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Mr. [illegible]

SUSITNA HYDROELECTRIC PROJECT
PRELIMINARY ECONOMIC EVALUATION UPDATE
(Normalized Cost Analysis)

ALASKA POWER AUTHORITY SUSITNA		
FILE #5/00 15.1101		
SEQUENCE NO. F 598		
ACTION	DATE	INITIAL
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XC		
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②	3/17	
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⑥	FILE	

← Cover Only

July 1980

(Task 11.02)

SUMMARY

ECONOMIC EVALUATION OF S.P.H. BASED ON B-C RATIOS
(NORMALIZED COST ANALYSIS AT THE JANUARY 1980 PRICES LEVEL)

RANKING	ALTERNATIVE	ANNUAL PRODUCTION COST (mills/kwh)	B-C RATIO
2	Susitna Hydroelectric Project (Incl Transmission)	47.5	—
5	Alt. I, Coal-fired Steam, adjusted for Alaska location = Capacity Value (\$345/kw.yr & CP=0.70) = 56.3 = Energy Value (Blend Healy + Beluga) = 11.9	68.2	1.44
4	Alt. II (Oil-fired) Combined Cycle, adjusted for Alaska loc. = Capacity Value (\$80.2/kw.yr & CP=0.5) = 18.3 = Energy Value (Washington State Fuel Cost) = 35.7	54.0	1.14
3	Alt. III (N.Gas-fired) Combined Cycle, adjusted for Alaska loc. = Capacity Value (\$80.2/kw.yr & CP=0.5) = 18.3 = Energy Value (Washington State Fuel Cost) = 31.2	49.5	1.04
1	Alt. IV (N.Gas-fired) Combined Cycle, adjusted for Alaska loc. = Capacity Value (\$80.2/kw.yr & CP=0.5) = 18.3 = Energy Value (Alaska Average for Fuel) = 6.4	24.7	0.52

✓ Does Not represent a life-cycle cost analysis and, consequently, does not account for Differential Cost Escalation (DCE) for fuels.

July 1980

ACV,

SUSITHA Hydroelectric Project - 2 BAMS Scheme...

BASIC ASSUMPTIONS IN THE ECONOMIC EVALUATION UPDATE.

Space

1. January 1980 Price Level.
2. Private Financing at $11\frac{1}{2}$ percent
3. Federal Financing at 8 percent.
4. Ten years Construction Period of SHP.
5. Handy-Whitman Index of Public Utility Construction Costs
6. for Pacific-Northwest applied to Alaska.
7. No Taxes considered as Carrying Charges in Alaska.
8. Fuel Coal : a blend Healy-Beluga considered.
9. Fuel Oil : Pacific Northwest and/or Nationwide costs considered.
10. Fuel Gas : Pacific Northwest and/or Alaska, Chugach average considered

CONSIDERATIONS RELATED TO THE DECISIONS :-

- A) To perform Life-Cycle Analysis, incorporating Differential Cost Escalation (DCE) for Fuels.
 - B) To perform Sensitivity Analyses based on certain parameters
-

1. Location Adjustment Factors for the Capital Costs of Alternatives range from 1.5 to about 2.2, depending on source and particular location within the State.
2. Present status of "No Taxes" in evaluating private financed alternatives within the State of Alaska may change under future conditions.
3. Presently, the Fuel Oil cost is estimated at the Nationwide and/or the Pacific Northwest price level. Under future conditions, preferential contracts for the Alaskan utilities using local resources may be considered (currently there is no significant oil-fired electric generation in Alaska).
4. Presently, the Fuel N. Gas cost burned by utilities in Alaska is, in average, four times cheaper than the nationwide cost, and six times cheaper than the Pacific-Northwest cost. Under future conditions, the Alaskan M. Gas may become a strategic energy national resource implying the reevaluation of existing preferential contracts.
5. Regardless the geographic basis used in evaluating the fuel costs, the occurrence of a differential cost escalation for fossil fuels has a high probability.



Calculations

SUBJECT: SPH

GENERAL DATA (FOR ECONOMIC EVAL.)

