EPRICCTF Electric Power Research Institute Coal Cleaning Test Facility

COAL CLEANING TESTS

ON

HAT CREEK RAW COAL

for

B.C. Hydro

December, 1982

Prepared for the Electric Power Research Institute

by

Kaiser Engineers

of Pennsylvania, Inc.

COAL CLEANING TESTS

ON

HAT CREEK RAW COAL

Sponsoring Utility

B.C. Hydro Box 12121, 555 W. Hastings St. Vancouver, B.C. V6E4T6 Canada

Prepared for

Electric Power Research Institute 4318 Northern Pike Monroeville, PA 15146

EPRI Project Managers

C.D. Harrison J.D. Hervol

Prepared by

Kaiser Engineers of Pennsylvania, Inc. PO Drawer "H" Homer City, PA 15748

Principal Investigators

A.G. Gagnon Associate Engineer Processing

> E.R. Torak Operations Manager

> R.B. Bosold Laboratory Manager

Table of Contents

		Page
I.	EXECUTIVE SUMMARY	I-1
II.	INTRODUCTION	II-1
III.	TEST OBJECTIVES	III-1
	Phase I Phase II	III-1 III-2
IV.	.TEST PROGRAM	IV-1
	A. Flowsheet Phase I Phase II Test 1 Phase II Test 2 B. Raw Coal Bulk Samples C. Operating Conditions D. Sampling E. Laboratory Analyses	IV-1 IV-1 IV-3 IV-5 IV-7 IV-8 IV-9 IV-9
V.	EVALUATION	V-1
	Phase I A. Thickener Operation B. Clarified Water Quality C. Solid Bowl Centrifuge Performance D. Raw Coal Washability Data E. Recommendation for Phase II	V-1 V-1 V-2 V-2
	Phase II A. Raw Coal Washability B. Cleaning Circuit Performance C. Belt Filter Press Performance D. Clean Coal Bulk Sample E. Raw Coal & Clean Coal Combustion Data.	V-2 V-3 V-10 V-12 V-12
VI	ENGINEERS COMMENTARY	VI-1
APPEN	NDIX Plant and Laboratory Data(Separate	e Cover)

List of Tables

Page

Table 1	Sampling Points - Phase I	IV-10
Table 2	Sampling Points-Phase II, Test 1 & 2.	IV-11
Figure 4	Water Only Cyclone 9.4mm x 0.6mm Partition Curve	V-4
Figure 5	Water Only Cyclone 0.6mm x 0.15mm Partition Curve	V-5
	Partition Curve	V-6
Figure 7	Heavy Media Cyclone 19.0mm x 0.6mm Partition Curve	V-7
Table 3	Summary of Cyclone Tests	V-8
Table 4	Summary of Belt Filter Press Tests	V-11

ii

List of Figures

21.7

		Page
Figure 1	CCTF B.C. Hydro Hat Creek Flowsheet	
	Phase I	IV-2
Figure 2	CCTF B.C. Hydro Hat Creek Flowsheet	
	Phase II, Test l	IV-4
Figure 3	CCTF B.C. Hydro Hat Creek Flowsheet	
	Phase II, Test 2	IV-6

I. EXECUTIVE SUMMARY

A test program was conducted during September, 1982 by the Electric Power Research Institute (EPRI) at its Coal Cleaning Test Facility (CCTF) for B.C. Hydro. Throughout the test program 160 short tons (145 metric tons) of Hat Creek A Zone subbituminous raw coal was processed at the CCTF. The test program permitted an observation of the material handling characteristics and established performance characteristics of two conventional coal processing circuits.

This test program demonstrated that a high rate static thickener circuit could adequately thicken the high clay content fines generated throughout processing and maintain acceptable water clarity. The thickener was operated during one test for sim(6) hours with a stable sludge bed. It was also indicated that a belt filter press was capable of dewatering these fines, however, the operation became more sensitive as the fineness increased.

The circuit performance tests indicated that a conventional heavy media cyclone circuit could achieve an organic efficiency of 97% (Ep value of .05, BTU Yield of 93%) while processing 3/4" x 28M(19.0mm x 0.6mm) raw coal. An organic efficiency of approximately 88% (Ep value of .21, BTU Yield of 87%) was obtained in a conventional, two-stage, recycling water-only, cyclone circuit in the processing of 3/8" x 100M (9.4mm x 0.15mm) raw coal.

II. INTRODUCTION

B.C. Hydro's Hat Creek coal deposit, located in British Columbia, Canada, has been identified as a fuel supply source for a future power plant complex. This deposit contains significant quantities of clays which are known to separate from the subbituminous coal during processing. This separation of clays necessitates special consideration of clarified water and refuse tailings disposal circuits in any preparation plant that would be constructed to process this coal. It is recognized that effective methods of handling the clarified water and refuse tailings must be developed if a facility is to be utilized to clean Hat Creek coal. The design of such a coal preparation facility would require pilot plant work and further research to establish handleability and separation characteristics.

B.C. Hydro, through their consultant Boyd Payne, contacted EPRI at the CCTF for the possibility of conducting a test program on the Hat Creek coal. **TFRI** prepared a coal cleaning test program work scope and presented it to B.C. Hydro on July 30, 1982. The overall test program was divided into two phases with Phase I consisting of a preliminary 10-short ton(9-metric ton) plant test run. The Phase II work scope was to be developed after an evaluation of the results from the Phase I run.

The Phase I test run was conducted September 15, 1982. This test run demonstrated that the plant was capable of

1.1

handling the Hat Creek coal from a materials handling aspect. A request for an accelerated work schedule by B.C. Hydro necessitated that the Phase II work commence prior to the completion of the laboratory work from Phase I.

A Phase II work scope was developed consisting of two different CCTF test runs incorporating different flowsheets and feed rates. The Phase II, Test 1 run was conducted September 27, 1982 and the Phase II, Test 2 work on September 29, 1982. At the completion of these tests, the decision was made to suspend any outstanding laboratory work from Phase I in an attempt to expedite Phase II results. As a result of this, all the laboratory work as specified in the Phase I work scope does not appear in this report.

 $\sum_{i=1}^{n}$

During the Phase 1 and II test runs, 160 st (145 mt) of Hat Creek A Zone raw coal was processed at the CCTF. The results of this test are presented in this report.

II-2

III. TEST OBJECTIVES

The test program at the CCTF for the Hat Creek project was defined to achieve different objectives in each of the two phases as follows:

Phase I

The primary objective of this phase of the test program was to observe the handleability of the various material streams during the processing of this coal. Particular emphasis was placed upon operation and performance of the fines(-23%, -0.6mm) dewatering circuit, and included evaluation of:

- o thickener operation
- o solid bowl centrifuge performance
- o clarified water quality

Additional overall objectives of this phase included:

- o provide washability information for the raw coal to be used by B.C. Hydro in possible future design work.
- supply foundation for recommendations for the
 Phase II test program.

An initial objective of determining the efficiency of separation of the process cleaning circuit was deleted to allow the laboratory efforts to be directed towards the Phase II work.

III-1

Phase II

This phase of the Hat Creek project test program was designed to accomplish the following five(5) objectives:

- Provide washability information of the raw
 coal for future use by B.C. Hydro
- Operate the plant using two different circuit flowsheets to determine material balance and efficiencies of separation of the water only cyclone and the heavy media cyclone circuits. Of particular concern was the build up of slimes in the heavy media circuitry.
- Operate the Arus-Andritz truck mounted belt filter press to determine the dewatering capability on both 28M x 0 (0.6mm x 0) and 100M x 0 (0.15mm x 0) size fractions.
- Produce a small bulk sample of clean coal for future use by B.C. Hydro
- Subject the run-of-mine raw coal and clean
 coal to laboratory tests to provide pertinent
 combustion data.

III-2

IV. TEST PROGRAM

To achieve the test objectives, the Hat Creek program was divided into two phases. The Phase I program consisted of one test and the Phase II program required two tests. A description of the overall test program follows.

A. Flowsheet

Phase I

The flowsheet (Figure 1) for the Phase I test program required the 6" x 0 (150mm x 0) as-received raw coal to be crushed to a 3/8" x 0 (9.4mm x 0) product size.

The crushed $3/8" \ge 0$ (9.4mm ≥ 0) raw coal was delivered at 10 stph (9 mtph) to the plant to be processed in the two-stage, water-only, cyclone circuit.

The material discharged from the feed conveyor was slurried, and this 3/8" x 0 (9.4mm x 0) raw coal slurry was pumped to the two-stage, water-only circuit. The cyclone circuit consists of a 14½" (362mm) primary water-only cyclone and a 8"(203mm) secondary water-only cyclone, both manufactured by Roberts & Schaefer. The overflow of the primary cyclone reported to a fine clean coal sieve bend and screen and the underflow was pumped to the secondary cyclone. The overflow of the primary cyclone. The overflow of the primary cyclone, and the underflow reported to the fine

IV-1

• •



refuse screen. This is known as a two-stage, recycling, water-only cyclone circuit.

The clean coal screen oversize 3/8" x 28M (9.4mm x 0.6mm) reported to the basket centrifuge for final dewatering. The centrifuge prodischarged to the clean coal conveyor. The refuse screen oversize, 3/8" x 28M (9.4mm x 0.6mm) discharged to the refuse conveyor. The thru material (-28M, 0.6mm) of the clean coal and refuse screens reported to the 17' (5.2M) diameter Eimco static thickener. The thickener underflow was dewatered in the Bird solid bowl centrifuge after the completion of the plant run.

Phase II Test 1

The flowsheet (Figure 2) for Phase II, Test 1 required the 6" x 0 (150mm x 0) as-received raw coal to be crushed to a 3/8" x 0 (9.4mm x 0) product size. The material was reduced in a Gundlach twostage four(4)-roll crusher. The crushed 3/8" x 0 (9.4mm x 0) raw coal was delivered at 10 stph (9 mtph) to the plant to be processed.

The discharge from the plant feed conveyor was slurried and pumped to the two-stage, water-only cyclone circuit. The cyclone circuit was the same as that described above for the Phase I test program.

IV-3

••







The thickener underflow was withdrawn periodically and collected in a 16,000 gallon $(60M^3)$ agitated storage tank for eventual dewatering in the belt filter press. When the Phase I, Test 1 plant run was completed, the thickened 28M x 0 (0.6mm x 0) sludge was fed to the 39"(1M) Arus-Andritz truck mounted belt filter press. The use of the storage tank offered the opportunity to optimize the flowrates of both the thickener underflow and the belt filter press feed.

Phase II Test 2

The flowsheet (Figure 3) for Phase II, Test 2 required the 6" x 0 (150mm x 0) as-received raw coal to be crushed to minus 3/4" (19mm). The material was crushed in the Gunlach two-stage, four(4)-roll crusher. The crushed 3/4" x 0 (19mm x 0) raw coal was fed to the plant at 20 stph (18 mtph) to be processed in the heavy media circuit.

The material entering the plant was deslimed on a 3' x 12' (0.9m x 3.6m) Tabor vibrating screen at 28M (0.6mm). The coarser size fraction, 3/4" x 28M (19mm x 0.6mm) reported to a pulping sump where is was mixed with media and delivered via a variable speed pump to a 14" (356mm) diameter Roberts & Schaefer heavy-media cyclone (HMC). The products of the heavy-media cyclone were drained and rinsed on

IV-5



.

two 3' x 10' (0.9m x 3.0m) Tabor vibrating screens. The refuse reported to the plant refuse conveyor and the clean coal was dewatered in a CMI CY-26 basket centrifuge, then discharged onto the plant clean coal conveyor.

