Description	Energy (GWh)	Ratio (%)
• Sold energy		
Residential	1,708	24.0
Industrial	3,454	48.6
Commercial	723	10.2
Rural	670	9.4
Public & Others	556	7.8
Sub-total	7,111	100
• Bulk supply to local distribution companies	123	
• Losses and difference	565	
• Total energy required :	7,798	
- own generation by CELESC	(376)	
- received from ELETROSUL and others	(7,422)	
• Annual peak demand	1,358 MWh/h	
• Average load factor	65.6%	

In the recent 10 years, the number of consumers in the system has rapidly increased especially in residential and industrial sectors; to 1.8 times and 2.8 times, respectively. Sectoral share of energy consumption increased in the residential sector from 19% level to 23% level for the 10 years. The share of the industrial sector, however, dropped from 55% level to 50% level due to faster growth of the other sectors.

4.2 Load Curve

Taking into account a development scale of the Salto Pilão Project anticipated to the 100 to 150MW, load curves of two power networks are discussed herein.One is the whole CELESC network currently having 1,300 MW load scale and another is a CELESC's sub-network for the Itajaí river basin which has 300 MW load scale. The Itajaí sub-network covers cities of Blumenau, Rio do Sul and Itajaí and their surroundings.

Hourly power demands in various days in the CELESC network and the Itajaí sub-network are shown in Table V.4.3 for which a weekday and a weekend day in each of four seasons in 1992 are picked up as typical days. Those demands are illustrated in Figs. V.4.1. to V.4.3 as daily load curves and daily load duration curves.

Monthly peak power demands for the recent 10 years in the CELESC system are shown in Table V.4.4 and illustrated in Fig. V.4.3. Yearly growth of the monthly peak demands for recent 13 years and variation of annual average load factors for the recent 22 years is illustrated in Fig. V.4.4.

From these records, the followings are made clear;

(1) There are two load-peaks every day; high peak in night time and low peak in day time. Ratios between high and low peaks are 1.05 to 1.35 on weekdays

(2) Daily load factors varies between 0.65 and 0.81 in the CELESC network and between 0.65 and 0.89 in the Itajaí sub-network. Usual load factor on weekdays is 0.71 to 0.84 but the load factors in Sunday become rather low as 0.64 to 0.67.

(3) In the recent 10 years, monthly peak demand gradually increased on linear tendency. Annual peak appeared almost in 3 months from May to July, though difference between loads of peak and off-peak months was relatively small. The annual load factor was improved and raised from a 55% level in early 1970s to a 65% level in early 1990s while decrease was observed 3 times; 1973, 1981 - 83 and 1989 - 91 due to economic recession.

4.3 Trend of Power Market Growth in CELESC System

Historical records of energy consumption by various sectors in the CELESC system for the recent 10 years from 1983 to 1992 are shown in Table V.4.2 and illustrated in Fig.V.4.8 Annual rates of consumption growth computed from the records are as follows:

Growth Rates in %

(Unit : %)

Year	Residential	Industrial	Commer-cial	Rural	Public & others	Overall
1983	18.8	8.0	14.2	11.8	16.4	11.6
1984	7.2	15.8	4.8	13.1	6.4	12.0
1985	8.1	13.8	2.2	15.7	9.0	11.4
1986	7.8	3.8	-1.5	11.2	-3.9	4.1
1987	15.9	5.6	15.2	12.6	15.8	9.7
1988	7.5	5.4	3.4	4.0	8.4	5.7
1989	11.7	6.9	6.8	6.9	1.8	7.5
1990	13.0	-5.0	7.6	0.3	6.5	1.1
1991	9.7	3.1	7.5	8.9	9.5	6.1
1992	3.8	0.6	5.4	4.9	7.1	2.7
Average Rate	10.3	5.6	6.4	8.8	7.6	7.1

As seen in this table, overall energy demand has steadily grown in the recent 10 years, and average annual growth rate was 7.1%. In 1990, the demand growth has slightly retarded mainly due to recession of the industrial sector. Average rate of demand growth in the industrial sector was rather low but this sector still consumes approximately a half of total energy of the CELESC system. Residential and rural sectors have grown at relatively high rates in energy consumption.

Meanwhile, in the period of 6 years from 1986 to 1991, growth rate of overall demand in the CELESC system was 5.6% on an annual average while the gross regional domestic product (GRDP) of the state of Santa Catarina was as low as 2.2% according to the economic statistics given in Table IV.4.2 of Annex IV. The power market of CELESC has expanded at much higher rate than that of GRDP mainly due to steady increase of economic activities and rapid rise of living standard in the state.

The following table shows coefficients of correlations between the annual sectoral energy consumptions and the GRDP of the state for the period from 1985 to 1991 and between both consumptions by the residential sector and the other sectors;

	Correlation Coefficient Between	
Sectors	GRDP and Each Sector	Residential and Other Sector
Residential	0.927	-
Industrial	0.941	0.928
Commercial	0.916	0.996
Rural	0.962	0.969
Public & Others	0.927	0.988
Overall	0.958	0.980

These correlation coefficients are all close to 1. Thus, the energy consumption growth of each sector is correlated well to GRDP's growth and the residential sector's consumption growth represents the other sectors' growth.

4.4 Electric Tariffs

Tariff rates of electric power and energy are subject to approval of DNAEE. Change of the tariff rates are proposed by either federal or state power enterprises (concessionaires) to DNAEE. Approved tariff rates are applied to power supply to consumers and to power trading between the concessionaires. When the tariff rates have been changed, it is immediately published on the official gazetteers. In order to cope with continuous price escalation in Brazil, the tariff rates are raised every month. In this report, the tariff rates decided on March 11, 1993 are considered. The tariffs expressed in Cr$ are converted to US$ at the rate of Cr$ 20,062 to US$ 1 on March 1, 1993.

The current CELESC's tariff rates without including taxes are as follows:

(1) Tariffs for consumers

Large consumers (500kW load or more)

The tariff rates are different between peak and off-peak hours and also between dry and wet seasons as shown below. The peak hour is from 17:00 to 20:00 and the dry season is from May to November.

				Peak Time		Off-peak time	
Class	Voltage(kV)		Season:	Dry	Wet	Dry	Wet
A2	88 to 138	Power		4.35	4.35	1.00	1.00
		Energy		24.43	22.79	17.50	16.06
Ac	69	Power		5.84	5.84	1.60	1.60
		Energy		27.68	24.54	17.50	16.06
A3a	30 to 44	Power		6.82	6.82	2.28	2.28
		Energy		44.76	41.43	21.29	18.82
A3	2.3 to 25	Power		7.07	7.07	2.36	2.36
		Energy		46.61	42.96	22.06	19.50

Note: Power : contract capacity (US$/kW)
Energy : consumption (US$/MWh)

Small Consumer

Constant price is applied to throughout all seasons. Tariff rates excluding tax are as follows:

			Tariff : US$/MWh
B1	Residential :	E < 30	16.58
		30 ≤ E < 100	39.50
		100 ≤ E < 200	67.03
		E > 200	87.69
B2	Rural		45.91
B3	Other		73.24
B4	Public Illumination		50.94

Note : E is consumption in KWh

(2) Tariffs for concessionaires

Tariffs rate for power trading between the regional and state power enterprises (concessionaires) is derived from system expansion marginal cost. It is composed of the following three different classes in terms of steadiness of energy consumption.

Class	Applied to:
T1	Long term contracted power (P1) and energy (E1)
T2	Short term contracted power (P2) and energy (E2) exceeding P1 and/or E1
T3	Actually consumed power (P3) and energy (E3) exceeding (P1 + P2) and/or (E1 + E2)

P1 and E1 are computed every year by the Electric System Planning Coordination Group (GCPS). P2 and E2 are decided based on short term operation plan of the state power enterprises.

Breakdown of the tariffs for T1, T2 and T3 to be applied to CELESC for purchasing energy from ELETROSUL are as follows:

		Tariff Class		
		T1	T2	T3
Energy	(US$/MWh)	19.33	5.46	2.22
Power, Peak	(US$/kW)	1.36	1.36	1.36
Off-peak	(US$/kW)	1.35	1.35	1.35

In the present contract, as the peak and off-peak classification have been deleted, only the peak power tariffs shown above are applied for all electric power.

(3) Tariffs for electricity from Itaipu Binational

CELESC receives electric power from the Itaipu Binational via ELETROSUL's transmission system under the contract between them. The contracted power demand is 422 MW as of March 1993. Tariff rate for electricity from the Itaipu to CELESC is composed of the following two costs;

- Generation cost to be paid to the Itaipu : 17.017 US$/MWh

- Transmission cost to be paid to ELETROSUL : 2.688 US$/MWh

5 POWER DEMAND FORECAST

5.1 Demand Forecast for Regional Power System

The latest official forecast of nation-wide and regional power demand is given in the 10-Year Expansion Plan (1992/2003) prepared by GCPS and approved by DNAEE in 1992. The Plan is based on the ELETROBRAS's National Electric Energy Plan - 1987/2010 (Plano 2010).

On the basis of state-wide demand projections indicated in the 10-Year Plan, annual energy demands for each of the four regional power systems and annual peak demands for the south/southeast systems are computed as shown in Tables V.5.1 and V.5.2, respectively. The projected demands for 1992, 1995, 2000 and 2003 are summarized as below:

Power System	1992		1995		2000		2003
Energy (GWh)							
North	18,256		20,966		29,685		37,282
Northeast	27,767		32,734		44,271		52,715
Southeast	137,200		155,961		195,317		223,725
South	32,684		38,338		49,778		57,901
Whole of Brazil	215,907		247,999		319,051		371,623
		(4.5)		(5.3)		(5.2)	
Peak Power (MW)							
Southeast	26,268		30,083		38,369		42,134 *
South	6,655		7,666		9,525		10,406 *
Total	32,923		37,749		47,894		52,540 *
		(4.8)		(4.9)		(4.7)	

* : Peak power in 2002

( ) : Annual growth rate in %

5.2 Demand Forecast for CELESC System

Power demand projection for the CELESC system is made by CELESC and revised every year analyzing past trends of energy consumption and forecast of future economic activities in the state of Santa Catarina. The CELESC's latest demand forecast for the period up to 2003 for each consumer sector is shown in Table V.5.3 and summarized as follows;

	Sectors	1992	1995	2000	2003
Energy (GWh)					
	Consumption	7,111	8,226	10,578	12,207
	Bulk supply	123	137	168	189
	Losses, others	564	625	803	926
	Total required	7,798	8,988	11,549	13,322
			(4.8)	(5.1)	(4.9)
Peak Load (MW)		1,358	1,569	1,957	2,215
			(4.9)	(4.5)	(4.2)

( ) : Annual growth rate in %

This CELESC's forecast was made based on ELETROBRAS's method, which is applied to all the power companies in Brazil in order to coincide nation-wide power demand forecasting.

The forecast was reviewed in this study with an economic parameter method in which the power consumption is devided into several categories or sectors, i.e. residential, industrial, commercial, rural, public and other, bulk supply, loss and difference. Growth of the power demand could be correlated to the growth of GRDP as proved in the previous Sectors 4.3. Referring to the past records of energy consumption and future socio-economic forecast, the parameter for each sector to assess the power demand was estimated as follows;

-Annual growth rate of energy consumption (1992-2003)

Residential	7.0 - 5.0%
Industrial	5.0 - 5.0%
Commercial	5.5 - 4.5%
Rural	5.5 - 4.5%
Public and Others	5.5 - 3.5%

-Ratio to total consumption

Bulk supply	1.6%
Loss and difference	7.5%

The above estimation was based on the following asumptions;

1) As a world-wide economic activities is retarded recently and Santa Catarina State is fairly developed area, annual growth rate of each sector will rather decrease slightly in the coming 10 years than the past.

2) Annual growth rates of population in Santa Catarina from 1992 to 2003 are 1.6 - 1.3%.

3) Though the growth rate of industrial sector is much affected by world and domestic economies, it will keep the same rate as past average.

4) As the rate of urbanization will increase from 74.2% to 80.1% in the coming 10 years, share of rural sector will decrease.

5) Ratio of bulk supply and loss to total consumption will not change from the past average, i.e. 1.6% and 7.5% respectively.

The demand forecast calculated applying the above parameters is shown in Table V.5.4. Future energy demands obtained by this independent forecast approximately coincide with those of the said CELESC's forecast. It his therefore concluded that the forecast by CELESC is reasonable.

6. POWER BALANCE

6.1 Power Expansion Program

In compliance with the demand forecast set out in the previous Section 5, ELETROBRAS prepared the National Generation Expansion Program for 1993/2002 and it was revised by GCPS in 1992.

Future expansion of nation-wide energy production projected in the program is summarized in Table V.6.1. Peak power generation expansion projected for the south/southeast systems is also summarized in Table V.6.2. Both energy and peak power expansions in the integrated south/southeast system as well as the south system itself are also illustrated in Figs. V.6.1 and V.6.2, respectively. List of future power plants which were taken up in the program for the south/southeast system is shown in Table V.6.3. Some out of those power plants would be located in the state of Santa Catarina as listed in Table V.6.4.

The projected chronological expansion of power generation in the south/southeast system and in the state is summarized as follows:

(1) Power expansion program in south/southeast system

Year	Installed Capacity Increment (MW)						Firm Energy Increment* (GWh/year)	
	Hydro		Thermal		Total			
Existing plants in 1992								
South/Southeast Sys.	41,416	(5,983)	3,115	(1,133)	44,531	(7,116)	150,001	(28,531)
Itaipu	12,600		-		12,600		50,519	
Ongoing & new plants								
1993	1,702	(630)	-	(-)	1,702	(630)	6,824	(2,526)
1994	2,314	(315)	350	(350)	2,664	(665)	10,681	(2,666)
1995	119	(-)	425	(425)	544	(425)	2,181	(1,704)
1996	861	(63)	375	(375)	1,236	(438)	4,956	(1,756)
1997	1,406	(63)	350	(-)	1,756	(63)	7,041	(253)
1998	3,286	(1,310)	350	(350)	3,636	(1,660)	14,577	(6,656)
1999	2,139	(1,310)	875	(50)	3,014	(1,360)	12,085	(5,453)
2000	1,808	(826)	400	(400)	2,208	(1,226)	8,853	(4,916)
2001	2,731	(962)	50	(50)	2,781	(1,012)	11,503	(4,058)
2002	4,696	(3,032)	175	(175)	4,871	(3,207)	19,530	(12,858)

Remark; ( ) : values of south system
* : calculated using the assumed capacity factor of 0.4577 which is 90% of capacity factor of south/southeast system in 1992

(2) Power expansion program in the state of Santa Catarina

Year	Installed capacity increment(MW)	
	CELESC	ELETROSUL
1992	3	-
1993	-	-
1994	-	350
1995	45	-
1996	-	-
1997	-	-
1998	-	810
1999	-	810
2000	-	440
2001	-	1,640
2002	-	992

6.2 Balance of Power

Future balance of power and energy in south/southeast system, which is expressed in difference between demand and supply is shown in Figs. V.6.1 and V.6.2, respectively. Supply capacities of both peak power and energy seem to have sufficient reserve against demands for the future 10 years if all the planned projects are implemented on schedule. Due to recent difficulties for obtaining construction fund and environmental clearance, many of the on-going power projects in the south/southeast system are delaying in their completion. Many of the other planned projects are also anticipated to be postponed due to the same reasons.

Even if the CELESC's present expansion plan is achieved on schedule and total of a 45 MW new plants is put into service by the end of 1995, share of the CELESC's own generation will still be as low as 7.8% of its total energy demand in that year. This CELESC's self supply ratio is very low compared with the present ratios of other state power utilities in the south system; 100 % of COPEL and 50 % of CEEE. CELESC is continuously vulnerable to power shortage because its own generation capacity is small and most of its required electricity has to be purchased from the other companies..

In order to minimize possible future power shortage of CELESC due to retardation of power projects planned by the federal utilities and to stabilize CELESC's power supply capability, furtherinput of CELESC's own generation plants is indispensable.

Table

Table V.3.1 Existing Power Stations in South/Southeast Power System (1992) (1/2)

Enterprise	Power Station	Type	Installed Capacity (MW)
<u>Southeast System</u>			
CERJ	S. Hydro Total	H	(66.4)
CEB	Paranoá	H	27.0
	Thermal	T	10.0
	Total		(37.0)
CELG	C. Dourada	H	448.0
	S. Hydro Total	H	16.7
	Thermal	T	3.4
	Total		(468.1)
ESCELSA	Mascarenhas	H	123.0
	S. Hydro Total	H	50.9
	Total		(173.9)
CEMAT	S. Hydro Total	H	21.5
	Thermal	T	3.8
	Total		(25.3)
CPFL	Public Producers	H	11.7
	Others	H	108.1
	Carioba	T	32.0
	Total		(151.8)
ELETRO-PAULO	H. Borden	H	880.0
	Public Produc.	H	9.0
	Rasgão	H	22.0
	Others	H	17.7
	Piratininga	T	470.0
	Total		(1,398.7)
CESP	Caconde	H	80.0
	Euclides Cunha	H	108.0
	A. S. Oliveira	H	32.0
	Água Vermelha	H	1,380.0
	Ilha Solteria	H	3,240.0
	Jupiá	H	1,414.0
	Barra Bonita	H	140.0
	A.S. Lima	H	144.0
	Ibitinga	H	132.0
	Promissão	H	264.0
	N. Avanhandava	H	303.0
	A. A. Laydner	H	98.0
	Xavantes	H	416.0
CESP	I. N. Garcez	H	72.0
CESP	Capivara	H	640.0
	Taquaruçu	H	101.0
	Rosana	H	160.0
	Paraibuna	H	86.0
	Jaguari	H	28.0
	S. Hydro	H	9.8
	S. Ther	H	5.1
	Total	-	(8,852.9)
LIGHT	Nilo Peçanha	H	380.0
	Fontes	H	132.0
	Pereira Passos	H	100.0
	Ilha Dos Pombos	H	156.0
	Total	-	(768.0)
CEMIG	Camargos	H	48.0
	Itutinga	H	54.0
	Jaguara	H	412.0
	Volta Grande	H	380.0
	Emborcação	H	1,192.0
	São Simao	H	1,680.0
	Três Marias	H	396.0
	Salto Grande	H	102.0
	S. Hydro Total	H	140.1
	Total of Hydro	-	(4,404.1)
	Igarapé	T	125.0
	Total	-	(125.0)
		-	(4,529.1)
FURNAS	Furnas	H	1,312.0
	M. De Moraes	H	478.0
	Estreito	H	1,104.0
	Porto Colúmbia	H	328.0
	Marimbondo	H	1,488.0
	Funil	H	222.0
	Itumbiara	H	2,280.0
	Total of Hydro	-	(7,212.0)
	Santa Cruz	T	608.0
	R. Silveira	T	32.0
	São Gonçalo	T	33.0
	Total of Thermal	T	(673.0)
	Angra	N	657.0
	Total	-	(8,542.0)

Source: F-08

Remakrs: H : Hydro / T : Thermal / N : Nuclear
S.Hydro Total : Total of small hydros

Table V.3.1 Existing Power Stations in South/Southeast Power System (1992) (2/2)

Enterprise	Power Station	Type	Installed Capacity (MW)
<u>South System</u>			
CEEE	Passo Real	H	140.0
	Jacuí	H	180.0
	Itaúba	H	500.0
	Bugres	H	11.5
	Canastra	H	44.0
	Others	H	20.3
	Total of Hydro	-	(895.8)
	P. Medici A	T	126.0
	P. Medici B	T	320.0
	San Jeronimo	T	17.0
	Nutepa	T	24.0
	Total of Thermal	-	(487.0)
	Total	-	(1,382.8)
COPEL	G. B. Munhoz	H	1,676.0
	Segredo	H	630.0
	G. P. Souza	H	252.0
	J. Mesquita F	H	50.0
	Guaricana	H	36.0
	Others	H	50.0
	Total of Hydro	H	(2,694.0)
	Figueira	T	20.0
	Total	-	(2,714.0)
ELETRO-SUL	Passo Fundo	H	220.0
	Salto Osório	H	1,050.0
	Salto Santiago	H	1,332.0

Source : F-08

Enterprise	Power Station	Type	Installed Capacity (MW)
ELETRO-SUL	Total of Hydro	H	(2,602.0)
	J. Lacerda A + B	T	482.0
	Charqueadas	T	72.0
	Alegrete	T	66.0
	Total of Thermal	T	(620.0)
	Total	-	(3,222.0)
CELESC	S. Hydro Total	H	(74.9)
ENERSUL	S. Hydro	H	31.2
	Thermal	T	6.0
	Total	-	(37.2)
<u>SUMMATION</u>			
Southeast System		H	23,039.0
		T	1,317.2
		N	657.0
		Total	(25,013.2)
South System		H	6,297.9
		T	1,133.0
		Total	(7,430.9)
Itaipu-Binational	50 Hz		6,300.0
	60 Hz		6,300.0
		Total	(12,600.0)
Total --Integrated System			45,044.1

Table V.3.2. Existing Power Stations in Santa Catarina (1992)

(1) Owned by CELESC

	Name of Station	Type	Installed Capacity (MW)	Firm Capacity (MW)	Firm Energy (MWh/year)	Commission Date
1.	Palmeiras	Hydro	17.4	9.0	80,000	1964
2.	Garcia	Hydro	8.6	7.1	62,000	1963
3.	Cedros	Hydro	7.4	7.1	62,000	1949
4.	Salto	Hydro	6.3	4.0	35,000	1914
5.	Brachinho	Hydro	16.5	8.0	70,000	1931
6.	Celso Ramos	Hydro	4.6	3.8	33,000	1963
7.	Caveiras	Hydro	3.5	2.5	22,000	1920
8.	Ivo Silveira	Hydro	2.4	2.0	17,500	1967
9.	Pery	Hydro	4.4	4.0	35,000	1965/92 *
10.	Piraí	Hydro	0.75	0.4	3,500	1908
11.	Rio do Peixe	Hydro	0.60	0.5	3,500	1956
12.	São Lourenço	Hydro	0.42	0.18	1,600	1914
	Total		72.87	48.58	425,100	

