Book (P) UNIT COSTS - BACKUP CALCULATIONS

TRANSMISSION COSTS

ACRES

Record of Telephone Call

~~① I. Hammer~~ ~~②~~ ~~③~~ 1/18/82 ~~④~~

Project No. P5700.07

Date Dec 18/81

File P5700.07.09

RECEIVED

DEC 31 1981

AC

Project: Susitna ⑤ File

Subject: Cost Data

Call (to) ~~(from)~~ G. Warnock (Company)

Telephone No. 2050

Discussion between JRP (of Company) and (of Acres)

Details of Call	Action Required
① Transmission line costs	
345 KV Single Circuit Line	JRP to
CAI / Acres	review with
Cost/mile $590,000 / $600,000	E. Shadeed.
?	
Base 1984 ? Jan 82	Cost breakdown
	required.
AFUDC 7% Not Included	
	?
CAI at 1982 Base $450,000	?
Acres cost/mile appears high	ENS
and will be checked	
	Note. Cost of transmission
② Cost to mine gravel from	per mile by CAI for
d/s riverbed, haul 8 miles	Sept/81.
and stockpile —	Costs have been changed
$7.00/ton or $12.00/cy	everytime they do additional
Markup 40% on direct costs	work on it.
No allowance for site development	[signature]
or roads.	

Copies to (1) E. J. Lawrence (2) D. Mailhede (3) [illegible]

Circulation to (1) [illegible] (2) (3) (4) (5) (6) (7) (8) File

2

ALASKA POWER AUTHORITY
ANCHORAGE-FAIRBANKS INTERTIE
PROJECT COST ESTIMATE
(Thousands of Dollars)

CAI Report Oct. 1/81

Route Description: Eastern-100% Overhead with Broad Pass East

Configuration: 1B19 138/345

Super Link No.	Miles	Total Cost
1	21.6	6,747
3	41.4	14,055
6	28.5	9,713
7	5.1	1,427
9	14.9	4,640
12	22.4	6,794
13	19.9	6,964
15	14.9	4,759
16	0.9	328
Subtotal Intertie	169.6	55,427
Teeland-Willow	5.5	1,129
Total Line	175.1	56,556
Total Substation Cost		9,449
Subtotal		66,005
R/W Acquisition ($40,000/Mile)		6,784
Mobilization-Demobilization 5%		3,300
Surveying		3,100
Engineering 6%		3,960
Construction Management 5%		3,300
Subtotal		86,449
Contingencies 25%		21,612
Total September 1981 Dollars		108,061
Inflation @ 10%/Year - 2 Years		130,754

Cost per mile
$108,061,000 / 175.1 = 617,138

ACRES

OFFICE MEMORANDUM

TO: Dave MacDonald

FROM: J. Plummer

Date: January 12, 1982

File: P5700.07.09

SUBJECT: Susitna Hydroelectric Project
Feasibility Report Estimate
Information Requirements

In reply to your memo dated January 6, 1982, I have reviewed and marked up the attached sheet. I have also attached a similar activity listing for Watana.

James R. Plummer

JRP:dmb

Attachment

cc: F. Toth
R. Lang
[redacted]

ACRES

OFFICE MEMORANDUM

TO: J. Plummer

Date: January 6, 1982

File: AN-AB4

FROM: D. H. MacDonald

cc:

SUBJECT: Susitna Hydroelectric Project
Feasibility Report Estimate
Information Requirements

Attached is a very preliminary listing of activities associated with the estimating and planning of Devil Canyon dam site. I have made a fast indication on that listing as to where I understand the assigned pricing is to be carried out.

Example - tunnels and plugs - the escalation pricing and quantities will be done in Buffalo

- lining and plugs - will be quantified and priced in Niagara Falls.

This list is being provided for discussion, so that we can break down the assignment packaging in the very near future. I would like to take certain quantifying and pricing packages and assign them to people in this office - and, with your agreement, have you do the same with those items associated with the total Devil Canyon estimate.

DHMacD:pm
Attachment

D. H. MacDonald
Head, Planning & Estimating Dept.

5

SUSITNA ACTIVITY LIST

	Assigned To
Watana	
1 - Diversion	
-Tunnels and Plug	B
-Portals	N
-Gates	B
-Cofferdams	B
-Dewatering	B
2 - Chute Spillway	
-Exc. O/B and Rock	B
-Headworks	N
-Gates	B
-Chute	N
-Anchors	N
-Flip Bucket	N
3 - Emergency Spillway	
-Exc.	B
-Slab	N
-Anchors	N
-Fuse Plug	B
-Bridge	N
4 - Service Spillway Tunnel	
-Exc.	B
-Headworks	N
-Gate	B
-Outlet: Civil	N
Mechanical	B
5 - Main Dam	
-Exc. O/B & Rock	B
-Fill	B
-Grouting	B
-Valves Spillway	B
-Access Shaft	B

SUSITNA ACTIVITY LIST - 2

Watana - Continued	Assigned To
6 - Relict Channel	
-Exc.	B
-Fill	B
7 - Construction Facilities	
-Roads	B
-Yards	B
-Bridges	B
-Batch Plant	N
-Agg. Plant	N
-Gran. Fill Plant	B
Power Facilities	
8 - Intake	
-Exc. O/B & Rock	B
-Concrete	N
-Anchors	N
-Gates	B
-Bulkhead	B
9 - Powerhouse	
-Access exc. - Portal and Tunnel	B
-T/R Exc. - Portal and Tunnel	B
-Access Tunnel - Lining	N
-T/R Tunnel - Lining	N
-Penstocks - Exc.	B
-Conc. Lining	N
-Steel Lining	B(S) N(I)
10 - Transformer Gallery	
-Exc. Rock	B
-Concrete	N
-Equipment	B
11 - Vault	
-Exc. Rock	B
-Concrete - 1st Stage	N
2nd Stage	N
-Crane Support	N
-Crane	B
-Roof	B

SUSITNA ACTIVITY LIST - 3

Watana - Continued	Assigned To
11 - Vault - Continued	
-Turb. EP	B
RP	B
-Gen.	B
12 - Surge Chamber	
-Exc. Rock	B
-Concrete	N
-Gates	B
-Crane	B

B = Pricing in Buffalo
N = Pricing by Niagara Falls

Estimate Work Sheet

ACRES

ITEM REFERENCE No.

