

4.4.3 Reactive Supply and Voltage Control

Table 1
Summary of Costs Assigned to TBL for the Generation Input to
Reactive Power and Voltage Control

Costs for Electric Plant	Total for Electric Plant	Total Allocated to Reactive
O&M	\$55,270	
A&G Expense	\$17,293	
Depreciation	\$10,223	
Net Interest Expense	\$24,164	
Minimum Required Net Revenues	\$448	
Generation Integration (BPA Facilities)	\$8,000	
Revenue Requirement for Electrical Equipment (Total)	\$115,398	
Reactive allocation of Electrical RR (19%)	\$115,398 X 19%	\$21,926
Non-Federal Projects (WNP-2)	\$2,649	
Reactive allocation of Electrical RR (5%)	\$2,649 X 5%	\$132
<u>Other Costs (Assigned 100% to Reactive)</u>		
Synchronous condenser real power consumption		\$1,647
Synchronous condenser modifications		\$352
Real power losses due to reactive		\$1,672
Total Average Annual Cost		\$25,729

TABLE 2

Reactive Power and Voltage Control Costs
Summary of Cost Assignment for COE Net Plant

COE Project 1/	Net (Ex)iter	Net	Net	Net	Net	Net (T)urbine	Net Plant Assigned	Less		Net (S)tep-up
		(V)oltage	(G)enerator	(E)lectrical	(A)ccessory		to Generator	(S)tep-up	components	
		Regulator		Equip	Equip 4/		(Ex+V+G+E+A/2)	5/	segmented to	Transformer
							3/	Network		
AlbeniF	0	0	1,622,175	54,429	285,420	440,831	1,819,314	198,364	0	198,364
Bonn 1	0	1,439,578	0	0	143,031	0	1,511,094	0	0	0
Bonn 2	2,069,776	1,007,443	24,838,258	3,601,911	2,734,458	34,395,197	32,884,617	3,515,694	0	3,515,694
Bonn 1&2 Total	2,069,776	2,447,021	24,838,258	3,601,911	2,877,489	34,395,197	34,395,711	3,515,694	0	3,515,694
Ch Jo	0	2,074,286	48,979,825	12,500,043	7,158,300	48,043,196	67,133,304	12,757,617	0	12,757,617
Cougar	2,471	16,552	91,115	61,324	157,481	549,990	250,204	28,046	0	28,046
Detroit	0	0	290,464	50,228	119,970	320,239	400,677	28,978	0	28,978
Dworsh*	0	0	0	0	5,411,210	6,236,075	5,823,642	873,284	0	873,284
GrnPct	0	33,019	735,521	63,435	431,479	1,557,157	1,047,716	115,099	0	115,099
HillsCr	58,392	0	769,965	195,951	527,584	190,804	1,288,100	33,640	0	33,640
IceHar*	0	0	0	2,986,803	856,748	16,061,152	11,445,753	583,971	0	583,971
JohnDay	0	0	35,777,880	266,269	5,479,224	14,002,981	38,783,761	262,484	0	262,484
Libby	174,286	160,000	29,620,920	3,492,567	3,783,353	17,007,939	35,339,449	3,041,449	0	3,041,449
LitGoose*	0	0	0	3,072,122	2,210,077	28,616,224	18,485,272	1,840,073	0	1,840,073
LookOut	0	0	364,463	0	207,400	570,651	468,163	54,754	0	54,754
LostCr	0	0	1,206,092	188,171	1,128,594	1,981,148	1,958,561	268,685	0	268,685
LowGran*	0	0	0	7,822,827	1,349,337	26,786,446	21,890,718	2,801,797	0	2,801,797
LowMon*	0	0	0	4,035,495	602,278	28,573,955	18,623,611	1,551,509	0	1,551,509
McNary*	0	0	0	0	2,300,441	11,167,795	6,734,118	930,771	0	930,771
TheDalles	333,768	249,378	14,898,515	184,689	3,380,592	23,446,313	17,356,645	1,750,531	0	1,750,531
TOTAL COE 2/	2,638,692	4,980,256	159,195,193	38,576,265	38,266,978	259,948,092	283,244,719	30,636,745	0	30,636,745

1/ *Indicates plants which do not separate turbine investment from generator investment. The total turbine/generator is shown in the (T)urbine category. See 3/ below.