Source : F-03 and CELESC's data in Mar. 1993
* Up-rated in 1992

(2) Owned by ELETROSUL

Name of Station	Type	Installed Capacity (MW)	Firm Capacity (MW)	Firm Energy (GWh/year)	Commission Date
Jorge Lacerda II	Thermal	100			Mar/1964
Jorge Lacerda III	Thermal	132	385 *	3,300 *	June/1963
Jorge Lacerda III	Thermal	250			Nov/1949
Total		482	385	3,300	

* : Total of three stations

Table V.3.3 Existing Substations in CELESC System (1/3)

Name	Trans. Nr.	Capacity (MVA)	Voltage (kV/kV)
Coqueiros	1	25.0	69 / 13.8
	2	25.0	69 / 13.8
	3	12.5	69 / 13.8
Ilha Norte	1	16.6	138 / 13.8
Rocado	4	26.6	138 / 13.8
	5	26.6	138 / 13.8
	6	9.4	69 / 13.8
Tijucas	1	26.6	138 / 23
	2	26.6	138 / 23
Trindade	1	26.6	138 / 13.8
	2	26.6	138 / 13.8
Canoinhas	1	26.6	138 / 13.8
	2	16.6	138 / 13.8
Jaraguá do Sul	2	25.0	69 / 13.8
	3	15.6	69 / 13.8
	4	26.6	69 / 34.5
			138 / 13.8
Joinville I	1	12.0	69 / 34.5
	2	10.0	69 / 13.8
Joinville III	1	26.6	69 / 13.8
	2	15.6	69 / 13.8
	3	26.6	69 / 13.8
Joinville IV	1	66.6	138 / 69 ~ 13.8
	2	66.6	138 / 69 ~ 13.8
	3	66.6	138 / 69 ~ 13.8
Joinville V	1	7.5	69 / 13.8
	2	9.4	69 / 13.8
	3	9.4	69 / 13.8
	4	7.5	69 / 13.8
Mafra	1	12.5	138 / 69
	2	16.6	69 / 13.8
	3	16.6	69 / 13.8
	4	12.5	138 / 69
	5	7.5	69 / 34.5
Rio Negrinho	1	16.6	138 / 13.8
São Bento do Sul	1	16.6	138 / 13.8
	2	26.6	138 / 13.8
São Francisco do Sul	1	15.6	69 / 13.8
	2	10.0	69 / 13.8

Source : F-019

Name	Trans. Nr.	Capacity (MVA)	Voltage (kV/kV)
Blumenau Garcia	1	33.3	138 / 69
	2	33.3	138 / 69
	3	33.3	138 / 69
	4	15.6	69 / 23
	5	26.6	69 / 23
	6	16.6	69 / 23
	7	7.5	69 / 23
Blumenau II	1	26.6	138 / 69
	2	26.6	138 / 69
	4	66.6	138 / 69
	5	66.6	138 / 69
	7	9.3	69 / 13.8
Brusque	1	16.6	69 / 23
	2	26.6	138 / 23
	3	26.6	138 / 23
Camboriú	1	16.6	69 / 13.8
	2	10.0	69 / 13.8
	3	10.0	69 / 13.8
	7	10.0	69 / 13.8
	8	9.4	69 / 13.8
Ibirama	1	15.0	69 / 23
	2	7.5	69 / 23
Itajaí Salseiros	1	16.6	69 / 23
	2	16.6	69 / 23
	3	16.6	69 / 23
Picarras	1	16.6	69 / 13.8
	2	10.0	
Rio do Sul	1	10.0	69 / 23
	2	9.4	69 / 23
Rio do Sul II	1	33.3	138 / 69
	2	33.3	138 / 69
	3	26.6	138 / 23
Salto	1	13.2	69 / 13.8
	2	16.0	69 / 13.8
	3	20.0	69 / 13.8
Timbó	3	9.4	69 / 23
	4	26.6	69 / 23
	5	9.4	69 / 23
Otacílio Costa	1	33.3	138 / 69
	2	3.1	69 / 23
	4	33.3	138 / 69

Table V.3.3 Existing Substations in CELESC System (2/3)

Name	Trans. Nr.	Capacity (MVA)	Voltage (kV/kV)
Ponte Alta	1	3.1	69 / 23
São Cristóvão	2	16.6	69 / 23
São Joaquim	1	9.4	138/ 23
Vidal Ramos Jr.	1	33.3	138 / 69
	2	26.6	138 / 23
	3	26.6	138 / 23
Caçador	1	16.6	138 / 23
	2	16.6	138 / 23
Capinzal	1	9.3	69 / 23
	2	6.3	69 / 23
	3	7.5	69 / 23
Campos Novos	1	16.6	138 / 23
Fraiburgo	1	10.0	69 / 23
	2	10.0	69 / 23
Herval D'Oeste	2	33.3	138 / 69
	3	12.5	138 / 69
	5	16.6	69 / 23
	6	16.6	69 / 23
Videira	1	26.6	138 / 23
	2	26.6	138 / 23
	3	15.6	138 / 69
	4	15.6	138 / 69
Arabuta	1	3.1	69 / 23
	2	3.1	69 / 23
Chapecó	1	16.6	69 / 23
	3	26.6	69 / 23
Concórdia	1	10.0	69 / 23
	2	16.6	69 / 23
Faxinal dos Guedes	1	3.1	69 / 23
	2	10.0	69 / 23
Itapiranga	1	7.5	69 / 23
	2	7.5	69 / 23
Pinhalzinho	2	16.6	69 / 23
	3	26.6	138 / 23
São Miguel D'Oeste	1	15.0	69 / 23

Source : F-19

Name	Trans. Nr.	Capacity (MVA)	Voltage (kV/kV)
São Miguel D'Oeste	2	10.	69 / 23
São Miguel D'Oeste II	1	33.3	138 / 69
	3	26.6	138 / 23
Seara	1	9.3	69 / 23
	2	9.3	69 / 23
Xanxerê	1	33.3	138 / 69
	2	33.3	138 / 69
	3	10.0	69 / 23
	4	26.6	138 / 23
	5	66.6	138 / 69
Araranguá	1	16.6	69 / 13.8
Braço do Norte	1	15.0	69 / 13.8
Criciúma	1	26.6	69 / 13.8
	2	26.6	69 / 13.8
Ermo	1	10.0	69 / 13.8
Forquilhinha	1	12.5	69 / 13.8
	2	12.5	69 / 13.8
Gravatal	1	6.3	69 / 13.8
Içara	1	16.6	69 / 13.8
	2	6.2	138 / 44
	3	10.0	69 / 13.8
Imbituba	3	16.6	138 / 13.8
	4	16.6	138 / 13.8
Jaguaruna	1	6.3	69 / 13.8
	2	6.3	69 / 13.8
Lauro Muller	1	10.0	69 / 13.8
Maracajá	1	6.3	69 / 13.8
Siderópolis	1	6.3	69 / 13.8
	2	6.3	69 / 13.8
Sombrio	1	6.3	69 / 13.8
Tubarão	1	26.6	69 / 13.8
	2	26.6	69 / 13.8
	3	5.0	138 / 44
Tubarão II	1	16.6	69 / 13.8

Table V.3.3 Existing Substations in CELESC System (3/3)

Name	Trans. Nr.	Capacity (MVA)	Voltage (kV/kV)
Urussanga	1	10.0	69 / 13.8
	2	10.0	69 / 13.8
	3	6.3	69 / 13.8
Azambuja	1	6.3	44 / 13.8
Esperança	1	6.3	44 / 13.8
	2	6.3	44 / 13.8
Laguna	1	16.6	138 / 13.8
Nova Veneza	1	3.1	44 / 2.3
Palhoça	1	26.6	138 / 13.8
Ilha Centro	1	33.3	138 / 13.8
	2	33.3	138 / 13.8
Picarras	1	16.6	6.9 / 13.8
	2	7.5	6.9 / 13.8
Itajaí II	1	26.6	138 / 23
	2	26.6	138 / 13.8
Gaspar	1	26.6	138 / 23
Trombudo Central	1	26.6	138 / 23
ChapecóII	1	26.6	138 / 23
Palmitos	1	26.6	138 / 23
São Lourenço D'Oeste	1	16.6	138 / 23
Criciúma Floresta	1	16.6	69 / 13.8
Bracinho P/S	1	3.5	34 / 6.9
	3	10.0	34 / 6.9
	4	10.0	34 / 6.9
Garcia P/S	1	6.0	69 / 13.8
	2	6.0	69 / 13.8
	3	2.5	69 / 13.8
Palmeiras P/S	1	11.0	69 / 6.9
	2	11.0	69 / 6.9
	3	9.3	69 / 23
Celdo Ramos P/S	1	3.7	69 / 2.4
	2	3.7	69 / 2.4

Table V.4.1 Recent Energy and Power Supply in South System (COPEL + CELESC + CEEE + ENERSUL)

1. DIRECT SUPPLY

CLASSES	CONSUMPTION - MWH			RATE OF INCREASE (%)	
	1990	1991	1992	91/90	92/91
RESIDENTIAL	7,747,377	8,367,927	8,571,880	8.0	2.4
COMMERCIAL	3,669,945	3,943,233	4,145,311	7.4	5.1
INDUSTRIAL	12,031,012	12,290,382	12,770,278	2.2	3.9
RURAL	2,489,890	2,793,617	2,879,246	12.2	3.1
OTHERS	3,106,552	3,352,252	3,478,508	7.9	3.7
PUBLIC ILLUMINATION	1,299,774	1,347,320	1,424,481	3.7	5.7
PUBLIC POWER	686,756	723,787	770,784	5.4	6.5
PUBLIC SERVICES	852,291	944,869	981,650	10.9	3.8
OWN USE	267,731	336,276	301,593	25.6	-10.3
TOTAL	29,044,776	3,0747,411	31,845,223	5.9	3.6

2. REQUIRED ENERGY

DESCRIPTION	ENERGY - MWH			RATE OF INCREASE (%)	
	1990	1991	1992	91/90	92/91
OWN GENERATION	17,393,679	9,885,202	14,295,987	-43.2	44.6
HYDRO	15,988,438	8,335,860	13,004,018	-47.9	56.0
THERMAL	1,405,241	1,549,342	1,291,969	10.3	-16.6
RECEIVED ENERGY	15019,721	24,742,073	21,363,844	64.7	-13.7
ELETROSUL	17,991,065	18,853,394	20,181,106	4.8	7.0
OTHERS	-2971,344	5,888,679	1,182,738	-298.2	-79.9
REQUIRED ENERGY	32,413,400	34,627,275	35,659,831	6.8	3.0
BULK SUPPLY	494,981	525,972	572,312	6.3	8.8
AVAILABLE ENERGY	31,918,419	34,101,303	35,087,519	6.8	2.9
DIRECT DISTRIBUTION	29,044,783	30,747,411	31,848,398	5.9	3.6
LOSS AND DIFFERENCE	2,873,636	3,353,892	3,239,121	16.7	-3.4

3. PEAK POWER

DESCRIPTION	PEAK POWER * - MWH/H			RATE OF INCREASE (%)	
	1990	1991	1992	91/90	92/91
OWN GENERATION	2,264	2,066	2,027	-8.7	-1.9
RECEIVED	2,991	3,360	3,837	12.3	14.2
TOTAL	5,255	5,426	5,864	3.3	8.1

* : Sum of peaks of individual companies

Table V.4.2 Recent Power Supply by CELESC (1983 - 1992)

(Unit : kWH)

Specification	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1. Own Generation	482,337,357	404,018,324	332,552,353	281,293,962	411,467,634	375,335,322	385,758,503	405,766,646	309,023,804	376,160,677
1.1 Hydro	482,312,487	404,007,224	332,551,913	281,293,962	411,467,634	375,335,322	385,758,503	405,766,646	309,023,804	376,160,677
1.2 Thermal	24,870	11,100	440	0	0	0	0	0	0	0
2. Energy Received	3,877,355,402	4,489,566,318	5,079,090,790	5,340,419,090	5,766,990,767	6,208,555,667	6,674,854,706	6,731,786,504	7,256,007,844	7,421,998,078
2.1 Eletrosul	3,868,328,202	4,489,566,318	4,827,021,795	4,687,024,806	4,535,966,870	4,708,000,863	4,651,851,594	4,109,496,010	4,483,122,688	4,575,203,284
2.2 Itaipú	0	0	252,068,995	653,394,284	1,231,023,897	1,496,514,504	2,002,628,312	2,589,257,639	2,737,465,000	2,806,291,864
2.3 Hidrelétrica Xanxerê	9,027,200	0	0	0	0	0	0	0	0	0
2.4 E.T.S.T	0	0	0	0	0	0	0	8,147,455	9,784,606	10,724,147
2.5 Copel (PR) - Porto União	0	0	0	0	0	2,501,100	3,943,200	4,888,800	5,218,500	7,344,633
2.6 Copel (PR) - Itapoá	0	0	0	0	0	0	3,788,400	4,447,800	5,578,650	6,248,550
2.7 Fábrica de Papel Primo Tedesco	0	0	0	0	0	1,539,200	12,643,200	15,548,800	14,838,400	16,185,600
3. Energy Required	4,359,692,759	4,893,584,642	5,411,643,143	5,621,713,052	6,178,458,401	6,583,890,989	7,060,613,209	7,137,553,150	7,565,031,648	7,798,158,755
4. Energy Supply (Bulk)	41,684,703	70,531,831	85,204,356	90,616,666	98,627,350	99,223,674	102,981,432	106,596,952	110,175,304	123,133,144
4.1 Empresa Força e Luz João Cesa	2,098,320	2,148,600	2,532,072	2,510,496	2,621,856	3,201,312	3,398,496	3,546,720	3,743,376	3,915,458
4.2 Força e Luz Nova Veneza	1,342,664	1,394,000	1,583,200	1,688,400	1,943,600	2,185,200	2,385,600	2,314,000	310,400	0
4.3 Força e Luz Urussanga	12,261,600	16,313,440	21,451,104	22,960,416	24;110,064	22,497,696	25,192,344	22,671,240	20,899,160	28,683,880
4.4 Hidrelétrica Xanxerê	25,982,119	50,675,791	59,637,980	63,457,354	69,951,830	71,339,466	72,004,992	78,064,992	85,222,368	90,533,144
5. Consumption Total	3,993,766,172	4,472,742,119	4,979,502,421	5,181,642,907	5,685,205,225	6,008,591,491	6,456,704,745	6,528,420,787	6,923,483,661	7,110,815,076
5.1 Residential	763,322,924	817,736,973	883,842,455	952,642,306	1,104,761,931	1,188,218,844	1,326,651,373	1,498,993,951	1,644,832,164	1,707,961,254
5.2 Industrial	2,155,807,371	2,496,113,014	2,840,939,152	2,947,883,116	3,113,514,044	3,281,996,744	3,506,689,574	3,330,571,411	3,433,971,426	3,453,567,696
5.3 Commercial	441,787,213	463,363,780	472,902,392	466,123,733	537,254,354	555,211,189	593,415,110	637,742,104	685,532,186	723,113,867
5.4 Rural	150,707,100	175,960,052	206,667,634	227,020,792	259,776,249	272,985,549	293,534,735	311,222,005	342,718,601	358,446,426
5.5 Rural Cooperation	170,197,731	187,091,440	213,765,688	239,702,041	266,455,170	273,643,649	291,489,190	276,105,626	296,283,573	670,292,419
5.6 Public Power	75,196,075	79,435,386	89,117,816	84,162,817	99,659,808	115,441,201	116,778,687	126,847,054	134,938,749	143,130,869
5.7 Public Illumination	167,100,603	173,661,382	187,295,976	173,697,543	205,022,568	214,256,009	216,328,040	225,013,055	248,096,904	272,125,307
5.8 Public Service	61,047,024	71,201,265	76,896,278	83,268,865	89,698,387	98,131,414	103,456,385	112,230,259	126,339,542	129,363,364
5.9 Own Use	8,600,131	8,178,827	8,075,030	7,141,694	9,062,714	8,706,892	8,361,651	9,695,322	10,770,516	11,260,300
6. Losses, Diff.	324,241,884	350,310,692	346,936,366	349,453,479	394,625,826	476,075,824	500,927,032	502,535,411	531,372,683	564,210,535
7. Max Demand (kWh/h)	824,200	894,800	967,600	1,003,500	1,081,300	1,135,400	1,228,400	1,259,500	1,376,100	1,357,700
8. No. of Clients	735,064	777,720	819,911	868,834	910,792	960,092	1,013,717	1,077,865	1,131,821	1,184,762
8.1 Residential	557,091	589,215	620,115	654,448	687,857	727,937	772,528	822,670	864,883	909,641
8.2 Industrial	8,899	11,319	13,414	17,038	18,490	19,430	20,837	22,384	24,494	25,207
8.3 Commercial	65,103	65,682	66,307	70,499	73,321	75,837	78,623	83,530	88,685	91,612
8.4 Rural	96,226	103,043	110,798	116,751	120,372	125,268	129,749	136,589	140,643	144,726
8.5 Public Power	6,746	7,350	8,095	8,844	9,455	10,205	10,567	11,342	11,712	12,094
8.6 Public Illumination	213	221	215	212	247	270	216	229	230	233
8.7 Public Service	467	511	541	590	592	644	672	704	754	818
8.8 Own Consumer	319	379	426	452	458	501	525	417	420	431
9. No. of Supply Points	5	6	6	6	5	5	5	5	4	4
Annual Load Factor (%)	60.38	62.43	63.85	63.95	65.23	66.20	65.61	64.95	62.76	65.57

Source : F-12

Table V.4.3 Hourly Load Variations in CELESC System and Itajaí Sub-System in 1992

(Unit: MW)

Hour	AUTUM				WINTER				SPRING				SUMMER			
	25/03/92 - Wed.		28/03/92 - Sat.		17/06/92 - Wed.		21/06/92 - Sun.		16/09/92 - Wed.		20/09/92 - Sun.		16/12/92 - Wed.		20/12/92 - Sun.	
	Itajaí	CELESC	Itajaí	CELESC	Itajaí	CELESC	Itajaí	CELESC	Itajaí	CELESC	Itajaí	CELESC	Itajaõ	CELESC	Itajaí	CELESC
1	177.3	794.5	187.2	864.5	174.5	755.2	116.9	596.7	151.5	759.8	97.3	602.2	170.4	812.0	155.4	714.8
2	175.1	763.7	186.9	828.5	172.3	721.6	110.8	565.0	151.3	729.5	94.1	563.2	171.0	773.7	146.3	657.5
3	175.1	751.5	188.5	806.5	171.1	712.7	106.3	549.7	150.3	722.3	90.8	538.9	171.7	758.4	141.7	625.8
4	184.1	756.6	184.2	796.7	175.1	716.6	108.0	537.6	149.3	719.4	89.3	528.7	169.4	757.0	139.7	611.7
5	182.1	766.0	186.0	792.0	177.6	733.5	102.6	529.6	157.3	734.5	91.0	526.9	187.2	765.3	135.2	599.8
6	200.7	837.6	204.5	820.9	203.9	802.0	101.4	523.6	188.5	806.5	88.0	527.3	195.3	835.2	125.6	598.2
7	215.5	909.4	195.5	835.2	237.9	930.2	102.4	539.5	197.7	881.2	79.0	491.6	202.8	874.0	110.3	540.0
8	234.4	975.8	203.1	836.3	231.0	1,013.7	96.5	503.0	213.9	966.2	80.0	471.0	214.2	957.8	108.3	494.6
9	228.1	1,037.3	203.8	873.8	239.2	1,024.0	99.8	515.4	206.8	1,013.7	82.0	477.5	220.0	1,013.6	112.7	520.1
10	243.3	1,061.8	210.0	890.0	251.9	1,049.7	102.9	522.2	221.1	1,037.1	87.9	510.4	233.2	1,048.4	113.1	543.0
11	251.0	1,098.9	211.6	901.7	256.1	1,070.9	104.0	528.1	232.4	1,068.7	88.7	508.4	240.6	1,077.4	115.5	555.4
12	234.0	1,096.9	207.7	889.5	236.1	1,052.5	101.1	528.8	207.1	1,066.3	86.4	520.8	217.0	1,060.7	111.9	564.7
13	219.2	949.3	174.5	807.3	210.7	896.0	98.6	509.3	197.2	922.3	80.3	504.0	213.2	981.3	112.6	563.6
14	244.0	1,043.2	168.1	768.0	229.2	988.7	95.7	506.4	210.9	1,006.5	84.3	505.1	232.5	1,026.8	114.6	562.0
15	248.1	1,100.3	164.1	781.7	242.2	1,035.1	97.4	507.8	213.7	1,048.3	80.1	507.2	239.7	1,085.9	111.5	572.8
16	246.1	1,085.4	161.3	784.1	243.2	1,032.0	98.4	506.6	209.9	1,037.1	82.1	504.4	227.5	1,083.8	113.7	571.7
17	241.1	1,083.1	165.9	773.8	245.5	1,045.8	108.1	523.9	224.4	1,037.0	93.4	514.1	227.5	1,085.0	112.5	569.5
18	232.9	1,036.5	174.1	788.9	299.4	1,150.1	187.2	692.0	224.1	1,022.8	104.3	564.6	216.0	1,021.7	111.8	579.5
19	291.2	1,150.3	204.5	994.4	285.1	1,319.4	171.5	929.2	287.6	1,233.8	161.6	791.4	216.0	987.4	116.0	605.1
20	258.5	1,304.8	193.5	1,054.6	282.5	1,207.5	172.1	874.6	267.0	1,278.9	155.0	905.9	222.0	1,015.2	147.0	641.3
21	267.8	1,213.8	178.4	974.7	259.1	1,147.0	164.8	829.3	251.0	1,193.2	143.3	848.3	252.0	1,204.7	177.0	843.1
22	239.5	1,132.9	161.1	902.2	240.2	1,059.0	54.1	757.0	216.4	1,095.6	133.0	766.3	229.6	1,192.5	184.5	930.0
23	217.5	1,013.3	142.2	809.0	219.3	951.7	168.6	720.6	190.8	984.9	152.6	734.4	213.5	1,081.5	202.1	875.9
24	190.4	898.9	138.2	737.1	196.2	844.0	162.0	673.3	177.0	865.9	145.2	703.0	200.9	934.9	189.5	796.0
Total	5, 397.0	23,861.8	4,394.9	20,311.4	5,479.3	23,258.9	2,931.2	14,469.2	4,897.2	23,231.5	2,469.7	14,115.6	5,083.2	23,434.2	3,208.5	15,136.1
Aver.	224.9	994.2	183.1	846.3	228.3	969.1	122.1	602.9	204.1	968.0	102.9	588.2	211.8	976.4	133.7	630.6
Max.	291.2	1,304.8	204.5	1,054.6	299.4	1,319.4	187.2	929.2	287.6	1,278.9	161.6	905.9	252.0	1,204.7	202.1	930.0
Load Factor	0.77	0.76	0.89	0.80	0.76	0.73	0.65	0.65	0.71	0.76	0.64	0.65	0.84	0.81	0.66	0.67

