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COMMERCIAL CONCEPTUAL DESIGN AND COMMERCIAL FEASIBILITY EVALUATION FOR CLEAN BOILER FUEL FACILITY

CAPITAL COST ESCALATION AND VALIDATION OF DRAVO REPORT/COST ESTIMATE - FEBRUARY 1976

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PREPARED BY:

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ABSTRACT

The US Army Engineer Division Huntsville (USAEDH) has reviewed, validated and updated a capital cost estimate of the "Conceptual Commercial Design and Commercial Feasibility Evaluation for Clean Boiler Fuel Facility", Report #FE-1772-13 dated February 1976, as prepared by DRAVO Corporation, Pittsburgh, PA. This facility was designed to have a feed rate of 50,000 tons of coal per day and is expected to produce 58,000 barrels per day of heavy fuel oil, 21,000 barrels per day of light fuel oil, 122 million standard cubic feet per day of LPG fraction, 240 million standard cubic feet per day of pipeline gas, 170 tons per day of ammonia and 1100 tons per day of sulfur.

Capital cost were estimated by DRAVO to be at 1.2 billion dollars based on last quarter 1975 dollars. Escalation and validation by USAEDH resulted in a fixed capital cost of $ 1.16 billion dollars for the facility. The overall accuracy factor of the DRAVO estimate was determined to be plus or minus 17 percent.

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INTRODUCTION

Periodically, the US Army Engineer Division Huntsville (USAEDH), reviews, validates, and updates capital cost estimates that have been prepared for Department of Energy (DOE) by its contractors. USAEDH is qualified for this type work by their extensive experience on major construction projects with which they have been associated.

This study includes a review and evaluation of the "Conceptual Commercial Feasibility Evaluation for the Clean Boiler Fuel Facility" Report #FE-1772-13 dated February 1976 as prepared by DRAVO Corporation. In this study USAEDH reviewed the capital costs of the process equipment. The basic costs were substantiated and a confidence factor was derived. These basic equipment costs were then escalated from DRAVO's last quarter 1975 cost to a June 1977 cost. For the purposes of this particular task, DRAVO's markup factors (ratio of total construction cost to equipment cost) were modified to reflect USAEDH's concept.

ESTIMATE SUMMARY

The USAEDH estimate was developed on a procedural step-by-step basis as follows:

Procedure #1 - Develop escalation rate

Procedure #2 Escalate the DRAVO cost

Procedure #3 - Develop cost verification factors

Procedure #4 - Apply USAEDH cost verification factors to escalated DRAVO cost of material and subcontract

Procedure #5 - Develop construction factors

Procedure #6 - Apply USAEDH construction factors to subcontracts and material to derive total cost inplace

Procedure #7 - Adjust DRAVO's estimates for priority data

Procedure #8 - Determine total validated capital cost

Procedure #9 - Determine accuracy factor

The result of this study produced an estimated $ 1.16 billion (Jun 77 $) capital cost required for construction of a commercial facility. An overall accuracy factor of plus or minus 17 percent was determined. Neither the DRAVO or the USAEDH estimates include the following:

1) Contingency
2) Working Capital and Interest During Construction
3) Sales and Use Taxes
4) Land Cost and Major Site Grading
5) Startup Cost

For both the DRAVO and USAEDH estimates, the equipment costs are tabulated in the following categories:

1) Note #1 includes those facilities where a supplier will provide a completely engineered and erected system within a battery limit. Facilities such as proprietary systems or a system which could be completely subcontracted.

2) Subcontract includes equipment that is normally assembled and erected on the jobsite by the supplier. Equipment such as field fabricated vessels, boilers, cooling towers, etc.

3) Material includes equipment that is shipped assembled by the supplier and is erected on the jobsite by the construction contractor's labor. Equipment such as heat exchangers, pumps, compressors, etc.

PROCEDURE #1

DEVELOPMENT ESCALATION RATIO

A. Explanation

Developed escalation rate to bring DRAVO's prices to Jun 77.

B. Formula

$$E_H = \text{Escalation}_{\text{USAEDH}}$$

ESCALATION DEVELOPMENT (E_H)

The DRAVO capital cost estimate was based on late 1975 equipment prices and did not include any escalation. Since the DRAVO estimate did not include escalation during the design/construct phase - we choose not to address escalation in that phase. However, to bring the report up to date, we will escalate to June 1977 as directed.

We used escalation rates per Army Regulations 415-17. These rates are based on a projected cost growth of skilled labor and selected construction materials which are least influenced by purely local conditions. These rates are revised periodically and have generally been proven reasonably accurate by actual building cost indexes published by Engineering News Record.

Current escalation is based on the May 1977 projected growth rates:

Late 1975 Index = 1350

Jun 1977 Index = 1525

Escalation = 1525 $\div$ 1350 = 1.1296

Use = 13.0%

PROCEDURE #2

ESCALATE THE DRAVO COST

A. Explanation

Escalate Capital Equipment Cost to Jun 77.

B. Formula

$M_D \times E_H = EM_D$

M_D = Material DRAVO

E_H = Escalation USAEDH

EM_D = Escalated Material DRAVO

$S_D \times E_H = ES_D$

S_D = Subcontracts DRAVO

E_H = Escalation USAEDH

ES_D = Escalated Subcontracts DRAVO

$N1_D \times E_H = EN1_D$

$N1_D$ = Note #1 DRAVO

E_H = Escalation USAEDH

$EN1_D$ = Escalated Note #1 DRAVO

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

Sheet 1 of 7

Prepared For: Department of Energy
Prepared By: U.S. Army Corps of Engineers, Huntsville Division

SUMMARY SHEET AREA 1 OF 7

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
31	000	HEAT EXCHANGERS	4				206000	26780	232780			
32	000	TOWERS & COLUMNS										
33	000	AGITATED VESSELS	2				5000	650	5650		COL 3 TO PAGE	46
34	000	FIELD FABRICATED TANKS	34	8250000	1073000	9323000	113000	14690	127690		COL 6 TO PAGE	54
35	000	PROCESS TANK & OTHER VESSELS									COL 9 TO PAGE	85
41	000	PUMPS	24				318000	41340	359340			
42	000	COMPRESSORS	3				1600000	208000	1808000			
43	000	MECHANICAL CONVEYING EQUIPMENT	36				627000	81510	708510	15500000	2015000	17515000
44	000	FURNACES, HEATERS, BOILERS AND COOLERS	2				170000	22100	192100			
45	000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.										
46	000	PACKAGE UNITS OR SYSTEMS	7				14050000	1826500	15876500			
47	000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	14				5196000	675480	5871480			
48	000	UNCLASSIFIED PROCESS EQUIP.										
49	000	HV & AC BLDG. SERVICE EQUIPMENT										
50	000	MECHANICAL DESIGN EQUIPMENT										
		TOTAL		8250000	*	9323000	22285000	*	25182050	15500000	*	17515000
				* FOR INDIVIDUAL ITEM ESCALATION SEE BACKUP SHEETS								
		FORMULA REFERENCE		S_D		ES_D	M_D		EM_D	$N1_D$		$EN1_D$

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

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SUMMARY SHEET AREA 2 OF 7

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
31	000	HEAT EXCHANGERS										
32	000	TOWERS & COLUMNS										
33	000	AGITATED VESSELS									COL 3 TO PAGE 47	
34	000	FIELD FABRICATED TANKS	13	24604000	3198520	27802520	156000	20280	176280		COL 6 TO PAGE 55	
35	000	PROCESS TANKS & OTHER VESSELS	3				22000	2860	24860		COL 9 TO PAGE 86	
41	000	PUMPS	6				6000	780	6780			
42	000	COMPRESSORS										
43	000	MECHANICAL CONVEYING EQUIPMENT										
44	000	FURNACES, HEATERS, BOILERS & COOLERS	2				900000	117000	1017000			
45	000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.										
46	000	PACKAGE UNITS OR SYSTEMS	1				4000	520	4520			
47	000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	4				532000	69160	601160			
48	000	UNCLASSIFIED PROCESS EQUIP.										
49	000	HV & AC BLDG. SERVICE EQUIPMENT										
50	000	MECHANICAL DESIGN EQUIPMENT										
		TOTAL		24604000	*	27802520	1620000	*	1830600			
				* FOR INDIVIDUAL ITEM ESCALATION SEE BACKUP SHEETS								
		FORMULA REFERENCE		S_D		ES_D	M_D		EM_D	$N1_D$		$EN1_D$

CLEAN BOILER FUEL FACILITY

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SUMMARY SHEET - AREA 3 OF 7

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
31	000	HEAT EXCHANGERS	178				40135000	5217550	45352550			
32	000	TOWERS & COLUMNS	44	19472000	2531360	22003360	12018000	1562340	13580340			
33	000	AGITATED VESSELS	4				6000	780	6780		COL 3 TO PAGE 48	
34	000	FIELD FABRICATED TANKS	9	6973000	906490	7879490					COL 6 TO PAGE 56	
35	000	PROCESS TANKS & OTHER VESSELS	28				605000	78650	683650		COL 9 TO PAGE 87	
41	000	PUMPS	196				1777000	231010	2008010			
42	000	COMPRESSORS	18				22540000	2930200	25470200			
43	000	MECHANICAL CONVEYING EQUIPMENT										
44	000	FURNACES, HEATERS, BOILERS & COOLERS	4				1834000	238420	2072420			
45	000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.	8				250000	32500	282500			
46	000	PACKAGE UNITS OR SYSTEMS	10	12600000	1638000	14238000	2930000	380900	3310900	14000000	1820000	15820000
47	000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.										
48	000	UNCLASSIFIED PROCESS EQUIP.	9				436000	56680	492680			
49	000	HV & AC BLDG. SERVICE EQUIPMENT										
50	000	MECHANICAL DESIGN EQUIPMENT										
		TOTAL		39045000	*	44120850	82531000	*	93260030	14000000	*	15820000
		* FOR INDIVIDUAL ITEM ESCALATION SEE BACKUP SHEETS										
		FORMULA REFERENCE		S_D		ES_D	M_D		EM_D	$N1_D$		$EN1_D$

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

Prepared For: Department of Energy
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SUMMARY SHEET - AREA 4 OF 7

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
31	000	HEAT EXCHANGERS	41				43338000	5633940	48971940			
32	000	TOWERS & COLUMNS	8	24634000	3202420	27836420	72000	9360	81360			
33	000	AGITATED VESSELS									COL 3 TO PAGE 49	
34	000	FIELD FABRICATED TANKS	5	2250000	292500	2542500					COL 6 TO PAGE 57	
35	000	PROCESS TANKS & OTHER VESSELS	15				858000	111540	969540		COL 9 TO PAGE 88	
41	000	PUMPS	146				1055000	137150	1192150			
42	000	COMPRESSORS	6				9750000	1267500	11017500			
43	000	MECHANICAL CONVEYING EQUIPMENT										
44	000	FURNACES, HEATERS, BOILERS & COOLERS	11				1125000	146250	1271250			
45	000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.										
46	000	PACKAGE UNITS OR SYSTEMS	16				1953000	253890	2206890	207533000	26979290	234512290
47	000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	6				1915000	248950	2163950			
48	000	UNCLASSIFIED PROCESS EQUIP.	13				238000	30940	268940			
49	000	HV & AC BLDG. SERVICE EQUIPMENT										
50	000	MECHANICAL DESIGN EQUIPMENT										
		TOTAL		26884000	*	30378920	60304000	*	68143520	207533000	*	234512290
				* FOR INDIVIDUAL ITEM ESCALATION SEE BACKUP SHEETS								
		FORMULA REFERENCE		S_D		ES_D	M_D		EM_D	$N1_D$		$EN1_D$

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

Sheet 5 of 7

Prepared For: Department of Energy
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SUMMARY SHEET - AREA 5 OF 7