2/ Excludes Lower Snake and Columbia River bypass, which are fish related investments.

3/ For plants marked "*" which do not separate turbine and generator investment, half of the turbine/generator investment is assumed to be generator equipment.

For these plants, 1/2 of (T) is included in "Net Plant Assigned to Generator."

4/ 50% of the (A)ccessory Category is assigned to the generator.

5/ Includes all switchyard equipment, including any facilities segmented to Generation Integration and Network.

TABLE 3
COE Facilities Included in Reactive Allocation

Category	From COE Account	Items included
Generator	072 Turbine/Generator	Generator, stator, air coolers, rotor, compressor for condensing.
Exciter	072 Turbine/Generator	Generator exciter.
Voltage regulator	073 Power plant	Voltage regulation and excitation equipment.
Electrical Equipment	073 Power plant	Miscellaneous equipment, generator grounding, main bus or cable, generator switchgear, control cable, load control equipment.
Switchyard	076 Switchyard	All switchyard equipment.
Accessory Equipment	071 Powerhouse	Lighting.
	073 Power plant	Station service main bus, annunciator system, grounding system, station service, antenna towers, radio buildings, engine generator sets, control switchboards, battery switchboards, recording annunciators, data logging equip, SCADA equip, central processor, radio/MW equipment, batteries, oscillograph.
	074 Miscellaneous powerplant equipment	Bridge/gentry cranes, lubrication, fire protection, air system, radio/MW buildings and equip, oil purifiers, air compressors, plant communication equipment. (Excluded are tailrace cranes and drainage equipment).

TABLE 4

Summary of Assignment/Segmentation for BOR Gross Investment

BOR Plants	Cap- acity	Turbine Type	Gross Plant 6/ [1]	Gross Waterwheels, Turbines and Generators (includes Generator/Exciter/ Voltage Regulator) [2]	Accessory Electrical Equipment [3]	Gross Waterwheels, Turbines and Generators + 50% Accessory Electrical [4]	% Electrical/ Electrical + Turbine 4/ [5]	Gross Electrical (Generators/ Voltage Regulators/ Electrical/Exciters+ 50% Accessory Electrical [6]	% Gross Electrical (Generators/ Voltage Regulators/ Electrical/Exciters+ 50% Accessory Electrical Divided by Gross Plant [7]	Gross Turbine [8]	Gross Generation Integration 7/ [9]	Network Facilities [10]	Delivery Facilities [11]	Gross Generation Integration (% of Transmission) [12]	Gross Plant assigned to Electrical [13]	Gross Plant assigned to Electrical (% of Gross Plant) [13] / [1]
						[2] + 1/2 [3]		[4] X [5]	[6] / [1]	[4] - [6]					[6] + [9]	[13] / [1]
Boise 3/ Columbia Basin Grand Coulee 1st and 2nd 1/			\$14,819,205	\$2,285,329	\$4,698,333	\$4,634,496	52.2%	2,419,207	16.3%	\$2,215,288.85	\$1,021,087	\$0	\$0	100.0%	\$3,440,294	23.2%
Columbia Basin Grand Coulee 3rd Powerhouse 1/			\$468,458,272	\$113,343,325	\$28,637,024	\$127,661,837	61.1%	78,001,382	16.7%	\$49,660,454.59	\$43,658,027	\$26,532,495	\$1,146,717	24.8%	\$121,659,409	26.0%
Hungry Horse 2/ Minidoka/ Palisades 3/			\$631,573,610	\$183,820,522	\$9,881,519	\$188,761,282	61.1%	115,333,143	18.3%	\$73,428,138.50	\$88,297,362	\$16,430,712	\$0	50.2%	\$203,630,505	32.2%
Yakima 3/			\$111,774,913	\$25,059,957	\$1,144,877	\$25,632,396	67.5%	17,301,867	15.5%	\$8,330,528.54	\$9,420,064	\$2,488,319	\$0	79.1%	\$26,721,931	23.9%
			\$105,041,250	\$77,779,846	\$3,737,165	\$79,648,429	52.2%	41,576,480	39.6%	\$38,071,948.82	\$2,348,031	\$1,281,386	\$397,870	58.3%	\$43,924,511	41.8%
			\$5,286,253	\$2,968,908	\$649,479	\$3,293,648	52.2%	1,719,284	32.5%	\$1,574,363.51	\$1,112,325	\$0	\$0	100.0%	\$2,831,609	53.6%
Notes																
1/ Chief Joseph used to estimate generator vs turbine costs																
2/ Libby used to estimate generator vs turbine costs																
3/ Average Cougar/Detroit/Green Peter/Hills Creek/Lookout/Lost Creek used to estimate generator vs turbine costs																
4/ COE generator/turbine cost data used to determine percentage of electric plant to turbine (from COE plant ratios)																
5/ BOR Data taken from Plant Account Costs as of October 1997																
6/ BOR Data taken Trial Balance - Asset Accounts, September 1998																
7/ %s determined using Transmission Segmentation Study in 1996 rate case. Grand Coulee Network and delivery costs updated with more detailed cost data in Generation Integration Study.																