Source : F-16

Table V.4.4 Monthly Peak Demands in CELESC System (1983 - 1992)

(Unit: MW)

Month	Year									
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Jan.	749.3	780.2	897.1	890.3	988.3	1,045.5	1,095.7	1,208.6	1,171.5	1,267.2
Feb.	755.3	824.9	892.6	797.8	1,034.3	1,075.2	1,124.8	1,202.0	1,239.4	1,331.9
Mar.	790.7	841.5	933.9	826.8	1,064.3	1,112.1	1,157.8	1,225.7	1,269.2	1,354.4
Apr.	794.0	833.6	941.3	939.0	1,066.8	1,117.5	1,191.8	1,219.4	1,317.9	1,345.3
May	804.0	894.8	966.6	988.3	1,058.5	1,130.0	1,209.5	1,200.8	1,359.6	1,357.7
Jun.	824.2	878.8	967.6	994.2	1,081.3	1,135.4	1,218.9	1,234.4	1,376.1	1,353.6
July	770.8	871.6	949.7	1,003.5	1,051.8	1,111.5	1,228.4	1,247.5	1,356.6	1,330.0
Aug.	772.5	837.3	942.0	980.4	1,037.0	1,083.9	1,225.7	1,233.7	1,321.4	1,292.1
Sep.	773.8	833.9	910.9	963.5	1,017.1	1,088.8	1,185.2	1,230.4	1,313.3	1,305.4
Oct.	799.4	886.8	948.9	994.7	1,040.4	1,080.2	1,215.2	1,259.5	1,324.7	1,349.7
Nov.	800.8	875.4	942.0	988.3	1,037.9	1,075.8	1,194.7	1,216.2	1,286.6	1,317.5
Dec.	778.7	871.1	918.2	977.0	1,019.0	1,080.5	1,165.5	1,170.9	1,234.0	1,261.9
Max.	824.2	894.8	967.6	1,003.5	1,081.3	1,135.4	1,228.4	1,259.5	1,376.1	1,357.7

Source : F-01, F-02, F-03, and others

Table V.5.1 Energy Demand Forecast for Brazil

(Unit: GWh)

Power System	Year												
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
North *1	17,431	18,256	18,894	19,817	20,966	22,131	23,781	25,480	27,895	29,685	32,298	34,721	37,282
Northeast *1	26,592	27,767	28,951	30,702	32,734	34,579	36,335	38,586	41,208	44,271	47,305	50,063	52,715
Southeast *2	133,104	137,200	142,882	149,152	155,961	163,022	170,335	177,972	186,303	195,317	204,404	213,895	223,725
South *2	31,303	32,684	34,337	36,327	38,338	40,469	42,526	44,758	47,193	49,778	52,476	55,135	57,901
Brazil Total	208,430	215,907	225,064	235,998	247,999	260,201	272,977	286,796	302,599	319,051	336,483	353,814	371,623
Integrated South/ Southeast System	164,407	169,884	177,219	185,479	194,299	203,491	212,871	222,730	233,496	245,095	256,880	269,030	281,626
Load factor		0.68	0.68	0.69	0.69	0.69	0.69	0.70	0.70	0.70	0.70	0.70	0.70

Source : F-09

Note: *1 : State of Maranhão in the northeast region is included in the north system.
*2 : State of Mato Grosso do Sul in the central-west region is included in the south system.

Table V.5.2 Peak Power Demand Forecast for South/Southeast System

(Unit: MW)

Power System	Year										
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
South System											
Average MW (Annual)	4,309	4,571	4,868	5,138	5,418	5,739	6,081	6,402	6,729	7,093	7,456
Peak MW	6,655	6,932	7,318	7,666	7,980	8,366	8,775	9,176	9,525	9,981	10,406
Power factor (%)	65	66	67	67	68	69	69	70	71	71	72
Southeast System											
Average MW (Annual)	16,092	19,037	19,971	20,942	21,913	23,089	24,336	25,562	26,868	28,196	29,539
Peak MW	26,268	27,565	28,850	30,083	31,461	33,146	34,911	36,592	38,369	40,271	42,134
Load factor (%)	69	69	69	70	70	70	70	70	70	70	70
Integrated South/Southeast System											
Average MW (Annual)	22,401	23,608	24,839	26,080	27,331	28,828	30,417	31,964	33,597	35,289	36,995
Peak MW	32,923	34,497	36,168	37,749	39,441	41,512	43,686	45,768	47,894	50,252	52,540
Load factor (%)	68	68	69	69	69	69	70	70	70	70	70

Source : F-09

Table V.5.3 Power Demand Forecast for CELESC System

DESCRIPTION	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	YEAR												
CONSUMPTION - GWh													
RESIDENTIAL	1,644.8	1,708.0	1,874.9	2,006.1	2,144.5	2,283.9	2,425.5	2,568.6	2,712.5	2,859.0	3,010.5	3,164.0	3,322.2
INDUSTRIAL	3,434.0	3,453.6	3,528.3	3639.7	3,790.4	3.970.4	4,169.3	4,379.8	4,601.4	4,836.1	5,083.9	5,347.4	5,627.5
COMMERCIAL	685.5	723.1	768.2	811.6	856.0	904.4	953.5	1,004.4	1,056.9	1,111.1	1,166.9	1,224.2	1,283.0
RURAL	639.0	670.3	713.4	754.6	795.9	837.1	878.3	919.8	960.8	1,002.0	1,043.3	1,084.5	1,125.7
PUBLIC ILLUMI.	248.1	272.1	277.4	287.6	297.7	307.7	317.4	326.9	336.1	345.4	354.5	363.6	372.6
PUBLIC POWER	134.9	143.1	151.3	159.8	168.7	177.6	186.7	195.8	205.1	214.5	224.2	234.1	244.2
PUBLIC SERVICE	126.3	129.4	143.7	151.8	159.7	167.4	175.0	182.5	189.9	197.2	204.4	211.5	218.5
OWN USE	10.8	11.3	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.3	13.5	13.7
TOTAL	6.923.5	7,110.9	7,468.8	7,823.0	8,225.9	8,660.7	9,118.1	9,590.4	10,075.5	10,578.3	11,101.0	11,642.8	12,207.4
BULK SUPPLY - GWh	110.2	123.1	125.8	131.2	137.2	143.2	149.4	155.6	162.0	168.4	175.1	181.8	188.8
LOSSES AND DIFF - GWh	531.3	564.2	567.8	594.7	625.2	658.2	692.9	728.6	765.3	803.4	843.0	884.0	926.1
REQUIRED ENERGY - GWh	7,565.0	7,798.2	8,120.1	8,516.2	8,954.8	9,426.5	9,923.4	10,436.5	10,963.6	11,509.7	12,077.4	12,665.7	13,278.1
OWN GENERATION	309.0	376.2	446.8	446.8	446.8	658.8	657.0	657.0	657.0	657.0	657.0	657.0	657.0
PURCHASED	7,256.0	7,422.0	7,673.3	8,069.4	8,508.0	8,767.7	9,266.4	9,779.5	10,306.6	10,852.7	11,420.4	12,008.7	12,621.1
PEAK LOAD - MWh/h	1,376.1	1,357.7	1,437.0	1,497.0	1,569.0	1,645.0	1,720.0	1,801.0	1,878.0	1,957.0	2,043.0	2,127.0	2,215.0
OWN MARKET	1,355.9		1,414.0	1,473.0	1,544.0	1,620.0	1,694.0	1,775.0	1,851.0	1,929.0	2,015.0	2,098.0	2,185.0
AVER. LOAD	863.6	887.8	927.0	962.0	1,022.0	1,073.0	1,133.0	1,191.0	1,252.0	1,314.0	1,379.0	1,446.0	1,516.0
OWN MARKET	854.0		916.2	960.8	1,010.2	1,060.8	1,120.2	1,177.6	1,238.0	1,299.4	1,363.8	1,430.1	1,499.0
LOAD FACTOR	62.7	65.4	64.5	64.9	65.1	65.2	65.9	66.1	66.7	67.1	67.5	68.0	68.4
OWN MARKET	62.8		64.9	65.2	65.4	65.5	66.1	66.4	66.9	67.4	67.7	68.2	68.6
DATA BASE													
NO. OF RESIDENCE (X1000)	864.9	905.0	945.0	985.0	1,025.0	1,064.0	1,102.0	1,139.0	1,175.0	1,211.0	1,247.0	1,283.0	1,319.0
NO. C R + NO C RU (X1000)	1,005.5	1,048.4	1,091.1	1,133.6	1,176.0	1,217.3	1,257.5	1,296.6	1,334.6	1,372.5	1,410.3	1,448.1	1,485.9
CONSUM.AVE.RESID (kWh)	1,901.8	1,934.4	1,984.0	2,036.6	2,092.2	2,146.5	2,201.0	2,255.1	2,308.5	2,360.9	2,414.2	2,466.1	2,511.5
P. ILUM./ CONSUM RESID (w)	71.7	73.8	73.4	73.0	72.6	72.3	72.0	71.8	71.5	71.3	71.1	70.8	70.6
NO. CONSUM TOTAL (X1000)	1,131.8	1,179.0	1,229.0	1,279.0	1,330.0	1,380.0	1,430.0	1,480.0	1,530.0	1,580.0	1,630.0	1,680.0	1,730.0
POP URBAN (X1000)	3,147.9	3,230.2	3,312.1	3,393.3	3,473.9	3,553.7	3,633.0	3,711.5	3,789.2	3,866.5	3,942.8	4,018.4	4,095.2
POP TOTAL (X1000)	4,281.8	4,353.4	4,424.7	4,495.3	4,565.4	4,634.8	4,703.9	4,772.4	4,840.5	4,908.3	4,975.6	5,042.6	5,109.9
TAX OF URBANIZATION (%)	73.5	74.2	74.9	75.5	76.1	76.7	77.2	77.8	78.3	78.8	79.2	79.2	80.1
POPULATION DENSITY	49.1	49.9	50.7	51.5	52.3	53.1	53.9	54.7	55.5	56.2	57.0	57.8	58.5
kWh/HABITANT (TOTAL)	1,617.0	1,643.3	1,680.0	1,740.3	1,801.8	1,868.6	1,938.4	2,009.5	2,018.5	2,155.2	2,231.1	2,308.9	2,389.0
kWh/HABITANT (RESID)	384.1	402.1	423.7	446.3	469.7	492.8	515.6	538.2	560.4	582.5	605.0	627.5	650.1

Source : F-12

Table V.5.4 Demand Forecast for CELESC System (Estimated by JICA Team)

	Year												
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
ENERGY (MWh)	-												
CONSUMPTION													
RESIDENTIAL	1,844.8	1,708.0	1,827.6	1,951.8	2,080.7	2,213.8	2,351.1	2,492.1	2,836.7	2,784.3	2,934.7	3,087.3	3,241.7
INDUSTRIAL	3,434.0	3,453.8	3,828.3	3,507.6	3,998.0	4,197.9	4,407.8	4,828.2	4,859.6	5,102.5	5,357.7	5,825.8	5,908.8
COMMERCIAL	885.5	723.1	782.9	804.1	848.7	590.7	936.1	962.9	1,031.1	1,050.5	1,131.4	1,183.4	1,238.7
RURAL	639.0	670.3	707.2	782.6	821.0	859.8	898.2	936.9	975.3	1,013.3	1,050.8	1,087.8	
PUBLIC & OTHERS	520.1	555.9	583.7	611.7	539.9	688.0	696.1	723.9	751.4	778.5	804.9	830.7	855.6
TOTAL CONSM	6,923.4	7,110.9	7,507.6	7,919.9	8,347.8	8,791.4	9,250.6	9,725.4	10,214.4	10,721.2	11,242.0	11,777.8	12,328.4
BULK SUPPLY	110.2	123.1	120.1	126.7	133.6	140.7	148.0	155.6	183.4	171.5	179.9	188.4	197.3
LOSS & DIFF.	531.3	584.2	553.1	594.0	828.1	859.4	893.8	729.4	788.2	804.1	843.1	883.3	924.6
REQ. ENER.	7,584.9	7,798.2	8,190.8	8,640.8	9,107.4	8,591.4	10,092.4	10,810.4	11,145.2	11,896.8	12,285.0	12,849.5	13,450.2

GROWTH RATE (%)	PAST 10 YEARS	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	AVE.RATE
RESIDENTIAL	10.28	3.84	7.00	6.50	6.80	6.40	6.20	6.00	5.50	5.60	5.40	5.20	5.00	6.00
INDUSTRY	5.63	0.57	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
COMMERCIAL	3.45	5.49	5.50	5.40	5.30	5.20	5.10	5.00	4.90	4.80	4.70	4.60	4.50	5.00
RURAL	3.65	4.90	5.50	5.30	5.10	4.90	4.70	4.50	4.30	4.10	3.90	3.70	3.50	4.50
PUB & OTHERS	7.57	6.66	5.00	4.30	4.60	4.40	4.20	4.00	3.80	3.80	3.40	3.20	3.00	4.00
TOTAL CONSUM		2.71	5.56	5.49	5.40	5.31	5.22	5.13	5.04	4.95	4.66	4.77	4.67	5.13
BULK SUPPLY		11.71	-2.42	5.49	5.40	5.31	5.22	5.13	5.04	4.95	4.86	4.77	4.87	4.38
LOSS & DIFF		6.19	-0.20	5.49	5.40	5.31	5.22	5.13	5.04	4.95	4.86	4.77	4.87	4.59
REQ. ENER.		3.08	5.03	5.49	5.40	5.31	5.22	5.13	5.04	4.95	4.86	4.77	4.87	5.08
BULK/TOTAL CONS	1.59	1.73	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	
LOSS/TOTAL CONS	7.67	7.93	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	

Table V.6.1 Generation Expansion Program of Brazil - Energy

(Unit: GWh)

Power System	Year										
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Integrated North/Northeast System		52,542	57,054	59,918	63,133	66,813	72,428	83,658	83,658	90,114	94,678
Integrated Southeast/South System	199,664	206,806	217,739	228,697	239,420	252,533	266,453	280,005	294,310	309,132	324,076
Southeast System	(161,897)	(166,764)	(174,946)	(183,452)	(191,958)	(202,260)	(213,183)	(223,923)	(235,364)	(246,997)	(258,762)
South System	(37,767)	(40,042)	(42,793)	(45,245)	(47,462)	(50,274)	(53,270)	(56,082)	(58,946)	(62,135)	(65,315)
Isolated Cities		3,889	4,328	4,825	5,361	5,940	6,811	7,595	8,392	9,099	9,862
Isolated Districts		1,698	1,605	1,719	1,835	1,775	1,559	1,719	1,897	1,220	1,303
Brazil (Total)	253,505	264,935	280,726	295,159	309,749	327,061	347,251	372,977	388,257	409,565	429,919

Source : F-09

Table V.6.2 Generation Expansion Program for South/Southeast System - Peak Power (Installed Capacity)

Unit: MW

Power System	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
South System											
Hydro	6,298	6,928	6,928	6,979	7,042	7,104	8,414	9,724	10,550	11,512	14,194
Thermal	1,133	1,133	1,483	1,908	2,283	2,633	2,633	2,683	3,083	3,133	3,658
Total	7,431	8,061	8,411	8,887	9,325	9,737	11,047	12,407	13,633	14,645	17,852
Southeast System											
Hydro *	35,639	36,711	39,024	39,091	39,782	41,125	43,258	44,137	45,119	46,888	48,568
Thermal	1,974	1,974	1,974	1,974	1,974	3,283	3,633	4,458	4,458	4,458	4,458
Total	37,613	38,685	40,998	41,065	41,756	44,408	46,891	48,595	49,577	51,346	53,026
Integrated South/ Southeast System											
Hydro *	41,937	43,639	45,952	46,070	46,824	48,229	51,672	53,861	55,669	58,400	62,762
Thermal	3,107	3,107	3,457	3,882	4,257	5,916	6,266	7,141	7,541	7,591	8,116
Total	45,044	46,746	49,409	49,952	51,081	54,145	57,938	61,002	63,210	65,991	70,878

Notes : Figures above are total installed capacities at beginning of the year.
* : Including Itaipu's 12,600 MW

Table V.6.3 Generation Expansion Program of South/Southeast System for 1993 - 2003 (1/4)

South System

Name of Power Plant	Type	Installed Capacity (MW)	Unit No.	Scheduled Commissioning
Segredo	H	4 x 315	3/4	Mar/1993
			4/4	Dec/1993
J. Lacerda IV	T	1 x 350	1/1	Jun /1994
Jacuí	T	1 x 350	1/1	Dec/1995
Porto Soares	T	6 x 75	1/6	Dec/1995
			2/6	Jan /1996
			3/6	Feb /1996
			4/6	Mar/1996
			5/6	Apr /1996
			6/6	May /1996
Cubatão	H	2 x 22.5	1/2	Dec/1995
			2/2	Dec/1995
Aquarius	H	3 x2.16	1/3	Dec/1995
			2/3	Dec/1995
			3/3	Dec/1995
D. Francisca	H	2 x 62.5	1/2	Dec/1996
			2/2	Mar/1997
Candiota III-1	T	1 x 350	1/1	Dec/1997
Itá	H	6 x 270	1/6	Jun /1998
			2/6	Sep /1998
			3/6	Dec/1998
			4/6	Mar/1999
			5/6	Jun /1999
			6/6	Sep /1999
Salto Caxias	H	4 x 250	1/4	Sep /1998
			2/4	Dec/1998
			3/4	Mar/1999
			4/4	Jun /1999
Carvão 50MW-I	T	1 x 50	1/1	Dec/1999
Jataizinho	H	3 x 64	1/3	Mar/2000
			2/3	Jun /2000
			3/3	Sep /2000

Name of Power Plant	Type	Installed Capacity (MW)	Unit No.	Scheduled Commissioning
Cebolão	H	2 x 97	1/2	Jun /2000
			2/2	Sep /2000
Campos Novos	H	4 x 220	1/4	Sep /2000
			2/4	Dec /2000
			3/4	Mar/2001
			4/4	Jun /2001
Candiota III-2	T	1 x 350	1/1	Dec/2000
Carvão 50MW-II	T	1 x 50	1/1	Dec/2000
Garabí - 50%	H	6 x 50	1/6	Sep /2001
			2/6	Dec /2001
			3/6	Mar/2002
			4/6	Jun /2002
			5/6	Sep /2002
			6/6	Dec/2002
São Jerônimo	H	2 x 222	1/2	Dec/2001
			2/2	Mar/2002
Carvão 50MW-III	T	1 x 50	1/1	Dec/2001
Machadinho	H	4 x 300	1/4	Mar/2002
			2/4	Jun /2002
			3/4	Sep /2002
			4/4	Dec/2002
Candiota III-3	H	1 x 350	1/1	Jun /2002
Barra Grande	H	3 x 230	1/3	Sep /2002
			2/3	Dec/2002
			3/3	Mar/2003
Telemaco Borba	H	2 x 64	1/2	Sep /2002
			2/2	Dec/2002
Monjolinho-Sul	H	2 x 36	1/2	Sep /2002
			2/2	Dec/2002
Carvão 125MW-I	T	1 x 125	1/1	Dec/2002
Carvão 50MW-IV	T	1 x 50	1/1	Dec/2002

Source : F-08

Note; H : Hydro, T : Thermal, N : Nuclear

Table V.6.3 Generation Expansion Program of South/Southeast System for 1993 - 2003 (2/4)