JOB NUMBER _____
FILE NUMBER _____
SHEET 1 OF _____
BY ACV DATE _____
APP _____ DATE _____

JAN 1975 level / CE (Upper Sensitive R.B.) - $6\frac{1}{8}\%$

OCT 1978 level / CE + APAD (Hel. Power & Related Purposes) - $7\frac{1}{2}\%$

(NEW) JAN 1980 Level / ACRES (Prelim. Study, July 1980) - 8%

SCHEME 2 DAMS : Devil Canyon - Wataha Dam ($B/c = 1.4$ against coal)

(6 yrs Constr. Period) WATANA	795 MW	$\left[\begin{array}{l} 3 \times 265 \\ 4 \times 194 \end{array} \right]$ Francis ($H \approx 800'$)
(5 yrs Constr. Period) D. CANYON	776 -H-	

(10 yrs Constr. Period) $\rightarrow \Sigma \approx 1570$ MW: Dependable } $CP \approx \underline{0.5}$
Av. En. Production $\rightarrow \approx 6.91 \times 10^9$ kWh/yr



Calculations

SUBJECT: SUSITNA HYDROEL. PROJECT (SPH)

UPDATE OF CONSTRUCTION COSTS. - JAN 1980

JOB NUMBER	
FILE NUMBER	
SHEET 2	OF
BY ACW	DATE
APP	DATE

CONSTRUCTION COSTS
(\$ 1,000)

H-W Index (Pacific Region)
(Electric Utility Construction)

Oct 78

Jan 1980

1/WATANA

Total HYDRO-PLANT $\frac{540}{476.5} = 1.133$

1,427,000

1,616,800

2/D. CANYON

--

1.133

665,000

753,400

3/TRANSMISSION

Total TRANSM. LINES $\frac{473}{416} = 1.137$

338,000

384,300

TOTAL CONST. COSTS (\$1000) 2,430,000

2,754,500

ACRES

Calculations SPH

SUBJECT:

INVESTMENT COST & ANNUAL INV. COSTS
(PROJECT SCHEDULE IN TWO STAGES)