TABLE 5

COE Gross Plant

COE Plants	Capacity	Turbine Type	Gross Plant	Gross Exciter	Gross Voltage Regulator	Gross Generator	Gross Electrical	Gross Accessory Equip	Total Gross Electrical	Gross Step-up Transformer	Gross Turbine	% weighted by electrical plant	% weighted average by electrical plant	% Electrical/ Electrical + Turbine 4/	Total Electrical
Note 1/															
Ch Jo			558,799,962	0	3,480,000	87,630,855	20,960,357	11,368,449	117,755,436.24	19,770,689	74,955,266			61.1%	\$ 143,210,349.81
Note 2/									0.00						
Libby			427,923,922	250,000	240,000	37,590,000	4,622,071	5,311,543	45,357,842.13	3,981,690	21,867,631			67.5%	\$ 51,995,303.60
Note 3/									0.00						
Cougar			20,305,707	39,963	25,022	397,400	251,909	510,311	969,449.66	143,103	2,127,442	303,476.14		31.3%	\$ 1,367,708.06
Detroit			41,292,185	216,354	36,508	3,030,384	824,881	1,233,157	4,724,704.79	1,141,762	3,042,018	2,874,164.01		60.8%	\$ 6,483,045.09
GrnPet			49,966,745	0	113,637	1,902,891	215,271	1,442,377	2,952,988.28	350,687	3,943,338	1,264,461.57		42.8%	\$ 4,024,864.03
HillsCr			17,521,064	58,704	0	773,123	196,874	754,270	1,405,836.00	133,724	968,413	832,420.99		59.2%	\$ 1,916,694.57
LookOut			47,428,264	197,005	12,004	3,390,091	438,374	1,567,233	4,821,089.99	603,041	4,288,027	2,551,609.55		52.9%	\$ 6,207,747.39
LostCr			27,073,286	0	0	2,048,722	354,163	1,855,566	3,330,668.46	462,080	3,311,879	1,670,044.97		50.1%	\$ 4,720,530.93
Total Group 3/								24,042,904	18,204,737.16			9,496,177.23	52.2%		\$219,926,243

1/ Chief Joseph used to estimate generator vs turbine costs for Grand Coulee

2/ Libby used to estimate generator vs turbine costs for Hungry Horse

3/ Average Cougar/Detroit/Green Peter/Hills Creek/Lookout/Lost Creek used to estimate generator vs turbine costs for Minidoka/Palisades and Yakima

4/ COE generator/turbine cost data used to determine percentage of electric plant to turbine for BOR projects