Southeast System

Name of Power Plant	Type	Installed Capacity (MW)	Unit No.	Scheduled Commissioning
Taquaruçu	H	5 x 101	2/5	Apr /1993
			3/5	Aug/1993
			4/5	Dec /1993
			5/5	Apr /1994
Rosana-2/4	H	4 x 80	3/4	May/1993
			4/4	Oct /1993
Igarapée I desat	H	1 x 125	1/1	Jan /1993
C. Dourada ampl.	H	2 x 95	1/2	Mar/1993
			2/2	Aug/1993
Igarapé I (RV)	H	1 x 125	1/1	Mar/1993
Três Irmãos	H	4 x 162	1/4	Dec /1993
			2/4	Apr /1994
			3/4	Aug/1994
			4/5	Dec /1994
Pinhal	H	2 x 3.5	1/2	Dec /1993
			2/2	Dec /1993
S. Cruz 1/2 desat	H	2 x 84	1/2	Mar/1994
			2/2	Apr /1994
S. Cruz 1/2 (RASF)	H	2 x 84	1/2	Apr /1994
			2/2	May/1994
Nova Ponte	H	3 x 170	1/3	Jun /1994
			2/3	Sep /1994
			3/3	Dec /1994
S. Cruz 3/4 desat	H	2 x 220	1/2	Jun /1994
			2/2	Aug/1994
S. Cruz 3/4 (RASF)	H	2 x 220	1/2	Jul /1994
			2/2	Sep /1994
Anhanguera	H	3 x 6.67	1/3	Dec /1995
			2/3	Dec /1995
			3/3	Dec /1995
Retiro	H	3 x 5	1/3	Dec /1995
			2/3	Dec /1995
			3/3	Dec /1995
Palmeiras	H	3 x 5	1/3	Dec /1995
			2/3	Dec /1995
			3/3	Dec /1995
Muniz Freire I	H	1 x 9.96	1/1	Dec /1995
Primavera	H	1 x 0.6	1/1	Dec /1995
Glicério	H	1 x 6.5	1/1	Dec /1995
Carrapatos	H	2 x 8.5	1/2	Feb /1996
			2/2	May/1996
Igarapava	H	5 x 42	1/5	Mar/1996
			2/5	Jun /1996
			3/5	Sep /1996
			4/5	Dec /1996
			5/5	Mar/1997
P. Primavera	H	18 x 101	1/18	May/1996
			2/18	Jul /1996
			3/18	Sep /1996
			4/18	Nov/1996
			5/18	Feb /1997
			6/18	Apr /1997
			7/18	Jul /1997
			8/18	Sep /1997
			9/18	Dec /1997
			10/18	Feb /1998
			11/18	May/1998
			12/18	Jul /1998
			13/18	Oct /1998
			14/18	Dec /1998
			15/18	Mar/1999
			16/18	May/1999
			17/18	Aug/1999
			18/18	Oct /1999
São Jose	H	2 x 9.50	1/2	Aug/1996
			2/2	Nov/1996
Jaguara ampl.	H	2 x 108	1/2	Dec /1996
			2/2	Mar/1997
Canoas I	H	3 x 27.5	1/3	Dec /1996
			2/3	Mar/1997
			3/3	Jun /1997

Table V.6.3 Generation Expansion Program of South/Southeast System for 1993 - 2003 (3/4)

Southeast System

Name of Power Plant	Type	Installed Capacity (MW)	Unit No.	Scheduled Commissioning
Rosal	H	2 x 29	1/2	Dec /1996
			2/2	Mar /1997
Braço Norte II	H	1 x 9.6	1/1	Dec /1996
Mambaí	H	1 x 8	1/1	Dec /1996
Braço Norte I		1 x 6	1/1	Dec /1996
Muniz Freire II		1 x 2.4	1/1	Dec /1996
Santa Branca		2 x 24.5	1/2	Mar /1997
			2/2	Jun /1997
Miranda	H	3 x 130	1/3	Jun /1997
			2/3	Sep /1997
			3/3	Dec /1997
Canoas II	H	3 x 24	1/3	Jun /1997
			2/3	Sep /1997
			3/3	Dec /1997
Angra II	N	1 x 1309	1/1	Dec /1997
Manso	H	4 x 52.5	1/4	Dec /1997
			2/4	Apr /1998
			3/4	Aug/1998
			4/4	Dec /1998
Monjolinho-SE	H	3 x 7.23	1/3	Dec /1997
			2/3	Dec /1997
			3/3	Dec /1997
São Sebastião	H	3 x 6.33	1/3	Dec /1997
			2/3	Dec /1997
			3/3	Dec /1997
Serra Da Mesa	H	3 x 400	1/3	Apr /1998
			2/3	Aug/1998
			3/3	Dec /1998
Funil-Rib.	H	3 x 50	1/3	Jul /1998
			2/3	Oct /1998
			3/3	Jan /1999
Corumbá I	H	3 x 125	1/3	Sep /1998
			2/3	Jan /1999
			3/3	May/1999
S. Rita-Sapucaí	H	3 x 5.5	1/3	Dec /1998
			2/3	Dec /1998
			3/3	Dec /1998
Paulínia-I (RV)	T	1 x 350	1/1	Dec /1998
Sapucaí	H	3 x 5.07	1/3	Dec /1998
			2/3	Dec /1998
			3/3	Dec /1998
S. Domingos-CPFL	H	3 x 4.63	1/3	Dec /1998
			2/3	Dec /1998
			3/3	Dec /1998
Queimado	H	2 x 50	1/2	Mar /1999
			2/2	Jun /1999
Sta. Rita-MG	H	3 x 25	1/3	Mar /1999
			2/3	Jun /1999
			3/3	Sep /1999
Paulínia-II (RV)	T	1 x 350	1/1	Jun /1999
S. J. Campos (RASF)	T	1 x 350	1/1	Dec /1999
IgarapéII (RV)	T	1 x 125	1/1	Dec /1999
C. Magalhães	H	4 x 55	1/4	Mar /2000
			2/4	Jun /2000
			3/4	Sep /2000
			4/4	Dec /2000
Bocaina	H	2 x 75	1/2	Mar /2000
			2/2	Jun /2000
Picada	H	2 x 50	1/2	Mar /2000
			2/2	Jun /2000
Cana Brava	H	4 x 112.5	1/4	Sep /2000
			2/4	Dec /2000
			3/4	Mar /2001
			4/4	Jun /2001
Formoso	H	3 x 100	1/3	Sep /2000
			2/3	Dec /2000
			3/3	Mar /2001
Simplício	H	3 x 60	1/3	Oct /2000
			2/3	Jan /2001
			3/3	Apr /2001
Franca Amaral	H	2 x 16.5	1/2	Dec /2000
			2/2	Mar /2001
Tombos	H	1 x 5.4	1/1	Dec /2000

Table V.6.3 Generation Expansion Program of South/Southeast System for 1993 - 2003 (4/4)

Southeast System

Name of Power Plant	Type	Installed Capacity (MW)	Unit No.	Scheduled Commissioning
Duas Vendas	H	1 x 5.3	1/1	Dec /2000
Quartel	H	2 x 50	1/2	Mar/2001
			2/2	Jun /2001
Viradouro	H	3 x 15	1/3	Mar/2001
			2/3	Jun /2001
			3/3	Sep /2001
Capim Branco	H	3 x 200	1/3	Jun /2001
			2/3	Sep /2001
			3/3	Dec /2001
Irapê	H	3 x 140	1/3	Jun /2001
			2/3	Sep /2001
			3/3	Dec /2001
Barretos	H	3 x 17	1/3	Sep /2001
			2/3	Dec /2001
			3/3	Mar/2002
Sapucaia	H	3 x 100	1/3	Dec /2001
			2/3	Mar/2002
			3/3	Jun /2002
Anta	H	2 x 8	1/2	Dec /2001
			2/2	Mar/2002
Barra Do Peixe	H	4 x	1/4	Mar/2002
		11	2/4	Jul /2002
		2.	3/4	Nov/2002
		5	4/4	Mar/2003

Name of Power Plant	Type	Installed Capacity (MW)	Unit No.	Scheduled Commissioning
Itaocara	H	3 x 70	1/3	Mar/2002
			2/3	Jun /2002
			3/3	Sep /2002
Serra Do Facão	H	3 x 70	1/3	Mar/2002
			2/3	Jun /2002
			3/3	Sep /2002
Manhuaçu	H	2 x 55	1/2	Mar/2002
			2/2	Jun /2002
Jaborandi	H	3 x17	1/3	Mar/2002
			2/3	Jun /2002
			3/3	Sep /2002
Foz Do Bezerra	H	3 x 100	1/3	Sep /2002
			2/3	Dec /2002
			3/3	Mar/2003
Funil-Grande	H	2 x 82	1/2	Sep /2002
			2/2	Dec /2002
Sobragi	H	2 x 55	1/2	Sep /2002
			2/2	Dec /2002
Batatal	H	3x 31.67	1/3	Sep /2002
			2/3	Dec /2002
			3/3	Mar/2003

Source : F-08

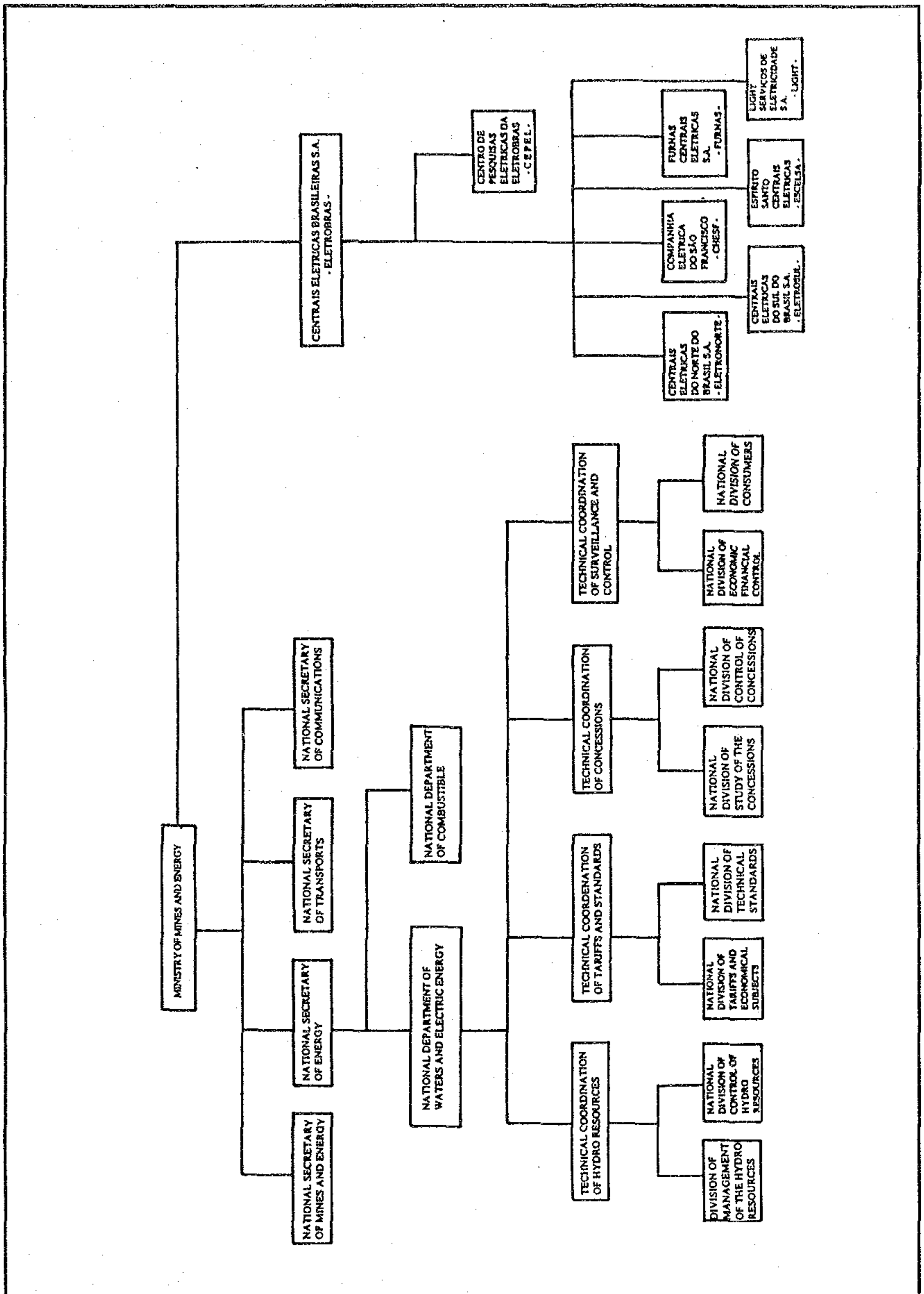
Note; H: Hydro, T: Thermal, N: Nuclear

Table V.6.4 Power Expansion Program in Santa Catarina

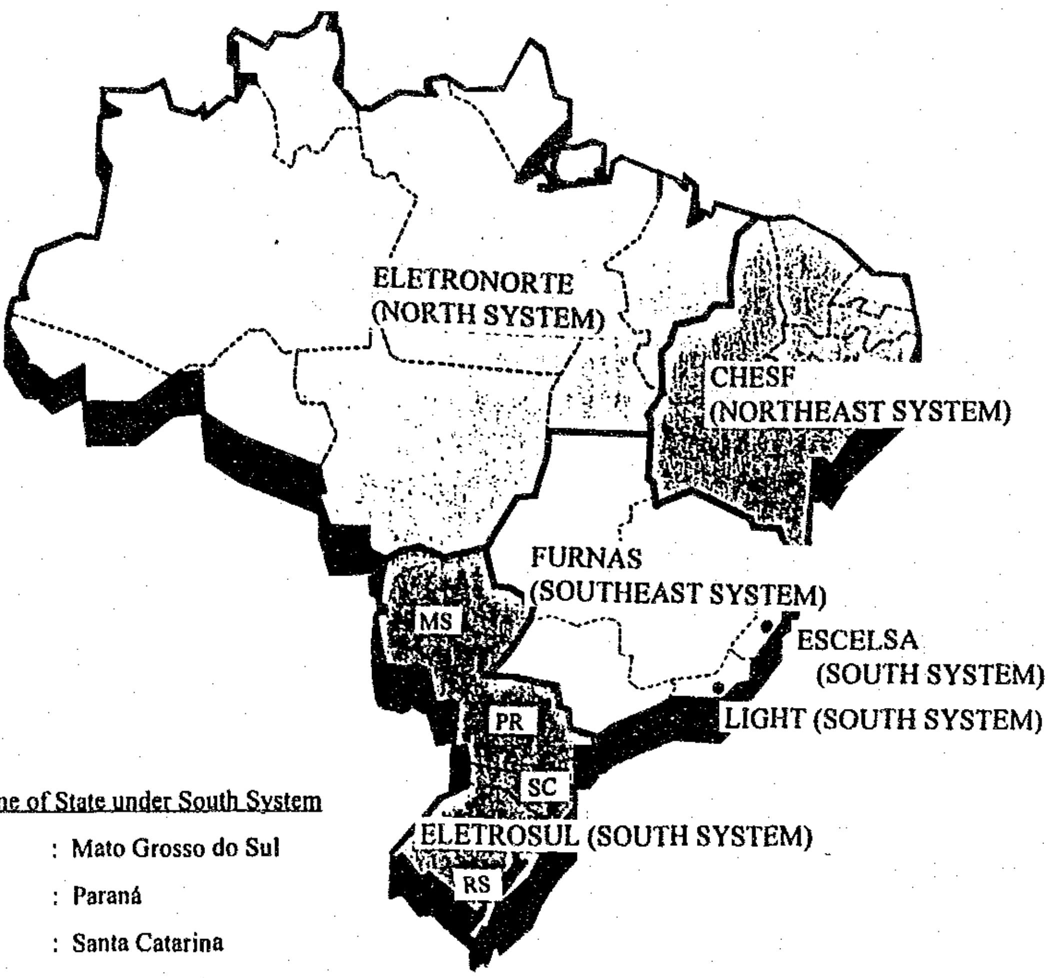
	Enterprise	Scheduled Commission Date	Name of Plant	Unit Nr.	Type	Installed Capacity (MW)
1992	ELETROSUL	(Existing Total)				482.0
	CELESC	(Existing Total)				72.9
1994	ELETROSUL	30/06/94	J. Lacerda IV		T	350
1995	CELESC	31/12/95	Cubatão		H	45
1998	ELETROSUL	30/06/98	Itá	1	H	270
	"	30/09/98	Itá	2	H	270
	"	30/12/98	Itá	3	H	270
1999	ELETROSUL	31/03/99	Itá	4	H	270
	"	30/06/99	Itá	5	H	270
	"	30/06/99	Itá	6	H	270
2000	ELETROSUL	30/09/00	Campos Novos	1	H	220
			Campos Novos	2	H	220
2001	ELETROSUL	31/03/01	Campos Novos	3	H	220
	"	30/06/01	Campos Novos	4	H	220
	"	31/03/01	Machadinho	1	H	300
	"	30/06/01	Machadinho	2	H	300
	"	30/09/01	Machadinho	3	H	300
	"	31/12/01	Machadinho	4	H	300
2002	ELETROSUL	30/09/02	Monjolinho	1	H	36
	"	31/12/02	Monjolinho	2	H	36
		30/09/02	Barra Grande		H	920

Source : F-08
Note; H : Hydro, T : Thermal

Figure



JAPAN INTERNATIONAL COOPERATION AGENCY CENTRAIS ELÉTRICAS DE SANTA CATARINA S.A.,BRAZIL SALTO PILÃO HYDROELECTRIC POWER DEVELOPMENT PROJECT	**Fig. V.2.1** **National Organization of Power Sectors in Brazil**



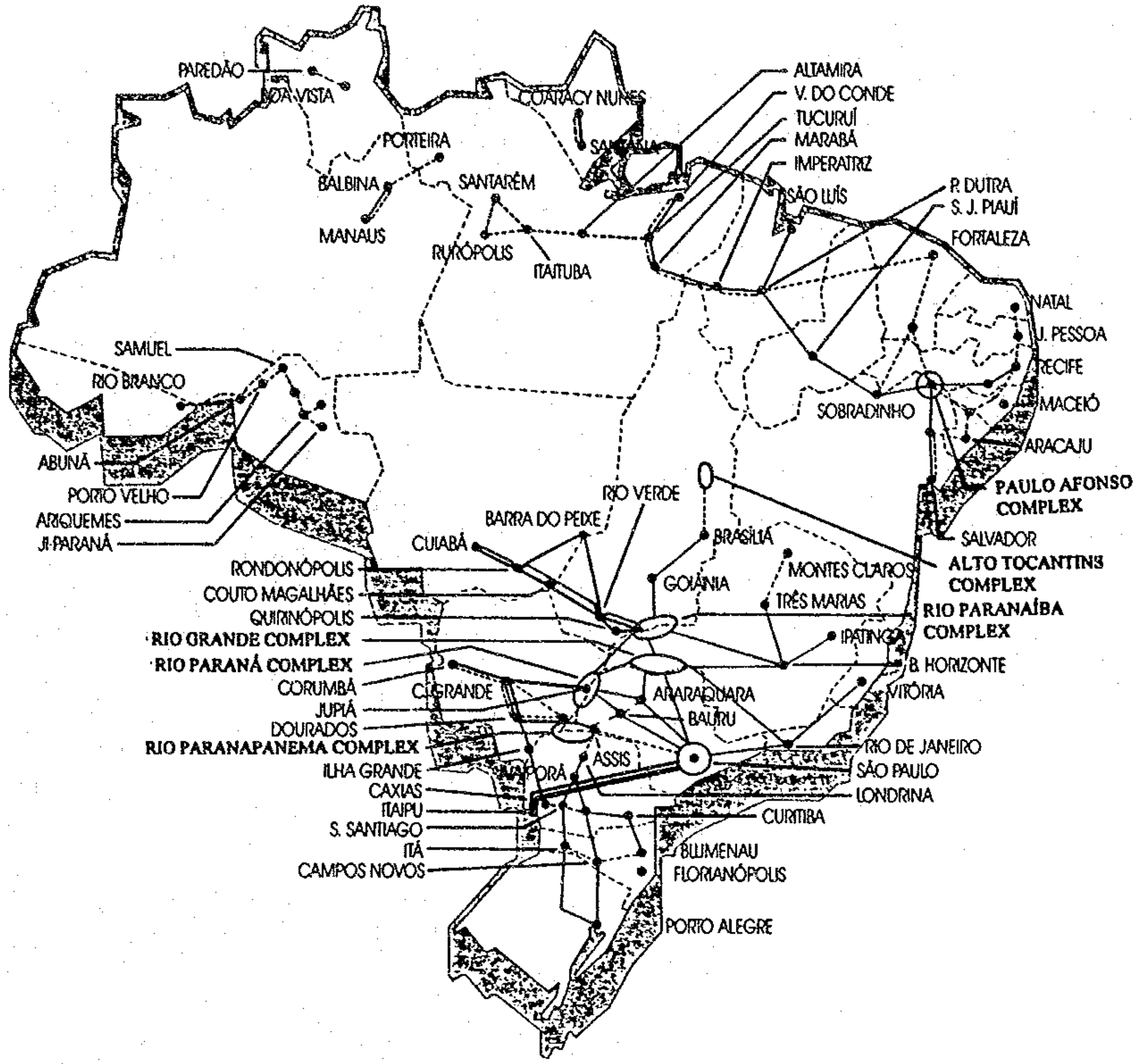
Name of State under South System

MS	:	Mato Grosso do Sul
PR	:	Paraná
SC	:	Santa Catarina
RS	:	Rio Grande do Sul

JAPAN INTERNATIONAL COOPERATION AGENCY
CENTRAIS ELÉTRICAS DE SANTA CATARINA S.A.,BRAZIL
SALTO PILÃO HYDROELECTRIC POWER DEVELOPMENT PROJECT