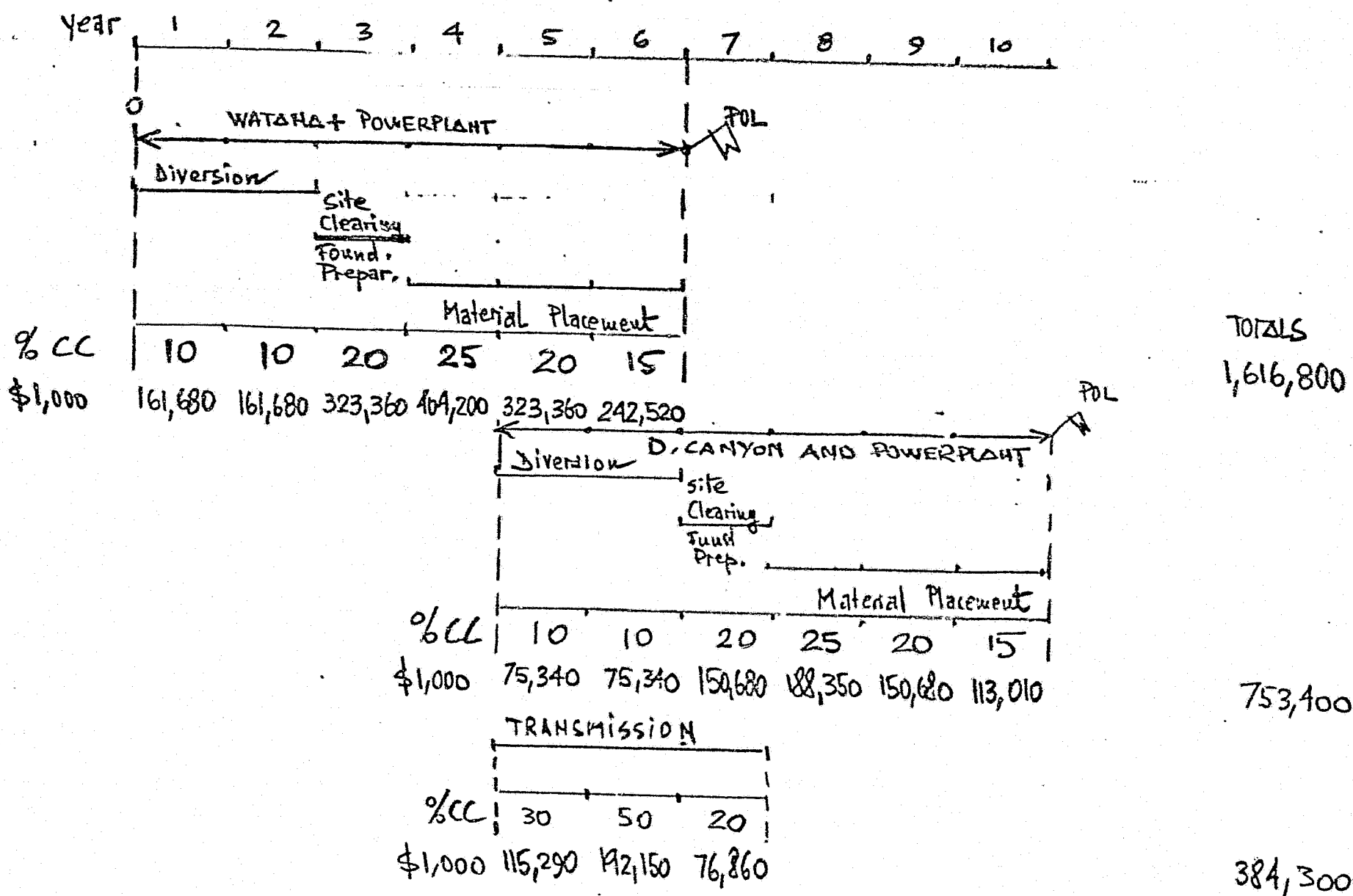
JOB NUMBER _____

FILE NUMBER _____

SHEET 3 OF _____

BY ACW DATE _____

APP _____ DATE _____



Year	1	2	3	4	5	6	7	8	9	10	10
cc, \$1000	161,680	161,680	323,360	404,200	513,990	510,010	227,540	188,350	150,680	113,010	2,754,500
idc, 8%/yr	12,934	25,869	51,738	84,074	125,193	165,994	184,197	199,265	211,319	220,360	1,280,943
ic, \$1000	174,614	187,549	375,098	488,274	639,183	676,004	411,737	387,615	361,999	333,370	4,035,443

CAPITAL REC. FACTOR (8%, 100 yrs) = 8.00364%

ANNUAL INVESTMENT COSTS (\$1,000/yr)
(Interest & Amortization)

322,982



Calculations

SUBJECT: SP# ✓

UPDATE OF REPLACEMENT COSTS - JAN. 1980

JOB NUMBER _____
FILE NUMBER _____
SHEET 4 OF _____
BY ACW DATE _____
APP _____ DATE _____

	ANN. REPLACEMENT (OCT 1978)			(El. Utility) H-W INDEX	ANN. REPL (JAN 1980) TOTAL
	<u>WATANA</u>	<u>D. CANYON</u>	<u>TOTAL</u>		
POWERPLANT	\$197,370	\$120,860	\$318,230	(T/G) $\frac{566}{502} \rightarrow$	358,801
TRANSMISSION (towers, fixtures, cond.)	25,130	—	25,130	$\frac{589}{515.5} \rightarrow$	28,713
SUBSTATIONS (Switchyards)	36,300	48,710	85,010	$\frac{372}{335} \rightarrow$	94,399
TOTAL	258,800	169,570	428,370	(Round)	\$481,913 482,000



