AT	70 200	0.	F F GPM GPM	*SOL	.IDS:		. 0			
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING	TEMP W: O: WATE WATE	ERA R F	O. O. LOW: LOW:	AT AT	70 200	0.	F F GPM GPM	%\$ 0L	IDS:		. 0			
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING	TEMP W: O: WATE WATE	ERA R F	O. O. LOW: LOW:	AT AT	70 200	0.	F F GPM GPM	*SOL	.IDS:		. 0			
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING	TEMP W: O: WATE WATE	ERA R F	O. O. LOW: LOW:	AT AT	70 200	0.	F F GPM GPM							
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING	TEMP W: O: WATE WATE	ERA R F	O. O. LOW: LOW:	AT AT	70 200	0.	F F GPM GPM		.IDS:					
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING	TEMP W: O: WATE WATE	ERA R F	O. O. LOW: LOW:	AT AT	70 200	0.	F F GPM GPM							
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING	TEMP W: O: WATE WATE	ERA R F	O. O. LOW: LOW:	AT AT	70 200	0.	F F GPM GPM							
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING	TEMP W: O: WATE WATE	ERA R F	O. O. LOW: LOW:	AT AT	70 200	0.	F F GPM GPM							
SCFM ACFM L/G PROC COOL	FLO RATI ESS ING ENDE	TEMP W: O: WATE WATE D SO	R F F LID	TURE: O. O. LOW: LOW: S OU'	AT AT	70 200	0.	F F GPM GPM							
SCFM ACFM L/G PROC COOL SUSP	FLO RATI ESS ING ENDE	TEMP W: O: WATE WATE D SO	R F F LID	TURE: O. O. LOW: LOW: S OU'	AT AT	70 200	0.	F F GPM GPM							
SCFM ACFM L/G PROC COOL SUSP	FLO RATI ESS ING ENDE	TEMP W: O: WATE WATE D SO	R F F LID	TURE: O. O. LOW: LOW: S OU'	AT AT	70 200	0.	F F GPM GPM							

CAPITAL COST:

PPSES: 516. QUENCHING - DIRTY WAT	ER CO		PTION 2			_
Procov Side Wolnelling - Dinii Wal	EN CO	N L	5			
CAPACITY: 2.834 MILLION TON	S/YEAR		······································			_
TOTAL COST (COST BASIS IS 110.00	Y OF JUNE	1977	DOLLARS	FOR	4078	
					<u>.</u>	
CATEGORY	COST IN	DOLL	IRS		. مَوْ	
*** DIRECT COST ***						
EQUIPMENT OR MATERIAL	114100.					
INSTRUMENTATION	0.					
PIPING	30800.					
ELECTRICAL	6200.					_
FOUNDATIONS	900.					
STRUCTURAL	0.					
SITE WORK	600.					_
INSULATION	0.					
PROTECTIVE COATING	900.					
BUILDINGS	0.					_
EQUIPMENT/MATERIAL LABOR	80300.					
DIRECT COST SUBTOTAL		217	8800			
						_
*** INDIRECT COST ***						
FIELD OVERHEAD	45400.					
CONTRACTORS FEE	27900.					_
ENGINEERING	35100.					
FREIGHT	4400					
OFFSITE WORK	0.					
TAXES	5700.					
SHAKEDOWN	1300.					
SPARES	3500.	·				
CONTINGENCY	71400.					
INDIRECT COST SUBTOTAL		194	1700.			
INTEREST DURING INSTALLATI	O.N.	10	700.			
	VII					
TOTAL COST		439	.005			
TOTAL COST WITH RETROFIT		571	000.			
80	·					
	<u> </u>				·····	
			Water Janes			

. .. .

PPSES: 516. QL	ENCHING - DIRTY WAT	UNITS OPTION COKE 2	
	2.834 MILLION TON		
CAPACITY:	P.034 MILLIUN IUN	STEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST
	*** UTILIT	IES ***	÷
WATER	0. MGAL/YR	\$.1595/1000 GAL	0.
ELECTRICITY	0. KWH/YR	\$.0266/KWH	0.
STEAM	0. MLBS/YR	\$ 4.0920/MLBS	0.
FUEL	0. GAL/YR	\$ _4180/GAL	0
	*** OPERATING	LABOR ***	
DIRECT	0. HRS/YR	\$14.34/HR	0. (
SUPERVISION	U. HRS/YR	\$17.20/HR	0. (1
	*** MAINTENANCE	& SUPPLIES ***	
DIRECT LABOR	1200. HRS/YR	\$14.34/HR	17200. (
SUPERVISION	240. HR\$/YR	\$17,20/HR	4100. (
MATERIALS			8600. (
SUPPLIES		•	4500. (
WATER TREATMENT			0
SOLID WASTE Dispusal	9067. TON/YR	6 9 35/TON	74800.
UISPUSAL	7007. TUN/TK	\$ 8.25/TON	74600.
DIRECT OPERAT	ING COST		109200.
	EAD =20.0% OF A+B+C		4300.
PLANT OVERHEA	D =50.0% OF A+B+C+D)+E+F	17200.
TOTAL OPERATI			130700.
	T IN DOLLARS PER TO		. 05
	IT AS PERCENT OF CAP	N OF DUST COLLECTED	28.83
	TIME IN WEEKS	TIAL COST	22.9 26.
	E OF SYSTEM IN YEAR	. S	20.
KWH PER TON		. •	.0
	ERY (11.75% OF TOTA	L CAPITAL)	67100.
	N OVERHEAD (2.0% O		11400.
	S & INS. (2.0% OF		11400.
TOTAL ANNUAL	ZED COST - RETROFIT	•	220600.
	- NEW		199900.
		eg i e	
			<u></u>

