4.7 Loss Reduction Plan

SENELEC is currently engaged in a program to reduce power losses on its low voltage distribution system. This involves a change-over from the B1 system (127 V/220 V) to the B2 system (220 V/380 V) for the supply voltage to the consumers. The losses occurring in the power grid can be divided into technical and non-technical losses.

The causes of, and remedies for, the technical losses include the following:

a. Too long low voltage distribution feeders:
Reduce their length to the voltage drop.

b. Connection of conductors:
Use appropriate materials and fittings such as connectors and sleeves.

c. Incorrect functioning of the watt-hour meters:
Calibrate the watt-hour meters on a regular basis.

d. Equipment overload conditions:
Extend equipment and/or change the load distribution.

Generally, it is difficult to isolate the non-technical losses from the technical losses.

Technical losses can be quantitatively estimated on the basis of calculations and are due to load conditions. In contrast, non-technical losses are due primarily to human factors and cannot be estimated through calculations. It is easy to realize that the reduction of non-technical (human factor-related) losses is of crucial importance in any measures designed to reduce losses.

The following factors may be regarded as the main causes of non-technical losses. They are preventable to a certain extent by carrying out regular patrols and inspections of the distribution facilities.

a. Non-registered consumers

b. Direct connection to the distribution line

c. Manipulation of the watt-hour meters.

The rehabilitation work to be undertaken as part of SENELEC's short-term plan embraces the following objectives:

- Resolving the bottlenecks on the distribution lines
- Reducing excessive voltage drops
- Enhancing the reliability of power supply

The construction work under the rehabilitation schedule will play a significant role in reducing power losses in the distribution network and offers a further potential for SENELEC to increase its receipts from electricity charges.

Table 4.1.1-1 Operation Record for Generating Units in 1993

RGI

No.	Item	Unit	Bel-Air CI G105	Bel-Air CI G106	Bel-Air CII G101	Bel-Air CII G102	Bel-Air CII G103	Bel-Air CII G104	Cap-des-Biches CIII TAG1	Cap-des-Biches CIII TAG2	Cap-des-Biches CIV G401	Cap-des-Biches CIV G402	Cap-des-Biches CIII G301	Cap-des-Biches CIII G302	Cap-des-Biches CIII G303	Total Dakar	Total Saint-Louis	Total Kaolack	Total RGI
1	Nominal producible energy	MWh	39,420	39,420	-	112,128	112,128	112,128	144,540	176,200	166,440	166,440	240,900	262,800	262,800	1,834,344	98,988	134,028	2,067,360
	Capacity : rated	kW	5,000	6,000	12,800	12,800	12,800	12,600	16,500	21,500	20,000	20,000	27,500	30,000	30,000	226,700	10,500	14,000	251,200
	actual limit	kW	5,000	5,000	5,000	9,000	11,000	5,000	16,000	19,000	20,000	20,000	27,500	20,000	15,000	176,500	10,500	14,000	201,000
2	Annual operation time	Hours	3,004	3,611		5,220	4,801	6,286	5,363	3,178	6,884	6,772	7,497	7,964	7,237	5,634	-	-	-
	Time availability factor	%	34.3	41.2		59.6	54.8	71.8	61.2	36.3	78.3	77.3	85.6	90.8	82.6				
3	Gross energy production	MWh	12,086	15,113		33,294	35,125	47,041	45,459	32,425	111,491	117,277	170,573	165,975	115,386	901,245	16,025	30,711	947,981
4	Energy consumption for auxiliary	MWh	643	804		3,808	2,728	3,127	308	135	7,772	8,686	11,556	12,271	9,372	61,210	694	2,046	63,950
5	Auxiliary KWh consumption rate	%	5.3	5.3		11.4	7.8	6.6	0.7	0.4	7.0	7.4	6.8	7.4	8.1	6.8	4.3	6.7	6.7
	Average output calculated	kW	4,023	4,185		6,378	7,316	7,483	8,476	10,203	16,680	17,318	22,752	20,857	15,944	159,968			
	Auxiliary kW consumption rate	%	4.3	4.5		5.7	4.4	3.8	0.3	0.2	5.8	6.4	5.6	5.1	4.3	4.8			
	Capacity factor at rated	%	80.5	83.7		49.8	57.2	58.5	51.4	47.5	83.4	86.6	82.7	69.6	53.1	70.6			
6	Net energy produced	MWh	11,443	14,309		29,486	32,397	43,914	45,151	32,290	103,719	108,591	159,017	153,704	106,014	840,035	15,331	28,665	884,031
7	Unavailable energy	MWh	9,690	6,452		32,089	39,821	27,022	29,348	22,322	44,546	43,107	42,362	48,790	102,722	448,271	44,775	-	-
	Maintenance day	Day	68	44		52	64	44	57	35	67	64	44	48	103				-
	Fault day	Day	11	8		26	33	22	7	4	13	13	9	10	20				-
8	Available energy	MWh	29,730	32,968		80,039	72,307	85,106	115,192	152,878	121,894	123,333	198,538	214,010	160,078	1,386,073	54,213	-	2,067,360
9	Availability rate	%	75.42	83.63		71.38	64.49	75.90	79.70	87.26	73.24	74.10	82.42	81.43	60.91	75.56	54.77	-	-
10	Utilization factor	%	40.65	45.84		41.60	48.58	55.27	39.46	21.21	91.47	95.09	85.91	77.56	72.08	65.02	29.56	-	45.85
11	Fuel consumption																		
	Heavy oil	Tons	1,832	2,586		14,502	15,300	20,491	-	-	23,523	24,601	51,983	52,232	37,384	244,434	-	6,826	251,260
	Diesel oil	Tons	896	808		7	7	9	7,943	16,726	1,478	1,355	-	-	-	29,231	4,049	366	33,646
	Natural gas	1000Nm3	-	-		-	-	-	14,833	-	-	-	-	-	-	14,833	-	-	14,833
	Calorific value																		
	Heavy oil	kcal/kg	9,700	9,700		9,700	9,700	9,700	-	-	9,700	9,700	9,700	9,700	9,700	-	-	9,700	-
	Diesel oil	kcal/kg	12,900	12,900		12,900	12,900	12,900	12,900	12,900	12,900	12,900	-	-	-	-	8,900	8,900	-
	Natural gas	kcal/Nm3	-	-		-	-	-	9,709	-	-	7,800	-	-	-	-	-	-	-
	Energy convertible																		
	Heavy oil	MWh	20,667	29,173		163,599	172,601	231,161	-	-	265,365	277,526	586,425	589,234	421,733	2,757,484	-	77,005	2,834,489
	Diesel oil	MWh	13,442	12,122		105	105	135	119,166	250,965	22,174	20,329	-	-	-	438,544	41,910	3,788	484,242
	Natural gas	MWh	-	-		-	-	-	167,488	-	-	-	-	-	-	167,488	-	-	167,488
	Sub total	MWh	34,109	41,295		163,704	172,706	231,296	286,654	250,965	287,539	297,855	586,425	589,234	421,733	3,363,516	41,910	80,793	3,496,219
	Annual thermal efficiency (gross)	%	35.4	36.6		20.3	20.3	20.3	15.9	12.9	38.8	39.4	29.1	28.2	27.4	26.8	38.2	38.0	27.2
	Annual thermal efficiency (net)	%	33.5	34.7		18.0	18.8	19.0	15.8	12.9	36.1	36.5	27.1	26.1	25.1	25.0	36.6	35.5	25.4
12	Fuel consumption rate																		
	Heavy oil	g/KWh	151.58	171.11		435.57	435.59	435.60	-	-	210.99	209.77	304.76	314.70	323.99	-	-	222.27	-
	Diesel oil	g/KWh	74.14	53.46		0.21	0.20	0.19	174.73	515.90	13.26	11.55	-	-	-	-	252.67	11.92	-
	Natural gas	Nm3/KWh	-	-		-	-	-	326.29	-	-	-	-	-	-	-	-	-	-
13	Lub-oil consumption rate	g/KWh	3.00	2.47		-	-	-	-	-	1.90	1.40	-	-	-	-	2.90	3.30	-
14	Cost for fuel and lubrication-oil	FCFA/kWh	16.34	14.53		18.24	18.23	18.23	46.44	58.09	10.98	10.56	12.74	13.16	13.55	-	33.22	14.86	-
	Cost for :																		
	Heavy oil	FCFA/kg	41,811	41,811		41,811	41,811	41,811	-	-	41,811	41,811	41,811	41,811	41,811	-	-	51,096	-
	Diesel oil	FCFA/kg	112,605	112,605		112,605	112,605	112,605	112,605	112,605	112,605	112,605	112,605	112,605	112,605	-	124,264	120,570	-
	Natural gas	FCFA/Nm3	-	-		-	-	-	82,0151	-	-	-	-	-	-	-	-	-	-
	Lubrication-oil	FCFA/kg	550,103	550,103		-	-	-	-	-	348,364	348,364	-	-	-	-	827,325	825,972	-
	Price for :																		
	Heavy oil	MFCFA	76,599	108,123		608,343	639,708	856,749	-	-	983,520	1,028,592	2,173,481	2,193,972	1,563,062	-	-	346,781	-
	Diesel oil	MFCFA	100,894	90,985		0.788	0.788	1.013	894,422	1,883,858	166,430	152,580	0.000	0.000	0.000	-	503,145	44,129	-
	Natural gas	MFCFA	-	-		-	-	-	1,216,530	-	-	-	-	-	-	-	-	-	-
	Lubrication-oil	MFCFA	19,946	20,535		-	-	-	-	-	73,795	57,197	-	-	-	-	29,153	63,440	-

Source : Statistical Record by SENELEC (August 1994)

Table 4.1.1-2 Price of Fuel

Piric without Tax at 24/Jan/1994

No	Name of site	Name of station	Fuel price				Lubricating oil	
			Heavy oil	Diesel oil	Gas	Light oil	Type	Price
			FCFA/ton	FCFA/ton	FCFA/km3	FCFA/ton		FCFA/ton
1	Bel-Air	Bel-Air	50,173	135,126			ICHF304	660,124
2	CIII (Steam)	Cap-des-Biches	50,173	135,126			-	-
3	CIV (Diesel)	Cap-des-Biches	50,173	135,126			HMA430	418,037
4	CIII (Gas)	Cap-des-Biches			19,581			
5		Cap-des-Biches				110,484		
6	Kahone	Kaolack	61,315	144,684			ICHF304	751,166
7	Koungheul	Kaolack	-	144,403			ARGT40	645,929
8	Medina sabakh	Kaolack	-	144,403			ARGT40	645,929
9	Nganda	Kaolack	-	144,403			ARGT40	645,929
10	Saint-Louis	Saint-Louis	65,748	149,117			ARGT40	752,790
11	Dagana	Saint-Louis	-	156,469			ARGT40	645,929
12	Dahra	Saint-Louis	-	149,062			ARGT40	645,929
13	Linguere	Saint-Louis	-	151,438			ARGT40	645,929
14	Ndioum	Saint-Louis	-	158,858			ARGT40	645,929
15	Ourossogui	Saint-Louis	-	175,134			ARGT40	850,452
16	Podor	Saint-Louis	-	161,221			ARGT40	645,929
17	Richard Toll	Saint-Louis	-	155,396			ARGT40	549,761
18	Tamba	Tambacouda	77,230	160,598			ARGT40	645,929
19	Bakel	Tambacouda	-	182,477			ARGT40	645,929
20	Goudiry	Tambacouda	-	168,163			ARGT40	645,929
21	Kedougou	Tambacouda	-	179,300			ARGT40	645,929
22	Kidira	Tambacouda	-	185,693			ARGT40	645,929
23	Koumpentoum	Tambacouda	-	154,772			ARGT40	645,929
24	Meidina Gounass	Tambacouda	-	166,796			ARGT40	645,929
25	Velingara	Tambacouda	-	168,354			ARGT40	645,929
26	Boulouie	Ziguinchor	86,173	162,119			ARGT40	851,314
27	Diamacounta	Ziguinchor	-	155,852			ARGT40	645,929
28	Dioulouiou	Ziguinchor	-	163,543			ARGT40	645,929
29	Kolda	Ziguinchor	-	162,566			ARGT40	645,929
30	Maisassoum	Ziguinchor	-	164,710			ARGT40	645,929
31	Sedhiou	Ziguinchor	-	158,609			ARGT40	645,929
32	Thionck Essyl	Ziguinchor	-	160,566			ARGT40	645,929

Source : Prix Des Combustible Et Huiles Moteurs by SENEREC (August 1994)

Table 4.1.2-1 Time Interval for Operation & Maintenance of Generating Facilities

Name of station	Unit name	Operation & Maintenance		Step for Time Interval																																							
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Bel-Air	G105	Operation	Hour	2,500		2,500		2,500		2,500		2,500		2,500		2,500		2,500		2,500		2,500		2,500																					
		Mainte-nance	Hour		672		672		672		672		672		672		672		672		672		672		672																				
			Day		28		28		28		28		28		28		28		28		28		28		28																				
	G106	Operation	Hour	2,500		2,500		2,500		2,500		2,500		2,500		2,500		2,500		2,500		2,500		2,500																					
		Mainte-nance	Hour		672		672		672		672		672		672		672		672		672		672		672																				
			Day		28		28		28		28		28		28		28		28		28		28		28																				
	G101	Operation	Hour	2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000											
		Mainte-nance	Hour		168		168		168		168		168		168		168		336		168		168		168		168		168		168		168		1,008										
			Day		7		7		7		7		7		7		7		14		7		7		7		7		7		7		7		42										
	G102	Operation	Hour	2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000											
		Mainte-nance	Hour		168		168		168		168		168		168		168		336		168		168		168		168		168		168		168		1,008										
			Day		7		7		7		7		7		7		7		14		7		7		7		7		7		7		7		42										
	G103	Operation	Hour	2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000											
		Mainte-nance	Hour		168		168		168		168		168		168		168		336		168		168		168		168		168		168		168		1,008										
			Day		7		7		7		7		7		7		7		14		7		7		7		7		7		7		7		42										
	G104	Operation	Hour	2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000											
		Mainte-nance	Hour		168		168		168		168		168		168		168		336		168		168		168		168		168		168		168		1,008										
			Day		7		7		7		7		7		7		7		14		7		7		7		7		7		7		7		42										
Cap des Biches	G301	Operation	Hour	2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000											
		Mainte-nance	Hour		168		168		168		168		168		168		168		336		168		168		168		168		168		168		168		1,008										
			Day		7		7		7		7		7		7		7		14		7		7		7		7		7		7		7		42										
	G302	Operation	Hour	2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000											
		Mainte-nance	Hour		168		168		168		168		168		168		168		336		168		168		168		168		168		168		168		1,008										
			Day		7		7		7		7		7		7		7		14		7		7		7		7		7		7		7		42										
	G303	Operation	Hour	2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000											
		Mainte-nance	Hour		168		168		168		168		168		168		168		336		168		168		168		168		168		168		168		1,008										
			Day		7		7		7		7		7		7		7		14		7		7		7		7		7		7		7		42										
	TAG1	Operation	Hour	2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000											
		Mainte-nance	Hour		168		168		168		168		168		168		168		336		168		168		168		168		168		168		168		1,008										
			Day		7		7		7		7		7		7		7		14		7		7		7		7		7		7		7		42										
	TAG2	Operation	Hour	2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000		2,000											
		Mainte-nance	Hour		168		168		168		168		168		168		168		336		168		168		168		168		168		168		168		1,008										
			Day		7		7		7		7		7		7		7		14		7		7		7		7		7		7		7		42										
	G401	Operation	Hour	1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500	
		Mainte-nance	Hour		24		120		24		672		24		120		24		1,008		24		120		24		672		24		120		24		1,008		24		120		24		672		24
			Day		1		5		1		28		1		5		1		42		1		5		1		28		1		5		1		42		1		5		1		28		1
	G402	Operation	Hour	1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500		1,500	
		Mainte-nance	Hour		24		120		24		672		24		120		24		1,008		24		120		24		672		24		120		24		1,008		24		120		24		672		24
			Day		1		5		1		28		1		5		1		42		1		5		1		28		1		5		1		42		1		5		1		28		1

Source : Operation standard for generating facilities by SENELEC (August 1994)

Table 4.1.2-2 Maintenance Schedule for Generationg Facilities

Actual results in 1993				Estimation of Maintenacne Time		
unit	Time (hour)	Output (kW)	TAF (%)	Case 1 (TAF ≦ 70%) (annual operation hour ≦ 6,132H)	Case 2 (TAF ≦ 75%) (annual operation hour ≦ 6,570H)	Case 3 (TAF ≦ 80%) (annual operation hour ≦ 7,008H)
G105	3,004	4,023	34.3	0:2,500H→M:672H→0:2,500H→M:672H M=1,344H	Same as Case 1 M=1,344H	Same as Case 1 M=1,344H
G106	3,611	4,185	41.2	ditto M=1,344H	ditto M=1,344H	ditto M=1,344H
G101	-	-	-	0:2,000H→M:168H→0:2,000H→M:168H→ 0:2,000H M= 336H	0:2,000H→M:168H→0:2,000H→M:336H→ 0:2,000H M= 504H	0:2,000H→M:168H→0:2,000H→M:1,008H→ 0:2,000H M=1,176H
G102	5,220	6,378	59.6	ditto M= 336H	ditto M= 504H	ditto M=1,176H
G103	4,801	7,316	54.8	ditto M= 336H	ditto M= 504H	ditto M=1,176H
G104	6,286	7,483	71.8	ditto M= 336H	ditto M= 504H	ditto M=1,176H
G301	7,497	22,752	85.6	ditto M= 336H	ditto M= 504H	ditto M=1,176H
G302	7,954	20,867	90.8	ditto M= 336H	ditto M= 504H	ditto M=1,176H
G303	7,237	15,944	82.6	ditto M= 336H	ditto M= 504H	ditto M=1,176H
TAG1	5,363	8,476	61.2	ditto M= 336H	ditto M= 504H	ditto M=1,176H
TAG2	3,178	10,203	36.3	ditto M= 336H	ditto M= 504H	ditto M=1,176H
G401	6,684	16,680	76.3	0:1,500H→M:24H→0:1,500H→M:120H→ 0:1,500H→M:24H→0:1,500H M= 169H	0:1,500H→M:120H→0:1,500H→M:24H→ 0:1,500H→M:1,008H→0:1,500H M=1,176H	Same as Case 2 M=1,176H
G402	6,772	17,318	77.3	0:1,500H→M:24H→0:1,500H→M:120H→ 0:1,500H→M:24H→0:1,500H M= 169H	0:1,500H→M:120H→0:1,500H→M:24H→ 0:1,500H→M:1,008H→0:1,500H M=1,176H	Same as Case 2 M=1,176H
Total of annual maintenance time and day				Maintenance hour=6,048H Maintenance day = 252D	Maintenance hour=9,576H Maintenance day = 399D	Maintenance hour=15,624H Maintenance day = 651D

Source : Operation standard of generating facilities by SENELEC (August 1994)
TAF : Time Availability Factor (operation time/8760x100)
O : Operation, M : Maintenance
Output : gross energy production / operation time

Table 4.3.1 Evolution of Energy Consumption, Energy Generation & Peak Generation classified into Voltage Levels

Whole Country

	Unit	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1. Whole senegal											
Energy consumption included load shedding (A)	GWh	380.99	406.15	442.78	482.05	519.44	533.83	558.54	530.20	597.21	645.95
Low voltage	GWh	100.66	112.71	126.50	146.43	167.07	174.35	183.12	180.20	204.54	207.28
Medium voltage	GWh	186.11	200.75	220.85	242.68	257.91	264.81	288.36	292.23	301.35	288.28
High voltage	GWh	94.22	94.70	95.44	92.94	94.46	94.68	116.46	56.95	89.76	148.62
Energy generation	GWh	440.83	475.77	528.20	581.92	638.11	638.27	675.72	635.57	710.20	764.93
2. RCI (3,+4,+5,)											
Energy consumption	GWh	377.44	403.86	438.10	478.31	512.64	526.12	560.04	519.71	584.27	622.78
Energy consumption included load shedding (B)	GWh	377.44	403.86	438.10	478.31	512.64	526.12	560.64	520.53	585.83	626.56
Low voltage	GWh	98.29	109.83	122.99	141.77	161.79	168.17	178.83	172.27	196.26	193.90
Load shedding	GWh							0.60	0.82	1.56	3.77
Medium voltage	GWh	184.93	199.33	219.68	241.61	256.39	263.27	266.75	290.49	298.25	280.56
High Voltage	GWh	94.22	94.70	95.44	92.94	94.46	94.68	116.46	56.96	89.76	148.62
Energy generation	GWh	435.39	469.33	521.16	573.43	627.75	627.39	663.27	621.92	695.18	743.13
Energy for auxiliary use	GWh	28.96	31.10	34.12	36.85	40.09	40.87	41.99	40.34	47.29	47.64
Peak load	MW	72.20	68.40	81.23	88.83	98.99	97.57	105.26	98.71	108.87	117.61
Peak generation	MW	76.00	72.00	85.50	93.50	104.20	102.70	110.80	103.90	114.60	123.80
Loss factor (transmission & distribution)	%	7.13	7.84	10.05	11.23	12.77	10.30	9.76	10.50	9.58	9.91
Load factor	%	64.26	73.14	68.45	68.96	67.77	69.63	67.38	67.26	67.93	67.51
Ratio of (B) to (A)	%	99.07	98.95	98.94	98.81	98.59	98.56	98.61	98.18	98.00	97.00
3. Dakar area (Dakar & Rufisque)											
Energy consumption (C)	GWh	245.01	259.96	287.30	317.72	348.11	353.82	361.86	374.61	404.36	408.70
Low voltage	GWh	82.14	90.98	101.11	115.26	131.58	134.63	141.75	137.27	157.09	153.82
Medium voltage	GWh	162.87	168.98	186.19	202.46	216.53	219.19	220.11	237.34	239.27	212.88
High voltage	GWh									8.00	42.00
Energy generation	GWh	435.10	469.20	520.90	573.10	627.40	622.20	646.00	604.80	663.30	707.90
Peak generation	MW	76.00	72.00	85.50	93.50	104.20	102.70	108.00	102.00	108.90	118.00
Ratio of (C) to (A)	%	64.31	63.69	64.89	65.91	67.02	66.26	63.65	70.65	67.71	63.27
4. Thies & Taiba area											
Energy consumption	GWh	117.18	126.65	128.92	131.96	132.85	134.56	157.58	102.88	134.65	161.10
Low voltage	GWh	5.52	6.22	7.34	9.03	10.42	11.62	12.78	13.02	14.57	14.96
Medium voltage	GWh	17.44	25.73	26.15	30.00	27.97	28.26	28.34	32.91	38.32	39.52
High voltage	GWh	94.22	94.70	95.44	92.94	94.46	94.68	116.46	56.95	81.76	106.62
5. Saint-Louis & Kaolack area											
Energy consumption	GWh	15.25	17.25	21.88	26.63	31.68	37.72	40.60	42.22	45.26	52.98
Low voltage	GWh	10.63	12.63	14.54	17.48	19.79	21.92	22.30	21.98	24.60	24.82
Medium voltage	GWh	4.62	4.62	7.34	9.15	11.89	15.80	18.30	20.74	20.66	28.16
Energy generation	GWh	0.29	0.13	0.26	0.33	0.35	5.19	17.27	17.12	31.88	35.33
Peak generation	MW	-	-	-	-	-	-	-	-	-	-
6. Ziguinchor, Tambacounda and other area											
Energy consumption	GWh	3.556	4.293	4.680	5.738	6.802	7.713	7.899	9.070	11.380	19.400
Low voltage	GWh	2.376	2.877	3.509	4.667	5.286	6.177	6.291	7.930	8.280	13.680
Medium voltage	GWh	1.180	1.416	1.171	1.071	1.516	1.536	1.608	1.740	3.100	5.720
Energy generation	GWh	5.440	6.440	7.040	8.490	10.360	10.880	12.450	13.650	15.020	21.800
Peak generation	MW	--	--	--	--	--	--	--	--	--	--

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Annual mean growth rate(%) 1975-1993	1986-1993
1. Whole senegal												
Energy consumption included load shedding (A)	623.22	618.85	661.84	692.84	686.14	722.91	737.42	808.49	802.82	869.85	4.35	3.85
Low voltage	215.69	214.95	234.87	231.23	248.72	271.68	275.15	302.15	322.00	359.92	6.81	6.02
Medium voltage	264.51	266.72	273.06	289.82	276.21	291.02	301.63	320.48	316.40	344.78	3.12	2.56
High voltage	141.46	136.75	153.63	169.39	161.70	159.39	160.27	165.73	160.00	159.91	5.93	2.75
Energy generation	756.46	751.30	811.86	862.79	868.75	890.13	915.68	983.79	987.93	1,020.81	4.70	4.03
2. RCI (3,+4,+5,)												
Energy consumption	600.00	597.37	635.54	663.08	640.96	684.60	706.03	769.89	761.00	825.53	4.10	3.60
Energy consumption included load shedding (B)	601.56	597.80	635.82	665.48	641.47	685.42	706.40	770.02	765.42	830.77	4.14	3.68
Low voltage	201.90	201.05	220.62	215.68	228.05	249.78	254.32	281.44	299.00	334.02	6.53	5.93
Load shedding	1.56	0.43	0.28	2.40	0.51	0.82	0.37	0.13	4.42	5.24		
Medium voltage	258.64	259.57	261.29	278.01	251.21	275.43	291.44	302.72	302.00	331.60	2.94	2.36
High Voltage	141.46	136.75	153.63	169.39	161.70	159.39	160.27	165.73	160.00	159.91	5.93	2.75
Energy generation	730.63	726.70	765.06	829.87	832.58	851.51	877.44	944.04	947.94	976.19	4.53	3.93
Energy for auxiliary use	48.63	46.04	47.26	48.77	47.33	66.53	64.09	77.58	63.95	63.95		
Peak load	117.14	118.66	122.74	130.34	134.62	131.29	145.54	151.34	148.39	154.28	kW Loss Rate : 5%	
Peak generation	123.30	124.90	129.20	137.20	141.70	138.20	153.20	159.30	156.20	162.40	4.28	3.33
Loss factor (transmission & distribution)	11.80	11.78	13.82	14.80	18.31	12.68	13.15	11.13	13.41	9.13		
Load factor	66.47	65.20	68.02	68.41	66.59	68.25	63.90	65.36	68.00	67.65	at sending end	
Ratio of (B) to (A)	96.52	96.60	96.07	96.05	93.49	94.81	95.79	95.24	95.34	95.51		
3. Dakar area (Dakar & Rufisque)												
Energy consumption (C)	399.22	391.23	413.26	420.30	411.96	432.30	466.42	498.07	509.00	544.37	4.23	3.88
Low voltage	160.40	159.16	176.07	169.26	182.21	186.50	197.70	214.53	231.00	241.37	6.07	5.57
Medium voltage	196.82	202.07	199.19	206.04	190.75	199.80	217.72	227.54	222.00	242.84	1.91	1.48
High voltage	42.00	30.00	38.00	45.00	39.00	46.00	51.00	58.00	56.00	60.18	-	10.05
Energy generation	697.40	693.80	749.60	786.90	777.90	795.60	834.00	869.10	901.20	926.89	4.24	3.86
Peak generation	117.50	120.00	123.60	130.00	133.50	132.60	147.20	164.70	150.70	159.60	4.06	3.39
Ratio of (C) to (A)	64.06	63.22	62.44	60.66	60.04	59.80	63.25	61.61	63.40	62.58		
4. Thies & Taiba area												
Energy consumption	155.99	161.93	172.46	184.38	177.77	186.29	175.72	199.45	178.00	237.07	3.30	1.67
Low voltage	15.60	16.60	16.81	17.70	18.61	25.57	20.98	24.01	26.00	63.16	9.53	7.70
Medium voltage	40.93	38.58	40.02	42.29	36.46	47.33	45.47	45.71	48.00	74.16	6.61	3.86
High voltage	99.46	106.75	115.63	124.39	122.70	113.39	109.27	129.73	104.00	99.75	2.74	0.37
5. Saint-Louis & Kaolack area												
Energy consumption	44.79	44.21	49.82	58.40	51.23	66.01	63.89	72.37	74.00	44.09	9.87	8.40
Low voltage	25.90	25.29	27.74	28.72	27.23	37.71	35.64	42.90	42.00	29.49	8.47	8.47
Medium voltage	18.89	18.92	22.08	29.68	24.00	28.30	28.25	29.47	32.00	14.60	13.39	8.95
Energy generation	33.23	31.90	35.46	43.97	54.68	55.71	43.44	44.94	46.74	51.50	101.47	6.69
Peak generation	-	-	-	-	-	-	-	-	16.69	-		
6. Ziguinchor, Tambacounda and other area												
Energy consumption	21.660	21.050	26.020	27.360	44.670	37.490	31.020	38.470	37.400	39.090	15.99	11.42
Low voltage	13.790	13.900	14.250	15.560	20.670	21.900	20.830	20.710	23.000	25.900	14.52	8.02
Medium voltage	7.870	7.150	11.770	11.810	24.000	15.590	10.190	17.760	14.400	13.180	21.94	21.98
Energy generation	25.830	25.600	26.800	32.910	36.170	38.620	38.240	39.750	39.990	42.620	12.22	0.82
Peak generation	--	--	--	--	--	--	--	--	--	--		

Source : Statistical operation record by SENELEC (February 1995)