The through product of the deslime screen, $28M \ge 0$ (0.6mm ≥ 0) raw coal flowed to the fine coal sump and was delivered via a variable speed pump to a 14" (356mm) diameter Roberts & Schaefer classifying cyclone. The classifying cyclone underflow, nominally $28M \ge 100M$ (0.6mm ≥ 0.15 mm) reported to the $18" \ge 42"$ (46cm ≥ 107 cm) Bird screen bowl centrifuge. The centrifuge product discharged to the plant refuse conveyor. The nominal 100M \ge 0 (0.15mm ≥ 0) size fraction in the cyclone overflow was fed to the thickener.

The mode of operation of the tailings thickener/storage tank and the Arus-Andritz belt filter press was the same as for Phase I Test 1. However, the feed size was finer in this test than the previous test.

B. Raw Coal Bulk Samples

The raw coal bulk sample processed in Phase I was received at the CCTF in approximately 50 sealed drums. The drums were identified as "Hat Creek A Zone 1982". The somewhat "wet" raw coal contained within the drums was passed through the 6" x 6"

IV-7

(150mm x 150mm) grizzly at the CCTF receiving station prior to introduction to the crusher.

The raw coal bulk sample for Phase II was shipped in two railcars covered with plastic sheets. This shipment was also extracted from the Hat Creek A Zone. Due to local rail spur difficulties, the cars could not be delivered to the CCTF. The cars were directed to a nearby coal gasification pilot plant receiving station. The coal in the cars was not free flowing and approximately fifty (50) manhours of manual labor was required to remove the coal from the two (2) bottom dump railcars. The discharged coal from the railcars passed through a 4" x 8" (102mm x 204mm) gnizzly and was collected in The bin discharged to a conveying system a bin. which discharged directly to haulage trucks. The coal was then hauled to the CCTF and passed through the 6" x 6" (150mm x 150mm) grizzly at the receiving station.

C. Operating Conditions

Pertinent plant variables and settings were recorded during each test at the CCTF. A Plant Test Conditions sheet for each of the three(3) completed tests is located in the Appendix (under separate cover). Operational problems, if any, that occurred during any test are recorded on the CCTF Daily Operation Report for the day of the test. Copies of

IV-8

these reports are included in the Appendix.

D. Sampling

A plant stabilization period of one(1) hour was allowed prior to the commencement of sampling. In addition to noting plant operating conditions, material samples of key process streams were collected during each test. The specific sample points for each of the tests is given in Tables 1 and 2. A combination of manual and automatic sampling procedures were used which conform with ASTM-2234.

Gerry .

E. Laboratory Analyses

The samples collected during the testing program were forwarded to Cole Homer City Coal Laboratory (HCCL) for analysis. The raw laboratory data for each sample is available in the Appendix.

The unusual character of the Hat Creek subbituminous coal requires special laboratory procedures. The Phase I samples provided the HCCL with material to develop the necessary procedures. All screening was done wet because of the clays. For sizes larger than 28M (0.6mm) a screening time of 5 min. was set. This time was chosen because it approximates the "wet-time" the material would endure in a actual process plant.

Previous work by others with the Hat Creek coal had indicated a tendency for the coal to break down

Table 1

.

EPRICCTF Electric Power Research Institute Coal Cleaning Test Facility

B.C. HYDRO

PHASE I

SAMPLE POINTS

Sample Point	Sampler No.	Type	Frequency		
Plant Feed	41003A	Auto Cross Stream	l mi	n.	
Primary WOC O'flow	41007B	Manual	l min.	30 sec	
Secondary WOC U'flow	41011B	Manual	l min.	30 sec	
Thickener Feed	41046B	Manual	10	min.	
Clarified Water	41050B	Manual	10	min.	
Thickener U'flow	41047B .	Manual	4	min.	
Solid Bowl Cent. Cake	41048B	Manual	4	min.	

KAISER ENGINEERS

.

TABLE 2

.-

EPRICCIF BC Hydro

<u>Phase II</u>

Sample Points

Sample Point C	CTF Sample /	Type Frequency(min)
Run of Mine Raw	41001B	Stopped Belt 4 min.30 sec.
Plant Feed	41003A	Auto.Cross Stream 3 min.
Deslime Screen	-	
U'flow	41005	Auto.Cross Stream 2 min.
Primary WOC O'flow	41007B ·	Manual 6 min.
Secondary WOC		
U'flow	410113	Manual 6 min.
Plant Clean Coal	41051A	Auto.Cross Stream 3 min.
Fine Ref.Screen.	•	
Oversize	41019	Auto.Cross Stream 3 min.
Thickener Feed	41046B	Manual Smin(timed)
Clarified Water	41050B	Manual at Deslime
		Sprays 30min(timed)
Agitator Tank		-
J'flow	43047E	3r Hanual 3min(timed) .
Belt Press Cake	-X/K-	Manual 3min(timed)
Belt Press Effluent	N/A	Manual 3min(timed)
	TES	
Plant Feed	41003A	AUCO.Cross Stream 3 min.
Deslime Screen		
Oversized	41004	Auto.Cross Stream 2 min.
Clean Coal D&R		· · · · ·
Product	41037	Auto.Cross Stream 2 min.
Refuse D&R Product	41040	Auto.Cross Stream 2 min.
Circulating Heavy		Manual at Central
Media	N/A	Box 30min(timed)
Deslime Screen	•	
U'flow	41005	Auto.Slurry Divt. 2 min.
Bird Cent.Cake	41048 ·	Auto.Cross Stream & min.
Thickener Fred	41046B	Manual Smin(timed)
Clarifled Water	61050 <u>D</u>	Manual at Deslime
		Sprays 30min(timed)
Agitator Tank		Manual Slurry
U'flow	410478	Diverter 3min(timed)
Belt Press Cake	N/A	Manual 3min(timed)
Belt Press Effluent	t N/A	Manual Imin(timed)

during conventional float/sink incremental analysis. The contention is that repeated subjection to the organic liquid baths and air drying caused degradation. A cumulative method of float/sink was

The HCCL performed cumulative float/sinks on the material but was unable to obtain crediable results. The conventional incremental method of float/sink was then tried with no noticable material degradation. The clay was actually observed to become harder when soaked in the organic liquid. All float/sink analyses in the Appendix have been done using the incremental proceedure.

Since wet screening was employed, a significant amount of minus 28M (0.6mm) clay slurry resulted. This material was very hard to filter because the filter paper quickly blinded with clays. The volume problem was handled by subsampling the slurry and the filter paper blockage was reduced by flocculating the slurry.

IV-12

V. EVALUATION

Using the plant measurements and sample laboratory data, an evaluation of the test program has been conducted.

The results of the evaluation are presented to fulfill the objectives for each phase as follows:

<u>Phase I</u>

A. Thickener Operation

The thickener was shown to have adequate capacity during this test run. The test was very short in duration (50 min.) A sample withdrawn from the thickener centerwell indicated the formation of "large" flocs which settled rapidly. A field determination indicated the settling rate of the flocs to exceed 48"/min (l.2m/min.).

B. Clarified Water Quality

The clarified water (thickener overflow) appeared very clear throughout the test run. The laboratory data verified this observation with a maximum suspended solids concentration of 118 ppm being recorded towards the end of the test. The laboratory results of all the samples taken throughout the test are contained in the Appendix.

C. Solid Bowl Centrifuge Performance

The centrifuge cake produced throughout the test was very sticky in nature; the laboratory analysis indicated 40% total moisture. The refuse conveyor belt scraper was unable to adequately clean the belt which

resulted in significant carryback.

D. Raw Coal Washability Data

The raw coal washability data of the plant feed sample (41003A) are contained in the Appendix.

E. Recommendation for Phase II

It was noted during the Phase I run that approximately 5% of the plant feed was plus 3/8" (9.4mm). Accordingly, the crusher setting was altered in an attempt to produce a smaller top size for the Phase II, Test 1. Care was required in crusher roll adjustment in that bring the rolls closer than 1/4" (6.3mm) caused the damp coal to be matted into flat sheets.

The test run also conditioned that the solid bowl centrifuge was not suitable for dewatering Hat Creek fines and set the stage for the use of the Arus-Andritz belt filter press in Phase II. The decision was made to utilize a screen bowl centrifuge for dewatering 28M x 100M (0.6mm x 0.15mm) fines in Phase II, Test 2.

Phase II

A. Raw Coal Washability Data

A 6" x 0 (150mm x 0) raw coal sample (41001B) was obtained for detailed laboratory analysis. The results of this analysis is contained in the Appendix.

B. Cleaning Circuit Performance

In Phase II, Test 1, the water only cyclone circuit was operated, sampled and analyzed to produce performance data for the $3/8" \times 28M$ (9.4mm x 0.6mm) and 204 x 100M (0.0mm x 0.15mm) size fractions. A mathematical composite of these results produced the performance data for the $3/8" \times 100M$ (9.4mm x 0.15mm) size fraction. The partition curve for each respective 113 fraction has been constructed and is shown in Figures 4, 5 & 6.

In Phase II, Test 2, the heavy-media cyclone circuit testing was conducted to produce performance data for the 3/4" x 28M (19 mm x 0.6mm) size fractions. The partition curve for this test is shown in Figure 7. It will be noted that the exact location of the partition curves is a matter of subjective judgement. For this reason, the determined Ep values should not be considered as absolute values. Organic efficiency values are considered a better (more objective) assessment of performance.