TABLE 6

Percent to apply COE and BOR Capital Replacements

	Planned Replacements (Total)	Electrical Replacements	Electrical Replacements (Percentage) 1/
Seattle District			
year			
1997	\$1,840,677	\$1,156,210	62.8%
1996	\$803,454	\$403,904	50.3%
1995	\$1,866,381	\$981,861	52.6%
1994	\$803,454	\$403,904	50.3%
Portland			
year			
1997	\$986,960	\$398,681	40.4%
1996	\$2,962,669	\$839,616	28.3%
1995	\$9,931,923	\$7,833,548	78.9%
1994	\$2,191,551	\$768,077	35.0%
Total	\$21,387,069	\$12,785,799	59.8%

Notes

1/ Based on COE 1994-1997 historical electrical vs mechanical replacements

TABLE 7

Capital Budget

	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11
<i>Bureau of Reclamation</i>														
Boise	150	410	605	475	487	500	513	526	540	554	568	583	598	614
Columbia Basin (GCL)	3,159	4,403	3,389	3,065	3,145	3,226	3,310	3,396	3,485	3,575	3,668	3,764	3,862	3,962
Green Springs	-	-	-	75	77	79	81	83	85	87	90	92	94	97
Hungry Horse	435	130	517	450	462	474	486	499	512	525	539	553	567	582
Minidoka Palisades	407	395	290	250	257	263	270	277	284	292	299	307	315	323
Yakima Chandler	260	144	100	100	103	105	108	111	114	117	120	123	126	129
Subtotal Bureau	4,411	5,482	4,901	4,415	4,530	4,648	4,768	4,892	5,020	5,150	5,284	5,421	5,562	5,707
<i>Corps of Engineers</i>														
Albeni Falls	-	200	200	200	200	200	205	211	216	222	227	233	239	246
Donneville	-	400	400	400	400	400	410	421	432	443	455	467	479	491
Chief Joseph	-	500	500	500	500	500	513	526	540	554	568	583	598	614
Cougar	-	200	200	200	200	200	205	211	216	222	227	233	239	246
Detroit Big Cliff	-	200	200	200	200	200	205	211	216	222	227	233	239	246
Dworshak	-	200	200	200	200	200	205	211	216	222	227	233	239	246
Green Peter Foster	-	200	200	200	200	200	205	211	216	222	227	233	239	246
Hills Creek	-	200	200	200	200	200	205	211	216	222	227	233	239	246
Ice Harbor	-	400	400	400	400	400	410	421	432	443	455	467	479	491
John Day	-	500	500	500	500	500	513	526	540	554	568	583	598	614
Libby	-	400	400	400	400	400	410	421	432	443	455	467	479	491
Little Goose	-	400	400	400	400	400	410	421	432	443	455	467	479	491
Lookout Point Dexter	-	200	200	200	200	200	205	211	216	222	227	233	239	246
Lost Creek	-	200	200	200	200	200	205	211	216	222	227	233	239	246
Lower Granite	-	400	400	400	400	400	410	421	432	443	455	467	479	491
Lower Monumental	-	400	400	400	400	400	410	421	432	443	455	467	479	491
McNary	-	500	500	500	500	500	513	526	540	554	568	583	598	614
The Dalles	-	500	500	500	500	500	513	526	540	554	568	583	598	614
Subtotal Corps of Engineers	-	6,000	6,000	6,000	6,000	6,000	6,156	6,316	6,480	6,649	6,822	6,999	7,181	7,368
Total	4,411	11,482	10,901	10,415	10,530	10,648	10,924	11,208	11,500	11,799	12,106	12,420	12,743	13,075
Francis "Big 10" Total (\$ 000)	3,159	4,903	3,889	3,565	3,645	3,726	3,823	3,923	4,025	4,129	4,237	4,347	4,460	4,576
Kaplan "Big 10" Total (\$ 000)	-	3,500	3,500	3,500	3,500	3,500	3,591	3,684	3,780	3,878	3,979	4,083	4,189	4,298
Francis Capacity (MW)	7,635													
Kaplan Capacity (MW)	7,360													
Francis \$/kW - year	0.41	0.64	0.51	0.47	0.48	0.49	0.50	0.51	0.53	0.54	0.55	0.57	0.58	0.60
Kaplan \$/kW - year	-	0.48	0.48	0.48	0.48	0.48	0.49	0.50	0.51	0.53	0.54	0.55	0.57	0.58