GENERAL INFORMATION: UNITS OPTION QUENCHING - DIRTY WATER PPSES: 516. COKE 3 PARTICULATE LOAD IN: 3.200000 LBS/ION COAL ALLOWABLE: .480000 LBS/TON COAL EFFICIENCY: 85.0% 221.80 LBS/HR BSO .006400 LBS/TON COAL LOAD IN: ALLOWABLE: __.001600 LBS/TON COAL __EFFICIENCY: _75.0% _____ .74 LBS/HR LOAD IN: .000310 LBS/TON COAL ALLOWABLE: .000062 LBS/TON COAL EFFICIENCY: 80.0% _____03_LBS/HR ...____ BENZENE ALLOWABLE: .000065 LBS/TON COAL EFFICIENCY: 75.0% .03 LBS/HR DUST COLLECTED PER DAY: 15.1 TONS(DRY) EXHAUST TEMPERATURE: 200. F 0. AT 200. F ACFM FLOW: ...L/G RATIO: PROCESS WATER FLOW: 1213. GPM COOLING WATER FLOW: 0. GPM 0. GPM SUSPENDED SOLIDS OUT:1707, MG/LXSOLIDS:2

CONTROL SYSTEM CONFIGURATION: QUENCH TOWER BAFFLES COKE PLANT WASTEWATER TREATMENT FEET OF ADDITIONAL DUCT:		RMATION:			UNITS -		
CONTROL SYSTEM CONFIGURATION: QUENCH TOWER BAFFLES COKE PLANT WASTEWATER TREATMENT FEET OF ADDITIONAL DUCT: O. DIAMETER: O. JINCHES O FANS @ O. MP EACH SPARE FAN CAPACITY: O.X OPERATING HOURS AT FULL MP: 8760. OPERATING HOURS AT REDUCED MP: O. DIAMETER: O. NO. OF OVENS 60. OVEN HEIGHT: O. DIAMETER: O. OVEN WOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT							
QUENCH TOWER BAFFLES COKE PLANT WASTEWATER TREATMENT FEET OF ADDITIONAL DUCT:							
FEET OF ADDITIONAL DUCT:	DIAFA	ICH TOWER BAFFA					
TOTAL PRESSURE DROP: 0 FANS @ 0. MP EACH SPARE FAN CAPACITY: 0.X OPERATING HOURS AT FULL HP: 8760. OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. OVEN MEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. YIELD 70 TONS COAL/YEAR 4047868.			-	T			
O FANS # 0. MP EACH SPARE FAN CAPACITY: 0.% OPERATING HOURS AT FULL HP: 8760. OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. NO. OF OVENS 60. OVEN HEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. YIELD 7.0 TONS COAL/YEAR 4047868.	FEET OF A	IDDITIONAL DUCT	: 0		DIAMETER:	0.	
OPERATING HOURS AT FULL HP: 8760. OPERATING HOURS AT REDUCED HP: 0. STACK HEIGHT: 0. DIAMETER: 0. NO. OF OVENS 60. OVEN HEIGHT 6.0 METERS OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH 24. AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FT. YIELD 7.0 TONS COAL/YEAR 4047868.							
STACK HEIGHT: NO. OF OVENS OVEN HEIGHT OVEN VOLUME TONS COKE/PUSH AVG. COKING TIME, HRS. BULK DENSITY YIELD TONS COAL/YEAR 10. DIAMETER: 0. DIAMETER: 0	OPERATING	HOURS AT FULL	HP: 8760				
NO. OF OVENS OVEN HEIGHT OVEN VOLUME 1348. CUBIC FEET TONS COKE/PUSH AVG. COKING TIME, HRS. NO. CYCLES/DAY BULK DENSITY YIELD TONS COAL/YEAR 4047868.	OPERATING	; HOURS AT-REDU (GHT:	CED HP:0	-	DIAMFTER:		
OVEN VOLUME TONS COKE/PUSH AVG. COKING TIME, HRS. NO. CYCLES/DAY BULK DENSITY TIELD TONS COAL/YEAR 4047868.	NO. OF OV	ENS	60	•			
TONS COKE/PUSH AVG. COKING TIME, HRS. NO. CYCLES/DAY BULK DENSITY YIELD TONS COAL/YEAR 4047868.							
-AVG. COKING TIME, HRS. 17.5 NO. CYCLES/DAY 82. BULK DENSITY 50. LBS/CUBIC FTYIELD					UBIC FEET		
TONS COAL/YEAR 4047868.	AVGCOKI	ING TIME, HRS		•5			
TONS COAL/YEAR 4047868.	NO. CYCLE	S/DAY	82 50	•	RS/CURIC E	т	
	YIELD	/	JV	.7 0	B3/CUBIC F	· · · · · · · · · · · · · · · · · · ·	
	·			_			
,	· · · · · · ·	,					
		<u> </u>	<u> </u>				
		e de samo e commentate o de la seconda					
	•			•	•		•
			<u> </u>			**	
		<u>.</u>	· · · · · · · · · · · · · · · · · ·				