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
31	000	HEAT EXCHANGERS										
32	000	TOWERS & COLUMNS										
33	000	AGITATED VESSELS									COL 3 TO PAGE 50	
34	000	FIELD FABRICATED TANKS									COL 6 TO PAGE 58	
35	000	PROCESS TANKS & OTHER VESSELS									COL 9 TO PAGE 89	
41	000	PUMPS										
42	000	COMPRESSORS										
43	000	MECHANICAL CONVEYING EQUIPMENT										
44	000	FURNACES, HEATERS, BOILERS & COOLERS										
45	000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.										
46	000	PACKAGE UNITS OR SYSTEMS	2							47500000	6175000	53675000
47	000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.										
48	000	UNCLASSIFIED PROCESS EQUIP.	4				3000	390	3390			
49	000	HV & AC BLDG. SERVICE EQUIPMENT										
50	000	MECHANICAL DESIGN EQUIPMENT										
		TOTAL					3000	*	3390	47500000	*	53675000
				* FOR INDIVIDUAL ITEM ESCALATION SEE BACKUP SHEETS								
		FORMULA REFERENCE		S_D		ES_D	M_D		EM_D	$N1_D$		$EN1_D$

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

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SUMMARY SHEET - AREA 6 OF 7

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
31	000	HEAT EXCHANGERS	1				10000	1300	11300			
32	000	TOWERS & COLUMNS										
33	000	AGITATED VESSELS	12				48000	6240	54240		COL 3 TO PAGE 51	
34	000	FIELD FABRICATED TANKS	44	22154000	2880020	25034020					COL 6 TO PAGE 59	
35	000	PROCESS TANKS & OTHER VESSELS	22				563000	73190	636190		COL 9 TO PAGE 90	
41	000	PUMPS	116				236000	30680	266680			
42	000	COMPRESSORS										
43	000	MECHANICAL CONVEYING EQUIPMENT	43				185000	24050	209050			
44	000	FURNACES, HEATERS, BOILERS & COOLERS	1				95000	12350	107350			
45	000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.										
46	000	PACKAGE UNITS OR SYSTEMS	24				108000	14040	122040			
47	000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	10				167000	21710	188710			
48	000	UNCLASSIFIED PROCESS EQUIP.	10				1144000	148720	1292720			
49	000	HV & AC BLDG. SERVICE EQUIPMENT										
50	000	MECHANICAL DESIGN EQUIPMENT										
		TOTAL		22154000	*	25034020	2556000	*	2888280			
				* FOR INDIVIDUAL ITEM ESCALATION SEE BACKUP SHEETS								
		FORMULA REFERENCE		S_D		ES_D	M_D		EM_D	$N1_D$		$EN1_D$

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

Sheet 7 of 7

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SUMMARY SHEET - AREA 7 OF 7

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
31	000	HEAT EXCHANGERS	1				58000	7540	65540			
32	000	TOWERS & COLUMNS										
33	000	AGITATED VESSELS	2				5000	650	5650		COL 3 TO PAGE 52	
34	000	FIELD FABRICATED TANKS	12	342000	44460	386460					COL 6 TO PAGE 60	
35	000	PROCESS TANKS & OTHER VESSELS	39				627000	81510	708510		COL 9 TO PAGE 91	
41	000	PUMPS	143				14146000	1838980	15984980			
42	000	COMPRESSORS										
43	000	MECHANICAL CONVEYING EQUIPMENT										
44	000	FURNACES, HEATERS, BOILERS & COOLERS	7	104440000	13577200	118017200	1570000	204100	1774100			
45	000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.										
46	000	PACKAGE UNITS OR SYSTEMS	39	20000000	2600000	22600000	3224000	419120	3643120	12679000	1648270	14327270
47	000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.										
48	000	UNCLASSIFIED PROCESS EQUIP.	11				136000	17680	153680	3557000	462410	4019410
49	000	HV & AC BLDG. SERVICE EQUIPMENT										
50	000	MECHANICAL DESIGN EQUIPMENT										
		TOTAL		124918000	*	141157340	19630000	*	22181900	16236000		18346680
				* FOR INDIVIDUAL ITEM ESCALATION SEE BACKUP SHEETS								
		FORMULA REFERENCE		S_D		ES_D	M_D		EM_D	$N1_D$		$EN1_D$

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

Prepared For: Department of Energy
Prepared By: U.S. Army Corps of Engineers, Huntsville Division

ALL FIGURES = THOUSANDS ($000) DOLLARS

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
31	101	STEAM CONDENSER	2				56	7	63		(BEGIN AREA	1)
31	103	HYDROCARBONIZER FEED GAS COOLER	2				150	20	170			
33	101	COAL FINES MIXING TANK	1				3	0.4	3.4			
33	101A	COAL FINES MIXING TANK AGITATOR	1				2	0.3	2.3			
34	101	COAL HEATER	2	864	112	976						
34	102	COAL FEED LOCK HOPPERS	4	1645	214	1859						
34	102A	COAL HOPPER PLATE COIL	4				60	8	68			
34	103	COAL HOLDING VESSEL	2	1729	225	1954						
34	103A	HOLDING VESSEL PLATE COILS	2				53	7	60			
34	104	COAL FEED INJECTOR	2	1597	208	1805						
34	105	COAL FEED HOPPER	4	103	13	116						
34	106	ROM COAL SURGE HOPPER	1							*		
34	107	CRUSHED COAL SURGE HOPPER	1							*		
34	108	CRUSHED COAL STORAGE SILO	6	1089	142	1231						
34	109	GROUND COAL FEED HOPPER	6	1223	159	1382						
41	101	CONDENSATE CIRCULATION PUMP	4				120	16	136			
41	102	COOLING TOWER PUMPS	6				178	23	201			
41	103	INJECTOR COMPRESSOR CONDENSATE PUMP	6				6	1	7			
41	104	COAL FINES MIXING PUMP	2				8	1	9			
41	105	INJECTION COMP. RETURN PUMP	6				6	1	7			

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

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ALL FIGURES = THOUSANDS ($000) DOLLARS

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42	101	COAL INJECTOR COMPRESSOR	3				1600	208	1808			
43	101	GROUND COAL FEEDER	6				102	13	115			
43	102	HOLDING POND DRAG CONVEYOR	2				150	20	170			
43	103	HOT COAL FEEDER	16				128	17	145			
43	104	FINES FEEDER	2									
43	105	EMERGENCY STACK-OUT CONVEYOR	1							*		
43	106	ROM COAL RECLAIM CONVEYOR	1							*		
43	107	STACK-OUT TOWER	1							*		
43	108	ROM BELT SCALE	1							*		
43	109	ROM COAL SAMPLER	1							*		
43	110	RECLAIM CONVEYOR FEEDER	2							*		
43	111	ROM RECLAIM CONVEYOR	1							*		
43	112	CRUSHED COAL CONVEYOR TO T-3	1							*		
43	113	ROM COAL CRUSHER FEEDER	3							*		
43	114	COAL STACKER RECLAIMER	1							15500	2015	17515
43	115	EMERGENCY RECLAIM CONVEYOR NO. 1	1							*		
43	116	EMERGENCY RECLAIM CONVEYOR FEEDER	2							*		
43	117	EMERGENCY RECLAIM CONVEYOR NO. 2	1							*		
43	118	CRUSHED COAL CONVEYOR FROM T-2	2							*		
43	119	DOZERS	3							*		

CLEAN BOILER FUEL FACILITY

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ALL FIGURES = THOUSANDS ($000) DOLLARS

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
43	120	CRUSHED COAL HOPPER SAMPLER	1							*		
43	121	CRUSHED COAL TRIPPER FEEDER	4							*		
43	122	CRUSHED COAL BELT SCALES	2							*		
43	123	CRUSHED COAL TRIPPERS	2							*		
43	124	CRUSHED COAL CONVEYORS	2							*		
43	125	SLIDE GATES	4							*		
43	126	DUST SUPPRESSION SYSTEM	1							*		
43	127	ROLL MILL FEEDER	6				34	4	38			
43	128	CRUSHED COAL WEIGHT BELT	6				213	28	241			
44	101	CONDENSATE COOLING TOWER	2				170	22	192			
45	101	ROM MAGNETIC SEPARATOR	1							*		
46	101	COAL PULVERIZING SYSTEM	6				14040	1825	15865			
46	103	H.P. STEAM DESUPERHEATER	1				10	1	11			
47	101	COAL HEATER CYCLONE	2				1296	168	1464			
47	102	RECYCLE GAS BLOWER	2				900	117	1017			
47	103	RECYCLE GAS BOOSTER	2				900	117	1017			
47	104	HEATER SECONDARY CYCLONE	2				[W/47101]					
47	105	DUST COLLECTION SYSTEM T-1	1							*		
47	106	DUST COLLECTION SYSTEM CRUSHER HOUSE	1							*		
47	107	DUST COLLECTION SYSTEM T-2	1							*		

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

Prepared For: Department of Energy
Prepared By: U.S. Army Corps of Engineers, Huntsville Division

ALL FIGURES = THOUSANDS ($000) DOLLARS

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
47	108	DUST COLLECTION SYSTEM EMERGENCY RECLAIM	1							*		
47	109	DUST COLLECTION SYSTEM T-3	1							*		
47	110	PULVERIZER DUST COLLECTOR	6				2100	273	2373			
48	101	ROM COAL CRUSHER SYSTEM	3							*	(END AREA 1	

* FURNISHED WITH 43114

NOTE 1: A COMPLETELY ENGINEERED AND ERECTED SYSTEM WITHIN A BATTERY LIMIT.

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34	201	HYDROCARBONIZER	2	15134	1967	17101					(BEGIN AREA	2)
34	202	CHAR SURGE HOPPER	2	4107	534	4641						
34	202A	CHAR SURGE PLATE COIL	2				52	7	59			
34	203	CHAR LOCK HOPPER	2	3200	416	3616						
34	203A	CHAR LOCK HOPPER PLATE COIL	2				52	7	59			
34	204	CHAR FEEDER VESSEL	1	2159	281	2440						
34	204A	CHAR FEEDER PLATE COIL	1				52	7	59			
34	206	API SEPARATOR	1	4	1	5						
35	201	AGGLOMERATE LOCK HOPPER	2				15	2	17			
35	204	EVACUATION CONDENSATE DRUM	1				7	1	8			
41	201	EVACUATION COND. PUMP	2				2	0.3	2.3			
41	202	API SEPARATE OIL PUMP	2				2	0.3	2.3			
41	203	API SEPARATOR WATER PUMP	2				2	0.3	2.3			
44	201	HOT OIL SYSTEM	2				900	117	1017			
46	201	AREA 2 EVACUATION SYSTEM	1				4	1	5			
47	210	HYDROCARBONIZER INTERNAL CYCLONE	2				156	20	176			
47	211	HYDROCARBONIZER EXTERNAL CYCLONE	2				376	49	425		(END AREA	2)

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31	301	H.P. BFW PREHEATER	4				1132	147	1279		(BEGIN AREA	3)
31	302	FRACTIONATOR GAS COOLER	16				4858	632	5490			
31	303	SOUR WATER CONDENSER	2				394	51	445			
31	304	300 PSIG STEAM GENERATOR	4				1509	196	1705			
31	305	300 PSIG RFW PREHEATER	2				226	29	255			
31	306	HEAVY OIL COOLER	2				208	27	235			
31	307	LEAN SOLUTION COOLER	2				148	19	167			
31	308	LEAN-RICH SOLUTION EXCHANGER	2				200	26	226			
31	310	TOP STRIPPER CONDENSER	2				234	30	264			
31	311	BOTTOM STRIPPER CONDENSER	2				124	16	140			
31	312	AMMONIA FRACTIONATOR CONDENSER	2				88	11	99			
31	314	AMMONIA FRACTIONATOR BOTTOMS COOLER	2				121	16	137			
31	315	RECYCLE H_2 SULFINOL SOLUTION COOLER	14				1061	138	1199			
31	316	RECYCLE H_2 SULFINOL SOLUTION EXCHANGER	10				2718	353	3071			
31	317	RECYCLE H_2 STRIPPER REBOILER	6				2906	378	3284			
31	318	RECYCLE H_2 SULFINOL CONDENSER	2				213	28	241			
31	319	RECYCLE H_2 SUFFINOL SUPERHEATER	2				51	7	58			