DESCRIPTION

JOB No. P 3700.09

SHEET 1 OF

PROJECT SUSITNA – WATANA

OPERATION No. REF.

BY R.D. Chamberlain 18 February 1982.

CONTRACT Transmission Plant

DESCRIPTION

CKD DATE

DESCRIPTION AND BASIS OF ESTIMATE	QUANTITY	UNIT	LABOR		JOB MATERIALS		PERM.MATERIALS		SUBCONTRACTS		EQPT.OWNERSHIP		EQPT.OPERATION			
			UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	Equiv UNIT	TOTAL AMOUNT
350 Land and Land Rights				000's				000's		000's		. 000's		$000's		$000's
– Transmission	179	miles							40000 / 70000	7550					40000 / 70000	7550
– Substations (4 sites)		LS								1100						1100
										8650						8650
353 Substation/Switching Station Equip. – 1995																
Ester	1	LS		2932				20 775				330		403		24,440
Willow	1	LS		1829				12 960				206		251		15,246
Knik Arm	1	LS		1512				10700				170		208		12,590
University	1	LS		4496				31 800				506		618		37,420
Devil Canyon	1	LS		1812				12750				204		249		15,015
				12581				88 985				1416		1729		104,711
352 Substation and Switching Station Switchyard	1	LS		1211				9820				225		294		11550

Estimate Work Sheet

ACRES

ITEM REFERENCE No.

JOB No. P5700.09

PROJECT SUSITNA – WATANA

DESCRIPTION

SHEET 2 OF

CONTRACT Transmission Plant

OPERATION No. REF.

BY R.D. Chamberlain 18 February 1982

DESCRIPTION

CKD DATE

DESCRIPTION AND BASIS OF ESTIMATE	QUANTITY	UNIT	LABOR UNIT COST	LABOR AMOUNT	JOB MATERIALS UNIT COST	JOB MATERIALS AMOUNT	PERM.MATERIALS UNIT COST	PERM.MATERIALS AMOUNT	SUBCONTRACTS UNIT COST	SUBCONTRACTS AMOUNT	EQPT.OWNERSHIP UNIT COST	EQPT.OWNERSHIP AMOUNT	EQPT.OPERATION UNIT COST	EQPT.OPERATION AMOUNT	Equiv UNIT	TOTAL AMOUNT
				$000's				$000's		$000's		$000's		$000's		$000's
353 Willow Energy Mngmt Sys (EMS)																
– Equipment and System Costs	1	LS		2736				8110				308		376		11530
– Microwave Communications Equipment	1	LS		2224				2140				250		306		4920
– EMS Control Center Bldg + Equip.	1	LS		1400				2110				158		192		3860
– Watana and Devil Canyon (in-plant monitoring and control equipment).	1	LS		1416 -354 1062				3080 -770 2310				159 -40 119		195 -49 146		4850 -1213 3637
				~~7776~~				~~15440~~				~~838~~		1069		25,160
354 Steel Towers and Fixtures – 1993 (Watana)	2447	Each	18274	44716			30280	74095			2056	5031	2513	6149	55125	129992
356 Overhead Conductors and Devices – 1993 Watana Conductors (2x954 kcmil/phase)	556	miles	62526	34764			35715	19858			645	359	1289	717	100175	55698
– Submarine Cables	6	LS	2837.50	17063			41666.67	25,000			125,000	750	156250	937	791667	43750
				51827				44858				1109		1654		99448
359 Roads and Trails – Roads and Trails	200	miles	12355	2471	7920	1584					7020	1404	8705	1741	36000	7200
– Clearing and Roads	340	miles	6179	2101	3960	1346					5510	1193	4352	1480	18000	6120
				4572		2930						2597		3221		13320

57.02.02 Form 131A

Estimate Work Sheet

ACRES

ITEM REFERENCE No.

JOB No. P5700.09

DESCRIPTION

SHEET 3 OF

PROJECT SUSITNA – DEVIL CANYON

OPERATION No. REF.

BY R.D. Chamberlain 18 February 1982

CONTRACT Transmission Plant

DESCRIPTION

CKD DATE

DESCRIPTION AND BASIS OF ESTIMATE	QUANTITY	UNIT	LABOR		JOB MATERIALS		PERM.MATERIALS		SUBCONTRACTS		EQPT.OWNERSHIP		EQPT.OPERATION			
			UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	Equiv UNIT	TOTAL AMOUNT
				000's		000's		000's		000's		000's		000's		000's
352 – Substation and Switching Station																
Switchyard	1	LS		721				5900				134		175		6930 ✓
353 Substation/Switching Station Equip.																
Ester (2000+)	1	LS		348				2455				39		48		2890 ✓
Willow	1	LS		840				6000				95		115		7050 ✓
Knik Arm	1	LS		140				980				16		19		1155 ✓
University	1	LS		1068				7565				120		147		8900 ✓
				2,596				17,000				270		329		19995
354 2000+ (Devil Canyon) – Towers (Includes foundations + hardware)	546	Each	18274	9978			30280	16533			2056	1125	2513	1372	53123	29,005 ✓
356 Overhead Conductors & Devices																
– Conductors (2x 954 kcmil / phase)	12.4	miles	54791	6794			35715	4429			5868	480	5801	719	100175	12422 ✓
– Submarine Cables (3)	3	LS	481250	8344			4166667	12500			156250	469	187500	562	291667	21875 ✓
				15138				16929				949		1281		34297 ✓
353 WILLOW ENERGY MGMT SYS 1/4 OF INPLANT COSTS				354				770				40		49		1213

TRANSMISSION LINE COSTS

January 12, 1982
P5700.07.09

Basically transmission line costs breakdown into the following elements

- right of way
- clearing
- structures
- foundations
- hardware
- conductors
- engineering and construction management
- owners cost.

In our estimate we included all the elements except the last two which will be looked after by the project.

Background - Transmission Estimates

During Acres trip to Alaska in 1980, we met with our sub-contractor R. W. Retherford Associates and discussed various facets of transmission line design and construction in Alaska. RWRA had developed a special type of tower, X-type which was suitable for installation in permafrost. This X-tower design was hinged at the foundations and guyed for stability. Further developments saw a move from aluminum lattice design to tubular steel tower members. This lowered the cost of the labor component.