The results of cyclone performance for the four size fractions is summarized in Table 3. A comparison of the organic efficiency values indicate the expected result that the heavy-media cyclone circuit (greater than 97%) was much more efficient than the water only cyclone circuit (less that 90%). The organic

:			EF	R	G(<u>ار د</u>		Electr Coel (ic Po Xeen	wer ing 1	Rece Test F	arch acili	instii ty :_	tuta .					E I	GUI	<u>د</u> للغ	4	_
. ,	· ·	TUO	STACE	DEC							· · · · · · · · · · · · · · · · · · ·										· · · · · · · · · · · · · · · · · · ·		-
		100	JIAGE	ICEC		LING	WA:	LER	NO	<u>LY</u>	CY			<u>. CI</u>	RCI	TIL				<u></u>		<u>. : . :</u>	:
` <u> </u>	:		<u>.</u>		- 121 GT	ART	ETI(DN HO	CUR	VE		<u> </u>											_
				<u>, 111</u>		ANI	NG-	<u>4</u>	<u></u>	<u>x </u>	3.6		(37	8!!!!	x	28M)			33			
		÷`		BC	HYI	DRO	!	山井	C R	EEI	< P	ROJ	IEC'	T								 	:
				÷ …÷	PI	IAS	EI		TE	SŢ	1.							=					
	<u> </u>			••			1					-			· · · · · ·								
								·		.	· · · · · ·									; 	····	- 1 	
			<u> </u>																				
		•····																			12		
		-100 -	┨━╧━╧					·			: :(Yie	1d	-	78	27					
		+								-		Sp.⊥	Gr.	.Se	p		E -	7					
	· · ·	90	1	2									Ep		I4				_				1
	· · ·	ļ			\mathbf{X}								·····		+								-
	- <u></u>	80			Ē	کر: -							<u></u>										
-	:				. ;												+						-
	\sim	70																					-
=	<u> </u>		. –				ų											-			+	+	2
	AL	<u> </u>	l !			1		X															-
	<u>0</u>								1								-	-					1
	Z	·							T.				_					-				1:=	
	— <u>ш</u>	50	·						<u>+</u>]										-		<u> ::::</u>		
	U									$\left \frac{1}{2} \right $											<u></u>		
		-40			+		·····			<u> </u>													
·										: : \	XIII		ļ.							1	[<u></u>	í	
	- A									i iii	<u>R</u>			<u>+111</u>									:
	;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;																						-
••••		_20			ļ.,								s S										
		· · ·		-			<u> </u>				-												
	_		· · ·																				
		 				:: <u>+</u>		-									b		1.1			· · · · ·	÷
				_																		<u></u>	-
		1.	3 1.4	1.	5	1.0	5 1	.7	1	.8	1	.9	2.	.0	2	1	2	2	2	2			-
						SI	PECI	FIC	G	٨v	'ITY	+ 4	1		· · · · ·							<u></u>	+
·	· · · · ·									1			1.:		· · · · ·								+
. t	<u> </u>									†			<u> </u>				1111						İ
. ;								+	<u>+</u>	+		∤-											1
								1	•	 ;	1									··· : :::::			1
							·	· ·	 	<u> </u>		<u> </u>				••••		•••	::::	<u></u>	[ł
	• •			<u> </u>		1	•		I .	1.	1	L.:	11111		1 4 4 4 F	4411		1117	CAI	SE	P		5

(

(

No T 10 X 10 TO 5 INCH + 71, X 10 I HES

(

; i





46 1472

A 2 10 A 10 TO 1, INCH + 4 A 10 F0 H4 4 A 24 A MULTINE ESSLE CO #24 20 F1 4



46 1472

Ket 10 X 10 TO - INCH - // 2 10 INCH S KEWFEL & ESSER CO MAN AUT -



SUMMARY OF CYCLONE TESTS

B.C. HYDRO - HAT CREEK

	- ~	דד . רוני	Phase T	Phase II
	WOC	WOC	WOC	HI4C
Feed	9.4mmx0.6mm (3/8''x28M)	0.6mmx0.15mm (28Mx100M)	9.4mmx0.15mm (3/8"x100M)	19.0mmx0.6mm (3/4"x28M)
Ash(%)(Dry)	30.6	40.6	32.0	30.1
Clean Coal				
Ash(%)(Dry)	20.7	26.1	21.3	20.3
BTU/lb.(Dry)	9657	8086	9478	9333
Refuse				
Ash(%)(Dry)	57.7	5: 7	57.5	68.0
BTU/lb.(Dry)	3274	3331	3140	2411
Performance				
Sp. Gr. Sep.	1.77	1.84	1.77	1.83
Near Gravity(±.1)	10.0	14.7	10.5	7.8
Ep	.14	.27	.21	.05
Wt. Yield (%)	73.2	52.6	70.4	79.5
Organic Eff (%)	90.3	73.9	88.7	97.5
BTU Yield (%)	89.0	72.9	87.8	93.8
Misplaced Material:				
Float in U'Flow(%) 32.2	25.8	29.7	15.8
Sink in O'Flow(%)	5.9	22.6	8.4	2.8

KAISER ENGINEERS

efficiency is the ratio of the actual circuit yield to the theoretical laboratory float/sink yield at the same product ash level expressed as a percentage.

Throughout Phase II, Test 2, the circulating heavy media was sampled every 30 minutes to monitor the build-up of non-magnetics. The laboratory analyses of these samples indicated very little flucuation of the non-magnetics content throughout the test run. The results of these laboratory determinations are included

Throughout Phase II the thickener performed well. The first test in Phase II was six(6) hours long and the second four(4) hours. The laboratory data indicated that the maximum suspended schids concentration in the clarified water throughout Phase II, Test 1 was 116 ppm with a maximum value of 254 ppm determined during Phase II, Test 2.

The pH value of the clarified water was also monitored throughout the tests. The results indicate that the Hat Creek coal contains mildly acidic components. In Phase II, Test 1, the initial pH value of 8.65 had been reduced to 7.02 towards the end of the test run. In Phase II, Test 2, the first recorded reading was 6.95. Shortly after this determination, 50 lbs. of lime was added to the thickener. The last pH determination made near the end of the test was 6.82.

During Phase II, Test 2, it was noted that the

screen bowl centrifuge was able to produce a suitable cake while dewatering the 28M x 100M (0.6mm x 0.15mm) fines, however, continous plugging of the discharge chute occurred which caused interruptions to the test run.

Problems were encountered during the Phase II, Test 2 run with plant feed hangups in the raw coal bins. The 3/4" x 0 (19.0mm x 0) raw coal had been stored in the bins 20 hours prior to the commencement of the test run. The day after completion of the last test of Phase II, the clean coal centrifuge was found to be bound with clay along the top edge of the basket. The centrifuge cover had to be removed to clear the material.

C. Belt Filter Press Performance

The belt filter press circuit testing was conducted to produce performance **data** on the dewatering of fines of different size consists. A summary of the data and performance determined from the tests is shown in Table 4.

It was generally noted that the belt filter press performed well and stable throughout the Phase II, Test 1 (coarser size consist) test run. The average wet cake discharge rate throughout this test was 6.1 ton/hr. with a range of 5.5 - 6.6 stph (5.0 - 6.0 mtph). Average total cake moisture was 39.5%.

During the Phase II, Test 2 (finer size consist),



SUMMARY OF BELT FILTER PRESS TESTS

B.C. HYDRO - HAT CREEK

	Phase II Test l	Phase II Test 2
Feed		
Ash (%)(Dry) Total Moisture (%) % Minus 0.075mm (200M)	57.2 70.1 48.0	65.0 78.6 70.5
Cake		
Ash (%)(Dry) Total Moisture (%) Surface Moisture (%) % Minus 0.075mm (200M)	55.0 39.5 31.9 49.4	64.4 50.0 46.7 61.3
Effluent		
Ash (%)(Dry) Total Moisture (%)	56.1 99.1	65.5 99.0
Performance		
Wet Cake Disch. Rate (stph) Solids Recovery (%)	6.10 98.2	2.81 96.8

KAISER ENGINEERS

test run, both the stability of operation and discharge rate had been reduced. At the point of initial introduction of feed to the filter press it was noted that the majority of the product extruded from the sides of the filter press rather than the product discharge end. Operator adjustments to the flocculant addition rate were required to stabilize the operation and produce a cake that was handleable. After stabilization, sampling commenced. The average wet cake discharge rate was determined to be 2.8 stph (2.5 mtph) at an average 50.0% total moisture.

D. Clean Coal Bulk Sample

A 3/4" x 23M (19.0rm x 0.6rm) clean coal sample (41051A) was obtained during Phase II, Test 2 for future use by B.C. Hydro.

E. Raw Coal and Clean Coal Combustion Data

A 6" \times 0 (150mm \times 0) raw coal sample (41001B) and 3/8" \times 28M (9.4mm \times 0.6mm) clean coal sample (41051A) was collected during the Phase II, Test 1 run to provide pertinent combustion data. The laboratory analyses of these samples are contained in the Appendix.

VI. ENGINEERS COMMENTARY

The flowsheets implemented in this test program were selected to obtain process design information on various material streams for future design studies. None of these flowsheets were conceived to represent a design process for treating Hat Creek coal. For example, no 28M x 100M (0.6mm x 0.15mm) product reported to the clean coal belt in any test run. It is also speculated that a much larger top size would be processed in any future commercial preparation plant. Therefore, any conclusions drawn from the <u>overall</u> determined plant performance should be done with extreme caution. November 4, 1902

			HOMER C PENNSYLVANI	ITY LADORATORY A ELECTRIC COMPANY		
SAMPLE NUMBER: DATE SAMPLED FLANT DESCRIPTION:	10029 NZA EPRI 1 410514 RC HYD	TIME EST FACILITY	E: N/A	FROJECT CODE PROJECT NUMB ACCOUNT NUMB SUBMITTED BY	: 82092701 ER: 41051A ER: J5-186.1-450 : J W FARKINSO	995 N
CONTAINER ID:	FLANT DO331,	CLEAN COAL PRO D0205.D0341	DUCT	DATE RECEIVE GROSS WEIGHT	D: 10/01/82 : 231.2	KG
LAR NUMBER 5 R	aw Head CE	RTIFICATE OF A	**************************************	*****		
		AS RECEIVED	DRY	DRY ASH FREE		
% Total Noistur % Ash % Total Sulfur Btu/lb % Carbon % Hydrogen	****** 2	28.47 14.49 .63 63 6792.00 38.06 2.80	20.26 .88 9496.00 53.21 3.92	1.11 / 11708.00		

χ	Hydrogen	2.80	3.92	
7	Nitrogen ·	. 69	.96	
χ	Oxyaen	14.86	20.77	
%	Fixed Carbon	29.15	40.76	51.11
7	Volatile (sparking)	27.89	38,99	48.89
;:	Chiorine	.00	.00	.00
7	Fyritle Sulfur	. 47 -	.65	.82
X	Sulfate Sulfur	.03 -	.04	.04
7	Organic Sulfur	.13	.19	.25
	Bulk Density	47.81		
	Grindability	45,00		
	Free Swelling Index	. Úð		

AS RECEIVED VALUES FOR HYDROGEN AND OXYGEN DO NOT INCLUDE H AND O IN SAMPLE MOISTURE

APPROVED: Thomas Rightrour DATE: BDV 0 5 1982

٠ : *** HÖHER CITY LABORATORY PENNSYLVANIA ELECTRIC COMPANY SAMFLE NUMBER 10029 FI-OJECT CODE -82992701 PATE SAMPLED. N/A TIME: N/A FROJECT HUMBER. 41051A EFRI TEST FACILITY CLONT ACCOUNT NUMBER: J5-186.1-45005 DESCRIPTION: 41051A SUBHITTED BY J W PARKINSON SAMPLED RY: Date Received: EC HYDRO PHASE 2 - TEST 1 ROSER FLANT CLEAN COAL FRODUCT 10/01/82 CONTAINER ID: D0331.D0205,D0341 GROSS WEIGHT: 231.2 KG **** *****************

LAB NUMBER:5 Raw Head PERCENT ANALYSIS EFFICIENCY - 99.845

X 5102 50.47 29.66 % AL203 % FE203 4,99 2 CAO 4.08 % MGO 2.08 .32 Z NA20 7 K20 7 TIG2 2.79 Z hro2 .09 1 P205 7 S03 4.62 X SCASH)

APPROVED: Thomas Rightmour DATE: NOV 05

.

WE Merine.



Phillips Barratt Kaiser

COAL PREPARATION PLANT COST ESTIMATE

HAT CREEK PROJECT

for B. C. Hydro

December, 1982

by

Phillips Barratt Kaiser

and Boys Payne.