Table 8

Reactive Power and Voltage Control Costs

WNP-2 SYSTEMS				
<u>DESCRIPTION</u>	<u>ACQUISITION COST</u>	<u>ACCUM DEPR 12/31/1997</u>	<u>NET PLANT 12/31/1997</u>	<u>LIFE/YEARS</u>
Nuclear Production - Turbogenerator*				
Excitation & Voltage	\$ 1,292,835	\$ 420,720	\$ 872,116	40
Main generator	\$ 18,966,373	\$ 6,150,485	\$ 12,815,889	40
Hydrogen - Generator cooling	\$ 1,865,010	\$ 696,136	\$ 1,168,874	35
Hydrogen - Generator seal oil	\$ 806,016	\$ 300,824	\$ 505,192	35
Storage & Supply - Generator Hydrogen	\$ 400,529	\$ 138,471	\$ 262,058	35
Stator - Generator Cooling	\$ 618,090	\$ 230,705	\$ 387,385	35
Isolated Phase - Bus Duct Cooling	\$ 89,150	\$ 46,604	\$ 42,546	25
Subtotal	\$ 24,038,003	\$ 7,983,944	\$ 16,054,058	
Transmission - Station Equipment				
Transformers	\$ 4,750,999	\$ 2,057,206	\$ 2,693,793	30
Circuit Breakers	\$ 124,182	\$ 64,553	\$ 59,629	25
Tie-ins	\$ 47,911	\$ 24,905	\$ 23,006	25
Subtotal	\$ 4,923,092	\$ 2,146,664	\$ 2,776,428	
Total Electrical & Transmission	\$ 28,961,095	\$ 10,130,608	\$ 18,830,486	
Total Net Plant (from "Combining Balance Sheets - Assets")			\$ 2,531,782,112	
Transmission as percent of net plant investment			0.11%	
Electrical as percent of net plant investment			0.63%	
Electrical and Transmission as percent of net plant investment			0.74%	

