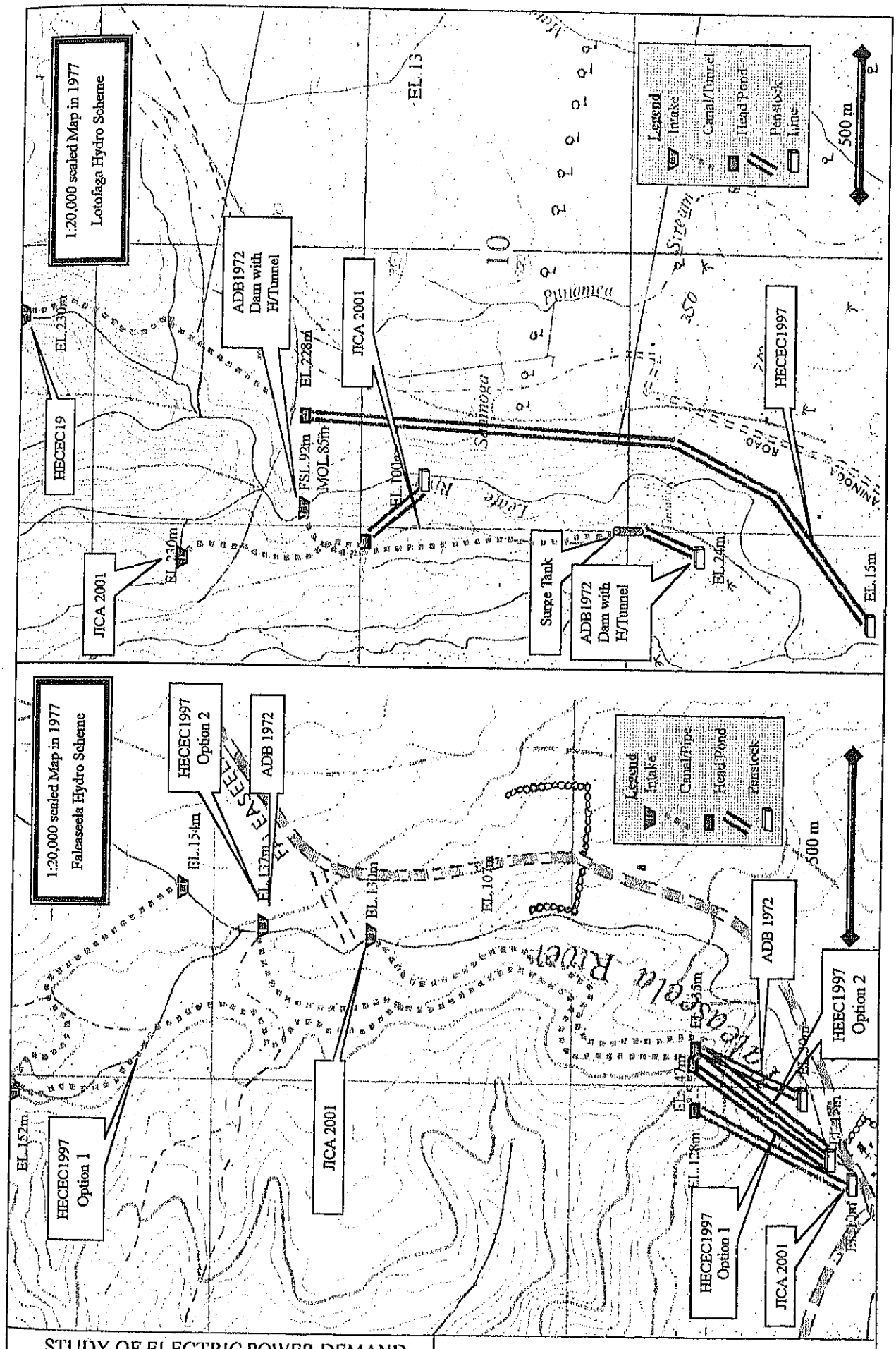
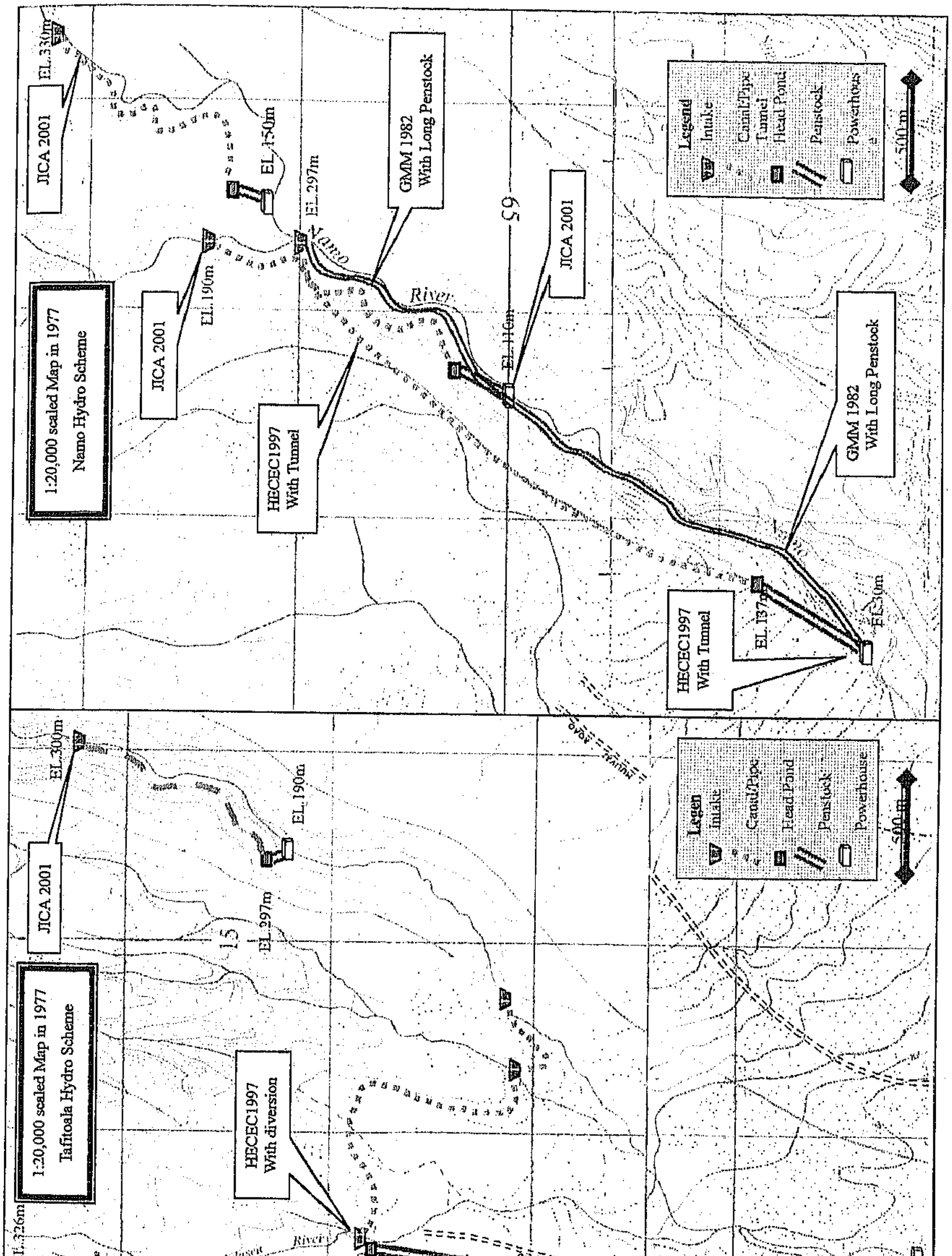
CHAPTER - 5

ANNEX

CONTENTS

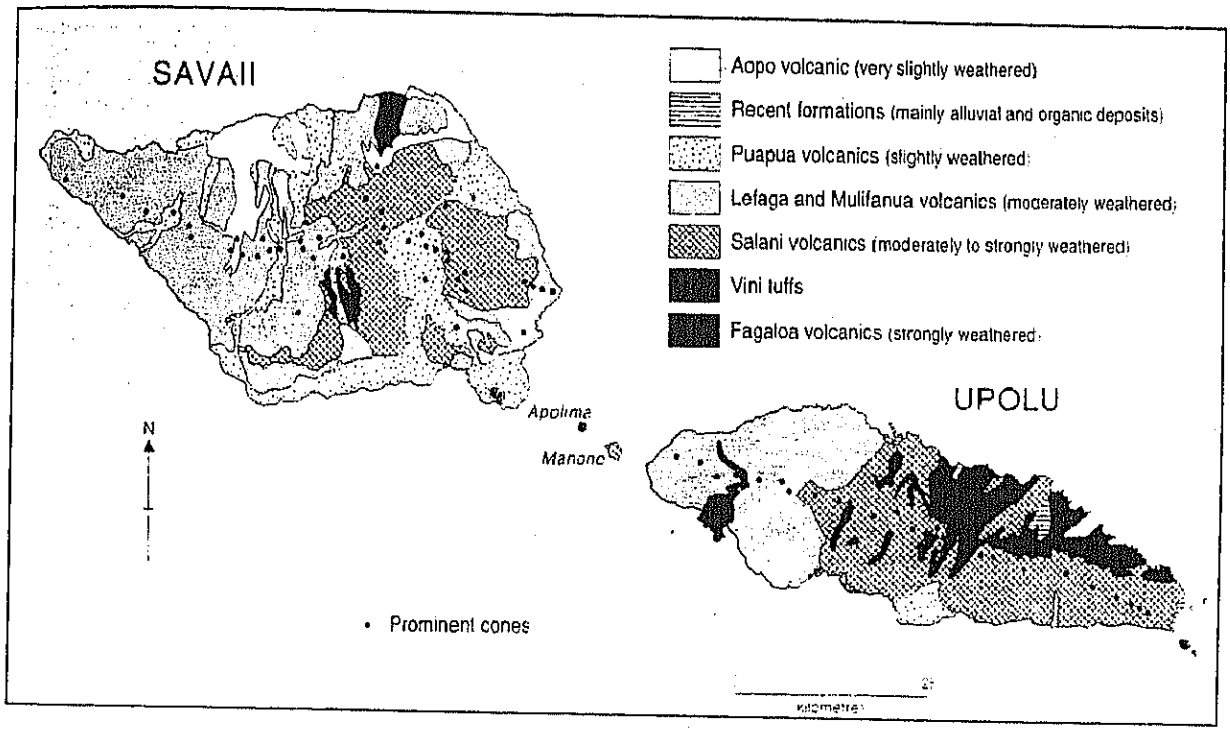


STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA	ANNEX 5.1 (1) Previous Study of Hydro Develop. Faleaseela & Lotofaga Hydropower Schemes (based on 1:20,000 scaled map)
JAPAN INTERNATIONAL COOPERATION AGENCY	

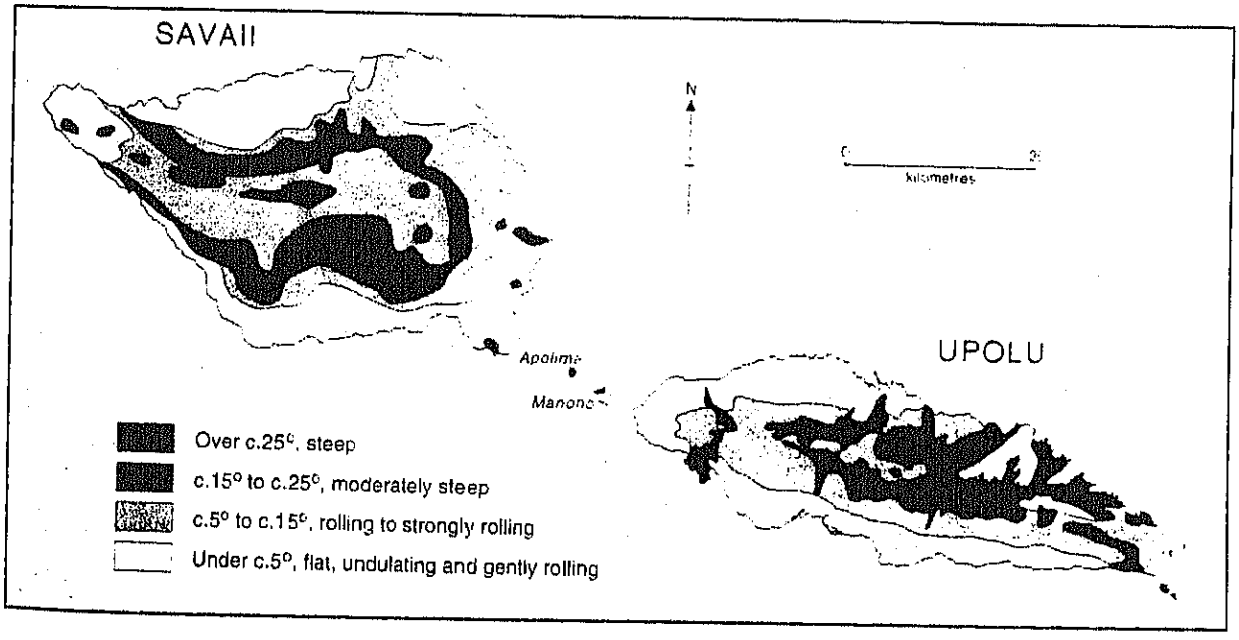


STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA	ANNEX 5.1 (2) Previous Study of Hydro Develop. Tafitoala & Namo Hydropower Schemes (based on 1:20,000 scaled map)
JAPAN INTERNATIONAL COOPERATION AGENCY	

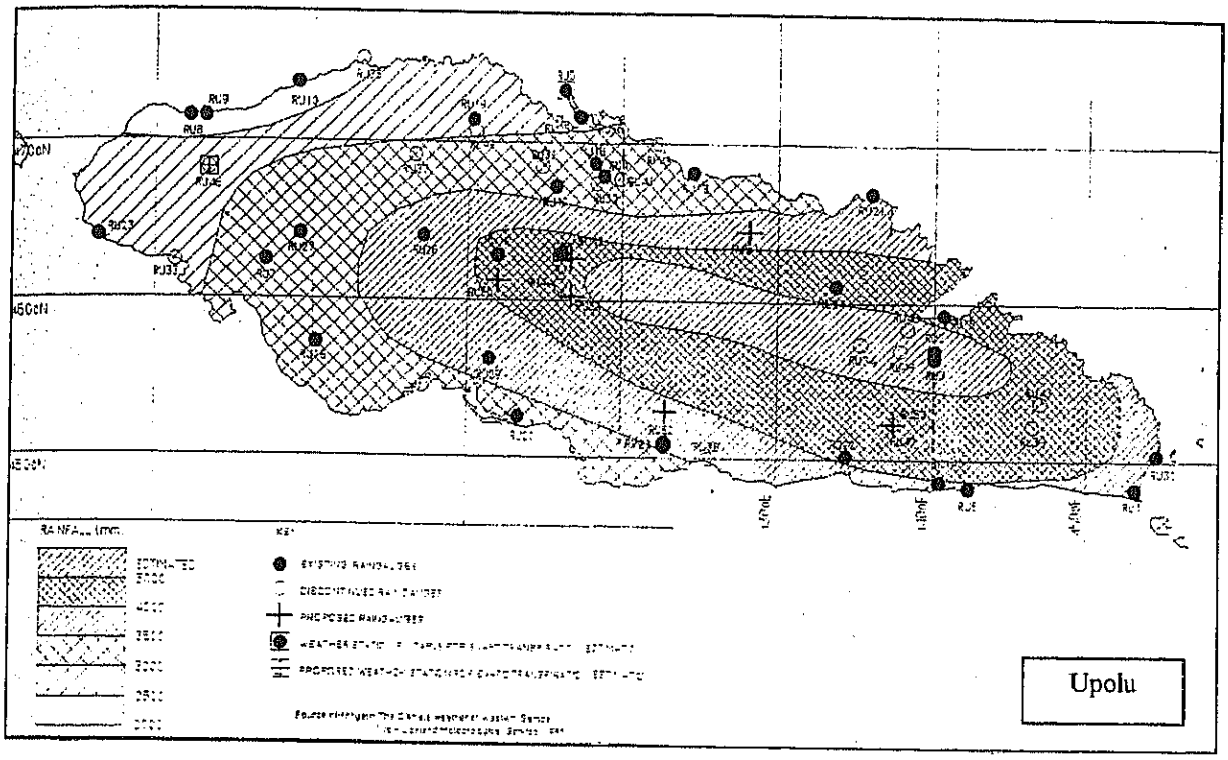
ANNEX 5.2 GENERAL DATA OF SAMOA

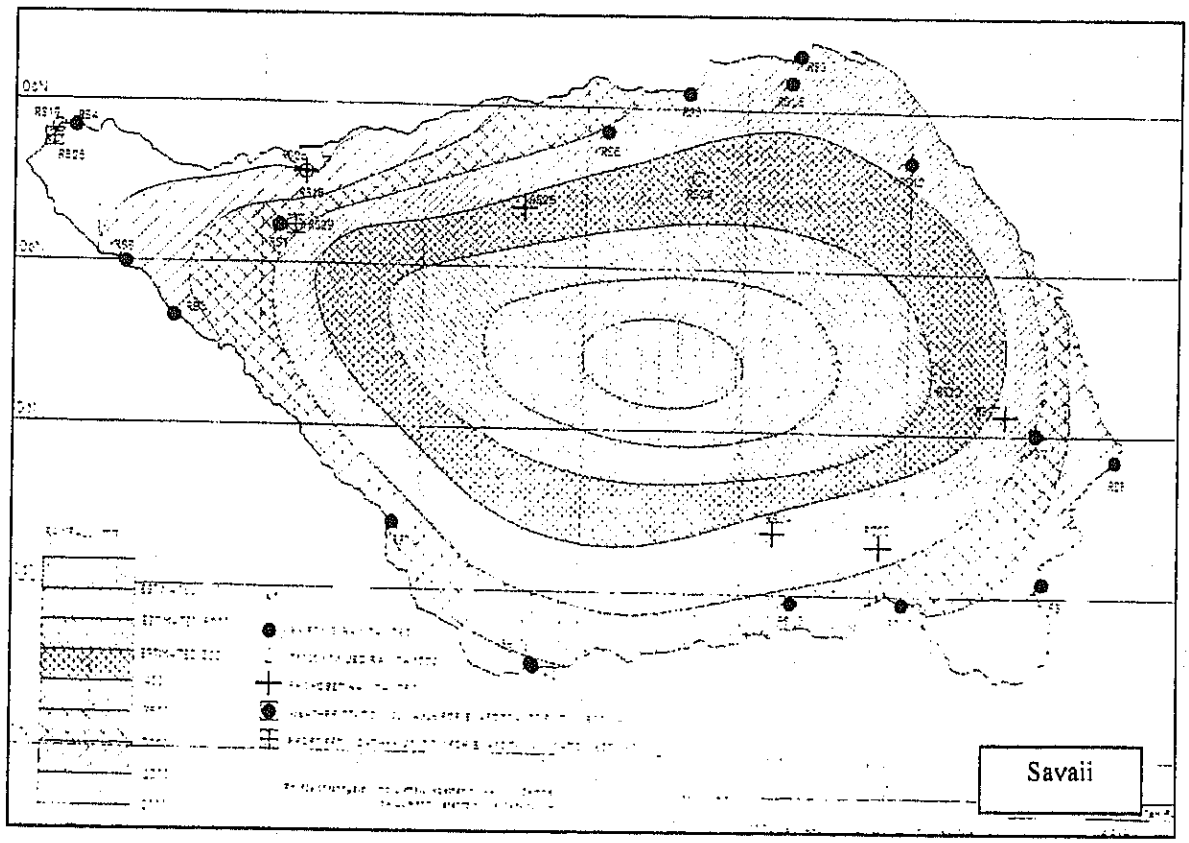


Annex 5.2 (1) Geology in Samoa

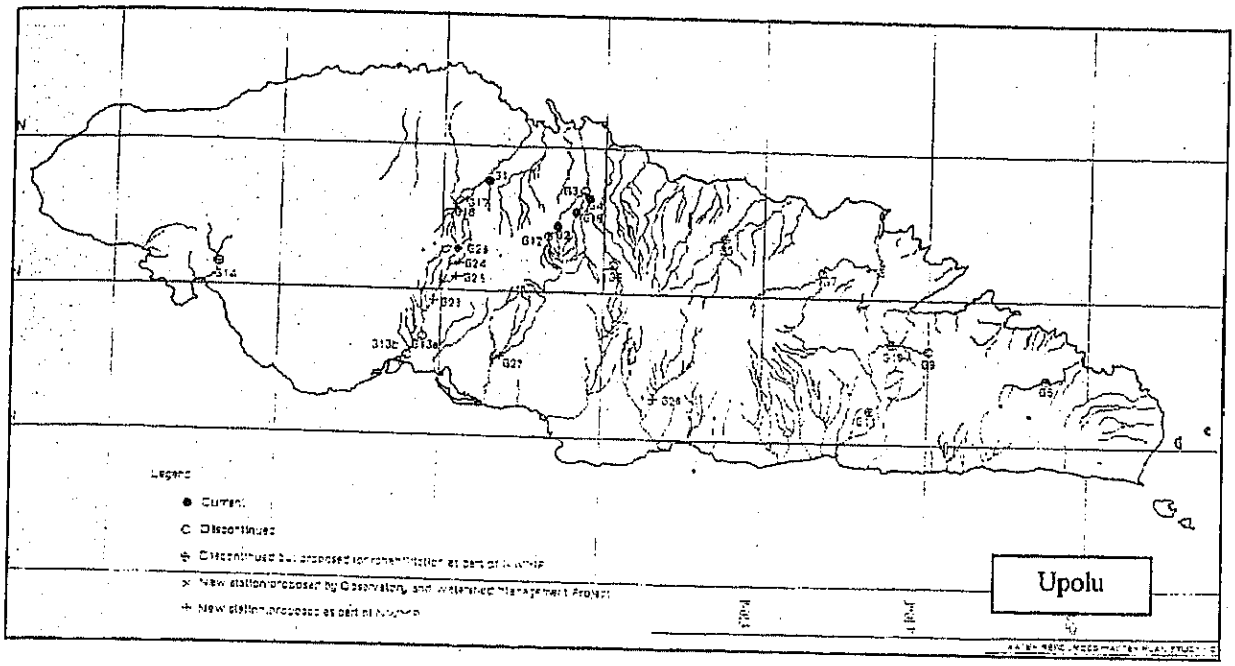


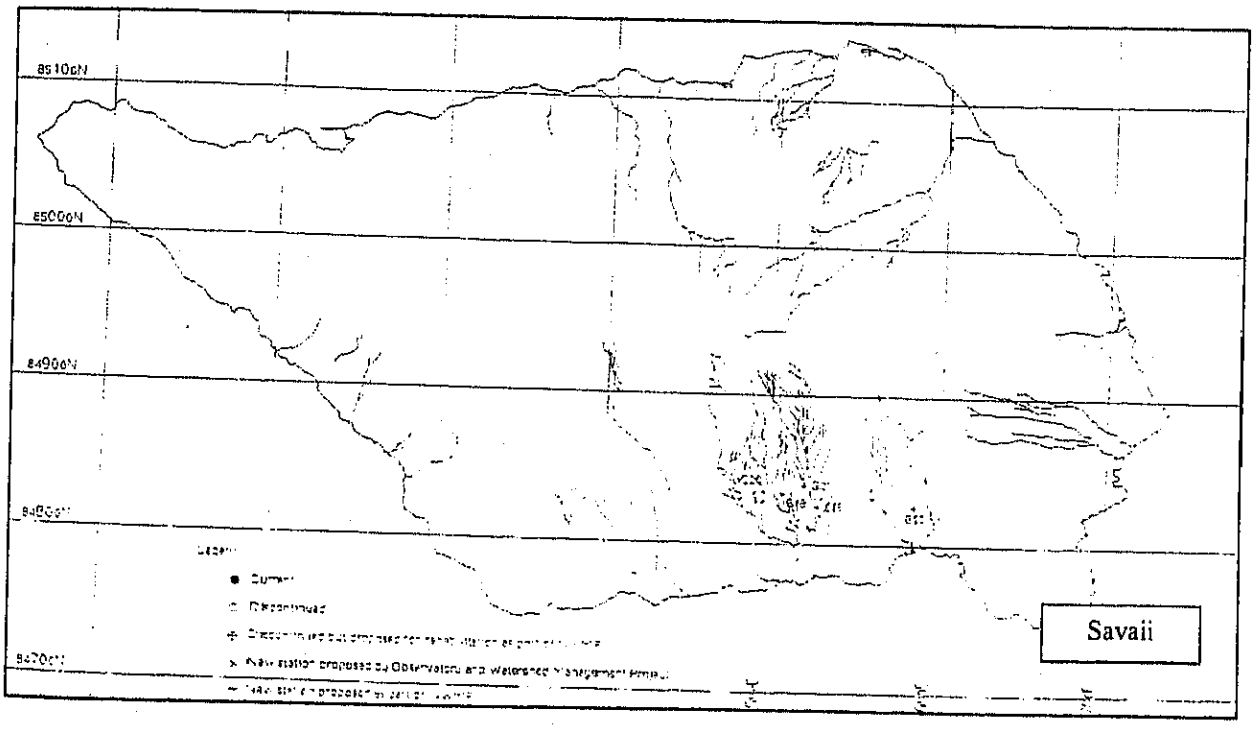
Annex 5.2 (2) Land Slope Distribution in Samoa