CONTENTS

B.C. HYDRO - HAT CREEK

COAL PREPARATION PLANT COST ESTIMATE

Section

- I. FOREWARD
 - A. Scope of Study
 - B. Source of Information
 - C. Projection of Coal Qaulity

II. SUMMARY

- A. Raw Coal Quality
- B. Clean Coal Quality
- C. Coal Preparation Plant Capital Cost Estimate
- D. Coal Preparation Plant Operating and Maintenance Costs

.---.

III. COAL QUALITY - GENERAL

- A. Raw Coal Quality
- B. Clean Coal Quality

IV. GENERAL DESCRIPTION

- A. Study Criteria
 - B. Process Circuitry
 - C. Process Equipment

V. CAPITAL COSTS

- A. General
- B. Criteria

VI. OPERATING COSTS

- A. Summary
- B. Details

I. FORWARD

A. SCOPE OF STUDY

This report has been prepared for B. C. Hydro to estimate the washed coal quality and capital and operating costs of processing raw coal from the Hat Creek deposit. The capital cost estimate is a Phillips Barratt Kaiser Type 1 estimate which utilizes a 25% contingency.

B. SOURCES OF INFORMATION

Information used in preparing this report was obtained from various B. C. Hydro files (including the December 1982 report by EPRI entitled "Coal Cleaning Tests on Hat Creek Raw Coal"), from technical literature and from Phillips Barratt Kaiser's in-house files.

C. PROJECTION OF COAL QUALITY

The yield projections in this report were based on the assumption that the sample run at EPRI's Coal Cleaning Test Facility (CCTF) is representative of the A, B and C zone coals at Hat Creek. Further bulk samples and a study with considerably larger scope would be required to confirm these projections.

II. SUMMARY

A. RAW COAL QUALITY

The raw coal quality is assumed to be as outlined in the December 1982 EPRI-CCTF report entitled "Coal Cleaning Tests on Hat Creek Raw Coal".

B. CLEAN COAL QUALITY

The washed coal quality and yields were projected from actual test data from the CCTF test runs. Material balances were calculated for each plant circuit, however balances of ash constituents and sulfur forms were considered to be beyond the scope of this assignment.

C. COAL PREPARATION PLANT CAPITAL COST ESTIMATE

A factored capital cost estimate has been prepared for a 1000tonne/h coal preparation plant. The assumed plant circuitry includes heavy media drum separators, heavy media cyclones, and two stage water only cyclones. Fines (0.6mm x 0) are dewatered using continuous belt filter presses. Based on the criteria and scope of work contained in this report, the estimated capital cost for the coal preparation plant is approximately \$65,075,000. The estimated costs for the continuous belt filter press section of the preparation plant is \$22,180,000, including contingency.

D. COAL PREPARATION PLANT OPERATING AND MAINTENANCE COSTS

The estimated operating and maintenance costs for the 1000-tonne/h coal preparation plant are \$3.09/raw tonne processed.

III. COAL QUALITY - GENERAL

This section outlines the general methods and assumptions used in determining the raw coal quality and clean coal quality projections.

A. RAW COAL QUALITY

The raw coal was assumed to be made up of a uniform blend of A, B and C zone from the 35-year pit of the B.C. Hydro 800 M.W. study. It was further assumed that this blend of coals would exhibit similar washability characteristics to the A zone sample which was processed at EPRI's Coal Cleaning Test Facility.