* Excludes turbine and steam components

Service Date: 12/84

Depreciation Method: Straight Line

rsg041398/wnp2pltr1

TABLE 10

DRAFT--Privileged and Confidential
Prepared at the Request of Counsel

Expenses

	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11
<i>Bureau of Reclamation</i>														
Boise	3,107	2,929	2,900	3,079	3,159	3,241	3,241	3,241	3,241	3,325	3,412	3,501	3,592	3,685
Columbia Basin (GCL)	28,815	29,744	30,705	31,686	32,510	33,355	33,355	33,355	33,355	34,222	35,112	36,025	36,962	37,923
Green Springs	-	-	-	630	646	663	663	663	663	680	698	716	735	754
Hungry Horse	2,400	2,016	1,785	1,837	1,885	1,934	1,934	1,934	1,934	1,984	2,036	2,089	2,143	2,199
Minidoka Palisades	4,346	4,144	4,150	4,270	4,381	4,495	4,495	4,495	4,495	4,612	4,732	4,855	4,981	5,110
Yakima Chandler	2,089	2,252	1,907	1,958	2,009	2,061	2,061	2,061	2,061	2,115	2,170	2,226	2,284	2,343
Subtotal Bureau	40,757	41,085	41,447	43,460	44,590	45,749	45,749	45,749	45,749	46,939	48,159	49,411	50,696	52,014
<i>Corps of Engineers</i>														
Albeni Falls	-	3,136	2,984	3,005	3,164	3,277	3,277	3,277	3,277	3,362	3,450	3,539	3,631	3,726
Bonneville	-	11,953	12,115	12,209	12,847	13,309	13,309	13,309	13,309	13,655	14,010	14,374	14,748	15,132
Chief Joseph	-	12,138	13,148	12,759	13,416	13,881	13,881	13,881	13,881	14,242	14,612	14,992	15,382	15,782
Cougar	-	570	591	609	656	694	694	694	694	712	731	750	769	789
Detroit Big Cliff	-	1,903	1,926	1,986	2,138	2,266	2,266	2,266	2,266	2,325	2,385	2,447	2,511	2,576
Dworshak	-	5,412	5,343	5,380	5,659	5,857	5,857	5,857	5,857	6,009	6,166	6,326	6,490	6,659
Green Peter Foster	-	1,885	1,947	2,000	2,146	2,268	2,268	2,268	2,268	2,327	2,387	2,450	2,513	2,579
Hills Creek	-	427	475	316	575	642	642	642	642	659	676	693	711	730
Ice Harbor	-	5,910	5,221	5,253	5,523	5,714	5,714	5,714	5,714	5,863	6,015	6,171	6,332	6,496
John Day	-	12,435	13,101	13,647	14,754	15,321	15,321	15,321	15,321	15,719	16,128	16,547	16,978	17,419
Libby	-	4,266	4,326	4,359	4,587	4,752	4,752	4,752	4,752	4,876	5,002	5,132	5,266	5,403
Little Goose	-	4,542	4,567	4,595	4,827	4,992	4,992	4,992	4,992	5,122	5,255	5,392	5,532	5,676
Lookout Point Dexter	-	2,376	2,456	2,522	2,706	2,857	2,857	2,857	2,857	2,931	3,007	3,086	3,166	3,248
Lost Creek	-	1,312	1,330	1,341	1,376	1,412	1,462	1,462	1,462	1,500	1,539	1,579	1,620	1,662
Lower Granite	-	6,019	5,999	6,038	6,346	6,566	6,566	6,566	6,566	6,737	6,912	7,092	7,276	7,465
Lower Monumental	-	5,344	4,803	4,808	5,053	5,227	5,227	5,227	5,227	5,363	5,502	5,645	5,792	5,943
McNary	-	10,297	10,300	10,352	10,621	10,838	10,989	10,989	10,989	11,275	11,568	11,869	12,177	12,494
The Dalles	-	10,073	10,367	10,623	10,899	11,355	11,929	11,929	11,929	12,239	12,557	12,884	13,219	13,563
Subtotal Corps of Engineers	-	99,998	100,999	102,002	107,293	111,228	112,003	112,003	112,003	114,915	117,903	120,968	124,114	127,340
Total	40,757	141,083	142,446	145,462	151,883	156,977	157,752	157,752	157,752	161,854	166,062	170,380	174,810	179,355
Francis "Big 10" Total (\$ 000)	28,815	41,882	43,853	44,445	45,926	47,236	47,236	47,236	47,236	48,464	49,724	51,017	52,344	53,705
Kaplan "Big 10" Total (\$ 000)	-	66,573	66,473	67,525	70,870	73,322	74,047	74,047	74,047	75,972	77,947	79,974	82,053	84,187
Francis Capacity (MW)	7,635													
Kaplan Capacity (MW)	7,360													
Francis \$/kW - year	3.77	5.49	5.74	5.82	6.02	6.19	6.19	6.19	6.19	6.35	6.51	6.68	6.86	7.03
Kaplan \$/kW - year	-	9.04	9.03	9.17	9.63	9.96	10.06	10.06	10.06	10.32	10.59	10.87	11.15	11.44