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31	320	RECYCLE H_2 SULFINOL VAPORIZER	2				91	12	103			
31	322	LPG EXCHANGER	2				168	22	190			
31	323	METHANATOR GAS EXCHANGER	4				149	19	168			
31	324	RECYCLE GAS EXCHANGER	2				164	21	185			
31	327	REACTOR FEED PREHEATER	2				413	54	467			
31	328	METHANATOR WASTE HEAT BOILER	4				788	102	890			
31	329	METHANATOR RECYCLE COOLER	8				3293	428	3721			
31	330	HOT LEAN OIL-RICH OIL INTERCHANGER	34				10322	1342	11664			
31	332	FUEL OIL-RICH OIL INTERCHANGER	4				972	126	1098			
31	333	DEBUTANIZER FEED BOTTOMS EXCHANGER	4				1080	140	1220			
31	334	DEBUTANIZER REBOILER	2				316	41	357			
31	335	DEBUTANIZER OVERHEAD CONDENSER	2				88	11	99			
31	336	LEAN OIL FEED COOLER	14				4916	639	5555			
31	338	FUEL OIL COOLER	2				128	17	145			
31	339	SOUR WATER FEED/PRODUCT EXCHANGER	2				360	47	407			
31	349	AMMONIA FRACTIONATOR SIDE DRAW COOLER	2				4	1	5			
31	350	L.P. AMMONIA ABSORBER BOTTOMS COOLER	2				79	10	89			

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31	351	AMMONIA STRIPPER REBOILER	2				153	20	173			
31	353	DEETHANIZER BOTTOMS COOLER	4				100	13	113			
31	354	DEETHANIZER CONDENSER	4				360	47	407			
32	301	FRACTIONATOR	2	16160	2101	18261						
32	303	L.P. AMMONIA ABSORBER	2				97	13	110			
32	304	H.P. AMMONIA ABSORBER	2				2077	270	2347			
32	305	AMMONIA STRIPPER	2				455	59	514			
32	306	AMMONIA FRACTIONATOR	2				166	22	188			
32	307	RECYCLE H_2 SULFINOL ABSORBER	2	2196	285	2481						
32	308	RECYCLE H_2 SULFINOL STRIPPER	2	348	45	393						
32	309	RECYCLE H_2 SULFINOL RECLAIMER	2				55	7	62			
32	310	RECYCLE H_2 SULFINOL WASH COLUMN	2				1673	217	1890			
32	311	CRYOGENIC FEED ADSORBERS	8				1638	213	1851			
32	313	METHANATION REACTOR	2				1922	250	2172			
32	314	PRODUCT GAS DRYING TOWERS	4				2884	375	3259			
32	315	FUEL OIL STRIPPER	2				66	9	75			
32	317	SOUR WATER STRIPPER	2				257	33	290			
32	318	DEBUTANIZER	2				244	32	276			
32	319	OIL ABSORBER	2	768	100	868						

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32	320	HEAVY OIL STRIPPER	2				32	4	36			
32	326	DEETHANIZER	2				452	59	511			
33	301	SULFINOL MAKEUP TANK	2				4	1	5			
33	301A	AGITATOR FOR 33301	2				2	0.3	2.3			
34	302	H.C. PRODUCT FRACTIONATOR DECANTER	2	4844	630	5474						
34	303	METHANATOR SEPARATOR	2	426	55	481						
34	304	TAR/RKH SOLUTION TANK	2	18	2	20						
34	305	LEAN OIL SURGE TANK	2	1681	219	1900						
34	306	AREA 3 API SEPARATOR	1	4	1	5						
35	301	SOUR WATER DECANTER	2				31	4	35			
35	302	DEBUTANIZER REFLUX DRUM	2				28	4	32			
35	303	RICH SOLUTION CONTACTOR	4				121	16	137			
35	306	RECYCLE H_2 SULFINOL REFLUX DRUM	2				10	1	11			
35	308	AMMONIA FRACTIONATOR FEED TANK	2				56	7	63			
35	309	RECYCLE H_2 FLASH TANK	2				60	8	68			
35	310	METHANATOR RECYCLE FLASH TANK	2				54	7	61			
35	311	PRODUCT GAS KNOCK OUT DRUM	2				14	2	16			
35	324	AMMONIA FRACTIONATOR SIDE DRAW DECANTER	2				43	6	49			
35	325	CAUSTIC ADDITIONS TANK	1				5	1	6			

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35	327	FUEL OIL FLASH TANK	2				20	3	23			
35	328	AREA 3 EVACUATION TANK	1				7	1	8			
35	329	DEETHANIZER REFLUX DRUM	2				108	14	122			
35	330	GLYCOL HOLD TANK	2				48	6	54			
41	301	BOTTOMS PUMP	2				58	8	66			
41	302	REFLUX PUMP	4				79	10	89			
41	304	LIGHT FUEL PUMP	4				2	0.3	2.3			
41	309	H.P. AMMONIA ABSORBER LEAN SOLN. FEED PUMP	4				41	5	46			
41	310	TAR-RICH SOLUTION RETURN PUMP	4				6	1	7			
41	311	RICH SOLUTION FEED PUMP	4				90	12	102			
41	313	RICH SOLUTION FEED BOOSTER PUMP	4				44	6	50			
41	314	AMMONIA FRACTIONATOR REFLUX PUMP	4				16	2	18			
41	315	RECYCLE H_2 SULFINOL BOOSTER PUMP	4				685	89	774			
41	316	RECYCLE H_2 LEAN SOLUTION PUMP	4				223	29	252			
41	317	RECYCLE H_2 SULFINOL REFLUX PUMP	4				7	1	8			
41	318	RECYCLE H_2 SULFINOL WATER PUMP	4				54	7	61			
41	319	RECYCLE H_2 SULFINOL WATER CIRC. PUMP	4				34	4	38			

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41	320	SULFINOL MAKEUP PUMP	4				2	0.3	2.3			
41	322	SOUR WATER REFLUX PUMP	4				5	1	6			
41	323	SOUR WATER BOTTOMS PUMP	4				6	1	7			
41	324	DEBUTANIZER REFLUX PUMP	4				17	2	19			
41	325	RICH OIL PUMP	4				67	9	76			
41	340	AMMONIA FRACTIONATOR FEED PUMP	4				40	5	45			
41	341	CAUSTIC METERING PUMP	2				2	0.3	2.3			
41	342	AMMONIA FRACTIONATOR SIDE DRAW RET. PUMP	4				15	2	17			
41	343	DEETHANIZER REFLUX PUMP	4				65	8	73			
41	344	GLYCOL CIRCULATION PUMP	4				105	14	119			
41	345	BOOSTER COMPRESSOR CONDENSATE PUMP	6				7	1	8			
41	346	RECYCLE H_2 SOLUTION CONDENSATE PUMP	20				20	3	23			
41	347	RECYCLE H_2 LEAN SOLUTION COND. PUMP	12				12	2	14			
41	348	DEETHANIZER COMPRESSOR CONDENSATE PUMP	6				7	1	8			
41	349	METHANATION COMPRESSOR CONDENSATE PUMP	6				23	3	26			
41	350	RECYCLE COMPRESSOR CONDENSATE PUMP	6				6	1	7			
41	351	AREA 3 EVACUATION PUMP	2				2	0.3	2.3			
41	352	AREA 3 API OIL PUMP	2				2	0.3	2.3			

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41	353	AREA 3 API WATER PUMP	2				2	0.3	2.3			
41	354	BOOSTER COMP. RETURN PUMP	6				6	1	7			
41	355	RECYCLE H_2 SULFINOL SOLN. RETURN PUMP	20				4	1	5			
41	357	DEETHANIZER COMP. RETURN PUMP	6				6	1	7			
41	358	METHANATION COMP. RETURN PUMP	6				6	1	7			
41	359	PRODUCT GAS RECYCLE COMP. RETURN PUMP	6				6	1	7			
41	360	TAR SOLUTION PUMP	2				5	1	6			
42	303	BOOSTER COMPRESSOR	3				3000	390	3390			
42	304	FLASH RECYCLE H_2 GAS COMPRESSOR	4				200	26	226			
42	306	METHANATION COMPRESSOR	3				10500	1365	11865			
42	307	NITROGEN COMPRESSOR	2				40	5	45			
42	308	PRODUCT GAS RECYCLE COMPRESSOR	3				2200	286	2486			
42	309	DEETHANIZER COMPRESSOR	3				6600	858	7458			
44	301	START-UP FURNACE	2				34	4	38			
44	302	REFRIGERATION SYSTEM	2				1800	234	2034			
45	301	RECYCLE H_2 SULFINOL STRIPPER FEED FILTER	2				20	3	23			
45	302	FEED FILTER SEPARATOR	2				135	18	153			
45	303	CRYOGENIC FEED POLISHING FILTER	2				67	9	76			

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45	304	PHENOL RECOVERY SOLIDS FILTER	2				28	4	32			
46	301	CRYOGENIC PURIFIER	2	12600	1638	14238						
46	302	925 RW GENERATOR	2				130	17	147			
46	303	DEETHANIZER REFRIGERATION SYSTEM	2				2800	364	3164			
46	304	PHENOL RECOVERY PLANT	2							14000	1820	15820
46	305	PYRIDINE RECOVERY PLANT	2							[W/46304]		
48	301	H.C. PRODUCT GAS VENTURI	2				202	26	228			
48	302	DETARRER	2				75	10	85			
48	304	AREA 3 EVACUATION SYSTEM	1				4	1	5			
48	305	METHANATOR BOILER BLOWDOWN SYSTEM	2				55	7	62			
48	306	FRACTIONATION BOILER BLOWDOWN SYSTEM	2				100	13	113		(END AREA 30)	

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31	405	CO SHIFT REACTOR I EFFLUENT COOLER	6				553	72	625		(BEGIN AREA	4)
31	406	CO SHIFT REACTOR II EFFLUENT COOLER	2				275	36	311			
31	414	GASIFIER WATER CONDENSER	2				5	1	6			
31	416	GASIFIER WASTE HEAT BOILER	4				29400	3822	33222			
31	417	GASIFIER STEAM GENERATOR	2				8060	1048	9108			
31	418	GASIFIER SCRUBBER COOLER	4				853	111	964			
31	419	GASIFIER STRIPPER REBOILER	2				18	2	20			
31	433	CO SHIFT STEAM GENERATOR	14				3882	505	4387			
31	437	LIQUID NITROGEN VAPORIZER	1				20	3	23			
31	441	LIQUID OXYGEN VAPORIZER	4				272	35	307			
32	403	CO SHIFT REACTOR I	2	3393	441	3834						
32	404	CO SHIFT REACTOR II	2	3688	479	4167						
32	410	GASIFIER	2	17553	2282	19835						
32	412	GASIFIED WATER STRIPPER	2				72	9	81			
34	405	LIQUID NITROGEN STORAGE TANK	1	450	59	509						
34	406	LIQUID OXYGEN STORAGE TANK	4	1800	234	2034						
35	405	CO SHIFT CATALYST BIN	2				3	0.4	3.4			
35	423	CO SHIFT CONDENSATE TANK	2				115	15	130			
35	426	AREA 4 EVACUATION TANK	1				7	1	8			
35	427	FLARE FEED DRUM	4				73	9	82			
35	429	GASIFIER SLAG REMOVAL BIN	2				4	1	5			

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35	430	GASIFIER QUENCH TANK	4				656	85	741			
41	418	GASIFIER WATER PUMP	4				23	3	26			
41	422	SCRUBBER WATER PUMP	4				191	25	216			
41	436	GAS SCRUBBER CONDENSATE PUMPS	6				6	1	7			
41	437	BENFIELD #1 CONDENSATE PUMPS	8				8	1	9			
41	438	MAKEUP COMPRESSOR CONDENSATE PUMPS	6				8	1	9			
41	439	BENFIELD #2 CONDENSATE PUMPS	8				8	1	9			
41	440	OXYGEN COMPRESSOR CONDENSATE PUMPS	12				20	3	23			
41	441	AIR COMPRESSOR CONDENSATE PUMPS	12				46	6	52			
41	442	LIQUID NITROGEN PUMP	2				68	9	77			
41	443	LIQUID OXYGEN PUMP	8				592	77	669			
41	444	AREA 4 EVACUATION PUMP	2				2	0.3	2.3			
41	445	THERMAL OXIDIZER FEED PUMP	8				13	2	15			
41	446	GAS SCRUBBER RETURN PUMP	6				6	1	7			
41	447	BENFIELD #1 RETURN PUMP	8				8	1	9			
41	448	MAKEUP COMP. RETURN PUMP	12				6	1	7			
41	449	BENFIELD #2 RETURN PUMP	8				8	1	9			
41	450	O_2 COMP. RETURN PUMP	12				12	2	14			
41	451	AIR COMP. RETURN PUMP	12				13	2	15			