The average sulfur, ash and calorific values for the four major subzones of the Hat Creek deposit and of the CCTF sample are listed as follows (all results shown on a dry-basis):

~~~~

| -                          | A     | B     | C     | D     | (A,B,C) | Sample |
|----------------------------|-------|-------|-------|-------|---------|--------|
| Ash f                      | 39.3  | 31.7  | 44.3  | 21.9  | 37.7    | 36.8   |
| Calorific Value<br>(MJ/Kg) | 13.60 | 18.55 | 14.14 | 22.22 | 15.52   | 15.77  |
| Sulfur &                   | 0.76  | 0.67  | 0.47  | 0.32  | 0.66    | 0.80   |

The CCTF washability data from the 150mm x 0 raw coal sample was not applied directly in the development of the coal preparation plant flowsheet. The size consist and ash distributions were modified as follows to reflect the experience gained during the pilot plant test run.

|                | Raw (o<br>Actual<br>(dry | Sample<br>Basis)    | Proposed<br>(dry | Plant Feed<br>basis) |
|----------------|--------------------------|---------------------|------------------|----------------------|
| Size           | Wte                      | Ash%                | Wt8              | Ash%                 |
| 150mm x 19.0mm | 26.7                     | 25.9                | 25               | 25.9                 |
| 19.0mm x 0.6mm | 63.3                     | 36.4                | 55               | 36.4                 |
| 0.6mm x 0.15mm | 4.4                      | 55.2                | 12               | 40.6                 |
| 0.15mm x 0     | <u>5.6</u><br>100.0      | $\frac{60.1}{35.8}$ | 8<br>100         | <u>68.0</u><br>36.8  |

#### B. CLEAN COAL QUALITY

The clean coal quality and yield predictions are based primarily on the washability data generated during the recent pilot plant washing tests at EPRI's Homer City Coal Cleaning Test Facility. Table III-1 shows a comparison of the raw and clean coal characteristics from CCTF test run (Phase II Test 2) and the assumed plant product which incorporates previous B.C. Hydro data from A, B and C zones. The <u>calorific</u> recovery for the preparation plant was calculated to be 92.2% with 26.0% total moisture and 17.9% (a.r.b.) ash in the clean coal.

#### TABLE III-1

|                                | CCT        | F Scupti.     | Sector         |
|--------------------------------|------------|---------------|----------------|
|                                | Homer City | CCTP_Samples  | Proposed       |
|                                | 150mm x 0  | Plus 0.6mm    | Average        |
| (As Received Basis)            | Raw Coal   | Clean Coal    | Me Washed Coal |
| Moisture, Total %              | 23.21      | 26.56         | 26.0           |
| Volatile Matter %              | 24.53      | 31.86         | 29.0           |
| Fixed Carbon %                 | 20.95      | 26.97         | 27.1           |
| Ash %                          | 31.31      | 14.61         | 17.9           |
| Carbon %                       | 25.13      | 38.47         | 37.33          |
| Hydrogen %                     | 2.17       | 2.81          | 2.80           |
| Nitrogen %                     | 0.46       | 0.93          | 0.60           |
| Chlorine %                     | -          | -             | 0.02           |
| Sulfur %                       | 0.61       | 0.61          | 0.35           |
| Oxygen % by difference         | 17.11      | 16.01         | 15.00          |
| Gross Calorific Value<br>MJ/Kg | 11.86      | 16.09         | 15.1           |
| Hardgrove Grindability Index   | 58         | 52            | 50             |
| Sulfur Forms, %                |            |               |                |
| Pyritic                        | 0/49       | 0 / 25        | مدر ٥          |
| Ørgápic                        | q.q8       | Ø <b>.4</b> 5 | 9.74           |
| Sul⁄fate                       | 0.04       | 0.01          | 0.01           |

#### IV. GENERAL DESCRIPTION

#### A. STUDY CRITERIA

ο

The following calculations and assumptions were used to develop design criteria for the study:

#### 1. Power Plant Energy Requirements

The winter tonnages from the 800 M.W. study were:

o 110,000 tonnes per week at 13.8 MJ/Kg (a.r.b) with 64% contribution from A, B and C zones.

ie. 110,000 tonnes/week x 13.8 MJ/Kg x 1000 Kg/tonne x 0.64 = 9.7152 x  $10^8$  MJ/week

#### 2. Preparation Plant Clean Coal Requirements

Clean coal quality assumptions

Ash - 24.2% (d.b.) Total Moisture - 26.0% C.V. - 20.39 MJ/Kg (d.b.) C.V. - 15.09 MJ/Kg (a.r.b.)

Therefore:  $9.7152 \times 10^8 \text{ MJ/wk} = 64,380 \text{ tonnes/week}$  $15.09 \text{ MJ/Kg} \times 1000 \text{ Kg/tonne}$ 

#### 3. Raw Coal Requirements

- o Yield Assumptions
  - Dry basis yield 71.3%
  - As received basis yield at 22.5% Raw Coal Total Moisture

Therefore:  $\frac{(.713/0.74)}{(1.00/0.775)} = 0.747$ 

o Raw Coal Required

 $\frac{64,380}{0.747}$  tonnes/week clean coal = 86,180 tonne/wk raw coal

#### 4. Plant Capacity

- o Operating Assumptions
  - 5 day/week operation
  - three shifts/day

#### 4. Plant Capacity (cont.)

- weekend maintenance shutdowns
- 0.83 availability={20 hours/day}

Therefore:

hourly tonnage =  $\frac{86,180}{100}$  tonnes/week = 862 tonnes/hour

- o Tonnage required with a design factor of 1.15 862 tonnes/hr x 1.15 = 991 tonnes/hr
- o <u>Nominal Design Capacity 1000 tonnes per hour</u>

#### 5. Plant Feed Screen Analysis

The following average distribution and design sizes were established:

| Size           | Average Wt% | Max. Design Wt% |
|----------------|-------------|-----------------|
| 150mm x 19.0mm | 25          | 35              |
| 19.0mm x 0.6mm | 55          | 65              |
| 0.6mm x 0.15mm | 12          | 15              |
| 0.15mm x 0     | 8           | 15              |

#### 6. Process Equipment Performance Yields by Size

| Equipment Name           | <u>Size (mm)</u> | Wt.%<br>(d.b.) | Theor.<br>Yield % | Org.<br>Eff.% | Yield<br>%(d.b.) | C.C.Ash<br>%(d.b.) | C.V.<br>MJ/Kg(d.b.) |
|--------------------------|------------------|----------------|-------------------|---------------|------------------|--------------------|---------------------|
| H.M.D.                   | 150 x 19         | 25             | 92.8              | 97.5          | 90.5             | 21.7               | 21.39               |
| H.M.C.                   | 19 x 0.6         | 55             | 79.0              | 97.5          | 77.0             | 25.1               | 20.09               |
| C.W.O.C.                 | 0.6 x 0.15       | 12 、           | 1.928.9           | 73.9          | 52.6             | 26.1               | 18.81               |
| Ref. Th. )<br>B. Filt. ) | 0.15 x 0         | 8              | N/A               | N/A           | N/A              | <u>N/A</u>         | N/A                 |
| Average Plant P          | erformance       |                |                   |               | 71.3             | 24.2               | 20.39               |

· • .

It should be noted that the equipment performance efficiencies were derived from the CCTF test data. It was assumed that the organic efficiencies determined during the pilot plant runs for separating at 1.83 density were applicable for separations at 1.90.

#### B. PROCESS CIRCUITRY

The CCTF test run demonstrated that conventional heavy media circuits could be utilized in treating the Hat Creek coal. Based on this verification an assumed conceptual heavy media process plant circuit was developed. The CCTF test work indicated satisfactory performance of the belt filter press in dewatering high clay content fines. As a result, belt filter presses have been selected for dewatering all 0.6mm x 0 solids.

For purposes of this study, the assumed 1000-tonne/h coal preparation plant consists of dual 500-tonne/h circuitry utilizing the following process circuits for cleaning the 150mm x 0.15mm raw coal:

- Heavy media drum separators for processing 150mm x 19.0mm raw coal.
- Heavy media cyclones for processing the 19.0mm x
  0.6mm raw coal.
- Two stage water only cyclones for processing the 0.6mm x 0.15mm raw coal.
- o Classification of 0.15mm x 0 raw coal to refuse.

A flowsheet, included at the end of this section, outlines the process circuitry.

#### C. PROCESS EQUIPMENT

A brief description of the selection and function of the process equipment follows:

- Raw coal screens for classification of the raw coal at 19.0mm
  - Plus 19.0mm material reports to heavy media drum separators
  - Minus 19.0mm material reports to the deslime screens
- Heavy media drum separators for processing the 150mm x 19.0mm raw coal
- Coarse product and refuse drain and rinse screens for media recovery
  - Drained media reports to heavy media sump
  - 150mm x 19.0mm product reports to the clean coal conveyor
  - 150mm x 19.0mm refuse reports to the refuse conveyor

- Deslime sieve bends and screens for classifying 19.0mm
  x 0 raw coal
  - 19.0mm x 0.6mm oversize reports to the heavy media cyclone feed sump
    - 0.6mm x 0 undersize report to the water only cyclone feed sump
- Heavy media cyclones for processing 19.0mm x 0.6mm raw coal
- o Product drain and rinse screens for media recovery
  - Drained media reports to heavy media sump
  - 19mm x 0.6mm product reports to dewatering centrifuges
  - 19mm x 0.6mm refuse reports to dewatering centrifuges
- Centrifuges for dewatering 19.0mm x 0.6mm product and refuse
  - Dewatered 19.0mm x 0.6mm product reports to the clean coal conveyor
  - Dewatered 19.0mm x 0.6mm refuse reports to the refuse conveyor
- o Two stage water only cyclones for treating 0.6mm x 0 raw coal
  - Primary water only cyclone overflow reports to vibrated classifying sieve bends
  - Primary water only cyclone underflow feeds secondary water only cyclone feed sump
  - Secondary water only cyclone overflow reports to primary water only cyclone feed sump
  - Secondary water only cyclone underflow reports to refuse thickener
- Vibrated classifying sieve bends for treating primary water only cyclone overflow
  - 0.6mm x. 0.15mm sieve bend overflow reports to product continuous belt filter presses
  - 0.15mm x 0 sieve bend effluent reports to the refuse thickener
- Continuous belt filter presses for dewatering 0.6mm
  x 0.15mm clean coal
  - 0.6mm x 0.15mm cake reports to the clean coal conveyor

- Refuse thickener for thickening 0.6mm x 0 refuse
  - Thickened 0.6mm x 0 thickener underflow reports to refuse continuous belt filter presses
- O Continuous belt filter presses for dewatering 0.6mm x 0 refuse
  - 0.6mm x 0 cake reports to the refuse conveyor



#### V. CAPITAL COSTS

#### A. <u>GENERAL</u>

A factored capital cost estimate summary is shown in Table V-1 and was developed for a 1000-tonne/h coal preparation plant and associated raw coal storage facilities. Equipment selection was based on the conceptual flowsheet as outlined in the previous section. The estimated cost of the raw coal storage facilities, plant feed conveyor and coal preparation plant is \$65,075,000. A general description of this Type 1 estimate is included at the end of this section.

#### B. CRITERIA

1. This estimate has been developed from an approximate equipment list which was factored by various percentages based on previous work in similar facilities to arrive at an estimated capital cost. The estimate includes raw coal storage capacity, plant feed conveyor and the coal preparation plant. It was assumed that the limits of the preparation plant would be the building walls and that all power, water, sewage, fire protection, communication, and other utilities in sufficient quantities would be available at the wall line. Facilities outside the wall line, with the exception of the raw coal storage area and plant feed conveyor, would be estimated by others.

2. The site has not been located and no soils investigation has been made. Therefore, a level cleared site with foundations of at least 3,000 lb/ft<sup>2</sup> has been assumed.

3. All conveyors from the building will be estimated by others and has not been included.

4. As no schedule has been established, escalation has been excluded. In addition the following items have been excluded in the capital cost:

- o Land and rights-of-way
- o Owner administrative or management costs
- Interest or financing charges

o Training of operating personnel

- o **Permits and licenses**
- Spare parts other than installed capital spares, lubrication, and operating supplies

- o Startup assistance
- All other costs except those specifically stated as being included
- o Construction camp

5. The estimates are in Canadian dollars and are based on prices in effect as of the last quarter of 1982.

## TABLE V-1

# CAPITAL COST ESTIMATE SUMMARY 1000-tonne/h Coal Preparation Plant

#### Construction Costs

| Buildings and structures<br>Installed equipment<br>Piping, HVAC, instrumentation<br>Electrical | \$15,124,000<br>17,398,000<br>6,437,000<br>5,045,000 |
|------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Subtotal:                                                                                      | \$44,004,000                                         |
| Taxes on material and equipment                                                                | 1,265,000                                            |
| Estimated total construction costs                                                             | \$45,269,000                                         |
| Engineering, Supervision, Procurement,<br>and Contracts Management                             | 6,790,000                                            |
| Subtotal:                                                                                      | \$52,059,000                                         |
| Escalation                                                                                     | excluded                                             |
| Subtotal:                                                                                      | \$52,059,000                                         |
| Contingency                                                                                    | 13,016,000                                           |
| Total Estimated Cost:                                                                          | \$65,075,000                                         |

#### DEFINITION OF TYPE 1 ESTIMATE

#### MAGNITUDE

#### BASIS

A Type 1 estimate is based on assumed flowsheets and assumed process requirements. No design drawings are prepared beyond "scratch pad" sketches. Equipment lists are prepared based on the assumed flowsheet and priced on updated former quotations, telephone quotes from vendors' representatives, and, occasionally, letter quotes. No equipment specifications are prepared, nor formal vendors' proposals are solicited. Total facility costs are determined by roughly estimating the shelter volume and applying experience unit costs. Percentage factors are used for installation of equipment. Electrical costs, other than motors and substations, are estimated as unit costs per installed horsepower or percentage of total cost. Percentage factors are used for contractor's field overhead, construction plant and construction camp. Additional percentage factors are used for engineering, design and procurement. Contingency and escalation evaluations are also prepared.

#### INFORMATION REQUIRED

- It is necessary to know the following:
  - 1. End use of Magnitude Estimate.
  - 2. Type of product the plant is to produce.
  - 3. Capacity of the plant.
  - 4. Geographical location of the plant.
  - 5. A facility description.
  - 6. A layout drawing or sketch of the plant.
  - 7. Estimated process flow diagrams.
  - 8. Any design sketches that may have been prepared.
  - 9. Construction Schedule.

USE OF ESTIMATES

A Type 1 estimate contains heavy contingencies. These may range from 20% to 25% on structures and 15% to 20% on equipment. A Type 1 estimate may frequently be suitable to reject a project but it is seldom adequate for positive accepatance of a project. A Type 1 generally describes a hypothetical installation and seldom becomes the basis for conceptual design.

#### VI. OPERATING COSTS

#### A. SUMMARY

An operating cost estimate based on 1982 dollars was developed for a 1000 tonne/h coal preparation plant. The basis for this estimate is outlined in the following section. The summarized unit cost based on raw coal throughput is as follows:

#### Item

\$/Tonne of Raw Coal

| 1.  | Hourly labor          | \$0.55 |
|-----|-----------------------|--------|
| 2.  | Salaried supervision  | 0.30   |
| з.  | Maintenance supplies  | 0.26   |
| 4.  | Refuse disposal       | 0.29   |
| 5.  | Power                 | 0.05   |
| 6.  | Rentals and contracts | 0.06   |
| 7.  | Laboratory costs      | 0.04   |
| 8.  | Environmental         | 0.04   |
| 9.  | Miscellaneous         | 0.04   |
| 10. | Flocculants           | 0.71   |
| 11. | Magnetite             | 0.13   |
| 12. | Contingency at 25%    | 0.62   |
|     | TOTAL                 | \$3.09 |

#### B. DETAILS

The operating cost estimate was based on the following process plant operating parameters:

- o 3,000,000-tonne/yr raw coal throughput
- o 3,480 operating hours per year

A brief description outlining the assumptions and methods used in the calculation of each item follows:

#### 1. Hourly Labor

- o Total manpower of 40
- o Labor distribution
  - 21 plant operators (7 per shift)
  - 19 maintenance personnel 10 millwright
    - 3 electricians
    - 3 pipefitters
    - 2 welders

- 1 instrument mechanic

- Average wage of \$24,000/year
- o Fringe benefits at 73% —

#### 2. Salaried Supervision & Annual Wages

- o Total manpower of 11
- o Supervision distribution

| - | Plant superintendent<br>Two senior foremen | \$58,000 |
|---|--------------------------------------------|----------|
|   | operating                                  | 50,000   |
|   | maintenance                                | 50,000   |
| - | Plant engineer                             | 50,000   |
| - | Five foremen                               |          |
|   | three operating                            | 45,000   |
|   | two maintenance                            | 45,000   |
| - | Maintenance planner                        | 45,000   |
| - | Senior analyst                             | 45,000   |

o Fringe benefits at 73%

#### 3. Maintenance Supplies

Cost distribution

- o Replacement parts, \$.24/tonne raw coal mechanical consumables and lubricants
- o Filter cloth

\$.02/tonne raw coal

#### 4. Refuse Disposal

- o Based on 71.3% Plant Yield
- o Assumed refuse disposal cost of \$1.00 per tonne

#### 5. Power

.

- o Based on 2,000 connected hp
- o Assumed Power Cost of \$.03/kWh
- o Cost distribution
  - process equipment \$.04/tonne raw coal
    other (lighting, maintenance) \$.01/tonne raw coal
- 6. <u>Rentals and Contracts</u> assumed at \$15,000 per month
- 7. Laboratory Costs assumed at \$10,000/month
- 8. Environmental based on an allowance of \$10,000/month

### 9. Miscellaneous

- o Assumed at \$10,000/month
- Includes items such as travel, plant heating and miscellaneous consumables.

# 10. Flocculants

- o Thickener
  - High M.W. flocculant dosage of 0.4 lb/tonne at \$3.60/lb
  - Low M.W. flocculant dosage of 1.2 lb/tonne at \$0.48/lb
- o Belt Filter Press
  - High M.W. flocculant dosage of 0.9 lb/tonne at \$3.60/lb