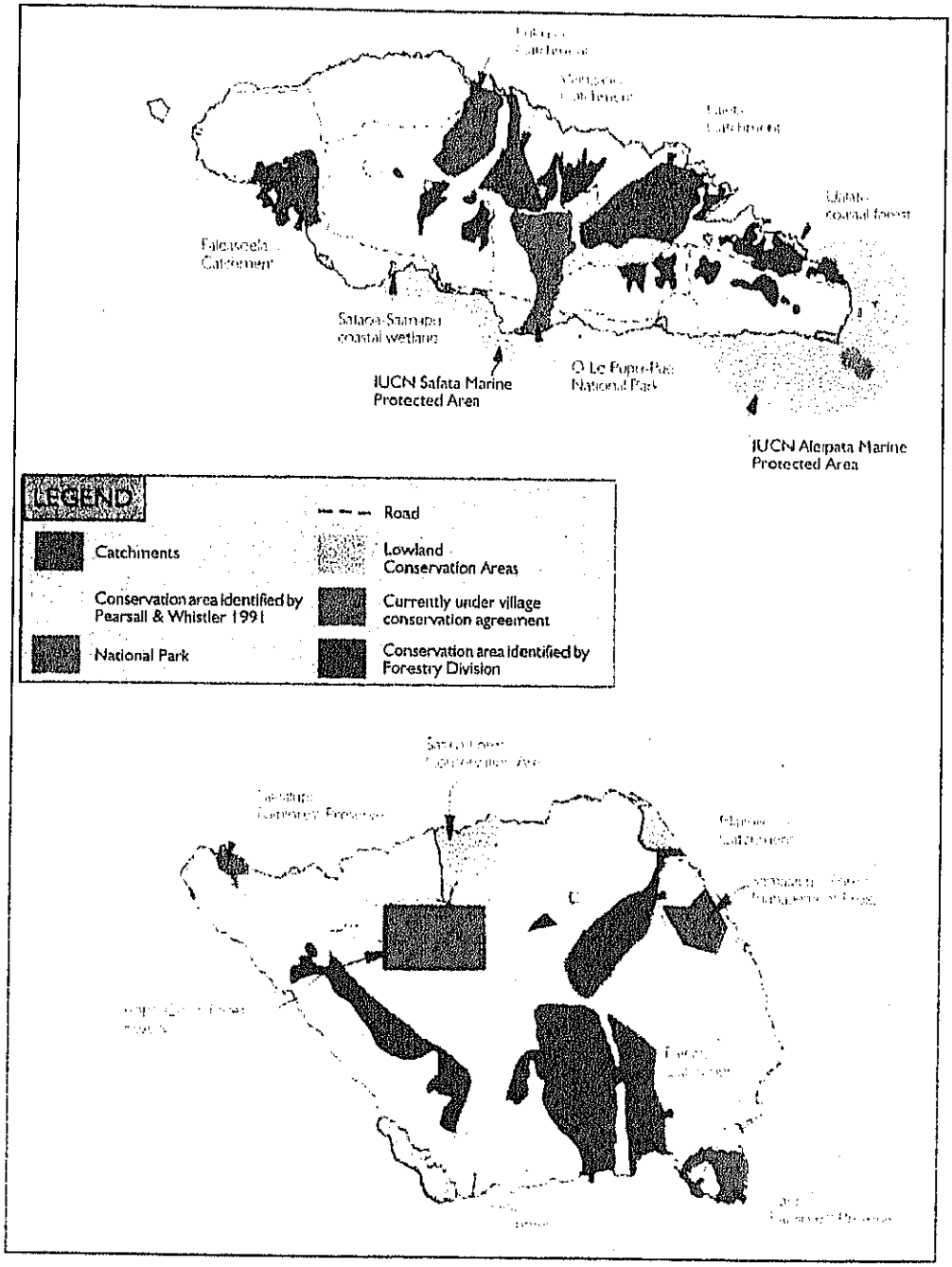


Annex 5.2 (3) Isohyetal Map in Samoa





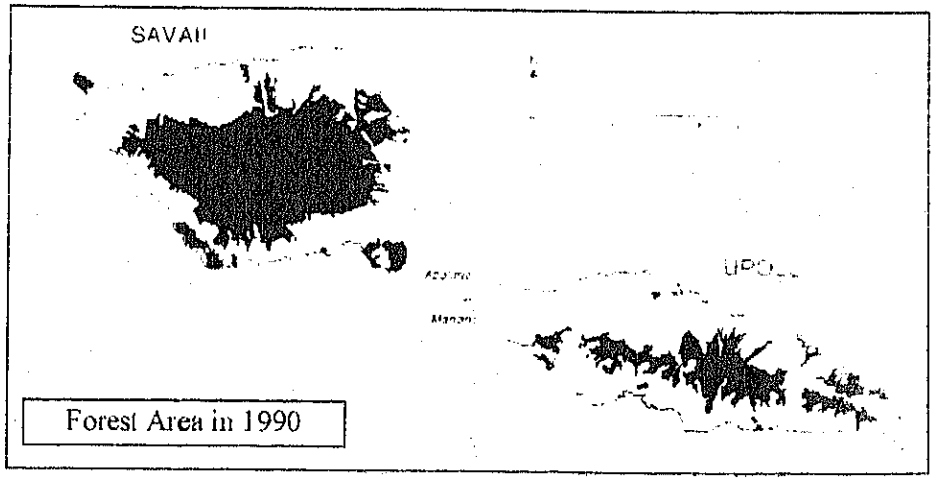
Annex 5.2 (4) Previous Discharge Measurement Station in Samoa

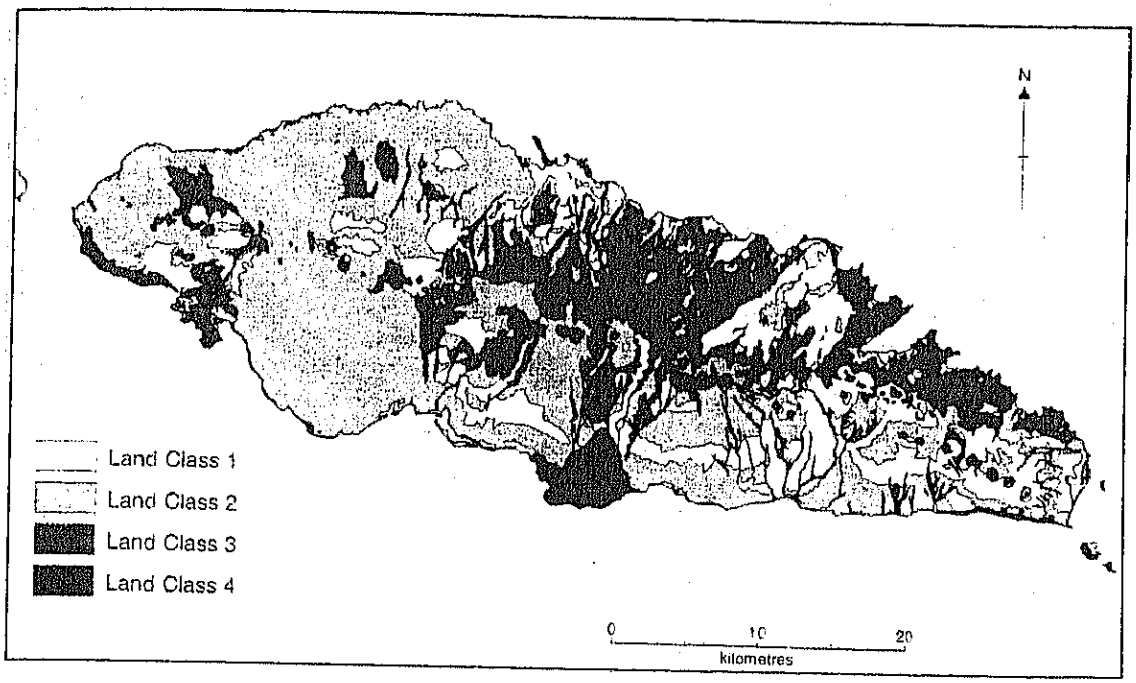


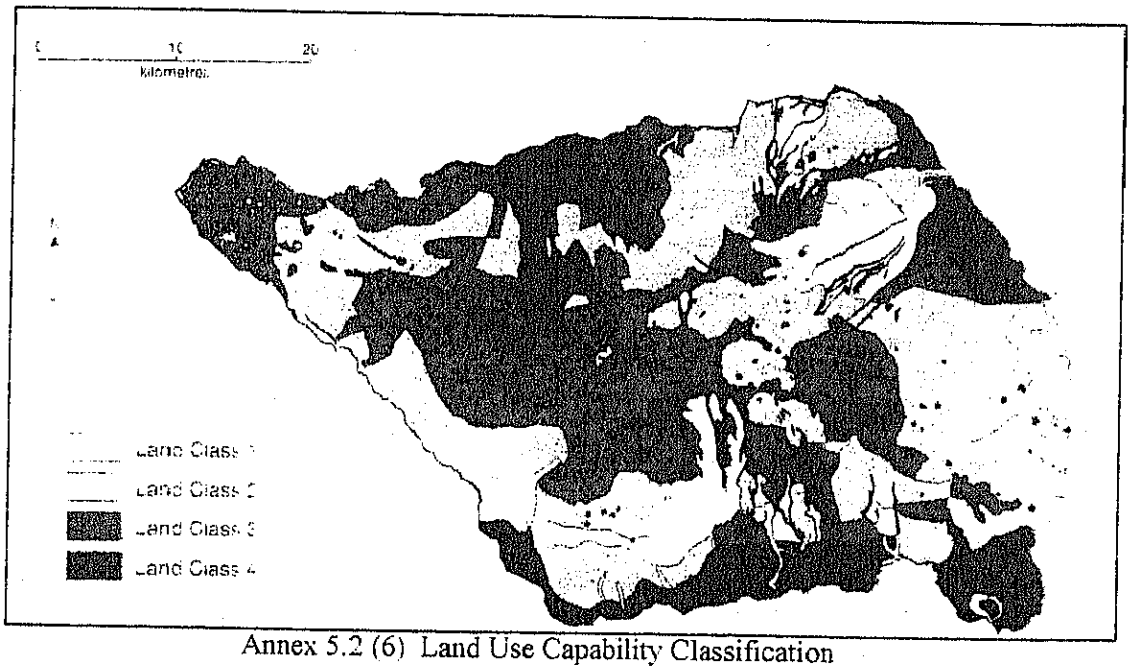
Annex 5.2 (5) Environmental Conservation Area

Percentage of Land Area under Forest

Year	Upolu	Savaii	Total
1954	65 %	79 %	74 %
1987	43 %	63 %	55 %
1990	25 %	50 %	40 %







Annex 5.2 (6) Land Use Capability Classification

Area in each Land Class

Land Class	Description	Upolu		Savaii		Total	
		km²	%	km²	%	km²	%
1	Few limitations to agricultural use	221.9	19.6	179.8	10.6	1401.6	14.2
2	Moderate limitations to agricultural use and few limitation to forestry	561.6	49.6	632.7	37.3	1,193.6	42.2
3	Severe limitations to agricultural use and moderate to severe limitations to forestry	108.7	9.6	490.2	28.9	599.6	21.2
4	Unsuitable for agriculture or forestry	238.9	21.1	393.5	393.5	633.6	22.4
Total		1,131.1	100.0	1,696.2	100.0	2,827.3	100.0

ANNEX 5.3 DATA USED FOR HYDROPOWER DEVELOPMENT PLANNING

Annex 5.3 (1) Catchment Area at Intake Site

No.	Name of Scheme	Name of River	EL.(m)	Intake No.	Area (km²)	Total (km²)
1	Faleaseela	Faleaseela (West)	155	No.1	3.43	4.47
2		Faleaseela (East)	156	No.2	1.04	
3	Lotofaga	Leafa (West)	90	No.1	7.36	15.59
4		Leafa (East)	90	No.2	8.23	
5	Tafitoala	Saleseu (West)	140	No.1	4.03	14.41
6			142	No.2	1.03	
7		Saleseu (Center)	144	No.3	3.25	
8		Saleseu (East)	146	No.4	4.44	
9		Tumu-ole-Manu	320	Diversion	1.66	
10	Namo-1	Namo (Main)	75	No.1	16.49	16.49
11	Namo-2	Namo (Main)	120	No.1	15.08	15.08
12	Namo-3	Namo (East)	196	No.1	8.55	13.38
13		Namo (West)	195	No.2	4.83	
14	Namo-4	Namo (East)	278	No.1	5.42	7.49
15			277	No.2	0.99	
16			276	No.2	1.08	
17	Sili-1 (1)	Vaiola	228	No.1	2.05	9.45
18		Lata (West)	225	No.2	3.94	
19		Lata (Center)	225	No.3	3.46	
20	Sili-1 (2)	Vaitai	258	No.4	8.57	15.32
21			257	No.5	5.42	
22		Lata (East)	230	No.6	1.33	
23	Sili-2	Vaitai	420	No.7	7.90	12.8
24			405	No.8	4.90	

Annex 5.3 (2) Monthly mean temperature (at Togitogiga Climate Station in Upolu-South)

Mon	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	Ave.
Jan	28.5	29.6	29.6	28.1	28.5	28.3	28.8	28.7	29.0	28.2	28.7	-	28.7
Feb	-	26.8	29.0	27.5	28.6	28.7	29.0	26.6	27.7	28.9	28.1	-	28.1
Mar	-	27.7	29.0	28.3	29.2	28.0	27.9	28.4	27.6	28.5	28.3	28.3	28.3
Apr	-	27.7	29.0	28.3	29.2	27.5	29.0	28.2	28.5	28.1	28.4	28.4	28.4
May	-	27.1	29.0	28.7	27.9	27.6	27.4	27.7	27.8	27.2	27.0	27.7	27.7
Jun	-	26.6	28.6	28.4	28.9	27.6	25.3	27.9	27.6	28.0	26.9	27.6	27.6
Jul	-	26.0	29.2	27.7	28.6	25.8	27.0	27.1	27.2	26.0	26.1	27.1	27.1
Aug	-	26.1	28.5	27.4	28.2	26.0	26.8	26.8	27.0	26.7	24.9	26.8	26.8
Sep	-	26.4	28.5	28.8	26.4	27.1	27.7	26.7	27.0	28.2	26.5	27.3	27.3
Oct	-	26.4	28.8	28.4	26.1	27.7	29.5	27.2	28.0	28.1	26.4	27.7	27.7
Nov	-	28.3	28.9	28.8	27.6	28.5	27.0	28.4	27.5	29.1	26.6	28.1	28.1
Dec	-	28.1	29.0	29.3	27.8	28.4	27.0	28.9	28.1	29.0	28.1	28.4	28.4
Ave.	28.5	27.2	28.9	28.3	28.1	27.6	27.7	27.7	27.8	28.0	27.2	27.7	334.2

Annex 5.3 (3) Monthly Rainfall Data converted from Daily Data (Dry season : May to October)

No.6 Matautu	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	Ave.
Jan	380.0	438.0	242.3	491.4	491.4	448.6	534.4	491.4	232.1	315.6	-	-	406.5
Feb	-	351.9	389.4	435.4	435.4	243.1	328.9	435.4	276.5	315.6	-	-	356.8
Mar	-	329.1	347.4	436.3	128.2	403.0	490.6	503.8	215.2	169.0	-	-	335.8
Apr	-	320.0	230.0	104.1	172.5	112.8	157.5	437.7	254.8	272.9	-	-	229.1
May	-	297.3	180.2	285.0	503.6	237.5	125.8	224.8	381.1	388.8	-	-	291.6
Jun	-	319.2	392.9	310.4	164.5	282.5	234.4	159.8	99.4	438.5	-	-	266.8
Jul	-	317.1	692.9	113.4	62.9	348.3	223.8	63.7	177.2	175.8	-	-	241.7
Aug	-	330.1	230.7	456.5	59.3	188.1	540.2	190.6	347.9	205.0	-	-	283.2
Sep	-	609.2	511.5	150.4	579.4	440.2	502.5	156.9	147.6	83.0	295.9	-	347.7
Oct	-	436.6	458.7	317.3	503.3	177.0	305.5	272.8	503.3	355.8	192.7	-	352.3
Nov	-	389.0	351.4	337.1	351.4	351.4	194.4	303.1	351.4	377.1	156.5	-	316.3
Dec	-	243.2	560.9	236.7	407.0	407.0	3340.8	456.1	407.0	407.0	407.0	-	687.3
Total	-	4380.7	4,588.3	3,674.0	3,858.9	3,639.5	6,978.8	3,696.1	3,393.5	3,504.1	1,052.1	-	4,115.1

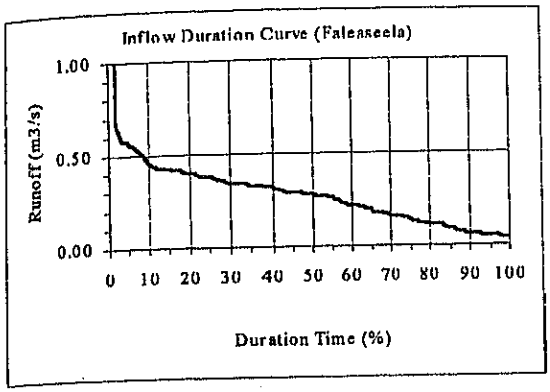
No.8 Nuusuatia	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	Ave.
Jan	299.1	335.4	394.0	516.3	389.3	363.6	331.9	647.2	284.5	472.1	415.1	-	404.4
Feb	-	191.9	493.0	203.8	343.4	270.1	331.4	318.2	498.9	357.3	164.0	-	317.2
Mar	-	225.3	539.0	419.4	135.1	132.6	756.5	296.9	359.0	512.3	302.3	663.9	394.8
Apr	-	298.8	789.0	232.4	88.7	60.6	212.7	236.6	528.5	436.7	320.6	230.8	312.3
May	-	452.4	258.0	316.4	921.4	225.4	251.7	38.3	644.9	518.3	407.2	157.7	381.1
Jun	-	341.2	341.2	402.2	226.9	225.6	285.7	120.2	552.4	694.6	364.7	35.7	326.4
Jul	-	502.6	563.0	162.1	591.4	227.1	200.1	208.5	68.0	356.9	253.7	165.0	299.9
Aug	-	602.5	622.0	93.7	776.8	336.5	650.1	412.8	555.5	482.9	171.2	398.7	463.9
Sep	-	439.5	783.0	708.4	488.0	459.8	462.7	84.4	582.3	229.8	443.3	411.8	463.0
Oct	-	406.0	507.0	375.8	636.4	353.6	70.0	433.2	158.1	616.7	596.1	197.1	395.5
Nov	-	421.7	439.0	299.4	516.2	170.9	155.8	164.0	618.9	544.9	193.3	406.8	357.4
Dec	-	525.4	528.2	516.8	731.6	174.9	123.1	361.4	192.9	516.8	345.4	331.8	395.3
Total	-	4742.7	6,256.4	4,246.7	5,845.2	3,000.7	3,831.7	3,321.7	5,043.9	5,739.3	3,976.9	2,999.3	4,511.0

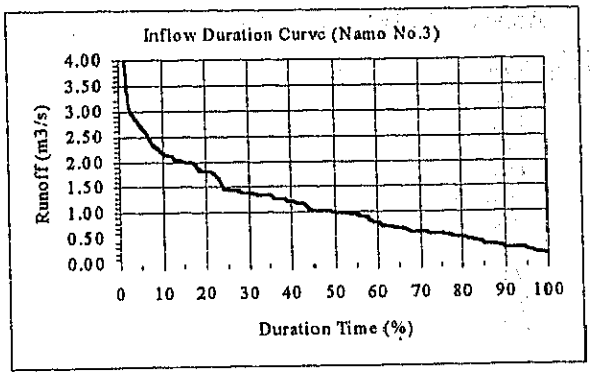
No.11 Sauniatu	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	Ave.
Jan	472.9	435.5	251.2	794.5	942.8	646.6	1349.0	560.0	-	-	-	-	681.6
Feb	-	318.5	240.7	600.7	632.8	541.9	378.2	551.0	-	-	-	-	466.3
Mar	-	370.9	642.7	453.1	118.8	343.4	839.5	462.5	-	-	-	-	461.6
Apr	-	718.7	601.4	201.8	117.9	145.1	96.3	437.5	-	-	-	-	331.2
May	-	254.0	393.8	615.1	645.3	241.3	287.1	679.5	381.5	-	-	-	437.2
Jun	-	159.8	407.7	315.0	246.5	290.3	412.6	227.0	20.0	-	-	-	259.9
Jul	-	246.3	221.9	268.7	162.2	108.0	233.3	120.0	345.0	-	-	-	213.2
Aug	-	211.1	160.6	196.8	77.6	230.7	434.4	95.0	588.5	-	-	-	249.3
Sep	-	348.7	177.7	155.7	596.4	230.3	215.7	231.0	390.0	-	-	-	293.2
Oct	-	405.7	405.9	542.7	852.2	201.2	368.8	446.5	240.0	-	-	-	432.9
Nov	-	366.4	376.9	405.2	405.6	234.3	236.9	189.8	333.0	-	-	-	318.5
Dec	-	460.3	898.1	354.6	466.5	593.2	439.5	55.6	214.5	-	-	-	435.3
Total	-	4295.9	4,778.6	4,903.9	5,264.6	3,806.3	5,291.3	4,055.4	2,512.5	-	-	-	4,580.1

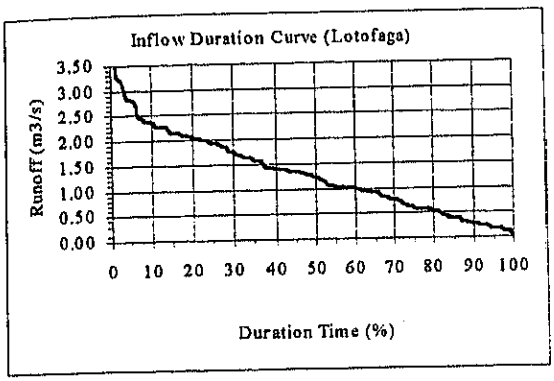
No.11 Sili	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	Ave.
Jan	347.2	367.3	377.6	345.5	423.6	420.9	333.2	423.6	-	-	-	-	379.9
Feb	-	510.3	277.0	249.0	419.0	187.3	398.6	255.7	-	-	-	-	328.1
Mar	-	632.3	376.8	612.4	166.0	488.1	253.5	520.3	-	-	-	-	435.6
Apr	-	306.1	157.3	204.2	227.1	100.9	228.9	192.4	-	-	-	-	202.4
May	-	141.0	320.5	484.7	618.9	148.8	253.5	220.0	-	-	-	-	312.5
Jun	-	145.2	131.0	225.2	155.6	205.3	287.4	180.1	-	-	-	-	190.0
Jul	-	265.9	133.9	347.4	109.6	292.3	383.0	217.5	-	-	-	-	249.9
Aug	-	149.7	49.7	165.2	82.8	109.1	1109.7	121.0	752.5	-	-	-	317.5
Sep	-	243.4	42.9	244.5	410.5	359.4	468.8	447.7	592.4	-	-	-	351.2
Oct	-	790.4	179.2	953.4	461.5	442.2	215.7	440.5	402.5	-	-	-	485.7
Nov	-	376.2	453.3	371.8	229.7	246.0	91.9	205.0	460.9	-	-	-	304.4
Dec	-	244.9	241.4	328.3	419.6	337.5	457.2	248.8	234.8	-	-	-	314.1
Total	-	4172.7	2,740.6	4,531.6	3,723.9	3,337.8	4,481.4	3,472.6	2,443.1	-	-	-	3,871.2