Calculations

SUBJECT: SPH. ✓

UPDATE OF (O&M) COSTS - JAN. 1980

JOB NUMBER _____
FILE NUMBER _____
SHEET 5 OF _____
BY AW DATE _____
APP _____ DATE _____

	<u>ANN. (O&M) - OCT 1978</u>			<u>Av. U.S. Inflation Rate</u>	<u>ANN. (O&M) - JAN 80</u>
	<u>WATANA</u>	<u>D. CANYON</u>	<u>TOTAL</u>		
Salaries/Wages	\$1,429,700	\$274,700	\$1,704,400	$\left[1 + \frac{(\frac{1}{4})(7.7)}{100}\right] \left[1 + \frac{13.3}{100}\right] \approx 1.15$	\$1,960,060
M & A	165,000	35,000	200,000	1.15	230,000
Miscellaneous	273,000	130,900	403,900	1.15	464,485
Equip (Ann. Cost Replacement)	98,300	3,400	101,700	$\frac{540}{477} (4W)$	115,132
<u>SUBTOTAL</u>					2,769,677
Contingencies (20% ±)					<u>3,324,000</u>



Calculations

SUBJECT: SPH

JOB NUMBER _____

FILE NUMBER _____

SHEET 6 OF _____

BY ACV

DATE _____

APP _____

DATE _____

HYDRO INVESTMENT COSTS, ANNUAL INVESTMENT AND

(O&M) COSTS SUMMARY

JANUARY 1980

\$1000

<u>INV. COSTS</u> \$1,000	<u>WATAHA</u>	<u>D. CANYON</u>	<u>TRANSM.</u>	<u>TOTAL</u>
CONSTR. COSTS	1,616,800	753,400	384,300	2,754,500
IOC (8%)	<u>931,278</u>	<u>192,870</u>	<u>156,795</u>	<u>1,280,943</u>
INV. COSTS	2,548,078	946,270	541,095	4,035,443.

IOC should only be calculated on P.C.L.

<u>ANN. COSTS</u> \$/yr				
ANNUAL INV. COSTS, (CRF = 8.00364%)	203,939,000	75,736,000	43,307,000	322,982,000
ANN. REPLACEMENTS	291,600 //	190,400	—	482,000
ANN. (O&M) COSTS	<u>2,712,400 //</u>	<u>611,600</u>	—	<u>3,324,000</u>
TOTAL ANN. COSTS \$/yr	206,943,000 //	76,538,000	43,307,000	326,788,000
AT 1570 MW, \$/KW-yr				208.1
AT 50% C.F., mills/KW				<u>(47.5)</u>

1/ Include Transmission Costs, -



Calculations

SUBJECT: SPIT

JOB NUMBER _____
 FILE NUMBER _____
 SHEET 7 OF _____
 BY ACV DATE _____
 APP _____ DATE _____

CAPACITY VALUE FOR COAL-FIRED STEAM ELECTRIC ALTERNATIVE I -

30 year Life Span.

11.5%	Interest	} 18.66%
0.46	Depreciation	
0.00	Taxes (No taxes in Alaska)	
0.35	Interim Repl.	
0.25	Insurance	
6.10	(O&M) + (A&G)	

↓
 Total under fixed costs
 (acceptable for 0.70 capacity factor)

$$\text{Capacity Value} = (1850) \frac{18.66}{100} = \$345/\text{KW.-yr}$$

$$\text{Cap. Value (No Adj)} = (1029) \frac{18.66}{100} = \$192/\text{KW.-yr}$$

INVESTMENT COST FOR ALTERNATIVE I - COAL

- = Minemouth Beluga / Anchorage
- = Minemouth Healy / Fairbank - Tanana
- = Analysis for Plants with 500-MW units (appropriate for Alaska)
- = W Public Power Supply System - WPPSS Study (Washington, Montana, Wyoming):

Plants with 1000-MW units, July 1976, with scrubbers \$684/KW
 Handy-Whitman Index (Steam plant) 496/366 → Jan 80, with scr: \$927/KW.
 Upgrading of Plants with 500 MW-units $2 \left[\left(\frac{500}{1000} \right)^{.85} \right] \times (927) = \$1029/\text{KW}$

To adjust Pacific Northwest to Alaska conditions: Factor of 1.8 (Beluga)

