FINAL REPORT

VOLUME III SUPPORTING REPORT

E. HYDROPOWER

STUDY
ON
INTEGRATED WATER RESOURCES DEVELOPMENT
IN THE CAÑETE RIVER BASIN
IN
THE REPUBLIC OF PERU

FINAL REPORT
VOLUME III
SUPPORTING REPORT

E: Hydropower

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Chapter 1 Introduction

1. Introduction

1.1 Background

Several studies were carried out on Cañete river basin aimed at regulation and development of water resources. Among the most important ones are the following:

- In year 1955, La Panadile Peruana S.A., ordered by Compañía Peruana de Irrigación, made a study on evaluation of several alternatives for seasonal regulation and/or water transfer from Mantaro river basin in order that the agricultural demands of Cañete Valley and requirements for extension of agricultural frontier in Concón-Topará pampas were met.
- In year 1950, Electricite de France as part of the National Electrification Plan in Cañete river basin identified and recommended the development and equipping of El Platanal Hydropower Station, including schemes of daily and seasonal regulation.
- In year 1966, Motor Columbus made the study "Hydropower Development in Cañete River Valley" ordered by Empresas Eléctricas Asociadas. Integrated development of hydropower resources in the basin were put forward in such study, based on two hydropower schemes (Yauyos and El Platanal Hydropower Stations) and regulation works in lakes located at the upper part of basin and water transfer works in lakes located in Mantaro river basin.
- In year 1978, Lahmeyer Salzgitter Consortium, as part of Evaluation of National Hydropower Potential studied hydropower potential of Cañete river basin and evaluated several alternatives of hydropower development made up groups of stations in cascade.
- In years 1985-1986, the association of Motor Columbus, ElectroWatt, Cesel, MotLima and Ipesa, ordered by Electroperú S.A. carried out the feasibility study of El Platanal Hydropower Station, taking into account seasonal regulation of lakes located in upper part of Cañete river basin.
- In year 1995, CyA Consultores SRL, ordered by SEDAPAL made the "Feasibility Study of Cañete river basin for Water Supply to Lima city" where diversion of water in excess to Lima city after being met requirements of agricultural and local urban uses was proposed, considering facilities plan of El Platanal Hydropower Station.
- Finally Cementos Lima within the framework of Electrical Concession law has been developing in last years the integrated project in Cañete river basin "El Platanal Hydropower Station and Irrigation of Uncultivated Lands

Concón-Topará" which includes two seasonal regulation dams, two hydropower stations and impounding works and diversion of waters to Concón-Topará pampas.

1.2 Objective

Main objective of this report is to submit the hydropower development plan which is part of Master Plan for Integrated Development of Water Resources in Cañete River Basin in accordance with agreement signed upon Japanese International Cooperation Agency (JICA) and the Services of Drinking Water and Sewerage of Lima (SEDAPAL).

In order to comply with this objective it is necessary first of all to analyze the legal and institutional framework of Peruvian electrical sector, and to evaluate present and projected electrical Supply and Demand nationwide and within study area.

Chapter 2. Nationwide Power Development

2.1 Legal and Institutional Framework

Electrical sector in Peru is ruled by the law of Electrical Concessions enacted 19th November, 1992 and its regulation approved 25th February of the following year.

Enactment of this law decided the role of the State in this sector turning from operator into investor, being in charge of normative, concession, regulation and supervision activities.

Within normative framework, it is mainly considered the following:

- Transformation of electrical sector structure by separating the electricity generating, transmission and distribution processes, limiting their duties and economical relationships among companies and of these companies with users by means of a tariff system that has as main objective to promote efficient management in operation and costs in this sector.
- Promotion of private investment stating basic conditions to guarantee investors´activities and to allow that any of sector activities may be carried out by individuals or legal entities, national or international, in accordance with stated Concession and Authorization System.
- Conditions under which electricity service is rendered, quality of service received by final users depend on not only of commercial operation but also of investments that will be made so as to improve supply system and facilities in general.

Institutions in charge of regulation of electric sector are:

- Commission for Energy Tariff (CTE) in charge of tariff regulation
- Economical System Operation Committee (COES) which organizes selling of energy in the system
- General Directorate of Electricity (DGE) of Ministry of Energy and Mining (MEM) in charge of normative matters and Referential Plan of Electricity.
- Controller Organism of Investment on Energy (OSINERG) in charge of supervising activities of sector.
- National Institute of Defense of Competence and Protection of Copyright (INDECOPI) in charge of look after free competence and consumer protection.

2.2 Interconnected Systems

Peruvian electrical system is composed of following system:

- two electrical interconnected systems,
- electrical isolated systems,
- self-producers which are mainly large mining and industrial companies.

Installed capacity of Middle North and South Interconnected Systems (SICN and SISUR) makes up more than 80% of installed capacity all around the country.

Middle North Interconnected System (SICN) covers coast strip from Marcona to Tumbes in the North and central area of the country from Ayacucho in the South to Aucayacu in the North.

South Interconnected System (SISUR) composed of interconnections of South-east systems (Cuzco, Puno and Apurimac) and Southeast (Arequipa, Moquegua and Tacna) since beginning of 1997.

These two systems, as shown in Figure 1, will be interconnected with Mantaro-Socabaya Transmission Line in the year 2000, setting up the National Interconnected System (SIN).

Installed and effective capacity in SICN and SISUR Interconnected Systems are shown in Tables 1 and 2.

2.2.1 Hydropower Generation

Hydropower generation capacity in Middle North Interconnected System corresponds to 16 hydropower stations with a total installed power of 2045MW and an effective power of 1771 MW. Companies with highest effective power in hydropower generation are Electroperú with 780MW, Edegel with 520MW, Egenor with 225MW and Electroandes with 165MW.

In South System, there are 9 hydropower stations with a total installed power of 314MW, however effective power is only 200MW due that Macchu Picchu Hydropower Station is at present out of service because of alluvium occurred in February, 1998. Egasa company is the one which has more stations (6 in total), being the most important one Charcani V Hydropower Station with an effective power of 135 MW.

2.2.2 Thermal Generation

Installed power of thermal station in the SICN sums up 1346 MW and total effective power 1254MW. The most important stations are Thermal Station in Ventanilla in charge of Etevensa with 493 MW of effective power, Santa Rosa

Thermal Station of Edegel with 260 MW, stations of Egenor company that sum up a total of 172MW, Aguaytia Thermal Station with natural gas of 155MW and Malacas Thermal Station with natural gas of 111MW, as well.

In the South System total installed capacity of thermal stations is 398MW and the effective power 341MW. The most important Thermal Station is that of Ilo in charge of Enersur of 261MW of installed power and 212Mw of effective power.

2.2.3 Transmission Network

According to Electrical Concession law, transmission systems are classified in two types of networks: main and secondary one.

- Main System: which permits generators to commercialize the power and energy at any bar of such system, is made up circuits that do not permit to identify flux in two ways and their tension levels are at the order of high to very high tension.
- Secondary System: which permits generators to be connected to Main System to commercialize power and energy or to permit supply to specific charges.

In the Middle North Interconnected System, length of transmission lines of main system is 982 km and that of the Secondary System is 5184 km.

In the South Interconnected System, length of transmission lines of Main System is 392 km and Secondary System is 1919 km.

2.2.4 Current Supply and Demand Balance

The total effective capacity and the demand in 1998 are compared in Table 3. It is observed that the effective power capacity has reserves of 43% and 32% in SICN and SISUR, respectively. As for energy balance, reserves are estimated at 38% and 28% in SICN and SISUR, adopting an average plant factor of 0.7.

2.3 Referential Plan of Electricity

2.3.1 Demand Forecast as of year 2030

Three levels of demand forecast, low medium and high forecasts, are usually prepared, taking into account of how the Gross National Product and population will grow in the future.

A medium forecast as of year 2030 for the National Interconnected System is 9,700 MW; 1998 Referential Electricity Plan made in 1998 by the Ministry of Energy and Mining (MEM) has given a forecast for the period between 2000

and 2010. Assuming an annual increase of energy demand at 4% and a load factor at 0.79, forecast is extended to the year 2030, as shown the Figure 2.

2.3.2 Expansion Plan of Power Generation Up to Year 2010

Plan up to 2003

Expansion plan of power generation for the year of 2000 – 2003 which is on the basis of Facilities Plan published in the "Procedimiento y Cálculo de la Tarifa en Barra" by the Commission of Energy Tariff in May, 1999 is shown in Table 4. According to the Electricity Concession Law, the MEM is in charge of the elaboration of Referential Plan of Electricity which includes this expansion plan of power generation for 4 years so as that Tariff Commission can estimate the tariff.. Additional capacity of 1,039 MW is assumed by the year 2003.

Plan up to 2010

According to the Referential Electricity Plan, the expansion of power generation depends on Project of Transportation of Natural Gas from Camisea to Lima. Therefore, in order to meet the increase of demand for the period 2003-2010, the following is proposed:

- transformation of the thermal station of Santa Rosa into a natural gas station,
- transformation of thermal station of Ventanilla into a combined system station, obtaining an additional capacity of 250 MW, and
- four turbo gas generator sets of 150 MW each.

In addition to this, transformation of the Aguaytia and Malacas Station into combined cycle system is also proposed in this Referential Plan in order to obtain additional capacities of 85 MW and 43 MW, respectively with the natural gas existing in the vicinity of those stations.

In general, the proposed generation plans for the year of 2003 – 2010 are currently at study stage, which technical characteristics will depend largely on the on-going bidding of Camisea Project.

As for the nationwide hydropower generation alternatives, temporary concessions were given in June, 1998 for development of 25 hydropower objects under Electricity Concession Law. Any concession, temporary or definitive, has been suspended since September 1998.

Chapter 3. Power Development in Study Area

3.1 Current Power Supply

Present situation of power supply in the study area is illustrated in Figure 3, as briefed below.

Area of Luz del Sur S.A.

Lima districts. Pucusana, Santa María, San Bartolo, Punta Negra, Punta Hermoza and Lurin and a part of Cañete districts (Chilca, Santa Cruz de Florez, San Antonio, Mala, Calango and Asia) area supplied by the distribution company Luz del Sur with 3 sub-stations (Lurín, San Bartolo and Bujama) and by means of a 60-kv transmission line coming from San Juan Sub-station, part of Center-North Interconnected System. Total installed capacity is 37 MW.

Area of EDECAÑETE

Districts of Cañete central area (Zúñiga, Pacarán, Lunahuaná, San Vicente de Cañete Imperial, Nuevo Imperial, San Luis, Quilmana and Cerro Azul) are supplied by the distribution company EDECAÑETE with the San Vicente Sub-station which is fed by a line of 60kv that comes from the Independencia Sub-Station, part of the Center-North Interconnected System, located in Ica department to the South of Cañete. The installed capacity is of 17 MW.

Area of Small Electric Existing Systems

Catahuasi district is supplied by a 60-kw hydropower mini-station.

Hongos, Cacra, Huangascar, Viñas, Madean districts are supplied by a 125 – kw hydropower mini-station.

Huancaya, Vitis, Tomás, Alis, Miraflores, Carania and Laraos are supply by a small electric system from the Chumpe substation of Electroandes electric system, part of the Center-North Interconnected System. The installed capacity of Chumpe substation is 0.4 MW.

Coayllo, Tupe, Lincha, Chocos, Azangaro, Colonia, Ayauca, Putinza y Tanta do not have electricity.

Present situation of power capacity and demand is shown in Table 5, which shows surplus in the Luz del Sur and Edecañete area, while deficit in the Small Electric Systems is due that 9 districts do not have any electricity service.

3.2 Present and Projected Demand up to 2030

The demand forecast of power and energy projected for the year of 2030 is shown in Table 5.

In estimating demand in the areas of Luz del Sur and Edecañete, annual growing rate of energy demand is assumed at 3%, and the present load factor provided by electricity companies are adopted to calculate power.

In estimating demand in the area of the Small Electric Systems, information from previous studies which include demand projections up to year 2015 was referred to and the projection for the year 2030 was made by adopting the same values of the growing rate and load factor of such studies.

