SUSITNA
HYDROELECTRIC PROJECT

FEDERAL ENERGY REGULATORY COMMISSION
PROJECT No. 7114

HARZA-EBASCO
Susitna Joint Venture
Document Number

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ALASKA POWER AUTHORITY
RESPONSE TO
FEDERAL ENERGY REGULATORY COMMISSION
DATA REQUEST
OF OCTOBER 24, 1984

VOLUME I

RESPONSE

HARZA-EBASCO
SUSITNA JOINT VENTURE

NOVEMBER 13, 1984

ALASKA POWER AUTHORITY

1. QUESTION

Input data for the OGP-6 runs used to develop the new cost comparisons as indicated in Volume 3, Appendix I - Fuel Pricing and Economics (e.g., data preparation model).

RESPONSE

The requested input data to the OGP-6 model is provided in Attachments 1.1 and 1.2 to this response. The cost comparisons contained in Volume 3, Appendix J of the Alaska Power Authority's (Power Authority) comments on the Draft Environmental Impact Statement (DEIS) presented two Railbelt expansion plans: the With-Susitna Plan and the Without-Susitna Plan. The input data for the With-Susitna Plan is contained in Attachment 1.1. The input data for the Without-Susitna Plan is contained in Attachment 1.2.

It should be noted that execution of the OGP-6 model requires four basic input models. These are:

- Data Preparation Model;
- Generation Planning Model;
- Existing Generation Model; and
- Load Model.

Attachment 1.1 comprises the data preparation and generation planning models for the With-Susitna Plan. The data preparation model encompasses lines 10 through 2250. The generation planning model begins at line 2260 and encompasses the remainder of the data file. Attachment 1.2 is similarly organized. The data preparation model encompasses lines 100 through 1970; the generation planning model starts at line 1980.

All OGP-6 analyses use the same Existing Generation Model and Load Model. The most recent versions of these inputs are provided in Attachments 1.3 and 1.4. Both have undergone review and minor revision since the July 1983 License Application submission.

Data Preparation/Generation Planning Model

With-Susitna Case

```
10 BRU *
20 BEN
30##NORM:
40$:PROGRAM:RLHS
50$:LIMITS:05,70K,,15K
60$:PRMFL:H*,E,R,AQ43093/,GP6DP
70$:PRMFL:01,R,S,AQ43682/LMNSDU
80$:PRMFL:02,R,S,AQ43682/GMB4UP
90$:FILE:03,X3S,10L
100$:DATA:15
110$:REMOTE:06
120$:REMOTE:07
130       N. PANSIC
140       HARZA-EBASCO SUSITNA JOINT VENTURE:
150       711 H STREET
160       ANCHORAGE, ALASKA 99510
170 $INPUT
180 ID1=15HALASKA RAILBELT,
190 ID2=60HDEISSU3 W2185 IN 1993, LOLP 0.1, D&M COAL,SHCA GAS, EBASCOAL,
200 NSTART=1993,
210 NTOTAL=28,
220 NYCOST=1982,
230 NYPWTH=1982,
240 IDTYPE=48HNUCLEAR     COAL   STEAMNGAS TURBINEOIL GAS TURB,
250           24HDIESEL    ICCOM CYCLE CC,
260           48HCONV.  HYDROPUMP STORAGEENG STOR   2ENG STOR   3,
270 IDTONE=36HNUKE  COAL  NGASGTOIL GTDIESELCOMCYC,
280           24HHYDRO PSH   ES-2  ES-3   ,
290 NNMANY=1,
300 NNAHED=1,
310 KTTYPE=-1,0,2,2,2,1,
320 XSIZES(1,1)=1500,
330 MANFYR(1,1)=2050,
340 XSIZES(1,2)=200,
350 MANFYR(1,2)=1982,
360 XSIZES(1,3)=87,
370 MANFYR(1,3)=1982,
380 XSIZES(1,4)=87,
390 MANFYR(1,4)=1982,
400 XSIZES(1,5)=10,
410 MANFYR(1,5)=2050,
420 XSIZES(1,6)=228,
430 MANFYR(1,6)=1982,
440 DERHYD=0.95,0,0,0,
450 CAPMIN=0.1,,
460 STIMES=0,
470 ESIZEG=333,250,50,
480 ESIZEP=333,250,50,
490 ESIZES=3330,2500,500,
500 HRES(2)=4500,
```

Data Preparation/Generation Planning Model

With-Susitna Case

503

```
510 PLCMW=750,200,87,87,10,228,
520 PLCOKW=1000,2552,479,479,869,616,
530 PLCOF=0,20,5*0,
540 PATPC(1,1)=1.000,
550 IYRPC(1,2)=1982,1990,1991,1992,
560 PATPC(1,2)=1.000,1.000,1.000,1.000,
570 PATPC(1,3)=1.000,1.000,1.000,1.000,
580 PATPC(1,4)=1.000,
590 PATPC(1,6)=1.000,1.000,1.000,1.000,
600 IYRPC(1,3)=1982,1990,1991,1992,
610 IYRPC(1,6)=1982,1990,1991,1992,
620 PATPC(1,5)=1.000,
630 PATHPC(1,1)=1.000,1.000,1.000,1.000,
640 IYRHPC(1,1)=1982,1990,1991,1992,
650 PATHPC(1,2)=3*1.000,
660 FIXCHG(1,1)=4.93,
670 FIXCHG(1,2)=5.69,
680 FIXCHG(1,3)=7.29,
690 FIXCHG(1,4)=7.29,
700 FIXCHG(1,5)=7.29,
710 FIXCHG(1,6)=5.69,
720 HYDFCR(1,1)=4.36,
730 HYDFCR(1,2)=16.05,
740 HYDFCR(1,3)=16.86,
750 NMFUEL=48HJ308         LBCOALH1     TONCOALH2     TONOIL#2G     GAL,
760             48HOIL#2FI     GALOIL#2C     GALNGAS1A     MCFNGAS2A     MCF,
770             36HNGAS3A      MCFNGAS4A     MCFCOALFB     TON,
780 FCOPT=1,
790 FUCOST=100.,203.,203.,638.,0.,704.,3*330.,302.,203.,
800 HVTAB=12+8,152+5,152+5,136000,136000,136000,1005+6,1005+6,1005+6,
810           1005+6,15+6,
820 IFTAB=1,11,7,4,6,10,
830 IPATFC=6,2,2,3,3,3,1,1,1,5,4,
840 PATFC(1,1)=1.000,1.0384,1.16598,1.0372,1.030,
850 IYRFC(1,1)= 1982, 1993, 2007,  2008,  2010,
860 PATFC(1,2)=1.000,1.01014,1.01001,1.01019,
870 IYRFC(1,2)= 1982,  1993,   2000,   2010,
880 PATFC(1,3)=1.000,1.040,1.030,
890 IYRFC(1,3)=1982,1993,2010,
900 PATFC(1,4)=1.000,1.01014,1.01015,1.00874,1.01491,
910 IYRFC(1,4)=1982,  1993,   2000,   2001,   2010,
920 PATFC(1,5)=1.000,1.0385,1.28779,1.0372,1.030,
930 IYRFC(1,5)= 1982, 1993,  2007,  2008, 2010,
940 OMMW=750,200,87,87,10,228,
950 OMDKW=9.1,51.36,2*7.61,.55,11.79,
960 OMDF=0.5,5*0.,
970 OMDHR=.11,3.61,2*0.28,5.38,0.54,
980 PATOM(1,1)=1.000,
990 PATOM(1,2)=1.000,1.000,1.000,1.000,1.000,
1000 IYROM(1,2)=1982,1983,1985,1986,1988,
1010 PATOM(1,3)=1.000,1.000,1.000,1.000,1.000,
1020 IYROM(1,3)=1982,1983,1985,1986,1988,
1030 PATOM(1,4)=1.000,
1040 PATOM(1,5)=1.000,
1050 PATOM(1,6)=1.000,1.000,1.000,1.000,1.000,
1060 IYROM(1,6)=1982,1983,1985,1986,1988,
```

Data Preparation/Generation Planning Model

With-Susitna Case

```
1070 OMHYD=27.3,0,0,0,
1080 OMVHYD=0,0,0,0,
1090 PATHOM(1,1)=1.000,1.000,1.000,1.000,1.000,
1100 IYRHOM(1,1)=1982,1983,1985,1986,1988,
1110 PATHOM(1,2)=1.000,
1120 PATHOM(1,3)=1.000,
1130 PATHOM(1,4)=1.000,
1140 NYRET=40,30,20,20,20,30,50,50,50,50,
1150 FORMN=500,1000,1500,150,200,250,3,87,80,3,87,80,
1160          2,5,10,150,228,250,
1170 FORATE=3*0.01,3*0.057,6*0.080,3*0.05,3*0.080,
1180 PORMN=500,1000,1500,150,200,250,3,87,80,3,87,80,
1190          2,5,10,150,228,250,
1200 PORATE=3*0.1,3*0.080,6*0.032,3*0.01,3*0.070,
1210 XHRDB=10500,10300,11060,11060,11500,8300,
1220 XPOW1=0.50,0.50,3*0.20,0.32,
1230 XFIN1=0.55,0.55,3*0.38,0.45,
1240 MONPR=0,
1245 IPATRN(1,1)=12*1,
1250 MSD=7,
1260 KPRINT=29*1,
1270 LPRINT=29*0,
1280 IPNAME=36HUNIT   TYPE 1UNIT   TYPE 2UNIT   TYPE 3,
1290           36HUNIT   TYPE 4UNIT   TYPE 5UNIT   TYPE 6,
1300 IREGN=6*1,
1310 IRNAME=12HALASKA        ,
1320 KPLANT=1,2,3,4,5,6,
1330 MANUAL=1,
1340 NREAD=1$
1350 $INPUT
1360 IFTAB(4)=7,
1370 MRDB(4)=3,
1380 PMINDB(4)=0.32,
1390 FMINDB(4)=0.45,
1400 MRDB(10)=3,
1410 PMINDB(10)=0.32,
1420 FMINDB(10)=0.45,
1430 NREAD=2$
1440 $INPUT
1450 MRDB(1)=1,
1460 MRDB(15)=3*1,3,1,
1470 NREAD=3$
1480 $INPUT
1490 MRDB(12)=3*1,
1500 NREAD=0$
1510 $INPUT
1520 IMAX=6,
1530 NAMEDB=
1540 12HBRADLEY LAKE,
1550 12HBELUGA TRANS,
1560 12HGRANT LAKE  ,
1570 12HCHAKACHAMNA ,
1580 12HNENANA TRANS,
1585 12HNENANA COAL1,
1590 INSTDB=88,121,88,121,121,121,
1600 KINDB=7,1,7,7,1,2,
1610 CAPDB(2)=1.,
1620 CAPDB(5)=1.,
1630 PMAXDB(2)=0.0000001,
1640 PMAXDB(5)=0.0000001,
```

Data Preparation/Generation Planning Model

With-Susitna Case

```
1650 PORDB(2)=1,
1660 PORDB(5)=1,
1670 DKNDB(1)=4111,
1680 DKNDB(2)=220000,
1690 DKNDB(3)=3705,
1700 DKNDB(4)=4230,
1710 DKNDB(5)=117000,2434,
1720 KFTDB(2)=5,
1730 KFTDB(5)=5,11,
1733 MPATDB(2)=1,
1736 MPATDB(5)=1,
1738 HRDB(6)=11000,
1740 OMDB(6)=65,40,
1742 CAPDB(6)=150,
1744 OMVDB(6)=3,10,
1748 GMINDB(1,1)=12*0,
1750 GMAXDB(1,1)=12*90,
1760 ENGYDB(1,1)=31,27.7,28.2,23.4,26.4,26.6,30.2,31.7,
1770                28.4,30.6,30.6,31.7,
1780 GMINDB(1,3)=12*0,
1790 GMAXDB(1,3)=12*7,
1800 ENGYDB(1,3)=2.0,2.0,1.0,4*2.0,2*3.0,3*2.0,
1810 GMINDB(1,4)=12*0,
1820 GMAXDB(1,4)=12*330,
1830 ENGYDB(1,4)=133.,114.,113.,98.,94.,96.,138.,228.,179.,126.,128.,144.,
1840 KMORE=0$
1850 $INPUT
1860 IMAX=5,
1870 NAMEDB=
1880      7HWATANA1,
1890      13HDEVIL CANYON1,
1900      7HWATANA2,
1910      13HDEVIL CANYON2,
1920      7HWATANA3,
1930 KRETDB(1)=2002,2010,2010,
1940 KINDB=5*7,
1950 INSTDB=93,102,102,110,110,
1960 DKNDB= 7289,3957,0,0,0,
1970 GMINDB(1,1)=395,342,254,194,186, 82,
1980               109,421,380,266,405,390,
1990 GMAXDB(1,1)=466,428,355,336,304,259,
2000               290,460,393,409,557,539,
2010 ENGYDB(1,1)=345,287,264,241,226,186,
2020               215,342,283,304,401,400,
2030 GMINDB(1,2)=328,327,292,317,254,283,
2040               245,257,302,229,301,354,
2050 GMAXDB(1,2)=395,393,334,318,325,328,
2060               276,293,304,309,394,434,
2070 ENGYDB(1,2)=295,264,248,228,241,235,
2080               205,218,219,229,283,323,
2090 GMINDB(1,3)=12*0,
2100 GMAXDB(1,3)=715,697,676,657,656,691,
2110               735,762,774,773,760,740,
2120 ENGYDB(1,3)=326,285,262,229,190,163,
2130               177,222,236,298,323,363,
```

Data Preparation/Generation Planning Model

With-Susitna Case

```
2140 GMINDB(1,4)=320,319,286,367,252,278,
2150             265,294,365,272,311,343,
2160 GMAXDB(1,4)=457,450,360,368,366,366,
2170             323,363,366,335,457,503,
2180 ENGYDB(1,4)=340,302,273,265,272,263,
2190             240,270,263,249,329,374,
2200 GMINDB(1,5)=12*0,
2210 GMAXDB(1,5)=693,667,643,619,615,650,
2220             703,743,764,762,745,720,
2230 ENGYDB(1,5)=369,319,281,252,214,188,
2240             180,249,264,350,371,417,
2250 KMORE=1$
2260$:PROGRAM,RLHS
2270$:LIMIT:50,72K,5K,20K
2280$:PRMFL:H*,E,R,AQ43093/.GP6GP
2290$:FILE:01,X1R,200L
2300$:FILE:02,X2R,10L
2310$:FILE:03,X3R,20L
2320$:FILE:04,X4R,10L
2330$:FILE:10,X10R,2L
2340$:FILE:11,X11R,20L
2350$:FILE:12,X12R,50L
2360$:FILE:13,X13R,10L
2370$:FILE:14,X14R,5L
2380$:FILE:16,X16R,10L
2390$:DATA:15
2400$:REMOTE:06
2410$:REMOTE:07
2420$:REMOTE:08
2430 $INPUT
2440 PWRATE=1.0350,
2450 PROVER=50,
2460 KOPOVR=1,0,0,1,1,0,1,1,1,1,
2470 NYROVR=28*1,
2480 EXCHYD=1,
2490 EXCMAX=0,
2500 IYRAUT(1)=40,30,20,20,20,30,50,50,50,
2510 IVCSJB(1)=10*1,
2520 PCTRIM=6*0,
2530 SPRES=-1.0,
2540 SRCRDT=1.0,.01,1.0,
2550 MIX=1,
2560 MATOR=0,
2570 NLOW=10,
2580 EXMXPU=1.00,
2590 EXOMWH=0.0001,
2600 RANFOR=-1,
2610 KEYENV=-1,
2620 KOPT=1,0,0,1,1,0,1,1,1,1,
2630 FAIL=0,
2640 KCYCLE=1,1,3,3,3,3,
2650 NUMZON=6,,
2660 KZONE=4,8,8,4,12,12,
2670 KEYCMT=-1,
2680 KORDER=1,3,2,
2690 NKODE(8)=0,
```

Data Preparation/Generation Planning Model

With-Susitna Case

```
2700 IMSTYP=6,3,1,1,1,2,
2710 SHKFOR=2.0,1.5,1.0,1.0,1.0,1.25,
2720 SHKPOR=2.0,1.5,1.0,1.0,1.0,1.25,
2730 KEYPRC=1,
2740 HRINMX=1.0,
2745 YRINMX=0.20,
2750 KLOLP(1)=0.,
2760 KLOLP(2)=0.,
2770 KLOLP(4)=1,
2780 RELENG=54000,49000,37000,40000,46000,33000,
2790           36000,34000,37000,38000,34000,38000,
2800 KOSTPC=1,
2810 IFSP=0,
2820 TYCST=0,
2830 NKODE(1)=1,
2840 NKODE(4)=0,
2850 NKODE(5)=1,
2860 KWHERE=0,
2870 NFIRST=0,
2880 MNTPKM=1,
2890 MPRINT=12*0,
2900 KODE3=25*0,
2910 KODE2=28*-1,
2920 KPRENV=3*1.0,
2930 EEPRNT=5.0,
2940 KPCUMT=1,
2950 KPSUM2=1,
2960 KPSUM4=1,
2970 KODE(6)=1,
2980 M3D=7,
2990 LSPARE=1,
3000 KEYSUM=0,
3010 M4D=8,
3020 IYREAD=1993$
3030 $INPUT
3040 KODE(7)=0,
3050 YRINMX=0.10,
3055 DMHYD=21.02,
3060 IYREAD=1996$
3070 $INPUT
3100 RELENG=349000,279000,225000,180000,185000, 92000,
3110           117000,316000,311000,236000,326000,403000,
3140 IYREAD=1997$
3150 $INPUT
3155 DMHYD=19.24,
3160 RELENG=349000,279000,225000,180000,185000, 92000,
3170           117000,325000,311000,236000,326000,403000,
3180 IYREAD=1999$
3190 $INPUT
3200 RELENG=349000,279000,225000,180000,185000, 92000,
3210           117000,338000,311000,236000,326000,403000,
3220 IYREAD=2000$
3230 $INPUT
3250 IYREAD=2001$
```

Data Preparation/Generation Planning Model

With-Susitna Case

```
3250 IYREAD=2001$
3260 $INPUT
3270 RELENG=349000,279000,225000,180000,185000, 92000,
3280          117000,347000,311000,236000,326000,403000,
3290 IYREAD=2002$
3300 $INPUT
3310 OMHYD=10,26,0,0,0,
3320 RELENG=539000,461000,465000,402000,350000,345000,
3330          346000,363000,380000,457000,505000,585000,
3340 IYREAD=2004$
3350 $INPUT
3360 RELENG=560000,497000,482000,420000,350000,362000,
3370          360000,378000,398000,474000,505000,591000,
3380 IYREAD=2006$
3390 $INPUT
3400 OMHYD= 8,67,0,0,0,
3410 RELENG=563000,504000,482000,423000,350000,384000,
3420          366000,401000,419000,478000,505000,591000,
3430 IYREAD=2008$
3440 $INPUT
3450 RELENG=563000,504000,482000,423000,350000,391000,
3460          366000,420000,444000,478000,505000,591000,
3470 IYREAD=2010$
3480 $INPUT
3490 OMHYD= 9,49,0,0,0,
3500 RELENG=539000,483000,461000,409000,328000,421000,
3510          368000,446000,470000,548000,493000,563000,
3520 IYREAD=2012$
3530 $INPUT
3540 RELENG=539000,483000,461000,409000,328000,421000,
3550          368000,452000,490000,548000,493000,563000,
3560 IYREAD=2013$
3570 $INPUT
3580 KODE(7)=1,
3590 PRGOAL=30,
3600 IYREAD=2014$
3610 $INPUT
3620 RELENG=539000,483000,461000,409000,328000,421000,
3630          368000,452000,520000,548000,493000,563000,
3632 IYREAD=2015$
3634 $INPUT
3636 KODE(7)=0,
3637 PRGOAL=0,
3640 IYREAD=2016$
3650 $INPUT
3660 RELENG=539000,483000,461000,409000,328000,421000,
3670          368000,452000,531000,548000,493000,563000,
3680 IYREAD=2018$
3690 $INPUT
3700 RELENG=539000,483000,461000,409000,328000,421000,
3710          368000,452000,531000,548000,493000,563000,
3720 IYREAD=2020$
3725 KOPT=1,0,0,1,1,0,1,1,1,1,
3730 $INPUT
3740 RELENG=539000,483000,461000,409000,328000,421000,
3750          368000,452000,531000,548000,493000,563000,
3760 IYREAD=0$
```

Data Preparation/Generation Planning Model

Without-Susitna Case

```
BRU *
BEN
##NORM
$:PROGRAM:RLHS
$:LIMITS:05,70K,,15K
$:PRMFL:H*,E,R,AG43093/,GP6DP
$:PRMFL:01,R,S,AG43682/LMNSDU
$:PRMFL:02,R,S,AG43682/GM84UP
$:FILE:03,X3S,10L
$:DATA:15
$:REMOTE:06
$:REMOTE:07
     N. PANSIC
     HARZA-EBASCO SUSITNA JOINT VENTURE
     711 H STREET
     ANCHORAGE, ALASKA 99510
$INPUT
ID1=15HALASKA RAILBELT,
ID2=60HDETSTR7, NSD GAS/COAL, COAL 88MM, SCHAGAS, EBASCOAL,
NSTART=1993,
NTOTAL=28,
NYCOST=1982,
NYPNTH=1982,
IDTYPE=48HNUCLEAR      COAL    STEAMNGAS TURBINEOIL GAS TURB,
          24HDIESELI   ICCOM CYCLE CC,
          48HCONV. HYDROPUMP STORAGEENG STOR   2ENG STOR   3,
IDTONE=36HNUKE  COAL  NGASGTOIL GTDIESELCOMCYC,
          24HHYDRO PSH   ES-2  ES-3  ,
NNMANY=1,
NNAHED=1,
KTTYPE=-1,0,2,2,2,1,
XSIZES(1,1)=1500,
MANFYR(1,1)=2050,
XSIZES(1,2)=200,
MANFYR(1,2)=1982,
XSIZES(1,3)=87,
MANFYR(1,3)=1982,
XSIZES(1,4)=87,
MANFYR(1,4)=1982,
XSIZES(1,5)=10,
MANFYR(1,5)=2050,
XSIZES(1,6)=228,
MANFYR(1,6)=1982,
DERHYD=0.95,0,0,0,
CAPMIN=0.1,
GTIMES=0,
```

Data Preparation/Generation Planning Model

Without-Susitna Case

```
560 ESIZEG=333,250,50,
570 ESIZEP=333,250,50,
580 ESIZES=3330,2500,500,
590 HRES(2)=4500,
600 PLCMW=750,200,87,87,10,228,
610 PLCDKW=1000,2552,479,479,869,616,
620 PLCDF=0,20,5*0,
630 PATPC(1,1)=1.000,
640 IYRPC(1,2)=1982,1990,1991,1992,
650 PATPC(1,2)=1.000,1.000,1.000,1.000,
660 PATPC(1,3)=1.000,1.000,1.000,1.000,
670 PATPC(1,4)=1.000,
680 PATPC(1,6)=1.000,1.000,1.000,1.000,
690 IYRPC(1,3)=1982,1990,1991,1992,
700 IYRPC(1,6)=1982,1990,1991,1992,
710 PATPC(1,5)=1.000,
720 PATHPC(1,1)=1.000,1.000,1.000,1.000,
730 IYRHPC(1,1)=1982,1990,1991,1992,
740 PATHPC(1,2)=3*1.000,
750 FIXCHG(1,1)=4.93,
760 FIXCHG(1,2)=5.69,
770 FIXCHG(1,3)=7.29,
780 FIXCHG(1,4)=7.29,
790 FIXCHG(1,5)=7.29,
800 FIXCHG(1,6)=5.69,
810 HYDFCR(1,1)=4.36,
820 HYDFCR(1,2)=16.05,
830 HYDFCR(1,3)=16.56,
840 NMFUEL=48HJ308         LBCOALH1     TONCOALH2     TONOIL#2G     GAL,
850             48HOIL#2F     GALOIL#2C     GALNGAS1A     MCFNGAS2A     MCF,
860             36HNGAS3A     MCFNGAS4A     MCFCOAL 5     TON,
870 FCCPT=1,
880 FUCOST=100.,203.,203.,638.,0.,704.,3*334.,302.,203.,
890 HVTAB=12+8,152+5,152+5,136000,136000,136000,1005+6,1005+6,1005+6,
900             1005+6,15+6,
910 IFTAB=1,11,7,4,6,10,
920 IPATFC=6,2,2,3,3,3,1,1,1,5,4,
930 PATFC(1,1)=1.000,1.0384,1.16598,1.0372,1.030,
940 IYRFC(1,1)= 1982, 1993, 2007,  2008,  2010,
950 PATFC(1,2)=1.000,1.01014,1.01001,1.01019,
960 IYRFC(1,2)= 1982,  1993,   2000,   2010,
970 PATFC(1,3)=1.000,1.040,1.030,
980 IYRFC(1,3)=1982,1993,2010,
990 PATFC(1,4)=1.000,1.01014,1.01015,1.00874,1.01491,
1000 IYRFC(1,4)=1982,  1993,   2000,   2001,   2010,
1010 PATFC(1,5)=1.000,1.0385,1.28779,1.0372,1.030,
1020 IYRFC(1,5)= 1982, 1993,  2007,  2008, 2010,
1030 OMMW=750,200,87,87,10,228,
1040 OMOKW=9.1,51.36,2*7.61,.55,11.75,
1050 OMOF=0,5,5*0.,
1060 OMOHR=.11,3.61,2*0.28,5.38,0.54,
1070 PATOM(1,1)=1.000,
1080 PATOM(1,2)=1.000,1.000,1.000,1.000,1.000,
```

Data Preparation/Generation Planning Model

Without-Susitna Case

```
IYROM(1,2)=1982,1983,1985,1986,1988,
PATOM(1,3)=1.000,1.000,1.000,1.000,1.000,
IYROM(1,3)=1982,1983,1985,1986,1988,
PATOM(1,4)=1.000,
PATOM(1,5)=1.000,
PATOM(1,6)=1.000,1.000,1.000,1.000,1.000,
IYROM(1,6)=1982,1983,1985,1986,1988,
OMHYD=27.3,0,0,0,
OMVHYD=0,0,0,0,
PATHOM(1,1)=1.000,1.000,1.000,1.000,1.000,
IYRHOM(1,1)=1982,1983,1985,1986,1988,
PATHOM(1,2)=1.000,
PATHOM(1,3)=1.000,
PATHOM(1,4)=1.000,
NYRET=40,30,20,20,20,30,50,50,50,50,
FORMW=500,1000,1500,150,200,250,3,87,80,3,87,80,
          2,5,10,150,228,250,
FORATE=3*0.01,3*0.057,6*0.080,3*0.05,3*0.080,
PORMW=500,1000,1500,150,200,250,3,87,80,3,87,80,
          2,5,10,150,228,250,
PORATE=3*0.1,3*0.080,6*0.032,3*0.01,3*0.070,
XHRDB=10500,10300,11060,11060,11500,8300,
XPOW1=0.50,0.50,3*0.20,0.32,
XFIN1=0.55,0.55,3*0.38,0.45,
IPATRN(1,1)=12*1,
MONPR=0,
M3D=7,
KPRINT=28*1,
LPRINT=28*0,
IPNAME=36HUNIT  TYPE 1UNIT  TYPE 2UNIT  TYPE 3,
          36HUNIT  TYPE 4UNIT  TYPE 5UNIT  TYPE 6,
IREGN=6*1,
IRNAME=12HALASKA
KPLANT=1,2,3,4,5,6,
MANUAL=1,
NREAD=1$
$INPUT
IFTAB(1)=7,
MRDB(1)=3,
PMINDB(1)=0.32,
FMINDB(1)=0.45,
IFTAB(4)=10,
MRDB(5)=3,
PMINDB(5)=0.32,
FMINDB(5)=0.45,
NREAD=2$
$INPUT
MRDB(1)=1,
MRDB(15)=3*1,3,1,
NREAD=3$
$INPUT
MRDB(12)=3*1,
NREAD=0$
$INPUT
IMAX=7,
```

Data Preparation/Generation Planning Model

Without-Susitna Case

```
1640 NAMEDB=
1650 12HBRADLEY LAKE,
1660 12HFIRST  TRANS,
1670 12HGRANT LAKE  ,
1680 12HCHAKACHAMNA ,
1690 12HSECOND TRANS,
1692 12HNENANA COAL1,
1694 12HNENANA COAL2,
1700 INSTDB=88,93,88,121,105,93,96,
1710 KINDB=7,1,7,7,1,2,2,
1720 CAPDB(2)=1,,
1730 CAPDB(5)=1,200,200,
1740 PMAXDB(2)=0.0000001,
1750 PMAXDB(5)=0.0000001,
1760 PORDB(2)=1,
1770 PORDB(5)=1,
1780 DKWDB(1)=4111,
1790 DKWDB(2)=220000,
1800 DKWDB(3)=3705,
1810 DKWDB(4)=4230,
1820 DKWDB(5)=117000,
1830 KFTDB(2)=5,
1840 MPATDB(2)=1,
1845 DKWDB(6)=2*2607,
1847 KFTDB(6)=2,2,
1850 KFTDB(5)=5,
1860 MPATDB(5)=1,
1870 GMINDB(1,1)=12*0,
1880 GMAXDB(1,1)=12*90,
1890 ENGYDB(1,1)=31,27.7,28.2,23.4,26.4,26.6,30.2,31.7,
1900             28.4,30.6,30.6,31.7,
1910 GMINDB(1,3)=12*0,
1920 GMAXDB(1,3)=12*7,
1930 ENGYDB(1,3)=2.0,2.0,1.0,4*2.0,2*3.0,3*2.0,
1940 GMINDB(1,4)=12*0,
1950 GMAXDB(1,4)=12*330,
1960 ENGYDB(1,4)=133.,114.,113.,98.,94.,96.,138.,228.,179.,126.,128.,144.,
1970 KMORE=1$
1980 $:PROGRAM:RLHS
1990 $:LIMITS:50,72K,8K,20K
2000 $:PRMFL:H*,E,R,AG43093/.GP6GP
2010 $:FILE:01,X1R,200L
2020 $:FILE:02,X2R,10L
2030 $:FILE:03,X3R,20L
2040 $:FILE:04,X4R,10L
2050 $:FILE:10,X10R,2L
2060 $:FILE:11,X11R,20L
2070 $:FILE:12,X12R,50L
2080 $:FILE:13,X13R,10L
2090 $:FILE:14,X14R,5L
2100 $:FILE:16,X16R,10L
2110 $:DATA:15
2120 $:REMOTE:06
2130 $:REMOTE:07
2140 $:REMOTE:08
2150 $INPUT
2160 PWRATE=1.0350,
2170 PROVER=50,
```

Data Preparation/Generation Planning Model

Without-Susitna Case

```
2180 KOPOVR=1,0,0,1,1,0,1,1,1,1,
2190 NYROVR=28*1,
2200 EXCHYD=1,
2210 EXCMAX=0,
2220 IYRAUT(1)=40,30,20,20,20,30,50,50,50,
2230 IVCSUB(1)=10*1,
2240 PCTRIM=6*0,
2250 SPRES=-1.0,
2260 SRCRDT=1.0,.01,1.0,
2270 MIX=1,
2280 MATOR=0,
2290 NLPW=10,
2300 EXMXPU=1.00,
2310 EXOMWH=0.0001,
2320 RANFOR=-1,
2330 KENENV=-1,
2340 KOPT=1,0,0,1,1,0,1,1,1,1,
2350 FAIL=0,
2360 KCYCLE=1,1,3,3,3,3,
2370 NUMZON=6,,
2380 KZONE=4,8,8,4,12,12,
2390 KEYCMT=-1,
2400 KORDER=1,3,2,
2410 NKODE(8)=0,
2420 IMSTYP=6,3,1,1,1,2,
2430 SHKFOR=2.0,1.5,1.0,1.0,1.0,1.25,
2440 SHKPOR=2.0,1.5,1.0,1.0,1.0,1.25,
2450 KEYPRC=-1,
2460 YRINMX=0.1,
2470 HRINMX=1.0,
2480 KLOLP(1)=0.,
2490 KLOLP(2)=0.,
2500 KLOLP(4)=1,
2510 RELENG=54000,49000,37000,40000,46000,33000,
2520            36000,34000,37000,38000,34000,38000,
2530 KODE(7)=0,
2540 KOSTPC=1,
2550 IFSP=0,
2560 TYCST=0,
2570 NKODE(1)=1,
2580 NKODE(4)=0,
2590 NKODE(5)=1,
2600 KWHERE=0,
2610 NFIRST=0,
2620 MNTPKM=1,
2630 MPRINT=12*0,
2640 KODE3=28*0,
2650 KODE2=28*-1,
2660 KPRENV=3*1,0,
2670 EEPRNT=5.0,
2680 KPCUMT=1,
2690 KPSUM2=1,
2700 KPSUM4=1,
2710 KODE(6)=1,
2720 M3D=7,
2730 LSPARE=1,
2740 KEYSUM=0,
2750 M4D=8$
```

ALASKA RAILBELT
EXISTING GENERATION MODEL GM84UP

```
                          LISTING OF INPUT DATA
 1        HARZA-EBASCO SUSITNA JOINT VENTURE
 2        711 H STREET
 3        ANCHORAGE,ALASKA 99510
 4        ATTN       N. PAVSIC
 5    $INPUT
 6   ID1=15HALASKA.RAILBELT,
 7   ID2=32HEXISTING GENERATION MODEL GM84UP,
 8   NEW=1,
 9   M7=7$
10   $INPUT
 8   NEW=1,
 9   M7=7$
10   $INPUT
11   IMAX=18,
12   NAMEDB=
13   48HAMLPD UNIT#1AMLPD UNIT#2AMLPD UNIT#3AMLPD UNIT#4,
14   48HAMLPD UNITCCAMLPD UNIT#8BELUGA  GT#1BELUGA  GT#2,
15   36HBELUGA  GT#3BELUGA  GT#5BELUGA  CC#8,
16   48HBERNICE GT#1BERNICE GT#2BERNICE GT#3BERNICE GT#4,
17   36HINTSTA  GT#1INTSTA  GT#2INTSTA  GT#3,
18   INSTDB=
19   62,64,68,72,79,82,68,68,73,75,82,
20   63,72,78,82,64,65,70,
21   HRDB=
22   3*14000,12500,8500,12500,2*15000,2*10000,8500,
23   3*23400,12000,3*15000,
24   CAPDB=
25   2*16.25,18,32,139,90,2*16.1.53,58,178,8.6,
26   18.9,2*26.4,2*14,18,
27   KINDB=
28   4*3,6,5*3,6,4*3,3*3,
29   KFTDB=
30   6*7,5*10,4*7,3*7,
31   KMORE=0$
32   $INPUT
33   IMAX=23,
34   NAMEDB=
35   48HHEALY   ST#1HEALY   IC#2NOPOLE  CT#1NOPOLE  CT#2,
36   48HZ UNIT  #1CTZ UNIT  #2CTZ UNIT  #3CTZ UNIT  #4CT,
37   48HZ UNIT  #5ICZ UNIT  #6ICZ UNIT #7 ICZUNIT   #8IC,
38   48HZ UNIT  #9ICZ UNIT #10ICCHENA   #1STCHENA   #2ST,
39   48HCHENA   #3STCHENA   #4CTCHENA   #5STCHENA   #6CT,
40   36HFMUS    #1ICFMUS    #2ICFMUS    #3IC,
41   INSTDB=
42   67,67,76,77,71,72,75,75,6*65,
43   54,52,52,63,70,76,67,68,68,
44   HRDB=
45   13200,10500,2*14000,4*14000,
46   6*14000,18000,22000,22000,15000,13320,15000,3*12150,
47   CAPDB=
48   25,2.75,65,65,18.4,17.4,3.5,3.5,6*3.5,
49   5,2.5,1.5,
50   7,21,28.8,3*2.75,
51   KINDB=
```

ALASKA RAILBELT
EXISTING GENERATION MODEL GM84UP

```
2,5,4,4,4*4,6*5,2,2,2,4,2,4,3*5,
KFTDB=
2,6,4,4,4*4,6*6,3*2,4,2,4,3*6,
KMORE=0$
$INPUT
IMAX=16,
NAMEDB=
48HHOMERKEN  ICPT. GRAHAMICSELDOVIA  #1SELDOVIA  #2,
48HSELDOVIA  #3TALKEETNA ICSES UNIT  #1SES UNIT  #2,
36HSES UNIT  #3EKLUTNA HYDRCOOPER  LAKE,
60HUNIV AK #1STUNIV AK #2STUNIV AK #3STUNIV AK #1ICUNIV AK #2IC,
KINDB=
9*5,7,7,
KINDB(12)=3*2,2*5,
INSTDB=
79,71,52,64,70,67,65,65,65,55,61,5*80,
KRETDB(10)=
2*2051,
HRDB=
9*15000,
HRDB(12)=3*12000,2*10500,
CAPDB=
0.9,0.2,0.3,0.6,0.6,0.9,1.5,1.5,2.5,
CAPDB(12)=2*1.5,10,2*2.75,
KFTDB=
9*6,
KFTDB(12)= 3*2,2*6,
GMINDB(1,10)=12*0,
GMAXDB(1,10)=12*30,
ENGYDB(1,10)=14,12,12,10,12,12,
                   13,14,13,14,14,14,
GMINDB(1,11)=12*0,
GMAXDB(1,11)=12*16.,
ENGYDB(1,11)=4,5*3,4,4,3,3*4,
KMORE=1$
$ENDJOB
```

LOAD MODEL - LMNSDU

```
110 BRU *
120 BEN
130##NORM
140$:PROGRAM:RLHS
150$:LIMITS:02,32K,,10K
160$:PRMFL:H*,E,R,AQ43093/.LDMD6
170$:PRMFL:01,W,S,AQ43682/LMNSDU
180$:DATA:15
190$:REMOTE:06
200$:REMOTE:07
210 HARZA-EBASCO SUSITNA JOINT VENTURE
220 711 H STREET
230 ANCHORAGE, ALASKA 99510
240 ATTN: N.PANSIC
250 1563.040 TASK 40
260$INPUT
270 ID1=34HHARZA-EBASCO SUSITNA JOINT VENTURE,
280 ID2=35HALASKA RAILBELT NSD UPDATE FORECAST,
290 NTOTAL=40,
300 NSTART=1981,
310 NEW=1,
320 NEWNUM=1,
330 NEWP=6HRAILBT,
340 NEWC=6HRAILBT,
350 POOLMW=569,601,637,670,703,734,764,794,825,855,
360        876,895,915,935,955,972,989,1005,1023,1040,
370        1065,1090,1114,1140,1165,1200,1234,1269,1305,1339,
380        1373,1408,1444,1481,1519,1558,1598,1639,1681,1724,
390 AEMWH=2750000,2906000,3083000,3245000,3406000,
400       3546000,3687000,3829000,3970000,4111000,
410       4206000,4302000,4397000,4492000,4588000,
420       4670000,4751000,4833000,4915000,4996000,
430       5117000,5238000,5359000,5481000,5602000,
440       5771000,5939000,6107000,6276000,6444000,
450       6610000,6780000,6955000,7135000,7318000,
460       7507000,7701000,7899000,8103000,8312000,
465 ISPEC=1,
466 PUANR=.917,.867,.787,.695,.630,.600,.596,.636,
470       .690,.794,.926,1.000,
480 PUANP=.917,.867,.787,.695,.630,.600,.596,.636,
490       .690,.794,.926,1.000,
500 PUMR(1,1)=1.0000,0.9157,0.8892,0.6322,
510 PUMR(1,2)=1.0000,0.9246,0.8977,0.6333,
520 PUMR(1,3)=1.0000,0.9335,0.9063,0.6343,
530 PUMR(1,4)=1.0000,0.9424,0.9149,0.6356,
540 PUMR(1,5)=1.0000,0.9429,0.9025,0.6059,
550 PUMR(1,6)=1.0000,0.9433,0.8901,0.5762,
560 PUMR(1,7)=1.0000,0.9437,0.8777,0.5465,
570 PUMR(1,8)=1.0000,0.9442,0.8653,0.5168,
580 PUMR(1,9)=1.0000,0.9348,0.8691,0.5454,
590 PUMR(1,10)=1.0000,0.9225,0.8729,0.5739,
600 PUMR(1,11)=1.0000,0.9161,0.8768,0.6025,
610 PUMR(1,12)=1.0000,0.9068,0.8806,0.6310,
```

LOAD MODEL - LMNSDU

```
620 PUMWK(1,1)=1.00000,0.99503,0.97999,0.97158,0.95529,0.92996,
630            0.92696,
640            0.92461,0.92263,0.91884,0.91365,0.90660,0.90634,
650            0.89240,0.87701,0.82231,0.80053,0.75277,0.71006,
660            0.70088,0.67716,0.66897,0.66555,0.66323,
670 PUMWK(1,2)=1.00000,0.99341,0.98114,0.97468,0.96297,0.94207,
680            0.93890,0.93528,0.93271,0.92825,0.92210,0.91655,
690            0.91622,0.90541,0.88075,0.83249,0.79704,0.75811,
700            0.71054,
710            0.70006,0.67904,0.66986,0.66698,0.66537,
720 PUMWK(1,3)=1.00000,0.99175,0.98230,0.97778,0.97064,0.95419,
730            0.95084,0.94596,0.94280,0.93765,0.93055,0.92649,
740            0.92610,0.91841,0.88450,0.84266,0.79354,0.76345,
750            0.71102,0.69925,0.68092,0.67075,0.66242,0.66751,
760 PUMWK(1,4)=1.00000,0.99009,0.98345,0.98089,0.97831,0.96631,
770            0.96279,0.95664,0.95288,0.94705,0.93900,0.93644,
780            0.93599,0.93142,0.88824,0.85284,0.75004,0.76879,
790            0.71150,0.69844,0.68280,0.67165,0.66985,0.66964,
800 PUMWK(1,5)=1.00000,0.99008,0.98462,0.97988,0.97621,0.96595,
810           0.96173,0.95518,0.95164,0.94112,0.92685,0.92291,
820            0.92019,0.91562,0.87480,0.83360,0.77936,0.74303,
830            0.69789,0.67675,0.65955,0.64903,0.64759,0.64235,
840 PUMWK(1,6)=1.00000,0.99007,0.98578,0.97887,0.97410,
850            0.96560,0.96067,0.95372,0.95040,0.93519,
860            0.91470,0.90938,
870            0.90439,0.89983,0.86136,0.81435,0.76878,0.71727,
880            0.68427,0.65507,0.63629,0.62641,0.62534,0.61506,
890 PUMWK(1,7)=1.00000,0.99006,0.98694,0.97787,0.97199,0.96524,
900            0.95961,0.95225,0.94916,0.92926,0.90255,0.89586,
910            0.88859,0.88404,0.84792,0.79510,0.75800,0.69151,
920          0.67065,0.63338,0.61304,0.60379,0.60308,0.58776,
930 PUMWK(1,8)=1.00000,0.99005,0.98811,0.97686,0.96988,0.96488,
940            0.95855,0.95079,0.94792,0.92332,0.89041,0.88233,
950            0.87279,0.86825,0.83447,0.77586,0.74732,0.66575,
960            0.65703,0.61169,0.58978,0.58118,0.58082,0.56047,
970 PUMWK(1,9)=1.00000,0.99173,0.98579,0.97476,0.96431,0.95312,
980            0.94767,0.94157,0.93908,0.91985,0.89411,0.88591,
990            0.87871,0.87104,0.84417,0.78493,0.76150,0.68617,
1000            0.67017,0.63419,0.61116,0.60290,0.60164,0.58563,
1010 PUMWK(1,10)=1.0000,0.99340,0.98347,0.97267,0.95875,0.94136,
1020            0.93678,0.93236,0.93024,0.91638,0.89781,0.88949,
1030            0.88462,0.87383,0.85387,0.79400,0.77568,0.70659,
1040            0.68331,0.65669,0.63253,0.62463,0.62247,0.61078,
1050 PUMWK(1,11)=1.0000,0.99507,0.98115,0.97057,0.95318,0.92960,
1060            0.92590,0.92314,0.92139,0.91291,0.90150,0.89307,
1070            0.89054,0.87661,0.86357,0.80307,0.78985,0.72701,
1080            0.69644,0.67919,0.65391,0.64635,0.64329,0.63594,
1090 PUMWK(1,12)=1.00000,0.99674,0.97883,0.96848,0.94762,0.91784,
1100            0.91502,0.91393,0.91255,0.90944,0.90520,0.89665,
1110            0.89645,0.87940,0.87327,0.81214,0.80403,0.74743,
1120            0.70958,0.70169,0.67528,0.66808,0.66412,0.66110,
1130 PUMWE(1,1)=0.93928,0.93733,0.91934,0.90359,0.89041,0.87125,
1140            0.86376,0.85890,0.85508,0.85266,0.84488,0.82874,
1150            0.82235,0.79315,0.78208,0.73686,0.72538,0.70842,
1160            0.68216,0.67250,0.66258,0.65772,0.65127,0.64850,
```

LOAD MODEL - LMNSDU

```
1170 PUMWE(1,2)=0.93338,0.93070,0.91381,0.89654,0.88755,0.87420,
1180            0.86586,0.86175,0.85626,0.85216,0.84686,0.83188,
1190            0.82718,0.80431,0.78961,0.74219,0.72669,0.71376,
1200            0.68459,0.67271,0.66438,0.66081,0.65454,0.64909,
1210 PUMWE(1,3)=0.92748,0.92407,0.90429,0.88948,0.88468,0.87715,
1220            0.86796,0.86461,0.85743,0.85166,0.84885,0.83501,
1230            0.83201,0.81547,0.79714,0.74751,0.72801,0.71911,
1240            0.68703,0.67292,0.66618,0.66390,0.65780,0.64967,
1250 PUMWE(1,4)=0.92158,0.91743,0.89676,0.88242,0.88181,0.88010,
1260            0.87006,0.86746,0.85860,0.85116,0.85084,0.83815,
1270            0.83684,0.82663,0.80467,0.75284,0.72932,0.72445,
1280            0.68947,0.67314,0.66797,0.66700,0.66107,0.65025,
1290 PUMWE(1,5)=0.90898,0.90455,0.88695,0.87319,0.87249,0.87055,
1300            0.86173,0.85938,0.85185,0.84581,0.84303,0.83259,
1310            0.82685,0.81653,0.78454,0.74035,0.71380,0.69907,
1320            0.67098,0.65362,0.64591,0.64118,0.63456,0.62401,
1330 PUMWE(1,6)=0.89637,0.89247,0.87715,0.86396,0.86316,0.86100,
1340            0.85341,0.85129,0.84510,0.84047,0.83523,0.82704,
1350            0.81687,0.80644,0.76441,0.72786,0.69828,0.67369,
1360            0.65248,0.63410,0.62385,0.61536,0.60806,0.59777,
1370 PUMWE(1,7)=0.88377,0.87999,0.86735,0.85474,0.85383,0.85145,
1380            0.84509,0.84320,0.83834,0.83513,0.82743,0.82149,
1390            0.80688,0.79634,0.74429,0.71537,0.68277,0.64831,
1400            0.63399,0.61458,0.60180,0.58954,0.58155,0.57153,
1410 PUMWE(1,8)=0.87116,0.86751,0.85755,0.84551,0.84451,0.84189,
1420            0.83677,0.83511,0.83159,0.82978,0.81962,0.81594,
1430            0.79689,0.78625,0.72416,0.70288,0.66725,0.62293,
1440            0.61550,0.59506,0.57974,0.56373,0.55505,0.54529,
1450 PUMWE(1,9)=0.88967,0.88662,0.87488,0.86180,0.85670,0.84849,
1460            0.84299,0.84035,0.83717,0.83563,0.82544,0.81836,
1470            0.80205,0.78518,0.73676,0.71004,0.68145,0.64296,
1480            0.63156,0.61436,0.60000,0.58645,0.57829,0.57095,
1490 PUMWE(1,10)=0.90818,0.90574,0.89221,0.87808,0.86889,0.85509,
1500            0.84921,0.84558,0.84275,0.84147,0.83126,0.82077,
1510            0.80721,0.78412,0.74936,0.71721,0.69566,0.66300,
1520             0.64761,0.63367,0.62026,0.60918,0.60153,0.59661,
1530 PUMWE(1,11)=0.92668,0.92485,0.90954,0.89437,0.88109,0.86169,
1540             0.85544,0.85081,0.84833,0.84732,0.83707,0.82319,
1550             0.81237,0.78305,0.76195,0.72437,0.70986,0.68303,
1560             0.66367,0.65298,0.64053,0.63190,0.62477,0.62226,
1570 PUMWE(1,12)=0.94519,0.94397,0.92687,0.91065,0.89328,0.86829,
1580             0.86166,0.85604,0.85391,0.85316,0.84289,0.82561,
1590             0.81753,0.78199,0.77455,0.73154,0.72406,0.72307,
1600             0.67972,0.67228,0.66079,0.65463,0.64801,0.64792,
1610 M7=7,
1620 MOD=0,
1630 MODWK=0,
1640 IYREAD=1985$
1650$INPUT
1660 PUANR=.915,.866,.785,.695,.632,.607,.597,.637,
1670       .689,.792,.922,1.000,
1680 PUANP=.915,.866,.785,.695,.632,.607,.597,.637,
1690       .689,.792,.922,1.000,
```

LOAD MODEL - LMNSDU

```
1700 IYREAD=1990$
1710 $INPUT
1720 PUANR=.915,.866,.785,.695,.630,.603,.595,
1730        .632,.685,.790,.922,1.000,
1740 PUANP=.915,.866,.785,.695,.630,.603,.595,
1750        .632,.685,.790,.922,1.000,
1760 PUMR(1,1)=1.0000,0.9148,0.8859,0.6318,
1770 PUMR(1,2)=1.0000,0.9224,0.8939,0.6321,
1780 PUMR(1,3)=1.0000,0.9300,0.9020,0.6324,
1790 PUMR(1,4)=1.0000,0.9375,0.9101,0.6328,
1800 PUMR(1,5)=1.0000,0.9395,0.8998,0.6049,
1810 PUMR(1,6)=1.0000,0.9414,0.8895,0.5769,
1820 PUMR(1,7)=1.0000,0.9434,0.8792,0.5490,
1830 PUMR(1,8)=1.0000,0.9454,0.8690,0.5211,
1840 PUMR(1,9)=1.0000,0.9358,0.8712,0.5487,
1850 PUMR(1,10)=1.0000,0.9263,0.8734,0.5763,
1860 PUMR(1,11)=1.0000,0.9168,0.8756,0.6039,
1870 PUMR(1,12)=1.0000,0.9073,0.8778,0.6314,
1880 IYREAD=1995$
1890$INPUT
1900 PUANR=.914,.865,.785,.695,.633,.609,.599,
1910        .637,.689,.792,.922,1.000,
1920 PUANP=.914,.865,.785,.695,.633,.609,.599,
1930        .637,.689,.792,.922,1.000,
1940 IYREAD=2000$
1950$INPUT
1960 PUANR=.914,.865,.784,.696,.636,.617,.605,.644,
1970        .694,.794,.922,1.000,
1980 PUANP=.914,.865,.784,.696,.636,.617,.605,.644,
1990        .694,.794,.922,1.000,
2000 PUMR(1,1)=1.0000,0.9165,0.8908,0.6266,
2010 PUMR(1,2)=1.0000,0.9268,0.9000,0.6270,
2020 PUMR(1,3)=1.0000,0.9371,0.9091,0.6274,
2030 PUMR(1,4)=1.0000,0.9474,0.9182,0.6278,
2040 PUMR(1,5)=1.0000,0.9473,0.9043,0.6007,
2050 PUMR(1,6)=1.0000,0.9472,0.8904,0.5737,
2060 PUMR(1,7)=1.0000,0.9471,0.8765,0.5466,
2070 PUMR(1,8)=1.0000,0.9470,0.8626,0.5195,
2080 PUMR(1,9)=1.0000,0.9368,0.8674,0.5462,
2090 PUMR(1,10)=1.0000,0.9266,0.8722,0.5729,
2100 PUMR(1,11)=1.0000,0.9164,0.8769,0.5995,
2110 PUMR(1,12)=1.0000,0.9062,0.8817,0.6262,
2120 IYREAD=2005$
2130$INPUT
2140 PUANR=.913,.864,.783,.696,.637,.619,.605,.643,
2150        .694,.793,.921,1.000,
2160 PUANP=.913,.864,.783,.696,.637,.619,.605,.643,
2170 .694,.793,.921,1.000,
2180 IYREAD=0$
2190$:ENDJOB
```

2. QUESTION

Output results for the OGP-6 runs noted above (e.g., similar to the outputs L4R1, L1W7, L1X7, and L275 that the APA had previously filed with the Commission).

RESPONSE

The requested output results for the two OGP-6 runs noted in Question 1 are provided in Volume II, Appendix 1 of this filing. The output for each run is comprised of two sections:

- Summary OGP-6 analysis for 1993-2020, coupled with extension to year 2051; and

- Detailed OGP-6 analysis for years 1993-2020.

Part A of Appendix 1 provides the above data for the With-Susitna Plan, and Part B of Appendix 1 provides the output data for the Without-Susitna Plan. For reference, the OGP-6 job identification number for the With-Susitna Plan is LJM5, and the Without-Susitna Plan identification is LJN1.

3. QUESTION

a) Information and data to support the capital costs used in the APA revised analysis of Susitna. The information should be in sufficient detail to fully document the APA "detailed review of actual equipment requirements with present labor rates, budgetary equipment quotations, and shipping costs" and justify the capital cost changes indicated.

RESPONSE

The capital cost estimates prepared for the original License Application were based upon the Railbelt Electric Power Alternatives Study,[1] a reconnaissance level survey done to provide an assessment of the power alternatives in Alaska. Subsequently, because of the importance attached to the thermal alternatives, the Power Authority commissioned a detailed review of the conceptual cost estimates for the thermal power alternatives. This review included obtaining budgetary equipment estimates for the following major capital equipment:

1/ Battelle-Pacific Northwest Laboratories (1982).

- Turbine Generator;
- Steam Generator (Boiler);
- Flue Gas Desulfurization (FGD) System;
- Particulate Control Equipment; and
- Cooling Towers

The experience of Ebasco Services in designing and constructing coal-fired power plants provided a basis upon which to estimate installation and material requirements for the balance of plant systems not directly obtained from equipment quotations. Also considered in the review were union wage rates, including Workmen's Compensation, FICA and Public Liability Property Damage insurance rates. The wage rates were based on six 10-hour days, within a camp-type operation.

The capital cost estimates of the initial 200 MW coal unit and the extension unit were prepared in 1983 dollars and de-escalated to January, 1982 dollars, as shown on the attached summary sheet (Attachment 3a.1).

The estimate entitled "Unit 1" (Attachment 3a.2), consists of the first coal-fired unit installed in Alaska. The unit 1 estimate includes all facilities that are common to coal-fired power plants. The unit 2 estimate (Attachment 3a.3) consists of an "extension" unit at the power plant site, also rated at 200 MW. The significant difference in capital costs between the two units reflects the infrastructure and common service facilities necessary to support the initial installation of a power plant.

The capital cost estimates provided were prepared for a Beluga power plant. A capital cost estimate for a coal-fired power plant at Nenana is under preparation. The work done to date supports the DEIS comments that the Nenana plant will have O&M costs at least $50/kW higher, on an installed cost basis, than the Beluga cost.

In addition to the capital cost estimates, a Basis of Estimate is also provided for each unit which presents the assumptions used in the estimate. (Attachments 3a.4 and 3a.5). Selected vendor quotes, which establish the validity of the capital cost estimates are provided in Attachment 3a.6.

Traditionally, finance charges, land, start-up services, town sites and owners' services are separated from the project direct capital costs. These are described in the Basis of Estimate. In order to arrive at the cost basis for the DEIS comments, these additional costs must be added to the capital cost estimate. This addition is shown on the sheet entitled "Capital Cost Estimate Summary" (Attachment 3a.1). The town site costs were estimated using the same approach used for the preparation of the Susitna Hydroelectric Project cost estimates. Owners' costs, spare parts, land and maintenance equipment costs included in the estimate were based upon Ebasco Service's past experience in the utility industry.

Labor and shipping costs are further discussed in the response to Question 3(e).