Conclusion Investment Cost for Coal fired Plants with 500-MW units,
 Jan. 1980 price level, with scrubbers:

$$IC_{\text{Coal}} = (1.8) \times (1029) \approx \$1,850/\text{KW}$$

ACRES

Calculations

SUBJECT: SPII

JOB NUMBER _____

FILE NUMBER _____

SHEET 8 OF _____BY ACW DATE _____

APP _____ DATE _____

ENERGY VALUE FOR COAL-FIRED STEAM
ELECTRIC - ALTERNATIVE I. -

Upper Suitha R.B. / Corps of Engineers / 1979

Sept. 1978 Healy \$1.15/10⁶ BtuOct. 1978 Beluga \$1.0... \$1.40/10⁶ BtuMid 1980 Conditions, AP Addition: \$1.0 - \$1.50/10⁶ Btu for mine-mouth (Both Beluga/Healy)Say at the 1980 Prices Level: \$1.25/10⁶ Btu

Heat Rate of about 9500 Btu/kWh (for 70% Cap. Factor)

$$\text{Fuel Cost} = (1.25)(10^{-6})(9,500)(1000) = \underline{11.9 \text{ mills/kWh}}$$



Calculations

SUBJECT: SPH

ECONOMIC EVALUATION (NORMALIZED COSTS)
B/C Ratio Against Alternative I (Coal)

JOB NUMBER _____
FILE NUMBER _____
SHEET 9 OF _____
BY AW DATE _____
APP _____ DATE _____

ANNUAL COSTS \$/yr

INV & AMORT (CRF = 8.00364%)

ANNU. REPLACEMENTS

ANNU (O&M) COSTS

322,982,000

482,000

3,324,000

TOTAL I

326,788,000

ANNUAL BENEFITS \$/yr

→ equiv. cap. at CP = 0.70
CAPACITY (1,125,000 kW) × (345 $\frac{\$}{\text{kW-yr}}$)

ENERGY (6.9 × 10⁹ $\frac{\text{kWh}}{\text{yr}}$) (11.9 × 10⁻³ $\frac{\$}{\text{kWh}}$)

388,209,000

82,110,000

TOTAL II

470,319,000

BENEFIT/COST RATIOS

1.44

(B/C without Alaska Adjustment of 1.8)

1.17



Calculations

SUBJECT: SPH ALTERNATIVE II, OIL

BENEFITS

CAPACITY VALUE — COMBINED CYCLE, OIL-FIRED.

JOB NUMBER _____

FILE NUMBER _____

SHEET 10 OF _____

BY ACW DATE _____

APP _____ DATE _____

CAPITAL COSTS
Const. Cost

~ \$ 300 / KW

JAN, 1980, Plant w/ unit life
of 400 - 500 KW

IDC

~ 90 / KW

INVESTMENT COST

\$ 390 / KW

→ Anchorage Area

Adjustment for Alaska IC = $(1.6) \times (390) = \$ 625 / KW$. —
CARRYING CHARGES (30 year life span).

11.5%	Interest	} <u>12.56%</u>
0.46	Depreciation	
0.00	Taxes (No txs. in Alaska)	
0.35	Int. Replacement	
0.25	Insurance	

ANN. INV. COST

(With adjustment)	= $(625) \frac{12.56}{100} = \$ 78.5 / KW - yr$
(No adjustment)	= $(390) \frac{12.56}{100} = \$ 49 / KW - yr$

(O&M) Fixed 1.7 \$ / KW - yr

FUEL, Fixed —

|| CAPACITY VALUE (Adj) = \$ 80.2 / KW - yr
CAPACITY VALUE (No Adj) = \$ 50.7 / KW - yr



Calculations

SUBJECT: SPH ALTERNATIVE II, oil
BENEFITS,
ENERGY VALUE. - COMB. CYCLE,

JOB NUMBER _____
FILE NUMBER _____
SHEET 11 OF _____
BY ASW DATE _____
APP _____ DATE _____

O&M, Variable 2.75 mills/kwh

FUEL, Variable

JAN, 1980 State of Washington Fuel Cost : \$ 3.66 / 10⁶ Btu
(Future) Heat Rate : ~ 9,000 Btu/kwh } $\approx \underline{\underline{32.9}} \frac{\text{mills}}{\text{kwh}}$