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41	455	SLAG REMOVAL CLEAR WELL PUMP	4				9	1	10			
41	456	SLAG REMOVAL COLD WELL PUMP	4				8	1	9			
42	401	GASIFIER SCRUBBER COMPRESSOR	3				2250	293	2543			
42	403	MAKEUP H_2 COMPRESSOR	3				7500	975	8475			
44	401	CO SHIFT START-UP HEATER	2				450	59	509			
44	403	FLARE	4				281	37	318			
44	404	NITROGEN AIR HEATER	1				10	1	11			
44	405	OXYGEN AIR HEATER	1				300	39	339			
44	406	THERMAL OXIDIZER	1				60	8	68			
44	408	SLAG REMOVAL COOLING TOWER	2				24	3	27			
46	401	OXYGEN PLANT	6							108000	14040	122040
46	403	GASIFIER START-UP HEATER SYSTEM	4				300	39	339			
46	404	GASIFIER ASH REMOVAL SYSTEM	2				1653	215	1868			
46	405	BENFIELD #1	1							26530	3449	29979
46	406	BENFIELD #2	1							73003	9490	82493
47	401	GASIFIER CYCLONE	2				1111	144	1255			
47	402	GASIFIER VENTURI SCRUBBER	2				202	26	228			
47	403	GASIFIER INTERNAL CYCLONE	2				602	78	680			
48	401	CO SHIFT HOIST	2				22	3	25			
48	405	AREA 4 EVACUATION SYSTEM	1				4	1	5			

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

Prepared For: Department of Energy
Prepared By: U.S. Army Corps of Engineers, Huntsville Division

ALL FIGURES = THOUSANDS ($000) DOLLARS

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
48	406	GASIFIER WASTE HEAT BLOWDOWN SYSTEM	2				60	8	68			
48	407	GASIFIER STEAM BOILER BLOWDOWN SYSTEM	2				46	6	52			
48	408	CO SHIFT BOILER BLOWDOWN SYSTEM	2				100	13	113			
48	409	GASIFIER ASH EDUCTOR	4				6	1	7		(END AREA 4)	
		AREA 5										
46	501	CLAUS PLANT	1							40500	5265 (BEGIN AREA 5)	45765
46	502	STRETFORD PLANT	1							7000	910	7910
48	501	CLAUS H.P. WHB BLOWDOWN SYSTEM	2				2	0.3	2.3			
48	502	CLAUS L.P. WHB BLOWDOWN SYSTEM	2				1	0.1	1.1		(END AREA 5)	

NOTE 1: A COMPLETELY ENGINEERED AND ERECTED SYSTEM WITHIN A BATTERY LIMIT.

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31	601	CHLORINE VAPORIZER	1				10	1	11		(BEGIN AREA	6)
33	602	STRETFORD MAKEUP TANK	1				2	0.3	2.3			
33	603	HEAVY OIL SURGE TANK	1				15	2	17			
33	604	PHOSPHATE MIX TANK	1				7	1	8			
33	605	DISODIUM PHOSPHATE MIX TANK	1				7	1	8			
33	606	SULFITE MIX TANK	1				2	0.3	2.3			
33	607	POTASSIUM CARBONATE MIX TANK	1				4	1	5			
33	602A	AGITATOR FOR 33602	1				1	0.1	1.1			
33	603A	AGITATOR FOR 33603	1				4	1	5			
33	604A	AGITATOR FOR 33604	1				2	0.3	2.3			
33	605A	AGITATOR FOR 33605	1				2	0.3	2.3			
33	606A	AGITATOR FOR 33606	1				1	0.1	1.1			
33	607A	AGITATOR FOR 33607	1				1	0.1	1.1			
34	603	LPG STORAGE TANK	12	10500	1365	11865						
34	605	FUEL OIL TANK	13	5200	676	5876						
34	611	OFF SPEC TANK	6	2400	312	2712						
34	615	BRINE MAKEUP BASIN	1	4	1	5						
34	618	LIGHT FUEL TANK	4	1560	203	1763						
34	620	AMMONIA OFF SPEC TANK	1	96	12	108						
34	621	LPG OFF SPEC TANK	1	750	98	848						
34	622	PHENOL STORAGE TANK	1	153	20	173						

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34	623	PYRIDINE STORAGE TANK	2	707	92	799						
34	624	AREA 6 API SEPARATOR	1	4	1	5						
34	625	LIGHT FUEL OFF SPEC TANK	2	780	101	881						
35	601	SULFUR STORAGE TANK	2				71	9	80			
35	602	CATIONIC PAYMER STORAGE TANK	1				12	2	14			
35	603	REFRIGERANT STORAGE TANK	1				9	1	10			
35	604	ODORANT STORAGE TANK	1				10	1	11			
35	606	PHOSPHATE STORAGE BIN	1				28	4	32			
35	607	DISODIUM PHOSPHATE STORAGE BIN	1				28	4	32			
35	608	SULFITE STORAGE BIN	1				14	2	16			
35	609	SODA ASH STORAGE BIN	1				14	2	16			
35	610	SULFUR BIN	1				19	2	21			
35	611	PHOSPHORIC ACID TANK	1				7	1	8			
35	612	SULFOLANE TANK	1				33	4	37			
35	613	SULFINOL TANK	1				33	4	37			
35	614	ANTIFOAM AGENT STORAGE TANK	1				9	1	10			
35	615	CHILLER SURGE TANK	1				8	1	9			
35	616	ACETONE STORAGE TANK	1				20	3	23			
35	617	POTASSIUM CARBONATE STORAGE TANK	1				64	8	72			
35	618	ACID STORAGE TANK	1				67	9	76			

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35	619	CAUSTIC TANK	1				64	8	72			
35	621	AREA 6 EVACUATION TANK	1				7	1	8			
35	622	SALT HOPPER	1				23	3	26			
35	623	LIME STORAGE BIN	1				23	3	26			
41	601	AMMONIA LOADING PUMP	2				19	2	21			
41	602	SULFUR STORAGE PUMP	4				20	3	23			
41	603	LPG LOADING PUMP	12				14	2	16			
41	604	HEAVY OIL SURGE PUMP	2				17	2	19			
41	605	FUEL OIL LOADING PUMP	13				29	4	33			
41	606	PHOSPHORIC ACID MAKEUP PUMP	2				1	0.1	1.1			
41	607	PHOSPHORIC ACID UNLOADING PUMP	1				2	0.3	2.3			
41	608	CAUSTIC DISTRIBUTION PUMP	2				1	0.1	1.1			
41	609	CAUSTIC UNLOADING PUMP	1				2	0.3	2.3			
41	610	SULFOLANE MAKEUP PUMP	2				3	0.4	3.4			
41	611	SULFOLANE UNLOADING PUMP	1				7	1	8			
41	612	SULFINOL MAKEUP PUMP	2				3	0.4	3.4			
41	613	SULFINOL UNLOADING PUMP	1				5	1	6			
41	614	ANTIFOAM AGENT DISTRIBUTION PUMP	2				1	0.1	1.1			
41	615	ANTIFOAM AGENT UNLOADING PUMP	1				1	0.1	1.1			

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41	616	OFF SPEC PUMP	2				4	1	5			
41	617	REFRIGERANT UNLOADING PUMP	1				1	0.1	1.1			
41	618	REFRIGERANT DISTRIBUTION PUMP	2				1	0.1	1.1			
41	619	ODORANT UNLOADING PUMP	1				2	0.3	2.3			
41	620	ACID UNLOADING PUMP	1				2	0.3	2.3			
41	621	ACID DISTRIBUTION PUMP	2				1	0.1	1.1			
41	622	STRETFORD REAGENT MAKEUP PUMP	1				1	0.1	1.1			
41	623	STRETFORD REAGENT DRUM PUMP	1				1	0.1	1.1			
41	626	CATIONIC POLYMER DISTRIBUTION PUMP	2							[W/46710]		
41	628	PHOSPHATE DISTRIBUTION PUMP	2				1	0.1	1.1			
41	630	DISODIUM PHOSPHATE DISTRIBUTION PUMP	2				1	0.1	1.1			
41	632	SULFITE DISTRIBUTION PUMP	2				6	1	7			
41	634	LIGHT FUEL DAY PUMP	2				7	1	8			
41	635	CATIONIC POLYMER UNLOADING PUMP	1				1	0.1	1.1			
41	636	ODORANT METERING PUMP	2				2	0.3	2.3			
41	637	ANIONIC POLYMER DISTRIBUTION PUMP	2							[W/46710]		
41	638	CHILLER FEED PUMP	2				15	2	17			
41	639	CHILLER RETURN PUMP	2				15	2	17			
41	640	AMMONIA OFF SPEC PUMP	2				5	1	6			

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41	641	LPG OFF SPEC PUMP	2				4	1	5			
41	643	PHENOL LOADING PUMP	1				1	0.1	1.1			
41	644	PYRIDINE LOADING PUMP	1				3	0.4	3.4			
41	645	ACETONE DISTRIBUTION PUMP	2				1	0.1	1.1			
41	646	ACETONE UNLOADING PUMP	1				1	0.1	1.1			
41	647	POTASSIUM CARBONATE DISTRIBUTION PUMP	2				1	0.1	1.1			
41	648	POTASSIUM CARBONATE UNLOADING PUMP	1				1	0.1	1.1			
41	651	AREA 6 EVACUATION PUMP	2				2	0.3	2.3			
41	652	AREA 6 API OIL PUMP	2				2	0.3	2.3			
41	653	AREA 6 API WATER PUMP	2				2	0.3	2.3			
41	654	LIGHT FUEL OFF SPEC PUMP	2				3	0.4	3.4			
41	655	PLANT CT PHOSPHATE PUMP	2				3	0.4	3.4			
41	656	OXYGEN PLANT CT PHOSPHATE PLANT	2				2	0.3	2.3			
41	657	PLANT CT ZINC INHIBITOR	2				3	0.4	3.4			
41	658	OXYGEN PLANT CT ZINC INHIBITOR PUMP	2				2	0.3	2.3			
41	659	PLANT CT DISPERSANT PUMP	2				3	0.4	3.4			
41	660	OXYGEN PLANT CT DISPERSANT PUMP	2				2	0.3	2.3			
41	661	PLANT CT SULFURIC ACID PUMP	2				5	1	6			
41	662	OXYGEN PLANT CT SULFURIC ACID PUMP	2				4	1	5			

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41	663	WASTE WATER POLYMER PUMP	2							[W/48704]		
43	601	SULFUR CONVEYOR	1				58	8	66			
43	602	LIME SCREW CONVEYOR	1				12	2	14			
43	603	SODA ASH WEIGH BELT	1				13	2	15			
43	604	SALT CONVEYOR	1				7	1	8			
43	605	)AD ASH ROTARY FEEDER	1				2	0.3	2.3			
43	606	RADIAL STACKER CONVEYOR	1				30	4	34			
43	607	INCLINED BELT CONVEYOR	1				60	8	68			
43	608	PHOSPHATE SCREW CONVEYOR	1				1	0.1	1.1			
43	609	DISODIUM PHOSPHATE SCREW CONVEYOR	1				1	0.1	1.1			
43	610	SULFITE SCREW CONVEYOR	1				1	0.1	1.1			
44	601	FLAKER CHILLER	1				95	12	107			
46	601	DUST CONTROL SYSTEM	1				2	0.3	2.3			
46	602	CITRIC ACID STORAGE	1				7	1	8			
46	603	AMMONIA SYSTEM	1				42	5	47			
46	605	ANIONIC POLYMER SYSTEM	1							[W/46710]		
46	606	WASTE WATER POLYMER SYSTEM	1							[W/48704]		
46	607	STEAM BOILER CHEMICAL SYSTEM	5				15	2	17			
46	608	METHANATOR WHB CHEMICAL SYSTEM	2				6	1	7			
46	609	GASIFIER GENERATOR CHEMICAL SYSTEM	2				6	1	7			