RWRA provided Acres with the details of their estimates for a 230 kV, tubular steel tower line between Point Mackenzie and Fairbanks. This was based on 230 kV line (aluminum lattice) constructed in 1975 and 115 kV line (tubular steel) constructed in 1978. The RWRA estimate was in 1978 dollars.

Acres very first estimates were based on a tubular steel, X-type tower. This has been justified by the decision of Commonwealth Associates recommending this type of tower and the eventual acceptance by APA.

The Acres first estimates used the RWRA data and were developed for various voltage levels for the electric system studies. Telephone consultation with CAI confirmed Acres line costs. The present costs which are in the attached back-up material are based on CAI "Route Selection Report" dated October 1981. The estimate is in September, 1981 dollars.

The following table sectionalizes the transmission lines with number of circuits and cost per mile. A total is generated for each section. The total cost is then divided by the estimated total length. This will give an average cost per mile. This cost will be used to stage the estimates, e.g. Watana 1993 and Devil Canyon 2002. The differences in costs per mile are accounted for by the terrain, difficulty of access, type of foundations required, etc. Some areas will require winter construction or helicopter assistance.

Section	No. of Circuits	Length Miles	Cost per Mile ($)	Total ($)
Watana-Devil Canyon	2	52	340,000	17,680,000
Devil Canyon - Gold Creek	5	65	340,000	22,100,000
Gold Creek - Willow	3	213	331,394	70,587,000
Willow - Knik Arm	3	120	285,000	34,200,000
Knik Arm - University (one tower)	2	36	251,111	9,040,000
Gold Creek - Healy	2	200	318,990	63,798,000
Healy - Ester	2	164	310,000	50,840,000
Total		850		268,245,000

September, 1981 average cost of transmission per mile including intertie = $\frac{268,245,000}{850}$ = $315,582.

The FERC format requires splitting the estimate into steel towers and fixtures and overhead conductors and devices.

For 1993 construction we require 600 mi of transmission. The average cost per mile developed above does not include costs for mobilization/demobilization or surveying. We also have to bring the costs up to January 1982 figures.

For 1993 construction -

600 mi x $315,582	$189,349,200
mobilization/ demobilization 5%	9,467,460
surveying	3,500,000
	$202,316,660

January 1982 costs x 1.04	210,409,326
deduct clearing	10,409,326
	$200,349,326

$$\text{cost per mi} = \frac{200,349,326}{600} = \$333,916$$

The tower costs according to FERC should include towers, foundations, hardware and insulators. Tower costs account for approximately 70 percent of line costs which are in turn split into approximately 57 percent for material and 43 percent for labor.

We are assuming that towers will be spaced at 1,200 ft and will require 4.4 towers per mile. The total towers for 600 mi would be 600 x 4.4 = 2,640.

The tower costs will be

$$333,916 \times 0.7 = \$233,741/\text{mi}$$

$$\frac{233,741}{4.4} = \$53,122.96/\text{tower}$$

Material cost per tower = $53,123 x 0.57 = $30,280
Labor cost per tower = $53,123 x 0.43 = $22,843

The conductor costs will be

333,916 - 233,741 = $100,175/mi

Conductor 954 kcmil

Weight-pounds per foot	1.075
Cost per pound	$0.97

Shield wire 3/8 in.

Weight-pounds per foot	0.273
Cost per pound	0.97

Material cost

5,280 x 1.075 x 0.97 x 6 =	$33,034
5,280 x 0.273 x 0.93 x 2 =	2,681
	$35,751/mi

Labor costs per mile will be

100,175 - 35,715 = $64,460

The above figures were used in the FERC format.

Substation/Switchyard Estimates

Substations/switchyards costs based on the number of elements contained and the space required to accommodate voltage levels. The costs for this estimate were based on the following

- station base costs
- circuit breaker positions
- transformer positions.

The costs were contained in the preliminary electric system report. These costs were upgraded to January 1982 figures and an additional factor to equalize them with the higher line costs.

Substations 1993

Willow

Base Cost		$ 2,310,000
Circuit Breakers	9 x 345 kV @ $1,155,000	10,395,000
	3 x 138 kV @ $ 462,000	1,386,000
Transformers	2 x 75 MVA @ $ 577,500	1,155,000
Total		$15,246,000

Knik Arm

Base Cost		$ 2,310,000
Circuit Breakers	8 x 345 kV @ $1,155,000	9,240,000
	1 x 138 kV @ $ 462,000	462,000
Transformers	1 x 75 MVA @ $ 578,000	578,000
Total		$12,590,000

University

Base Cost		$ 2,310,000
Circuit Breakers	9 x 345 kV @ $1,155,000	10,395,000
	6 x 230 kV @ $ 810,000	4,860,000
Transformers	4 x 250 MVA @ $1,500,000	6,000,000
Static Var Source	400 MVAR	13,855,000
Total		$37,420,000

Devil Canyon

Base Cost		$ 2,310,000
Circuit Breakers	11 x 345 kV @ $1,155,000	12,705,000
Total		$15,015,000

Ester

Base Cost			$ 2,310,000
Circuit Breakers	10 x 345 kV	@ $1,155,000	11,550,000
	4.5 x 138 kV	@ $ 462,000	2,080,000
Transformers	3 x 150 MVA	@ $1,040,000	3,120,000
Static Var Source	100 MVAR		3,460,000
Shunt Reactors	2 x 75 MVAR	(345 kV)	1,920,000
Total			$24,440,000

Total Substations 1993	$104,711,000
Material	88,985,000
Labor	15,726,000

Substations 2007

Ester

Circuit Breakers	1 x 345 kV	@ $1,155,000	$ 1,155,000
	1.5 x 138 kV	@ $ 462,000	695,000
Transformers	1 x 150 MVA	@ $1,040,000	1,040,000
Total			$ 2,890,000

Willow

Circuit Breakers	5 x 345 kV	@ $1,155,000	$ 5,775,000
	1.5 x 138 kV	@ $ 462,000	695,000
Transformers	1 x 75 MVA		580,000
Total			$ 7,050,000

Knik Arm

Circuit Breaker	1 x 345 kV	@ $1,155,000	$ 1,155,000
Total			$ 1,155,000

University

Circuit Breakers	3 x 345 kV @ $1,155,00	$ 3,465,000
	3 x 230 kV @ $ 810,000	2,435,000
Transformers	2 x 250 MVA @ $1,500,000	3,000,000
Total		$ 8,900,000
Total Substations 2000+		$19,995,000
Material		17,000,000
Labor		2,995,000