Table 4.3.6-1(1) Daily Maximum Generation Record

19/October/1990

Hour	Bel-Air (CI)			Bel-Air (CII)					Cap des Biches (CIII)						Cap des Biches (CIV)			Total			
	G105	G106	Total	G101	G102	G103	G104	Total	G301	G302	G303	TAG1	TAG2	Total	G401	G402	Total	Dakar	Saint-L	Kaolack	RGI
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
00-01	-	-	-	0.0	10.9	0.0	7.3	18.2	12.0	26.0	0.0	13.0	0.0	51.0	17.1	18.6	35.7	104.9	-	-	-
01-02	-	-	-	0.0	10.2	0.0	6.9	17.1	11.0	27.0	0.0	8.0	0.0	46.0	15.1	16.5	31.6	94.7	-	-	-
02-03	-	-	-	0.0	9.6	0.0	6.6	16.2	13.0	26.0	0.0	5.0	0.0	44.0	18.1	19.9	38.0	98.2	-	-	-
03-04	-	-	-	0.0	10.5	0.0	7.0	17.5	12.0	27.0	0.0	4.0	0.0	43.0	15.2	16.5	31.7	92.2	-	-	-
04-05	-	-	-	0.0	10.5	0.0	7.0	17.5	20.0	26.0	0.0	4.0	0.0	50.0	15.6	17.4	33.0	100.5	-	-	-
05-06	-	-	-	0.0	10.9	0.0	5.7	16.6	14.0	25.0	0.0	5.0	0.0	44.0	17.1	18.5	35.6	96.2	-	-	-
06-07	-	-	-	0.0	10.9	0.0	7.3	18.2	17.0	25.0	0.0	5.0	0.0	47.0	17.6	17.3	34.9	100.1	-	-	-
07-08	-	-	-	0.0	9.6	0.0	6.9	16.5	21.0	19.0	0.0	10.0	3.0	53.0	16.6	18.1	34.7	104.2	-	-	-
08-09	-	-	-	0.0	10.5	0.0	7.2	17.7	23.0	16.0	0.0	11.0	1.0	51.0	18.7	19.0	37.7	106.4	-	-	-
09-10	-	-	-	0.0	9.9	0.0	7.0	16.9	25.0	22.0	9.0	9.0	8.0	73.0	18.6	18.5	37.1	127.0	-	-	-
10-11	-	-	-	0.0	9.7	0.0	2.2	11.9	24.0	26.0	22.0	12.0	0.0	84.0	18.8	17.7	36.5	132.4	-	-	-
11-12	-	-	-	0.0	9.0	0.0	5.6	14.6	23.0	24.0	23.0	10.0	0.0	80.0	19.0	19.0	38.0	132.6	-	-	-
12-13	-	-	-	0.0	8.0	0.0	4.9	12.9	22.0	24.0	22.0	0.0	0.0	68.0	19.0	18.9	37.9	118.8	-	-	-
13-14	-	-	-	0.0	4.4	0.0	4.5	8.9	22.0	27.0	21.0	0.0	0.0	70.0	17.3	17.2	34.5	113.4	-	-	-
14-15	-	-	-	0.0	5.3	0.0	5.8	11.1	22.0	22.0	22.0	0.0	0.0	66.0	17.3	17.4	34.7	111.8	-	-	-
15-16	-	-	-	0.0	7.0	0.0	6.5	13.5	24.0	26.0	25.0	0.0	0.0	75.0	19.4	19.6	39.0	127.5	-	-	-
16-17	-	-	-	0.0	7.0	0.0	6.5	13.5	26.0	28.0	27.0	0.0	0.0	81.0	15.4	15.0	30.4	124.9	-	-	-
17-18	-	-	-	0.0	5.0	0.0	4.8	9.8	23.0	27.0	25.0	0.0	0.0	75.0	18.6	19.3	37.9	122.7	-	-	-
18-19	-	-	-	0.0	5.1	0.0	5.5	10.6	24.0	23.0	25.0	0.0	0.0	72.0	17.7	17.5	35.2	117.8	-	-	-
19-20	-	-	-	0.0	8.6	0.0	9.2	17.8	25.0	25.0	28.0	0.0	0.0	78.0	16.9	16.0	32.9	128.7	-	-	-
20-21	-	-	-	0.0	5.5	0.0	5.6	11.1	25.0	24.0	26.0	0.0	0.0	75.0	18.4	19.5	37.9	124.0	-	-	-
21-22	-	-	-	0.0	5.2	0.0	5.2	10.4	25.0	22.0	26.0	0.0	0.0	73.0	16.9	17.1	34.0	117.4	-	-	-
22-23	-	-	-	0.0	4.7	0.0	4.4	9.1	24.0	20.0	25.0	0.0	0.0	69.0	17.2	17.4	34.6	112.7	-	-	-
23-24	-	-	-	0.0	4.8	0.0	0.2	5.0	25.0	19.0	24.0	0.0	0.0	68.0	16.1	18.9	35.0	108.0	-	-	-
Max.	0.0	0.0	0.0	0.0	10.9	0.0	9.2	18.2	26.0	28.0	28.0	13.0	8.0	84.0	19.4	19.9	39.0	132.6	-	-	-
Min.	0.0	0.0	0.0	0.0	4.4	0.0	0.2	5.0	11.0	16.0	0.0	0.0	0.0	43.0	15.1	15.0	30.4	92.2	-	-	-

Source : Statistical operation record by SENELEC (August 1994)

Table 4.3.6-1(2) Daily Maximum Generation Record

30/October/1991

Hour	Bel-Air (CI)			Bel-Air (CII)					Cap des Biches (CIII)						Cap des Biches (CIV)			Total			
	G105	G106	Total	G101	G102	G103	G104	Total	G301	G302	G303	TAG1	TAG2	Total	G401	G402	Total	Dakar	Saint-L	Kaolack	RG1
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
00-01	4.5	0.0	4.5	0.0	0.6	3.5	0.0	4.1	26.0	22.0	26.0	0.0	0.0	74.0	18.0	18.2	36.2	118.8	-	-	-
01-02	4.5	0.0	4.5	0.0	0.0	0.0	0.0	0.0	26.0	20.0	23.0	0.0	0.0	69.0	18.6	19.0	37.6	111.1	-	-	-
02-03	4.5	0.0	4.5	0.0	0.0	0.0	0.0	0.0	26.0	20.0	22.0	0.0	0.0	68.0	19.2	19.3	38.5	111.0	-	-	-
03-04	4.5	0.0	4.5	0.0	0.0	0.0	0.0	0.0	25.0	18.0	21.0	0.0	0.0	64.0	19.1	18.9	38.0	106.5	-	-	-
04-05	4.5	0.0	4.5	0.0	0.0	0.0	0.0	0.0	26.0	19.0	22.0	0.0	0.0	67.0	18.8	18.8	37.6	109.1	-	-	-
05-06	4.5	0.0	4.5	0.0	0.0	0.0	0.0	0.0	26.0	19.0	21.0	0.0	0.0	66.0	18.5	18.6	37.1	107.6	-	-	-
06-07	4.5	0.0	4.5	0.0	0.0	0.0	0.0	0.0	26.0	21.0	25.0	0.0	0.0	72.0	19.1	19.3	38.4	114.9	-	-	-
07-08	4.5	0.0	4.5	0.0	0.0	2.6	0.0	2.6	26.0	21.0	24.0	0.0	0.0	71.0	19.1	18.6	37.7	115.8	-	-	-
08-09	4.5	0.0	4.5	0.0	0.0	5.9	0.0	5.9	25.0	23.0	26.0	0.0	2.0	76.0	19.3	19.8	39.1	125.5	-	-	-
09-10	4.5	0.0	4.5	0.0	0.0	6.6	0.0	6.6	26.0	26.0	25.0	0.0	5.0	82.0	18.0	18.4	36.4	129.5	-	-	-
10-11	4.5	0.0	4.5	0.0	1.4	6.4	0.0	7.8	26.0	27.0	26.0	0.0	3.0	82.0	19.2	19.2	38.4	132.7	-	-	-
11-12	4.5	0.0	4.5	0.0	1.9	6.4	0.0	8.3	27.0	25.0	25.0	0.0	9.0	86.0	19.2	18.4	37.6	136.4	-	-	-
12-13	4.5	0.0	4.5	0.0	7.0	6.3	0.0	13.3	26.0	25.0	25.0	0.0	4.0	80.0	19.0	18.9	37.9	135.7	-	-	-
13-14	4.5	0.0	4.5	0.0	5.2	5.4	0.0	10.6	25.0	26.0	25.0	0.0	0.0	76.0	18.0	19.4	37.4	128.5	-	-	-
14-15	4.5	0.0	4.5	0.0	7.4	8.0	0.0	15.4	25.0	25.0	26.0	0.0	0.0	76.0	18.9	20.2	39.1	135.0	-	-	-
15-16	4.5	0.0	4.5	0.0	6.3	9.7	0.0	16.0	25.0	25.0	24.0	0.0	0.0	74.0	16.5	16.3	32.8	127.3	-	-	-
16-17	4.5	0.0	4.5	0.0	5.2	4.8	0.0	10.0	26.0	24.0	24.0	0.0	0.0	74.0	17.5	18.2	35.7	124.2	-	-	-
17-18	4.5	0.0	4.5	0.0	6.2	5.9	0.0	12.1	26.0	20.0	23.0	0.0	0.0	69.0	18.2	18.1	36.3	121.9	-	-	-
18-19	4.5	0.0	4.5	0.0	5.8	6.0	0.0	11.8	26.0	22.0	23.0	0.0	0.0	71.0	17.0	16.7	33.7	121.0	-	-	-
19-20	4.5	0.0	4.5	0.0	7.3	7.5	0.0	14.8	25.0	26.0	25.0	0.0	13.0	89.0	19.3	19.6	38.9	147.2	-	-	-
20-21	4.5	0.0	4.5	0.0	9.3	8.3	0.0	17.6	27.0	27.0	24.0	0.0	5.0	83.0	19.0	19.5	38.5	143.6	-	-	-
21-22	4.5	0.0	4.5	0.0	7.5	6.8	0.0	14.3	25.0	25.0	23.0	0.0	2.0	75.0	17.7	17.4	35.1	128.9	-	-	-
22-23	4.5	0.0	4.5	0.0	8.6	9.0	0.0	17.6	26.0	26.0	24.0	0.0	0.0	76.0	19.6	19.6	39.2	137.3	-	-	-
23-24	4.5	0.0	4.5	0.0	6.7	7.2	0.0	13.9	26.0	26.0	24.0	0.0	0.0	76.0	19.5	19.7	39.2	133.6	-	-	-
Max.	4.5	0.0	4.5	0.0	9.3	9.7	0.0	17.6	27.0	27.0	26.0	0.0	13.0	89.0	19.6	20.2	39.2	147.2	-	-	-
Min.	4.5	0.0	4.5	0.0	0.0	0.0	0.0	0.0	25.0	18.0	21.0	0.0	0.0	64.0	16.5	16.3	32.8	106.5	-	-	-

Source : Statistical operation record by SENELEC (August 1994)

Table 4.3.6-1(3) Daily Maximum Generation Record

22/October/1992

Hour	Bel-Air (CI)			Bel-Air (CII)					Cap des Biches (CIII)						Cap des Biches (CIV)			Total			
	G105	G106	Total	G101	G102	G103	G104	Total	G301	G302	G303	TAG1	TAG2	Total	G401	G402	Total	Dakar	Saint-L	Kaolack	RGI
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
00-01	4.3	0.0	4.3	0.0	6.0	0.0	5.0	11.0	16.0	25.0	22.0	6.0	0.0	69.0	18.3	18.0	36.3	120.6	-	-	-
01-02	4.2	0.0	4.2	0.0	7.0	0.0	5.0	12.0	12.0	22.0	21.0	5.0	0.0	60.0	18.0	16.7	34.7	110.9	-	-	-
02-03	4.2	0.0	4.2	0.0	9.0	0.0	5.0	14.0	16.0	20.0	22.0	10.0	0.0	68.0	6.8	8.2	15.0	101.2	-	-	-
03-04	4.2	0.0	4.2	0.0	9.0	0.0	5.0	14.0	16.0	20.0	20.0	0.0	0.0	56.0	17.8	18.1	35.9	110.1	-	-	-
04-05	4.2	0.0	4.2	0.0	5.0	0.0	7.0	12.0	14.0	16.0	15.0	0.0	0.0	45.0	17.0	17.3	34.3	95.5	-	-	-
05-06	4.2	0.0	4.2	0.0	5.0	0.0	8.0	13.0	19.0	18.0	18.0	0.0	0.0	55.0	18	14.7	32.7	104.9	-	-	-
06-07	4.2	0.0	4.2	0.0	5.0	0.0	8.0	13.0	18.0	17.0	15.0	0.0	0.0	50.0	17.7	16.1	33.8	101.0	-	-	-
07-08	2.2	0.0	2.2	0.0	5.0	0.0	8.0	13.0	20.0	17.0	16.0	0.0	0.0	53.0	17.9	18.1	36.0	104.2	-	-	-
08-09	0.0	0.0	0.0	0.0	11.0	0.0	12.0	23.0	23.0	23.0	21.0	3.0	0.0	70.0	17.5	19.3	36.8	129.8	-	-	-
09-10	0.0	0.0	0.0	0.0	10.0	0.0	12.0	22.0	22.0	24.0	21.0	8.0	0.0	75.0	17.2	18.4	35.6	132.6	-	-	-
10-11	0.0	0.0	0.0	0.0	10.0	0.0	12.0	22.0	21.0	22.0	19.0	12.0	0.0	74.0	18.2	19.1	37.3	133.3	-	-	-
11-12	0.0	0.0	0.0	0.0	10.0	0.0	12.0	22.0	21.0	25.0	22.0	11.0	0.0	79.0	17.4	18.0	35.4	136.4	-	-	-
12-13	0.0	0.0	0.0	0.0	10.0	2.0	12.0	24.0	23.0	24.0	20.0	8.0	0.0	75.0	18.3	17.7	36.0	135.0	-	-	-
13-14	0.0	0.0	0.0	0.0	9.0	7.0	10.0	26.0	21.0	23.0	20.0	5.0	0.0	69.0	15.8	14.4	30.2	125.2	-	-	-
14-15	0.0	0.0	0.0	0.0	9.0	9.0	9.0	27.0	25.0	24.0	22.0	8.0	0.0	79.0	19.0	17.9	36.9	142.9	-	-	-
15-16	0.0	0.0	0.0	0.0	8.0	8.0	8.0	24.0	23.0	24.0	21.0	8.0	0.0	76.0	18.4	17.1	35.5	135.5	-	-	-
16-17	2.5	0.0	2.5	0.0	9.0	9.0	9.0	27.0	23.0	25.0	21.0	3.0	0.0	72.0	17.6	15.6	33.2	134.7	-	-	-
17-18	4.2	0.0	4.2	0.0	6.0	6.0	8.0	20.0	23.0	25.0	21.0	0.0	0.0	69.0	18.0	15.9	33.9	127.1	-	-	-
18-19	4.2	0.0	4.2	0.0	6.0	6.0	9.0	21.0	22.0	23.0	20.0	0.0	0.0	65.0	17.6	16.2	33.8	124.0	-	-	-
19-20	4.2	0.0	4.2	0.0	10.0	10.0	10.0	30.0	23.0	24.0	21.0	10.0	0.0	78.0	18.4	17.2	35.6	147.8	-	-	-
20-21	4.2	0.0	4.2	0.0	11.0	11.0	11.0	33.0	24.0	25.0	22.0	10.0	0.0	81.0	17.7	16.8	34.5	152.7	-	-	-
21-22	4.2	0.0	4.2	0.0	10.0	10.0	11.0	31.0	20.0	24.0	22.0	10.0	0.0	76.0	17.9	17.3	35.2	146.4	-	-	159.35
22-23	4.2	0.0	4.2	0.0	9.0	10.0	11.0	30.0	20.0	23.0	20.0	8.0	0.0	71.0	17.5	16.8	34.3	139.5	-	-	-
23-24	4.2	0.0	4.2	0.0	7.0	7.0	8.0	22.0	23.0	25.0	22.0	6.0	0.0	76.0	17.8	17.8	35.6	137.8	-	-	-
Max.	4.3	0.0	4.3	0.0	11.0	11.0	12.0	33.0	25.0	25.0	22.0	12.0	0.0	81.0	19.0	19.3	37.3	152.7	-	-	159.4
Min.	0.0	0.0	0.0	0.0	5.0	0.0	5.0	12.0	12.0	16.0	15.0	0.0	0.0	45.0	6.8	8.2	15.0	95.5	-	-	-

Source : Statistical operation record by SENELEC (August 1994)

Table 4.3.6-1(4) Daily Maximum Generation Record

3/May/1993

Hour	Bel-Air (CI)			Bel-Air (CII)					Cap des Biches (CIII)						Cap des Biches (CIV)			Total			
	G105	G106	Total	G101	G102	G103	G104	Total	G301	G302	G303	TAG1	TAG2	Total	G401	G402	Total	Dakar	Saint-L	Kaolack	RGI
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
00-01	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	20.0	19.0	15.0	0.0	0.0	54.0	18.6	19.1	37.7	96.7	-	-	-
01-02	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	20.0	19.0	17.0	0.0	0.0	56.0	14.8	18.7	33.5	94.5	-	-	-
02-03	0.0	0.0	0.0	0.0	0.0	0.0	6.0	6.0	18.0	18.0	18.0	0.0	0.0	54.0	14.9	9.4	24.3	84.3	-	-	-
03-04	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	16.0	16.0	17.0	0.0	0.0	49.0	16.7	17.0	33.7	87.7	-	-	-
04-05	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	16.0	17.0	17.0	0.0	0.0	50.0	18.6	19.3	37.9	92.9	-	-	-
05-06	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	16.0	17.0	15.0	0.0	0.0	48.0	18.2	19.1	37.3	90.3	-	-	-
06-07	0.0	0.0	0.0	0.0	0.0	0.0	7.0	7.0	18.0	19.0	18.0	0.0	0.0	55.0	19.7	20.6	40.3	102.3	-	-	-
07-08	0.0	0.0	0.0	0.0	0.0	0.0	6.0	6.0	20.0	21.0	18.0	0.0	0.0	59.0	20.0	18.8	38.8	103.8	-	-	-
08-09	0.0	0.0	0.0	0.0	5.0	0.0	5.0	10.0	20.0	21.0	19.0	0.0	0.0	60.0	18.3	18.0	36.3	106.3	-	-	-
09-10	0.0	0.0	0.0	0.0	5.0	0.0	5.0	10.0	21.0	20.0	18.0	0.0	0.0	59.0	18.6	17.7	36.3	105.3	-	-	-
10-11	0.0	0.0	0.0	0.0	7.0	0.0	7.0	14.0	11.0	21.0	18.0	0.0	5.0	55.0	19.2	19.4	38.6	107.6	-	-	-
11-12	0.0	0.0	0.0	0.0	6.0	0.0	6.0	12.0	0.0	21.0	20.0	0.0	6.0	47.0	17.8	17.7	35.5	94.5	-	-	-
12-13	0.0	0.0	0.0	0.0	5.0	0.0	5.0	10.0	0.0	19.0	18.0	0.0	12.0	49.0	17.0	19.0	36.0	95.0	-	-	-
13-14	0.0	0.0	0.0	0.0	5.0	0.0	6.0	11.0	4.0	20.0	19.0	0.0	8.0	51.0	17.0	17.5	34.5	96.5	-	-	-
14-15	0.0	0.0	0.0	0.0	4.0	0.0	5.0	9.0	15.0	20.0	18.0	0.0	0.0	53.0	19.3	19.8	39.1	101.1	-	-	-
15-16	0.0	0.0	0.0	0.0	5.0	0.0	5.0	10.0	18.0	19.0	18.0	0.0	0.0	55.0	18.5	18.8	37.3	102.3	-	-	-
16-17	0.7	0.0	0.7	0.0	5.0	0.0	5.0	10.0	20.0	20.0	19.0	0.0	0.0	59.0	19.0	19.8	38.8	108.5	-	-	-
17-18	3.9	0.0	3.9	0.0	5.0	0.0	5.0	10.0	20.0	21.0	19.0	0.0	0.0	60.0	18.9	18.4	37.3	111.2	-	-	-
18-19	4.4	0.0	4.4	0.0	5.0	0.0	6.0	11.0	16.0	20.0	19.0	0.0	0.0	55.0	19.9	19.4	39.3	109.7	-	-	-
19-20	4.1	0.0	4.1	0.0	6.0	0.0	8.0	14.0	20.0	23.0	20.0	0.0	8.0	71.0	19.7	19.1	38.8	127.9	-	-	-
20-21	4.3	4.4	8.7	0.0	7.0	0.0	11.0	18.0	22.0	25.0	20.0	0.0	18.0	85.0	19.7	19.3	39.0	150.7	-	-	-
21-22	4.2	4.6	8.8	0.0	7.0	0.0	11.0	18.0	18.0	22.0	19.0	0.0	15.0	74.0	18.4	18.6	37.0	137.8	-	-	-
22-23	2.3	2.9	5.2	0.0	6.0	0.0	11.0	17.0	21.0	24.0	19.0	0.0	6.0	70.0	18.6	18.4	37.0	129.2	-	-	-
23-24	0.0	0.0	0.0	0.0	6.0	0.0	7.0	13.0	19.0	23.0	17.0	0.0	0.0	59.0	19.8	19.5	39.3	111.3	-	-	-
Max.	4.4	4.6	8.8	0.0	7.0	0.0	11.0	18.0	22.0	25.0	20.0	0.0	18.0	85.0	20.0	20.6	40.3	150.7	-	-	-
Min.	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	0.0	16.0	15.0	0.0	0.0	47.0	14.8	9.4	24.3	84.3	-	-	-

Source : Statistical operation record by SENELEC (August 1994)

Table 4.3.6-1(5) Daily Maximum Generation Record

18/October/1993

Hour	Bel-Air (CI)			Bel-Air (CII)					Cap des Biches (CIII)						Cap des Biches (CIV)			Total			
	G105	G106	Total	G101	G102	G103	G104	Total	G301	G302	G303	TAG1	TAG2	Total	G401	G402	Total	Dakar	Saint-L	Kaolack	RG1
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW
00-01	0.0	0.3	0.3	0.0	0.0	6.0	6.0	12.0	24.0	24.0	15.0	7.0	0.0	70.0	17.0	18.3	35.3	117.60	-	-	-
01-02	0.0	0.0	0.0	0.0	0.0	7.0	7.0	14.0	24.0	24.0	15.0	7.0	0.0	70.0	16.6	17.3	33.9	117.90	-	-	-
02-03	0.0	0.0	0.0	0.0	0.0	8.0	6.0	14.0	23.0	21.0	15.0	8.0	0.0	67.0	16.4	4.4	20.8	101.80	-	-	-
03-04	0.0	0.0	0.0	0.0	0.0	10.0	7.0	17.0	24.0	23.0	15.0	6.0	0.0	68.0	4.9	15.9	20.8	105.80	-	-	-
04-05	0.0	0.0	0.0	0.0	0.0	5.0	5.0	10.0	24.0	20.0	15.0	6.0	0.0	65.0	11.5	18.5	30.0	105.00	-	-	-
05-06	0.0	0.0	0.0	0.0	0.0	5.0	5.0	10.0	23.0	17.0	14.0	6.0	0.0	60.0	17.0	17.5	34.5	104.50	-	-	-
06-07	0.0	0.0	0.0	0.0	0.0	6.0	5.0	11.0	24.0	18.0	17.0	8.0	0.0	67.0	17.4	19.2	36.6	114.60	-	-	-
07-08	0.0	2.5	2.5	0.0	0.0	6.0	5.0	11.0	25.0	20.0	16.0	7.0	0.0	68.0	17.0	18.0	35.0	116.50	-	-	-
08-09	0.0	4.5	4.5	0.0	0.0	8.0	7.0	15.0	26.0	22.0	17.0	7.0	4.0	76.0	17.0	18.2	35.2	130.70	-	-	-
09-10	0.0	4.5	4.5	0.0	0.0	7.0	7.0	14.0	22.0	22.0	15.0	13.0	6.0	78.0	16.5	18.3	34.8	131.30	-	-	-
10-11	0.0	4.5	4.5	0.0	0.0	8.0	7.0	15.0	23.0	22.0	16.0	13.0	7.0	81.0	17.0	19.0	36.0	136.50	-	-	-
11-12	0.0	4.5	4.5	0.0	0.0	10.0	7.0	17.0	24.0	21.0	16.0	16.0	3.0	80.0	16.3	18.8	35.1	136.60	-	-	-
12-13	0.0	4.5	4.5	0.0	0.0	10.0	7.0	17.0	26.0	22.0	15.0	10.0	0.0	73.0	16.5	18.4	34.9	129.40	-	-	-
13-14	0.0	4.4	4.4	0.0	0.0	9.0	7.0	16.0	26.0	23.0	13.0	13.0	0.0	75.0	16.6	18.4	35.0	130.40	-	-	-
14-15	0.0	4.5	4.5	0.0	0.0	10.0	7.0	17.0	26.0	23.0	15.0	14.0	4.0	82.0	16.8	18.4	35.2	138.70	-	-	-
15-16	0.0	4.5	4.5	0.0	0.0	10.0	7.0	17.0	25.0	21.0	16.0	0.0	13.0	75.0	17.5	19.0	36.5	133.00	-	-	-
16-17	0.0	4.5	4.5	0.0	0.0	9.0	6.0	15.0	26.0	23.0	16.0	6.0	11.0	82.0	17.4	17.1	34.5	136.00	-	-	-
17-18	0.0	4.4	4.4	0.0	0.0	8.0	6.0	14.0	24.0	22.0	14.0	6.0	7.0	73.0	16.2	16.6	32.8	124.20	-	-	-
18-19	0.0	4.5	4.5	0.0	0.0	5.0	5.0	10.0	21.0	22.0	16.0	8.0	7.0	74.0	16.8	18.7	35.5	124.00	-	-	-
19-20	0.0	4.6	4.6	0.0	0.0	9.0	6.0	15.0	27.0	24.0	16.0	9.0	15.0	91.0	16.9	18.7	35.6	146.20	-	-	-
20-21	0.0	4.6	4.6	0.0	0.0	10.0	8.0	18.0	26.0	22.0	15.0	12.0	10.0	85.0	17.2	20.1	37.3	144.90	-	-	-
21-22	0.0	4.5	4.5	0.0	0.0	10.0	7.0	17.0	26.0	23.0	15.0	10.0	6.0	80.0	16.8	18.8	35.6	137.10	-	-	-
22-23	0.0	4.5	4.5	0.0	0.0	10.0	6.0	16.0	27.0	24.0	15.0	10.0	9.0	85.0	16.5	19.0	35.5	141.00	-	-	-
23-24	0.0	4.6	4.6	0.0	0.0	11.0	7.0	18.0	25.0	22.0	13.0	8.0	4.0	72.0	16.6	17.3	33.9	128.50	-	-	-
Max.	0.0	4.6	4.6	0.0	0.0	11.0	8.0	18.0	27.0	24.0	17.0	16.0	15.0	91.0	17.5	20.1	37.3	146.2	-	-	-
Min.	0.0	0.0	0.0	0.0	0.0	5.0	5.0	10.0	21.0	17.0	13.0	0.0	0.0	60.0	4.9	4.4	20.8	101.8	-	-	-

Source : Statistical operation record by SENELEC (August 1994)

Table 4.3.6-2 Monthly Maximum and Minimum Generation

Month	1989			1990			1991			1992			1993			1994		
	Demand		Ratio	Demand		Ratio	Demand		Ratio	Demand		Ratio	Demand		Ratio	Demand		Ratio
	Max (MW)	Min (MW)	(%)	Max (MW)	Min (MW)	(%)	Max (MW)	Min (MW)	(%)	Max (MW)	Min (MW)	(%)	Max (MW)	Min (MW)	(%)	Max (MW)	Min (MW)	(%)
Jan	114.8	48.1	86.0	110.6	51.5	83.4	123.2	50.7	83.7	139.5	75.5	90.2	141.0	65.4	93.6	146.8	-	90.4
Feb	113.3	55.0	84.9	109.9	57.0	82.9	131.1	57.2	89.1	137.4	65.5	88.8	140.7	73.0	93.4	147.0	-	90.5
Mar	121.1	57.0	90.7	125.0	65.0	94.3	125.4	57.2	85.2	139.8	58.0	90.4	138.0	62.4	91.5	147.1	-	90.6
Apr	113.7	51.0	85.2	117.0	51.0	88.2	125.2	60.3	85.1	136.5	69.2	88.2	148.5	62.0	98.5	150.7	-	92.8
May	115.0	46.0	86.1	121.8	51.0	91.9	126.7	49.3	86.1	141.5	62.3	91.5	150.7	70.4	100.0	156.7	-	96.5
Jun	125.8	62.4	94.2	126.0	71.5	95.0	124.0	60.8	84.2	146.0	72.5	94.4	142.5	64.8	94.6	159.6	-	98.2
Jul	126.5	55.6	94.8	127.1	70.0	95.9	128.0	63.7	87.0	145.2	77.0	93.9	149.0	56.2	98.9	154.5	-	95.1
Aug	125.5	55.3	94.0	128.3	62.5	96.8	137.9	76.5	93.7	141.3	65.1	91.3	140.1	79.9	93.0	159.3	-	98.1
Sep	124.0	47.8	92.9	132.0	50.5	99.5	143.7	77.3	97.6	148.0	74.6	95.7	143.0	65.2	94.9	156.7	-	96.5
Oct	133.5	72.2	100.0	132.6	72.9	100.0	147.2	72.3	100.0	154.7	74.6	100.0	149.2	60.2	99.0	162.4	-	100.0
Nov	129.3	53.4	96.9	126.4	62.2	95.3	146.6	74.9	99.6	149.5	77.2	96.6	141.9	68.4	94.2	158.7	-	97.7
Dec	120.9	45.1	90.6	127.0	62.5	95.8	142.7	70.9	96.9	147.1	70.4	95.1	136.6	65.1	90.6	157.3	-	96.9

Ratio : Monthly maximum demand to yearly maximum demand (%)
Source : Statistical operation record by SENELEC (August 1994)