Capital Cost Estimate Summary

Unit 1 Estimate, APA 1707-M-1 ($1983) $554,647,987		
Unit 1 Estimate; De-escalated to $1982 at 6.4% inflation rate		$521,286,000
Unit 2 Estimate, APA 1707-M-1 ($1983) $372,993,683		
Unit 2 Estimate; De-escalated to $1982 at 6.4% inflation rate		350,560,000
	Subtotal	$871,846,000
Items not included in Estimate		
Town Site Cost ($1982)		16,600,000
Owners Cost (at 2½% of Direct Project)		21,800,000
Start up, Spare Parts and Special Tools		10,000,000
Maintenance Shop Machinery, Laboratory Equipment and Office Furniture		2,000,000
Land (200 acres at $10,000 per acre)		2,000,000
	Subtotal	$52,400,000
	Project Total Cost =	924,246,000
	Average Cost per kW = (1982)	$2,310

"UNIT 1"

APA
SUSITNA 200 MW COAL
ESTIMATE NO. APA 1707 M-1

BY: JDF CHECKED: JDF

DATE: 21-JUN-84 TIME: 16:40:54

SUMMARY
MATERIAL & INSTALLATION REPORT

ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
99.000000	TOTAL PROJECT COST	LS*	----	----	554647987*	210690570	---- *	----	343957417*	********	********	********
100.000000	CONTINGENCY	LS*	----	----	67438000*	22573988	---- *	----	44864012*	0	0	0
200.000000	ESCALATION	LS*	----	----	-25642565*	-9900868	---- *	----	-15741697*	********	-9900868	********
300.000000	TOTAL COST W/O CONT	LS*	----	----	512852552*	198017450	---- *	----	314835102*	********	-9900868	********
1.000000	IMPROVEMNTS TO SITE	LS*	----	----	4076672*	1184850	---- *	----	2891822*	-203829	-59242	-144587
2.000000	EARTHWORK & PILING	LS*	----	----	34210384*	14816500	---- *	----	19393884*	-1710508	-740824	-969684
3.000000	CIRC WATER SYSTEM	LS*	----	----	8176240*	3982650	---- *	----	4193590*	-408804	-199132	-209672
4.000000	CONCRETE	LS*	----	----	20339785*	3763000	---- *	----	16576785*	-1016987	-188150	-828837
5.000000	STRCT STL/LFT EQP	LS*	----	----	27330950*	10663500	---- *	----	16667450*	-1366545	-533174	-833371
6.000000	BUILDINGS	LS*	----	----	18242737*	5880650	---- *	----	12362087*	-912124	-294031	-618093
7.000000	TURBINE GENERATOR	LS*	----	----	19064900*	16400000	---- *	----	2664900*	-953245	-820000	-133245
8.000000	STM GENER & ACCESS	LS*	----	----	42900000*	24000000	---- *	----	18900000*	-2145000	-1200000	-945000
9.000000	AQCS	LS*	----	----	53956000*	30148300	---- *	----	23807700*	-2697800	-1507415	-1190385
10.000000	OTHER MECHAN EQUIP	LS*	----	----	19909906*	14724200	---- *	----	5185706*	-995480	-736210	-259270
11.000000	COAL&ASH HNDL EQUIP	LS*	----	----	22802750*	13343300	---- *	----	9[illegible]59450*	-1140136	-667165	-472971
12.000000	PIPING	LS*	----	----	28004420*	9876800	---- *	----	18127620*	-1400221	-493840	-906381
13.000000	INSULATION	LS*	----	----	6880000*	580000	---- *	----	6300000*	-344000	-29000	-315000
14.000000	INSTRUMENTATION	LS*	----	----	7067000*	6500000	---- *	----	567000*	-353350	-325000	-28350
15.000000	ELECTRICAL EQUIPMENT	LS*	----	----	57570000*	21000000	---- *	----	36570000*	-2878500	-1050000	-1828500
16.000000	PAINTING	LS*	----	----	2224340*	155000	---- *	----	2069340*	-111217	-7750	-103467
17.000000	OFF-SITE FACILITIES	LS*	----	----	13460700*	6030000	---- *	----	7430700*	-673035	-301500	-371535
18.000000	WATERFRONT FACILITY	LS*	----	----	7837739*	1888700	---- *	----	5949039*	-391884	-94435	-297449
19.000000	SUBSTATION/T-LINE	LS*	----	----	23198950*	13080000	---- *	----	10118950*	-1159947	-654000	-505947

Attachment 3a.2

APA
SUSITNA 200 MW COAL
ESTIMATE NO. APA 1707 M-1

BY: JDF CHECKED: JDF DATE: 21-JUN-84 TIME: 16:40:54

SUMMARY
MATERIAL & INSTALLATION REPORT

ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
71.000000	INDIRECT CONST COST	LS*	----	----	40949079*	0	---- *	----	40949079*	-2047453	0	-2047453
72.000000	PROFESSIONAL SERVCS	LS*	----	----	54650000*	0	---- *	----	54650000*	-2732500	0	-2732500

APA
SUSITNA 200 MW COAL
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DETAILED
MATERIAL & INSTALLATION REPORT

ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
99.000000	TOTAL PROJECT COST	LS*	----	----	554647987*	210690570	---- *	----	343957417*	********	********	********
100.000000	CONTINGENCY	LS*	----	----	67438000*	22573988	---- *	----	44864012*	0	0	0
200.000000	ESCALATION	LS*	----	----	-25642565*	-9900868	---- *	----	-15741697*	********	-9900868	********
300.000000	TOTAL COST W/O CONT	LS*	----	----	512852552*	198017450	---- *	----	314835102*	********	-9900868	********
1.000000	IMPROVEMNTS TO SITE	LS*	----	----	4076672*	1184850	---- *	----	2891822*	-203829	-59242	-144587
1.100000	SITE PREPARATION	LS*	----	----	440133*	0	---- *	----	440133*	-22006	0	-22006
1.110000	CLEARING	AC*	105	4191.7	440133*	0	0.00*	4191.7	440133*	-22006	0	-22006
1.200000	ROADS,BRDG,WALKS	LS*	----	----	683148*	168850	---- *	----	514298*	-34155	-8442	-25713
1.210000	ROADS	LS*	----	----	542530*	100000	---- *	----	442530*	-27126	-5000	-22126
1.213000	24' WIDE ROADS	SY*	40000	13.6	542530*	100000	2.50*	11.1	442530*	-27126	-5000	-22126
1.240000	FENCING	LS*	----	----	140618*	68850	---- *	----	71768*	-7029	-3442	-3587
1.241000	PROPERTY FENCE	LF*	3800	24.8	94373*	45600	12.00*	12.8	48773*	-4718	-2280	-2438
1.242000	SECURITY FENCE	LF*	1500	24.8	37252*	18000	12.00*	12.8	19252*	-1862	-900	-962
1.243000	GATES	EA*	7	1284.7	8993*	5250	750.00*	534.7	3743*	-449	-262	-187
1.300000	SITE DRAINAGE	LS*	----	----	1326552*	620000	---- *	----	706552*	-66327	-31000	-35327
1.500000	SEWAGE FACILITIES	LS*	----	----	389723*	150000	---- *	----	239723*	-19486	-7500	-11986
1.700000	RAILROAD	LS*	----	----	1237116*	246000	---- *	----	991116*	-61855	-12300	-49555
1.720000	STACKER RECL TRCK	LF*	600	2061.9	1237116*	246000	410.00*	1651.9	991116*	-61855	-12300	-49555
2.000000	EARTHWORK & PILING	LS*	----	----	34210384*	14816500	---- *	----	19393884*	-1710508	-740824	-969684
2.200000	STRCTR & EQUIP EXC	LS*	----	----	14888641*	4580000	---- *	----	10308641*	-744429	-229000	-515429
2.210000	STATION AREA	LS*	----	----	10776505*	4580000	---- *	----	6196505*	-538825	-229000	-309825
2.212000	EARTH EXCAVATION	CY*	18700	29.1	545105*	0	0.00*	29.1	545105*	-27255	0	-27255
2.214000	SELECT BACKFILL	LS*	----	----	10231400*	4580000	---- *	----	5651400*	-511570	-229000	-282570

APA
SUSITNA 200 MW COAL

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ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
2.214100	7' GRAVEL PAD	CY*	510000	16.9	8639400*	4080000	8.00*	8.9	4559400*	-431970	-204000	-227970
2.214200	INSULATION BRD	SF*	2000000	0.8	1592000*	500000	0.25*	0.5	1092000*	-79600	-25000	-54600
2.220000	STACK FOUNDATIONS	LS*	----	----	221816*	0	---- *	----	221816*	-11090	0	-11090
2.222000	EARTH EXCAVATION	CY*	2300	23.3	53636*	0	0.00*	23.3	53636*	-2681	0	-2681
2.223000	ROCK EXCAVATION	CY*	2000	84.1	168180*	0	0.00*	84.1	168180*	-8409	0	-8409
2.230000	COAL HAND FDN	LS*	----	----	2086470*	0	---- *	----	2086470*	-104323	0	-104323
2.232000	EARTH EXCAVATION	CY*	43400	29.1	1265110*	0	0.00*	29.1	1265110*	-63255	0	-63255
2.233000	ROCK EXCAVATION	CY*	11200	73.3	821360*	0	0.00*	73.3	821360*	-41068	0	-41068
2.240000	OUTLY TKS EQP/STR	LS*	----	----	201135*	0	---- *	----	201135*	-10056	0	-10056
2.242000	EARTH EXCAVATION	CY*	6900	29.1	201135*	0	0.00*	29.1	201135*	-10056	0	-10056
2.250000	AQCS FDNS	LS*	----	----	1602715*	0	---- *	----	1602715*	-80135	0	-80135
2.252000	EARTH EXCAVATION	CY*	27900	29.1	813285*	0	0.00*	29.1	813285*	-40664	0	-40664
2.253000	ROCK EXCAVATION	CY*	10600	74.5	789430*	0	0.00*	74.5	789430*	-39471	0	-39471
2.300000	TRENCHING	LS*	----	----	2816831*	0	---- *	----	2816831*	-140840	0	-140840
2.310000	CIRC WATER COND	LS*	----	----	529478*	0	---- *	----	529478*	-26473	0	-26473
2.312000	EARTH EXCAVATION	CY*	13700	28.2	386091*	0	0.00*	28.2	386091*	-19304	0	-19304
2.313000	ROCK EXCAVATION	CY*	1800	79.7	143387*	0	0.00*	79.7	143387*	-7169	0	-7169
2.320000	YARD PIPING	LS*	----	----	1334289*	0	---- *	----	1334289*	-66714	0	-66714
2.322000	EARTH EXCAVATION	CY*	43400	30.7	1334289*	0	0.00*	30.7	1334289*	-66714	0	-66714
2.330000	SEWERS & DRAINS	LS*	----	----	953064*	0	---- *	----	953064*	-47653	0	-47653
2.332000	EARTH EXCAVATION	CY*	31000	30.7	953064*	0	0.00*	30.7	953064*	-47653	0	-47653
2.400000	EARTH STRUCTURES	CY*	5500	29.0	159698*	0	0.00*	29.0	159698*	-7984	0	-7984
2.500000	PILES (H PILES)	LS*	----	----	14779687*	9750000	---- *	----	5029687*	-738983	-487500	-251483

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MATERIAL & INSTALLATION REPORT

ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
2.510000	STATION AREA	LF*	180000	59.1	10641375*	7020000	39.00*	20.1	3621375*	-532068	-351000	-181068
2.520000	AQCS AREA	LF*	70000	59.1	4138312*	2730000	39.00*	20.1	1408312*	-206915	-136500	-70415
2.700000	CECI-EXCV-ERTH STR	LS*	----	----	1565527*	486500	---- *	----	1079027*	-78272	-24324	-53948
2.710000	CL PL SEEP&RO CTR	LS*	----	----	910052*	441000	---- *	----	469052*	-45502	-22050	-23452
2.711000	PVC LINER	SF*	300000	0.5	151002*	135000	0.45*	0.1	16002*	-7550	-6750	-800
2.712000	SAND	CY*	17000	24.4	413950*	170000	10.00*	14.4	243950*	-20697	-8500	-12197
2.713000	GRAVEL	CY*	17000	20.3	345100*	136000	8.00*	12.3	209100*	-17255	-6800	-10455
2.720000	WST WTR TRMT AREA	LS*	----	----	463279*	19350	---- *	----	443929*	-23162	-967	-22195
2.721000	PVC LINER	SF*	43000	0.5	21643*	19350	0.45*	0.1	2293*	-1081	-967	-114
2.722000	EXCAVATION	CY*	19000	17.9	339720*	0	0.00*	17.9	339720*	-16986	0	-16986
2.723000	BACKFILL	CY*	3800	26.8	101916*	0	0.00*	26.8	101916*	-5095	0	-5095
2.730000	SLD WST STK PILE	LS*	----	----	166696*	21150	---- *	----	145546*	-8333	-1057	-7276
2.731000	PVC LINER	SF*	47000	0.5	23656*	21150	0.45*	0.1	2506*	-1182	-1057	-125
2.732000	EXCAVATION	CY*	5300	17.9	94764*	0	0.00*	17.9	94764*	-4738	0	-4738
2.733000	BACKFILL	CY*	1800	26.8	48276*	0	0.00*	26.8	48276*	-2413	0	-2413
2.740000	EMER WST BASIN	LS*	----	----	25500*	5000	---- *	----	20500*	-1275	-250	-1025
3.000000	CIRC WATER SYSTEM	LS*	----	----	8176240*	3982650	---- *	----	4193590*	-408804	-199132	-209672
3.200000	INTK & DISC PIPING	LS*	----	----	2141914*	894550	---- *	----	1247364*	-107093	-44727	-62366
3.2[illegible]0000	CONCR PIPE: 60"	LF*	3400	355.8	1209822*	646000	190.00*	165.8	563822*	-60491	-32300	-28191
3.260000	BEDDING MATERIAL	CY*	2000	30.5	61000*	20000	10.00*	20.5	41000*	-3050	-1000	-2050
3.270000	CONCRET STRUCTURE	LS*	----	----	821798*	208950	---- *	----	612848*	-41088	-10447	-30641
3.271000	THRST & TRNS BLK	CY*	750	430.0	322518*	93750	125.00*	305.0	228768*	-16125	-4687	-11438
3.272000	CONDENS BLOCKS	CY*	400	903.4	361372*	81600	204.00*	699.4	279772*	-18068	-4080	-13988

APA
SUSITNA 200 MW COAL
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3.273000	PITOT TUBE PIT	CY*	200	689.5	137908*	33600	168.00*	521.5	104308*	-6895	-1680	-5215
3.280000	MISCELLAN STEEL	TN*	7	7042.0	49294*	19600	2800.00*	4242.0	29694*	-2464	-980	-1484
3.400000	COOL TOWER FACIL	LS*	----	----	6034326*	3088100	---- *	----	2946226*	-301711	-154405	-147306
3.410000	TOWER BASIN	LS*	----	----	772465*	196500	---- *	----	575965*	-38622	-9825	-28797
3.411000	EXCAVATION	CY*	6500	22.4	145275*	0	0.00*	22.4	145275*	-7263	0	-7263
3.412000	CONC CW COOL TWR	CY*	1500	418.1	627190*	196500	131.00*	287.1	430690*	-31359	-9825	-21534
3.420000	PUMP CHAMBER	LS*	----	----	848470*	220600	---- *	----	627870*	-42422	-11030	-31392
3.422000	EXCAVATION	CY*	4500	22.4	100575*	0	0.00*	22.4	100575*	-5028	0	-5028
3.423000	CONCRETE	CY*	1500	465.7	698601*	201000	134.00*	331.7	497601*	-34930	-10050	-24880
3.424000	MISC STEEL	TN*	7	7042.0	49294*	19600	2800.00*	4242.0	29694*	-2464	-980	-1484
3.430000	INTAKE EQUIPMENT	LS*	----	----	397160*	335000	---- *	----	62160*	-19857	-16750	-3107
3.433000	SCREENS	SF*	500	58.3	29140*	15000	30.00*	28.3	14140*	-1457	-750	-707
3.435000	STOP LOGS	SF*	500	74.1	37070*	30000	60.00*	14.1	7070*	-1853	-1500	-353
3.436000	CRANE BRIDGE 15T	EA*	1	0.0	330950*	290000	---- *	0.0	0950*	-16547	-14500	-2047
3.440000	PMP HS SPR STRUCT	LS*	----	----	757743*	336000	---- *	----	421743*	-37886	-16800	-21086
3.441000	CRANE & HST SUPP	TN*	75	3155.4	236655*	120000	1600.00*	1555.4	116655*	-11832	-6000	-5832
3.442000	BUILDING SPRSTR	SF*	6000	86.8	521088*	216000	36.00*	50.8	305088*	-26054	-10800	-15254
3.450000	TOWER SPR STRUCT	LS*	----	----	3258488*	2000000	---- *	----	1258488*	-162924	-100000	-62924
4.000000	CONCRETE	LS*	----	----	20339785*	3763000	---- *	----	16576785*	-1016987	-188150	-828837
4.100000	TURBINE BLDG CONCR	CY*	4700	834.4	3921596*	667400	142.00*	692.4	3254196*	-196079	-33370	-162709
4.200000	BOILER AREA CONCRT	CY*	1900	735.8	1397976*	269800	142.00*	593.8	1128176*	-69898	-13490	-56408
4.300000	SILO AREA CONCRETE	CY*	1700	768.7	1306840*	241400	142.00*	626.7	1065440*	-65342	-12070	-53272
4.400000	AQCS CONCRETE	CY*	9100	767.4	6982969*	1292200	142.00*	625.4	5690769*	-349148	-64610	-284538

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4.500000	COAL HANDLG CONCRT	CY*	5600	872.8	4887924*	795200	142.00*	730.8	4092724*	-244396	-39760	-204636
4.900000	MISCELL CONCRETE	CY*	3500	526.4	1842480*	497000	142.00*	384.4	1345480*	-92124	-24850	-67274
5.000000	STRCT STL/LFT EQP	LS*	----	----	27330950*	10663500	---- *	----	16667450*	-1366545	-533174	-833371
5.100000	TURBINE BUILDING	LS*	----	----	4195290*	2047900	---- *	----	2147390*	-209764	-102395	-107369
5.110000	MAIN STEEL	TN*	1200	2440.0	2928000*	1500000	1250.00*	1190.0	1428000*	-146400	-75000	-71400
5.120000	FRAMING	LS*	----	----	372750*	189000	---- *	----	183750*	-18637	-9450	-9187
5.121000	WALL FRAMING	TN*	105	3550.0	372750*	189000	1800.00*	1750.0	183750*	-18637	-9450	-9187
5.130000	MISC STEEL	LS*	----	----	563740*	128900	---- *	----	434840*	-28187	-6445	-21742
5.131000	GRATING 1-3/4"	SF*	12000	28.0	336000*	84000	7.00*	21.0	252000*	-16800	-4200	-12600
5.132000	CHECKERED PLATE	SF*	600	57.9	34740*	6600	11.00*	46.9	28140*	-1737	-330	-1407
5.133000	HANDRAIL	LF*	1000	103.0	103000*	15500	15.50*	87.5	87500*	-5150	-775	-4375
5.134000	LADDERS & STRWYS	TN*	12	7500.0	90000*	22800	1900.00*	5600.0	67200*	-4500	-1140	-3360
5.140000	LIFTING EQUIP	LS*	----	----	330800*	230000	---- *	----	100800*	-16540	-11500	-5040
5.141000	CRANE: 40 T CAP	LS*	----	----	330800*	230000	---- *	----	100800*	-16540	-11500	-5040
5.200000	STEAM GENERATOR	LS*	----	----	12073520*	4595350	---- *	----	7478170*	-603675	-229767	-373908
5.210000	MAIN STEEL	TN*	2300	2440.0	5612000*	2875000	1250.00*	1190.0	2737000*	-280600	-143750	-136850
5.220000	FRAMING	LS*	----	----	1933000*	666000	---- *	----	1267000*	-96650	-33300	-63350
5.221000	WALL FRAMING	TN*	330	5300.0	1749000*	594000	1800.00*	3500.0	1155000*	-87450	-29700	-57750
5.222000	ELEV FRAMING	TN*	40	4600.0	184000*	72000	1800.00*	2800.0	112000*	-9200	-3600	-5600
5.230000	MISC STEEL	LS*	----	----	4283820*	929350	---- *	----	3354470*	-214190	-46467	-167723
5.231000	GRATING (1-3/4")	SF*	70000	28.0	1960000*	490000	7.00*	21.0	1470000*	-98000	-24500	-73500
5.232000	CHECKERED PLATE	SF*	1600	57.9	92640*	17600	11.00*	46.9	75040*	-4632	-880	-3752
5.233000	HANDRAIL	LF*	12500	106.5	1331180*	193750	15.50*	91.0	1137430*	-66558	-9687	-56871

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5.234000	LADDERS & STRWY	TN*	120	7500.0	900000*	228000	1900.00*	5600.0	672000*	-45000	-11400	-33600
5.240000	LIFTING EQUIP	LS*	----	----	244700*	125000	---- *	----	119700*	-12235	-6250	-5985
5.242000	ELEV EQUIPMENT	LS*	----	----	144500*	50000	---- *	----	94500*	-7225	-2500	-4725
5.243000	OTHER LIFT EQUIP	LS*	----	----	100200*	75000	---- *	----	25200*	-5010	-3750	-1260
5.243100	(3) 15 TON HST	LS*	----	----	100200*	75000	---- *	----	25200*	-5010	-3750	-1260
5.300000	SILO BAY	LS*	----	----	3626640*	1860750	---- *	----	1765890*	-181331	-93037	-88294
5.310000	MAIN STEEL	TN*	225	2440.0	549000*	281250	1250.00*	1190.0	267750*	-27449	-14062	-13387
5.320000	FRAMING	LS*	----	----	344500*	117000	---- *	----	227500*	-17225	-5850	-11375
5.321000	WALL FRAMING	TN*	65	5300.0	344500*	117000	1800.00*	3500.0	227500*	-17225	-5850	-11375
5.330000	MISC STEEL	LS*	----	----	347000*	200000	---- *	----	147000*	-17350	-10000	-7350
5.340000	LIFTING EQUIPMENT	LS*	----	----	77640*	60000	---- *	----	17640*	-3882	-3000	-882
5.343000	OTHER LIFT EQUIP	LS*	----	----	77640*	60000	---- *	----	17640*	-3882	-3000	-882
5.350000	SUPPORT STEEL	LS*	----	----	755000*	265000	---- *	----	490000*	-37750	-13250	-24500
5.351000	EQUIP SUPPORTS	TN*	100	7550.0	755000*	265000	2650.00*	4900.0	490000*	-37750	-13250	-24500
5.360000	STL SILO & CVR PL	LS*	----	----	1553500*	937500	---- *	----	616000*	-77675	-46875	-30800
5.361000	STEEL SILOS	TN*	170	6950.0	1181500*	705500	4150.00*	2800.0	476000*	-59075	-35275	-23800
5.362000	SS PLATES	TN*	40	9300.0	372000*	232000	5800.00*	3500.0	140000*	-18600	-11600	-7000
5.500000	CONCRETE STACKS	LS*	----	----	7087000*	2000000	---- *	----	5087000*	-354350	-100000	-254350
5.700000	CECI STEEL	LS*	----	----	69500*	38000	---- *	----	31500*	-3475	-1900	-1575
5.900000	UNCLASS STEEL	TN*	45	6200.0	279000*	121500	2700.00*	3500.0	157500*	-13950	-6075	-7875
6.000000	BUILDINGS	LS*	----	----	18242737*	5880650	---- *	----	12362087*	-912124	-294031	-618093
6.100000	TURBINE BUILDING	LS*	----	----	2123684*	870000	---- *	----	1253684*	-106183	-43500	-62683
6.110000	ARCHITECT FEATURE	LS*	----	----	971438*	300000	---- *	----	671438*	-48571	-15000	-33571

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6.170000	HVAC	LS*	----	----	857540*	450000	---- *	----	407540*	-42877	-22500	-20377
6.180000	PLUMB & DRAINAGE	LS*	----	----	229360*	100000	---- *	----	129360*	-11468	-5000	-6468
6.190000	MISCELLANEOUS	LS*	----	----	65346*	20000	---- *	----	45346*	-3267	-1000	-2267
6.200000	STEAM GEN BUILDING	LS*	----	----	2561596*	950000	---- *	----	1611596*	-128079	-47500	-80579
6.210000	ARCHTITECT FEATRS	LS*	----	----	1265080*	380000	---- *	----	885080*	-63254	-19000	-44254
6.270000	HVAC	LS*	----	----	1131400*	500000	---- *	----	631400*	-56570	-25000	-31570
6.280000	PLUMB & DRAINAGE	LS*	----	----	71160*	30000	---- *	----	41160*	-3558	-1500	-2058
6.290000	MISCELLANEOUS	LS*	----	----	93956*	40000	---- *	----	53956*	-4697	-2000	-2697
6.300000	SILO BAY	LS*	----	----	778890*	281500	---- *	----	497390*	-38943	-14075	-24868
6.310000	ARCHITECT FEATRS	LS*	----	----	263118*	80000	---- *	----	183118*	-13155	-4000	-9155
6.370000	HVAC	LS*	----	----	349600*	120000	---- *	----	229600*	-17480	-6000	-11480
6.380000	PLUMB & DRAINAGE	LS*	----	----	151440*	75000	---- *	----	76440*	-7572	-3750	-3822
6.390000	MISCELLANEOUS	LS*	----	----	14732*	6500	---- *	----	8232*	-736	-325	-411
6.400000	AQCS BUILDINGS	LS*	----	----	3551873*	886700	---- *	----	2665173*	-177590	-44334	-133256
6.410000	AQCS SWGR BLDG	SF*	1350	137.3	185409*	47250	35.00*	102.3	138159*	-9269	-2362	-6907
6.420000	AQCS CTRL BLDG	SF*	3600	173.4	624251*	169200	47.00*	126.4	455051*	-31212	-8460	-22752
6.430000	DIESEL GEN BLDG	SF*	850	148.2	125949*	29750	35.00*	113.2	96199*	-6296	-1487	-4809
6.440000	PUMP HOUSE	SF*	14000	149.2	2088464*	504000	36.00*	113.2	1584464*	-104423	-25200	-79223
6.450000	LIMESTN PREP BLDG	SF*	6500	81.2	527800*	136500	21.00*	60.2	391300*	-26390	-6825	-19565
6.900000	MISC BUILDINGS	LS*	----	----	9226694*	2892450	---- *	----	6334244*	-461329	-144622	-316707
6.930000	ADMIN BUILDING	SF*	4000	268.6	1074600*	292000	73.00*	195.6	782600*	-53730	-14600	-39130
6.940000	CONTROL BUILDING	LS*	----	----	1246580*	470000	---- *	----	776580*	-62329	-23500	-38829
6.950000	WTR TRTMT BLDG	SF*	3250	224.5	729755*	201500	62.00*	162.5	528255*	-36487	-10075	-26412

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6.990000	ALL OTHER	LS*	----	----	6175759*	1928950	---- *	----	4246809*	-308783	-96447	-212336
6.991000	PLANT MAINT	SF*	3000	169.3	508020*	201000	67.00*	102.3	307020*	-25401	-10050	-15351
6.992000	AUX BOILER	SF*	1000	240.6	240580*	66000	66.00*	174.6	174580*	-12029	-3300	-8729
6.993000	YD EQP MAINT BLD	SF*	1200	151.3	181596*	62400	52.00*	99.3	119196*	-9079	-3120	-5959
6.994000	CHLORINE BLDG	SF*	1000	151.4	151370*	40000	40.00*	111.4	111370*	-7568	-2000	-5568
6.995000	FIRE/SRV PUMP HS	SF*	800	160.4	128304*	36800	46.00*	114.4	91504*	-6415	-1840	-4575
6.996000	GUARD HOUSE	SF*	225	250.6	56385*	15750	70.00*	180.6	40635*	-2818	-787	-2031
6.997000	WAREHOUSE NO. 1	SF*	23000	63.1	1451760*	621000	27.00*	36.1	830760*	-72588	-31050	-41538
6.998000	BULK GAS STR BLD	SF*	1200	149.4	179244*	45600	38.00*	111.4	133644*	-8962	-2280	-6682
6.999000	OTHER BUILDINGS	LS*	----	----	3278500*	840400	---- *	----	2438100*	-163923	-42020	-121903
6.999100	SWTH YD CTRL BL	SF*	800	146.4	117088*	30400	38.00*	108.4	86688*	-5854	-1520	-4334
6.999200	CONTROL & SWGR	SF*	2000	143.3	286680*	82000	41.00*	102.3	204680*	-14334	-4100	-10234
6.999300	SWER TRTMT BLDG	SF*	3000	147.4	442110*	108000	36.00*	111.4	334110*	-22105	-5400	-16705
6.999400	DEWTR & FIXTN	SF*	8000	135.3	1082720*	264000	33.00*	102.3	818720*	-54136	-13200	-40936
6.999500	SWTCH YD CTRL	SF*	700	148.4	103852*	28000	40.00*	108.4	75852*	-5192	-1400	-3792
6.999600	CRSHING & SAMPL	SF*	2000	149.4	298740*	76000	38.00*	111.4	222740*	-14937	-3800	-11137
6.999700	WASTEWTR TRTMT	SF*	7000	135.3	947310*	252000	36.00*	99.3	695310*	-47365	-12600	-34765
7.000000	TURBINE GENERATOR	LS*	----	----	19064900*	16400000	---- *	----	2664900*	-953245	-820000	-133245
7.100000	TURBINE GENERATOR	LS*	----	----	19064900*	16400000	---- *	----	2664900*	-953245	-820000	-133245
8.000000	STM GENER & ACCESS	LS*	----	----	42900000*	24000000	---- *	----	18900000*	-2145000	-1200000	-945000
8.100000	STEAM GENERATOR	LS*	----	----	42900000*	24000000	---- *	----	18900000*	-2145000	-1200000	-945000
9.000000	AQCS	LS*	----	----	53956000*	30148300	---- *	----	23807700*	-2697800	-1507415	-1190385
9.100000	BAGHOUSE	LS*	----	----	8006800*	4000000	---- *	----	4006800*	-400340	-200000	-200340

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ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
9.200000	FLUE GAS DESULFUR	LS*	----	----	37475700*	20157000	---- *	----	17318700*	-1873785	-1007850	-865935
9.210000	COMPONENTS	LS*	----	----	37475700*	20157000	---- *	----	17318700*	-1873785	-1007850	-865935
9.211000	DUCTWORK FOR FGD	LS*	----	----	3418000*	1528000	---- *	----	1890000*	-170900	-76400	-94500
9.213000	SO2 ABSORB MODULE	LS*	----	----	27694500*	15000000	---- *	----	12694500*	-1384725	-750000	-634725
9.215000	LMST ULD,STR&RECL	LS*	----	----	3076000*	1438000	---- *	----	1638000*	-153800	-71900	-81900
9.216000	LIMESTN PREGENER	LS*	----	----	3287200*	2191000	---- *	----	1096200*	-164360	-109550	-54810
9.300000	WASTE DISPOSAL	LS*	----	----	6229000*	4276000	---- *	----	1953000*	-311450	-213800	-97650
9.310000	WASTE DISPOS SYS	LS*	----	----	6229000*	4276000	---- *	----	1953000*	-311450	-213800	-97650
9.311000	WASTE PROCESS EQ	LS*	----	----	6229000*	4276000	---- *	----	1953000*	-311450	-213800	-97650
9.400000	FANS	LS*	----	----	2244500*	1715300	---- *	----	529200*	-112225	-85765	-26460
9.410000	I.D. FANS	LS*	----	----	1398900*	1065000	---- *	----	333900*	-69945	-53250	-16695
9.420000	SILENCERS	LS*	----	----	845600*	650300	---- *	----	195300*	-42280	-32515	-9765
10.000000	OTHER MECHAN EQUIP	LS*	----	----	19909906*	14724200	---- *	----	5185706*	-995480	-736210	-259270
10.100000	PUMPS	LS*	----	----	3486968*	2987000	---- *	----	499968*	-174342	-149350	-24992
10.110000	BOILER PUMPS	LS*	----	----	3038370*	2648400	---- *	----	389970*	-151918	-132420	-19498
10.111000	BOILER FEED PUMPS	EA*	2	400420.0	800840*	644600	---- *	78120.0	156240*	-40042	-32230	-7812
10.112000	BF PUMP TURBINES	EA*	2	865000.0	1730000*	1604000	---- *	63000.0	126000*	-86500	-80200	-6300
10.113000	BF BOOSTER PUMPS	EA*	2	121750.0	243500*	186800	93400.00*	28350.0	56700*	-12175	-9340	-2835
10.114000	BF STRT UP/STD BY	LS*	----	----	264030*	213000	---- *	----	51030*	-13201	-10650	-2551
10.120000	FEEDWTR SYS PUMPS	LS*	----	----	9753*	7800	---- *	----	1953*	-487	-390	-97
10.121000	CONDEN TRANSFER	LS*	----	----	9753*	7800	---- *	----	1953*	-487	-390	-97
10.130000	SRV & COOL WTR PMP	LS*	----	----	68064*	41100	---- *	----	26964*	-3402	-2055	-1347
10.131000	SERVICE WATER	EA*	4	6861.0	27444*	15600	3900.00*	2961.0	11844*	-1372	-780	-592

APA
SUSITNA 200 MW COAL
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10.132000	AIR HTR WASH PMPS	LS*	----	----	19112*	11300	---- *	----	7812*	-955	-565	-390
10.133000	CLSD CYC COOL WSP	EA*	2	10754.0	21508*	14200	7100.00*	3654.0	7308*	-1075	-710	-365
10.140000	OIL PUMPS	LS*	----	----	59171*	45500	---- *	----	13671*	-2956	-2275	-681
10.141000	LGT OIL UNLD PMPS	EA*	2	7253.0	14506*	10600	5300.00*	1953.0	3906*	-725	-530	-195
10.142000	IGNITER OIL PUMPS	EA*	3	10253.0	30759*	24900	8300.00*	1953.0	5859*	-1537	-1245	-292
10.143000	TURB LO TRANS PMP	LS*	----	----	6953*	5000	---- *	----	1953*	-347	-250	-97
10.145000	LO COND PUMP	LS*	----	----	6953*	5000	---- *	----	1953*	-347	-250	-97
10.150000	SUMP PUMPS	EA*	6	20660.0	123960*	116400	19400.00*	1260.0	7560*	-6198	-5820	-378
10.160000	OTHER PUMPS	LS*	----	----	187650*	127800	---- *	----	59850*	-9381	-6390	-2991
10.161000	COOLING TOWER MU	LS*	----	----	35332*	18700	---- *	----	16632*	-1766	-935	-831
10.162000	OP CYC CLG WTR	EA*	2	24420.0	48840*	31200	15600.00*	8820.0	17640*	-2442	-1560	-882
10.163000	FIRE PROTECT PMPS	EA*	3	24252.0	72756*	53100	17700.00*	6552.0	19656*	-3637	-2655	-982
10.164000	AIR PREHTR GLY	EA*	2	15361.0	30722*	24800	12400.00*	2961.0	5922*	-1536	-1240	-296
10.200000	CONDENSING PLANT	LS*	----	----	2478399*	1780800	---- *	----	697599*	-123918	-89040	-34878
10.210000	CONDENSER & AUXIL	LS*	----	----	1585900*	1000000	---- *	----	585900*	-79295	-50000	-29295
10.220000	EQUIPMENT	LS*	----	----	892499*	780800	---- *	----	111699*	-44623	-39040	-5583
10.221000	CW PUMPS	EA*	2	148832.0	297664*	264400	---- *	16632.0	33264*	-14883	-13220	-1663
10.222000	CONDENSATE PUMPS	EA*	2	89624.0	179248*	148000	74000.00*	15624.0	31248*	-8962	-7400	-1562
10.223000	VACUUM PUMPS	EA*	2	84667.0	169334*	155600	77800.00*	6867.0	13734*	-8466	-7780	-686
10.226000	COND CLEAN SYS	LS*	----	----	243500*	212000	---- *	----	31500*	-12175	-10600	-1575
10.227000	COND COLL PUMP	LS*	----	----	2753*	800	---- *	----	1953*	-137	-40	-97
10.300000	HEAT EXCHANGERS	LS*	----	----	1993318*	1811500	---- *	----	181818*	-99665	-90575	-9090
10.310000	FEEDWATER HEATERS	EA*	7	180838.0	1265866*	1166200	---- *	14238.0	99666*	-63293	-58310	-4983

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10.132000	AIR HTR WASH PMPS	LS*	----	----	19112*	11300	---- *	----	7812*	-955	-565	-390
10.133000	CLSD CYC COOL WSP	EA*	2	10754.0	21508*	14200	7100.00*	3654.0	7308*	-1075	-710	-365
10.140000	OIL PUMPS	LS*	----	----	59171*	45500	---- *	----	13671*	-2956	-2275	-681
10.141000	LGT OIL UNLD PMPS	EA*	2	7253.0	14506*	10600	5300.00*	1953.0	3906*	-725	-530	-195
10.142000	IGNITER OIL PUMPS	EA*	3	10253.0	30759*	24900	8300.00*	1953.0	5859*	-1537	-1245	-292
10.143000	TURB LO TRANS PMP	LS*	----	----	6953*	5000	---- *	----	1953*	-347	-250	-97
10.145000	LO COND PUMP	LS*	----	----	6953*	5000	---- *	----	1953*	-347	-250	-97
10.150000	SUMP PUMPS	EA*	6	20660.0	123960*	116400	19400.00*	1260.0	7560*	-6198	-5820	-378
10.160000	OTHER PUMPS	LS*	----	----	187650*	127800	---- *	----	59850*	-9381	-6390	-2991
10.161000	COOLING TOWER MU	LS*	----	----	35332*	18700	---- *	----	16632*	-1766	-935	-831
10.162000	OP CYC CLG WTR	EA*	2	24420.0	48840*	31200	15600.00*	8820.0	17640*	-2442	-1560	-882
10.163000	FIRE PROTECT PMPS	EA*	3	24252.0	72756*	53100	17700.00*	6552.0	19656*	-3637	-2655	-982
10.164000	AIR PREHTR GLY	EA*	2	15361.0	30722*	24800	12400.00*	2961.0	5922*	-1536	-1240	-296
10.200000	CONDENSING PLANT	LS*	----	----	2478399*	1780800	---- *	----	697599*	-123918	-89040	-34878
10.210000	CONDENSER & AUXIL	LS*	----	----	1585900*	1000000	---- *	----	585900*	-79295	-50000	-29295
10.220000	EQUIPMENT	LS*	----	----	892499*	780800	---- *	----	111699*	-44623	-39040	-5583
10.221000	CW PUMPS	EA*	2	148832.0	297664*	264400	---- *	16632.0	33264*	-14883	-13220	-1663
10.222000	CONDENSATE PUMPS	EA*	2	89624.0	179248*	148000	74000.00*	15624.0	31248*	-8962	-7400	-1562
10.223000	VACUUM PUMPS	EA*	2	84667.0	169334*	155600	77800.00*	6867.0	13734*	-8466	-7780	-686
10.226000	COND CLEAN SYS	LS*	----	----	243500*	212000	---- *	----	31500*	-12175	-10600	-1575
10.227000	COND COLL PUMP	LS*	----	----	2753*	800	---- *	----	1953*	-137	-40	-97
10.300000	HEAT EXCHANGERS	LS*	----	----	1993318*	1811500	---- *	----	181818*	-99665	-90575	-9090
10.310000	FEEDWATER HEATERS	EA*	7	180838.0	1265866*	1166200	---- *	14238.0	99666*	-63293	-58310	-4983

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10.320000	DEAER/ VENT CONDEN	LS*	----	----	240740*	197900	---- *	----	42840*	-12037	-9895	-2142
10.330000	CLSD CYC COOL WHE	EA*	2	171250.0	342500*	311000	---- *	15750.0	3[illegible]00*	-17125	-15550	-1575
10.340000	AIR PRHTR GLY HE	EA*	2	72106.0	144212*	136400	68200.00*	3906.0	7812*	-7210	-6820	-390
10.400000	TANKS	LS*	----	----	721815*	277300	---- *	----	444515*	-36086	-13865	-22221
10.410000	WATER TANKS	LS*	----	----	448315*	145600	---- *	----	302715*	-22415	-7280	-15135
10.412000	CONDEN STRG TANK	LS*	----	----	200175*	53700	---- *	----	146475*	-10008	-2685	-7323
10.414000	FIRE&SRV WTR STRG	LS*	----	----	248140*	91900	---- *	----	156240*	-12407	-4595	-7812
10.430000	LGT OIL STRG TANK	LS*	----	----	126232*	40300	---- *	----	85932*	-6311	-2015	-4296
10.440000	OTHER FL OIL STRG	EA*	3	14352.0	43056*	23400	7800.00*	6552.0	19656*	-2152	-1170	-982
10.450000	OTHER OIL TANKS	LS*	----	----	104212*	68000	---- *	----	36212*	-5208	-3400	-1808
10.452000	BATCH OIL TANK	LS*	----	----	35600*	19800	---- *	----	15800*	-1780	-990	-790
10.453000	CONT BLWDWN FL TK	LS*	----	----	6550*	3400	---- *	----	3150*	-327	-170	-157
10.454000	INT BLWDWN FLH TK	LS*	----	----	23559*	17700	---- *	----	5859*	-1177	-885	-292
10.455000	COND COLL TANK	LS*	----	----	9753*	7800	---- *	----	1953*	-487	-390	-97
10.456000	CLSD CYC CL WHT	LS*	----	----	9950*	6800	---- *	----	3150*	-497	-340	-157
10.457000	AIR PREHT CL EX	LS*	----	----	18800*	12500	---- *	----	6300*	-940	-625	-315
10.500000	MISCELLANEOUS EQUIP	LS*	----	----	3308706*	2662200	---- *	----	646506*	-165434	-133110	-32324
10.510000	CONPRESSED AIR EQP	LS*	----	----	274026*	192000	---- *	----	82026*	-13701	-9600	-4101
10.512000	STAT AIR COMPRESS	EA*	2	115060.0	230120*	152000	76000.00*	39060.0	78120*	-11506	-7600	-3906
10.513000	AIR DRYERS	LS*	----	----	43906*	40000	---- *	----	3906*	-2195	-2000	-195
10.520000	WTR TREAT EQUIP	LS*	----	----	3034680*	2470200	---- *	----	564480*	-151733	-123510	-28223
10.521000	MKUP WTR TRTMT	LS*	----	----	1120660*	886300	---- *	----	234360*	-56033	-44315	-11718
10.522000	COND POL DEMINER	LS*	----	----	1089560*	855200	---- *	----	234360*	-54478	-42760	-11718

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10.523000	CHLORINAT EQUIP	LS*	----	----	319060*	280000	---- *	----	39060*	-15953	-14000	-1953
10.524000	BOILER CHEM FEED	LS*	----	----	70670*	58700	---- *	----	11970*	-3533	-2935	-598
10.525000	SAMPLING SYSTEM	LS*	----	----	195640*	178000	---- *	----	17640*	-9782	-8900	-882
10.526000	BLK GAS STR&DISTR	LS*	----	----	239090*	212000	---- *	----	27090*	-11954	-10600	-1354
10.600000	AUXILIARY BOILER	LS*	----	----	732900*	575400	---- *	----	157500*	-36645	-28770	-7875
10.700000	CECI	LS*	----	----	2982000*	2100000	---- *	----	882000*	-149100	-105000	-44100
10.800000	EQUIP UNLOAD FACIL	LS*	----	----	1356000*	1230000	---- *	----	126000*	-67800	-61500	-6300
10.900000	TURBINE BYPASS	LS*	----	----	2849800*	1300000	---- *	----	1549800*	-142490	-65000	-77490
11.000000	COAL&ASH HNDL EQUIP	LS*	----	----	22802750*	13343300	---- *	----	9459450*	-1140136	-667165	-472971
11.100000	COAL HANDLING	LS*	----	----	18070090*	10627900	---- *	----	7442190*	-903504	-531395	-372109
11.110000	THAWING FACILITY	LS*	----	----	2356800*	2041800	---- *	----	315000*	-117840	-102090	-15750
11.120000	UNLOADING FACILITY	LS*	----	----	912500*	440000	---- *	----	472500*	-45625	-22000	-23625
11.122000	CONVEYOR NO 1	LS*	----	----	912500*	440000	---- *	----	472500*	-45625	-22000	-23625
11.130000	STACKOUT SYSTEM	LS*	----	----	2532600*	1260000	---- *	----	1272600*	-126630	-63000	-63630
11.131000	CONVEYOR NO 2	LS*	----	----	2532600*	1260000	---- *	----	1272600*	-126630	-63000	-63630
11.140000	RECLAIM SYSTEM	LS*	----	----	6777500*	3829100	---- *	----	2948400*	-338875	-191455	-147420
11.141000	STACKER RECLAIMER	LS*	----	----	4291000*	2590000	---- *	----	1701000*	-214550	-129500	-85050
11.142000	CONVEYOR NO 5	LS*	----	----	817400*	401600	---- *	----	415800*	-40870	-20080	-20790
11.143000	EMER RECLM HOPPER	LS*	----	----	27300*	14700	---- *	----	12600*	-1365	-735	-630
11.144000	CONVEYOR NO 6	LS*	----	----	645000*	304800	---- *	----	340200*	-32250	-15240	-17010
11.145000	CONVEYOR NO 7A&7B	EA*	2	498400.0	996800*	518000	---- *	239400.0	478800*	-49840	-25900	-23940
11.160000	CRUSH & TRANSF SYS	LS*	----	----	3323300*	1616000	---- *	----	1707300*	-166165	-80800	-85365
11.161000	CONVEYOR NO 8A&8B	EA*	2	828400.0	1656800*	800000	---- *	428400.0	856800*	-82840	-40000	-42840

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11.162000	SURGE BIN	LS*	----	----	260000*	102500	---- *	----	157500*	-13000	-5125	-7875
11.163000	SAMPLING SYSTEM	LS*	----	----	595000*	280000	---- *	----	315000*	-29750	-14000	-15750
11.164000	COAL CRUSHERS	LS*	----	----	114100*	70000	---- *	----	44100*	-5705	-3500	-2205
11.165000	CONVEYOR NO 9A	LS*	----	----	697400*	363500	---- *	----	333900*	-34870	-18175	-16695
11.170000	MISC SYSTEMS	LS*	----	----	2167390*	1441000	---- *	----	726390*	-108369	-72050	-36319
11.172000	FIRE PROTECTION	LS*	----	----	881600*	491000	---- *	----	390600*	-44080	-24550	-19530
11.173000	TUNNEL VENT	LS*	----	----	27330*	7800	---- *	----	19530*	-1366	-390	-976
11.174000	INSTRUM & CONTROL	LS*	----	----	682260*	643200	---- *	----	39060*	-34113	-32160	-1953
11.176000	MISC EQUIPMENT	LS*	----	----	576200*	299000	---- *	----	277200*	-28810	-14950	-13860
11.200000	BTM ASH HNDL SYSTEM	LS*	----	----	3021560*	1615400	---- *	----	1406160*	-151077	-80770	-70307
11.210000	FURN BTM ASH SYS	LS*	----	----	1150800*	672000	---- *	----	478800*	-57540	-33600	-23940
11.220000	PYRITE HNDL SYSTEM	LS*	----	----	114630*	63600	---- *	----	51030*	-5731	-3180	-2551
11.230000	ECONOMIZER ASH SYS	LS*	----	----	316300*	184000	---- *	----	132300*	-15815	-9200	-6615
11.240000	DEWTW BIN&SET TKS	LS*	----	----	1129600*	487000	---- *	----	642600*	-56480	-24350	-32130
11.250000	MAJOR PUMPS	EA*	3	64390.0	193170*	130800	43600.00*	20790.0	62370*	-9658	-6540	-3118
11.260000	BTM ASH INSTRUM	LS*	----	----	117060*	78000	---- *	----	39060*	-5853	-3900	-1953
11.400000	FLY ASH INST & CTL	LS*	----	----	1711100*	1100000	---- *	----	611100*	-85555	-55000	-30555
12.000000	PIPING	LS*	----	----	28004420*	9876800	---- *	----	18127620*	-1400221	-493840	-906381
12.100000	LARGE BORE PIPING	TN*	920	19711.0	18134120*	8454800	9190.00*	10521.0	9679320*	-906706	-422740	-483966
12.200000	SMALL BORE PIPING	LF*	90000	109.7	9870300*	1422000	15.80*	93.9	8448300*	-493515	-71100	-422415
13.000000	INSULATION	LS*	----	----	6880000*	580000	---- *	----	6300000*	-344000	-29000	-315000
13.100000	INSULATION	LS*	----	----	6880000*	580000	---- *	----	6300000*	-344000	-29000	-315000
14.000000	INSTRUMENTATION	LS*	----	----	7067000*	6500000	---- *	----	567000*	-353350	-325000	-28350

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14.100000	INSTRUMENTATION	LS*	----	----	7067000*	6500000	---- *	----	567000*	-353350	-325000	-28350
15.000000	ELECTRICAL EQUIPMENT	LS*	----	----	57570000*	21000000	---- *	----	36570000*	-2878500	-1050000	-1828500
16.000000	PAINTING	LS*	----	----	2224340*	155000	---- *	----	2069340*	-111217	-7750	-103467
16.100000	TURBINE BUILDING	LS*	----	----	650600*	50000	---- *	----	600600*	-32530	-2500	-30030
16.200000	STEAM GEN BLDG	LS*	----	----	1167000*	75000	---- *	----	1092000*	-58350	-3750	-54600
16.300000	SILO BAY	LS*	----	----	118200*	9000	---- *	----	109200*	-5910	-450	-5460
16.900000	MISCELLANEOUS	LS*	----	----	288540*	21000	---- *	----	267540*	-14427	-1050	-13377
17.000000	OFF-SITE FACILITIES	LS*	----	----	13460700*	6030000	---- *	----	7430700*	-673035	-301500	-371535
17.100000	RANNEY WELL SYSTEM	LS*	----	----	3083700*	570000	---- *	----	2513700*	-154185	-28500	-125685
17.200000	ACCESS ROADS	MI*	20	518850.0	10377000*	5460000	---- *	245850.0	4917000*	-518850	-273000	-245850
18.000000	WATERFRONT FACILITY	LS*	----	----	7837739*	1888700	---- *	----	5949039*	-391884	-94435	-297449
18.100000	BARGE UNLOADNG FAC	LS*	----	----	577920*	0	---- *	----	577920*	-28896	0	-28896
18.110000	DREDGING	CY*	32000	18.1	577920*	0	0.00*	18.1	577920*	-28896	0	-28896
18.200000	MOOR/DOCK FACILITY	LS*	----	----	7259819*	1888700	---- *	----	5371119*	-362988	-94435	-268553
18.210000	EXCAVATION	CY*	45000	8.3	372487*	0	0.00*	8.3	372487*	-18624	0	-18624
18.220000	FILL	CY*	27500	9.7	266062*	0	0.00*	9.7	266062*	-13303	0	-13303
18.230000	H PILES	LF*	1800	58.6	105435*	70200	39.00*	19.6	35235*	-5271	-3510	-1761
18.240000	SHEET PILING	TN*	2100	2518.8	5289375*	1470000	700.00*	1818.8	3819375*	-264468	-73500	-190968
18.250000	STRUCTURAL STEEL	TN*	85	2458.0	208930*	93500	1100.00*	1358.0	115430*	-10446	-4675	-5771
18.260000	CONCRETE	CY*	1200	471.9	566280*	180000	150.00*	321.9	386280*	-28314	-9000	-19314
18.270000	MISCELLANOUS	LS*	----	----	451250*	75000	---- *	----	376250*	-22562	-3750	-18812
19.000000	SUBSTATION/T-LINE	LS*	----	----	23198950*	13080000	---- *	----	10118950*	-1159947	-654000	-505947
19.100000	SUBSTATION	LS*	----	----	3714550*	3000000	---- *	----	714550*	-185727	-150000	-35727

APA
SUSITNA 200 MW COAL
ESTIMATE NO. APA 1707 M-1

BY: JDF CHECKED: JDF

DATE: 21-JUN-84 TIME: 16:40:54

DETAILED
MATERIAL & INSTALLATION REPORT

ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
19.200000	230KV T-LINE:1 CIR	MI*	48	405925.0	19484400*	10080000	---- *	195925.0	9404400*	-974220	-504000	-470220
71.000000	INDIRECT CONST COST	LS*	----	----	40949079*	0	---- *	----	40949079*	-2047453	0	-2047453
71.100000	FIELD LOCAL HIRES	LS*	----	----	4472325*	0	---- *	----	4472325*	-223616	0	-223616
71.200000	CRAFT P/R FRINGES	LS*	----	----	3000000*	0	---- *	----	3000000*	-150000	0	-150000
71.210000	PREM PAY-CASUAL	LS*	----	----	2000000*	0	---- *	----	2000000*	-100000	0	-100000
71.220000	PREM PAY-SCHED	LS*	----	----	1000000*	0	---- *	----	1000000*	-50000	0	-50000
71.300000	CONSTR EQUIPT	LS*	----	----	180000*	0	---- *	----	180000*	-9000	0	-9000
71.310000	AUTOMOTIVE(C/M)	LS*	----	----	180000*	0	---- *	----	180000*	-9000	0	-9000
71.400000	CONSTRUCTION PLANT	LS*	----	----	26871384*	0	---- *	----	26871384*	-1343569	0	-1343569
71.410000	CONSTRUCTN BLDGS	LS*	----	----	1626000*	0	---- *	----	1626000*	-81300	0	-81300
71.420000	TEMP FACILITIES	LS*	----	----	25245384*	0	---- *	----	25245384*	-1262269	0	-1262269
71.421000	LABOR CAMP	LS*	----	----	10000000*	0	---- *	----	10000000*	-500000	0	-500000
71.422000	FOOD SERVICE	LS*	----	----	11000000*	0	---- *	----	11000000*	-550000	0	-550000
71.423000	TEMPORARY POWER	LS*	----	----	2205002*	0	---- *	----	2205002*	-110250	0	-110250
71.423100	69KV T-LINE	MI*	10	220500.2	2205002*	0	0.00*	220500.2	2205002*	-110250	0	-110250
71.424000	OTHER TEMP FACIL	LS*	----	----	2040382*	0	---- *	----	2040382*	-102019	0	-102019
71.600000	OFFICE/LABOR EXP	LS*	----	----	2069870*	0	---- *	----	2069870*	-103493	0	-103493
71.610000	OFFICE EXPENSE	LS*	----	----	155000*	0	---- *	----	155000*	-7750	0	-7750
71.620000	LABOR EXPENSE	LS*	----	----	691070*	0	---- *	----	691070*	-34553	0	-34553
71.630000	TESTING	LS*	----	----	761800*	0	---- *	----	761800*	-38090	0	-38090
71.640000	SECURITY GUARDS	LS*	----	----	462000*	0	---- *	----	462000*	-23100	0	-23100
71.700000	OFF-SITE UNLDG/HLG	LS*	----	----	4088800*	0	---- *	----	4088800*	-204440	0	-204440
71.800000	CONSTRUCTN CLEANUP	LS*	----	----	266700*	0	---- *	----	266700*	-13335	0	-13335

APA
SUSITNA 200 MW COAL
ESTIMATE NO. APA 1707 M-1

BY: JDF CHECKED: JDF

DATE: 21-JUN-84 TIME: 16:40:54

DETAILED
MATERIAL & INSTALLATION REPORT

ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
72.000000	PROFESSIONA SERVCS	LS*	----	----	54650000*	0	---- *	----	54650000*	-2732500	0	-2732500

$

"UNIT 2"

APA
SUSITNA 200MW UNIT2
ESTIMATE NO. APA 1707 M-1

BY: WMP CHECKED: JDF

DATE: 23-OCT-84 TIME: 18:04:19

SUMMARY
MATERIAL & INSTALLATION REPORT

ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
99.000000	TOTAL PROJECT COST	LS*	----	----	372993683*	160570971	---- *	----	212422712*	0	0	0
100.000000	CONTINGENCY	LS*	----	----	44911344*	17204032	---- *	----	27707312*	0	0	0
300.000000	TOTAL COST W/O CONT	LS*	----	----	328082339*	143366939	---- *	----	184715400*	0	0	0
1.000000	IMPROVEMNTS TO SITE	LS*	----	----	321140*	168000	---- *	----	153140*	0	0	0
2.000000	EARTHWORK & PILING	LS*	----	----	13641083*	7410000	---- *	----	6231083*	0	0	0
3.000000	CIRC WATER SYSTEM	LS*	----	----	7404345*	3698942	---- *	----	3705403*	0	0	0
4.000000	CONCRETE	LS*	----	----	13036040*	2529175	---- *	----	10506865*	0	0	0
5.000000	STRCT STL/LFT EQP	LS*	----	----	18866183*	8220120	---- *	----	10646063*	0	0	0
6.000000	BUILDINGS	LS*	----	----	9030239*	3157732	---- *	----	5872507*	0	0	0
7.000000	TURBINE GENERATOR	LS*	----	----	18264278*	15619048	---- *	----	2645230*	0	0	0
8.000000	STM GENER & ACCESS	LS*	----	----	42445644*	22857144	---- *	----	19588500*	0	0	0
9.000000	AQCS	LS*	----	----	39715660*	21184103	---- *	----	18531557*	0	0	0
10.000000	OTHER MECHAN EQUIP	LS*	----	----	13762103*	9957312	---- *	----	3804791*	0	0	0
11.000000	COAL&ASH HNDL EQUIP	LS*	----	----	5530266*	3399907	---- *	----	2130359*	0	0	0
12.000000	PIPING	LS*	----	----	25175560*	8926217	---- *	----	16249343*	0	0	0
13.000000	INSULATION	LS*	----	----	6774331*	552381	---- *	----	6221950*	0	0	0
14.000000	INSTRUMENTATION	LS*	----	----	6730093*	6190476	---- *	----	539617*	0	0	0
15.000000	ELECTRICAL EQUIPMENT	LS*	----	----	43916857*	17904762	---- *	----	26012095*	0	0	0
16.000000	PAINTING	LS*	----	----	2100475*	127620	---- *	----	1972855*	0	0	0
17.000000	OFF-SITE FACILITIES	LS*	----	----	3484604*	542857	---- *	----	2941747*	0	0	0
19.000000	SUBSTATION/T-LINE	LS*	----	----	17997823*	10921143	---- *	----	7076680*	0	0	0
71.000000	INDIRECT CONST COST	LS*	----	----	26285615*	0	---- *	----	26285615*	0	0	0
72.000000	PROFESSIONAL SERVCS	LS*	----	----	13600000*	0	---- *	----	13600000*	0	0	0

Attachment 3a.3

00250

APA
SUSITNA 200MW UNIT2
ESTIMATE NO. APA 1707 M-1

BY: WMP CHECKED: JDF

DATE: 23-OCT-84 TIME: 18:04:19

DETAILED
MATERIAL & INSTALLATION REPORT

ACCT NO.	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
99.000000	TOTAL PROJECT COST	LS*	----	----	372993683*	160570971	---- *	----	212422712*	0	0	0
100.000000	CONTINGENCY	LS*	----	----	44911344*	17204032	---- *	----	27707312*	0	0	0
300.000000	TOTAL COST W/O CONT	LS*	----	----	328082339*	143366939	---- *	----	184715400*	0	0	0
1.000000	IMPROVEMNTS TO SITE	LS*	----	----	321140*	168000	---- *	----	153140*	0	0	0
1.300000	SITE DRAINAGE	LS*	----	----	279580*	150000	---- *	----	129580*	0	0	0
1.500000	SEWAGE FACILITIES	LS*	----	----	41560*	18000	---- *	----	23560*	0	0	0
2.000000	EARTHWORK & PILING	LS*	----	----	13641083*	7410000	---- *	----	6231083*	0	0	0
2.200000	STRCTR & EQUIP EXC	LS*	----	----	1295429*	0	---- *	----	1295429*	0	0	0
2.210000	STATION AREA	LS*	----	----	486736*	0	---- *	----	486736*	0	0	0
2.212000	EARTH EXCAVATION	CY*	18700	26.0	486736*	0	0.00*	26.0	486736*	0	0	0
2.250000	AQCS FDNS	LS*	----	----	808693*	0	---- *	----	808693*	0	0	0
2.252000	EARTH EXCAVATION	CY*	17200	26.0	447694*	0	0.00*	26.0	447694*	0	0	0
2.253000	ROCK EXCAVATION	CY*	5400	66.9	360999*	0	0.00*	66.9	360999*	0	0	0
2.300000	TRENCHING	LS*	----	----	1518789*	0	---- *	----	1518789*	0	0	0
2.310000	CIRC WATER COND	LS*	----	----	314841*	0	---- *	----	314841*	0	0	0
2.312000	EARTH EXCAVATION	CY*	12600	25.0	314841*	0	0.00*	25.0	314841*	0	0	0
2.320000	YARD PIPING	LS*	----	----	817776*	0	---- *	----	817776*	0	0	0
2.322000	EARTH EXCAVATION	CY*	30000	27.3	817776*	0	0.00*	27.3	817776*	0	0	0
2.330000	SEWERS & DRAINS	LS*	----	----	386172*	0	---- *	----	386172*	0	0	0
2.332000	EARTH EXCAVATION	CY*	10000	38.6	386172*	0	0.00*	38.6	386172*	0	0	0
2.500000	PILES (H PILES)	LS*	----	----	10826865*	7410000	---- *	----	3416865*	0	0	0
2.510000	STATION AREA	LF*	140000	57.0	7977690*	5460000	39.00*	18.0	2517690*	0	0	0
2.520000	AQCS AREA	LF*	50000	57.0	2849175*	1950000	39.00*	18.0	899175*	0	0	0