3.3 Expansion Plan of Electrical Frontier

The MEM foresees 4 Small Electric Systems as follows:

- Small electric System Lunahuana.- which consists in the extension of the existing primary line from Zúñiga to Catahuasi and Tupe.
- Small Electric System Hongos : Stage II.- which consists in the extension of Villafranca Hydropower Station up to 250 kW and to extend the small existing system up to Chocos, Azangaro and Lincha. Also it proposes to interconnect this system with the small Lunahuana system in a close place to San Juanito.
- Small Yauyos System.- capacity of Chumpe sub-station will be increased up to 1.6 MW and small existing system will be extended up to Huantan, Yauyos, Colonia, Ayauca, Putinza and Tanta districts.
- Small Asia-Coayllo System.- existing primary line will be extended from Asia up to Coayllo, comprising Omas and Tauripampa districts which are out of study area.

With the above expansion plan of electrification, MEM intends to integrate all district capitals and most of the towns in the Study area into the National Interconnected System in the year 2000.

3.4 Hydropower Potential in the Basin

Cañete river has rather high potential of hydropower, indicating specific hydropower capacity at a value of 3,42 MW/km, which is one of the highest among those in the Pacific Watershed in Peru, as shown in Table 6.

Stretches of specific hydropower potential capacity higher than 10 MW/km are located between the elevation 2,650 and 825 masl, as shown in Table 7.

3.5 Hydropower Development Plan

Hydropower development currently under considerations are depicted on Figure 4.

1) El Platanal hydropower scheme being promoted by Cementos Lima deems to be the best development, comprising two storage dams (Paucarcocha and Morro de Arica) with 50 MW power capacity in the upstream reach and 220 MW run-off-river type power station in the downstream reach, utilizing a 600 m high head yielded by river bent and a steep slope of river stretch.
2) A storage dam tentatively named as Auco dam is being examined for the purpose to regulate runoff for M/I and irrigation uses. A power station would be able to be attached to the dam, which would yield power between 60 MW and 110 MW depending dam height.
3) A possible dam (tentatively named as Paruco dam) and power development is assumed at a location between Morro de Arica and Auco dam, which would yield power of about 50 MW

3.6 Evaluation of El Platanal Hydropower Project

Evaluation of El Platanal hydropower project was made within the framework of National Interconnected System.

The hydropower Stations: El Platanal (220 MW) and Morro de Arica (50 MW) are included in such project developed by Cementos Lima. Their main features are described as follows:

Total installed power	:	270 MW
Total peak power	:	270 MW
Energy in the System		
(Hydrology – Average Year)	:	1502 GWh
Energy in system		
(Hydrology – Dry Year)	:	821 GWh
Construction years	:	4
Start-up year	:	2004

According to the methodology showed in Annex 1, model of economical dispatching (PDE, in Spanish) has been used as follows:

- Year 2001 is considered as initial year for technical-economical analysis

- Two alternatives for expansion plan of National Interconnected System were prepared: “WITH Project” and “WITHOUT Project” making a supply-demand balance of the system with similar reserve margins (see table 8)
- Demand data, existing hydropower and thermal station data, investment data and date of starting-up of new electrical stations of each alternative of expansion plan are entered.
- With the PDE model, flows of operation expenditures are determined for the following cases (see Annex 2):
    - Expansion plan WITHOUT project
      Hydrocondition: Average year
    - Expansion plan WITH project
      Hydrocondition: Average year
    - Expansion Plan WITHOUT project
      Hydrocondition: Dry year
    - Expansion Plan WITH project
      Hydrocondition: Dry year
- The weighed economical flows that are shown in tables 9 and 10 are determined, considering the average year hydrocondition with an occurrence probability of 85% and the dry year hydrocondition with a probability of 15%.
- Finally Present Net Value as of 2001 of investment costs and costs of operation and maintenance for different updating rates were calculated, considering as benefits the updated costs of the alternative WITHOUT project and as costs those related to the alternative WITH project, the economical indicators that are shown in table 11 are determined.

TABLES

Interconnected Systems

Table N° 1
Central North Interconnected System (SICN)
1998

Company	Central	Type	Installed Power (MW)	Effective Power (MW)
ELECTROPERU S.A.	C.H. MANTARO	HIDROPOWER	798.0	580.0
	C.H. RESTITUCION	HIDROPOWER	210.4	200.0
	Sub - Total	*HIDROPOWER*	*1008.4*	780.0
	TOTAL ELECTROPERU		1008.4	780.0
EDEGEL S.A.	C.H. HUINCO	HIDROPOWER	258.4	240.0
	C.H. MATUCANA	HIDROPOWER	120.0	120.0
	C.H. CALLAHUANCA	HIDROPOWER	71.0	71.0
	C.H. MOYOPAMPA	HIDROPOWER	63.0	60.0
	C.H. HUAMPANI	HIDROPOWER	31.4	29.0
	Sub - Total	*HIDROPOWER*	*543.8*	*520.0*
	CT SANTA ROSA	THERMAL	289.7	259.8
	Sub - Total	*THERMAL*	*289.7*	*259.8*
	TOTAL EDEGEL		833.5	779.8
CAHUA S.A.	C.H. CAHUA	HIDROPOWER	41.5	41.5
	C.H. PARIAC	HIDROPOWER	5.2	5.2
	Sub - Total	*HIDROPOWER*	*46.7*	46.7
	TOTAL CAHUA		46.7	46.7
ETEVENSA - EEPSA	TG VENTANILLA	THERMAL	519.2	493.2
	TG MALACAS	THERMAL	116.0	111.0
	Sub - Total	*THERMAL*	*635.2*	*604.2*
	TOTAL ETEVENSA		635.2	604.2
EGENOR S.A.	C.H. CAÑON DEL PATO	HIDROPOWER	153.9	150.0
	C.H. CARHUAQUERO	HIDROPOWER	75.1	75.0
	Sub - Total	*HIDROPOWER*	*229.0*	*225.0*
	TG CHIMBOTE	THERMAL	63.4	58.7
	TG PIURA	THERMAL	24.3	20.4
	TG TRUJILLO	THERMAL	22.8	19.9
	GD PIURA	THERMAL	26.3	22.3
	GD CHICLAYO NORTE	THERMAL	7.5	6.0
	GD CHICLAYO OESTE	THERMAL	21.0	18.0
	GD PAITA	THERMAL	8.3	7.9
	GD SULLANA	THERMAL	8.0	7.6
	TV TRUPAL	THERMAL	12.0	11.0
	Sub - Total	*THERMAL*	*193.6*	*171.8*
	TOTAL EGENOR		422.6	396.8
SHOUGESA	TV SAN NICOLAS	THERMAL	62.5	54.7
	Sub - Total	*THERMAL*	*62.5*	*54.7*
	TOTAL SHOUGESA		62.5	54.7
CNP ENERGIA S.A.	GD PACASMAYO	THERMAL	10.1	8.8
	Sub - Total	*THERMAL*	*10.1*	*8.8*
	C.H. GALLITO CIEGO	HIDROPOWER	34.0	34.0
	Sub - Total	*HIDROPOWER*	*34.0*	*34.0*
	TOTAL CNP ENERGIA		44.1	42.8
ELECTROANDES S.A.	C.H. YAUPI	HIDROPOWER	108.0	100.0
	C.H. OROYA	HIDROPOWER	9.0	9.0
	C.H. PACHACAMAC	HIDROPOWER	12.0	12.0
	C.H. MALPASO	HIDROPOWER	54.4	44.0
	Sub - Total	*HIDROPOWER*	*183.4*	*165.0*
	TOTAL ELECTROANDES		183.4	165.0
MAPLE GAS	CT AGUAYTIA	THERMAL	155.0	155.0
	Sub -Total	*THERMAL*	*155.0*	*155.0*
	TOTAL MAPLE GAS		*155.0*	*155.0*
TOTAL HIDROPOWER STATION			2045.3	1770.7
TOTAL THERMAL STATION			1346.1	1254.3
TOTAL CENTER - NORTH INTERCONNECTED SYSTEM			3391.4	3025.0

Table N° 2
South Interconnected System (SISUR)
1998

Company	Central	Type	Installed Power (MW)	Effective Power (MW)
EGASA	CC.HH. CHARCANI (I,II,III,IV,VI)	HIDROPOWER	32.02	29.70
	CHARCANI V	HIDROPOWER	136.80	135.00
	Sub - Total	*HIDROPOWER*	*168.82*	*164.70*
	CT CHILINA	THERMAL	52.40	52.40
	CT MOLLENDO	THERMAL	32.09	31.70
	Sub - Total	*THERMAL*	*84.49*	*84.10*
	TOTAL EGASA		253.31	248.80
EGESUR	CC.HH. ARICOTA I Y II	HIDROPOWER	35.7	34.90
	Sub - Total	*HIDROPOWER*	*35.70*	*34.90*
	CT CALANA	THERMAL	19.20	19.20
	CT PARA	THERMAL	2.50	2.50
	Sub - Total	*THERMAL*	*21.70*	*21.70*
	TOTAL EGESUR		57.40	56.60
ENERSUR	CT ILO (VAPOR)	THERMAL	176.00	132.00
	CT ILO (CATKATO)	THERMAL	3.30	3.30
	CT ILO (TGAS)	THERMAL	81.69	77.00
	Sub - Total	*THERMAL*	*260.99*	*212.30*
	TOTAL ENERSUR		260.99	212.30
EGEMSA	C.H. MACHUPICCHU	HIDROPOWER	109.90	(1)
	Sub - Total	*HIDROPOWER*	*109.90*	(1)
	CT DOLORESPATA	THERMAL	15.62	12.20
	CT BELLAVISTA	THERMAL	7.83	5.90
	CT TAPARACHI	THERMAL	7.80	5.10
	Sub - Total	*THERMAL*	*31.25*	*23.20*
	TOTAL EGEMSA		141.15	23.20
TOTAL HIDROPOWER STATIONS			314.42	199.60
TOTAL THERMAL STATIONS			398.43	341.30
TOTAL SOUTH INTERCONNECTED SYSTEM			712.85	540.90

(1) Out of service, at present

Table N° 3
Effective Power Capacity and Demand
1998

System	Effective Power (MW)	Demand (1) Power (MW)	Demand (1) Energy (GWH)
SICN	3025	2121	13410
SISUR	541	410	2598

(1) Source: "Procedimiento y Cálculo de la Tarifa en Barra." Commission of EnergyTariff, May 1999

Table N° 4
Expansion Generation Program
1999 - 2003

Company	Project	Type	Installed Power (MW)	Operation Starting
EGENOR	CARHUAQUERO EXTENSION	HIDROPOWER	12.0	1999
EGENOR	CAÑON DEL PATO EXTENSION	HIDROPOWER	90.0	1999
EGASA	CT MOLLENDO EXTENSION	TURBO - GAS THERMAL POWER	74.0	1999
EGESUR	C.T. CALANA EXTENSION	DIESEL SET THERMAL POWER	6.4	1999
ELECTROPERU	INCLUDING CC.TT. TUMBES	THERMAL	27.8	1999
EDEGEL	YANANGO	HIDROPOWER	40.5	2000
EGESG	SAN GABAN II	HIDROPOWER	125.0	2000
ENERSUR	TV N° 1 de C.T. ILO II	COAL THERMAL POWER	125.0	2000
TRANSMANTARO	SICN -SIS MANTARO - SOCABAYA INTERCONNECTED LINE			2000
EDEGEL	CHIMAY	HIDROPOWER	142.0	2001
EGEMSA	REENTRY OF C.H. MACCHUPICHU (PELTON)	HIDROPOWER	75.0	2001
ENERSUR	TV N° 2 de C.T. ILO II	COAL THERMAL POWER	125.0	2001
EGEMSA	REENTRY OF C.H. MACCHUPICHU (FRANCIS)	HIDROPOWER	66.0	2002
EGECEN	YUNCAN	HIDROPOWER	130.0	2002
		TOTAL	**1038.7**	

SOURCE: "Procedimiento y Cálculo de la Tarífa en Barra."
Commission of Energy Tariff, May 1999

Table Nº 5

Electrical Capacity and Demand in Study Area

Electric Sistem	Installed Capacity (MW)	Present Demand		Future demand 2030	
		Power (MW)	Annual Energy (GW H)	Power (MW)	Annual Energy (GW H)
Luz del Sur	37.00	17.60	113.80	44.11	284.51
EDECAÑETE	14.00	9.38	52.20	26.74	150.00
Small Electrical Systems	0.66	0.94	2.51	3.73	10.71
Total	**51.66**	**27.92**	**168.51**	**74.58**	**445.22**

Source : Table made based on information from Luz del Sur, EDECAÑETE and Ministry of Energy and Mining.