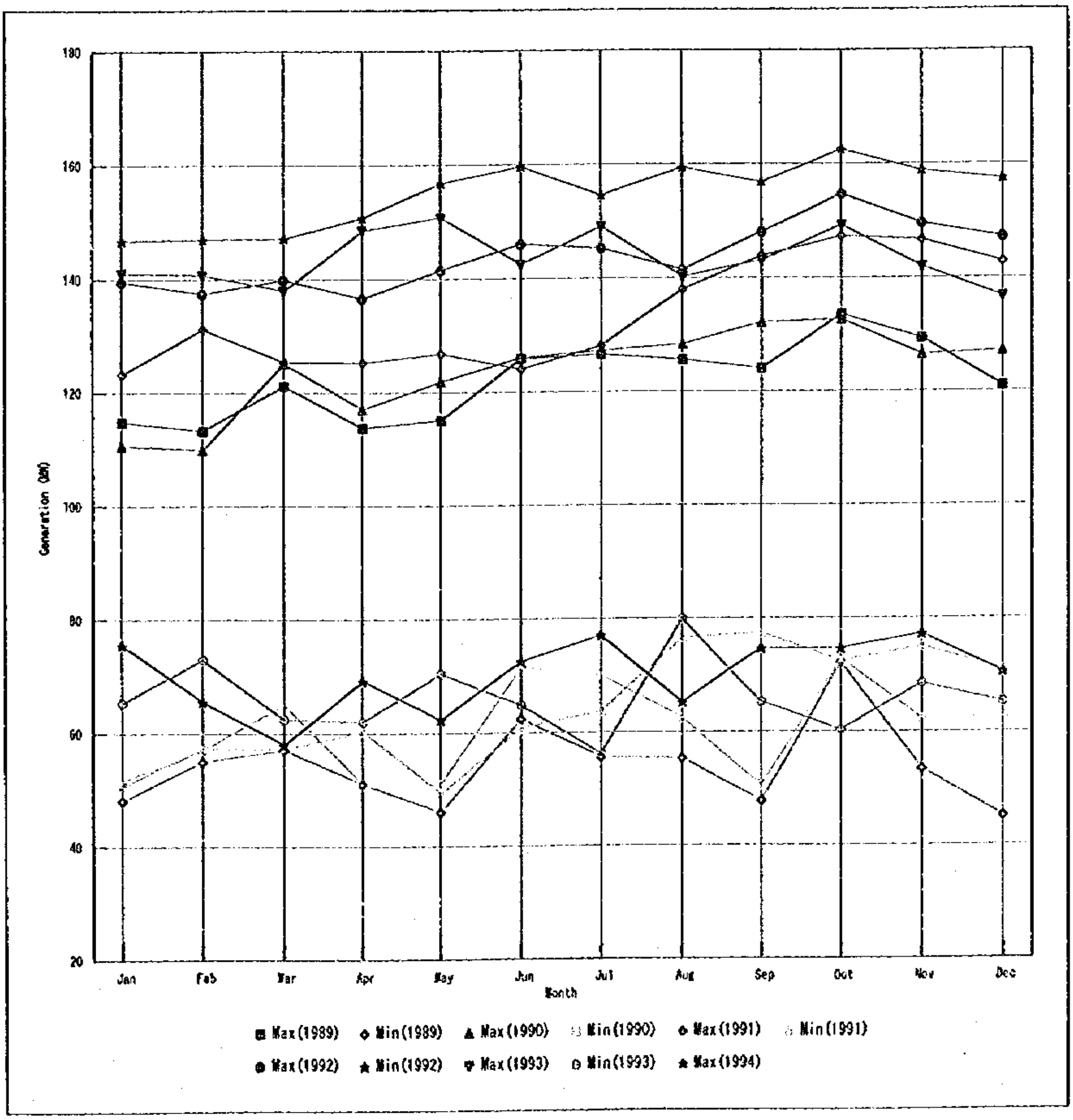


Table 4.3.8 Power Demand and Supply Balance

RGI:Existing Generating Facilities

Item	Unit	Capacity	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Remarks
Existing capacity (RI) :	kW	Rated																40,000	50,000	50,000	50,000	
Diesel unit	kW	Economical																36,000	45,000	45,000	45,000	
	kW	Short time																46,000	57,000	57,000	57,000	
	kW	Actual limit																			50,000	
Steam turbine	kW	Rated	108,700	108,700	108,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	138,700	
	kW	Actual limit																			87,500	
Gas turbine	kW	Rated	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	38,000	
	kW	Economical	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	
	kW	Actual limit																			34,000	
Existing capacity (SAINT-LOUIS & KAOLCK)	kW	Rated					6,500	10,500	10,500	17,500	17,500	17,500	17,500	17,500	21,000	24,500	24,500	24,500	24,500	24,500	24,500	
	kW	Economical					5,850	9,450	9,450	15,750	15,750	15,750	15,750	15,750	18,900	22,050	22,050	22,050	22,050	22,050	22,050	
	kW	Short time					7,150	11,550	11,550	19,250	19,250	19,250	19,250	19,250	23,100	26,950	26,950	26,950	26,950	26,950	26,950	
	kW	Actual limit																			24,500	
Total existing capacity : RGI	kW	Rated	125,200	125,200	125,200	156,200	156,200	156,200	156,200	156,200	156,200	178,700	178,700	178,700	178,700	178,700	178,700	216,700	226,700	226,700	226,700	
	kW	Economical	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	30,000	30,000	30,000	30,000	30,000	30,000	66,000	75,000	75,000	75,000	
	kW	Actual limit																			196,000	
Peak load (RI) (B)	kW	-	76,000	72,000	85,500	93,500	104,200	102,700	108,000	102,000	108,900	116,000	117,500	120,000	123,600	130,000	133,500	132,600	147,200	154,700	150,700	at generating terminal
Off-peak load (RI) (C)	kW	-	38,000	36,000	42,750	46,750	52,100	51,350	54,000	51,000	54,450	59,000	58,750	60,000	61,800	65,000	66,750	66,300	73,600	77,350	75,350	estimated as 50% of peak load
Reserve margins (RI:1) :																						
Stoppage of 1st & 2nd largest units	kW	Rated	30,000	30,000	30,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	F:G302(30,000),S:G303(30,000)
ditto (D)	kW	Actual limit																			47,500	F:G301(27,500),S:G302(20,000)
Balance[(actual limit of RI)-(B)-(D)]	kW	Actual limit																			-28,700	at generating terminal
Reserve margins (RI:2) :		-																				
20% capacity of peak load (E)	kW	-																			30,140	at generating terminal
Balance [(A)-(B)-(E)]	kW	Actual limit																			15,160	
Spinning reserve (RI) :																						
Deviation of load fluctuation (σp)	kW	-	2.6	2.5	2.8	2.9	3.1	3.0	3.1	3.0	3.1	3.3	3.3	3.3	3.3	3.4	3.5	3.5	3.6	3.7	3.7	Proportional constant of σp = 0.3
Regulating capacity (≦1Hz) (G)	Hz	-	8,461	8,182	9,096	9,603	10,249	10,161	10,471	10,118	10,523	11,035	11,008	11,145	11,341	11,882	11,895	11,818	12,559	12,925	12,791	Power constant : 1%MW/0.1Hz
Difference : corresponding unit (H)	kW	-																			TAG2	
Difference [(H)-(G)]	kW	Actual limit																			6,799	
Unit capacity of peak load (RI) :																						
Variation : corresponding unit	-	-	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	
unit capacity	kW	Actual limit	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	27,500	
frequency variation	Hz	-	3.6	3.8	3.2	2.9	2.6	2.7	2.5	2.7	2.5	2.3	2.3	2.3	2.2	2.1	2.1	2.1	1.9	1.8	1.8	Power constant : 1%MW/0.1Hz
Allowable unit capacity : ≦1Hz	kW	-	7,600	7,200	8,560	9,360	10,420	10,270	10,800	10,200	10,880	11,800	11,750	12,000	12,380	13,000	13,350	13,280	14,720	15,470	15,070	Allowable frequency deviation
≦2.5Hz	kW	-	19,000	18,000	21,375	23,375	26,050	25,675	27,000	25,500	27,025	29,500	29,375	30,000	30,900	32,500	33,375	33,150	36,800	38,675	37,675	Activation of load shedding (3rd)
Unit capacity of off-peak load (RI) :																						
Variation : corresponding unit	-	-	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	G301	
unit capacity	kW	Actual limit	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	16,500	estimated as 60% of rated
frequency variation	Hz	-	4.3	4.6	3.9	3.5	3.2	3.2	3.1	3.2	3.0	2.8	2.8	2.8	2.7	2.5	2.5	2.6	2.2	2.1	2.2	Power constant : 1%MW/0.1Hz
Allowable unit capacity : ≦1Hz	kW	-	3,800	3,600	4,275	4,675	5,210	5,135	5,400	5,100	5,445	5,900	5,875	6,000	6,180	6,500	6,675	6,630	7,380	7,735	7,535	Allowable frequency deviation
≦2.5Hz	kW	-	9,500	9,000	10,988	11,688	13,025	12,838	13,500	12,750	13,613	14,750	14,688	15,000	15,450	16,250	16,688	16,575	18,400	19,338	18,838	Activation of load shedding (3rd)

Source : statistical operation record by SENELEC (August 1984)

Peak load : calculated as rate of auxiliary kW use 5%

Table 4.6-1 Fault and Supply Restriction Energy Record (30kV Network)

(1992.1.1 ~ 12.31)

No	Cause	Number of fault		Supply restriction energy		Remarks
		Times	%	kWh	%	
1	Equipment failure	39	13.31	113,243	34.39	
2	Circumstantial	6	2.05	84,960	25.80	
3	Default of protection	37	12.63	25,232	7.66	
4	Humidity	17	5.80	19,497	5.92	
5	Rain	13	4.44	16,431	4.99	
6	Unknown	138	47.10	15,916	4.83	
7	Accidental shock	4	1.37	12,506	3.80	
8	Customer's equipment	3	1.02	8,317	2.53	
9	Fire	1	0.34	8,203	2.49	
10	Wind, storm	6	2.05	5,541	1.68	
11	Operation	7	2.39	4,840	1.47	
12	Dilapidation	2	0.68	4,782	1.45	
13	Malevolence	5	1.71	3,462	1.05	
14	Lightning	4	1.37	3,068	0.93	
15	Wrong operation	2	0.68	1,575	0.48	
16	Incident	5	1.71	1,022	0.31	
17	Foreign material	2	0.68	704	0.21	
18	Overload	2	0.68	0	0.00	
Total		293	100.00	329,299	100.00	

Table 4.6-2 Fault and Supply Restriction Energy Record (30kV Network)

(1993.1.1 ~ 12.31)

No.	Cause	Number of Fault		Supply restriction energy		Remarks
		Times	%	kWh	%	
1	Equipment failure	42	7.45	137,545	35.64	
2	Unknown	305	54.08	79,686	20.65	
3	Rain	47	8.33	59,425	15.40	
4	Default of protection	52	9.22	30,821	7.99	
5	Essai sur defaut	33	5.85	24,319	6.30	
6	Accidental shock	5	0.89	13,898	3.60	
7	Foreign material	20	3.55	12,304	3.19	
8	Humidity	17	3.01	5,769	1.49	
9	Wrong operation	3	0.53	5,509	1.43	
10	Fire	2	0.35	3,780	0.98	
11	Wind, storm	6	1.06	3,597	0.93	
12	Overload	6	1.06	1,517	0.39	
13	Circumstantial	3	0.53	1,499	0.39	
14	Customer's equipment	1	0.18	1,360	0.35	
15	Corrosion	1	0.18	1,073	0.28	
16	Search for fault point	7	1.24	1,007	0.26	
17	Insufficient pruning	2	0.35	907	0.24	
18	Malevolence	2	0.35	837	0.22	
19	Dilapidation	6	1.06	793	0.21	
20	Pollution	2	0.35	166	0.04	
21	Animals	1	0.18	100	0.03	
22	Works	1	0.18	0	0.00	
	Total	564	100.00	385,912	100.00	

Table 4.6-3 Fault and Supply Restriction Energy Record (30kV Network)

(1994.1.1 ~ 12.31)

No.	Cause	Number of Fault		Supply restriction energy		Remarks
		Times	%	kWh	%	
1	Equipment failure	60	11.01	62,394	24.93	
2	Rain	49	8.99	47,841	19.12	
3	Humidity	55	10.09	28,964	11.57	
4	Default of protection	91	16.70	27,311	10.91	
5	Unknown	161	29.54	22,845	9.13	
6	Essai sur defaut	49	8.99	15,394	6.15	
7	Accidental shock	6	1.10	12,247	4.89	
8	Circumstantial	1	0.18	6,720	2.69	
9	High Voltage equipment	26	4.77	6,436	2.57	
10	Foreign material	10	1.83	6,218	2.48	
11	Wrong operation	14	2.57	3,796	1.52	
12	Malevolence	5	0.92	3,151	1.26	
13	Dilapidation	3	0.55	2,270	0.91	
14	Fire	1	0.18	1,599	0.64	
15	Customer's equipment	1	0.18	667	0.27	
16	Insufficient pruning	2	0.37	482	0.19	
17	Protection	2	0.37	442	0.18	
18	Animals	1	0.18	405	0.16	
19	Operation	2	0.37	386	0.15	
20	Overload	2	0.37	355	0.14	
21	Incident	4	0.73	347	0.14	
	Total	545	100.00	250,270	100.00	

Table 4.6-4 Fault and Supply Restriction Energy Record (6.6kV Network)

(1992.1.1 ~ 12.31)

No	Cause	Number of fault		Supply restriction energy		Remarks
		Times	%	kWh	%	
1	Rain	35	11.01	21,728	18.80	
2	Equipment failure	30	9.43	21,542	18.64	
3	Accidental shock	8	2.52	14,809	12.82	
4	Unknown	174	54.72	13,275	11.49	
5	Default of protection	21	6.60	11,572	10.01	
6	Dilapidation	12	3.77	14,105	12.21	
7	Malevolence	11	3.46	12,770	11.05	
8	Foreign material	7	2.20	1,908	1.65	
9	Lightning	3	0.94	1,105	0.96	
10	Operation	5	1.57	741	0.64	
11	Dilapidation	1	0.31	725	0.63	
12	Animals	1	0.31	510	0.44	
13	Circumstantial	4	1.26	471	0.41	
14	Overload	3	0.94	209	0.18	
15	Humidity	1	0.31	64	0.06	
16	Customer's equipment	1	0.31	21	0.02	
17	Wrong operation	1	0.31	0	0.00	
Total		318	100.00	115,555	100.00	

Note : (294) in PLAN D'ACTION 1993

Table 4.6-5 Fault and Supply Restriction Energy Record (6.6kV Network)

(1993.1.1 ~ 12.31)

No.	Cause	Number of Fault		Supply restriction energy		Remarks
		Times	%	kWh	%	
1	Rain	43	10.19	46,576	27.24	
2	Equipment failure	35	8.29	35,183	20.58	
3	Default of protection	33	7.82	29,788	17.42	
4	Unknown	229	54.27	24,276	14.20	
5	Accidental shock	16	3.79	12,476	7.30	
6	Wind, storm	5	1.18	4,647	2.72	
7	Foreign material	6	1.42	4,556	2.66	
8	Dilapidation	6	1.42	3,094	1.81	
9	Malevolence	7	1.66	2,087	1.22	
10	Overload	4	0.95	2,087	1.22	
11	Circumstantial	1	0.24	1,922	1.12	
12	Humidity	6	1.42	1,894	1.11	
13	Lightning	3	0.71	1,305	0.76	
14	Essai sur defaut	10	2.37	641	0.37	
15	Customer's equipment	2	0.47	115	0.07	
16	Search for fault point	5	1.18	110	0.06	
17	Wrong operation	1	0.24	88	0.05	
18	Insufficient pruning	6	1.42	64	0.04	
19	Works	2	0.47	64	0.04	
20	Shortage of generation	1	0.24	0	0.00	
21	Corrosion	1	0.24	0	0.00	
Total		422	100.00	170,973	100.00	

Table 4.6-6 Fault and Supply Restriction Energy Record (6.6kV Network)

(1994.1.1 ~ 12.31)

No.	Cause	Number of Fault Times	Number of Fault %	Supply restriction energy kWh	Supply restriction energy %	Remarks
1	Equipment failure	61	16.05	60,553	37.79	
2	Rain	22	5.79	39,488	24.64	
3	Unknown	139	36.58	12,481	7.79	
4	Accidental shock	9	2.37	8,591	5.36	
5	Essai sur defaut	44	11.58	7,314	4.56	
6	Default of protection	41	10.79	7,271	4.54	
7	Foreign material	6	1.58	5,426	3.39	
8	Malevolence	4	1.05	4,257	2.66	
9	Fire	1	0.26	2,952	1.84	
10	Circumstantial	11	2.89	2,915	1.82	
11	Dilapidation	3	0.79	2,583	1.61	
12	Wrong operation	17	4.47	1,830	1.14	
13	Operation	7	1.84	1,704	1.06	
14	Animals	1	0.26	893	0.56	
15	Insufficient pruning	1	0.26	862	0.54	
16	Overload	4	1.05	680	0.42	
17	Protection	4	1.05	251	0.16	
18	Humidity	3	0.79	127	0.08	
19	Customer's equipment	1	0.26	76	0.05	
20	Without damage	1	0.26	0	0.00	
	Total	380	100.00	160,254	100.00	

Table 4.6-7 Fault Record for Each Equipment (30 kV Network)

(1992.1.1 ~ 12.31)

No.	Cause	Number of Fault		Supply restriction energy		Remarks
		Times	%	kWh	%	
1	Without damage	210	71.67	153,150	46.51	
2	MT/BT Transformer	6	2.05	63,330	19.23	
3	Cable	21	7.17	48,085	14.60	
4	Conductor	19	6.48	18,713	5.68	
5	Insulator	14	4.78	11,568	3.51	
6	Other MT equipment	4	1.37	8,522	2.59	
7	Bridge, jumper	5	1.71	6,438	1.96	
8	MT circuit breaker	1	0.34	5,723	1.74	
9	Junction box	2	0.68	2,667	0.81	
10	Hardware	2	0.68	2,380	0.72	
11	MT/MT transformer	1	0.34	2,153	0.65	
12	Disconnecting switch	3	1.02	1,851	0.56	
13	Support	1	0.34	1,830	0.56	
14	Cable head	3	1.02	1,562	0.47	
15	Attaches (**)	1	0.34	1,327	0.40	
Total		293	100.00	329,299	100.00	

Table 4.6-8 Fault Record for Each Equipment (30 kV Network)

(1993.1.1 ~ 12.31)

No.	Cause	Number of Fault		Supply restriction energy		Remarks
		Times	%	kWh	%	
1	Without damage	439	77.84	160,097	41.49	
2	Cable	32	5.67	63,467	16.45	
3	Conductor	37	6.56	39,936	10.35	
4	Other MT equipment	10	1.77	29,683	7.69	
5	Junction box	3	0.53	27,573	7.14	
6	Cable head	8	1.42	22,477	5.82	
7	BT poste	2	0.35	7,600	1.97	
8	Insulator	6	1.06	7,120	1.84	
9	MT/BT transformer	8	1.42	7,100	1.84	
10	MT circuit breaker	6	1.06	6,570	1.70	
11	MT Disconnecting switch	3	0.53	5,992	1.55	
12	Bridge, jumper	2	0.35	3,515	0.91	
13	MT/MT transformer	5	0.89	3,000	0.78	
14	Support	1	0.18	1,598	0.41	
15	Unknown	1	0.18	163	0.04	
16	Attache (**)	1	0.18	21	0.01	
Total		564	100.00	385,912	100.00	

Table 4.6-9 Fault Record for Each Equipment (30 kV Network)

(1994.1.1 ~ 12.31)

No.	Cause	Number of Fault		Supply restriction energy		Remarks
		Times	%	kWh	%	
1	Without damage	366	67.16	81,070	32.39	
2	Cable	16	2.94	43,459	17.36	
3	(*****)	34	6.24	28,170	11.26	
4	Insulator	17	3.12	21,838	8.73	
5	MT/BT transformer	16	2.94	15,822	6.32	
6	HT equipment	32	5.87	14,614	5.84	
7	MT disconnecting switch	8	1.47	12,187	4.87	
8	Conductor	25	4.59	10,780	4.31	
9	Cable head	9	1.65	7,965	3.18	
10	Other MT equipment	6	1.10	6,658	2.66	
11	Bridge, jumper	9	1.65	4,061	1.62	
12	MT circuit breaker	3	0.55	1,516	0.61	
13	Attache (**)	1	0.18	1,320	0.53	
14	Junction box	1	0.18	600	0.24	
15	Support	1	0.18	166	0.07	
16	BT poste MT/	1	0.18	44	0.02	
	Total	545	100.00	250,270	100.00	

Table 4.6-10 Fault Record for Each Equipment (6.6kV Network)

(1992.1.1 ~ 12.31)

No	Cause	Number of Fault		Supply restriction energy		Remarks
		Times	%	kWh	%	
1	Without damage	222	75.51	31,053	31.50	
2	Insulator	12	4.08	25,967	26.34	
3	Conductor	13	4.42	15,746	15.97	
4	Cable	12	4.08	8,120	8.24	
5	Support	1	0.34	7,075	7.18	
6	Cable head	5	1.70	3,064	3.11	
7	Bridge, jumper	6	2.04	2,104	2.13	
8	MT/MT transformer	3	1.02	2,073	2.10	
9	Attache (**)	1	0.34	961	0.97	
10	MT circuit breaker	4	1.36	791	0.80	
11	MT/BT transformer	7	2.38	656	0.67	
12	Other MT equipment	2	0.68	560	0.57	
13	Disconnecting switch	4	1.36	206	0.21	
14	BT poste	2	0.68	201	0.20	
Total		294	100.00	98,577	100.00	

Table 4.6-11 Fault Record for Each Equipment (6.6 kV Network)

(1993, 1, 1 ~ 12, 31)

No.	Cause	Number of Fault		Supply restriction energy		Remarks
		Times	%	kWh	%	
1	Without damage	302	71.56	51,308	30.01	
2	Insulator	12	2.84	34,891	20.41	
3	Conductor	38	9.00	22,850	13.36	
4	Cable	14	3.32	14,053	8.22	
5	MT/MT transformer	6	1.42	11,090	6.49	
6	Other MT equipment	6	1.42	7,904	4.62	
7	MT circuit breaker	12	2.84	6,513	3.81	
8	Bridge, jumper	7	1.66	5,422	3.17	
9	MT disconnecting switch	4	0.95	4,193	2.45	
10	Cable head	3	0.71	3,751	2.19	
11	Attache (**)	4	0.95	3,022	1.77	
12	Support	4	0.95	3,021	1.77	
13	MT/BT transformer	5	1.18	1,886	1.10	
14	BT poste MT/	2	0.47	780	0.46	
15	Hardware	2	0.47	285	0.17	
16	BT poste	1	0.24	4	0.00	
Total		422	100.00	170,973	100.00	

Table 4.6-12 Fault Record for Each Equipment (6.6 kV Network)

(1994.1.1 ~ 12.31)

No.	Cause	Number of Fault		Supply restriction energy		Remarks
		Times	%	kWh	%	
1	Without damage	261	68.68	49,805	31.08	
2	Cable	18	4.74	25,945	16.19	
3	Insulator	18	4.74	22,931	14.31	
4	Conductor	21	5.53	21,219	13.24	
5	Cable head	6	1.58	6,234	3.89	
6	MT circuit breaker	9	2.37	5,958	3.72	
7	Support	4	1.05	4,817	3.01	
8	(*****)	13	3.42	4,264	2.66	
9	Attache (**)	5	1.32	4,098	2.56	
10	MT/BT transformer	3	0.79	3,897	2.43	
11	Bridge, jumper	9	2.37	3,465	2.16	
12	MT disconnecting switch	8	2.11	2,457	1.53	
13	MT/MT transformer	1	0.26	2,403	1.50	
14	Other MT equipment	3	0.79	2,324	1.45	
15	Hardware	1	0.26	437	0.27	
	Total	380	100.00	160,254	100.00	

Table 4.6-13 Fault Record of BT Network (1990)

(1990.1.1 ~ 12.31)

No	Kinds of fault	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	(%)
	(1) Customer's equipment														
1	Connection box on leading-in pole	91	64	101	65	58	63	69	117	159	97	66	58	1,008	3.5
2	Fusing of fuse	96	76	88	66	55	70	90	81	93	103	67	65	950	3.3
3	Defect of circuit breaker	1	5	5	7	12	5	10	5	14	11	12	13	100	0.3
4	Trip of circuit breaker	6	9	6	4	3	6	26	14	14	18	5	3	114	0.4
5	Defect in consumers' facility	12	19	21	20	16	11	23	13	28	16	15	10	204	0.7
6	Fusing of fuse on pole	175	116	137	126	114	105	136	145	214	144	74	75	1,561	5.3
7	Disconnection at branching point	69	77	87	83	83	68	89	76	254	82	64	53	1,085	3.7
8	Defect of watt-hour meter	11	7	5	9	3	1	1	10	18	7	8	5	85	0.3
9	Defect in connecting method	101	181	188	137	98	286	136	230	218	105	115	125	1,920	6.6
10	Disconnection for abolition	0	4	6	2	3	4	1	2	4	1	9	1	37	0.1
11	Changing of cable connection	19	42	30	19	51	72	30	24	73	30	25	30	445	1.5
12	Investigation of damage	3	4	1	0	4	0	0	0	1	0	0	0	13	0.0
13	Investigation of connection	3	13	0	0	5	0	0	0	3	0	1	1	26	0.1
14	Temporaly connection	6	23	22	9	1	36	15	4	4	8	23	7	158	0.5
15	Repairing	56	48	75	84	73	65	83	175	183	221	111	117	1,291	4.4
	Sub-total	649	688	772	631	579	792	709	896	1,280	843	595	563	8,997	30.8
	(2) Fault at poste														
16	Fault of transformer	0	0	0	0	0	0	1	0	1	0	0	0	2	0.0
17	Replacement of transformer	0	0	0	0	0	0	1	0	1	0	0	0	2	0.0
18	Fusing of MT fuse	5	3	3	0	3	0	4	1	6	3	0	2	30	0.1
19	Fusing of BT fuse	25	14	16	10	6	17	30	45	88	83	24	28	386	1.3
20	Cleaning of poste	0	44	8	1	0	0	0	0	1	0	0	0	54	0.2
21	Fault in HT portion	6	3	8	5	0	8	9	5	13	19	10	5	91	0.3
	Sub-total	36	64	35	16	9	25	45	51	110	105	34	35	565	1.9
	(3) Fault in distribution lines														
22	Breaking/cutting of cable	44	28	35	38	35	40	32	58	179	93	23	24	629	2.2
23	Fusing of fuse for branch	16	26	32	10	8	17	25	52	96	48	25	19	374	1.3
24	Damage of anchor bolt	0	7	10	16	18	7	14	25	18	97	27	30	269	0.9
25	Replacement of cable	0	41	61	26	25	28	55	53	27	22	20	23	381	1.3
26	Defect in connecting point	4	154	60	71	74	84	92	190	166	184	91	98	1,268	4.3
27	Defect of connection box	5	3	0	2	0	0	1	0	14	2	2	1	30	0.1
28	Withou damage	0	13	5	10	3	0	0	0	0	4	1	2	38	0.1
	Sub-total	69	272	203	173	163	176	219	378	500	450	189	197	2,989	10.2
	(4) Others														
29	Load shedding	1,622	2,462	2,629	1,350	1,035	1,411	687	1,019	280	2	190	175	12,862	44.0
30	Re-charging of feeder	365	479	503	471	282	367	162	164	150	27	86	88	3,144	10.8
31	Re-charging of power source	0	1	0	0	0	0	0	0	1	0	0	0	2	0.0
32	Connection of new feeder	19	14	35	82	23	48	2	1	3	37	23	35	322	1.1
33	Installation of meters	17	27	37	64	23	50	2	1	2	37	23	35	318	1.1
34	Replacement of meters	0	1	0	0	0	1	0	3	1	0	0	0	6	0.0
	Sub-total	2,023	2,984	3,204	1,967	1,363	1,877	853	1,188	437	103	322	333	16,654	57.0
	(1) + (2) + (3) + (4)	2,777	4,008	4,214	2,787	2,114	2,870	1,826	2,513	2,327	1,501	1,140	1,128	29,205	100.0
	Ratio to each month	9.5	13.7	14.4	9.5	7.2	9.8	6.3	8.6	8.0	5.1	3.9	3.9	100.0	

Table 4.6-14 Fault Record of BT Network (1991)

(1991.1.1 ~ 12.31)