Substations at Powerhouses

Watana

Base Cost	$ 2,310,000
Circuit Breakers 8 x 345 kV @ $1,155,000	9,240,000
Total	$11,550,000
Material	9,820,000
Labor	1,730,000

Devil Canyon

To be built in year 2002 for 4 units

Circuit Breakers 6 x 345 kV @ $1,155,000	$ 6,930,000
Total	$ 6,930,000
Material	5,900,000
Labor	1,030,000

Land Rights (ROW)

Transmission		
166 mi @ $40,000		$ 6,640,000
13 mi @ $70,000		910,000
		$ 7,550,000
Substations		
Willow	$ 200,000	
Knik Arm	200,000	
University	500,000	
Ester	200,000	
	$1,100,000	$1,100,000
Total		$8,650,000

ENS:jlh

ACRES

OFFICE MEMORANDUM

J. R. Plummer
D. Meilhede

Date: January 25, 1982

File: P5700.07.08

FROM: E. N. Shadeed

cc: J. D. Lawrence/Circulation
R. T. Sarofim
A. Jex/D. Kaushal

SUBJECT: SUSITNA HYDROELECTRIC PROJECT
TRANSMISSION SYSTEM
COST ESTIMATES - JANUARY, 1982

I am attaching copies of sheets 3 and 4 of the preliminary cost estimates which were revised. The revision was related to transmission line length which should be coordinated with the system diagram forwarded recently.

The total Susitna length is 850 mi which is constructed at various times as follows.

Year	Miles
1984	170 (Intertie)
1993	556
2002	124
Total	850

The length of transmission was revised to coordinate with the above. This will change the cost estimates as shown on revised sheets.

ENS:jlh

Attachment

E. N. Shadeed

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SUSITNA HYDROELECTRIC PROJECT
PRELIMINARY ESTIMATE - ACRES AMERICAN
WATANA - DAM CREST EL 2205 FT - 3

Item	Description	Quantity	Units	Unit Price	Amount ($)	Total ($)
354	Steel Tower and Fixtures					
	Steel Tower and Fixtures - 1993 (Watana) Towers (Includes foundations and hardware)	2,447	Each	M 30,280 L 22,843	74,095,160 55,896,821	
					129,991,981	
	- 2000+ (Devil Canyon) Towers (Includes foundations and hardware)	546	Each	M 30,280 L 22,843	16,532,880 12,472,278	
					29,005,158	158,997,139
356	Overhead Conductors and Devices					
	Overhead Conductors and Devices - 1993 (Watana - Conductors (2 x 954 kcmil/phase) Shield Wire (3/8 in., 2/circuit)	556	Miles	M 35,715 L 64,460	19,857,540 35,839,760	
					55,693,300	
	- Submarine Cables	6	Lump sum	Material Labor	25,000,000 18,750,000	
					43,750,000	

12

M - Material
L - Labor

Revised January 25, 1982

SUSITNA HYDROELECTRIC PROJECT
PRELIMINARY ESTIMATE - ACRES AMERICAN
WATANA - DAM CREST EL 2205 FT - 4

Item	Description	Quantity	Units	Unit Price	Amount ($)	Total ($)
	- 2000+ (Devil Canyon) - Conductors (2 x 954 kcmil/phase)	124	Miles	M 35,715 L 64,460	4,428,660 7,993,040	
					12,421,700	
	- Submarine Cables	3	Lump sum	Material Labor	12,500,000 9,375,000	
					21,875,000	133,740,000
359	Roads and Trails Roads and Trails - Clearing and Roads	200 ~~170~~ 340	Miles Miles	$36,000 $18,000	7,200,000 3,060,000	
					10,060,000	10,060,000

M - Material
L - Labor

Revised January 25, 1982

ARCO

OFFICE MEMORANDUM

J. R. Plummer
D. Meilhede ←

Date: January 12, 1982

File: P5700.07.08

FROM: E. N. Shadeed

cc: J. D. Lawrence/circulation
M. W. Stoddart/U. J. Woelke
R. T. Sarofim
A. Jex/D. Kaushal

SUBJECT: SUSITNA HYDROELECTRIC PROJECT
TRANSMISSION SYSTEM
COST ESTIMATES - JANUARY 1982

I am attaching a report on transmission line costs which gives a history of the development of transmission costs and shows how they were arrived at. The transmission line costs were estimated on a per mile basis and then broken down to suit the FERC format. We also used the CAI estimates for different terrain. This is summarized on page 2 of the report. The CAI estimates are close to ones we have developed. See telephone conversation to D. Meilhede dated November 10, 1981 which explains main differences. At that time John Lawrence requested that our line estimates be adjusted to include the differences applicable to our lines.

I tried in the report to give you a breakdown of the substation costs for each one and explained the main elements used.

I am also including revised copies of the estimates.

E. N. Shadeed

ENS:jlh

Attachment

23

ACRES

OFFICE MEMORANDUM

J. R. Plummer
D. Meilhede

Date: January 5, 1982

File: P5700.07.08

FROM: E. N. Shadeed

cc: J. D. Lawrence/Circulation
M. W. Stoddart/U. J. Woelke
R. T. Sarofim
A. Jex/D. Kaushal
L. Pereira

SUBJECT: SUSITNA HYDROELECTRIC PROJECT
TRANSMISSION SYSTEM
COST ESTIMATES - JANUARY 1982

The attached cost estimates do not include the following

- contingency allowance
- engineering
- construction management
- owners cost.

Previously we have used the following formula for our estimates

(engineering 5% + construction management 5% + Owners cost 2-1/2%) x contingency 20%. The total percentage would then amount to 35%.

The cost estimate for switchyards at the powerhouses, e.g. Watana and Devil Canyon have not been included. The cost estimate for the In-Plant Control System at Watana has been included. Also note that the Energy Management System Center (System Control Center) is now included in the estimate.

The material and labor costs were identified as requested. You will also note that the estimates have been staged for transmission lines and substations, e.g. 1993 and 2000+.

The cost estimates have been identified by item numbers in accordance with FERC requirements. I believe the contingency etc should be applied to each item number rather than at the end of the total estimate.