	PPSES: 516.					R COI					
						_		_			
	CAPACITY:	5.	-834 M]	ILLI	ON TONS	YEAR			······································		
1	TOTAL COST	(COST	BASIS	18	110.00%	OF JUNE	1977	DOLLARS	FOR	4078	COST
	CATEGORY					COST IN	DOLL	ARS		ं	
		-** -D I	RECT	-c 08	T-***			<u> </u>			
	EQUIPMENT	OR MAT	ERIAL								
	INSTRUMEN	TATION				424400.					
	PIPING										
	ELECTRICA					233900.					
	FOUNDATIO	NS				131400.					
	STRUCTURA										
	SITE WORK					166600.					
	INSULATIO					121100.					
	PROTECTIV					-					
	BUILDINGS					546000.					
	EQUIPMENT	/MATERI	AL LAE	BOR		321600.					
	····DIRE	CT-COST	SUB T(STAL			601	1800			
					ST ***						
	FIELD OVE					-					
	CONTRACTO					228100.					
	ENGINEERI FREIGHT	NG				633400.					
						_		·			
	OFFSITE W	URK				149600.					
	SHAKEDOWN					126300.					
	SPARES					124100.					
	CONTINGEN	~ v									
	INDI			TOT		1559900.		4200			
								-			
	INTE	REST DU			ALLATIO	N 		2500 . 			
	TOTA	L COST					1112	8500.			
	TOTA	L COST	WITH F	REIR	OFIT		-1339	8200.		** *	
					n ram - manus muserum - 1 100 - 104 -						
								·			

PPS	ES: 516.	QUENCHING -	DIRTY WA	TER	UNITSOF	3			
CAP	ACITY:	2.834 MI	LLION TO	NS/YEAR					
CAT	EGORY	QUANTI	TY	RATE			ANNUAL	COST	(\$
			** UTILI	TIES **	*				
	ER	· ·	MGAL-/YR		1595/10 00	-6AI		0	
ELE	CTRICITY	4250262	KWH/YR	S.	0566/KMH		1131	00-	
STF	AM	4250262. 1062566.	MLBS/YR	5.4.	0920/MLRS		43480	00.	
FUE	L	2312143.	GAL/YR		4180/GAL		9665	00.	
		·····································	oper ating	G LABOR	·食食食 · · · · · · · · · · · · · · · · ·				
DID	FrT	9740	HDC/YD	\$ • #	7/1/UD		1257	•	<i>(</i>
SIID	EUI Edvietor	8760. 1752.	HDC/YD	514.	24/ MK		1621	00.	(A)
	EKATOTON		-MK3/4K	·	EU/HK			UU •	(0)
			NTENANCE	&-SUPP	LIES-**	w			
DIR	ECT LABOR	17200.	HRS/YR	\$14.	34/HR		2467	00_	(c)
SUP	ERVISION	3440	HRS/YR	\$17.	20/HR		592	00	(0)
	ERIALS			_				00.	
SUP	PLIES						7/77	^	_
	ER TREATMENT				-			-0.	•••
	ID WASTE							•	
		11010.	TON/YR	\$ 8.	25/TON		908	00.	
	DIRECT OPER	RATING COST			· ·		65859	00.	
	PAYROLL OVE	RHEAD =20.0X	OF A+B+	C+D				00.	
	PLANT OVERH	EAD =50.0% C	F A+B+C+I	D+E+F			5338	300.	
	TOTAL OPERA	TING COST					72120	00.	
	OPERATING C	OST IN DOLLA	RS PER TO	DN - PR	ODUCTION -			2.5	5
		OST IN DOLLA							
	OPERATING C	OST AS PERCE	NT OF CAL	PITAL C	OST			53.8	
	-INSTALLATIO	N TIME IN WE	EKS					04.	
		IFE OF SYSTE						15.	
	KWH PER TON	• • • • • • • • •		-				37.4	
		OVERY (13.15		AL CAPI	T.AL.)				
		ION OVERHEAD							
	PROPERTY TA	XES & INS. (2.0% OF	TOTAL	CAPITAL	•	26800		
	TOTAL ANNUA	LIZED COST	RETROET'	T.			950950	00.	
			NEW	•			912030		
									

PPSI	ES: 516.	QUENCHING	- DIRTY	WATER	COKE	4	
CAP	ACITY:	2.834	MILLION	TONS/Y	/EAR		· · · · · · · · · · · · · · · · · · ·
DAD'	TICULATE						
			RS/ION	- C 0A1			
			_		EFFICIENCY		
		73.93					
BSO							
		.006400					
	ALLOWABLE			-COAL	-EFFICIENCY	85.0x	
		- 44	LBS/HR				
BAP							
		.000310					
					EFFICIENCY		
	· · · · · ·		-L90/11K				
	ZENE	0000/0	. 56 (50)				
					EFFICIENCY		
	ALLUWABLE		LBS/HR	CUAL	EFFICIENCY	, /5.0%	
DUS	T COLLECTED	PER DAY:	16,9	TONS (C	ORY)		4.4
			-				
EXH	AUST TEMPER	ATURE:	200,	F			
_	_	-	7				
ACF	M FLOW:	0. AT	200.	F			
			_				
F\e	RATIO: "					·- · · · · · · · · · · · · · · · · · ·	
PRO	CESS WATER	FLOW:	1213.	GPM			
PR0(C00)	CESS WATER	FLOW: FLOW:	1213. 0.	GPM GPM			
PR0(C00)	CESS WATER	FLOW: FLOW:	1213. 0.	GPM GPM	- % SOLIDS:		
PR0(C00)	CESS WATER	FLOW: FLOW: DS OUT:	1213. 0. - 1707.	GPM GPM MG/L	- % SOLIDS:	2	
PR0(C00)	CESS WATER	FLOW: FLOW: DS OUT:	1213. 0. - 1707.	GPM GPM MG/L		2	
PR0(C00(SUS)	CESS WATER LING WATER PENDED SOLI	FLOW: FLOW: DS OUT:	1213. 0. - 1707.	GPM GPM MG/L	#SOLIOS:		
PR0(C00(SUS)	CESS WATER	FLOW: FLOW: DS OUT:	1213. 0. - 1707.	GPM GPM MG/L	#SOLIOS:	2	
PR0(C00(SUS)	CESS WATER LING WATER PENDED SOLI	FLOW: FLOW: DS OUT:	1213. 0. - 1707.	GPM GPM MG/L	#SOLIOS:		
PR00 C000 SUS	CESS WATER LING WATER PENDED SOLI	FLOW: FLOW: DS OUT:	1213. 0. - 1707.	GPM GPM MG/L	#SOLIOS:		
PR00 C000 SUS	CESS WATER LING WATER PENDED SOLI	FLOW: FLOW: DS OUT:	1213. 0. - 1707.	GPM GPM MG/L	XSOLIOS:		
PROI COOI SUS	CESS WATER LING WATER PENDED SOLI	FLOW: FLOW: DS OUT:	1213. 0. - 1707.	GPM GPM MG/L	XSOLIOS:	2	
PROI COOI SUS	CESS WATER LING WATER PENDED SOLI	FLOW: FLOW: DS OUT:	1213. 0. - 1707.	GPM GPM MG/L	¥SOLIOS:	2	
PROI COOI SUS	CESS WATER LING WATER PENDED SOLI	FLOW: FLOW: DS OUT:	1213.	GPM GPM MG/L	#SOLIDS:		
PROI COOI SUS	CESS WATER LING WATER PENDED SOLI	FLOW: FLOW: DS OUT:	1213.	GPM GPM MG/L	¥SOLIOS:		
PROI COOI	CESS WATER LING WATER PENDED SOLI	FLOW: FLOW: DS OUT:	1213.	GPM GPM MG/L	XSOLIDS:	2	
PROI COOI	CESS WATER LING WATER PENDED SOLI	FLOW: FLOW: DS OUT:	1213.	GPM GPM MG/L	XSOLIDS:		