No	Kinds of fault	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	(%)
	(1) Customer's equipment														
1	Connection box on leading-in pole	51	60	82	60	74	66	103	152	172	115	83	69	1,087	6.9
2	Fusing of fuse	41	49	64	75	50	52	59	95	128	56	56	58	783	5.0
3	Defect of circuit breaker	2	4	6	4	3	3	6	21	2	4	8	4	67	0.4
4	Trip of circuit breaker	3	6	3	8	13	5	16	17	9	7	10	7	104	0.7
5	Defect in consumers' facility	20	15	17	18	21	21	17	116	36	37	37	22	377	2.4
6	Fusing of fuse on pole	111	84	152	115	167	108	159	372	245	147	112	124	1,896	12.0
7	Disconnection at branching point	77	81	115	97	95	76	92	316	139	111	73	63	1,385	8.8
8	Defect of watt-hour meter	7	6	4	91	12	17	7	18	11	7	2	11	193	1.2
9	Defect in connecting method	135	226	216	151	175	140	155	564	440	237	206	281	2,926	18.6
10	Disconnection for abolition	2	5	2	2	3	4	1	1	8	5	7	2	42	0.3
11	Changing of cable connection	42	8	9	12	15	15	17	28	40	30	24	21	261	1.7
12	Investigation of damage	1	1	1	0	0	1	0	0	0	2	1	1	8	0.1
13	Investigation of connection	2	2	15	3	0	0	0	0	12	0	6	0	40	0.3
14	Temporaly connection	9	12	11	8	7	34	5	0	8	4	4	4	106	0.7
15	Repairing	108	138	199	119	108	191	217	335	216	233	144	131	2,139	13.6
	Sub-total	611	697	896	763	743	733	854	2,035	1,516	995	773	798	11,414	72.4
	(2) Fault at poste														
16	Fault of transformer	1	0	0	3	0	0	0	2	0	0	1	1	8	0.1
17	Replacement of transformer	0	0	1	0	0	0	0	1	0	0	0	0	2	0.0
18	Fusing of NT fuse	1	0	0	0	0	0	0	5	4	2	3	1	16	0.1
19	Fusing of BT fuse	24	8	2	21	23	23	40	56	53	54	41	25	370	2.3
20	Cleaning of poste	0	0	15	0	0	0	0	0	11	1	0	0	27	0.2
21	Fault in HT portion	11	17	0	11	3	6	3	2	4	8	6	5	76	0.5
	Sub-total	37	25	18	35	26	29	43	66	72	65	51	32	499	3.2
	(3) Fault in distribution lines														
22	Breaking/cutting of cable	47	23	9	46	35	30	53	132	112	47	46	29	609	3.9
23	Fusing of fuse for branch	16	1	21	17	18	32	43	77	68	63	28	22	406	2.6
24	Damage of anchor bolt	38	98	44	11	19	1	8	10	17	7	8	3	264	1.7
25	Replacement of cable	48	21	42	40	41	15	22	10	51	2	1	2	295	1.9
26	Defect in connecting point	353	263	242	180	220	131	168	65	51	0	13	22	1,708	10.8
27	Defect of connection box	1	0	4	0	0	1	1	3	2	0	0	1	13	0.1
28	Withou damage	0	2	0	0	0	0	3	3	18	0	0	0	26	0.2
	Sub-total	503	408	362	294	333	210	298	300	319	119	96	79	3,321	21.1
	(4) Others														
29	Load shedding	38	1	2	1	4	1	0	0	0	4	0	0	51	0.3
30	Re-charging of feeder	21	13	20	16	11	29	0	12	7	7	6	0	142	0.9
31	Re-charging of power source	0	0	0	0	0	0	6	29	10	0	32	40	117	0.7
32	Connection of new feeder	12	48	13	0	1	0	0	0	0	27	0	0	101	0.6
33	Installation of meters	24	48	13	0	1	0	0	0	0	27	0	0	113	0.7
34	Replacement of meters	0	1	0	0	3	0	0	0	0	1	0	0	5	0.0
	Sub-total	95	111	48	17	20	30	6	41	17	66	38	40	529	3.4
	(1) + (2) + (3) + (4)	1,246	1,241	1,324	1,109	1,122	1,002	1,201	2,442	1,924	1,245	958	949	15,763	100.0
	Ratio to each month	7.9	7.9	8.4	7.0	7.1	6.4	7.6	15.5	12.2	7.9	6.1	6.0	100.0	

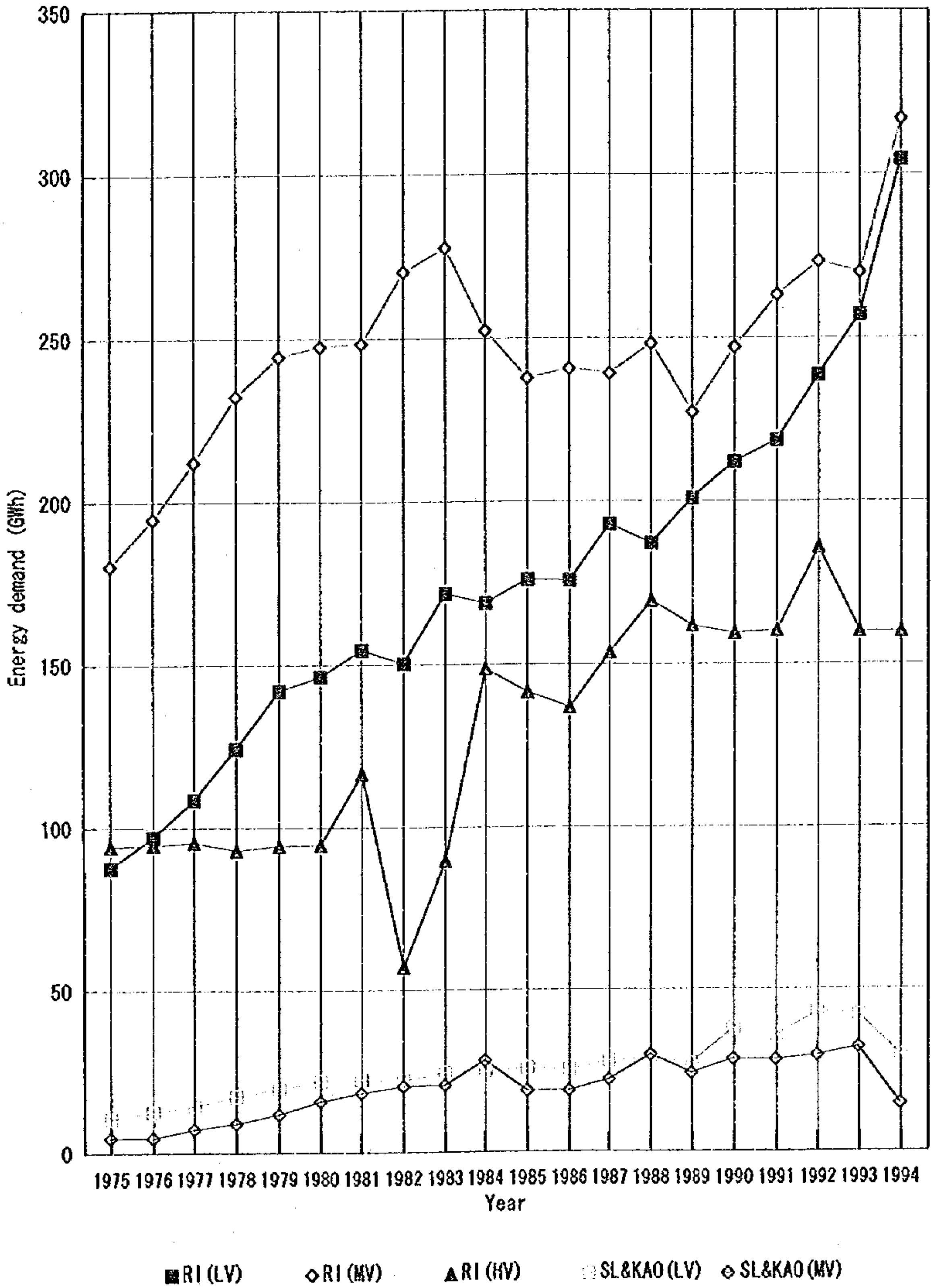
Table 4.6-15 Fault Record of BT Network (1992)

(1992.1.1 ~ 12.31)

No	Kinds of fault	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	(%)
	(1) Customer's equipment														
1	Connection box on leading-in pole	66	55	69	69	74	67	155	110	129	81	75	68	1,018	8.6
2	Fusing of fuse	71	68	86	55	51	96	86	112	99	75	64	57	920	7.8
3	Defect of circuit breaker	2	1	4	9	7	6	13	18	13	10	10	12	105	0.9
4	Trip of circuit breaker	10	5	6	13	12	8	13	24	21	16	8	4	140	1.2
5	Defect in consumers' facility	7	8	16	11	16	10	39	44	32	12	13	15	223	1.9
6	Fusing of fuse on pole	65	58	133	116	116	110	155	189	254	103	98	138	1,535	12.9
7	Disconnection at branching point	23	55	75	87	98	58	143	123	115	89	82	76	1,024	8.6
8	Defect of watt-hour meter	0	1	7	3	5	2	3	5	4	10	4	3	47	0.4
9	Defect in connecting method	97	135	296	169	158	167	278	176	241	180	125	134	2,156	18.2
10	Disconnection for abolition	1	0	3	6	0	0	1	5	3	0	6	12	37	0.3
11	Changing of cable connection	10	18	36	9	23	25	17	37	50	22	15	20	282	2.4
12	Investigation of damage	2	3	3	1	2	0	6	4	2	0	0	3	31	0.3
13	Investigation of connection	1	3	0	2	1	2	0	0	0	0	0	0	9	0.1
14	Temporaly connection	4	1	5	11	2	2	3	1	2	4	5	12	52	0.4
15	Repairing	39	48	44	102	90	86	172	140	186	150	132	111	1,300	11.0
	Sub-total	398	464	783	663	655	639	1,084	988	1,151	752	637	665	8,879	74.9
	(2) Fault at poste														
16	Fault of transformer	0	0	0	1	0	1	0	2	1	2	0	2	9	0.1
17	Replacement of transformer	0	0	0	0	0	1	1	0	1	1	0	0	4	0.0
18	Fusing of MT fuse	0	1	0	2	3	7	16	1	2	0	2	2	36	0.3
19	Fusing of BT fuse	13	7	14	5	8	26	0	49	38	40	18	15	233	2.0
20	Cleaning of poste	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
21	Fault in MT portion	0	0	0	1	0	0	4	0	2	0	1	0	8	0.1
	Sub-total	13	8	14	9	11	35	21	52	44	43	21	19	290	2.4
	(3) Fault in distribution lines														
22	Breaking/cutting of cable	25	28	39	41	36	20	58	64	74	39	27	23	474	4.0
23	Fusing of fuse for branch	15	13	14	23	24	28	37	84	36	31	20	27	352	3.0
24	Damage of anchor bolt	0	0	7	10	0	2	1	6	0	4	3	6	39	0.3
25	Replacement of cable	0	0	0	0	0	1	0	0	0	0	0	4	5	0.0
26	Defect in connecting point	11	5	27	105	151	140	419	194	213	176	45	35	1,521	12.8
27	Defect of connection box	1	0	1	0	0	0	0	0	0	0	0	0	2	0.0
28	Withou damage	0	0	0	0	0	0	1	7	0	0	0	0	8	0.1
	Sub-total	52	46	88	179	211	191	516	355	323	250	95	95	2,401	20.2
	(4) Others														
29	Load shedding	0	0	0	0	0	0	0	0	0	3	5	1	9	0.1
30	Re-charging of feeder	10	15	0	34	29	0	0	34	16	20	10	13	181	1.5
31	Re-charging of power source	0	0	33	0	0	18	50	0	0	0	0	0	101	0.9
32	Connection of new feeder	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
33	Installation of meters	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
34	Replacement of meters	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
	Sub-total	10	15	33	34	29	18	50	34	16	23	15	14	291	2.5
	(1) + (2) + (3) + (4)	473	533	918	885	906	883	1,671	1,429	1,534	1,068	768	793	11,861	100.0
	Ratio to each month	4.0	4.5	7.7	7.5	7.6	7.4	14.1	12.0	12.9	9.0	6.5	6.7	100.0	

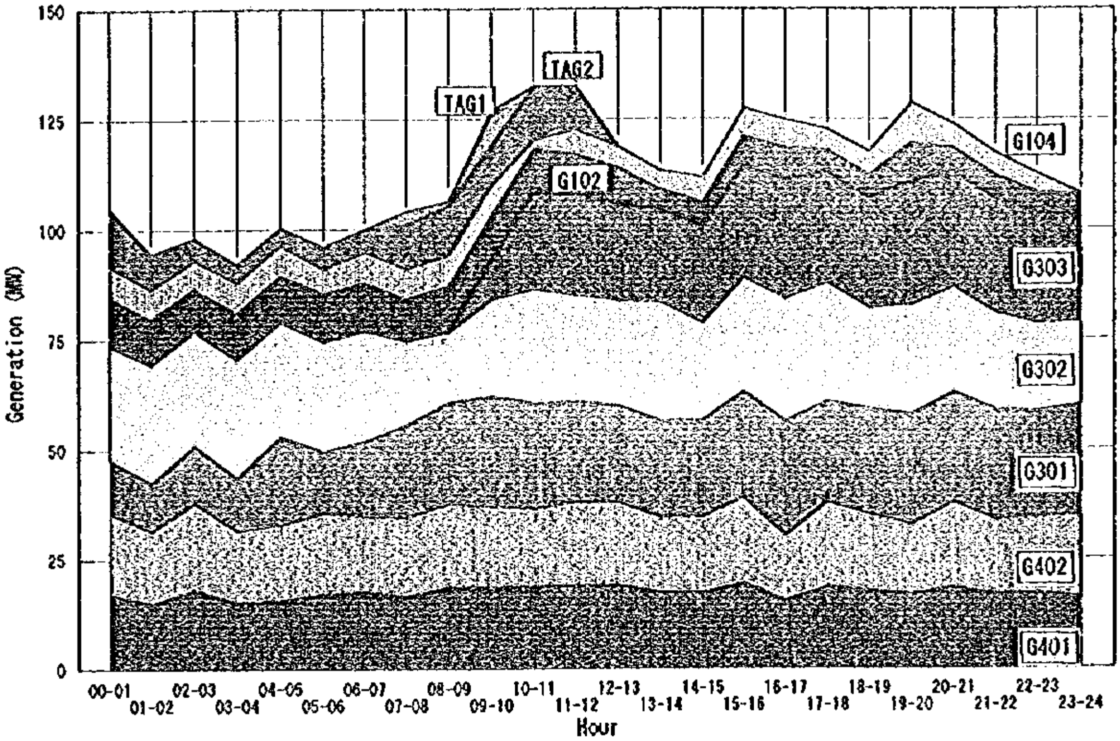
Graph 4.3.1 Evolution of Energy Demand for Voltage Levels