APA
SUSITNA 200MW UNIT2

BY: WMP   CHECKED: JDF   ESTIMATE NO. APA 1707 M-1   DATE: 23-OCT-84   TIME: 18:04:19

DETAILED
MATERIAL & INSTALLATION REPORT

ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
3.000000	CIRC WATER SYSTEM	LS*	----	----	7404345*	3698942	---- *	----	3705403*	0	0	0
3.200000	INTK & DISC PIPING	LS*	----	----	1866809*	778552	---- *	----	1088257*	0	0	0
3.210000	CONCR PIPE: 60"	LF*	3000	337.4	1012113*	543000	181.00*	156.4	469113*	0	0	0
3.260000	BEDDING MATERIAL	CY*	1850	28.9	53508*	17612	9.52*	19.4	35896*	0	0	0
3.270000	CONCRET STRUCTURE	LS*	----	----	758840*	199250	---- *	----	559590*	0	0	0
3.271000	THRST & TRNS BLK	CY*	750	397.4	298047*	89250	119.00*	278.4	208797*	0	0	0
3.272000	CONDENS BLOCKS	CY*	400	833.4	333363*	78000	195.00*	638.4	255363*	0	0	0
3.273000	PITOT TUBE PIT	CY*	200	637.2	127430*	32000	160.00*	477.1	95430*	0	0	0
3.280000	MISCELLAN STEEL	TN*	7	6049.7	42348*	18690	2670.00*	3379.7	23658*	0	0	0
3.400000	COOL TOWER FACIL	LS*	----	----	5537536*	2920390	---- *	----	2617146*	0	0	0
3.410000	TOWER BASIN	LS*	----	----	707003*	187500	---- *	----	519503*	0	0	0
3.411000	EXCAVATION	CY*	6500	19.4	126260*	0	0.00*	19.4	126260*	0	0	0
3.412000	CONC CW COOL TWR	CY*	1500	387.2	580743*	187500	125.00*	262.2	393243*	0	0	0
3.420000	PUMP CHAMBER	LS*	----	----	776096*	210690	---- *	----	565406*	0	0	0
3.422000	EXCAVATION	CY*	4500	19.4	87412*	0	0.00*	19.4	87412*	0	0	0
3.423000	CONCRETE	CY*	1500	430.9	646336*	192000	128.00*	302.9	454336*	0	0	0
3.424000	MISC STEEL	TN*	7	6049.7	42348*	18690	2670.00*	3379.7	23658*	0	0	0
3.430000	INTAKE EQUIPMENT	LS*	----	----	369911*	316400	---- *	----	53511*	0	0	0
3.433000	SCREENS	SF*	500	51.5	25765*	14500	29.00*	22.5	11265*	0	0	0
3.435000	STOP LOGS	SF*	500	68.3	34131*	28500	57.00*	11.3	5631*	0	0	0
3.436000	CRANE BRIDGE 15T	EA*	1	0.0	310015*	273400	---- *	0.0	36615*	0	0	0
3.440000	PMP HS SPR STRUCT	LS*	----	----	683443*	320100	---- *	----	363343*	0	0	0
3.441000	CRANE & HST SUPP	TN*	75	2763.3	207247*	114300	1524.00*	1239.3	92947*	0	0	0

APA
SUSITNA 200MW UNIT2
ESTIMATE NO. APA 1707 M-1

BY: WNP CHECKED: JDF DATE: 23-OCT-84 TIME: 18:04:19

DETAILED
MATERIAL & INSTALLATION REPORT

ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
3.442000	BUILDING SPRSTR	SF*	6000	79.4	476196*	205800	34.30*	45.1	270396*	0	0	0
3.450000	TOWER SPR STRUCT	LS*	----	----	3001083*	1885700	---- *	----	1115383*	0	0	0
4.000000	CONCRETE	LS*	----	----	13036040*	2529175	---- *	----	10506865*	0	0	0
4.100000	TURBINE BLDG CONCR	CY*	4500	766.2	3447777*	608625	135.25*	630.9	2839152*	0	0	0
4.200000	BOILER AREA CONCRT	CY*	1900	676.1	1284519*	256975	135.25*	540.8	1027544*	0	0	0
4.300000	SILO AREA CONCRETE	CY*	1700	706.2	1200535*	229925	135.25*	570.9	970610*	0	0	0
4.400000	AQCS CONCRETE	CY*	8800	705.3	6206308*	1190200	135.25*	570.0	5016108*	0	0	0
4.900000	MISCELL CONCRETE	CY*	1800	498.3	896901*	243450	135.25*	363.0	653451*	0	0	0
5.000000	STRCT STL/LFT EQP	LS*	----	----	18866183*	8220120	---- *	----	10646063*	0	0	0
5.100000	TURBINE BUILDING	LS*	----	----	3936778*	1951495	---- *	----	1985283*	0	0	0
5.110000	MAIN STEEL	TN*	1200	2285.5	2742552*	1429200	1191.00*	1094.5	1313352*	0	0	0
5.120000	FRAMING	LS*	----	----	349072*	180075	---- *	----	168997*	0	0	0
5.121000	WALL FRAMING	TN*	105	3324.5	349072*	180075	1715.00*	1609.5	168997*	0	0	0
5.130000	MISC STEEL	LS*	----	----	523096*	123170	---- *	----	399926*	0	0	0
5.131000	GRATING 1-3/4"	SF*	12000	26.0	312168*	80400	6.70*	19.3	231768*	0	0	0
5.132000	CHECKERED PLATE	SF*	600	53.6	32179*	6300	10.50*	43.1	25879*	0	0	0
5.133000	HANDRAIL	LF*	1000	95.2	95225*	14750	14.75*	80.5	80475*	0	0	0
5.134000	LADDERS & STRWYS	TN*	12	6960.3	83524*	21720	1810.00*	5150.3	61804*	0	0	0
5.140000	LIFTING EQUIP	LS*	----	----	322058*	219050	---- *	----	103008*	0	0	0
5.141000	CRANE: 40 T CAP	LS*	----	----	322058*	219050	---- *	----	103008*	0	0	0
5.200000	STEAM GENERATOR	LS*	----	----	11270284*	4380275	---- *	----	6890009*	0	0	0
5.210000	MAIN STEEL	TN*	2300	2285.5	5256558*	2739300	1191.00*	1094.5	2517258*	0	0	0
5.220000	FRAMING	LS*	----	----	1799828*	634550	---- *	----	1165278*	0	0	0

APA
SUSITNA 200MW UNIT2
ESTIMATE NO. APA 1707 M-1

BY: WMP CHECKED: JDF DATE: 23-OCT-84 TIME: 18:04:19

DETAILED
MATERIAL & INSTALLATION REPORT

ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
5.221000	WALL FRAMING	TN*	330	4934.0	1628220*	565950	1715.00*	3219.0	1062270*	0	0	0
5.222000	ELEV FRAMING	TN*	40	4290.2	171608*	68600	1715.00*	2575.2	103008*	0	0	0
5.230000	MISC STEEL	LS*	----	----	3972526*	887375	---- *	----	3085151*	0	0	0
5.231000	GRATING (1-3/4")	SF*	70000	26.0	1820980*	469000	6.70*	19.3	1351980*	0	0	0
5.232000	CHECKERED PLATE	SF*	1600	53.6	85814*	16800	10.50*	43.1	69014*	0	0	0
5.233000	HANDRAIL	LF*	12500	98.4	1230484*	184375	14.75*	83.7	1046109*	0	0	0
5.234000	LADDERS & STRWY	TN*	120	6960.4	835248*	217200	1810.00*	5150.4	618048*	0	0	0
5.240000	LIFTING EQUIP	LS*	----	----	241372*	119050	---- *	----	122322*	0	0	0
5.242000	ELEV EQUIPMENT	LS*	----	----	144190*	47620	---- *	----	96570*	0	0	0
5.243000	OTHER LIFT EQUIP	LS*	----	----	97182*	71430	---- *	----	25752*	0	0	0
5.243100	(3) 15 TON HST	LS*	----	----	97182*	71430	---- *	----	25752*	0	0	0
5.300000	SILO BAY	LS*	----	----	3398526*	1772610	---- *	----	1625916*	0	0	0
5.310000	MAIN STEEL	TN*	225	2285.5	514228*	267975	1191.00*	1094.5	246253*	0	0	0
5.320000	FRAMING	LS*	----	----	320710*	111475	---- *	----	209235*	0	0	0
5.321000	WALL FRAMING	TN*	65	4934.0	320710*	111475	1715.00*	3219.0	209235*	0	0	0
5.330000	MISC STEEL	LS*	----	----	325698*	190500	---- *	----	135198*	0	0	0
5.340000	LIFTING EQUIPMENT	LS*	----	----	75176*	57150	---- *	----	18026*	0	0	0
5.343000	OTHER LIFT EQUIP	LS*	----	----	75176*	57150	---- *	----	18026*	0	0	0
5.350000	SUPPORT STEEL	LS*	----	----	703160*	252500	---- *	----	450660*	0	0	0
5.351000	EQUIP SUPPORTS	TN*	100	7031.6	703160*	252500	2525.00*	4506.6	450660*	0	0	0
5.360000	STL SILO & CVR PL	LS*	----	----	1459554*	893010	---- *	----	566544*	0	0	0
5.361000	STEEL SILOS	TN*	170	6528.2	1109794*	672010	3953.00*	2575.2	437784*	0	0	0
5.362000	SS PLATES	TN*	40	8744.0	349760*	221000	5525.00*	3219.0	128760*	0	0	0

AFA
SUSITNA 200MW UNIT2
ESTIMATE NO. AFA 1707 M-1

BY: WMP CHECKED: JDF

DATE: 23-OCT-84 TIME: 18:04:19

DETAILED
MATERIAL & INSTALLATION REPORT

ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
5.900000	UNCLASS STEEL	TN*	45	5791.0	260595*	115740	2572.00*	3219.0	144855*	0	0	0
6.000000	BUILDINGS	LS*	----	----	9030239*	3157732	---- *	----	5872507*	0	0	0
6.100000	TURBINE BUILDING	LS*	----	----	2067696*	828577	---- *	----	1239119*	0	0	0
6.110000	ARCHITECT FEATURE	LS*	----	----	932009*	285715	---- *	----	646294*	0	0	0
6.170000	HVAC	LS*	----	----	845725*	428572	---- *	----	417153*	0	0	0
6.180000	PLUMB & DRAINAGE	LS*	----	----	224498*	95240	---- *	----	129258*	0	0	0
6.190000	MISCELLANEOUS	LS*	----	----	65464*	19050	---- *	----	46414*	0	0	0
6.200000	STEAM GEN BUILDING	LS*	----	----	2499343*	904762	---- *	----	1594581*	0	0	0
6.210000	ARCHTITECT FEATRS	LS*	----	----	1213838*	361905	---- *	----	851933*	0	0	0
6.270000	HVAC	LS*	----	----	1122484*	476190	---- *	----	646294*	0	0	0
6.280000	PLUMB & DRAINAGE	LS*	----	----	69699*	28572	---- *	----	41127*	0	0	0
6.290000	MISCELLANEOUS	LS*	----	----	93322*	38095	---- *	----	55227*	0	0	0
6.300000	SILO BAY	LS*	----	----	763977*	268095	---- *	----	495882*	0	0	0
6.310000	ARCHITECT FEATRS	LS*	----	----	252452*	76190	---- *	----	176262*	0	0	0
6.370000	HVAC	LS*	----	----	349302*	114286	---- *	----	235016*	0	0	0
6.380000	PLUMB & DRAINAGE	LS*	----	----	147809*	71429	---- *	----	76380*	0	0	0
6.390000	MISCELLANEOUS	LS*	----	----	14414*	6190	---- *	----	8224*	0	0	0
6.400000	AQCS BUILDINGS	LS*	----	----	2182604*	535088	---- *	----	1647516*	0	0	0
6.410000	AQCS SWGR BLDG	SF*	[illegible]	133.3	114622*	28724	33.40*	99.9	85898*	0	0	0
6.420000	AQCS CTRL BLDG	SF*	2280	168.1	383343*	102030	44.75*	123.4	281313*	0	0	0
6.430000	DIESEL GEN BLDG	SF*	540	143.8	77670*	18036	33.40*	110.4	59634*	0	0	0
6.440000	PUMP HOUSE	SF*	8860	144.8	1282504*	303898	34.30*	110.5	978606*	0	0	0
6.450000	LIMESTN PREP BLDG	SF*	4120	78.8	324465*	82400	20.00*	58.8	242065*	0	0	0

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6.900000	MISC BUILDINGS	LS*	----	----	1516619*	621210	---- *	----	895409*	0	0	0
6.990000	ALL OTHER	LS*	----	----	1516619*	621210	---- *	----	895409*	0	0	0
6.997000	WAREHOUSE NO. 1	SF*	23000	61.0	1403055*	592250	25.75*	35.3	810805*	0	0	0
6.999000	OTHER BUILDINGS	LS*	----	----	113564*	28960	---- *	----	84604*	0	0	0
6.999100	SWTH YD CTRL BL	SF*	800	142.0	113564*	28960	36.20*	105.8	84604*	0	0	0
7.000000	TURBINE GENERATOR	LS*	----	----	18264278*	15619048	---- *	----	2645230*	0	0	0
7.100000	TURBINE GENERATOR	LS*	----	----	18264278*	15619048	---- *	----	2645230*	0	0	0
8.000000	STM GENER & ACCESS	LS*	----	----	42445644*	22857144	---- *	----	19588500*	0	0	0
8.100000	STEAM GENERATOR	LS*	----	----	42445644*	22857144	---- *	----	19588500*	0	0	0
9.000000	AQCS	LS*	----	----	39715660*	21184103	---- *	----	18531557*	0	0	0
9.100000	BAGHOUSE	LS*	----	----	7692908*	3809524	---- *	----	3883384*	0	0	0
9.200000	FLUE GAS DESULFUR	LS*	----	----	29876227*	15740953	---- *	----	14135274*	0	0	0
9.210000	COMPONENTS	LS*	----	----	29876227*	15740953	---- *	----	14135274*	0	0	0
9.211000	DUCTWORK FOR FGD	LS*	----	----	3287023*	1455238	---- *	----	1831785*	0	0	0
9.213000	SO2 ABSORB MODULE	LS*	----	----	26589204*	14285715	---- *	----	12303489*	0	0	0
9.400000	FANS	LS*	----	----	2146525*	1633626	---- *	----	512899*	0	0	0
9.410000	I.D. FANS	LS*	----	----	1337901*	1014286	---- *	----	323615*	0	0	0
9.420000	SILENCERS	LS*	----	----	808624*	619340	---- *	----	189284*	0	0	0
10.000000	OTHER MECHAN EQUIP	LS*	----	----	13762103*	9957312	---- *	----	3804791*	0	0	0
10.100000	PUMPS	LS*	----	----	3337605*	2844768	---- *	----	492837*	0	0	0
10.110000	BOILER PUMPS	LS*	----	----	2906706*	2522287	---- *	----	384419*	0	0	0
10.111000	BOILER FEED PUMPS	EA*	2	383960.0	767920*	613904	---- *	77008.0	154016*	0	0	0
10.112000	BF PUMP TURBINES	EA*	2	825913.5	1651827*	1527620	---- *	62103.5	124207*	0	0	0

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10.113000	BF BOOSTER PUMPS	EA*	2	116899.5	233799*	177906	88953.00*	27946.5	55893*	0	0	0
10.114000	BF STRT UP/STD BY	LS*	----	----	253160*	202857	---- *	----	50303*	0	0	0
10.120000	FEEDWTR SYS PUMPS	LS*	----	----	9353*	7429	---- *	----	1924*	0	0	0
10.121000	CONDEN TRANSFER	LS*	----	----	9353*	7429	---- *	----	1924*	0	0	0
10.130000	SRV & COOL WTR PMP	LS*	----	----	65723*	39146	---- *	----	26577*	0	0	0
10.131000	SERVICE WATER	EA*	4	6633.8	26535*	14860	3715.00*	2918.8	11675*	0	0	0
10.132000	AIR HTR WASH PMPS	LS*	----	----	18461*	10762	---- *	----	7699*	0	0	0
10.133000	CLSD CYC COOL WSP	EA*	2	10363.5	20727*	13524	6762.00*	3601.5	7203*	0	0	0
10.140000	OIL PUMPS	LS*	----	----	56807*	43335	---- *	----	13472*	0	0	0
10.141000	LGT OIL UNLD PMPS	EA*	2	6972.5	13945*	10096	5048.00*	1924.5	3849*	0	0	0
10.142000	IGNITER OIL PUMPS	EA*	3	9830.0	29490*	23715	7905.00*	1925.0	5775*	0	0	0
10.143000	TURB LO TRANS PMP	LS*	----	----	6686*	4762	---- *	----	1924*	0	0	0
10.145000	LO COND PUMP	LS*	----	----	6686*	4762	---- *	----	1924*	0	0	0
10.150000	SUMP PUMPS	EA*	6	19717.8	118307*	110856	18476.00*	1241.8	7451*	0	0	0
10.160000	OTHER PUMPS	LS*	----	----	180709*	121715	---- *	----	58994*	0	0	0
10.161000	COOLING TOWER MU	LS*	----	----	34205*	17810	---- *	----	16395*	0	0	0
10.162000	OP CYC CLG WTR	EA*	2	23551.0	47102*	29714	14857.00*	8694.0	17388*	0	0	0
10.163000	FIRE PROTECT PMPS	EA*	3	23315.0	69945*	50571	16857.00*	6458.0	19374*	0	0	0
10.164000	AIR PREHTR GLY	EA*	2	14728.5	29457*	23620	11810.00*	2918.5	5837*	0	0	0
10.200000	CONDENSING PLANT	LS*	----	----	2383666*	1696000	---- *	----	687666*	0	0	0
10.210000	CONDENSER & AUXIL	LS*	----	----	1529943*	952381	---- *	----	577562*	0	0	0
10.220000	EQUIPMENT	LS*	----	----	853723*	743619	---- *	----	110104*	0	0	0
10.221000	CW PUMPS	EA*	2	142300.0	284600*	251810	---- *	16395.0	32790*	0	0	0

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ACCT NO	DESCRIPTION	UN*	(QTY)	(UN $ TOT)	(TOTAL AMT)*	(TOT MATL)	(UN $MAT)*	(U $ INS)	(TOT INST)*	(TOT ESC)	(MAT ESC)	(INS ESC)
10.222000	CONDENSATE PUMPS	EA*	2	85877.0	171754*	140952	70476.00*	15401.0	30802*	0	0	0
10.223000	VACUUM PUMPS	EA*	2	80863.5	161727*	148190	74095.00*	6768.5	13537*	0	0	0
10.226000	COND CLEAN SYS	LS*	----	----	232956*	201905	---- *	----	31051*	0	0	0
10.227000	COND COLL PUMP	LS*	----	----	2686*	762	---- *	----	1924*	0	0	0
10.300000	HEAT EXCHANGERS	LS*	----	----	1904467*	1725241	---- *	----	179226*	0	0	0
10.310000	FEEDWATER HEATERS	EA*	7	172702.3	1208916*	1110669	---- *	14035.3	98247*	0	0	0
10.320000	DEAER/ VENT CONDEN	LS*	----	----	230705*	188476	---- *	----	42229*	0	0	0
10.330000	CLSD CYC COOL WHE	EA*	2	163620.5	327241*	296190	---- *	15525.5	31051*	0	0	0
10.340000	AIR PRHTR GLY HE	EA*	2	68802.5	137605*	129906	64953.00*	3849.5	7699*	0	0	0
10.400000	TANKS	LS*	----	----	503094*	184572	---- *	----	318522*	0	0	0
10.410000	WATER TANKS	LS*	----	----	437072*	138667	---- *	----	298405*	0	0	0
10.412000	CONDEN STRG TANK	LS*	----	----	195532*	51143	---- *	----	144389*	0	0	0
10.414000	FIRE&SRV WTR STRG	LS*	----	----	241540*	87524	---- *	----	154016*	0	0	0
10.450000	OTHER OIL TANKS	LS*	----	----	66022*	45905	---- *	----	20117*	0	0	0
10.453000	CONT BLWDWN FL TK	LS*	----	----	6342*	3238	---- *	----	3104*	0	0	0
10.454000	INT BLWDWN FLH TK	LS*	----	----	22632*	16857	---- *	----	5775*	0	0	0
10.455000	COND COLL TANK	LS*	----	----	9353*	7429	---- *	----	1924*	0	0	0
10.456000	CLSD CYC CL WHT	LS*	----	----	9580*	6476	---- *	----	3104*	0	0	0
10.457000	AIR PREHT CL EX	LS*	----	----	18115*	11905	---- *	----	6210*	0	0	0
10.500000	MISCELLANEOUS EQUIP	LS*	----	----	2867430*	2268636	---- *	----	598794*	0	0	0
10.510000	CONPRESSED AIR EQP	LS*	----	----	263588*	182731	---- *	----	80857*	0	0	0
10.512000	STAT AIR COMPRESS	EA*	2	110822.0	221644*	144636	72318.00*	38504.0	77008*	0	0	0
10.513000	AIR DRYERS	LS*	----	----	41944*	38095	---- *	----	3849*	0	0	0

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10.520000	WTR TREAT EQUIP	LS*	----	----	2603842*	2085905	---- *	----	517937*	0	0	0
10.521000	MKUP WTR TRTMT	LS*	----	----	1075119*	844095	---- *	----	231024*	0	0	0
10.522000	COND POL DEMINER	LS*	----	----	1045500*	814476	---- *	----	231024*	0	0	0
10.524000	BOILER CHEM FEED	LS*	----	----	67703*	55905	---- *	----	11798*	0	0	0
10.525000	SAMPLING SYSTEM	LS*	----	----	186912*	169524	---- *	----	17388*	0	0	0
10.526000	BLK GAS STR&DISTR	LS*	----	----	228608*	201905	---- *	----	26703*	0	0	0
10.900000	TURBINE BYPASS	LS*	----	----	2765841*	1238095	---- *	----	1527746*	0	0	0
11.000000	COAL&ASH HNDL EQUIP	LS*	----	----	5530266*	3399907	---- *	----	2130359*	0	0	0
11.100000	COAL HANDLING	LS*	----	----	[illegible]	813810	---- *	----	175239*	0	0	0
11.160000	CRUSH & TRANSF SYS	LS*	----	----	483574*	346191	---- *	----	137383*	0	0	0
11.165000	CONVEYOR NO 9A	LS*	----	----	483574*	346191	---- *	----	137383*	0	0	0
11.170000	MISC SYSTEMS	LS*	----	----	505475*	467619	---- *	----	37856*	0	0	0
11.172000	FIRE PROTECTION	LS*	----	----	505475*	467619	---- *	----	37856*	0	0	0
11.200000	BTM ASH HNDL SYSTEM	LS*	----	----	2901321*	1538478	---- *	----	1362843*	0	0	0
11.210000	FURN BTM ASH SYS	LS*	----	----	1104052*	640000	---- *	----	464052*	0	0	0
11.220000	PYRITE HNDL SYSTEM	LS*	----	----	110030*	60572	---- *	----	49458*	0	0	0
11.230000	ECONOMIZER ASH SYS	LS*	----	----	303462*	175238	---- *	----	128224*	0	0	0
11.240000	DEWTW BIN&SET TKS	LS*	----	----	1086616*	463810	---- *	----	622806*	0	0	0
11.250000	MAJOR PUMPS	EA*	3	61673.0	185019*	124572	41524.00*	20149.0	60447*	0	0	0
11.260000	BTM ASH INSTRUM	LS*	----	----	112142*	74286	---- *	----	37856*	0	0	0
11.400000	FLY ASH INST & CTL	LS*	----	----	1639896*	1047619	---- *	----	592277*	0	0	0
12.000000	PIPING	LS*	----	----	25175560*	8926217	---- *	----	16249343*	0	0	0
12.100000	LARGE BORE PIPING	TN*	873	18693.3	16319213*	7641369	8753.00*	9940.3	8677844*	0	0	0

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12.200000	SMALL BORE PIPING	LF*	85372	103.7	8856347*	1284848	15.05*	88.7	7571499*	0	0	0
13.000000	INSULATION	LS*	----	----	6774331*	552381	---- *	----	6221950*	0	0	0
13.100000	INSULATION	LS*	----	----	6774331*	552381	---- *	----	6221950*	0	0	0
14.000000	INSTRUMENTATION	LS*	----	----	6730093*	6190476	---- *	----	539617*	0	0	0
14.100000	INSTRUMENTATION	LS*	----	----	6730093*	6190476	---- *	----	539617*	0	0	0
15.000000	ELECTRICAL EQUIPMENT	LS*	----	----	43916857*	17904762	---- *	----	26012095*	0	0	0
16.000000	PAINTING	LS*	----	----	2100475*	127620	---- *	----	1972855*	0	0	0
16.100000	TURBINE BUILDING	LS*	----	----	705237*	47619	---- *	----	657618*	0	0	0
16.200000	STEAM GEN BLDG	LS*	----	----	1267099*	71429	---- *	----	1195670*	0	0	0
16.300000	SILO BAY	LS*	----	----	128139*	8572	---- *	----	119567*	0	0	0
17.000000	OFF-SITE FACILITIES	LS*	----	----	3484604*	542857	---- *	----	2941747*	0	0	0
17.100000	RANNEY WELL SYSTEM	LS*	----	----	3484604*	542857	---- *	----	2941747*	0	0	0
19.000000	SUBSTATION/T-LINE	LS*	----	----	17997823*	10921143	---- *	----	7076680*	0	0	0
19.100000	SUBSTATION	LS*	----	----	3356863*	2857143	---- *	----	499720*	0	0	0
19.200000	230KV T-LINE:1 CIR	MI*	1	0.0	14640960*	8064000	---- *	0.0	6576960*	0	0	0
71.000000	INDIRECT CONST COST	LS*	----	----	26285615*	0	---- *	----	26285615*	0	0	0
71.100000	FIELD LOCAL HIRES	LS*	----	----	1237500*	0	---- *	----	1237500*	0	0	0
71.200000	CRAFT P/R FRINGES	LS*	----	----	2220000*	0	---- *	----	2220000*	0	0	0
71.210000	PREM PAY-CASUAL	LS*	----	----	1480000*	0	---- *	----	1480000*	0	0	0
71.220000	PREM PAY-SCHED	LS*	----	----	740000*	0	---- *	----	740000*	0	0	0
71.300000	CONSTR EQUIPT	LS*	----	----	135000*	0	---- *	----	135000*	0	0	0
71.310000	AUTOMOTIVE(C/M)	LS*	----	----	135000*	0	---- *	----	135000*	0	0	0
71.400000	CONSTRUCTION PLANT	LS*	----	----	17870289*	0	---- *	----	17870289*	0	0	0

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71.410000	CONSTRUCTN BLDGS	LS*	----	----	1220000*	0	---- *	----	1220000*	0	0	0
71.420000	TEMP FACILITIES	LS*	----	----	16650289*	0	---- *	----	16650289*	0	0	0
71.421000	LABOR CAMP	LS*	----	----	7200000*	0	---- *	----	7200000*	0	0	0
71.422000	FOOD SERVICE	LS*	----	----	7920000*	0	---- *	----	7920000*	0	0	0
71.424000	OTHER TEMP FACIL	LS*	----	----	1530289*	0	---- *	----	1530289*	0	0	0
71.600000	OFFICE/LABOR EXP	LS*	----	----	1556201*	0	---- *	----	1556201*	0	0	0
71.610000	OFFICE EXPENSE	LS*	----	----	120000*	0	---- *	----	120000*	0	0	0
71.620000	LABOR EXPENSE	LS*	----	----	518301*	0	---- *	----	518301*	0	0	0
71.630000	TESTING	LS*	----	----	571400*	0	---- *	----	571400*	0	0	0
71.640000	SECURITY GUARDS	LS*	----	----	346500*	0	---- *	----	346500*	0	0	0
71.700000	OFF-SITE UNLDG/HLG	LS*	----	----	3066600*	0	---- *	----	3066600*	0	0	0
71.800000	CONSTRUCTN CLEANUP	LS*	----	----	200025*	0	---- *	----	200025*	0	0	0
72.000000	PROFESSIONAL SERVCS	LS*	----	----	13600000*	0	---- *	----	13600000*	0	0	0

$

"UNIT 1"

Attachment 3a.4

ALASKA POWER AUTHORITY
Susitna Need for Power Study
200 MW Coal-fired Plant
Beluga Site
Estimate No. APA 1707 M-1

BASIS OF ESTIMATE

GENERAL

This conceptual estimate is prepared in the Ebasco Code of Accounts. The estimate is for a one unit facility and excludes Owner's cost (including Land and AFUDC). This overnight estimate has a base pricing level of January, 1984, for each line item de-escalated to a January, 1983 pricing level on a summary basis.

The estimate is based on a downsized version of Ebasco's Coal Fired Reference Plant Program (CFRP), which is a combination of recommended pre-engineered plant general arrangements (GA's) in building block segments, to define the plant layout. It also contains a comprehensive set of System Design Descriptions (SDD's) which define all aspects of every plant system in a standardized format.

Site-related capital cost adjustments are made to the CFRP for sizing, logistics, civil site features, temporary and permanent power connection points, building enclosures, insulation levels, cooling requirements, and type of coal.

The estimate is based on the following:

a. Wage rates applicable to Anchorage Union Agreements south of 63° latitude including Workmen's Compensation, FICA, and Public Liability Property Damage insurance rates as calculated by Ebasco.

7176B

BASIS OF ESTIMATE (continued)

GENERAL (continued)

b. A work week consisting of 6-10 hour days.

c. Sufficient craftsmen available to meet project requirements housed in labor camps.

d. Professional Services including Engineering, Design, Related Services and Construction Management based on a generic plant of comparable size using the CFRP concept.

e. Land and Land Rights not included.

f. Allowance for Funds Used During Construction (AFUDC) not included.

g. Client costs not included.

h. Permanent town for plant operating personnel and mine production personnel not included.

i. Capital cost of mine and coal export facility not included.

j. Operating and maintenance costs not included.

k. Contingency included at the rate of 12% for material and 15% for installation.

ALASKA POWER AUTHORITY
Susitna Need for Power Study
200 MW Coal-fired Plant
Beluga Site
Estimate No. APA 1707 N-1

BASIS OF ESTIMATE (continued)

GENERAL (continued)

l. Construction performed on a Contract basis.

m. Project being exempt from sales tax.

n. Labor productivity being "average U.S." with no Alaskan adjustment.

o. Spare parts and special tools not included.

p. Start-up costs not included.

q. Maintenance machinery, laboratory and office equipment not included.

CIVIL (Categories 1, 2, 3, 4, 5, 6, 16, 17, 18)

Clearing is assumed based on scrub brush and trees up to 25'. Some rock excavation is assumed in deep cuts. No dewatering of excavated areas is assumed. No railroad or barge delivery of coal is assumed for this mine - mouth plant. Coal is assumed to be trucked from the mine. Twenty (20) miles of access road is assumed.

Eighty (80) foot long piles are assumed under heavily loaded foundations. A four hundred (400) foot high concrete stack with 2 - 11' diameter steel flues is assumed. No ash ponds are included; a waste processing system is included. Waste would be trucked to a

7176B

ALASKA POWER AUTHORITY
Susitna Need for Power Study
200 MW Coal-fired Plant
Beluga Site
Estimate No. APA 1707 M-1

BASIS OF ESTIMATE (continued)

CIVIL (continued)

disposal area off-site. The capital cost of constructing the disposal area is not included. No asphalt or concrete paving is included.

Cooling tower pricing is based on a Zurn budgetary quotation for a Model 3-Z-460 rectangular multi-cell unit rated at 66,000 gpm. A Ranney well make-up water system is included. An equipment barge unloading facility is included.

MECHANICAL (Categories 7, 8, 9, 10, 11, 14)

Ecolaire provided a budgetary quotation for a 105,000 ft^2 surface condenser. The condenser is a single-shell, single-pass, single-pressure type designed for 66,000 gpm and 27°F temperature rise.

Ecolaire provided a budgetary quotation for a reverse gas 662,000 ACFM Baghouse with a 300°F gas temperature. Low sulfur, sub-bituminous coal with a heating value of 7,950 btu/lb and a coal firing rate of 253,400 lb/hr is assumed. The quotation is based on design, fabrication and erection of one baghouse and auxiliary equipment with 10 compartments/ baghouse and 368 bags per compartment.

Combustion Engineering Power Systems and Foster Wheeler provided budgetary quotations for the coal-fired steam generator and

7176B

ALASKA POWER AUTHORITY
Susitna Need for Power Study
200 MW Coal-fired Plant
Beluga Site
Estimate No. APA 1707 M-1

BASIS OF ESTIMATE (continued)

MECHANICAL (continued)

accessories. Pricing is based on 1,590,000 lb/hr, 2650 psig and 1008°F main steam; 1,351,000 lb/hr, 600 psig, 630°F (@ inlet) reheat; and 525°F feedwater.

The 7950 btu/lb coal analysis is as follows:

Proximate	Weight Percent
Moisture	26.1
Ash	6.4
Volatiles	36.3
Fixed Carbon	31.2
Ultimate	
Hydrogen	3.6
Carbon	47.2
Oxygen	15.5
Nitrogen	1.05
Sulfur	0.12
Chlorine	---
Moisture	26.1
Ash	6.4

Combustion Engineering provided a budgetary quotation for a "dry" SO_2 scrubbing system utilizing multi-cell sprayer absorbers with 85% SO_2

ALASKA POWER AUTHORITY
Susitna Need for Power Study
200 MW Coal-fired Plant
Beluga Site
Estimate No. APA 1707 M-1

<u>BASIS OF ESTIMATE (continued)</u>

<u>MECHANICAL (continued)</u>

(70% guarantee) removal. The system is rated at 662,000 ACFM with a flue gas temperature of 300°F and 20% excess air.

Westinghouse Electric, General Electric and Utility Power Corporation provided budgetary quotes for the steam turbine generators. The quotations are based on an indoor type, tandem compound condensing turbine, two flow, single reheat, regenerative designed for operating steam conditions of 2400 psig and 1000°F/1000°F. The turbine design throttle flow will be 1,[illegible]90,000 lb/hr. The maximum gross turbine output will be 220,000 kW with 2520 psig, 1000/1000°F, 2.7/4.0 in.Hg absolute back pressure. The generator is 244,400 KVA @ 45 psig, 0.9 PF, 3 phase, 60 Hz, 24,000 V and 0.5 shortcircuit ratio complete with an excitation system.

<u>PIPING AND INSULATION</u> (Categories 12 and 13)

Large bore and small bore piping sizing and quantities are downsized based on Ebasco's CFRP estimates. Pricing is based on recent quotations and historical pricing data from similar units. Insulation prices are based on Ebasco's CFRP estimates with an additional allowance for insulating yard systems.

Attachment 3a.6

SELECTED VENDOR QUOTES

ZURN a step ahead of tomorrow

April 25, 1984

Ebasco Services, Inc.
400 112th Avenue, N.E.
Bellevue, WA 98004

Attention: Mr. Joseph J. Marshall
Senior Engineer

Subject: Cooling Tower Selection and Budgetary Pricing
for the Alaska Power Authority Study
Zurn Reference No. OS-84011

Dear Mr. Marshall:

In response to your March 28, 1984 letter, we are pleased to submit our preliminary cooling tower selections and budgetary pricing for your Alaska Power Authority Study. As discussed in our April 12, 1984 telephone conversation, our design wet bulb temperature is taken from the ASHRAE Handbook for the 2.5% design wet bulb in Juneau.

The Zurn cooling towers we have selected for the various design waterflows and specified on the attached data sheets are a Model 12-Z-3600 Round Multi-Fan for the 193,000 gpm waterflow, a Model 7-Z-2700 Round Multi-Fan for the 130,100 gpm waterflow and a 3Z-460 Rectangular Multi-Cell for the 66,000 gpm waterflow. These Zurn cooling towers are all counterflow units constructed mainly of reinforced precast concrete sections. The thermal exchange system is a high efficiency PVC fill pack which is supported by a network of precast concrete beams and columns and is located entirely within the confines of the tower shell. This arrangement contributes substantially to the control of ice accumulation and algae build-up. The combination of a structurally sound tower constructed of nearly inert materials and designed in strict compliance with the maximum thermal requirements specified, insures the delivery of a dependable system that will provide an extended service life with absolute minimum operating and maintenance costs.

An issue of major importance in your study of these cooling towers will surely be the control of ice accumulation and the towers ability to withstand the loads resulting from icing during winter operation. Because of operator error and other reasons, cooling towers can and, very often do, ice up. This unavoidable icing frequently results in very expensive, major structural repair and/or fill material replacement.

ZURN INDUSTRIES, INC. COOLING TOWER DIVISION
405 NORTH REO STREET, TAMPA, FL PHONE: 813/870-0040 TELEX: 52-410
MAILING ADDRESS: P.O. BOX 24718, TAMPA, FL U.S.A. 33623
Zurn Cooling Towers "Constructed under license from Balcke-Dürr, Ratingen, Federal Republic of Germany"
BALCKE

Zurn Round Multi-Fan Cooling Towers are designed with several unique features to help prevent ice-formation and are recommended for use in locations of severe winter operating conditions such as this project. Also, the durable design and high ice load capacity of Zurn all concrete towers and fill systems insures minimum susceptability to damage due to icing.

We have enclosed several copies of "Cooling Tower Ice Prevention Systems: State-of-the-Art Designs" for your information and use. We have also enclosed several cooling tower brochures for your files.

We appreciate your interest in Zurn Cooling Towers and look forward to working with you as this project progresses. Please feel free to contract us when we can be of further assistance.

Very truly yours,

ZURN INDUSTRIES, INC.
Cooling Tower Division

Thomas J. Herron

Thomas J. Herron
Sales Engineer

TJH:bgb

Encls.

ZURN a step ahead of tomorrow

RECTANGULAR MULTI-CELL COOLING TOWER SELECTION
FOR
EBASCO SERVICES, INC.
ALASKA POWER AUTHORITY
ZURN REFERENCE NO. OS-84011

DESIGN CONDITIONS

WATERFLOW RATE:	66,000 GPM
HOT WATER TEMPERATURE:	118 DEGREES F.
COLD WATER TEMPERATURE:	90 DEGREES F.
DESIGN WET BULB TEMPERATURE:	59 DEGREES F.
RELATIVE HUMIDITY:	50%
MAXIMUM DRIFT RATE:	.01%

COOLING TOWER DATA

TOWER TYPE:	RECTANGULAR MULTI-CELL
MODEL NO.:	3Z-460
NO. OF CELLS:	3
TOWER LENGTH:	216 FEET
TOWER WIDTH:	68.8 FEET
TOWER HEIGHT (to top of stacks):	41.5 FEET
DIAMETER OF FANS:	40 FEET
OPERATING FAN HORSEPOWER:	119.3 HP
TOTAL OPERATING HORSEPOWER:	357.8 HP
APPROX. TOTAL DYNAMIC PUMPHEAD:	23.2 FEET
BUDGETARY PRICE NOT INCLUDING BASIN AND FOUNDATIONS:	$2.7 MILLION

ZURN a step ahead of tomorrow

RECTANGULAR MULTI-CELL COOLING TOWER SELECTION
FOR
EBASCO SERVICES, INC.
ALASKA POWER AUTHORITY
ZURN REFERENCE NO. OS-84011

DESIGN CONDITIONS

WATERFLOW RATE:	66,000 GPM
HOT WATER TEMPERATURE:	118 DEGREES F.
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TOTAL OPERATING HORSEPOWER:	357.8 HP
APPROX. TOTAL DYNAMIC PUMPHEAD:	23.2 FEET
BUDGETARY PRICE NOT INCLUDING BASIN AND FOUNDATIONS:	$2.7 MILLION ✓

GENERAL ELECTRIC

LARGE STEAM TURBINE-GENERATOR MARKETING OPERATION
GENERAL ELECTRIC COMPANY • SCHENECTADY, NEW YORK 12345 • (518' 5-2211

July 10, 1984

Subject: Alaska Power Authority
200 MW Power Plant Study

Mr. L. J. Becker
Mechanical Engineer
EBASCO
400 - 112th Ave. N.E.
Bellevue, Wash. 98004

Mr. Becker:

Attached you will find the general outline of a tandem compound two flow 30" last stage bucket (TC2F-30" LSB) turbine. This is in response to a specific request on your behalf by Mr. M. Allison of EUSD.

At this time I would like to point out that a TC2F-26" LSB turbine would fulfill the 200 MW alternative probably at a higher efficiency and lower cost.

Also, attached are some General Electric publications which should enable you to gain a general idea of the inspection and maintenance for large steam turbine-generators.

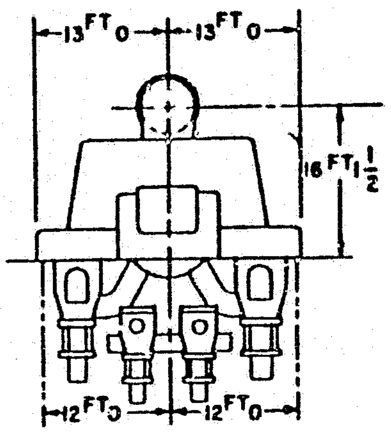
As is stated in GEK-63355, most utilities plan for a major outage once every five years. Of course this frequency should be increased when a specific unit has the potential for solid particle carryover from the boiler.

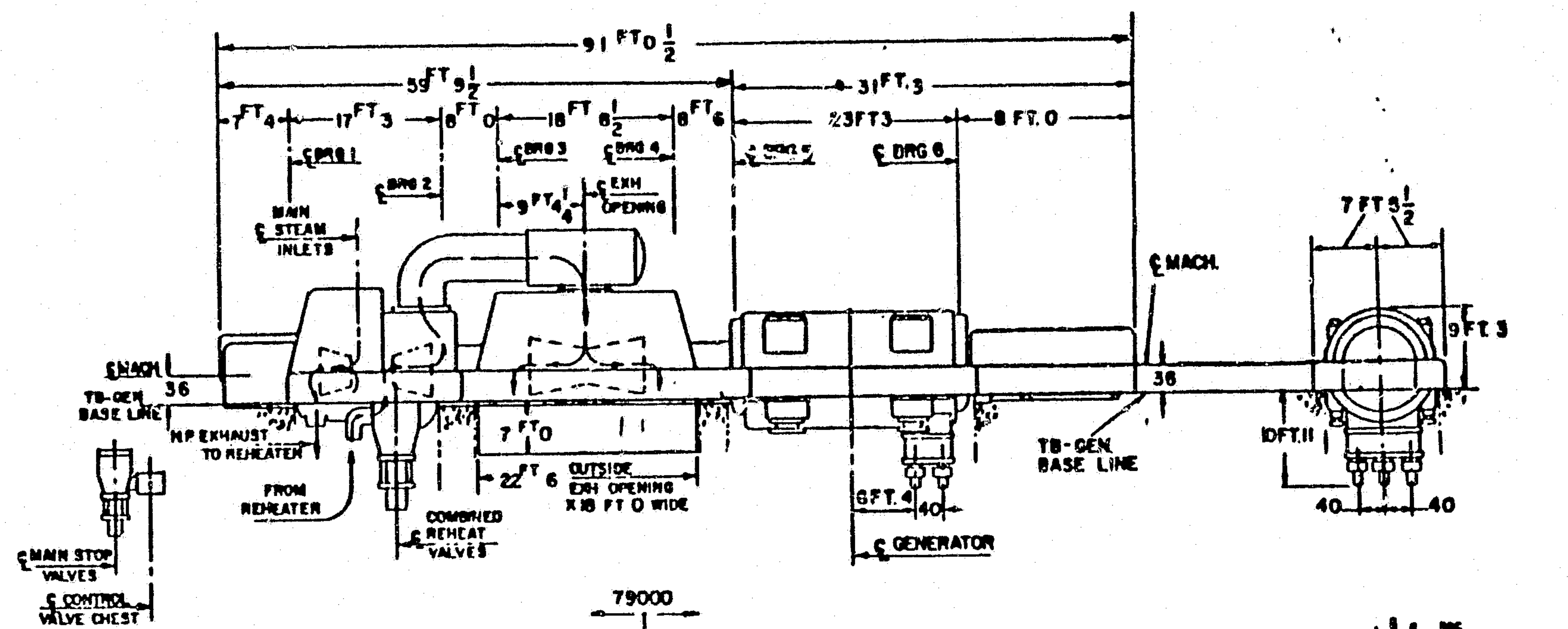
William E Tessaro

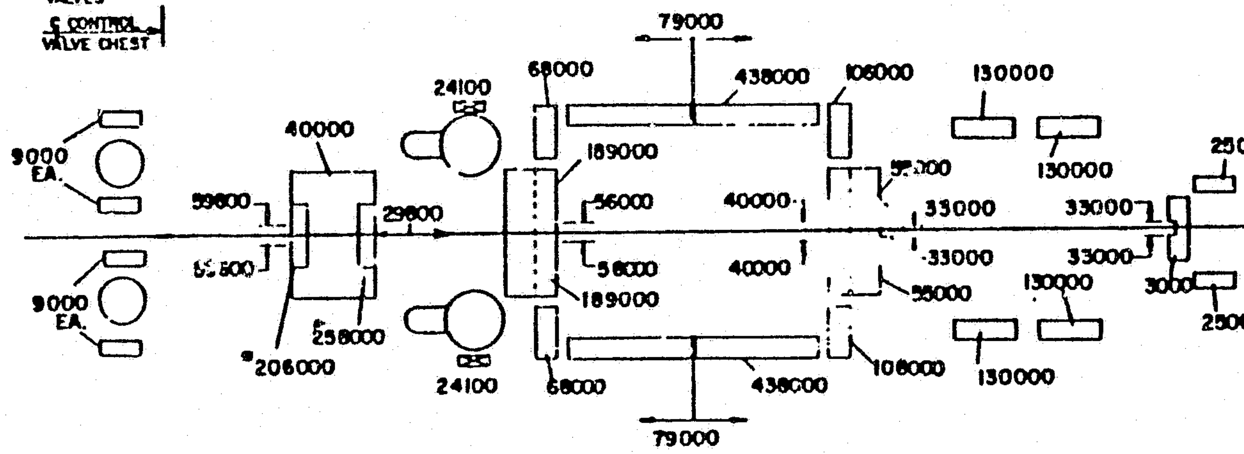
William E. Tessaro
Sales Engineer - Region I

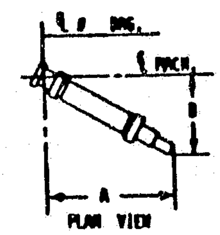
cc: ML Doane - GE, Schdy
MM Allison - GE, Seattle

169C3044









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DISTANCE REQ'D TO REMOVE GEN. FIELD

METHOD OF REMOVAL	A	B
STRAIGHT PULL	31 FT 0	-
CANTING HORIZONTALLY	26 FT 6	20 FT 0

NOTES:

1. STEAM CONDITIONS: 2400 PSIG-1000/1000 °F REHEAT WITH 30 IN. LAST STAGE BUCKETS
2. HEAVIEST PIECE DURING ERECTION - (GENERATOR STATOR) 370000 LBS.
   HEAVIEST PIECE AFTER ERECTION - (UPPER HALF HP-IP TB SHELL) 107,000 LBS.
*3. 206000 & 258000 LB LOADINGS DO NOT OCCUR SIMULTANEOUSLY BUT ARE SUPERIMPOSED ON 40000 LB. LOAD 206000 LB LOAD IS ZERO FOR NORMAL OPERATION. FOR FULL VALUE OF 206000 LB LOAD 258000 LB. LOAD IS ZERO.
4. THE COMBINED REHEAT VALVE ARRANGEMENT INCLUDES THE REHEAT STOP AND INTERCEPT VALVES.
5. SHAFT ROTATION IS CLOCKWISE WHEN VIEWED FROM COLLECTOR END OF GENERATOR
6. LOAD VALUES SHOWN ARE FOR TURBINE-GENERATOR UNIT ONLY. ADDITIONAL LOAD CONTRIBUTED BY CONDENSER NOT INCLUDED
7. DISTANCE REQUIRED TO REMOVE MAJOR PARTS - NOT INCLUDING SLINGS:
   A. GENERATOR STATOR - 13 FT. 0 FROM TB-GEN. BASE LINE WITH TERMINAL BOX ATTACHED.
   B. GENERATOR COOLERS - 20 FT 6 FROM TB-GEN. BASE LINE
8. THIS OUTLINE SHALL NOT BE USED FOR CONSTRUCTION PURPOSES. THE GENERAL EQUIPMENT ARRANGEMENT, DIMENSIONS AND LOADINGS ARE TO BE CONSIDERED PRELIMINARY AND SUBJECT TO LATER MODIFICATION.
9. RECOMMENDED MINIMUM CRANE HOOK HEIGHT ABOVE TB. GEN. BASE LINE - 31 FT 0
10. RECOMMENDED MINIMUM FOUNDATION HEIGHT - 30 FT. 0 IN.

ALT. II REV. 1: 2/22/78

PROPOSITION OUTLINE

STEAM TURBINE GENERATOR UNIT

TURBINE	217718 KW - 3600 RPM - TC2F 30" LSB
GENERATOR	ATB-2 - 266,600 KVA - 3600 RPM - HT-22000V
	0.85 PF - .58 SCR - 45 # H2
	CONDUCTOR COOLED
TRANS THY	970 KW 375 V
APPROVED LS-1154 TB. ENGR. F GIACALONE GEN. ENGR. J.T.Y.LL	DRAWN BY D. GAUVIN 1-4-78 INSPECTED
GENERAL ELECTRIC SCHENECTADY WORKS	169C3044

9117039

-? X 116

ILLINOIS WATER
TREATMENT COMPANY

ALLEGHENY INTERNATIONAL

4669 Shepherd Trail
Rockford, Illinois 61105
Phone 815/877-3041
Telex 257-441
Twx 910-631-3438

July 18, 1984

RECEIVED
JUL 23 1984
PROJECT SERVICES DEPT.
EBASCO SEATTLE

Ebasco Services Inc.
400 112th Ave. NE
Bellevue, WA 98004

Attention: Mr. Lawrence Becker
Project Engineer

Subject: Budget for an Alaskan 200MW Power Plant Water Treatment System
IWT Ref. No. SG-84-143 (Combined Cycle)

Dear Sir:

Thank you for allowing IWT the opportunity to assist you with your water treatment needs. This letter summarizes the system that was discussed during our phone conversation of 7-12-84.

The supplied water analysis did not balance well. The balanced feed water analysis is given below with ions given as ppm $CaCO_3$:

Ca	98	HCO_3	84
Mg	33	SO_4	53
Na	13	Cl	7
Total Cations	144	Sub - Total Anions	144
		Free CO_2	17
		SiO_2	4
		Total Anions	165

Ideal Alternate

The budget price for alternate "A" is $430,000. Add $75,000 to $150,000 for a vacuum degasifier whose price is heavily dependent on feed water temperature and desired effluent oxygen level. Estimated sulfuric acid cost is $10,000 per year based on using 200,000# of 66° Bé H_2SO_4 at $.05/#. Estimated caustic cost is $33,500 per year based on using 134,000# of 100% NaOH at $.25/#.

The budget price for alternate "B" is $280,000. Estimated sulfuric acid cost is $9,000 per year. Estimated caustic cost is $29,000 per year.

iwt
making waves in liquid processing

ILLINOIS WATER
TREATMENT COMPANY

The price difference between alternate "A" and "B" reflects the inclusion of polishing mixed beds for alternate "A". These budget prices reflect a water treatment system designed for the power industry with options and quality normally requested in specifications.

Equipment Summary

A. Triplex Multimedia Filter System - IWT Model 3AMF-300S

Tanks: 30" dia. x 60" S.S. w/ 100 psi Asme Code
Internal Plasite 7122 epoxy lining
16" dia. manhole
3" media removal nozzle
Finish Paint
Skid mounted

Media: Sand, garnet and anthrafilt

Pipe: 2" galv. C.S.

Service Flow: 50 gpm each

Inlet flow indicators: Signet type

Purpose: Reduction of particulates down to 10 micron nominal

B. Triplex Carbon Filter System - IWT Model 3ACS-306S

Tanks: 30" dia. x 60" S.S. w/ 100 psi Asme Code
Plasite 7122 lining
16" dia. manhole
3" media removal nozzle
Finish paint
Skid mounted

Media: ORC carbon

Pipe: 2" Galv. C.S.

Service Flow: 50 gpm each

Purpose: Organic and chlorine reduction

C. Triplex Two Bed Deionizers - IWT Model 3ASB-3030S

Tanks: 30" dia. x 96" S.S. w/ 100 psi Asme Code
3/32" Koroseal lining
16" dia. manhole
3" media removal nozzle
Finish paint
Skid mounted

Media: C-211 strong acid cation resin
A-464 Type 1 strong base anion resin

Pipe: 2" PPL lined Sch. 40 C.S. w/ fail safe diaphragm valves

Service Flow: 40 gpm each

Cation Regenerant: 2-step H_2SO_4

Anion Regenerant: Heated caustic @ 120°F available for silica reduction if required

Chemical System: Pumped regenerants

Purpose: Reduce ion load to 5-20 micromhos
Reduce SiO_2 to ca. 0.02 ppm

D. Triplex Polishing Mixed Bed - IWT Model AMB-2496S

Tanks: 24" dia. by 96" S.S. w/ 100 psi Asme Code
3/32" Koroseal lining
16" dia. manhole
3" media removal nozzle
Finish paint
Skid mounted

Media: C-361 strong acid cation resin
A-464 Type 1 strong base anion resin

Pipe: 2" PPL lined Sch. 40 C.S. w/ fail safe diaphragm valves

Cation Regenerant: 1-step H_2SO_4

Anion Regenerant: Heated caustic @ 120°F

Chemical System: Pumped regenerants common with two bed

Purpose: Used with alternate "A" only
Water quality of 10 megohm and SiO_2 of 0.01 ppm

ILLINOIS WATER
TREATMENT COMPANY

The system price includes interconnect service piping and NEMA 12 solid state controls.

Please note the attached rough block diagram for your review.

I trust this information will assist you in the development of your project. If there are any further questions, please feel free to contact this office or our local representative, Mr. Don Gaddis.

Sincerely,

ILLINOIS WATER TREATMENT COMPANY

Wayne T. Bates

Wayne T. Bates
Sales Engineer

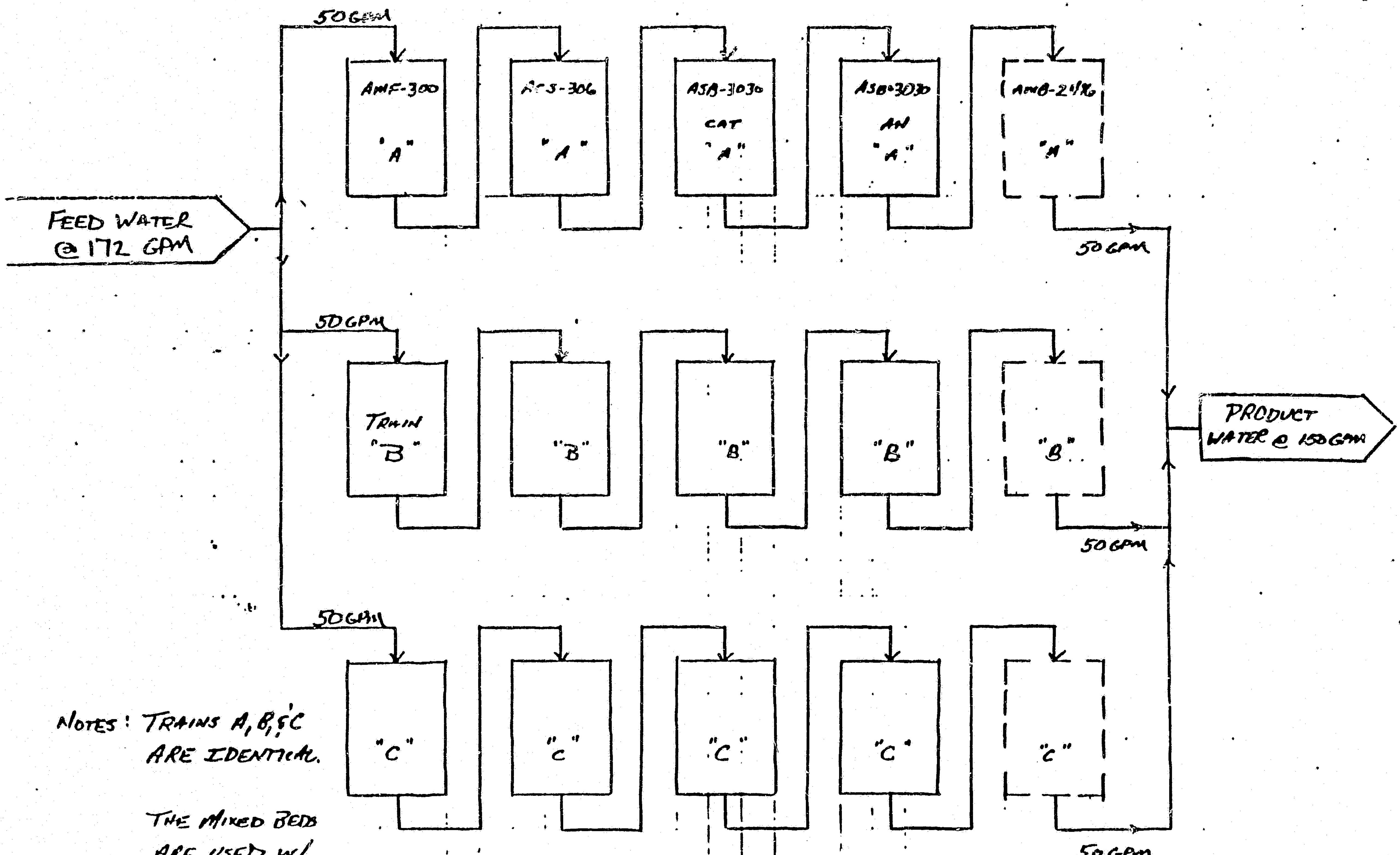
WTB/gbs7/Nw

Our representative is:

Northwest Process Equipment Company
300 120th N.E.
Bldg. 2
Suite 210
Bellevue, WA 98005
Phone: (206) 451-8591
TWX: 910-443-2308 (Vantage Corp.)

BUDGET BLOCK DIAGRAMS

EBASCO SERVICES
INT Ref. No. SG-84- 3
7-16-84 W. BATES



NOTES: TRAINS A, B, & C
ARE IDENTICAL.

THE MIXED BEDS
ARE USED W/
ALTERNATE "A"

C-E Power Systems
Combustion Engineering, Inc.
1800 South West First Avenue
Portland, Oregon 97201

Tel. 503/224-9132

POWER SYSTEMS

April 13, 1984

Mr. Gordon Villesvik
Ebasco Services Incorporated
400 - 112th Avenue N. E.
Bellevue, Washington 98004

Dear Gordie:

Subject: Alaska Power Authority
Nenana Coal Field - Thermal Station
Negotiation No. PTD-84059-B

In response to your letter of March 26 concerning the subject project we are pleased to respond in part to your request for budgetary information.