TABLE 11

Plant Power Factor at Mid Range of Peak Efficiency Band

Generating Plant	MW @ efficiency band midrange	MVARS @ efficiency band midrange	Efficiency band mid-range PF	# of Units	Weighted value of the power factor (PF*MW)	Total number of MW	Average power factor
COE projects							0.9
**Bonneville units 3-10	41.00	33.00	0.78	8.00	255.5	328	
**Bonneville units 11-18	65.00	29.00	0.91	8.00	474.9	520	
**Chief Joseph units 1-16	73.00	34.00	0.91	16.00	1058.8	1,168	
**Chief Joseph units 17-27	86.00	49.00	0.87	11.00	821.9	946	
**Ice Harbor units 1-3	79.00	40.00	0.89	3.00	211.4	237	
**Ice Harbor units 4-6	98.00	51.00	0.89	3.00	260.8	294	
**John Day units 1-16	122.00	88.00	0.81	16.00	1583.1	1,952	
**Little Goose units 1-3	116.00	63.00	0.88	3.00	305.8	348	
**Little Goose units 4-6	126.00	63.00	0.89	3.00	338.1	378	
**Lower Granite units 1-3	122.00	62.00	0.89	3.00	326.3	366	
**Lower Granite units 4-6	137.00	61.00	0.91	3.00	375.5	411	
**McNary units 1-14	55.00	39.00	0.82	14.00	628.1	770	
**The Dalles units 1-14	72.00	36.00	0.89	14.00	901.6	1,008	
**The Dalles units 15-22	76.00	42.00	0.88	8.00	532.1	608	
BOR projects						0	
**Grand Coulee units 1-6	80.00	41.00	0.89	6.00	427.2	480	
**Grand Coulee units 7-18	92.00	37.00	0.93	12.00	1024.3	1,104	
**Grand Coulee units 19-21	582.00	290.00	0.90	3.00	1562.7	1,746	
**Grand Coulee units 22-24	701.00	320.00	0.91	3.00	1913.1	2,103	
Totals					13001.3	14,767	

TABLE 12

Reactive Power and Voltage Control Costs

Value of Energy Consumed for
Synchronous Condenser (Motoring) Operation

Project	Nameplate rating (MW/unit)	Motoring power		Hourly Energy Consumption	Motoring hours/year	Total Cost of Energy
		consumption (MW/unit)	Number of Units used			
John Day units (4units) 1/	155	2	4	8.0	1,014	181,141
The Dalles units 14-20 1/	99	1.2	6	7.2	2,150	345,668
Libby units 1-5	120	1.6	1	1.6	100	3,483
Palisades units 1-4	44	0.6	1	0.6	100	1,277
Hungry Horse units 1-4 2/	107	1.4	1	1.4	4,380	136,928
Grand Coulee units 22-24 2/	825	10.0	1	10.0	4,380	978,054
						\$1,646,552
Value of energy (mills/kW-hr)	22.33					

1/ The hours shown for The Dalles are those hours estimated that the units will be required to spin from April through October. This is an upper bound for the hours, as there may be times when some of the units can produce power, depending upon river flows. The Dalles units are assumed to spin 12 hrs a day for 6 months. John Day units were spun a total of 1,014 hours in 1999.

2/ At Coulee, six units (19-24) are connected to the 500kV bus, and are kept spinning essentially all the time. For this study, one unit is considered "used," even though six are generally online. This is a conservative estimate for the number of units required for voltage control.

TABLE 13**Generator Losses - Allocated to Generation Input for Reactive Power and Voltage Control**

A. Generating Capacity (MW)	21,353
B. Stator Load Loss Differential (MW) 1/	8
C. Rotor (Field) Load Loss Differential 1/	12
D. Exciter Load Loss Differential 1/	1
E. Total Load Loss Due to Reactive Loading	<u>20</u>

No-Load Loss Component

1. No-Load Loss	
2. Generator Allocation Factor (19%)	11
3. No-Load Reactive Component	X 0.19
F. No-Load Loss Component	<u>2</u>