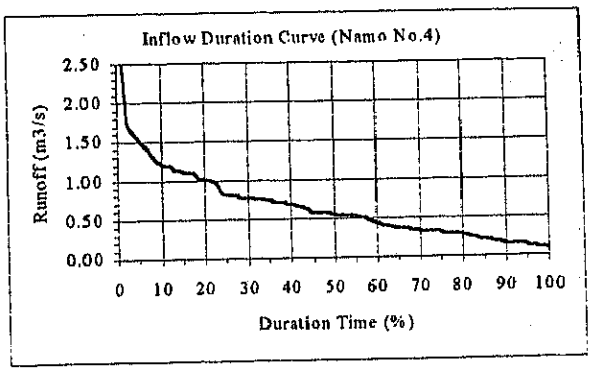
Annex 5.3 (4) Dependable Runoff at River Basin

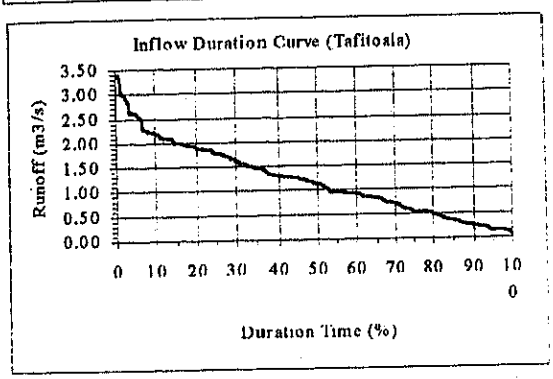
Runoff(m^3/s) Dependability (%)	Faleas	Lotofa	Tafit	Namo-1	Namo-1	Namo-1	Namo-1	Sili-1(1)	Sili-1(1)	Sili-2
90%	0.06	0.26	0.24	0.35	0.32	0.29	0.16	0.14	0.22	0.32
80%	0.11	0.53	0.49	0.62	0.57	0.51	0.28	0.27	0.44	0.57
70%	0.16	0.77	0.72	0.74	0.67	0.60	0.33	0.38	0.62	0.67
60%	0.22	1.00	0.93	0.97	0.89	0.79	0.44	0.48	0.77	0.89
50%	0.28	1.23	1.14	1.21	1.11	0.99	0.55	0.59	0.96	1.11
40%	0.31	1.41	1.30	1.51	1.38	1.22	0.69	0.72	1.16	1.38
30%	0.34	1.73	1.60	1.70	1.55	1.38	0.77	0.87	1.41	1.55
20%	0.40	2.03	1.87	2.22	2.03	1.80	1.01	1.00	1.62	2.03
10%	0.45	2.34	2.16	2.63	2.41	2.14	1.20	1.18	1.91	2.41

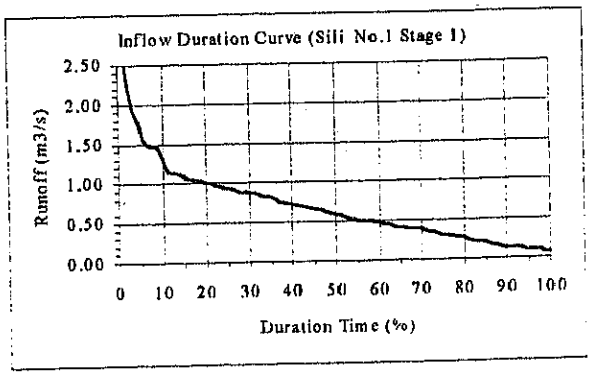


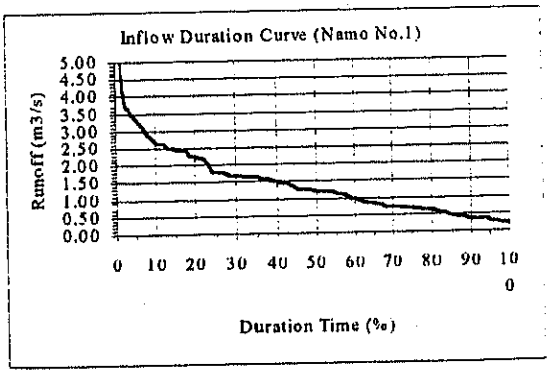


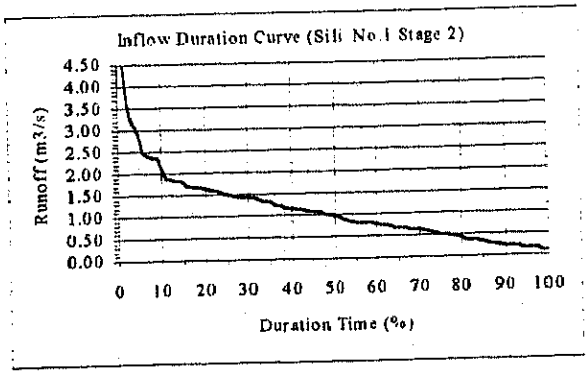


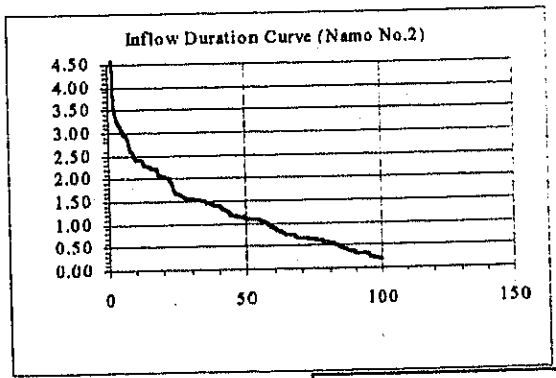


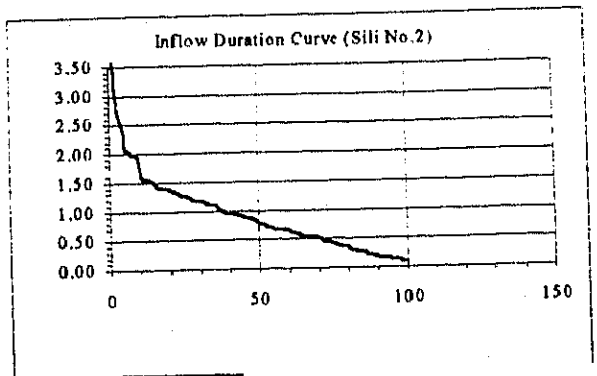












Annex 5.3 (5) Flow Duration Curve

ANNEX 5.3 (6) Head Loss Calculation for Namo No.3 Hydropower Scheme

	No.1	No.2
FSWL at Intake	196.00	195.00
FSWL at Head Tank	194.00	
TWL at Tailrace	125.00	
Discharge (m3/scc)	1.600	
Combined Efficiency of Turbine & Generator	0.850	

PENSTOCK

(1) Screen $h_{11} = f_r \cdot \frac{v_1^2}{2g}$ $f_r = \beta(\sin\theta)(\frac{t}{b})^{4/3}$

B(m)	H(m)	f_r	Velocity (m/s)	Head Loss (m)	Coefficient x 10^{-6} Q^2
2.50	1.50	0.97			

(2) Inlet $h_{12} = f_e \cdot \frac{v_2^2}{2g}$ fe = 0.5 fe = 0.25 fe = 0.2

D (m)	f_e			
0.80	0.20			

(3) Friction $h_{13} = \frac{124.5n^2}{D^{4/3}} L \frac{v^2}{2g}$

$Q(m^3/s)$	n	D (m)	L (m)			
1.60	0.0120	0.80	161.00			
0.00	0.0120	0.80	0.00			
0.00	0.0120	0.80	0.00			

(4) Bend $h_{14} = \{0.131 + 0.1632 \cdot (\frac{D}{R})^{3.5}\} \cdot (\frac{\theta}{90})^{0.5} \cdot \frac{v^2}{2g}$

$Q(m^3/s)$	R	D(m)	0 (°)			
1.60	4.000	0.80	20.00			
1.60	4.000	0.80	10.00			
1.60	4.000	0.80	15.00			
1.60	4.000	0.80	20.00			
0.00	4.000	0.80	10.00			
0.00	4.000	0.80	45.00			

(5) Transition $h_{15} = f_{gc} \frac{v_2^2}{2g}$

D_1(m)	D_2(m)	L(m)	$f_{transition}$			
0.80	0.80	0.00	0.000			

(6) Branch $h_{16} = f_b \cdot \frac{v_0^2}{2g}$

D_0(m)	f_b			
0.80	0.000			

(7) Inlet valve $h_{17} = f_v \cdot \frac{v^2}{2g}$

$Q(m^3/s)$	D(m)	f_{valve}			
1.60	0.80	0.200			

(8) Others Round-up

Sub-total (1) - (8)

TAILRACE

Discharge $Q(m^3/s)$ 1.60

(1) Friction in transition $h_{21} = \frac{2.37 \cdot n^2 Q^2 L}{D_2 - D_1} \cdot (\frac{1}{D_1^{13/3}} - \frac{1}{D_2^{13/3}})$

n	D_1(m)	D_2(m)	L(m)	Velocity (m/s)	Head Loss (m)	Coefficient x 10^{-7} Q^2

(2) Enlargement $h_{21} = f_{ge}\{1 - (\frac{A_1}{A_2})\}^2 \cdot \frac{v_1^2}{2g}$

D_1(m)	D_2(m)	f_{ge}			

(3) Exit $h_{23} = f_{exit} \cdot \frac{v^2}{2g}$

D(m)	f_{exit}			
0.80	1.000			

(4) Others 10%

Sub-total

Total of Head Loss

Gross Head (m)

Effective Head (m)

Power Output (kW)

ANNEX 5.3 (7) Preliminary Cost Estimate of Hydropower Scheme

Name of Scheme

The Namo No.3 Hydropower Scheme

Input Data

No.	Structure	Items	Unit	Input data
1	General	Install Capacity	kW	880
2		Annual energy	GWh	4.47
3		Max. power discharg	m^3/s	1.6
4		Effective Head	m	66
5		Nos. of unit	Nos.	1
6	Intake weir	Height	m	2.0
7		Length	m	10.0
8		Nos. of intake	Nos.	2
9	Inlet	Radius	m	1.0
10	Headrace canal No.1	Max. intake discharg	m^3/s	1.0
11		Open/Culvert	ratio	0.4
12		Total length	m	756
13	Headrace canal No.2	Max. intake discharg	m^3/s	1.0
14		Open/Culvert	ratio	0.4
15		Total length	m	585
16	Spillway	Spillway discharge	m^3/s	18.0
17		Gradient (%)	%	0.05
18		Length	m	20.0
19	Penstock	Length	m	161
20	Tailrace	Width	m	1.0
21	Access road	New construction	m	300
22		Improvement	m	200
23	Transmission line (22kV)	Length	km	1.0
24	Reduction ratio for Civil work	No.2,4-7,9,11,18	ratio	0.4

Head(m)	a	b
50	0.888	0.370
100	0.876	0.367
200	0.853	0.361
300	0.841	0.355

Q(m3/s)	c	d
1	0.0003	0.04
2	0.0006	0.08
3	0.0009	0.12
4	0.0012	0.14
5	0.0014	0.16

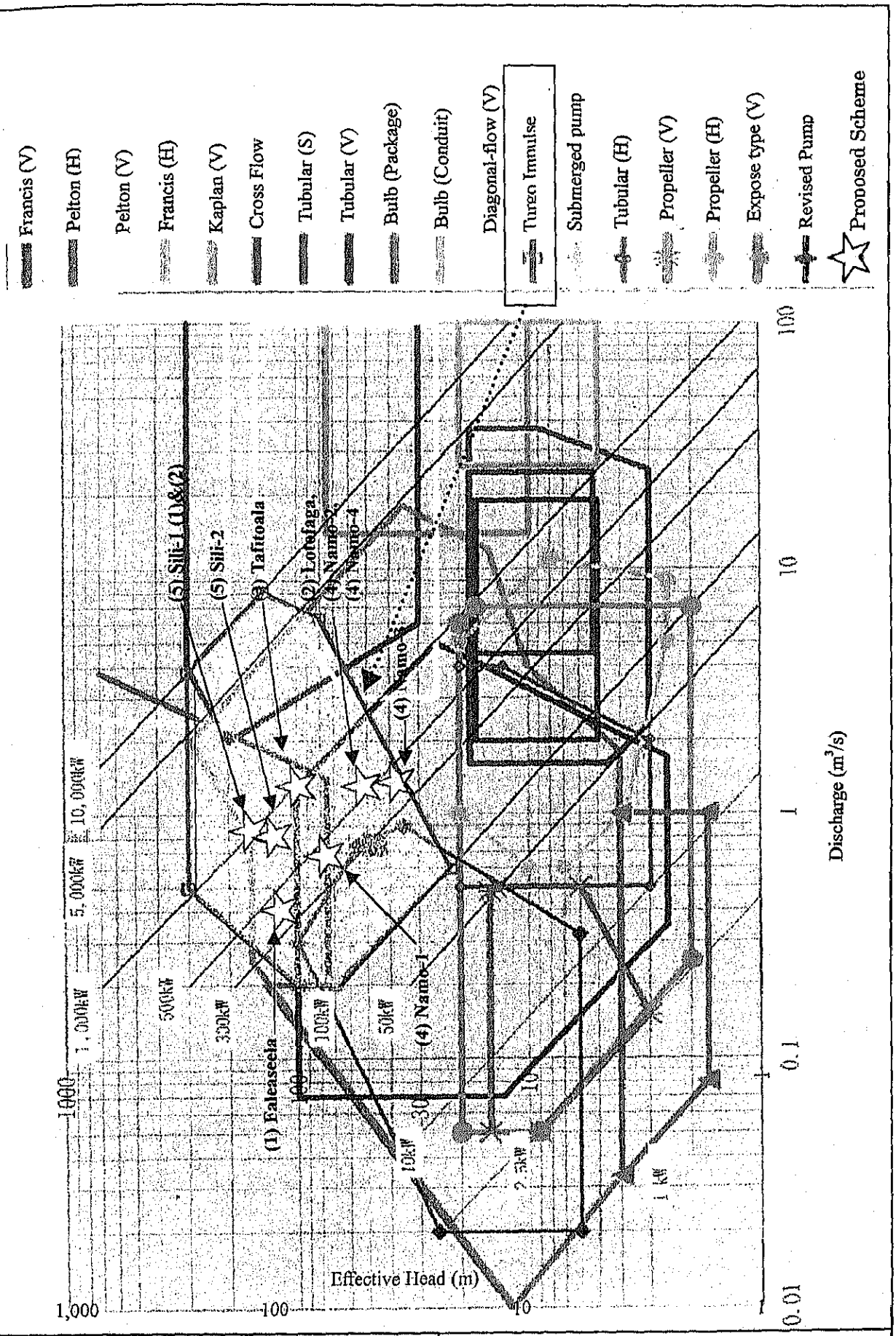
Output Data

No.	Structure	Items	Unit	Calculation Results	Remarks
1	Intake weir	Concrete volume	m^3	447	=15.8*(Height^2*Length)^0.718*Nos of intake
2	Headrace canal	Width x Depth (No.1	m^2	1.2	=(1.09*$Q^0.379)^2
3		Width x Depth (No.2	m^2	1.2	=(1.09*$Q^0.379)^2
4	Spillway pipe	Diameter	m	2.04	=0.394*(Q/Gradient^0.5)^0.375
5		Unit weight	t/m	0.402	=0.165*Dia^1.25
6	Penstock	Diameter	m	1.04	=a*Q^b (Sec. Table in above)
7		Unit weight	t/m	0.120	=c*Head+d (Sec. Table in above)

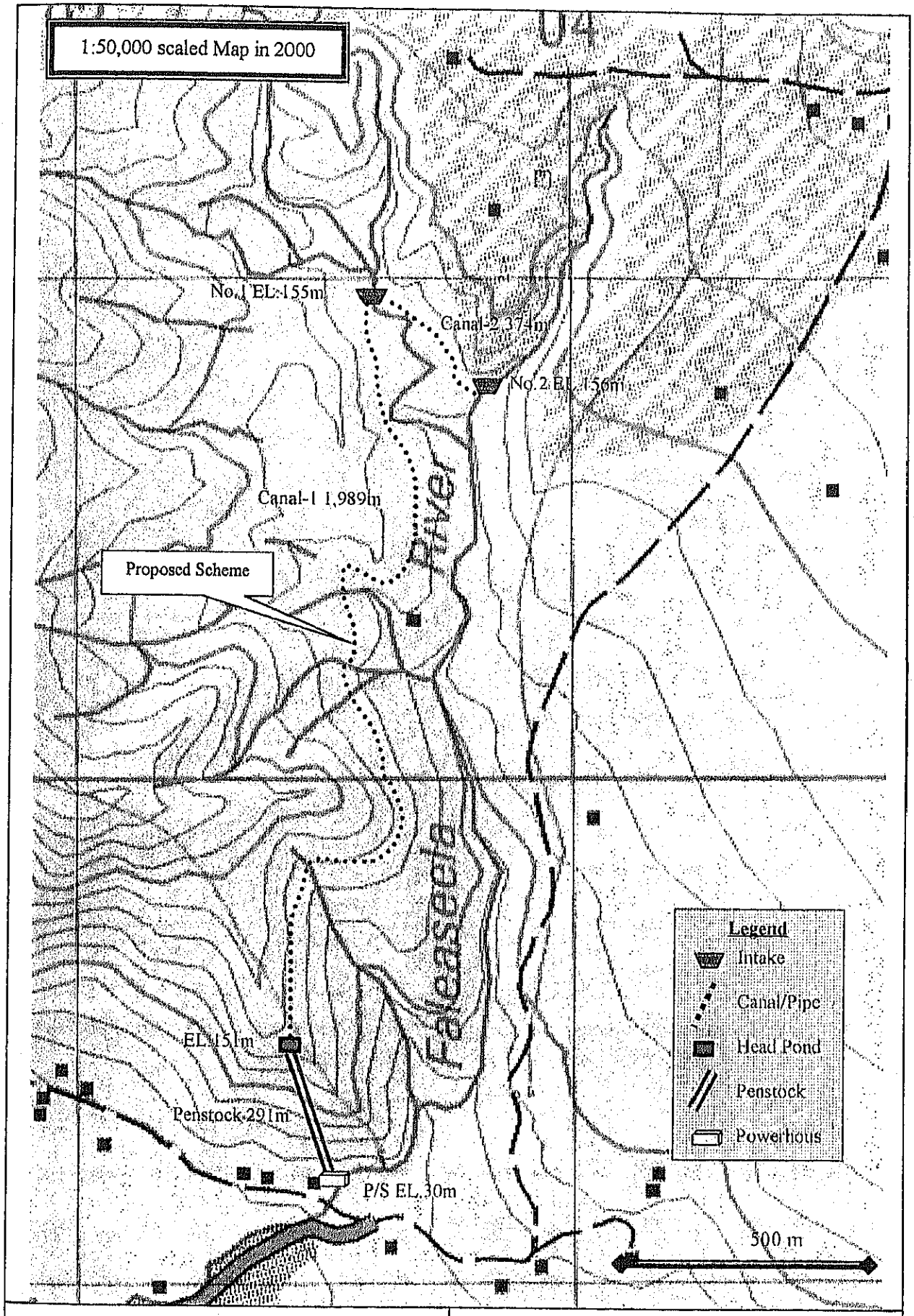
Calculated Cost

(Exchange rate : US$1.00=J.Yen 120)

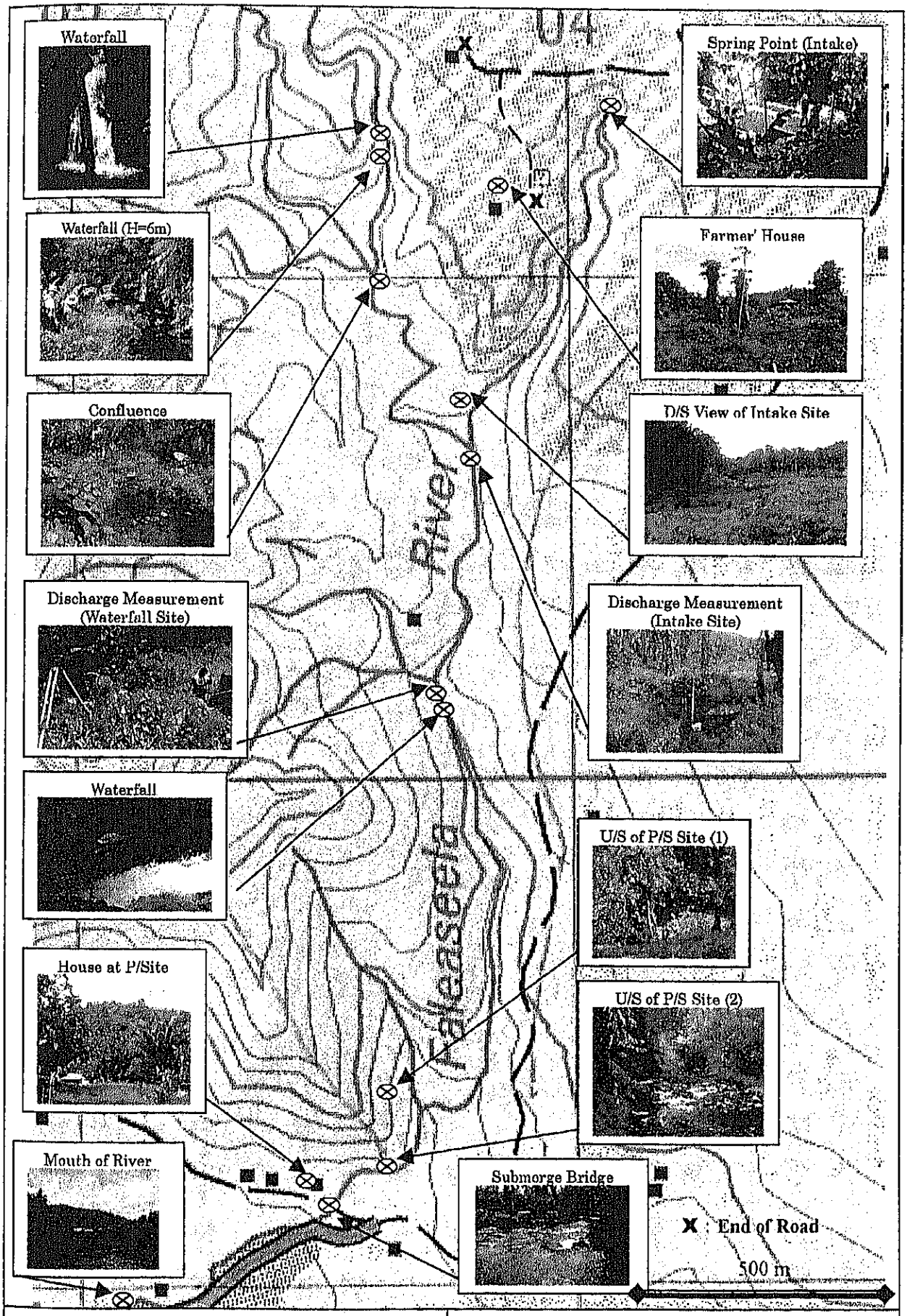
No.	Structure	Cost (Million J.Yen)	Cost (Equiv.US$)	Remarks
1	Powerhouse	21.7	181,000	=0.078*Capacity^0.83
2	**Intake weir**	23.7	198,000	=0.2*$Conc.Vol.^0.866
3	Inlet structure	23.3	194,000	=18.4*(Radius*Q)^0.506
4	**Headrace canal No.1**	73.3	611,000	=L*Ratio(Open)*114*(SQRT(B*D))^1.19/1000+L*Ratio(Culvert)*163*(S
5	**Headrace canal No.2**	56.7	473,000	Same as above
6	**Head pond**	22.9	191,000	=27.9*Q^0.669
7	**Spillway (Civil)**	13.6	113,000	=384*Dia^1.52*Length/1000
8	Spillway (Pipe)	10.8	90,000	=Length*Unit weight*(1903*(Length*Unit weight)^-0.169)/1000
9	**Penstock (Civil)**	33.7	281,000	=333*Dia^1.14*Length/1000
10	Penstock (Pipe)	22.7	189,000	=1819*(Unit weight*Length)^(-0.147)*(Unit weight*Length)/1000
11	**Tailrace**	4.7	39,000	=8.96*(Q*Width/2)^0.613
	Sub-Total (A)	307.1	2,559,000	Total (No.1 to No.11)
12	Miscellaneous (Civil)	15.4	128,000	=5% of Sub-total (A)
13	Foundation of unit	7.2	60,000	=0.0555*(Q*Head^(2/3)*Nos.^(1/2))^1.49
	Sub-Total (B)	314.3	2,619,000	Total (No.1 to No.11 & No.13)
14	Miscellaneous (Mecha.)	9.4	78,000	=3% of Sub-total (B)
15	Generating Equipment	268.5	2,238,000	=8.99*(Capacity/SQRT(Head))^0.725
16	Transmission line	6.0	50,000	Unit price: 6M Yen/km
	Sub-Total (C)	613.6	5,113,000	Total (No.1 to No.16)
17	Temporary facilities	61.4	512,000	=10% of Sub-total (C)
18	**Access road**	45.4	378,000	Unit price : 0.19M Yen/m (New), 0.093M Yen/m (Renovation)
	Sub-Total (D)	720.4	6,003,000	Total (No.1 to No.18)
19	Other expenses	93.7	781,000	=13% of Sub-total (D)
20	Ground-total	814.1	6,784,000	Total (No.1 to No.18)
	Reference (Unit cost per kW)		7,709	=Ground-total/Install capacity
	Reference (Unit cost per kWh)		1.52	=Ground-total/Annual energy