ENS:jlh

Attachment

E. N. Shadeed

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SUSITNA HYDROELECTRIC PROJECT
PRELIMINARY ESTIMATE - ACRES AMERICAN
WATANA - DAM CREST EL 2205 FT

January 5, 1982

Item	Description	Quantity	Units	Unit Price	Amount ($)	Total ($)
	Transmission Plant					
350	Land and Land Rights					
	Land and Land Rights - Transmission	179	Miles	40,000/70,000	7,550,000	
	- Substations (4 sites)		Lump Sum		1,100,000	8,650,000
353	Substation/Switching Station Equipment					
	Substation/Switching Station Equipment - 1993					
	Ester	1	Lump sum	Material	20,775,000	
				Labor	3,665,000	
	Willow	1	Lump sum	Material	12,960,000	
				Labor	2,286,000	
	Knik Arm	1	Lump sum	Material	10,700,000	
				Labor	1,890,000	
	University	1	Lump sum	Material	31,800,000	
				Labor	5,620,000	
	Devil Canyon	1	Lump sum	Material	12,750,000	
				Labor	2,265,000	
				Material	88,985,000	
				Labor	15,726,000	104,711,000

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Revised January 12, 1982

SUSITNA HYDROELECTRIC PROJECT
PRELIMINARY ESTIMATE - ACRES AMERICAN
WATANA - DAM CREST EL 2205 FT - 2

Item	Description	Quantity	Units	Unit Price	Amount ($)	Total ($)
	- 2000+					
	Ester	1	Lump sum	Material	2,455,000	
				Labor	435,000	
	Willow	1	Lump sum	Material	6,000,000	
				Labor	1,050,000	
	Knik Arm	1	Lump sum	Material	980,000	
				Labor	175,000	
	University	1	Lump sum	Material	7,565,000	
				Labor	1,335,000	
				Material	17,000,000	
				Labor	2,995,000	19,995,000
	Willow Energy Management System (EMS)					
	- Equipment and System Costs	1	Lump sum	Material	8,110,000	
				Labor	3,420,000	
	- Microwave Communications Equipment	1	Lump sum	Material	2,140,000	
				Labor	2,780,000	
	- EMS Control Center Building and Equipment	1	Lump sum	Material	2,110,000	
				Labor	1,750,000	
	- Watana/Devil Canyon In-Plant Monitoring and Control Equipment	1	Lump sum	Material	3,080,000	
				Labor	1,770,000	
				Material	15,440,000	
				Labor	9,720,000	25,160,000

Revised January 12, 1982

SUSITNA HYDROELECTRIC PROJECT
PRELIMINARY ESTIMATE - ACRES AMERICAN
WATANA - DAM CREST EL 2205 FT - 3

Item	Description	Quantity	Units	Unit Price	Amount ($)	Total ($)
354	Steel Tower and Fixtures					
	Steel Tower and Fixtures					
	- 1993 (Watana)					
	Towers					
	(Includes foundations and hardware)	2 640	Each	M 30,280	79,939,200	
				L 22,843	60,305,520	
					140,244,720	
	- 2000+ (Devil Canyon)					
	Towers					
	(Includes foundations and hardware)	546	Each	M 30,280	16,532,880	
				L 22,843	12,472,278	
					29,005,158	169,249,878
356	Overhead Conductors and Devices					
	Overhead Conductors and Devices					
	- 1993 (Watana					
	- Conductors (2 x 954 kcmil/phase) Shield Wire (3/8 in., 2/circuit)	600	Miles	M 35,715	21,429,000	
				L 64,460	38,676,000	
					60,105,000	
	- Submarine Cables	6	Lump sum	Material	25,000,000	
				Labor	18,750,000	
					43,750,000	

M - Material
L - Labor

Revised January 12, 1982

SUSITNA HYDROELECTRIC PROJECT
PRELIMINARY ESTIMATE - ACRES AMERICAN
WATANA - DAM CREST EL 2205 FT - 4

Item	Description	Quantity	Units	Unit Price	Amount ($)	Total ($)
	- 2000+ (Devil Canyon) - Conductors (2 x 954 kcmil/phase)	124	Miles	M 35,715 L 64,460	4,428,660 7,993,040	
					12,421,700	
	- Submarine Cables	3	Lump sum	Material Labor	12,500,000 9,375,000	
					21,875,000	138,151,700
359	Roads and Trails Roads and Trails - Clearing and Roads	200 170	Miles Miles	$36,000 $18,000	7,200,000 3,060,000	
					10,060,000	10,060,000

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M - Material
L - Labor

Revised January 12, 1982

SUSITNA HYDROELECTRIC PROJECT
PRELIMINARY ESTIMATE - ACRES AMERICAN
WATANA - DAM CREST EL 2205 FT

January 5, 1982

Item	Description	Quantity	Units	Unit Price	Amount ($)	Total ($)
	Transmission Plant					
350	Land and Land Rights					
	Land and Land Rights - Transmission	189	Miles	40,000	7,950,000	
	Land and Land Rights - Substations (4 sites)		Lump Sum		1,100,000	9,050,000
353	Substation/Switching Station Equipment					
	Substation/Switching Station Equipment					
	~~Ester~~					
	Ester	1	Lump sum	Material	20,775,000	
				Labor	3,665,000	24440
	Willow	1	Lump sum	Material	12,965,000	
				Labor	2,285,000	15250
	Knik Arm	1	Lump sum	Material	10,700,000	
				Labor	1,890,000	12590
	University	1	Lump sum	Material	31,800,000	
				Labor	5,620,000	37420
	Devil Canyon	1	Lump sum	Material	12,750,000	
				Labor	2,250,000	15000
				Material	88,990,000	
				Labor	15,710,000	104,700,000