SCOPE OF SUPPLY FOR EACH OF THE FOLLOWING CASES

Furnace Wall System
Superheater
Reheater
Economizer
Pressure Parts Support Steel
Casing & Buckstays
Ducts & Dampers
Tilting Tangential Firing Eqpmt.
Coal Piping
C-E Pulverizers
Stock Gravimetric Coal Feeders
Sealing

Setting, Insulation & Lagging
Circulation Pumps, Valves & Drives
Ljungstrom Air Preheaters
Platforms & Stairways
Complete Structural Steel
Soot Blowers & Temperature Probe(s)
Valves & Accessories
Forced Draft Fan(s) & Drive(s)
Primary Air Fan(s) & Drive(s)
Shop Subassembly Phases I, II & III
Erection Representative
Service Representative

Mr. Gordon Villesvik
Page 2
April 13

BOILERS

Case I (200 MW)

One (1) 1,590,000 #/hr., 2650 #, 1000°F/1005°F unit, firing subbituminous "C" coal:

Total Approximate Present Day D&R Sell:	$28,400,000
Total Approximate Present Day Erection Sell:	$14,000,000
Estimated Erection Man-hours Northwest:	To Follow

CASE II (400 MW)

One (1) 3,158,000 #/hr., 2650#, 1008°F/1005°F unit, firing subbituminous "C" coal:

Total Approximate Present Day D&R Sell:	$41,000,000
Total Approximate Present Day Erection Sell:	$20,500,000
Estimated Erection Man-hours Northwest:	To Follow

used

CASE III (600 MW)

One (1) 4,703,500 #/hr., 2650 #, 1008°F/1005°F unit, firing subbituminous "C" coal:

Total Approximate Present Day D&R Sell:	$52,000,000
Total Approximate Present Day Erection Sell:	$26,000,000
Estimated Erection Man-hours Northwest:	To Follow

EBASCO NORTHWEST PRICING 700,000 MH × 28/MH × 1.4 = $27,440,000 (.8)

BACK END EQUIPMENT

Pricing to follow in approximately two (2) weeks.

We trust this information will be of assistance to you and will follow up with the balance of requested information as soon as it is available.

Very truly yours,

COMBUSTION ENGINEERING, INC.

G R Dahlinger
mf

G. R. Dahlinger
District Manager

GRD:mlf

Westinghouse
Electric Corporation

5901 S W Macadam Avenue
Portland Oregon 97201

503-221-4430

April 17, 1984

Mr. Joseph J. Marshall,
Senior Engineer
Ebasco Services Inc.
400 110th Avenue N.E.
Bellevue, WA 98004

Subject: Alaska Power Authority
Estimating Prices
Steam Turbine Generators

used these quotes

Dear Mr. Marshall:

This is a response to your letter dated March 23, 1984 and our subsequent telephone conversations regarding estimating prices on 600 MW, 400 MW and 200 MW fossil turbine generators for Alaska Power Authority.

Estimating prices are as follows:

	600 MW	-	$38.5M ✓
73% of 600MW	400 MW	-	$28.1M ✓
58% of 400MW	200 MW	-	$16.4M ✓

Catagory C 7.1

Westinghouse would be very interested in providing this type of equipment to Alaska Power Authority. I would appreciate you keeping me informed on the progress of this project.

Very truly yours,

C. J. Yarbrough

C.J. Yarbrough

CJY:sc

cc: Mr. T.A. Rossman
Westinghouse Electric Corporation
Seattle, WA

cc: Mr. D.M. Johnson
Westinghouse Electric Corporation
Orlando, FL

ECOLAIRE HEAT TRANSFER CO.

1550 Lehigh Drive
Easton, PA 18042
Phone 215-250-1000
Telex 84-7330

27 April 1984

Joseph J. Marshall, Senior Engineer
Ebasco Services, Inc
400 - 112th Ave NE
Bellevue, WA 98004

Sub: Alaska Power Authority
Surface Condenser Estimate

Dear Mr. Marshall:

The following is confirmation of estimated prices supplied verbally earlier this month:

Item	Price
200 MW Unit	$ 861,000
400 MW Unit	1,489,000
600 MW Unit (multi-pressure)	3,203,000

These prices are fob W. Easton, PA, subject to escalation. Included in these prices are tubes, shop tubing and a stainless steel expansion joint at the turbine exhaust flange.

We have also included three sketches which show the estimated overall dimensions of the units proposed.

Respectfully,

Jorge A. Camacho
Lead Application Engineer
Sales and Marketing Dept
215-250-1108

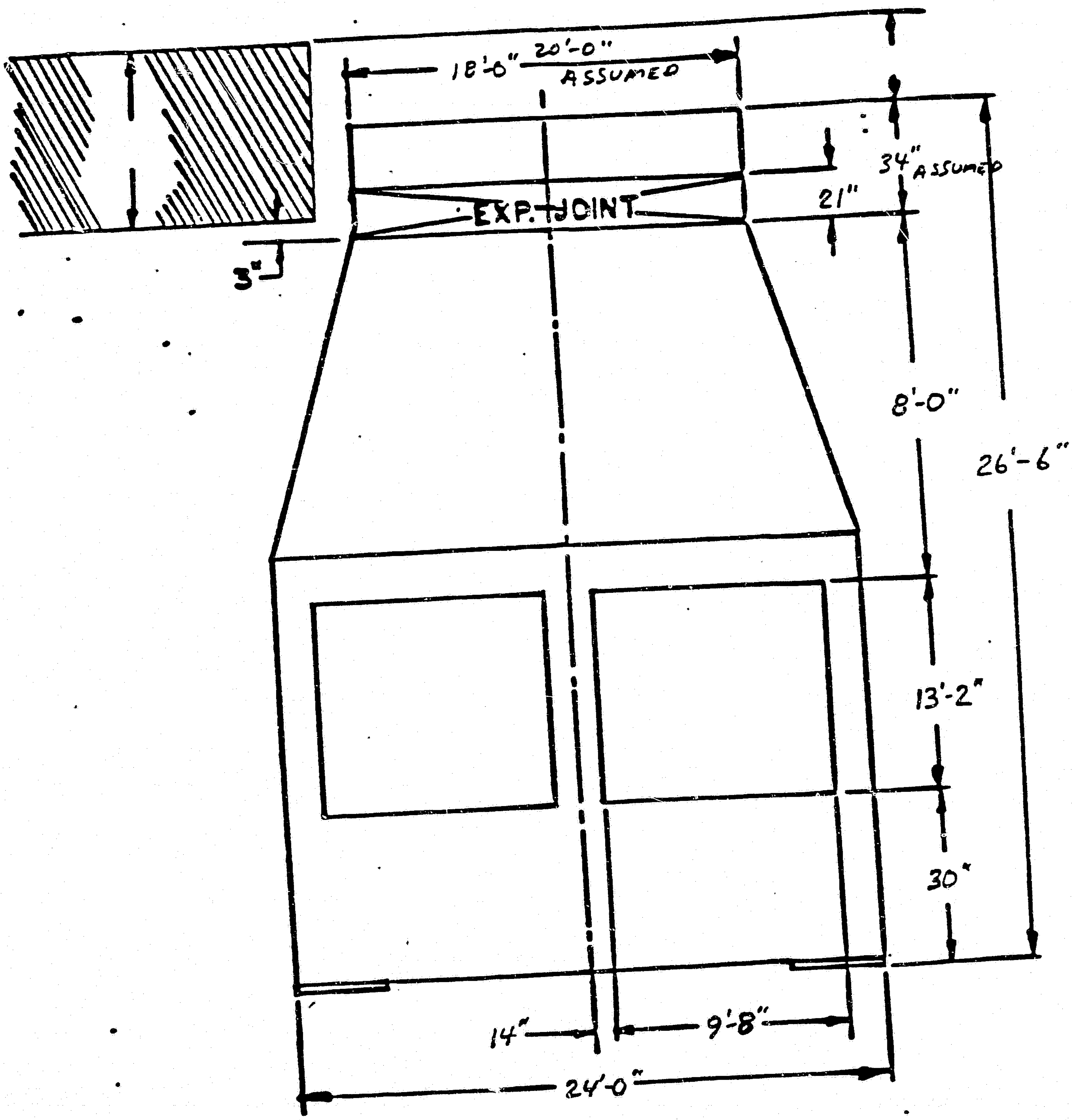
JAC/mgb
Enclosures
CC Engineered Equipment-Northwest - D.J. Wold

PRELIMINARY DIMENSIONS

CUSTOMER *EBASCO / ALASKA POWER AUTH.* DATE *17 APRIL 84*

NO.

UNIT *600 mw multi-pressure*



EACH SHELL

ECOLAIRE CONDENSER INC.

ECOLAIRE ENVIRONMENTAL COMPANY

380 Civic Drive
Pleasant Hill, CA 94523
Phone 415-676-6315
Telex 34-0314

April 13, 1984

Ebasco Services Incorporated
400 112th Avenue N. E.
Bellevue, WA. 98004

Attention: Mr. Joseph J. Marshall
Senior Engineer

Reference: Alaska Power Authority

Dear Mr. Marshall:

We are pleased to respond to your request of April 9, 1984, for budgetary cost estimates on three (3) different baghouses, sized for 600 MW (1,982,000 ACFM), 400 MW (1,324,000 ACFM), and 200 MW (662,000 ACFM), respectively.

We have described our selections on separate data sheets for your convenience. We have also included our installations list for utility coal fired boilers, and installation reports on two recent projects.

Your client may be interested to know that Ecolaire has a baghouse installed on a small coal fired boiler at Golden Valley Electric Association's Healy Station Unit 1 near Fairbanks, Alaska. This unit has been in operation since 1980.

If you have any questions concerning the above or enclosed information, or if you require additional data at this time, please feel free to contact our local sales representative, listed below, or this office directly. We would be pleased to assist in specification preparation/recommendations if your study should progress to that stage. We look forward to an opportunity to be of service.

Very truly yours,
ECOLAIRE ENVIRONMENTAL COMPANY

E. S. Kuldner
Applications Engineer
/11

ECOLAIRE ENVIRONMENTAL COMPANY

cc: Engineered Equipment Northwest
P. O. Box 02252
Portland, OR. 97202
(503) 238-0093
Mr. Don Wold

Ecolaire Environmental Company
1868 E. Sixth Street
Tempe, AZ. 85282
(602) 897-8989
Mr. Craig Wennerholm

Enclosures: CB 83
Utility Boiler Installations List
Installation Reports: N-6771, N-6592

ECOLAIRE ENVIRONMENTAL COMPANY

600 MW

Gas Volume:	1,982,000 ACFM
Gas Temp:	300°F
Fuel Fired:	Low Sulfur Sub-bituminous Coal
No. of Baghouses:	Two (2)
No. of Compartments:	Twelve (12) per Baghouse, 24 Total
Baghouse Cleaning:	Reverse Gas
Bag Type:	Woven Fiberglass with Teflon B Finish
Bag Size:	12"Ø x 36'-9" Long
No. of Bags:	450 per Compartment, 10,800 Total
Air/Cloth Ratios:	
Gross:	1.70 : 1
Net:	1.94:1 including Reverse Gas
Net-Net:	2.14:1 including Reverse Gas
Plan Area:	163'L x 161'W x 103'H
Budget Price:	$17,400,000 installed and insulated, exclusive of foundations or field wiring.

Note that the baghouse we have selected for this application is virtually identical in size and arrangement to the unit Ecolaire has provided to Deseret Generation and Transmission Cooperative for their Moon Lake Station.

ECOLAIRE ENVIRONMENTAL COMPANY

600 MW

Gas Volume:	1,982,000 ACFM
Gas Temp:	300°F
Fuel Fired:	Low Sulfur Sub-bituminous Coal
No. of Baghouses:	Two (2)
No. of Compartments:	Twelve (12) per Baghouse, 24 Total
Baghouse Cleaning:	Reverse Gas
Bag Type:	Woven Fiberglass with Teflon B Finish
Bag Size:	12"Ø x 36'-9" Long
No. of Bags:	450 per Compartment, 10,800 Total
Air/Cloth Ratios:	
Gross:	1.70 : 1
Net:	1.94:1 including Reverse Gas
Net-Net:	2.14:1 including Reverse Gas
Plan Area:	163'L x 161'W x 103'H
Budget Price:	$1[illegible],400,000 installed and insulated, exclusive of foundations or field wiring.

Note that the baghouse we have selected for this application is virtually identical in size and arrangement to the unit Ecolaire has provided to Deseret Generation and Transmission Cooperative for their Moon Lake Station.

FOSTER WHEELER ENERGY CORPORATION

110 SOUTH ORANGE AVENUE · LIVINGSTON, NEW JERSEY 07039 · PHONE 201-533-1100

ADDRESS REPLY TO:
11061 N.E. 2nd, P.O. Box 807, Bellevue, Washington 98009
Telephone (206) 454-7955 Telex: 152201

CC DeFies ✓
Keegan

May 21, 1984

Ebasco Services Inc.
400-112th Avenue N.E.
Bellevue, WA. 98004

Attention: Mr. G. Villesvik

Subject: Alaska Power Authority
Nenana Coal Field - Thermal Station
FWEC Ref. No.1015

Gentlemen:

In response to your inquiry letter of March 26, 1984, we herewith submit pricing for coal fired boilers of 200, 400 and 600 MW sizes.

The present day, escalatable material supply budget prices are as follows:

	MW SIZE		
	200	400	600
Steam flow, M Lb/Hr	1,590	3,158	4,703.5
Pressure, psig	2,650	2,650	2,650
Steam Temp. deg. F. SH/RH	1008/1005	1008/1005	1008/1005
Material Price, FOB Seattle	$25,000,000	$41,500,000	$56,500,000
Deduct for FD/ID Fans and Drives	$ 1,400,000	$ 2,400,000	$ 3,700,000

Budget prices for precipitators to follow.

The scope of supply included in the above is as follows:

Structural steel and platforms; boiler pressure parts; flues and ducts (fan to fan); Air heater and steam coil; firing equipment; burner front piping; burner management system; feeders and piping; pulverizers with drives; burners; primary air fan system with fans and drives; ID/FD fans and drives; sootblowers and piping; lagging, insulation and setting materials; normal complement of valves and fittings; normal start-up services.

Please note that the flue gas desulfurization system and precipitator are not included in the scope of supply.

May 21, 1984

Ebasco Services Inc.
for Alaska Power Authority
FWEC Ref. 1015

Erection Manhours

An estimate of erection manhours for each of the three sizes of boiler with the complete scope listed above is as follows:

	MW Size		
	200	400	600
Est. Manhours (Pacific N.W. area)	325,000	550,000	750,000

Weights

The steam drum is the heaviest piece of each of the boilers. Estimated weights for the drums are as shown:

	MW Size		
	200	400	600
Est. Drum Weight, Lb.	350,000	550,000	780,000

These budget prices are predicated upon the Corporation's Standard Price Adjustment Terms and Terms of Payment. Terms of Payment are of a progress nature consistent with the Corporation's outlay of capital.

These budget prices and selection information are provided for informational purposes and for convenience only. Accordingly, all work performed and/or decisions made shall be at the entire risk and obligation of the user.

Please let me know if I can be of further assistance.

Yours very truly,

FOSTER WHEELER ENERGY CORPORATION

Parker Trewin/nm

Parker Trewin, Manager
Northwest District Sales

cc: S.G. Conover, FWEC
H.J. Melosh, FWEC

nm

Utility Power Corporation

405 Lexington Avenue, New York, New York 10174 / (212) 682-8601 / Telex 12-5733

714-978-7401
Roger Woods -

April 27, 1984

Ebasco Services, Inc.
400 112th Avenue N.E.
Bellevue, WA 98004

Attention: Mr. Joseph J. Marshall
Senior Engineer

Re: Alaska Power Authority
Request for Estimate of Cost
for Turbine-Generators

Dear Mr. Marshall:

I refer to your request for cost estimates on furnishing of turbine-generators sized 600 MW, 400 MW and 200 MW.

In the following I am listing the prices based on our standard scope of supply, a copy of which is attached to this letter.

600 MW	4-Flow 30	$ 46,600,000
	4-Flow 35	49,800,000
400 MW	4-Flow 22	$ 34,000,000
	4-Flow 27	36,100,000
200 MW	2-Flow 22	$ 24,000,000

Should there be any more questions, please do not hesitate to call me.

Very truly yours,

Klaus Miller

Klaus Miller
Regional Vice President

KM:ns
encl.

SCOPE OF SUPPLY

SCOPE OF SUPPLY
TURBINE AND STANDARD TURBINE ACCESSORIES

A. TANDEM-COMPOUND SINGLE-REHEAT TURBINE

Consisting of one high-pressure section, one intermediate-pressure section, and either one, two or three low-pressure sections.

***B. STOP AND CONTROL VALVE SYSTEM**

1. Two or four main valve combinations, each consisting of a stop valve and a control valve, complete with supports. Each valve has its own hydraulic actuators.
2. Four reheat valve combinations, each consisting of a stop valve and control valve, complete with supports. Each valve has its own hydraulic actuator.
3. Piping with breech-lock type connections between main valve combinations and HP turbine casing. Piping with flanged or welded connections as required by design between reheat valve combinations and IP turbine casing.
4. Permanent fine-mesh steam strainer complete with separate casing for each main and reheat valve combination. The six or eight casings to be located in Purchaser's main and hot reheat steam piping.
5. Provision for local and remote testing of main stop and control valves, and of reheat stop and control valves while turbine is in operation.
6. Limit switches for the main and reheat stop valves with four double-pole, double-throw (DPDT) contacts at each end of the valve stroke and three DPDT contacts for each main and reheat control valve.
7. Position transducer for each main and reheat control valve.
8. Temporary sealing devices for main and reheat stop valves for boiler hydrostatic test. One set for duplicate units.

***C. TURBINE DRAINS**

1. Motor-operated drain valves for turbine valves, casings and steam piping as required with:
   a. Torque and travel limit switches.
   b. Manual isolating valves.
2. Piping from turbine equipment to each drain valve (up to 25 feet). Pipe hangers and supports not included.

D. SEAL-STEAM SYSTEM

1. Seal-steam pressure control system with supply and leak-off valves including a motor-operated bypass valve for each. The system automatically regulates seal-steam header pressure and has provision for local/remote manual operation.
2. Seal-steam condenser suitable for 125°F cooling water and 400 psig maximum pressure with one motor-driven vapor exhauster and one high water-level alarm. Stainless steel or 90-10 copper-nickel tubes.
3. Complete seal-steam piping from turbine to the regulating valves and to the seal-steam condenser. Pipe supports and hangers not included.

***E. EXHAUST HOOD SPRAY SYSTEM**

1. Spray nozzles installed in each LP turbine exhaust casing.
2. Piping between the control valve and spray nozzles. Pipe supports and hangers not included.
3. Solenoid valve with motor-operated bypass valve.
4. Temperature sensors with alarm contacts mounted in the LP turbine exhaust casings.

***F. LUBRICATING OIL SYSTEM**

1. Shaft-driven centrifugal main oil pump.
2. Lube oil tank (oil not included), equipped with:
   a. Oil turbine-driven vertical centrifugal booster pump.
   b. Two full-capacity vertical centrifugal auxiliary oil pumps with a-c motors.
   c. Vertical centrifugal emergency bearing oil pump with d-c motor and starter.
   d. Oil vapor exhauster with a-c motor.
   e. Oil mist eliminator.
   f. Basket-type oil strainers located at oil return to tank.
   g. Float-type oil-level indicator.
   h. Float-type oil-level switch with separate high and low-level contacts.
   i. Hinged and removable access covers.
   j. Two 100% capacity positive displacement shaft-lift oil pumps with a-c motors.
   k. Two 100% capacity oil coolers with 5/8 in OD 18 BWG minimum wall, 90-10 copper-nickel or Ad-

*REVISED SINCE LAST EDITION

Supersedes Page Dated Aug. 1, 1978

SCOPE OF SUPPLY
TURBINE AND STANDARD TURBINE ACCESSORIES

miralty metal integrally finned tubes for 95°F cooling water at 125 psig maximum, and a manually operated three-way transfer valve.

l. Pressure switches and solenoid valves for remote testing of auxiliary and emergency bearing oil pumps.

3. Duplex oil filter with transfer valve in oil piping feeding the combined thrust and journal bearing, complete with local indication and alarm of oil-pressure drop across filters and a pressure switch for alarm of low lube-oil pressure.

4. Complete interconnection oil piping between all pumps, coolers, turbine-generator bearings and tank. Pipe hangers and supports not included. All the oil-supply piping adjacent to the turbine is guarded by special pipe enclosure. Connections are provided on tank to accommodate Purchaser's external piping for his oil conditioning system.

5. All electrical connections, except motor power supplies, will be factory-wired to terminal boxes.

*G. MOTOR DRIVES

1. All motors are totally enclosed fan cooled with a service factor of 1.15 and Class B insulation. They are equipped with grounding provision, drain devices, thermostats, space heaters and oversized gasketed conduit boxes.

2. Standard a-c motors are rated 3-phase 460 volts ± 10% for continuous operation and are capable of starting and accelerating at 75% rated voltage.

3. Standard d-c motors are rated either 120 or 240 volts and are capable of operating with a ± 15% voltage variation.

H. OIL-HYDRAULIC TURNING GEAR

1. Oil-impulse turbine mounted on shaft system for rotation at approximately 150 rpm.

2. Piping between auxiliary oil pump discharge header and oil turbine, complete with motor-operated control valve.

3. Mechanical shaft rotating device to allow turbine-generator shaft to be turned manually.

*I. TURBINE CONTROL SYSTEM

1. Electro-Hydraulic Control (EHC) System.

a. Electronic control circuits, including:

(1) Speed control for both speed and load operation consisting of:

(a) Three-channel speed measuring system with shaft-mounted disc, pulse converters and one spare transducer.

(b) Limiting signals from the Turbine Stress and Start-Up Control (TSC) System (see Item J).

(2) Load control consisting of:

(a) Two-channel electrical load measuring system.

(b) Provisions for HP turbine admission pressure or control valve position feedback.

(c) Remotely adjustable loading rate.

(d) Automatic transfer from load to speed control.

(e) Remotely adjustable load limit set point.

(f) Frequency-load control unit.

(g) Four load run-backs (three for Purchaser's use).

(h) Limiting signals from the TSC system.

(3) Pressure control consisting of:

(a) Main steam pressure transducer.

(b) Throttle pressure and limit pressure control.

(4) Admission control with electro-hydraulic converter for positioning the main and reheat control valves.

(5) Tracking device for Mechanical-Hydraulic Control (MHC) back-up operation.

(6) Interface provisions for Purchaser's automatic load dispatch or coordinated boiler control.

(7) Provisions for Early Valve Actuation, if required by Purchaser.

b. Speed Measuring Unit (SMU) including:

(1) Speed measuring circuits mounted in the EHC cabinet.

*REVISED SINCE LAST EDITION

SCOPE OF SUPPLY
TURBINE AND STANDARD TURBINE ACCESSORIES

(2) Speed signals consisting of:

(a) Analog outputs for local and remote unit speed indication, recording and TSC.

(b) Limit-value monitors for TSI, ATT, ATC, TVR and generator condition monitoring system.

(3) Speed signals for Purchaser's use consisting of:

(a) Analog output.

(b) Limit-value monitors for:

1. Minimum speed.
2. Automatic operation of turning gear.
3. Automatic operation of shaft-lift oil pumps.
4. Automatic shutoff of LP exhaust hood spray valve.

(c) Digtal output from pulse converter.

c. Free-standing EHC cabinets containing:

(1) Solid-state control circuits.

(2) Remotely operated reference setters.

(3) Alarm contacts for indicating failures within the electronic system.

(4) Grounding provisions, convenience outlet.

d. Control panel (Item L2) for mounting in Purchaser's Control Room.

2. Mechanical-Hydraulic Control (MHC) System.

The MHC functions as back-up to the EHC and it includes the following:

a. Turbine shaft-driven impeller which provides the hydraulic speed signal.

b. Mechanical-hydraulic speed governor, including an a-c motor-operated reference speed setter, hydraulically in series with an a-c motor-operated starting and load limit device. Each device has a local handwheel. Remote-control pushbuttons are located on turbine control panel (Item L.2).

3. Electro-Hydraulic and Hydraulic-Hydraulic Converters to provide a hydraulic positioning signal to the main and reheat control valves.

4. Hydraulic Control Equipment Rack located at the turbine front end and Control Fluid Supply Racks located near control valves.

5. Control Fluid System with fire resistant fluid operating at 450/110 psig including the following:

a. Fluid tank (fluid not included) with access door, level indicator, high and low level alarm contacts.

b. Two 100% capacity submerged centrifugal pumps with vertical a-c motor mounted on top of tank, each with inlet strainer.

c. Two 100% capacity fluid coolers with 5/8" OD, 18 BWG minimum 90-10 copper-nickel tubes for 95° F cooling water at 125 psig maximum, and a manually operated transfer valve.

d. Fluid conditioning equipment consisting of:

(1) Filter pump with a-c motor.

(2) Fuller's earth filter with differential pressure switch.

(3) Fine-mesh filter with differential pressure switch.

(4) Relief valve.

(5) Interconnecting piping.

e. Fluid accumulators.

f. Tank-mounted fluid heaters.

g. Pressure switch with solenoid valves for remote testing of fluid pump motors and for low pressure alarm.

h. Carbon steel piping for control fluid system. Pipe hangers and supports not included.

i. All electrical connections, except motor power supplies, will be factory-wired to terminal boxes.

*J. TURBINE STRESS AND START-UP CONTROL (TSC) SYSTEM

1. The TSC performs the following functions:

a. Continuous monitoring of thermal stress conditions in turbine valves, casings and rotors.

b. Computation, logging and recording of life expenditure of turbine components due to low-cycle fatigue.

*REVISED SINCE LAST EDITION

SCOPE OF SUPPLY
TURBINE AND STANDARD TURBINE ACCESSORIES

c. Control, in conjunction with the EHC, of manual and automatic turbine start-up and loading.

d. Automatic Turbine-Generator Start-Up Control (ATC) from turning gear to preset load and shut-down including the following pre-programmed functions:

(1) Monitoring of unit prestart conditions.

(2) Opening of stop valves.

(3) Control of acceleration to holding and/or rated speed.

(4) Synchronization with automatic synchronizer.

(5) Loading and unloading.

(6) Continuous supervision of turbine thermal stresses and proper functioning of turbine auxiliary systems.

2. Sensing equipment on the turbine-generator:

a. Special thermocouples.

b. Temperature transducers.

3. Free-standing TSC cabinet containing:

a. Programmable microprocessor based solid-state circuits with memory, automatic self-testing features and alarm contacts.

b. Grounding provisions.

c. Data link to station computer for data logging.

4. Colored CRT and keyboard for mounting in Purchaser's control room.

5. Instruments and control for mounting in Purchaser's control room including:

a. Cycling selector pushbuttons for normal/medium/fast turbine start-up and loading.

b. Turbine Stress Indicator for graphic display of:

(1) Turbine speed and permissible temperature margins.

(2) Generator load and permissible load margins.

c. Multi-point recorders for:

(1) Turbine metal temperatures.

(2) Computed rotor mean and center temperatures.

(3) Permissible temperature and load margins.

(4) Turbine speed or generator load.

d. Teleprinter for:

(1) Data per item c above.

(2) Life expenditure per thermal cycle.

(3) Remaining life expectancy.

(4) ATC program steps, operating criteria and alarms.

e. Life expectancy counters for each monitored turbine component.

f. TSC control panel (Item L.2) for mounting in Purchaser's control room.

6. Programming equipment with fixed program storage.

*K. AUTOMATIC TURBINE TESTER (ATT)

1. The ATT provides on-line automatic functional testing of the following:

a. All turbine stop and control valves.

b. Protective devices:

(1) Two remote trip solenoids.

(2) Two overspeed trip bolts.

(3) Thrust bearing failure trip.

2. Indicating lights on the control panel for:

a. Malfunction of system(s).

b. Test program steps.

c. Criteria failures.

d. Common alarms.

3. Components on the turbine including:

a. Motor-operated positioner for each control valve and overspeed test device.

b. Solenoid valves, pressure switches and limit switches for testing or check-back signals of all stop valves, control valves or mechanical protective devices.

4. Electrical overspeed back-up trips during testing of protective devices. Back-up trips are individually tested before actuation.

SCOPE OF SUPPLY
TURBINE AND STANDARD TURBINE ACCESSORIES

5. Free-standing ATT cabinets containing digital solid-state control circuits, contactors, grounding provisions, and alarm contacts for monitoring internal failures.

6. Control panel for mounting in Purchaser's control room (Item L.3).

*L. TURBINE-GENERATOR CONTROL PANELS

1. Control panels for mounting in Purchaser's control room including:
   a. Miniaturized control inserts.
   b. Instruments of modular design with lamp testing.
   c. Up to 100 feet of flame-retardant plug-in cables.

2. T-G control panel with system fault indications and lamp tests including:
   a. Electro-Hydraulic Control (EHC) System with:
      (1) Indicator for:
         (a) Speed
         (b) Load
         (c) Main steam pressure
         (d) Reheat steam pressure
      (2) Speed reference setter and indicators for 0-4200 rpm and 3300-4200 rpm.
      (3) Limited speed reference indicator.
      (4) Load control on/off with indicating lights.
      (5) Load reference setter and indicator.
      (6) Limited load reference indicator.
      (7) Automatic dispatch system on/off with indicating lights and dispatch load reference indicator.
      (8) Load limit reference and indicator.
      (9) Loading rate setter on/off with indicating lights and indicator.
      (10) Total load reference indicator.
      (11) Frequency load control on/off with indicating lights and frequency/load deviation indicator.
      (12) Pressure deviation indicator.
      (13) Throttle pressure or limit pressure mode selector with indicating lights.
      (14) Master turbine trip pushbutton with cover plate for protection from accidental activation.
      (15) Release pushbutton.
      (16) Indicating lights for:
         (a) Speed/load/pressure control in operation.
         (b) EHC failure.
         (c) Limit pressure value reached.
         (d) Acceleration low limit value reached.
         (e) Load runback switched off.
         (f) TSC switched off.
         (g) ATC switched off.
   b. Mechanical-Hydraulic Control (MHC) System with:
      (1) Tracking on/off with indicating lights.
      (2) Hydraulic load limit setter and position indicator.
      (3) Hydraulic speed setter and position indicator.
   c. Turbine Stress and Start-Up Control (TSC) System with:
      (1) Cycling normal/medium/fast selector.
      (2) Pushbutton selector for Turbine Stress Indicator.
      (3) Life-expectancy counters.
      (4) Pushbuttons for TSC test program.
      (5) Pushbuttons for ATC program start/stop and on/off.
      (6) Step and criteria indication lights.
   d. Valve Position Indication (VPI) with:
      (1) Individual stop valve open/closed indicating lights.
      (2) Individual control valve position indicators.
   e. Seal-Steam Control (SSC) System with:
      (1) Seal-steam supply and leak-off valve position setter with position indicators.
      (2) Seal-steam header pressure indicator.
      (3) SSC on/off with indicating lights and control deviation indicator.

SCOPE OF SUPPLY
TURBINE AND STANDARD TURBINE ACCESSORIES

3. Automatic Turbine Tester (ATT) with:
   a. Valves/Protective devices test selector with indicating lights.
   b. Individual stop and control valve test program selector with indicating lights.
   c. Remote solenoid trip test program selector with indicating lights.
   d. Overspeed trip test program selector with indicating lights.
   e. Thrust-bearing trip test program selector with indicating lights.
   f. Visual display of program steps, criteria failures and common alarms for above tests.
4. Thyristor Voltage Regulator (TVR) with:
   a. Generator field current indicator.
   b. Reference setter for channel 1 (auto) and 2 (auto/-manual) with deviation indicator.
   c. Automatic and matching control mode selector with indicating lights.
   d. Exciter field breaker open/closed.

*M. TURBINE-GENERATOR SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

1. Microprocessor based data acquisition system (DAS) to evaluate, display and retrieve long and short-time storage for:
   a. Real-time information of actual data, trend graphics and alarm conditions.
   b. Instruction messages to the operator for manual control.
   c. Paging capability for display of systems and/or variables as selected by the operator.
2. Sensing equipment for:
   a. Absolute and relative shaft vibration.
   b. Absolute bearing vibration.
   c. Differential and absolute expansion.
   d. Shaft position at thrust bearing.
   e. Shaft eccentricity.
   f. Control valve position (Item B.7).
   g. Temperature and pressure-sensing equipment listed under other systems.
3. Vibration phase-angle meter and selector switch, including shaft mounted reference detector and required circuitry.
4. Free-standing cabinets containing analog solid-state and microprocessor based circuits, grounding provisions, alarm contacts for monitoring internal failures, etc. including:
   a. Alarm contacts for indication of excessive absolute shaft vibrations, expansions and shaft position.
   b. Analog signals for Purchaser's computer.
   c. Local indicators mounted at the amplifier face for M.2.a, b, c, d and e.
5. Recorders for mounting in Purchaser's control room for vibration, expansion, eccentricity, turbine metal temperatures and bearing metal temperatures, including one year's supply of paper.
6. Colored CRT and teleprinter for mounting in Purchaser's control room.

*N. TURBINE PROTECTIVE DEVICES

1. Emergency trip devices including:
   a. Two mechanical-hydraulic overspeed trip devices with alarm contacts and provisions for local manual testing.
   b. Two-channel vacuum trip system with pressure transducers and pre-trip alarm.
   c. Two thrust bearing failure trip devices; one mechanical-hydraulic device with alarm contacts, and one electrical system derived from shaft position measurement with pre-trip alarm.
   d. Two remote trip solenoids and alarm contacts.
   e. Two-channel low lube-oil pressure trip system with pressure transducers and pre-trip alarm.
   f. High absolute shaft vibration trip with pre-trip alarm.
   g. Manual trip devices at front of turbine with alarm contacts and remote trip pushbutton on turbine control panel.
2. Load Rejection Relay (LRR) for fast control valve closure mounted in cabinet.

SCOPE OF SUPPLY
TURBINE AND STANDARD TURBINE ACCESSORIES

3. Atmospheric relief diaphragms mounted in each LP turbine outer casing.
4. Three separate pressure switches actuated by a hydraulic relay to operate Purchaser's extraction non-return valves.

*O. TURBINE MONITORING EQUIPMENT

1. Gauges to indicate locally:
   a. Main oil pump discharge pressure.
   b. Control fluid pressures.
   c. Lubricating oil pressure.
   d. Shaft lift oil pressure.
   e. Seal steam pressure.
2. Remote indicators for mounting in operating control panels including transducers for:
   a. Main steam pressure.
   b. Reheat steam pressure.
   c. Turbine-generator kW load.
3. Dial-type thermometers to indicate locally:
   a. Control fluid temperatures at inlet and outlet of fluid coolers.
   b. Temperature of oil leaving combined thrust and journal bearing.
   c. Temperature of oil leaving each main journal bearing.
   d. Oil temperatures at inlet and outlet of oil coolers.
4. Thermocouples to measure:
   a. HP and IP turbine and valve casing metal temperatures.
   b. Thrust bearing metal temperaturs.
   c. Journal bearing metal temperatures.
   d. Exhaust hood temperatures.
   e. Oil temperatures at inlet and outlet of oil coolers.
   f. Fluid temperatures at inlet and outlet of control fluid coolers.
5. Digital speed indicator (0–4200 rpm).
6. Position indicating lights for stop valves and overspeed trip bolts.

*P. POWER SUPPLY

Free-standing cabinet(s) with power supply for all turbine-generator electronic control systems with inputs from:

1. Permanent magnet generator (PMG).
2. Purchaser's single-phase or three-phase a-c power supply bus.

*Q. ELECTRICAL JUNCTION BOXES

NEMA 12 boxes mounted at the equipment and/or at various accessible locations adjacent to the turbine-generator to which electrical instrumentation and controls are wired.

*R. THERMAL INSULATING MATERIAL

For installation by Purchaser on HP and IP turbines, valves and strainer casings, seal steam condenser, and on all steam piping supplied with the turbine, in accordance with PowerCorp specifications, including the following:

1. Reusable blankets for the barrel-type HP turbine.
2. Scored block insulation for IP turbine, main and reheat valve bodies, strainer casings, and seal steam condenser. Reusable blankets or reusable block insulation for flanged joints, expansion joints and connections.
3. Pre-formed pipe insulation with either fabric or aluminum jacketing for piping furnished with the turbine.

S. TURBINE METAL APPEARANCE LAGGING

For enclosing HP and IP turbines installed indoors, with sound-absorption material applied on all inside surfaces. Embedded support plates to be supplied by Purchaser.

T. TURBINE SUPPORT ACCESSORIES

Foundation plates, shims and subsole plates, guide keys, as required, to set and align turbine.

*U. BARREL-TYPE TURBINE FIXTURES

(One set per station with duplicate units)

1. Special assembly and disassembly device for breech lock.
2. Special jigs for disassembly and assembly of HP turbine rotor and inner and outer casings including:

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SCOPE OF SUPPLY
TURBINE AND STANDARD TURBINE ACCESSORIES

a. Centering rings to lock HP turbine rotating and stationary parts to one another both axially and radially.

b. Eye-hook bolt-in extension for HP turbine rotor.

c. Four-point supporting fixture for HP turbine.

V. MAINTENANCE EQUIPMENT

1. One set of lifting slings and one lifting beam (one set per station with duplicate units).
2. Special tools and wrenches (maximum of two sets per station with duplicate units).
3. Steam strainer removal devices (one set per station with duplicate units).

*W. MANUALS

Maximum of twenty-five (25) copies of each of the following manuals (one set per station with duplicate units):

1. Turbine operating instructions.
2. Generator operating instructions.
3. Turbine-generator maintenance.
4. Renewal parts.

*X. SEISMIC RESTRAINTS

Special seismic restraints for turbine-generator equipment are not included. Where required, such restraints are to be applied by Purchaser and suitable attachment provisions will be made where feasible.

SCOPE OF SUPPLY
GENERATOR AND STANDARD GENERATOR ACCESSORIES

GENERATOR

The synchronous generator is totally enclosed with water-cooled stator winding, hydrogen-cooled core suspended in spring cage, hydrogen-cooled rotor winding and rotor damper winding system.

*B. TERMINAL BUSHINGS

1. Six water-cooled high-voltage bushings with air-end terminals.
2. Two bushing-type current transformers per bushing (total of twelve) with C-800 relaying accuracy and 0.3B2 metering accuracy. Provisions for installation of one additional current transformer per bushing.

*C. INSTRUMENTATION

1. RTD's on hydrogen coolers for gas inlet and outlet temperature indication.
2. Alarm thermostats for cooler gas inlets and outlets.
3. Thermocouples for cooler gas outlets.
4. Thermocouples for bearing metal temperature.
5. Liquid monitors to detect possible liquid leakage in generator casing and terminal bushing box.
6. Six RTD's in stator slots.
7. One thermocouple on each stator coil water outlet.
8. Terminal boxes with terminals for RTD's, thermostats, thermocouples, etc.
9. Generator condition monitoring system.
10. Shaft vibration sensors.

*D. SEAL-OIL SYSTEM

1. One seal-oil unit assembled on a common base including:

Hydrogen Side:

a. Seal-oil tank with two low oil level detectors and local level gauge.

b. One seal-oil pump with a-c motor.

c. One pressure relief valve for seal-oil pump.

d. One seal oil cooler with 5/8" OD 18 BWG minimum 90-10 CuNi or Admiralty metal tubes designed for a cooling water temperature of 95° F at a pressure of 125 psig.

e. Dual seal-oil filters with transfer valve.

f. One control valve for seal-oil pump discharge pressure.

Air Side:

a. Two main seal-oil pumps with a-c motors.

b. One back-up seal-oil pump with d-c motor and starter.

c. One pressure relief valve for each main and back-up seal-oil pump.

SCOPE OF SUPPLY
TURBINE AND STANDARD TURBINE ACCESSORIES

a. Centering rings to lock HP turbine rotating and stationary parts to one another both axially and radially.

b. Eye-hook bolt-in extension for HP turbine rotor.

c. Four-point supporting fixture for HP turbine.

V. MAINTENANCE EQUIPMENT

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2. Alarm thermostats for cooler gas inlets and outlets.
3. Thermocouples for cooler gas outlets.
4. Thermocouples for bearing metal temperature.
5. Liquid monitors to detect possible liquid leakage in generator casing and terminal bushing box.
6. Six RTD's in stator slots.
7. One thermocouple on each stator coil water outlet.
8. Terminal boxes with terminals for RTD's, thermostats, thermocouples, etc.
9. Generator condition monitoring system.
10. Shaft vibration sensors.

*D. SEAL-OIL SYSTEM

1. One seal-oil unit assembled on a common base including:

Hydrogen Side:

a. Seal-oil tank with two low oil level detectors and local level gauge.

b. One seal-oil pump with a-c motor.

c. One pressure relief valve for seal-oil pump.

d. One seal oil cooler with 5/8" OD 18 BWG minimum 90-10 CuNi or Admiralty metal tubes designed for a cooling water temperature of 95° F at a pressure of 125 psig.

e. Dual seal-oil filters with transfer valve.

f. One control valve for seal-oil pump discharge pressure.

Air Side:

a. Two main seal-oil pumps with a-c motors.

b. One back-up seal-oil pump with d-c motor and starter.

c. One pressure relief valve for each main and back-up seal-oil pump.

SCOPE OF SUPPLY
GENERATOR AND STANDARD GENERATOR ACCESSORIES

d. Two differential-pressure regulating valves for seal-oil pressure control.

e. Two 100% capacity seal oil coolers with 5/8" OD 18 BWG minimum 90-10 CuNi or Admiralty metal tubes designed for a cooling water temperature of 95°F at a pressure of 125 psig, and manual transfer valves.

f. Duplex seal-oil filter with manual transfer valves.

Common to Hydrogen and Air Side:

a. Check valves and shutoff valves.

b. Piping and fittings, excluding vent piping.

2. Valve rack.

a. Two differential pressure regulating valves for hydrogen side seal-oil pressure control.

b. One differential pressure regulating valve in by-pass to orifice.

c. Piping, check and shutoff valves.

3. Degassing tank with low oil level detector.

4. Two oil/hydrogen vapor exhausters with a-c motors, and one pressure transmitter.

5. Instrumentation.

a. Four pump discharge pressure gauges and pressure switches.

b. One oil pressure gauge, one pressure transmitter and two pressure switches for air side seal ring inlets.

c. Two differential pressure gauges for oil pressure difference between hydrogen side and air side seal oil.

d. One pressure gauge and pressure transmitter in each air side signal line.

e. One pressure gauge in generator casing pressure signal line.

f. Differential pressure indicators with alarm contacts for hydrogen and air side seal-oil filters.

g. One pressure gauge for air side seal-oil supply.

h. One pressure gauge for hydrogen side seal oil supply.

i. Two seal ring relief oil pressure gauges.

j. Four oil temperature RTD's after seal-oil coolers.

k. Four thermometers in oil inlet and outlet lines of seal-oil coolers.

l. Two generator prechamber high liquid level detectors.

m. Two oil temperature RTD's in generator prechamber.

n. Flow meters in air side, hydrogen side seal-oil and seal ring relief oil circuits.

6. Miscellaneous.

a. NEMA-12 junction boxes for all electrical connections except for motors.

b. All required piping between generator and seal-oil unit. Pipe hangers, supports and vent pipes not included.

E. HYDROGEN COOLERS

Four vertical hydrogen coolers, located in the generator casing end section(s), with 5/8" OD 18 BWG minimum 90-10 copper-nickel or Admiralty metal finned tubes designed for a cooling water temperature of 95°F at a pressure of 125 psig.

*F. GAS SYSTEM

1. One hydrogen/carbon dioxide supply unit consisting of:

a. CO_2/H_2 purity transducer.

b. Fan differential pressure gauge for H_2 purity indication.

c. One generator casing pressure gauge and one pressure transducer.

d. Piping and fittings. Pipe hangers and supports not included.

e. One NEMA-12 junction box for all electrical connections.

f. Compressed air filter.

g. Connection for Purchaser's piping from central H_2 and CO_2 gas supply including pressure regulator and gauges.

2. One gas drier with heater, thermostat and regeneration blower including valve position switch.

3. One hydrogen bottle manifold assembly.

a. Bottle connectors with shutoff valves.

b. Two pressure regulators with gauges.

c. One pressure gauge and pressure switch for bottle pressure.

Utility Power Corporation

STEAM TURBINE-GENERATORS

FOSSIL • REHEAT • CONDENSING • 3-PHASE • 60 HERTZ • 3600 RPM

SCOPE OF SUPPLY
GENERATOR AND STANDARD GENERATOR ACCESSORIES

4. One carbon dioxide bottle manifold assembly.
   a. Bottle connectors with shutoff valves.
   b. One pressure gauge for bottle pressure.
   c. One CO_2 flash evaporator with heater, relief valves, thermometer and RTD.
5. One nitrogen bottle manifold assembly.
   a. Bottle connector with shutoff valve.
   b. Pressure regulator with gauge.
   c. Pressure gauge for bottle pressure.
   d. Flow meter.
6. Miscellaneous.

   All required piping between generator, hydrogen/carbon dioxide supply unit, gas drier and bottle H_2, CO_2, and N_2 manifolds. Vent pipes, pipe hangers and supports not included.

PRIMARY WATER SYSTEM

Demineralized water-cooling system for a generator with water-cooled stator winding, connector leads and terminal bushings.

1. Primary water supply unit mounted on common base including:
   a. Two 100%-capacity circulating water pumps with a-c motors.
   b. Main filter.
   c. Ion exchanger.
   d. Fine mesh filter.
   e. NEMA-12 junction box for all electrical connections except motors.
   f. Check and shutoff valves.
   g. Make-up water filter.
2. Primary water cooler unit with three 50%-capacity coolers with 5/8" OD 18 BWG minimum copper or 90-10 CuNi tubes, designed for a cooling water temperature of 95°F at a pressure of 125 psig.
3. Primary water tank with water level sight gauge mounted on top of generator with connections for waste gas system.
4. NaOH injection unit.
5. Waste gas pressure regulator.
6. Strainers at inlet and outlet of stator coil.
7. Sight glasses in bushing circuits and waste gas system.
8. All required piping (stainless steel) between generator, primary water supply unit, cooler unit, and valve rack. Vent pipes, drain pipes, pipe hangers and supports not included.
9. Instrumentation includes:
   a. Two conductivity measuring sensors: one in main loop, and one in ion exchanger circuit.
   b. Four metering orifices for primary water flow measurement, one in stator outlet and three in bushing outlets.
   c. Eight flow transmitters with indicators, two at stator outlet and six at bushing outlets.
   d. Flow meter in ion exchanger circuit.
   e. Two water pressure gauges and two pressure switches for pump discharges and one pressure gauge and transmitter for stator inlet.
   f. Six RTD's, four in the stator inlet, one in stator outlet and one in bushing outlet.
   g. One primary water tank level monitor with low and high level alarm contacts.
   h. Differential pressure transmitter to indicate pressure drop across main and fine mesh filters.
   i. One dial-type thermometer for measuring primary water temperature in stator coil inlet and one in common terminal bushing outlet.
   j. Flow meter for make-up water.
   k. Waste gas pressure gauge and switch.
   l. One differential pressure transmitter for primary water pressure drop in stator winding.

*H. MOTOR DRIVES

1. All motors are totally enclosed fan-cooled with a service factor of 1.15 and Class B insulation. They are equipped with grounding provision, drain devices, thermostats, space heaters and oversized gasketed conduit boxes.
2. Standard a-c motors are rated 3-phase 460 volts ± 10% for continuous operation and are capable of starting and accelerating at 75% rated voltage.
3. Standard d-c motors are rated either 120 or 240 volts and are capable of operating with a ± 15% voltage variation.

SCOPE OF SUPPLY
GENERATOR AND STANDARD GENERATOR ACCESSORIES

*I. GENERATOR PROTECTION EQUIPMENT

1. Trips with pre-trip alarms for:
   a. High liquid level in generator terminal box.
   b. High absolute generator/exciter shaft vibration.
   c. Rotor ground fault.
   d. Generator runback failure.
2. Runbacks with alarms for:
   a. Low primary water flow in stator circuits.
   b. Low primary water flow in bushing circuits.
   c. High primary water temperature downstream of coolers.
   d. High hydrogen temperature.

*J. GENERATOR AUXILIARY CABINET (GAC)

Control and supervisory NEMA 12CV cabinets for the generator and for the hydrogen, primary water and seal oil supply systems including:

1. Control circuits with control switches and on/off indicating lights for all motors and heaters (a-c motor starters not included).
2. Supervisory circuits with front panel-mounted indicators for:
   a. Percentage of CO_2 in air and H_2 in CO_2.
   b. Hydrogen purity.
   c. Hydrogen pressure.
   d. Primary water conductivity in main circuit.
   e. Primary water conductivity in ion exchanger circuit.
   f. Primary water flow in stator and terminal bushings.
3. Supervisory circuits for liquid level alarm in:
   a. Generator terminal box.
   b. Generator housing.
   c. Generator seal oil tank, degassing tank and prechambers.
   d. Primary water tank.
4. Annunciator, including alarms from generator auxiliaries, seal-oil, gas and primary water systems (a-c and d-c alarm horns for external mounting included).
5. Signals for Purchaser's use consisting of:
   a. Analog signals for items 2b, c, d and e.
   b. Alarm contacts for the following:
      (1) Items 2b, c, d, e and f.
      (2) Items 3a, b and c.
      (3) GAC failure.
      (4) A-c and d-c power supply failure.
      (5) Items in J.4.
6. Space heaters.
7. Interior lighting and convenience outlets.

*K. MISCELLANEOUS

1. Sole plates, shims and, if required, sub-sole plates. Support plates for lagging not included.
2. Removable lagging from center line to floor.
3. Four generator frame grounding pads and shaft grounding brushes.
4. Terminals for testing bearing and seal housing insulation.

L. MAINTENANCE EQUIPMENT

1. Necessary equipment for assembling the rotor into the armature (one set per station with duplicate units).
2. Special devices for installing end shields, bearings and shaft seals (one set per station with duplicate units).
3. Lifting slings for generator rotor (one set per station with duplicate units).
4. Special tools and wrenches (maximum of two sets per station with duplicate units).

*M. SEISMIC RESTRAINTS

Special seismic restraints for turbine-generator equipment are not included. Where required, such restraints are to be applied by Purchaser and suitable attachment provisions will be made where feasible.

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SCOPE OF SUPPLY
BRUSHLESS EXCITATION SYSTEM AND STANDARD ACCESSORIES

*A. EXCITER

Mounted on a common base plate including:

1. Shaft-driven permanent magnet generator to excite the main a-c exciter field through a thyristor voltage regulator and provide power supply to the control systems.
2. Shaft-driven a-c main exciter with a rotating armature and stationary field winding including special coils for sensing the main generator field current.
3. Rotating rectifier wheels with silicon diodes, resistance-capacitive circuits and fuses with visual failure indicators.
4. Sole plates including shims and, if required, sub-sole plates.
5. An exciter shaft-mounted fan for the closed-circuit air cooling system with two coolers having finned 90-10 copper-nickel or Admiralty metal 18 BWG tubes, Muntz metal tube sheets and steel water boxes and designed for 95°F cooling water at a pressure of 125 psig maximum.
6. Insulated pedestal bearing(s), including insulated oil flanges.
7. One exciter housing mounted over the rectifier wheels, main a-c exciter, pilot exciter, air coolers, with the following features:
   a. Motor-operated louvers for admitting and discharging ambient air for emergency cooling.
   b. Observation windows.
   c. Doors with locking devices at the end of the housing for access to all parts of the rotating excitation system.
   d. Set of internal lights, switches and convenience outlets.
   e. Make-up air filter(s).
8. Junction box on exciter base.
9. Slip rings, brush holder assembly and brushes for continuous rotor ground fault detection.
10. Instrumentation
    a. Duplex RTD's and thermostats for main exciter cold air temperatures, main exciter hot air temperatures and rectifier wheel hot air temperature. Cold air temperature thermostat provided for emergency louver control.
    b. Thermocouple for exciter bearing metal temperatures.
    c. Shaft and bearing housing vibration sensors.
    d. Portable stroboscope for diode fuse inspection.

*B. THYRISTOR VOLTAGE REGULATOR (TVR)

1. TVR cabinets containing solid-state electrical control circuits for 2 channel automatic and manual control, breakers, contactors, alarm contacts for monitoring failures, power supply connections, grounding provisions, etc., including the following:
   a. Power supply for thyristors from pilot exciter with under voltage supervision.
   b. Three draw-out type thyristor sets (two required for operation) each with pulse amplifiers and monitoring circuits, for exciting the main exciter field.
   c. Automatic 2 channel voltage regulator with:
      (1) Voltage measuring and control circuits.
      (2) Reactive current compensation.
      (3) Remotely operated, motor-driven reference setter.
      (4) Overexcitation limiter.
      (5) Underexcitation limiter.
      (6) Field forcing limiter.
      (7) Field forcing protection circuits.
      (8) Excitation buildup circuits.
      (9) V/Hz limiter.
      (10) Continuous matching of automatic channels 1 and 2.
      *(11) Manual limitation of field forcing in case of rotating diode or fuse failure.
   d. Manual excitation control circuits for operation during checkout and maintenance with remote motor-operated reference setter (from channel 2) adjustable from zero to full load excitation.
   e. Gate control units for supplying firing pulses to thyristors including stabilized power supply.

SCOPE OF SUPPLY
BRUSHLESS EXCITATION SYSTEM AND STANDARD ACCESSORIES

f. Runback circuits (reactive load to minimum).

g. Connections for Purchaser's 125 volts d-c battery supply for control of field breaker, power supply breakers, etc.

h. Main exciter field breaker and field discharge resistor with two-channel trip system with connections for Purchaser's master trip signals, including de-excitation circuits for inverter operation of thyristors prior to main exciter field breaker trip.

i. Field breaker closing circuits with speed interlock to prevent excitation below 95% speed at start-up and automatic de-excitation when speed drops below 90%.

j. Exciter field current shunts.

k. Input circuits for lower/raise commands from automatic synchronizer.

l. Automation interface for closing field breaker.

m. Analog signals for exciter and generator field current.

n. Digital signals for field breaker position for Purchaser's use.

2. TVR control panel for mounting in Purchaser's control room.

3. <u>QUESTION</u>

b) The operation and maintenance (O&M) cost data developed for the APA/Harza review of O&M cost for Alaskan based coal-fired steam electric power plants.

<u>RESPONSE</u>

The information used to estimate the O&M cost for an Alaska based coal-fired power plant was derived from an analysis of the O&M costs of a number of 200 MW power plants in the Lower 48, since no comparably sized units are currently operating in Alaska. The information obtained from this analysis of Lower 48 units, which is presented in response to Question 3(d), was adjusted for Alaska conditions. The adjustments are also discussed in response to Question 3(d).

Also consulted in developing the O&M cost estimate was a report prepared by the Electric Power Research Institute (EPRI), entitled "Operating and Maintenance Cost Survey of FGD Systems", (March 1983). This report, which surveyed the widely-varying O&M costs of FGD systems in coal-fired power plants, is provided as Volume III, Appendix 2 of this response.

3. QUESTION

c) Documentation and detailed explanation of changes in environmental regulations which translate into increased O&M costs for coal-fired plants between the time the application was filed and the submittal of comments on the DEIS.

RESPONSE

As indicated in the DEIS comments, increased O&M costs for the FGD system were due to the change in regulatory requirements between EPA's 1973 New Source Performance Standards (NSPS) and the 1979 NSPS.

At the time the Railbelt study was prepared (1982), power plants designed to the standards of the 1979 NSPS were only commencing operation, hence experience-based data did not exist and O&M costs were based on the 1973 NSPS. Experience-based data were required for the new standards in order to estimate O&M costs, since O&M costs are dependent on the reliability of the new system and reliability could only be ascertained after operating experience.

The basic difference between the two standards is inclusion of a minimum percent reduction requirement of SO_2 emissions in the new standard. The 1973 standard limited emissions to 1.2 lb SO_2 per million Btu of heat input. The 1979 NSPS regulations now in effect require a minimum of 70 percent removal for all controlled emissions less than 0.6 lb SO_2 per million Btu. The major effect of the new standard has been to require SO_2 emissions control on low sulfur coals which under the 1973 standard would not have required any SO_2 control.

The 1979 NSPS[2/] also significantly strengthened the reliability requirements for FGD systems. The 1973 regulations permitted bypass of the FGD system during malfunction of portions of the system, hence permitting continued power plant operation.

The 1979 requirments allow the utility to bypass the system only if the following are true:

- The system has a spare FGD module;

2/ New Stationary Source Performance Standards; Electric Utility Steam Generating Units, 44 Fed. Reg. 33580 (June 11, 1979).

- Enough modules are not available to treat the entire flue gas generated;
- All available power is being used in the power pool or "grid"; and
- Power cannot be purchased from neighboring utilities.

Because of these greater reliability requirements, systems are not only more expensive, but are also being maintained to a much higher level than they were in years prior to the 1979 requirements.

3. QUESTION

d) A copy of the detailed Power Authority/Harza analysis of O&M cost for coal-fired power plants in other parts of the country, including identification of the plants considered and appropriate technical plant similarities or differences.

RESPONSE

The Power Authority analysis of O&M cost data for coal-fired power plants reviewed utility fixed and variable costs for 200 MW nominal units in the Lower 48 states, since there are presently no operational coal-fired power plants of this size range in Alaska.

The basic selection criteria was to evaluate plants not only in the 200 MW size range but also to evaluate plants burning coal with characteristics similar to Alaska coals. It was also considered desirable in the selection process to evaluate coal plants with similar flue gas particulate and sulfur removal equipment.

As can be seen in the attached summary table (Attachment 3d.1), the plants considered in the evaluation were as follows:

- ° Huntington #1 (Utah Power & Light)
- ° Parish Plant (Houston Power & Light)
- ° Southwest Plant (Springfield City Utility)
- ° Asbury Plant (Empire District)
- ° Dave Johnson (Pacific Power & Light)
- ° Hawthorne #3 (Kansas City Power & Light)

Written responses from several utilities, which serve as examples of the survey material from which the O&M data were drawn, are attached (Attachment 3d.2).

The differences between coal plants surveyed and the hypothetical Alaska coal powerplant are discussed below.

<u>Plant Staff and Wages</u>

Because of the higher wage rate in Alaska ($36/hr) versus the average in the Lower 48 ($26/hr), the cost of labor is significantly higher in Alaska. In addition, due to the remote location of the plants in Alaska (central interior or in the Beluga field), staff levels were based upon the high side of the survey to account for this remoteness.

FGD System Maintenance Costs

The FGD system maintenance costs are somewhat lower for the hypothetical Alaska coal power plant because of the larger staff employed full time at the power plant. By having a larger full time permanent staff, the cost of outside labor from different service organizations is reduced.

Landfill Disposal Costs

A large majority of the plants surveyed by Harza-Ebasco employ on site disposal of scrubber sludge and ash in evaporation ponds. Because a majority of the plants are in arid areas of the Western United States, evaporation can be counted upon for disposal of the sludge and ash.