ERAL INF		₩		UNITS		
PPSES:	516.	QUENCHING	- DIRTY WATER	COKE	4	
					·	
 		COMMENT OF THE PROPERTY OF THE PARTY.		1938/19 AMASS (* 200 - 201 - 200 - 201) WYS (* P. 1988)		
 CONTROL	SYSTER	M CONFIGURAT	ION:			
		OWER BAFFLES NT WASTEWATE				ş
 		-				
FEET OF	ADDIT	IONAL DUCT:	0.	DIAMETER:	0.	
 TOTAL _P	RESSURE	E_DROP:		INCHES		
			SPARE FAI	N CAPACITY:	0.1	
		RS AT FULL H				
		45 -AT -REDUCE				
STACK H				DIAMETER:	0.	
NO. OF			60.	METERO		
 OVEN VO			1348.			
TONS CO			24.			
 NO. CYC			82.	•		
BULK DE				LBS/CUBIC F	T .	
 TONS CO			4047868.	· · · · · · · · · · · · · · · · · · ·		
		`	4047000			
						- <i>-</i>
	••					
	···		•	•		
						
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PPS	ES: 516.	BUENCE	IING -	DIRT					OPTION -			
CAP	ACITY:	5,	834 M	ILLIO	N-TONS	/YE	AR	·			·	
TOT	AL COST	(cost	BASIS	IS 1	10.00%	OF	JUNE	1977	DOLLARS	FOR	4078	cos
	CATEGORY					COS	ST IN	DOLL	ARS		· · ·	
			RFCT-	–cost				·				
	EQUIPMENT											
	INSTRUMEN						5200.					
	PIPING											
	ELECTRICA						7700.					
	FOUNDATIO						0500.					
	STRUCTURA	L									<u> </u>	
	SITE WORK						4800.					
	INSULATIO	N				120	9000.					
	PROTECTIV	E-COAT	NG			5	1800.					
	BUILDINGS						6000.					
	EQUIPMENT	/MATER]	AL LA	BOR		896	6000.					
	DIRE	CT-COST	SUBT	OTAL-				742	5300			
		*** IN										
	FIELD OVE										·	· ·
	CONTRACTO						-					
•	ENGINEERI	NG				848	2500.					
	ENGINEERI FREIGHT		· · · · · · · · · · · · · · · · · · ·			2.4	4100.					
	OFFSITE W	IORK				19.	3600.					
	TAXES						9000.					
	SHAKEDOWN											
	SPARES	. =					4600.					
	CONTINGEN	_					6500.					
	INDI	REC1CL)S1 -SU	BIDIA	\ L	· · ·		539	3700	• -		
	INTE	REST DU	JRING	INSTA	LLATIO	N		112	6900.			
, 100	TOTA	L COST						1394	5900.			
	TOTA	u cost	WITH .	RETRO	FIT .			1 706	0800.			
	7072		***	ne me				1100				
												 ·
							····-		·····			
								·				

PPSES: 516.	QUENCHING - DIRTY WAT	TER COKE 4	
CAPACITY:		IS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST
	*** UTILIT	IES ***	
WATER		\$.1595/1000 GAL \$.0266/KWH \$ 4.0920/MLBS	0.
ELECTRICITY	4250262. KWH/YR	\$.0266/KWH	113100.
STEAM	1062566. MLBS/YR	\$ 4.0920/MLBS	4348000.
FUEL	2312143GAL/YR	\$ -4180/GAL	966500 .
		5 LABOR -+++	
DIRECT	8760. HRS/YR	\$14.34/HR	125700. (
SUPERVISION	1752,_HR\$/YR	\$14.34/HR \$17.20/HR	30100. (
	*** -MAINTENANCE	-8 -SUPPL-IES -***	
DIRECT LABOR	20000 HRS/YR	\$14.34/HR	286900. (
SUPERVISION	4000HRS/YR	\$17.20/HR	68800 . {
MATERIALS			344300. (
SUPPLIES			391100. (
SOLID WASTE			••
DISPOSAL	12306. TON/YR	\$ 8.25/TON	101500.
DIRECT OPER	ATING COST		6776000.
PAYROLL_OVE	RHEAD -=20.0% OFA+B+0	.+D	
)+E+F	623500.
TOTAL OPERA			7501800.
DPERATING _C	OST IN DOLLARS PER IC	N _ PRODUCTION	2.65
		ON OF DUST COLLECTED	
INSTALLATIO	N TIME IN WEEKS	'ITAL COST	44.0
	IFE OF SYSTEM IN YEAR		15.
	CAPACITY	. •	37.4
CAPITAL _REC	OVERY _(13.15% OF .TOTA	L CAPITAL)	2243100
		OF TOTAL CAPITAL)	
PROPERTY TA	XES & INS. (2.0% OF	TOTAL CAPITAL)	341200.
TOTAL ANNUA			
	- NEW		9893100.
			