JAN, 1980 National Average Fuel Cost : \$ 4.36 / 10⁶ Btu
~ 9,000 Btu/kwh } $\approx \underline{\underline{39.2}} \frac{\text{mills}}{\text{kwh}}$

$$\text{ENERGY VALUE (W)} = 32.9 + 2.75 = 35.7 \frac{\text{mills}}{\text{kwh}}$$

$$\text{ENERGY VALUE (U.S.)} = 39.2 + 2.75 = 42.0 \frac{\text{mills}}{\text{kwh}}$$

AGRES

Calculations

SUBJECT: SPH

ECONOMIC EVALUATION (NORMALIZED COSTS)
B/C RATIO AGAINST ALTERNATIVE II (OIL)

JOB NUMBER _____
FILE NUMBER _____
SHEET 12 OF _____
BY AW DATE _____
APP _____ DATE _____

ANNUAL COSTS \$/yr

INV & AMORT. (CRF = 8.00364%)

ANN. REPLACEMENT

ANN. (O&M) COSTS

322,982,000

482,000

3,324,000

TOTAL I

326,788,000. -

ANNUAL BENEFITS \$/yr (Capacity, with Adjustments; Energy, Washington State)

CAPACITY (1,570,000 KW) $(80.2 \frac{\$}{\text{KW} \cdot \text{yr}})$

ENERGY $(6.9 \times 10^9 \frac{\text{KWh}}{\text{yr}}) \times (35.7 \times 10^{-3} \frac{\$}{\text{KWh}})$

125,914,000

246,330,000

TOTAL II A

372,244,000

ANNUAL BENEFITS \$/yr (Capacity, w/out Adjustments; Energy, Nationwide)

CAPACITY (1,570,000 KW) $(50.7 \frac{\$}{\text{KW} \cdot \text{yr}})$

ENERGY $(6.9 \times 10^9 \frac{\text{KWh}}{\text{yr}}) \times (42.0 \times 10^{-3} \frac{\$}{\text{KWh}})$

79,599,000

289,800,000

TOTAL II B

369,399,000

BENEFIT-COST RATIOS

A (Adjustments / Washington)

1.14

✓

B (No Adjustments / Nationwide)

1.13

✓

C (Adjustments / Nationwide)

1.27



Calculations

SUBJECT: SPH ALTERNATIVE III, N.GAS.

BENEFITS

JOB NUMBER _____
FILE NUMBER _____
SHEET 13 OF _____
BY AW DATE _____
APP _____ DATE _____

ASSUMPTION : Same Capacity Values as for Alternative II (oil).

CAPACITY VALUE

$$\begin{aligned} \text{CAP. VALUE (Adj.)} &= \$80.2/\text{KW-yr} \\ \text{CAP. VALUE (No Adj.)} &= \$50.7/\text{KW-yr} \end{aligned}$$

ENERGY VALUE

OBM , Variable 2.75 mills/kwh. —

Fuel , Variable JAN, 1980

ALASKA, CHUGACH AVERAGE	$\$0.402/10^6 \text{ Btu}$	}	3.62 $\frac{\text{mills}}{\text{kwh}}$
	$\sim 9,000 \text{ Btu/kwh}$		
ALASKA, MAX. PAID (Bernia Lake)	$\$1.03/10^6 \text{ Btu}$	}	9.27 $\frac{\text{mills}}{\text{kwh}}$
	$\sim 9,000 \text{ Btu/kwh}$		
NATIONWIDE (lower than Wash. St)	$\$2.02/10^6 \text{ Btu}$	}	18.2 $\frac{\text{mills}}{\text{kwh}}$
	$\sim 9,000 \text{ Btu/kwh}$		
PACIFIC N-W	$\$3.16/10^6 \text{ Btu}$	}	28.4 $\frac{\text{mills}}{\text{kwh}}$
	$\sim 9,000 \text{ Btu/kwh}$		

$$\text{EN. VALUE (Alaska Ave.)} = 2.75 + 3.62 = 6.37 \frac{\text{mills}}{\text{kwh}}$$

$$(\text{Alaska Max}) = 2.75 + 9.27 = 12.0 \text{ —}$$

$$(\text{Nationwide}) = 2.75 + 18.2 = 21.0 \text{ —}$$

$$(\text{P-NW}) = 2.75 + 28.4 = 31.2 \text{ —}$$



Calculations

SUBJECT: SPH

ECONOMIC EVALUATION (NORMALIZED COSTS)
B/C RATIO AGAINST ALT. III (N. GAS)