Fig. V.3.1

Main Subsidiaries of ELETROBRAS

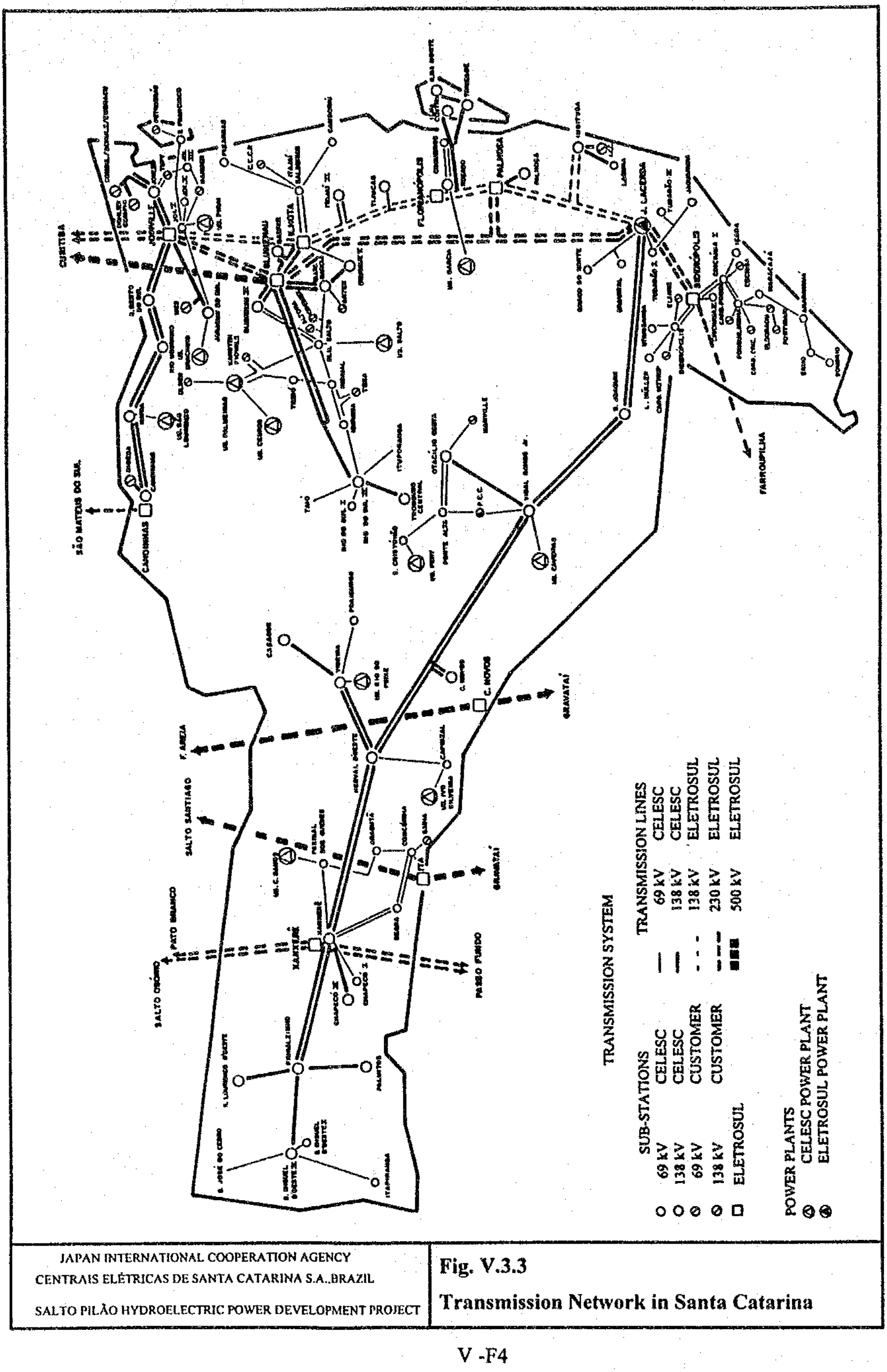


Note :
. 138 and 230 kV were represented only in North region, Mato Grosso and Goiás

LEGEND

	Existing	Future
138 kV	———	- - - - - -
230 kV	———	- - - - - -
345/440/500 kV	———	- - - - - -
± 600 kV cc	———	- - - - - -
750 kV	▬▬▬	▬ ▬ ▬ ▬

JAPAN INTERNATIONAL COOPERATION AGENCY CENTRAIS ELÉTRICAS DE SANTA CATARINA S.A.,BRAZIL SALTO PILÃO HYDROELECTRIC POWER DEVELOPMENT PROJECT	**Fig. V.3.2** **Major Transmission Lines in Brazil**



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CENTRAIS ELÉTRICAS DE SANTA CATARINA S.A.,BRAZIL
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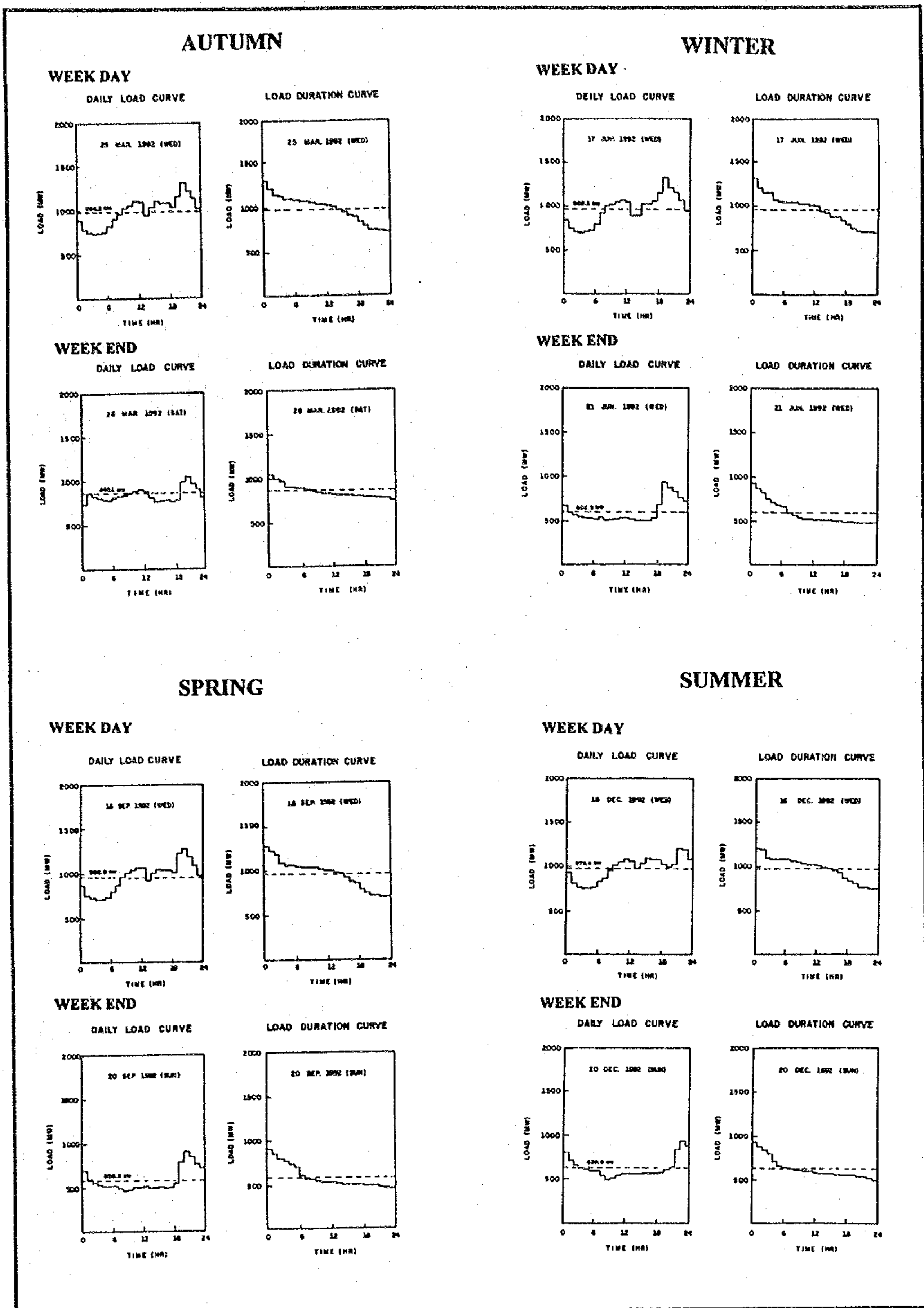
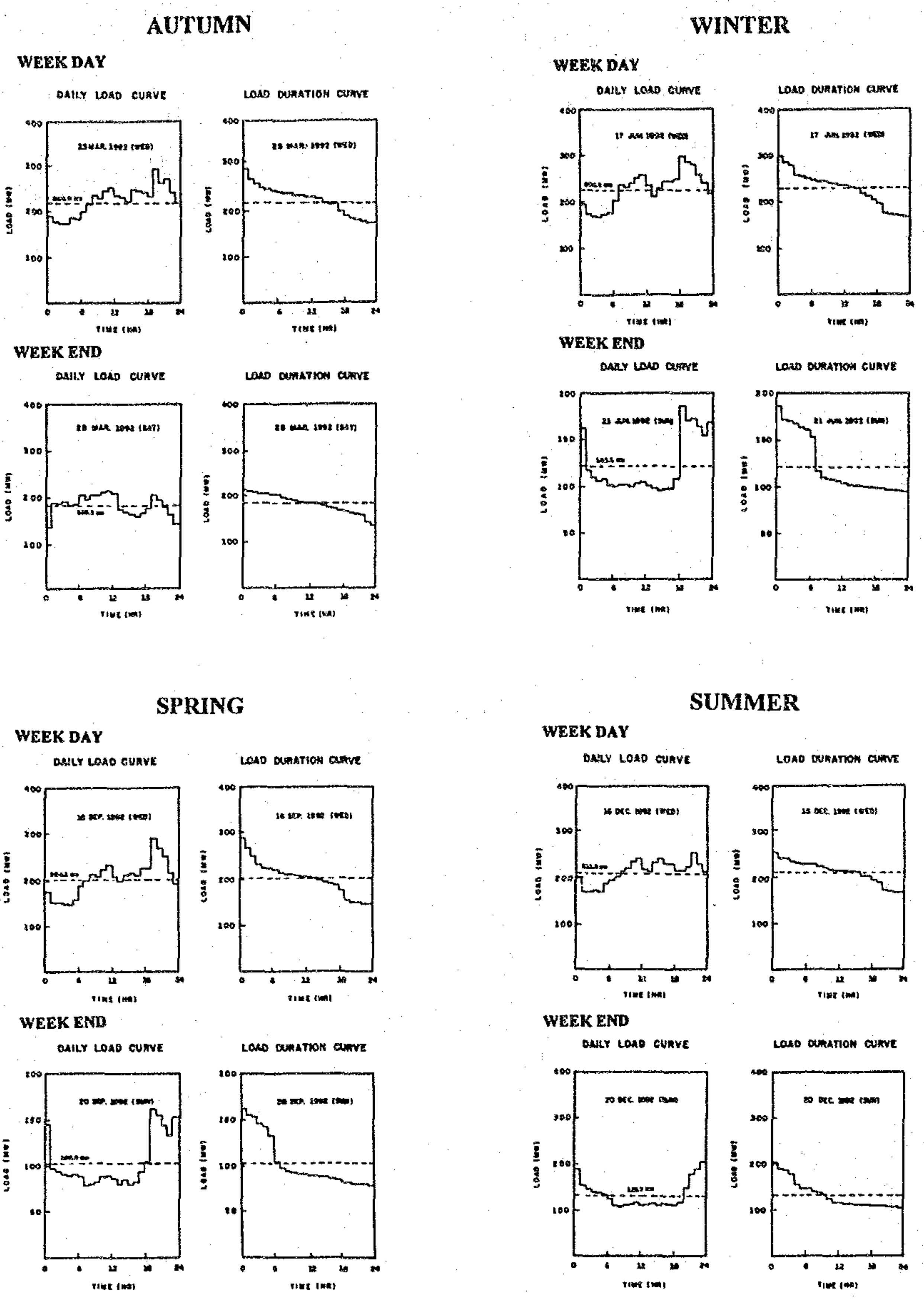
Fig. V.3.3

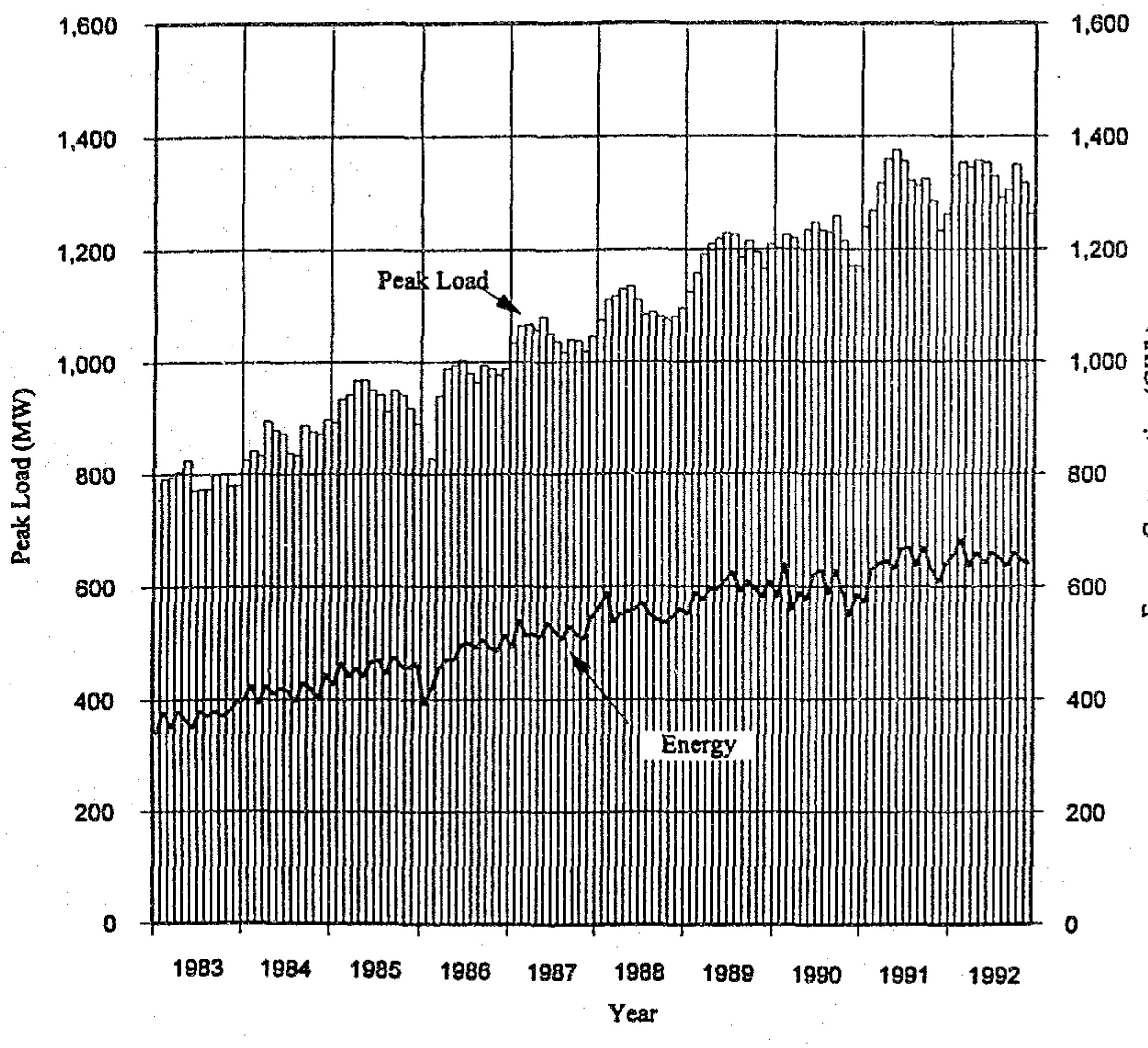
Transmission Network in Santa Catarina



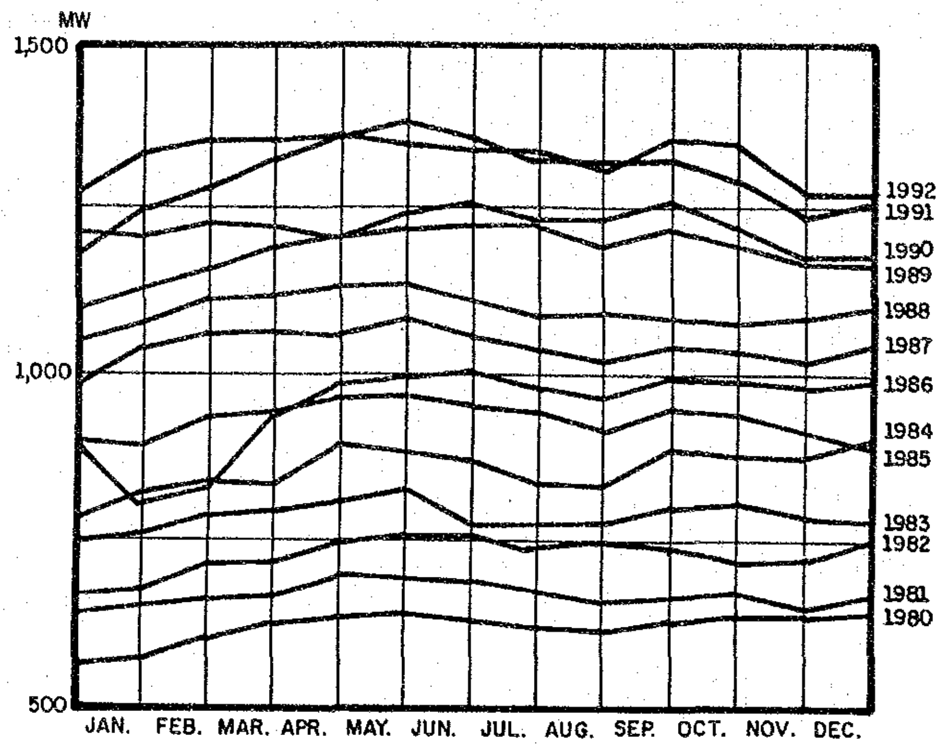
JAPAN INTERNATIONAL COOPERATION AGENCY CENTRAIS ELÉTRICAS DE SANTA CATARINA S.A.,BRAZIL SALTO PILÃO HYDROELECTRIC POWER DEVELOPMENT PROJECT	**Fig V.4.1** **Daily Load Curves of CELESC System**



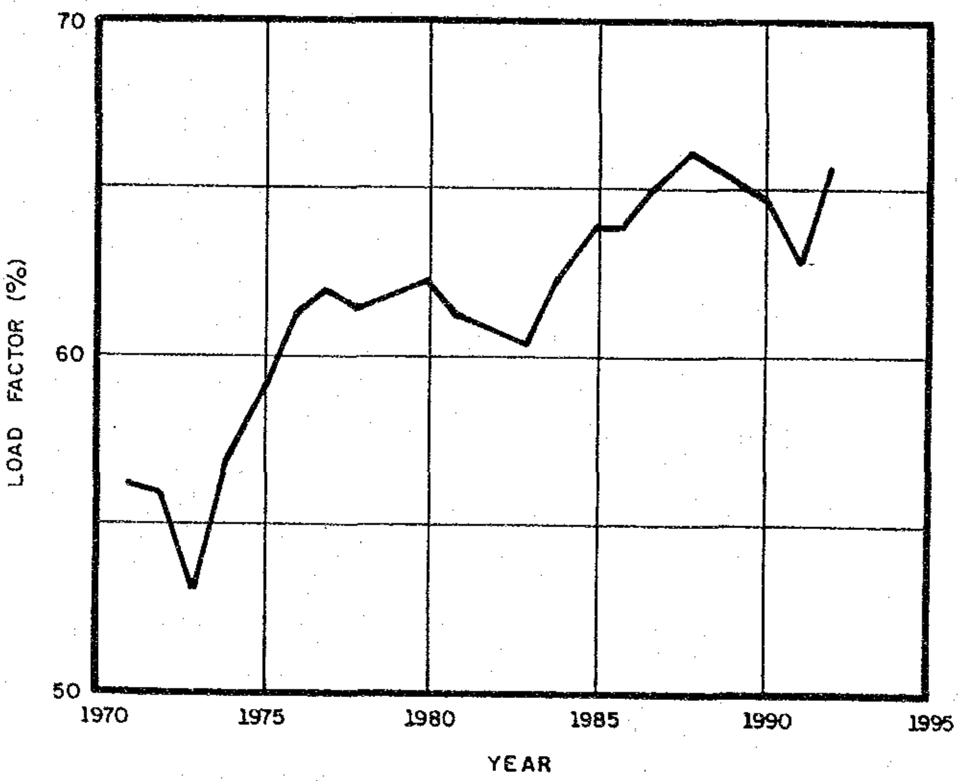
JAPAN INTERNATIONAL COOPERATION AGENCY CENTRAIS ELÉTRICAS DE SANTA CATARINA S.A.,BRAZIL SALTO PILÃO HYDROELECTRIC POWER DEVELOPMENT PROJECT	**Fig. V.4.2** **Daily Load Curves of Itajaí Sub-network**



JAPAN INTERNATIONAL COOPERATION AGENCY CENTRAIS ELÉTRICAS DE SANTA CATARINA S.A.,BRAZIL SALTO PILÃO HYDROELECTRIC POWER DEVELOPMENT PROJECT	**Fig. V.4.3** **Variation of Monthly Loads of CELESC System (1983-92)**