SUSITNA HYDROELECTRIC PROJECT
PRELIMINARY ESTIMATE - ACRES AMERICAN
WATANA - DAM CREST EL 2205 FT - 2

Item	Description	Quantity	Units	Unit Price	Amount ($)	Total ($)
~~2000+~~						
	Ester	1	Lump sum	Material	2,000,000	
				Labor	370,000	2 370 000
	Willow	1	Lump sum	Material	6,000,000	
D.C.				Labor	1,050,000	7050000
	Knik Arm	1	Lump sum	Material	985,000	
				Labor	175,000	1160 000
	University	1	Lump sum	Material	7,565,000	
				Labor	1,335,000	8 900 000
				Material	16,550,000	
				Labor	2,930,000	19,480,000
1993	Willow Energy Management System (EMS)					
(W)	- Equipment and System Costs	1	Lump sum	Material	8,110,000	1,882,500 x 3 | 8,647,500
				Labor	3,420,000	] 11530 000
	- Microwave Communications Equipment	1	Lump sum	Material	2,140,000	1230 000 x 3 | 3,690,000
				Labor	2,780,000	] 4920 000
	- EMS Control Center Building and Equipment	1	Lump sum	Material	2,110,000	16 500 x 3 | 2,895,010
				Labor	1,750,000	] 3860 000
3/4 W 1/4 D.C.	- Watana/Devil Canyon In-Plant Monitoring and Control Equipment	1	Lump sum	Material	3,080,000	1,212,500 x 3 | 3,637,510
				Labor	1,770,000	] 4850 000
W. 3 637 500				Material	15,440,000	
D.C. 1 212 500				Labor	9,720,000	25,160,000

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SUSITNA HYDROELECTRIC PROJECT
PRELIMINARY ESTIMATE - ACRES AMERICAN
WATANA - DAM CREST EL 2205 FT - 3

Item	Description	Quantity	Units	Unit Price	Amount ($)	Total ($)
354	Steel Tower and Fixtures					
	Steel Tower and Fixtures					
	~~- 1993 (Watana)~~					
W	Towers (Includes foundations and hardware)	2 650	Each	M 30,413 L 22,943 53,356	80,594,450 60,798,950 141,393,400	] 141 393 400
	~~- 2000+ (Devil Canyon)~~					
DC	Towers (Includes foundations and hardware)	665	Each	M 30,413 L 22,943 53356	20,224,645 15,257,095 35,481,740	] 35 481 740
						176,875,140
356	Overhead Conductors and Devices					
	Overhead Conductors and Devices					
	~~- 1993 (Watana~~					
W	- Conductors (2 x 954 kcmil/phase) Shield Wire (3/8 in., 2/circuit)	602	Miles	M 35,614 L 70,000 105,614	21,439,628 42,140,000 63,579,628	] 63 579 628
W	- Submarine Cables	6	Lump sum	Material Labor	25,000,000 18,750,000 43,750,000	] 43 750 000

M - Material
L - Labo

SUSITNA HYDROELECTRIC PROJECT
PRELIMINARY ESTIMATE - ACRES AMERICAN
WATANA - DAM CREST EL 2205 FT - 4

Item	Description	Quantity	Units	Unit Price	Amount ($)	Total ($)
	~~2000+ (Devil Canyon)~~					
06	- Conductors (2 x 954 kcmil/phase)	151	Miles	M 35,614 L 70,000	5,377,714 10,570,000	] 15 947 714
				10,5614	15,947,714	
06	- Submarine Cables	3	Lump sum	Material Labor	12,500,000 9,375,000	] 21 875 000
					21,875,000	145,152,342
359	Roads and Trails					
	Roads and Trails					
	- Clearing and Roads	200	Miles	$36,000	7,200,000	
		170	Miles	$18,000	3,060,000	
					10,060,000	10,060,000

M - Material
L - Labor

```
UNIT FULL GATE FLOW=      875
UNIT FULL GATE OUTPUT=      1
UNIT BEST GATE OUTPUT=      1
KAPLAN TURBINES SPECIFIED
THIS PLANT DOES NOT HAVE A


                         POWER (KW
UNITS              FULL
 1                 1999.


UNITS            ENERGY (KWH)
 1                 654860.


TOTAL ENERGY=      654860. KWH
TOTAL CAPACITY REVENUE=$
TOTAL ENERGY REVENUE= $
TOTAL REVENUE=               $

PLANT CAPACITY FACTOR= 44.9%


DO YOU WISH TO RE-EVALUATE?
1
INDICATE VARIABLE, 1=PLANT T
 UNITS, 4=POWER VALUES,  5=E
8=FLOW-DURATION CURVE, 9=MAI
77
UNIT FULL GATE FLOW,CFS?
1332255

O



Username: SIMON
Password:
          Welcome to VAX/VMS Version
ENTER PROJECT CODE [P123456] : P53
Terminal, (P)rinter or (V)ideo: P
***********************************

                  PM'S AT 3:30 MON

***********************************


          * * * * DISK SPACE DRB2:
$     RUN HYDRO1
NO OF VALUES ON WHICH FLOW-DU
```

```
UNIT FULL GATE FLOW=     875. CFS
UNIT FULL GATE OUTPUT=     1999. KW
UNIT BEST GATE OUTPUT=     1800. KW
KAPLAN TURBINES SPECIFIED
THIS PLANT DOES NOT HAVE A PENSTOCK


                    POWER (KW)
UNITS          FULL            BEST        % TIME      VALUE($/KW)      REVENUE($)
 1             1999.           1800.        4.80          0.00             0.00

UNITS       ENERGY (KWH)        % TIME      VALUE (MILLS/KWH)      REVENUE ($)
 1            654860.            4.80            0.00                  0.00


TOTAL ENERGY=     654860. KWH
TOTAL CAPACITY REVENUE=$          0.
TOTAL ENERGY REVENUE= $           0.
TOTAL REVENUE=        $           0.

PLANT CAPACITY FACTOR= 44.9%


DO YOU WISH TO RE-EVALUATE? 0=NO, 1=YES
1
INDICATE VARIABLE, 1=PLANT TYPE,PENSTOCK LENGTH, VELOCITY, 2=UNIT TYPE, 3=NO. OF
 UNITS, 4=POWER VALUES,  5=ENERGY VALUES, 6=GROSS HEAD, 7=UNIT FULL GATE FLOW,
8=FLOW-DURATION CURVE, 9=MAINTENANCE FLOW, 10=OMIN
77
UNIT FULL GATE FLOW,CFS?
1332255

0

0


Username: STMAN
Password:
        Welcome to VAX/VMS Version V2.3
ENTER PROJECT CODE [P1234561 : P579AA1
Terminal, (P)rinter or (V)ideo: P
************************************************************

                PM'S AT 3:30 MONDAY NOV. 14

********************* ************************************

        * * * * DISK SPACE DBB2: IS STILL LOW * * * *
$     RUN HYDRO1
NO OF VALUES ON WHICH FLOW-DURATION CURVE IS BA
```

ACRES

Memo Re Telephone Call

JOB No. P5700.08 FROM (Originator) E.N. Ahadeed

DATE Nov. 10/81 Company Elec.