Recent power plant designs approved by the EPA and state authorities have required a more permanent solution to the scrubber sludge and ash disposal problems. This solution has taken the form of byproduct sale or providing-stabilized sludge landfills. Harza-Ebasco developed costs associated with an environmentally acceptable approach to stabilized sludge landfill operations. The concept employed is similar to that utilized at other stabilized sludge landfills in the utility industry. It consists of excavation of a ground area, installation of an impermeable barrier to protect ground water and the disposal of a blend of stabilized sludge (a mixture of scrubber sludge, ash and lime to act as a setting agent), which resembles low grade concrete.

<u>Chemical Make-up Costs</u> (Lime and Limestone)
The cost for FGD chemicals is a widely varying cost factor between utilities in the Lower 48. As documented in the EPRI report CS-2916, (Appendix 2), the costs vary significantly in various parts of the country. Because there is no source of lime in Alaska, Harza-Ebasco developed the costs based upon discussions with Seattle, Washington firms. These costs reflect the high transportation charge for delivery to the Cook Inlet ($300/ton). In comparison, if the powerplant were located in Seattle, Washington, the annual cost for the FGD system would be approximately $230,000, rather than the $1,102,500 Alaska estimate.

Precipitator and Baghouse Maintenance

The survey showed that a much higher cost is associated with particulate removal system maintenance than what was initially assumed by the Power Authority. This higher maintenance cost is still the subject of review by Harza-Ebasco. The data contained in the DEIS was derived from estimates prepared by original equipment manufacturers' estimates received in telephone conversations.

Boiler Maintenance Costs

The boiler maintenance costs reflected in the survey conform to the values obtained from boiler manufacturers for their equipment. The number used was based upon the data obtained from the manufacturers.

Coal Handling Equipment Maintenance

The costs used in the Harza-Ebasco estimate of coal handling equipment reflect data obtained by telephone conversations with coal handling equipment manufacturers. This estimate compares favorabley to that found during the utility survey.

Turbine Generator Maintenance Costs

The costs used for maintenance of the turbine generator are derived from data supplied by the original equipment manufacturers. This estimate compares favorably to that found during the utility survey.

<u>Other Costs</u> (Cooling Tower, Water Treatment, and Lubricant Costs)

These costs were developed by contacts with original equipment manufacturers and averages of the utility survey. They are in line with the costs found during the survey.

SPECIFIC UTILITY REPORTED DATA
O&M COST ESTIMATE BACKUP 200 MW COAL PLANT
1983 $

Operating Characteristics	Utah P&L Huntington #1	Houston P&L Parish Plant	Springfield City Utilities Southwest Plant	Empire District Asbury Plant	Pacific Power and Light D. Johnson Unit #3	Kansas City Power and Light Hawthorne #3	Adjusted Alaska Annual O&M Costs 12/
Plant Rated Capacity (MW)	415 MW	570 MW	415 MW	200 MW	220 MW	235 KW	200 MW
° Coal HHV Btu/lb	11,900	8,600	12,000	11,500	7,800	12,000	
° No. Total Staff	125 5/	100 5/	90 5/	42 5/	90 5/	100 5/	123
° Fixed Labor Costs $/kW/yr	21.74	13.30	16.45	15.92	31.02	32.27	$59.80
° Plant Ht. Rate Btu/kWh	9,883	10,400	11,008	10,542	11,101	11,949	--
° Sulfur in Fuel (%)	.5%	.5%	3.5%	5.4%	.45%	3.0%	--
° Flue Gas Desulfurization Maintenance Cost	$ 660,000 1/	$ 500,000 1/	$ 500,000 1/	$ 50,000 2/	$ 630,000 1/	$ 550,000 1/	$ 395,895
° Landfill Disposal Costs	$ 200,000	N/A 3/	N/A 3/	N/A 3/	N/A 3/	N/A 3/	$1,750,000
° Chem. Makeup Cost Limestone	$ 330,000	$ 250,000	$ 200,000	$ 200,000	$ 400,000	$ 300,000	$1,102,500
° Precipitator & Baghouse	$ 910,000	$1,200,000	$ 700,000	$ 500,000	$1,150,000	$ 900,000	$ 500,000
• Boiler Maint. Costs	$1,100,000	$1,000,000	$ 800,000	$ 625,000	$3,100,000	$ 500,000	$1,345,921
° Coal Handling Equip. Maint.	$ 800,000	$1,030,000	$ 200,000 6,9/	$ 277,000	$ 210,000	$ 200,000 9/	$ 459,500
° Turbine/Gen. Maint. Cost	$ 350,000	$ 400,000	$ 250,000*	$ 220,000	$ 380,000	$ 400,000	$ 257,000
• Cooling Tower Maint. Cost	$ 100,000	$ 100,000	$ 80,000	N/A 11/	N/A 11/	N/A 11/	$ 93,000
• Water Treatment System Costs	$ 300,000	$ 343,000	$ 100,000 10/	$ 140,000 10/	$ 420,000	$ 250,000	$ 130,000
° Lubricant Cost	$ 50,000 7/	$ 50,000 7/	$ 50,000 7/	$ 50,000 7/	$ 80,000 7/	N/A	$ 56,000
• Total Maintenance Cost	$4,800,000 8/	$4,873,000 8/	$2,880,000 8/	$2,062,000	$6,370,000	$3,100,000	$6,303,240
• Variable Maintenance Cost ($/MW Hr)	$1.45	$1.07	$.87	$1.29	$3.62	$1.65	$3.93

1/ Costs are annualized average per unit for scrubber, fans, ducts, and breeching on site where multiple units exist.
2/ Costs are annual maintenance estimate for electrostatic precipitator only.
3/ Landfill is on-site with ponding; Haulage charges were reported under $50,000 annually.
4/ Bottom ash/FGD sludge sold at $3.50/ton.
5/ Staffing level is per unit average for reported plant total which is higher. Hourly rate averaged $26.00 with fringes.
6/ Cost estimate is per unit average, otherwise reported per unit rating.
7/ Lube oil is for turbine and generator lubrication only; balance of plant excluded.
8/ Individual unit estimate based on multiple units at one site.
9/ Pulverizers are ball mill type.
10/ Boiler and cooling tower water treatment cost only.
11/ Plant has once through cooling from lake at site.
12/ Average O&M cost estimates include Alaska labor rates and transportation costs.

Attachment 3d.1

EXAMPLES OF
REPORTED UTILITY O&M DATA

CITY UTILITIES of SPRINGFIELD
301 E. Central • P.O. Box 551 • Springfield, Missouri 65801 • (417) 831-8311

July 24, 1984

Mr. L. J. Becker
Ebasco Services, Inc.
400, 112th Avenue, N.E.
Bellevue, Washington 98004

Dear Larry:

We hope that the enclosed information will be of use in the FERC Licensing hearing for the Alaska Power Authority, Susitna Hydroelectric Project.

Sheet #1, Items 1 to 9, specifically address your O & M cost evaluation concerns as per your request dated July 10, 1984. Item 10 and Sheet 2 address the additional areas of concern as per your discussion with Bryan Brooker on the 19th of July.

If further questions should arise and you feel we could be of assistance, please feel free to contact us.

Sincerely,

Dale Hicks

Dale Hicks, P.E.
Superintendent
Southwest Power Station

ml

Enclosures

COST ESTIMATES.

1) PLANT CAPACITY — 194.5 MW.

2) PLANT STAFF — 86 + 2 PART TIME

3) PLANT HEAT RATE.

MW	NET (BTU/KWH)
195	10,677
150	10,815
110	11,455
80	11,810

4) FGD SYSTEMS.

	(MILLS/KWH)
A) LABOUR (MAINT).	0.502
B) ENERGY COSTS	0.220
C) MATERIAL (PARTS OIL ETC)	1.004
D) DISPOSAL COSTS	0.376
E) FEED MATERIAL, CHEMICALS (DEAL)	0.237
	2.339

5) PLANT WATER COSTS (DEMINERALIZED) — ($0.1)/GAL.

6) TOTAL AIR QUALITY (O&M) COSTS — 2.640.

7) COOLING TOWER (O&M) COSTS — 0.125

8) BOILER MAINT COSTS (COAL SYSTEM ETC.. — 1.882

9) T.G MAINT COSTS — 0.251

INSPECTION : MAJOR 40,000 HRS / 5 YRS.

MINOR AS REQ'D

10) GUARD SERVICE — $ 5.39/HR / GUARD.

$

Turbine (5yr overhaul)

SUPERVISION	167,343
NDT	27,000
INPLACE MACHINING	16,000
AIR LEAKAGE TEST	8,400
BLADE REPAIR	3,000
TOTAL	<u>221,743</u>

COAL BELT REPLACEMENT

LAB & MATERIALS

* a) #2 BELT	32,000
b) #3 BELT	8,600.

* (a) 1020' Lg x 60" wd
(b) 406' Lg x 36" wd
} George Duck Plylon 4PLY, 600 PIW with 3/16 x 1/16 NMHA FIRE RESISTANT COVER

COOLING TOWER REPAIR 15,300.

THE ABOVE ITEMS ARE <u>FOR</u> CONTRACT LABOUR AND MATERIALS; THEY <u>DO NOT</u> INCLUDE ANY C.U. LABOR OR PARTS PURCHASED PRIOR TO THE WORK BEING DONE.

PACIFIC POWER & LIGHT COMPANY
920 S.W. SIXTH AVENUE • PORTLAND, OREGON 97204 • (503) 243-1122

October 31, 1984

Mr. Lawrence J. Becker
Ebasco Services, Incorporated
400 112th Avenue N.E.
Bellevue, WA 98004

Dear Mr. Becker:

In regard to your recent request for cost estimates relative to the operation and maintenance of a typical 200 mw rated coal-fired power plant, I've enclosed a summary providing a breakdown of the estimates for each of the requested areas.

If you have any questions, please feel free to contact me.

Sincerely,

W C Brauer

W. C. Brauer
Manager, Thermal Staff

WCB:mjs
Enclosure

TELECOPIER 243-4774 • TWX 910-464-1594

1) Turbine nameplate - 332 gr mw

Net peak demand (1 hr) - 347 net mw

2) Average employees - 114

3) Net heat rate (1983) - 12,140

4) Retrofit FGD system is scheduled for operation in December 1986. Cost projections are estimated in 1983 dollars.

a)	Labor	-	0.20 mill/kwh
b)	Energy	-	0.07 " "
c)	Material	-	0.01 " "
d)	Disposal	-	0.12 " "
e)	Chemicals	-	0.45 " "

5) \$0.02/gal.

6) Air quality 0.06 mill/kwh.

7) Unit is equipped with an air-cooled condenser - 0.03 mills/kwh.

8) Boiler maintenance cost (for pulverizer and fuel delivery system only) was 0.36 mill/kwh.

9) Turbine-generator maintenance cost was 0.13 mill/kwh. Unit is overhauled under a sectionalized maintenance concept; therefore, a major/minor differentiation is not applicable.

DSS/10-31-84

3. QUESTION

e) Documentation of the differences in labor rates and transportation and construction costs which contributed to the increased costs associated with the proposed coal plants.

RESPONSE

Construction Costs

Cost estimates developed in the original reconnaissance level study were a conceptual level estimate. At that time, no allowance was made for land and land rights costs, client charges, temporary or permanent transmission line costs, or access road costs in the construction cost estimate. Further, waterfront and environmental mitigation costs were understated. Material costs were generic in the reconnaissance study and were not based on vendor budgetary equipment quotations.

In the subsequent estimate, Harza-Ebasco prepared brief technical descriptions of the equipment and obtained budgetary quotations for this equipment. While these values tend to verify the validity of the estimate, this remains a conceptual estimate due to the lack of site specific data and firm equipment quotations.

Labor Costs

The estimate for labor costs and labor rates was based on the construction manhours required for constructing similar size (200 MW) coal plants. The estimated construction manhours were then multiplied by the developed Alaskan union wage rates.

In the original estimate, Alaskan labor rates for each craft labor category, as summarized on the Power Authority's Susitna wage rate form dated December 17, 1981 (Attachment 3e.1) were utilized. A revised labor rate analysis, documented on the Susitna wage rate form dated November 8, 1983 (Attachment 3e.2) was used to price the payroll costs of the updated estimate. In both cases, wage rates are based on actual union rates, as stipulated in union labor agreements and as gathered by the Power Authority in its survey of all relevant crafts. Contractor indirect costs were then added to complete installation costs to both estimates.

Transportation Costs

The added transportation costs are based upon barge crating of equipment for Alaska delivery. This is reflected in the equipment costs and represents 1-2% of the cost. These added costs are an Ebasco Services estimate, based upon preparing 50 similar estimates for Alaskan clients over the last three years. Actual equipment quotations, as compared to costs in the Lower 48, were also considered.

996-3-73

ALASKA POWER AUTHORITY
SUSITNA HEP
CONTRACT
WAGE RATES

ACTUAL ——
0 % ESCALATED ——— (Apply to EA HR) 60 HRS/wk

RATES INCLUDE:
- FOREMAN ☑
- P/R TAXES ☑
- P/R INS ☑
- FRINGES ☑

DISTRIBUTED 12/18/81
DATE: 12/17/81
BY: C. Y. HU
APPROVED: JDF
SOURCE: LABOR AGREEMENTS

CRAFT (all Journeymen)		1980	1981	1982	1983
LABORERS			37.22	35.21	37.76
CARPENTERS			33.75	35.40; 38.15	41.21
PILE DRIVERS		34.05	38.57	42.70	47.76
OPERATING ENGINEERS:					
HEAVY			38.83	42.69	47.29
MEDIUM			36.24	39.83	44.10
LIGHT			35.59	39.09	43.28
CEMENT FINISHERS			37.43	38.06	48.00
ELECTRICIANS		INSIDE	42.19; 43.40	45.33; 46.87	48.50; 50.21
		OUTSIDE	43.71; 45.25	47.17; 48.19	50.60; 52.69
IRONWORKERS:					
REINFORCING		39.08	42.19	45.65	49.17
STRUCTURAL		39.08	42.19	45.55	49.17
MILLWRIGHTS					
BOILERMAKERS		38.34	41.58	44.97	48.70
PAINTERS: 3					
BRUSH			37.60	40.89	44.46
SPRAY			38.48	41.74	45.67
TEAMSTERS			34.73	38.21	42.46
PIPEFITTERS		36.69	39.05	41.55	44.21
PLUMBERS		36.69	39.05	41.55	44.21
BRICK MASONS			34.79	39.65	44.83
SHEET METAL		35.42	38.24	41.20	44.56
ASBESTOS			43.34	47.67	52.47
ROOFERS		36.34	40.83	45.87	51.[illegible]

Attachment 3e.1

896-3-73

6U HR WORKWEEK
RATES APPLIED TO EACH HOUR

O.T. FACTORED
INTO HOURLY
RATE

NO APPRENTICE RATES
APA ESCALATION RATE
NO TRAVEL & SUBSISTANCE

ALASKA
(GENERAL - BASED OF ANCHORAGE)

ACTUAL
7 % ESCALATED APA RATE

RATES INCLUDE:
- FOREMAN ☑
- P/R TAXES ☑
- P/R INS ☑
- FRINGES ☑

DATE: 11-8-83
BY: MJV
APPROVED:
SOURCE:

WAGE RATES

CRAFT		1984	1985	1986	1987	
LABORERS	GENERAL / TUNNEL	38.73 / 43.49	40.80 / 46.53	43.66 / 49.79	46.71 / 53.28	49.98 / 57.00
CARPENTERS		43.66	46.72	49.99	53.49	57.23
PILE DRIVERS		43.43	46.47	49.72	53.20	56.93
OPERATING ENGINEERS:	TBM	46.12	49.35	52.80	56.50	60.45
HEAVY		46.12	49.35	52.80	56.50	60.45
MEDIUM		43.93	47.00	50.30	53.82	57.58
LIGHT	INCLUDES OILERS	41.91	44.84	49.98		
CEMENT FINISHERS		43.00				
ELECTRICIANS: INSIDE &	OUTSIDE	46.08	48.63	52.03	55.68	59.57
OVER 65'	TOWERS	80.41	84.86	90.80	97.16	103.96
IRONWORKERS	REBAR	50.55	54.08	57.87	61.92	66.26
STRUCTURAL		50.55	54.08	57.87	61.92	66.26
MILLWRIGHTS		45.75	48.95	52.38	56.05	59.97
BOILERMAKERS		42.40	45.37	48.54	51.94	55.58
PAINTERS BRUSH SPRAY		38.97	41.70	44.62	47.74	51.08
HELICOPTER PILOT		43.49	46.53	49.79	53.28	57.00
TEAMSTERS		41.67	44.59	47.71	51.05	54.62
PIPEFITTERS		42.01	44.95	48.10	51.46	55.06
PLUMBERS		42.01	44.95	48.10	51.46	55.06
BRICK MASONS		40.83				
SHEET METAL		40.90	43.76	46.83	50.10	53.61
ASBESTOS		56.28	60.22	64.44	68.95	73.77
ROOFERS		43.33	46.36	49.61	53.08	56.80

Attachment 3e.2

3. QUESTION

f) A copy of the studies and underlying data for the APA-Harza "review of auxiliary power requirements for coal fired power plants of similar size with similar equipment" and "survey of similar operating units burning similar coal." The information should include identification of plants and units selected for both the review and the survey.

RESPONSE

A review[3/] was made of the auxiliary power requirements of the six coal-fired power plants listed below:

Plant	Required Auxiliary Power Expressed as a Percentage of Gross Plant Output
Coal-Fired Reference Plant[4/] 400 MW Sub-bituminous Coal	10%
Limestone Electric Generating Station - Houston Light and Power Company (2-750 MW Lignite Unit)	10%

3/ "Review" and "survey" are synonymous in the context of the quotations noted in Question 3(f).

4/ Ebasco reference plant estimate, non-site specific plant developed for generic use.

Clay Boswell Unit 4 - Minnesota Power and Light (500 MW Sub-bituminous Coal Unit)	6.4%
Killen Power Plant[5/] - Dayton Power and Light (600 MW Bituminous Coal Unit)	7.5%
Somerset Plant - N.Y. State Electric and gas (625 MW Bituminous Coal Unit)	11.0%
Asbury Plant[5/] Empire District (200 MW Bituminous Unit)	7.4%

This review included power plants burning similar coal of a similar size or plants with FGD systems and with wet and dry scrubbers. There was not a separate study of the plants performed. This review consisted of conversations with design engineers and power plant operators for the plants listed.

The data on power plants varies significantly, due to the actual systems selected and the number of units at the station. For example, the Clay Boswell Unit 4 auxiliary power is lower than the average for other plants with FGD systems because the shared systems in the power plant are being supplied power by other units

---

5/ Does not have an FGD system. The energy load for FGD systems averages approximately 2-3% for lime and limestone systems in the throw-away technology. The auxiliary load for wet scrubbers is 1-2%.

(e.g., make-up well water, coal handling systems, fire protection and sewage treatment, and so forth).

An independent estimate of the auxiliary loads associated with a nominal 200 MW coal-fired power plant, including FGD, was made by Harza-Ebasco and is shown below:

Auxiliary	Power Requirement
Steam Generator	5,500 kW
Turbine Generator	250 kW
Coal Handling System	1,000 kW
Ash Handling	350 kW
HVAC Systems and Lighting	100 kW
Circulating, Condensate, and Feedwater System Pumps	7,000 kW
Miscellaneous Pumps	1,800 kW
Cooling Tower, Wastewater, Make-up Water System	500 kW
Miscellaneous Equipment	500 kW
Total	17,000 kW

The total auxiliary power requirements shown above are 7.8 percent of the plant's gross outpu[illegible] 217 MW. This value of 7.8 percent is below the average of about 10 percent for the three plants (Reference Plant, Limestone and Somerset) for which unshared FGD and wet scrubber facilities are used. Since the design for the hypothetical alternative, coal-fired plant has not been established, the value of 17 MW was used for plant heat rate calculations, (See response to Question 3(g)), because using a low value for auxiliary power would yield a lower (better) plant heat rate and thus favor the thermal plant in a comparison with the Susitna Project.

3. QUESTION

g) Data to substantiate how the coal quality and changes in auxiliary power requirements effected a heat rate change from 10,000 Btu/kWh to the 10,300 Btu/kWh used in the APA revised analysis of Susitna.

RESPONSE

As noted previously, the basis for the License Application was the Railbelt electric power alternative study. Because this was a reconnaissance level study, an approximation of the heat rate was made for a plant of this type. In the DEIS comments analysis, actual calculations were performed based upon the turbine generator performance, coal quality and auxiliary power requirements.

The coal quality found in the Railbelt report was a general analysis for Alaska coal. This analysis is found below:

Heating Value	8,000 Btu/lb
Ash Content	8-11%
Moisture	28%
Sulfur	.2%
Nitrogen	.6%
Ash Softening Temperature	2350°F
Solium in Ash	0.1%
Hardgrove Grindability Index	30.

In the DEIS comments, Harza-Ebasco performed combustion calculations based upon more detailed analysis of Beluga and Nenana field coal. The detailed coal quality analyses are set forth in Attachments 3g.1 and 3g.3. Analyses of the resulting boiler efficiencies are found in the combustion calculations attached to this response (Attachments 3g.2 and 3g.4). Line 30 of these attachments provides the boiler efficiency for burning the coal specified. For Beluga field (Diamond) coal, an efficiency of 82.70% is calculated. For Nenana field coal, an 81.62% efficiency was calculated.

The auxiliary power requirements, as noted in response to Question 3(f), are based upon a projection of the power requirements of a typical 200 MW power plant.

The calculation of net station heat rate is defined by the formula found below:

$$\text{Net Station Heat Rate} = \frac{\text{Turbine Heat Rate}}{\text{Boiler Efficiency}} \times \frac{\text{Gross Power}}{\text{Net Power}}$$

Thus, a change in the boiler efficiency and gross power (net power and auxiliary power) will cause adjustments to be made to the net station heat rate.

Applying the boiler efficiency values just noted, the respective heat rates are as follows:

(Beluga) $$\frac{7850}{.8270} \times \frac{217{,}500 \text{ kW}}{200{,}000} = 10{,}322 \frac{\text{Btu}}{\text{kWH}}$$

(Nenana) $$\frac{7850}{.8162} \times \frac{217{,}500 \text{ kW}}{200{,}000} = 10{,}459 \frac{\text{Btu}}{\text{kWH}}$$

It should be noted that the net effect of this change is only a 3% difference in coal consumption for the power plant.

Attachment 3g.1

FUEL - DIAMOND COAL FIELD-28% MOIS DATE: 07-Nov-84
WEIGHT METHOD - FOSSIL FUEL - STANDARD AIR*
(Complete Combustion Assumed)

Ultimate Analysis, % By Weight As Fired		Required For Combustion Total Air = 100 % Unit Fuel = 2000 lb/hr lb/lb Fuel	lb/lb Fuel	lb/Unit Fuel
		O_2	Dry Air	Dry Air
C	45.4	1.208	5.235	10469.24
H_2	2.9	0.230	0.996	1991.72
O_2	14.4	—	—	—
N_2	0.7	—	—	—
S	0.14	0.001	0.006	12.01
H_2O	28	—	—	—
Ash	7.9	—	—	—
Sum	99.44	1.439	6.236	12472.97
Less O2 in fuel (deduct)**		0.144	0.622	1244.16
Required (at 100% Total Air)		1.295	5.614	11228.81
** Air equivelent of O2 in fuel				

Required For Combustion Total Air = 120.00 %	O_2	Dry Air	Dry Air
O2 and Air, Total	1.554	6.737	13474.57
Excess Air	—	1.123	2245.76
Excess O2	0.259	—	—

Products of Combustion Total Air = 120.00 %	lb/lb Fuel	lb/Unit Fuel
CO_2	1.662	3323.28
H_2O	0.628	1256.38
SO_2	0.003	5.60
O_2 (excess)	0.259	518.12
N_2	5.185	10369.21
Weight, Wet	7.736	15472.59
Weight, Dry	7.108	14216.21

* Air at 60% relative humidity and 80 F dry bulb, or 0.0132 lb of moisture per lb dry air.

Attachment 3g.2

COMBUSTION CALCULATION

BASED ON QUANTITIES PER 10,000 BTU FUEL INPUT

LINE						CONDITIONS BY SPECIFICATION		DATE	
1	FUEL - DIAMOND FIELD COAL							DATE	a
2	ANALYSIS AS FIRED							07-Nov-84	
3	ULTIMATE, % BY WT		PROXIMATE, % BY WT			TOTAL AIR	%	120.00	b
4	C	45.40	MOISTURE	0.00		AIR TEMPERATURE TO HEATER	F	80.00	c
5	H2	2.90	VOLATILE	0.00		AIR TEMPERATURE FROM HEATER	F	500.00	d
6	O2	14.40	FIXED CARBON	0.00		FLUE GAS TEMPERATURE LEAVING UNIT	F	300.00	e
7	N2	0.70	ASH	0.00		H2O PER LB DRY AIR	LB	0.0132	f
8	S	0.14	TOTAL	0.00					g
9	H2O	28.00				UNBURNED FUEL LOSS	%	2.00	h
10	ASH	7.90				UNACCOUNTED LOSS & MFR MARGIN	%	1.50	i
11	TOTAL	99.44				RADIATION LOSS (ABMA), FIG.20, CHAPTER 7	%	0.80	j
12	BTU PER LB, AS FIRED :		7,800						k

LINE	QUANTITIES PER LB AND BTU FUEL INPUT	UNIT FUEL/HR	10,000 BTU	LINE
14	FUEL BURNED	2000.0 LB	1.28	14
15	TOTAL AIR REQUIRED	13479.1 LB	8.64	15
16	H2O IN AIR	177.9 LB	0.11	16
17	WET GAS, TOTAL	15657.0 LB	10.04	17
18	H2O IN FUEL	1078.5 LB	0.69	18
19	H2O IN FLUE GAS, TOTAL	1256.4 LB	0.81	19
20	H2O IN FLUE GAS, TOTAL IN PERCENT	8.0 %	8.02	20
21	DRY GAS, TOTAL	14400.6 LB	9.23	21

LINE	LOSSES PER 10,000 BTU FUEL INPUT				LINE
23	UNBURNED FUEL		BTU	200.00	23
24	UNACCOUNTED & MFR MARGIN		BTU	150.00	24
25	RADIATION		BTU	80.00	25
26	LATENT HEAT, H2O IN FUEL		BTU	719.01	26
27	SENSIBLE HEAT, FLUE GAS	BTU FROM FIG. 2 @ LINE e AND 20 = 57.84	BTU	580.54	27
28	TOTAL LOSSES		BTU	1729.55	28
29	TOTAL LOSSES IN PERCENT		%	17.30	29
30	EFFICIENCY, BY DIFFERENCE		%	82.70	30

LINE	QUANTITIES PER 10,000 BTU FUEL INPUT				LINE
32	HEAT INPUT FROM FUEL		BTU	10000.00	32
33	HEAT INPUT FROM AIR		BTU	933.93	33
34	HEAT INPUT, TOTAL		BTU	10933.93	34
35	LESS LATENT HEAT LOSS, H2O IN FUEL		BTU	719.01	35
36	HEAT AVAILABLE, MAXIMUM		BTU	10214.92	36
37	LESS LINES 24 & 25 *		BTU	115.00	37
38	HEAT AVAILABLE		BTU	10099.92	38
39	HEAT AVAILABLE PER LB OF FLUE GAS	BTU 1006.31			39
40	ADIABATIC TEMPERATURE FROM FIG. 2 FOR LINES 20 & 39	F 3625			40

* NOTE: IT IS CUSTOMARY TO REDUCE THE MAXIMUM HEAT AVAILABLE, LINE 36, BY FROM 1/3 TO 1/2 OF THE UNACCOUNTED & MFR MARGIN PLUS RADIATION LOSSES, ON THE ASSUMPTION THAT A PORTION OF THESE LOSSES OCCUR IN THE COMBUSTION ZONE.

Attachment 3g.3

FUEL - NENANA COAL FIELD DATE: 07-Nov-84

WEIGHT METHOD - FOSSIL FUEL - STANDARD AIR*

(Complete Combustion Assumed)

Ultimate Analysis, % By Weight As Fired		Required For Combustion Total Air = 100 % Unit Fuel = 2000 lb/hr lb/lb Fuel	lb/lb Fuel	lb/Unit Fuel
		O2	Dry Air	Dry Air
C	45	1.197	5.189	10377.00
H2	3.6	0.286	1.236	2472.48
O2	15.5	----	----	----
N2	1.05	----	----	----
S	0.2	0.002	0.009	17.16
H2O	26	----	----	----
Ash	8.3	----	----	----
Sum	99.65	1.485	6.433	12866.64
Less O2 in fuel (deduct)**		0.155	0.670	1339.20
Required (at 100% Total Air)		1.330	5.764	11527.44

** Air equivelent of O2 in fuel

Required For Combustion
Total Air = 120.00 %

	O2	Dry Air	Dry Air
O2 and Air, Total	1.596	6.916	13832.93
Excess Air	----	1.153	2305.49
Excess O2	0.266	----	----

Products of Combustion
Total Air = 120.00 %

	lb/lb Fuel	lb/Unit Fuel
CO2	1.647	3294.00
H2O	0.673	1346.27
SO2	0.004	8.00
O2 (excess)	0.266	531.94
N2	5.326	10651.61
Weight, Wet	7.916	15831.82
Weight, Dry	7.243	14485.54

* Air at 60% relative humidity and 80 F dry bulb, or 0.0132 lb of moisture per lb dry air.

Attachment 3g.4

COMBUSTION CALCULATION

BASED ON QUANTITIES PER 10,000 BTU FUEL INPUT

LINE					CONDITIONS BY SPECIFICATION		DATE	LINE
1	FUEL - NENANA FIELD COAL						DATE	a
2	ANALYSIS AS FIRED						07-Nov-84	
3	ULTIMATE, % BY WT		PROXIMATE, % BY WT		TOTAL AIR	%	120.00	b
4	C	45.00	MOISTURE	26.00	AIR TEMPERATURE TO HEATER	F	80.00	c
5	H2	3.60	VOLATILE	34.30	AIR TEMPERATURE FROM HEATER	F	500.00	d
6	O2	15.50	FIXED CARBON	31.20	FLUE GAS TEMPERATURE LEAVING UNIT	F	300.00	e
7	N2	1.05	ASH	8.30	H2O PER LB DRY AIR	LB	0.0132	f
8	S	0.20	TOTAL	99.80				g
9	H2O	26.00			UNBURNED FUEL LOSS	%	2.00	h
10	ASH	8.30			UNACCOUNTED LOSS & MFR MARGIN	%	1.50	i
11	TOTAL	99.65			RADIATION LOSS (ABMA), FIG. 20, CHAPTER 7	%	0.80	j
12	BTU PER LB, AS FIRED :			7,600				k

LINE	QUANTITIES PER LB AND BTU FUEL INPUT	UNIT FUEL/HR	10,000 BTU	LINE
13				13
14	FUEL BURNED	2000.0 LB	1.32	14
15	TOTAL AIR REQUIRED	13841.3 LB	9.11	15
16	H2O IN AIR	182.7 LB	0.12	16
17	WET GAS, TOTAL	16024.0 LB	10.54	17
18	H2O IN FUEL	1163.7 LB	0.77	18
19	H2O IN FLUE GAS, TOTAL	1346.4 LB	0.89	19
20	H2O IN FLUE GAS, TOTAL IN PERCENT	8.4 %	8.40	20
21	DRY GAS, TOTAL	14677.6 LB	9.66	21

LINE	LOSSES PER 10,000 BTU FUEL INPUT				LINE
22					22
23	UNBURNED FUEL		BTU	200.00	23
24	UNACCOUNTED & MFR MARGIN		BTU	150.00	24
25	RADIATION		BTU	80.00	25
26	LATENT HEAT, H2O IN FUEL		BTU	796.20	26
27	SENSIBLE HEAT, FLUE GAS	BTU FROM FIG. 2 @ LINE e AND 20 = 58.03	BTU	611.71	27
28	TOTAL LOSSES		BTU	1837.92	28
29	TOTAL LOSSES IN PERCENT		%	18.38	29
30	EFFICIENCY, BY DIFFERENCE		%	81.62	30

LINE	QUANTITIES PER 10,000 BTU FUEL INPUT				LINE
31					31
32	HEAT INPUT FROM FUEL		BTU	10000.00	32
33	HEAT INPUT FROM AIR		BTU	984.26	33
34	HEAT INPUT, TOTAL		BTU	10984.26	34
35	LESS LATENT HEAT LOSS, H2O IN FUEL		BTU	796.20	35
36	HEAT AVAILABLE, MAXIMUM		BTU	10188.06	36
37	LESS LINES 24 & 25 *		BTU	115.00	37
38	HEAT AVAILABLE		BTU	10073.06	38
39	HEAT AVAILABLE PER LB OF FLUE GAS	BTU 955.51			39
40	ADIABATIC TEMPERATURE FROM FIG. 2 FOR LINES 20 & 39	F 3625			40

* NOTE: IT IS CUSTOMARY TO REDUCE THE MAXIMUM HEAT AVAILABLE, LINE 36, BY FROM 1/3 TO 1/2 OF THE UNACCOUNTED & MFR MARGIN PLUS RADIATION LOSSES, ON THE ASSUMPTION THAT A PORTION OF THESE LOSSES OCCUR IN THE COMBUSTION ZONE.

Attachment 3g.4

COMBUSTION CALCULATION

BASED ON QUANTITIES PER 10,000 BTU FUEL INPUT

LINE					CONDITIONS BY SPECIFICATION		DATE 07-Nov-84	LINE
1	FUEL - NENANA FIELD COAL							a
2	ANALYSIS AS FIRED							
3	ULTIMATE, % BY WT		PROXIMATE, % BY WT		TOTAL AIR	%	120.00	b
4	C	45.00	MOISTURE	26.00	AIR TEMPERATURE TO HEATER	F	80.00	c
5	H2	3.60	VOLATILE	34.30	AIR TEMPERATURE FROM HEATER	F	500.00	d
6	O2	15.50	FIXED CARBON	31.20	FLUE GAS TEMPERATURE LEAVING UNIT	F	300.00	e
7	N2	1.05	ASH	8.30	H2O PER LB DRY AIR	LB	0.0132	f
8	S	0.20	TOTAL	99.80				g
9	H2O	26.00			UNBURNED FUEL LOSS	%	2.00	h
10	ASH	8.30			UNACCOUNTED LOSS & MFR MARGIN	%	1.50	i
11	TOTAL	99.65			RADIATION LOSS (ABMA), FIG.20, CHAPTER 7	%	0.80	j
12	BTU PER LB, AS FIRED :		7,600					k

LINE	QUANTITIES PER LB AND BTU FUEL INPUT	UNIT FUEL/HR	10,000 BTU	LINE
14	FUEL BURNED	2000.0 LB	1.32	14
15	TOTAL AIR REQUIRED	13841.3 LB	9.11	15
16	H2O IN AIR	182.7 LB	0.12	16
17	WET GAS, TOTAL	16024.0 LB	10.54	17
18	H2O IN FUEL	1163.7 LB	0.77	18
19	H2O IN FLUE GAS, TOTAL	1346.4 LB	0.89	19
20	H2O IN FLUE GAS, TOTAL IN PERCENT	8.4 %	8.40	20
21	DRY GAS, TOTAL	14677.6 LB	9.66	21

LINE	LOSSES PER 10,000 BTU FUEL INPUT				LINE
23	UNBURNED FUEL		BTU	200.00	23
24	UNACCOUNTED & MFR MARGIN		BTU	150.00	24
25	RADIATION		BTU	80.00	25
26	LATENT HEAT, H2O IN FUEL		BTU	796.20	26
27	SENSIBLE HEAT, FLUE GAS	BTU FROM FIG. 2 @ LINE e AND 20 = 58.03	BTU	611.71	27
28	TOTAL LOSSES		BTU	1837.92	28
29	TOTAL LOSSES IN PERCENT		%	18.38	29
30	EFFICIENCY, BY DIFFERENCE		%	81.62	30

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32	HEAT INPUT FROM FUEL		BTU	10000.00	32
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34	HEAT INPUT, TOTAL		BTU	10984.26	34
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37	LESS LINES 24 & 25 *		BTU	115.00	37
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39	HEAT AVAILABLE PER LB OF FLUE GAS	BTU 955.51			39
40	ADIABATIC TEMPERATURE FROM FIG. 2 FOR LINES 20 & 39	F 3625			40

* NOTE: IT IS CUSTOMARY TO REDUCE THE MAXIMUM HEAT AVAILABLE, LINE 36, BY FROM 1/3 TO 1/2 OF THE UNACCOUNTED & MFR MARGIN PLUS RADIATION LOSSES, ON THE ASSUMPTION THAT A PORTION OF THESE LOSSES OCCUR IN THE COMBUSTION ZONE.

4. QUESTION

a) Data compiled in the APA/Harza analyses of gas-turbine and combined-cycle plant O&M costs, including utility reported, equipment manufacturers, and FERC source information.

RESPONSE

A survey was conducted of combustion turbine gas-fired simple and combined-cycle plants to investigate O&M costs. The survey considered utility-reported data from Alaska and Lower 48 utilities. Specifically, the utilities contacted were:

- Anchorage Municipal Light and Power (Plant Nos. 1 and 2)
- Chugach Electric (Beluga site)
- Houston Light and Power (T. H. Wharton plant)
- Portland General Electric (Beaver plant)
- Public Service of Oklahoma (Comanche station)
- Arizona Public Service Company (Santan station)

As an additional check on the utility reported data, manufacturers (GE and Westinghouse) of combustion turbine equipment were contacted to develop standard overhaul and maintenance interval periods.

The manufacturer's data were compared to the utility-reported O&M costs, set forth in Attachments 4a.1 and 4a.2. In most instances, it was found that utility maintenance practices coincide directly with manufacturers standard recommendations.

The values provided in Attachments 4a.1 and 4a.2 are higher than those set forth in the DEIS for two reasons. First, the values in the attachments are stated in 1983 dollars, rather than the 1982 dollars used in the DEIS. Second, the attachment values are based on ISO conditions, rather than the site-specific conditions used in the DEIs analysis.

An average of costs for the Alaska utilities based on plant operating hours for inspection and overhaul periods, utilizing adjusted Alaska labor rates, was developed for the DEIS comments.

Subsequent to the DEIS Comments, Harza-Ebasco obtained an O&M cost estimate as reported by the General Electric Company in a report entitled, "STAG Combined

Cycle Power System Operation and Maintenance"
(Attachment 4a.3).

The GE report analyzed six individual sites representing 21 combustion turbines for the years 1975 through 1982 and was based upon FERC-reported data. The results indicate that fixed O&M costs in a combined cycle plant would range between $12.00 and $12.50 per kW. This compared with the Power Authority's DEIS comments estimate of $11.75 per kW.

The analysis indicated the variable cost element of O&M expenses is strongly influenced by the following factors:

- Frequency of starts per total operating hours
- Fuel type
- Load duty (peaking or base load)

The report further analyzed the effect of individual utility operating practices and related variable maintenance expenses to the above three factors in developing a reasonable cost estimate average.

SPECIFIC UTILITY REPORTED DATA
O&M COST ESTIMATE BACKUP 200 MW COMBINED CYCLE PLANT
1983 $

Cost Description	Anchorage Municipal Plant	Chugach Electric Beluga Site	Houston Light & Power T.M. Wharton Plant (300 MW)	Portland G.E. Beaver Plant	Pub. Srv. Okla. Comanche Station	Arizona Pub. Srv. Santan Station	Adjusted Alaska Average O&M Costs 3/
Plant Rating (MW)	160 MW	178 MW	300 MW	500 MW	255 MW	289 MW	217 MW
Plant Staff 1/	15	17	28	20	20	15	19
Fixed Labor 1/ Cost $/kW/yr 2/	$10.93	$11.14	$7.078	$3.033	$5.94	$3.93	$13.13
Fuel Cost	$1.41/10^6 BTU $10,323,000	$.25/10^6 BTU $4,450,000	$3.00/10^6 BTU $52,110,000	$22,500,000	$20,953,732	$4.35/10^6 BTU $22,[illegible]	$4.0 x 10^6
Plant Heat Rate	11,000 BTU/KW-Hr	12,500 BTU/KW-Hr	9,650 BTU/KW-Hr	8,800 BTU/KW-Hr	9,445 BTU/KW-Hr	8,860 BTU/KW-Hr	--
Operating Schedule Hrs/Yr.	8,000 Hr/Yr	8,000 Hr/Yr	6,500 Hr/Yr	1,000 Hr/Yr	2,000 Hr/Yr	2,000 Hr/Yr	7000 Hr/Yr
Water Costs (Injected)	$350,820 No	$320,000 Yes	$200,000 Yes	N/A No	$11,680 No	N/A No	$354,000 yes
Major Overhaul Cost (Annual)	$200,000	$162,500	$500,000	$200,000	$400,000	$450,000	$[illegible]75,000
Minor Overhaul Cost (Annual)	$89,700	$70,000	$200,000	$250,000	$200,000	$300,000	$175,000
Consumables Lube, Oil, etc.	$60,000	$80,000	$130,000	$ 90,000	$ 65,000	$110,000	$ 80,000
Total Maintenance Costs (Annual)	$700,520	$854,500	$1,030,000	$1,080,000	$1,341,680	$1,720,000	$884,000
Variable Costs $/MW/hr	$.55	$.60	$.53	$2.16	$2.63	$2.98	$ .65

1/ Plant staffing where units are located at large thermal installations was average for combined cycle plant reported by utility for the specific installation.
2/ Labor cost for Alaskan utility personnel average $36-$40/hr. Lower 48 utility average was $26-$30/hr with fringes.
3/ Average Annual O&M Costs include Alaska labor and transportation costs.
NOTE: Information was tabulated from phone calls and letter correspondence with power plant personnel as documented in Section 5 Appendices.

Attachment 4a.1

SPECIFIC UTILITY REPORTED DATA
O&M COST ESTIMATE BACKUP 200 MW SIMPLE CYCLE COMBUSTION TURBINE
1983 $

Cost Description	Arizona Public Service Company - Yuma Plant	Chugach Electric - Beluga	Commonwealth Edison Company - Crawford	Florida Power Bartow P.L. - St. Petersburg	Commonwealth Edison Company - Calumet	Anchorage Municipal Power & Light Plant No. 1	Adjusted Alaska Average O&M Costs 3/
Plant Rating	185 MW	340 MW	208.0 MW	222.8 MW	297.0 MW	77 MW	237.0 MW
Plant Staff	15	7	15	20	20	7	14.0
Fixed Labor Cost 1/ $/kW/yr 2/	$3.79	$ 4.9	$9.375	$14.0	$10.5	$11.636	$8.99
Fuel Cost (Annual)	$2,391,000	$1,418,000	$2,037,000	$5,489,000	$2,999,000	$8,130,200	--
Plant Heat Rate (Btu/kWHR)	14,565	18,897	16,587	13,459	16,897	22,000	--
Annual Operating Schedule (Hrs/Yr)	1,800	600	500	600	600	3,200	7000
Consumables Lube, Oil, etc.	$ 50,000	$ 30,000	$ 25,000	$ 30,000	$ 45,000	$ 20,000	$ 30,000
Major Overhaul Costs (Annual)	$200,000	$600,000	$550,000	$650,000	$550,000	$700,000	$120,000
Minor Overhaul Costs (Annual)	$135,000	$250,000	$250,000	$302,700	$250,000	$200,000	$130,000
Total Maintenance Cost	$435,000	$880,000	$825,000	$992,700	$845,000	$920,000	$280,000
O&M Variable Cost ($1 MW/hr)	$1.31	$4.313	$7.93	$7.42	$4.74	$3.73	$ .46

1/ Plant staffing where units are located at large thermal installations was average reported by utility for the specific installation.
2/ Labor cost for Alaskan utility personnel average $36-$40/hr. Lower 48 utility average was $26-$30/hr with fringes.
3/ Average O&M costs include Alaska labor and transportation costs.
NOTE: Information was tabulated from phone calls and letter correspondence with power plant personnel as documented in Section 5 Appendices.

Attachment 4a.2

Attachment 4a.3

GER-3407

stag

Combined-Cycle Power Systems

STAG Combined-Cycle Power System Operation and Maintenance

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CONTENTS

A TABLE OF CONVERSION FACTORS IS INCLUDED AT THE END OF THIS PUBLICATION

INTRODUCTION

Operation and maintenance (O&M) costs tend to receive significant attention when comparing alternate types of generating equipment. They reflect the quality of the equipment purchased and the operational techniques of a user. The fact is that these costs represent a very small percentage of the total cost for generating power and are controllable with good equipment, proper attention, and good maintenance planning.

The intent of this paper is to show the significant experience and data associated with General Electric STAG* combined-cycle power generating systems. These data permit a reasonable prediction of the O&M cost of a General Electric STAG combined-cycle plant.

This paper also provides an overview of the type of maintenance required to ensure the achievement of economical operation, and the high availability reliability inherent in a General Electric STAG combined-cycle plant.

*Trademark of General Electric Co., USA

Derivation of O&M Cost from Federal Energy Regulatory Commission (FERC)

Reports issued each year by the United States FERC are considered the best neutral sources available to show actual production costs of US utility plants. Early each year every electric generating utility in the United States sends reports to the FERC detailing the previous year's costs for generating power for a specific site.

The report includes the type of plant (fossil steam, gas turbine simple cycle, gas turbine combined cycle or nuclear), year installed, capacity, net generation (kW hours), fuel(s) used, heat content of fuel and production expenses for fuel burned, operating personnel, electrical, maintenance supervision and engineering, and total maintenance (including parts and labor). Figure 1 shows a typical FERC report with costs outlined while Fig. 2 illustrates the method of calculating O&M costs from these data.

CALCULATION OF O&M COST FROM FERC REPORTS

TOTAL PRODUCTION EXPENSES	$16,452,505
LESS	
FUEL	15,261,173
O&M COST	$ 1,191,332

TO DETERMINE ON A MILLS/KW-HR BASIS DIVIDE ABOVE O&M BY NET GENERATION

$1,191,332/706,469,000

x 1,000

1.69 or 1.7 MILLS/KW-HR

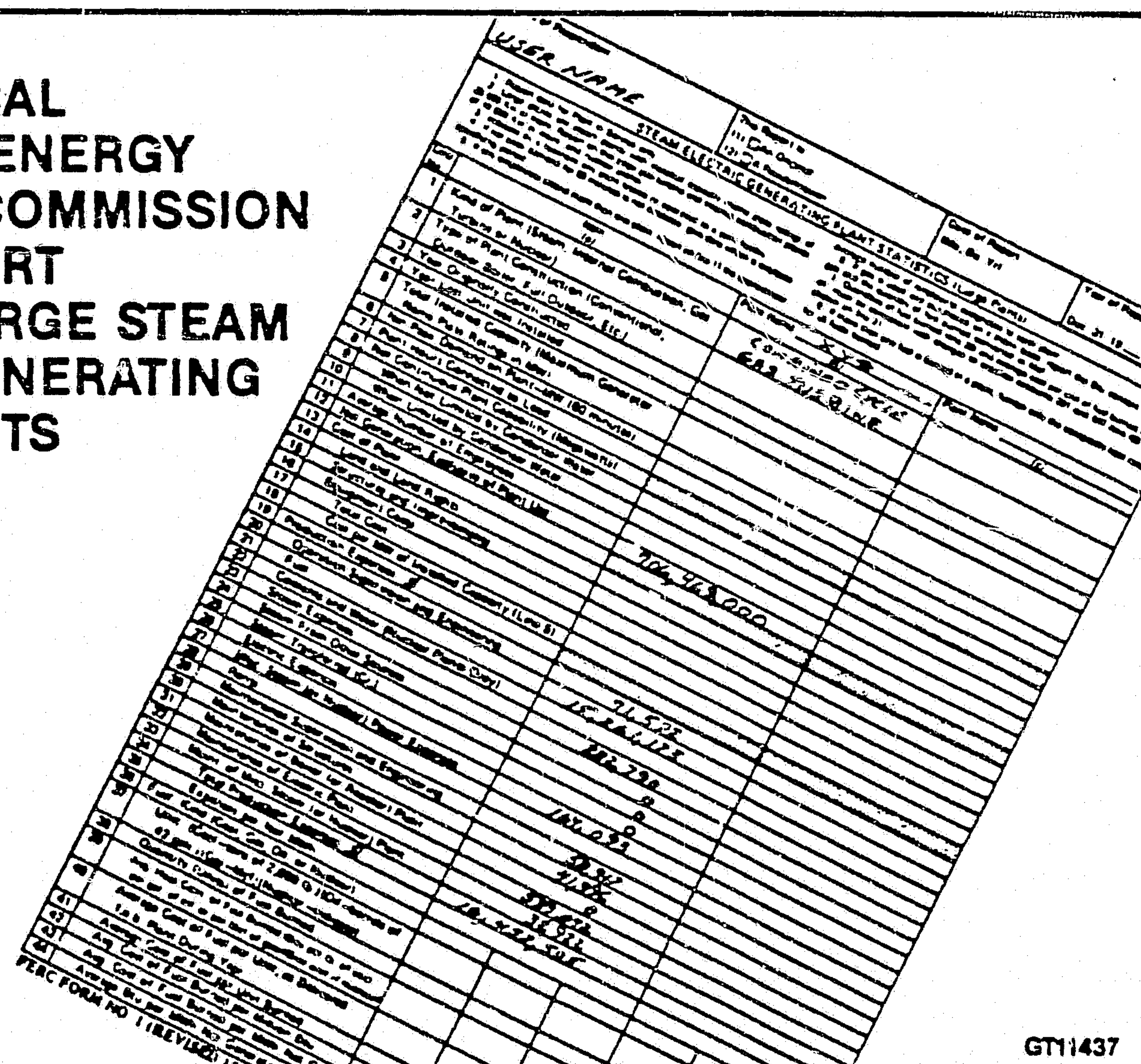
GT11438

Figure 2

O&M Cost Analysis

Fuel cost is the largest single production expense of any fossil plant and, therefore, has a tremendous effect on the price of electricity generated. Normally, fuel costs are reasonably predictable. The O&M costs of a plant are generally small relative to fuel costs, particularly for a base-loaded plant, and can be predicted by the operating personnel assigned, based on the plant design.

TYPICAL FEDERAL ENERGY REGULATORY COMMISSION REPORT COVERING LARGE STEAM ELECTRIC GENERATING PLANTS



GT11437

Figure 1

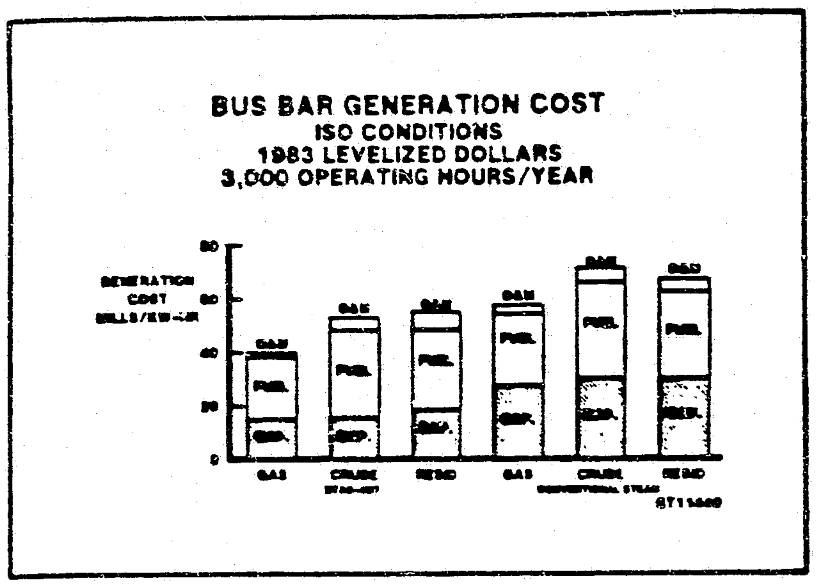


Figure 3

Figures 3 and 4 show the results of a study, done by GE, which reflect the relatively small imp ct O&M costs have on plant costs. These costs are leveliz d over a 30-year life cycle. These data also show the relative cost advantages that a GE STAG plant has over a conventional steam plant of equivalent size with similar services.

The O&M costs probably will not be large enough to determine what kind of plant (combined cycle, distillate/residual burning, or conventional steam) is selected by the purchasers, since efficiency has such an overriding impact. The O&M costs of alternative combined cycles may, however, determine which manufacturer's equipment is finally selected. O&M data are often incorrectly applied, as when peaking gas turbine data is compared with base load fossil plants. Peaking gas turbine plants tend to be less predictable because they require more maintenance (due to thermal cycling) and in any given year, the fired hours accumulated in previous years may dictate a planned inspection but system loads do not require the use of the plant. Therefore, net generation is low, while O&M costs are re atively high. The development of O&M costs for a GE STA combined-cycle plant requires a close look at past expe ence.

FERC data combine operating costs and maintenance costs into one number, as separating the two would leave the validity of both questionable. Data published in a recent paper by one of our STAG combined-cycle users (Fig. 5) illustrates the low maintenance costs achievable with a GE STAG combined-cycle plant over a five-year period while operating in base load service and properly maintained. The higher cost of maintenance in 1982 reflects the impact of major inspections of the gas turbines following 24,000 hours of service. In subsequent years, lower maintenance costs are again expected.

O&M Historical Data

FERC data on GE's MS7000 STAG combined-cycle plant data were examined for the years 1975 through 1982. The sites chosen were those where data were reported for at least six out of seven years and no other basis for selection was used. The individual site data are summarized by year and location in Tables I, II and III. Figure 6 illustrates these data and the relative portion of O&M cost compared to production and fuel cost on a cumulative basis for these six plants. As expected, O&M is a small portion of operating cost.

The cumulative O&M cost data per site from Table III were plotted against net kW hours generated on a per-unit basis, showing how O&M cost decreases as the hours per year increase (Fig. 7). This is typical of all types of power plants because relatively constant O&M costs are spread over more generation. At very low operational hours (less than 200), this relationship becomes irrelevant and the data were not used. A summarization of this data is shown in Fig. 8. Despite the fact that these data represent early MS7000 STAG com-

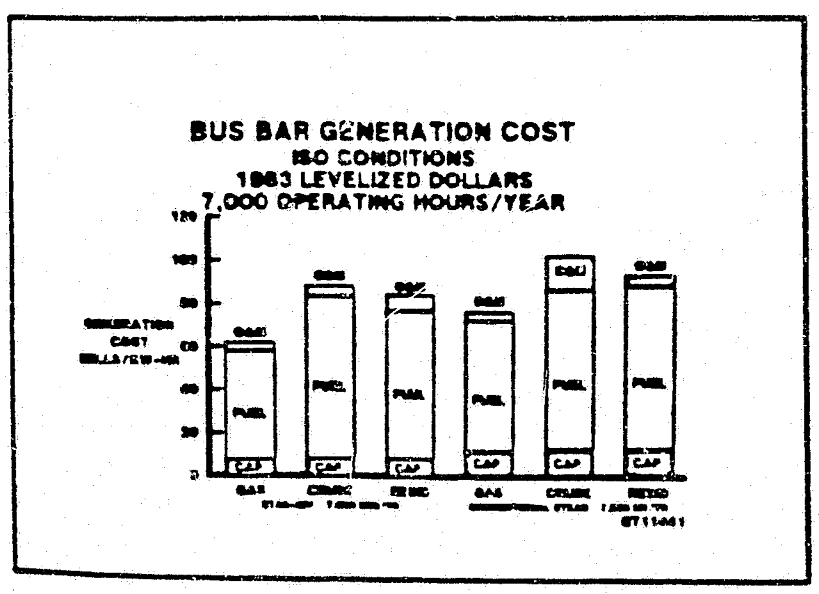


Figure 4

WESTERN FARMERS COOP
3 STAG 107S, 300 MW COMBINED-CYCLE PLANT

YEAR	NET GENERATION KW-HR x 10⁶	MAINTENANCE COST MILLS/KW-HR	PLANT UTILIZATION %	AVAILABILITY %
1978	1,386.19	0.384	86.0	79.2
1979	1,847.42	0.4427	88.6	83.8
1980	1,864.86	0.31	82.9	84.9
1981	1,942.10	0.85	86.9	94.7
1982	1,906.25	0.880	83.0	96.7

Figure 5

FERC MS7000 STAG COMBINED-CYCLE
POWER PRODUCTION COST DATA
6 SITES - 21 UNITS

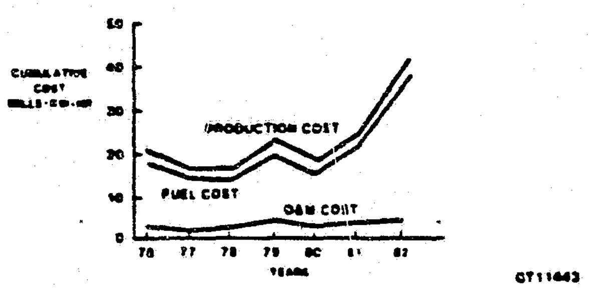


Figure 6

O&M COST FOR GE MS7000
STAG GAS TURBINES
FERC DATA 1975-1982

FIRED HR/YEAR	2.000	4.000	8.000
O&M COST/MILLS/KW-HR			
MINIMUM	0.6	0.49	0 43
MAXIMUM	3 5	2.5	1.90
AVERAGE	2.05	1.5	1 17

GT11445

Figure 8

bined-cycle plants using a range of fuel qualities (mostly No. 2 distillate) with widely varying environments and operating factors, the MS7000 STAG combined-cycle plant is a power generation plant which can be operated economically in the mid-range to base-load service. It is anticipated that the GE STAG combined-cycle plant should have O&M costs, in current dollars, lower than the early plants now in operation.

STAG COMBINED-CYCLE SYSTEM O&M COSTS

The gas turbine is the most significant item of maintenance costs in any combined-cycle system and, therefore, should be put on a preventative maintenance program and operational format that will keep costs at a minimum. This component operates at high temperatures while subject to rotational stresses. General Electric's advances in design technology have resulted in high efficiencies based on firing temperatures in the order of 2000 F/1093 C and metal temperatures approaching 1600 F/871 C on some hot-gas-path parts. By comparison, the associated heat recovery steam generator (HRSG) and steam turbine operate at temperatures no higher than those exhausted from the gas turbine, around 1000 F/538 C to 1050 F/566 C.

STAG combined-cycle O&M costs can be estimated using basic FERC data. Fuel type, availability, and cost have a significant influence on the O&M cost of any combined-cycle plant. The availability of low cost, clean, gaseous or liquid fuels is most desirable. For example, our recent estimates (Fig. 9) indicate that for a STAG 407, the O&M costs, when operated on gas fuel in base load service will be 1.5 mills/kWh. Crude fuel operation will result in an O&M cost of approximately 3.0 mills/kWh. These numbers also reflect lower than expected O&M costs for simple-cycle peaking gas turbine plants because of the relatively low O&M costs of the steam portion (unfired boiler and small steam turbine) which provides one-third of the plant output. As the quality of fuel decreases, such as going to ash-forming or residual fuels, decisions have to be made whether to initially purchase the capability to handle such fuels or modifying the equipment in the field.