#### 11. <u>Magnetite</u>

- Assumed consumption of 6 lb/tonne of raw coal processed
- o Magnetite cost of \$55/ton delivered.
- 12. Contingency 25% of above costs

| KAISER     | TITLE Hat Greek F                 | Project  |                    | JOB NO           | 82137          |
|------------|-----------------------------------|----------|--------------------|------------------|----------------|
|            | CLIENT B.C. Hydro.                | LOCAT    | ION <u>B.C.</u>    | DATE _/_2        | 2/13/82        |
|            | SUBJECT 1,000 TPH C               | OAL Pres | <u>p. Plant</u>    | BY_ <u>_H. k</u> | <u>v. H</u>    |
|            | - Factored                        | Estin'   | ate                | SHEET            | OF             |
| <b>-</b> 1 |                                   |          |                    | CHECKED          |                |
| CODE       | DESCRIPTION                       | QUANTITY | COST               | AMOUNT           | TOTAL          |
| ╞╾═╼┢═     |                                   |          |                    |                  |                |
|            | Ruldinge & Structures             |          |                    |                  | 15 174 01      |
|            | <u>0 011011195 2 01 01 10[53]</u> |          |                    |                  |                |
|            | Installed Equipiment              |          |                    |                  | 17 395 00      |
|            | 1.7                               |          |                    |                  |                |
|            | PIPING, HVAC                      |          |                    |                  |                |
|            | <u>rioitotiorentation</u>         |          | <b>└──└──┤──</b> ╽ |                  | 6 437 00       |
|            |                                   |          | <u> </u>           |                  | •<br>•         |
|            | Electrical                        |          |                    |                  | 504500         |
| '<br>      |                                   |          |                    |                  |                |
|            | SUBTOTAL                          |          |                    |                  | <u>4400400</u> |
|            | Taxas Dia Matil & Faulto          |          |                    |                  | 12AEN          |
|            | CARES ON MAIL & EQUIP             |          |                    |                  |                |
|            | Subtotal                          |          |                    |                  | 4526900        |
| i!         |                                   |          |                    |                  |                |
|            | ESEPAND (M@15 Mp                  |          |                    |                  | 6 790 00       |
|            |                                   |          |                    |                  |                |
|            | <u> </u>                          |          |                    |                  | 5205900        |
|            | <u> </u>                          |          |                    |                  |                |
|            | ESCATATION                        |          |                    |                  | EXCLUDE        |
| ┝╶╼━┢╴     | Subtatal                          |          |                    |                  | 5205900        |
|            |                                   |          |                    |                  |                |
|            | Contingency @ 25.010              |          |                    |                  | 13016.00       |
|            |                                   |          |                    |                  |                |
|            | Total Estimated Co                | st       |                    |                  | 6507500        |
| ┝╌╌═╼┫┥╴   |                                   |          |                    |                  |                |
| ·          |                                   |          |                    |                  |                |
|            |                                   |          |                    |                  |                |
| ·····      |                                   |          |                    |                  | ┝              |
|            |                                   |          | ┍──┼──╀──╢         |                  |                |
|            |                                   |          |                    |                  |                |
|            |                                   |          |                    |                  |                |
|            |                                   |          |                    |                  |                |
|            |                                   |          |                    |                  |                |
|            |                                   |          |                    |                  |                |
|            |                                   |          |                    |                  |                |

# KAISER

| PROJECT TITLE                                   | JOB NO. 82137     |
|-------------------------------------------------|-------------------|
| CLIENT B.C. 114000 LOCATION                     | DATE 11-6 3/3. BY |
| COAP'SE CLEF'15:16 150 mm × 19.0 mm (H.M. Drum) | SHEET OF7         |

#### EQUIPMENT LIST AND COST ESTIMATE

| <b>– –</b>       |               | 1            | <u>r</u>    | T                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>1</b> · 1 | DEL                                    |                             | T            | <b></b>                                | <b>F</b>          |                |               | 1                    | <b>n.</b>    | · · · · ·      |             |                                       | · · · · · ·         | ¥Z                |
|------------------|---------------|--------------|-------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------------|-----------------------------|--------------|----------------------------------------|-------------------|----------------|---------------|----------------------|--------------|----------------|-------------|---------------------------------------|---------------------|-------------------|
| NE AI            | COST          | EQUIP<br>HO. | SPEC<br>NO. | QUANT                                         | EQUIPMENT DESCRIPTION, INCLUDING MOTORS, DRIVES, GUARDS & BASES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | HP           | FOB<br>POINT                           | SHIPPING<br>WEIGHT<br>TOTAL | UNIT<br>M.H. | MAN-<br>HOURS                          | LABOR &<br>BURDEN | EQUIP<br>USAGE | MATE-<br>RIAL | SUB<br>CON-<br>TRACT | AMOUNT       | SALES<br>TAXES |             | [[]]                                  | TOTAL<br>EQUIP      | TOTAL<br>ESTIMATE |
| ٦,               | 91            |              |             | 2                                             | Plant Food Compan Discharge Churle to P/G Screens                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |                                        |                             |              |                                        | Incl.             | wic            | Inute         | WOrk                 |              |                |             |                                       |                     |                   |
| 2                |               |              |             |                                               | o 1/2" R 1/2" AP Linin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |              |                                        | 1                           |              |                                        |                   |                |               |                      | 1            |                | 1           | 1                                     |                     |                   |
| ۱.               |               |              | I           | 4                                             | 6" x 16" Gingle doct planting RK screens                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |                                        |                             |              | 576                                    | 17,200            | 4,300          |               |                      | 110,000      | [              |             | 5.600                                 | 145.600             | 167.100           |
| •                |               |              |             |                                               | · Va dort CW down gunds discharge 1.p                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |                                        |                             |              |                                        |                   |                |               |                      |              |                |             | 1 1                                   |                     |                   |
| '                |               |              | ļ           |                                               | - 25 Hp 1800 Rth                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 100          |                                        | L                           |              |                                        |                   |                |               |                      |              |                |             |                                       |                     |                   |
| •                | <u> 11</u>    |              | ļ           | 2                                             | Undenling Pan - B'-6" Y 21'-6"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ļ            |                                        |                             |              |                                        | Incl.             | w/cl           | uter          | VOFK                 |              |                |             |                                       |                     |                   |
| '                |               |              |             |                                               | · YA R. YA" Troublan lines.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |                                        |                             |              |                                        |                   | ,              |               |                      |              |                |             |                                       |                     |                   |
| •                |               |              | 1           | 2                                             | Screen Ormanie Chale to H.M. Vessel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>_</b>     |                                        | <u> </u>                    |              |                                        | Incl              | WIG            | rute          | WOLK                 | [ <u> </u>   |                |             |                                       |                     |                   |
| •                |               |              | ļ           |                                               | • 1/2" A. 1/2" AR Liner.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | L            |                                        |                             |              |                                        |                   |                |               |                      |              |                |             | 1                                     |                     |                   |
| "                |               | <b> </b>     | <b> </b>    | z                                             | H.M. Drom Separator                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              | <br>                                   | 78 T                        |              | 1,549                                  | 46,50             | 14,000         | <br>          |                      | 432,000      | ł              |             | 17.300                                | 449,300             | 509.800           |
| "                |               | <b>_</b>     | <u> </u>    |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |                                        |                             |              |                                        | ļ                 |                |               |                      |              |                | L           |                                       |                     |                   |
| "  -             | · ·           | . <i> </i> . | ļ           | <b> </b>                                      | * * * * * * * * * * * * * * * * *                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | I            |                                        |                             |              | l                                      | <b> </b>          |                |               |                      |              |                |             | <b></b>                               |                     |                   |
| "⊢               |               | <u>'</u> .   | <u> </u>    | 2                                             | Clean Cool choles                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |                                        | l                           | <u> </u>     |                                        | Incl              | w/cl           | nutes         | NO+K                 |              |                |             | <b></b>                               |                     |                   |
| "⊢               |               | i            |             |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b> </b>     |                                        | <b> </b>                    |              | <u> </u>                               | <b>_</b>          |                |               |                      | l            |                |             |                                       |                     |                   |
| "-               | <u>.</u>      |              |             | 2                                             | Fired C.C. screens                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |                                        | <u> </u>                    |              | 143                                    | 4,300             | _1,100         |               |                      | 28,000       |                | <b> </b>    | 1,100                                 | 29,100              | 34,500            |
| <b>-</b>         |               | <b> </b>     |             |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |                                        |                             |              |                                        |                   |                |               |                      | i            |                |             |                                       |                     |                   |
| " –              |               |              | ┨───        | 2                                             | 6'r 16' Man Coal Serren                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |                                        | ┢┈┈                         |              |                                        | 10,800            | 007,6          |               |                      | 70,000       |                |             | 2,800                                 | _ 72,800            |                   |
| "  -             | <del></del> , | <b> </b>     | <u> </u>    | <u> </u>                                      | 25 NP, 1800+pm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 50           | • • · • • · · · · ·                    |                             | ļ            |                                        |                   |                |               |                      |              |                | l           | ·                                     |                     |                   |
| <u>"</u>  -      |               | <b>}</b> -   | <u> </u>    | <u>                                      </u> | tierd refere screen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ·            |                                        | <b>}</b>                    |              | 72.                                    | 2,200             | _600           |               |                      | 14,000       |                |             | 600                                   |                     |                   |
| <u>"</u>         |               | <b> </b>     |             | <u> </u>                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              | •·•··                                  | ·                           |              |                                        | ·                 |                |               |                      | ···· · · · · |                | <b> </b>    |                                       |                     |                   |
|                  |               | †            |             | <u>                                     </u>  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              | ······································ | · <b> -</b> · - · - · -     | · ·          |                                        |                   |                |               |                      |              | · ··           | · · · · · · | · · · · · · · · · · · · · · · · · · · |                     |                   |
| ,,               |               | <u> </u>     |             |                                               | 23 10 100 10m                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>.</b>     |                                        |                             |              | 120-                                   | 5,400             | 1,400          |               | <b></b>              | 35,000       |                | <b>+</b>    | 1,400                                 | 36,400              | <u>43,</u> 700    |
|                  |               |              | <u> </u>    | 1                                             | E.C. Shile to and or man                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |                                        | ł–                          |              | h                                      | Trad              |                |               |                      | ·            |                | <b> </b>    | <u></u> ∤}                            |                     |                   |
| " †              |               | <u> </u>     |             |                                               | Contraction of the state of the | <b>+</b>     |                                        | +                           |              |                                        | 1 17 (1.          | WIL            | 7 V. T.E      | WOFK                 | _ <u></u>    |                | f           | ŧŧ                                    |                     |                   |