RGI

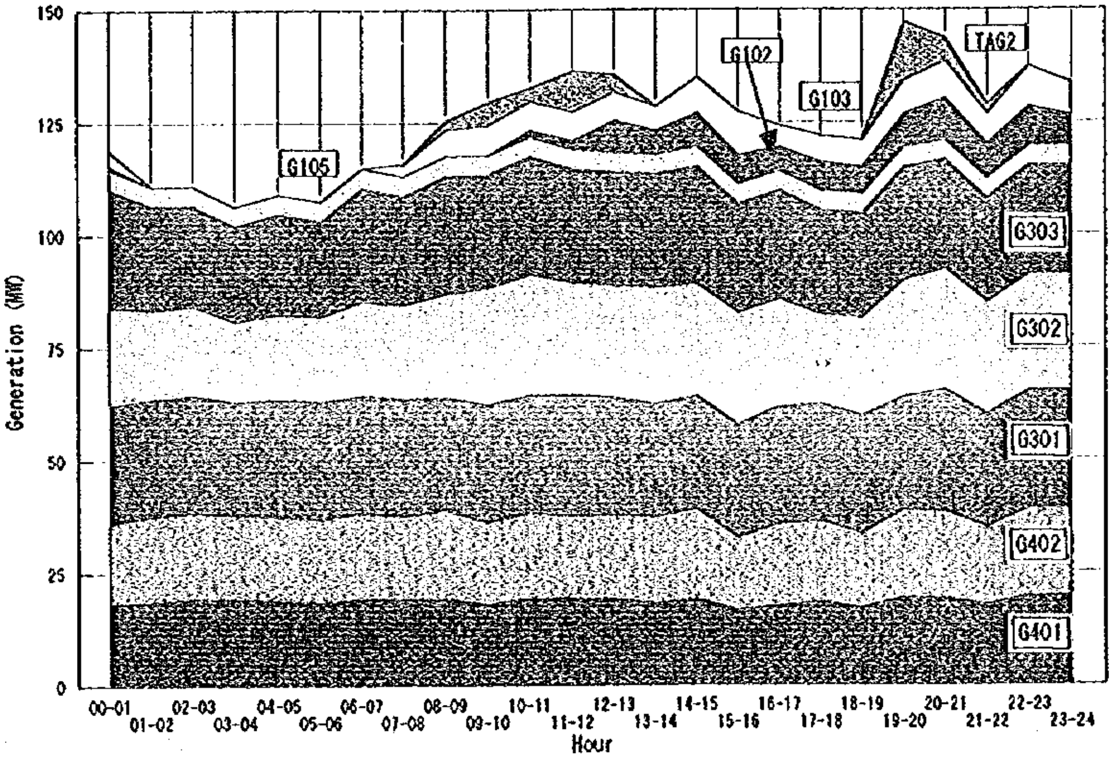


Graph 4.3.6-1(1) Daily Maximum Generation

19/October/1990

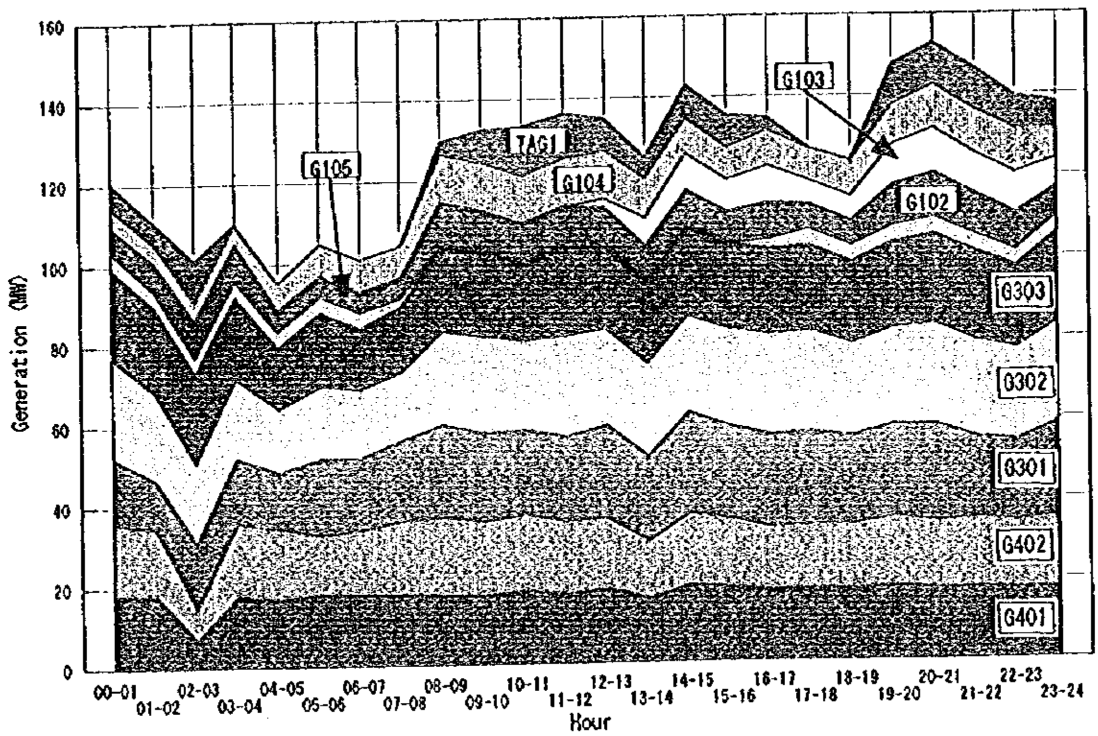


30/October/1991

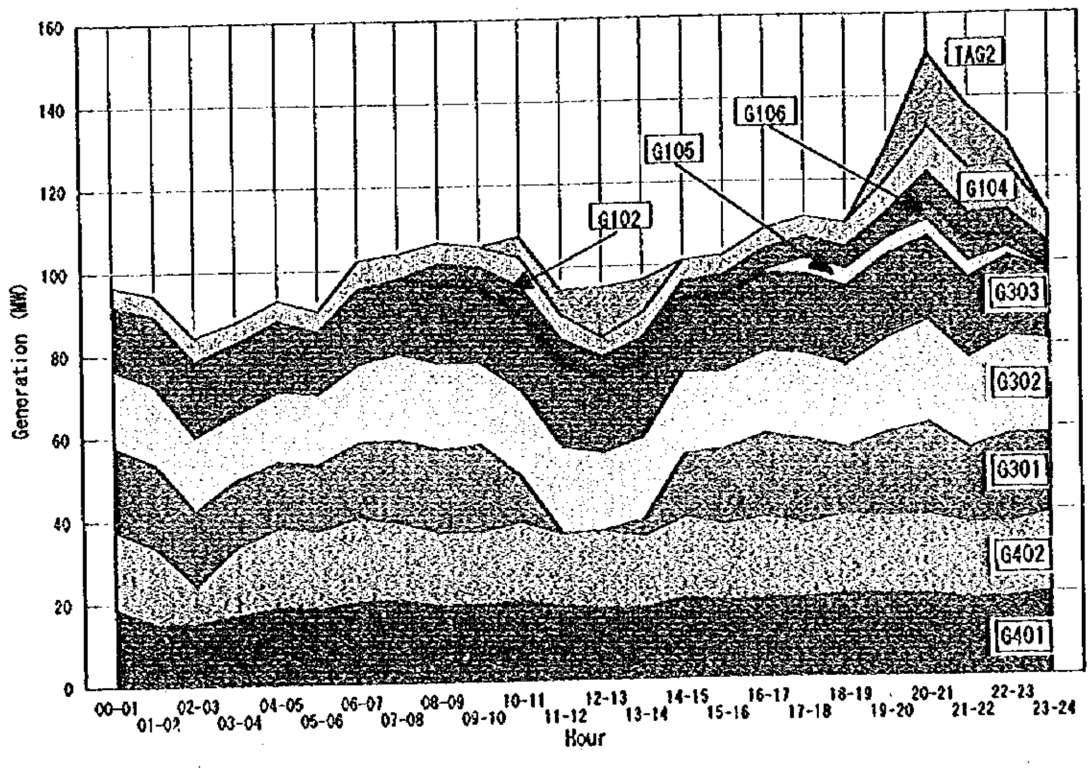


Graph 4.3.6-1(2) Daily Maximum Generation

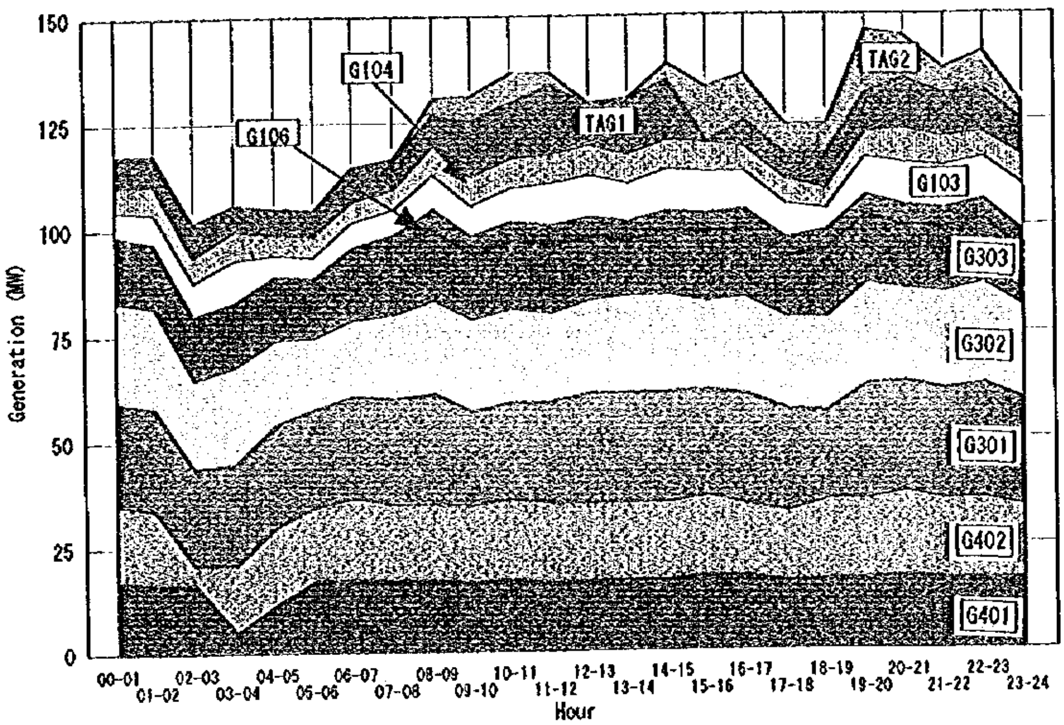
22/October/1992



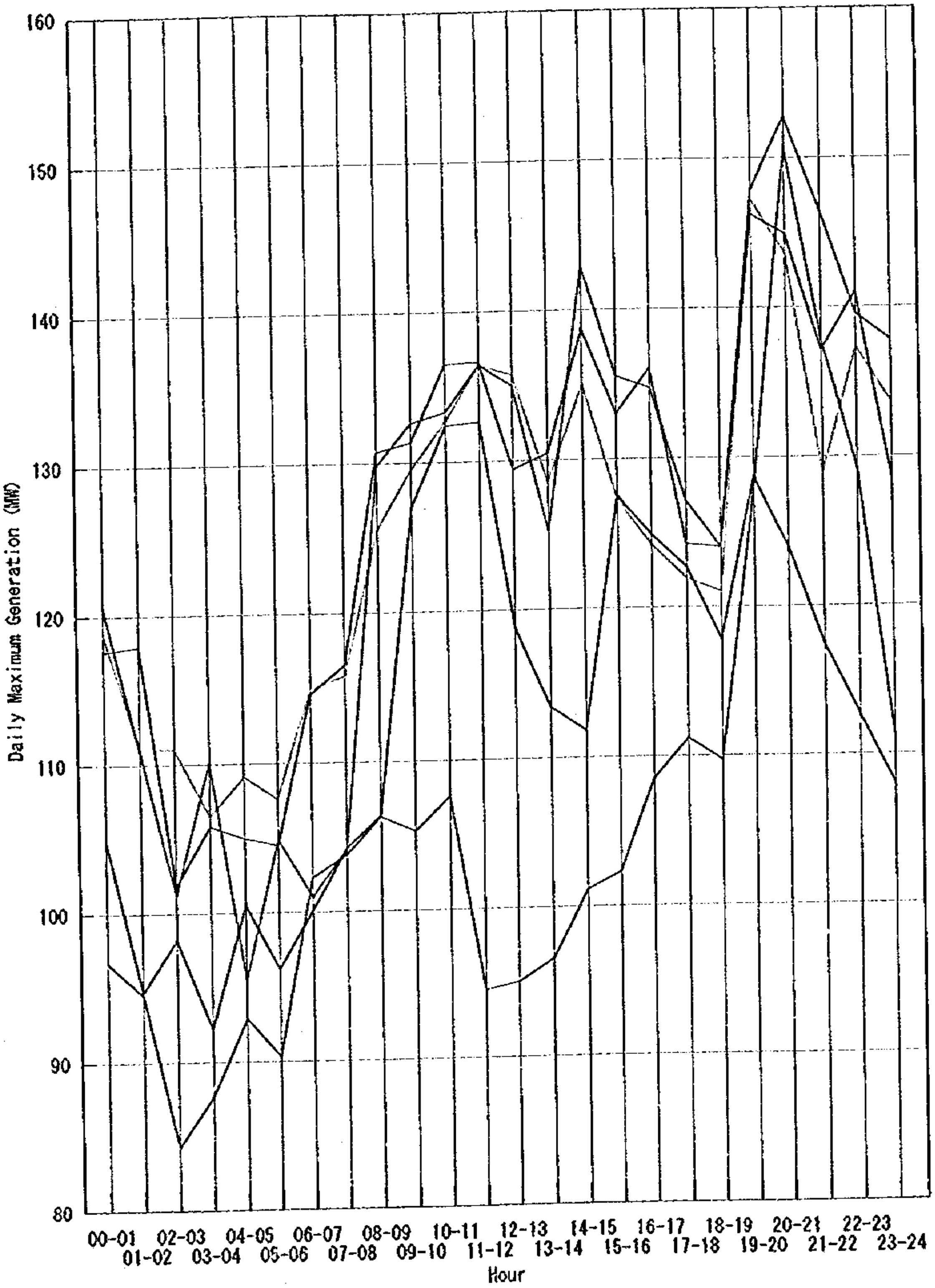
3/MAY/1993



Graph 4.3.6-1(3) Daily Maximum Generation
18/October/1993



Graph 4.3.6-2 Evolution of Daily Maximum Generation



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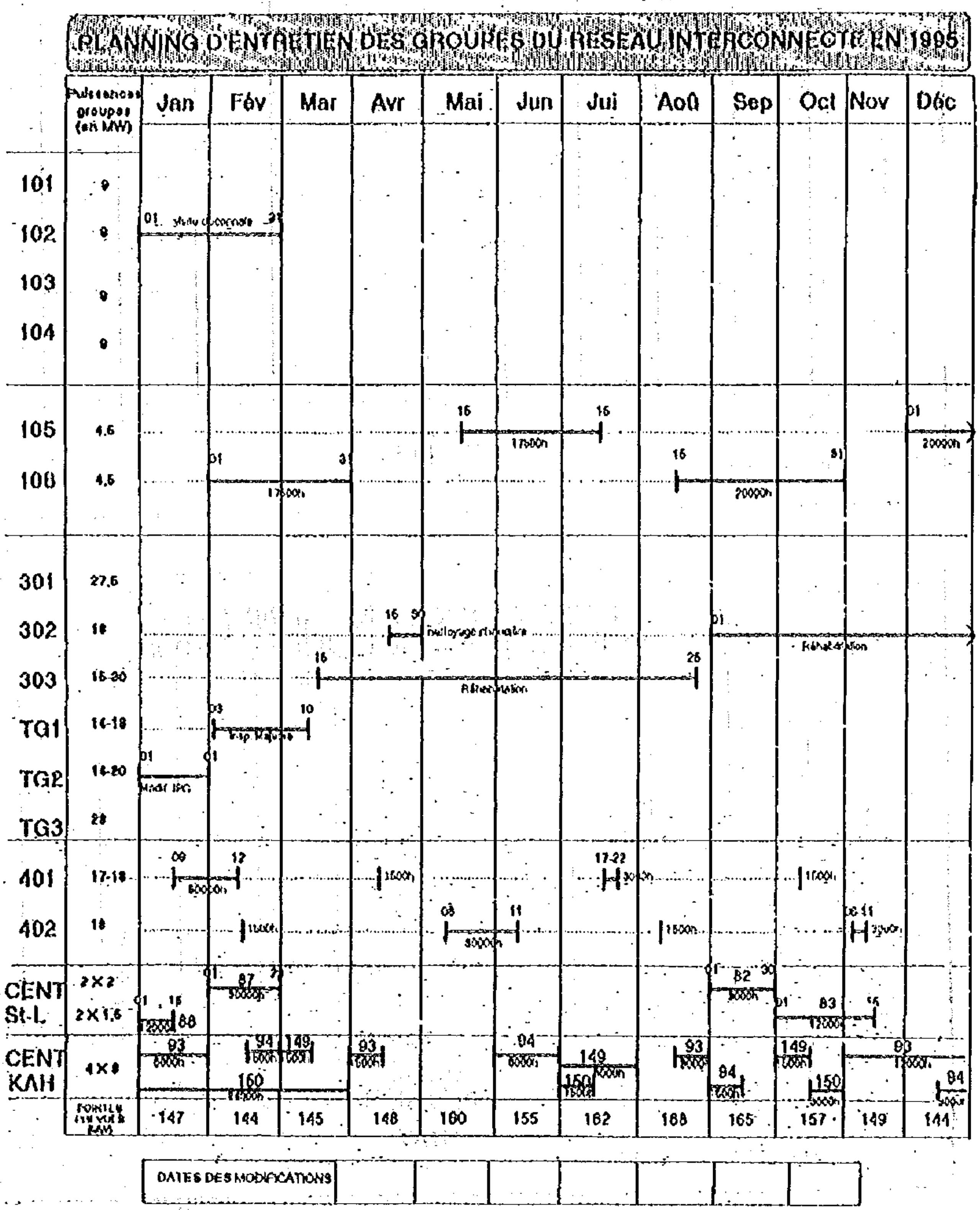
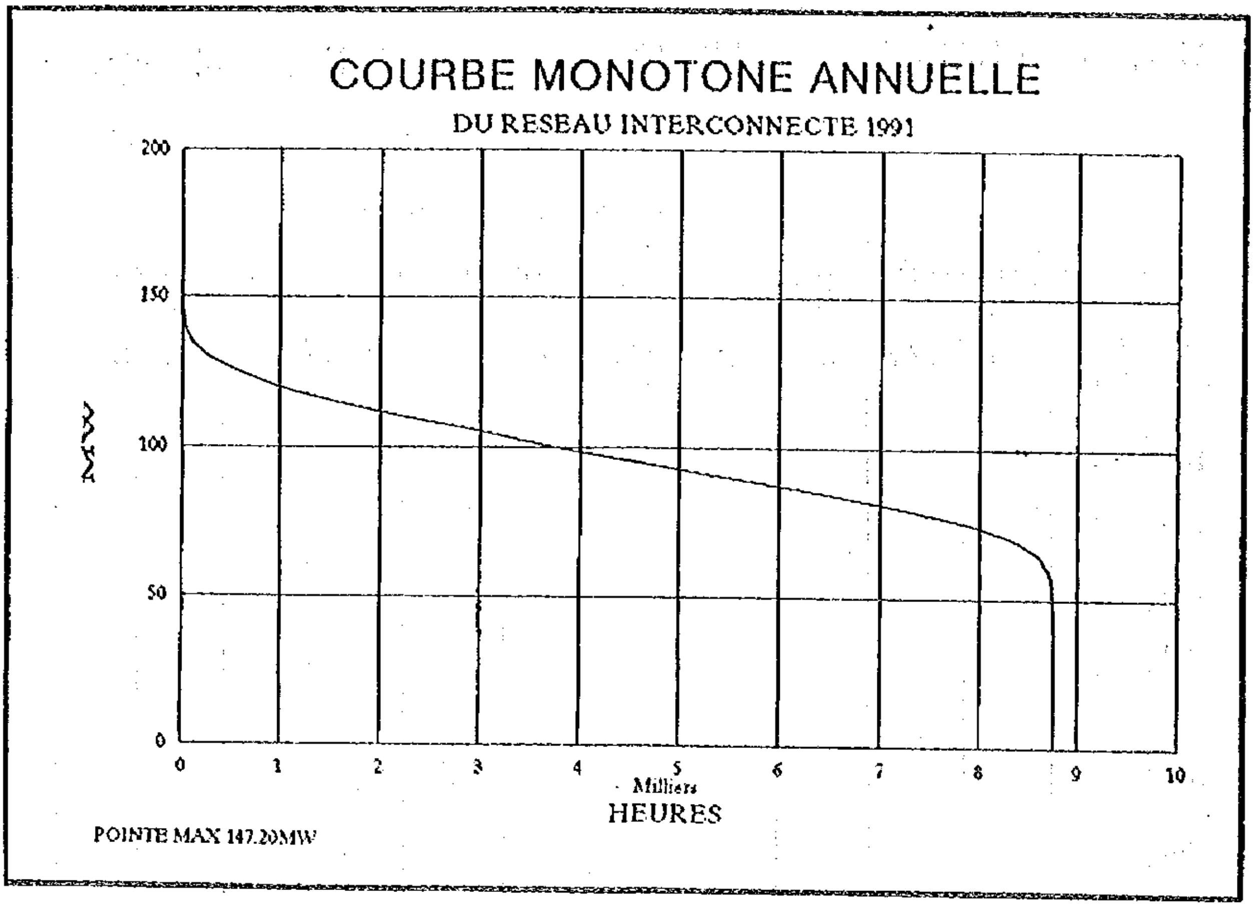


Fig. 4.1.2 Annual Maintenance Schedule



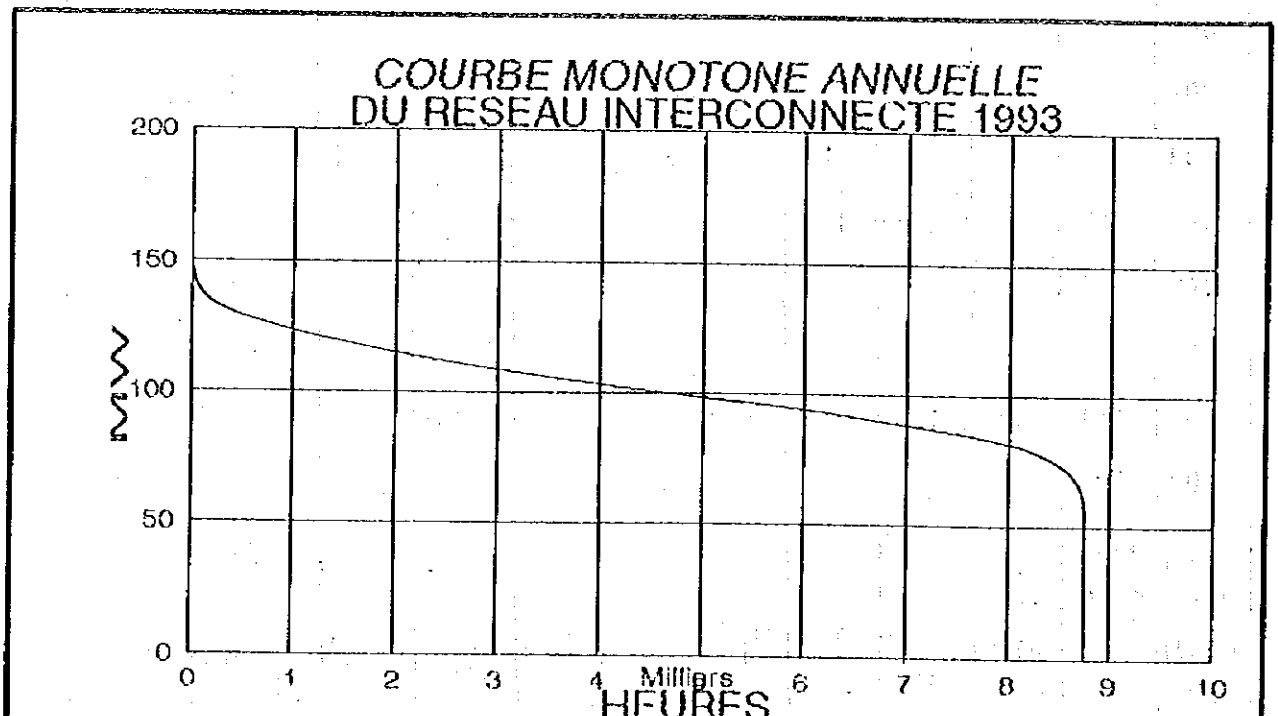


Fig. 4.3.6 Load Duration Curve

CHAPTER 5

POWER DEMAND FORCAST

CHAPTER 5 POWER DEMAND FORECAST

5.1 Economical Background

(1) Outlook

The growth in the power demand is closely related to that of the national economy. The economy of Senegal between 1975 and 1984 has repeated the cycle of one-year growth and two-year decline. Between 1984 and 1988, it recorded a strong growth in the GDP; and ever since 1989, despite some fluctuations, it has continued its steady growth.

Table 5.1.1-1 shows how the real GDP (based on 1985 price) had increased between 1975 and 1993. Graphs 5.1.1-1(1) to (3) express the trend graphically. According to the Table and Graphs above, a major factor for the GDP fluctuation is considered to be the field of agriculture, which belongs to the primary industry. As was described in "2.3 Economic Conditions" the Senegalese economy is centered on the agriculture based on peanut production, which started from the period of colonial rule by France. Although the country has strived for industrialization since its independence, it has suffered a decline in the agricultural production due to frequent droughts, crash in the peanut price as its major export item, and accompanying stagnation in the agricultural product processing industry, thus its annual mean growth rate recording -1.03% between 1986 and 1993. However, Senegal recorded a growth rate of 3.86% between 1979 and 1993, and -1.3% between 1991 and 1993, thus showing a sign of reduction. Thus, what is important is a continued growth hereafter.

In the secondary industry, the oil refining is showing an decline of growth rate: -6.24% between 1986 and 1993 and -23.96% between 1991 and 1993. Oil refining by the SAR (Senegal African Refinery) oil refinery company and oil export to neighboring countries are playing an important role in earning foreign currencies for the country.

The tertiary industry occupies about half of the GDP of Senegal. A remarkable growth is seen especially in the commercial field, which has recorded a stable growth rate of 3.3 to 3.4% since 1986.

The non-trade service sector has maintained the same level or recorded an upward growth rate since 1975. Per-capita energy consumption has shown steady growth despite certain variations. In 1986 when the nation reached its most stable GDP growth rate energy consumption stood at 94.7 kWh and rose further to 101.5 kWh in 1993. In contract to the nation's growth energy consumption, its per-capita GDP has shown a declining trend. In 1979, it recorded a level of 978US$ but only 609US$ in 1993.

The table below shows real GDP's annual mean growth rate.

	1975-1993	1979-1993	1986-1993	1991-1993
Primary industry	-	2.1	0.2	2.2
Secondary industry	-	3.6	2.4	3.3
Tertiary industry	-	3.0	3.2	3.7
Non-trade service	-	0.3	0.8	1.1
Total	2.5	2.3	2.1	3.0

For a smooth execution of economic activities, it is absolutely necessary to have a considerable amount of foreign currencies holdings. However, Senegal is confronted by various problems for lack of foreign exchange reserve as a result of problems of trade and financial deficits, which in turn were caused by increase in raw material and food imports.

(2) Economic Rehabilitation Plan

To emerge from such a depressing condition and revitalize the economy, the Senegalese Government has received deferment of debts since 1981 and announced the "mid-and-long-term economic and financial structural adjustments" of its national economy to be implemented on 1985 to 1992 as the target period. The government also formulated the "7th four-year plan" targeting from 1985 to 1989 to tackle structural adjustments and economic reconstruction and inaugurated its "8th economic and social development plan," which targets from 1989 to 1995 placing the priority in continued improvement of the national productivity, i.e., the goals of the GDP annual mean growth rates mapped out at 2.5% for the low scenario, 3.0 % for the medium scenario, and 3.5% for the high scenario.

In the course of proceeding with its development plan, Senegal experienced a drop in the agricultural production due to droughts between 1988 and 1989, stalemate in structural adjustments due to political instability in 1988, decline in the customs duties income in 1990, and lack of control on public services fees. And, in 1991, the country invited delay in the advancement of funds from the IMF and the World Bank. However, its annual mean growth rate of the real GDP between 1991 and 1993 is 3.0%, showing a rising trend. Therefore, by continuously encouraging the efforts for structural adjustments and economic rehabilitation, Senegal is expected to improve its GDP growth rates in various parts of the economy by making a breakthrough in the influx of foreign currencies in forms of loans and aids from various countries.

(3) Population

A census is taken in Senegal once every ten years. The latest one was conducted in September 1988, the results of which are shown in Table 5.1.1-2 and their trend shown in Graph 5.1.1-2.

The total population of Senegal is 6,881,919 persons. And 1,500,459 persons, which is 21.8% of the total population, live in the Dakar area (Dakar, Rufisque, Thies). The population per household is 7.7 persons in the Dakar area, while the national average is 8.8 persons. (A slight variation is seen in the figures between the statistical data of Senegal and that of IMF.)

According to SENELEC's statistics, the population increase rate is 2.76% nationally and 3.63% in the Dakar area. By 2005, the population is expected to exceed 10 million persons.

5.2 Forecasting Techniques

5.2.1 Correlation between Demands

There are two methods of forecasting the power demand, i.e., accumulated forecast by category (micro technique) and macro economical forecast based on the whole country as a unit. A method used in general is to have the results of the accumulated forecast verified by the macro forecast.

In this project, since SENELEC's demand forecast of Senegal was made through the technique of accumulated forecast by category, based on the EDF demand forecast of the France Power Public Corporation, the results shall be verified through the macro technique.

The relationship between the three parameters, i.e., GDP, population and consumption of energy, is as follows:

Table 5.1.2-1 shows the GDP, population, energy demand, as well as the yearly evolution of the GDP ratio (price elasticity) as to the energy demand. The annual mean growth rate (%) of each parameter is shown below.

	1975-1985	1986-1993
GDP	2.39	2.42
Population	2.72	2.77
Energy comsumption	4.94	3.68
Price elasticity	-0.50	0.97

It is understood from the above that the GDP price elasticity as to the energy demand is also growing steadily. Table 5.1.2-2 shows the correlation of the above parameters. This Table shows Senegal has experienced a proportional population increase, and the GDP increase similarly proportional to that of the population from 1984 despite some GDP fluctuations until 1984 has supported a steady increase in the consumption of energy.

5.2.2 Multiple Regression Model

The following multiple regression model is calculated from the consumption of energy shown in Section 4.3.1, GDP and population.

Y : Consumption of energy (GWh)

X1: GDP (1985 price: BFCFA)

X2: Population (x 1,000 persons)

Regression model of RGI system:

Y = -0.22175 X1 + 0.14982 X2 - 97.35968 (multiple correlation coefficient R = 0.95)

The influence of the supply restraints which started from 1981 is shown especially in the frequency of the restraint in 1993, which was 157 days amounting to 442.2 hours; however, the energy shortage was 4.4 GWh. The quantity of annual energy shortage is small despite these supply restraint days, because the energy restraints are concentrated in the time zone of peak load. The multiple regression model is calculated based on the values of actual performance (including the quantity of energy shortage caused by supply restraints). However, as it does not indicate the quantity of consumption energy in actual demand, it will invite trouble to use this model in drawing up a supply plan for the future.

Therefore, it is necessary to consider two forecasts, that is, an estimate in which the power supply restraints currently being implemented continue and the other in which no power supply restraints are applied. This project used the latter forecast in adjusting the above regression model in the following manner.

During the summer period of 1993, operations at the Taiba company (phosphoric acid manufacturing factory) show records of having complied with SENELEC's request to cut the peak load of about 10,000 kW as to its maximum demand of 20,000 kW. The energy consumption by this company in 1993 was 99.07 GWh while its production volume was 1,500,000 tons, 68% of its gross production capacity of 2,200,200 tons. Thus, it is estimated that the company consumed 63.04 kWh/ton. In reality, however, a near-full 90% production (2,000,000 tons) was achieved consuming 126.08 GWh of the electric energy, thus the difference becoming 27.01 GWh. This differential amount of energy becomes the quantity of energy consumption which is required to be supplied by SENELEC.

The regression model after adjustment is:

$$Y = 0.01408\ X1 + 0.11189\ X2 - 70.95518$$

5.3 Preconditions Used in Power Demand Forecast

5.3.1 Forecasting the Economic Growth

As the power demand is directly associated with the economic growth, the timing of the highly hopeful national economic rehabilitation in the future and the GDP growth rate are the most important factors in forecasting the power demand. Furthermore, it is necessary to draft and executing an adequate power generation plan and relax the current power supply restraints by SENELEC, so that the obstacles in power generation caused by facility shortage are eliminated by 1999 at the latest.

The timing of the economic rehabilitation and the expected GDP growth rate in the future, which were used in predicting the power demand, are described below.

(1) Transient-period Forecasting (1994-1999: From the 8th Economic and Social Rehabilitation and Development Plan period until the start of the operation of the Senegal River Basin Irrigation and Agricultural Improvement Project)

1) Primary industry

In Senegal, the largest part of the primary industry is occupied by agriculture. However, due to shortage of rainfalls in the past and drop in the prices of peanuts, which are a major export item, the primary industry was depressed drastically between 1988 and 1989 despite a remarkable growth during the initial period (1984) of the development plan. Its GDP also repeated its fluctuation, almost interlocked with this depression. However, since 1991, the primary industry has continued its unstable growth.

The growth rate during the transition period of the primary industry comprising roughly of agriculture, livestock industry, fishery, and forestry is estimated to grow as shown below, considering the target of the 8th Economic and Social Rehabilitation and Development Plan and the performance records of the annual mean growth rate between 1991 and 1993.

Scenario	GDP Growth Rate
Low-growth scenario	2.1%
Base-growth scenario	3.3%
High-growth scenario	4.6%

2) Secondary industry

The secondary industry comprising of mining, oil refinery, energy, construction, and others occupies a small portion of the GDP, except the item categorized as "others." Therefore, even with some ups and downs in the mean growth rate, no fluctuation factors leading to a large amount are found in this industry. The "others" item occupies about half of the commercial field of the tertiary industry and has maintained a stable growth except during the depression in 1989. Similarly with the primary industry, the secondary industry is estimated to grow as shown below, considering the target of the Development Plan and the performance records of the annual mean growth rate between 1991 and 1993.

Scenario	GDP Growth Rate
Low-growth scenario	2.9%
Base-growth scenario	4.4%
High-growth scenario	5.1%

3) Tertiary industry

In Senegal, the tertiary industry covers about 51.6% of the entire GDP as of 1993. Of this, the ratio of the commercial field is approximately 24%, thus making an outstanding contribution to the economy. The annual mean growth rate of 4.1% between 1987 and 1993 exceeded the growth rate of the entire GDP, which was 2.75% and the tertiary industry in this country is expected to continue to grow in the future, thus making up for the minus growth of the administrative management field of the non-trade service. Transportation and other fields have also achieved a stable growth together with commerce. As they are expected to continue to grow at the rates between 1991 and 1993, their growth rates are estimated to be as follows:

Scenario	GDP Growth Rate
Low-growth scenario	2.4%
Base-growth scenario	3.0%
High-growth scenario	3.7%

4) Non-trade services

The field of non-trade services recorded minus growth rates in recent years between 1991 and 1992. Judging from the reduction trend in the growth rates, it is expected that the minus growth may change its direction to the plus one in 1993. However, regarding matters related to the administrative management, it may be hard to expect a rapid recovery, due to delays in making concessions between the World Bank, IMF and the Senegalese Government regarding various problems of the structural adjustment project.

The growth rate of this non-trade service field is estimated to be as follows, based on the performance records between 1991 and 1993.

Scenario	GDP Growth Rate
Low-growth scenario	0.3%
Base-growth scenario	0.8%
High-growth scenario	1.3%

(2) Long-term Plan (1999 to 2010)

To forecast a long-term growth rate, it is necessary not only to study the historical process of the national economic growth but also to pay attention to various changes and government's economic policy taking place at the current time.

1) GDP's annual mean growth rate

GDP's annual mean growth rate is described in previous section.

2) To-GDP ratio

The ratio of each industry to GDP is described below over the period of 1984 to 1993, which achieved a stable growth.

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Primary industry	16.9	18.7	22.3	21.7	22.4	19.4	19.8	19.3	19.8	19.0
Secondary industry	17.0	17.7	17.5	17.9	18.4	18.8	18.7	18.0	17.9	18.1
Tertiary industry	49.3	48.4	48.2	48.3	47.6	49.8	49.5	51.0	51.1	51.7
Non-trade services	16.8	15.2	12.1	12.2	11.6	12.1	11.6	11.7	11.3	11.3

The table above shows that the primary, secondary and tertiary industries are in the trend of growth, while the non-trade service field has been declining. The field of agriculture, which is a pillar of economic rehabilitation, shows the growth rate of 7.7% in 1984, 12.7% in 1988, and 9.0% in 1993 as to the entire GDP, thus declining or remaining about the same.

(3) 9th Economic and Social Development Plan

The 8th economic and social development plan is ending in 1995. And, nothing is clear about the 9th one. The intermediate target value 3.0% of the 8th plan is likely to be met considering that the annual mean growth rate between 1986 and 1993 was 2.11% and 1991 to 1993 was 3.03%. In this regard, it is desired that the 9th development plan be inaugurated to continue the 8th.

(4) Energy Policy

The following table shows the state of primary energy consumption.

(Oil-equivalent 1,000 tons)

	1985	1986	1987	1988	Ratio (%)
Timber	985.5	1,015.1	1,045.8	1,019.0	52.0
Natural gas	0.0	0.0	0.0	0.0	0.0
Straws	11.7	17.1	27.1	7.1	33.1
Petrochemical product	912.0	853.0	875.0	885.0	45.0
Total	1,909.2	1,885.2	1,947.9	1,945.1	100.0

The following table shows the breakdown of petrochemical products.

(Unit: 1,000 t)

	1985	1986	1987	1988
Domestic production	0.0	0.0	0.0	0.0
Imported crude oil	225.0	487.0	593.0	732.0
Imported refined material	687.0	366.0	281.0	150.0
Total	912.0	853.0	875.0	885.0

The following table shows the energy consumption for commercial division

(Oil equivalent 1,000 t)

	1985	1986	1987	1988	1992	Ratio (%)
Firedwood	460.0	471.0	481.0	492.0	613.0	41.0
Charcoal	149.0	154.0	160.0	149.0	234.0	16.0
Vegetative waste	7.0	10.0	14.0	17.0	22.0	1.0
Power	56.0	57.0	59.0	59.0	70.0	5.0
Petrochemical product	531.0	482.0	458.0	480.0	566.0	38.0
Total	1,203.0	1,174.0	1,172.0	1,197.0	1,505.0	100.0

Of the primary energy consumption figure, firewood covers about half as of 1988 and is increasing year after year though slightly. Considering the impact that the progress of forest exploitation will have on nature by destroying its ecological balance, the Senegalese Government is being careful in drafting and promoting the energy policy.

Of the petrochemical products, the natural gases are a large burden to the government because they occupy only a small part of the domestic oil products and thus most of them have to be imported.

Under such a circumstance, the Senegalese Government announced at the onset of 1990 the following goals regarding the electric power in its energy policy.

- Reduction of timber fuel consumption
- Development of petrochemical fuel resources
- Commercialize brown coal and peat
- Development of hydraulic resources
- Strengthening and expansion of the electric utilities

(5) Power Policy

To proceed with the energy policy above, the power policy of the Senegalese Government is based on the following as its fundamentals.

Fundamental 1:	Development of hydraulic resources Development of hydraulic power station (Felow and Manantali) in Senegal river system.
Fundamental 2:	Strengthening of the electric utilities Rehabilitation of existing facilities Promotion of regional electrification Strengthening of the distribution network Lowering of electric tariff Utilization of solar energy

(6) Large-scale Projects

Cayor waterway:

This projects is for the supply of water to the Dakar district from Lake Guiers in the region of Louga. Completion is scheduled for the year 2000 at the latest, and even if there should be a further delay, the project is due to be completed in 2002.

Senegal River basin irrigation improvement project:
Refers to irrigation improvement of the Senegal River basin (Dagana, Podor, Matam, and Bakel) by SAED (Societe d'Amenagement et de Developpement) at the rate of 2,180 ha yearly, to complete 88,000 ha by year 2,005.

Although no convincing and specifiable data are available, the GDP for the future is itemized as: actual records of the GDP share by each field since 1979; goals and fundamentals raised by the Senegalese Government in its future energy and power policies; materialization of large-scale projects; economic and social development plan expected to continue beyond 1995; and the actual annual mean growth rate between 1975 and 1993 being 2.5%, as previously mentioned. Accordingly, this report presents its estimate of the long-term GDP growth rate by industry as follows:

GDP Annual Mean Growth Rate (between 1999 and 2010)

By industry	Low-growth scenario	Base-growth scenario	High-growth scenario
Primary industry	3.2%	6.0%	6.9%
Secondary industry	2.8%	5.0%	5.6%
Tertiary industry	2.7%	3.1%	4.5%
Non-trade services	0.4%	0.9%	1.4%
Total	2.6%	3.9%	5.0%

GDP Annual Mean Growth Rate (between 1994 and 2010)

By industry	Low-growth scenario	Base-growth scenario	High-growth scenario
Primary industry	2.8%	5.1%	6.1%
Secondary industry	2.8%	4.8%	5.4%
Tertiary industry	2.6%	3.1%	4.2%
Non-trade services	0.5	3.6%	4.6%
Total	2.5%	3.6%	4.6%

Forecasting the GDP growth based on the above conditions is shown in Table 5.1.3. The trend of the GDP growth is graphically shown in Graph 4.1.3.

5.3.2 Population Forecast

As was described in para (3) in Section 5.3, the national population increase rate based on SENELEC's statistics is 2.76%. Considering the annual mean growth rate from 1975 to 1993, this forecasting estimates the rate to be 2.7% in its base-growth rate scenario, 2.484%, down by 10%, in its low-growth rate scenario, and 3.036%, up by 10%, in its high-growth rate scenario.

5.4 Condition of Power System

The ratios of the transmission and distribution loss factor, load factor, station-service kW loss factor, and station-service kWh loss factor during the target period until the year 2010 are estimated to be as follows:

(1) Transmission and Distribution Loss Factor

As is described in 4.3.3, the power transmission and distribution loss factor at the sending end of RGI system is estimated to be somewhere between 13% and 14% as of 1994. This figure can be accepted as reflecting a proper level. As it is most likely that the quantity of energy consumption refers to the quantity of instantly-sold energy, the amount of unidentifiable or unspecifiable energy consumption for reasons other than pilferage use of energy, meter reading, or trouble in settlement, or both, can be very minimal.

According to this study, the future transmission and distribution loss factor on RGI system was estimated to increase to 13.5% in 1995, and 16% in 2010.

(2) Load Factor at Sending End

As described in 4.3.5, it is impossible to correctly figure out the load factor at sending end due to influences caused by power supply restraints. However, in reality, it is currently estimated to be somewhere between 61% and 62%.

Judging from the current situation in which SENELEC is placed, it is necessary to grasp the actual figure of the future load factor rather than an estimate based on performance records, which is 62% for 1994 and 65% for 2010.

(3) Station Service kW Loss Factor

Based on the actual performance records of the operation of generating facilities in 1993, the station-service kW loss factor of RGI system is estimated to be 5%. It is estimated that this trend will continue on in the future.

(4) Station Service kWh Loss Factor

In the same manner as with (3) above, based on the actual performance records of the operation of generating facilities in 1993, the station-service kWh loss factor of RGI system is estimated to be 6.7%. The figure is estimated to remain the same for 1994; however, in the future, the number of aged facilities will be reduced through disposal, thus improving the figure to 5.0%.

(5) Diversity Factor of Peak Load

In this project, the peak load of RGI system shall occur at the same time in each area, as described in 4.3.7.

(6) Supply to Large Consumers and Projects from RGI Systems

a. Large consumers

Large consumers in RGI system include: Taiba Co., Sococim Co., and ICS Co. The state of energy consumption by each company is described below.

<u>Taiba Co.:</u>

The production in 1993 by Taiba Co. recorded 1,500,000 tons; and its electric power consumption rate amounted to 63.40 kWh/ton. The table in the following page shows the trend of the production from 1994.

(Unit: 1,000 tons)

Scenario	1994	1995	1996	1997	1998	1999	2000	2000~
Low-growth scenario	1,500	1,500	2,000	2,000	2,000	2,000	2,000	0
Base-growth scenario	1,500	2,000	2,000	2,000	2,000	2,000	2,000	0
High-growth scenario	1,500	2,000	2,000	2,000	2,000	2,000	2,000	0

After 2001, the Taiba company is planning to have non-utility generating facilities installed. The portion of power reduced due to non-utility generating facilities is 126.8 GWh in the low-growth scenario, and 139.48 GWh in the base and high-growth scenario. Although the details are still unclear at this point, the installation will be completed by 2,000 at the latest, thus self-supplying the required energy by 2,001. This demand forecast will include the energy to be consumed by the Taiba company as the necessary power in demand; and the non-utility generating facilities shall be considered within the power generation facility plan.

Sococim Co.:

The production in 1993 by Sococim Co. recorded 650,000 tons; and its energy consumption amounted to 60.938 GWh. The table below shows the trend of the production from 1994.

(Unit: 1,000 tons)

Scenario	1994	1995	1996	1998	2000	2010
Low-growth scenario	650	600	600	600	650	650
Base-growth scenario	650	650	650	650	650	650
High-growth scenario	650	650	650	700	700	700

The energy consumption by the Sococim company is either remaining at the same level or slightly rising, thus lying within the realism of prediction. Therefore, it is not considered in this demand forecast.