					UNITSOF	
PPSE	5: 516.	QUENCHING	- DIRTY	WATER	COKE	5,
CAP	CITY:	2.834	-MILLION	-TONS/4	YEAR	
DADI	CICULATE					
		3-200000	ABS/TON	LACO.		
					EFFICIENCY:	
		14.79	LBS/HR			-
850						
	LOAD IN:					
	ALLOWABLE			COAL	_EFFICIENCY:	99.0%
		.03	LBS/HR			
BAP						
		.000310				
					EFFICIENCY:	
		00 _	LBS/HR			
BENZ						
		-	_			
	VETOWABLE		LBS/IUN	CUAL	EFFICIENCY:	99.0%
						THE RESERVE OF THE PERSON OF T
DUST	COLLECTED	PER DAY:	17.6	TONS (DRY)	
EXH	UST TEMPER	ATURE:	200.	F		
SCF	1 FLOW: 54	9000. AT	70.	F		
ACF	FLOW: 68	3000. AT	200.	F		
···L/6	RATIO:		0			
	ESS WATER		1213.			
	ING WATER		0.			
SUSF	ENDED SOLI	DS OUT:	1707.	MG/L	#SOLIDS:	• 5
					•	
•						

			UNITS	NOTION	
PPSES: 516. QUEN	CHING - DIRTY	WATER	COKE	5	
CONTROL SYSTEM CONF	IGURATION:				_
DRY QUENCHING COKE PLANT WAS	STEWATER TREAT	MENT			
FEET OF ADDITIONAL TOTAL PRESSURE DROP	DUCT:	0.	DIAMETER:	15.	
O FANS @ 0. HP E	FULL HP: 8	760.			
OPERATING HOURS AT-			DIAMETER:		
NO. OF OVENS		60.	DIAMETER.	•	
OVEN HEIGHT			TERS		
OVEN VOLUME	-	348. CI	BIC FEET		
TONS COKE/PUSH		24.			
-AVGCOKING TIME, HR					
NO. CYCLES/DAY Bulk density		82.	SS/CUBIC F	7	
TONS COAL/YEAR					
					· · · - · ·
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	PPSES:		QUENCHING -						·		
			2.834-M								
	GAPAG14	•		ILLIUN TUNS	/1EA						
	TOTAL C	DST	(COST BASIS	IS 110.00%	OF .	JUNE	1977	DOLLARS	FOR	4078	cos
	CA	TEGORY			COST	T IN	DOLL	ARS			
			-***-DIRECT	-COST-+++							
	EO	UIPMENT	OR MATERIAL	1	2393(000.					
	IN	STRUMENT	TATION		4244	400.					
											•
		ECTRICAL			2277						
	FO	UNDATION	NS		130	500.					
						-				<u>-</u>	
		TE WORK			1660	-					
		SULATION	v ECOATING		1211	200.					
****** ***** ** ** ** **						_					
	Fal	ITPMENT	MATERIAL LA	ROR							
		DIREC	CT_COST_SUBT	DTAL			_1.963/	8700			
				- · · · •							
		•	*** INDIRECT	COST ***							
	FI	ELD OVER	RHEAD		33986	500.					
	CO	NTRACTOR	RS FEE		17915						
		GINEERIN			10746	300.					
						-					-
			ORK		5548						
	I A	XES AKEDOWAL	•		570						
	6.0	ADEC			192						
	COL	NTINCENO	CY	4	17E:	_					
			RECTCOST -SU					8000			
		2110 21	(201 0001 00	DIVIAL			1470				
		INTER	REST DURING	INSTALLATIO	N		407	5500.			
					_						
		TOTAL	L COST				3862	2200.			
		70744						- "			
		JAIUI	L COST WITH	RETRUPTI			4555	3400.	• •		
					··· · · · · · · · · · · · · · · · · ·						
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ELECTRICITY 26918328, KMH/YR \$.0266/KMH 71666 STEAM =1204241, MLBS/YR \$ 4.0920/MLBS FUEL =2312143, GAL/YR \$ 4.0920/MLBS FUEL =2312143, GAL/YR \$ 4.0920/MLBS PUEL =2312143, GAL/YR \$ 4.0920/MLBS		QUENCHING - DIRTY WAT		
### UTILITIES ### WATER	-CAPACITY: -	2.834-MILLION-TON	S/YEAR	
### ### ### ### ### ### ### ### ### ##	CATEGORY	QUANTITY	RATE	ANNUAL COS
ELECTRICITY 26918328, KWH/YR \$.0266/KWH 71666 STEAM -1204241, MLBS/YR \$ 4.0920/MLBS FUEL -2312143, GAL/YR \$ 4.0920/MLBS FUEL -2312143, GAL/YR \$.4180/GAL 96656		*** UTILIT	IES ***	, i
ELECTRICITY 26918328, KWH/YR \$.0266/KWH 71666 STEAM -1204241, MLBS/YR \$ 4.0920/MLBS FUEL -2312143, GAL/YR \$ 4.0920/MLBS FUEL -2312143, GAL/YR \$ -4180/GAL 96656	WATER			
### OPERATING LABOR *** DIRECT 17520. HRS/YR \$14.34/HR 2513: SUPERVISION 3504. HRS/YR \$17.20/HR 603: *** MAINTENANCE & SUPPLIES *** DIRECT LABOR 78337. HRS/YR \$14.34/HR 11237: SUPERVISION 15667. HRS/YR \$17.20/HR 2695: MATERIALS 6766: SUPPLIES 5966: WATER TREATMENT 50LID WASTE DISPOSAL 6412. TON/YR \$ 8.25/TON 529: DIRECT OPERATING COST 47140 PAYROLL OVERHEAD =20.0% OF A+B+C+D 3410: PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 14890 TOTAL OPERATING COST 65440 OPERATING COST IN DOLLARS PER TON PRODUCTION 65440 OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 10 OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY	ELECTRICITY	26918328. KWH/YR	\$.0266/KWH	716600.
DIRECT 17520. HRS/YR \$14.34/HR 2513 SUPERVISION 3504. HRS/YR \$17.20/HR 603 *** MAINTENANCE 8 SUPPLIES *** DIRECT LABOR 78337. HRS/YR \$14.34/HR 11237 SUPERVISION 15667. HRS/YR \$17.20/HR 2695 MATERIALS 67666 SUPPLIES 59666 WATER TREATMENT SOLID WASTE DISPOSAL 6412. TON/YR \$ 8.25/TON 529 DIRECT OPERATING COST 47140 PAYROLL OVERHEAD =20.0% OF A+B+C+D 3410 PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 14890 TOTAL OPERATING COST 65440 OPERATING COST IN DOLLARS PER TON PRODUCTION 65440 OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 10 OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY	STEAM	-1204241. MLBS/YR	\$ 4.0920/MLBS	0.
DIRECT 17520. HRS/YR \$14.34/HR 2513 SUPERVISION 3504. HRS/YR \$17.20/HR 6034 -** MAINTENANCE & SUPPLIES *** DIRECT LABOR 78337. HRS/YR \$14.34/HR 11237 SUPERVISION 15667. HRS/YR \$17.20/HR 2695 MATERIALS 67664 SUPPLIES 59666 WATER TREATMENT SOLID WASTE DISPOSAL 6412. TON/YR \$ 8.25/TON 5296 DIRECT OPERATING COST 47140 PAYROLL OVERHEAD =20.0% OF A+B+C+D 3410 PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 14890 TOTAL OPERATING COST 65440 OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 10 OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS 1 ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY	FUEL	2312143GAL/YR	\$4180/GAL	9665 00,