Table N° 6
Hidropower Potencial Capacity of Rivers
Part of Pacific Watershed in Peru

N°	River	Watershed Area (KM^2)	Theorical Potencial Capacity (MW)	Specific Potencial Capacity (MW/KM)
1	ZARUMILLA	817.00	17	0.13
2	TUMBES	2729.00	278	1.18
3	CHIRA	11564.00	722	0.70
4	PIURA	10476.00	209	0.29
5	CASCAJAL	4147.00	21	0.07
6	OLMOS	965.00	22	0.24
7	MOTUPE	1951.00	61	0.26
8	LA LECHE	1578.00	107	0.71
9	CHANCAY - LAMBAYEQUE	4906.00	531	1.34
10	ZAÑA	2080.00	125	0.74
11	CHAMAN	1248.00	19	0.19
12	JETEQUEPEQUE	4257.00	695	1.70
13	CHICAMA	4454.00	443	0.98
14	MOCHE	2161.00	278	0.91
15	VIRU	1967.00	151	0.67
16	CHAO	1443.00	82	0.51
17	SANTA	12479.00	4953	4.34
18	LACRAMARCA	685.00	9	0.13
19	NEPEÑA	1885.00	87	0.33
20	CASMA	3064.00	207	0.68
21	CULEBRAS	671.00	16	0.15
22	HUARMEY	2354.00	169	0.88
23	FORTALEZA	2342.00	114	0.41
24	PATIVILCA	4908.00	1675	3.26
25	SUPE	1078.00	78	0.68
26	HUAURA	4483.00	1062	2.95
27	CHANCAY - HUARAL	3382.00	576	2.37
28	CHILLON	2321.00	332	1.57
29	RIMAC	3134.00	887	2.98
30	LURIN	1600.00	176	1.06
31	CHILCA	798.00	29	0.30
32	MALA	2522.00	527	2.23
33	OMAS	1741.00	82	0.81
34	CAÑETE	5981.00	1927	3.42
35	TOPARA	489.00	24	0.40
36	SAN JUAN	5333.00	774	2.50
37	PISCO	4054.00	872	2.50
38	ICA	7366.00	458	1.35
39	GRANDE	10522.00	424	0.38
40	ACARI	4082.00	660	1.95
41	YAUCA	4589.00	298	0.83
42	CHALA	1284.00	42	0.26
43	CHAPARRA	1387.00	67	0.48
44	ATICO	1425.00	32	0.21
45	CARAVELI	2009.00	75	0.38
46	OCONA	15908.00	3248	2.27
47	MAJES - CAMANA	17141.00	2910	2.80
48	QUILCA O CHILI	13254.00	1030	1.17
49	TAMBO	12697.00	1508	1.64
50	OSMORE	3595.00	164	0.51
51	LOCUMBA	5316.00	97	0.25
52	SAMA	4809.00	83	0.30
53	CAPLINA	1629.00	54	0.43
	Sub-Total Pacific Watershed: Theorical Potencial Capacity = 29256.5 MW			

SOURCE: "Evaluación del Potencial Hidroeléctrico Nacional"
(Assesment of National Hidropower Potencial Capacity)
Consorcio LAHMEYER - SALZGITTER, 1979

NOTE: Specific Theorical Potencial Capacity is obtaired by dividing Theorical Potencial by total length of Main River and this tributaries.

Table Nº 7

Hydropower Potential of Cañete River

Stretch	Length (KM.)	Altitude (masl)	Discharge (m3/s)	Affluent (m3/s)	Length Difference (km)	Altitude Difference (m)	Slope %	Mean Discharge (m3/s)	Theoretical Potential Capacity (MW)	Specific Potential Capacity (MW/KM)
1	222.0	4429.0	0.4	0.0						
					12.0	179.0	1.49	1.50	2.63	0.22
2	210.0	4250.0	2.6	0.0						
					10.0	100.0	1.00	3.85	3.77	0.38
3	200.0	4150.0	5.1	0.0						
					10.0	180.0	1.80	6.00	10.58	1.06
4	190.0	3970.0	6.9	0.0						
					10.0	140.0	1.40	7.65	10.50	1.05
5	180.0	3830.0	8.4	0.0						
					10.0	210.0	2.10	9.35	19.24	1.92
6	170.0	3620.0	10.3	0.0						
					11.0	390.0	3.55	10.95	41.85	3.80
7	159.0	3230.0	11.6	1.7						
					4.0	90.0	2.25	13.30	11.73	2.93
8	155.0	3140.0	13.3	6.3						
					6.0	205.0	3.42	19.85	39.88	6.65
9	149.0	2935.0	20.1	2.7						
					9.0	206.0	2.29	23.40	47.24	5.25
10	140.0	2729.0	24.0	0.0						
					5.0	79.0	1.58	24.15	18.70	3.74
11	135.0	2650.0	24.3	5.7						
					5.0	225.0	4.50	30.15	66.48	13.30
12	130.0	2425.0	30.3	0.0						
					10.0	235.0	2.35	31.45	72.43	7.24
13	120.0	2190.0	32.6	0.0						
					10.0	240.0	2.40	33.10	77.85	7.79
14	110.0	1950.0	33.6	1.7						
					8.0	250.0	3.13	35.40	86.73	10.84
15	102.0	1700.0	35.5	3.6						
					6.0	80.0	1.33	39.25	30.77	5.13
16	96.0	1620.0	39.4	0.0						
					10.0	200.0	2.00	39.75	77.91	7.79
17	86.0	1420.0	40.1	0.0						
					10.0	70.0	0.70	40.25	27.61	2.76
18	76.0	1350.0	40.4	2.6						
					1.0	60.0	6.00	43.00	25.28	25.28
19	75.0	1290.0	43.0	7.4						
					6.0	110.0	1.83	50.40	54.33	9.06
20	69.0	1180.0	50.4	5.2						
					9.0	355.0	3.94	55.40	192.74	21.42
21	60.0	825.0	55.2	0.0						
					20.0	350.0	1.75	54.90	188.31	9.42
22	40.0	475.0	54.6	0.0						
					12.0	135.0	1.13	54.70	72.37	6.03
23	28.0	340.0	54.8	0.0						
					3.0	40.0	1.33	54.80	21.48	7.16
24	25.0	300.0	54.8	0.0						
					25.0	300.0	1.20	54.85	161.26	6.45
25	0.0	0.0	54.9	0.0						

Source : "Evaluación del potencial hidroeléctrico Nacional" (Assessment of National Hydropower Potential Capacity). Consorcio Lahmeyer - Salzgitter, 1979

Note : The theoretical potential capacity of each stretch is obtained by multiplying the mean discharge by the altitude difference and by the gravity acceleration (9.8 m3/s). This value is obtained by dividing by 1,000 so as to be converted into Megawatts

Table Nº 8

National Interconnected System

Expansion Plan

Years	Demand	with Project	Supply (MW)	Reserve (%)	without Project	Supply (MW)	Reserve (%)
2001	2905	Chimay - 142 MW Restart Macchu Picchu (Pelton) : 75 MW Ilo II (Nº 2) : 125 MW	4393	51.2	Chimay : 142 MW Restart Macchu Picchu (Pelton) : 75 MW Ilo II (Nº 2) : 125 MW	4393	51.2
2002	3165	Restart Macchu Picchu (Francis) : 66 MW Yuncan : 130 MW	4589	45.0	Restart Macchu Picchu (Francis) : 66 MW Yuncan : 130 MW	4589	45.0
2003	3357		4589	36.7		4589	36.7
2004	3625	El Platanal : 270 MW Santa Rosa and Ventanilla conversion to Natural Gas Camisea : 300 MW	5159	42.3	Camisea : 300 MW Santa Rosa and Ventanilla conversion to Natural Gas	4889	34.9
2005	3767		5159	37.0	Camisea : 300 MW	5189	37.7
2006	3955		5159	30.4		5189	31.2
2007	4074		5159	26.6		5189	27.4
2008	4174		5159	23.6		5189	24.3
2009	4295	Camisea : 150 MW	5309	23.6		5189	20.8
2010	4415		5309	20.2		5189	17.5
2011	4604		5309	15.3	Camisea : 300 MW	5489	19.2
2012	4788	Camisea : 300 MW	5609	17.1	Camisea : 150 MW	5639	17.8
2013	4979	Camisea : 150 MW	5759	15.7	Camisea : 150 MW	5789	16.3
2014	5178	Camisea : 300 MW	6059	17.0	Camisea : 300 MW	6089	17.6
2015	5386	Camisea : 150 MW	6209	15.3	Camisea : 150 MW	6239	15.8

Note: From the year 2016, supply and demand are considered constant for economical evaluation in PDE model.

Table Nº 9

National Interconnected System
Economic Flow (Millions of dollars)
Alternative without Project

Year	Hydro Investment	Hydro O&M	Thermal Investment	Fixed O&M	Variable O&M	Total
2001	0.0	35.2	0.0	12.4	64.1	111.7
2002	300.0	35.2	0.0	12.4	115.3	462.9
2003	0.0	38.6	150.0	12.4	135.2	336.2
2004	0.0	38.6	150.0	13.7	167.0	369.3
2005	0.0	38.6	0.0	15.6	189.6	243.8
2006	0.0	38.6	0.0	15.6	222.5	276.7
2007	0.0	38.6	0.0	15.6	241.3	295.5
2008	0.0	38.6	0.0	15.6	257.2	311.4
2009	0.0	38.6	0.0	15.6	319.6	373.8
2010	0.0	38.6	150.0	15.6	297.6	501.8
2011	0.0	38.6	75.0	17.6	323.8	455.0
2012	0.0	38.6	75.0	18.9	354.0	486.5
2013	0.0	38.6	150.0	20.2	385.3	594.1
2014	0.0	38.6	75.0	22.8	417.5	553.9
2015	0.0	38.6	0.0	24.1	451.7	514.4
2016	0.0	38.6	0.0	24.1	451.7	514.4
2017	0.0	38.6	0.0	24.1	451.7	514.4
2018	0.0	38.6	0.0	24.1	451.7	514.4
2019	0.0	38.6	150.0	24.1	451.7	664.4
2020	0.0	38.6	150.0	24.1	451.7	664.4
2021	0.0	38.6	0.0	24.1	451.7	514.4
2022	0.0	38.6	0.0	24.1	451.7	514.4
2023	0.0	38.6	0.0	24.1	451.7	514.4
2024	0.0	38.6	0.0	24.1	451.7	514.4
2025	0.0	38.6	0.0	24.1	451.7	514.4
2026	0.0	38.6	150.0	24.1	451.7	664.4
2027	0.0	38.6	75.0	24.1	451.7	589.4
2028	0.0	38.6	75.0	24.1	451.7	589.4
2029	0.0	38.6	150.0	24.1	451.7	664.4
2030	0.0	38.6	75.0	24.1	451.7	589.4
2031	0.0	38.6	0.0	24.1	451.7	514.4
2032	0.0	38.6	0.0	24.1	451.7	514.4
2033	0.0	38.6	0.0	24.1	451.7	514.4
2034	0.0	38.6	150.0	24.1	451.7	664.4
2035	0.0	38.6	150.0	24.1	451.7	664.4
2036	0.0	38.6	0.0	24.1	451.7	514.4
2037	0.0	38.6	0.0	24.1	451.7	514.4
2038	0.0	38.6	0.0	24.1	451.7	514.4
2039	0.0	38.6	0.0	24.1	451.7	514.4
2040	0.0	38.6	0.0	24.1	451.7	514.4
2041	0.0	38.6	150.0	24.1	451.7	664.4
2042	0.0	38.6	75.0	24.1	451.7	589.4
2043	0.0	38.6	75.0	24.1	451.7	589.4
2044	0.0	38.6	150.0	24.1	451.7	664.4
2045	0.0	38.6	75.0	24.1	451.7	589.4
2046	0.0	38.6	0.0	24.1	451.7	514.4
2047	0.0	38.6	0.0	24.1	451.7	514.4
2048	0.0	38.6	0.0	24.1	451.7	514.4
2049	0.0	38.6	150.0	24.1	451.7	664.4
2050	0.0	38.6	150.0	24.1	451.7	664.4
2051	-12.0	0.0	-510.0	0.0	0.0	-522.0

Table Nº 10

National Interconnected System
Economic Flow (Millions of dollars)
Alternative with Project