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46	610	CO SHIFT CHEMICAL SYSTEM	2				6	1	7			
46	611	CLAUS L.P. CHEMICAL SYSTEM	2				6	1	7			
46	612	CLAUS H.P. CHEMICAL SYSTEM	2				6	1	7			
46	613	300 PSIG STEAM CHEMICAL SYSTEM	2				6	1	7			
46	614	GASIFIER WHB CHEMICAL SYSTEM	2				6	1	7			
47	601	LIME DUST COLLECTOR	1				16	2	18			
47	602	PROPANE DILUTION BLOWER	1							[W/48604]		
47	603	SODA ASH BLOWER	1				37	5	42			
47	604	SODA ASH DUST COLLECTOR	1							[W/47603]		
47	605	PHOSPHATE UNLOADING BLOWER	1				38	5	43			
47	606	DISODIUM PHOSPHATE UNLOADING BLOWER	1				38	5	43			
47	607	SULFITE UNLOADING BLOWER	1				38	5	43			
47	608	PHOSPHATE DUST COLLECTOR	1							[W/47605]		
47	609	DISODIUM PHOSPHATE DUST COLLECTOR	1							[W/47606]		
47	610	SULFITE DUST COLLECTOR	1							[W/47607]		
48	601	SULFUR FLAKER	1				343	45	388			
48	602	SLIDE GATE	1				3	0.4	3.4			
48	603	RETRACTABLE LOADING SPROUT	1				2	0.3	2.3			
48	604	PROPANE VAPORIZER	1				720	94	814			

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48	605	PROPANE-AIR MIXER	1							[W/48604]		
48	606	STRETFORD SCALE	1				3	0.4	3.4			
48	607	STRETFORD HOIST	1				2	0.3	2.3			
48	608	FRONT END LOADER	1				65	8	73			
48	609	ANIONIC POLYMER HOIST	1				2	0.3	2.3			
48	610	AREA 6 EVACUATION SYSTEM	1				4	1	5		(END AREA 6	

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31	701	L.P. BFW INTERCHANGER	1				58	8	66		(BEGIN AREA 7)	
33	706	LIME HOLD TANK	1				4	1	5			
33	707	$_{p}$H ADJUSTMENT REACTOR	1							[W/48704]		
33	706A	AGITATOR FOR 33706	1				1	0.1	1.1			
33	707A	AGITATOR FOR 33707	1							[W/48704]		
34	701	CLEAR WELL	1							[W/46710]		
34	702	SLUDGE SUMP	1							[W/47610]		
34	706	NEUTRALIZATION SUMP	1							[W/46708]		
34	707	DEMINERALIZED WATER SURGE TANK	1	52	7	59						
34	709	FILTRATE SUMP	1							[W/48704]		
34	710	STEAM BOILER DEAERATOR VESSEL	5	130	17	147						
34	711	CO SHIFT DEAERATOR VESSEL	2	41	5	46						
34	713	L.P. BFW STORAGE TANK	1	38	5	43						
34	714	GASIFIER WHB DEAERATOR VESSEL	2	46	6	52						
34	715	SPENT BRINE SUMP	1							[W/46707]		
34	716	POTABLE WATER STORAGE TANK	1	35	5	40						
35	701	PLANT AIR RECEIVER	5				40	5	45			
35	702	WET INSTRUMENT AIR RECEIVER	6				174	23	197			
35	703	DRY INSTRUMENT AIR RECEIVER	6				174	23	197			
35	705	GRIT BOX	3				6	1	7			

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35	707	20 PSIG CONDENSATE TANK	3				54	7	61			
35	708	900 PSIG CONDENSATE TANK	2				2	0.3	2.3			
35	709	300 PSIG CONDENSATE TANK	2				26	3	29			
35	710	TURBINE CONDENSATE TANK	2				30	4	34			
35	714	METHANATOR WHB DEAERATOR VESSEL	2				29	4	33			
35	715	GASIFIER GENERATOR DEAERATOR VESSEL	2				22	3	25			
35	716	CLAUS L.P. DEAERATOR VESSEL	2				25	3	28			
35	717	CLAUS H.P. DEAERATOR VESSEL	2				16	2	18			
35	718	300 PSIG STEAM DEAERATOR VESSEL	2				29	4	33			
41	701	SLUDGE PUMP	2							[W/46710]		
41	702	CLARIFIED WATER PUMP	4							[W/46710]		
41	703	FILTER FEED PUMP	2							[W/46710]		
41	705	FILTERED WATER PUMP	2							[W/46710]		
41	706	POTABLE WATER PUMP	2							[W/46710]		
41	707	PLANT HOT WELL PUMP	16				5056	657	5713			
41	708	PLANT COLD WELL PUMP	14				4844	630	5474			
41	709	O_2 PLANT HOT WELL PUMP	2				220	29	249			
41	710	O_2 PLANT COLD WELL PUMP	2				336	44	380			
41	711	CHLORINATION BOOSTER PUMP	2				6	1	7			
41	713	POTABLE WATER FEED PUMP	2				4	1	5			

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41	714	NEUTRALIZATION SUMP PUMP	2				5	1	6			
41	715	H.P. DEAERATOR FEED PUMP	4				37	5	42			
41	717	350 PSIG BFW PUMP	2				72	9	81			
41	718	75 PSIG BFW PUMP	2				69	9	78			
41	722	COAL PILE RUNOFF PUMP	2							[W/48704]		
41	723	LIME PUMP	2				2	0.3	2.3			
41	727	WASTE WATER CLARIFIER SLUDGE PUMP	3							[W/48704]		
41	728	FILTRATE SUMP PUMP	2							[W/48704]		
41	735	FIRE PROTECTION PUMP	6				185	24	209			
41	736	L.P. DEAERATOR FEED PUMP	2				55	7	62			
41	737	20 PSIG CONDENSATE PUMP	6				67	9	76			
41	739	TURBINE CONDENSATE PUMP	4				48	6	54			
41	742	GASIFIER CONDENSATE PUMP	4				4	1	5			
41	743	985 PSIG CONDENSATE PUMPS	4				5	1	6			
41	748	GASIFIER RETURN PUMP	4				4	1	5			
41	749	985 PSIG RETURN PUMP	4				4	1	5			
41	750	SPENT BRINE SUMP PUMP	2							[W/46707]		
41	751	STEAM BOILER FEED PUMP	10				2315	301	2616			
41	752	METHANATOR WHD FEED PUMP	4				19	2	21			
41	753	GASIFIER GENERATOR FEED PUMP	4				9	1	10			

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

Prepared For: Department of Energy
Prepared By: U.S. Army Corps of Engineers, Huntsville Division

ALL FIGURES = THOUSANDS ($000) DOLLARS

ACCT NO. C'TRL	ACCT NO. DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
41	754	CO SHIFT STEAM GENERATOR FEED PUMP	4				25	3	28			
41	755	CLAUS L.P. WHB FEED PUMP	4				8	1	9			
41	756	CLAUS H.P. WHB FEED PUMP	4				123	16	139			
41	757	300 PSIG STEAM GENERATOR FEED PUMP	4				128	17	145			
41	758	GASIFIER WHB FEED PUMP	4				496	64	560			
44	701	STEAM BOILER	1	92040	11965	104005						
44	702	HEATING GAS GENERATOR	1				100	13	113			
44	704	RECYCLE GAS SECONDARY HEATER	1				360	47	407			
44	705	RECYCLE GAS PRIMARY HEATER	1				775	101	876			
44	706	L.P. STEAM SUPERHEATER	1				335	44	379			
44	707	PLANT COOLING TOWER	1	11000	1430	12430						
44	708	O_2 PLANT COOLING TOWER	1	1400	182	1582						
45	701	INSTRUMENT WET AIR FILTER	6							[W/48701]		
45	702	INSTRUMENT DRY AIR FILTER	6							[W/48701]		
45	704	SLUDGE BELT FILTER SYSTEM	1							[W/48704]		
46	701	PLANT AIR SYSTEM	5				70	9	79			
46	702	INSTRUMENT AIR SYSTEM	6				348	45	393			
46	704	RIVER WATER PUMPING STATION	1							3466	451	3917
46	707	ZEOLITE WATER SOFTENER	1				443	58	501			
46	708	DEMINERALIZATION SYSTEM	1				965	125	1090			

CLEAN BOILER FUEL FACILITY

CONCEPTUAL COMMERCIAL DESIGN AND FEASIBILITY EVALUATION

Prepared For: Department of Energy
Prepared By: U.S. Army Corps of Engineers, Huntsville Division

ALL FIGURES = THOUSANDS ($000) DOLLARS

ACCT NO C'TRL	ACCT NO DETAIL	DESCRIPTION	QTY	DRAVO M.L. OHP SUB-CONTR	USAEDH ESCALATION	SUB-CONTR M.L. OHP W/ESCALATION	DRAVO PURCHASE MAT'L	USAEDH ESCALATION	M.L. OHP W/ESCALATION	DRAVO NOTE 1	USAEDH ESCALATION	NOTE 1 W/ESCALATION
46	709	CHLORINATOR	2				30	4	34			
46	710	DEEP BED SAND FILTER SYSTEM	1							5429	706	6135
46	711	CHLORINATOR POTABLE WATER SYSTEM	1							[W/46710]		
46	712	ORGANIC & SANITARY WASTE TREAT. PLANT	1							3784	492	4276
46	713	STEAM BOILER DEAERATOR	5				570	74	644			
46	714	METHANATOR WHB DEAERATOR	2				110	14	124			
46	715	GASIFIER GENERATOR DEAERATOR	2				64	8	72			
46	716	CO SHIFT DEAERATOR	2				180	23	203			
46	717	CLAUS L.P. DEAERATOR	2				63	8	71			
46	718	CLAUS H.P. DEAERATOR	2				40	5	45			
46	719	300 PSIG STEAM DEAERATOR	2				137	18	155			
46	720	GASIFIER WHB DEAERATOR	2				204	27	231			
46	722	ELECTROSTATIC PRECIPITATOR	1	20000	2600	22600						
48	701	AIR DRYER	6				111	14	125			
48	702	REACTOR CLARIFIER	2							[W/46710]		
48	703	LIME SLAKER	1				25	3	28			
48	704	WASTE WATER CLARIFIER	2							3357	436 (END AREA 7)	3793

NOTE 1: A COMPLETELY ENGINEERED AND ERECTED SYSTEM WITHIN A BATTERY LIMIT.

PROCEDURE #3

DEVELOP COST VERIFICATION FACTORS

A. Explanation

Validation capital cost of material subcontracted items developing a factor for cost accuracy.

B. Formula

$$\text{Cost Verification Factor}_{\text{USAEDH}} = CVF_H$$

BASIS FOR COST VERIFICATION FACTOR (CVF_H)

USAEDH randomly selected entries from the subcontracts and materials columns of the DRAVO estimate. These items are believed to be representative of the various prices. The items were selected from each of the plant areas and from each of the subcategories of the plant area.

These items were then independently priced based on the specifications and available data. The individual item prices were derived from various pricing manuals, previous estimates, quoted prices, and various other means.

The USAEDH item prices were then compared with the DRAVO item prices resulting in the following:

6% of the DRAVO item prices were 10% lower than the USAEDH item prices

18% of the DRAVO item prices were the same as the USAEDH item prices

37% of the DRAVO item prices were 13% higher than the USAEDH item prices

12% of the DRAVO item prices were 25% higher than the USAEDH item prices

25% of the DRAVO item prices were 35% higher than the USAEDH item prices

Based on the above percentages, a weighted average was then computed yielding a factor which indicated that the average DRAVO price was 15.9% high.

This factor or percentage was then applied to all the DRAVO prices to arrive at a new validated cost.

PROCEDURE #4

ADJUST DRAVO'S ESTIMATE

A. Explanation

The escalated DRAVO cost for material and sub-contract were multiplied by the cost verification factor to arrive at a USAEDH material and sub-contract cost.