| •                |               |              |             | 1,                                            | telas chale la salar constant                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |                                        |                             |              | •••••••••••••••••••••••••••••••••••••• |                   |                |               |                      |              | -;             | i           |                                       | ··· ·               |                   |
| " [ <sup>-</sup> |               | †            | 1           |                                               | Construction of the constr |              | • • ••• ••••                           | +·                          |              |                                        | 1 17 61           | w]6            | PUL           | WOFN                 | -            | 1              | · ·         | <u>ا</u> ا                            | · · · : .: <b>-</b> |                   |
| • [              |               | <b> </b>     | 1           | 1                                             | Coporte H.M. sure a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              | • • • • • • •                          | · · · · · ·                 |              |                                        | ·                 |                |               |                      | · ·          |                |             |                                       |                     |                   |
| ·• [             |               | 1            | 1           |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |                                        | <u> </u>                    |              |                                        | 1.00              | _wµ            | IALE          | ware.                |              | 1              |             |                                       |                     |                   |
| •                |               | <b> </b>     | 1           | Z                                             | ronze II.M. Pune                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 7.61         |                                        | t                           | •            | <u>הען</u>                             | 11 700            | 100            |               | <b>4</b> · · · · ·   | 6. 6. 5      |                |             | 2.00                                  | ( ) !! ( )          | 67 200            |
| " [              |               |              |             |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |                                        | 1                           |              |                                        | 1,000             | - 600          | -             | 4                    | 1 - 1 - 1    |                |             | 0,900                                 |                     |                   |
| "[               |               |              |             | 1                                             | in the helper                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1            |                                        | 1                           | 1            |                                        | Tinel             | wip            | ato           | VOI-K                | İ            |                |             |                                       |                     |                   |
| •• [             |               |              |             |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1            |                                        | 1                           | 1            |                                        | 1                 | **/* 1         | PICV          |                      |              |                |             |                                       |                     | . <b>.</b>        |



•

| PROJECT TITLE                                 | · - ·       | JOB NO. 82137 |
|-----------------------------------------------|-------------|---------------|
| CLIENT R.C. 11/500 LOCATION                   | · - <b></b> | DATE          |
| <u>Ц.М., //10/16_СІРСИ17 100 на С. 0.6 на</u> |             | SHEET OF7     |

#### EQUIPMENT LIST AND COST ESTIMATE

|           |                 |                                              |          |       | EQUIPMENT LIST AND COST ESTIMATE                                |     |                                       |                                       |                 |                                        |              |                |                |                      |                                       |                 |                         |         |                |                   |
|-----------|-----------------|----------------------------------------------|----------|-------|-----------------------------------------------------------------|-----|---------------------------------------|---------------------------------------|-----------------|----------------------------------------|--------------|----------------|----------------|----------------------|---------------------------------------|-----------------|-------------------------|---------|----------------|-------------------|
| 1         |                 |                                              |          | Γ     |                                                                 |     | DELIVERY DATA                         |                                       |                 | INSTALLATION COST                      |              |                | FQUIPMENT COST |                      |                                       |                 |                         |         |                |                   |
| NE<br>(0. | COST<br>ACCOUNT | EQUIP<br>NO.                                 | SPEC NO. | QUANT | EQUIPMENT DESCRIPTION, INCLUDING MOTORS, DRIVES, GUARDS & BASES | HP  | FOR<br>POINT                          | SHIPPING<br>WEIGHT<br>TOTAL           | UNIT<br>M.H.    | HAN-<br>HOURS                          | LABOR &      | EQUIP<br>USAGE | MATE-<br>RIAL  | SUB<br>CON-<br>TRACT | AMOUNT                                | SALES<br>TAXES  | DUTY                    | FPT     | TOTAL<br>EQUIP | TOTAL<br>ESTIMATE |
| 1         |                 |                                              | ļ        | Z     | from cool stuice to destime distributor                         |     |                                       | •                                     |                 |                                        | Incl.        | w/PI           | pton           | ork                  | · · · · · · · · · · · · · · · · · · · |                 |                         |         |                |                   |
| 2         |                 |                                              |          | 2     | Destime distributor                                             |     |                                       | •                                     |                 | ······································ | Linch        | w/P            | lote           | WOFK                 |                                       |                 | · · · · · · · · · · · · | ·••     |                | - <u>-</u>        |
| ,         |                 |                                              |          | 10    | 6' = 16' Single dock vibiling doctime schools                   | 250 | · · · · · · · · · · · · · · · · · · · |                                       |                 | 1,790                                  | 53,10        | 13,40          | q              |                      | 350,000                               |                 |                         | 14,00   | 364,000        | 431,100           |
| ,         |                 |                                              |          | 2     | H.M. Cyclme Ford Sumps                                          |     |                                       | +                                     |                 | <br>                                   | Ircl.        | wIPI           | otew           | PTK                  | •                                     |                 |                         | •       |                |                   |
|           |                 |                                              |          | 2     | H.M. Cycline modia distributors                                 | •   |                                       | · · · · · · · · · · · · · · · · · · · |                 | <b></b>                                | II-rel.      | wIP            | pten           | OFK_                 |                                       |                 |                         |         |                |                   |
|           |                 |                                              | ╞        | 8     | 24" HM. Cyclmes                                                 |     |                                       | ╡╌╴╸┙╌╸                               |                 | 283                                    | 8,500        | 1,700          | <br>           |                      | <u>%,cro</u>                          |                 |                         | 3,800   | 99,800         | 110,000           |
| •3        |                 | <i></i>                                      |          | 8     | 5' wide c.c. siege bends & ferd bores                           |     |                                       |                                       |                 | 83                                     | 2,500        | _500           |                | <br>                 | 64,002                                | · · · · ·       |                         | 2,600   | 66,600         | 69,600            |
| 14        |                 |                                              |          | 8     | 6'r 16' single drek vibrating c.c. screams                      | 200 |                                       | <u>+</u>                              |                 | 1,432                                  | <u>43,00</u> | 0_10,80        | ¢              |                      | 2.80,000                              | <br>            |                         | 11,200  | 291,200        | 345,000           |
| .,        |                 | <u></u>                                      |          | 4     | c.c. chute to centulfages                                       |     |                                       | +                                     |                 |                                        | Incl         | w/c            | vte            | vork.                |                                       | · ··· · · · · · |                         |         |                |                   |
| '8<br>79  |                 |                                              |          | 4     | c.c. contriliges                                                | 200 |                                       | +                                     | +<br>           | 6.46                                   | 19,400       | .5,80          |                | <br>                 | 189,000                               |                 | . <b></b>               | 7,200   |                | 212,400           |
| 20<br>21  |                 |                                              | ┤━──     | 4     | c.c. chute to product conveyor                                  | +   |                                       |                                       |                 | <b> </b>                               | Inch         | wich           | uten           | OFK                  |                                       |                 |                         | <u></u> |                |                   |
| 72<br>73  |                 |                                              |          | 2     | G' Y 16' single lock abording refore scherons                   | 50  |                                       |                                       | .               | 360                                    | 10,80        | 2,800          | 2              |                      | 70,000                                | <b>z</b>        |                         | 2,800   | 72,800         | 86,400            |
| 24        |                 | 1                                            |          |       |                                                                 |     | <b>  </b>                             |                                       | <b> </b>        |                                        |              | ······         |                |                      |                                       |                 |                         |         |                |                   |
| 26        |                 | <u> </u>                                     |          | 2     | o c/w barlists dense action                                     | 100 |                                       |                                       |                 | 425                                    | 12,800       | 3,800          | ?              |                      | 90,000                                | +               |                         | 3,600   | 93,600         | 110,200           |
| 27<br>78  |                 | <u> </u>                                     |          | -2-   | reise chule to reise contra                                     |     | ¥<br>                                 |                                       | ·               |                                        | Inc          | w./c           | nute           | VOrk                 | <br>                                  |                 | . · .                   |         |                |                   |
| 78<br>19  |                 |                                              |          | 2     | HHC Red to m                                                    |     |                                       |                                       |                 | 1.40                                   | 4,200        | 600            |                | · · · · ·            | <u>.</u>                              | · · · · · · · · |                         | 2,400   |                | 67,200            |
| 11<br>17  |                 | <u>†                                    </u> |          | 2     | en el en el este ales                                           |     | , , , , , , , , , , , , , , , , , , , | · · · · · · ·                         | · · · · · · · · |                                        | Inc          | w/P            | ater           | VOFK                 | <br>                                  |                 |                         |         | ·····          |                   |
| 11        |                 |                                              | <u> </u> |       | ······                                                          |     |                                       |                                       |                 | h                                      | <b>.</b>     |                |                |                      |                                       |                 |                         |         |                |                   |

KAISER

| PROJECT TITLE NAT CLOBERT  | JOB NO. 82137   |
|----------------------------|-----------------|
| CLIENT V.C. HIVOO LOCATION | DATE 1- 3/32 BY |
| Fines Circuit 0.6mm to     | SHEETY OF7_     |

\_\_\_\_

#### EQUIPMENT LIST AND COST ESTIMATE

|             |         |          |     |        | EQUIPMENT LIST AND COST ESTIMATE                                |             |                           |                             |              |                |                   |                |        |                      |            |                |                                       |         |                | 59                |
|-------------|---------|----------|-----|--------|-----------------------------------------------------------------|-------------|---------------------------|-----------------------------|--------------|----------------|-------------------|----------------|--------|----------------------|------------|----------------|---------------------------------------|---------|----------------|-------------------|
|             |         |          |     |        | DELIVERY DATA                                                   |             |                           | INSTALLATION COST           |              |                | EQUIPMENT COST    |                |        |                      | ·····      | I              |                                       |         |                |                   |
| 14E<br>'40, | ACCOUNT | NO.      | NO. | QUANT  | EQUIPMENT DESCRIPTION, INCLUDING MOTORS, DRIVES, GUARDS & BASES | ЧH          | FOB<br>POINT              | SHIPPING<br>WEIGHT<br>TOTAL | UNIT<br>M.H. | MAN-<br>HOURS  | LABOR &<br>BURDEN | EQUIP<br>USAGE | RIAL   | SUB<br>CON-<br>TRACT | AMQUINT    | SALES<br>TAXES | DUTY                                  | FP1     | TOTAL<br>EQUIP | TOTAL<br>ESTIMATE |
| 1           |         |          |     | \<br>\ | Princey 1) O Cycling Frod meres                                 |             | ₩ •·                      |                             |              |                | Incl.             | w/PI           | pten   | ork.                 |            |                | • • • • • • • • • • • • • • • • • • • |         |                | ·                 |
| 3           |         | <u>├</u> |     | 2      | Ping W.O.C. Fiel Stars                                          | 400         |                           | + ····                      |              | 210            | 6,300             | . 900          |        |                      | 90,000     | <br>           |                                       | 3,600   | 93,600         | 100,800           |
| 5           |         |          |     | 30     | 13 - Prinary W. O. Cyclines                                     |             |                           |                             |              | 708            | ə1,200            | 4,200          | f<br>  |                      | 247,473    |                |                                       | 9,600   | 249,600        | 275,000           |
| ,           |         |          |     |        | Secondary W. O.C. Cool 's P.                                    |             |                           |                             |              |                | Inclu             | w/Pl           | ater   | OFK.                 |            |                |                                       |         |                |                   |