O&M COST - MS7000 STAG
COMBINED CYCLE
FERC DATA 1975 - 1982/6 SITES, 27 UNITS

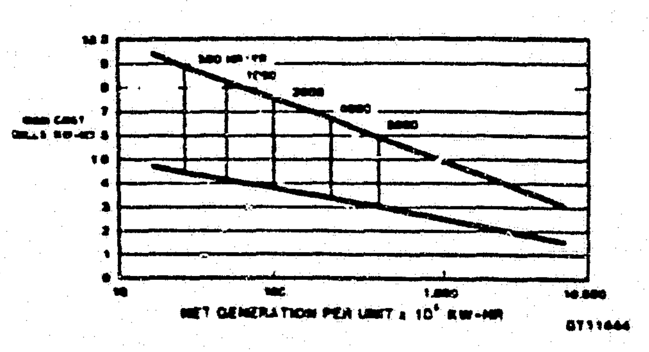


Figure 7

ESTIMATED O&M COST FOR GE STAG 407
COMBINED CYCLE PLANT
1983 DOLLARS, LEVELIZED/ISO CONDITIONS

FIRED HR/YEAR	2.000	4,000	8,000
O&M COST - MILLS/KW-HR			
GAS	2.8	1.90	1.5
CRUDE	5.25	3.85	3.0
RESIDUAL	7.00	5.13	4.0

GT11446

Figure 9

TABLE I

FERC DATA — MS7000 STAG PRODUCTION COSTS (INCLUDES FUEL AND O&M COSTS)

Utility	No. of Units	1976		1977		1978		1979		1980		1981		1982	
		Net Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh
HL&P	8	982.2	5.8	2,701.9	7.2	3,583.6	8.0	3,164.6	10.6	4,181.4	10.7	4,249.0	15.9	3,319.3	34.7
Arizona P.S.	3	189.1	24.3	443.4	24.3	188.7	32.8	175.6	25.9	67.0	60.9	24.8	94.3	17.8	136.0
Ohio Edison	2	303.4	32.4	253.5	37.8	400.1	37.7	255.6	48.2	—	—	29.2	179.0	17.2	262.7
Salt River	4	459.2	27.8	477.8	27.2	385.3	35.4	125.3	57.3	88.0	83.3	4.1	421.1	4.2	551.8
JCP&L	4	177.2	36.2	252.9	32.5	259.6	39.5	264.0	49.2	207.1	70.2	599.3	62.7	583.0	59.9
Port. G.E.	6	—	—	84.1	74.5	40.4	143.7	594.4	53.3	76.3	136.0	16.7	359.3	1.9	2,780.0
Cumulative		2,111.1	20.1	4,213.6	16.0	4,857.7	16.4	4,619.5	22.6	4,619.8	17.6	4,923.1	24.5	3,943.3	41.8

TABLE II

FERC DATA — MS7000 STAG FUEL COSTS

Utility	No. of Units	1976		1977		1978		1979		1980		1981		1982	
		Net Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh
HL&P	8	982.2	5.1	2,701.9	6.9	3,583.6	7.5	3,164.6	8.8	4,181.4	9.8	4,249.0	14.5	3,319.3	33.2
Arizona P.S.	3	189.1	22.8	443.4	22.1	188.7	25.8	175.6	19.9	67.0	44.7	24.8	51.8	17.8	57.0
Ohio Edison	2	303.4	27.0	253.5	32.4	400.1	33.0	255.6	40.6	—	—	29.2	124.0	17.2	181.1
Salt River	4	459.2	23.8	477.8	23.7	385.3	30.2	165.3	42.4	88.0	58.1	4.1	228.1	4.2	130.8
JCP&L	4	177.2	30.6	252.9	28.9	259.6	33.1	264.0	40.8	207.1	59.7	599.3	58.6	583.0	54.5
Port. G.E.	6	—	—	84.1	62.8	40.4	92.5	594.4	48.2	76.3	62.2	16.7	219.0	1.9	1551.0
Cumulative		2,111.1	17.5	4,213.6	14.4	4,657.7	14.2	4,619.5	19.0	4,619.8	15.0	4,923.1	21.6	3,943.3	38.0

TABLE III

FERC DATA — MS7000 STAG O&M COSTS

User	No. of Units	1976		1977		1978		1979		1980		1981		1982	
		Net Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh	Net. Gen. kWh × 10^6	Mills kWh
HL&P	8	982.2	0.7	2,701.9	0.3	3,583.6	0.5	3,164.6	1.8	4,181.4	0.8	4,249.0	1.4	3,319.3	1.5
Arizona P.S.	3	189.1	1.5	443.4	2.2	188.7	7.2	175.6	6.0	67.0	16.2	24.8	42.5	17.8	79.0
Ohio Edison	2	303.4	5.4	253.5	5.4	400.1	4.7	255.6	7.6	—	—	29.2	55.0	17.2	81.6
Salt River	4	459.2	4.0	477.8	3.5	385.3	5.2	165.3	14.9	88.0	25.2	4.1	19.3	4.2	427.0
JCP&L	4	177.5	5.6	252.9	3.6	259.6	6.4	264.0	8.4	207.1	10.5	599.3	4.1	583.0	5.4
Port. G.E.	6	—	—	84.1	11.7	40.4	51.2	594.4	5.1	76.3	73.8	16.7	140.3	1.9	1,229.0
Cumulative	27	2,111.4	2.6	4,213.6	1.6	4,857.7	2.2	4,619.5	3.6	4,619.8	2.6	4,923.1	2.9	3,943.3	3.8

Residual or ash-forming fuels have a relatively large effect on O&M costs The heavy ash content, contaminants (sodium, potassium, lead, etc.) always found in residual fuels (not necessarily crudes) require fuel treatment and periodic turbine washing and HRSG cleaning to restore power. These items add operational expenses because of additional personnel, treatment materials, etc. It should be expected that when burning some residual fuels, the O&M cost will increase by two to three times over burning natural gas.

Overview—STAG Combined Cycle Plant Maintenance

A planned maintenance program is essential to achieving the inherent economy, reliability and availability of the STAG combined-cycle power plant.

The plan should include the following:

- An understanding of the total plant environment
- Proper training of O&M personnel
- Regular inspections
- Adequate spare parts on site
- Operating data-collection & analysis
- Repair replacement of parts components when indicated by operating data
- Utilization of recommendations guidelines by GE

General Electric Company provides quality equipment with maintenance recommendations for each power plant installation However, it is the owner user who has the major impact upon the proper operation and maintenance of his equipment. The equipment's availability reliability are a direct result of his operating and maintenance plans. A maintenance program, therefore, which optimizes both maintenance costs and availability is vital to the owner.

For maximum effectiveness, the owner operator should develop a general understanding of the relationship between plant operation, types of inspections, spare parts planning, and the major factors affecting equipment life.

Maintenance Requirements—Gas Turbine

Gas turbine parts requiring the most careful attention are the "hot-gas-path" parts which include combustion liners, transition pieces, crossfire tubes, turbine nozzles and buckets. The basic design and recommended maintenance of GE gas turbines are oriented toward:

- Maximum periods of operation between overhauls
- In place, on-site maintenance
- Use of available labor for all disassembly inspections

In addition to the maintenance of the basic gas turbine, control devices and turbine auxiliaries require periodic inspections and maintenance.

The requirements outlined in the maintenance manual establish a pattern of planned inspections and maintenance. These start with very minor work at shorter intervals and progress to a major inspection (overhaul) after which the cycle is repeated.

Operating Factors Affecting Maintenance

The major factors having the greatest influence on the life of gas turbine parts for any given turbine are:

- Type of fuel
- Starting frequency
- Load cycle
- Environment

Type of Fuel

The effect of the fuel on the life (or time between inspection repair) of the combustion parts is associated with the radiant energy in the combustion process and the ability to atomize or treat various liquid fuels. Natural gas, therefore, which has the lowest level of radiant energy, will yield the longest parts life. Clean diesel fuels will yield similar parts lives. Contaminants in a gas or distillate fuel system, however, can erode or corrode valves and fuel nozzles. Liquid hydrocarbons in gas fuels must be eliminated to ensure satisfactory operation and low maintenance costs. The combination of distillate fuels with impurities during transport must be avoided or provisions for treatment must be provided. The use of crude or residual fuels, which have high radiant energy and are more difficult to atomize, will result in somewhat shorter parts lives than gas or distillate fuel. Contaminants in the form of salts (sodium, potassium, etc.) in the fuel, if not removed, will affect not only combustion parts lives but also buckets and, to some degree, nozzles in the form of hot corrosion. Contaminants in the fuel will also shorten maintenance intervals. This is particularly true for liquid fuels in which dirt results in accelerated replacement of pumps, metering devices, fuel nozzles, etc.

Clean or properly treated fuels will invariably result in reduced maintenance and extended parts life. Fuel treatment provided by GE effectively provides protection and longer parts lives. The treatment method varies with the type of fuel and contaminants involved but generally consists of purification systems for many light crudes, water wash systems for residual and heavy oils and, when required, vanadium inhibition systems. Fuel-handling equipment is designed and sized to meet the specific fuel characteristics. Fuel monitoring equipment is also supplied which provides simple, accurate monitoring of fuel received at the site and delivered to the turbine.

Starting Frequency

Although most of the new STAG combined-cycle power plant applications today are applied to base load duty (one start per 100 hours or greater) because of their high efficiency, each start and stop of a gas turbine subjects the hot-gas-path parts to a significant thermal cycle. The gas turbine control system is designed and adjusted to minimize this effect (therefore, these systems are less susceptible to cyclic damage than fossil plants); however, frequent starting and stopping does reduce parts lives.

Load Cycle

The load cycle of the gas turbine, up to its continuous duty rating, will have little effect on parts life provided it does not require frequent, rapid large load changes which would have the similar effect of frequent starts and stops. Full load trips should be avoided since their effect is to shorten hot-gas-path parts lives considerably. Corrective action should be taken immediately if this problem appears prevalent.

Environment

The quality of the inlet air for the gas turbine can have a significant effect on maintenance if it contains abrasive or corrosive constituents. In the case of abrasives in the inlet air, such as from desert sand storms, careful attention should be paid to proper maintenance of the inlet filtration system. Self-cleaning inlet air filters are a cost-effective, proven method for improved availability and lower maintenance costs for base-loaded units.

If a gas turbine is to be operated in a corrosive atmosphere, such as salt in marine, seashore, or earth deposits, close attention should be paid to the inlet arrangement to insure application of correct materials and or protective coatings.

KINDS OF INSPECTION

General Electric broadly classifies its types of scheduled inspections as "stand-by", "operational data gathering", and "disassembly." The "operational data-gathering" inspections are used as indicators of the general condition of the equipment and as a guide for planning the disassembly maintenance program. These inspections are performed during start-up and when the unit is running. The "disassembly" inspections are performed when the unit is on standstill and includes the combustion, hot-gas-path and major overhaul inspections. They require disassembly of the turbine to varying degrees, depending upon the type of inspection.

Stand-by Inspections

Stand-by inspections apply to gas turbines used in intermittent service where stand-by reliability is of primary concern. This maintenance includes changing filters, checking oil and water levels, and checking calibrations. A periodic test run is an essential part of the stand-by inspection and, therefore, for continuous-duty, base-loaded applications, the stand-by inspection loses its significance.

Operational Data-Gathering Inspections

A good maintenance program starts with recording information about the equipment during installation, initial operation, and after each turbine shutdown or disassembly inspection. Data should be taken to establish normal equipment startup parameters, and critical benchmarks vs. time recorded from the initial start signal. GE STAG combined-cycle plants provide equipment for the automatic printout of such data, reducing the operational data-taking manpower requirements. A plot of these parameters will provide a basis for judging the condition of the control system.

OPERATING DATA FOR OPERATIONAL INSPECTIONS OF COMBINED-CYCLE PLANTS

COMPONENTS	PARAMETERS
GAS TURBINE	SPEED LOAD FIRED HOURS FIRED STARTS SITE BAROMETER READING TEMPERATURES AMBIENT AXIAL FLOW COMPRESSOR TURBINE WHEELSPACE EXHAUST LUBE OIL HEADER LUBE OIL TANK BEARING DRAINS IF USED PRESSURES LUBE OIL PUMP S BEARING HEADER AXIAL COMPRESSOR DISCHARGE COOLING WATER FUEL S ATOMIZING AIR IF APPLICABLE FILTERS FUEL, LUBE ETC FUEL NOZZLES
GAS TURBINE GENERATOR	OUTPUT VOLTAGE PHASE CURRENT VARS FIELD VOLTAGE FIELD CURRENT STATOR TEMPERATURE TOTAL LOAD USING KWH METER DISK VIBRATION DATA GAS TURBINE AND GENERATOR PLUS GEARING COUPLING ETC GENERAL LUBE LEVELS COOLING WATER LEVELS IF APPLICABLE

Figure 10

Deviations from the norm help pinpoint impending trouble, changes in calibration, or damaged components. Operating data of this type, shown in Fig. 10, should be recorded or printed out at least once each shift. The data should be analyzed for abnormal trends.

The general relationship between load and exhaust temperatures should be recorded and compared to previous data. Variations in exhaust temperature spread should also be recorded.

Excessive power loss, resulting from deterioration of parts or leaks, may require disassembly of the turbine in order to restore power. Loss in performance, however, may only be due to fouling of the compressor which can be restored by on-line cleaning.

The vibration level of the unit should be observed and recorded. Small changes will occur for various operating conditions; however, large changes, or a continuous, increasing trend, are indications that corrective action is required.

The fuel system should be observed for fuel use vs load. Fuel pressure through the system should be monitored. Periodic checks should be made of the fuel quality entering the turbine to insure contaminants are not prevalent, particularly those that can cause hot corrosion of hot-gas-path parts.

Disassembly Inspections

Borescoping

To aid in maintenance-planning and a possible reduction of maintenance costs and longer intervals between scheduled turbine inspections, GE recommends borescoping of the turbine. Borescoping can be very useful in planning future parts requirements or repairs needed, as well as the timing for the next scheduled inspection. General Electric gas turbines have built-in borescope capability which consists of holes machined into the outer casing at strategic positions. This feature allows borescope examination of critical parts in both the compressor and the hot-gas-path.

To support these inspections, GE has published descriptions of the borescope technique. GE Field Engineers have also been trained and equipped to perform borescope inspections and to report and interpret the results.

Borescope inspections cannot replace the need for visual inspection and nondestructive testing. Nevertheless, the judicial use of this technique can reduce maintenance cost by extending inspection intervals and overhauls to a "need-to-do" point in time rather than on an elapsed time or fired-hours basis.

The early review of the hot-gas-path parts can be helpful in establishing replacement part requirements in advance of need, particularly for the hot-gas-path and major inspections. Hot-gas-path parts, visible with borescope, are described in Table IV and Fig. 11.

Combustion Inspection

The combustion inspection is a relatively short disassembly inspection of the combustion liners, transition pieces, fuel nozzles, cross-fire tubes, and retainers, spark plug assemblies, flame detectors and radiation shields. During a combustion inspection, both a borescope and visual inspection should be made of those areas accessible by these means.

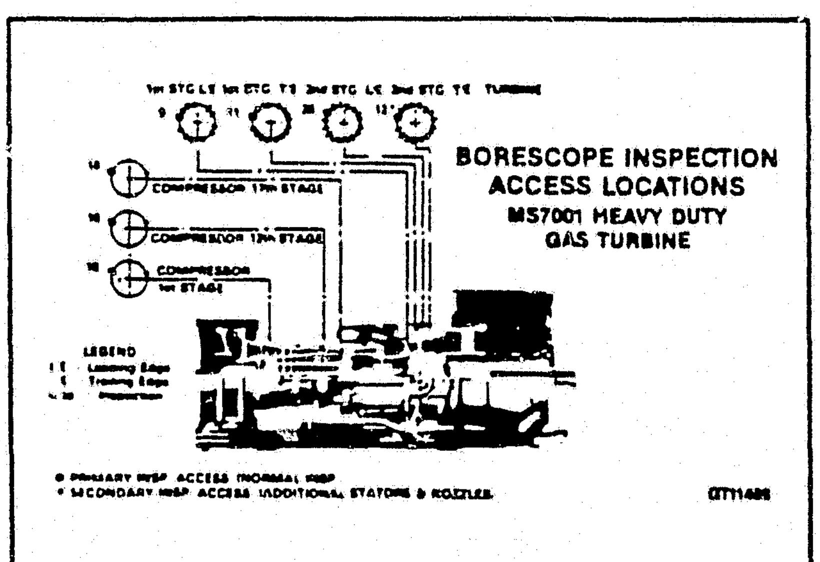


Figure 11

TABLE IV

BORESCOPE INSPECTION AREAS

Access Location	MS 7001 and 9001
Compressor Case	Stages 1, 12 & 17 Stator and Rotor
*Fuel Nozzles Hole & Combustion Wrapper	Liner & Transition Pieces First Stage Nozzle Leading Edge
Turbine Case	1. First-stage trailing edge & third-stage buckets leading edge. 2. First-stage buckets trailing edge & second-stage nozzle leading edge. 3. Second-stage nozzle trailing edge & second-stage bucket leading edge. 4. Second-stage bucket trailing edge & third stage nozzle leading edge.

*Use flexible fiber-optic borescopic only

It is recommended that one complete set of repaired new hardware be kept on site to insure that units can be returned to service in the shortest possible time. Figure 12 illustrates the section of a typical unit that is disassembled for a combustion inspection. Figure 13 describes the work scope associated with a combustion inspection. Combustion liners and transition pieces should be replaced with new or repaired parts. Fuel nozzles should be cleaned or replaced. After the unit is returned to service, the removed hardware can be inspected and repaired as necessary at a qualified off-site GE repair facility.

Hot-Gas-Path Inspection

The hot-gas-path inspection includes the combustion inspection and a visual inspection of turbine nozzles and buckets. The top half of the turbine shell must be removed for a hot-gas-path inspection. Referring back to Fig. 12, this illustrates the section of a typical unit that is disassembled for hot-gas-path inspection. Figure 14 illustrates the type of work scope required.

The on-site availability of a set of combustion hardware and first stage nozzle will minimize the inspection outage. The parts removed can be inspected and repaired at a qualified facility and returned to the user's inventory.

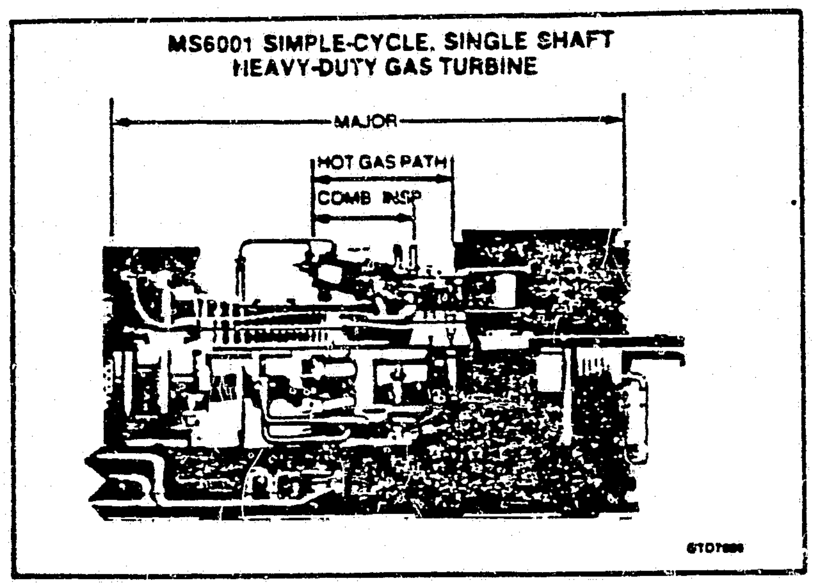


Figure 12

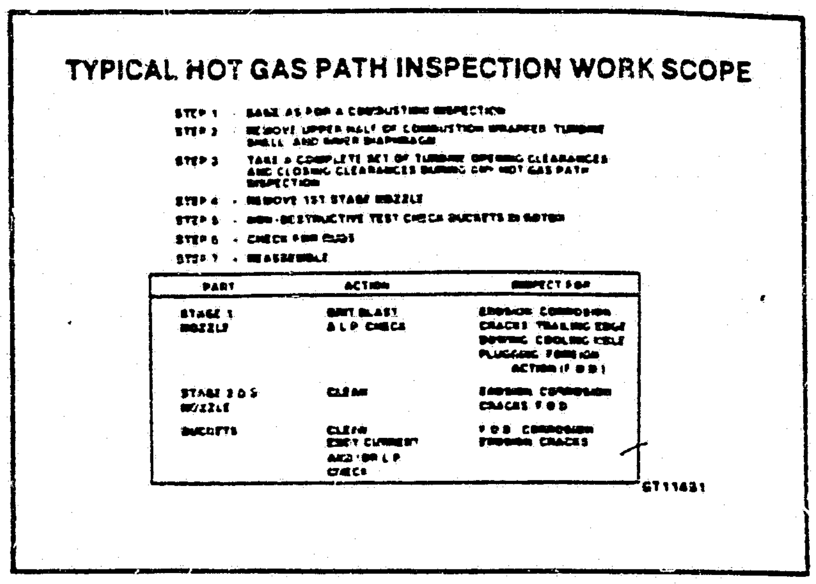


Figure 14

Major Inspections

Major inspections should be scheduled in accordance with General Electric's recommendations or may be modified by the results of previous inspections. The work scope of a major inspection (Fig. 15) includes that of a combustion inspection and in the laying open of the complete turbine at the horizontal joints, as indicated (refer to Fig. 12).

The first-stage nozzle is exposed to the direct discharge from the combustion process and is subjected to the highest temperature. Normally, nozzles can be repaired several times to extend their lives. Generally, the decision to repair or replace is made at the time of the previous hot-gas-path inspection. Similarly, a decision relative to having a set of first-stage buckets on site for a hot-gas-path or major inspection can be made on the basis of past inspections. Data from previous inspections help determine the rate of wear or deterioration, thereby making part life predictions more accurate and allowing adequate time to plan for the next outage.

Inspection Intervals

Based upon a wide variety of actual operating experience, GE has developed inspection interval criteria to be used as guidelines.

Table V lists recommended inspection intervals and estimated down time for current production gas turbines used in a STAG combined-cycle plant for base-load service, burning gas, distillate and heavy fuels. With experience, however, the maintenance planner should take advantage of system flexibility by adjusting maintenance intervals to suit system requirements, work crew availability, and similar factors.

A well-planned maintenance program insures anticipating the needs of the equipment and is tailored to meet the requirements of the STAG combined-cycle system for availability, reliability and maintenance cost. GE technical direction is available to help plan and direct the maintenance work that will ultimately reduce downtime and labor costs.

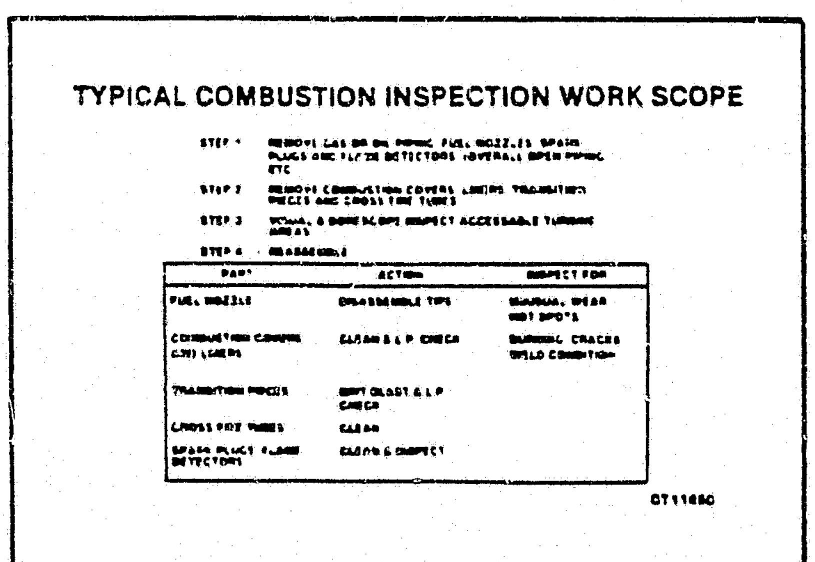


Figure 13

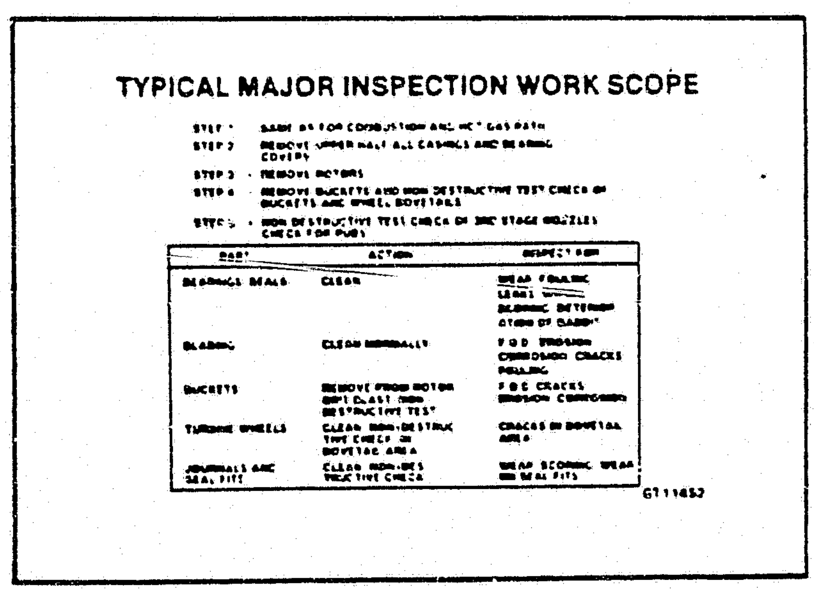


Figure 15

TABLE V

RECOMMENDED INSPECTION INTERVALS AND ESTIMATED DOWN TIME

Base Load

1 Start Per 100 or More Fired Hours

Inspection	Fuel	Fired Hours × 10 ³ & Estimated Down Time-Hours					
		MS6001		MS7001		MS9001	
		F.H.	D.T.	F.H.	D.T.	F.H.	D.T.
Combustion	G	8	64	8	64	8	64
	D	8	64	8	64	8	64
	C or R	L-3	30	L-3	30	L-3	30
		XP-6	64	XP-6	64	XP-6	64
H-G-P	G	24	160	24	160	24	160
	D	24	160	24	160	24	160
	C or R	10-14	160	10-14	160	10-14	160
Major	G	48	320	48	320	48	320
	D	48	320	48	320	48	320
	C or R	20-28	320	20-28	320	20-28	320

It is difficult to estimate the number of manhours required for each type of inspection, primarily because of the wide range of experience, productivity and working conditions that exist around the world. Based upon the assumptions in Fig. 16, however, such as use of an average crew of workers in the United States with trade skill, but not necessarily direct gas turbine experience, all parts available, i.e., no repair time, an estimate can be made as shown in Table V.

Steam-Side Equipment

The steam-side equipment in GE STAG combined-cycle plants consists of the HRSG, steam turbine, pumps, valves, etc. and has maintenance requirements normally required in a fossil-fired steam plant except for the HRSG, which is unfired and requires substantially less maintenance than a fired boiler (the major maintenance item in a conventional plant).

Like the gas turbine, the HRSG should have regular inspection criteria and intervals established. These criteria will depend upon the operating cycle, load duty, water and steam conditions and environmental factors that effect the various components.

One of the most important considerations for both the HRSG and the steam turbine is maintaining proper water

TABLE VI

HRSG's — TYPES OF INSPECTION 3 = 9

3 shifts
×40
120

Systems & Components	Types of Inspection: Standby	Types of Inspection: Operational	Types of Inspection: Disassembly	Remarks
Economizer, Evaporator	No	Yes 3	Yes 40	Check pumps & valves for proper operating steam drain for proper levels; check circulating pumps for cleanliness; record operation parameters; check water chemistry twice per shift; check ducting & joints for leakage; inspect tubes & repair leaks; check tubes for same & deposite buildup & clean periodically; hydrostatic test every two years; do all repairs during gas turbine outage.
Superheater	No	Yes	Yes 40	
Steam Drum	No	Yes	Yes 60	
Pumps	Yes	Yes	Yes 8	
Valves	Yes	Yes	Yes	
Gauges	Yes	Yes	Yes	
Switches	Yes	Yes	Yes	
Duct Work	Yes	Yes	Yes	
Expansion Joints	Yes	Yes	Yes	
Activators	Yes	Yes	Yes	
Dampers	Yes	Yes	Yes	

INSPECTION ASSUMPTIONS

- DIRECT LABOR - NO SUPERVISION
- NO REPAIR TIME - REPLACEMENT ONLY
- ALL PARTS AVAILABLE
- ALL NECESSARY TOOLS AVAILABLE
- CREWS WITH AVERAGE TRADE SKILL
- FLANGE-TO-FLANGE ONLY
- INSPECTION HAS BEEN PREPLANNED

GT11453

Figure 15

TABLE VII

HRSG PARAMETERS

Ambient temperatures
Relative humidity
Feed water flows and temperatures
Steam flows, temperatures, pressures
Drum pressures
Total solids in drum water
Saturated steam solids
Blow down flow
Stack temperature

chemistry. Successful operation of the steam generating equipment depends on the proper control of feedwater and operating variables to assure freedom from scale formation and corrosion of water and steam surfaces. The presence of oxygen, oil, grease, high alkalinity should be continuously monitored and prompt corrective action taken to eliminate such anomalies when they occur. Silica carryover will present a particular problem on superheater tubes and steam turbine blading. Samples of water should be taken from a continuous blowdown connection in addition to taking continuous samples of the saturated steam leaving the steam turbine. Sampling and determination of boiler water conditions can be made according to the methods in American Society for Testing & Materials (ASTM) special Technical Publication No. 148.

All boilers are susceptible to developing tube leaks. Although the design of GE HRSG's minimizes this problem, if such leaks do occur, they should be corrected as soon as possible to preclude damage to tubes and other elements of the HRSG. In general, HRSG inspections can be divided into three types—standby, operational and disassembly.

Table VI reflects the types of inspections and general maintenance considerations during these inspections. Table VII indicates the type of parameter data that should be recorded and analyzed on a regular basis on the HRSG.

Steam Turbine

The proper maintenance of the steam turbine in a GE STAG combined-cycle plant is the same as that which is normally required of a steam turbine in a fossil-fired plant. It is good practice, however, as indicated in Table VIII, for a disassembly inspection after the first year of operation to permit the internal evaluation of the unit. This inspection will allow time for corrective action (if needed) to be taken before an abnormal situation progresses to impact reliability, performance and or require expensive downtime. Table IX reflects the operating parameters that should be recorded and analyzed on a periodic basis for the steam turbine.

Generators—Steam and Gas Turbines

Although generators, in general, do not require a great deal of maintenance, there are several things that can be done to insure trouble-free operation. Shown in Table X are the types of applicable inspections related to the maintenance of both the gas turbine and steam turbine-generators. Table XI provides the type of operational parameters which should

TABLE VIII

STEAM TURBINE

Systems & Components	Types of Inspection: Standby	Operational	Disassembly	Remarks
Shells	No	Yes	Yes	Check for leakage; record performance parameters, complete first disassembly inspection at end of first years operation.
Bolting	No	No	Yes	
Diaphragm	No	No	Yes	
Valves	No	Yes	Yes	
Lube System	No	Yes	Yes	
Bearings	No	No	Yes	
H_2 System When Available	No	Yes	Yes	

be recorded and analyzed on a regular basis for trends that could indicate impending problems requiring corrective action at the next outage.

STAG Combined-Cycle Control Systems

GE STAG plant control systems are configured to provide basic functions:

- Automatic manual sequencing
- Automatic manual process control
- Plant protection

A wide range of plant control automation may be selected when buying a STAG combined-cycle plant. It is possible to start up a complete STAG combined-cycle plant by pushing a single button. Numerous parameters are recorded automatically, totalized and or displayed. The data acquisition system associated with the GE STAG combined-cycle plants will print out, upon request, those parameters which in older plants had to be recorded by hand. In order to reap the benefits built into the automation of the plant, it is necessary to have trained maintenance and operating personnel. Components such as sensing devices and regulating valves should be inspected regularly and maintained properly. Control valves, pressure and temperature devices, gauges, and control panels should be checked monthly by qualified personnel. Downtime can be reduced by having adequate spare parts on hand.

TABLE IX

STEAM TURBINE

Parameters

- Bearing oil inlet and discharge temperatures
- Inlet steam pressure
- Steam pressure
- Extraction of first stage shell pressure
- Vibration
- Shell meter temperatures
- Differential expansion
- Exhaust pressure or vacuum
- Hydraulic pressure

TABLE X

INSPECTION TYPES AND GENERAL REMARKS FOR THE INSPECTION OF GENERATORS

Systems	Types of Inspection			Remarks
	Standby	Operational	Disassembly	
Gas Turbine Steam Turbine	Yes Yes	Yes Yes	Yes Yes	Check for leaks; record performance parameters. After first year's operation, at a minimum, the top end shield should be removed and a borescope and cleanliness check made. Meggar and polarization tests should also be performed. Some manufacturers may recommend field removal at this time. Future inspections will depend upon usage and deterioration of performance parameters. Disassembly inspections should be performed while the gas turbine or steam turbine is undergoing an extended outage inspection.
Controls (Panels/Consoles) Station Gas Turbine HRSG Steam Turbine	 Yes Yes Yes Yes	 Yes Yes Yes Yes	 No No No No	Check for proper functioning; replace cards and/or devices not functioning properly; troubleshoot as required; vacuum cabinets periodically; check controls for calibration at least once a year and more often when possible.

TABLE XI

GENERATORS

Parameters

- Output voltage
- Phase current
- VARs
- Field voltage
- Field current
- Stator temperatures
- kWh total
- Load using kWh meter disk
- Vibration Data:
  - Gas turbine and generator plus gearing, coupling, etc.
- General:
  - Lube, levels
  - Cooling water levels (if applicable)
- Hydraulic pressure
- Generator cold-gas temperature
- Generator armature winding temperature
- Generator field winding temperature
- Collector and excitor (if applicable)
- Brush wear

SUMMARY

An analysis of the O&M costs for a power plant provides a good indication as to the quality of the equipment purchased and, to a large degree, the operation and maintenance practices of a given utility.

O&M costs normally represent a small portion of the total plant operating cost. The benefits, however, of using proper maintenance, planning, and equipment with trained personnel and using adequate operating procedures far outweigh the cost involved. Proper maintenance will provide maximum plant availability and reliability.

General Electric STAG combined-cycle maintenance cost data show similar values to those observed for conventional fossil plants. On natural gas, STAG combined cycles typically have lower O&M cost; while on heavy fuels, the costs are somewhat higher. At the current cost of fuels, however, the efficiency and availability advantages of combined cycles are the dominant economic factors for consideration.

This paper has described the types of recommended O&M schedules and procedures for optimum plant performance. General Electric personnel will be pleased to provide additional information or assistance in the development of a maintenance schedule or resolution of a maintenance problem.

CONVERSION FACTORS

The following is a list of conversion factors most commonly used for gas turbine performance.

To Convert	To	Multiply By
acres	hectares	4.047×10^{-1}
atm	kg/cm^2	1.0333
atm	lb/in.^{2}	1.47×10^{1}
bars	atm	9.869×10^{-1}
bars	lb/in.^{2}	1.45×10^{1}
Btu	J (joules)	1.055×10^{3}
Btu	kcal	2.52×10^{-1}
Btu/h	kcal/h	2.520×10^{-1}
Btu/h	kJ/h	1.0548
Btu/h	W (watts)	2.931×10^{-1}
Btu/hp-h	kcal/kWh	3.379×10^{-1}
Btu/hp-h	kJ/kWh	1.4148
Btu/kWh	kcal/kWh	2.5198×10^{-1}
Btu/kWh	kJ/kWh	1.0548
Btu/lb	kcal/kg	5.555×10^{-1}
Btu/lb	kJ/kg	2.3256
°C	°F	(°C × 9/5) + 32
°C	K	°C + 273.18
cm^3	ft^3	3.531×10^{-5}
cm^3	in.^{3}	6.102×10^{-2}
°F	°C	(°F − 32) × 5/9
ft	m	3.048×10^{-1}
ft^2	m^2	9.29×10^{-2}
ft^3	l (liters)	2.832×10^{1}
ft^3	m^3	2.832×10^{-2}
ft-lb	Btu	1.286×10^{-3}
ft-lb	kg-m	1.383×10^{-1}
ft/min	km/h	1.8288×10^{-2}
ft^3/min	l/s	4.720×10^{-1}
ft^3/min	m^3/min	2.832×10^{-2}
gal	m^3	3.785×10^{-3}
gal/min	l/s	6.308×10^{-2}
hectares	acres	2.471
hp (U.S.)	kW	7.457×10^{-1}
hp (U.S.)	hp (metric)	1.014
in.	cm	2.540
in.	mm	2.54×10^{1}
in.^{2}	mm^2	6.452×10^{2}
in. of mercury	kg/cm^2	3.453×10^{-2}
in. of water (at 4°C)	kg/cm^2	2.54×10^{-3}
in. of water (at 4°C)	lb/in.^{2}	3.613×10^{-2}
J	Btu	9.486×10^{-4}
kg	lb	2.2046
kg/cm^2	lb/in.^{2}	1.422×10^{1}
kg-m	ft-lb	7.233
kg/m^3	lb/ft^3	6.243×10^{-2}
km	miles (statute)	6.214×10^{-1}
kW	hp	1.341
l	ft^3	3.531×10^{-2}
lb	kg	4.536×10^{-1}
lb/in.^{2}	kg/cm^2	7.03×10^{-2}
lb/in.^{2}	Pa	6.8948×10^{3}
lb-ft^2	kg-m^2	4.214×10^{-1}
l/min	ft^3/s	5.886×10^{-4}
l/min	gal/s	4.403×10^{-3}
m	ft	3.281
m^2	ft^2	1.076×10^{1}
m^3	ft^3	3.531×10^{1}
mile (statute)	km	1.6093
tons (metric)	kg	1.0×10^{3}
tons (metric)	lb	2.205×10^{3}
W	Btu/h	3.4129
W	Btu/min	5.688×10^{-2}
W	ft-lb/s	7.378×10^{-1}
W	hp	1.341×10^{-3}

1983 GAS TURBINE REFERENCE LIBRARY

GER-3400	STAG Combined-Cycle Operating Experience
GER-3401	STAG Combined-Cycle Product Line
GER-3402	STAG Combined-Cycle Plant Engineering and Construction Management
GER-3403	Steam Turbines for STAG Combined-Cycle Power Systems
GER-3404	Heat Recovery Steam Generators for STAG Combined-Cycle Plants
GER-3405	Controls for STAG Combined-Cycle Plants
GER-3406	STAG Combined-Cycle Power Systems Reliability
GER-3407	STAG Combined-Cycle Power Systems Operation and Maintenance
GER-3408	STAG Combined-Cycle Fuel Flexibility and Economic Evaluation
GER-3409	STAG Combined-Cycle Plants in Power Generation Planning Analysis
GER-3410	Combined-Cycle Repowering Mechanics and Economics
GER-3411	STAG Combined-Cycle System Economics
GER-3412	Heavy-Duty Gas Turbine Maintenance Practices
GER-3413	GE MS6001 — Heavy-Duty Gas Turbine
GER-3414	Gas Turbine Parts and Performance Update
GER-3415	Gas Turbines in Mechanical Drive Applications
GER-3416	GE Compressors for Pipeline and Process Applications
GER-3418	Generators for Gas Turbine Applications
GER-3419	Gas Turbine Inlet Air Treatment
GER-3421	Advanced Materials and Coatings
GER-3422	GE MS7001 Heavy-Duty Gas Turbine
GER-3423	Electric Utility Gas Turbine Applications
GER-3424	Aircraft-Derivative Maintenance Practices
GER-3425	GE LM5000 Aircraft-Derivative Gas Turbine System
GER-3426	GE Mark IV SPEEDTRONIC Control System
GER-3427	GE Data-Tronic Information and Control System
GER-3428	Fuels Flexibility in Heavy-Duty Gas Turbines
GER-3429	Meeting the Quality Commitment with Experience and Technology
GER-3430	Industrial Gas Turbine Cogeneration Application Considerations
GER-3431	GE LM2500 Aircraft-Derivative Gas Turbine System
GER-3432	GE MS9000 Heavy-Duty Gas Turbine
GER-3433	Application of Gas Turbines in the Process Industry
GER-3434	Recent Developments and Design Philosophy for Heavy-Duty Gas Turbines
GER-3435	GE Gas Turbine Multiple-Combustion Systems
GER-3436	Project Management Concepts
GER-3437	Performance Characteristics
GER-3438	Liquid Fuel Treatment Systems
GER-3439	Coal-Fired STAG Combined-Cycle Applications
GER-3451	Legislation and Regulations Affecting Cogeneration

CANADIAN GENERAL ELECTRIC COMPANY
1900 Eglinton Avenue, East
Scarborough, Ontario, Canada

GENERAL ELECTRIC COMPANY
International Trading Operations
570 Lexington Avenue
New York City, New York 10022 USA

GAS TURBINE DIVISION
GENERAL ELECTRIC COMPANY
SCHENECTADY, NEW YORK 12345 USA

5–84 (3M)

GENERAL ELECTRIC

USA

4. QUESTION

b) Basis and supporting data for the portion of O&M costs represented by "in-house parts repair" and the effect it had on total fixed O&M costs.

RESPONSE

Telephone contacts of several Alaskan utilities revealed that significant in-house repair practices were being utilized in the overhaul and maintenance of their combustion turbine generators. This was most notably reflected in the Alaska utilities' practices regarding the repair and refurbishment of combustion turbine replacement parts. In the Lower 48, utilities regularly rely on the original equipment manufacturer to provide these repairs.

The Alaskan utilities contacted were Chugach Electric Association, and Golden Valley Electric Association, and Anchorage Municipal Light & Power Company. Anchorage Municipal Light & Power Company reported replacement and repair of the following combustion turbine parts through their own in-house repair capabilities:

- Combustion liners and transition pieces
- Compressor stationary blading components
- Hot parts stationary components
- First and second stage nozzle repair

Replacement and repair of these parts through in-house practices accounts for approximately 50 percent of the total cost of each combustion turbine overhaul, with in-house repair generally less costly than manufacturer repair. Also, in-house repair is normally a fixed cost while manufacturer repair is normally a variable cost.

A comparison of the O&M costs from the License Application with those of the Power Authority DEIS comments - Appendix I show a marked shift of cost from the variable to the fixed component as a result of taking this in-house repair function into account. Assuming a simple cycle unit operates at a 20 percent plant factor, total (fixed plus variable) O&M costs would be reduced by about 27 percent due to in-house maintenance. A reduction of about 19 percent would occur for a combined cycle unit assuming an 80 percent plant factor.

4. QUESTION

c) Equipment manufacturers data and related APA inputs used to justify the changes in the thermal cycle conditions and auxiliary power requirements which led to the changes in simple cycle gas turbine and combined cycle heat rate data.

RESPONSE

The calculation for plant performance used in the Power Authority's DEIS comment was based on informal contacts with turbine manufacturers. Subsequently, formal documentation was requested from GE, which resulted in some minor revisions of the original data. These revisions are found in the attached letter to Ebasco, dated October 19, 1984. (Attachment 4c.1) In that letter, GE documents the heat rate of the simple cycle, ISO ratings and auxiliary loads for both simple and combined cycle units. Since the basis of the letter is expressed in lower heating values than those used in the DEIS comments, the following corrections must be made to compare the number.

Heat Rate (LHV)		Correction Factor		Heat Rate (MHV)
10,610	x	1.11	=	11,777

The above number is at ISO conditions. At the average annual temperature of the Cook Inlet (33°F), the rating would be approximately 11,660.

The combined cycle data is taken from a GE publication entitled "STAG Combined Cycle Performance Data." In that publication, the following heat rate is given.

Heat Rate (LHV)		Correction Factor		Heat Rate (MHV)
7,620	x	1.11	=	8,458

The actual output of a combined cycle machine is dependent upon detailed auxiliary power requirements and the condenser back pressure of the steam cycle. Because an Alaskan unit's condenser will likely be air cooled, the output of the power plant will not be as efficient. New performance calculations at 33°F have not been completed for the combined cycle, based upon the revised data. However it is safe to assume that the valve used in the latest analysis is optimistic with respect to plant performance. Hence, it favors the thermal alternatives in a comparison with the Susitna Project.

4. QUESTION

d) A copy of the Alaska Public Utilities Commission ruling requiring a 20-year life for combustion turbines and justification for a 40-year life for transmission facilities.

RESPONSE

There is no formal Alaska Public Utilities Commission (APUC) "ruling" requiring a 20-year useful life for combustion turbines. The Power Authority's statement in the DEIS was based upon the fact that in recent rate filings with the APUC some Alaska electric utilities have proposed depreciating their combustion turbines over 16 2/3 years. Based on these filings, the Power Authority established the 20-year estimate noted in the DEIS.

The Power Authority has confirmed the validity of its 20-year useful life estimate for combustion turbines in discussions with APUC staff engineers. In those discussions, the APUC staff has indicated that the 30-year useful life typically assigned a combustion turbine in the Lower 48 is inapplicable for Alaska, where combustion turbines are operated as base-load

The Power Authority believes that the Lower 48 concensus of a 50-year economic lifetime for steel-towered transmission facilities, is inappropriate for Alaska, due to the extreme climate of Interior Alaska. Thus, the expected service of steel-towered transmission facilities has been reduced to 40 years for use in Susitna economic analyses.

5. QUESTION

Copies of the Power Authority/Harza-Ebasco detailed estimates of Susitna O&M which were used to justify the reduced Susitna O&M cost. (This pertains to the revised hydroelectric parameters as discussed in Volume 3, Appendix I of the Power Authority's comments).

RESPONSE

The Power Authority's original estimate of the Susitna operation and maintenance costs was presented in Table D-5 of the License Application, and is attached hereto as Attachment 5.1. The License Application scheme was based on full staffing on-site at both the Watana and Devil Canyon power plants for the life of the project. In conjunction with the project design refinements, the Power Authority has re-evaluated the Susitna operation and maintenance costs. The revised estimate is presented in Attachment 5.2.

The primary reason for the reduction in cost is a revised approach to the project operating and maintenance staffing requirements. Review of current practice by the U.S. Bureau of Reclamation indicates that full staffing on-site is neither warranted nor desireable for Susitna. The Power Authority recognizes the need to have an adequate staff on-site during the initial start-up and shake-down period for the Susitna power plants. However, after an estimated four-year break-in period, it will be desireable to move the Susitna operations center to a location better suited for dispatching the project power and energy.

It has been suggested that Willow might serve as the ultimate control point. Since it is closer to the power purchasers and users, the Susitna operation can better respond to changes in system load requirements. Also, the costs of maintaining staff at Willow will be less than staffing a remote site such as the Watana or Devil Canyon power plants.

The proposed staffing scheme which is the basis for the revised cost estimate is shown in Attachment 5.3. The initial staffing required at the powerplants has been reduced based on a more refined estimate by the Power Authority. Attachment 5.4 provides the unit prices applied to the staffing set forth in Attachment 5.3, thus providing the labor costs presented in Attachment 5.2.

With respect to Attachment 5.2, labor costs for Power Transmission and Townsite Operations are estimated based on the staffing shown in Attachment 5.3 and the annual costs shown in Attachment 5.4. The expense estimates for Power Transmission and Contracted Services are unchanged for the initial staffing at Watana and Devil Canyon. The eventual expense for Power Transmission is estimated to be the same as the Watana initial expense. The eventual expense for Contracted Services is estimated to be the Watana initial expense plus an additional $150,000 annually. This additional amount represents an allowance for special contracted services estimated on the following basis:

- crew of 10 workers;
- average annual cost of $60,000; and
- services required 3 months out of the year on average.

Hence:

$$10 \times \$60,000 \times 3/12 = \$150,000$$

The estimated expenses for Townsite Operations are reduced to reflect the reduction in initial staffing requirements on-site. In Attachment 5.2 eventual expenses for Townsite Operations are estimated to be the same as the Watana initial expense. Estimated costs of operation and maintenance related to Environmental Mitigation were not increased for addition of the Devil Canyon development. Hence, $1,000,000 annually was used for both Watana alone and combined project operation. This effectively reduces the License Application estimate by half for combined operation mitigation. Contingency on the estimate has been increased from 10 percent to 15 percent, providing a higher margin for uncertainty in the estimate. The allowance to replace community facilities has been eliminated.

Note that the Susitna O&M costs presented at the bottom of Table 8-2 (Appendix I of the Power Authority's Comments on DEIS) are in 1983 dollars (See Attachment 5.2). These 1983 values were deflated to the 1982 price level for use in the economic analysis.

TABLE D.5: SUMMARY OF OPERATION AND MAINTENANCE COSTS

	WATANA ($000's Omitted)			DEVIL CANYON[1] ($000's Omitted)		
	Labor	Expense Items	Subtotal	Labor	Expense Items	Subtotal
Power & Transmission Operation/ Maintenance	5330	990	6320	1920	500	2420
Contracted Services	--	900	900	--	480	480
Permanent Townsite Operations	540	340	880	120	80	200
Allowance for Environmental Mitigation	--	--	1000			1000
Contingency	--	--	900			500
Additional Allowance from 2002 to Replace Community Facilities			400			200
Total Operating and Maintenance Expenditure Estimate Power Development and Transmission Facilities		WATANA	10,400	DEVIL CANYON		4,800

(1) Incremental

Attachment 5.2

SUSITNA HYDROELECTRIC PROJECT
OPERATION AND MAINTENANCE COST ESTIMATES
($1000/yr)

	Initial Watana[1]			Initial Devil Canyon[2]			Eventual Total Project		
	Labor	Expenses	Subtotal	Labor	Expenses	Subtotal	Labor	Expenses	Subtotal
Power Transmission	3300	990	4920	625	500	1125	2470	990	3460
Contracted Services[2]		900	900		480	480		1050	1050
Townsite Operations	625	180	805	400	55	455	285	180	465
Environmental Mitigation			1000			--			1000
Contingency (15%)			1045			310			895
Total, January 1982 dollars			8040			2370			6870
Escalation to 1983 dollars (6%)			480			140			410
Total, January 1983 dollars			8520			2510			7280

1/ For first 4 years of operation of each development.
2/ Includes annual maintenance services, major maintenance overhaul, helicopter service, and road maintenance.

Attachment 5.3

PROPOSED PROJECT MANPOWER

	Initial			Eventual	
	Watana	Devil Canyon	Willow	Site	Willow
Superintendent	1				1
Assistant		1	1	1	
Chief Admin.	1				1
Clerk/Typists	3	2		1	3
Operators	21				14
Maintenance	25	8	1	17[1/]	1
Line Crew			5		5
Townsite	11	7		5	
Subtotal	80		7	24	25
Total	87			49	

1/ With support of 10 technicians on site about 3 months in each year included in contracted services.

Attachment 5.4

SUSITNA OPERATION AND MAINTENANCE LABOR COSTS
BASIS FOR REVISED ESTIMATE

Position	Annual Cost [1/]	Staffing Requirements & Associated Costs: Initial No.	Initial $1000/yr.	Eventual No.	Eventual $1000/yr.
Power Transmission					
Superintendent	$56,000	1/ - [2/]	56/ -	1	56
Assistant	47,500	1/1	47.5/47.5	1	47.5
Chief/Admin.	35,000 [3/]	1/ -	35/ -	1	35
Clerk/Typist	22,500	3/2	67.5/45	4	90
Operators					
Chief	48,000	1/ -	48/ -	1	48
Shift Operators	40,000	20/ -	800/ -	13	520
Plant Maintenance	50,000 [4/]	26/8	1,300/400	18	900
Line Crew	51,000 [5/]	51 -	255/ -	5	255
	Salaries and Wages	58/11	2,609/492.5	44	1952
	Allowances (15%)		391/ 75		293
	Overtime (10%)		300/ 57.5		225
			3300/625		2470
Townsite					
Security, Fire Protection, Paramedic, Warehouse	45,000 [6/]	11/7	495/315	5	225
	Salaries and Wages	11/7	495/315	5	225
	Allowances (15%)		74/ 48		34
	Overtime (10%)		56/ 37		26
	Labor Total		625/400		285
	Staffing Total	87		49	

1/ Annual costs are the same as those used in the License Application except as otherwise noted.

2/ "/" distinguishes Watana/Devil Canyon.

3/ New position created for this estimate.

4/ License Application value = $47,250.

5/ License Application value = $50,750.

6/ License Application value = $47,250.

6. <u>QUESTION</u>

A copy of the data (both before and after it was revised and provided) to the Anchorage Chamber of Commerce to support the Cook Inlet Natural Gas usages for power generation shown in Exhibits 31 and 34, pages 70 and 75 of the "Electric Power Generation for the Alaska Railbelt Region" by KENTCO dated January, 1984.

<u>RESPONSE</u>

The Cook Inlet natural gas usage for power generation presented in the KENTCO report are essentially those values contained in Table D-1.3 of the revised License Application of July 1983. The methodology for estimating gas consumption for power generation (presented in Table D-1.3 of the License Application) is described below. The basic steps are:

- Estimate the projected Railbelt generation requirements for the year. This net generation will comprise sales plus some assumed losses for transmission and distribution.

- Establish what portion of the generation will be served by gas-fired generation.

- Assume a heat rate that will apply to the gas-fired plants (Btu/kWh).

- Based on the assumed heat rate, the heating value of the gas being burned (Btu per unit volume), and the amount of energy to be generated, the gas consumption is calculated.

KENTCO has extended the estimates beyond year 2010 to year 2015. Also, the values presented by KENTCO for years 2003, 2004, 2005, and 2007 differ by 0.1 BCF from those presented in the Application. The Power Authority does not know the methodology which KENTCO employed to extend the usage beyond year 2010, nor can the Power Authority explain the slight difference in the four years noted above.

As is the case with many of the Power Authority's study parameters, the methodology for estimating gas consumption has undergone review and revision since the July 1983 License Application submission. Currently, the Applicant's natural gas consumption figures are obtained directly from the OGP program analysis. For the Without-Susitna expansion plan, the simulation of Railbelt system gross generation computes the fuel consumption each year. This is a preferred approach, because the gas-fired units are optimally dispatched within the system by OGP and the resulting consumption figures are therefore more realistic.

The current estimates of natural gas consumption are presented in Attachment 6.1. As an example of the relationship between these figures and the OGP analysis, the basis for the 23.2 billion cubic feet (Bcf) assumption for the "Without-Susitna" expansion plan is found on page 7 of output LJN10206 of Appendix 1, Part B of this submittal.

CONSUMPTION OF COOK INLET NATURAL GAS

Year	Consumption for Electric Generation 1/ (BCF)
1984	29.7
1985	31.3
1986	32.6
1987	34.2
1988	31.3
1989	32.8
1990	32.9
1991	33.8
1992	33.3
1993	23.2
1994	24.0
1995	25.0
1996	15.2
1997	16.7
1998	17.3
1999	17.0
2000	18.7
2001	19.6
2002	20.5
2003	21.5
2004	22.6
2005	14.5
2006	15.5
2007	16.7
2008	17.4
2009	11.5
2010	13.0
2011	13.8
2012	8.7
2013	9.5
2014	10.2
2015	11.0
2016	11.9
2017	7.4
2018	8.2
2019	9.3
2020	10.0

1/ Consumption for years 1993 through 2020 from OGP Without-Susitna run reported in Alaska Power Authority Comments on the DEIS, August 1984. Consumption for 1984 through 1992 based on a supplemental OGP run made for this purpose.

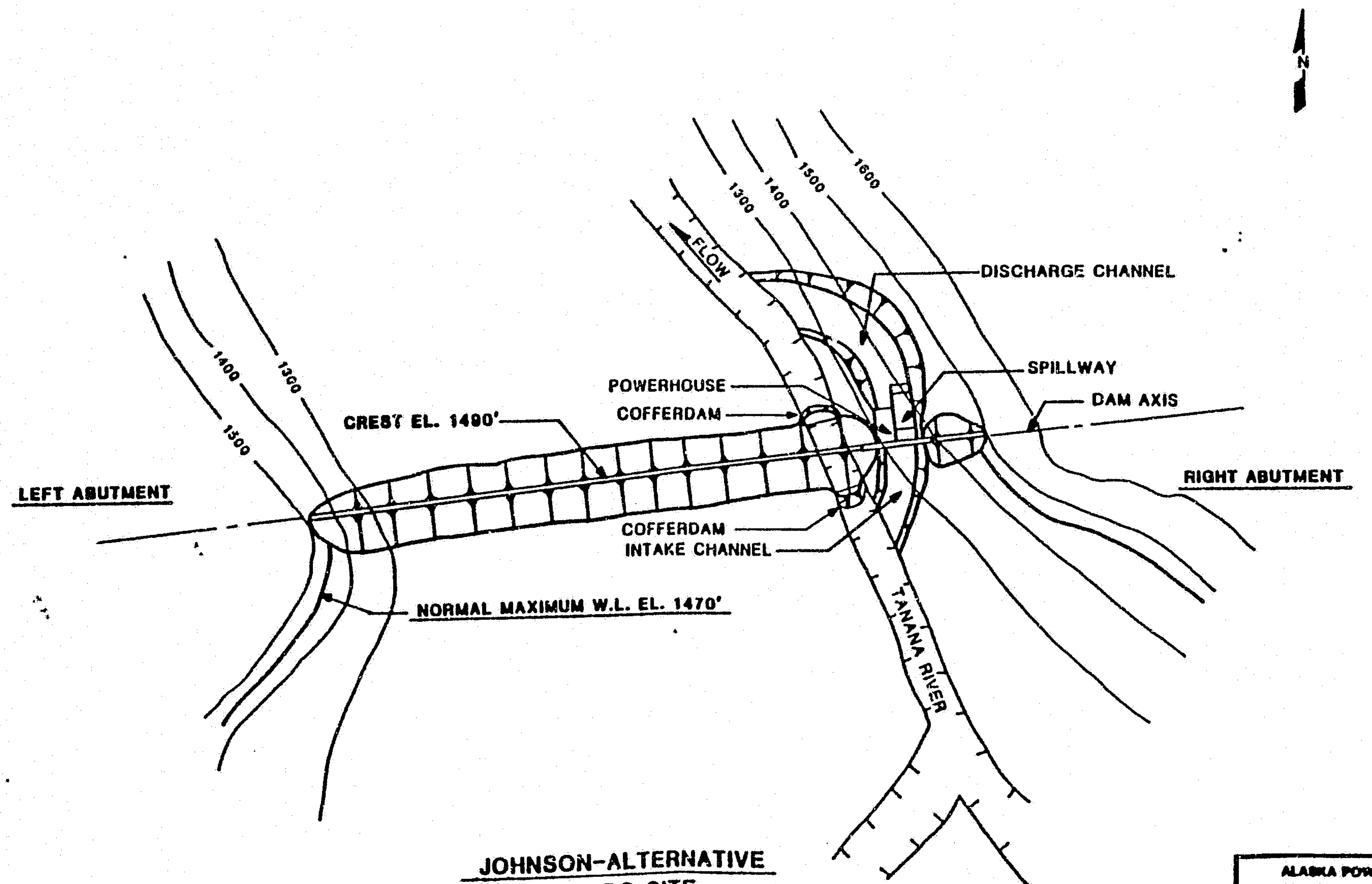
7. QUESTION

a) The unit cost estimate referred to in Table II for the Johnson project. Provide a site plan, geologic reports, and cross sections of major project features used to prepare the cost estimate.