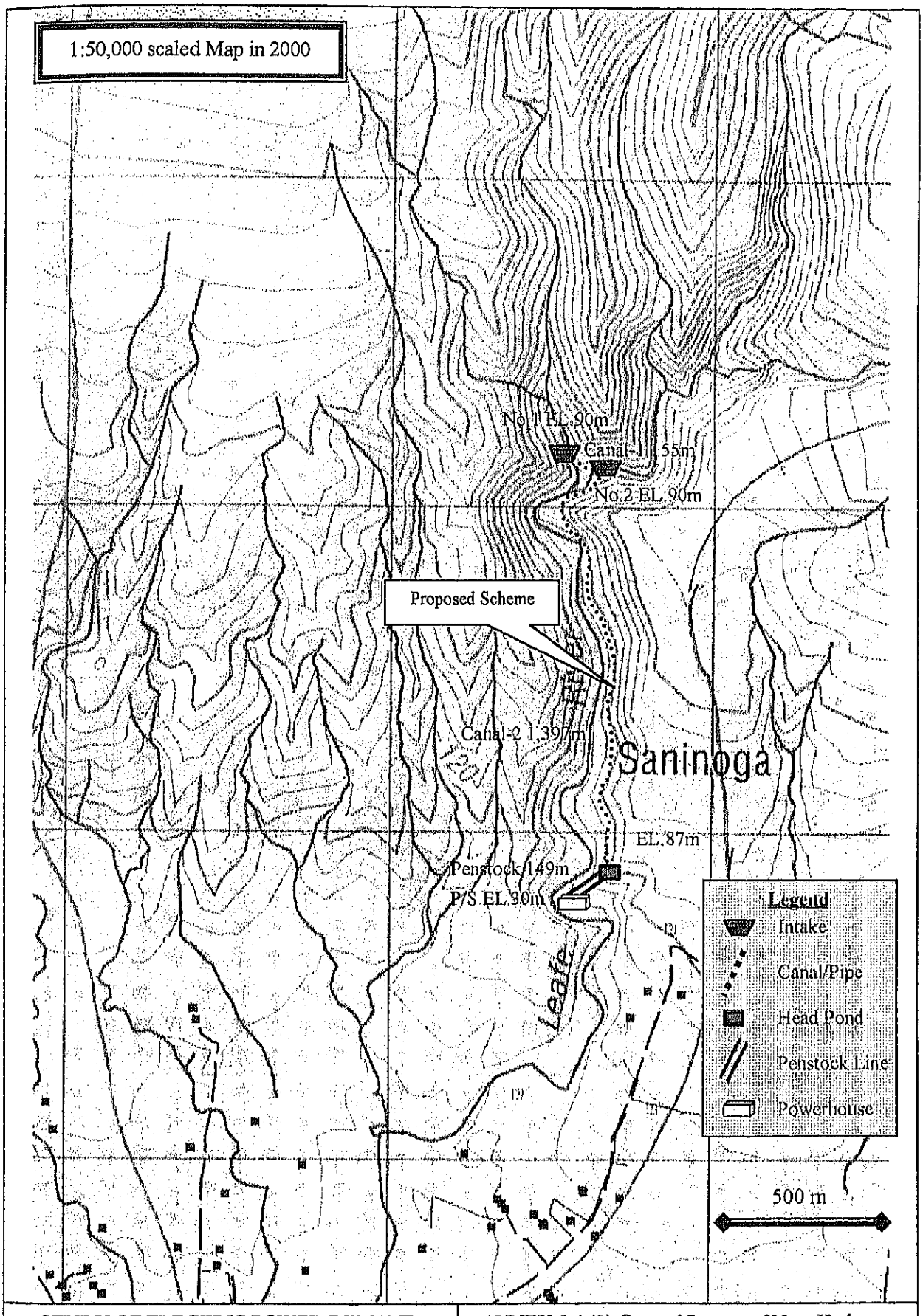
STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA	ANNEX 5.3 (8)
JAPAN INTERNATIONAL COOPERATION AGENCY	Turbine Selection Diagram (10MW - 1kW)



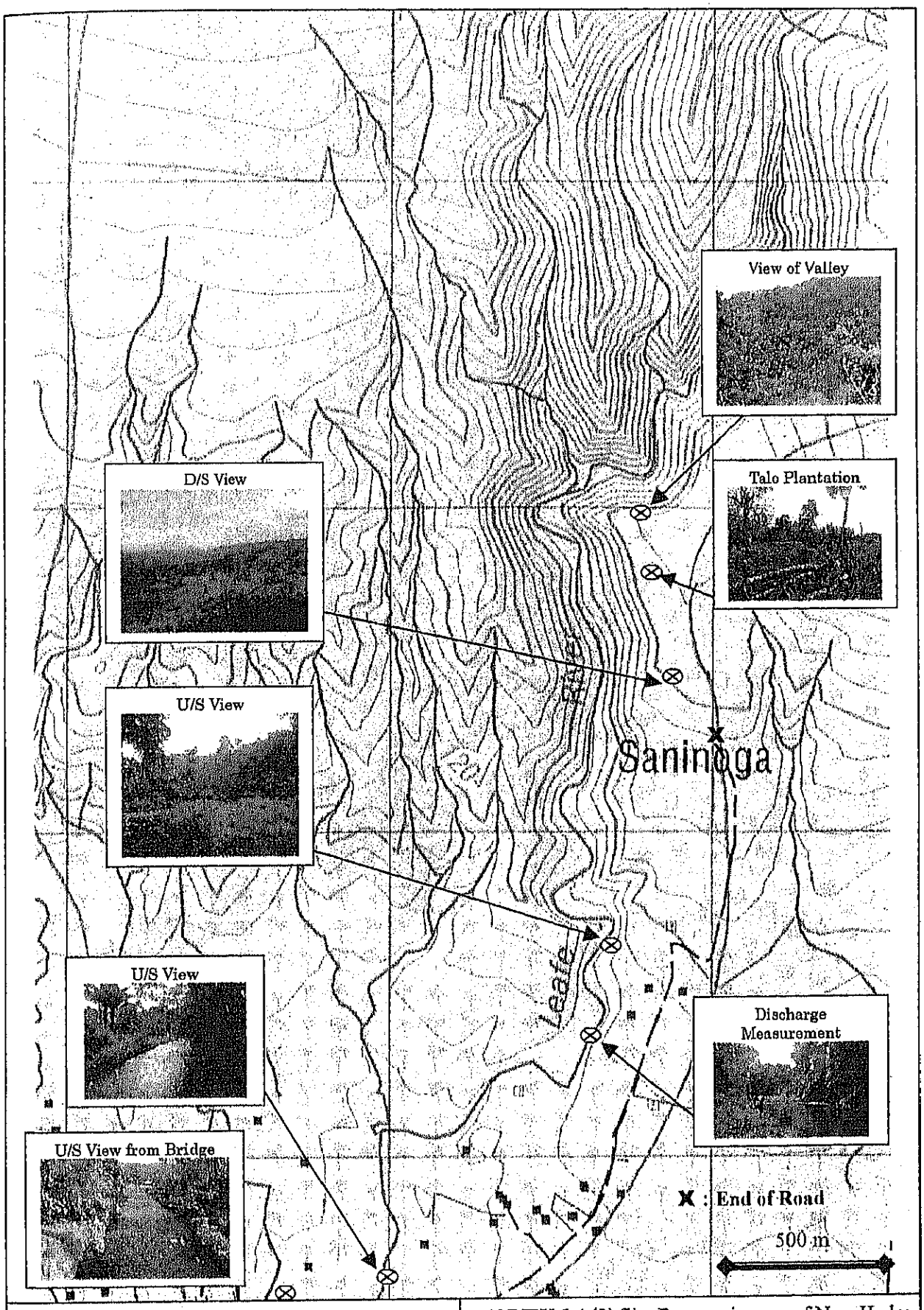
STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA	ANNEX 5.4 (1) General Layout of New Hydro Faleaseela Hydropower Scheme (based on 1:50,000 scaled map)
JAPAN INTERNATIONAL COOPERATION AGENCY	



STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA	ANNEX 5.4 (1) Site Reconnaissance of New Hydro Faleaseela Hydropower Scheme Site Photographs
JAPAN INTERNATIONAL COOPERATION AGENCY	



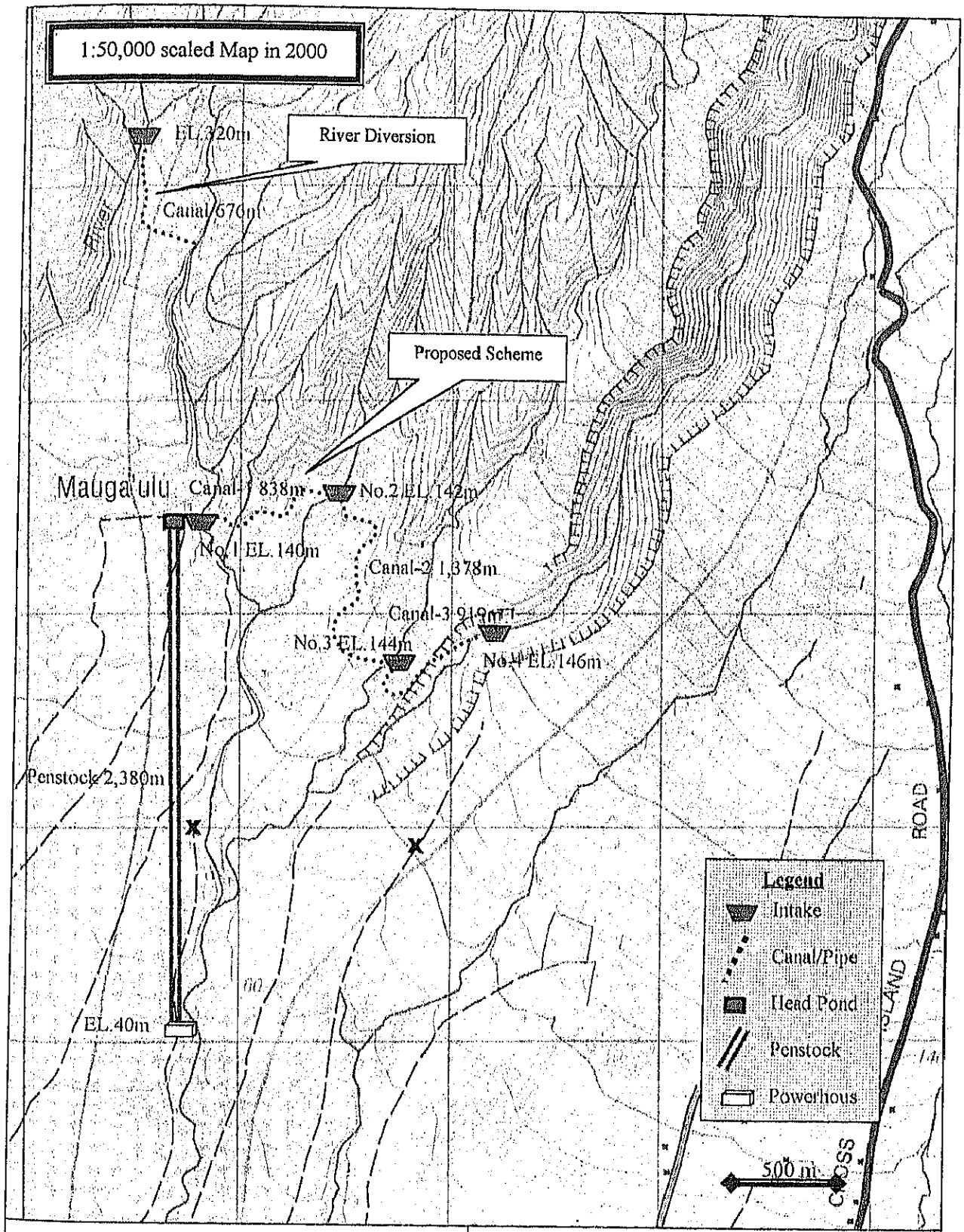
STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA	ANNEX 5.4 (2) General Layout of New Hydro Lotofaga Hydropower Scheme (based on 1:50,000 scaled map)
JAPAN INTERNATIONAL COOPERATION AGENCY	



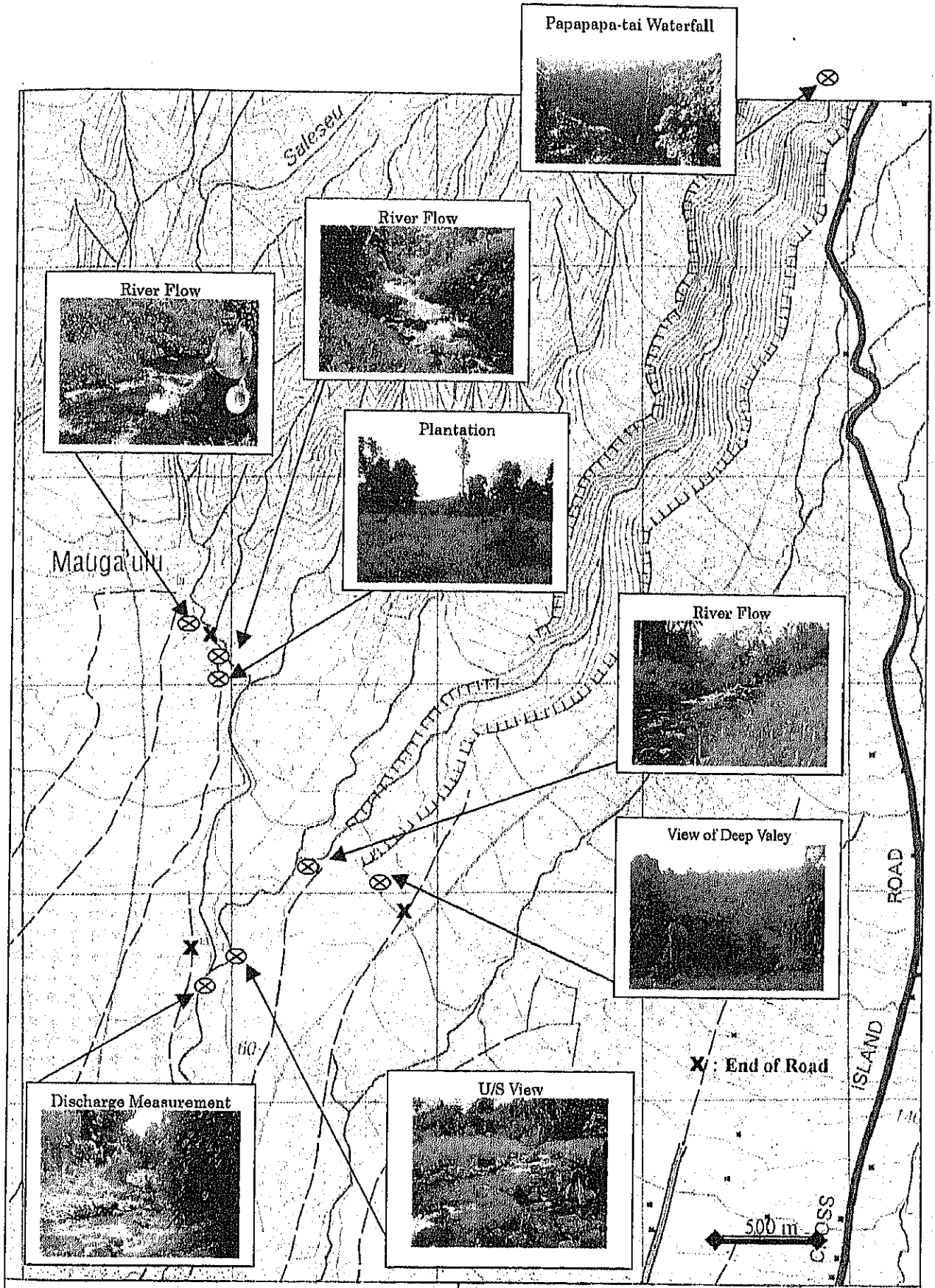
STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA

JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX 5.4 (2) Site Reconnaissance of New Hydro
Lotofaga Hydropower Scheme
Site Photographs



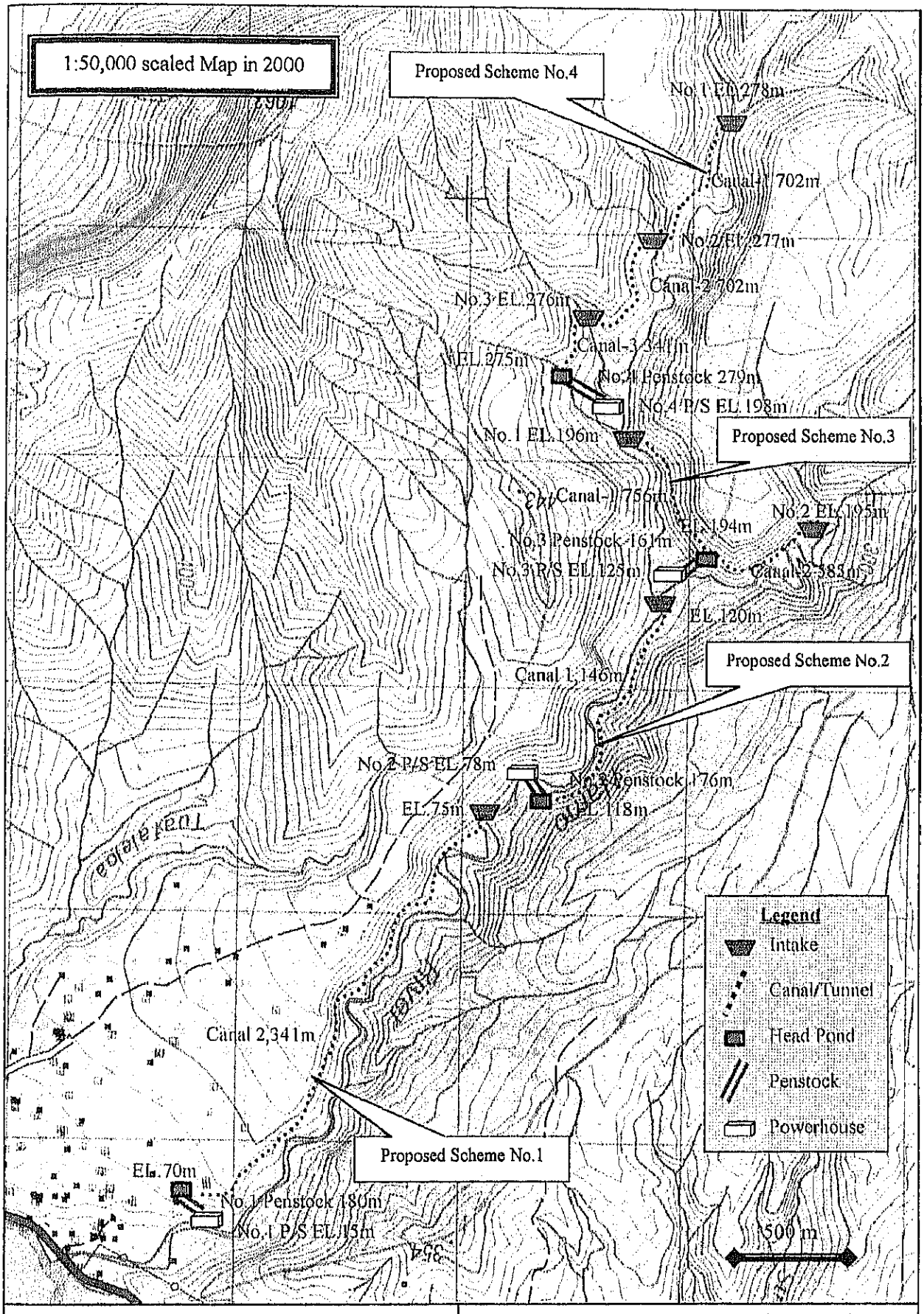
STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA	ANNEX 5.4 (3) General Layout of New Hydro Tafitoala Hydropower Scheme (based on 1:50,000 scaled map)
JAPAN INTERNATIONAL COOPERATION AGENCY	



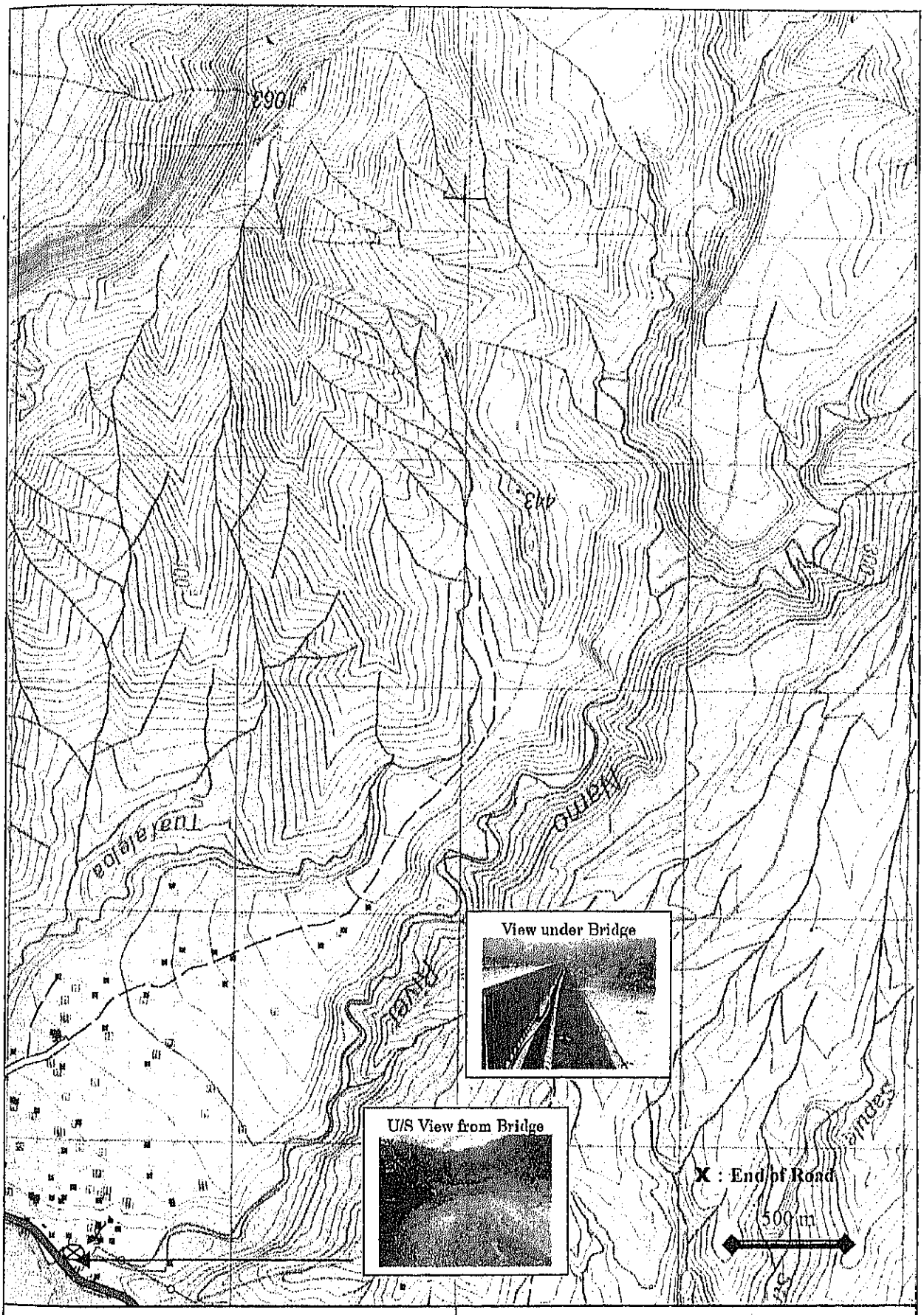
STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA

JAPAN INTERNATIONAL COOPERATION AGENCY

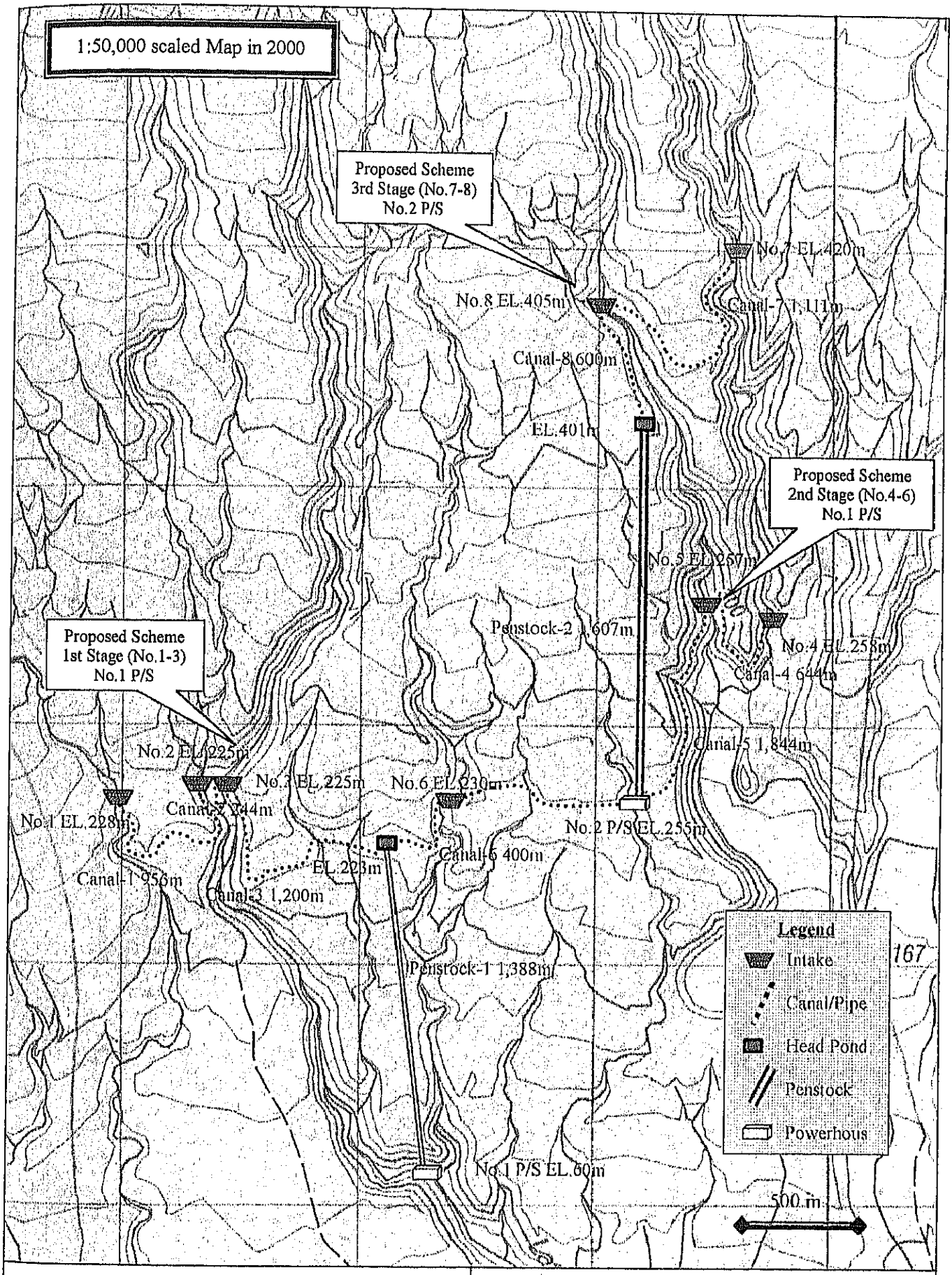
ANNEX 5.4 (3) Site Reconnaissance of New Hydro Tafitoala Hydropower Scheme
Site Photographs (Feb.15, 2003)



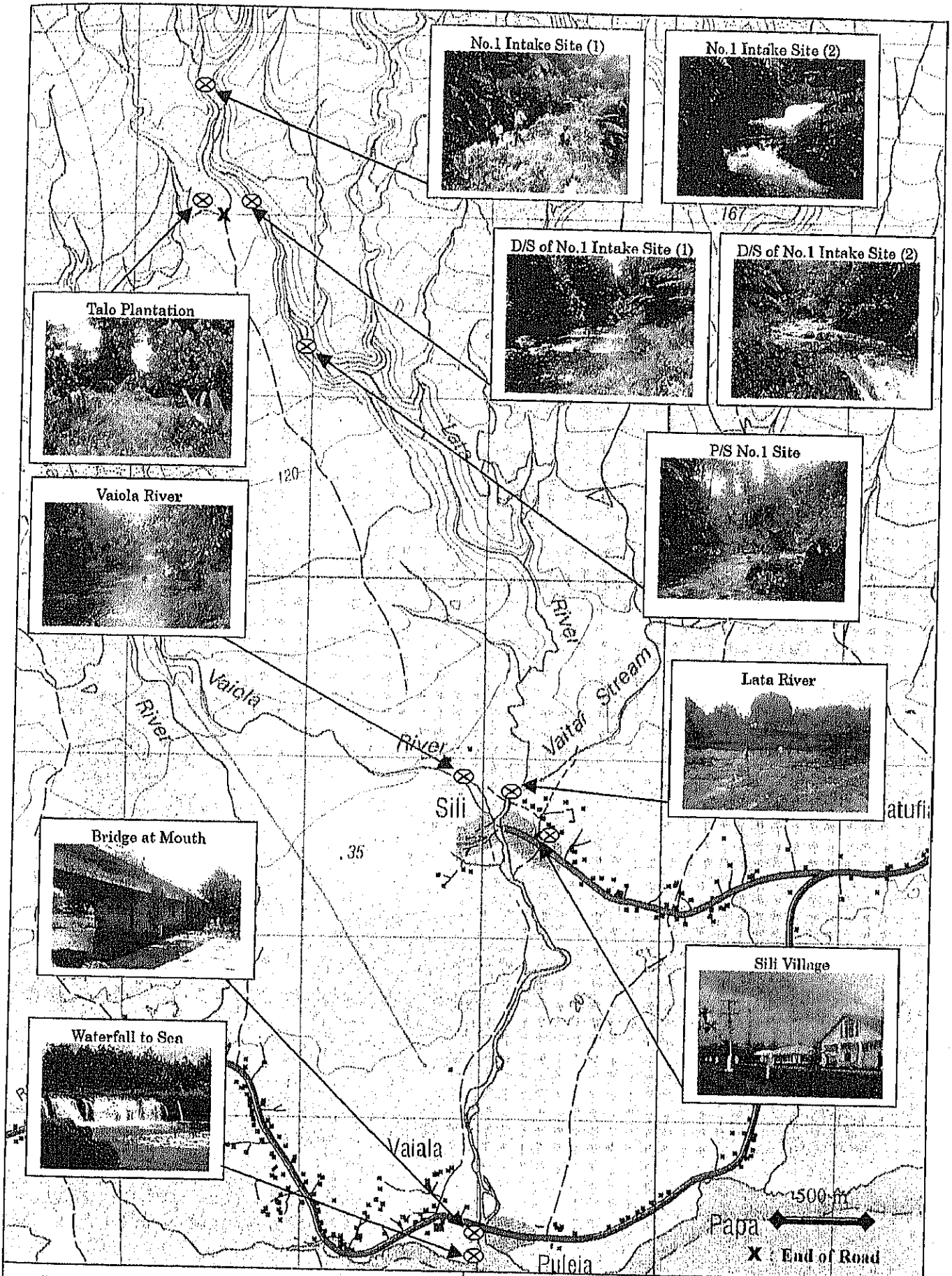
STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA	ANNEX 5.4 (4) General Layout of New Hydro Namo Hydropower Scheme (No.1 to No.4) (based on 1:50,000 scaled map)
JAPAN INTERNATIONAL COOPERATION AGENCY	



STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA	ANNEX 5.4 (4) Site Reconnaissance of New Hydro Namo Hydropower Scheme Site Photographs
JAPAN INTERNATIONAL COOPERATION AGENCY	



STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA	ANNEX 5.4 (5) General Layout of New Hydro Sili No.1 & No.2 Hydropower Scheme (based on 1:50,000 scaled map)
JAPAN INTERNATIONAL COOPERATION AGENCY	



STUDY OF ELECTRIC POWER DEMAND & SUPPLY IN SAMOA

JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX 5.4 (5) Site Reconnaissance of New Hydro
Sili Hydropower Scheme
Site Photographs

6. POWER SUPPLY PLANNING

6.1 EXISTING GENERATING PLANTS

6.1.1 GENERATING PLANTS IN UPOLU

The generating power plants in Upolu consist of approximately 29.2 MW of diesel and 11.3 MW of hydro power plants in their de-rated capacity basis. The details of those power plants are explained in Chapter 3 and 4. Outline of those power plants is given in Table 6.1.1. For the hydropower plants, only Taelefaga power station is reservoir type and the remaining are run-of-river (ROR) type with small regulating head-pond. The dry season capacity (dependable capacity) proposed in this study for the power supply planning study is discussed later.

Table 6.1.1 Details of Generating Plants in Upolu

Scheme	Installed Capacity (kW)	De-rated Capacity (kW)	Estimated Retirement (Year)	Manufactured/ Commission Year
Hydro				
Alaoa	1,045	1,000	2009	1959
Samasoni	2x950	1,360	2021	1982
Fale ole Fee	1,740	1,600	2031	1981
Lalomauga	2x1,850	3,300	2035	1984
Taelefaga	2x2,000	4,000	2042	1993
Hydro Total	12,390	11,260	-	-
Diesel				
No. 4A	2,200	1,800	2020	1968/1996
No. 5A	4,200	4,200	2021	2000/2001
No. 7A	4,200	4,200	2020	1998/1999
No. 9A	4,200	4,200	2022	2001/2002
No. 12	3,500	3,500	2014	1991/1992
No. 8	2,000	0	2003	1978/1979
Dieasel Total	20,495	17,900	-	-
Total	32,685	29,160	-	-

6.1.2 GENERATING PLANTS IN SAVAII

Savaii system has two diesel power plants, namely Salelologa and Vaipouli. No hydro scheme is developed. Outline of diesel power plants is given in Table 6.1.2 and its detail in Chapter 3.

Table 6.1.2 Details of Generating Plants in Savaii

Scheme	Installed Capacity (kW)	De-rated Capacity (kW)	Estimated Retirement (Year)	Manufactured/ Commission Year
Salelologa				
No. 1A	800	750	2008	1994/2001
No. 2B	400	350	2006	1994/2001
No. 3A	800	750	2008	1994/2001
No. 5A	1,000	800	2008	1993/1999
No.8	1,400	1,000	2010	1993/2002
No. 4	400	0	2003	?/1992
No. 6	400	0	2003	1994/1996
No. 7A	1,000	0	2003	1980/1997
Vaipouli				
No. 1	130	80	2004	?/1989
No. 2	200	150	2004	?/1989
No. 4	400	280	2004	?/1989
No. 3	300	0	2003	?/1997
Diesel Total	7,230	4,160	-	-

6.2 FIRM CAPACITY AND ENERGY OF EXISTING HYDRO

6.2.1 DEPENDABLE CAPACITY AND ENERGY IN PREVIOUS STUDIES

Detail of dependable output and firm energy used for their power supply planning study are shown in the Gibb's study report in 1991. However, no certain figures of estimated those values except for dependable outputs of each hydro power plants in dry season are explained in the HECEC's report in 1997. Those values clearly indicated in their reports are given in Table 6.2.1 together with estimated continuous operating hours checked in this study.

Table 6.2.1 Firm Output and Energy Estimated in The Report

	Alaoa	Samasoni	F.O.F	Lalomauga	Total
(Gibb's Report, 1991)					
Firm Output and Energy in The Report					
Wet Season					
Output (kW)	1,000	1,600	1,600	3,500	7,700
Energy (MWh/mth)	280	340	290	570	1,480
Dry Season					
Output (kW)	310	320	350	380	1,360
Energy (MWh/mth)	117	110	107	194	528
Estimated Operating Hours Checked in This Study					(Average)
Wet Season	9.3	7.1	6.0	5.4	6.4
Dry Season	12.6	11.5	10.2	17.0	6.4
(HECEC's Report,1997					
Outut in Dry Season	200	300	300	1,200	2,000

The above estimated operating hours of each plant in dry season checked in this study seem to have not something in common. This means that the dependable output of each plant is decided from the estimated firm energy without any certain criteria. As for the dependable outputs in wet season used in their study, they are same with de-rated maximum capacity of plant and are decided without any

consideration on reliable and stable power supply to the system.

Similar dependable output and firm energy are adopted by EPC in their development plan.

6.2.2 REVIEW OF DEPENDABLE OUTPUT AND FIRM ENERGY IN THIS STUDY

In this study, the dependable output and firm energy in wet and dry seasons are reviewed by means of using actual operating records for 9.5 years, namely monthly energy generated by each plant, because of no available records on daily river inflow at the intake weirs. As explained in Clause 2.3.1, the monthly energy generated by plant from June 1993 to December 2002 (115 months) is collected. Among these data, data of the month with outage of its operation more than 5 days per month are eliminated from the review, because of less effective use of available inflow. However, for Samasoni and Lalomauga power stations, one unit operation during dry month are considered as effective. Number of effective data subject to the review study are given in Table 6.2.2.

Table 6.2.2 Number of Monthly Generation Data

	Alaoa	Samasoni	F.O.F	Lalomauga	Taelefaga
Total Months	115	115	105	115	114
Eliminated Months	1	1	3	1	2
Effective Months	114	114	102	114	112
For Wet Season	56	56	50	55	56
For Dry Season	58	58	52	59	56

The firm energy of each plant is worked out from the monthly generation duration curves. These curves are illustrated on Figure 6.2.1. As shown by curves on Figure 6.2.1, Samasoni power station has the biggest difference of generated energy between wet and dry seasons, the second is Faele ole Fee. the third is Alaoa. The difference of Lalomauga power station is very small.

Averaged generated energy, annual plant factor against the de-rated capacity and a firm energy having 90 %, 80 % and 70 % probability by season and by plant calculated from those monthly generated energy and their duration curves, and are given in Table 6.2.3.

As shown in Figure 2.3.5 and 2.3.6, a duration hour of loads more than 80 % of the daily peak demand of weekday is 11 hours in the dry season and 10 hours in the wet season. The dependable outputs by probability are calculated on the basis of the above-mentioned firm energy and these high load duration hours (10 hours) and are given in Table 6.2.4.

Table 6.2.3 Calculated Firm Energy

	Alaoa	Samasoni	F.O.F	Lalomauga	Taelefaga
Averaged Monthly Energy Potential (MWh/mth)					
Wet Season Average	386	646	462	941	1,550
Dry Season Average	284	379	268	795	1,766
Annual Average	335	510	363	867	1,656
Plant Factor (%)					
Wet Season	55.1	64.1	40.1	37.3	53.8
Dry Season	39.4	37.6	23.3	31.6	63.5
Annual	47.1	50.6	31.5	34.4	58.6
Firm Energy (MWh/mth)					
90% Probability					
Wet Season	242	325	249	508	940
Dry Season	171	181	116	348	1,050
Annual	194	219	138	368	966
80% Probability					
Wet Season	309	427	295	587	1,064
Dry Season	207	220	138	534	1,254
Annual	235	287	218	542	1,135
70% Probability					
Wet Season	342	495	348	819	1,198
Dry Season	236	271	201	613	1,364
Annual	257	346	250	635	1,302

Table 6.2.4 Calculated Firm Outputs

	Alaoa	Samasoni	F.O.F	Lalomauga	Taelefaga
Firm Output (kW)					
90% Probability					
Wet Season	807	1,083	831	1,695	3,134
Dry Season	570	604	387	1,161	3,499
Annual	648	729	461	1,228	3,219
80% Probability					
Wet Season	1,000	1,360	984	1,956	3,548
Dry Season	689	732	461	1,745	4,000
Annual	784	1,360	727	1,806	3,740
70% Probability					
Wet Season	1,000	1,360	1,159	2,730	3,995
Dry Season	786	903	671	2,043	4,000
Annual	857	1,360	1,360	2,116	4,000

From the above tables, both the firm energy and dependable outputs of run-of-river schemes in the previous study seem as follows.

(i) The firm energy and dependable output in dry season are under-estimated.

(ii) The firm energy and dependable output in wet season are conversely over-estimated. Therefore, as a result, system reliability in wet season seems to be lower than that in dry season.

The firm energy and dependable output adopted for the power supply plannings study will be discussed in later.

6.3 NEW GENERATION OPTION

6.3.1 DIESEL GENERATING PLANTS

For future generation expansion, new diesel generating machine with a capacity of 4.0 MW is adopted throughout study horizon as commented in Chapter 3, of which capacity is less than 25 % of the present maximum peak demand.

For the Savaii system, a machine with a capacity 600 kW to 1,000 kW is recommended in Chapter 3. Therefore, for this study, a new machine with a capacity of 800 kW which is less than 30 % of the present maximum peak demand is recommended taking system reliability and low investment cost into consideration, because adoption of bigger machine needs bigger reserve capacity. However, with increasing of power demand of the system, a machine with a capacity of 1,400 kW will be adopted for the peak loads more than 4.7 MW.

6.3.2 RECOMMENDED NEW HYDRO SCHEME

As recommended in Chapter 5, the following hydro potential schemes will be considered for this study taking accounts of its estimated commissioning year.

Table 6.3.1 Candidates of Hydro Potential Scheme

Name of Project	Installed Capacity (kW)	Annual Energy (GWh/yr)			Estimated Capital Cost (US$M)	Estimated Commission Year
		Firm Energy Output	Secondary Energy Output	Total Energy Output		
Upolu						
Afulilo Augmentation	2,000	n.a	n.a	7.2 *1	6.60 *2	2006
Namo No.3	880	1.32	3.14	4.47	6.78	2007
Lotofaga	910	1.00	3.58	4.58	8.21	2010
Namo No.1	860	1.35	3.03	4.37	8.24	2013
Savaii						
Sili No.1 (First)	1,180	1.36	4.61	5.97	9.85	2007
Sili No.1 (Second)	1,800	2.40	6.99	9.38	12.93	2010
Sili No.2	1,600	3.49	4.80	8.29		2013

Remarks: *1: Sources: Table 10.9 of Vol-2 of HECEC's report, additional energy for "3rd machine, 15x10^6 storage & 40% exstra inflow".
*2: Sources: report of "Hydropower Specialist Review for Afulilo Hydroelectric Power Station Augmentation, PPTA-3203-SAM, by Worley, Sep. 2000"

6.4 ASSUMPTIONS FOR POWER SUPPLY PLANNING

6.4.1 FIRM ENERGY AND DEPENDABLE OUTPUT OF EXISTING HYDRO PLANTS

(1) Wet Season

For the wet season, dependable output and firm energy shall also be strictly considered for power supply planning, because, from the recorded rainfall data in the monthly reports prepared by EPC, many dry months similar to that in the dry season are observed even in the wet season. Therefore, the same criterion for the dry season is recommended for determining dependable output and firm energy in the wet season except for Taelefaga plant, i.e. dependable output and firm energy with 90 % probability. The recommended dependable output and firm energy by plant are given in Table 6.4.1.

Table 6.4.1 Dependable Output and Firm Energy in Wet Season

	Alaoa	Samasoni	F.O.F	Lalomauga	Taelefaga	Total
Dependable Output (MW)	0.81	1.08	0.83	1.70	4.00	8.42
Firm Energy (GWh/Season)	1.45	1.95	1.49	3.05	5.64	13.60

As for the Taelefaga power plant, the plant shall be operated with a higher priority for filling up the reservoir through the wet season before starting dry season. Therefore, firm energy with 90 % probability in the wet season is recommended. However, for the dependable output, de-rated capacity of 4.0 MW is recommended, because the plant has a capability of continuous operation for short-term basis (a few days) with full rated capacity when power supply shortage occurs due to forced outage of the other power plant(s) in the system, by using stored water.

As for the Alaoa power plant, the timing of its retirement is estimated at 2009 taking accounts of a practical lifetime of the hydro power plant as explained in Chapter 4. However, it is assumed for the power supply planning study that the Alaoa plant will be renewed with similar installed capacity and its dependable output and firm energy will be available with two years gap for the renewal works.

(2) Dry Season

For the dry season, adoption of dependable output and firm energy with 90 % reliability except Taelefaga plant are recommended and its detail are given in Table 6.4.2.

Table 6.4.2 Dependable Output and Firm Energy in Dry Season

	Alaoa	Smasoni	F.O.F	Lalomauga	Taelefaga	Total
Dependable Output (MW)	0.57	0.60	0.39	1.16	4.00	6.72
Firm Energy (GWh/Season)	1.02	1.09	0.70	2.09	6.30	11.20

As for Taelefaga power plant, 90 % probable firm energy is recommended for the power supply planning study, because the capability of energy supply in the dry season largely depends on the stored water at the beginning of dry season and additional inflow during dry season. For the dependable output, de-rated capacity is adopted for the study with the same reason for the wet season.

6.4.2 CANDIDATES OF ADDITIONAL PLANTS

(1) Diesel Power Plants

As explained in Clause 6.3.1, a machine with a capacity of 4.0 MW is recommended for the Upolu system throughout study horizon. For Savaii system, a machine with a capacity of 800 kW is recommended and 1,400 kW machine for the peak loads more than 4.7 MW.

(2) Hydro Potential Schemes

As explained in Clause 6.3.2, developments of the following hydro potentials are considered for the power supply planning study taking accounts of estimated its commissioning year which are worked out from its construction period including preparatory works in Chapter 5. The dependable output and firm energy of candidates of hydro potential schemes adopted for the power supply planning study are worked out on the basis of the relation between yearly firm energy and firm energy of each season of the each plant shown in Clause 6.2.2, because only annual firm energy with 90 % probability is available in the study in Chapter 5. The results of estimation on dependable output and firm energy by season given in Table 6.4.3 are recommended for the power supply planning study.

Table 6.4.3 Dependable Output and Firm Energy for New Hydro Projects

Project Name	Wet Season		Dry Season	
	Dependable Output (MW)	Firm Energy (GWh)	Dependable Output (MW)	Firm Energy (GWh)
Upolu				
Afulilo Augmentation	1.80	1.84	1.80	2.05
Namo No.3	0.53	0.95	0.33	0.59
Lotofaga	0.40	0.72	0.25	0..44
Namo No.1	0.54	0.97	0.33	0.60
Savaii				
Sili No.1 (First)	0.55	0.98	0.34	0.61
Sili No.1 (Second)	0.96	1.73	0.59	1.07
Sili No.2	1.39	2.51	0.86	1.55
Total	4.37	7.86	2.70	4.86

As for the Afulilo Augmentation project, the dependable output of 1.8 MW, of which value is used in HECEC's report, is adopted for the power supply planning study and applied to both the seasons. The firm energy are estimated on the basis of additional estimated annual energy taken from Table 10.9, Volume 2 of HECEC's report.

6.4.3 RESERVE CAPACITY

N-1-20 % reserve capacity used in HECEC's report used for counter-check of a reliability of the planned expansion plan worked out on the basis of the LOLE criteria is adopted for this study.

6.4.4 EXAMINATION OF LOSS OF LOAD PROBABILITY (LOLP)

Enough time was not available for making detail LOLP study. However, the LOLP study on the expansion plan of Upolu system with similar scale from 1997 to 2010 was made in the HECEC's report with a counter–check of N-1-20 % of reserve capacity criteria. Therefore, a power supply planning study of this study has similar or more higher level of the system reliability than that of the report, because of adoption of N-1-20 % reserve capacity criteria with a similar margin indicated in the report and more severe dependable output and firm energy for the wet season.

6.4.5 LEAST COST DEVELOPMENT STUDY

As explained in Clause 1.2, one of major objectives of this study is to seek some possibility for developing hydropower potentials in Upolu and Savaii. The team is intending to make clear the future generation expansion program in Upolu and Savaii in case of some feasible hydropower potentials have been developed, for effective use of renewal energy and reducing CO_2 due to consumption of fossil fuel.

6.5 RESULTS OF POWER SUPPLY PLANNING STUDY

6.5.1 UPOLU SYSTEM

The results of power supply planning study conducted with the above-mentioned assumptions for the median demand forecast are given in Table 6.5.1, for lowest forecast in Table 6.5.2 and for highest demand forecast in Table 6.5.3. In addition to these studies, a power supply planning study of 6.5 % AAGR is made for the condition without any development of new hydro schemes except for Afulilo Augmentation Project presently under the detailed design for evaluating the effect of new hydro potential development. The result of the study is given in Table 6.5.4.