| 9           |         |          |     |        | Serndory W. S.C. Faul Simp                                      | 50          |                           |                             |              | 53             | _1,600            | 300            |        |                      | 20,002     |                |                                       | 800     | 20,800         | 22,700            |
| 11          | · · · · |          |     | 4      | 13" Second ary W.O. Cyclones                                    |             |                           |                             |              | 110            | 3,300             | 700            |        |                      | 32 200     |                |                                       | 1,300   | 33,300         | 37,300            |
| 13          |         |          |     | 10     | 6' with Duble Vibrating Sieve Bady 4 Food Barrs                 |             |                           |                             |              | 130            | 3,900             | 900            |        | <br>                 | 100 1.71   |                |                                       | 4,000   | 104,000        | 108,800           |
| 15<br>16    |         |          |     | `      | 150'- Static Thickans Mechanism                                 |             |                           |                             | }            | 1, <u>57</u> 7 | 47,30             | _7,100         |        | }                    | 300,003    |                |                                       | 8,000   | 208,000        | <b>262,40</b> 0   |
| 17<br>18    |         |          |     | 2      | Thickener Uiflow Pumps                                          | 200         |                           | <br>                        |              | 250            | 7,500             | 1,000          |        |                      |            |                | · · ·                                 | 2,400   | 67,400         | 70,900            |
| 19<br>20    |         |          |     | •      | Thickoner Dislow Tank                                           | +<br>+      | ╉ <u>─</u> ─⁻···<br>╢╴─── | <u></u><br>↓                | <br> /       | ·              | Incl              | w/P            | aten   | ork_                 |            |                |                                       |         |                |                   |
| 21          |         |          |     | .2     | Thickmar O'Flow Jumps                                           | Sec         |                           |                             |              | 250            | 7,500             | 1,000          | /<br>/ |                      | <u></u>    | <br>           |                                       | 3,600   | 93,600         | 102,100           |
| 23<br>24    |         |          |     | · `    | Therefores It Place winterlying                                 | •           | ∦<br>∦                    | <u>↓</u>                    | <br>         |                | Inc               | w/P            | Vater  | VOrK_                |            |                |                                       |         |                |                   |
| 25<br>26    |         |          |     | 14     | 35 m Arus Andritz Continuous Bolt Filler Kirse                  | 308         | ₿<br>                     | 1,0087                      |              | 15,120         | 453,60            | 0.90,70        | p      | • <b></b>            | 10,920,000 |                | · • · · ·                             | 4.36,60 | LII, 356,800   | 11,901,100        |
| 27<br>78    |         |          |     |        | Filler Ross Floceubort System                                   | 20          | <br>                      | <u>+</u>                    |              | 330            | 10,000            | 4.700          |        |                      | 100,000    |                |                                       | 4,000   | 104,000        | .115,100          |
| 29<br>10    |         | <u> </u> |     | •      | Thilener Thurial System                                         | · · · · · · |                           |                             | •••          | 100            | 3,000             | 500            |        |                      | 3          |                |                                       | 1,200   | 31,200         | 34,700            |
| ,,<br>,,    |         | <u> </u> |     | ₽<br>  | ······································                          |             | · · · · ·                 |                             |              |                |                   |                |        |                      |            | <br>           |                                       |         |                |                   |
| **          |         |          |     |        | <b></b>                                                         |             | · · · · · ·               |                             | <b> </b>     |                |                   |                |        | }                    |            | }· .           |                                       |         |                |                   |

| PROJECT TITLE NAT CELL 12 12 |                                         | JOB NO           |
|------------------------------|-----------------------------------------|------------------|
| CLIENT B.C. HVIPD LOCATION   | • • • • • • • • • • • • • • • • • • • • | DATE Dec 8/22 BY |
| "AFIST SECURIST & MICC.      |                                         | SHEET 5 OF7      |

#### EQUIPMENT LIST AND COST ESTIMATE

| <b></b>      |       |                  |       | Ī        |                                                                 |                    | DELIVERY DATA INSTALLATION COST        |                                       |              |               | EQUIPMENT COST |                       |               |                      |                       |                                       |          |                 |                |                       |
|--------------|-------|------------------|-------|----------|-----------------------------------------------------------------|--------------------|----------------------------------------|---------------------------------------|--------------|---------------|----------------|-----------------------|---------------|----------------------|-----------------------|---------------------------------------|----------|-----------------|----------------|-----------------------|
| ACCOU        | NT NO | JAP SPE<br>2. Ni | C  01 | UANT     | EQUIPMENT DESCRIPTION, INCLUDING MOTORS, DRIVES, GUARDS & BASES | HP                 | F QB<br>POINT                          | SHIPPING<br>WEIGHT<br>TOTAL           | UNIT<br>M.H. | MAN-<br>HOURS | LABOR &        | EQUIP<br>USAGE        | NATE-<br>RIAL | SUB<br>CON-<br>TRACT | AMOUNT                | SALES<br>TAXES                        | DUTY     | <b>1</b> 97     | TOTAL<br>EQUIP | TOTAL<br>ESTIMATE     |
|              |       |                  |       | 1        | Dilute Sump                                                     |                    |                                        |                                       |              |               | Inch           | w/Pl                  | oten          | orK                  |                       |                                       |          |                 |                | · · · · · ·           |
| ,            |       |                  |       | 2        | Dilute Pump                                                     |                    | 4 .<br>                                | · · · · · · · · · · · · · · · · · · · | ··· • • •    | 16.7          | 5.000          | 700.                  | ·····         |                      | 60,000                | - · ·                                 | .<br>    | 2,400           | 67,400         | 68,100                |
| ; <b> </b>   |       |                  |       | 2        | May Sep. Distributer<br>UD May See. (30°6+84°)                  |                    |                                        |                                       | •            | 453           | .Incl.         | W/P                   | aten          | OFK                  | 320,000               |                                       |          | 12.80           | 332.600        | 362.20                |
| ·            |       |                  |       | 2        | May Concontrate Lounders                                        |                    | <u>-</u>                               |                                       |              |               | Linch          | w/Pl                  | oter          | OFK .                | <b>.</b>              |                                       |          |                 |                |                       |
| , <b> </b> - |       |                  |       | <u> </u> | Black Walm Sump                                                 | $\left  - \right $ |                                        |                                       | ·· .         | ····-••       | [ Incl         | WIP                   | otes          | vor K                | ·                     |                                       | <u> </u> | +               |                |                       |
| ,            | +     |                  |       | 2        | Elock Wolan Pump                                                |                    | · · · · · · · · · · · · · · · · · · ·  |                                       |              | 167           | 5,000          | 700                   |               |                      | 60,000                |                                       |          | 2,400           | 67,400         | 68,10                 |
|              | +-    |                  |       | 1        | Floor Jump Pump                                                 | <br>               | ···                                    | ╡÷<br>                                | ↓<br>↓       | 67            | 2,000          | 300                   | <u>↓</u>      | ╡ <i></i>            | 20,900                |                                       |          | 800             | 20,800         | a3,10                 |
| ,            | ;     | <u>.</u>         |       | 1        | Mag Mix System & Pennep.                                        | ┣┥<br>┨┤           | <b>  </b>                              |                                       | <u> </u>     | 47.           | 2,900          | 400                   | <u> </u>      |                      | 35,000                |                                       | <u> </u> | 1,400           | 36,400         | 39,70                 |
|              |       |                  |       | 1        | 36 Mag Thickman Mechanisma.                                     | }                  | <b> </b>                               | ·                                     |              | 3.93          | 11,800         | 1,800                 |               |                      | 1.0,000               |                                       | <b> </b> | 2,000           | 57,000         | _65,60                |
|              |       |                  |       | 1        | May Thickman U/F                                                |                    |                                        |                                       |              | 63            | ə,500          | 300                   |               |                      | 20,000                |                                       | ·        | 500             | 20,800         |                       |
|              |       | <u> </u> _       |       | 1        | Mog. Th. U/F distributor                                        | <br>               | ·                                      |                                       |              |               | Incl           | w/Pl                  | etew          | prK                  |                       |                                       | <br>     |                 |                | · · · · · · · · · · · |
|              |       |                  |       |          | Potro Googer Company Colley                                     | <br>               |                                        |                                       |              | 3,010         |                |                       |               | 450,000              | · · · · · · · · · · · | · · · · · · · · · · · · · · · · · · · |          |                 |                | 450,00                |
|              |       |                  |       |          | Raw Col Sib Area ( secutional Coprity)                          | .  <br>            | · · · · · ·                            |                                       | }            | 36,960        | <br>           | · · · · · · · · · · · | · · · · · ·   |                      |                       |                                       |          |                 |                | 4,623,3               |
|              |       |                  | -+    |          | Prop Plant Feed Conveyor                                        |                    |                                        |                                       |              | 2,020         | 60,60          | 0 12,100              |               |                      | دفقتر مر              |                                       |          | . 8,100         | 210,100        | 252,50                |
|              |       |                  |       |          | Park Comer held                                                 |                    | •••••••••••••••••••••••••••••••••••••• |                                       |              | 2 0 70        |                |                       |               |                      |                       |                                       |          |                 |                | UEIM                  |
|              | -+-   |                  | -     |          |                                                                 | 1                  |                                        |                                       | +<br>        |               | · ·            | • • •                 |               | א <i>ו</i> יד ו      | <b>f</b>              | ·                                     |          |                 |                |                       |
|              |       | _<br>            |       |          |                                                                 |                    | , .                                    | · · · · ·                             |              |               |                | <u> </u>              |               | <u> </u>             | <b>  </b>             |                                       |          | ┥╾╼             |                |                       |
| ,            |       |                  | -+    |          | .Totol Equipment                                                |                    |                                        |                                       |              | 73,972        | 926,10         | ¢193,20               | ¢             | <i>521,00</i>        | 14,618,0              | po                                    | }        | 564, <b>5</b> 0 | 15,202,800     | 21,843,10             |

(a)

|                                         | Kaiser Engineers                                                                                                                                | JOB NO. 82137                                                                    |   |  |  |  |  |  |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|---|--|--|--|--|--|
|                                         | Hat Greek Proj.<br>Richate Based On Installed                                                                                                   | DESIGNED BY<br>CHECKED BY Sy<br>Faur Cost                                        |   |  |  |  |  |  |
|                                         | Greenhills 800 TPH<br>Hat Greek 1,000 TPH                                                                                                       |                                                                                  |   |  |  |  |  |  |
|                                         | <u>Greenhills</u><br>Installed Equip Incl. Subs.<br>Less Disc Filters<br>Less Refuse Thickener & Pub                                            | 5,958,000<br>< 863,000<br>mps < 434,000<br>4,661,000                             | _ |  |  |  |  |  |
|                                         | <u>Hat Creek</u><br>Installed Equip, Incl. Subs.<br>Addit. Motors & Misc. Equip.<br>Less Belt Filters<br>Less Feed Convs.<br>Less Raw Coal Area | 21, 843,000<br>175,000)<br><11,901,000><br><283,000><br><4,620,000><br>5,214,000 | - |  |  |  |  |  |
| CALCULATIONS KE Form No. E-6 Rev. 10-71 | <u>5,214,000</u> = 1.12 - Adj. E<br>4,661,000 = 1.12 - Adj. E<br>Adj. Installed Equip 1                                                         | 5,214,000<br>5,019,000<br>4,620,000><br>7,398,000                                |   |  |  |  |  |  |

,

|         | Kaisan Engineena            | Jos No. 8   | 2137          |
|---------|-----------------------------|-------------|---------------|
|         |                             | SHEET 7     | of 7          |
|         | Hut CHOOK PHO:              | DESIGNED BY | DATE 12/13/55 |
|         | ACL &I # #                  | CHECKED BY  | DATE          |
|         | Buildings & Structures      |             |               |
|         | Greenhills                  | 5.920.000   |               |
|         | 1/2 THICKEMETS              | 417.000     |               |
|         | Sump & Pumphouse            | 322,000     |               |
|         | -                           | 6,659,000   |               |
|         | -                           | ×1.12       |               |
|         |                             | 7,458.000   |               |
|         | Belt Filts. @ 25 010        |             |               |
|         | 0f 11,901,000               | 2,975,000   |               |
|         | FRED CONVS. @25             |             |               |
|         | OF 283,000                  | 71,000      |               |
|         |                             | 10,504,000  | ļ             |
|         | Row Goal Area               | 4,620,000   |               |
|         | PIPING, HVAC & INSTEU       | 15, 124,000 | -             |
|         | @ 37 010 Of Installed Equip |             |               |
|         | 17, 398, 000 × 0.37 =       | 6, 437, 000 |               |
|         | ·                           |             |               |
|         | Electrical                  |             |               |
| -71     | @ 29 070 Of Installed Equip | ⊳.          |               |
| Rev. 10 | 17, 398,000 x 0, 29 =       | 5.045.000   |               |
| 0. E 6  |                             |             | ļ             |
| Ĕ       |                             |             |               |
| XE F    |                             |             |               |

.

CALCULATIONS KE Form No. E.6 Rev.