DIRECT LABOR 78337. HRS/YR \$14.34/HR 11237 SUPERVISION 15667. HRS/YR \$17.20/HR 2695 MATERIALS 6766 SUPPLIES 5966 WATER TREATMENT SOLID WASTE DISPOSAL 6412. TON/YR \$8.25/TON 529 DIRECT OPERATING COST 47140 PAYROLL OVERHEAD =20.0% OF A+B+C+D 3410 PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 14890 TOTAL OPERATING COST 65440 OPERATING COST 1N DOLLARS PER TON PRODUCTION 65440 OPERATING COST 1N DOLLARS PER TON UP DUST COLLECTED 10 OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS 1 ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY	-		-LABOR -+++	
DIRECT LABOR 78337. HRS/YR \$14.34/HR 11237 SUPERVISION 15667. HRS/YR \$17.20/HR 2695 MATERIALS 6766 SUPPLIES 5966 WATER TREATMENT SOLID WASTE DISPOSAL 6412. TON/YR \$8.25/TON 529 DIRECT OPERATING COST 47140 PAYROLL OVERHEAD =20.0% OF A+B+C+D 3410 PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 14890 TOTAL OPERATING COST 65440 OPERATING COST 1N DOLLARS PER TON PRODUCTION 65440 OPERATING COST 1N DOLLARS PER TON UP DUST COLLECTED 10 OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS 1 ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY	NIDECT	17530 Hbe/Vb	\$1/1 3 /1/HD	251700
DIRECT LABOR 78337. HRS/YR \$14.34/HR 11237 SUPERVISION 15667. HRS/YR \$17.20/HR 2695 MATERIALS 6766 SUPPLIES 5966 WATER TREATMENT SOLID WASTE DISPOSAL 6412. TON/YR \$8.25/TON 529 DIRECT OPERATING COST 47140 PAYROLL OVERHEAD =20.0% OF A+B+C+D 3410 PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 14890 TOTAL OPERATING COST 65440 OPERATING COST 1N DOLLARS PER TON PRODUCTION 65440 OPERATING COST 1N DOLLARS PER TON OF DUST COLLECTED 10 OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS 1 ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY	SUPERVISION	3504 HPS/YP	\$17_20/HR	
DIRECT LABOR 78337. HRS/YR \$14.34/HR 11237 SUPERVISION 15667. HRS/YR \$17.20/HR 2695 MATERIALS 67666 SUPPLIES 59666 WATER TREATMENT SOLID WASTE DISPOSAL 6412. TON/YR \$ 8.25/TON 529 DIRECT OPERATING COST 47140 PAYROLL OVERHEAD =20.0% OF A+B+C+D 3410 PLANT OVERHEAD =50.0% OF A+B+C+D+F+F 14890 TOTAL OPERATING COST 65440 OPERATING COST IN DOLLARS PER TON PRODUCTION 65440 OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 10 OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS 1 ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY				
SUPERVISION15667. HRS/YR\$17,20/HR2695 MATERIALS			8 SUPPLIES ***	
SUPERVISION	DIRECT LABOR	78337. HRS/YR	\$14.34/HR	1123700
SUPPLIES WATER TREATMENT SOLID WASTE DISPOSAL 6412. TON/YR \$ 8.25/TON 529 DIRECT OPERATING COST 47140 PAYROLL OVERHEAD =20.0% OF A+B+C+D -3410 PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 14890 TOTAL OPERATING COST 65440 OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 10 OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS 1 ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY				
WATER TREATMENT SOLID WASTE DISPOSAL 6412. TON/YR \$ 8.25/TON 529 DIRECT OPERATING COST 47140 PAYROLL OVERHEAD =20.0% OF A+B+C+D -3410 PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 14890 TOTAL OPERATING COST 65440 OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON UF DUST COLLECTED 10 OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS 1 ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY	MATERIALS			676600
DISPOSAL 6412. TON/YR \$ 8.25/TON 529 DIRECT OPERATING COST 47140 PAYROLL OVERHEAD =20.0% OF A+B+C+D -3410 PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 14890 TOTAL OPERATING COST 65440 OPERATING COST IN DOLLARS PER TON PRODUCTION	SUPPLIES			596600
DISPOSAL 6412. TON/YR \$ 8.25/TON 529 DIRECT OPERATING COST 47140 PAYROLL OVERHEAD =20.0% OF A+B+C+D -3410 PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 14890 TOTAL OPERATING COST 65440 OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED 10 OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS 1 ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY		T		· · · · · · · · • · · · • · • · • · • ·
DIRECT OPERATING COST PAYROLL OVERHEAD =20.0% OF A+B+C+D PLANT OVERHEAD =50.0% OF A+B+C+D+E+F TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON UF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY		(#4.2 TON (YE)	e o 35/70h	E300 0
PAYROLL OVERHEAD =20.0% OF A+B+C+D 3410 PLANT OVERHEAD =50.0% OF A+B+C+D+E+F 14890 TOTAL OPERATING COST 65440 OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON UF DUST COLLECTED 10 OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS 1 ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY	UISPUSAL		•	
PLANT OVERHEAD #50.0% OF A+B+C+D+E+F TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY	DIRECT OPE	RATING COST		4714000
TOTAL OPERATING COST OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON UF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY	PAYROLL OV	ERHEAD =20.0% OF A+B+C	.+D	-341000
OPERATING COST IN DOLLARS PER TON PRODUCTION OPERATING COST IN DOLLARS PER TON OF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY	PLANT OVER	HEAD #50.0% OF A+B+C+D	+E+F	1489000
OPERATING COST IN DOLLARS PER TON UF DUST COLLECTED OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY				6544000
OPERATING COST AS PERCENT OF CAPITAL COST INSTALLATION TIME IN WEEKS				
INSTALLATION TIME IN WEEKS				
ESTIMATED LIFE OF SYSTEM IN YEARS KWH PER TON CAPACITY				15
KWH PER TON CAPACITY				150
			. 9	45
LAPITAL REGUTERT:-LIDETDE-UPTUTAL CAPITALT DIEDIV			L CAPITAL)	
ADMINISTRATION OVERHEAD (2.0% OF TOTAL CAPITAL) 87110				
TOTAL ANNUALIZED COST - RETROFIT 1401230				14012300.
- NEW 1316660		- NEW		13166600.