Year	Hydro Investment	Hydro O&M	Thermal Investment	Fixed O&M	Variable O&M	Total
2001	113.2	35.2	0.0	12.4	64.1	224.9
2002	412.0	35.2	0.0	12.4	115.3	574.9
2003	44.8	38.6	150.0	12.4	135.2	381.0
2004	0.0	41.4	0.0	13.7	134.1	189.2
2005	0.0	41.4	0.0	13.7	157.1	212.2
2006	0.0	41.4	0.0	13.7	190.6	245.7
2007	0.0	41.4	0.0	13.7	210.7	265.8
2008	0.0	41.4	75.0	13.7	227.8	357.9
2009	0.0	41.4	0.0	14.3	289.5	345.2
2010	0.0	41.4	0.0	14.3	266.4	322.1
2011	0.0	41.4	150.0	14.3	301.4	507.1
2012	0.0	41.4	75.0	16.3	324.9	457.6
2013	0.0	41.4	150.0	17.6	355.8	564.8
2014	0.0	41.4	75.0	20.2	385.8	522.4
2015	0.0	41.4	0.0	21.5	419.8	482.7
2016	0.0	41.4	0.0	21.5	419.8	482.7
2017	0.0	41.4	0.0	21.5	419.8	482.7
2018	0.0	41.4	0.0	21.5	419.8	482.7
2019	0.0	41.4	150.0	21.5	419.8	632.7
2020	0.0	41.4	0.0	21.5	419.8	482.7
2021	0.0	41.4	0.0	21.5	419.8	482.7
2022	0.0	41.4	0.0	21.5	419.8	482.7
2023	0.0	41.4	0.0	21.5	419.8	482.7
2024	0.0	41.4	75.0	21.5	419.8	557.7
2025	0.0	41.4	0.0	21.5	419.8	482.7
2026	0.0	41.4	0.0	21.5	419.8	482.7
2027	0.0	41.4	150.0	21.5	419.8	632.7
2028	0.0	41.4	75.0	21.5	419.8	557.7
2029	0.0	41.4	150.0	21.5	419.8	632.7
2030	0.0	41.4	75.0	21.5	419.8	557.7
2031	0.0	41.4	0.0	21.5	419.8	482.7
2032	0.0	41.4	0.0	21.5	419.8	482.7
2033	0.0	41.4	0.0	21.5	419.8	482.7
2034	0.0	41.4	150.0	21.5	419.8	632.7
2035	0.0	41.4	0.0	21.5	419.8	482.7
2036	0.0	41.4	0.0	21.5	419.8	482.7
2037	0.0	41.4	0.0	21.5	419.8	482.7
2038	0.0	41.4	0.0	21.5	419.8	482.7
2039	0.0	41.4	75.0	21.5	419.8	557.7
2040	0.0	41.4	0.0	21.5	419.8	482.7
2041	0.0	41.4	0.0	21.5	419.8	482.7
2042	0.0	41.4	150.0	21.5	419.8	632.7
2043	0.0	41.4	75.0	21.5	419.8	557.7
2044	0.0	41.4	150.0	21.5	419.8	632.7
2045	0.0	41.4	75.0	21.5	419.8	557.7
2046	0.0	41.4	0.0	21.5	419.8	482.7
2047	0.0	41.4	0.0	21.5	419.8	482.7
2048	0.0	41.4	0.0	21.5	419.8	482.7
2049	0.0	41.4	150.0	21.5	419.8	632.7
2050	0.0	41.4	0.0	21.5	419.8	482.7
2051	-28.2	0.0	-365.0	0.0	0.0	-393.2

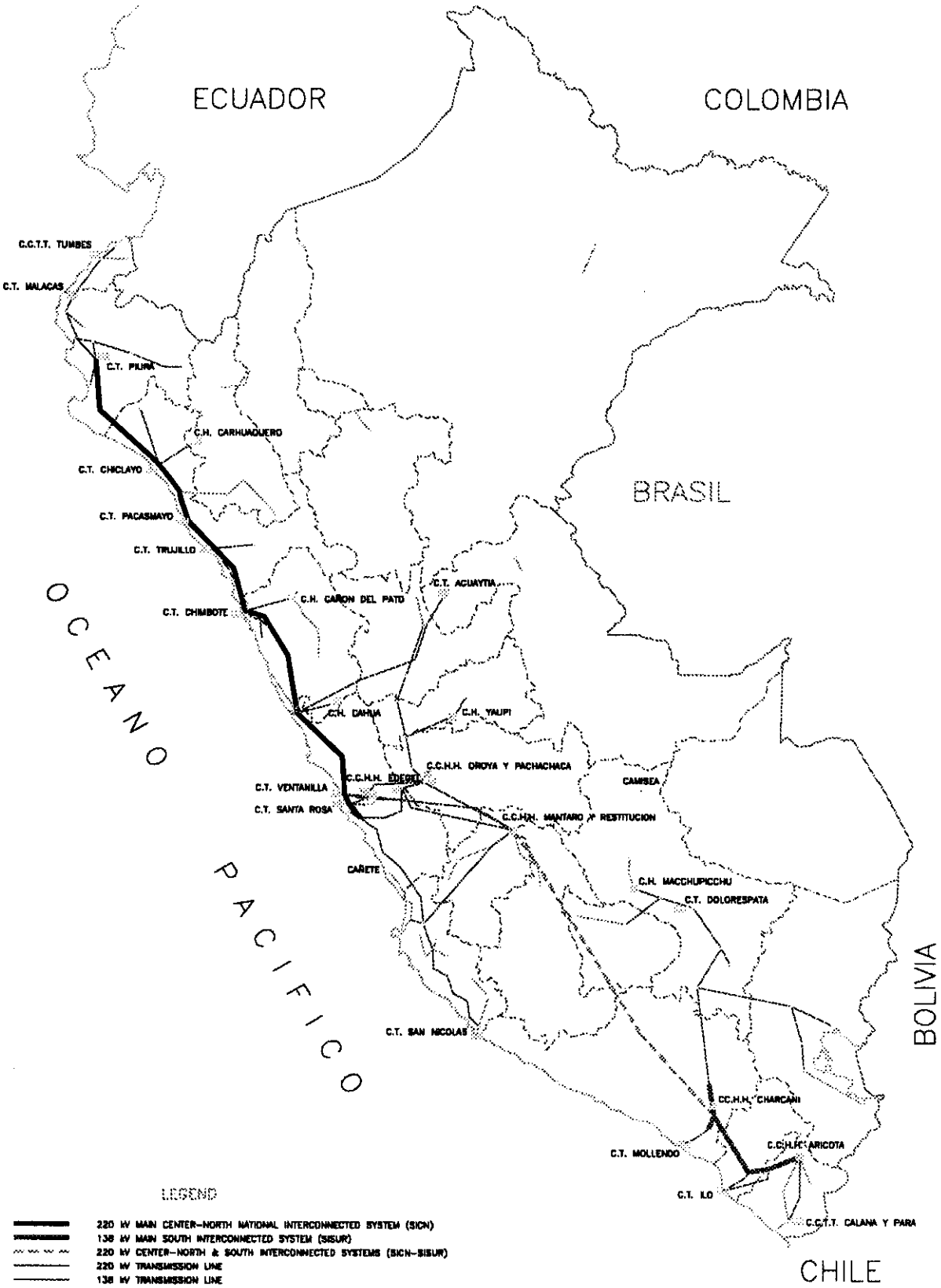
Table Nº 11

Net Present Value
Millions of Dollars

Updating Rate	Benefits			Costs			Economic Indicator	
	Alternative without Project			Alternative with Project				
%	Investment Costs	O & M Costs	Total	Investment	O & M Costs	Total	Present Net Cost	Cost-Benefit Rate
8	933.63	4,630.98	5,564.61	1,028.24	4,314.06	5,342.30	222.30	1.042
9	866.84	4,050.61	4,917.46	971.84	3,772.00	4,743.84	173.61	1.037
10	810.87	3,579.85	4,390.72	924.32	3,332.61	4,256.93	133.79	1.031
11	763.42	3,193.30	3,956.72	883.82	2,972.08	3,855.90	100.82	1.026
12	722.78	2,872.28	3,595.06	848.95	2,672.89	3,521.83	73.23	1.021
13	687.62	2,602.85	3,290.47	818.61	2,421.97	3,240.59	49.88	1.015
14	656.91	2,374.53	3,031.44	791.98	2,209.51	3,001.49	29.95	1.010

Internal Economic Rate of Return : 15.85%

FIGURES



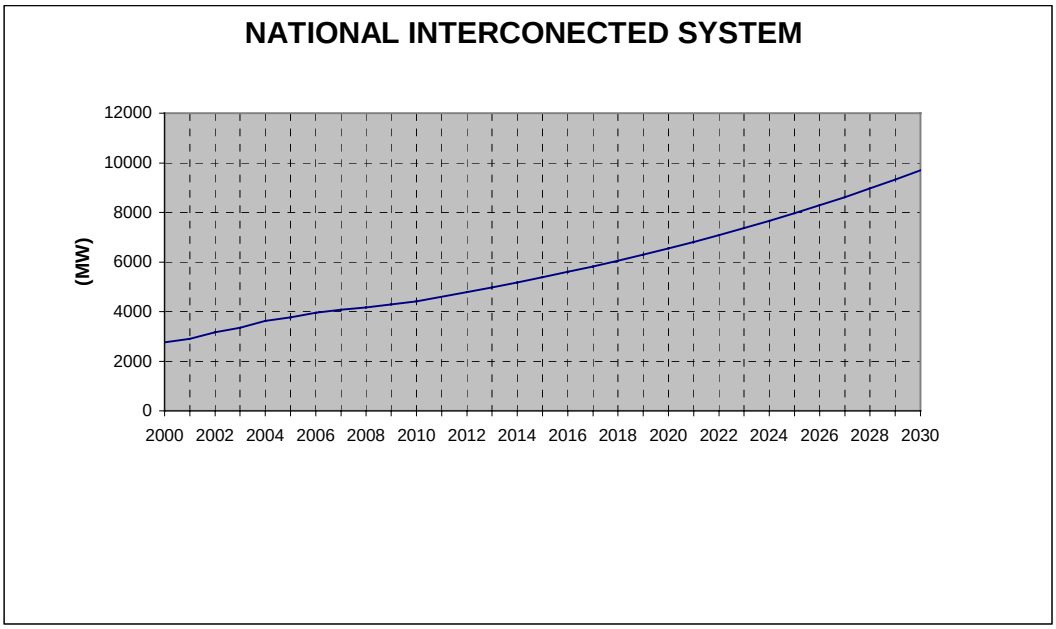
STUDY ON INTEGRATED WATER RESOURCES DEVELOPMENT OF THE CANETE RIVER BASIN IN THE REPUBLIC OF PERU