ICS Co.:

The demand by the ICS company is uncertain. Even in its normal operations, the company has power excess, thus supplying the surplus to public systems. Therefore, the demand by this company, which is also very small, is not considered in this demand forecast.

b. Large scale projects

SAED and Cayor waterway projects:

These refer to the SAED project of improving the irrigated agriculture in the basin of the River Senegal and the Cayor waterway project. The required energy demands are shown in the table below.

(Unit: GWh)

	2000	2002	2005	2010
SAED Project	20	23	26	31
CAYOR waterway	-	107	81	81

In this demand forecast, the demand by a large project is handled as a new demand. If the growth is low, the demand of the large scale project shall not be considered.

5.5 Results of Power Demand Forecast

Using the conditions described in 5.3 and the regression formula shown in 5.2.2 the power demand for 1994 to 2010 was forecasted. The forecast on the economic growth was made in terms of three scenarios, i.e., the low-growth scenario, the base-growth scenario, and the high-growth scenario.

The results of the power demand forecast are shown in Table 5.1.5-1 to -3.

	Low-growth scenario	Base-growth scenario	High-growth scenario
GDP's annual mean growth rate:			
1993-1999	2.5%	3.1%	3.9%
1999-2010	3.0%	4.0%	5.0%
1993-2010	2.9%	3.7%	4.7%

Table 5.1.5-4 shows SENELEC's middle, long term generating facility plan for RGI in Jan. 1995 modification result. Graph 5.1.5 "Load Forecast" graphically expresses the trend of the demand forecast by the JICA team and the results of the demand forecast by SENELEC (the generating end). Comparison of the forecast result of the two parties is shown in the following.

	1994	2000	2005	2010
1) Forecast by the JICA team:				
Low-growth scenario:				
Consumption of energy (GWh)	856.8	1,003.4	1,143.6	1,302.4
Generated energy (GWh)	1,060.5	1,241.2	1,423.7	1,632.1
Peak load (MW)	192.0	222.5	252.6	286.6
Base-growth scenario:				
Consumption of energy (GWh)	859.4	1,045.1	1,293.7	1,484.6
Generated energy (GWh)	1,063.7	1,292.8	1,610.6	1,860.3
Peak load (MW)	192.6	231.8	285.8	326.7
High-growth scenario:				
Consumption of energy (GWh)	862.1	1,067.2	1,338.0	1,555.6
Generated energy (GWh)	1,067.0	1,320.1	1,665.7	1,949.4
Peak load (MW)	193.2	236.7	295.5	342.4
2) Forecast by SENELEC				
Low-growth scenario:				
Consumption of energy (GWh)	825.5	811.6	937.8	1,090.6
Generated energy (GWh)	978.1	954.8	1,103.3	1,283.1
Peak load (MW)	162.4	165.1	190.8	221.9
Base-growth scenario:				
Consumption of energy (GWh)	825.5	1,055.9	1,338.1	1,678.8
Generated energy (GWh)	978.1	1,242.2	1,574.2	1,975.0
Peak load (MW)	162.4	214.8	272.2	341.6
High-growth scenario:				
Consumption of energy (GWh)	825.5	1,255.8	1,541.4	2,014.2
Generated energy (GWh)	978.1	1,477.5	1,813.4	2,369.6
Peak load (MW)	162.4	255.5	313.6	409.8

(1) Lifting of Supply Restraints

To draw up an electric power development plan based on the results of the demand forecast, it is necessary to know what facilities are actually required at the present time. However, as the purpose of this study is "to comprehensively review the master plan formulated by SENELEC, etc. to make a development of electric power system related to the electric power facilities which must be expanded without further delay, aimed at improving the electric power facilities in the outskirts of the Dakar city," the power demand forecast with regard to lifting the supply restraints shall be based on the forecasted results by the JICA team.

(2) Forecast Scenario

The power generation facility plan shall be based on the base-growth scenario in the demand forecast results. According to the forecast results by the SENELEC and JICA teams, the some of the forecasted figures by the JICA team are larger up to 2004, while some by the SENELEC team are larger after 2004.

Table 5.1.1-1 Economic Aggregates

(price in 1985 in BFCFA)

Item \ Year	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Annual mean growth rate (%) 1975-1993	1979-1993	1986-1993	1991-1993
(1) Primary industory					251.8	188.3	168.8	247.7	255.5	188.9	217.1	267.9	271.5	295.5	249.4	268.8	258.1	270.4	269.5	(431.6)	-	2.10	0.24	2.22
Agriculture					158.7	98.7	79.8	158.1	157.4	85.9	104.3	152.3	148.3	167.1	119.0	143.3	132.0	138.4	123.1	(198.8)	-	3.86	-1.03	-1.30
Stock raising					56.5	53.2	52.2	55.1	61.1	63.0	70.9	76.8	81.4	86.9	86.5	88.7	90.4	95.2	104.2	(151.3)	-	4.58	4.25	7.36
Fishery					20.7	20.4	22.8	24.6	26.5	26.7	28.2	27.3	29.4	28.7	29.8	25.6	25.2	26.0	25.4	(63.4)	-	1.68	-2.18	0.44
Forestry					15.8	16.0	14.0	9.9	10.4	13.3	13.7	11.1	12.4	12.9	14.1	11.3	10.3	10.9	11.7	(18.1)	-	-1.01	-0.39	6.39
(2) Secondary industory					159.3	153.3	149.7	171.2	183.9	190.2	205.0	209.8	223.8	242.3	242.1	253.6	239.8	244.3	256.0	(388.8)	-	3.58	2.36	3.33
Mining					2.5	2.8	2.9	2.3	2.9	3.0	3.4	3.3	2.9	6.2	9.8	6.7	5.4	5.1	3.9	(8.1)	-	8.12	15.32	-14.51
Oil refing					6.0	3.8	1.5	3.8	5.8	5.1	5.9	6.5	7.6	9.5	11.3	12.7	6.9	4.2	3.8	(9.7)	-	6.77	-6.24	-23.96
Energy					21.5	19.8	12.5	16.1	17.4	19.1	20.3	23.0	24.4	22.4	24.4	26.7	28.7	30.8	31.8	(45.5)	-	3.99	4.70	5.29
Construction					24.7	25.2	25.4	34.1	37.9	33.4	33.0	32.9	35.6	38.2	36.1	42.3	44.1	45.2	47.7	(69.0)	-	5.29	5.19	3.99
Others					104.5	101.7	107.3	114.9	120.0	129.5	142.4	144.0	153.3	165.9	160.5	165.1	154.7	158.9	168.8	(256.5)	-	3.59	1.74	4.46
(3) Tertiary industory					494.2	468.8	449.9	531.6	553.1	550.1	560.5	578.6	605.3	626.2	641.4	675.7	681.0	699.1	732.0	(1,125.2)	-	2.97	3.23	3.68
Transport					88.9	104.0	90.0	108.9	111.8	115.1	116.0	113.9	122.7	126.0	129.0	136.6	140.3	143.1	148.8	(204.5)	-	1.40	3.27	2.97
Commerce					294.7	225.9	235.8	275.8	292.7	277.5	289.6	283.4	285.0	294.3	301.1	317.8	319.6	328.4	339.4	(545.7)	-	1.22	2.97	3.04
Others					110.5	138.9	124.0	146.9	148.6	157.5	154.9	181.3	197.7	205.9	211.3	221.3	221.0	227.6	243.8	(375.0)	-	1.53	3.58	5.06
Sub total (1)+(2)+(3)					905.3	810.4	768.4	950.5	992.5	929.1	982.6	1,056.3	1,100.7	1,164.0	1,132.8	1,198.1	1,178.8	1,213.7	1,257.4	(1,945.6)	-	-	-	-
(4) Non-trade services					159.6	188.1	177.9	190.5	195.8	187.0	175.5	145.0	152.6	152.2	155.7	156.7	156.1	154.5	159.5	(199.6)	-	0.28	0.75	1.10
Management					17.6	19.5	18.4	20.7	21.4	18.4	19.7	20.1	21.0	21.2	21.7	22.4	22.6	22.6	24.4	(28.8)	-	1.08	2.52	3.99
Administration					142.0	168.7	159.6	169.8	174.5	168.6	155.8	124.9	131.6	131.0	133.9	134.3	133.5	131.9	135.1	(170.8)	-	0.19	0.45	0.61
(5) Gross Demestic Price :																								
Prices in 1985	945.1	1,027.5	999.0	959.4	1,064.9	998.6	946.3	1,141.0	1,188.3	1,116.1	1,158.1	1,201.3	1,253.3	1,316.1	1,288.5	1,354.8	1,334.9	1,368.3	1,416.9	-	2.48	2.26	2.11	3.03
Defrator (FY1985=100)	43.0	44.7	48.8	51.5	55.0	63.2	71.2	74.4	79.5	91.5	100.0	108.5	110.3	112.7	114.6	114.6	116.1	117.9	112.0	-				
Current prices	406.4	459.3	487.5	494.1	585.7	631.1	673.8	848.9	944.7	1,021.2	1,158.1	1,303.4	1,382.4	1,483.3	1,476.6	1,552.6	1,549.8	1,613.2	1,586.9	(2,145.2)				
(6) GDP/capita :																								
Population (in 1000)	4,866	4,998	5,134	5,274	5,417	5,565	5,716	5,871	6,031	6,195	6,363	6,537	6,714	6,897	7,103	7,298	7,499	7,704	7,913	8,127.4				
In 1000FCFA	194	206	195	182	197	179	166	194	197	180	182	184	187	191	181	186	178	178	179	-				
Official rate (FCFA/US$)	224.27	248.49	235.25	209.00	201.00	225.80	287.40	336.25	417.37	479.60	378.05	322.75	267.00	302.95	289.40	256.45	259.00	275.33	294.78	-				
In US$	866	827	827	870	978	795	576	578	472	376	481	569	699	630	627	724	687	645	607	-				
(7) Energy consumption/capita																								
Energy consumption (GWh)	381.0	408.2	442.8	482.1	519.4	533.8	568.5	530.2	597.2	646.0	623.2	618.9	661.8	692.8	686.1	722.9	737.4	808.5	802.8	869.8				
Energy consump./capita (KWh)	78.3	81.7	86.2	91.4	95.9	95.9	99.5	90.3	99.0	104.3	97.9	94.7	98.6	100.5	96.6	99.1	98.3	104.9	101.5	107.0				

Source : International Financial Statistic 1993 (IMF) and SOUS-DIRECTION LOGISTIQUE MANAGEMENT & STRATEGIE SERVICES ETUDES ECONOMIQUES GENERAILS MOD/dnd/SEEG/SD.LMS (August 1994 by SENELEC)
Data for year 1994 parenthesized : current price

Table 5.1.1-2 Consumers and Population of SENEGAL

As of September 1988

Code	Name of region	Concession (A)	Number of households (B)	Men (C)	Women (D)	Total (C)+(D)=(E)	(E)/(B)	(E)/(A)
01000	Region of Dakar	130,631	194,833	742,925	746,016	1,488,941	7.6	11.4
01100	Department of Dakar	61,971	95,666	342,435	338,497	680,932	7.1	11.0
01200	Department of Fikine	54,723	78,093	307,300	312,459	619,759	7.9	11.3
01300	Department of Rufinsque	13,937	21,074	93,190	95,060	188,250	8.9	13.5
02000	Region of Ziguinchor	39,793	53,489	196,613	201,724	398,337	7.4	10.0
02100	Department of Bignona	16,835	23,173	90,503	94,304	184,807	8.0	11.0
02200	Department of Oussouye	4,799	6,421	18,697	18,401	37,098	5.8	7.7
02300	Department of Ziguinchor	18,159	23,895	87,413	89,019	176,432	7.4	9.7
03000	Region of Diourbel	57,195	66,213	290,666	328,579	619,245	9.4	10.8
03100	Department of Banbey	14,891	18,783	95,485	103,405	198,890	10.6	13.4
03200	Department of Diourbel	16,924	20,352	87,339	96,644	183,983	9.0	10.9
03300	Department of Mbacke	25,380	27,078	107,842	128,530	236,372	8.7	9.3
04000	Region of Saint-Louis	62,664	77,493	310,932	349,350	660,282	8.5	10.5
04100	Department of Dagana	27,677	32,576	139,635	146,244	285,879	8.8	10.3
04200	Department of Matam	18,982	25,536	100,469	119,211	219,680	8.6	11.6
04300	Department of Podor	16,005	19,381	70,828	83,895	154,723	8.0	9.7
05000	Region of Tambacounda	37,387	42,998	189,143	196,839	385,982	9.0	10.3
05100	Department of Bakel	9,181	11,310	55,094	60,534	115,628	10.2	12.6
05200	Department of Kedougou	8,386	9,072	33,949	37,176	71,125	7.8	8.5
05300	Department of Tambacounda	19,820	22,616	100,100	99,129	199,229	8.8	10.1
06000	Region of Kaolack	66,869	83,775	395,614	415,644	811,258	9.7	12.1
06100	Department of Kaffrine	27,652	33,235	161,267	165,294	326,561	9.8	11.8
06200	Department of Kaolack	25,513	33,251	142,268	155,200	297,468	8.9	11.7
06300	Department of Nooro du Rip	13,704	17,289	92,079	95,150	187,229	10.8	13.7
07000	Region of Thies	73,563	97,962	455,685	485,466	941,151	9.6	12.8
07100	Department of Mbour	20,063	30,852	176,623	186,929	363,552	11.8	18.1
07200	Department of Thies	28,724	37,129	136,842	145,918	282,760	7.6	9.8
07300	Department of Tivaouane	24,776	29,981	142,220	152,619	294,839	9.8	11.9
08000	Region of Louga	47,313	52,559	232,001	258,076	490,077	9.3	10.4
08100	Department of Kebemer	15,879	17,056	76,409	85,578	161,987	9.5	10.2
08200	Department of Linguere	13,489	15,347	64,228	68,542	132,770	8.7	9.8
08300	Department of Louga	17,945	20,156	91,364	103,956	195,320	9.7	10.9
09000	Region of Fatick	41,188	55,041	248,393	261,310	509,703	9.3	12.4
09100	Department of Fatick	16,345	23,622	111,269	109,297	220,566	9.3	13.5
09200	Department of Foundiougne	9,336	13,733	80,679	89,509	170,188	12.4	18.2
09300	Department of Gosses	15,507	17,686	56,445	62,504	118,949	6.7	7.7
10000	Region of Kolda	45,755	60,121	291,628	300,205	591,833	9.8	12.9
10100	Department of Kolda	15,692	18,730	91,561	92,155	183,716	9.8	11.7
10200	Department of Sedhiou	18,612	27,119	137,170	144,434	281,604	10.4	15.1
10300	Department of Velingara	11,451	14,272	62,897	63,616	126,513	8.9	11.0
	Total of Regions	602,358	784,484	3,353,600	3,543,209	6,896,809	8.8	11.4

Source : February 1995 by SENELEC

Table 5.1.2-1 Annual Mean Growth Rate of GDP, Population and Consumption

No	Year	GDP		Population		Consumption (RGI)		Elasticity value
		Prices in 1985 (BFCFA)	Growth rate (%) (A)	Whole country (1000)	Growth rate (%)	Consumption (GWh)	Growth rate (%) (B)	(B)/(A)
1	1975	945.1	-	4,866	-	377.4	-	-
2	1976	1,027.5	8.7	4,998	2.7	403.9	7.0	0.803
3	1977	999.0	-2.8	5,134	2.7	438.1	8.5	-3.052
4	1978	959.4	-4.0	5,274	2.7	476.3	8.7	-2.203
5	1979	1,064.9	11.0	5,417	2.7	512.6	7.6	0.694
6	1980	998.6	-6.2	5,565	2.7	526.1	2.6	-0.422
7	1981	946.3	-5.2	5,716	2.7	560.6	6.6	-1.254
8	1982	1,141.0	20.6	5,871	2.7	520.5	-7.2	-0.348
9	1983	1,188.3	4.1	6,031	2.7	585.8	12.5	3.026
10	1984	1,116.1	-6.1	6,195	2.7	626.6	7.0	-1.143
11	1985	1,158.1	3.8	6,363	2.7	601.6	-4.0	-1.059
12	1986	1,201.3	3.7	6,537	2.7	597.8	-0.6	-0.168
13	1987	1,253.3	4.3	6,714	2.7	635.8	6.4	1.469
14	1988	1,316.1	5.0	6,897	2.7	665.5	4.7	0.930
15	1989	1,288.5	-2.1	7,103	3.0	641.5	-3.6	1.716
16	1990	1,354.8	5.1	7,298	2.8	685.4	6.9	1.331
17	1991	1,334.9	-1.5	7,499	2.7	706.4	3.1	-2.082
18	1992	1,368.3	2.5	7,704	2.7	770.0	9.0	3.600
19	1993	1,416.9	3.6	7,913	2.7	765.4	-0.6	-0.168

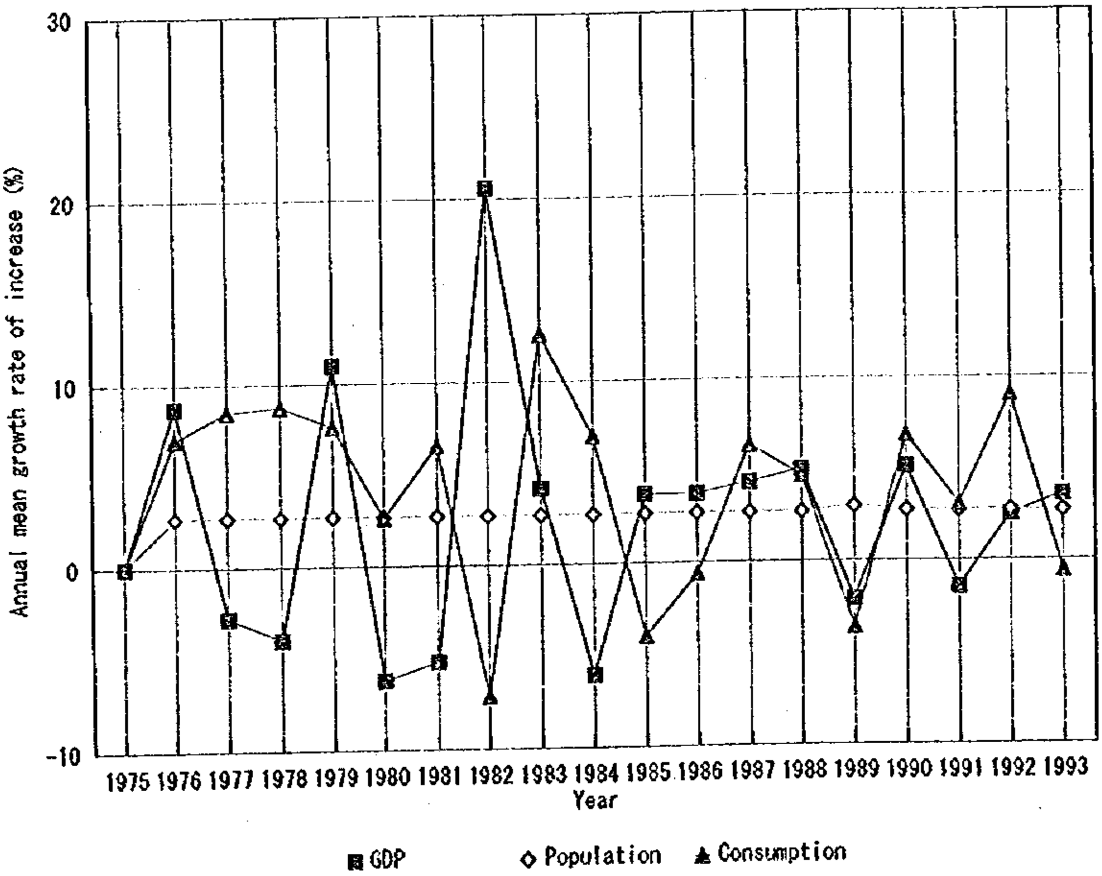


Table 5.1.2-2 Demand Relationship

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Consumption (GWh)	377.4	403.9	438.1	476.3	512.6	526.1	560.6	520.5	585.8	626.6
% to 1975 value	-	7.0	16.1	26.2	35.8	39.4	48.5	37.9	55.2	66.0
GDP (1985 price)	945	1,028	999	959	1,065	999	946	1,141	1,188	1,116
% to 1975 value	-	8.7	5.7	1.5	12.7	5.7	0.1	20.7	25.7	18.1
Population (x1000)	4,866	4,998	5,134	5,274	5,417	5,565	5,716	5,871	6,031	6,195
% to 1975 value	-	2.7	5.5	8.4	11.3	14.4	17.5	20.7	23.9	27.3

	1985	1986	1987	1988	1989	1990	1991	1992	1993	
Consumption (GWh)	601.6	597.8	635.8	665.5	641.5	685.4	706.4	770.0	765.4	
% to 1975 value	59.4	58.4	68.5	76.3	70.0	81.6	87.2	104.0	102.8	
GDP (1985 price)	1,158	1,201	1,253	1,316	1,289	1,355	1,335	1,368	1,417	
% to 1975 value	22.5	27.1	32.6	39.3	36.3	43.3	41.2	44.8	49.9	
Population (x1000)	6,363	6,537	6,714	6,897	7,103	7,298	7,499	7,704	7,913	
% to 1975 value	30.8	34.3	38.0	41.7	46.0	50.0	54.1	58.3	62.6	

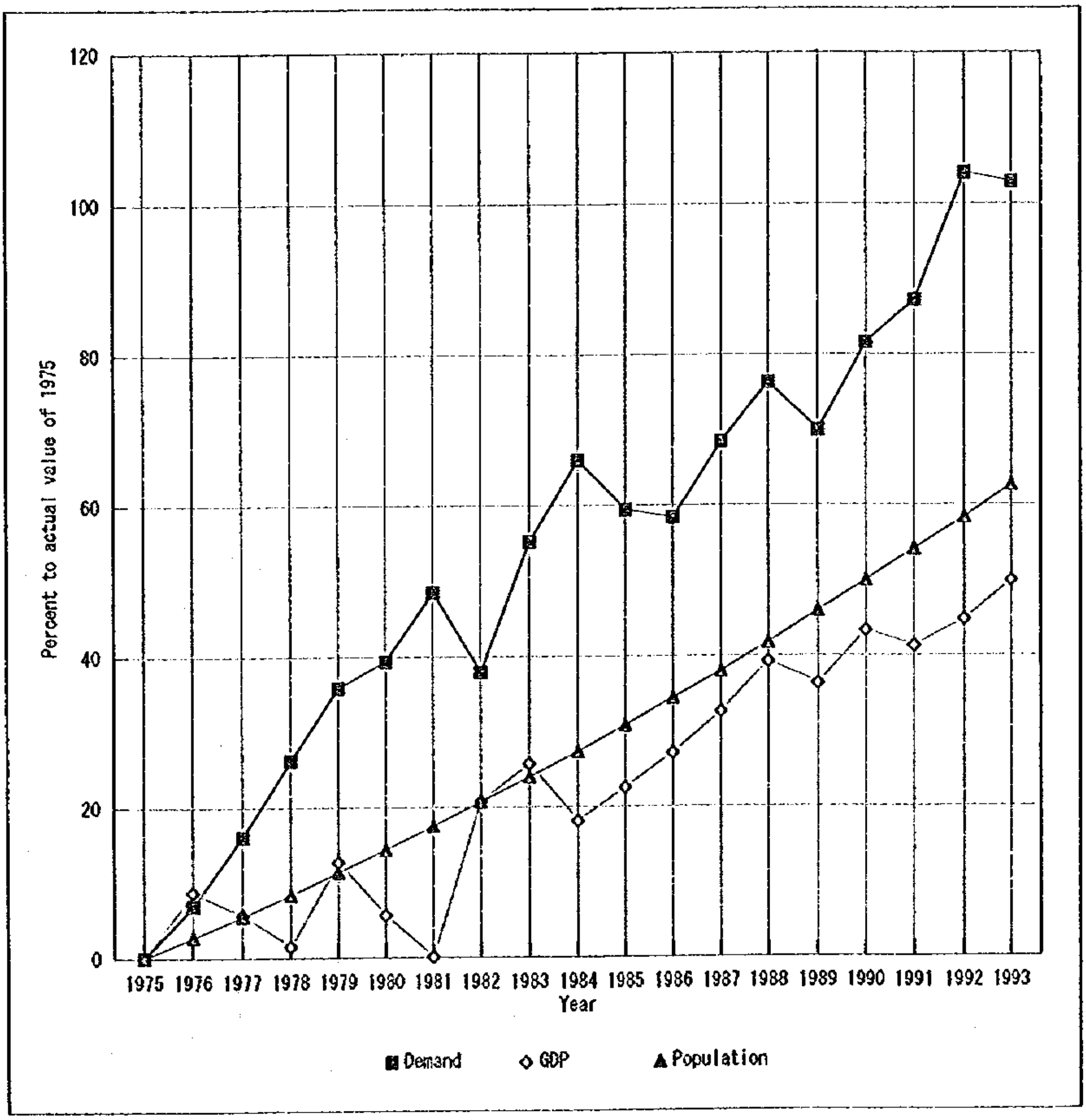


Table 5.1.3 Forecast of Economic Growth

(GFCFA - 1985 constant prices)

Year	Low scenario					Base scenario					High scenario				
	Primary industry	Secondary industry	Tertiary industry	Non-trade services	Total	Primary industry	Secondary industry	Tertiary industry	Non-trade services	Total	Primary industry	Secondary industry	Tertiary industry	Non-trade services	Total
1979	251.8	159.3	494.2	159.6	1,064.9										
1980	188.3	153.3	468.8	188.1	998.6										
1981	168.8	149.7	449.9	177.9	946.3										
1982	247.7	171.2	531.6	190.5	1,141.0										
1983	255.5	183.9	553.1	195.8	1,188.3										
1984	188.9	190.2	550.1	187.0	1,116.1										
1985	217.1	205.0	560.5	175.5	1,158.1										
1986	267.9	209.8	578.6	145.0	1,201.3										
1987	271.5	223.8	605.3	152.6	1,253.3										
1988	295.5	242.3	626.2	152.2	1,316.1										
1989	249.4	242.1	641.4	155.7	1,288.5										
1990	268.8	253.6	675.7	156.7	1,354.8										
1991	258.1	239.8	681.0	156.1	1,334.9										
1992	270.4	244.3	699.1	154.5	1,368.3										
1993	269.5	256.0	732.0	159.5	1,416.9										
1994	274.9	262.5	749.5	160.1	1,448.0	277.6	267.4	753.9	160.7	1,459.7	281.4	269.1	759.5	161.6	1,471.6
1995	280.5	271.3	767.5	160.7	1,480.0	286.4	279.3	776.5	162.1	1,504.2	294.1	282.8	788.2	163.7	1,528.7
1996	286.4	279.3	785.9	161.3	1,512.9	295.7	291.7	799.8	163.4	1,550.6	307.6	297.3	817.9	165.9	1,588.6
1997	292.6	287.6	804.8	161.8	1,546.9	305.7	304.7	823.8	164.7	1,598.9	322.0	312.5	848.7	168.0	1,651.2
1998	299.2	296.2	824.1	162.4	1,581.9	316.4	318.2	848.5	166.1	1,649.2	337.3	328.4	880.7	170.3	1,716.8
1999	306.0	305.0	843.9	163.0	1,617.9	327.8	332.4	874.0	167.5	1,701.6	353.7	345.2	913.9	172.5	1,785.4
2000	315.7	313.5	867.0	163.8	1,659.9	346.7	348.9	901.7	169.0	1,766.2	377.2	364.8	955.7	175.0	1,872.6
2001	325.7	322.2	890.7	164.5	1,703.1	366.8	366.3	930.2	170.6	1,833.9	402.4	385.4	999.3	177.5	1,964.6
2002	336.1	331.2	915.1	165.3	1,747.6	388.3	384.5	959.7	172.2	1,904.7	429.6	407.1	1,045.0	180.1	2,061.8
2003	346.8	340.4	940.2	166.0	1,793.5	411.3	403.6	990.1	173.8	1,978.9	458.8	430.2	1,092.7	182.7	2,164.4
2004	357.9	349.9	966.1	166.8	1,840.7	435.9	423.7	1,021.5	175.5	2,056.5	490.3	454.5	1,142.7	185.3	2,272.8
2005	369.5	359.7	992.7	167.5	1,889.4	462.2	444.8	1,053.9	177.2	2,138.0	524.2	480.2	1,194.9	188.0	2,387.4
2006	381.4	369.8	1,020.0	168.3	1,939.5	490.3	466.9	1,087.3	178.9	2,223.3	560.8	507.3	1,249.5	190.8	2,508.5
2007	393.7	380.2	1,048.2	169.1	1,991.1	520.3	490.1	1,121.7	180.7	2,312.8	600.1	536.0	1,306.7	193.7	2,636.5
2008	406.5	390.8	1,077.1	169.9	2,044.3	552.5	514.5	1,157.3	182.5	2,406.7	642.6	566.3	1,366.5	196.6	2,772.0
2009	419.8	401.8	1,106.9	170.7	2,099.1	586.8	540.1	1,194.0	184.3	2,505.3	688.3	598.4	1,429.0	199.5	2,915.3
2010	433.5	413.1	1,137.5	171.5	2,155.6	623.7	567.0	1,231.9	186.2	2,608.7	737.7	632.2	1,494.5	202.5	3,066.9