B. Formula

EM_D = Escalated Material DRAVO

$EM_D \times CVF_H = EMVC_H$

CVF_H = Cost Verification Factor USAEDH

$EMVC_H$ = Escalated Material Verified Cost USAEDH

ES_D = Escalated Subcontracts DRAVO

$ES_D \times CVF_H = ESVC_H$

CVF_H = Cost Verification Factor USAEDH

$ESVC_H$ = Escalated Subcontract Verified Cost USAEDH

U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 1 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: SUMMARY | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	ESCALATED SUBCONTRACT VERIFIED COST USAEDH SUMMARY BY AREA				
	AREA NO. 1 - COAL HANDLING & PREP.				$ 7,840,643
	AREA NO. 2 - HYDROCARBONIZATION				$ 23,381,919
	AREA NO. 3 - FRACTIONATION & GAS PURIFICATION				$ 37,105,635
	AREA NO. 4 - HYDROGEN PRODUCTION				$ 25,548,672
	AREA NO. 5 - SULFUR RECOVERY				$ -0-
	AREA NO. 6 - STORAGE				$ 21,053,611
	AREA NO. 7 - UTILITIES				$118,584,078
	TOTAL $ESVC_H$				$233,514,558

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4 MAR 68

U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 2 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 1 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	ES_D	X	CVF_H	$ESVC_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	9,323,000	X	0.841	$ 7,840,643
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(FROM PAGE 6, COL. 3)				
	(TO PAGE 68)				
	(TO PAGE 45 FOR REF. ONLY)				
	TOTAL ESCALATED SUBCONTR. VERIFIED COST AREA NO. 1				$ 7,840,643

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 3 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 2 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	ES_D	X	CVF_H	$ESVC_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	27,802,520	X	0.841	$ 23,381,919
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(FROM PAGE 7, COL. 3)				
	(TO PAGE 69)				
	(TO PAGE 45 FOR REF. ONLY)				
	TOTAL ESCALATED SUBCONTR. VERIFIED COST AREA NO. 2				$ 23,381,919

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 4 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 3 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	ES_D	X	CVF_H	$ESVC_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS	22,003,360	X	0.841	$ 18,504,826
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	7,879,490	X	0.841	6,626,651
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS	14,238,000	X	0.841	11,974,158
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(THESE FROM PAGE 8, COL. 3)				
	(THESE TO PAGE 70)				
	(TO PAGE 45 FOR REF. ONLY)				
	TOTAL ESCALATED SUBCONTR. VERIFIED COST AREA NO. 3				$ 37,105,635

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE	DATE PREPARED: 27 September 1977	SHEET 5 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO	CWE	PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 4	ESTIMATOR: FORDHAM	CHECKED BY: SKETO	APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	ES_D	X	CVF_H	$ESVC_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS	27,836,420	X	0.841	$ 23,410,429
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	2,542,500	X	0.841	2,138,243
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(THESE FROM PAGE 9, COL. 3)				
	(THESE TO PAGE 71)				
	(TO PAGE 45 FOR REF. ONLY)				
	TOTAL ESCALATED SUBCONTR. VERIFIED COST AREA NO. 4				$ 25,548,672

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 6 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 5 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	ES_D	X	CVF_H	$ESVC_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS				
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				-0-
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(TO PAGE 45 FOR REF. ONLY)				
	TOTAL ESCALATED SUBCONTR. VERIFIED COST AREA NO. 5				$ -0-

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE	DATE PREPARED: 27 September 1977	SHEET 7 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO	CWE:	PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 6	ESTIMATOR: FORDHAM	CHECKED BY: SKETO	APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	ES_D	X	CVF_H	$ESVC_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	25,034,020	X	0.841	$ 21,053,611
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(FROM PAGE 11, COL. 3)				
	(TO PAGE 73)				
	(TO PAGE 45 FOR REF. ONLY)				
	TOTAL ESCALATED SUBCONTR. VERIFIED COST AREA NO. 6				$ 21,053,611

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 8 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 7 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	ES_D	X	CVF_H	$ESVC_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	386,460	X	0.841	$ 325,013
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &	118,017,200	X	0.841	99,252,465
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS	22,600,000	X	0.841	19,006,600
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(THESE FROM PAGE 12, COL. 3)				
	(THESE TO PAGE 74)				
	(TO PAGE 45 FOR REF. ONLY)				
	TOTAL ESCALATED SUBCONTR. VERIFIED COST AREA NO. 7				$ 118,584,078

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE	DATE PREPARED: 27 September 1977	SHEET 1 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO	CWE	PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. SUMMARY	ESTIMATOR: FORDHAM	CHECKED BY: SKETO	APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	ESCALATED MATERIAL VERIFIED COST USAEDH				
	AREA NO. 1 - COAL HANDLING & PREP.				$ 21,178,105
	AREA NO. 2 - HYDROCARBONIZATION				$ 1,539,534
	AREA NO. 3 - FRACTIONATION & GAS PURIFICATION				$ 78,431,686
	AREA NO. 4 - HYDROGEN PRODUCTION				$ 57,308,701
	AREA NO. 5 - SULFUR RECOVERY				$ 2,851
	AREA NO. 6 - STORAGE				$ 2,429,044
	AREA NO. 7 - UTILITIES				$ 18,784,223
	TOTAL $EMVC_H$				$179,674,144

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 2 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 1 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	EM_D	X	CVF_H	$EMVC_H$
31000	HEAT EXCHANGERS	232,780	X	0.841	$ 195,768
32000	TOWERS & COLUMNS	-		-	-
33000	AGITATED VESSELS	5,650	X	0.841	$ 4,752
34000	FIELD FABRICATED TANKS	127,690	X	0.841	$ 107,387
35000	PROCESS TANKS & OTHER VESSELS	-		-	-
41000	PUMPS	359,340	X	0.841	302,205
42000	COMPRESSORS	1,808,000	X	0.841	1,520,528
43000	MECHANICAL CONVEYING EQUIP.	708,510	X	0.841	595,857
44000	FURNACES, HEATERS, BOILERS & COOLERS	192,100	X	0.841	161,556
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.	-		-	-
46000	PACKAGE UNITS OR SYSTEMS	15,876,500	X	0.841	13,352,137
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	5,871,480	X	0.841	4,937,915
48000	UNCLASSIFIED PROCESS EQUIPMENT	-		-	-
	(THESE FROM PAGE 6, COL. 6)				
	(THESE TO PAGE 76)				
	(TO PAGE 53 FOR REF. ONLY)				
	TOTAL ESCALATED MAT'L. VERIFIED COST AREA NO. 1				$21,178,105

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 3 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 2 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	EM_D	X	CVF_H	$EMVC_H$
31000	HEAT EXCHANGERS	-		-	-
32000	TOWERS & COLUMNS	-		-	-
33000	AGITATED VESSELS	-		-	-
34000	FIELD FABRICATED TANKS	176,280	X	0.841	$ 148,251
35000	PROCESS TANKS & OTHER VESSELS	24,860	X	0.841	20,907
41000	PUMPS	6,780	X	0.841	5,702
42000	COMPRESSORS	-		-	-
43000	MECHANICAL CONVEYING EQUIP.	-		-	-
44000	FURNACES, HEATERS, BOILERS &	1,017,000	X	0.841	855,297
	COOLERS				
45000	MECHANICAL SEPARATORS,	-		-	-
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS	4,520	X	0.841	3,801
47000	PROCESS BLOWER SYSTEM,	601,160	X	0.841	505,576
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT	-		-	-
	(THESE FROM PAGE 7, COL 6.)				
	(THESE TO PAGE 77)				
	(TO PAGE 53 FOR REF. ONLY)				
	TOTAL ESCALATED MAT'L. VERIFIED COST AREA NO. 2				$1,539,534

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4 MAR 68

U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 4 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 3 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	EM_D	X	CVF_H	$EMVC_H$
31000	HEAT EXCHANGERS	45,352,550	X	0.841	$38,141,495
32000	TOWERS & COLUMNS	13,580,340	X	0.841	11,421,066
33000	AGITATED VESSELS	6,780	X	0.841	5,702
34000	FIELD FABRICATED TANKS	-		-	-
35000	PROCESS TANKS & OTHER VESSELS	683,650	X	0.841	574,950
41000	PUMPS	2,008,010	X	0.841	1,688,736
42000	COMPRESSORS	25,470,200	X	0.841	21,420,438
43000	MECHANICAL CONVEYING EQUIP.	-		-	-
44000	FURNACES, HEATERS, BOILERS & COOLERS	2,072,420	X	0.841	1,742,905
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.	282,500	X	0.841	237,583
46000	PACKAGE UNITS OR SYSTEMS	3,310,900	X	0.841	2,784,467
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	-		-	-
48000	UNCLASSIFIED PROCESS EQUIPMENT	492,680	X	0.841	414,344
	(THESE FROM PAGE 8, COL. 6)				
	(THESE TO PAGE 78)				
	(TO PAGE 53 FOR REF. ONLY)				
	TOTAL ESCALATED MAT'L. VERIFIED COST AREA NO. 3				$78,431,686

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE	DATE PREPARED: 27 September 1977	SHEET 5 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO	CWE	PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 4	ESTIMATOR: FORDHAM	CHECKED BY: SKETO	APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	EM_D	X	CVF_H	$EMVC_H$
31000	HEAT EXCHANGERS	48,971,940	X	0.841	$41,185,402
32000	TOWERS & COLUMNS	81,360	X	0.841	68,424
33000	AGITATED VESSELS	-		-	-
34000	FIELD FABRICATED TANKS	-		-	-
35000	PROCESS TANKS & OTHER VESSELS	969,540	X	0.841	815,383
41000	PUMPS	1,192,150	X	0.841	1,002,598
42000	COMPRESSORS	11,017,500	X	0.841	9,265,718
43000	MECHANICAL CONVEYING EQUIP.	-		-	-
44000	FURNACES, HEATERS, BOILERS & COOLERS	1,271,250	X	0.841	1,069,121
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.	-		-	-
46000	PACKAGE UNITS OR SYSTEMS	2,206,890	X	0.841	1,855,994
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	2,163,950	X	0.841	1,819,882
48000	UNCLASSIFIED PROCESS EQUIPMENT	268,940	X	0.841	226,179
	(THESE FROM PAGE 9, COL. 6)				
	(THESE TO PAGE 79)				
	(TO PAGE 53 FOR REF. ONLY)				
	TOTAL ESCALATED MAT'L. VERIFIED COST AREA NO. 4				$57,308,701

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE	DATE PREPARED: 27 September 1977	SHEET 6 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO	CWE	PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 5	ESTIMATOR: FORDHAM	CHECKED BY: SKETO	APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	EM_D	X	CVF_H	$EMVC_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS				
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT	3,390	X	0.841	$ 2,851
	(FROM PAGE 10, COL. 6)				
	(TO PAGE 80)				
	(TO PAGE 53 FOR REF. ONLY)				
	TOTAL ESCALATED MAT'L. VERIFIED COST AREA NO. 5				$ 2,851

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 7 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 6 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	EM_D	X	CVF_H	$EMVC_H$
31000	HEAT EXCHANGERS	11,300	X	0.841	$ 9,503
32000	TOWERS & COLUMNS	-		-	-
33000	AGITATED VESSELS	54,240	X	0.841	45,616
34000	FIELD FABRICATED TANKS	-		-	-
35000	PROCESS TANKS & OTHER VESSELS	636,190	X	0.841	535,036
41000	PUMPS	266,680	X	0.841	224,278
42000	COMPRESSORS	-		-	-
43000	MECHANICAL CONVEYING EQUIP.	209,050	X	0.841	175,811
44000	FURNACES, HEATERS, BOILERS & COOLERS	107,350	X	0.841	90,281
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.	-		-	-
46000	PACKAGE UNITS OR SYSTEMS	122,040	X	0.841	102,636
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	188,710	X	0.841	158,705
48000	UNCLASSIFIED PROCESS EQUIPMENT	1,292,720	X	0.841	1,087,178
	(THESE FROM PAGE 11, COL. 6)				
	(THESE TO PAGE 81)				
	(TO PAGE 53 FOR REF. ONLY)				
	TOTAL ESCALATED MAT'L. VERIFIED COST AREA NO. 6				$2,429,044

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 8 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 7 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	EM_D	X	CVF_H	$EMVC_H$
31000	HEAT EXCHANGERS	65,540	X	0.841	$ 55,119
32000	TOWERS & COLUMNS	-		-	-
33000	AGITATED VESSELS	5,650	X	0.841	4,752
34000	FIELD FABRICATED TANKS	-		-	-
35000	PROCESS TANKS & OTHER VESSELS	708,510	X	0.841	595,857
41000	PUMPS	15,984,980	X	0.841	13,443,368
42000	COMPRESSORS	-		-	-
43000	MECHANICAL CONVEYING EQUIP.	-		-	-
44000	FURNACES, HEATERS, BOILERS & COOLERS	1,774,100	X	0.841	1,492,018
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.	-		-	-
46000	PACKAGE UNITS OR SYSTEMS	3,643,120	X	0.841	3,063,864
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	-		-	-
48000	UNCLASSIFIED PROCESS EQUIPMENT	153,680	X	0.841	129,245
	(THESE FROM PAGE 12, COL. 6)				
	(THESE TO PAGE 82)				
	(TO PAGE 53 FOR REF. ONLY)				
	TOTAL ESCALATED MAT'L. VERIFIED COST AREA NO. 7				$ 18,784,223

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PROCEDURE # 5

DEVELOP CONSTRUCTION FACTORS

A. Explanation

Construction factors were developed to indicate cost for piping, concrete, instrumentation, steel, etc.