FILE No. P5700.07.08 TO D Meilleke

Company Proj. Mgmt

SUBJECT Transmission Line Estimates

CAI estimate for Configuration 1B19

consisting of 169.6 miles is $108,061,000

The difference can be explained as follows:

Substations for Intertie (approx)	$10,000,000
Shield Wire	1,500,000
Structure Weight (CAI added 40%* 12000 → 16000#)	4,000,000
Mobilization - Demobilization (5%)	2,000,000
Surveying (not in Acres estimate	3,100,000
Tieland - Without upgrading	1,129,000
Difficulty Factor / Helicopter	7,990,000
	29,719,000
	say 29.7×10^6

Contingency (25%) for CAI = 21.6×10^6

(20%) Fines = 7.0

14.6×10^6

CAI contingency as on total Amount including R/W'd Clearing

Therefore $(63.3 + 29.7 + 14.6) \times 10^6 = 107.6 \times 10^6$

CIRCULATE TO:

- [V] J. D. Lawrence
- [V] J W. Hayden
- XC. [V] D. Meilleke
- [V] R.T. Sarofeen
- [V] File

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ACRES

Calculations SUSITNA

SUBJECT: TRANSMISSION

JOB NUMBER
FILE NUMBER
SHEET 1 OF 2
BY DM DATE 11/10/81
APP GM DATE 11/10/81

AE ENS 11/09/81

TRANSMISSION COSTS

	LAND	TRANSMISSION	SUBSTATIONS
WATANA CONST. TOTAL	29.77 M	195.04 M	90.65
LESS INTERTIE	12.75	35.19	—
TOTAL	17.02	159.85	90.65
CONT/OWNER @ 35	NA	—	—
	17.02	215.80	122.37

TOTAL 232.82 X 1.05
1982 PRICES

244.5 | 128.5

	TRANSMISSION	SUBSTATION
DEVIL CANYON CONST. TOTAL	48.50	17.28
CONT./OWNER	16.98	6.05
	65.48	23.33
X 1.05		35
	68.8	24.5

FORM NO. 152 REV. 1

ACRES

Calculations

SUBJECT: TRANSMISSION COSTS

JOB NUMBER
FILE NUMBER
SHEET 2 OF 2
BY DATE 11/10/81
APP GAF-1 DATE 11/13/81

WATANA W/O INTERTIE

244.5	LANDS
128.5	TRANSMISSION
	SUBSTATIONS
373.0	

D.C.

68.8
24.5
93.3

WATANA IN 1982

	MID 1981	JAN 1982
TRANSMISSION & STATIONS	159.85	167.84
	90.65	95.18
	250.50	263.02
CONT	50.10	52.61
	300.60	315.63
ADMIN	37.58	39.46
	338.18	355.09
LAND	17.02	17.88
	355.20	372.97 ← checks w/ ENL 11/09

DEVIL CANYON IN 82

TRANS & STATIONS	65.78	69.07
CONT	13.16	13.82
ENGR ADMIN	9.87	10.36
TOTAL	88.81	93.25 ← CKD W/ ENL OCT 30 81

FORM NO. 152 REV. 1

OK

PER E SHADEED 11/09/21

REMOVE INTERTIE COSTS FROM WATANA LINES

$ 307.8 - WATANA

less $ 49.9 (170 MILE @ $ 207 k)(1.05)(1.35)

less 13.4 land (170 MILE @ 75 k)(1.05)

$ 244.5 WATANA LESS INTERTIE

128.5 SUBSTATIONS

373 NEW WATANA TRANSMISSION COSTS

UC.30/21

Susitna Hydroelectric Transmission Costs (1982 $)

	Millions	Total Millions
a) Watana (1993/97)		
Lines	$ 307.8	
Substations	128.5	
	$ 436.3	$ 436.3
b) Devil Canyon (2000)		
Lines	$ 68.8	
Substations	24.5	
	$ 93.3	$ 93.3
		$ 529.6

Notes:

1) Costs do not include switchyards at generating plants or dispatch center
2) The above figures include 20% contingency and engineering and other costs equal to 12½% of the total.
3) This transmission system includes transformers and low voltage at the load end substations
4) This estimate includes submarine cables which were not included previously because power was being delivered to Port Mackenzie only.

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Susitna Hydroelectric Transmission Costs (1982 $)

	Millions	Total Millions
a) Watana (1993/97)		
Lines	$ 307.8 (1)+(2)	
Substations	128.5 (4)	
	$ 436.3	$ 436.3
b) Devil Canyon (2000)		
Lines	$ 68.8 (3)	
Substations	24.5 (5)	
	$ 93.3	$ 93.3
		$ 529.6

Notes:

1) Costs do not include switchyards at generating plants or dispatch center

2) The above figures include 20% contingency and engineering and other costs equal to 12½% of the total

3) This transmission system includes transformers and low voltage at the load end substations

4) This estimate excludes permanent camp which were not included previously because power was being delivered to Fort Wainwright only.

October 30, 1981

TRANSMISSION - 1993

	$M
Watana - Devil Canyon	
2 x 26 mi, 345 kV, 2 x 954 kcmil	
@ $207,000/mi	10.76
Devil Canyon - Fairbanks	
2 x 189 mi, 345 kV, 2 x 954 kcmil (note conductor)	
@ $207,000/mi	78.25
Devil Canyon - Willow	
2 x 90 mi, 345 kV, 2 x 954 kcmil	
@ $207,000/mi	37.26
Willow - Knik Arm	
2 x 38 mi, 345 kV, 2 x 954 kcmil	
@ $207,000/mi	15.73
Knik Arm Crossing	
2 x 4 mi, 345 kV submarine cable	
@ $22,000,000/circuit	44.00
Knik Arm - University Substation	
2 x 18 mi, 345 kV, 2 x 1,351 kcmil	
@ $251,000/mi	9.04
Subtotal	$195.04
Contingency etc - 35 percent	68.26
Total Transmission 1993	$263.30M