The energy balance of the power supply plan (AAGR: 6.5 %) with and without new hydro potential development are also examined for two cases, namely firm energy and averaged energy generation basis, and its results are given in Table 6.5.5 and 6.5.6.

As shown in the table from Table 6.5.1 to 6.5.4, timing of additional diesel units required for the stable power system operation up to 2015 are given in Table 6.5.7.

Table 6.5.7 Required Additional Diesel Units for Upolu

	AGGR			Without Hydro (AAGR: 6.5%)
	6.5 %	4.0 %	9.0 %	
No. 1	2004	2005	2004	2004
No. 2	2008	2010	2006	2008
No. 3	2010	2014	2008	2010
No. 4	2011		2009	2011
No. 5	2013		2010	2013
No. 6			2012	2015
No. 7			2013	
No. 8			2014	
No. 9			2015	
No. 10			2015	

As shown in Table 6.5.7, the effect of the development of new hydro potentials is appeared not so clear, because of its total installed capacity of 3.7 MW which is smaller than unit capacity of additional diesel generator (4.0 MW).

6.5.2 SAVAII SYSTEM

As same as the Upolu system, the results of power supply planning study are given in Table 6.5.8, 6.5.9 and 6.5.10 for each recommended AAGR, the results of the study without development hydro potentials (AAGR: 6.5 %) are in Table 6.5.11, and the energy balance for with and without hydro development are in Table 6.5.12 and 6.5.13.

Timing of required diesel unit addition for Savaii system is given in Table 6.5.14.

Table 6.5.14 Required Additional Diesel Units for Savaii

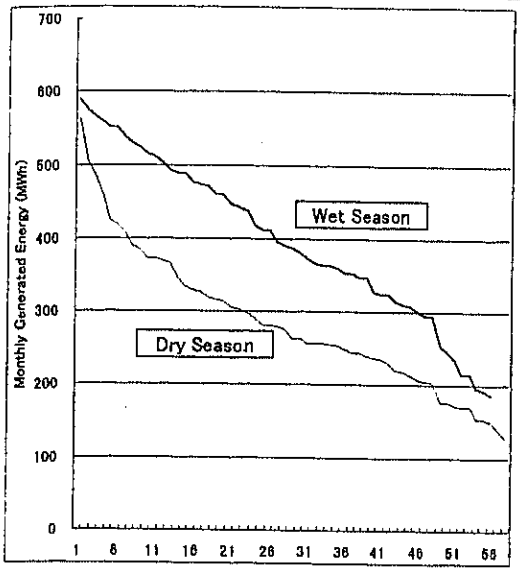
	AGGR			Without Hydro (AAGR: 6 %)
	6.0 %	3.0 %	8.0 %	
No. 1	2003	2003	2003	2003
No. 2	2005	2005	2005	2005
No. 3	2006	2007	2006	2006
No. 4	2008	2009	2007	2008
No. 5	2009	2009	2008	2008
No. 6	2009	2011	2009	***2011***
No. 7	2010		***2009***	***2012***
No. 8	***2012***		***2010***	***2015***
No. 9			***2012***	

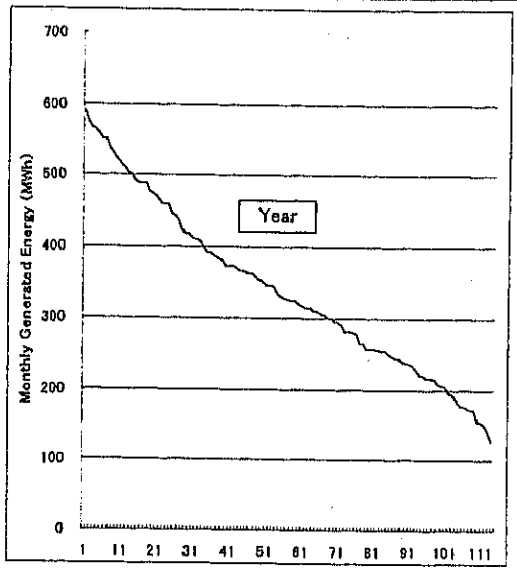
Remark: Bold and italic letter shows a machine having capacity of 1,400 kW.

As shown in Table 6.5.12, generation by diesel becomes almost zero after the development of Sili No.2 in case of using averaged energy generation of the hydro plants to be developed.

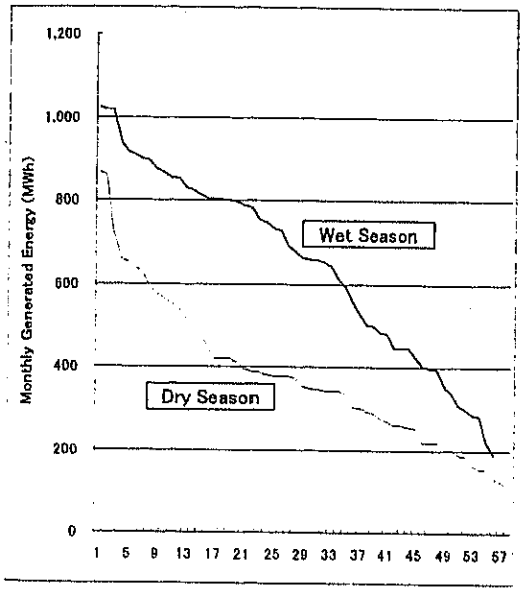
6.6 RECOMMENDATION

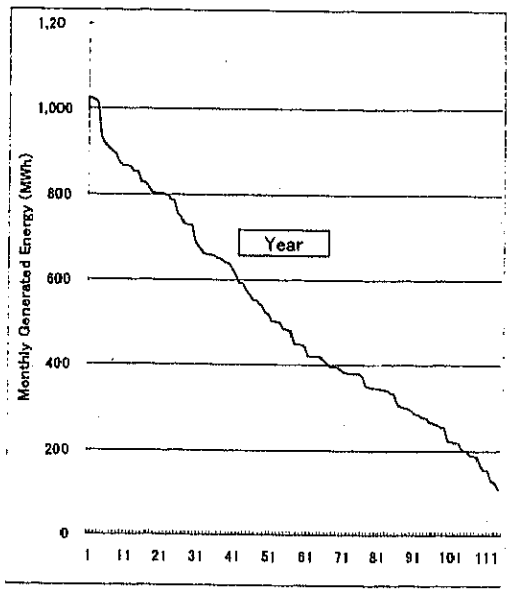
The dependable output and firm energy of the existing hydro plants for both the seasons are estimated on the basis of monthly energy duration curves for 9.5 years due to no available daily inflow data at the intake sites. In this connection, it is recommended that facilities for measuring daily inflow shall be installed at the intake weirs and dependable output and firm energy used for a power supply planning shall be decided from the inflow duration curves worked out using accumulated long-term daily inflow data in future.



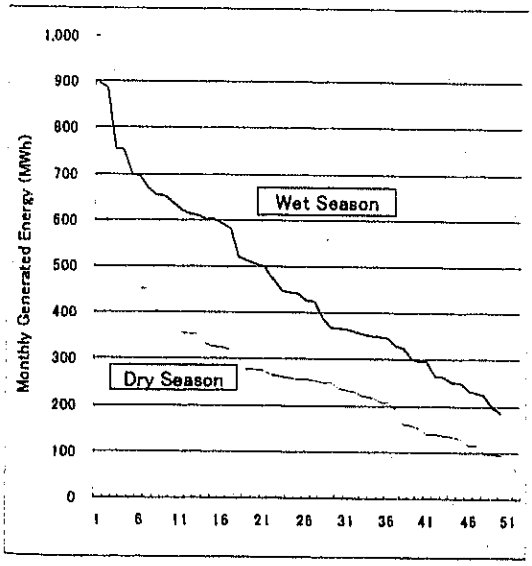


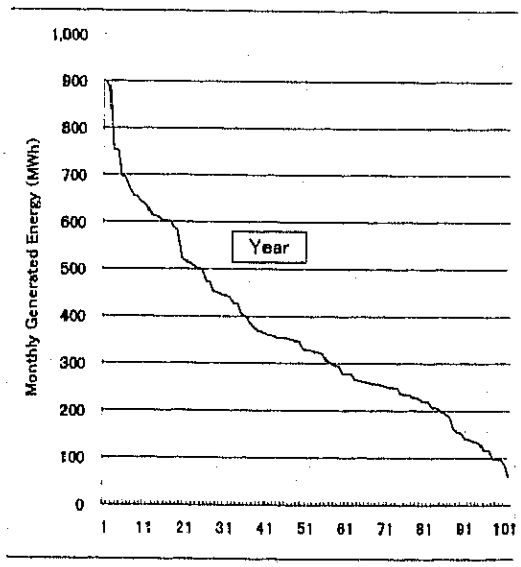
Alaoa Power Station





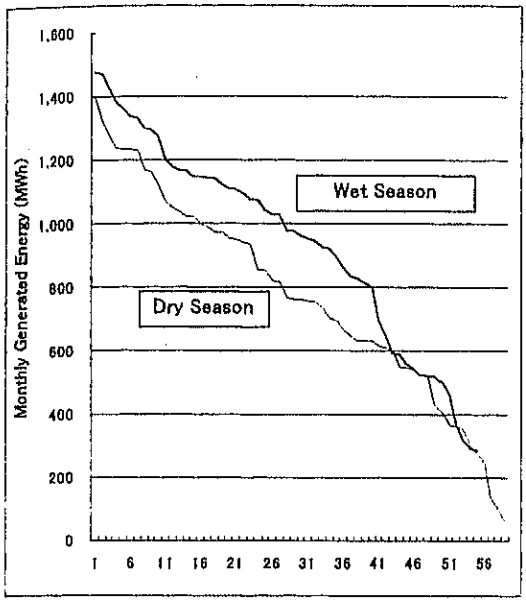
Samasoni Power Station

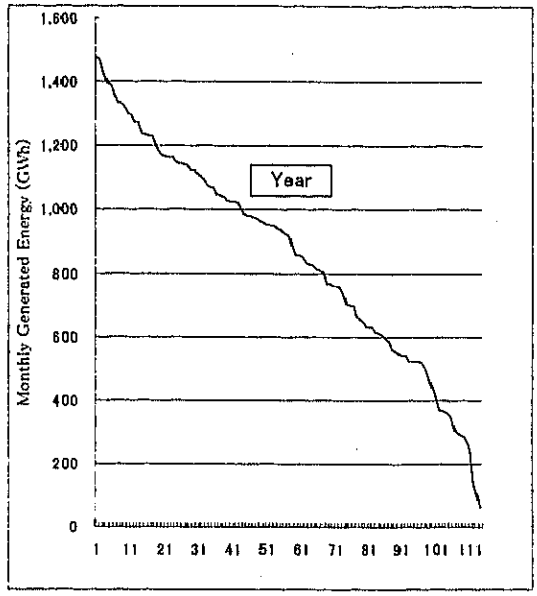




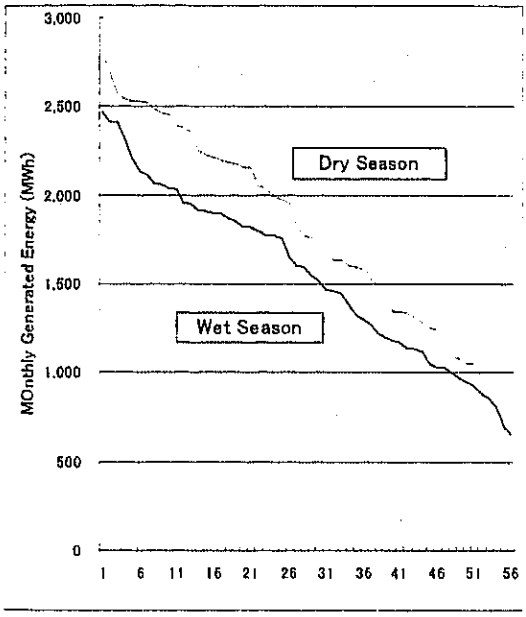
Fale ole Fee Power Station

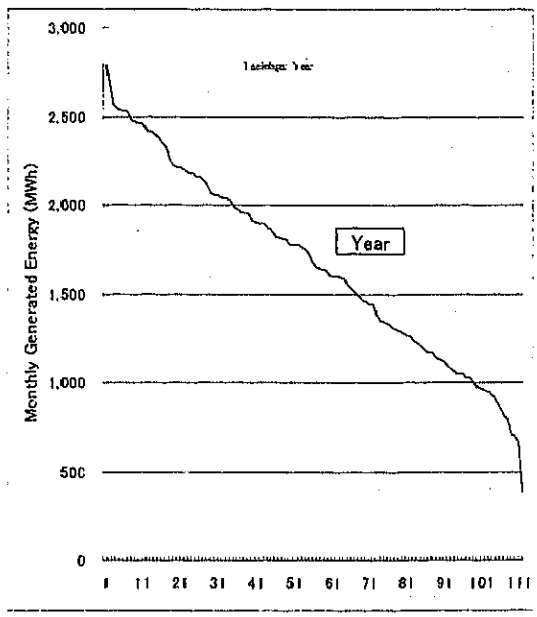
Figure 6.2.1 Monthly Generated Energy Duration Curves (1/2)





Lalomauga Power Station





Taelefaga Power Station

Figure 6.2.1 Monthly Generated Energy Duration Curves (2/2)

Table 6.5.1 Power Supply Plan upto 2015 of Upolu (6.5 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Hydro: ROR																										
Alaoa	0.57	0.81	0.57	0.81	0.57	0.81	0.57	0.81	0.57	0.81	0.57	0.81					0.57	0.81	0.57	0.81	0.57	0.81	0.57	0.81	0.57	0.81
Samasoni	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08
F.O.F	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83
Lalomauga	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70
Hydro: Dam	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
New Hydro																										
AfuliloAugmentation							1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Namo No.3									0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53
Lotofaga															0.25	0.40	0.25	0.40	0.25	0.40	0.25	0.40	0.25	0.40	0.25	0.40
Namo No.1																					0.33	0.54	0.33	0.54	0.33	0.54
Total Hydro	6.72	8.42	6.72	8.42	6.72	8.42	8.52	10.22	8.85	10.75	8.85	10.75	8.28	9.94	8.53	10.34	9.10	11.15	9.10	11.15	9.43	11.69	9.43	11.69	9.43	11.69
Diesel: Existing																										
No. 4A	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80												
No. 5A	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
No. 7A	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
No 9A	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
No. 12	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Diesel: New Addition																										
No. 1			4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No. 2											4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No. 3															4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No 4																	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No. 5																					4.00	4.00	4.00	4.00	4.00	4.00
Total Diesel	17.90	17.90	21.90	21.90	21.90	21.90	21.90	21.90	21.90	21.90	25.90	25.90	25.90	25.90	28.10	28.10	32.10	32.10	32.10	32.10	36.10	36.10	36.10	36.10	36.10	36.10
Available Capacity	24.62	26.32	28.62	30.32	28.62	30.32	30.42	32.12	30.75	32.65	34.75	36.65	34.18	35.84	36.63	38.44	41.20	43.25	41.20	43.25	45.53	47.79	45.53	47.79	45.53	47.79
Peak Demand	16.86	16.86	17.96	17.96	19.12	19.12	20.37	20.37	21.69	21.69	23.10	23.10	24.60	24.60	26.20	26.20	27.91	27.91	29.72	29.72	31.65	31.65	33.71	33.71	35.90	35.90
Margin	7.76	9.46	10.66	12.36	9.50	11.20	10.05	11.75	9.06	10.96	11.65	13.55	9.58	11.24	10.43	12.24	13.29	15.34	11.48	13.53	13.88	16.14	11.82	14.08	9.63	11.89
Reserve Capacity	8.28	8.62	9.08	9.42	9.08	9.42	9.44	9.78	9.51	9.89	10.31	10.69	10.20	10.53	10.69	11.05	11.60	12.01	11.60	12.01	12.47	12.92	12.47	12.92	12.47	12.92
Max. Unit	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
20% of Remain	4.08	4.42	4.88	5.22	4.88	5.22	5.24	5.58	5.31	5.69	6.11	6.49	6.00	6.33	6.49	6.85	7.40	7.81	7.40	7.81	8.27	8.72	8.27	8.72	8.27	8.72
Balance	-0.53	0.83	1.58	2.94	0.41	1.77	0.61	1.97	-0.45	1.07	1.34	2.86	-0.62	0.71	-0.26	1.19	1.69	3.33	-0.12	1.52	1.41	3.22	-0.65	1.16	-2.84	-1.03

Table 6.5.2 Power Suuply Plan upto 2015 of Upolu (4.0 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Hydro: ROR																										
Alaoa	0 57	0 81	0 57	0 81	0 57	0 81	0 57	0 81	0.57	0 81	0 57	0.81					0.57	0.81	0.57	0.81	0.57	0.81	0.57	0.81	0.57	0.81
Samasoni	0 60	1 08	0 60	1 08	0 60	1.08	0 60	1 08	0.60	1 08	0 60	1.08	0.60	1 08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08
F.O.F	0 39	0.83	0 39	0 83	0 39	0.83	0.39	0 83	0.39	0 83	0 39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0 39	0.83	0.39	0.83	0.39	0.83
Lalomauga	1 16	1 70	1.16	1 70	1 16	1 70	1 16	1 70	1.16	1 70	1.16	1.70	1.16	1 70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70
Hydro Dam	4.00	4 00	4 00	4 00	4 00	4 00	4 00	4.00	4.00	4 00	4 00	4.00	4.00	4 00	4 00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
New Hydro																										
AfuliloAugmentation							1 80	1 80	1.80	1 80	1 80	1.80	1 80	1.80	1.80	1.80	1.80	1.80	1.80	1 80	1.80	1.80	1.80	1.80	1.80	1.80
Namo No 3									0.33	0 53	0 33	0.53	0.33	0 53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53
Lotofaga															0.25	0.40	0.25	0.40	0.25	0.40	0.25	0.40	0.25	0.40	0.25	0.40
Namo No 1																					0.33	0.54	0.33	0.54	0.33	0.54
Total Hydro	6.72	8.42	6.72	8 42	6.72	8.42	8.52	10.22	8.85	10 75	8 85	10.75	8.28	9.94	8.53	10.34	9.10	11.15	9.10	11.15	9.43	11.69	9.43	11.69	9.43	11.69
Diesel. Existing																										
No 4A	1 80	1 80	1 80	1 80	1 80	1 80	1 80	1 80	1.80	1 80	1 80	1.80	1.80	1 80												
No. 5A	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4.20	4 20	4 20	4.20	4.20	4 20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
No. 7A	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4.20	4 20	4 20	4.20	4.20	4 20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
No. 9A	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4.20	4 20	4 20	4.20	4.20	4 20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
No 12	3 50	3 50	3 50	3 50	3 50	3.50	3 50	3 50	3 50	3 50	3 50	3.50	3 50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Diesel New Addition																										
No 1					4 00	4 00	4 00	4 00	4 00	4 00	4 00	4.00	4 00	4 00	4 00	4.00	4.00	4.00	4.00	4.00	4 00	4.00	4.00	4.00	4.00	4.00
No 2															4 00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No. 3																							4.00	4.00	4.00	4.00
Total Diesel	17 90	17 90	17 90	17 90	21 90	21 90	21 90	21 90	21 90	21 90	21 90	21 90	21 90	21 90	24 10	24 10	24 10	24 10	24 10	24 10	24 10	24 10	28 10	28 10	28 10	28 10
Available Capacity	24 62	26 32	24 62	26 32	28 62	30.32	30 42	32 12	30 75	32 65	30 75	32.65	30 18	31 84	32 63	34.44	33.20	35.25	33.20	35.25	33.53	35.79	37.53	39.79	37 53	39.79
Peak Demand	16 47	16 47	17 12	17 12	17 81	17.81	18 52	18 52	19.26	19.26	20 03	20.03	20 83	20.83	21.67	21.67	22.53	22.53	23.44	23.44	24.37	24.37	25.35	25.35	26.36	26.36
Margin	8 15	9 85	7 50	9.20	10 81	12.51	11.90	13.60	11.49	13 39	10 72	12.62	9.35	11.01	10.96	12.77	10.67	12.72	9.76	11.81	9.16	11.42	12.18	14.44	11.17	13.43
Reserve Capacity	8 28	8.62	8 28	8 62	9 08	9.42	9 44	9 78	9.51	9 89	9 51	9.89	9 40	9 73	9 89	10.25	10.00	10.41	10.00	10.41	10.07	10.52	10.87	11.32	10.87	11.32
Max. Unit	4.20	4 20	4 20	4 20	4 20	4.20	4 20	4.20	4.20	4 20	4 20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
20% of Remain	4.08	4 42	4 08	4 42	4 88	5 22	5.24	5.58	5.31	5.69	5 31	5.69	5.20	5.53	5.69	6.05	5.80	6.21	5.80	6.21	5.87	6.32	6.67	7.12	6.67	7.12
Balance	-0 13	1 23	-0.79	0 57	1 73	3.09	2.45	3.81	1.98	3.50	1.21	2.73	-0.05	1.28	1.08	2.52	0.67	2.31	-0.24	1.40	-0.91	0.90	1.32	3.12	0.30	2.11

Table 6.5.3 Power Suuply Plan upto 2015 of Upolu (9.0 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Hydro. ROR																										
Alaoa	0 57	0 81	0 57	0 81	0 57	0 81	0 57	0 81	0 57	0 81	0 57	0 81														
Samasoni	0 60	1 08	0 60	1 08	0 60	1 08	0 60	1 08	0.60	1 08	0 60	1.08	0 60	1.08	0.60	1.08	0.57	0.81	0.57	0.81	0.57	0.81	0.57	0.81	0.57	0.81
F.O.F	0 39	0 83	0 39	0 83	0 39	0 83	0 39	0 83	0.39	0 83	0 39	0.83	0 39	0 83	0.39	0.83	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08
Lalomauga	1 16	1 70	1 16	1 70	1 16	1 70	1 16	1 70	1.16	1 70	1.16	1.70	1.16	1 70	1 16	1.70	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83
Hydro. Dam	4 00	4 00	4 00	4 00	4 00	4 00	4 00	4 00	4.00	4 00	4 00	4.00	4.00	4 00	4.00	4.00	1.16	1.70	1.16	1.70	1 16	1.70	1.16	1.70	1.16	1.70
New Hydro																	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
AfuliloAugmentation							1 80	1 80	1.80	1 80	1.80	1.80	1.80	1 80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Namo No.3									0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53	0.33	0.53
Lotofaga															0.25	0.40	0.25	0.40	0.25	0.40	0.25	0.40	0.25	0.40	0.25	0.40
Namo No 1																					0.33	0.54	0.33	0.54	0.33	0.54
Total Hydro	6.72	8.42	6.72	8.42	6.72	8.42	8.52	10.22	8.85	10.75	8.85	10.75	8.28	9.94	8.53	10.34	9.10	11.15	9.10	11.15	9.43	11.69	9.43	11.69	9.43	11.69
Diesel. Existing																										
No. 4A	1 80	1 80	1 80	1 80	1 80	1 80	1 80	1 80	1.80	1 80	1.80	1.80	1 80	1 80												
No. 5A	4 20	4.20	4 20	4 20	4 20	4 20	4 20	4.20	4.20	4 20	4 20	4.20	4.20	4 20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
No. 7A	4 20	4 20	4 20	4 20	4 20	4.20	4 20	4 20	4.20	4 20	4 20	4.20	4 20	4 20	4.20	4 20	4.20	4.20	4.20	4 20	4.20	4.20	4.20	4.20	4.20	4.20
No 9A	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4.20	4 20	4 20	4.20	4 20	4 20	4.20	4 20	4.20	4.20	4.20	4 20	4.20	4.20	4.20	4.20	4.20	4.20
No. 12	3 50	3 50	3 50	3 50	3 50	3 50	3 50	3 50	3.50	3 50	3 50	3.50	3.50	3 50	3 50	3 50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Diesel. New Addition																										
No. 1			4 00	4 00	4 00	4 00	4 00	4 00	4.00	4 00	4 00	4.00	4 00	4.00	4 00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No. 2							4 00	4 00	4.00	4 00	4 00	4.00	4 00	4.00	4 00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No. 3											4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No. 4													4 00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No 5															4 00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No 6																	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No. 7																			4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No. 8																					4.00	4.00	4.00	4.00	4.00	4.00
No. 9																							4.00	4.00	4.00	4.00
No 10																									4.00	4.00
																									4.00	4.00
Total Diesel	17.90	17 90	21.90	21.90	21 90	21.90	25 90	25 90	25.90	25.90	29 90	29.90	33.90	33.90	36.10	36.10	36.10	36.10	40.10	40.10	44.10	44.10	48.10	48.10	56.10	56.10
Available Capacity	24.62	26 32	28.62	30 32	28 62	30.32	34 42	36 12	34.75	36 65	38 75	40 65	42 18	43.84	44.63	46.44	45.20	47.25	49.20	51.25	53.53	55.79	57.53	59.79	65.53	67.79
Peak Demand	17 26	17 26	18 81	18 81	20 50	20.50	22 35	22 35	24.36	24 36	26.55	26.55	28.94	28.94	31.55	31.55	34.39	34.39	37.48	37.48	40.85	40.85	44.53	44.53	48.54	48.54
Margin	7.36	9 06	9.81	11 51	8 12	9.82	12.07	13 77	10.39	12 29	12.20	14.10	13.24	14.90	13.08	14.89	10.81	12.86	11.72	13.77	12.68	14.94	13.00	15 26	16.99	19.25
Reserve Capacity	8.28	8.62	9.08	9 42	9.08	9.42	10.24	10.58	10.31	10.69	11.11	11.49	11.80	12.13	12.29	12.65	12.40	12.81	13.20	13.61	14.07	14.52	14.87	15.32	16.47	16.92
Max. Unit	4.20	4 20	4.20	4 20	4 20	4.20	4.20	4 20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
20% of Remain	4.08	4.42	4.88	5.22	4.88	5.22	6.04	6.38	6.11	6.49	6.91	7.29	7.60	7.93	8.09	8.45	8.20	8.61	9.00	9.41	9.87	10.32	10.67	11.12	12.27	12.72
Balance	-0.92	0.44	0.73	2.09	-0 97	0.39	1.83	3.19	0.08	1.60	1.09	2.61	1.44	2.77	0.80	2.24	-1.59	0.05	-1.48	0.16	-1.39	0.42	-1.87	-0.06	0.52	2.33