RESPONSE

The data requested is contained in Table 11 of Appendix II of the Power Authority's August 23, 1984 comments on the DEIS, not Table II.

Available data used in preparing the Johnson site cost estimate are provided herewith as Attachments 7a.1 and 7a.2. These include the general site plan (Attachment 7a.1) and dam embankment typical cross section (Attachment 7a.2). No geologic reports are known to exist for the Johnson site.



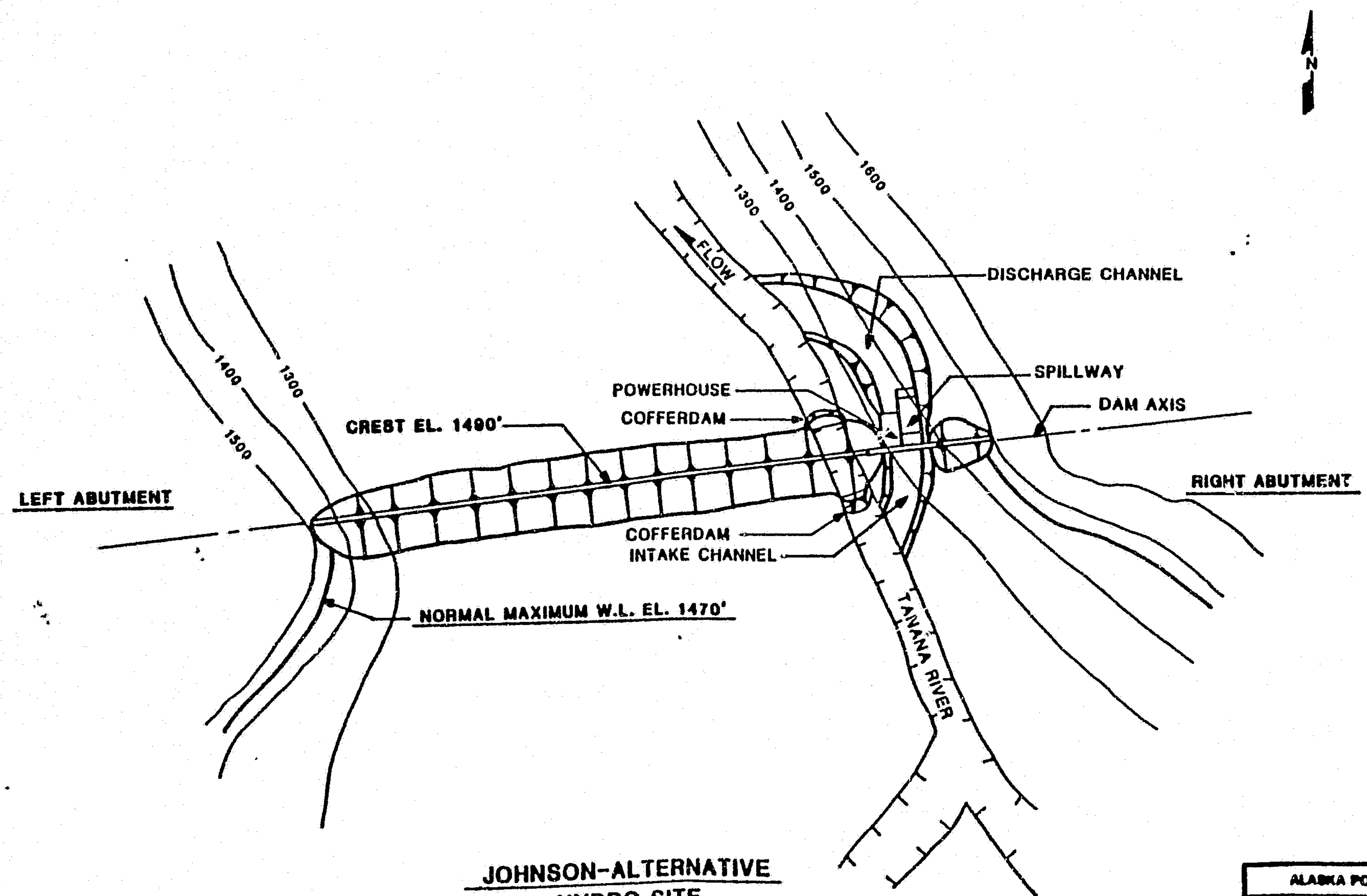
JOHNSON-ALTERNATIVE
HYDRO SITE

SCALE 1" 1000'

FIGURE. 1

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

Attachment 7a.1



JOHNSON-ALTERNATIVE HYDRO SITE

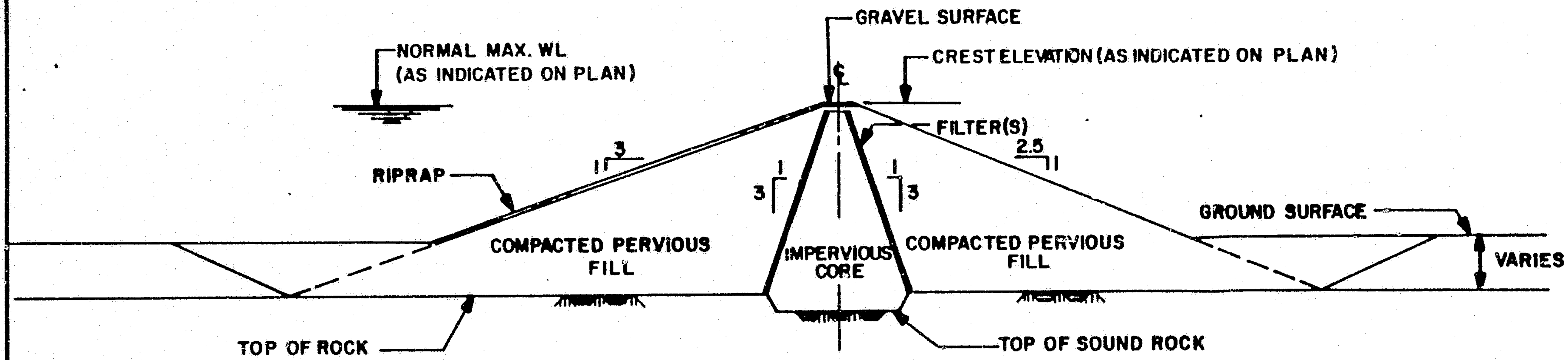
SCALE 1" 1000'

FIGURE 1

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

Attachment 7a.1



DAM CROSS SECTION

ALTERNATIVE HYDRO SITES
TYPICAL DAM SECTION
FIGURE 2

0 150 300
SCALE: 1" = 300'

Attachment 7a.2

7. QUESTION

b) The operation simulations for the alternative hydro sites referred to on page 9-4. Include a description of the computer program, RESOP, and all input and output data.

RESPONSE

The RESOP computer model used to perform the operation simulations for the alternative hydro sites is essentially the Susitna simulation model described in detail in Exhibit B, Volume 1, Section 2.8 of the License Application.

The Applicant has made some minor modifications to include the effects of variable tailwater elevations and variable turbine efficiencies. The model can simulate the operation of one or two reservoirs.

Attachments 7b.1 through 7b.5 transmit the requested operation simulation data for the Snow, Keetna, Browne, Chakachamna, and Johnson developments, respectively. The attached data support Table 18 of Appendix II of the Power Authority's DEIS comments. As discussed in those comments, the results of the three different arrangements are quite similar. Hence, data for the base case only is provided.

The simulation data provided for each project is organized as follows (refer to Attachment 7b.1):

<u>Input Data</u>

1. Natural Streamflow (monthly)
2. Evaporation (neglected)
3. Reservoir area-volume and tailwater rating
4. Powerplant characteristics
5. Operation constraints (rule curve)
6. Release constraints (natural streamflow and required monthly minimum)
7. Energy generation criteria (system demand, monthly and annual)

<u>Output Data</u>

8. Turbine discharge (total from powerhouse)
9. Energy production
10. Post-project flows downstream of project
11. Summary of project capability and energy

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The simulation data provided for each project is organized as follows (refer to Attachment 7b.1):

<u>Input Data</u>

1. Natural Streamflow (monthly)
2. Evaporation (neglected)
3. Reservoir area-volume and tailwater rating
4. Powerplant characteristics
5. Operation constraints (rule curve)
6. Release constraints (natural streamflow and required monthly minimum)
7. Energy generation criteria (system demand, monthly and annual)

<u>Output Data</u>

8. Turbine discharge (total from powerhouse)
9. Energy production
10. Post-project flows downstream of project
11. Summary of project capability and energy

1) SNOW ALTERNATIVE HYDRO PROJECT　　NSD YEAR 2010: 6444 GWH

RESPONSE TO DEIS　　REVISED FLOW DATA　　RATED CAPACITY 100 MW

Table 18 · Snow　P. 1

INPUT

INPUT DATA FOR SNOW

NATURAL STREAMFLOW AT DAMSITE

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1948	640.	490.	306.	56.	40.	25.	60.	493.	1835.	2342.	1365.	444.
1949	466.	137.	33.	16.	12.	16.	28.	337.	1181.	1471.	1388.	1509.
1950	310.	435.	173.	39.	23.	21.	23.	204.	1839.	2108.	2219.	1238.
1951	216.	45.	21.	17.	12.	12.	31.	306.	1055.	2309.	1411.	2058.
1952	170.	83.	41.	20.	17.	16.	13.	79.	1064.	2401.	1473.	709.
1953	877.	588.	195.	78.	48.	29.	111.	913.	3568.	3018.	2226.	1012.
1954	816.	125.	51.	34.	23.	18.	33.	565.	1555.	1702.	1682.	667.
1955	418.	336.	94.	46.	23.	17.	20.	222.	1056.	3034.	1659.	978.
1956	152.	52.	26.	23.	18.	16.	35.	349.	823.	1970.	2173.	697.
1957	106.	86.	78.	28.	24.	26.	49.	456.	1934.	1595.	1667.	2359.
1958	723.	466.	95.	67.	32.	23.	135.	502.	2238.	2031.	1910.	417.
1959	211.	108.	55.	30.	21.	18.	59.	663.	2318.	1663.	1400.	370.
1960	285.	173.	85.	45.	39.	25.	37.	1287.	1828.	2260.	1564.	720.
1961	298.	180.	233.	334.	96.	34.	48.	775.	1970.	2547.	1895.	1141.
1962	270.	123.	42.	31.	21.	15.	75.	277.	1581.	2028.	1289.	504.
1963	152.	359.	78.	36.	35.	41.	31.	389.	1074.	2351.	1516.	1055.
1964	364.	90.	107.	60.	38.	22.	132.	262.	2486.	1995.	2040.	828.
1965	359.	197.	113.	79.	34.	53.	133.	269.	1130.	2050.	1565.	1350.
1966	317.	71.	50.	36.	23.	22.	48.	247.	1828.	2023.	2301.	2105.
1967	537.	175.	56.	30.	26.	22.	30.	396.	1561.	1747.	2051.	3416.
1968	448.	151.	102.	68.	61.	86.	41.	653.	1418.	1851.	1464.	526.
1969	134.	95.	34.	16.	22.	23.	66.	556.	2425.	1920.	755.	516.
1970	2564.	373.	355.	113.	111.	93.	79.	448.	1316.	1892.	1775.	578.
1971	148.	658.	90.	31.	24.	23.	25.	216.	1668.	2968.	2639.	1006.
1972	351.	79.	40.	19.	13.	17.	14.	174.	802.	1896.	1754.	988.
1973	288.	91.	45.	26.	20.	20.	35.	402.	1056.	1743.	1235.	647.
1974	153.	55.	38.	25.	19.	18.	49.	392.	1460.	1712.	1273.	1543.

1

NET RESERVOIR EVAPORATION, INCHES

2

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

********* RESERVOIR DATA *********　　**** TAILWATER DATA ****

ELEVATION (FT,MSL)	VOLUME (ACRE-FEET)	AREA (ACRES)	DISCHARGE (CFS)	ELEVATION (FT,MSL)
920.0	0.	0.	0.	500.0
1000.0	1040.	0.	1000000.	500.0
1050.0	6000.	0.	0.	0.0
1100.0	17040.	0.	0.	0.0
1140.0	46000.	0.	0.	0.0
1170.0	96000.	0.	0.	0.0
1190.0	140000.	0.	0.	0.0
1200.0	179000.	0.	0.	0.0

3

THE RATED HEAD IS 620.0 FT.
THE RATED CAPACITY IS 63.0 MW.
THE HEADLOSS IS 0.046 TIMES THE HEAD

THE GENERATOR EFFICIENCY IS 0.980
THE TRANSFORMER EFFICIENCY IS 0.990

4

Table 18 Snow P. 2

****************** POWERPLANT DATA, 1 UNITS ********************

NET HEAD (%RATED)	NET HEAD (FEET)	PLANT CAPACITY (MW)	PLANT CAPACITY (% RATED)	EFFICIENCY TURBINE	EFFICIENCY PLANT
0.750	465.0	38.4	0.628	0.880	0.854
0.800	496.0	42.7	0.698	0.888	0.862
0.850	527.0	47.0	0.769	0.894	0.867
0.900	558.0	51.6	0.844	0.900	0.873
0.950	589.0	56.3	0.921	0.905	0.878
1.000	620.0	61.1	1.000	0.910	0.883
1.030	638.6	63.8	1.043	0.908	0.881
1.060	657.2	66.4	1.086	0.906	0.879
1.100	682.0	70.0	1.145	0.903	0.876
1.150	713.0	74.5	1.219	0.900	0.873

RESERVOIR OPERATION CONSTRAINTS

MAXIMUM RESERVOIR ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1200.	1200.	1200.	1200.	1200.	1200.	1200.	1200.	1200.	1200.	1200.	1200.

5

RULE CURVE ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1198.	1193.	1183.	1171.	1157.	1143.	1119.	1125.	1145.	1179.	1193.	1200.

MINIMUM RESERVOIR ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1050.	1050.	1050.	1050.	1050.	1050.	1050.	1050.	1050.	1050.	1050.	1050.

RESERVOIR RELEASE CONSTRAINTS

MINIMUM CONSUMPTIVE RELEASE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

6

MINIMUM NON-POWER RELEASE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

DOWNSTREAM RELEASE CRITERIA

PRE-PROJECT FLOWS AT BELOW DAM

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1948	640.	490.	306.	56.	40.	25.	60.	493.	1835.	2342.	1365.	444.
1949	466.	137.	33.	16.	12.	16.	28.	337.	1181.	1971.	1388.	1509.
1950	310.	435.	173.	39.	23.	21.	23.	204.	1839.	2108.	2219.	1238.
1951	216.	45.	21.	17.	12.	12.	31.	306.	1055.	2309.	1411.	2058.
1952	170.	83.	41.	20.	17.	16.	13.	79.	1064.	2401.	1473.	709.
1953	877.	588.	195.	78.	48.	29.	111.	913.	3568.	3018.	2226.	1012.
1954	816.	125.	51.	34.	23.	18.	33.	565.	1555.	1702.	1682.	667.
1955	418.	336.	94.	46.	23.	17.	20.	222.	1056.	3034.	1659.	978.
1956	152.	52.	26.	23.	18.	16.	35.	349.	823.	1970.	2173.	697.
1957	106.	86.	78.	28.	24.	26.	49.	456.	1934.	1595.	1667.	2359.
1958	723.	466.	95.	67.	32.	23.	135.	502.	2238.	2031.	1910.	417.
1959	211.	108.	55.	30.	21.	18.	59.	663.	2318.	1663.	1400.	370.
1960	285.	173.	85.	45.	39.	25.	37.	1287.	1828.	2260.	1564.	720.
1961	298.	180.	233.	334.	96.	34.	48.	775.	1970.	2547.	1895.	1141.
1962	270.	123.	42.	31.	21.	15.	75.	277.	1581.	2028.	1289.	504.
1963	152.	359.	78.	36.	35.	41.	31.	389.	1074.	2351.	1516.	1055.
1964	364.	90.	107.	60.	38.	22.	132.	262.	2486.	1995.	2040.	828.
1965	359.	197.	113.	79.	34.	53.	133.	269.	1130.	2050.	1565.	1350.
1966	317.	71.	50.	36.	23.	22.	48.	247.	1828.	2023.	2301.	2105.
1967	537.	175.	56.	30.	26.	22.	30.	396.	1561.	1747.	2051.	3416.
1968	448.	151.	102.	68.	61.	86.	41.	653.	1418.	1851.	1464.	526.
1969	134.	95.	34.	16.	22.	23.	66.	556.	2425.	1920.	755.	516.
1970	2564.	373.	355.	113.	111.	93.	79.	448.	1316.	1892.	1775.	578.
1971	148.	658.	90.	31.	24.	23.	25.	216.	1668.	2968.	2639.	1006.
1972	351.	79.	40.	19.	13.	17.	14.	174.	802.	1896.	1754.	988.
1973	288.	91.	45.	26.	20.	20.	35.	402.	1056.	1743.	1235.	647.
1974	153.	55.	38.	25.	19.	18.	49.	392.	1460.	1712.	1273.	1543.

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Table 18 Snow P. 3

MINIMUM POST-PROJECT FLOWS AT BELOW DAM

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
210.	210.	210.	210.	210.	210.	210.	210.	740.	740.	740.	210.

NSD FORECAST, YEAR 2010 ANNUAL ENERGY DEMAND = 6444. GWH.

ENERGY GENERATION CRITERIA

SYSTEM ENERGY DEMAND, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
563.	640.	717.	659.	582.	575.	491.	459.	427.	420.	446.	465.

MONTHLY GENERATION FROM OTHER SOURCES, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
51.0	51.0	52.0	51.0	45.0	44.0	38.0	43.0	44.0	49.0	53.0	47.0

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ADJUSTED SYSTEM ENERGY DEMAND, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
512.	589.	665.	608.	537.	531.	453.	416.	383.	371.	393.	418.

MONTHLY GENERATION, PERCENT OF ANNUAL

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.087	0.100	0.113	0.104	0.091	0.090	0.077	0.071	0.065	0.063	0.067	0.071

TARGET FIRM ANNUAL ENERGY = 156.

TARGET MONTHLY FIRM ENERGY, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
13.6	15.6	17.7	16.1	14.3	14.1	12.0	11.0	10.2	9.9	10.4	11.1

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END OF INPUT

TURBINE DISCHARGE (CFS)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1948	773.2	837.3	739.1	478.1	463.7	409.8	393.1	423.5	1399.8	1399.8	833.6	312.9
1949	369.4	440.4	486.5	452.1	450.3	412.2	377.7	344.5	740.0	884.7	803.5	1043.8
1950	443.2	782.3	606.1	461.1	448.2	408.9	372.8	342.4	1288.4	1102.2	1399.8	1015.2
1951	367.9	440.1	486.8	452.6	450.9	413.5	379.5	347.0	740.0	1036.8	826.5	1399.8
1952	368.1	440.3	486.7	452.4	450.5	412.5	378.6	327.9	740.0	936.5	888.5	312.0
1953	944.1	935.3	628.1	500.1	471.7	413.8	444.1	843.5	1399.8	1399.8	1399.8	1012.0
1954	949.2	472.3	485.6	454.7	448.2	408.9	372.7	481.7	1240.5	740.0	1053.7	312.2
1955	444.3	683.3	527.1	468.1	448.2	408.9	373.1	342.3	740.0	1399.8	1399.8	602.5
1956	368.2	440.6	487.6	453.6	452.0	415.4	381.9	348.1	740.0	740.0	1322.9	312.1
1957	368.9	441.8	488.6	454.4	452.8	416.5	382.9	345.8	1399.8	740.0	976.3	1399.8
1958	856.2	813.3	528.1	489.1	455.7	408.8	467.1	432.5	1399.8	1399.8	1399.8	312.6
1959	370.2	443.0	490.5	456.8	455.6	422.3	400.4	356.4	1399.8	1128.4	815.5	313.1
1960	370.7	442.9	489.6	455.3	453.5	417.6	386.8	969.6	1399.8	1364.2	979.5	312.0
1961	375.8	527.3	666.1	756.1	519.7	418.8	381.1	705.5	1399.8	1399.8	1399.8	985.1
1962	403.2	470.3	485.7	450.7	448.4	409.2	366.5	339.3	1130.3	1022.2	740.0	312.9
1963	370.5	442.1	487.2	452.6	450.4	411.2	375.8	341.2	740.0	1252.3	931.5	589.8
1964	497.2	439.7	537.8	482.1	461.7	408.6	463.0	339.7	1399.8	1399.8	1399.8	615.5
1965	492.2	544.3	546.1	501.1	457.7	437.8	466.1	339.5	740.0	977.2	980.5	884.8
1966	450.2	439.8	485.9	450.9	448.6	409.3	372.8	340.8	1331.8	1017.2	1399.8	1399.8
1967	670.2	522.3	489.1	452.1	449.7	408.8	372.5	336.8	1224.3	741.2	1399.8	1399.8
1968	581.2	498.3	535.1	490.1	484.7	470.8	374.1	583.5	1103.5	845.2	879.5	312.6
1969	370.1	443.5	491.5	458.3	457.7	425.9	375.4	365.9	1399.8	1324.1	740.0	317.9
1970	1399.8	857.9	788.1	535.1	534.7	477.8	412.1	378.5	1001.5	866.2	1190.5	312.4
1971	369.7	714.2	523.1	453.1	448.2	408.8	372.7	341.8	1135.6	1399.8	1399.8	1006.0
1972	484.2	439.8	485.9	451.1	449.1	410.1	375.2	349.0	740.0	740.0	748.4	522.8
1973	421.2	439.7	485.6	450.8	448.5	409.3	373.2	337.4	740.0	740.0	740.0	313.0
1974	370.1	443.7	491.9	458.7	458.0	426.8	337.1	383.9	740.0	740.0	740.0	919.9
AVG	527.7	549.5	534.4	476.7	460.0	418.6	390.7	421.8	1090.9	1065.1	1066.3	687.1

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OUTPUT

ENERGY FROM RESERVOIR (GWH)

Table 18 [illegible] R5

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1948	28.5	29.8	26.9	17.1	14.7	14.1	12.7	13.9	45.7	49.3	30.3	11.1	294.3
1949	13.6	15.6	17.7	16.1	14.3	14.1	12.0	11.0	23.7	31.0	29.2	37.2	235.4
1950	16.4	27.8	22.0	16.5	14.3	14.1	12.0	11.0	41.2	38.7	50.9	36.2	301.2
1951	13.6	15.6	17.7	16.1	14.3	14.1	12.0	11.0	23.2	36.0	30.0	49.9	253.5
1952	13.6	15.6	17.7	16.1	14.3	14.1	12.0	9.9	21.8	32.1	32.2	11.1	210.6
1953	34.8	33.3	22.8	17.9	15.0	14.3	14.4	27.7	47.5	51.6	51.8	36.2	367.2
1954	35.0	16.8	17.7	16.3	14.3	14.1	12.0	15.8	40.4	26.0	38.2	11.1	257.6
1955	16.4	24.3	19.2	16.8	14.3	14.1	12.0	11.0	23.4	49.1	51.2	21.5	273.3
1956	13.6	15.6	17.7	16.1	14.3	14.1	12.0	11.0	22.9	25.1	47.8	11.1	221.3
1957	13.6	15.6	17.7	16.1	14.3	14.1	12.0	11.0	45.0	26.0	35.4	49.9	270.7
1958	31.6	28.9	19.2	17.5	14.5	14.1	15.1	14.2	46.3	49.9	51.0	11.1	313.4
1959	13.6	15.6	17.7	16.1	14.3	14.1	12.0	11.0	45.9	40.1	29.6	11.1	241.1
1960	13.6	15.6	17.7	16.1	14.3	14.1	12.0	31.1	45.7	48.0	35.5	11.1	274.9
1961	13.9	18.7	24.2	27.1	16.5	14.5	12.3	23.2	45.9	49.8	51.3	35.2	332.7
1962	14.9	16.7	17.7	16.1	14.3	14.1	12.5	11.0	36.4	35.9	26.8	11.1	227.5
1963	13.6	15.6	17.7	16.1	14.3	14.1	12.0	11.0	23.8	43.9	33.8	21.0	236.9
1964	18.4	15.6	19.6	17.3	14.7	14.1	15.0	11.0	45.9	50.1	51.1	22.0	294.7
1965	18.2	19.4	19.9	18.0	14.6	15.1	15.1	11.0	23.8	34.2	35.6	31.5	256.2
1966	16.6	15.6	17.7	16.1	14.3	14.1	12.0	11.0	42.8	35.7	51.0	50.0	296.9
1967	24.7	18.6	17.8	16.2	14.3	14.1	12.0	11.0	39.8	26.0	50.8	49.9	295.3
1968	21.5	17.7	19.5	17.6	15.4	16.2	12.1	19.2	35.9	29.7	31.9	11.1	247.7
1969	13.6	15.6	17.7	16.1	14.3	14.1	11.1	11.0	45.2	47.0	26.6	11.1	243.4
1970	51.2	30.5	28.7	19.2	17.0	16.5	13.3	12.4	32.6	31.1	43.2	11.1	306.9
1971	13.6	25.3	19.0	16.2	14.3	14.1	12.0	11.0	36.4	49.6	51.5	36.0	299.1
1972	17.9	15.6	17.7	16.1	14.3	14.1	12.0	11.0	22.4	24.9	26.9	18.6	221.6
1973	15.5	15.6	17.7	16.1	14.3	14.1	12.0	11.0	24.0	25.9	26.8	11.1	204.3
1974	13.6	15.6	17.7	16.1	14.3	14.1	9.9	11.0	22.5	25.9	26.8	32.7	220.2
AVG	19.4	19.5	19.4	17.0	14.6	14.3	12.4	13.6	35.2	37.5	38.8	24.5	266.2

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Table 18 Snow P. 6

POST-PROJECT FLOWS (CFS)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1948	773.2	837.3	739.1	478.1	463.7	409.8	393.1	423.5	1399.8	1399.8	833.6	312.9
1949	369.4	440.4	486.5	452.1	450.3	412.2	377.7	344.5	740.0	884.7	603.5	1043.8
1950	443.2	782.3	606.1	461.1	448.2	408.9	372.8	342.4	1288.4	1102.2	1399.8	1015.2
1951	367.9	440.1	486.8	452.6	450.9	413.5	379.5	347.0	740.0	1036.8	826.5	1592.8
1952	368.1	440.3	486.7	452.4	450.5	412.5	378.6	327.9	740.0	936.5	888.5	312.0
1953	944.1	935.3	628.1	500.1	471.7	413.8	444.1	843.5	1399.8	2771.3	2226.0	1012.0
1954	949.2	472.3	485.6	454.7	448.2	408.9	372.7	481.7	1240.5	740.0	1053.7	312.2
1955	444.3	683.3	527.1	468.1	448.2	408.9	373.1	342.3	740.0	1399.8	1399.8	602.5
1956	368.2	440.6	487.6	453.6	452.0	415.4	381.9	348.1	740.0	740.0	1322.9	312.1
1957	368.9	441.8	488.6	454.4	452.8	416.5	382.9	345.8	1399.8	740.0	976.3	1893.8
1958	856.2	813.3	528.1	489.1	455.7	408.8	467.1	432.5	1399.8	1399.8	1399.8	312.6
1959	370.2	443.0	490.5	456.8	455.6	422.3	400.4	356.4	1399.8	1128.4	815.5	313.1
1960	370.7	442.9	489.6	455.3	453.5	417.6	386.8	969.6	1399.8	1364.2	979.5	312.0
1961	375.8	527.3	666.1	756.1	519.7	418.8	381.1	705.5	1399.8	1399.8	1399.8	985.1
1962	403.2	470.3	485.7	450.7	448.4	409.2	386.5	339.3	1130.3	1022.2	740.0	312.9
1963	370.5	442.1	487.2	452.6	450.4	411.2	375.8	341.2	740.0	1252.3	931.5	589.8
1964	497.2	439.7	537.8	482.1	461.7	408.8	463.0	339.7	1399.8	1399.8	1399.8	615.5
1965	492.2	544.3	546.1	501.1	457.7	437.8	466.1	339.5	740.0	977.2	980.5	884.8
1966	450.2	439.8	485.9	450.9	448.6	409.3	372.8	340.8	1331.8	1017.2	1399.8	1967.0
1967	670.2	522.3	489.1	452.1	449.7	408.8	372.5	336.8	1224.3	741.2	1399.8	3019.6
1968	581.2	498.3	535.1	490.1	484.7	470.8	374.1	583.5	1103.5	845.2	879.5	312.6
1969	370.1	443.5	491.5	458.3	457.7	425.9	375.4	365.9	1399.8	1324.1	740.0	317.9
1970	1736.0	857.9	788.1	535.1	534.7	477.8	412.1	378.5	1001.5	886.2	1190.5	312.4
1971	369.7	714.2	523.1	453.1	448.2	408.8	372.7	341.8	1135.6	1399.8	2166.6	1006.0
1972	484.2	439.8	485.9	451.1	449.1	410.1	375.2	349.0	740.0	740.0	748.4	522.8
1973	421.2	439.7	485.6	450.8	448.5	409.3	373.2	337.4	740.0	740.0	740.0	313.0
1974	370.1	443.7	491.9	456.7	458.0	426.8	337.1	383.9	740.0	740.0	740.0	919.9
AVG	540.2	549.5	534.4	476.7	460.0	418.6	390.7	421.8	1090.9	1115.9	1125.3	793.6

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Table 18 Snow P. 7

AVERAGE CAPABILITIES (MW)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
SNOW	68.	67.	66.	64.	63.	60.	57.	55.	58.	63.	66.	67.
TOTAL	68.	67.	66.	64.	63.	60.	57.	55.	58.	63.	66.	67.

MINIMUM CAPABILITIES (MW)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
SNOW	67.	66.	65.	63.	61.	57.	51.	47.	51.	59.	65.	65.
TOTAL	67.	66.	65.	63.	61.	57.	51.	47.	51.	59.	65.	65.

AVERAGE ENERGY PRODUCTION (GWH)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
SNOW	19.4	19.5	19.4	17.0	14.6	14.3	12.4	13.6	35.2	37.5	38.8	24.5	266.2
TOTAL	19.4	19.5	19.4	17.0	14.6	14.3	12.4	13.6	35.2	37.5	38.8	24.5	266.2

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MINIMUM ENERGY PRODUCTION (GWH)

		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
SNOW	(1973)	15.5	15.6	17.7	16.1	14.3	14.1	12.0	11.0	24.0	25.9	26.8	11.1	204.3
TOTAL	(1973)	15.5	15.6	17.7	16.1	14.3	14.1	12.0	11.0	24.0	25.9	26.8	11.1	204.3

2) KEETNA ALTERNATIVE HYDRO PROJECT NSD YEAR 2010: 6444 GWH *Table 18 Keetna P. 1*
RESPONSE TO DEIS W/ RULE CURVE RATED CAPACITY 100 MW

INPUT DATA FOR KEETNA

NATURAL STREAMFLOW AT DAMSITE

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1961	695.	977.	692.	449.	386.	336.	361.	2165.	6911.	6343.	6948.	6611.
1962	2765.	910.	516.	443.	328.	246.	263.	1502.	8082.	6294.	6686.	3316.
1963	1488.	559.	467.	397.	340.	293.	266.	2562.	5786.	7851.	8824.	4344.
1964	1264.	781.	615.	530.	484.	463.	613.	5508.	8786.	6998.	4702.	2567.
1965	1020.	515.	346.	286.	250.	237.	323.	2411.	3245.	4412.	2360.	1290.
1966	904.	477.	366.	314.	285.	274.	340.	2461.	4972.	6431.	5454.	3734.
1967	1755.	1026.	687.	423.	286.	250.	313.	1337.	11864.	7320.	10450.	3733.
1968	1640.	816.	340.	453.	391.	300.	323.	2191.	7914.	7496.	5963.	5427.
1969	2262.	854.	554.	466.	408.	358.	356.	2405.	7608.	4783.	6186.	2406.
1970	1126.	598.	464.	402.	348.	300.	333.	3538.	5004.	4832.	4801.	2968.
1971	1231.	624.	482.	432.	374.	317.	325.	2545.	8213.	7521.	5288.	4960.
1972	1797.	482.	348.	327.	299.	293.	382.	2143.	6593.	5624.	5040.	1997.
1973	1157.	688.	666.	463.	342.	315.	341.	2645.	11391.	5823.	4908.	3716.
1974	8036.	699.	536.	465.	359.	302.	333.	1838.	4629.	6724.	4363.	3344.

NET RESERVOIR EVAPORATION, INCHES

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

********* RESERVOIR DATA *********			**** TAILWATER DATA ****	
ELEVATION (FT,MSL)	VOLUME (ACRE-FEET)	AREA (ACRES)	DISCHARGE (CFS)	ELEVATION (FT,MSL)
605.0	0.	0.	0.	615.0
650.0	20000.	0.	1000000.	615.0
675.0	40000.	0.	0.	0.0
700.0	70000.	0.	0.	0.0
750.0	145000.	0.	0.	0.0
800.0	280000.	0.	0.	0.0
820.0	350000.	0.	0.	0.0
850.0	480000.	0.	0.	0.0
900.0	680000.	0.	0.	0.0
945.0	850000.	0.	0.	0.0
950.0	880000.	0.	0.	0.0

THE RATED HEAD IS 286.0 FT.
THE RATED CAPACITY IS 100.0 MW.
THE HEADLOSS IS 0.015 TIMES THE HEAD

THE GENERATOR EFFICIENCY IS 0.980
THE TRANSFORMER EFFICIENCY IS 0.990

Table 18 Keetna P.2

******************** POWERPLANT DATA, 1 UNITS ********************

NET HEAD (%RATED)	NET HEAD (FEET)	PLANT CAPACITY (MW)	PLANT CAPACITY (% RATED)	EFFICIENCY TURBINE	EFFICIENCY PLANT
0.650	185.9	46.6	0.480	0.858	0.832
0.750	214.5	60.9	0.628	0.880	0.854
0.800	228.8	67.7	0.698	0.888	0.862
0.850	243.1	74.6	0.769	0.894	0.867
0.900	257.4	81.9	0.844	0.900	0.873
0.950	271.7	89.4	0.921	0.905	0.878
1.000	286.0	97.0	1.000	0.910	0.883
1.030	294.6	101.2	1.043	0.908	0.881
1.060	303.2	105.4	1.086	0.906	0.879
1.100	314.6	111.1	1.145	0.903	0.876
1.150	328.9	118.3	1.219	0.900	0.873
1.250	357.5	132.4	1.365	0.883	0.857

RESERVOIR OPERATION CONSTRAINTS

MAXIMUM RESERVOIR ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
945.	945.	945.	945.	945.	945.	945.	945.	945.	945.	945.	945.

RULE CURVE ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
945.	942.	936.	929.	922.	914.	908.	935.	907.	916.	911.	940.

MINIMUM RESERVOIR ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
820.	820.	820.	820.	820.	820.	820.	820.	820.	820.	820.	820.

RESERVOIR RELEASE CONSTRAINTS

MINIMUM CONSUMPTIVE RELEASE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

MINIMUM NON-POWER RELEASE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

DOWNSTREAM RELEASE CRITERIA

PRE-PROJECT FLOWS AT BELOW DAM

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1961	695.	977.	692.	449.	386.	336.	361.	2165.	6911.	6343.	6948.	6611.
1962	2765.	910.	516.	443.	328.	246.	263.	1502.	8082.	6294.	6686.	3316.
1963	1488.	559.	467.	397.	340.	293.	266.	2562.	5706.	7851.	8824.	4344.
1964	1264.	781.	615.	530.	484.	463.	613.	5508.	8786.	6998.	4702.	2567.
1965	1020.	515.	346.	286.	250.	237.	323.	2411.	3245.	4412.	2360.	1290.
1966	904.	477.	366.	314.	285.	274.	340.	2461.	4972.	6431.	5454.	3734.
1967	1755.	1026.	687.	423.	286.	250.	313.	1337.	11864.	7320.	10450.	3733.
1968	1640.	816.	340.	453.	391.	300.	323.	2191.	7914.	7496.	5963.	5427.
1969	2262.	854.	554.	466.	408.	358.	356.	2405.	7608.	4783.	6186.	2406.
1970	1126.	598.	464.	402.	348.	300.	333.	3538.	5004.	4832.	4801.	2968.
1971	1231.	624.	482.	432.	374.	317.	325.	2545.	8213.	7521.	5288.	4960.
1972	1797.	482.	348.	327.	299.	293.	382.	2143.	6593.	5624.	5040.	1997.
1973	1157.	688.	666.	463.	342.	315.	341.	2645.	11391.	5823.	4908.	3716.
1974	8036.	699.	536.	465.	359.	302.	333.	1838.	4629.	6724.	8363.	3344.

MINIMUM POST-PROJECT FLOWS AT BELOW DAM

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
720.	720.	720.	720.	720.	720.	720.	720.	5000.	5000.	5000.	720.

NSD FORECAST, YEAR 2010 ANNUAL ENERGY DEMAND = 6444. GWH.

ENERGY GENERATION CRITERIA

Table 18 Keetna P.3

SYSTEM ENERGY DEMAND, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
563.	640.	717.	659.	582.	575.	491.	459.	427.	420.	446.	465.

MONTHLY GENERATION FROM OTHER SOURCES, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
70.4	70.5	71.4	68.0	59.6	58.3	50.4	56.6	79.2	86.5	91.8	71.5

ADJUSTED SYSTEM ENERGY DEMAND, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
492.	569.	646.	591.	522.	517.	441.	402.	347.	334.	354.	394.

MONTHLY GENERATION, PERCENT OF ANNUAL

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.088	0.101	0.115	0.105	0.093	0.092	0.079	0.072	0.062	0.059	0.063	0.070

TARGET FIRM ANNUAL ENERGY = 113.

TARGET MONTHLY FIRM ENERGY, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
9.9	11.5	13.0	11.9	10.5	10.4	8.9	8.1	7.0	6.7	7.1	7.9

TURBINE DISCHARGE (CFS)

Table 18 [illegible] 84

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1961	720.0	1154.3	1079.0	879.0	855.2	821.2	754.5	720.0	4869.0	4869.0	4869.0	4869.0
1962	2765.0	1113.1	903.0	873.0	797.2	731.2	720.0	720.0	4869.0	4869.0	4869.0	3627.0
1963	1187.0	762.1	854.0	827.0	809.2	778.2	720.0	814.3	4869.0	4869.0	4869.0	4655.0
1964	963.0	984.1	1002.0	960.0	953.2	948.2	1006.5	3818.9	4869.0	4869.0	4869.0	2570.1
1965	720.0	720.0	739.4	720.0	720.0	720.0	720.0	720.0	4869.0	4869.0	4869.0	720.0
1966	728.5	877.3	997.6	954.8	977.1	916.2	728.2	720.0	4869.0	4869.0	4869.0	720.0
1967	720.0	720.0	987.8	853.0	755.2	735.2	720.0	720.0	4869.0	4869.0	4869.0	4044.0
1968	1339.0	1019.1	739.4	870.5	860.2	785.2	720.0	720.0	4869.0	4869.0	4869.0	4869.0
1969	2262.0	1057.1	941.0	896.0	877.2	843.2	749.5	720.0	4869.0	4869.0	4869.0	2717.0
1970	825.0	801.1	851.0	832.0	817.2	785.2	726.5	1848.9	4869.0	4869.0	4869.0	2269.1
1971	930.0	827.1	869.0	862.0	843.2	802.2	720.0	854.4	4869.0	4869.0	4869.0	4869.0
1972	1797.0	720.0	740.5	720.0	765.7	778.2	775.5	720.0	4869.0	4869.0	4869.0	2308.0
1973	856.0	891.1	1053.0	893.0	811.2	800.2	734.5	955.9	4869.0	4869.0	4869.0	3931.9
1974	4869.0	902.1	923.0	895.0	828.2	787.2	726.5	720.0	4869.0	4869.0	4869.0	2996.8
AVG	1477.3	896.3	905.7	859.6	833.6	802.3	751.6	1055.2	4869.0	4869.0	4869.0	3226.1

ENERGY FROM RESERVOIR (GWH)

[illegible] P. 5

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1961	12.9	19.9	19.0	15.2	13.1	13.6	11.8	12.0	82.8	87.2	87.2	84.4	459.1
1962	49.5	19.2	15.9	15.1	12.2	12.1	11.3	11.7	81.4	87.2	87.2	62.5	465.3
1963	21.1	13.2	15.0	14.3	12.4	12.9	11.3	13.6	83.2	87.2	87.2	80.2	451.6
1964	17.1	17.0	17.6	16.6	14.6	15.7	15.8	63.9	83.2	87.2	86.6	44.0	479.3
1965	12.8	12.4	13.0	12.4	11.0	11.9	11.3	12.0	78.8	76.7	69.3	9.2	330.9
1966	9.9	11.5	13.0	11.9	10.5	10.4	7.7	8.3	57.8	62.8	67.0	10.7	281.5
1967	12.3	12.2	17.3	14.7	11.5	12.2	11.3	11.7	81.2	87.2	87.2	69.6	428.6
1968	23.8	17.6	13.0	15.0	13.1	13.0	11.3	12.0	82.8	87.2	87.2	84.4	460.6
1969	40.5	18.2	6.6	15.5	13.4	14.0	11.7	12.0	83.2	86.8	86.8	46.6	445.6
1970	14.7	13.8	15.0	14.4	12.5	13.0	11.4	30.9	82.1	84.5	83.8	38.2	414.1
1971	16.5	14.3	15.3	14.9	12.9	13.3	11.3	14.3	83.2	87.2	87.2	84.4	454.9
1972	32.2	12.4	13.0	12.4	11.7	12.9	12.2	12.0	82.7	87.2	87.2	39.7	415.7
1973	15.2	15.4	18.5	15.4	12.4	13.2	11.5	16.0	83.2	87.2	87.1	67.6	442.8
1974	86.6	15.6	16.2	15.5	12.7	13.0	11.4	11.9	79.2	84.2	86.0	50.8	483.0
AVG	26.1	15.2	15.6	14.5	12.4	12.9	11.5	17.3	80.3	84.3	84.1	55.2	429.5

POST-PROJECT FLOWS (CFS)

Table 18 Kelna P. 6

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1961	720.0	1154.3	1079.0	879.0	855.2	821.2	754.5	720.0	6024.0	6343.0	6948.0	6611.0
1962	2765.0	1113.1	903.0	873.0	797.2	731.2	720.0	720.0	6446.4	6294.0	6686.0	3627.0
1963	1187.0	762.1	854.0	827.0	809.2	778.2	720.0	814.3	5151.3	7851.0	8824.0	4655.0
1964	963.0	984.1	1002.0	960.0	953.2	948.2	1006.5	3818.9	8151.3	6998.0	5000.0	2570.1
1965	720.0	720.0	739.4	720.0	720.0	720.0	720.0	720.0	5000.0	5000.0	5000.0	720.0
196[illegible]	728.5	877.3	997.6	954.8	977.1	916.2	728.2	720.0	5000.0	5000.0	5000.0	720.0
[illegible]7	720.0	720.0	987.8	853.0	755.2	735.2	720.0	720.0	10107.9	7320.0	10450.0	4044.0
1968	1339.0	1019.1	739.4	870.5	860.2	785.2	720.0	720.0	7050.4	7496.0	5963.0	5427.0
1969	2262.0	1057.1	941.0	896.0	877.2	843.2	749.5	720.0	6969.0	5000.0	5969.0	2717.0
1970	825.0	801.1	851.0	832.0	817.2	785.2	726.5	1848.9	5000.0	5000.0	5000.0	2269.1
1971	930.0	827.1	869.0	862.0	843.2	802.2	720.0	854.4	7578.3	7521.0	5288.0	4960.0
1972	1797.0	720.0	740.5	720.0	765.7	778.2	775.5	720.0	5683.3	5624.0	5040.0	2308.0
1973	856.0	891.1	1053.0	893.0	[illegible]	800.2	734.5	955.9	10756.[illegible]	5823.0	5000.0	3931.9
1974	7735.0	902.1	923.0	895.0	828.2	787.2	726.5	720.0	5000.0	5179.6	5000.0	2996.8
AVG	16[illegible].0	896.3	905.7	859.6	833.6	802.3	751.6	1055.2	6703.4	6175.0	6083.4	3396.9

Table 18 Keetna P. 7

AVERAGE CAPABILITIES (MW)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
KEETNA	112.	113.	110.	107.	103.	100.	96.	101.	108.	111.	110.	110.
TOTAL	112.	113.	110.	107.	103.	100.	96.	101.	108.	111.	110.	110.

MINIMUM CAPABILITIES (MW)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
KEETNA	77.	76.	73.	68.	64.	60.	56.	61.	66.	71.	78.	74.
TOTAL	77.	76.	73.	68.	64.	60.	56.	61.	66.	71.	78.	74.

AVERAGE ENERGY PRODUCTION (GWH)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
KEETNA	26.1	15.2	15.6	14.5	12.4	12.9	11.5	17.3	80.3	84.3	84.1	55.2	429.5
TOTAL	26.1	15.2	15.6	14.5	12.4	12.9	11.5	17.3	80.3	84.3	84.1	55.2	429.5

MINIMUM ENERGY PRODUCTION (GWH)

		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
KEETNA	(1966)	9.9	11.5	13.0	11.9	10.5	10.4	7.7	8.3	57.8	62.8	67.0	10.7	281.5
TOTAL	(1966)	9.9	11.5	13.0	11.9	10.5	10.4	7.7	8.3	57.8	62.8	67.0	10.7	281.5

43 BROWNE ALTERNATIVE HYDRO PROJECT NSD YEAR 2010: 6444 GWH *Table 18 Browne P. 1*
RESPONSE TO DEIS W/ RULE CURVE RATED CAPACITY 100 MW

INPUT DATA FOR BRO NE

NATURAL STREAMFLOW AT DAMSITE

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1951	1733.	781.	723.	698.	595.	550.	803.	7519.	9230.	10438.	9001.	10830.
1952	2469.	1398.	1062.	768.	640.	614.	653.	3005.	12864.	14451.	9414.	6017.
1953	3935.	1664.	1024.	550.	461.	550.	768.	4659.	14067.	11625.	10829.	7652.
1954	2179.	960.	832.	730.	625.	499.	576.	4006.	9751.	9454.	12262.	6733.
1955	3109.	1536.	707.	640.	589.	563.	486.	3813.	12680.	13773.	11717.	8051.
1956	2378.	1056.	819.	704.	653.	563.	559.	5404.	14387.	12813.	12550.	7684.
1957	2833.	1120.	915.	882.	778.	658.	653.	6977.	15834.	9693.	8256.	7917.
1958	3167.	2259.	1775.	987.	585.	472.	704.	4010.	13133.	9990.	10511.	3497.
1959	1924.	954.	703.	727.	616.	434.	512.	5724.	11473.	14438.	9498.	5728.
1960	3245.	1600.	973.	881.	718.	660.	742.	8246.	7014.	10328.	9903.	7817.
1961	2554.	1018.	978.	934.	581.	540.	813.	6760.	12537.	11564.	13478.	5614.
1962	2826.	1536.	973.	781.	602.	538.	666.	5687.	19277.	13901.	10285.	8865.
1963	3034.	1485.	858.	691.	640.	602.	666.	7114.	12650.	17882.	16230.	6976.
1964	3607.	1568.	742.	742.	538.	461.	646.	1176.	15718.	13133.	8413.	4620.
1965	3473.	1536.	947.	666.	563.	550.	762.	5285.	13606.	14182.	8152.	9175.
1966	3768.	1536.	992.	640.	640.	640.	691.	3136.	15923.	9714.	10129.	6353.
1967	3040.	947.	799.	710.	628.	589.	576.	4991.	15245.	19635.	16755.	6164.
1968	2341.	1152.	913.	845.	800.	767.	809.	6079.	18150.	13197.	7762.	3764.
1969	1647.	517.	335.	292.	282.	282.	599.	5289.	9516.	7521.	5513.	2700.
1970	1324.	844.	678.	611.	579.	563.	649.	5060.	10089.	14221.	9324.	5507.
1971	2406.	968.	699.	691.	691.	691.	682.	4756.	18560.	13734.	13325.	6227.
1972	3052.	1655.	1123.	868.	690.	591.	556.	4302.	13222.	11484.	8497.	5119.
1973	3241.	2134.	1016.	768.	640.	576.	671.	4207.	7937.	9868.	9188.	4014.
1974	1812.	982.	531.	316.	243.	243.	259.	3246.	7323.	9394.	8236.	6396.
1975	3028.	1169.	838.	640.	640.	640.	682.	3666.	13299.	12643.	8486.	6925.
1976	2618.	1024.	803.	607.	512.	461.	573.	4244.	9236.	7515.	6958.	3516.
1977	2168.	1238.	896.	768.	640.	576.	618.	4196.	15398.	12813.	10405.	7195.
1978	4494.	2065.	1080.	833.	737.	653.	1032.	5568.	8110.	10775.	8699.	4708.
1979	2372.	1187.	902.	741.	640.	576.	685.	6079.	9592.	13030.	8452.	5331.

NET RESERVOIR EVAPORATION, INCHES

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

********* RESERVOIR DATA *********   **** TAILWATER DATA ****

ELEVATION (FT,MSL)	VOLUME (ACRE-FEET)	AREA (ACRES)	DISCHARGE (CFS)	ELEVATION (FT,MSL)
770.0	0.	0.	0.	780.0
780.0	15000.	0.	1000000.	780.0
800.0	50000.	0.	0.	0.0
840.0	140000.	0.	0.	0.0
880.0	270000.	0.	0.	0.0
895.0	340000.	0.	0.	0.0
920.0	500000.	0.	0.	0.0
960.0	940000.	0.	0.	0.0
975.0	1100000.	0.	0.	0.0
1000.0	1403000.	0.	0.	0.0

THE RATED HEAD IS 170.0 FT.
THE RATED CAPACITY IS 100.0 MW.
THE HEADLOSS IS 0.015 TIMES THE HEAD

THE GENERATOR EFFICIENCY IS 0.980
THE TRANSFORMER EFFICIENCY IS 0.990

Table 18 Browne P.2

******************** POWERPLANT DATA, 1 UNITS ********************

NET HEAD (%RATED)	NET HEAD (FEET)	PLANT CAPACITY (MW)	PLANT CAPACITY (% RATED)	EFFICIENCY TURBINE	EFFICIENCY PLANT
0.650	110.5	46.6	0.480	0.858	0.832
0.750	127.5	60.9	0.628	0.880	0.854
0.800	136.0	67.7	0.698	0.888	0.862
0.850	144.5	74.6	0.769	0.894	0.867
0.900	153.0	81.9	0.844	0.900	0.873
0.950	161.5	89.4	0.921	0.905	0.878
1.000	170.0	97.0	1.000	0.910	0.883
1.030	175.1	101.2	1.043	0.908	0.881
1.060	180.2	105.4	1.086	0.906	0.879
1.100	187.0	111.1	1.145	0.903	0.876
1.150	195.5	118.3	1.219	0.900	0.873
1.250	212.5	132.4	1.365	0.883	0.857

RESERVOIR OPERATION CONSTRAINTS

MAXIMUM RESERVOIR ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
975.	975.	975.	975.	975.	975.	975.	975.	975.	975.	975.	975.

RULE CURVE ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
975.	970.	964.	957.	952.	946.	941.	963.	964.	969.	960.	974.

MINIMUM RESERVOIR ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
895.	895.	895.	895.	895.	895.	895.	895.	895.	895.	895.	895.

RESERVOIR RELEASE CONSTRAINTS

MINIMUM CONSUMPTIVE RELEASE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

MINIMUM NON-POWER RELEASE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

DOWNSTREAM RELEASE CRITERIA

PRE-PROJECT FLOWS AT BELOW DAM

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1951	1737.	781.	723.	648.	595.	550.	803.	7519.	9230.	10438.	9001.	10830.
1952	2469.	1398.	1062.	768.	640.	614.	653.	3005.	12864.	14451.	9414.	6017.
1953	3935.	1664.	1024.	550.	461.	550.	768.	4659.	14067.	11625.	10829.	7652.
1954	2179.	960.	832.	730.	625.	499.	576.	4006.	9751.	9454.	12262.	6733.
1955	3109.	1536.	707.	640.	589.	563.	486.	3813.	12680.	13773.	11717.	8051.
1956	2378.	1056.	819.	704.	653.	563.	559.	5404.	14387.	12813.	12550.	7684.
1957	2833.	1120.	915.	882.	778.	658.	653.	6977.	15834.	9693.	8256.	7917.
1958	3167.	2259.	1775.	987.	585.	472.	704.	4010.	13133.	9990.	10511.	3497.
1959	1924.	954.	703.	727.	616.	434.	512.	5724.	11473.	14438.	9498.	5728.
1960	3245.	1600.	973.	881.	718.	660.	742.	8246.	7014.	10328.	9903.	7817.
1961	2554.	1018.	978.	934.	581.	540.	813.	6760.	12337.	11564.	13478.	5614.
1962	2826.	1536.	973.	781.	602.	538.	666.	5687.	19277.	13901.	10285.	8865.
1963	3034.	1485.	858.	691.	640.	602.	666.	7114.	12650.	17882.	16230.	6976.
1964	3667.	1568.	742.	742.	538.	461.	646.	1176.	15718.	13133.	8413.	4620.
1965	3473.	1536.	947.	666.	563.	550.	762.	5285.	13606.	14182.	8152.	9175.
1966	3768.	1536.	892.	640.	640.	640.	691.	3136.	15923.	9714.	10129.	6353.
1967	3040.	947.	799.	710.	628.	589.	576.	4991.	15245.	19635.	16755.	6164.
1968	2341.	1152.	913.	845.	800.	767.	809.	6079.	18150.	13197.	7762.	3764.
1969	1647.	517.	335.	292.	282.	282.	599.	5289.	9516.	7521.	5513.	2700.
1970	1324.	844.	678.	611.	579.	563.	649.	5060.	10089.	14221.	9324.	5507.
1971	2406.	968.	699.	691.	691.	691.	682.	4756.	18560.	13734.	13325.	6227.
1972	3052.	1655.	1123.	868.	690.	591.	556.	4302.	13222.	11484.	8497.	5119.
1973	3241.	2134.	1016.	768.	640.	576.	671.	4207.	7937.	9868.	9188.	4014.
1974	1812.	982.	531.	316.	243.	243.	259.	3246.	7323.	9394.	8236.	6396.
1975	3028.	1169.	838.	640.	640.	640.	682.	3666.	13299.	12643.	8486.	6925.
1976	2618.	1024.	803.	607.	512.	461.	573.	4244.	9236.	7515.	6958.	3516.
1977	2168.	1238.	896.	768.	640.	576.	618.	4196.	15398.	12813.	10405.	7195.
1978	4494.	2065.	1080.	833.	737.	653.	1032.	5568.	8110.	10775.	8699.	4708.
1979	2372.	1187.	902.	741.	640.	576.	685.	6079.	9592.	13030.	8452.	5331.

Table 18 Browne P.3

MINIMUM POST-PROJECT FLOWS AT BELOW DAM

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1400.	1400.	1400.	1400.	1400.	1400.	1400.	1400.	9300.	9300.	9300.	1400.

NSD FORECAST, YEAR 2010 ANNUAL ENERGY DEMAND = 6444. GWH.

ENERGY GENERATION CRITERIA

SYSTEM ENERGY DEMAND, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
563.	640.	717.	659.	582.	575.	491.	459.	427.	420.	446.	465.

MONTHLY GENERATION FROM OTHER SOURCES, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
96.5	85.7	87.0	82.5	72.0	71.2	61.9	73.9	159.5	170.8	175.9	126.7

ADJUSTED SYSTEM ENERGY DEMAND, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
466.	554.	630.	577.	510.	504.	429.	385.	267.	249.	270.	339.

MONTHLY GENERATION, PERCENT OF ANNUAL

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.090	0.107	0.122	0.111	0.098	0.097	0.083	0.074	0.052	0.048	0.052	0.065

TARGET FIRM ANNUAL ENERGY = 122.