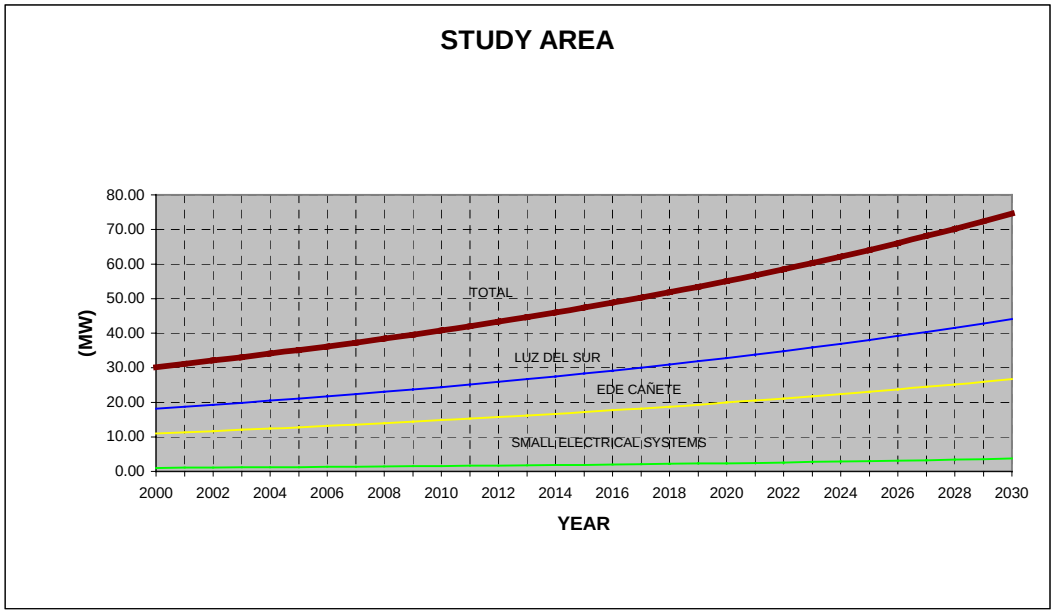
JAPAN INTERNATIONAL COOPERATION AGENCY

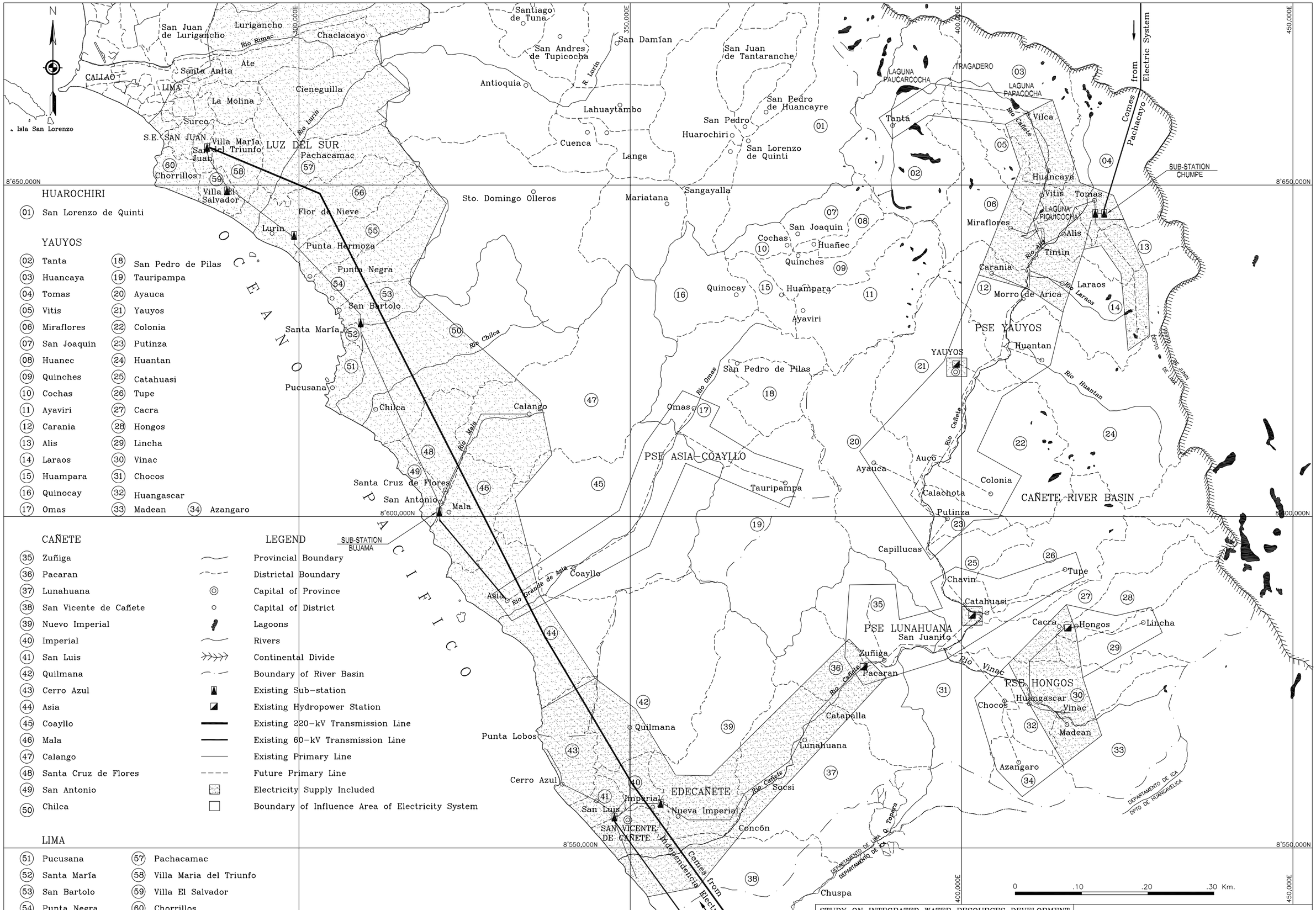
Fig. 1 National Interconnected System in Peru - 1999

Figure Nº 2

PROJECTION OF THE MAXIMUN POWER DEMAND
2000 - 2030







HUAROCHIRI

(01) San Lorenzo de Quinti

YAUYOS

(02) Tanta
(03) Huancaya
(04) Tomas
(05) Vitis
(06) Miraflores
(07) San Joaquin
(08) Huanec
(09) Quinches
(10) Cochas
(11) Ayaviri
(12) Carania
(13) Alis
(14) Laraos
(15) Huampara
(16) Quinocay
(17) Omas
(18) San Pedro de Pilas
(19) Tauripampa
(20) Ayauca
(21) Yauyos
(22) Colonia
(23) Putinza
(24) Huantan
(25) Catahuasi
(26) Tupe
(27) Cacra
(28) Hongos
(29) Lincha
(30) Vinac
(31) Chocos
(32) Huangascar
(33) Madean
(34) Azangaro

CAÑETE

(35) Zuñiga
(36) Pacaran
(37) Lunahuana
(38) San Vicente de Cañete
(39) Nuevo Imperial
(40) Imperial
(41) San Luis
(42) Quilmana
(43) Cerro Azul
(44) Asia
(45) Coayllo
(46) Mala
(47) Calango
(48) Santa Cruz de Flores
(49) San Antonio
(50) Chilca

LEGEND

- Provincial Boundary
- Districtal Boundary
- Capital of Province
- Capital of District
- Lagoons
- Rivers
- Continental Divide
- Boundary of River Basin
- Existing Sub-station
- Existing Hydropower Station
- Existing 220-kV Transmission Line
- Existing 60-kV Transmission Line
- Existing Primary Line
- Future Primary Line
- Electricity Supply Included
- Boundary of Influence Area of Electricity System

LIMA

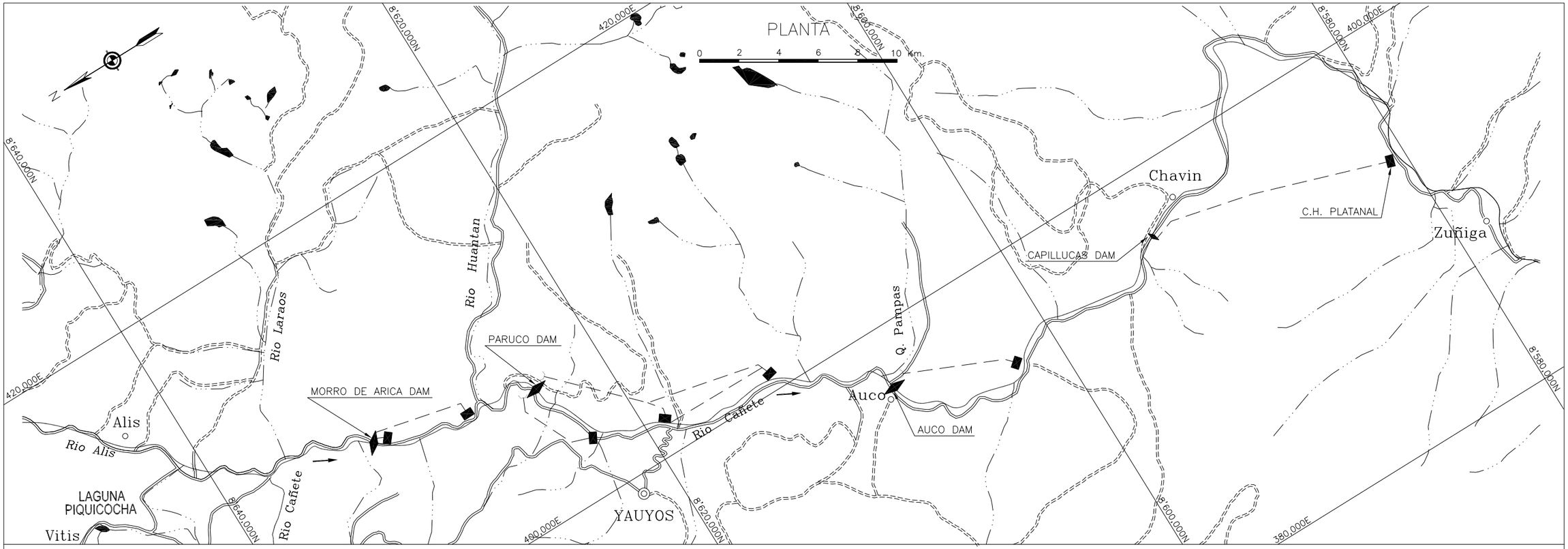
(51) Pucusana
(52) Santa María
(53) San Bartolo
(54) Punta Negra
(55) Punta Hermoza
(56) Lurin
(57) Pachacamac
(58) Villa Maria del Triunfo
(59) Villa El Salvador
(60) Chorrillos

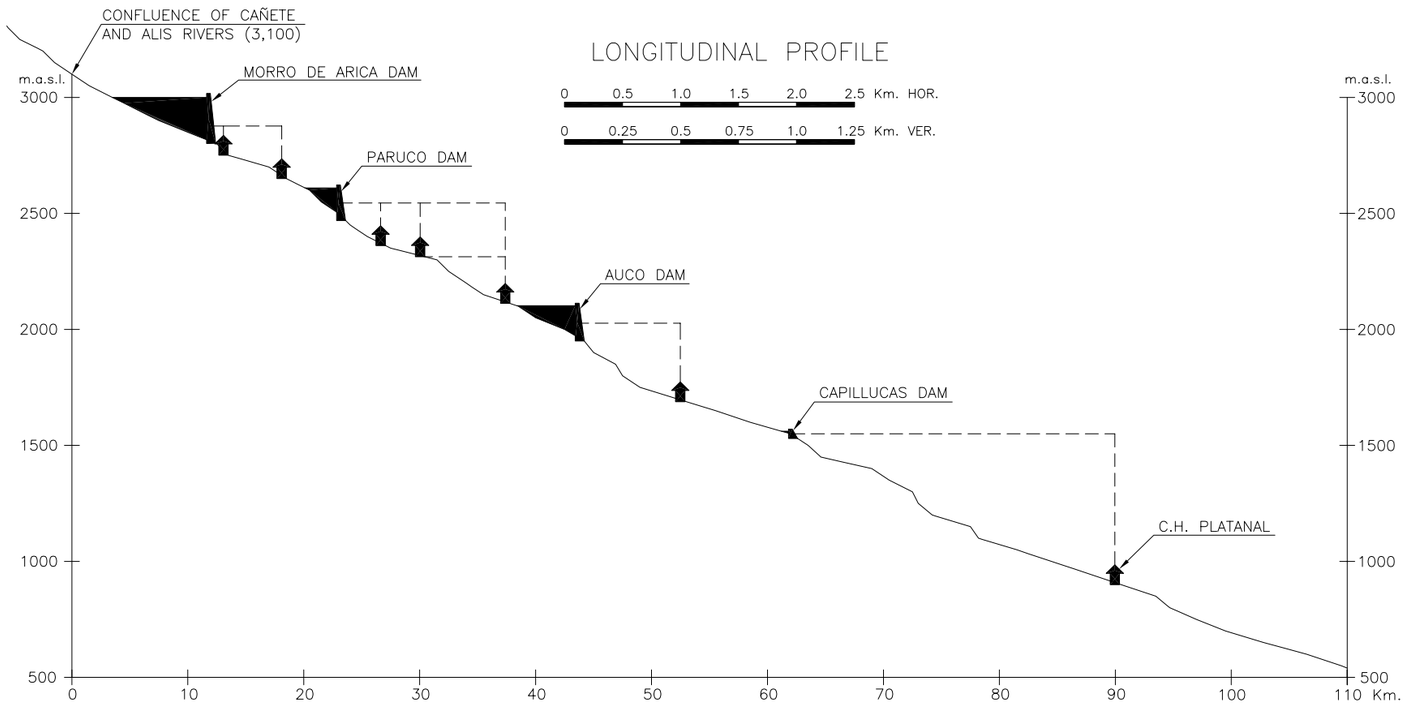
STUDY ON INTEGRATED WATER RESOURCES DEVELOPMENT IN THE CAÑETE RIVER BASIN IN THE REPUBLIC OF PERU

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 3

Existing and Future Electric Facilities in Study Area





STUDY ON INTEGRATED WATER RESOURCES DEVELOPMENT IN THE CAÑETE RIVER BASIN IN THE REPUBLIC OF PERU	Fig. 4
JAPAN INTERNATIONAL COOPERATION AGENCY	Alternatives for Hydropower Development

ANNEX Nº 1

METHODOLOGY PDE MODEL

METHODOLOGY FOR THE EVALUATION OF HYDROPOWER PLANT PROSPECTIVE PROJECTS

1. OBJECTIVE

This document aims to determine the methodology to be followed in order to evaluate Cañete River hydropower plant prospective projects in the framework of the future National Interconnected System (SISTEMA INTERCONECTADO NACIONAL, SIN).