APPENDIX B

5

EXAMPLE COMPUTER PRINTOUT FOR COST UPDATE PROGRAM

This appendix illustrates the output of the cost update program. In the example provided, the cost of Option 5, the enclosed hot car for the coke pushing source, has been adjusted by changing the cost basis from fourth quarter 1978 to mid-1979, assuming a 7 percent inflation rate. Also the cost of labor has been increased 10 percent. These increases are arbitrary and used only as an example. When the cost update program is run, one or all of the functions can be updated by using the data cards for whichever cases are to be modified.

COST UPDATE OF COKE OVEN MODEL COST FUNCTIONS BASIS: 2079

SOURCE:	2	UNITS OPTION COKE 5	
CAPACITY:	.272 MILLION TO	NS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (\$)
	*** UTILITIES	***	
WATER ELECTRICITY STEAM FUEL	2450. MGAL/YR 1603. KWH/YR 0. NLBS/YR 258563. GAL/YR	1600/1000 GAL.0266/KWH4.0920/MLBS.4180/GAL	392. 43. 0. 108079.
	*** OPERATING &	MAINT LABOR ***	
DIRECT Supervision	8000. HRS/YR 1600. HRS/YR	\$15.77/HR \$17.20/HR	126160. (A) 27520. (B)
	*** MAINT & SUP	PLIES ***	
MATERIALS SUPPLIES SOLID WASTE DISPOSAL	686. TONS/YR	\$ 8.2 5	114800. (C) 38600. (D) 5659.
DIRECT O	PERATING COST		421253.
PLANT OV TOTAL OP ESTIMATE CAPITAL ADMINIST PROPERTY TOTAL AN	OVERHEAD =20.0% OF A+B ERHEAD =50.0% OF A+B+C+ ERATING COST IL LIFE OF SYSTEM IN YEA RECOVERY (11.70% OF TOT RATION OVERHEAD (2.00% O TAXES & INS. (2.00% O NUALIZED COST- RETROFI - NEW PITAL COST - RETROFI - NEW	RS AL CAPITAL) OF TOTAL CAPITAL) F TOTAL CAPITAL) T	30736. 153540. 423096. 20. 659888. 112801. 112801. 1308587. 1228087. 5640066.