TARGET MONTHLY FIRM ENERGY, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
11.0	13.1	14.8	13.6	12.0	11.9	10.1	9.1	6.3	5.9	6.4	8.0

Table 18 Brown P. 4

TURBINE DISCHARGE (CFS)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1951	1733.0	1659.1	1833.0	1804.7	1723.7	1658.9	1616.2	3618.4	8165.3	8165.3	8165.3	8165.3
1952	2469.0	2276.1	2172.0	1874.7	1768.7	1722.9	1466.2	1400.0	8165.3	8165.3	8165.3	6267.9
1953	3692.2	2542.1	2134.0	1656.7	1589.7	1658.9	1581.2	1400.0	8165.3	8165.3	8165.3	7902.9
1954	1936.2	1838.1	1942.0	1836.7	1753.7	1607.9	1400.0	1400.0	8165.3	8165.3	8165.3	6983.9
1955	2866.2	2414.1	1817.0	1746.7	1717.7	1671.9	1400.0	1400.0	8165.3	8165.3	8165.3	8165.3
1956	2267.4	1934.1	1929.0	1810.7	1781.7	1671.9	1400.0	1476.5	8165.3	8165.3	8165.3	7934.9
1957	2590.2	1998.1	2025.0	1988.7	1906.7	1766.9	1466.2	3076.4	8165.3	8165.3	8165.3	7089.1
1958	2924.2	3137.1	2865.0	2093.7	1713.7	1580.9	1517.2	1400.0	8165.3	8165.3	8165.3	3747.9
1959	1681.2	1832.1	1813.0	1833.7	1744.7	1542.9	1400.0	1751.0	8165.3	8165.3	8165.3	5978.9
1960	3002.2	2478.1	2083.0	1987.7	1846.7	1768.9	1555.2	4345.4	8165.3	8165.3	8165.3	5316.7
1961	2311.2	1896.1	2088.0	2040.7	1709.7	1648.9	1626.2	2859.4	8165.3	8165.3	8165.3	5864.9
1962	2583.2	2414.1	2083.0	1887.7	1730.7	1646.9	1479.2	1786.4	8165.3	8165.3	8165.3	8165.3
1963	3034.0	2363.1	1968.0	1797.7	1768.7	1710.9	1479.2	3213.4	8165.3	8165.3	8165.3	7226.9
1964	3364.2	2446.1	1852.0	1848.7	1666.7	1569.9	1459.2	1400.0	8165.3	8165.3	8165.3	3954.3
1965	3230.2	2414.1	2057.0	1772.7	1691.7	1658.9	1575.2	1400.0	8165.3	8165.3	8165.3	8165.3
1966	3597.2	2414.1	2002.0	1746.7	1768.7	1748.9	1504.2	1400.0	8165.3	8165.3	8165.3	6603.9
1967	2797.2	1825.1	1909.0	1816.7	1756.7	1697.9	1400.0	1400.0	8165.3	8165.3	8165.3	6414.9
1968	2098.2	2030.1	2023.0	1951.7	1928.7	1875.9	1622.2	2178.4	8165.3	8165.3	8165.3	2425.6
1969	1404.2	1400.0	1457.4	1400.0	1400.0	1400.0	1400.0	1400.0	8165.3	8165.3	8165.3	1400.0
1970	[illegible]	1576.4	1799.7	1725.8	1788.1	1736.3	1550.5	1400.0	8165.3	8165.3	8165.3	2669.9
1971	2163.2	1846.1	1809.0	1797.7	1819.7	1799.9	1495.2	1400.0	8165.3	8165.3	8165.3	6477.9
1972	2809.2	2533.1	2233.0	1974.7	1818.7	1699.9	1400.0	1400.0	8165.3	8165.3	8165.3	4540.1
1973	2998.2	3012.1	2126.0	1874.7	1768.7	1684.9	1484.2	1400.0	8165.3	8165.3	8165.3	1400.0
1974	1400.0	1400.0	1480.7	1400.0	1411.3	1400.0	1400.0	1400.0	8165.3	8165.3	8165.3	1400.0
1975	1400.0	1400.0	1480.5	1415.3	1768.7	1748.9	1495.2	1400.0	8165.3	8165.3	8165.3	6334.8
1976	2375.2	1902.1	1913.0	1713.7	1640.7	1569.9	1400.0	1400.0	8165.3	8165.3	8165.3	1400.0
1977	1400.0	1461.7	1637.3	1541.7	1556.6	1438.3	1400.0	1400.0	8165.3	8165.3	8165.3	7445.9
1978	4251.2	2943.1	2190.0	1939.7	1865.7	1761.9	1845.2	1667.4	8165.3	8165.3	8165.3	2521.5
1979	2129.2	2065.1	2012.0	1847.7	1768.7	1684.9	1498.2	2178.4	8165.3	8165.3	8165.3	4705.6
AVG	2479.6	2119.0	1957.0	1797.5	1730.2	1659.8	1493.6	1839.7	8165.3	8165.3	8165.3	5402.4

ENERGY FROM RESERVOIR (GWH) *Table 18 Browns P. 5*

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1951	18.4	16.8	18.7	17.8	14.9	15.3	13.9	34.1	78.9	82.8	83.7	82.2	477.5
1952	26.2	23.1	22.1	18.5	15.3	15.9	12.6	12.7	77.7	85.4	86.5	64.0	459.9
1953	39.0	25.8	21.7	16.4	13.7	15.3	13.6	13.1	80.6	86.5	86.5	80.7	492.8
1954	20.4	18.6	19.8	18.1	15.2	14.8	12.1	12.9	76.5	79.7	83.2	71.4	442.7
1955	30.3	24.5	18.5	17.2	14.8	15.4	12.0	12.8	79.1	86.0	86.5	83.6	480.8
1956	24.0	19.6	19.7	17.9	15.4	15.4	12.1	13.9	81.3	86.5	86.5	81.1	473.3
1957	27.3	20.2	20.6	19.6	16.5	16.3	12.6	29.0	81.3	86.5	85.3	71.4	486.7
1958	30.9	31.8	29.4	20.7	14.8	14.6	13.1	12.9	79.9	86.5	86.5	38.3	459.2
1959	17.7	18.6	18.5	18.1	15.1	14.2	12.0	16.5	81.3	86.5	86.5	61.1	446.1
1960	31.7	25.1	21.2	19.6	16.0	16.3	13.4	41.0	76.5	77.6	79.5	52.3	470.3
1961	24.4	19.2	21.3	20.1	14.8	15.2	14.0	27.0	81.3	86.5	86.5	59.9	470.2
1962	27.3	24.5	21.2	18.6	15.0	15.2	12.7	16.9	81.3	86.5	86.5	83.7	489.3
1963	32.1	23.9	20.0	17.7	15.3	15.8	12.7	30.3	81.3	86.5	86.5	73.8	496.1
1964	35.5	24.8	18.9	18.2	14.4	14.5	12.6	12.2	76.7	86.5	85.4	39.9	439.7
1965	34.1	24.5	21.0	17.5	14.6	15.3	13.6	13.2	81.3	86.5	85.1	82.2	488.8
1966	38.0	24.5	20.4	17.2	15.3	16.1	13.0	12.7	78.9	86.5	86.5	67.5	476.5
1967	29.5	18.5	19.4	17.9	15.2	15.7	12.1	13.1	81.0	86.5	86.5	65.5	460.9
1968	22.2	20.6	20.6	19.3	16.7	17.3	14.0	20.6	81.3	86.5	84.7	24.3	427.8
1969	14.8	14.2	14.8	13.8	12.1	12.9	12.1	13.2	79.2	80.0	72.8	11.5	351.3
1970	12.2	13.1	14.8	13.6	12.0	11.9	9.3	9.7	63.1	73.0	79.4	26.2	338.3
1971	22.8	18.7	18.4	17.7	15.7	16.6	12.9	13.1	80.7	86.5	86.5	66.2	455.9
1972	29.7	25.7	22.7	19.5	15.7	15.7	12.1	13.0	80.2	86.5	85.5	45.9	452.0
1973	31.7	30.5	21.7	18.5	15.3	15.5	12.8	12.9	75.0	76.5	77.1	13.3	400.8
1974	14.3	13.8	14.8	13.6	12.0	12.7	11.7	12.3	69.4	69.2	67.9	12.1	323.9
1975	13.9	13.8	14.8	13.9	15.3	16.1	12.9	12.8	79.5	86.5	85.5	64.0	429.0
1976	25.1	19.3	19.5	16.9	14.2	14.5	12.1	12.9	76.5	76.8	71.1	11.7	370.5
1977	12.8	13.1	14.8	13.6	12.0	11.9	10.8	11.7	77.1	86.5	86.5	76.1	426.7
1978	44.9	29.8	22.3	19.1	16.1	16.3	15.9	15.7	77.7	80.6	81.6	24.9	445.0
1979	22.5	20.9	20.5	18.2	15.3	15.5	12.9	20.6	79.3	84.4	85.5	47.5	443.1
AVG	26.0	21.3	[illegible]	17.6	14.8	15.1	12.7	17.0	78.4	83.5	83.4	54.6	444.0

POST-PROJECT FLOWS (CFS)

Table 18 Browne · P. 6

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1951	1733.0	1659.1	1833.0	1804.7	1723.7	1658.9	1616.2	3618.4	9300.0	9300.0	9300.0	9476.4
1952	2469.0	2276.1	2172.0	1874.7	1768.7	1722.9	1466.2	1400.0	9300.0	13523.3	9414.0	6267.9
1953	3692.2	2542.1	2134.0	1656.7	1589.7	1658.9	1581.2	1400.0	11253.5	11625.0	10829.0	7902.9
1954	1936.2	1838.1	1942.0	1836.7	1753.7	1607.9	1400.0	1400.0	9300.0	9300.0	9466.2	6963.9
1955	2866.2	2414.1	1817.0	1746.7	1717.7	1671.9	1400.0	1400.0	9300.0	13377.7	11717.0	8165.3
1956	2267.4	1934.1	1929.0	1810.7	1781.7	1671.9	1400.0	1476.5	12236.5	12813.0	12550.0	7934.9
1957	2590.2	998.1	2025.0	1988.7	1906.7	1766.9	1466.2	3076.4	13683.5	9693.0	9300.0	7089.1
1958	2924.2	137.1	2885.0	2093.7	1713.7	1580.9	1517.2	1400.0	9648.9	9990.0	10511.0	3747.9
1959	1681.2	1832.1	1813.0	1833.7	1744.7	1542.9	1400.0	1751.0	9322.5	14438.0	9498.0	5978.9
1960	3002.2	2478.1	2083.0	1987.7	1646.7	1768.9	1555.2	4345.4	9300.0	9300.0	9300.0	5316.7
1961	2311.2	1896.1	2088.0	2040.7	1709.7	1648.9	1626.2	2859.4	10186.5	11564.0	13478.0	5864.9
1962	2583.2	2414.1	2083.0	1887.7	1730.7	1646.9	1479.2	1786.4	17126.5	13901.0	10285.0	8865.0
1963	3034.0	2363.1	1968.0	1797.7	1768.7	1710.9	1479.2	3213.4	10499.5	17882.0	16230.0	7226.9
1964	3364.2	2446.1	1852.0	1848.7	1666.7	1569.9	1459.2	1400.0	9305.4	13133.0	9300.0	3954.3
1965	3230.2	2414.1	2057.0	1772.7	1691.7	1658.9	1575.2	1400.0	11439.4	14182.0	9300.0	8165.3
1966	3597.2	2414.1	2002.0	1746.7	1768.7	1748.9	1504.2	1400.0	11535.8	9714.0	10129.0	6603.9
1967	2797.2	1825.1	1909.0	1816.7	1756.7	1697.9	1400.0	1400.0	12763.8	19635.0	16755.0	6414.9
1968	2098.2	2030.1	2023.0	1951.7	1928.7	1875.9	1622.2	2178.4	15999.5	13197.0	9300.0	2425.6
1969	1404.2	1400.0	1457.4	1400.0	1400.0	1400.0	1400.0	1400.0	9300.0	9300.0	9300.0	1400.0
1970	1400.0	1576.4	1799.7	1725.8	1788.1	1736.3	1550.5	1400.0	9300.0	9300.0	9300.0	2669.9
1971	2163.2	1846.1	1809.0	1797.7	1819.7	1799.9	1495.2	1400.0	15846.8	13734.0	13325.0	6477.9
1972	2809.2	2533.1	2233.0	1974.7	1818.7	1699.9	1400.0	1400.0	10008.8	11484.0	9300.0	4540.1
1973	2998.2	3012.1	2126.0	1874.7	1768.7	1684.9	1484.2	1400.0	9300.0	9300.0	9300.0	1400.0
1974	1400.0	1400.0	1480.7	1400.0	1411.3	1400.0	1400.0	1400.0	9300.0	9300.0	9300.0	1400.0
1975	1400.0	1400.0	1480.5	1415.3	1768.7	1748.9	1495.2	1400.0	9459.4	12643.0	9300.0	6334.8
1976	2375.2	1902.1	1913.0	1713.7	1640.7	1569.9	1400.0	1400.0	9300.0	9300.0	9300.0	1400.0
1977	1400.0	1461.7	1637.3	1541.7	1556.6	1438.3	1400.0	1400.0	9300.0	12807.6	10405.0	7445.9
1978	4251.2	2943.1	2190.0	1939.7	1865.7	1761.9	1845.2	1667.4	9300.0	9300.0	9300.0	2521.5
1979	2129.2	2065.1	2012.0	1847.7	1768.7	1684.9	1498.2	2178.4	9300.0	11231.4	9300.0	4705.6
AVG	2479.6	2119.0	1957.0	1797.5	1730.2	1659.8	1493.6	1839.7	10731.6	11871.3	10485.9	5471.7

Table 18 Browne P.7

AVERAGE CAPABILITIES (MW)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
BROWNE	113.	111.	107.	102.	97.	92.	87.	93.	105.	110.	109.	110.
TOTAL	113.	111.	107.	102.	97.	92.	87.	93.	105.	110.	109.	110.

MINIMUM CAPABILITIES (MW)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
BROWNE	86.	84.	79.	74.	68.	61.	52.	62.	76.	83.	80.	83.
TOTAL	86.	84.	79.	74.	68.	61.	52.	62.	76.	83.	80.	83.

AVERAGE ENERGY PRODUCTION (GWH)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
BROWNE	26.0	21.3	19.7	17.6	14.8	15.1	12.7	17.0	78.4	83.5	83.4	54.6	444.0
TOTAL	26.0	21.3	19.7	17.6	14.8	15.1	12.7	17.0	78.4	83.5	83.4	54.6	444.0

MINIMUM ENERGY PRODUCTION (GWH)

		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
BROWNE	(1974)	14.3	13.8	14.8	13.6	12.0	12.7	11.7	12.3	69.4	69.2	67.9	12.1	323.9
TOTAL	(1974)	14.3	13.8	14.8	13.6	12.0	12.7	11.7	12.3	69.4	69.2	67.9	12.1	323.9

4) CHAKACHAMNA(ALT. D) NSD YEAR 2010: 6444 GWH *Table 18 Chakachamna P.1*
RESPONSE TO DEIS W/RULE CURVE RATED CAPACITY 100 MW

INPUT DATA FOR CHAKACHAMNA

NATURAL STREAMFLOW AT DAMSITE

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1950	2659.	772.	606.	512.	458.	463.	511.	2025.	8542.	13164.	10518.	4491.
1951	1731.	539.	502.	465.	442.	420.	601.	3771.	10689.	13065.	8801.	8605.
1952	3186.	812.	669.	600.	465.	437.	480.	1997.	8174.	12545.	9401.	3532.
1953	2682.	835.	612.	493.	447.	447.	611.	3962.	13217.	13325.	10778.	4475.
1954	1972.	599.	520.	497.	442.	428.	511.	3404.	8972.	12061.	12016.	6045.
1955	2757.	725.	589.	548.	477.	436.	457.	2163.	6796.	12966.	9953.	5038.
1956	1958.	565.	502.	474.	445.	419.	466.	2906.	[illegible]	[illegible]	10205.	5910.
1957	2023.	553.	535.	539.	506.	475.	568.	4363.	14787.	13119.	10375.	6880.
1958	2677.	763.	532.	539.	480.	459.	645.	2466.	9900.	10133.	[illegible]	3422.
1959	1866.	496.	453.	396.	438.	419.	496.	3090.	9429.	10358.	11701.	3632.
1960	1340.	624.	478.	370.	277.	237.	363.	3607.	6807.	11179.	9307.	3115.
1961	1409.	769.	840.	847.	559.	440.	316.	1851.	7953.	12778.	10869.	6195.
1962	1556.	813.	666.	603.	511.	441.	440.	1235.	7895.	13119.	10381.	5512.
1963	1167.	833.	583.	468.	327.	285.	307.	1771.	4705.	13219.	12178.	5817.
1964	2056.	900.	680.	334.	405.	302.	447.	1800.	8063.	10670.	11768.	4216.
1965	1215.	879.	632.	389.	189.	307.	368.	1256.	3460.	11603.	11899.	10772.
1966	2084.	567.	436.	358.	306.	320.	380.	1863.	8042.	10273.	9944.	6578.
1967	1923.	880.	283.	501.	419.	354.	850.	2000.	8731.	14901.	15665.	6161.
1968	2010.	1185.	541.	504.	480.	437.	600.	2966.	7778.	13087.	11227.	2763.
1969	946.	659.	582.	455.	456.	470.	622.	1918.	9241.	12448.	7267.	2763.
1970	3027.	1185.	571.	467.	474.	520.	869.	2235.	6759.	10330.	7956.	2704.
1971	1329.	712.	430.	364.	411.	483.	1245.	4033.	12642.	13665.	16650.	5045.
1972	3151.	1060.	706.	551.	501.	462.	449.	3438.	8198.	13460.	9253.	4982.
1973	2366.	649.	484.	465.	462.	450.	556.	2101.	7427.	8820.	7779.	2764.
1974	2497.	710.	593.	528.	496.	471.	524.	4185.	6218.	6751.	6129.	6820.
1975	3029.	879.	500.	468.	455.	455.	459.	4754.	10619.	10859.	6772.	5077.
1976	3106.	784.	592.	514.	494.	468.	595.	5253.	8557.	8274.	6464.	4917.
1977	3887.	1028.	1025.	1014.	743.	576.	576.	5305.	19834.	13868.	11194.	6029.
1978	3679.	892.	670.	579.	507.	479.	528.	5357.	7887.	10116.	7835.	4483.
1979	3228.	678.	671.	567.	532.	517.	683.	6746.	8484.	8928.	9127.	4542.

NET RESERVOIR EVAPORATION, INCHES

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

********** RESERVOIR DATA ********** / **** TAILWATER DATA ****

ELEVATION (FT,MSL)	VOLUME (ACRE-FEET)	AREA (ACRES)	DISCHARGE (CFS)	ELEVATION (FT,MSL)
760.0	0.	0.	0.	439.0
765.0	2025.	810.	1000000.	439.0
780.0	27200.	2690.	0.	0.0
820.0	241000.	7320.	0.	0.0
860.0	572000.	9280.	0.	0.0
880.0	769000.	10400.	0.	0.0
900.0	988000.	11590.	0.	0.0
920.0	1224000.	11960.	0.	0.0
940.0	1467000.	12320.	0.	0.0
960.0	1717000.	12650.	0.	0.0
980.0	1973000.	12980.	0.	0.0
1000.0	2236000.	13280.	0.	0.0
1020.0	2504000.	13520.	0.	0.0
1040.0	2776000.	13740.	0.	0.0
1060.0	3053000.	13960.	0.	0.0
1080.0	3335000.	14170.	0.	0.0
1100.0	3620000.	14390.	0.	0.0
1120.0	3910000.	14620.	0.	0.0
1128.0	4033200.	15212.	0.	0.0
1140.0	4218000.	16100.	0.	0.0

Table 18 Chakachamna P.2

THE RATED HEAD IS 663.0 FT.
THE RATED CAPACITY IS 75.0 MW.
THE HEADLOSS IS 0.000 TIMES THE HEAD

THE GENERATOR EFFICIENCY IS 0.980
THE TRANSFORMER EFFICIENCY IS 0.990

******************** POWERPLANT DATA, 4 UNITS ********************

NET HEAD (%RATED)	NET HEAD (FEET)	PLANT CAPACITY (MW)	PLANT CAPACITY (% RATED)	EFFICIENCY TURBINE	EFFICIENCY PLANT
0.750	497.2	182.8	0.628	0.880	0.854
0.800	530.4	203.2	0.698	0.888	0.862
0.850	563.5	223.8	0.769	0.894	0.867
0.900	596.7	245.7	0.844	0.900	0.873
0.950	629.8	268.1	0.921	0.905	0.878
1.000	663.0	291.1	1.000	0.910	0.883
1.030	682.9	303.6	1.043	0.908	0.881
1.060	702.8	316.1	1.086	0.906	0.879
1.100	729.3	333.3	1.145	0.903	0.876
1.150	762.4	354.8	1.219	0.900	0.873

RESERVOIR OPERATION CONSTRAINTS

MAXIMUM RESERVOIR ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1128.	1128.	1128.	1128.	1128.	1128.	1128.	1128.	1128.	1128.	1128.	1128.

RULE CURVE ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1128.	1123.	1117.	1111.	1105.	1100.	1096.	1099.	1094.	1108.	1108.	1125.

MINIMUM RESERVOIR ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1014.	1014.	1014.	1014.	1014.	1014.	1014.	1014.	1014.	1014.	1014.	1014.

RESERVOIR RELEASE CONSTRAINTS

MINIMUM CONSUMPTIVE RELEASE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

MINIMUM NON-POWER RELEASE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

DOWNSTREAM RELEASE CRITERIA

PRE-PROJECT FLOWS AT BELOW POWERH

Table 18 Chakachamna P.3

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1950	2877.	858.	681.	580.	522.	528.	579.	2199.	9172.	14118.	11286.	4837.
1951	1884.	609.	569.	530.	505.	482.	675.	4067.	11469.	14012.	9449.	9239.
1952	3441.	901.	748.	674.	530.	500.	546.	2169.	8778.	13455.	10091.	3811.
1953	2902.	926.	687.	560.	510.	510.	686.	4271.	14174.	14290.	11565.	4820.
1954	2142.	673.	588.	564.	505.	490.	579.	3674.	9632.	12937.	12889.	6500.
1955	2982.	808.	662.	618.	542.	499.	521.	2347.	7304.	13906.	10682.	5423.
1956	2127.	637.	569.	539.	508.	480.	531.	3142.	7998.	15623.	10951.	6356.
1957	2197.	624.	605.	609.	574.	540.	640.	4701.	15854.	14069.	11133.	7394.
1958	2896.	849.	601.	609.	546.	523.	722.	2671.	10625.	10874.	9299.	3694.
1959	2029.	563.	517.	456.	501.	480.	563.	3338.	10121.	11115.	12552.	3918.
1960	1466.	700.	544.	428.	328.	286.	421.	3892.	7316.	11994.	9991.	3365.
1961	1540.	855.	931.	938.	630.	503.	370.	2013.	8542.	13705.	11662.	6661.
1962	1697.	902.	745.	677.	579.	504.	503.	1354.	8480.	14069.	11140.	5930.
1963	1281.	923.	656.	533.	382.	337.	361.	1927.	5066.	14176.	13063.	6256.
1964	2232.	995.	760.	389.	465.	355.	510.	1958.	8650.	11449.	12624.	4543.
1965	1332.	973.	708.	448.	234.	361.	426.	1376.	3734.	12447.	12764.	11558.
1966	2262.	639.	499.	415.	360.	375.	439.	2026.	8637.	11924.	10672.	7071.
1967	2090.	974.	335.	568.	480.	411.	942.	2172.	9374.	15975.	16794.	6624.
1968	2183.	1300.	611.	571.	546.	500.	674.	3206.	8355.	14035.	12045.	2989.
1969	1044.	737.	655.	519.	520.	535.	698.	2084.	9920.	13351.	7808.	2989.
1970	3271.	1300.	643.	532.	539.	588.	962.	2424.	7264.	11085.	8545.	2925.
1971	1454.	794.	492.	422.	472.	549.	1364.	4347.	13559.	14654.	17848.	5430.
1972	3404.	1166.	788.	622.	568.	526.	513.	3711.	8804.	14434.	9911.	5363.
1973	2564.	727.	550.	530.	526.	514.	627.	2280.	7979.	9469.	8356.	2990.
1974	2704.	792.	667.	597.	563.	536.	593.	4510.	6685.	7256.	6590.	7329.
1975	3273.	973.	567.	533.	519.	519.	523.	5119.	11394.	11651.	7278.	5464.
1976	3356.	871.	666.	582.	561.	533.	669.	5653.	9188.	8885.	6949.	5293.
1977	4191.	1132.	1129.	1117.	827.	648.	648.	5708.	21254.	14871.	12010.	6483.
1978	3969.	987.	749.	652.	575.	545.	597.	5764.	8471.	10856.	8416.	4829.
1979	3486.	752.	750.	639.	601.	585.	763.	7250.	9110.	9585.	9798.	4892.

Chakachamna p. 4

MINIMUM POST-PROJECT FLOWS AT HELOW POWERH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1100.	1100.	1100.	1100.	1100.	1100.	1100.	1100.	9900.	9900.	9900.	1100.

NSD FORECAST, YEAR 2010 ANNUAL ENERGY DEMAND = 6444. GWH.

ENERGY GENERATION CRITERIA

SYSTEM ENERGY DEMAND, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
563.	640.	717.	659.	582.	575.	491.	459.	427.	420.	446.	465.

MONTHLY GENERATION FROM OTHER SOURCES, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
122.5	107.0	106.7	100.1	86.8	86.3	74.6	90.9	237.9	254.3	259.3	181.3

ADJUSTED SYSTEM ENERGY DEMAND, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
440.	533.	611.	559.	495.	489.	416.	368.	189.	166.	187.	284.

MONTHLY GENERATION, PERCENT OF ANNUAL

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.093	0.113	0.129	0.118	0.105	0.103	0.088	0.078	0.040	0.035	0.039	0.060

TARGET FIRM ANNUAL ENERGY = 608.

TARGET MONTHLY FIRM ENERGY, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	24.2	21.3	24.0	36.5

TURBINE DISCHARGE (CFS)

Table 18 Chakachamna P.4

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1950	2659.0	1988.1	2186.7	1950.1	1893.6	1712.1	1506.8	1289.4	5322.4	4474.4	4952.9	3257.6
1951	1482.6	1860.1	2079.1	1920.9	1898.6	1708.8	1515.2	2199.5	5276.8	4415.4	4916.5	5980.6
1952	3186.0	2028.1	2249.7	2038.1	1900.6	1699.6	1507.1	1289.9	5332.6	4496.0	5002.6	1002.0
1953	1487.3	1860.0	2076.4	1917.5	1895.0	1704.6	1511.1	2763.5	5236.2	4367.6	4878.3	5380.6
1954	1481.7	1857.6	2075.5	1917.1	1894.5	1704.3	1511.5	2125.3	5309.5	4475.2	4948.6	5823.6
1955	1880.6	1941.1	2169.7	1986.1	1912.6	1699.6	1507.2	1289.3	5354.8	4530.3	5018.4	1166.7
1956	1481.7	1857.9	2076.1	1918.0	1895.5	1705.4	1512.8	1484.3	5340.1	4481.8	4944.0	4827.5
1957	1481.5	1857.3	2075.3	1916.6	1893.5	1702.4	1509.3	3313.8	5212.2	4348.0	4878.3	5980.6
1958	2677.0	1979.1	2112.7	1977.1	1915.6	1708.1	1602.7	1655.1	5291.2	4476.9	5032.2	1010.5
1959	1503.6	1886.8	2110.4	1952.8	1934.7	1743.6	1547.2	1319.2	5406.5	4574.6	5075.9	1008.2
1960	1501.5	1886.4	2109.0	1951.2	1934.3	1745.3	1550.6	1320.3	5454.8	4646.7	5186.6	1038.8
1961	1547.3	1945.1	2176.2	2011.6	1990.3	1794.1	1594.1	1366.9	5661.4	4769.5	5254.6	1034.5
1962	1524.7	1913.6	2140.8	1981.1	1961.5	1767.7	1569.4	1349.0	5596.8	4710.3	5193.9	1027.2
1963	1520.5	1910.5	2137.0	1979.1	1961.7	1770.0	1573.2	1349.2	5662.8	4824.2	5275.6	1034.6
1964	1524.1	1909.6	2134.5	1976.9	1960.0	1767.9	1570.3	1345.9	5572.1	4733.3	5241.0	1035.4
1965	1537.3	1933.0	2163.1	2004.1	1988.7	1795.8	1596.2	1371.6	5801.7	5003.4	5508.3	1060.5
1966	1533.2	1923.7	2156.5	1999.5	1983.5	1790.1	1590.8	1363.7	5645.6	4803.9	5366.4	1058.4
1967	1554.0	1949.2	2184.6	2026.5	2009.1	1812.9	1606.5	1375.9	5677.5	4727.2	5070.7	3755.0
1968	1481.5	2041.6	2121.7	1942.1	1915.6	1699.6	1543.8	2155.1	5333.4	4493.9	4963.9	1527.1
1969	1485.8	1867.9	2086.8	1927.9	1905.6	1716.2	1521.5	1302.1	5363.0	4504.9	5046.2	1019.7
1970	1515.0	1891.0	2110.3	1951.3	1932.5	1740.6	1541.9	1317.1	5470.5	4676.9	5266.2	1062.0
1971	1584.7	1994.0	2236.5	2076.0	2060.9	1860.2	1648.2	1396.6	5627.5	4638.6	4998.5	5641.3
1972	2274.6	2276.1	2286.7	1989.1	1936.6	1711.1	1507.1	2529.9	5324.9	4476.7	4970.6	2402.2
1973	1489.6	1865.1	2070.7	1712.8	1890.3	1699.6	1506.6	1288.7	5340.5	4580.0	5192.2	1047.5
1974	1556.1	1948.9	2183.0	2022.3	2004.2	1807.0	1604.4	1362.5	5630.8	4898.9	5647.4	1129.7
1975	1648.1	2060.2	2311.0	2146.3	2131.8	1926.4	1714.4	1452.9	5879.4	4936.5	5574.4	1119.7
1976	1644.4	2055.6	2305.6	2139.9	2124.5	1919.1	1706.6	1442.4	5877.3	5034.4	5761.4	1159.5
1977	1697.1	2113.6	2366.3	2189.9	2169.6	1958.5	1742.0	1477.0	5718.2	4576.0	5025.3	2602.7
1978	2802.6	2108.1	2250.7	2017.1	1942.6	1728.1	1506.7	4525.8	5331.2	4541.7	5120.5	1026.6
1979	1515.1	1892.8	2114.8	1955.0	1935.2	1742.8	1544.9	2558.3	5319.2	4542.2	5119.0	1021.0
AVG	1741.9	1953.4	2161.9	1989.8	1959.1	1761.4	1565.7	1745.8	5479.0	4625.3	5147.7	2241.4

ENERGY FROM RESERVOIR (GWH) Table 18 Chakachamna P.5

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1950	101.7	73.4	82.8	73.2	63.7	63.3	53.5	47.2	188.7	165.8	186.[illegible]	119.7	1219.5
1951	56.5	68.4	78.4	71.8	63.6	62.8	53.5	80.4	188.7	165.8	186.6	220.4	1296.8
1952	121.9	74.8	85.1	76.5	63.9	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1163.4
1953	56.5	68.4	78.4	71.8	63.6	62.8	53.5	101.1	188.7	165.8	186.6	198.7	1295.9
1954	56.5	68.4	78.4	71.8	63.6	62.8	53.5	77.8	188.7	165.8	186.6	214.5	1288.2
1955	71.8	71.6	82.1	74.5	64.3	62.8	53.5	47.2	188.7	165.8	186.6	42.5	1111.5
1956	56.5	68.4	78.4	71.8	63.6	62.8	53.5	54.3	188.7	165.8	186.6	177.4	1227.7
1957	56.5	68.4	78.4	71.8	63.6	62.8	53.5	121.3	188.7	165.8	186.6	221.4	1338.8
1958	102.4	73.0	80.0	74.2	64.4	63.1	56.9	60.7	188.7	165.8	186.6	36.5	1152.3
1959	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1960	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1961	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1962	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1963	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1964	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1965	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1966	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1967	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	137.5	1180.7
1968	56.5	75.3	80.3	72.9	64.4	62.8	54.8	79.0	188.7	165.8	186.6	56.1	1143.2
1969	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1970	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1971	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	208.2	1251.4
1972	86.8	84.0	86.5	74.6	65.1	63.2	53.5	92.7	188.7	165.8	186.6	87.9	1235.6
1973	56.9	68.8	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1080.5
1974	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1975	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1976	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
1977	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	95.0	1138.2
1978	107.0	77.8	85.2	75.7	65.3	63.8	53.5	165.9	188.7	165.8	186.6	36.5	1271.7
1979	56.5	68.4	78.4	71.8	63.6	62.8	53.5	92.6	188.7	165.8	186.6	36.5	1125.1
AVG	64.9	70.1	79.5	72.4	63.8	62.9	53.6	62.3	188.7	165.8	186.6	81.2	1151.9

POST-PROJECT FLOWS (CFS)

Table 18 [illegible] R6

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1950	2877.0	2074.1	2261.7	2018.1	1957.6	1777.1	1574.8	1465.4	9900.0	9900.0	9900.0	3603.6
1951	1635.6	1930.3	2146.1	1985.9	1961.6	1770.8	1589.2	2495.5	9900.0	9900.0	9900.0	7505.2
1952	3441.0	2117.1	2328.7	2112.1	1965.6	1762.6	1573.1	1461.9	9900.0	9900.0	9900.0	1281.0
1953	1707.3	1951.0	2151.4	1984.5	1958.0	1767.6	1586.1	3072.5	9900.0	11568.9	11565.0	5725.6
1954	1651.7	1931.6	2143.5	1984.1	1957.5	1766.3	1579.5	2395.3	9900.0	9900.0	9900.0	6278.6
1955	2105.6	2024.1	2242.7	2056.1	1977.6	1762.6	1571.2	1473.3	9900.0	9900.0	9900.0	1551.7
1956	1650.7	1929.9	2143.1	1983.0	1958.5	1766.4	1577.8	1720.3	9900.0	9900.0	9900.0	5273.5
1957	1655.5	1928.3	2145.3	1986.6	1961.5	1767.4	1581.3	3651.8	9900.0	12973.7	11133.0	7394.0
1958	2896.0	2065.1	2181.7	2047.1	1981.6	1772.1	1679.7	1860.1	9900.0	9900.0	9900.0	1282.5
1959	1666.6	1953.8	2174.4	2012.8	1997.7	1804.6	1614.2	1567.2	9900.0	9900.0	9900.0	1294.2
1960	1627.5	1962.4	2175.0	2009.2	1985.3	1794.3	1608.6	1605.3	9900.0	9900.0	9900.0	1288.8
1961	1678.3	2031.1	2267.2	2102.6	2061.3	1857.1	1648.1	1528.9	9900.0	9900.0	9900.0	1500.5
1962	1665.7	2002.6	2219.8	2055.1	2029.5	1830.7	1632.4	1467.0	9900.0	9900.0	9900.0	1445.2
1963	1634.5	2000.5	2210.0	2044.1	2016.7	1822.0	1627.2	1505.2	9900.0	9900.0	9900.0	1473.6
1964	1700.1	2004.6	2214.5	2031.9	2020.0	1820.9	1633.3	1503.9	9900.0	9900.0	9900.0	1362.4
1965	1654.3	2027.0	2239.1	2063.1	2033.7	1849.8	1654.2	1491.6	9900.0	9900.0	9900.0	1846.5
1966	1711.2	1995.7	2219.5	2056.5	2037.5	1845.1	1649.8	1526.7	9900.0	9900.0	9900.0	1551.4
1967	1721.0	2043.2	2236.6	2093.5	2070.1	1869.9	1700.5	1547.9	9900.0	9900.0	9900.0	4218.0
1968	1654.5	2156.6	2191.7	2009.1	1981.6	1762.6	1617.8	2395.1	9900.0	9900.0	9900.0	1753.1
1969	1583.8	1945.9	2159.8	1991.9	1969.6	1781.2	1597.5	1468.1	9900.0	9900.0	9900.0	1245.7
1970	1759.0	2006.0	2182.3	2016.3	1997.5	1808.6	1634.9	1506.1	9900.0	9900.0	9900.0	1283.0
1971	1709.7	2076.0	2298.5	2134.0	2121.9	1926.2	1767.2	1710.6	9900.0	9900.0	9900.0	6026.3
1972	2527.6	2382.1	2368.7	2060.1	2003.6	1775.1	1571.1	2802.9	9900.0	9900.0	9900.0	2783.2
1973	1687.6	1943.1	2136.7	1977.8	1954.3	1763.6	1577.6	1467.7	9900.0	9900.0	9900.0	1273.5
1974	1763.1	2030.9	2257.0	2091.3	2071.2	1872.0	1673.4	1687.5	9900.0	9900.0	9900.0	1638.7
1975	1892.1	2154.2	2378.0	2211.3	2195.8	1990.4	1778.4	1817.9	9900.0	9900.0	9900.0	1506.7
1976	1894.[illegible]	2142.6	2379.6	2207.9	2191.5	1984.1	1780.6	1842.4	9900.0	9900.0	9900.0	1535.5
1977	2001.1	2217.6	2470.3	2292.9	2253.6	2030.5	1814.0	1875.0	9900.0	9900.0	9900.0	3056.7
1978	3092.6	2203.1	2329.7	2090.1	2010.6	1794.1	1575.7	4932.8	9900.0	9900.0	9900.0	1372.6
1979	1773.1	1972.8	2193.8	2027.0	2004.2	1810.8	1624.9	3062.3	9900.0	9900.0	9900.0	1371.0
AVG	1933.9	2040.1	2234.9	2057.9	2022.9	1823.5	1636.5	1996.9	9900.0	10058.1	9996.6	2690.7

Table 18 Chakachamna P.7

AVERAGE CAPABILITIES (MW)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
CHAKACHAMNA	295.	294.	291.	286.	282.	278.	274.	275.	277.	280.	285.	290.
TOTAL	295.	294.	291.	286.	282.	278.	274.	275.	277.	280.	285.	290.

MINIMUM CAPABILITIES (MW)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
CHAKACHAMNA	250.	252.	249.	245.	241.	237.	233.	237.	249.	247.	241.	242.
TOTAL	250.	252.	249.	245.	241.	237.	233.	237.	249.	247.	241.	242.

AVERAGE ENERGY PRODUCTION (GWH)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
CHAKACHAMNA	64.9	70.1	79.5	72.4	63.8	62.9	53.6	62.3	188.7	165.8	186.6	81.2	1151.9
TOTAL	64.9	70.1	79.5	72.4	63.8	62.9	53.6	62.3	188.7	165.8	186.6	81.2	1151.9

MINIMUM ENERGY PRODUCTION (GWH)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
CHAKACHAMNA (1965)	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7
TOTAL (1965)	56.5	68.4	78.4	71.8	63.6	62.8	53.5	47.2	188.7	165.8	186.6	36.5	1079.7

Table 18 Johnson P. 1

5) JOHNSON ALTERNATIVE HYDRO PROJECT NSD YEAR 2010: 6444 GWH
RESPONSE TO DEIS W/ RULE CURVE RATED CAPACITY 100 MW

INPUT DATA FOR JOHNSON

NATURAL STREAMFLOW AT DAMSITE

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1961	6439.	3875.	3690.	3749.	2961.	2897.	2804.	12090.	21513.	21082.	22853.	11572.
1962	5517.	3321.	2952.	2952.	2952.	2829.	2956.	12362.	30332.	32201.	34735.	17392.
1963	7175.	4712.	3198.	3321.	3198.	2706.	2956.	13050.	10777.	27122.	24957.	15227.
1964	6852.	3198.	2829.	3075.	2829.	2583.	2583.	4870.	30664.	31058.	24895.	11838.
1965	6513.	3690.	3327.	3151.	2829.	2583.	2460.	6402.	12202.	23149.	24010.	12195.
1966	5937.	3075.	2829.	2829.	2706.	2706.	2829.	10208.	21722.	25793.	20357.	9118.
1967	4916.	3075.	2952.	2829.	2829.	2829.	3075.	11567.	22017.	25793.	30049.	15646.
1968	5455.	3711.	3456.	3134.	3075.	3075.	3123.	10792.	20492.	30356.	26138.	15080.
1969	7144.	4087.	3910.	3785.	3598.	3389.	3411.	9101.	18389.	27601.	14588.	7940.
1970	5160.	3994.	3531.	3262.	3198.	3075.	3100.	6684.	10872.	19815.	17983.	9675.
1971	5818.	3317.	2365.	2214.	2214.	2214.	2499.	10952.	18093.	26728.	29594.	12866.
1972	5879.	3809.	3266.	2865.	2528.	2253.	2242.	11387.	20726.	27577.	26937.	12337.
1973	4749.	3260.	2909.	2829.	2829.	2824.	3139.	8092.	19409.	26285.	21304.	11219.
1974	476[illegible].	3022.	2499.	2460.	2460.	2651.	3337.	8470.	13985.	25818.	26777.	15867.
1975	5212.	3998.	3499.	3130.	2851.	2829.	3011.	11521.	18241.	34169.	23136.	18512.
1976	7096.	4031.	3269.	3075.	2952.	2995.	3370.	9526.	18413.	22780.	27983.	9902.
1977	7895.	4244.	3257.	3198.	3198.	3134.	3723.	8807.	19692.	25658.	31869.	12386.
1978	6439.	3526.	3198.	2952.	2916.	2829.	4407.	9242.	12657.	23161.	29372.	12681.
1979	5374.	3813.	3483.	3246.	3198.	3198.	4822.	11106.	15018.	31365.	36666.	15314.
1980	6672.	4264.	3317.	2952.	2706.	2793.	3895.	8108.	13530.	25326.	21759.	12767.
1981	8183.	4916.	4380.	3872.	3813.	3813.	4182.	8788.	16162.	24047.	20959.	9589.
1982	4904.	3681.	3221.	2984.	2952.	2829.	2854.	12423.	18315.	25055.	23382.	10518.

NET RESERVOIR EVAPORATION, INCHES

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

********* RESERVOIR DATA *********			**** TAILWATER DATA ****	
ELEVATION (FT,MSL)	VOLUME (ACRE-FEET)	AREA (ACRES)	DISCHARGE (CFS)	ELEVATION (FT,MSL)
1280.0	0.	0.	0.	1290.0
1390.0	1700000.	0.	1000000.	1290.0
1420.0	2600000.	0.	0.	0.0
1440.0	3600000.	0.	0.	0.0
1460.0	5200000.	0.	0.	0.0
1470.0	7000000.	0.	0.	0.0

THE RATED HEAD IS 149.0 FT.
THE RATED CAPACITY IS 210.0 MW.
THE HEADLOSS IS 0.015 TIMES THE HEAD

THE GENERATOR EFFICIENCY IS 0.980
THE TRANSFORMER EFFICIENCY IS 0.990

Table 18 Johnson P.2

********************* POWERPLANT DATA, 1 UNITS *********************

NET HEAD (%RATED)	NET HEAD (FEET)	PLANT CAPACITY (MW)	PLANT CAPACITY (% RATED)	EFFICIENCY TURBINE	EFFICIENCY PLANT
0.650	96.9	97.8	0.480	0.856	0.832
0.750	111.8	127.9	0.628	0.880	0.854
0.800	119.2	142.2	0.698	0.888	0.862
0.850	126.6	156.7	0.769	0.894	0.867
0.900	134.1	172.0	0.844	0.900	0.873
0.950	141.5	187.6	0.921	0.905	0.878
1.000	149.0	203.7	1.000	0.910	0.883
1.030	153.5	212.5	1.043	0.908	0.881
1.060	157.9	221.3	1.086	0.906	0.879
1.100	163.9	233.3	1.145	0.903	0.876
1.150	171.3	248.4	1.219	0.900	0.873
1.250	186.3	278.1	1.365	0.883	0.857

RESERVOIR OPERATION CONSTRAINTS

MAXIMUM RESERVOIR ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1470.	1470.	1470.	1470.	1470.	1470.	1470.	1470.	1470.	1470.	1470.	1470.

RULE CURVE ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1470.	1470.	1469.	1468.	1468.	1467.	1467.	1469.	1467.	1468.	1465.	1469.

MINIMUM RESERVOIR ELEVATION

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1390.	1390.	1390.	1390.	1390.	1390.	1390.	1390.	1390.	1390.	1390.	1390.

RESERVOIR RELEASE CONSTRAINTS

MINIMUM CONSUMPTIVE RELEASE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

MINIMUM NON-POWER RELEASE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

DOWNSTREAM RELEASE CRITERIA

PRE-PROJECT FLOWS AT BELOW DAM

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1961	6439.	3875.	3690.	3749.	2961.	2897.	2804.	12090.	21513.	21082.	22853.	11572.
1962	5517.	3321.	2952.	2952.	2952.	2829.	2956.	12362.	30332.	32201.	34735.	17392.
1963	7175.	4712.	3198.	3321.	3198.	2706.	2956.	13050.	10777.	27122.	24957.	15227.
1964	6852.	3198.	2829.	3075.	2829.	2583.	2563.	4870.	30664.	31058.	24895.	11838.
1965	6513.	3690.	3327.	3151.	2829.	2583.	2460.	6402.	12202.	23149.	24010.	12195.
1966	5937.	3075.	2829.	2829.	2706.	2706.	2829.	10208.	21722.	25793.	20357.	9118.
1967	4916.	3075.	2952.	2829.	2829.	2829.	3075.	11567.	22017.	25793.	30049.	15646.
1968	5455.	3711.	3456.	3134.	3075.	3075.	3123.	10792.	20492.	30356.	26138.	15080.
1969	7144.	4087.	3910.	3785.	3598.	3389.	3411.	9101.	18389.	27601.	14588.	7940.
1970	5160.	3994.	3531.	3262.	3198.	3075.	3100.	6684.	10872.	19815.	17983.	9675.
1971	5818.	3317.	2365.	2214.	2214.	2214.	2499.	10952.	18093.	26728.	29594.	12866.
1972	5879.	3809.	3266.	2865.	2528.	2253.	2242.	11387.	20726.	27577.	26937.	12337.
1973	4749.	3260.	2909.	2829.	2829.	2829.	3139.	8092.	19409.	26285.	21304.	11219.
1974	4761.	3022.	2499.	2460.	2460.	2651.	3337.	8470.	13985.	25818.	26777.	15867.
1975	5212.	3998.	3499.	3130.	2851.	2829.	3011.	11521.	18241.	34169.	23136.	18512.
1976	7096.	4031.	3269.	3075.	2952.	2995.	3370.	9526.	18413.	22780.	27983.	9902.
1977	7595.	4244.	3257.	3198.	3198.	3134.	3723.	8807.	19692.	25658.	31869.	12386.
1978	6439.	3526.	3198.	2952.	2916.	2829.	4407.	9242.	12657.	23161.	29372.	12681.
1979	5374.	3813.	3483.	3246.	3198.	3198.	4022.	11106.	15018.	31365.	36666.	15314.
1980	6672.	4264.	3317.	2952.	2706.	2793.	3895.	8108.	13530.	25326.	21759.	12767.
1981	8183.	4916.	4380.	3872.	3813.	3813.	4182.	8788.	16162.	24047.	20959.	9589.
1982	4904.	3681.	3221.	2984.	2952.	2829.	2854.	12423.	18315.	25055.	23382.	10518.

Table 18 Johnson P. 3

MINIMUM POST-PROJECT FLOWS AT BELOW DAM

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
3200.	3200.	3200.	3200.	3200.	3200.	3200.	3200.	24000.	24000.	24000.	3200.

NSD FORECAST, YEAR 2010 ANNUAL ENERGY DEMAND = 6444. GWH.

ENERGY GENERATION CRITERIA

SYSTEM ENERGY DEMAND, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
563.	640.	717.	659.	582.	575.	491.	459.	427.	420.	446.	465.

MONTHLY GENERATION FROM OTHER SOURCES, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
187.4	177.1	186.2	172.5	150.6	149.2	128.2	153.2	426.6	419.9	445.9	262.5

ADJUSTED SYSTEM ENERGY DEMAND, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
375.	463.	531.	487.	431.	426.	363.	306.	0.	0.	0.	203.

MONTHLY GENERATION, PERCENT OF ANNUAL

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
0.105	0.129	0.148	0.136	0.120	0.119	0.101	0.085	0.000	0.000	0.000	0.057

TARGET FIRM ANNUAL ENERGY = 397.

TARGET MONTHLY FIRM ENERGY, GWH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.8	0.0	0.0	0.0	22.5

TURBINE DISCHARGE (CFS)

Table 18 Johnson P.4

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1961	6439.0	5471.4	6093.2	5602.6	5513.6	4937.8	4354.9	4538.4	~~20163.8~~	26.0	2.6	3674.8
1962	4302.1	5487.5	6117.2	5631.4	5545.7	4967.3	4380.9	3551.0	~~20163.8~~	25.7	2.6	20163.8
1963	4492.6	6224.1	6094.7	5607.8	5519.7	4943.[illegible]	4359.9	4807.6	~~20163.8~~	26.3	2.6	5009.3
1964	4297.9	5477.1	6106.5	5621.5	5535.7	4959.5	4376.0	3568.2	~~20163.8~~	25.8	2.6	14862.2
1965	4299.0	5477.9	6103.0	5615.8	5529.7	4954.1	4371.6	3560.7	~~20163.8~~	26.6	2.7	3200.0
1966	4380.0	5586.9	6231.5	5744.5	5664.6	5080.2	4485.0	3639.2	~~20163.8~~	26.7	2.7	3200.0
1967	4424.8	5650.5	6308.1	5815.9	5751.3	5187.0	4599.8	3706.5	~~20163.8~~	26.9	2.7	3200.0
1968	4345.8	5542.3	6175.1	5682.7	5595.6	5012.8	4422.1	3585.4	~~20163.8~~	26.2	2.6	9071.0
1969	4297.0	5516.8	6251.3	5601.2	5509.7	4930.3	4344.7	3529.1	~~20163.8~~	26.0	2.6	3200.0
1970	4354.8	5554.0	6186.7	5692.6	5604.7	5021.9	4430.3	3605.4	~~20163.8~~	27.5	2.8	3200.0
1971	4608.7	5890.1	6636.0	6193.1	6179.4	5605.0	4997.[illegible]	4031.3	~~20163.8~~	29.8	2.9	3200.0
1972	4608.9	5883.6	6607.8	6144.0	6115.6	5540.4	4940.[illegible]	3982.8	~~20163.8~~	29.0	2.8	3200.0
1973	4559.1	5839.7	6570.0	6111.9	6078.7	5494.9	4881.5	3957.4	~~20163.8~~	29.3	2.9	3200.0
1974	4750.4	6094.7	6881.2	6429.5	6449.2	5923.0	533[illegible].4	4306.6	~~20163.8~~	33.8	3.3	3200.0
1975	4940.6	6326.4	7145.3	6743.4	6845.0	6324.6	573[illegible].1	4576.0	~~20163.8~~	32.7	3.1	3200.0
1976	4774.6	6080.9	6837.2	6365.5	6337.1	5758.7	5159.1	4151.2	~~20163.8~~	31.3	3.1	3200.0
1977	4872.6	6194.3	6967.3	6491.2	6513.2	5971.8	5364.1	4312.5	~~20163.8~~	32.0	3.1	3200.0
1978	4768.8	6089.0	6855.6	6386.5	6361.2	5800.1	5185.4	4156.8	~~20163.8~~	33.1	3.2	3200.0
1979	4934.5	6318.5	7136.0	6728.3	6813.8	6271.6	5622.1	4452.4	~~20163.8~~	33.3	3.0	3200.0
1980	4631.5	5897.5	6616.9	6151.0	6119.5	5535.1	4910.7	3974.4	~~20163.8~~	30.3	3.0	3200.0
1981	4835.8	6133.4	6866.9	6366.1	6314.7	5692.3	5047.6	4071.4	~~20163.8~~	31.1	3.1	3200.0
1982	5054.5	6528.1	7489.9	7148.9	7303.8	6869.4	6449.7	5088.4	~~20163.8~~	38.2	3.8	3383.2
AVG	4680.6	5875.7	6558.1	6085.2	6054.6	5490.0	4898.2	4052.[illegible]	~~20163.8~~	29.4	2.9	4880.2

Note: Subsequent to this run, error in June energy production was noted and corrected (by hand) for presentation in Table 18 of Applicant's DEIS Comment Document, Appendix II.

ENERGY FROM RESERVOIR (GWH)

Table 18 Johnson P. 5

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1961	62.4	51.3	58.8	53.9	47.8	47.2	40.2	43.5	~~187.6~~	0.2	0.0	34.1	~~627.[illegible]~~
1962	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.6	~~169.1~~	0.2	0.0	188.7	~~751.6~~
1963	43.5	58.3	58.8	53.9	47.8	47.2	40.2	46.0	~~186.2~~	0.2	0.0	46.4	~~628.5~~
1964	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.8	~~186.2~~	0.2	0.0	139.1	~~700.1~~
1965	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.6	~~164.3~~	0.2	0.0	29.1	~~588.2~~
1966	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.8	~~182.2~~	0.2	0.0	28.9	~~585.9~~
1967	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.8	~~180.4~~	0.2	0.0	29.3	~~584.5~~
1968	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.8	~~184.7~~	0.2	0.0	84.3	~~643.9~~
1969	41.5	51.7	60.3	53.9	47.8	47.2	40.2	33.8	~~187.2~~	0.2	0.0	29.4	~~593.3~~
1970	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.8	~~181.1~~	0.2	0.0	27.5	~~583.3~~
1971	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.8	~~164.3~~	0.2	0.0	27.3	~~566.4~~
1972	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.8	~~167.4~~	0.2	0.0	27.7	~~569.9~~
1973	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.6	~~166.8~~	0.2	0.0	26.6	~~568.2~~
1974	41.5	51.2	58.6	53.9	47.8	47.2	40.2	33.8	~~149.4~~	0.2	0.0	24.9	~~549.0~~
1975	41.5	51.2	58.8	53.9	47.8	47.2	40.2	33.6	~~145.3~~	0.2	0.0	25.8	~~545.9~~
1976	41.6	51.3	58.8	53.9	47.8	47.2	40.2	33.8	~~159.1~~	0.2	0.0	25.8	~~559.7~~
1977	41.6	51.3	58.8	53.9	47.8	47.2	40.2	33.8	~~153.4~~	0.2	0.0	26.3	~~564.5~~
1978	41.6	51.2	58.8	53.9	47.8	47.2	40.2	33.8	~~154.6~~	0.2	0.0	25.3	~~554.6~~
1979	41.5	51.2	58.8	53.9	47.8	47.2	40.2	33.8	~~146.9~~	0.2	0.0	27.0	~~548.6~~
1980	41.6	51.3	58.8	53.9	47.8	47.2	40.2	33.8	~~163.7~~	0.2	0.0	25.8	~~564.3~~
1981	41.6	51.3	58.8	53.9	47.8	47.2	40.2	33.8	~~160.2~~	0.2	0.0	24.8	~~559.7~~
1982	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.6	~~132.0~~	0.2	0.0	22.5	~~529.2~~
AVG	42.6	51.6	58.9	53.9	47.6	47.2	40.2	34.8	~~166.7~~	0.2	0.0	43.0	~~584.7~~
									1.0				423

See note on p. 4

POST-PROJECT FLOWS (CFS)

Table 18 Johnson P. 6

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1961	6439.0	5471.4	6093.2	5602.6	5513.6	4937.8	4354.9	4538.4	24000.0	24000.0	24000.0	3674.8
1962	4302.1	5487.5	6117.2	5631.4	5545.7	4967.3	4380.9	3551.0	24000.0	31626.9	34735.0	20163.8
1963	4492.6	6224.1	6094.7	5607.8	5519.7	4943.3	4359.9	4807.6	24000.0	24000.0	24000.0	5009.3
1964	4297.9	5477.1	6106.5	5621.5	5535.7	4959.5	4376.0	3568.2	24000.0	24000.0	24745.3	14862.2
1965	4299.0	5477.9	6103.0	5615.8	5529.7	4954.1	4371.6	3560.7	24000.0	24000.0	24000.0	3200.0
1966	4380.0	5586.9	6231.5	5744.5	5664.6	5080.2	4485.0	3639.2	24000.0	24000.0	24000.0	3200.0
1967	4424.8	5650.5	6308.1	5815.9	5751.3	5187.0	4599.8	3706.5	24000.0	24000.0	24000.0	3200.0
1968	4345.8	5542.3	6175.1	5682.7	5595.6	5012.8	4422.1	3585.4	24000.0	24000.0	24000.0	9071.0
1969	4297.0	5516.8	6251.3	5601.2	5509.7	4930.3	4344.7	3529.1	24000.0	24000.0	24000.0	3200.0
1970	4354.8	5554.0	6186.7	5692.6	5604.7	5021.9	4430.3	3605.4	24000.0	24000.0	24000.0	3200.0
1971	4608.7	5890.1	6636.0	6193.1	6179.4	5605.0	4997.6	4031.3	24000.0	24000.0	24000.0	3200.0
1972	4608.9	5883.6	6607.8	6144.0	6115.6	5540.4	4940.0	3982.8	24000.0	24000.0	24000.0	3200.0
1973	4559.1	5839.7	6570.0	6111.9	6078.7	5494.9	4881.5	3957.4	24000.0	24000.0	24000.0	3200.0
1974	4750.4	6094.7	6881.2	6429.5	6449.2	5923.0	5339.4	4306.6	24000.0	24000.0	24000.0	3200.0
1975	4940.6	6326.4	7145.3	6743.4	6845.0	6324.6	5738.1	4576.0	24000.0	24000.0	24000.0	3200.0
1976	4774.6	6080.9	6837.2	6365.5	6337.1	5758.7	5159.1	4151.2	24000.0	24000.0	24000.0	3200.0
1977	4872.6	6194.3	6967.3	6491.2	6513.2	5971.8	5364.1	4312.5	24000.0	24000.0	24000.0	3200.0
1978	4768.8	6089.0	6855.6	6386.5	6361.2	5800.1	5185.4	4156.8	24000.0	24000.0	24000.0	3200.0
1979	4934.5	6318.5	7136.0	6728.3	6813.8	6271.6	5622.1	4452.4	24000.0	24000.0	24000.0	3200.0
1980	4631.5	5897.5	6616.9	6151.0	6119.5	5535.1	4910.7	3974.4	24000.0	24000.0	24000.0	3200.0
1981	4835.8	6133.4	6866.9	6366.1	6314.7	5692.3	5047.6	4071.4	24000.0	24000.0	24000.0	3200.0
1982	5054.5	6528.1	7489.9	7148.9	7303.8	6869.4	6449.7	5088.4	24000.0	24000.0	24000.0	3383.2
AVG	4680.6	5875.7	6558.1	6085.2	6054.6	5490.0	4898.2	4052.4	24000.0	24346.7	24521.8	4880.2

Table 18 Johnson K 7

AVERAGE CAPABILITIES (MW)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
JOHNSON	236.	236.	232.	228.	224.	220.	216.	219.	219.	216.	219.	225.
TOTAL	236.	236.	232.	228.	224.	220.	216.	219.	219.	216.	219.	225.

MINIMUM CAPABILITIES (MW)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
JOHNSON	201.	197.	188.	177.	167.	155.	141.	148.	151.	143.	144.	154.
TOTAL	201.	197.	188.	177.	167.	155.	141.	148.	151.	143.	144.	154.

AVERAGE ENERGY PRODUCTION (GWH)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
JOHNSON	42.6	51.6	58.9	53.9	47.8	47.2	40.2	34.8	~~168.7~~ 1.0	0.2	0.0	43.0	~~588.9~~ 423
TOTAL	42.6	51.6	58.9	53.9	47.8	47.2	40.2	34.8	~~168.7~~ 1.0	0.2	0.0	43.0	~~588.9~~ 423

MINIMUM ENERGY PRODUCTION (GWH)

		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
JOHNSON	(1982)	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.8	132.0	0.2	0.0	22.5	529.2
TOTAL	(1982)	41.5	51.3	58.8	53.9	47.8	47.2	40.2	33.8	132.0	0.2	0.0	22.5	529.2

See note on p. 4

8. <u>QUESTION</u>

The Anchorage Chamber of Commerce recently provided a report prepared by KENTCO entitled "Electric Power Generation for the Alaska Railbelt Region," January 1984. If available, please provide the following information:

a) A copy of the report by the Governor's Economic Committee on North Slope Gas, January 1983 - "Trans Alaska Gas System - Economics of an Alternative for the North Slope Natural Gas."

b) The Harza - Ebasco Fall, 1983 update of the Susitna Hydroelectric Project Study referred to on pages 56 and 61 of the KENTCO report.

RESPONSE

The requested report by the Governor's Economic Committee on North Slope Gas, entitled "Trans Alaska Gas Systems - Economics of an Alternative for North Slope Gas" (January 1983), is provided herewith as Volume IV, Appendix 3.

The "Harza-Ebasco Fall, 1983 update," referenced in the KENTCO report, was a document prepared in draft form for internal Power Authority discussion and was never released to the public. A revised version of that "update" was prepared in February, 1984 and, at the direction of the Power Authority Board of Directors, was the subject of Statewide public hearings. The February draft has not yet been finalized as a Power Authority final report. At such time as the report becomes final, the Power Authority would be willing to provide the FERC with a copy.