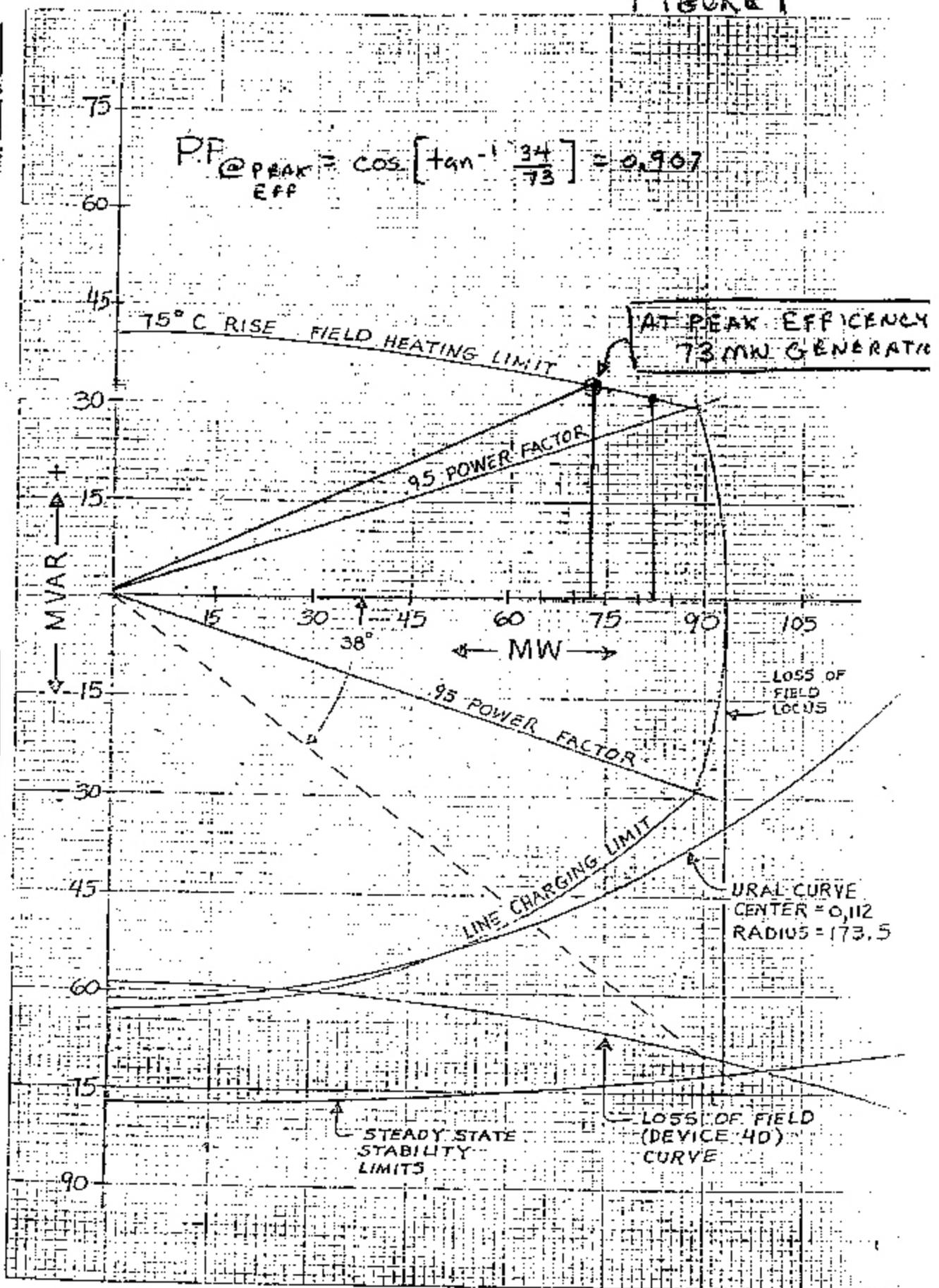
G. Total Losses	22
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Note 1. Differential Loss = Losses at rated MW and rated power factor - losses and MW at unity power factor.

H. Average Generation (MW)	9,280
I. MVAR usage (August 10th 1996) MVAR	1,647
J. Generation (August 10, 1996) (MW)	5,040
K. Total Max MVARs (available machine data)	6,597
L. MAX Actual MVARs = (I / J) X A	5,773
M. Average MVARs = (L/A) X H	2,509
N. Average Losses (kW-hr) = (G/K X M) X 8760	74,893
O. Value of Energy (mills/kW-hr)	22.33
Total Cost (N X O)/1000	\$1,672

FIGURE 1

PART _____ OF _____
PAGE _____ OF _____



U. S. ARMY ENGINEER DIVISION, NORTH PACIFIC
 PROJECT CHIEF JOSEPH PROJECT
 SUBJECT UNITS 1 THRU 16 GEN. CAPABILITY CURVE
 BY C.J.G. DATE SEPT. 85 CHECKED MSP

UNITS 1-16 @ CHIEF JOSEPH DAM Ch Jd
 1-16

3.4.85
 1-16
 1-16