Table 6.5.4 Power Suuply Plan Without Development of New Hydro Potentials upto 2015 of Upolu (6.5 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Hydro ROR																										
Alaoa	0 57	0 81	0 57	0 81	0 57	0.81	0 57	0 81	0 57	0 81	0 57	0.81														
Samasoni	0 60	1 08	0 60	1 08	0 60	1.08	0 60	1.08	0.60	1 08	0 60	1.08	0 60	1.08	0.60	1 08	0.57	0.81	0.57	0.81	0.57	0.81	0.57	0.81	0.57	0.81
F.O.F	0 39	0 83	0 39	0 83	0 39	0.83	0 39	0 83	0.39	0 83	0 39	0.83	0 39	0 83	0 39	0.83	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08	0.60	1.08
Lalomauga	1 16	1 70	1 16	1 70	1.16	1.70	1 16	1 70	1.16	1.70	1.16	1.70	1 16	1.70	1.16	1.70	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83	0.39	0.83
Hydro. Dam	4 00	4.00	4 00	4.00	4.00	4.00	4 00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70	1.16	1.70
New Hydro																	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Afulilo Augmentation							1 80	1 80	1 80	1 80	1.80	1.80	1 80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Namo No.3																										
Lotofaga																										
Namo No 1																										
Total Hydro	6 72	8 42	6 72	8 42	6 72	8 42	8 52	10 22	8 52	10 22	8 52	10.22	7 95	9.41	7 95	9.41	8.52	10.22	8.52	10.22	8.52	10.22	8 52	10.22	8.52	10.22
Diesel: Existing																										
No. 4A	1 80	1 80	1 80	1 80	1 80	1 80	1 80	1 80	1.80	1 80	1 80	1.80	1.80	1.80												
No. 5A	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4.20	4 20	4 20	4.20	4.20	4 20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
No 7A	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4.20	4 20	4 20	4.20	4.20	4 20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
No 9A	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4 20	4.20	4 20	4 20	4.20	4.20	4 20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
No. 12	3 50	3 50	3 50	3 50	3 50	3 50	3 50	3 50	3.50	3 50	3 50	3.50	3.50	3 50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Diesel. New Addition																										
No 1			4 00	4 00	4 00	4.00	4 00	4 00	4 00	4 00	4 00	4.00	4.00	4 00	4 00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No. 2											4 00	4.00	4.00	4 00	4 00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No. 3															4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No 4																	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
No 5																					4.00	4.00	4.00	4.00	4.00	4.00
No. 6																									4.00	4.00
Total Diesel	17.90	17.90	21.90	21.90	21.90	21.90	21.90	21.90	21.90	21.90	25.90	25.90	25.90	25.90	28.10	28.10	32.10	32.10	32.10	32.10	36.10	36.10	36.10	36.10	40.10	40.10
Available Capacity	24 62	26 32	28.62	30 32	28 62	30.32	30 42	32 12	30.42	32 12	34 42	36.12	33.85	35.31	36.05	37.51	40.62	42.32	40.62	42.32	44.62	46.32	44.62	46.32	48.62	50.32
Peak Demand	16 86	16 86	17 96	17 96	19 12	19 12	20 37	20 37	21 69	21 69	23 10	23.10	24.60	24 60	26.20	26.20	27.91	27.91	29.72	29.72	31.65	31.65	33.71	33.71	35.90	35.90
Margin	7.76	9 46	10 66	12.36	9 50	11.20	10 05	11 75	8.73	10.43	11.32	13.02	9.25	10.71	9.85	11.31	12.71	14.41	10.90	12.60	12.97	14.67	10.91	12.61	12.72	14.42
Reserve Capacity	8.28	8.62	9.08	9.42	9.08	9.42	9.44	9.78	9.44	9.78	10.24	10.58	10.13	10.42	10.57	10.86	11.48	11.82	11.48	11.82	12.28	12.62	12.28	12.62	13.08	13.42
Max. Unit	4.20	4 20	4.20	4 20	4.20	4.20	4.20	4 20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
20% of Remain	4 08	4 42	4 88	5 22	4 88	5.22	5 24	5 58	5.24	5 58	6 04	6.38	5.93	6.22	6.37	6.66	7.28	7.62	7.28	7.62	8.08	8.42	8.08	8.42	8.88	9.22
Balance	-0 53	0 83	1.58	2 94	0.41	1.77	0 61	1.97	-0.72	0.64	1.07	2.43	-0.88	0.28	-0.72	0 45	1.23	2.59	-0.58	0.78	0.68	2.04	-1.37	-0.01	-0.36	1.00

Table 6.5.5 Energy Balance upto 2015 of Upolu (6.5 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Required Energy	48.7	48.7	51.9	51.9	55.3	55.3	58.9	58.9	62.7	62.7	66.8	66.8	71.1	71.1	75.7	75.7	80.7	80.7	85.9	85.9	91.5	91.5	97.4	97.4	103.8	103.8
I) Firm																										
Existing																										
Alaoa	1.03	1.45	1.03	1.45	1.03	1.45	1.03	1.45	1.03	1.45	1.03	1.45					1.03	1.45	1.03	1.45	1.03	1.45	1.03	1.45	1.03	1.45
Samasoni	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95
F.O.F	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49
Lalomauga	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05
Taelefaga	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64
Total of Exist.	11.21	13.58	11.21	13.58	11.21	13.58	11.21	13.58	11.21	13.58	11.21	13.58	10.18	12.13	10.18	12.13	11.21	13.58	11.21	13.58	11.21	13.58	11.21	13.58	11.21	13.58
New Hydro																										
Afulilo Augmentation							2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84
Namo No.3									0.59	0.95	0.59	0.95	0.59	0.95	0.59	0.95	0.59	0.95	0.59	0.95	0.59	0.95	0.59	0.95	0.59	0.95
Lotofaga															0.44	0.72	0.44	0.72	0.44	0.72	0.44	0.72	0.44	0.72	0.44	0.72
Namo No.1																					0.60	0.98	0.60	0.98	0.60	0.98
Total of New Hydro		0.00	0.00	0.00	0.00	0.00	2.05	1.84	2.64	2.79	2.64	2.79	2.64	2.79	3.08	3.51	3.08	3.51	3.08	3.51	3.68	4.49	3.68	4.49	3.68	4.49
Hydro Total	11.2	13.6	11.2	13.6	11.2	13.6	13.3	15.4	13.9	16.4	13.9	16.4	12.8	14.9	13.3	15.6	14.3	17.1	14.3	17.1	14.9	18.1	14.9	18.1	14.9	18.1
Diesel	37.5	35.2	40.7	38.3	44.1	41.7	45.6	43.5	48.9	46.3	52.9	50.4	58.3	56.2	62.5	60.1	66.4	63.6	71.6	68.8	76.6	73.4	82.6	79.4	88.9	85.7
Plant Factor of Diesel (%)	23.9	22.4	21.2	20.0	23.0	21.7	23.8	22.7	25.5	24.2	23.3	22.2	25.7	24.8	25.4	24.4	23.6	22.6	25.5	24.5	24.2	23.2	26.1	25.1	28.1	27.1
II) Averaged Energy																										
Existing																										
Alaoa	1.70	2.38	1.70	2.38	1.70	2.38	1.70	2.38	1.70	2.38	1.70	2.38					1.70	2.38	1.70	2.38	1.70	2.38	1.70	2.38	1.70	2.38
Samasoni	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88
F.O.F	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77
Lalomauga	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65
Taelefaga	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30
Total of Exist.	20.99	23.98	20.99	23.98	20.99	23.98	20.99	23.98	20.99	23.98	20.99	23.98	19.29	21.60	19.29	21.60	20.99	23.98	20.99	23.98	20.99	23.98	20.99	23.98	20.99	23.98
New Hydro																										
Afulilo Augmentation							3.84	3.36	3.84	3.36	3.84	3.36	3.84	3.36	3.84	3.36	3.84	3.36	3.84	3.36	3.84	3.36	3.84	3.36	3.84	3.36
Namo No 3									1.87	2.58	1.87	2.58	1.87	2.58	1.87	2.58	1.87	2.58	1.87	2.58	1.87	2.58	1.87	2.58	1.87	2.58
Lotofaga															2.41	2.19	2.41	2.19	2.41	2.19	2.41	2.19	2.41	2.19	2.41	2.19
Namo No 1																					1.83	2.52	1.83	2.52	1.83	2.52
Total of New Hydro		0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.71	5.94	5.71	5.94	5.71	5.94	8.12	8.13	8.12	8.13	8.12	8.13	9.95	10.65	9.95	10.65	9.95	10.65
Hydro Total	21.0	24.0	21.0	24.0	21.0	24.0	21.0	24.0	26.7	29.9	26.7	29.9	25.0	27.5	27.4	29.7	29.1	32.1	29.1	32.1	30.9	34.6	30.9	34.6	30.9	34.6
Diesel	27.8	24.8	30.9	27.9	34.3	31.3	37.9	34.9	36.0	32.8	40.1	36.9	46.1	43.6	48.3	46.0	51.6	48.6	56.8	53.8	60.6	56.9	66.5	62.8	72.8	69.2
Plant Factor of Diesel (%)	17.7	15.8	16.1	14.6	17.9	16.3	19.8	18.2	18.8	17.1	17.7	16.2	20.3	19.2	19.6	18.7	18.3	17.3	20.2	19.1	19.1	18.0	21.0	19.9	23.0	21.9

Table 6 5 6 Energy Balance Without Development of New Hydro Potentials upto 2015 of Upolu (6.5 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Required Energy	48 7	48.7	51 9	51.9	55 3	55 3	58.9	58.9	62.7	62 7	66 8	66 8	71.1	71.1	75.7	75.7	80.7	80.7	85.9	85.9	91.5	91.5	97.4	97.4	103.8	103.8
I) Firm																										
Existing																										
Alaoa	1 03	1 45	1 03	1 45	1 03	1 45	1 03	1.45	1 03	1 45	1 03	1.45					1 03	1.45	1 03	1.45	1.03	1.45	1.03	1.45	1.03	1.45
Samasoni	1.09	1.95	1 09	1.95	1 09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95	1.09	1.95
F O F	0.70	1 49	0 70	1 49	0 70	1 49	0 70	1 49	0 70	1 49	0.70	1.49	0 70	1 49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49	0.70	1.49
Lalomauga	2 09	3 05	2 09	3 05	2 09	3 05	2.09	3 05	2 09	3 05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05	2.09	3.05
Taelefaga	6.30	5.64	6 30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64	6.30	5.64
Total of Exist	11 21	13 58	11 21	13 58	11 21	13 58	11 21	13.58	11 21	13.58	11.21	13 58	10.18	12.13	10.18	12.13	11.21	13.58	11.21	13.58	11.21	13.58	11.21	13.58	11.21	13.58
New Hydro																										
Afulilo Augmentation							2 05	1.84	2 05	1 84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84
Namo No 3																										
Lotofaga																										
Namo No 1																										
Total of New Hydro		0 00	0 00	0 00	0 00	0 00	2.05	1.84	2.05	1.84	2 05	1.84	2 05	1.84	2.05	1 84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84	2.05	1.84
Hydro Total	11.2	13.6	11.2	13 6	11.2	13 6	13 3	15.4	13.3	15.4	13.3	15.4	12.2	14.0	12.2	14.0	13.3	15.4	13.3	15.4	13.3	15.4	13.3	15.4	13.3	15.4
Diesel	37.5	35 2	40 7	38 3	44 1	41 7	45 6	43.5	49 4	47 3	53.5	51.4	58.9	57 2	63.5	61.8	67.4	65.3	72.7	70.5	78.2	76.1	84.2	82.0	90.5	88.4
Plant Factor of Diesel (%)	23 9	22 4	21 2	20 0	23 0	21 7	23 8	22 7	25 8	24.6	23.6	22.6	26 0	25 2	25 8	25 1	24 0	23.2	25 8	25.1	24.7	24.1	26.6	25.9	25.8	25 2
II) Averaged Energy																										
Existing																										
Alaoa	1 70	2 38	1 70	2 38	1 70	2 38	1 70	2 38	1 70	2 38	1 70	2 38					1.70	2.38	1.70	2.38	1.70	2.38	1.70	2.38	1.70	2.38
Samasoni	2 27	3 88	2 27	3 88	2 27	3 88	2 27	3 88	2 27	3 88	2 27	3 88	2.27	3 88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88	2.27	3.88
F O F	1 61	2 77	1 61	2 77	1 61	2 77	1 61	2 77	1 61	2.77	1 61	2.77	1 61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77	1.61	2.77
Lalomauga	4 77	5 65	4 77	5 65	4 77	5 65	4 77	5 65	4 77	5 65	4 77	5 65	4.77	5 65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65	4.77	5.65
Taelefaga	10 64	9 30	10.64	9.30	10 64	9 30	10.64	9.30	10 64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30	10.64	9.30
Total of Exist	20 99	23 98	20 99	23 98	20 99	23 98	20 99	23 98	20 99	23 98	20 99	23 98	19 29	21 60	19.29	21.60	20.99	23.98	20.99	23.98	20.99	23.98	20.99	23.98	20.99	23.98
New Hydro																										
Afulilo Augmentation							3.84	3 36	3 84	3 36	3 84	3 36	3.84	3 36	3.84	3.36	3.84	3.36	3.84	3.36	3.84	3.36	3.84	3.36	3.84	3.36
Namo No 3																										
Lotofaga																										
Namo No 1																										
Total of New Hydro		0 00	0 00	0 00	0 00	0 00	3 84	3 36	3 84	3 36	3 84	3.36	3.84	3 36	3.84	3.36	3.84	3.36	3 84	3.36	3.84	3.36	3.84	3.36	3.84	3.36
Hydro Total	21.0	24 0	21.0	24.0	21 0	24.0	24 8	27.3	24.8	27.3	24 8	27.3	23 1	25.0	23.1	25.0	24.8	27.3	24.8	27.3	24.8	27.3	24.8	27.3	24.8	27.3
Diesel	27.8	24 8	30.9	27.9	34 3	31 3	34 1	31.5	37 9	35.4	42 0	39 4	48.0	46.2	52.6	50 8	55.8	53.3	61 1	58.6	66.7	64.2	72.6	70.1	79.0	76.4
Plant Factor of Diesel (%)	17 7	15 8	16 1	14 6	17 9	16 3	17 7	16 4	19 7	18 4	18 5	17 4	21.2	20.3	21 4	20.6	19.9	19.0	21.7	20 8	21.1	20.3	23.0	22.2	22.5	21.8

Table 6.5.8 Power Supply Plan upto 2015 of Savaii (6.0 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
New Hydro																										
Sili No. 1 (1)											0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55
Sili No. 1 (2)																	0.59	0.96	0.59	0.96	0.59	0.96	0.59	0.96	0.59	0.96
Sili No.2																							0.86	1.40	0.86	1.40
Total Hydro	0	0	0	0	0	0	0	0	0	0	0.34	0.55	0.34	0.55	0.34	0.55	0.93	1.51	0.93	1.51	0.93	1.51	1.79	2.91	1.79	2.91
Diesel: Existing																										
Salelologa																										
No. 1A	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75																
No. 2B	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35																		
No. 3A	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75														
No. 9A	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80														
No. 8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00										
No. 4	Outage/Retire																									
No. 6	Outage/Retire																									
No. 7A	Outage/Retire																									
Vaipouli																										
No. 1	0.08	0.08	0.08	0.08																						
No. 2	0.15	0.15	0.15	0.15																						
No. 4	0.28	0.28	0.28	0.28																						
No. 3	Outage/Retire																									
Diesel: New Addition																										
No. 1	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 2					0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 3							0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 4											0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 5													0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 6													0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 7															0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 8																			1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
Total Diesel	4.96	4.96	4.96	4.96	5.25	5.25	6.05	6.05	5.70	5.70	5.75	5.75	5.80	5.80	6.60	6.60	5.60	5.60	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Available Capacity	4.96	4.96	4.96	4.96	5.25	5.25	6.05	6.05	5.70	5.70	6.09	6.30	6.14	6.35	6.94	7.15	6.53	7.11	7.93	8.51	7.93	8.51	8.79	9.91	8.79	9.91
Peak Demand	3.12	3.12	3.30	3.30	3.50	3.50	3.70	3.70	3.92	3.92	4.16	4.16	4.40	4.40	4.66	4.66	4.94	4.94	5.23	5.23	5.54	5.54	5.87	5.87	6.22	6.22
Margin	1.84	1.84	1.66	1.66	1.75	1.75	2.35	2.35	1.78	1.78	1.93	2.14	1.74	1.95	2.28	2.49	1.59	2.17	2.70	3.28	2.39	2.97	2.92	4.04	2.57	3.69
Reserve Capacity																										
Max. Unit	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.40	0.80	0.80	0.80	1.40	1.40	1.40	1.40	1.40	1.40	1.40
20% of Remain	0.79	0.79	0.79	0.79	0.85	0.85	1.01	1.01	0.94	0.94	1.02	1.06	1.03	1.07	1.23	1.15	1.15	1.26	1.43	1.42	1.31	1.42	1.48	1.70	1.48	1.70
Balance	0.05	0.05	-0.13	-0.13	-0.10	-0.10	0.34	0.34	-0.16	-0.16	-0.08	0.08	-0.29	-0.12	0.25	-0.06	-0.36	0.11	0.47	0.45	-0.32	0.14	0.04	0.94	-0.31	0.59

Table 6.5.9 Power Supply Plan upto 2015 of Savaii (3.0 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
New Hydro																										
Sili No. 1 (1)											0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55
Sili No. 1 (2)																	0.59	0.96	0.59	0.96	0.59	0.96	0.59	0.96	0.59	0.96
Sili No.2																							0.86	1.40	0.86	1.40
Total Hydro	0	0	0	0	0	0	0	0	0	0	0.34	0.55	0.34	0.55	0.34	0.55	0.93	1.51	0.93	1.51	0.93	1.51	1.79	2.91	1.79	2.91
Diesel Existing																										
Salelologa																										
No. 1A	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75																
No 2B	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35																		
No. 3A	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75														
No. 9A	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80														
No 8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00										
No. 4	Outage/Retire																									
No. 6	Outage/Retire																									
No. 7A	Outage/Retire																									
Vaipouli																										
No 1	0.08	0.08	0.08	0.08																						
No. 2	0.15	0.15	0.15	0.15																						
No 4	0.28	0.28	0.28	0.28																						
No. 3	Outage/Retire																									
Diesel New Addition																										
No. 1	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No 2					0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No 3									0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 4													0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 5													0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 6																	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Total Diesel	4.96	4.96	4.96	4.96	5.25	5.25	5.25	5.25	5.70	5.70	4.95	4.95	5.00	5.00	5.00	5.00	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80
Available Capacity	4.96	4.96	4.96	4.96	5.25	5.25	5.25	5.25	5.70	5.70	5.29	5.50	5.34	5.55	5.34	5.55	5.73	6.31	5.73	6.31	5.73	6.31	6.59	7.71	6.59	7.71
Peak Demand	3.03	3.03	3.12	3.12	3.21	3.21	3.30	3.30	3.40	3.40	3.50	3.50	3.60	3.60	3.71	3.71	3.82	3.82	3.93	3.93	4.04	4.04	4.16	4.16	4.28	4.28
Margin	1.93	1.93	1.84	1.84	2.04	2.04	1.95	1.95	2.30	2.30	1.79	2.00	1.74	1.95	1.63	1.84	1.91	2.49	1.80	2.38	1.69	2.27	2.43	3.55	2.31	3.43
Reserve Capacity																										
Max Unit	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
20% of Remain	0.79	0.79	0.79	0.79	0.85	0.85	0.85	0.85	0.94	0.94	0.86	0.90	0.87	0.91	0.87	0.91	0.99	1.10	0.99	1.10	0.99	1.10	1.16	1.38	1.16	1.38
Balance	0.14	0.14	0.05	0.05	0.19	0.19	0.10	0.10	0.36	0.36	-0.07	0.10	-0.13	0.04	-0.23	-0.07	0.13	0.59	0.02	0.48	-0.10	0.37	0.47	1.37	0.35	1.25

Table 6.5.10 Power Supply Plan upto 2015 of Savaii (8.0 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
New Hydro																										
Sili No 1 (1)											0 34	0.55	0.34	0.55	0.34	0 55	0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55	0.34	0.55
Sili No 1 (2)																	0.59	0.96	0.59	0.96	0.59	0.96	0.59	0.96	0.59	0.96
Sili No.2																							0.86	1.40	0.86	1.40
Total Hydro	0	0	0	0	0	0	0	0	0	0	0 34	0.55	0.34	0.55	0.34	0.55	0.93	1.51	0.93	1.51	0.93	1.51	1.79	2.91	1.79	2.91
Diesel: Existing																										
Salelologa																										
No 1A	0 75	0 75	0 75	0 75	0 75	0 75	0 75	0 75	0.75	0 75																
No 2B	0 35	0 35	0 35	0 35	0 35	0 35	0 35	0 35																		
No 3A	0 75	0 75	0 75	0 75	0 75	0 75	0 75	0 75	0 75	0 75	0 75	0 75														
No 9A	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80														
No. 8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1 00	1.00										
No 4	Outage/Retire																									
No. 6	Outage/Retire																									
No. 7A	Outage/Retire																									
Vaipouli																										
No. 1	0 08	0 08	0 08	0 08																						
No 2	0 15	0 15	0 15	0 15																						
No. 4	0 28	0 28	0 28	0 28																						
No. 3	Outage/Retire																									
Diesel: New Addition																										
No 1	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0 80	0.80	0.80	0.80	0 80	0.80	0.80	0.80	0.80	0.80	0.80
No. 2					0 80	0.80	0 80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No 3							0 80	0 80	0.80	0.80	0.80	0.80	0 80	0 80	0 80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No 4									0 80	0 80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 5											0 80	0.80	0 80	0 80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No 6													0 80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 7													0 80	0 80	0.80	0.80	0.80	0.80	0.80	0 80	0.80	0.80	0.80	0.80	0 80	0.80
No 8													1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
No 9															1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
																			1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
Total Diesel	4 96	4 96	4 96	4 96	5 25	5.25	6 05	6 05	6.50	6 50	6.55	6.55	7.20	7.20	8.60	8.60	7.60	7.60	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Available Capacity	4 96	4 96	4 96	4 96	5 25	5 25	6 05	6 05	6 50	6 50	6 89	7.10	7 54	7.75	8 94	9.15	8.53	9.11	9.93	10.51	9.93	10.51	10.79	11.91	10.79	11.91
Peak Demand	3 18	3 18	3 43	3 43	3 70	3 70	3 99	3 99	4.31	4 31	4.65	4.65	5.02	5 02	5 42	5.42	5.85	5.85	6.31	6.31	6.81	6.81	7.35	7.35	7.93	7.93
Margin	1.78	1.78	1.53	1.53	1.55	1.55	2.06	2.06	2.19	2.19	2.24	2.45	2.52	2.73	3.52	3.73	2.68	3.26	3.62	4.20	3.12	3.70	3.44	4.56	2.86	3.98
Reserve Capacity																										
Max Unit	1 00	1.00	1 00	1 00	1 00	1 00	1 00	1 00	1.00	1 00	1.00	1.00	1 00	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
20% of Remain	0 79	0.79	0 79	0.79	0.85	0.85	1.01	1 01	1.10	1 10	1.18	1.22	1.31	1.27	1.51	1.55	1.43	1.54	1.71	1.82	1.71	1.82	1.88	2.10	1.88	2.10
Balance	-0.01	-0 01	-0.26	-0.26	-0 30	-0.30	0 05	0.05	0.09	0.09	0 06	0.23	0.21	0.06	0.62	0.78	-0.14	0.32	0.52	0.98	0.02	0.48	0.16	1.06	-0.42	0.48