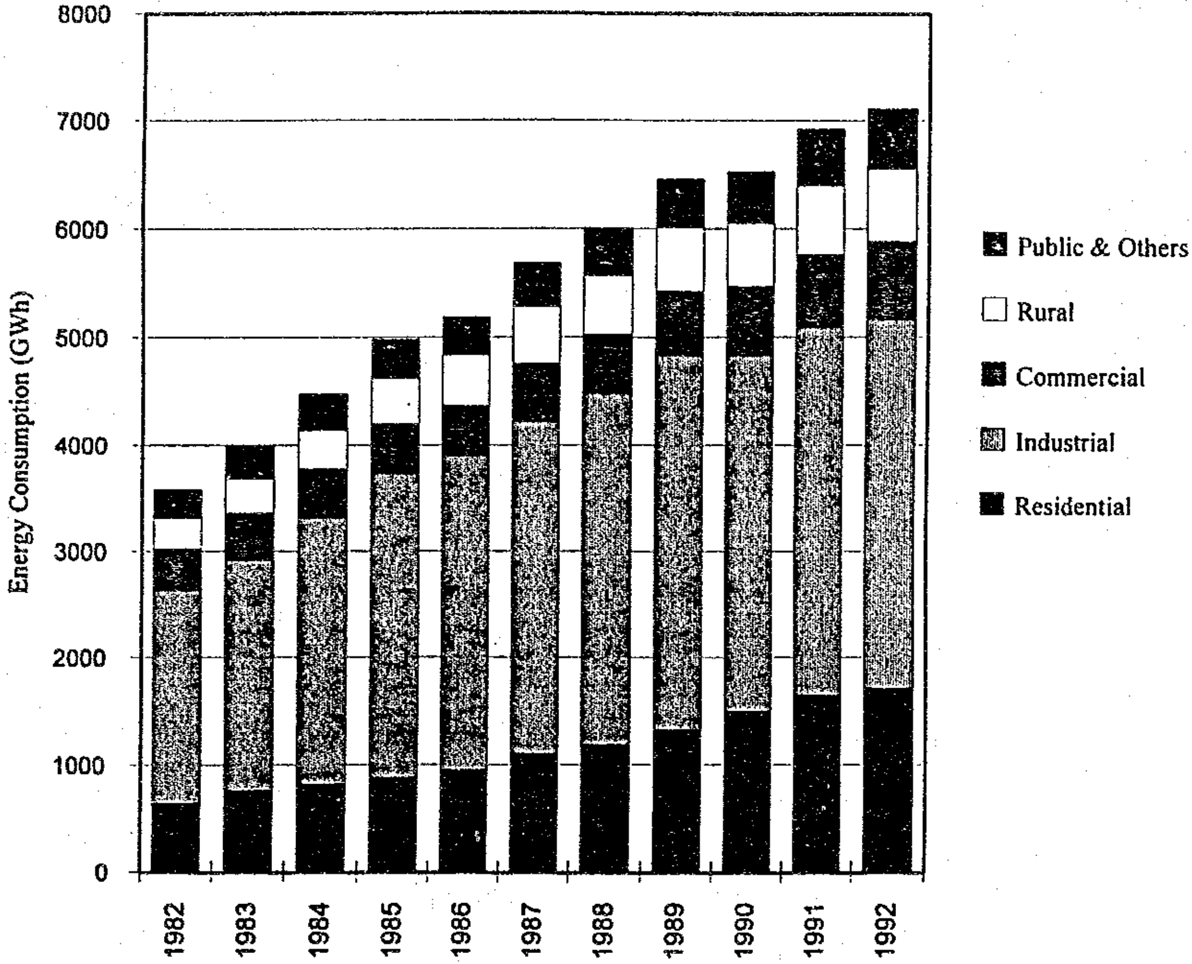


CHANGE OF MONTHLY PEAK DEMAND IN CELESC (1980 - 1992)

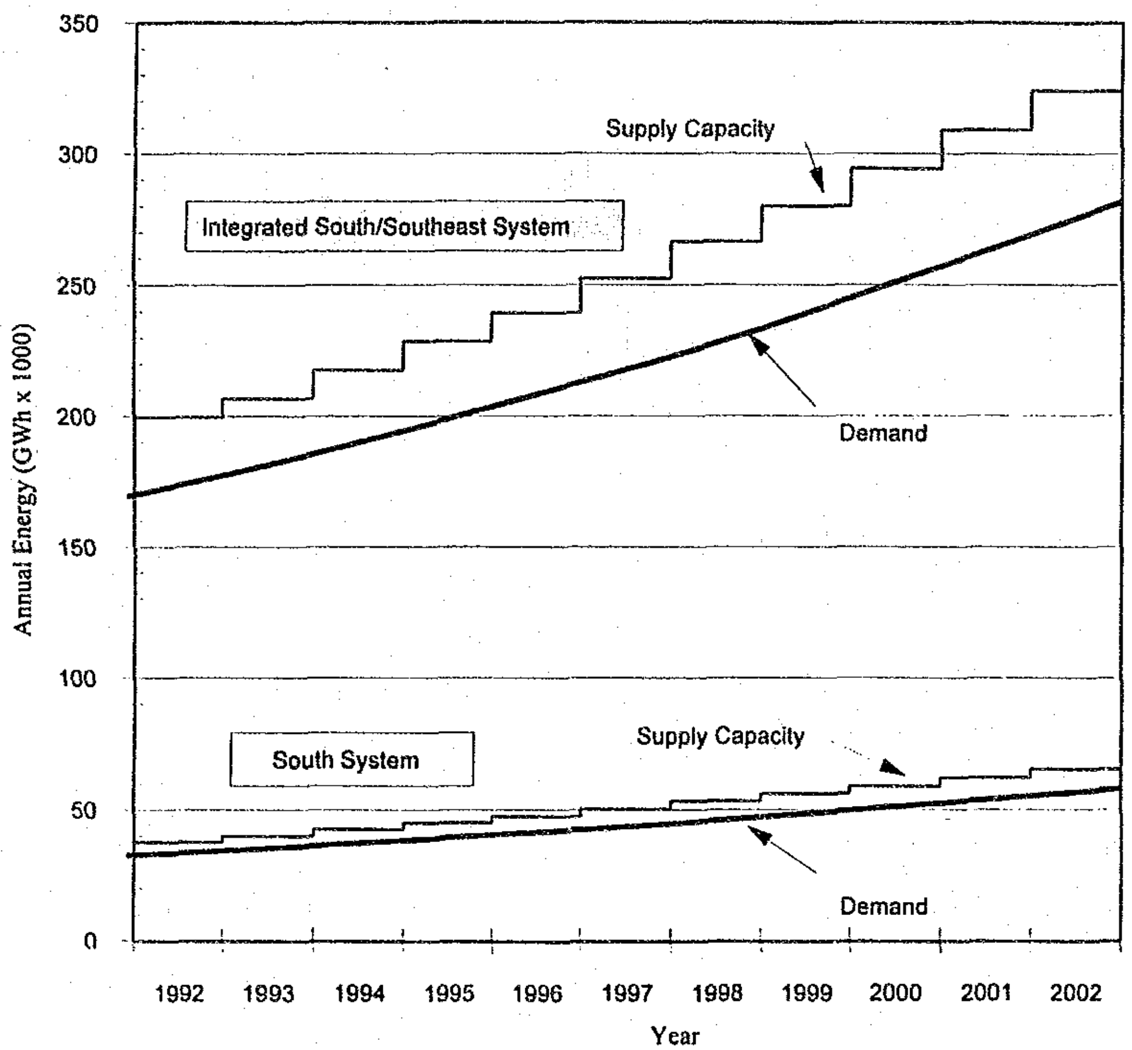


CHANGE OF ANNUAL LOAD FACTOR IN CELESC (1970 - 1992)

JAPAN INTERNATIONAL COOPERATION AGENCY CENTRAIS ELÉTRICAS DE SANTA CATARINA S.A.,BRAZIL SALTO PILÃO HYDROELECTRIC POWER DEVELOPMENT PROJECT	**Fig. V.4.4** **Change of Monthly Peak Demand and Annual Load Factor in CELESC**

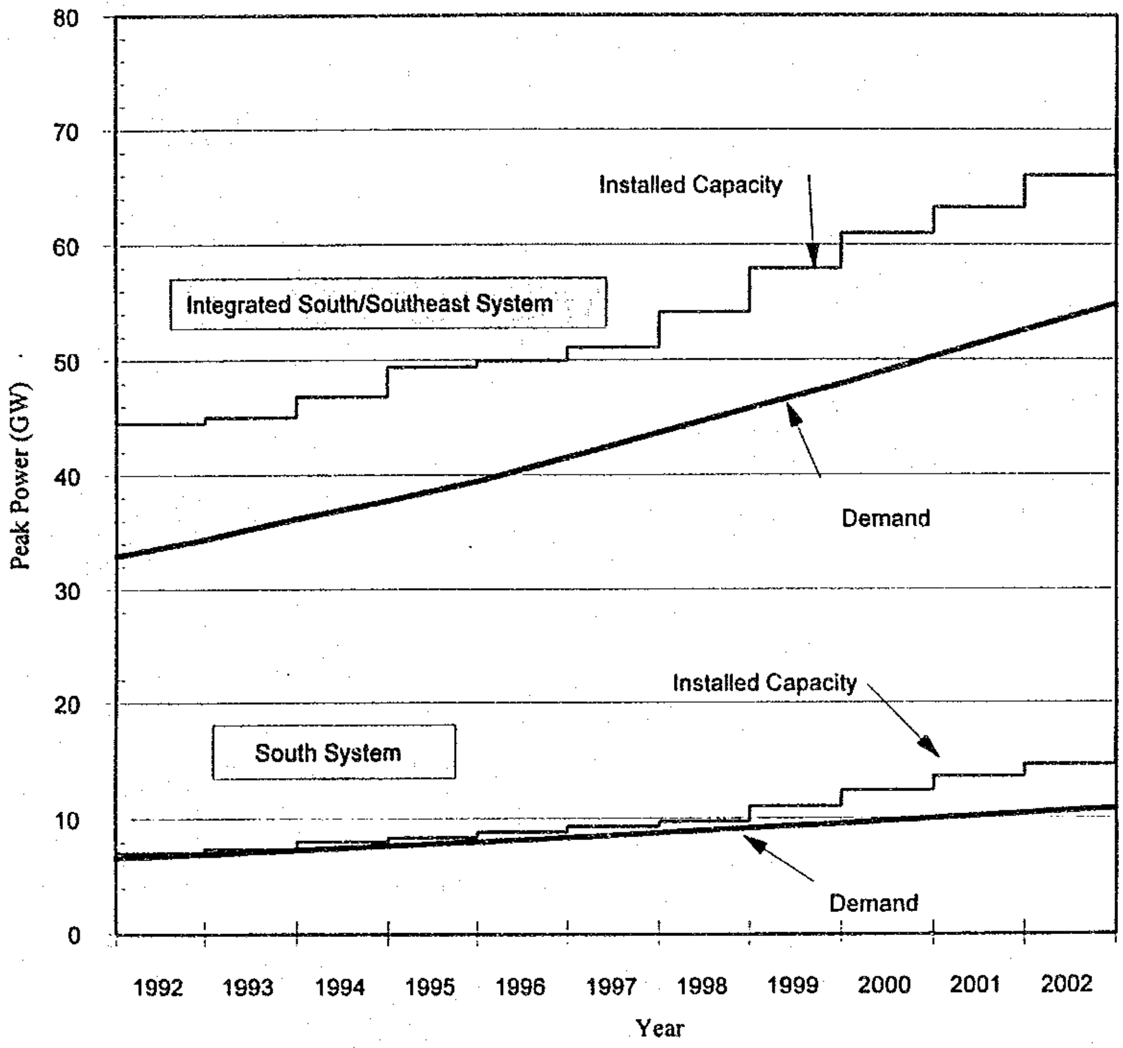


JAPAN INTERNATIONAL COOPERATION AGENCY CENTRAIS ELÉTRICAS DE SANTA CATARINA S.A.,BRAZIL SALTO PILÃO HYDROELECTRIC POWER DEVELOPMENT PROJECT	**Fig V.4.5** **Annual Energy Consumption by Sectors in CELESC System (1982 - 92)**



JAPAN INTERNATIONAL COOPERATION AGENCY
CENTRAIS ELÉTRICAS DE SANTA CATARINA S.A.,BRAZIL
SALTO PILÃO HYDROELECTRIC POWER DEVELOPMENT PROJECT

Fig. V.6.1
Energy Demand and Supply Projection for South/Southeast System



JAPAN INTERNATIONAL COOPERATION AGENCY CENTRAIS ELÉTRICAS DE SANTA CATARINA S.A.,BRAZIL SALTO PILÃO HYDROELECTRIC POWER DEVELOPMENT PROJECT	**Fig. V.6.2** **Peak Power Demand and Supply Projection for South/Southeast System**

ANNEX VI

ENVIRONMENTAL STUDY

ANNEX VI ENVIRONMENTAL STUDY

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ATTACHMENT

STUDY ON RIVER MAINTENANCE FLOW VI-A1

1. INTRODUCTION

Comparative study on selection of dam axis was make for three alternative sites, namely dam axes B, C and D from the technical and financial aspects and it has been decided to adapt the dam axis B. Based on this decision, definitive paln for the related intake site, headrace tunnel route and power house site were determined.

The purpose of this environmental impact assessment (E.I.A) study was to identify and predict the impacts of the Salto Pilão hydropower project, on the natural and social environments and to propose mitigating measures for the effects to the project.

This E.I.A was made based on the environmental impact study (EIS) performed by the local consultants of AMBIENTAL Consultora de Planejamiento, and the direct observation and reconnaissance and incorporating the related information such as photo interpretation and map plotting performed by the environmental expert of the JICA team in this present study. The project activities and locations that are different from those defined in AMBIENTAL's study as presented in March 1993 to the JICA team were also reflected to the study. In the course of the study, alternative sites for the dam and their work activities were also assessed for comparison purpose.

2. NATURAL AND SOCIAL CONDITIONS

2.1 Physical Environment

2.1.1 Climate

The Itajaí valley region is characterized by a subtropical rainy climate with dry and rainy seasons. The valley in the Itajaí river basin is kept from the cold and intense winds that blow from the southwest, and the oceanic cold air masses come from the southeast. The annual rainfall is between 1,300 and 1,500mm in the central area basin, and 1,600 to 1,800mm in the highest regions, situated northwest and southwestwards. The average annual rainfall for the basin ranges between 1,500 and 1,600mm. In the surroundings of the Salto Pilão Hydropower site, the average annual rainfall is 1,530 mm.

The annual mean temperature oscilates between 18-21 °C, the maximum means of 25 °C occurs in January - February, and the minimal of 15 °C in July.

The annual mean relative moisture reaches its peaks of 85.7 % in Itajaí, and the lowest values of 77% in Indaial. The highest values of relative moisture occur during the months of June to August.

2.1.2 Soils

The reservoir area in general is classified as red-yellow latosolic podsol type soils. They are mineral soils with fading waxy characteristics. Their colors are strong brown and yellowish red, with low natural fertility, with low contents of calcium and magnesium, moderate content of organic matter, and very low potasium content. These are insuficient for the normal development of most crops. They are highly acidic, with toxic content of aluminum.

The river stretch between the damsite and Itajaí do Norte can be divided into the follosing 4 main types of soil:

Section I: From the damsite downstream up to 1.5 km, and in both margins of the river, the soils are considered as those with restrictions for annual crops, regular aptitude for fruit growing and good aptitude for pasture and reforestation, the lands present high risk of degradation, high acidity, abundant presence of rocks.

Section II: From the downstream end of Section I up to 7 km, the soils are considered of lands which are improper for cultivation of any kind, including commercial forests, or any other crop of economic importance, extremely rocky and poor drainage.

Section III: From the downstream end of Section II and for approximately 1.5 km, soils are considered with aptitude for annual crops, with no or little limitations for degradation, slightly hilly topography, well drained

Section IV: From the downstream end of Section III until the intersection of the Itajaí do Norte river, soils for the right bank are considered improper for cultivation of any kind, including commercial forests, or any other crop of economic importance, extremely rocky and poor drainage. For the left bank, soils are considered as those with improper quality for fruit growing, regular aptitude for pasture and reforestation, not suitable for annual crops, but can bear permanent crops such as pasture and reforestation.

In general, the soil type in the powerhouse area is defined as Ferralic Cambisol, with moderate to high silt/clay ratio, calcium, magnesium levels are low, and potasium level is miderate, organic matter from moderate to high. They are strongly acid and aluminum which occur at toxic levels.

2.1.3 Topography

The Itajaí river valley makes up a peculiar part of the territory of Santa Catarina. It shows diverse geological structure and geomorphological expression. The valleys in this region are rather carved and have sharp declivity. This is a determining factor of the quick pluvial concentration responsible for the frequent floods in the region.

The topography of the Itajaí river basin differs from that of the northern part of Santa Catarina. Occurence of several sparse coastal ranges of mountains is a typical feature as well as the flowing towards the Atlantic Ocean. The declivity increases to 1:60 at the village of Subida and the Salto Pilão, allowing rapids and waterfalls. Between Subida and Blumenau the mean declivity is 1:500, wheraeas downstream from this city it decreases to less than 1:10,000, allowing the posibility of alluvial deposits.

In the upstream area of the Salto Pilão up to Rio do Sul city, the road lies again near the river, showing a wide valley of low declivity with alluvial plain dedicated to agriculture. On the right bank of the river the town of Lontras is located in a suitable area in the open valley.

2.1.4 Agricultural Soil Value

(1) Reservoir Site

The reservoir area is almost entirely composed of deep soils, with internal drainage which allows water runoff, good capacity for water retention, low natural fertility and moderate susceptibility to erosion. Most of this soils lay on strongly hilly topography, and so restricted to annual crops, and regular suitability for fruit growing, and good aptitude for pasture and reforestation. This class covers 55% of the area.

Suitable soils for annual crops cover 5% of the area, and 1/3 of this soils have very poor drainage. Soils with restricted aptitude for fruit growing compromise 6.5% of the area, and the water mass represents 20% of the area. The natural fertility is low, with low contents of calcium, magnesium, moderate organic matter, and very low potasium. Soils are highly acidic, with toxic contents of aluminum.

(2) Powerhouse Site

In the powerhouse area the rocks present, and 56% of the soils which are improper for annual crops, have regular aptitude for fruit growing, and good aptitude for pasture and reforestation. Twenty four % of the soils belong to soils improper for cultivation of any kind including forest or any other crop of commercial importance. Twelve % of the area belongs to soils of regular aptitude for annual climate adapted crops, with moderate risks of degradation. Eight % of the area belongs to soils with aptitude and restriction to fruit growing and regular aptitude for pasture and reforestation.

The soils have low natural fertility and are ferralic with low levels of calcium and magnesium moderate to high organic matter content, and strongly acid, and aluminum occurs at toxic levels.

(3) River Stretch between Damsite and Itajaí do Norte Confluence

There is no farming activity along this river stretch because of the steep slopes of the river banks. The soils for the first 1.5 km downstream of the damsite have high risk for degradation, strong limitations for annual crops, with rocky and hilly topography, and high susceptibility for erosion. The soils for the following 7 km are considered of lands which are improper for cultivation of any kind, including commercial forests or any other crop of economic importance, extremely rocky and poor drainage. The soils for the remaining stretch up to the Itajaí do Norte river confluence are considered improper for cultivation of any kind including commercial forests, or any other crop of economic importance.

2.1.5 Water Quality

The analysis of the campaign held by AMBIENTAL and DNAEE concludes that:

- The Biological Oxigen Demand (BOD) was always lower than 3.0ppm. It belongs to class 1 according to CONAMA resolution No. 20/86.

- Levels of Disolved Oxigen (DO) sampled were always above the minimal value required for the maintenance of aquatic life, characterizing good water quality.

- The values of ammonia nitrogen and total phospates appear at a higher concentration than those established by CONAMA resolution 20/86.

- Fecal and total coliforms in high contents reveal the existance of sanitary sewage from towns.

With a low BOD and a normal DO concentration, the levels of ammonia nitrogen to degrade to non toxic nitrates, especially when the conditions of the river offer rapid flows with high oxigenation in several stretches of the river. It forms slightly high phosphate concentration. Phosphate concentrations (0.002 - 0.53 ppm) will enhance the phytoplankton community, which will in turn affect the DO levels. Non the less the high turbidity of the waters throughout the year limits the light penetration and the phytoplankton develops.

The phosphorus concentration is probably related to the use of inorganic fertilizers in agricultural crops such as onions (Itajaí do Sul & Itajaí do Oeste) and rice (Itajaí do Oeste, Itajaí Açu), and the associated agricultural runoff from this areas.

2.1.6 Pollutant Sources

The total organic load estimated for the Itajaí river basin werewas at 880 tons BOD/day. This load is equivalent to a population of 16,000,000 inhabitants, which is 23 times the urban popullation of the basin.

The pollutant sources from the different activities were estimated as follows:

(i) From Industrial Activities; This activity contributes with an estimate of 86% of the total load, originating from textile, starch, metalmechanic and frigorific among others. Around 100 industries out of 2,500 are responsible for more than 80% of the polluant load.

The estimated load of 755tons BOD/day out of the main starch industries, plus an estimated chemical loads of 2.1 tons/year hg, 41 tons/year Zn, 0.4 tons/year Pb, 0.4 tons/year Ni, and 1.3 tons/year Cd was reduced to the estimated 76% by 1992 as a result of the controlling measures introduced to the industries. Pollution from industrial activities origin has been the only one receiving some kind of regulation.

In the upstream of the project area, an organic load of 156.4 tons BOD/day, equivalent to the disposals of a population of 2,900,000 inhabitants, and a reduction of 74% was achieved, after the implementation of the controlling measures.

(ii) From rural activities; The main rural activity generating pollution is the swine raising activity. This activity generates an estimated 10% of the total organic load for the basin, and an estimated 29% relative to the area upstream of the project area.

The pollutant sources from the different origins are as follows;

(i) From urban origin; In all the points analysed by DNAEE, polution due to sanitary sewage was found. The potential organic load is 4% of the entire Itajaí river basin. In the basin upstream of the project area, it was estimated at 3%. The main towns contributing to the sanitary sewage release are Rio do Sul, Lontras and Ibirama; although the sanitary discharge is done in an ineadequate way. However its levels are not critical due to the reduced population, but the situation is the most critical at the village of Subida, where nearly all residents release the effluents directly into the river.

(ii) From agricultural origin: The use of inorganic fertilizers, mainly in the crops of rice, tobacco and onions, contributes to the high levels of nutrients, specially phosphates.

2.1.7 Scenic Resources

In the upstream reaches of the town of Apiuna, outcropped rock walls and steep hillsides covered with secondary growth give room to the excavated canyons of the Itajaí river, where small tributaries flow into the Itajai river, through small waterfalls.

The highway upstream of Subida lies along the left bank of about 8 km long river stretch, and climbing about 100 m it crosses the steep hillsides, and many of them exploited for the extraction of masonry stone. In a following road stretch of about 6 km, the road passes through a strectch of easy topography and round shape hills, which are rich in granite areas, with crops and grasslands, with a background of mountain ranges of altitudes of about 800 m.

The landscape and topographic characters of the banks and proximities of the river offer steep gradients. In many cases a sort of canyon has some small tributaries which flow into the main river by way of small waterfalls. In this section, access is difficult.

Along the steep river banks igneous rocks are exposed with plenty granite boulders popping out throughout the hillside, many of them exploited or under exploitation for masonry stone. In these areas clearing by fire is common to expose the rock and find the quarries, leaving no vegetation cover.