Table 5.1.5-1 Energy Demand and Peak Load Forecast

RGI:Low Scenario

No	Year	Energy demand requirements (GWh)						GDP	Population	Loss rate	Rate of aux. use	Energy generation (GWh)		Load factor	Peak load (MW)			
		Actual (1)	Forecasted (2)	TAIBA (3)	SAED (4)	CAYOR (5)	Required (1)~(5)	(BFCFA)	(in1000)	(%)	(%)	sending end	generating end	(%)	Actual	Forecasted	Generation JICA	Generation SENELEC
1	1975	377.4					377.4	945.1	4,866				435.4		72.2		76.0	
2	1976	403.9					403.9	1,027.5	4,998				469.3		68.4		72.0	
3	1977	438.1					438.1	999.0	5,134				521.2		81.2		85.5	
4	1978	476.3					476.3	959.4	5,274				573.4		88.8		93.5	
5	1979	512.6					512.6	1,064.9	5,417				627.7		99.0		104.2	
6	1980	526.1					526.1	1,030.0	5,565				627.4		97.6		102.7	
7	1981	560.6					560.6	1,130.0	5,716				663.3		105.3		110.8	
8	1982	560.6					560.6	1,141.0	5,871				621.9		98.7		103.9	
9	1983	585.8					585.8	1,188.3	6,031				695.2		108.9		114.6	
10	1984	626.5					626.6	1,116.1	6,195				743.1		117.6		123.8	
11	1985	601.6					601.6	1,158.1	6,363				730.6		117.1		123.3	
12	1986	597.8					597.8	1,201.3	6,537				725.7		118.7		124.9	
13	1987	635.8					635.8	1,253.3	6,714				785.1		122.7		129.2	
14	1988	665.5					665.5	1,316.1	6,897				829.9		130.3		137.2	
15	1989	641.5					641.5	1,288.5	7,103				832.6		134.6		141.7	
16	1990	685.4					685.4	1,354.8	7,298				851.5		131.3		138.2	
17	1991	706.4					706.4	1,334.9	7,499				877.4		145.5		153.2	
18	1992	770.0					770.0	1,368.3	7,704				944.0		151.3		159.3	
19	1993	765.4					765.4	1,416.9	7,913	13.4	6.7		947.9	68.0	148.4		156.2	
20	1994	(830.77)	856.8				856.8	1,448.0	8,109	13.5	6.6	990.5	1,060.5	62.0		182.4	192.0	(162.4)
21	1995		879.7				879.7	1,480.0	8,310	13.5	6.6	1,017.0	1,088.9	62.0		187.3	197.1	179.1
22	1996		903.2				903.2	1,512.9	8,517	13.5	6.5	1,044.2	1,116.8	62.5		190.7	200.8	190.7
23	1997		927.3				927.3	1,546.9	8,728	14.0	6.5	1,078.3	1,153.3	62.5		197.0	207.3	186.1
24	1998		952.1				952.1	1,581.9	8,944	14.0	6.5	1,107.0	1,184.0	62.5		202.2	212.8	187.7
25	1999		977.4				977.4	1,617.9	9,166	14.0	6.5	1,136.5	1,215.5	63.0		205.9	216.8	163.6
26	2000		1,003.4		(19.9)		1,003.4	1,659.9	9,393	14.0	6.0	1,166.8	1,241.2	63.0		211.4	222.5	165.2
27	2001		1,030.1		(19.9)		1,030.1	1,702.1	9,626	14.5	6.0	1,204.8	1,281.7	63.0		218.3	229.8	170.0
28	2002		1,057.4	(-126.8)	(23.0)	(106.945)	1,057.4	1,747.6	9,865	14.5	6.0	1,236.7	1,315.7	63.5		222.3	234.0	175.0
29	2003		1,085.4	(-126.8)	(23.0)	(106.945)	1,085.4	1,793.5	10,110	14.5	6.0	1,269.5	1,350.6	63.5		228.2	240.2	180.1
30	2004		1,114.2	(-126.8)	(23.0)	(106.945)	1,114.2	1,840.7	10,360	15.0	6.0	1,310.8	1,394.4	63.5		235.6	248.0	185.4
31	2005		1,143.6	(-126.8)	(25.7)	(81.395)	1,143.6	1,889.4	10,617	15.0	5.5	1,345.4	1,423.7	64.0		240.0	252.6	190.8
32	2006		1,173.8	(-126.8)	(25.7)	(81.395)	1,173.8	1,939.5	10,881	15.0	5.5	1,380.9	1,461.3	64.0		246.3	259.3	196.7
33	2007		1,204.7	(-126.8)	(25.7)	(81.395)	1,204.7	1,991.1	11,150	15.5	5.5	1,425.6	1,508.6	64.0		254.3	267.7	202.7
34	2008		1,236.4	(-126.8)	(25.7)	(81.395)	1,236.4	2,044.3	11,427	15.5	5.5	1,463.2	1,548.3	64.5		259.0	272.6	208.9
35	2009		1,268.8	(-126.8)	(25.7)	(81.395)	1,268.8	2,099.1	11,710	15.5	5.5	1,501.6	1,589.0	64.5		265.8	279.7	215.3
36	2010		1,302.4	(-126.8)	(30.9)	(81.395)	1,302.4	2,155.6	12,003	16.0	5.0	1,550.5	1,632.1	65.0		272.3	286.6	221.9

Peak load actual (1975-1993) & peak load generated (1994-2010) : calculated as rate of auxiliary kW use = 5%

Annual average rate of increase of energy demand : actual (1986-1993) = 3.59%, forecasted (1993-2010) = 3.2%

Table 5.1.5-2 Energy Demand and Peak Load Forecast

RG1:Base Scenario

No	Year	Energy demand requirements (GWh)						GDP	Population	Loss rate	Rate of aux. use	Energy generation (GWh)		Load factor	Peak load (MW)			
		Actual	Forecasted	TAIBA	SAED	CAYOR	Required					sending end	generating end		Actual	Forecasted	Generation	
		(1)	(2)	(3)	(4)	(5)	(1)～(5)	(BFCFA)	(in1000)	(%)	(%)			(%)			JICA	SENELEC
1	1975	377.4					377.4	945.1	4,866				435.4		72.2		76.0	
2	1976	403.9					403.9	1,027.5	4,998				469.3		68.4		72.0	
3	1977	438.1					438.1	999.0	5,134				521.2		81.2		85.5	
4	1978	476.3					476.3	959.4	5,274				573.4		88.8		93.5	
5	1979	512.6					512.6	1,064.9	5,417				627.7		99.0		104.2	
6	1980	526.1					526.1	1,030.0	5,565				627.4		97.6		102.7	
7	1981	560.6					560.6	1,130.0	5,716				663.3		105.3		110.8	
8	1982	560.6					560.6	1,141.0	5,871				621.9		98.7		103.9	
9	1983	585.8					585.8	1,188.3	6,031				695.2		108.9		114.6	
10	1984	626.6					626.6	1,116.1	6,195				743.1		117.6		123.8	
11	1985	601.6					601.6	1,158.1	6,363				730.6		117.1		123.3	
12	1986	597.8					597.8	1,201.3	6,537				725.7		118.7		124.9	
13	1987	635.8					635.8	1,253.3	6,714				785.1		122.7		129.2	
14	1988	665.5					665.5	1,316.1	6,897				829.9		130.3		137.2	
15	1989	641.5					641.5	1,288.5	7,103				832.6		134.6		141.7	
16	1990	685.4					685.4	1,354.8	7,298				851.5		131.3		138.2	
17	1991	706.4					706.4	1,334.9	7,499				877.4		145.5		153.2	
18	1992	770.0					770.0	1,368.3	7,704				944.0		151.3		159.3	
19	1993	765.4					765.4	1,416.9	7,913	13.4	6.7		947.9	68.0	148.4		156.2	
20	1994	(830.77)	859.4				859.4	1,459.7	8,131	13.5	6.6	993.5	1,063.7	62.0		182.9	192.6	(162.4)
21	1995		885.1				885.1	1,564.2	8,356	13.5	6.6	1,023.3	1,095.6	62.0		188.4	198.3	186.4
22	1996		911.6				911.6	1,550.6	8,587	13.5	6.5	1,053.9	1,127.1	62.5		192.5	202.6	200.6
23	1997		938.8				938.8	1,598.9	8,824	14.0	6.5	1,091.6	1,167.5	62.5		199.4	209.9	198.1
24	1998		966.8				966.8	1,649.2	9,067	14.0	6.5	1,124.1	1,202.3	62.5		205.3	216.1	205.4
25	1999		995.5				995.5	1,701.6	9,317	14.0	6.5	1,157.5	1,238.0	63.0		209.7	220.8	210.0
26	2000		1,025.2		19.9		1,045.1	1,766.2	9,574	14.0	6.0	1,215.2	1,292.8	63.0		220.2	231.8	214.9
27	2001		1,055.7		19.9		1,075.6	1,833.9	9,839	14.5	6.0	1,258.0	1,338.3	63.0		227.9	239.9	204.8
28	2002		1,087.1	(-139.48)	23.0	106.9	1,217.0	1,904.7	10,110	14.5	6.0	1,423.4	1,514.3	63.5		255.9	269.4	225.6
29	2003		1,119.3	(-139.48)	23.0	106.9	1,249.3	1,978.9	10,389	14.5	6.0	1,461.1	1,554.4	63.5		262.7	276.5	240.1
30	2004		1,152.5	(-139.48)	23.0	106.9	1,282.5	2,056.5	10,676	15.0	6.0	1,508.8	1,605.1	63.5		271.2	285.5	255.6
31	2005		1,186.6	(-139.48)	25.7	81.4	1,293.7	2,138.0	10,971	15.0	5.5	1,522.0	1,610.6	64.0		271.5	285.8	272.3
32	2006		1,221.7	(-139.48)	25.7	81.4	1,328.8	2,223.3	11,274	15.0	5.5	1,563.3	1,654.3	64.0		278.8	293.5	284.8
33	2007		1,257.8	(-139.48)	25.7	81.4	1,364.9	2,312.8	11,585	15.5	5.5	1,615.2	1,709.2	64.0		288.1	303.3	297.9
34	2008		1,294.9	(-139.48)	25.7	81.4	1,402.0	2,406.7	11,904	15.5	5.5	1,659.1	1,755.7	64.5		293.6	309.1	311.8
35	2009		1,333.0	(-139.48)	25.7	81.4	1,440.1	2,505.3	12,233	15.5	5.5	1,704.3	1,803.5	64.5		301.6	317.5	326.3
36	2010		1,372.3	(-139.48)	30.9	81.4	1,484.6	2,608.7	12,571	16.0	5.0	1,767.3	1,860.3	65.0		310.4	326.7	341.6

Peak load actual (1975-1993) & peak load generated (1994-2010) : calculated as rate of auxiliary kW use = 5%

Annual average rate of increase of energy demand : actual (1986-1993) = 3.59%, forecasted (1993-2010) = 4.02%

Table 5.1.5-3 Energy Demand and Peak Load Forecast

RGI:High Scenario

No	Year	Energy demand requirements (GWh) Actual (1)	Forecasted (2)	TAIBA (3)	SAED (4)	CAYOR (5)	Required (1)~(5)	GDP (BFCFA)	Population (in1000)	Loss rate (%)	Rate of aux. use (%)	Energy generation (GWh) sending end	generating end	Load factor (%)	Peak load (MW) Actual	Forecasted	Generation JICA	Generation SENELEC
1	1975	377.4					377.4	945.1	4,866				435.4		72.2		76.0	
2	1976	403.9					403.9	1,027.5	4,998				469.3		68.4		72.0	
3	1977	438.1					438.1	999.0	5,134				521.2		81.2		85.5	
4	1978	476.3					476.3	959.4	5,274				573.4		88.8		93.5	
5	1979	512.6					512.6	1,064.9	5,417				627.7		99.0		104.2	
6	1980	526.1					526.1	1,030.0	5,565				627.4		97.6		102.7	
7	1981	560.6					560.6	1,130.0	5,716				663.3		105.3		110.8	
8	1982	560.6					560.6	1,141.0	5,871				621.9		98.7		103.9	
9	1983	585.8					585.8	1,188.3	6,031				695.2		108.9		114.6	
10	1984	626.6					626.6	1,116.1	6,195				743.1		117.6		123.8	
11	1985	601.6					601.6	1,158.1	6,363				730.6		117.1		123.3	
12	1986	597.8					597.8	1,201.3	6,537				725.7		118.7		124.9	
13	1987	635.8					635.8	1,253.3	6,714				785.1		122.7		129.2	
14	1988	665.5					665.5	1,316.1	6,897				829.9		130.3		137.2	
15	1989	641.5					641.5	1,288.5	7,103				832.6		134.6		141.7	
16	1990	685.4					685.4	1,354.8	7,298				851.5		131.3		138.2	
17	1991	706.4					706.4	1,334.9	7,499				877.4		145.5		153.2	
18	1992	770.0					770.0	1,368.3	7,704				944.0		151.3		159.3	
19	1993	765.4					765.4	1,416.9	7,913	13.4	6.7		947.9	68.0	148.4		156.2	
20	1994	(830.77)	862.1				862.1	1,471.6	8,154	13.5	6.6	996.6	1,067.0	62.0		183.5	193.2	(162.4)
21	1995		890.6				890.6	1,528.7	8,402	13.5	6.6	1,029.6	1,102.3	62.0		189.6	199.5	198.8
22	1996		920.0				920.0	1,588.6	8,657	13.5	6.5	1,063.6	1,137.5	62.5		194.3	204.5	209.2
23	1997		950.3				950.3	1,651.2	8,920	14.0	6.5	1,105.0	1,181.9	62.5		201.8	212.5	208.6
24	1998		981.6				981.6	1,716.8	9,191	14.0	6.5	1,141.4	1,220.7	62.5		208.5	219.4	218.5
25	1999		1,013.8				1,013.8	1,785.4	9,471	14.0	6.5	1,178.9	1,260.8	63.0		213.6	224.9	235.8
26	2000		1,047.3		19.9		1,067.2	1,872.6	9,759	14.0	6.0	1,240.9	1,320.1	63.0		224.8	236.7	255.6
27	2001		1,081.8		19.9		1,101.7	1,964.6	10,055	14.5	6.0	1,288.5	1,370.7	63.0		233.5	245.8	246.7
28	2002		1,117.3	(-139.48)	23.0	106.9	1,247.3	2,061.8	10,361	14.5	6.0	1,458.8	1,551.9	63.5		262.3	276.1	268.3
29	2003		1,154.0	(-139.48)	23.0	106.9	1,284.0	2,164.4	10,676	14.5	6.0	1,501.7	1,597.6	63.5		270.0	284.2	281.3
30	2004		1,191.9	(-139.48)	23.0	106.9	1,321.8	2,272.8	11,000	15.0	6.0	1,555.1	1,654.3	63.5		279.6	294.3	296.4
31	2005		1,230.9	(-139.48)	25.7	81.4	1,338.0	2,387.4	11,335	15.0	5.5	1,574.1	1,665.7	64.0		280.8	295.5	313.7
32	2006		1,271.1	(-139.48)	25.7	81.4	1,378.2	2,508.5	11,679	15.0	5.5	1,621.5	1,715.8	64.0		289.2	304.4	330.8
33	2007		1,312.7	(-139.48)	25.7	81.4	1,419.8	2,636.5	12,034	15.5	5.5	1,680.2	1,778.0	64.0		299.7	315.5	348.9
34	2008		1,355.5	(-139.48)	25.7	81.4	1,462.6	2,772.0	12,400	15.5	5.5	1,730.9	1,831.6	64.5		306.3	322.5	368.1
35	2009		1,399.7	(-139.48)	25.7	81.4	1,506.8	2,915.3	12,777	15.5	5.5	1,783.2	1,887.0	64.5		315.6	332.2	388.4
36	2010		1,443.3	(-139.48)	30.9	81.4	1,555.6	3,066.9	13,148	16.0	5.0	1,851.9	1,949.4	65.0		325.2	342.4	409.9

Peak load actual (1975-1993) & peak load generated (1994-2010) : calculated as rate of auxiliary kW use = 5%

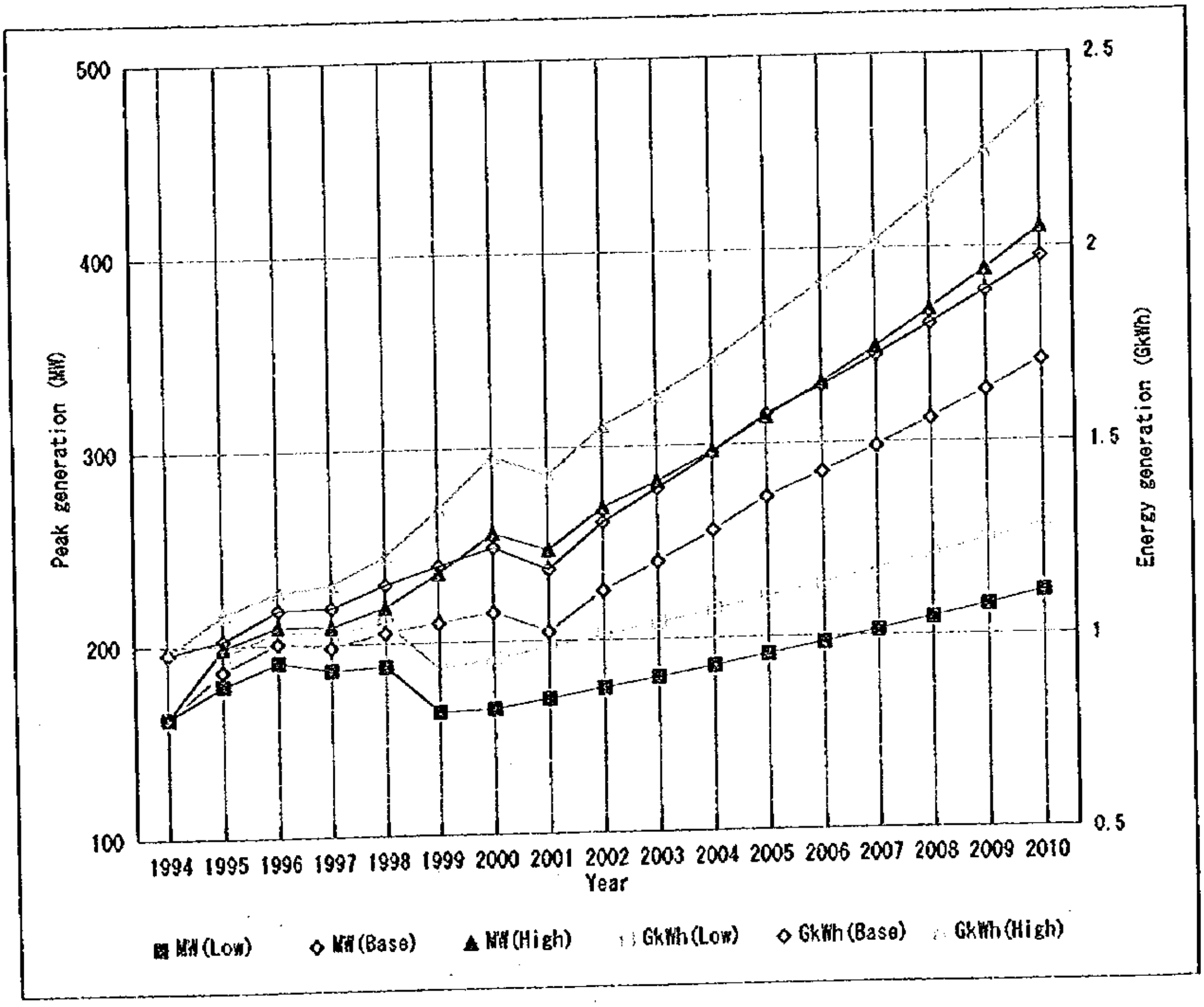
Annual average rate of increase of energy demand : actual (1986-1993) = 3.59%, forecasted (1993-2010) = 4.38%

Table 5.1.5-4 Load Forecast by SENELEC (Revised)

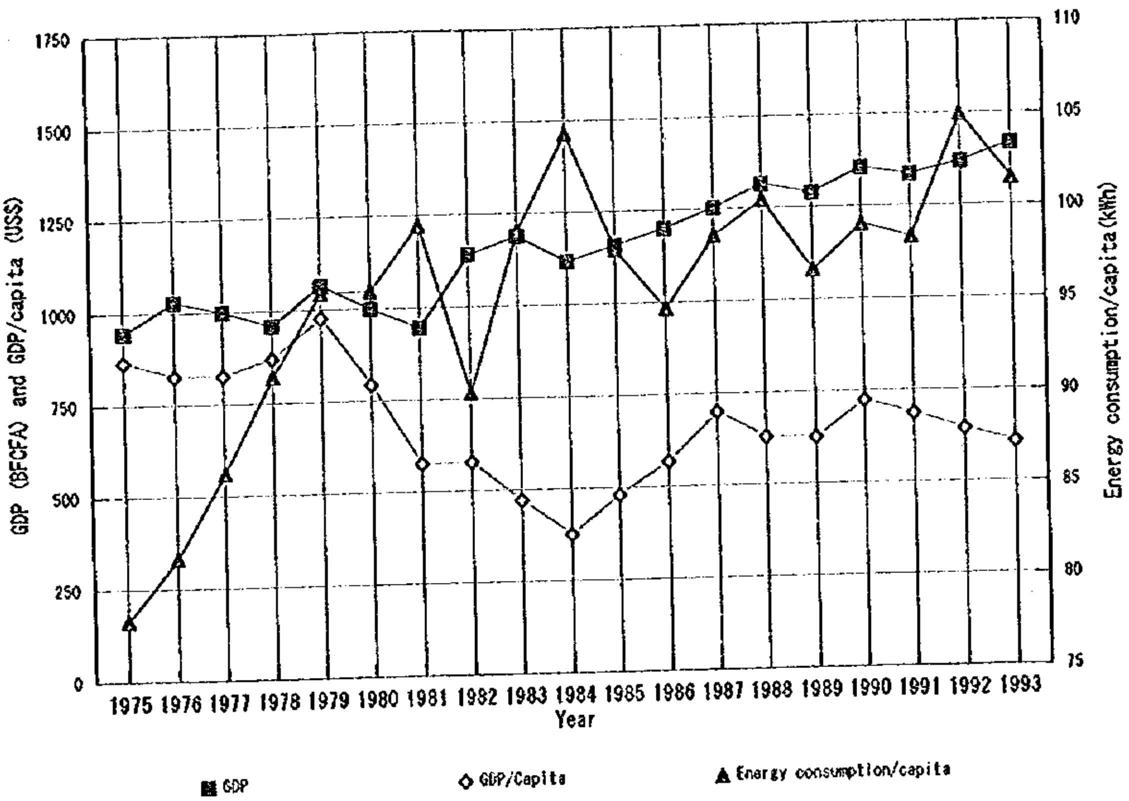
RGI

Year	Low scenario			Base scenario			High scenario		
	Energy demand GWh	Generation Peak MW	Generation Energy GWh	Energy demand GWh	Generation Peak MW	Generation Energy GWh	Energy demand GWh	Generation Peak MW	Generation Energy GWh
1994	825.53	162.40	978.19	825.53	162.40	978.19	825.53	162.40	978.19
1995	797.52	179.07	972.58	829.91	186.35	1,012.09	885.23	198.77	1,079.55
1996	849.10	190.65	1,035.48	893.51	200.63	1,089.65	931.75	209.21	1,136.28
1997	872.85	186.07	1,026.88	929.39	198.12	1,093.40	978.62	208.62	1,151.32
1998	894.62	187.73	1,052.50	978.73	205.38	1,151.45	1,041.15	218.48	1,224.88
1999	791.79	163.60	931.52	1,016.40	210.00	1,195.76	1,141.16	235.78	1,342.54
2000	811.64	165.16	954.87	1,055.90	214.86	1,242.24	1,255.88	255.55	1,477.51
2001	835.38	169.99	982.80	1,006.30	204.77	1,183.88	1,212.59	246.74	1,426.57
2002	859.90	174.98	1,011.65	1,108.46	225.56	1,304.08	1,318.53	268.30	1,551.21
2003	885.07	180.10	1,041.26	1,179.71	240.05	1,387.90	1,382.48	281.31	1,626.44
2004	911.05	185.39	1,071.83	1,256.14	255.61	1,477.81	1,456.69	296.41	1,713.75
2005	937.87	190.84	1,103.38	1,338.14	272.29	1,574.28	1,541.41	313.65	1,813.42
2006	966.44	196.66	1,136.99	1,399.54	284.78	1,646.51	1,625.58	330.78	1,912.44
2007	995.97	202.67	1,171.73	1,464.12	297.93	1,722.49	1,714.64	348.90	2,017.22
2008	1,026.50	208.88	1,207.64	1,532.07	311.75	1,802.43	1,808.90	368.08	2,128.11
2009	1,058.05	215.30	1,244.76	1,603.56	326.30	1,886.55	1,908.65	388.38	2,245.47
2010	1,090.66	221.93	1,283.13	1,678.81	341.61	1,975.07	2,014.22	409.86	2,369.67

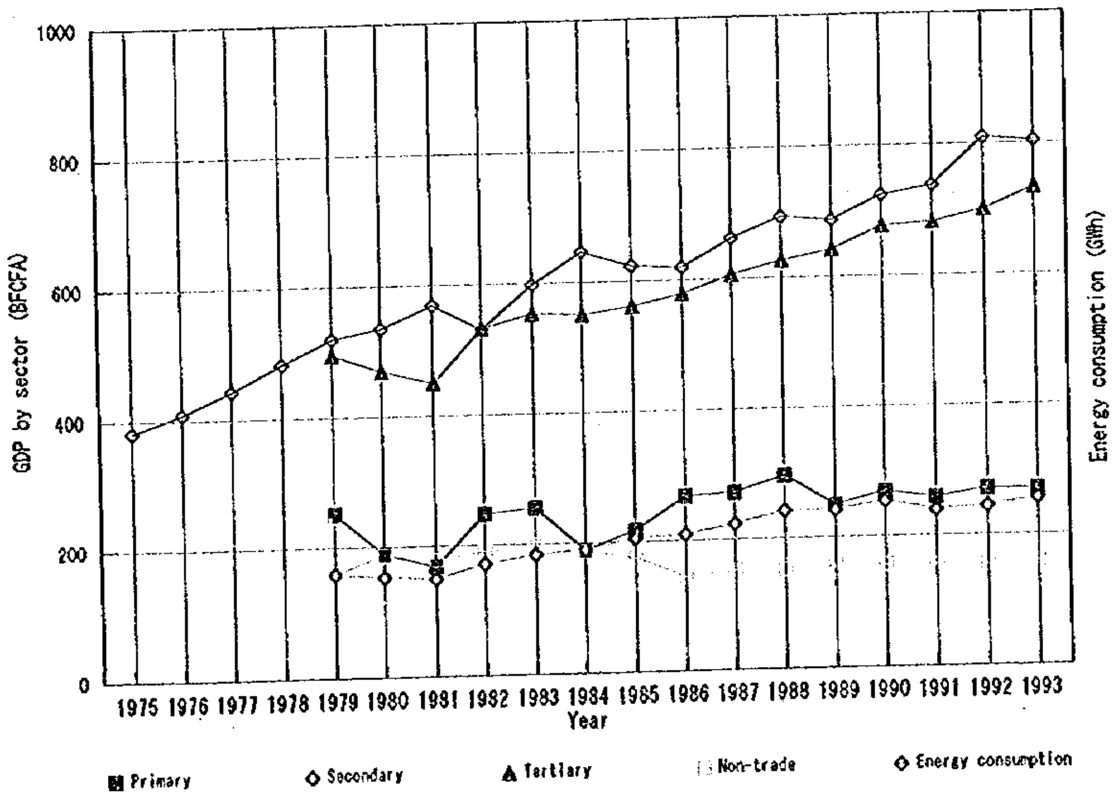
Note : energy demand of year 1994 = actual result



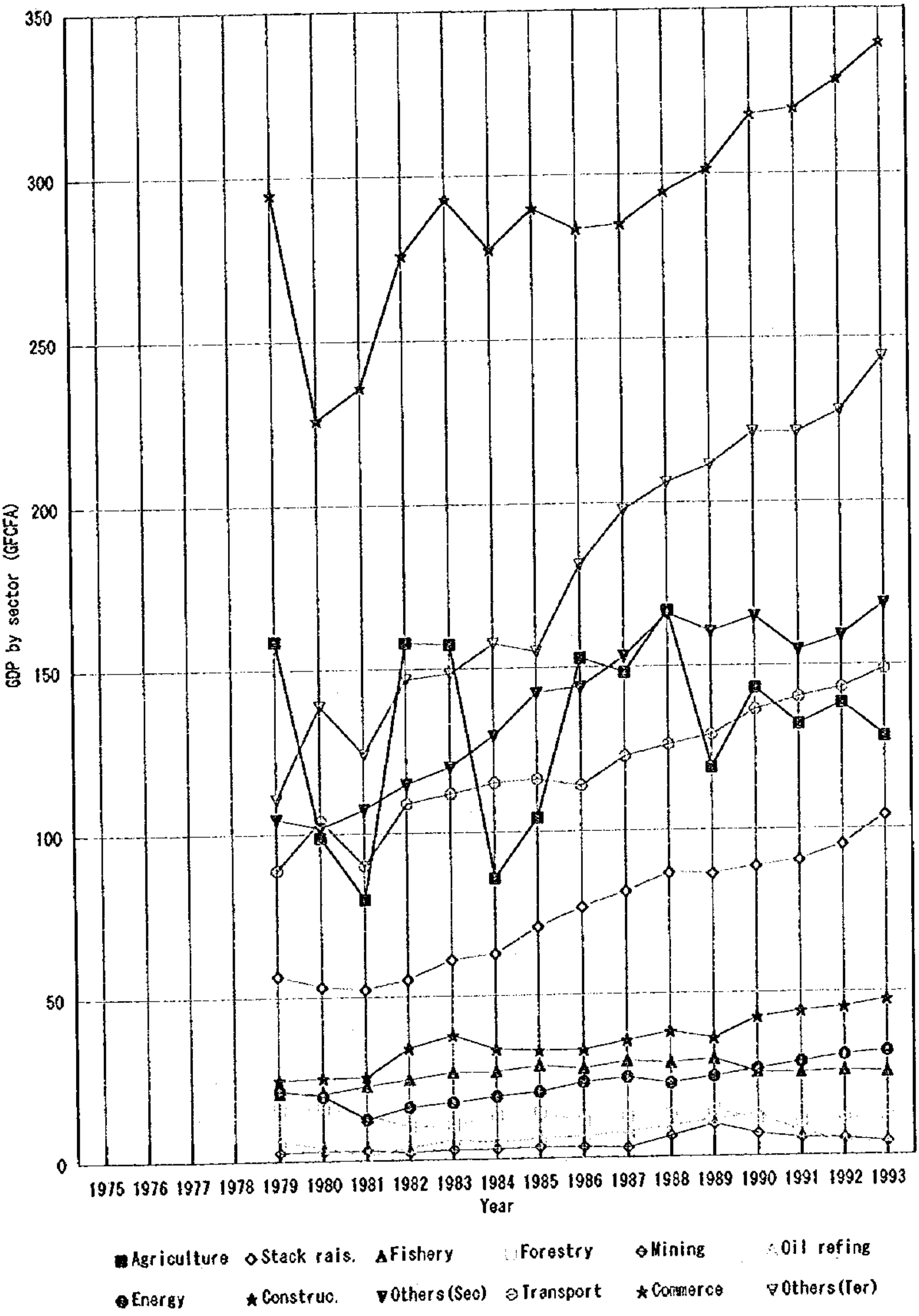
Graph 5. 1. 1-1(1) GDP, GDP/Capita and Energy/Capita