From this evaluation it will be possible to achieve:

- the benefits attributable to each prospective project and the economic convenience of its implementation in order to meet the demand projections up to 2030.
- the optimal sequence to join the SIN for each of the prospective projects which are suitable for the system.

2. MODEL TO BE USED

The model of economic dispatching (PDE in Spanish) will be used. It is a deterministic model elaborated in FORTRAN 77 and compiled in Microsoft version 5.0, which permits to know in detail how an interconnected system would work and to foresee starting and out-of-operation dates of hydropower and thermal stations.

The model of economic dispatching is a formulation in a single computer algorithm of the software named MEMOD developed by a COEPA (Peruvian-German Energy Cooperation) working group, which performs the economic dispatching in an integrated load duration curve, and DESPACHO designed in Electroperu, which simulates the electric dispatching of stations in a load unit duration curve.

The main goal is to complete the economical analysis that MEMOD does with the dispatching of stations in a load duration curve that DESPACHO does.

This model permits to simulate how would be the starting point of hydropower and thermal stations and which would be the generation of energy from year to year. This is used as a basis for the analysis of different estimation aspects in a hydropower station, such as:

a) Determination of installed capacity of a hydropower plant.

b) Optimal plan for the expansion of an interconnected system.

c) Economic-financial evaluation of a hydropower plant.

Initially, the software has the following limitations:

a) It makes calculations for systems without interconnections, and evaluates a hydro-condition by simulation.

b) It makes evaluations with up to 80 hydropower plants and 60 thermal stations.

c) The period for analysis is up to 50 years.

d) 4 annual subintervals to determine fuel costs and hydropower production.

e) It is not a probability software, it does not calculate the LOLP (Loss of Load Probability)

3. ESTIMATION PROCEDURE

The procedure to be followed is based on the flow chart shown in chart 1.

3.1 Input data

The following data will be entered:

a) Demand data (power and energy)

Firstly, it is necessary to estimate the duration curves for each of the 4 annual subintervals of the analysis period. Such estimation is made outside the software, and the duration curve is expressed as a fifth order polynomial. For each time subinterval, polynomial coefficients and maximum power demand are entered as data.

b) Hydropower plant data

For each of the existing and projected hydropower plants in the following data should be entered:

- Effective power
- Power and energy available for each time subinterval
- Operation and maintenance costs
- Peak power in GWh/day (based on the reservoir capacity)

Power and energy data will be obtained from the results of hydraulic system simulation made with the software HEC-5.

c) Thermal station data

For each of the existing and projected thermal stations the following data should be entered:

- Effective power
- Variable operation cost
- Technical characteristics for the estimation of fuel cost

d) Hydropower and thermal stations investment data

For each of the hydropower and thermal stations projected, it will be necessary to enter investment costs updated as of the starting date of the period of analysis.

e) Update rates in analysis

3.2 Estimation of base block and peak block of hydropower plants

a) For an easy estimation, all hydropower plants are divided into two blocks of operation: peak and base. Both concepts are defined as follows:

BASE BLOCK: This is the block that can guarantee in the whole time subinterval. For instance, if a hydropower plant has a base power of 10 MW, it will produce 21.90 GWh in a trimester (2190 hours).

PEAK BLOCK: In this block are considered only the stations with a daily regulation reservoir, and may contribute immediately when there is a sharp increase in demand.

b) Dispatching: For an easy estimation, hydropower plants have been divided into two blocks of operation: base and peak. Firstly, attempts are made to use all of the hydraulic power available in the base block.

Then, it is located the optimal position where the peak block is positioned is such a way that the power and energy placed is as highest as possible. This is done through Newton-Raphson method of approximations, which is an iterative method that enables a rapid convergence and provides an adequate solution.

3.3 Operation and Maintenance Costs

a) After finding an optimal position for hydropower plant peak and base blocks, the residual duration curve is determined, which is the original duration curve minus hydroelectric dispatching.

b) Based on the residual duration curve, thermal stations operate according to its efficiency or total variable operation and maintenance cost, which includes fuel consumption at full load.

c) Once the energy dispatch is made, the operation and maintenance costs of the entire system are estimated.

3.4 Economic Assessment

After making the estimations indicated in points 3.2 and 3.3 for the entire period of analysis, the cash flow of the alternative analyzed is prepared, including investment costs, fixed and variable operation and maintenance costs as well as fuel costs.

Finally, the net present value of the cash flow is estimated for different update rates.

4. ADDITIONAL CONSIDERATIONS

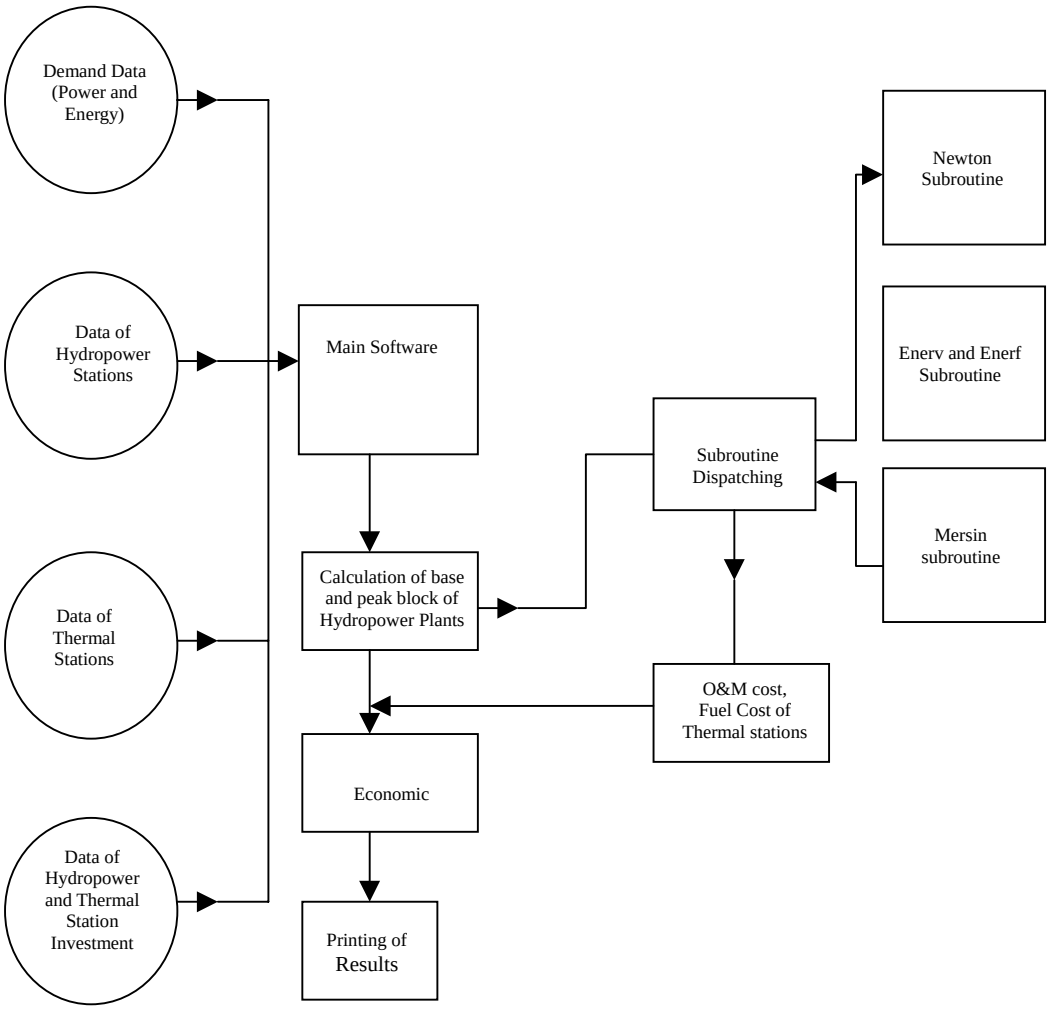
a) The different hydro-thermal alternatives should permit a balance with the system demand with similar energy reserve margins.

b) For each project is made the economic assessment of the system "with the project" and "without the project". For this, equipment costs are considered as benefits and those associated to the project analyzed are considered as costs.

c) Supply and demand has been divided on a quarterly basis with the objective to represent and simulate conveniently the seasonal differences of hydropower availability.

All alternatives should be simulated for an average year (hydro-condition 1) and a dry year (hydro-condition 2), assuming an 85% of probability for hydro-condition 1 and a 15% of probability for hydro-condition 2.

CHART Nº. 1
PDE MODEL
FLOW CHART



ANNEX Nº 2

OUTPUT OF THE PDE PROGRAM

EXPANSION PLAN

WITHOUT PROJECT

HYDROCONDITION : AVERAGE YEAR

1

EVALUACION TECNICO-ECONOMICA DEL PROYECTO
C.H. Platanal en el SIN
PERIODO 2001-2015

14-12-99 HIDROLOGIA PROMEDIO

CARACTERISTICAS DEL SISTEMA
==========

DURACION DEL PERIODO DE PLANIFICACION = 15

DURACION DEL PERIODO DE ANALISIS = 50

NUMERO DE SUBDIVISIONES ANUALES EN LOS QUE SE OPTIMIZA LA OPERACION = 4

NUMERO TOTAL DE PLANTAS HIDROELECTRICAS = 27

NUMERO TOTAL DE PLANTAS TERMOELECTRICAS = 59

NUMERO TOTAL DE LINEAS DE TRANSMISION = 0

NUMERO TOTAL DE SUBSISTEMAS INICIALES = 1

EL A¥O CERO = 2000

EL A¥O DESDE EL QUE LA DEMANDA SE CONSIDERA CONSTANTE = 2016

A¥O DESDE EL QUE SE CALCULAN COSTOS DE COMBUSTIBLE
Y MANTENIMIENTO PARA LAS PLANTAS = 2001

1

CARACTERISTICAS DE LOS SUBSISTEMAS INICIALES
==========

SUBSISTEMA D = 1 SIN

NO. TOTAL DE PLANTAS HIDROELECTRICAS = 27
NO. TOTAL DE PLANTAS TERMOELECTRICAS = 59
DMAXJ(D) = 27 DMAXI(D) = 59

DEMANDA DE POTENCIA Y ENERGIA
==========

NO.	A¥O	PMAX (MW)	PMIN (MW)	ENERGIA (GWH)	PMAX+RES (MW)
1	2001	2873.3	1561.0	4872.9	3160.7
2	2001	2905.0	1421.2	4862.8	3195.5
3	2001	2904.1	1640.8	4970.6	3194.5
4	2001	2897.4	1510.9	5006.6	3187.2
5	2002	3130.5	1754.1	5366.7	3443.6
6	2002	3165.0	1605.4	5355.6	3481.5
7	2002	3164.1	1841.2	5474.4	3480.5
8	2002	3156.8	1707.5	5514.0	3472.4
9	2003	3320.4	1896.1	5730.8	3652.5
10	2003	3357.0	1740.8	5718.9	3692.7
11	2003	3356.0	1988.6	5845.7	3691.6
12	2003	3348.3	1852.1	5888.1	3683.1
13	2004	3585.5	2099.5	6244.7	3944.0
14	2004	3625.0	1935.5	6231.7	3987.5
15	2004	3623.9	2199.7	6369.9	3986.3
16	2004	3615.6	2059.9	6416.0	3977.1
17	2005	3725.9	2179.8	6487.1	4098.5
18	2005	3767.0	2009.2	6473.7	4143.7
19	2005	3765.9	2283.8	6617.3	4142.5
20	2005	3757.2	2138.3	6665.2	4132.9
21	2006	3911.9	2302.8	6826.3	4303.1
22	2006	3955.0	2124.6	6812.1	4350.5
23	2006	3953.8	2412.1	6963.2	4349.2
24	2006	3944.7	2261.4	7013.6	4339.2
25	2007	4029.6	2360.9	7019.5	4432.5
26	2007	4074.0	2176.6	7004.9	4481.4
27	2007	4072.8	2473.4	7160.3	4480.1
28	2007	4063.4	2316.5	7212.2	4469.8
29	2008	4128.5	2408.7	7180.9	4541.4
30	2008	4174.0	2219.2	7166.0	4591.4
31	2008	4172.8	2524.0	7325.0	4590.0
32	2008	4163.1	2361.8	7378.0	4579.5
33	2009	4248.2	2839.5	7779.6	4673.0
34	2009	4295.0	2669.2	7763.4	4724.5
35	2009	4293.7	2959.3	7935.6	4723.1
36	2009	4283.8	2845.8	7993.0	4712.2
37	2010	4366.9	2525.3	7571.2	4803.6
38	2010	4415.0	2323.3	7555.5	4856.5
39	2010	4413.7	2647.2	7723.1	4855.0
40	2010	4403.5	2472.3	7779.0	4843.9
41	2011	4553.8	2613.7	7874.0	5009.2
42	2011	4604.0	2401.7	7857.6	5064.4
43	2011	4602.6	2740.7	8031.9	5062.9
44	2011	4592.0	2555.4	8090.0	5051.2
45	2012	4735.8	2718.6	8189.1	5209.4
46	2012	4788.0	2498.1	8172.1	5266.8
47	2012	4786.6	2850.6	8353.4	5265.2
48	2012	4775.5	2658.0	8413.8	5253.1
49	2013	4924.7	2827.8	8516.6	5417.2
50	2013	4979.0	2598.6	8498.9	5476.9
51	2013	4977.5	2965.1	8687.4	5475.3
52	2013	4966.0	2764.9	8750.3	5462.7
53	2014	5121.6	2941.0	8857.2	5633.7
54	2014	5178.0	2702.7	8838.8	5695.8
55	2014	5176.5	3083.8	9034.9	5694.1
56	2014	5164.5	2875.6	9100.3	5681.0
57	2015	5327.3	3057.9	9211.7	5860.0