COST UPDATE OF COKE OVEN MODEL COST FUNCTIONS BASIS: 2079

4

SOURCE:	2	UNITS OPTION COKE 5	
CAPACITY:	.405 HILLION TON	IS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (\$)
	*** UTILITIES	***	
WATER ELECTRICITY STEAM FUEL	3643. MGAL/YR 2385. KWH/YR 0. MLBS/YR 384576. GAL/YR	\$.0266/KWH \$ 4.0920/NLBS	583. 63. 0. 160753.
	*** OPERATING & M	MAINT LABOR ***	
DIRECT SUPERVISION	8000. HRS/YR 1600. HRS/YR		126160. (A) 27520. (B)
	*** MAINT & SUPF	PLIES ***	
MATERIALS SUPPLIES SOLID WASTE DISPOSAL	1020. TONS/YR	\$ 8.25	114800. (C) 38600. (I) 8415.
DIRECT OP	PERATING COST		4 7689 4.
PLANT OVE TOTAL OPE ESTIMATED CAPITAL R ADMINISTR PROPERTY TOTAL ANN	OVERHEAD =20.0% OF A+B ERHEAD =50.0% OF A+B+C+I ERATING COST O LIFE OF SYSTEM IN YEAR RECOVERY (11.70% OF TOTA RATION OVERHEAD (2.00% OF TAXES & INS. (2.00% OF HUALIZED COST — RETROFIT — NEW PITAL COST — RETROFIT — NEW	RS AL CAPITAL) OF TOTAL CAPITAL) F TOTAL CAPITAL) T	30736. 153540. 478737. 20. 712685. 121827. 1435075. 1348135. 6091328.

COST UPDATE OF COKE OVEN MODEL COST FUNCTIONS BASIS: 2079

SOURCE:	2	UNITS OPTIO COKE 5	N
CAPACITY:	.708 MILLION T	ONS/YEAR	
CATEGORY	QUANTITY	RATE	ANNUAL COST (\$)
	*** UTILITIE	S ***	
WATER ELECTRICITY STEAM FUEL	6375. NGAL/YR 4173. KWH/YR 0. NLBS/YR 672958. GAL/YR	\$.0266/KUH	1020. 111. 0. 281296.
	*** OPERATING 8	HAINT LABOR ***	
DIRECT SUPERVISION	BOOO. HRS/YR 1600. HRS/YR	\$15.77/HR \$17.20/HR	126160. (A) 27520. (B)
	*** MAINT & SU	PPLIES ***	
MATERIALS SUPPLIES SOLID WASTE DISPOSAL	1785. TONS/YR	\$ \$ 8.25	114800. (C) 38600. (D) 14726.
	PERATING COST		604234.
PLANT OV TOTAL OP ESTIMATE	OVERHEAD =20.0% OF A+B+C ERHEAD =50.0% OF A+B+C ERATING COST D LIFE OF SYSTEM IN YE RECOVERY (11.70% OF TO	C+D Cars	30736. 153540. 606076. 20. 794305.
PROPERTY	RATION OVERHEAD (2.00% TAXES & INS. (2.00% NUALIZED COST- RETROF - NEW	OF TOTAL CAPITAL)	135779. 135779. 1671939. 1575043.
TOTAL CA	PITAL COST - RETROF - NEW	TIT .	6788936. 6171760.

COST UPDATE OF COKE OVEN MODEL COST FUNCTIONS BASIS: 2079

REGRESSION ANALYSIS:

SOURCE: 2 UNITS OPTION COKE 5

.1938

CAPITAL COST - NEW = 453443.0(CAPACITY) CAPACITY IN UNITS PER YEAR

.1938
CAPITAL COST - RETROFIT = 498787.3(CAPACITY) CAPACITY IN UNITS PER YEAR

.2613
ANNUALIZED COST - NEW = 46504.8(CAPACITY) CAPACITY IN UNITS PER YEAR

.2573
ANNUALIZED COST - RETROFIT= 52125.7(CAPACITY) CAPACITY IN UNITS PER YEAR

TECHNICAL REPORT DATA (Please read Instructions on the reverse before	completing)		
1. REPORT NO. EPA-600/2-79-185	3. RECIPIENT'S ACCESSION NO.		
4. TITLE AND SUBTITLE Cost Effectiveness Model for Pollution Control at	5. REPORT DATE August 1979		
Coking Facilities	6. PERFORMING ORGANIZATION CODE		
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT: NO.		
William F. Kemner			
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.		
PEDCo Environmental, Inc.	1AB604		
11499 Chester Road	11. CONTRACT/GRANT NO.		
Cincinnati, Ohio 45242	68-02-2603, Task 44 and		
	68-02-3074, Task 6		
12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED		
EPA, Office of Research and Development	Task Final; 9/78 - 7/79		
Industrial Environmental Research Laboratory	14. SPONSORING AGENCY CODE		
Research Triangle Park, NC 27711	EPA/600/13		

15 SUPPLEMENTARY NOTES IERL-RTP project officer Twidwell is no longer with EPA; for details contact Norman Plaks, Mail Drop 62, 919/541-2733.

that allows the user to determine the optimum mix of pollution control devices to achieve a specified reduction in pollutant emission at the minimum annualized or capital cost. The computer program calculates and displays: the associated cost for each emission control; the total capital and annualized cost for the optimum mix of controls; and the emission levels in pounds of pollutant per ton of coal and tons of pollutant per year for each of the four pollutant types (total suspended solids, benzene-soluble organics, benzo(a)pyrene, and benzene). The program can consider 20 emission sources and 9 control options for each emission source.

17. KEY WORDS AND DOCUMENT ANALYSIS			
a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Pollution	Organic Compounds	Pollution Control	13B
Coking	Pyrenes	Stationary Sources	13H
Iron and Steel Industry		Suspended Solids	11F
Cost Effectiveness		Benzo(a)pyrene	14A
Mathematical Models			12A
Benzene	,		07C
18. DISTRIBUTION STATEMENT		19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release to Public		Unclassified	293
		20. SECURITY CLASS (This page) Unclassified	22. PRICE