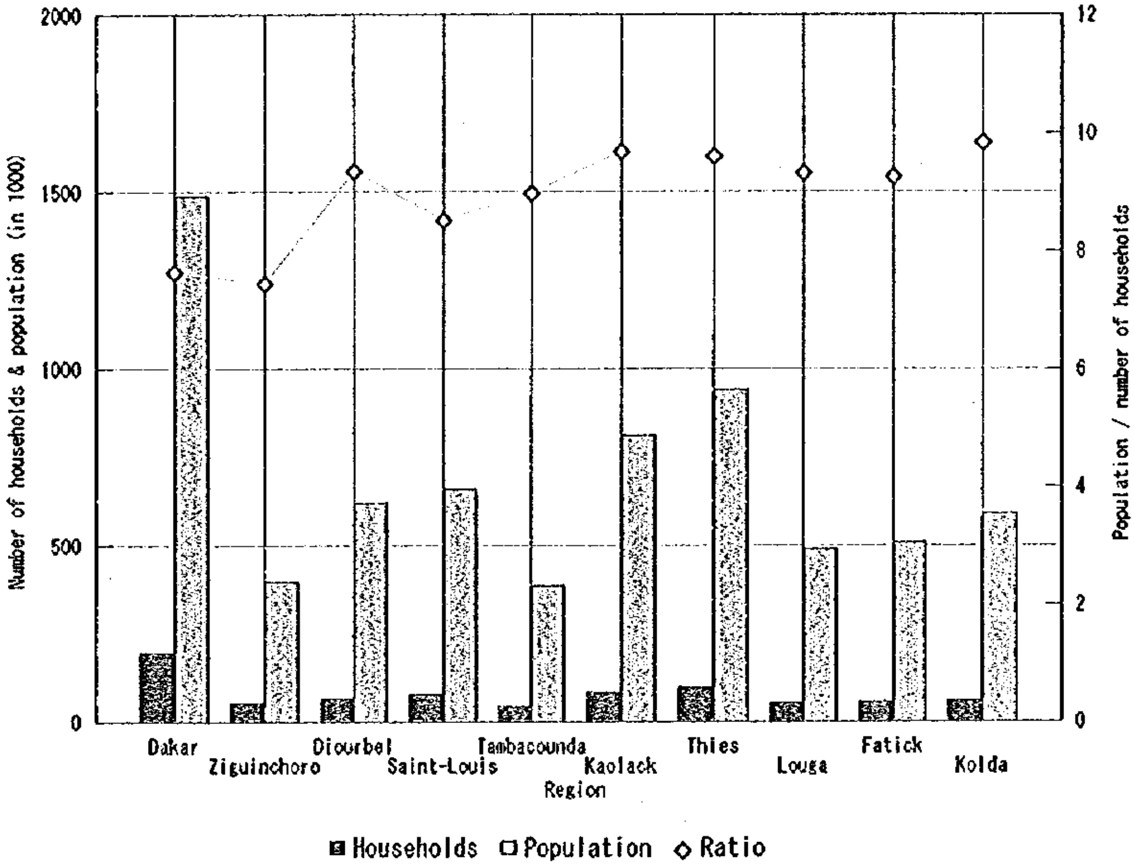
Graph 5. 1. 1-1(2) GDP by Sector (1)

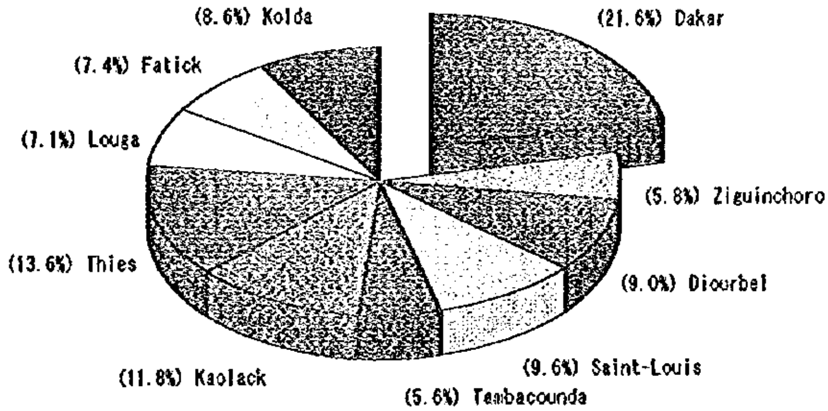


Graph 5.1.1-1 (3) GDP by Sector (2)

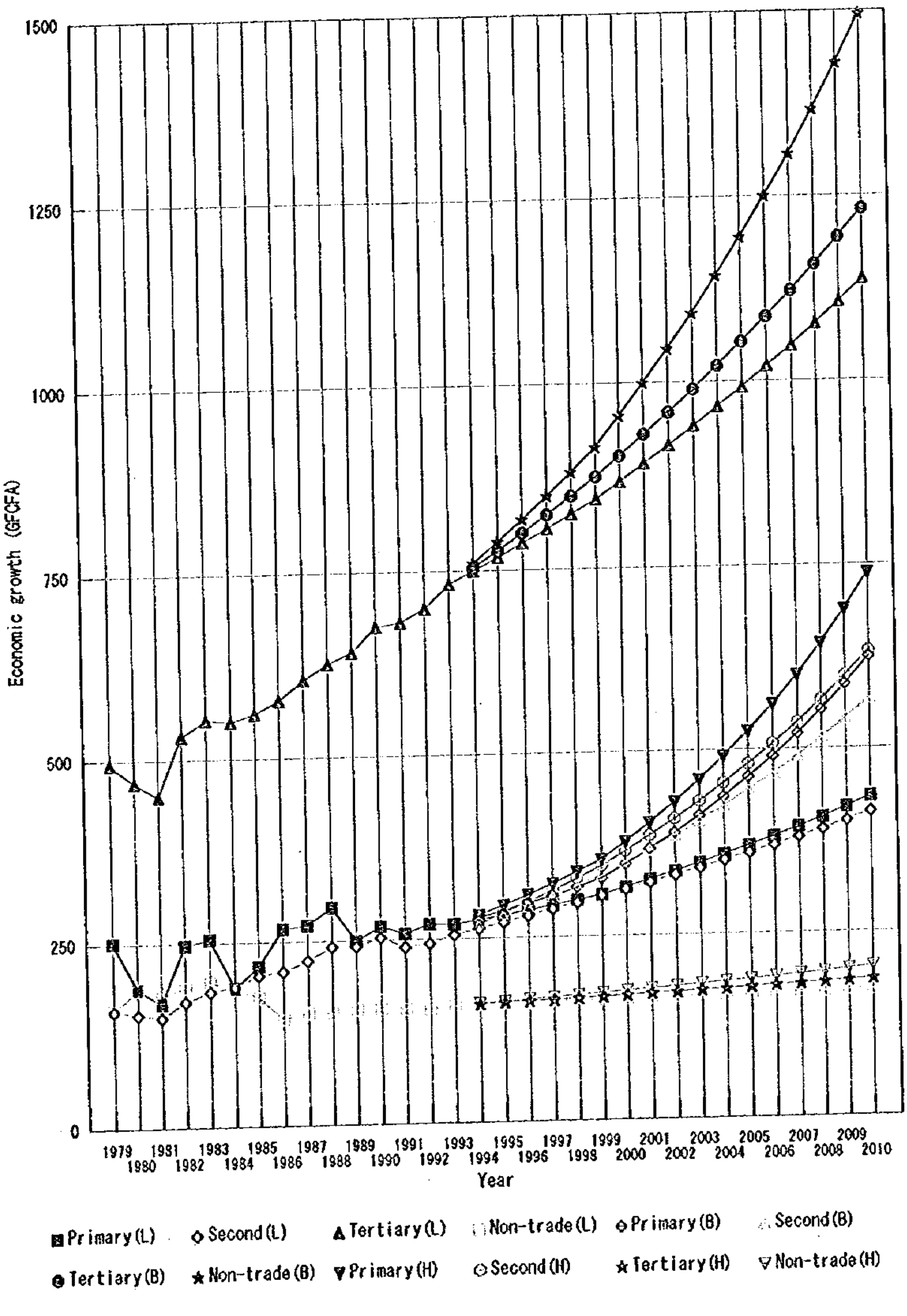


Graph 5.1.1-2 Population of SENEGAL
September 1988



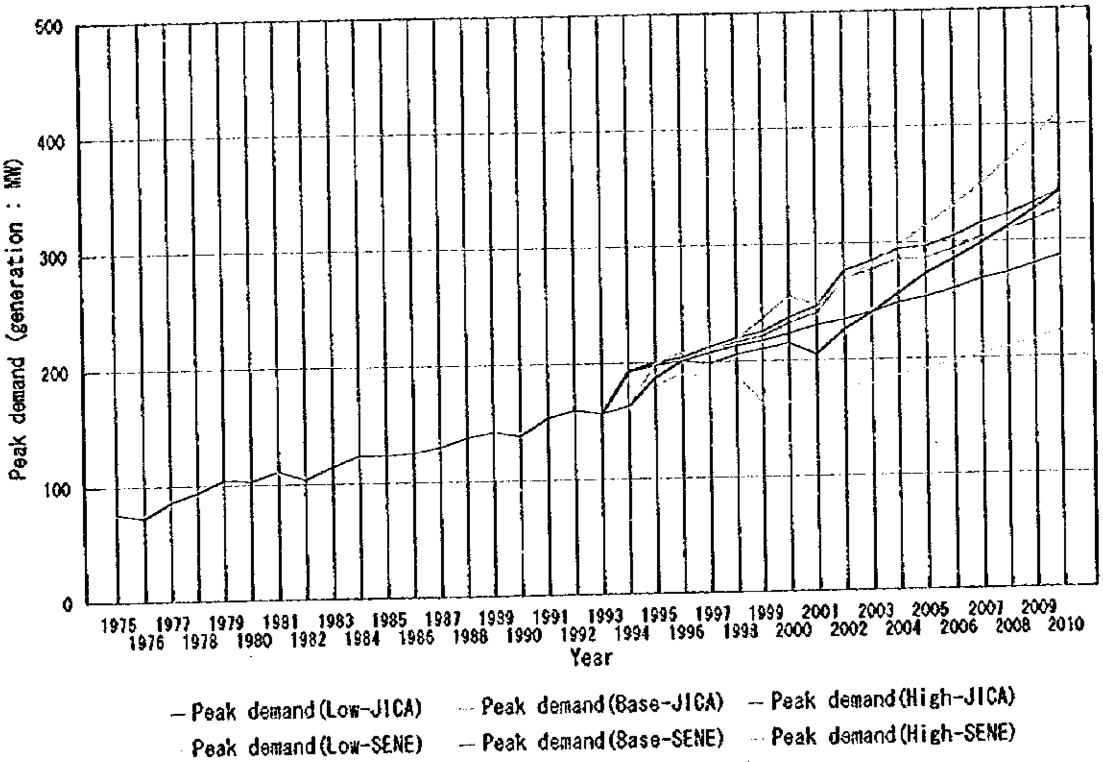


Graph 5.1.3 Forecast of Economic Growth

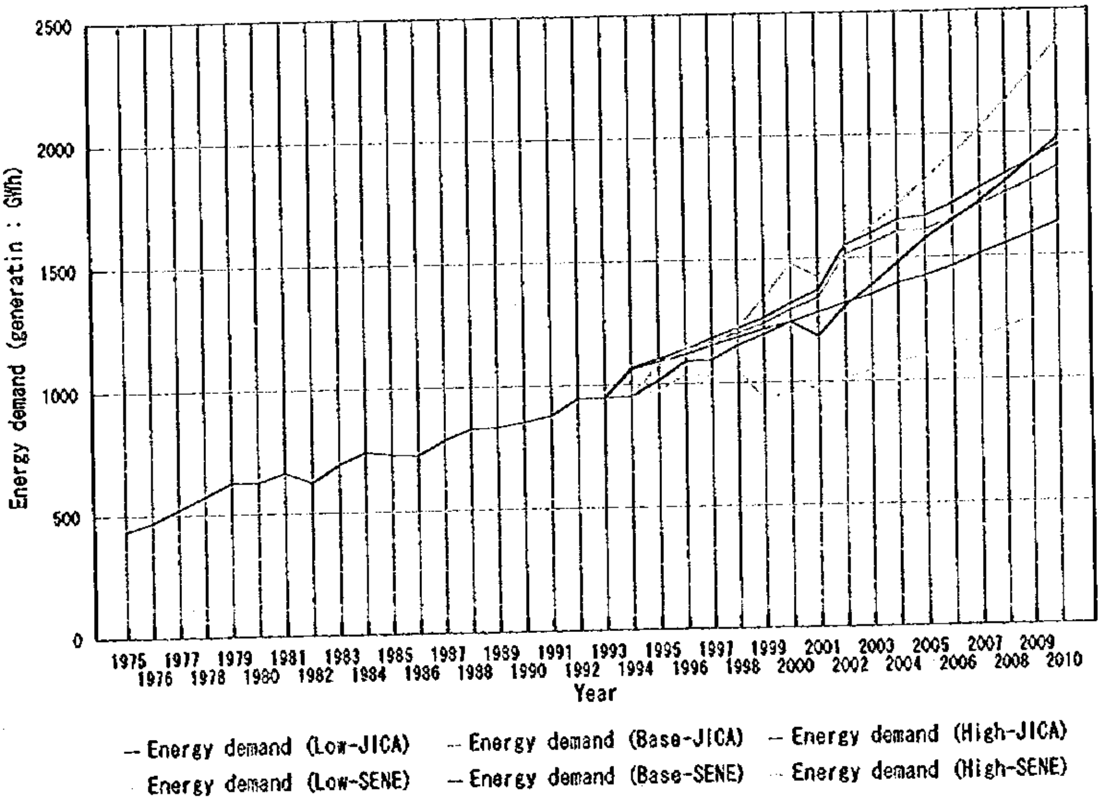


Graph 5.1.5 Load Forecast

Peak Demand



Energy Demand



CHAPTER 6

POWER DEVELOPMENT PLAN

CHAPTER 6 POWER DEVELOPMENT PLAN

6.1 Objective of the Power Development Plan

The purpose of the power development plan under this Project is to establish a development of electric power system for the electric power facilities which are in urgent need of extension. This will involve a general review of the existing master plan drawn up by SENELEC with a view to improving the electric power facilities for the Dakar area and its surrounds.

6.2 Review of SENELEC'S Medium- and Long-Term Power Development Plan

Under the terms of SENELEC's Medium- and Long-Term Power Development Plan (revised in September 1994), an analysis has been made to assess the appropriate power generating facility plan on both a medium- and long-term basis. The results are presented under the following main headings: History of the Power Supply System in Senegal; Current Status of Power Facilities; Power Facilities Capable of Being Reviewed; Demand Forecasts (review attempted at the time of the January 1995 study), Appropriate Facilities; Final Decision on the Plan; Conclusions and Recommendations.

The conclusions reached in connection with the medium- and long-term power generating facilities plan for the RI system can be summed up as follows.

The appropriate facilities plan is capable of being executed in the period from 1991 - 2005 and of fully meeting the targeted improvement in the power supply conditions as follows.

- Effective power generating system
- Quality of service (reduction in breakdowns/service disruptions)

Based on a review of the development of power demand and in view of the prevailing economic conditions, the fundamental issue of the appropriate facilities plan is the installation of steam generating sets (steam engines) with a larger capacity than the existing ones.

Medium-Term Plan

- Startup of one 20 MW gas turbine in 1998

  The principal merit of this unit is its ability to meet, at low cost, the increases in power demand for the period preceding the putting into service of the first steam generating set (steam engine) and the commissioning of the Manantali hydroelectric power station due for the year 2000.

- Startup in 2001 at the latest and putting into operation of a 90 MW steam generating set (Steam Engine)

  The advantage of such large-capacity plant is that the total investment costs required for the installation of all equipment required from the coming 15 years will be very much lower that the equivalent costs for a diesel plant during the same period.

The advantages of the use of a steam generating set (steam engine) will be considerable in a development approach that does not allow for hydroelectric generation or in the event that the Manantali hydroelectric power station should be put into operation at least two years behind schedule (that is, in 2002 instead of the scheduled commissioning year 2000). Under the prevailing economic conditions, the most favorable fuel for the steam generating set is and will remain heavy fuel oil.

The detailed master plan for the steam power plant in the Dakar area will need to be drawn up initially in 1995. At the same time, it will also be necessary to study the selection of the site by taking into account the need for purchasing coal.

Equipment and infrastructure for which coal will be used should be installed only if petroleum product prices should soar.

Long-Term Plan

Work on the development of a 90 MW steam generating set should be continued.

A maximum of two diesel generating sets would be economically advantageous in 2005 if petroleum prices should fall to a level short of 20 US$ per barrel.

6.3 Short-Term Power Development Plan

The short-term power development plan covers the calculation period from 1995 to 1995 (one year before 2000, year in which the Manantali hydroelectric power station is scheduled to come onto the grid) and is studied on the basis of the following considerations.

6.3.1 Power Supply and Demand Balance

The critical factors for the establishment of plans to assure the power supply and demand balance include the availability of reserve capacity, the selection of unit capacity of generators, and the use of spinning reserve capacity. These factors need to be taken into account as follows.

(1) Reserve Capacity

To draw up a supply and demand balance and to assure this balance, it will be necessary to allow for the appropriate reserve capacity needed to ensure the stability of power supply. There are various ways of thinking about how the level of reserve capacity should be determined. In the case of SENELEC's power system, however, it will be necessary to determine the reserve capacity by taking into account the following conditions.

a. Decrease in output from the system as whole due to regular inspection and maintenance

b. Decrease in output due to faults and breakdowns

In view of the above two conditions, the following method is generally used in deciding the reserve capacity.

Reserve capacity should be

- equivalent to the total output of the largest and second largest generator

- a constant output proportional to the peak load (generally 15% - 20%)
- whichever is the larger output from among the two outputs above.

The SENELEC power system is fed from thermal power generating facilities to meet the entire power supply.

This total dependence on thermal power will persist until the year 2000 when the Manantali hydroelectric power station, a joint tripartite development by Mali, Mauritania and the Senegal, is due to be put into operation. For a variety of factors, including in particular, the postponement of the power plant development projects with the capacity of around 60 MW, the continuous deferment of regular maintenance with consequential supply restrictions, the accelerated rate of equipment aging due to overload operation, and the difficulty of balancing out the peak and off-peak load, it is the view that a reserve capacity in the order of 10% is required to maintain the power supply system at a normal level of operation. Yet, this will remain an impracticable proposition for as long as the supply restrictions currently resorted to cannot be eased or eliminated altogether.

For this Project it will be necessary to confirm whether the reserve power capacity considered necessary in accordance with the criteria below:

- Power output equivalent to the total generator output of the largest and second largest generator

- Constant power output proportional to the system's peak load.

(2) Selection of Unit Capacity of Generators and Harmonization of the Power System (System Stability)

Excess output from a single generator in the planned power station has the problem that when the power system is a small-scale one, any drops or surges in frequency due to disconnection from the system can seriously affect the stability of the system.

SENELEC's service policy in connection with frequency drops has been fixed on the following principles, although these frequencies are subject to re-examination in connection with supply restrictions.

- Desired frequency for normal operation : 50±1 Hz
- Frequency after load shedding of first stage : 48.5 Hz
- Frequency after load shedding of second stage: 48.0 Hz
- Frequency after load shedding of third stage : 47.5 Hz
- System separation frequency : 47.0 Hz

The SENELEC power system which consists primarily of thermal power generating facilities is particularly vulnerable to rotor blades of turbine and drops in output of the ancillary equipment. The limiting frequency at which continuous operation can be maintained is 48.5 - 49.0 Hz. If frequency drops should occur exceeding 48.5 Hz for short intervals immediate measures (system separation or load shedding) must be taken to restore the frequency so that frequency drops to 47.5 Hz are permissible. In such cases, the system is disconnected to be operated separately with the result that the frequency and voltage will be unstable and dramatic load variations will occur. This therefore required careful observation.

In the present Project, the following will need to be confirmed in case of unit capacity of generator in the planned power station. This will necessary in order to achieve system stability in connection with frequency drops in the system.

- Check that the frequency drops during the operation of the generator concerned are within the permissible range (47.5 Hz) during peak load operation and at the system separation.

- During off-peak operation, check that the generator concerned has been operational at 60% of the rated capacity and that the frequency drop is within the maximum permissible range.

- State and make known the operational measures taken when frequency drops occur (operation at partial load, localized load shedding by operation of frequency relays).

Another item requiring confirmation in the case of the system operated by SENELEC is the actual occurrence of incidents associated with frequency drop due to system separation on one side of the system and frequency increase on the other side of the system as is the case in sudden violent frequency changes due to faults. This problem is covered by the analysis given in section 3.5.2 "Control Facilities" which section deals with the system frequency. In such incidents, the side subject to frequency drops is capable of responding by load shedding. On the side at which the frequency is increased, however, the measures to be taken may be the forced connection of a dummy load to decrease the frequency or disconnection of the generator, or, as a further, somewhat more time-consuming alternative, a winding down of power generation. For both systems, the frequency must be kept up to the range at which parallel operation of the systems is possible. For this reason, the following check item needs to be added.

- Indicating operational measures applicable in case of frequency increase.

(3) Spinning Reserve Capacity

For the spinning reserve capacity, the principles stated in the para. 3) in section 4.3.8 are applicable. As the system will increase further in the future, it is possible to anticipate significant load changes. For this reason, a values of 0.4 should be used for the proportional coefficient for the standard deviation of the amount of load variations.

6.3.2 Short-Term Power Development Plan

The short-term power development plan is as follows.

(1) SENELEC's Plan for Power Generating Facilities

In the plan for power generating facilities, the following generating facilities is being or is due to be added to SENELEC's power system:
1995: New installation of the TAG3 20 MW gas turbine at Cap des Biches
1997: New installation of the EXT-CIV 18 MW diesel unit at Cap des Biches

1999: Scheduled new installation of an EXT-CIV 18 MW diesel unit at Cap des Biches

The gas turbine scheduled the installation in 1995 had already completed the trial runs at the time of the field survey. The plan for the diesel unit to be installed in 1997 is making progress and is due to come on-stream in 1997. The diesel unit scheduled for 1999 has been proposed as part of the medium- and long-term plan.

(2) Items to be Considered on the Power Supply and Demand Balance

The following considerations should made in preparing the power supply and demand balance.

1) Reserve capacity

The principles concerning reserve capacity are as presented in section 6.3.1 (1) above.

2) Spinning reserve capacity

The principles concerning spinning reserve capacity are as presented in section 6.3.1 (3) above.

3) Requirements in connection with peak load measures

As can be concluded from Section 4.4 "Supply Restrictions", the generating facilities required on a most urgent basis to assure load dispatching is the capacity needed for absorbing the severe load variations occurring throughout the year in connection with the dramatic rises and falls in peak load. This generating capacity must also provide a relatively large power (kilowatt-hour) output for the many years to come until the bottleneck of the current supply restrictions can be eased. At present, this capacity comes from the gas turbine generating facilities.

In the off-peak time band, the time slot in which the load falls to its lowest level corresponds, in the case of the SENELEC's RI system, to the night-time from 2 - 3 a.m. During this time slot, there are comparatively abrupt rises and falls of the load and adjustment are being made using the gas turbine and the diesel unit with its favorable response speed. Recently, the G401 and G402 have been used for this purpose at Cap des Biches. However, the records show that these G401 and G402 units have been operated at less than 40% of their minimum permissible output. Operating conditions of this type are liable to accelerate equipment aging and to shorten equipment life to a considerable extent. It is clear therefore that the generating facilities with the greatest response in adjusting the load variations is the new gas turbine which affords the greatest ease to respond both to load decreases and load increases.

4) Assuring regular maintenance on a scheduled basis

Most of the major equipment of the existing power generating facilities are not stopped for maintenance as required. They are kept in operation to extend the time between consecutive routine maintenance and full-scale overhauls. Every effort should be made, however, to regularize maintenance as much as possible and it will be of vital importance to establish proper discipline in assuring regular maintenance on a scheduled basis. As can be seen from the operational records for 1993, the capacity utilization ratio for the G301, G302 and G303 steam turbines, the major units at Cap des Biches to feed the RI system, stood at 85.6% (for 7,497 hours), 90.8% (for 7,954 hours) and 82.6% (for 7,237 hours) so that capacity utilization ratio have to be throttled. If we assume that the capacity utilization ratio thus dropped to about 75%, it follows that other generating capacity is required to make up for the decreased portion of energy generated (approx. 60 GWh) of these three steam turbine (G301, G302 and G303).

As stated in section 4.1.2, the output restoration plan allowed for in SENELEC's annual shutdown schedule is as follows.

Bel-Air Power Station

Power generating facilities	Rated output (kW)	1993 output (MW)	Output after restoration (MW)
G101	12,800 kW	5,000	10,000 (1995 and thereafter)
G102	12,800 kW	9,000	10,000 (1995 and thereafter)
G103	12,800 kW	11,000	10,000 (1995 and thereafter)
G104	12,800 kW	5,000	10,000 (1995 and thereafter)

Cap des Biches Power Station

Power generating facilities	Rated output (kW)	1993 output (MW)	Output after restoration (MW)
G301	27,500 kW	27,500	27,500 (status quo)
G302	30,000 kW	20,000	30,000 (1995)
G303	30,000 kW	15,000	30,000 (1996 and thereafter)

5) Early interconnection of the Kaolack system to the grid

The Kaolack system is scheduled to interconnect with the grid in 1997, and it is recommended that this time should be brought forward as much as possible.

6) Connection of the manantali hydroelectric power station to the grid

The international connection of the Manantali hydroelectric power station will provide substantial advantages to the load dispatching.

For the unification of the Senegalese power grid, the addition of the Manantali station would mark the establishment of a "combination" of hydro and thermal power. It will therefore be necessary to take the necessary steps to resolve as early as possible the technical problems associated with the connection of the SENELEC's power system to the international tripartite grid. To permit international grid-sharing, it is vital that the national grid system should be brought under sound control in an effort to coordinate operation with the grid management of the partner countries sharing the gird. This requires, in particular, that the system frequency should be maintained in sound order.

7) Service life and allowable operating time

The facilities still kept in operation beyond their service life include the G101 and G102 at the Bel-Air Power Station. Both these units are still operational although their maximum permissible operating life has been exceeded. In the case of the G101 unit, the records show that it was put back into operation after a temporary shutdown. It is strongly recommended that the G101 should be scrapped at the earliest possible time. Similarly, at Cap des Biches, the TAG1 has already exceeded its service life and therefore needs to be included in the future plant scrapping schedules. The present Plan envisages the scrapping, at Bel-Air, of the G101 unit in 1997 and of the G102 unit in 2000.

(3) Decision on the Capacity of New Generating Facility and Selection of the Generating Facility Type

The plans for the new generating facilities have been decided upon as follows.

1) Time for connection in the system
The new generating facilities are scheduled to connect to the grid in 1997.

2) Decision on the capacity of generating facilities
The capacity of the new facilities has been calculated as follows. These calculations have been made on the premise that the problem of overcoming the shortage of power (kW) will

continue to have greater priority than electric energy (kWh) even after the commissioning of the TAG3 (20,000 kW) gas turbine at Cap des Biches in 1995.

Required capacity of generating facility = Actual limit capacity of the RGI system, excluding the Kaolack system - Peak load generating capacity - (Capacity of maximum output unit + capacity of second largest output unit) = 272,000 - 209,000 - 60,000 = 2,100 kW.

On this basis, the choice will be either two 5,000 kW units or one 10,000 kW unit, with the above being the standard capacity per unit.

3) Selection of the generating facility type

Given the unit class ratings of the previous section, the type of generating facility selected will be either a diesel generator or a gas turbine system. Since the new generating facility planned for 1995 is a gas turbine and the output level is in the scale of 20 MW, the selection will fall on a diesel generator system. The diesel generating unit will take over the base load so that it should be easy to carry out the required maintenance and inspection procedures in an effort to reduce the operating time of the G301 - G303 units at Cap des Biches.

(4) Power Supply and Demand Balance

Table 6.3.2-1 - 2 give the power supply and demand balances for the case that the time from 1994 until 1999 (the year before the Manantali hydroelectric power station is due to be connected to the grid) is taken as the short-term power development plan period. Table 6.3.2-3 assumes the average output on the basis of the actual operational records of each unit by allowing for an annual operational availability of 70% (6,132 hours), 75% (6,570 hours), and 80% (7,008 hours) in order to achieve the appropriate maintenance schedules and determines the energy generated in a year and calculates the difference against the power requirement determined from the demand forecast. Graph 6.3.2