58	2015	5386.0	2809.9	9192.5	5924.6
59	2015	5384.4	3206.4	9396.4	5922.8
60	2015	5372.0	2989.7	9464.4	5909.2

1

CARACTERISTICAS DE LAS PLANTAS HIDROELECTRICAS

NO.	PLANTA	L	CON	IS	W	P	PG	E.PUNTA	POTENCIA (MW) / ENERGIA (GWH)			
1	MANTARO	0	0	1	8.73	580.0	580.0	2.900	580.0	580.0	580.0	580.0
									1249.0	1228.0	1247.0	1233.0
2	RESTITU	0	0	1	3.13	200.0	200.0	1.000	200.0	200.0	200.0	200.0
									445.7	434.5	438.9	435.5
3	HUINCO	0	0	1	2.00	240.0	240.0	1.200	240.0	240.0	240.0	240.0
									324.8	204.9	224.8	202.0
4	MATU	0	0	1	1.55	120.0	120.0	.360	120.0	120.0	120.0	120.0
									200.4	192.6	162.5	175.8
5	CALLA	0	0	1	1.00	68.0	68.0	.340	68.0	68.0	68.0	68.0
									115.4	115.2	140.5	139.2
6	MOYOP	0	0	1	.84	80.0	80.0	.400	80.0	80.0	80.0	80.0
									106.8	130.6	132.4	132.0
7	HUAMP	0	0	1	.50	27.0	27.0	.135	27.0	27.0	27.0	27.0
									30.8	38.6	41.7	38.3
8	CAHUA	0	0	1	.70	40.0	40.0	.000	40.0	40.0	40.0	40.0
									81.7	75.6	59.7	66.9
9	CARHUA	0	0	1	1.20	87.0	87.0	.261	87.0	87.0	87.0	87.0
									166.4	172.1	93.6	152.0
10	CA¥ON	0	0	1	2.00	218.3	105.5	.000	218.3	182.5	113.9	196.8
									471.5	399.0	251.4	434.3
11	OROYA	0	0	1	.20	9.0	9.0	.027	9.0	9.0	9.0	9.0
									16.6	11.7	8.0	11.3
12	PACHA	0	0	1	.20	12.0	12.0	.036	12.0	12.0	12.0	12.0
									10.3	9.7	12.3	9.9
13	YAUPI	0	0	1	1.70	100.0	100.0	.300	100.0	100.0	100.0	100.0
									204.9	176.6	195.3	185.0
14	GALLITO	0	0	1	.40	33.7	33.7	.169	33.7	33.7	33.7	33.7
									56.4	42.2	13.0	10.9
15	CURUMUY	0	0	1	.20	10.0	10.0	.000	10.0	10.0	10.0	10.0
									13.2	21.5	11.5	14.4
16	ARI1-2	0	0	1	.61	33.4	33.4	.097	33.4	33.4	33.4	33.4
									27.0	27.2	27.3	27.2
17	CHAR123	0	0	1	.30	6.8	4.4	.000	5.5	5.1	4.9	5.1
									11.9	11.1	10.8	11.3
18	CHAR46	0	0	1	.45	23.4	23.4	.070	23.4	23.4	23.4	23.4
									38.5	33.2	31.4	34.2
19	CHAR5PC	0	0	1	1.20	135.0	135.0	.405	135.0	135.0	135.0	135.0
									170.4	122.9	111.3	119.6
20	SGII	0	0	1	1.56	105.0	105.0	.315	105.0	105.0	105.0	105.0
									226.8	183.2	98.8	206.8

1

NO.	PLANTA	L	CON	IS	W	P	PG	E.PUNTA	POTENCIA (MW) / ENERGIA (GWH)			
21	YANANGO	0	0	1	1.00	38.0	38.0	.000	38.0	38.0	38.0	38.0
									82.0	70.7	52.3	71.7
22	CHIMAY	0	0	1	3.50	142.0	142.0	.426	142.0	142.0	142.0	142.0
									303.0	230.7	145.2	250.3
23	YUNCAN	50	1	0	3.35	150.0	150.0	.450	150.0	150.0	150.0	150.0
									288.4	223.6	168.7	226.6
24	MACHU	0	0	1	1.56	107.0	104.6	.000	106.6	106.0	104.6	104.6
									230.3	231.4	230.9	230.9
25	PARIAC	0	0	1	.30	5.6	3.7	.000	5.0	5.2	4.1	5.6
									10.8	11.3	8.7	12.0
26	MALPASO	0	0	1	.40	44.0	44.0	.220	44.0	44.0	44.0	44.0
									78.4	59.3	48.5	46.2
27	PLATANAL	50	3	0	2.80	270.0	270.0	1.350	270.0	270.0	270.0	270.0
									444.7	410.0	264.1	382.8

L - DURACION DE VIDA (A¥OS)
IS - SI = 0 PLANTA PROYECTADA
SI = 1 PLANTA EXISTENTE
CON - SI IS=0 A¥OS DE CONSTRUCCION
SI IS=1 A¥O DEL PERIODO DE PLANIFICACION
QUE EMPIEZA A OPERAR
W - COSTOS ANUALES DE MANTENIMIENTO (MIO. DOLAR)
P - POTENCIA INSTALADA (MW)
PG - POTENCIA GARANTIZADA EN EL ANO SECO (MW)
HPUNTA ENERGIA EN HORAS DE PUNTA (GWH/DIA)
Q - POTENCIA (MW)
H - ENERGIA (GWH)

1

FLUJO DE INVERSION ANUAL (MIO. DOLAR)

NO.	PLANTA	EN MONEDA NACIONAL	EN MONEDA EXTRANJERA	PARA MANO DE OBRA NO CALIFICADA
23	YUNCAN	300.00		
		.00		
		.00		
27	PLATANAL	113.20	112.00	44.80
		.00	.00	.00
		.00	.00	.00

1

CARACTERISTICAS DE LAS PLANTAS TERMOELECTRICAS

NO.	PLANTA	L	CON	IS	W	NU	PE	PMB	HRBASE	HRINC	HR100%	TC	PCOMB	PGAS	OMV	DISP	OMVT	REND
1	MALACASD2	0	0	1	.25	1	46.0	10.00	329.00	329.0	329.00	1	1.165	.000	4.00	.94	60.82	.25
2	TALARAGN	0	0	1	.50	1	96.6	20.00	11.60	11.6	11.60	3	.00029	.300	2.25	.94	22.24	.25
3	CHIMBO TG	0	0	1	.25	1	58.7	15.00	346.00	346.0	346.00	1	1.165	.000	2.70	.94	63.56	.24
4	TRUJI TG	0	0	1	.15	1	19.9	5.00	346.00	346.0	346.00	1	1.165	.000	2.70	.94	63.18	.24
5	PIURA TG	0	0	1	.17	1	20.4	5.00	319.00	319.0	319.00	1	1.165	.000	2.70	.94	57.50	.26
6	PIURA D2	0	0	1	.10	1	12.1	4.00	234.00	234.0	234.00	1	1.165	.000	7.11	.94	47.31	.35
7	PIURA R6	0	0	1	.10	1	10.2	2.00	245.00	245.0	245.00	2	1.048	.000	7.04	.94	39.99	.35
8	CHICLA N	0	0	1	.08	1	6.0	1.00	239.00	239.0	239.00	1	1.165	.000	7.04	.94	48.51	.35
9	CHICLA O	0	0	1	.18	1	18.0	3.00	263.00	263.0	263.00	2	1.048	.000	7.04	.94	41.91	.33
10	SULLA GD	0	0	1	.10	1	7.6	2.00	241.00	241.0	241.00	1	1.165	.000	7.30	.94	49.47	.34
11	PAITA GD	0	0	1	.10	1	7.9	2.00	241.00	241.0	241.00	1	1.165	.000	7.54	.94	50.20	.34
12	PACAS SU	0	0	1	.10	1	7.4	2.00	247.00	247.0	247.00	2	1.048	.000	7.04	.94	34.23	.35
13	PACAS GD	0	0	1	.03	1	1.5	.50	228.00	228.0	228.00	2	1.048	.000	7.04	.94	38.09	.38
14	S_ROSA N	0	0	1	.50	1	103.2	20.00	287.00	287.0	287.00	1	1.165	.000	7.07	.94	58.04	.29
15	S_ROSA V	0	0	1	.30	1	36.6	5.00	472.00	472.0	472.00	1	1.048	.000	6.31	.94	90.23	.18
16	S_ROSA W	0	0	1	.60	1	120.0	20.00	266.00	266.0	266.00	1	1.165	.000	4.10	.94	51.34	.31
17	VEN TG1	0	0	1	.60	1	90.9	20.00	280.00	280.0	280.00	1	1.165	.000	3.32	.94	52.99	.30
18	VEN TG2	0	0	1	.60	1	94.2	20.00	275.00	275.0	275.00	1	1.165	.000	3.32	.94	52.10	.30
19	VEN TG3	0	0	1	.75	1	154.3	25.00	230.00	230.0	230.00	1	1.165	.000	4.00	.94	44.85	.36
20	VEN TG4	0	0	1	.75	1	153.8	25.00	232.00	232.0	232.00	1	1.165	.000	4.00	.94	45.20	.36
21	TV TRUPAL	0	0	1	.05	1	11.0	3.00	549.00	549.0	549.00	2	1.048	.000	8.00	.94	63.01	.16
22	TV SHOUGE	0	0	1	.30	1	54.6	2.00	346.00	346.0	346.00	2	1.048	.000	2.00	.94	36.67	.25
23	TG AGUAYT	0	0	1	.65	1	155.5	25.00	11.88	11.9	11.88	3	.00029	.300	2.89	.94	16.91	.24
24	TG CAM1	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
25	TG CAM2	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
26	TACNA GD	0	0	1	.03	1	2.5	1.00	248.00	248.0	248.00	1	1.165	.000	6.80	.94	52.42	.33
27	CHILINA CC	0	0	1	.10	1	20.0	6.00	290.00	290.0	290.00	1	1.165	.000	3.20	.96	55.88	.29
28	CHILI TV2	0	0	1	.18	1	8.0	2.00	474.00	474.0	474.00	2	1.048	.000	2.60	.96	48.20	.18
29	CHILI TV3	0	0	1	.18	1	10.0	2.00	438.00	438.0	438.00	2	1.048	.000	2.60	.96	44.74	.20
30	AREQ GD	0	0	1	.11	2	5.2	2.00	226.00	226.0	226.00	2	1.048	.000	6.60	.94	30.10	.38
31	MOLL GD	0	0	1	.50	3	10.0	2.00	217.00	217.0	217.00	2	1.048	.000	6.60	.94	26.40	.40
32	GD TACNA	0	0	1	.50	3	6.4	1.00	217.00	217.0	217.00	2	1.048	.000	6.30	.94	28.75	.40
33	DOL-PATA	0	0	1	.12	6	2.0	1.00	273.00	273.0	273.00	1	1.165	.000	6.80	.94	69.36	.30
34	GD JULI	0	0	1	.17	2	2.2	1.00	263.00	263.0	263.00	1	1.165	.000	6.80	.94	63.59	.31
35	GD PUNO	0	0	1	.19	1	2.3	1.00	263.00	263.0	263.00	1	1.165	.000	6.80	.94	66.41	.31
36	GD PUNO	0	0	1	.19	2	1.8	1.00	263.00	263.0	263.00	1	1.165	.000	6.80	.94	66.41	.31
37	ILO TV2	0	0	1	.10	1	21.0	15.00	4536.00	4536.0	4536.00	1	1.043	.000	3.80	.99	8.79	.02
38	ILO TV3	0	0	1	.20	1	55.0	35.00	298.00	298.0	298.00	2	1.048	.000	3.80	.97	24.33	.29
39	ILO TV4	0	0	1	.30	1	56.0	25.00	339.00	339.0	339.00	2	1.048	.000	3.80	.95	33.34	.26
40	ILO GD1	0	0	1	.05	1	3.3	1.00	205.00	205.0	205.00	1	1.165	.000	3.80	.95	38.30	.40