23
26
189
90
35
8
36
357
x 2
714

365 miles x 2 = 730

X 1.05 = 276.5 (1)

TRANSMISSION - 2000

	$M
Devil Canyon - Willow	
1 x 90 mi, 345 kV, 2 x 954 kcmil	
@ $207,000/mi	18.63
Willow - Knik Arm	
1 x 38 mi, 345 kV, 2 x 954 kcmil	
@ $207,000/mi	7.87
Knik Arm Crossing	
1 x 4 mi, 345 kV submarine cable	
@ $22,000,000/circuit	22.00
Subtotal	$ 48.50
Contingency etc - 35 percent	16.98
Total Transmission 2000	$ 65.48M
~~Grand Total Transmission~~	~~$328.78M~~

X 1.35 63.7 M

(3)

132 miles

TRANSMISSION LAND ACQUISITION AND CLEARING - 1993

	$M
Watana - Devil Canyon 26 mi @ $75,000/mi	1.95
Devil Canyon - Fairbanks 189 mi @ $75,000/mi	14.18
Devil Canyon - Willow 90 mi @ $96,000/mi	8.64
Willow - Knik Arm 38 mi @ $96,000/mi	3.65
Knik Arm - University Substation 18 mi @ $75,000/mi	1.35
Total Land Acquisition and Clearing	$29.77M

X 1.05 = $31.3 M

(2)

SUBSTATIONS - 1993

	$M
Watana	
Base Cost	2.00
Circuit Breakers - 8 x 345 kV	8.00
Subtotal	$10.00
Contingency etc - 35 percent	3.50
Total	$13.50M

	$M
Devil Canyon	
Base Cost	2.00
Circuit Breakers - 11 x 345 kV	11.00
Subtotal	$13.00
Contingency etc - 35 percent	4.55
Total	$17.55M

		HV $M	LV $M
Fairbanks			
Base Cost		2.00	
Circuit Breakers	- 10 x 345 kV	10.00	
	- 4.5 x 138 kV		1.80
Transformers	- 3 x 150 MVA, 345/138 kV		2.70
Shunt Reactors	- 2 x 75 MVAR, 345 kV	1.66	
Static Var Sources	- 100 MVAR	3.00	
Subtotal		$16.66	$ 4.50
Contingency etc - 35 percent		5.83	$ 1.58
Total		$22.49	$ 6.08
Station Total		$28.57M	

SUBSTATIONS 1993 - Cont'd

		HV $M	LV $M
Willow			
Base Cost		2.00	
Circuit Breakers	- 9 x 345 kV	9.00	
	- 3 x 138 kV		1.20
Transformers	- 2 x 75 MVA, 345/138 kV		1.00
Subtotal		$ 11.00	$ 2.20
Contingency etc - 35 percent		3.85	.77
Total		$ 14.85	$ 2.97
Station Total		$17.82M	
Knik Arm - East			
Base Cost		2.00	
Circuit Breakers	- 8 x 345 kV	8.00	
	- 1 x 138 kV		.40
Transformers	- 1 x 75 MVA, 345/138 kV		.50
Subtotal		$ 10.00	$ .90
Contingency etc - 35 percent		3.50	.32
Total		$ 13.50	$ 1.22
Station Total		$14.72M	
University Substation (AML&P Tap incl)			
Base Cost		2.00	
Circuit Breakers	- 9 x 345 kV	9.00	
	- 6 x 230 kV		4.20
Transformers	- 4 x 250 MVA, 345/230 kV		5.20
Static Var Sources	- 400 MVAR	12.00	
Subtotal		$ 23.00	$ 9.40
Contingency etc - 35 percent		8.05	3.29
Total		$ 31.05	$ 12.69
Station Total		$43.74M	
Total Substations 1993		~~$112.94~~	~~$ 22.96~~
		~~$135.90M~~	
		(135.9 - 13.5) x 1.05 = 128.5	

(4)

SUBSTATIONS 2000

	$M
Devil Canyon	
Circuit Breakers - 6 x 345 kV	$ 6.00
Subtotal	$ 6.00
Contingency etc - 35 percent	2.10
Total	$ 8.10M

	HV $M	LV $M
Fairbanks		
Circuit Breakers - 1 x 345 kV	1.00	
- 1.5 x 138 kV		.60
Transformers - 1 x 150 MVA, 345/138 kV		.90
Subtotal	$ 1.00	$ 1.50
Contingency etc - 35 percent	.35	.53
Total	$ 1.35	$ 2.03
Station Total		$3.38M

	HV $M	LV $M
Willow		
Circuit Breakers - 5 x 345 kV	5.00	
- 1.5 x 138 kV		.60
Transformers - 1 x 75 MVA, 345/138 kV		.50
Subtotal	$ 5.00	$ 1.10
Contingency etc - 35 percent	1.75	.39
Total	$ 6.75	$ 1.49
Station Total		$8.24M

SUBSTATIONS 2000 - Cont'd

	HV $M	LV $M
Knik Arm - East		
Circuit Breakers - 1 x 345 kV	1.00	
Contingency etc - 35 percent	.35	
Total	$ 1.35	$
Station Total	$1.35M	
University Substation (AML&P Tap incl)		
Circuit Breakers - 3 x 345 kV	3.00	
- 3 x 230 kV		2.10
Transformers - 2 x 250 MVA, 345/230 kV		2.60
Subtotal	$ 3.00	$ 4.70
Contingency etc - 35 percent	1.05	1.65
Total	$ 4.05	$ 6.35
Station Total	$10.40M	
Total Substations 2000	$ 21.60	$ 9.87
	$31.47M	
Grand Total Substations	~~$134.54~~	~~$ 32.83~~
	~~$167.37M~~	

(31.47 - 8.1) x 1.05 =
24.5M
(5)

	$M
Total Transmission	$328.78
Total Land Acquisition	29.77
Total Substations (EHV transmission and switchyards only)	134.54
Not included transformers and subtransmission switchyards	$493.09M

Notes

1. All quantities and equipment ratings, especially for Var compensating equipment are subject to revision in final electric system studies.

2. "Contingency etc" -
   consist of - 20 percent contingency
   plus - 5 percent engineering
   - 5 percent construction management
   - 2.5 percent owner's cost

3. HV substation costs include EHV switchyards only.
   LV substation costs include transformers and low-voltage circuit breakers for transformer entries.