In the upstream of the Salto Pilão, the road lies again near the river, and there are a wide valley of low declivity with alluvial planes, and crops such as casava, onion, tobacco and corn among others are grown. The town of Lontras is located on the right bank of the river. Ceramic industries have been common, taking advantage of sufficient materials obtainable in the clayey layer of the rocks.

2.1.8 Landscape Aspects

In the future reservoir area, the morphology is relatively gentle, consisting of round like hills with convex and no very steep hillsides.

In the powerhouse site the difference of altitude between the river side and hillside is more than 200 m. The hillside is steep in the upper part. This stretch probably corresponds to past slidings, accumulated at the foot of the hillside.

The proposed place for the damsite does not compose a typical scenery when compared with the traditional landscape of the Itajaí valley, which is made up of small rural establishments, spots of preserved forest, cultivated lands and pasture areas. There are several quarries over the hillside which is located in parallel with the river, and have seriously degraded the slopes.

The degradation of the landscape is caused mainly by deforestation and exploitation of granite. In respect to the actions to be performed by the project, it is estimated that the degradation of the landscape is of middle importance, due mainly to the effects caused by the construction of the surge tank and the exploitation of the quarry. These aspects will be further discussed.

2.1.9 Sediments

The specific sediment transportation has been estimated at 91.4 ton/km^2 per year, which is considered low. As a reference to this estimate, the hydroelectric project of "Usina Hidreletrica Xanxere" in Brazil, receives an estimate of 16,000 ton/km^{2}per year, on a 340 ha of reservoir area, and its estimated life span is considered to be 100 years, although it represents 175 times more sediment load than the estimated for this project.

2.1.10 Water Use

Most of the households in the upstream of the damsite depend on water from water wells, and water treatment is considered substandard.

In the directly affected area composed of areas belonging to the rural zone of the municipalities of Ibirama, Lontras and Apiúna, the water use is incipient, and there is some uses of water for irrigation in the upstream stretch of the damsite, and along the surroundings of the left bank, although its inconspicous quantities is corresponding to a few hectares.

2.1.11 Hydrogeological Conditions

In general, the geological formations found in the area do not have a great hydrogeological potential for the regional supply. The rocks of sedimentary basin have impermeable lithologies, and only the sandstones compose porous water holders, but they are not very thick, and are located in the upper levels with low retention capacity.

2.2 Biological Environment

2.2.1 Flora

(1) Aquatic Flora

There is no aquatic flora of economic or scientific interest in the area between the damsite and the Itajaí do Norte confluence. The suspended solids in the water column offer conditions for murky waters of low light penetration. For this reason the aquatic flora is poor.

(2) Terrestrial Flora

The exuberant vegetation in the Itajaí valley practically does not exist any more. The original primary forest gives place to the secondary vegetation.

Historically, the areas of Lontras, Ibirama, Apiúna, have been the areas dedicated to forestry activities and lumber extraction. The statistical data reflects the trends in the intensive use of this resource during 1959-1980. The clearing of the forest for the expansion of the agricultural area has disrupted the forest continuity, and altered the original conditions of the growth of vegetation in this area. There are isolated patches of secondary forest around the damsite. There are also small patches of reforested area, but the exuberant vegetation typical of the Itajaí valley practically does not exist anymore.

As shown in Fig. VI. 2.1, the project area is located in an area which is neither nucleus nor buffer zone of the atlantic forest ecosystem and is considered as the climax ecosystem of crucial importance for the maintenance of the genetic bank of plants and animals of this region. On the contrary, the area is classified as degraded.

In the reservoir area, most of the arboreal vegetation has been already removed. All the vegetation in the directly affected area is secondary type vegetation in several stages of regeneration.

In the river stretch between the damsite and the Itajaí do Norte confluence, the vegetation at the sides of the river is highly degraded due to deforestation and more recent burning by locals, in an effort to clear the bush, and expose the possible rocks that will give an indication of granite quarries to be exploited. The degraded vegetation along the slopes of the banks in this sector has none or very minimum relationship with the water source of the river. This is due to the steep slopes and the rather impermeable character of the soil in this area. Some patches of secondary forest are isolated by large open areas of grasses. These patches are associated with the small gulches where small tributaries flow, and they derive their water source from the tributaries, not from the river itself.

In the powerhouse area, the slopes are very steep and rocky and the vegetation is secondary.

Vegetation at the spoil bank areas is limited to grasses and bush, and all the spoil bank areas are degraded and offer no interesting flora of academic or commercial interest.

(3) Endangered Species

There are no endangered or protected species recorded or found in the reservoir site or the area between the damsite and the Itajaí do Norte river, and no species of commercial or scientific interest have been reported.

The project area is located at outside of buffer or nucleolus zones for terrestrial vegetation and the aquatic flora is incipient and almost non existing. The same is applicable to the power house site.

(4) Conservation Units

There are 15 conservation units in the Itajaí river basin (Fig. VI.3), protecting a total area of 26,580 ha, which correspond to 1.8% of the entire basin area. This structure implies a great environmental fragmentation. For controlling purposes, the remaining of the Atlantic forest has been divided into Nucleus Zone, Buffer Zone and Transition Zone. It is important to note that the whole study region for this project is not included in either of the control zones described.

2.2.2 Fauna

(1) Aquatic Fauna

River fish was more abundant in the past, according to local inhabitants, but as soon as the manioc starch production started during second World War, the population of fishes have been decreased due to pollution such as cyanic acid and solid residues from the lumber industry.

Recent surveys show the presence of 5 families and 12 species, with one family (cascudos) compromising 49.7% of the sample. According to the sampling and data available, it is probable that the dam will not become an obstacle to the migratory mechanisms since the fish species do not necessarily move through long distances in the water for their perpetuation.

The existing families of fish have a relative importance for the sport fishing activity although in the downstream ofthe damsite this activity is not prominent.

The local consultant surveyed the follosing three sites;

1 - Upstream the future damsite, near the Paraiso resort area
2 - On the axis chosen for the dam
3 - Downstream of the future dam, around 1.5 km from item 2

Five families and 12 species were observed. The most representative families were:

1 - Loricaridae representing 49.7% of the specimens captured,
2 - Characidae family represents 25.5% of the total,
3 - Pimelocidae family represents 13.7%,
4 - Cichlidae family represents 9.9%,
5 - Curimatidae family represents 1.2%

It was noticed that few species as represented by the Loricaridae family (cascudos) exist in exclusively limited area. The most representative family occur over all the area, showing species with great adaptive plasticity.

Captured species at the different sampling stations had total maximum lengths from 10.3cm to 29.1cm, with maximum weights from 13.39g to 259.72g respectively. There are no species of scientific or commercial importance.

(2) Avian Fauna

The Itajaí river is a habitat for an important population of birds. Some of them are progressively less abundant, non the less, the region of Salto Pilão for its most part and following the river upstream of the municipality of Lontras are completely altered. This fact together with the low impact due to small scale of the project offers no significant threat to the remaining bird populations of the region.

Since the project is located in a degraded area and outside the buffer and nucleus zones for the remaining vegetation of importance, the project does not entail a threat to the remaining population of birds.

(3) Other Wild Animals of Interest

(a) Mastofauna

Although there is no statistical data on the forest fauna in the municipalities studied previously, the region is characterized by a considerable human occupation, preventing to a great extent the occurrence of forests. At the same time, fauna has been hunted historically, associated with the livestock rearing, and in an effort to prevent the risk of loosing stock. The destruction of the forest habitat due to lumber activities and the expansion of the agricultural activity have eliminated the natural habitat for their subsistence. There are also records of the commercialization of forest animals in the municipality yearbook of 1957.

There is no evidence of mastofauna such as herbivorous animals and carnivors in this region according to the result of field surveys or information of local residents specially in the project area.

(b) Amphibians and Reptiles

The majority of the Itajaí valley has its forest cleared, or is covered with altered forests, where the light penetration has increased. Many species of amphibians and reptiles have elements of their habitats affected, and therefore disappear, depleting the environment of its original biological diversity.

The remaining forest are dicontinuous, and therefore do not allow the free traffic of organisms from one forest patch to another. With this fragmentation, the area is often insuficient to convey a poplulation, and the species disappear locally.

(c) Endangered Species

The discontinuity of the forest habitat throughout the region has contributed to the isolation and eventual disapearence of several species of interest once found in the area.

The project area is located at outside the buffer zones or any other category reflecting the natural forest regeneration process (refer to Fig. VI. 2.1). Due to this reason, there are no protected or endangered species which are found or have been reported in the area of interest. Since the project area is not covered with forest, it does not represent a sensitive or important habitat for species considerd endangered or protected.

2.3 Socio - Cultural Environment

2.3.1 Land Use

(1) Farming

There is no farming activity in the reservoir area. In the area of the water intake, the soil was used for agriculture, but is now abandoned.

There is no farming activity along the river stretch between the damsite and the Itajaí do Norte confluence, because of the steep slopes of the river banks. The soils for the first 1.5 km downstream of the damsite have high risk for degradation, strong limitations for annual crops, due to rocky and hilly topography, and high susceptibility for erosion. The soils for the following 7 km are considered as lands which are improper for cultivation of any kind, including commercial forests, or any other crop of economic importance, extremely rocky and poor drainage. The soils for the remaining stretch up to the Itajaí do

Norte river confluence are considered improper for cultivation of any kind, including commercial forests, or any other crop of economic importance, extremely rocky and poor drainage.

In the region of the surge tank, the soil is covered with a secondary forest, and the area for vegetation clearence is estimated at 1.1 ha. No agricultural activities are detected in this area. At the powerhouse area, the soil is covered with a field like vegetation and there are no agricultural activities in spite of its potential.

(2) Pasturage

The area of the reservoir surface is only 16 ha. Out of this area, narrow area of the adjacent banks (1 ha in total) will be submerged, and it basically comprises riparian vegetation, reforested area, or arboreal vegetation in isolated patches. No pasturage activity will be interfered in this area. Some cattle raising is done in the upper reaches of the slopes in the river stretch between the damsite and the Itajaí do Norte confluence. The activity does not dependent on the river water since the pronounced slopes present an obstacle for the animals to reach the water. There is no pasturage activity in the proposed powerhouse area.

(3) Recreation

On the upstream margin of the reservoir (axis B), a resort complex (Paraíso camping) operated by a landowner is located on the left bank. This area extends from the river side into hill along small stream. This complex is equipped with hotel, restaurant, swiming pool, play lots and other recreational facilities. The complex is located at scenic site where a waterfall on the Itajaí main stream is visible.

The use of the land for recreation in the left bank, 500 m downstream of the damsite (axis B) needs the relocation of 4 recreation houses and 3 pig houses of independent and private owners who spend weekends and holidays at their estate. These estates will not be directly affected by the dam.

There is a quarry located in front of the Paraiso camping site, on the right bank of the river. This quarry covers aproximately 1.6 ha.

There is no use of the land for recreation purposes in the river stretch between the damsite and the Itajaí do Norte confluence, because of the steep slopes of the river banks, the lack of vegetation and the high velocity of the river water.

(4) Dwelling

The dwellings located at 500 m downstream of the damsite (axis B) are recreational houses, used by their owners only during weekends and holidays. Only one of the dwellings belongs to a permanent resident of the area.

In the reservoir area including 100 m wide protection zone around the reservoir, three dwellings are located; one (L-1) on left bank near the Paraíso camping and another two on right bank 550 m upstream (R-1) and 350 m upstream (R-2) from the dam axis B, respectively.

In L-1, a family of 5 persons caltivating adjoining flat area dwells and the family is in charge of a guard of surrounding land including an island in the river entrusted by a land owener. In R-1, there is no permanent resident and the dwelling is used as a recreational house by its owner. In R-2, a family of 10 dwellers lives and caltivates land around the house. The land between the river and abandoned railway belongs to the goverment. In the spoil bank SB-1, there is a wooden house but no permanent resident.

There is no populations in the vicinity of the river banks along the river stretch between the damsite and the Itajaí do Norte confluence. Few isolated houses in the upper portion of the slopes do not use the river water for their subsistence, and the potable water is extracted from water wells.

At the powerhouse site, as part of the village of Subida, 10 estates are located in the influence area of the powerhouse site and a buffer area located in the east and west sides of the project area, aproximately 40 people, interrelated by family links and production means inhabit the area. Most of them directly related to the rock extraction in quarries, and several houses are located near the secondary municipal road, on the right bank of the river.

(5) Mineral Extraction

The mineral resources found in the region such as clay for ceramics and kaolin for masonry stone have low economic value. There are no mineral deposits in the project areas except for the hillsides of the powerhouse site, where granite blocks have been exploited for production of masonry stone.

The same is true for the river bank slopes located between the damsite and the Itajaí do Norte river confluence, where a severe degradation of the lanscape is evident due to the extraction of granite. Along the steep river banks igneous rocks are exposed with plenty granite boulders popping out throughout the hillside, many of them exploited or under exploitation for masonry stone. In these areas clearing by fire is common to expose the rock and find the quarries, leaving no vegetation cover.

2.3.2 Water Use

(1) Fishing

Sport fishing is popular in the upstream river stretch of the proposed damsite, and it is also the support activity for the camp site located at about 800 m in its upstream. The fish species sampled and recorded are very plastic and migrating upstream as well as downstream of the damsite. According to the information available, it seems that these species do not depend on a migration pattern to reproduce, feed, or complete a part of their life cycle. It is also believed that the creation of the reservoir will enhance the fish population in this area.

The river stretch between the damsite and the Itajaí do Norte confluence is characterized by rapid currents and high velocity, and murky river water throughout the year. A series of small waterfalls contributes to the main Itajaí river flow, as well as drainage from the small basins existing between the tributaries.

The high velocity of the water current offers no chance for sport or commercial fishing, and the area is considered poor by local fishermen.

(2) Irrigation

The directly affected area is composed of areas belonging to the rural zone of the municipalities of Ibirama, Lontras and Apiúna. The water use is incipient. There is some uses of water for irrigation in the upstream stretch of the damsite, and along the surroundings of the left bank, although it is inconspicuous quantities.

There are no uses of the water for irrigation in the stretch between the damsite and the Itajaí do Norte connfluence because agricultural activities are absent.

(3) Potable

Most of the households in the upstream of the damsite use water from water wells, and water treatment is considered substandard. There is no water use for municipal or industrial activities in the area directly related or affected by the project development.

(4) Recreational

In the upstream of the damsite, sport fishing activity is regular. There is a camping site located at about 1,000 m upstream of the damsite, which is regularly visited by sport fishermen and their families. Since some areas of the river in this stretch are suitable for swiming and water sports, this area is considered as valuable in terms of its recreation potential. It is believed that the formation of the resrvoir downstream of the camping site will enhance the turistic atractions of the area.

The river stretch between the damsite and the Itajaí do Norte confluence does not offer swimming places due to the high velocity of the water, and access is difficult due to steep slopes. Sport fishing is considered poor due to the strong currents. There are no tourist facilities along the river stretch, except for the Ilha Cotia (Cotia island), which is a tourist area located at about 8 km downstream of the damsite. This island has two houses for weekend rental and it is related to water sport activities such as swiming and fishing.

2.3.3 Population - Human Settlements

(1) Directly Affected Areas

The directly affected areas of the municipalities of Lontras and Ibirama are composed of 10 estates. Four of them in the municipality of Lontras (right bank) will be affected by the construction of the desanding basin and the spoil bank and 7 others in Ibirama (left bank) will be affected by the formation of the reservoir.

In the case of Subida, the rural estates in and around the powerhouse area will be affected by construction of the powerhouse, tailrace/substation, and surge tank. Ten estates were found composing the directly affected area of Subida in the surroundings of the powerhouse.

(2) Influence Area

(a) First Degree Area of Influnce

The most significative impacts would be distributed over a small part of the municipalities of Ibirama and Lontras, which will have a part of their land submerged due to the reservoir, as well as the municipalities of Apiúna caused by displacements necessary for construction of the powerhouse. These are considered as first degree area of influence. These municipalities of Ibirama and Lontras will have their resources increased due to the indemnification of the rural lands subject to submergence.

(b) Second Degree Area of Influence

Blumenau and Rio do Sul are considered to be second degree area of influence due to their political influence and their available infrastructure in commerce and services. No direct effect of the project actions is foreseen in these communities.

(3) Economic Activities

Manioc flour used to be the main product, together with sugar, coffee, beans, rice and the fishing activity was the basic food source of the population during the period of 1748-1850.

The agricultural exploitation for self supply, cattle raising and processing of agriproducts was the main activities during the period of 1850-1880.

Exploitation of coal, lumber activity and pork industrialization, along with the introduction of electric power marked the first phase of industrial development during the period of 1880-1914.

Consolidation of the coal mining, processing of celulose, paper, cardboard and wood; industrialization of mechanics, plastic materials and non-metalic minerals, and the expansion of agriculture and hog raising marked the period of diversified industrialization in the period of 1945-1963. The dynamization of the industrial sector marked the period between 1970-1980.

Between 1980-1990 known as the lost decade for Latin America, there is also an economic retraction, and the GNP reached only 50% of the average attained in the previous decade. The processing industry continues to act as a motive power in the state development.

The project will then be inserted in the acual economic retraction of the activities. The specific data related to the municipalities directly involved is as follows:

Ibirama (275 km²)

The economy is based on substantial farming, cattle raising and wood extraction. The industrial base is formed by foodstuffs such as starch, derivates, hog raising, dairy products and lumber. By 1960, the municipality had 11 types of processing industries, and 79 establishments.

There is an evident mechanization trend due to the rural exodus, and the different economic sectors are characterized as follows:

(i) Primary Sector: The natural vegetable cover of 34% of its area was lost. Agricultural products are predominantly manioc, sweet potato, corn, sugarcane, tobbaco and tabgerines.

(ii) Secondary Sector: Thirteen industries in the last 20 years closed. Majority of the lumber industry and the economically active population (EAP) increased from 115 to 4,625 in 1970-1990 period. This trend is explained by the growth of industries of clothing, footwear and textiles.

(iii) Tertiary Sector: It depends on farming and cattle raising, which in turn co-exist with the growing industrial sector.

Lontras (230 km²)

It is located in the upper part of the Itajaí river valley. Lontras presents a strong tendency to farming and cattle raising.

(i) Primary Sector: The agricultural structure consists of small extentions of land. Rural families are suffering from the migration of their children looking for better possibilities in the urban areas, non the less, they are keeping their properties and activities by mixing farming with small scale rearing. Natural woods and forests have been reduced from 6,079ha to 2,579 ha in 1980. Farming and cattle raising are incipient in this economic sector. The lack of storage facilities hampers the development of the sector.

(ii) Secondary Sector: Since the industrial performance is weak, it reflects in the 50% reduction in the number of industries in the 1970-1990 period.

(iii) Tertiary Sector: The development of the terciary sector is closely related to the demands of the primary sector. The tertiary sector has experienced periods of instability in the alst 20 years. There was a decrease of 52% of the establishments in the 1980's.

Apiúna (485 km²):

It is located in the Itajaí middle valley. Apiuna is experiencing a retraction of the agricultural activities, and a strong trend towards urbanization.

(i) Primary Sector: Since the agricultural structure consists of basically small properties, the production is small scale, with tobbaco, corn and beans as the representative products. Hog farming, cattle raising and apiculture are also shows present small scale.

(ii) Secondary Sector: Processing of products of extractive origin, farming and cattle raising, notably the extraction of oil, and lumber are the predominant industrial structure, which are restricted by environmental legislation at present.

(iii) Tertiary Sector: With the primary sector held back and an industrial development based on lumber firms. Apiúna has a tertiary sector reflecting this situation.

Rio do Sul (177 km²):

Is is the center of the previously analysed municipalities.

(i) Primary Sector: The agricultural structure is based on small properties. The local agriculture is short term cultivation of beans, corn, tobacco, rice, potatoes. Livestock is characterized by dairy herds and rearing of fowl and hogs, which form the income of the small agriculturists.

(ii) Secondary Sector: A significant expansion of the textile industry with an average of 4 companies per year reached 75 new industries in the 1970-1990 period.

(iii) Tertiary Sector: The sector increased 583 establishments in 1970, and 6,789 in 1990, Services presents a continuous increase, while commerce suffers from significant oscilations in the last two decades.

(4) Psychological Features

The psychological distress of this communities in respect to floods originates in the belief that the Salto Pilão is a barrier to the natural flow of the river, and the flood in the upstream of the proposed damsite will be accelerated due to construction of the dam. Due to this reason, the construction of a dam will be looked at as a barrier to natural river flow.

(5) Historical Patrimony

The occupation of the Itajaí valley started in 1850-1880 period and the economic evolution of Santa Catarina in 1880-1914 period with the advent of hydro-electric power. In the later part part of this period the first line of the Santa Catarina railroad was built, which mainly benefited the nuclei from Ibirama to Blumenau.

The identified cultural patrimony of the area of interest consists of the stretch of the former railroad which has been little altered, one can find a tunnel constructed by means of concrete and stone pitching technique.

This reminiscence of the first settlers of the area, which was mainly Germans and Italians, reminds of the origins of Blumenau and other nucleus cities of the Itajaí valley. The above remains of the railroad is surrounded by a beautiful scenery characterized by little human occupation, and offering a good possibility of restaurant as a recreational and historical sites.

3. DESCRIPTION OF PROJECT ACTIVITIES

3.1 Access Roads

Trunk access roads to the work sites are the existing federal highway BR-470 and the municipal road between Lontras and Subida (L-S road). Their usage in the project work is:

Old Lontras-Subida Road (L-S)

It will serve the transportation of workers from powerhouse and damsite to camp site, and total length is approximately 13.5 km. The road will also serve to access spoil banks SB - 11, 12, and 13, and the transportation of the crushed material for crushing plant to concrete batching plant..

Main Highway (BR-470)

It will serve to communicate the powerhouse site and spoil banks SB - 18 and 19, as well as with the concrete batching plant. It will also serve as alternative access to and from the powerhouse site, instead of using the south end section of the Subida community. In the dam area, it will serve to transport embankment rock material from the quarry C.