B. Formula

Subcontract Construction Factor $= SCF_H$
USAEDH

Material Construction Factor $= MCF_H$
USAEDH

Note #1 Construction Factor $= N1CF_H$
USAEDH

BASIS FOR MATERIAL CONSTRUCTION VERIFICATION FACTOR (MCF_H)

USAEDH construction factors were determined by using the ratio of total construction cost to equipment cost for similar items in other projects with appreciably more design completion.

Various methods and reasoning were used for determining construction factors in the different areas as follows:

Area 1 - Coal Handling

USAEDH's smaller factor is primarily attributed to prime erected tanks, the packaged system of coal pulverizing, and the process blower system. The magnitude and type of installation influenced the construction factor greatly in previous projects resulting in a USAEDH factor of 2.03 for this area.

Area 2 - Hydrocarbonization

Hydrocarbonization is a process that requires a mandatory amount of instrumentation crucial to certain aspects of a system's function, resulting in the 2.80 as an USAEDH factor.

Area 3 - Fractionation and Gas Purification

The piping and filters involved in this multicomponent process are essential for the distillation of the product and are also used to obtain USAEDH's factor of 2.05.

Area 4 - Hydrogen Production

The desired gas split which produced hydrogen is effected by the cryogenic separation system. This system with associated process equipment was weighed against similar items to reach the factor of 1.81.

Area 5 - Sulfur Recovery

The factor of 1.50 used in this area is drawn from USAEDH's experience with unclassified process equipment in similar projects of comparable size.

Area 6 - Storage

The size and peculiarities of chemical storage vessels, processes to solidify specified agents for storage, and the conveying of these substances brought about USAEDH's factor of 2.10.

Area 7 - Utilities

USAEDH's factor of 2.96 reflects the influence of a vast number of pumps with a large construction factor applied. This offsets the package units tendency to lower the overall factor for this area.

As an overall picture of the preceding statements, Dravo applied a construction factor of 2.25 to the cost of material (Column 2) to arrive at a cost in place. USAEDH derived a construction factor of 2.07 (a weighted average number based on different material categories). This factor was developed from past experience with facilities of this size and nature. In addition, the development of these numbers included the studies of ICGG, Wheelabrator-Frye and CONOCO.

BASIS FOR NOTE #1 CONSTRUCTION VERIFICATION FACTOR ($N1CVF_H$)

The Note #1 construction verification factor represents overhead and profit for the prime contractor. Based on the job size, degree of risk, job complexity, contractors investment and performance period, we choose a factor of 1.15. USAEDH believes this factor represents a fair and reasonable margin.

This factor is identical with DRAVO's factor of 1.15.

BASIS FOR SUCONTRACT CONSTRUCTION VERIFICATION FACTOR (SCF_H)

Areas 1, 2 & 6 - Coal Handling - Hydrocarbonization - Storage Field

fabricated tanks, being the only subcontracted item in these areas, were analyzed on an individual basis using size, material and function to determine the appropriate amount of foundation structure and piping work required. USAEDH applied a construction factor of 1.77.

Area 3 - Fractionation and Gas Purification

The complexity associated with towers and columns, the type of installation and the value of components in the three categories of subcontract equipment contribute to USAEDH's construction factor of 1.60.

Area 4 - Hydrogen Production

USAEDH's construction factor of 1.58 is based on the size and structure of the gasifier and reactors in this area.

Area 5 - Sulfur Recovery

Subcontract cost - N/A

Area 7 - Utilities

This area, having steam boilers, precipitators, and coolers represents the bulk of the subcontractor work and is the major determining factor for the decision to use 1.77 as USAEDH's construction factor.

In summary, a weighted average of factors for the applicable areas yields a factor of 1.72, which compares favorably with the factor of 1.75 used by DRAVO.

PROCEDURE # 6

ADJUST DRAVO's ESTIMATES FOR TOTAL INPLACE COST

A. Explanation

The USAEDH capital cost were then multiplied by USAEDH construction factors to develop total inplace cost.

B. Formula

$EMVC_H$ = Escalated Material Verified Cost USAEDH

$EMVC_H \times MCF_H = MTCIP_H$

MCF_H = Material Construction Factor USAEDH

$MTCIP_H$ = Material Total Cost Inplace USAEDH

$ESVC_H$ - Escalated Subcontract Verified Cost USAEDH

$ESVC_H \times SCF_H = STCIP_H$

SCF_H = Subcontract Construction Factor 2 USAEDH

$STCIP_H$ = Subcontract Total Cost Inplace USAEDH

U.S ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 1 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: SUMMARY | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT TOTAL COST INPLACE SUMMARY BY AREA				
	AREA NO. 1 - COAL HANDLING & PREP.				$ 13,877,938
	AREA NO. 2 - HYDROCARBONIZATION				$ 41,385,997
	AREA NO. 3 - FRACTIONATION & GAS PURIFICATION				$ 59,515,871
	AREA NO. 4 - HYDROGEN PRODUCTION				$ 40,304,959
	AREA NO. 5 - SULFUR RECOVERY				$ -0-
	AREA NO. 6 - STORAGE				$ 37,264,891
	AREA NO. 7 - UTILITIES				$210,252,663
	TOTAL STCIP H				$402,602,319
	(TO PAGE 93)				

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 2 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 1 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	$ESVC_H$	X	SCF_H	$STCIP_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	7,840,643	X	1.77	$ 13,877,938
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(FROM PAGE 46)				
	(TO PAGE 67 FOR REF. ONLY)				
	TOTAL SUBCONTRACT COST INPLACE AREA NO. 1				$ 13,877,938

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 3 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 2 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	ESVC H	X	SCF H	STCIP H
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	23,381,919	X	1.77	$ 41,385,997
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(FROM PAGE 47)				
	(TO PAGE 67 FOR REF. ONLY)				
	TOTAL SUBCONTRACT COST INPLACE AREA NO. 2				$ 41,385,997

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U.S ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 4 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 3 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	$ESVC_H$	X	SCF_H	$STCIP_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS	18,504,826	X	1.56	$ 28,867,529
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	6,626,651	X	1.77	11,729,172
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS	11,974,158	X	1.58	18,919,170
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(THESE FROM PAGE 48)				
	(TO PAGE 67 FOR REF. ONLY)				
	TOTAL SUBCONTRACT COST INPLACE AREA NO. 3				$ 59,515,871

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 5 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 4 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	ESVC H	X	SCF H	STCIP H
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS	23,410,429	X	1.56	$ 36,520,269
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	2,138,243	X	1.77	3,784,690
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(THESE FROM PAGE 49)				
	(TO PAGE 67 FOR REF. ONLY)				
	TOTAL SUBCONTRACT COST INPLACE AREA NO. 4				$ 40,304,959

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 6 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 5 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	$ESVC_H$	X	SCF_H	$STCIP_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS				
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				-0-
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(TO PAGE 67 FOR REF. ONLY)				
	TOTAL SUBCONTRACT COST INPLACE	AREA NO. 5			$ -0-

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 7 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 6 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	ESVC H	X	SCF H	STCIP H
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	21,053,611	X	1.77	$ 37,264,891
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(FROM PAGE 51)				
	(TO PAGE 67 FOR REF. ONLY)				
	TOTAL SUBCONTRACT COST INPLACE AREA NO. 6				$ 37,264,891

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 8 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 7 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	SUBCONTRACT	$ESVC_H$	X	SCF_H	$STCIP_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS	325,013	X	1.77	$ 575,273
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &	99,252,465	X	1.81	179,646,962
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS	19,006,600	X	1.58	30,030,428
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(THESE FROM PAGE 52)				
	(TO PAGE 67 FOR REF. ONLY)				
	TOTAL SUBCONTRACT COST INPLACE AREA NO. 7				$210,252,663

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 1 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: SUMMARY | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL TOTAL COST INPLACE SUMMARY BY AREA				
	AREA NO. 1 - COAL HANDLING & PREP.				$ 43,058,771
	AREA NO. 2 - HYDROCARBONIZATION				$ 4,311,172
	AREA NO. 3 - FRACTIONATION & GAS PURIFICATION				$160,822,028
	AREA NO. 4 - HYDROGEN PRODUCTION				$103,792,535
	AREA NO. 5 - SULFUR RECOVERY				$ 4,277
	AREA NO. 6 - STORAGE				$ 5,120,691
	AREA NO. 7 - UTILITIES				$ 55,655,649
	TOTAL MTCIP$_H$				$372,765,123
	(TO PAGE 93)				

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4 MAR 68

U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 2 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 1 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	EMVC H	X	MCF H	MTCIP H
31000	HEAT EXCHANGERS	195,768	X	1.71	$ 334,763
32000	TOWERS & COLUMNS	-		-	-
33000	AGITATED VESSELS	4,752	X	1.65	7,841
34000	FIELD FABRICATED TANKS	107,387	X	1.84	197,592
35000	PROCESS TANKS & OTHER VESSELS	-		-	-
41000	PUMPS	302,205	X	3.53	1,066,784
42000	COMPRESSORS	1,520,528	X	1.58	2,402,434
43000	MECHANICAL CONVEYING EQUIP.	595,857	X	1.37	816,324
44000	FURNACES, HEATERS, BOILERS &	161,556	X	1.93	311,803
	COOLERS				
45000	MECHANICAL SEPARATORS,	-		-	-
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS	13,352,137	X	1.15	15,354,958
47000	PROCESS BLOWER SYSTEM,	4,937,915	X	4.57	22,566,272
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT	-		-	-
	(THESE FROM PAGE 54)				
	(TO PAGE 75)				
	TOTAL MATERIAL COST INPLACE AREA NO. 1				$43,058,771

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 3 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 2 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	$EMVC_H$	X	MCF_H	$MTCIP_H$
31000	HEAT EXCHANGERS	-		-	-
32000	TOWERS & COLUMNS	-		-	-
33000	AGITATED VESSELS	-		-	-
34000	FIELD FABRICATED TANKS	148,251	X	1.84	$ 272,782
35000	PROCESS TANKS & OTHER VESSELS	20,907	X	2.52	52,686
41000	PUMPS	5,702	X	3.53	20,128
42000	COMPRESSORS	-		-	-
43000	MECHANICAL CONVEYING EQUIP.	-		-	-
44000	FURNACES, HEATERS, BOILERS & COOLERS	855,297	X	1.93	1,650,723
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.	-		-	-
46000	PACKAGE UNITS OR SYSTEMS	3,801	X	1.15	4,371
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	505,576	X	4.57	2,310,482
48000	UNCLASSIFIED PROCESS EQUIPMENT	-		-	-
	(THESE FROM PAGE 55)				
	(TO PAGE 75)				
	TOTAL MATERIAL COST INPLACE AREA NO. 2				$ 4,311,172

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 4 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 3 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	$EMVC_H$	X	MCF_H	$MTCIP_H$
31000	HEAT EXCHANGERS	38,141,495	X	1.71	$ 65,221,956
32000	TOWERS & COLUMNS	11,421,066	X	4.06	46,369,528
33000	AGITATED VESSELS	5,702	X	1.65	9,408
34000	FIELD FABRICATED TANKS	-		-	-
35000	PROCESS TANKS & OTHER VESSELS	574,950	X	2.52	1,448,874
41000	PUMPS	1,688,736	X	3.53	5,961,238
42000	COMPRESSORS	21,420,438	X	1.58	33,844,292
43000	MECHANICAL CONVEYING EQUIP.	-		-	-
44000	FURNACES, HEATERS, BOILERS & COOLERS	1,742,905	X	1.93	3,363,807
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.	237,583	X	3.28	779,272
46000	PACKAGE UNITS OR SYSTEMS	2,784,467	X	1.15	3,202,137
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	-		-	-
48000	UNCLASSIFIED PROCESS EQUIPMENT	414,344	X	1.50	621,516
	(THESE FROM PAGE 56)				
	(TO PAGE 75)				
	TOTAL MATERIAL COST INPLACE AREA NO. 3				$160,822,028