JOB NUMBER _____
FILE NUMBER _____
SHEET 14 OF _____
BY AW DATE _____
APP _____ DATE _____

ANNUAL COSTS, \$/yr

INV & AMORT (CRF = 8.00364%)

ANN. REPLACEMENTS

ANN. (O&M) COSTS

322,982,000

482,000

3,324,000

TOTAL I

326,788,000.-

ONLY WITH ADJUSTMENTS

ANNUAL BENEFITS, \$/yr (Alaska Ave. for Fuel)

CAPACITY (1,570,000 Kw) (80.2 $\frac{\$}{Kw\cdot yr}$)

ENERGY (6.9×10^9 Kw/yr) ($6.37 \times 10^{-3} \frac{\$}{Kwh}$)

TOTAL II A

125,914,000

43,953,000

169,867,000

ANNUAL BENEFITS, \$/yr (Alaska Max for Fuel)

CAPACITY (1,570,000 Kw) (80.2 $\frac{\$}{Kw\cdot yr}$)

ENERGY (6.9×10^9 Kw/yr) ($12.0 \times 10^{-3} \frac{\$}{Kwh}$)

TOTAL II B

125,914,000

82,800,000

208,714,000

ANNUAL BENEFITS, \$/yr (Nationwide level for fuel)

CAPACITY (1,570,000 Kw) (80.2 $\frac{\$}{Kw\cdot yr}$)

ENERGY (6.9×10^9 Kw/yr) ($21 \times 10^{-3} \frac{\$}{Kwh}$)

TOTAL II C

125,914,000

144,900,000

270,814,000

[P-NW West: (6.9×10^9) (31.2×10^{-3}) = 215,280,000]

125,914,000

215,280,000

341,194,000

BENEFIT - COST RATIOS

A (Alaska Ave. for Fuel)

0.52

B (Alaska Max for Fuel)

0.64

C (Nationwide for Fuel)

0.83

D (Pacific NW - West for Fuel)

1.04

And this
is w/out
D.C.E.
for Fuel!



Calculations

SUBJECT: SPH

BATTELLE - DIGEST (PG1)

JOB NUMBER _____
FILE NUMBER _____
SHEET 15 OF _____
BY AW DATE _____
APP _____ DATE _____

RAILBELT FUTURE EL. GENERATION. -

6.1. Capital Cost Estimates

6.2. Operating Cost Estimates

7.3. Cost of Power

6.1 Capital Cost Estimate

= Alaskan C.C. Location Adj. Factors

Battelle Estimate {
Lower 48 → Beluga (1.80)
Lower 48 → Healy (2.20)
Lower 48 → Anch. (1.55)

= Capacity Scaling Factor (0.85)

= Cycle Plant (Gas-fired) IR = 8500 - 9000 Btu/kwh
I.C. (1/1977) 280... 320 \$/kw
Life = 30 yrs.

= Coal Fired Steam

with FDG, Jan 1977 {
Anch. \$1284...\$1619
Beluga \$1400...\$1766
Healy \$1712...\$2158

6.2 Fuel Costs

= OIL (1980) { Unrefined Oil, Anchorage, ISER } ≈ \$3/10⁶ Btu.
Railbelt Residual, ISER

= GAS (1980) { C/B Contract [without Pac-Alk LNG] ≈ \$0.2/10⁶ Btu.
with " " ≈ \$0.9/10⁶ Btu.

FERC \$1.6/10⁶ Btu

Adm & House \$2 - \$2.2/10⁶ Btu (inflation after of 5-8%/yr).

= COAL (1980) Limits \$0.86...\$1.25/10⁶ Btu

→ Recommend a total inflation of (6%/yr)

Used \$3.66 - \$4.36/10⁶ Btu

→ Recommend a total inflation of (5%/yr)

Used \$4 - \$3.2/10⁶ Btu

Used \$1.25