There are 18 access road alternatives (AR-1 to AR-18), in addition to the existing highway and municipal road to be utilized in the implementation of the project as shown in Fig. VI.3.1. All of them except two (AR-1 and AR-17) are existing rural roads that must be reinforced to accept the continuous traffic of vehicles and the heavy weight of the materials to be transported. Environmental aspects of those road alternatives are listed in Table VI.3.1.

In general terms, the re-conditioning of the existing roads, as well as the construction of the new access road AR-1 and AR-17 do not impose a significative environmental impact to the surroundings of the project area. The topography of some of these roads could allow a gravel finish instead of an asphalt finish, reducing the costs of the road re-conditioning. This aspect will be further discussed. An increment of traffic in the above mentioned roads can be foreseen, with the consequent increase in dust, noise and possibility of accidents, and environmental discomfort for the inhabitants of the surrounding areas. The overload of traffic for the road infrastructure will have an effect only during construction phase, so this is considered as reversible impact.

3.2 Quarry

Quarry "A" (Q-A)

This is a quarry proposed for the axis B scheme and is located at the opposite side of the river, in front of the Paraiso camping lodge, at some 1 km from damsite (axis B), and its hill is part of the landscape of the Paraiso camping area. The vegetation covering the hill is degraded and scarce, since a part of the hill consists of abandoned cropland. This quarry location imposes some concerns that the rock extraction will be a rather permanent activity throughout the construction period. This extraction will entail the use of explosives, noise, dust, and the eventual degradation of the landscape of the area directly in front of the camping area. as shown in Fig. VI.3.1.

Quarry "B" (Q-B)

This quarry is located at some 2.5 km downstream of the damsite (axis C) on the right bank of the river. The quarry could be accessed through a road that has to be constructed following the old railroad tracks along the river margin. The road access should allow for open spaces every 500m or so for detour use since the track is so narrow between the mountain and the river.

This quarry is directly related to spoil bank #21 (SB-21), to be used as disposal area for non rock materials extracted from the quarry.

Since the area in the slopes of the river bank where the quarry is located is highly degraded by deforestation, it does not offer natural conditions of interest, except in the gulches and depressions, where vegetation is evident and endemic, to protect them from the water runoff. This isolated patches of forest must be preserved, since they provide a natural seed bank of genetic material that could be used in the future to recreate the natural environment once existing in this degraded area.

Quarry "C"

It is located at the left bank of the river at about 600 m from the BR-470 highway, and some 5 km from the damsite through the access road leading to spoil bank #5 (SB-5). This quarry is proposed for embankment materials for dam. This quarry is the existing one and is located at about 300 m long and 40m high hilly area where rock is exposed. It is also located in a degraded area where only grasses are evident as shown in Fig. VI.3.1.

Crushing Plant #1 (CP-1)

It is located near the quarry A, at some 1 km from damsite (axis B). The estimated area is 50 m in width and 100 m in length. Vegetation in this area is mainly grasses with no flora, fauna or cultural values of interest.

Crushing Plant #2 (CP-2)

It is located near the quarry B, at some 2.5 km from damsite. The estimated area is 30 m in width and 120 m in length. The proposed area is located in a gulch, where isolated banks of endemic vegetation persist. This area is considered of importance as a genetic bank of vegetative material to be eventually used to the regeneration of the degraded adjacent areas. Alternative #3 as stated below is considered more adequate for the location of the crushing plant.

Crushing Plant #3 (CP-3)

It is located at some 500 m east of the quarry B, as shown in Fig. VI.3.1.through the secondary road leading to spoil bank #21 (SB-21). Because this area is deforested and degraded with no vegetation of interest, it is considered more adequate for the installment of the crushing plant.

3.3 Spoil Banks

These are 21 alternatives of spoil banks to be used as disposal areas of materials excavated in project construction, as shown in Fig. VI.3.1. Environmental aspects of those spoil banks are listed in Table VI.3.2.

3.4 Construction Camp, Office and Concrete Plant

(1) Construction Camp (CC)

This is an area of auxiliary services, a center for living quarters, dinning room, medical assistance, and others of the like. It is an area for sanitary disposal, soaps and kitchen disposal as a result of the presence of approximately 400 persons (200~300 persons permanently) for an approximate period of 3~4 years.

Special considerations should be given to the appropriate environmental and cultural assimilation of this population such as proper treatment of sanitary and soap effluents, recreation, prevention of transmissible diseases etc.

The site is proposed to be settled in approximately 2.8 ha of relatively flat and in undulated land, located at some 1 km from the damsite. The area is close to the old Lontras-Ibirama road, or approximately 6 km from the powerhouse site.

The area is deprived of its original vegetation, and it is actually used as pasture land. There is no dwelling nor house in this area.

(2) Central Office and Storage (OS)

This is located at some 500 m apart from the damsite on undulated hill near the construction camp. The area required is aproximately 2.7 ha. The old Lontras-Subida road passes in this area. The area is also deprived of its original vegetation and its is actually used as pasture land. There are 2 old wooden houses of approximately 80 m^2 and 2 wooden warehouses of 40 m^2 each in property.

A southern part of this area is to be used maily for offices of project owner and contractors. The remaining northern part is to be used as storage space for construction materials including concrete aggregates.

(3) Powerhouse Construction Office (OA)

An alternative office area (OA-1), located at some 1.1 km apart from the powerhouse site is an area of narrow space surrounded by steep mountain slope and river side and is close to very small wooden houses along a deteriorated secondary road subject to heavy erosion in the rainy season.

Another alternative site (OA-2) at about 1.3 km apart from the damsite is located in a flat area of pasture land, and close to spoil bank #13 was considered suitable. The estimated available flat area is 2,000 m^2. (refer to Fig. VI.3.1)

(4) Concrete Batching Plant at Powerhouse Site

An alternative concrete batching plant site BP-1 is located at 500 m apart from the powerhouse site and near the bridge in the BR-470 highway. The area is occupied by 3 brick houses of about 150 m^2 and family complex with integrated agriculture of vegetables, pigs, oxidation pond, cattle and includes a well established family complex with their economic activities.

Another concrete batching plant site BP-2 is located at some 800 m from the powerhouse site, and some 300 m away from the entrance to the BP-1, near the BR-470 highway. The area is flat with 6,000 m^2, and on an straight stretch to the highway. It has a small restaurant-lanchonete in bad condition with area of about 100 m^2, and a tire repair center in bad condition of about 60 m^2. These facilities have to be relocated. No major problem is foreseen in this action and the compensation cost is estimated to be much lower than BP-1.

(5) Concrete Batching Plant at Damsite

Concrete batching plant site BP-3 at the damsite is located at some 500 m downstream of the damsite, on the right bank side of the river. Vegetation consist of grasses without any agriculture, and the area has no significant resources or values, and no flora, fauna or cultural resources of interest.

3.5 Cofferdams

Cofferdams has been planned for the safe construction of the main dam. It will lay transversely to the river, and with a horseshoe alignment, to enclose an area of approximately 2.5ha, alternating from right bank to left bank and always allowing the free flowing of the river through an approximate width of 100m.

There is no house to be relocated in case of the dam axis B. However, in case of the dam axis C , seven estates must be relocated. Six of these estates are summer vacation houses, and only one belongs to a permanent dweller, who takes care of the maintenance of the rest of the houses, and has additional edifices such as hen house and pig house. Eventually this area will be submerged by the reservoir waters. These houses are located at the left bank and the owners are aware of the relocation situation, and do not present any problem to this mater.

3.6 Dam Site and Reservoir Area

The reservoir to be created by the implementation of the project is substantially negligible small compared with other hydroelectric projects in Brazil. This characteristic offers a high water exchange performance, which is positive to avoid the accumulation of nutrients that could generate an eutrophic condition for the water quality.

The localized impact of the impoundment is minimal, beacause the influence stretch due to creation of the dam extends to only 800 m upstream of the damsite.

The volume of the reservoir (axis B) is approximately 0.3 million m^3 with an area of about 16 ha. The areas to be submerged are degraded areas with acid soil conditions. In general, the area to be affected shows a high degradation level because of deforestation and thus the impact degree is considered low.

3.7 Water Intake

It is planned to construct the water intake on the right bank beside the dam. The land except steep slope area is presently used for cultivation. The project actions in this stretch will include the desanding basin, portal of the headrace tunnel and headrace culvert. Area of excavation will occupy about 3 ha.

3.8 Headrace Tunnel

Headrace tunnel will have about 6 km in length. It is aligned with an initial depth of 17 m below surface level, and an average depth of 100 m throughout the tunnel. This work will not exert any impact on the existing environment since it will be constructed in underground.

3.9 Surge Tank

The surge tank is located almost under ground at the end of the headrace tunnel, 35 m before starting the descent through the penstock line towards the powerhouse. The structure is exposed and it is located in an area where the vegetation is well preserved with very steep slope.

Due to construction of the surge tank, clearing of the vegetation becomes more conspicuous, since it is well preserved in this area. It is estimated at 1.1 ha, including the access road. Since the area to be used is considered small, the impact will be minimum.

3.10 Penstock Line

The penstock line comprises about 174 m long vertical shaft and about 370 m long horizontal tunnel.

3.11 Power House and Tailrace

The powerhouse is located near the secondary municipal road and about 10 estates, are located in the powerhouse site. The estates have dwellings belonging to peoples that permanently inhabit in this area.

The houses are very close to the location of the powerhouse and will be exposed to the heavy traffic and construction activities entailing the powerhouse construction, such as blasting, heavy traffic, dust, noise and possible exposure to avalanches that might be generated by the explosive activities.

The tailrace is open canal from the powerhouse to the river to release the water tsed for power generation. It runs for about 80 m, and discharges into the existing river. Consideration should be given to the angle of discharge and protection for the possible erosion of the river bank at the opposite side of the river bank.

4. IDENTIFICATION OF SIGNIFICATIVE POTENTIAL IMPACTS

4.1 Physical Environment by the Project Activity

4.1.1 Scenic Resources

In respect to the activities to be performed by the project, it is expected that the degradation of the landscape is of middle importance due mainly to the effects caused by the construction of the surge tank, the possible exploitation of quarry A, and the effects of the river flow reduction on the island tourist resort. The quarry is located at the opposite side of the river in front of the Paraiso camping lodge, at about 1 km upstream of the damsite. The exploitation of this quarry will entail the use of explosives, noise, dust and the eventual degradation of the landscape directly across the camp site. These effects are considered as long term actions of direct effect on the camp site scenery, and negative for the development of activities. The construction of the surge tank needs open excavation of the mountain slope where the vegetation is sell preserved.

The reduction of the river flow to a river maintenance flow will have a potential impact in the water level surrounding the island tourist resort located at about 8 km downstream of the damsite. A reduction of flow and a decrease in the river turbidity are expected around this area. It is expected that this condition will enhance the use of the water resource by the turists because the strong current does not allow major use of this resource at present. This impact is considered irriversible to the actual condition, although it is possible to mitigate the impact and to make positive for the existing touristic facility.

4.1.2 Topography and Landscape

The proposed place for the project does not compose a typical scenery when compared with the traditional landscape of the Itajaí valley which is made up of small rural establishments, spots of preserved forest, cultivated lands and pasture areas. A large part of the vegetation of the area is altered, and there are several quarries over the hillside located in parallel with the river and these will cause serious degradation of the slope. In the area of the future reservoir, the morphology is relatively gentle, consisting of round like hills with convex and not very steep hillsides.

The proposed reservoir will only have 0.16 km^2, and the extent of the impounded water level will only reach some 0.8 km upstream of the damsite. This impoundment is considered very small with a very fast turnover rate for the impounded water and only a few properties are to be submerged.

The environmental impact is mainly represented by the number of households and acreage of land to be affected by the creation of intake, desanding basin, dam and construction of other project facilities. The area of submerged land is estimated at 4 ha, and the total number of affected properties is considered minimum.

4.1.3 Soils

Most of the soils in the reservoir area are of hilly topography restricting annual crops with good aptitude for reforestation and pasture. It is estimated that there is no land suitable for annual crops. The potential impact on the soils of this area is considered to be no significant.

The powerhouse area consists of 56% of the soils with improper quality for annual crops, and 24% of the soils with improper aptitude for any kind of crop. The area to be used by the project is 13-14ha, and the potential impact for the soils of this area due to the project activities are considered no significant.

In the spoil bank areas, the soils are dedicated to pasture and grasses. The topography of the areas have a steep gradient and no species of commercial or scientific interest are found or reported. Besides, these areas represent no significant subsistence of economic activities for the actual owners.

Some proposed spoil banks have been rejected because of the presence of altered primary vegetation patches in these areas. Such vegetation patches must be preserved as genetic banks for future reforestation. In general terms, the spoil bank areas will receive a posterior treatment to recover the landscape value of the areas to be used as dump sites.

The immediate effect of the activities will be an elevation of the level of the ground due to the filling by disposal materials and it is foreseen that the land value for use of these spoil banks will be increased for future construction purposes.

4.1.4 Water Quality

During implementation of the project, the main effect on the water quality is the increase in the water turbidiness, and the consequent effect the river downstream. This effect is considered to be of medium importance, due to the fact that the turbidiness of the river is already high throughout the year, and the associated communities are already adapted to this condition.

For the specific case of the reservoir area in terms of its physical and operational characteristics, it is considered that the water mass will be well mixed, avoiding stratification, and the absence of stagnation of the water mass will not provide deleterious effects on the water quality derived from an eutrophic condition.

No industrial activity or urban settlement exists in the stretch between the damsite and the Itajaí do Norte confluence, No water use for industry, agriculture or other human uses are detected, and no pollutant sewage, sanitary, agricultural or industrial are recorded or found to be released in the river.

Due to these facts, the water quality of this river stretch is not expected to be deteriorated since no sewage effluent is detected that requieres dilution.

4.1.5 Surface Water Hydrology

The most significant impact on the surface water hydrology is the expected reduction on the river maintenance flow between the damsite and the Itajaí do Norte confluence, in the stretch of 10.2 km.

4.1.6 Mineral Resources

No mineral resources are foreseen to be affected by the project activities. The mineral resources found in the area are only clay for ceramics and kaolin for masonry stone, and these have low economic importance.

Only in the hills of the powerhouse site, mineral deposits such as granite blocks are exploited. The impact on the mineral resources of the powerhouse site due to the project activities is considered of little importance due to the small extent of the area to be affected. This impact is possible to be mitigated.

4.1.7 Roads

There are 18 access roads to be utilized for the implementation of the project (AR-1 to AR-18). All of them except two (AR-1 and AR-17) are existing rural roads that must be reinforced and / or widened to accept the continuous traffic of vehicles, as well as the heavy weight of the materials to be transported.

The actions of road improvement will not cause a negative impact on the environment since these are existing road, and no new areas will be opened through the construction of new roads. The exception is the road leading to the surge tank (AR-1) and to the penstock drainage adit (AR-17), which need to be constructed to access the project areas, and some deforestation is required, non the less, these areas are minimum and the extent of the roads is very short.

In general terms, the re-conditioning of the existing roads as well as the construction of the new access road does not impose a significative environmental impact to the surroundings of the project area. The topography of some of these roads could allow a gravel finish instead of an asphalt finish, reducing the costs of the road re-conditioning.

An increment of the traffic can be foreseen in the above mentioned roads, with the consequent increase in dust, noise, possibilities of accidents, and environmental discomfort for the inhabitants of the surrounding areas. The overload in traffic for the road infrastructure will have an effect only during construction phase, and this is considered a reversible impact.

4.2 Biological Environment

4.2.1 Flora

(1) Terrestrial Flora

This project site is located in an area which is neither nucleus nor buffer zone of the atlantic forest ecosystem from the viewpoint of the climax ecosystem of crucial importance for the maintenance of the genetic bank of plants and animals of this region. On the contrary, the area is classified as degraded.

In the reservoir area, most of the arboreal vegetation has been already removed. All the vegetation in the directly affected area is secondary type vegetation in several stages of regeneration. The vegetation to be removed for reservoir exists only on the river banks and on the islands located in the reservoir. This impact is considered irreversible, but of little importance due to the small area to be affected.

The vegetation cover at the sides of the river in the stretches between the damsite and the Itajaí do Norte confluence is highly degraded due to deforestation and more recent burning by locals for the purpose of clearing brush, and exposition of the possible rocks that will give an indication of granite quarries to be exploited.

In the powerhouse area, the slopes are very steep and rocky, and the vegetation is secondary. In the surge tank area the clearing of the vegetation is more conspicuous. The probable area to be cleared consisting of 1.1 ha, including the access road, is considered small, and the impact is considered of middle importance and reversible through a restoration plan for degraded areas.

Spoil bank vegetation is limited to grasses and bush and all the spoil banks are degraded. The impacts on the flora are not considered significant. Some proposed spoil bank areas that are covered with secondary vegetation in a recuperation stage have been excluded from the possible spoil bank areas.

(2) Aquatic Flora

There is no aquatic flora of economic or scientific interest reported for the river stretch between the damsite and the Itajaí do Norte confluence. The suspended solids in the water column is high, and there is low light penetration. For this reason, the aquatic flora is poor.

4.2.2 Fauna

(1) Terrestrial

The region is characterized by a considerable degradation. Due to this degradation, and the small dimensions of the project area, it can be said that the project will have a weak impact on the fauna which is still existing. The almost complete absence of forest in the directly affected area restrains to a large extent impacts on the terrestrial fauna. This impact is considered reversible and of little importance.

(2) Aquatic Fauna

The construction of the dam implies the transformation from a fast moving water environment to a slower water movement environment and alterations such as an increase in the preying rate, and alimentary habit change can be foreseen in the reservoir area.

In the downstream area, the possible impacts could entail a reduction in the submersible area, alterations on the habitat, increase in water transparency, and fish concentration near the damsite. As for the upstream impacts, an increase in the slow moving waters species can be foreseen.

Many of the above mentioned impacts will have their effects appeased. Only 800m stretch which is the longitudinal length of the created reservoir will be the extension of the transformation from fast moving to slow moving waters. There is no thermal stratification foreseen in the reservoir. The eutrophic conditions to be expected in the reservoir will not cause deterioration of the water quality because of the absence of stratification and there is no evidence to infer that the fish species existing in the river require migration to fulfill any of their vital functions.

The strongest impact on the ichthyofauna will be the flow reduction in the river stretch between the damsite and the Itajai do Norte confluence, causing organisms to become more vulnerable to climatic, hydrologic and ecological conditions. Non the less, because of the lack of qualification studies about these impacts, only a qualitative assessment has been possible to forecast the extent of the impacts. This impact is considered irreversible. The river maintenance flow strategy in the attachement states in detail this condition.

(3) Avian Fauna

The bird species in the project area are common, and usually found in degraded areas. Since the project will not affect the forest areas, and the extent of the project area is relatively small, the impact on the avian fauna is considered to be no significant.

4.2.3 Endangered and Protected Species

Since the project area is located at outside of buffer and nucleus zones and highly degraded, no species in the category of endangered or protected species are found or reported in the project area.

4.2.4 Sensitive Habitats

Due to the same situations mentioned in the above, there are no sensitive habitats are encountered in the proposed project area.

4.2.5 Significative Wildlands

Due to also the same situations as the above, there are no significant wild lands to be affected within the project area.

4.2.6 Species of Commercial Importance

The species of commercial importance found within the project area are fish species which are an attraction for sport fishermen upstream of the damsite. It is foreseen that the creation of the reservoir will enhance the population of fish and also increase population of the sport fishermen. The impact created by the reservoir is considered positive.

4.3 Socio-Cultural Environment

4.3.1 Land

(1) Farming-Agriculture

In the reservoir area, the areas to be submerged are minimal and do not involve important agricultural activities. The areas are mainly dedicated to non permanent leisure dwellings belonging to urban inhabitants. No major impact in farming or agricultural activities is foreseen in the reservoir area.

There is no farming activity along the river stretch between the damsite and the Itajaí do Norte confluence. Because of the steep slopes of the river banks, the soils downstream of the damsite have high risk for degradation, strong limitations for annual crops with rocky and hilly topography and high susceptibility for erosion.

(2) Livestock

Some cattle raising has been carried out in the upper portions of the river stretch between the damsite and the Itajaí do Norte confluence. The activity does not dependent on the river since the pronounced slopes present an obstacle for the animals to reach the water. No impact for the linestock due to the project activity is foreseen.

(3) Dwelling & Resettlement

The CONAMA resolution NO.004/05 deals with the pretection belts required for reservoirs for power generation, and considers a strip of land of 100 m horizontally measured from the highest level of the reservoir.

In the reservoir area including the 100 m wide buffer area along the reservoir margin, 3 houses are expected to be relocated. The house owners will receive indemnities for their losses including re-location costs of facilities and infrastructure. This impact is considered reversible. In the damsite area including intake, desanding basin and headrace culvert, there is no local dweler to be affected by the project.

In the powerhouse site, the construction works will cause a disturbance in the economic basis of the community, and the permanent risk of accidents because of the increased traffic of vehicles, dislocation of rocks caused by blasting, with noise and dust. The relocation of the houses will probably be the option to reduce these impacts. This action will then become the most serious socio-economic impact in the project implementation. This impact is considered of great magnitude, as the relocation will not only be physical, but it will also involve the alteration in the socio-economic dynamics.

The environmental impact is mainly represented by the number of households and acreage of land to be affected by the construction of project facilities. These are estimated as shown in Table VI.4.1.

(4) Public Uses

The public infrastructures will be affected by the works of the project and the municipalities relating to the project; Lontras, Ibirama and Apiúna will have the right to indemnity, deriving from the development of water resources with the purpose of generating electricity. This impacts are considered significant in the case of Lontras, medium significance for Ibirama, and low significance for Apiúna.

(5) Tourism and Recreation

In the reservoir site, the public use for recreational purposes will probably increase, especially for sport fishermen. This pole of attraction could be enhanced by the historical patrimony rehabilitation, providing a second pole of attraction for tourism in the vicinity area of the reservoir. This impact is considered positive for the community of the area. CELESC