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 5 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 4 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	$EMVC_H$	X	MCF_H	$MTCIP_H$
31000	HEAT EXCHANGERS	41,185,402	X	1.71	$ 70,427,037
32000	TOWERS & COLUMNS	68,424	X	4.06	277,801
33000	AGITATED VESSELS	-		-	-
34000	FIELD FABRICATED TANKS	-		-	-
35000	PROCESS TANKS & OTHER VESSELS	815,383	X	2.52	2,054,765
41000	PUMPS	1,002,598	X	3.53	3,539,171
42000	COMPRESSORS	9,265,718	X	1.58	14,639,834
43000	MECHANICAL CONVEYING EQUIP.	-		-	-
44000	FURNACES, HEATERS, BOILERS & COOLERS	1,069,121	X	1.93	2,063,404
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.	-		-	-
46000	PACKAGE UNITS OR SYSTEMS	1,855,994	X	1.15	2,134,393
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	1,819,882	X	4.57	8,316,861
48000	UNCLASSIFIED PROCESS EQUIPMENT	226,179	X	1.50	339,269
	(THESE FROM PAGE 57)				
	(TO PAGE 75)				
	TOTAL MATERIAL COST INPLACE AREA NO. 4				$103,792,535

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 6 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 5 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	EMVC H	X	MCF H	MTCIP H
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS				
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS & COOLERS				
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT	2,851	X	1.50	$ 4,277
	(FROM PAGE 58)				
	(TO PAGE 75)				
	TOTAL MATERIAL COST INPLACE AREA NO. 5				$ 4,277

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 7 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 6 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	$EMVC_H$	X	MCF_H	$MTCIP_H$
31000	HEAT EXCHANGERS	9,503	X	1.71	$ 16,250
32000	TOWERS & COLUMNS	-		-	-
33000	AGITATED VESSELS	45,616	X	1.65	75,266
34000	FIELD FABRICATED TANKS.	-		-	-
35000	PROCESS TANKS & OTHER VESSELS	535,036	X	2.52	1,348,291
41000	PUMPS	244,278	X	3.53	791,701
42000	COMPRESSORS	-		-	-
43000	MECHANICAL CONVEYING EQUIP.	175,811	X	1.37	240,861
44000	FURNACES, HEATERS, BOILERS &	90,281	X	1.93	174,242
	COOLERS				
45000	MECHANICAL SEPARATORS,	-		-	
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS	102,636	X	1.15	118,031
47000	PROCESS BLOWER SYSTEM,	158,705	X	4.57	725,282
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT	1,087,178	X	1.50	1,630,767
	(THESE FROM PAGE 59)				
	(TO PAGE 75)				
	TOTAL MATERIAL COST INPLACE	AREA NO.	6		$ 5,120,691

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 8 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 7 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	MATERIAL	$EMVC_H$	X	MCF_H	$MTCIP_H$
31000	HEAT EXCHANGERS	55,119	X	1.71	$ 94,253
32000	TOWERS & COLUMNS	-		-	-
33000	AGITATED VESSELS	4,752	X	1.65	7,841
34000	FIELD FABRICATED TANKS	-		-	-
35000	PROCESS TANKS & OTHER VESSELS	595,857	X	2.52	1,501,560
41000	PUMPS	13,443,368	X	3.53	47,455,089
42000	COMPRESSORS	-		-	-
43000	MECHANICAL CONVEYING EQUIP.	-		-	-
44000	FURNACES, HEATERS, BOILERS & COOLERS	1,492,018	X	1.93	2,879,595
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.	-		-	-
46000	PACKAGE UNITS OR SYSTEMS	3,063,864	X	1.15	3,523,443
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.	-		-	-
48000	UNCLASSIFIED PROCESS EQUIPMENT	129,245	X	1.50	193,868
	(THESE FROM PAGE 60)				
	(TO PAGE 75)				
	TOTAL MATERIAL COST INPLACE AREA	NO. 7			$ 55,655,649

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PROCEDURE # 7

ADJUST DRAVO's ESTIMATES FOR PRIORITY DATA

A. Explanation

The DRAVO Note #1 could not be validated because of nonavailability of priority information. The prices of this equipment appeared reasonable and therefore was accepted. The escalated DRAVO Note #1 was multiplied by a construction factor to develop the USAEDH total inplace cost for each plant area.

B. Formula

$$EN1_D \times N1CF_H = N1TCIP_H$$

$EN1_D$ = Escalated Note #1 DRAVO

$N1CF_H$ = Note #1 Construction Factor USAEDH

$N1TCIP_H$ = Note #1 Total Cost Inplace USAEDH

U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 1 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: SUMMARY | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	NOTE 1 TOTAL COST INPLACE SUMMARY BY AREA				
	AREA NO. 1 - COAL HANDLING & PREP.				$ 20,142,250
	AREA NO. 2 - HYDROCARBONIZATION				$ -0-
	AREA NO. 3 - FRACTIONATION & GAS PURIFICATION				$ 18,193,000
	AREA NO. 4 - HYDROGEN PRODUCTION				$269,689,134
	AREA NO. 5 - SULFUR RECOVERY				$ 61,726,250
	AREA NO. 6 - STORAGE				$ -0-
	AREA NO. 7 - UTILITIES				$ 21,098,683
	TOTAL N1TCIP H				$390,849,317
	(TO PAGE 93)				

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 2 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 1 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	NOTE 1	EN1 D	X	N1CF H	N1TCIP H
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS				
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.	17,515,000	X	1.15	$ 20,142,250
44000	FURNACES, HEATERS, BOILERS & COOLERS				
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(FROM PAGE 6, COL. 9)				
	(TO PAGE 84)				
	TOTAL NOTE 1 COST INPLACE AREA NO. 1				$ 20,142,250

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 3 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION

ARCHITECT ENGINEER: DRAVO | CWE | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 2 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	NOTE 1	$EN1_D$	X	$N1CF_H$	$N1TCIP_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS				
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				-0-
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS & COOLERS				
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(TO PAGE 84)				
	TOTAL NOTE 1 COST INPLACE AREA NO. 2				$ -0-

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE	DATE PREPARED: 27 September 1977	SHEET 4 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO	CWE	PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 3	ESTIMATOR: FORDHAM	CHECKED BY: SKETO	APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	NOTE 1	$EN1_D$	X	$N1CF_H$	$N1TCIP_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS				
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS	15,820,000	X	1.15	$ 18,193,000
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(FROM PAGE 8, COL. 9)				
	(TO PAGE 84)				
	TOTAL NOTE 1 COST INPLACE AREA NO. 3				$ 18,193,000

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
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PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 5 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 4 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	NOTE 1	EN1 D	X	N1CF H	N1TCIP H
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS				
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS	234,512,290	X	1.15	$269,689,134
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(FROM PAGE 9, COL. 9)				
	(TO PAGE 84)				
	TOTAL NOTE 1 COST INPLACE AREA NO. 4				$269,689,134

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
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HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 6 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 5 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	NOTE 1	$EN1_D$	X	$N1CF_H$	$N1TCIP_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS				
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS & COOLERS				
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS	53,675,000	X	1.15	$ 61,726,250
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(FROM PAGE 10, COL. 9)				
	(TO PAGE 84)				
	TOTAL NOTE 1 COST INPLACE AREA NO. 5				$ 61,726,250

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
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HUNTSVILLE, ALABAMA

PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 7 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO. AREA 6 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	NOTE 1	$EN1_D$	X	$N1CF_H$	$N1TCIP_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS				
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				$ -0-
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS & COOLERS				
45000	MECHANICAL SEPARATORS, CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS				
47000	PROCESS BLOWER SYSTEM, CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT				
	(TO PAGE 84)				
	TOTAL NOTE 1 COST INPLACE AREA NO. 6				$ -0-

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U.S. ARMY ENGINEER DIVISION HUNTSVILLE
CORPS OF ENGINEERS
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PRELIMINARY COST ESTIMATE | DATE PREPARED: 27 September 1977 | SHEET 8 OF 8

PROJECT: CLEAN BOILER FUEL FACILITY

LOCATION:

ARCHITECT ENGINEER: DRAVO | CWE: | PROGRAMMED:

LINE ITEM NO. OR CAT. CODE NO.: AREA 7 | ESTIMATOR: FORDHAM | CHECKED BY: SKETO | APPVD. BY:

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	NOTE 1	$EN1_D$	X	$N1CF_H$	$N1TCIP_H$
31000	HEAT EXCHANGERS				
32000	TOWERS & COLUMNS				
33000	AGITATED VESSELS				
34000	FIELD FABRICATED TANKS				
35000	PROCESS TANKS & OTHER VESSELS				
41000	PUMPS				
42000	COMPRESSORS				
43000	MECHANICAL CONVEYING EQUIP.				
44000	FURNACES, HEATERS, BOILERS &				
	COOLERS				
45000	MECHANICAL SEPARATORS,				
	CENTRIFUGES, ETC.				
46000	PACKAGE UNITS OR SYSTEMS	14,327,270	X	1.15	$ 16,476,361
47000	PROCESS BLOWER SYSTEM,				
	CYCLONES, ETC.				
48000	UNCLASSIFIED PROCESS EQUIPMENT	4,019,410	X	1.15	4,622,322
	(THESE FROM PAGE 12, COL. 9)				
	(TO PAGE 84)				
	TOTAL NOTE 1 COST INPLACE AREA NO. 7				$ 21,098,683

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PROCEDURE # 8

DETERMINE TOTAL VALIDATED CAPITAL COST

A. Explanation

The total plant capital cost was developed by adding the USAEDH Note #1 total cost inplace, the USAEDH subcontract total cost inplace, and the USAEDH material total cost inplace, for each plant area.

B. Formula

$$N1TCIP_{H} + STCIP_{H} + MTCIP_{H} = TPCC$$

$N1TCIP_{H}$ = Note #1 total cost inplace USAEDH

$STCIP_{H}$ = Subcontract total cost inplace USAEDH

$MTCIP_{H}$ = Material total cost inplace USAEDH

$TPCC_{H}$ = Total Plant Capital Cost USAEDH

SUBJECT:	COMPUTED BY: SKETO	DATE: 27 Sep 77
CLEAN BOILER FUEL FACILITY	CHECKED BY: FORDHAM	DATE: 27 Sep 77

$N1TCIP_H$ = $ 390,849,317 (FROM PAGE 84)

$STCIP_H$ = $ 402,602,319 (FROM PAGE 67)

$MTCIP_H$ = $ 372,765,123 (FROM PAGE 75)

$TPCC_H$ = $ 1,166,216,759

PROCEDURE # 9

DETERMINE CONFIDENCE FACTOR

A. Explanation

Develop an overall estimate accuracy factor.

B. Formula

$$AF_H = \frac{TE_D \times E_H}{TE_H}$$

AF_H = Accuracy Factor

TE_D = Total Estimate DRAVO

* E_H = Escalation USAEDH

TE_H = Total Estimate USAEDH

*To develop accuracy factor it is necessary to compare estimates on same time frame.

SUBJECT:	COMPUTED BY: SKETO	DATE: 27 Sep 77
CLEAN BOILER FUEL FACILITY	CHECKED BY: FORDHAM	DATE: 27 Sep 77

ACCURACY FACTOR CALCULATIONS:

$$AF_H = \frac{TE_D \times E_H}{TE_H}$$

$$= \frac{\$1.2_B \times 13\%}{\$1.16_B}$$

$$= \frac{1.36}{1.16}$$

$$= 1.1724$$

$$AF_H = 1.17$$

Therefore; the USAEDH accuracy factor is 17%

TABLE I

COST COMPARISONS BY MAJOR AREAS

AREA NO.	AREA DESCRIPTION	DRAVO COST LATE 1975	DRAVO COST JUNE 1977	USAEDH COST JUNE 1977
1.	COAL HANDLING	82,403,750	93,116,237	77,078,959
2.	HYDROCARBONIZATION	46,702,000	52,773,260	45,697,149
3.	FRACTION & GAS PURIFICATION	270,123,500	305,239,555	238,530,899
4.	HYDROGEN PRODUCTION	421,393,950	476,175,163	413,786,628
5.	SULFUR RECOVERY	54,631,750	61,733,877	61,730,527
6.	STORAGE	47,842,022	54,061,484	42,385,582
7.	UTILITIES	281,445,400	318,033,302	287,006,995
	TOTAL	1,204,542,372	1,361,132,878	1,166,216,759
	USE	$ 1.2 Billion	$ 1.36 Billion	$ 1.16 Billion