Table 6.5.11 Power Supply Plan Without Development of Hydro Potentials upto 2015 of Savaii (6.0 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
New Hydro																										
Sili No. 1 (1)																										
Sili No. 1 (2)																										
Sili No.2																										
Total Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel Existing																										
Salelologa																										
No. 1A	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75																
No. 2B	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35																		
No. 3A	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75														
No. 9A	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80														
No. 8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00										
No. 4	Outage/Retire																									
No. 6	Outage/Retire																									
No. 7A	Outage/Retire																									
Vaipouli																										
No. 1	0.08	0.08	0.08	0.08																						
No. 2	0.15	0.15	0.15	0.15																						
No. 4	0.28	0.28	0.28	0.28																						
No. 3	Outage/Retire																									
Diesel New Addition																										
No. 1	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 2					0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 3							0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 4											0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 5											0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 6													0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 7													0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
No. 8																	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
No. 9																			1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
No. 10																									1.40	1.40
Total Diesel	4.96	4.96	4.96	4.96	5.25	5.25	6.05	6.05	5.70	5.70	6.55	6.55	6.60	6.60	6.60	6.60	7.00	7.00	8.40	8.40	8.40	8.40	8.40	8.40	9.80	9.80
Available Capacity	4.96	4.96	4.96	4.96	5.25	5.25	6.05	6.05	5.70	5.70	6.55	6.55	6.60	6.60	6.60	6.60	7.00	7.00	8.40	8.40	8.40	8.40	8.40	8.40	9.80	9.80
Peak Demand	3.12	3.12	3.30	3.30	3.50	3.50	3.70	3.70	3.92	3.92	4.16	4.16	4.40	4.40	4.66	4.66	4.94	4.94	5.23	5.23	5.54	5.54	5.87	5.87	6.22	6.22
Margin	1.84	1.84	1.66	1.66	1.75	1.75	2.35	2.35	1.78	1.78	2.39	2.39	2.20	2.20	1.94	1.94	2.06	2.06	3.17	3.17	2.86	2.86	2.53	2.53	3.58	3.58
Reserve Capacity																										
Max. Unit	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	0.80	0.80	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
20% of Remain	0.79	0.79	0.79	0.79	0.85	0.85	1.01	1.01	0.94	0.94	1.11	1.11	1.12	1.12	1.16	1.16	1.24	1.12	1.40	1.40	1.40	1.40	1.40	1.40	1.68	1.68
Balance	0.05	0.05	-0.13	-0.13	-0.10	-0.10	0.34	0.34	-0.16	-0.16	0.28	0.28	0.08	0.08	-0.02	-0.02	0.02	-0.46	0.37	0.37	0.06	0.06	-0.27	-0.27	0.50	0.50

Table 6.5.12 Energy Balance upto 2015 of Savaii (6.0 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Required Energy	5.46	5.46	5.78	5.78	6.13	6.13	6.49	6.49	6.88	6.88	7.28	7.28	7.71	7.71	8.17	8.17	8.66	8.66	9.17	9.17	9.71	9.71	10.29	10.29	10.90	10.90
I) Firm Energy																										
New Hydro																										
Sili No 1 (1st)									0.61	0.98	0.61	0.98	0.61	0.98	0.61	0.98	0.61	0.98	0.61	0.98	0.61	0.98	0.61	0.98	0.61	0.98
Sili No 1 2nd)															1.07	1.73	1.07	1.73	1.07	1.73	1.07	1.73	1.07	1.73	1.07	1.73
Sili No 2																					1.55	2.51	1.55	2.51	1.55	2.51
Total of New Hydro		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.98	0.61	0.98	0.61	0.98	1.68	2.71	1.68	2.71	1.68	2.71	3.23	5.22	3.23	5.22	3.23	5.22
Diesel	5.46	5.46	5.78	5.78	6.13	6.13	6.49	6.49	6.27	5.90	6.67	6.30	7.10	6.73	6.49	5.46	6.98	5.95	7.49	6.46	6.48	4.49	7.06	5.07	7.67	5.68
Plant Factor of Diesel (%)	12.6	12.6	13.3	13.3	13.3	13.3	12.2	12.2	12.5	11.8	13.2	12.5	14.0	13.3	11.2	9.4	14.2	12.1	12.2	10.5	10.6	7.3	11.5	8.3	12.5	9.3
II) Averaged Energy																										
New Hydro																										
Sili No 1 (1st)									2.55	3.23	2.55	3.23	2.55	3.23	2.55	3.23	2.55	3.23	2.55	3.23	2.55	3.23	2.55	3.23	2.55	3.23
Sili No 1 2nd)															4.02	5.09	4.02	5.09	4.02	5.09	4.02	5.09	4.02	5.09	4.02	5.09
Sili No 2																					3.53	4.50	3.53	4.50	3.53	4.50
Total of New Hydro		0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.55	3.23	2.55	3.23	2.55	3.23	6.57	8.32	6.57	8.32	6.57	8.32	10.10	12.82	10.10	12.82	10.10	12.82
Diesel	5.46	5.46	5.78	5.78	6.13	6.13	6.49	6.49	4.33	3.65	4.73	4.05	5.16	4.48	1.60	0.00	2.09	0.34	2.60	0.85	0.00	0.00	0.19	0.00	0.80	0.00
Plant Factor of Diesel (%)	12.6	12.6	13.3	13.3	13.3	13.3	12.2	12.2	8.7	7.3	9.4	8.0	10.2	8.8	2.8	0.0	4.3	0.7	4.2	1.4	0.0	0.0	0.3	0.0	1.3	0.0

Table 6.5.13 Energy Balance Without Development of New Hydro Potentials upto 2015 of Savaii (6.0 % AAGR)

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Required Energy	5.46	5.46	5.78	5.78	6.13	6.13	6.49	6.49	6.88	6.88	7.28	7.28	7.71	7.71	8.17	8.17	8.66	8.66	9.17	9.17	9.71	9.71	10.29	10.29	10.90	10.90
I) Firm																										
New Hydro																										
Sili No 1 (1st)																										
Sili No 1 2nd)																										
Sili No 2																										
Total of New Hydro	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diesel	5.46	5.46	5.78	5.78	6.13	6.13	6.49	6.49	6.88	6.88	7.28	7.28	7.71	7.71	8.17	8.17	8.66	8.66	9.17	9.17	9.71	9.71	10.29	10.29	10.90	10.90
Plant Factor of Diesel (%)	12.6	12.6	13.3	13.3	13.3	13.3	12.2	12.2	13.8	13.8	12.7	12.7	13.3	13.3	14.1	14.1	14.1	14.1	12.5	12.5	13.2	13.2	14.0	14.0	12.7	12.7
II) Averaged Energy																										
New Hydro																										
Sili No 1 (1st)																										
Sili No 1 2nd)																										
Sili No 2																										
Total of New Hydro	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diesel	5.46	5.46	5.78	5.78	6.13	6.13	6.49	6.49	6.88	6.88	7.28	7.28	7.71	7.71	8.17	8.17	8.66	8.66	9.17	9.17	9.71	9.71	10.29	10.29	10.90	10.90
Plant Factor of Diesel (%)	12.6	12.6	13.3	13.3	13.3	13.3	12.2	12.2	13.8	13.8	12.7	12.7	13.3	13.3	14.1	14.1	14.1	14.1	12.5	12.5	13.2	13.2	14.0	14.0	12.7	12.7

APPENDIX-1 TRAINING PROGRAM

DIESEL PLANT

Training Program for Operation and Maintenance Staffs of Diesel Generating Plant

(1) Necessity of Operation and Maintenance Training

As a method of technology transfer and educational training, it can be considered to adopt one of the following ways of training or their combination as seen in usual projects. Thus we hereby present our training program based upon a practical way of thinking as below.

(2) Necessity of improved technique of repair:

For improvement of repair technique such customary behavior as just exchanging faulty parts in generator stop must be avoided and the same failure as made in the past must not be repeated. For this purpose. trouble-shooting should dully be executed exactly. Daily operational data. power load changes and proper operation of generators should be watched and recorded in order to make them useful for the long term operation control plan. Planned execution of effective operation and maintenance for enhancing mechanical features results in obtaining stable availability (reliability) in power generation , but it is very difficult to clearly specify the causes of generator troubles unless the methods of trouble shooting. mechanical features of such machines and their control system are fully understood.

Therefore the educational training of operators. maintaining staff and power administrators who will participate in the power generating plant should be regarded as the most important matter to make them used to the long term control manual for power generation.

Education of power technology administrators and training of operating and maintaining staff

In the existing power plant of EPC, plant operation is performed without any mechanical engineer and the power generators are now operated and maintained by people having no special education. Accordingly, highly educated personnel will be required for power plant management with which plant operation, repair work, parts control and so on will have to be educated in the system different from the existing organization.

Thus in the training for technical education. the ease of understanding and the creation of technical reports for control, repair, inspection, troubles, etc. shall be taken seriously and provided as the Basic Maintenance Training (I), the Basic Trouble-shooting - (II), and the Basic Technical improvement - (III).

After making sure, together with EPC Headquarter, that the educational fruits have been obtained in the monitoring method (Confirming the educational results of Training - IV) , we propose the measures for problems, if any.

Understanding of enhanced technology of power generation and purpose of training

Some extent of technical education is preferably required to learn the technology for operation and repair of power generators. Not only understanding of technology but also safety control and technical expectation of accidents will be needed against sudden occurrence of troubles in rotary machines, high-voltage power sources, etc. It may be easy to handle and operate newest machines, which are, on the contrary, complex in their electrical control system, so that the basic knowledge of general education is not sufficient at all to handle it, repair it and judge its fault. This greatly influences the reliability of generator operation.

Thus the final purpose to be aimed at in the Basic Training hereby provided is to assist such trainees to independently do their own duties for power plant control in a long term maintenance system, based upon the judgment of EPC side.

(3) Contents and activities of the training

The training shall be carried out in the following 4 divisions:

Basic - I : Basic Maintenance Training

In the Basic - 1 Maintenance training, basic training of internal combustion engines is done by Consultant. Items and contents of the training are as follows:

Maintenance Training of Diesel Power Plant

No.	Items of Training	Contents and Activities of Training
1	Generator basic knowledge test	Test and confirm basic technical knowledge of trainees
2	Basic engineering of internal combustion engines	Training for technical standard, units, systems, etc
3	Specification relations between generators and engines	Explain specifications for generators and engines
4	Electrical control relations to generator specifications	Explain specifications for control of generator and engine
5	Specifications related to piping and equipment in each system	Confirm specifications of respective systems

Throughout the training above-mentioned, the following fruits are expected:

(i) Understanding of general concept of internal combustion engines and power generators.

(ii) Understanding of available units, equations and fuel consumption, rate

(iii) Control and planning for effective, economical operation of power generating units, numbers of units operated and power load rates of power generators

Basic - II : Basic Trouble-shooting of Power Generators Training

All operators and maintenance staff will be trained in the way of Trouble-shooting of power generators. The training items and educational fruits to be expected are as follows:

Basic Trouble-shooting of Power Generators Training

No.	Training Items	Educational Fruits to be expected
1	Generators equipment	Double alignment both in the driving side and in the rotary side of all rotary machines, Training for guessing any troubles from vibration and noise emission effected by miss-alignment
2	Acquisition of flow chart for flows between power generating units and auxiliaries	Confirm and acquire piping routes, operational system, protection and safety devices and distribution control system, and plan measures for repair, protection of secondary faults & long term maintenance.
3	Point of measurement and inspection of respective parts of engine	Appropriate measurement of equip.'s, standards, point of correction and handling of measuring instruments
4	Handling of auxiliaries	Point of handling auxiliaries and point of inspection, maintenance and adjustment of them

Basic - III : Technical Improvement of Operation and Maintenance Training

The III training is purpose of technical improvement of operation, maintenance for generators by the consultant or engine maker engineer.

Technical Improvement of Operation and Maintenance Training

No.	Items of Training	Contents and Activities of Training
1	Inspection before and after starting operation	Point of confirmation and inspection before and after operation
2	Regular inspection and maintenance	Point of maintenance for regular inspection and maintenance
3	Operation of generators and auxiliaries	Point of auxiliaries maintenance for whole power generating plant
4	Accidents and preventive measures	Confirm quick reference accidents
5	Handling of measuring instruments and special tools	Point of use of measuring tools for electrical and mechanical adjustment and so on
6	Point of creating reports	Point of creating reports of maintenance and control
7	Safety system	Confirmation of safety protection

The fruits expected from the training above-mentioned will be:

(i) Understanding of the inspection, confirmation & warming-up before generator start, synchronous operation and operational confirmation after starting operation.

(ii) Point of maintenance and inspection of control panels, display panels, protection devices etc. and detailed handling of various kinds of equipment and machines.

(iii) Handling manual of measuring instruments for maintenance, adjusting devices, special tools, calibration devices and so on.

(iv) Point of economical load operation and regular inspection and manual for maintenance

(v) Easy confirmation of basic causes of faults, expectation of secondary troubles, and system buildup for maintenance and control

(vi) Point of creating reports for operational records, troubles and repair, inspection work , etc.

(vii) Storage of dangerous objects and safety control around rotary sections

(viii) Environmental control related to noises, vibrations and pollution

Basic - IV : Confirming Educational Results of Training (Monitoring)

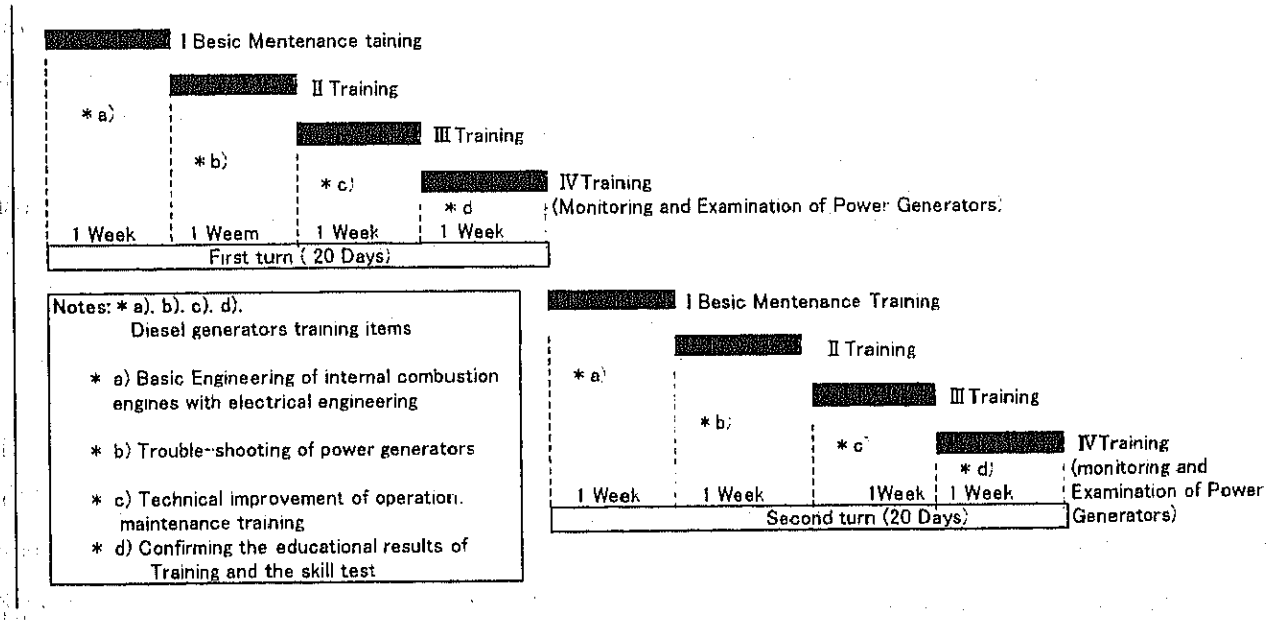
The IV training aims at confirming the educational results of training - I, II and III in which the status of generator operation and maintenance is watched and recorded in the monitoring method by working together with the consultant and EPC and appropriate suggestion will be made if any problem happens.

Confirming Educational Results of Training

No.	Items of Training	Contents and Activities of Training
1	Confirmation and advises for creation of operational reports	Re-confirmation of created reports
2	Confirmation and advises for initial trouble measures	Re-confirmation of previous courses of training and evaluation of training results
3	Operational work, inspection, questions	Re-confirmation of operational work and others
4	Final examination of power generators and internal combustion engines	Confirmation of educational fruits in the training

(4) Implementation Schedule

Above-mentioned schedule is twice times in two months. The estimated implementation schedule is shown below:



APPENDIX-2 TRAINING PROGRAM

HYDROPOWER PLANT

Training Program for Operation and Maintenance Staffs of Hydropower Generating Plant

Appropriate operation and maintenance are essential to realize the expected effects of the power generating facilities. The operation and maintenance system of EPC is not applied properly. The operation/maintenance staff of the existing power station seem not well educated and have not sufficient capability in general technology and maintenance technique. As a method of technology transfer and educational training, the conceivable training methods are mentioned below.

(1) Necessity of Upgrading Maintenance Technology

To upgrade maintenance technology, the maintenance staff must cease the past practice to merely replace faulty parts with available spares, and a proper system shall be established not to repeat the same failures. The maintenance staff must carefully review daily operation data of the machines and their variations, records of turbine-generators to utilize them for the long term operation planning. Planned execution of effective operation and maintenance to fully utilize turbine-generator features will result in stable operation (reliability) in power generation. However, it is very difficult to clarify the causes of turbine-generator troubles unless the methods of trouble shooting, mechanical features of such machines and their control system are fully understood by the operation and maintenance staff.

Therefore, the educational training of operators, maintenance staff and their managers is the most important item in performing the stable operation.

(2) Subjects to be Solved by the Training

The existing hydropower plants are operated and maintained by the members who have not enough technical capability and proper education on technology. For proper operation and maintenance of power station, well trained personnel are required for plant operation, maintenance works, spare parts stock control, etc. Thus, a proper system completely different from the existing organization needs to be established.

Thus, in carrying out the technology education, the Basic Training (I, II, III) will be aimed to train personnel who easily understand the aim of training and can prepare technical reports for control, inspection, troubles, etc. After the completion of training, its outcome will be reviewed with using the monitoring method (Basic Training-IV). These are essential parts of Basic Training .

(3) Understanding of Enhanced Technologies of Power Generation and Purposes of Training

Some extent of technical education is essential to understand the technologies of operation and maintenance of hydropower plant. The operation and maintenance staff must understand technologies and concepts of safety control of turbine and generator, and they must have capability to foresee occurrence of unexpected faults in turbine-generator, high-voltage power sources, etc. Up-to-date machines can be operated conveniently, and their electrical control system is complicated. But the existing hydropower plants are aged and operated more than 20 to 40 years operated except Taelefaga hydropower plant. Their handling, repairing and monitoring is difficult by operators with only basic knowledge based on general education. This fact greatly influences the reliability of generator operation.

(4) Contents and Activities of the Training

The training will be carried out in the following 4 steps, Basic Training-I to Training-IV:

Basic Training - I Training on Hydropower Plant in Systematically

In the Basic Training-1, the trainees will examined to know their technical knowledge level at first, to refer to in the succeeding training and then perform the basic training of the system of hydropower plant. Items and contents of the training are as presented in below:

Basic Training - I Training of System of Hydropower Plant

No.	Training Items	Contents and Activities of Training
1	Hydropower plant basic knowledge test	Test to confirm basic technical knowledge of trainees
2	Basic engineering of hydropower plant	Education on the system of hydropower plant, including the reservoir and headpond operations
3	Technical particular on turbine and generator	Structure and performance on each type of turbine-generators
4	Technical particular on ancillary equipment of turbine-generator	Structure and function of pressure oil, lubricating oil and water supply system
5	Safety measures of plant	Electrical/mechanical control and protection system of turbine-generator and their ancillary equipment

As the results of the above mentioned training, the following effects are expected:

(i) Understanding on general concept of hydropower plant in systematically

(ii) Understanding on general concept of turbine-generator and their ancillary equipment

(iii) Understanding on general concept of control and protection system of the hydropower plant.

Basic Training – II Training on Operation and Maintenance

In the Basic Training-II, training will be performed on the operation and maintenance of hydropower plant. Items and contents of the training are as presented in below:

Basic Training- II Training on Operation and Maintenance

No.	Training Items	Contents and Activities of Training
1	Operation of the hydropower plant	- Operation method of turbine and generator - Measures to the emergency case - Monitoring of operation states of turbine-generator and their ancillary equipment
2	Maintenance of hydropower plant	Maintenance method of plant in particulars - Daily inspection - Periodical inspection - Overhaul
3	Management	- Operation and maintenance record - Store management - Filling system of various records

As the results of the above mentioned training, the following effects are expected::

(i) The importance of the maintenance works to maintain the reliable and continuous operation, and to prevent the unexpected accident on the plant

(ii) The operation procedure for start, stop and emergency stop of the plant, and effective operation of the plants

(iii) The concept of the maintenances works for daily inspection, periodical inspection and overhaul

(iv) The maintenance works on the water turbine, inlet valve, governor, oil pressure supply system and other equipment

(v) The maintenance works on the electrical facilities such as generator, exciter, transformer, switchgears, DC power source

(vi) The arrangement various forms for systematic reporting of operation, inspection, maintenance, faults, etc.

(vii) The appropriate spare parts and quantities and its store management for maintenance works

Basic Training – III Measurement and Adjusting Method

In the Basic Training-III, the training will be performed on the measurement and adjustment of the instruments and devices for control and operation of the turbine-generator. Items and contents of the training are as presented in below:

Basic Training-III Measuring and Adjusting Method

No.	Training Items	Contents and Activities of Training
1	Handling of measuring instruments	Measuring apparatus and tools for maintenance, testing and adjusting works, etc.
2	Measurement method	- Appropriate measurement method of equipment and adjusting methods - Points of notice in measurement and inspection of respective parts of turbine-generator, control and protection devices - Calibration of measuring instruments
3	Testing method of operation and protection devices	- Test method of control and protection devices - Adjusting method of setting values of mechanical and electrical control and protection devices

As the results of the above mentioned training, it is expected their understanding on the followings:

(i) The handling of the measuring apparatus and devices to be used for the maintenance, testing, and adjusting works of the various equipment and devices

(ii) The adoption of the appropriate measurement method to meet the work purpose

(iii) The calibration of the various meters such as pressure, temperature, water level meters and etc.

(iv) The execution of the performance test on the control devices and protection system such as inlet valve, governor, exciter, voltage regulator and protection relays

(v) The adjustment of the setting points of protection relays for warning and tripping operation of the plant

Basic Training – IV Confirmation of Training Result

The Basic Training-IV, the training aims at confirmation of the education results of Basic-I, II and III training, it will be confirmed the conditions of understanding of trainees on operation and maintenance of generation equipment by the monitoring method.

Basic Training-IV Confirmation of Training Result

No.	Training Items	Contents and Activities of Training
1	Preparation of operation reports	Examination and advices
2	Preparation of maintenance and repair report	Examination and advices
3	Preparation of store management report	Examination and advices

In addition to the above training, their capability in general technology and maintenance technique is more developed in participation to the following works.

- Training during erection period: It is effective to participate in the erection works of the plant and become familiar with such equipment through guidance of instructors of the contractor and consultant personnel. It should be widely adopted the operation and maintenance staff as practice to employ local capable workers.

- Guidance with equipment supply manufacturer: Overhaul works will be carried out under the guidance contract with the equipment manufacturer

(5) Schedule of Basic Training

The schedule of above Basic Training will be conceivable as follows:

Activity of Basic Training		Training Period
Basic Training-I	Training on system of hydropower plant	2-weeks
Basic Training-II	Training on operation and maintenance	3-weeks
Basic Training-III	Measurement and adjustment method	2-weeks
Basic Training-IV	Confirmation of training result	2-weeks

It is necessary nine weeks in total, for the basic training of the operation and maintenance staffs and engineers of power generation section of EPC.