1

NO.	PLANTA	L	CON	IS	W	NU	PE	PMB	HRBASE	HRINC	HR100%	TC	PCOMB	PGAS	OMV	DISP	OMVT	REND
41	ILO TG1	0	0	1	.15	1	37.0	10.00	285.00	285.0	285.00	1	1.165	.000	3.80	.95	51.76	.29
42	ILO TG2	0	0	1	.15	1	40.0	10.00	225.00	225.0	225.00	1	1.165	.000	6.00	.95	43.87	.37
43	ILO TV5	0	0	1	1.00	1	125.0	50.00	364.00	364.0	364.00	4	.000	.000	3.00	.95	19.38	.37
44	ILO TV6	0	0	1	1.00	1	125.0	50.00	364.00	364.0	364.00	4	.000	.000	3.00	.95	19.38	.37
45	S_ROSA W	15	1	0	.65	1	120.0	20.00	10.75	10.8	10.75	3	.00029	.300	3.00	.94	24.50	.27
46	VEN TG1	15	1	0	.65	1	90.9	20.00	10.75	10.8	10.75	3	.00029	.300	3.00	.94	24.50	.27
47	VEN TG2	15	1	0	.65	1	94.2	20.00	10.75	10.8	10.75	3	.00029	.300	3.00	.94	24.50	.27
48	VEN TG3	15	1	0	.65	1	154.3	25.00	10.75	10.8	10.75	3	.00029	.300	3.00	.94	24.50	.27
49	VEN TG4	15	1	0	.65	1	153.8	25.00	10.75	10.8	10.75	3	.00029	.300	3.00	.94	24.50	.27
50	TG CAM3	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
51	TG CAM4	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
52	TG CAM5	15	1	0	1.30	2	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
53	TG CAM6	15	1	0	1.30	2	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
54	TG CAM7	15	1	0	1.30	2	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
55	TG CAM8	15	1	0	1.30	2	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
56	TG CAM9	15	1	0	1.30	2	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
57	TG CA10	15	1	0	1.30	2	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
58	TV1-CO	25	3	0	1.00	1	125.0	50.00	364.00	364.0	364.00	4	.000	.000	3.00	.95	19.38	.37
59	TG CA11	15	1	0	1.30	2	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27

```
L   - DURACION DE VIDA (A¥OS)
IS  -   SI = 0   PLANTA PROYECTADA
        SI = 1   PLANTA EXISTENTE
CON - SI IS=0  A¥OS DE CONSTRUCCION
      SI IS=1  A¥O DEL PERIODO DE PLANIFICACION
               QUE EMPIEZA A OPERAR
W   - COSTOS ANUALES DE MANTENIMIENTO (MIO. DOLAR )
PE - POTENCIA EFECTIVA (MW)
NU - NUMERO DE UNIDADES
PMB- POTENCIA MINIMA (MW)
HRBASE CONSUMO ESPECIFICO DE CALOR SIN CARGA KG/MWH
HRINC  CONSUMO ESPECIFICO DE CALOR INCREMENTAL KG/MWH
HR100% CONSUMO ESPECIFICO DE CALOR A PLENA CARGA KG/MWH
TC - TIPO DE COMBUSTILE
     1 DIESEL 2
     2 RESIDUAL 6
     3 GAS
     4 CARBON
PCOMB VOLUMEN ESPECIFICO COMBUSTIBLE (L/KG)
      1.156 DIESEL 2
      1.020 RESIDUAL 6
PGAS VOLUMEN ESPECIFICO GAS (PIE CUBICO/KG)
OMV- COSTOS VARIABLE O&M ( DOLAR/ MWH)
DISP DISPONIBILIDAD
OMVT COSTO VARIABLE TOTAL A PLENA CARGA ( DOLAR/ MWH)
REND RENDIMIENTO DE LA CENTRAL TERMICA
```

1

FLUJO DE INVERSION ANUAL (MIO. DOLAR)
==========

NO.	PLANTA	EN MONEDA NACIONAL	EN MONEDA EXTRANJERA	PARA MANO DE OBRA NO CALIFICADA
24	TG CAM1	75.00	.00	.00
25	TG CAM2	75.00	.00	.00
45	S_ROSA W	.00	.00	.00
46	VEN TG1	.00	.00	.00
47	VEN TG2	.00	.00	.00
48	VEN TG3	.00	.00	.00
49	VEN TG4	.00	.00	.00
50	TG CAM3	75.00	.00	.00
51	TG CAM4	75.00	.00	.00
52	TG CAM5	75.00	.00	.00

1

NO.	PLANTA	EN MONEDA NACIONAL	EN MONEDA EXTRANJERA	PARA MANO DE OBRA NO CALIFICADA
53	TG CAM6	75.00	.00	.00
54	TG CAM7	75.00	.00	.00
55	TG CAM8	75.00	.00	.00
56	TG CAM9	75.00	.00	.00
57	TG CA10	75.00	.00	.00
58	TV1-CO	41.25	55.00	41.25
		.00	.00	.00
		.00	.00	.00
59	TG CA11	75.00	.00	.00

ESTRATEGIA NO. 1
==========

SIN, platanal 2 sin

1

ESTRATEGIA NO. 1
==========

SIN, platanal 2 sin

PRESENCIA DE LAS PLANTAS HIDROELECTRICAS
==========

	1	2	3	4	5	6	7	8	9	0
0	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
10	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
20	-99	-99	3	-99	-99	-99	99			

PRESENCIA DE LAS PLANTAS TERMOELECTRICAS
==========

	1	2	3	4	5	6	7	8	9	0
0	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
10	-99	-99	-99	-99	-99	-4	-4	-4	-4	-4
20	-99	-99	-99	4	4	-99	-99	-99	-99	-99
30	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
40	-99	-99	-99	-99	4	4	4	4	4	5
50	11	11	12	13	14	14	15	99	5	

-LOS NUMEROS POSITIVOS INDICAN EN QUE INTERVALO DE TIEMPO T LAS PLANTAS O LAS LINEAS DE TRAMSMISION SE PONEN EN EXPLOTACION
-LOS NUMEROS NEGATIVOS INDICAN EL INTERVALO DE TIEMPO T EN EL QUE LAS PLANTAS EXISTENTES SE PARALIZAN

1

NUMERO DE SUBSISTEMAS EN CADA INTERVALO DE TIEMPO T

	1	2	3	4	5	6	7	8	9	0
0	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1					

1

PROGRAMA DE EQUIPAMIENTO

ALTERNATIVA 1 SUBSISTEMA SIN

A¥O	DEMANDA	N.	PLANTA	POTENCIA INSTALADA (MW)	POTENCIA GARANTIZADA (MW)
2001	2897.4		EXISTENTE	4336.3	4216.8
			T O T A L	4336.3	4216.8
2003	3348.3		EXISTENTE	4336.3	4216.8
		23H	YUNCAN	150.0	150.0
			T O T A L	4486.3	4366.8
2004	3615.6		EXISTENTE	3873.1	3753.6
		24T	TG CAM1	150.0	150.0
		25T	TG CAM2	150.0	150.0
		45T	S_ROSA W	120.0	120.0
		46T	VEN TG1	90.9	90.9
		47T	VEN TG2	94.2	94.2
		48T	VEN TG3	154.3	154.3
		49T	VEN TG4	153.8	153.8
			T O T A L	4786.3	4666.8
2005	3757.2		EXISTENTE	4786.3	4666.8
		50T	TG CAM3	150.0	150.0
		59T	TG CA11	150.0	150.0
			T O T A L	5236.3	5116.8
2011	4592.0		EXISTENTE	5236.3	5116.8
		51T	TG CAM4	150.0	150.0
		52T	TG CAM5	150.0	150.0
			T O T A L	5686.3	5566.8
2012	4775.5		EXISTENTE	5686.3	5566.8
		53T	TG CAM6	150.0	150.0
			T O T A L	5986.3	5866.8
2013	4966.0		EXISTENTE	5986.3	5866.8
		54T	TG CAM7	150.0	150.0
			T O T A L	6286.3	6166.8
2014	5164.5		EXISTENTE	6286.3	6166.8
		55T	TG CAM8	150.0	150.0
		56T	TG CAM9	150.0	150.0
			T O T A L	6886.3	6766.8
2015	5372.0		EXISTENTE	6886.3	6766.8
		57T	TG CA10	150.0	150.0
			T O T A L	7186.3	7066.8
	TOTAL SUBSISTEMA		HIDRAULICAS	150.0	150.0
			TERMICAS	3313.2	
	TOTAL DEL PAIS		HIDRAULICAS	150.0	150.0
			TERMICAS	3313.2	

1

ESTRATEGIA NO. 1

F L U J O D E I N V E R S I O N G L O B A L (MIO. DOLAR)

		PLANTAS HIDROELECTRICAS				P L A N T A S T E R M O E L E C T R I C A S						LINEAS DE TRANSMISION			
NO.	ANO	MN	ME	MONCA	MANT	MN	ME	MONCA	MANT	COMB1	COMB2	MN	ME	MONCA	MANT
1	2001	.0	.0	.0	35.2	.0	.0	.0	12.4	.0	50.3	.0	.0	.0	.0
2	2002	300.0	.0	.0	35.2	.0	.0	.0	12.4	.0	96.8	.0	.0	.0	.0
3	2003	.0	.0	.0	38.6	150.0	.0	.0	12.4	.0	114.8	.0	.0	.0	.0
4	2004	.0	.0	.0	38.6	150.0	.0	.0	13.7	.0	154.1	.0	.0	.0	.0
5	2005	.0	.0	.0	38.6	.0	.0	.0	15.6	.0	176.8	.0	.0	.0	.0
6	2006	.0	.0	.0	38.6	.0	.0	.0	15.6	.0	209.6	.0	.0	.0	.0
7	2007	.0	.0	.0	38.6	.0	.0	.0	15.6	.0	228.3	.0	.0	.0	.0
8	2008	.0	.0	.0	38.6	.0	.0	.0	15.6	.0	243.9	.0	.0	.0	.0
9	2009	.0	.0	.0	38.6	.0	.0	.0	15.6	.0	302.8	.0	.0	.0	.0
10	2010	.0	.0	.0	38.6	150.0	.0	.0	15.6	.0	282.4	.0	.0	.0	.0
11	2011	.0	.0	.0	38.6	75.0	.0	.0	17.6	.0	310.3	.0	.0	.0	.0
12	2012	.0	.0	.0	38.6	75.0	.0	.0	18.9	.0	340.5	.0	.0	.0	.0
13	2013	.0	.0	.0	38.6	150.0	.0	.0	20.2	.0	371.7	.0	.0	.0	.0
14	2014	.0	.0	.0	38.6	75.0	.0	.0	22.8	.0	404.4	.0	.0	.0	.0
15	2015	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
16	2016	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
17	2017	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
18	2018	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
19	2019	.0	.0	.0	38.6	150.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
20	2020	.0	.0	.0	38.6	150.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
21	2021	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
22	2022	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
23	2023	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
24	2024	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
25	2025	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
26	2026	.0	.0	.0	38.6	150.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
27	2027	.0	.0	.0	38.6	75.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
28	2028	.0	.0	.0	38.6	75.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
29	2029	.0	.0	.0	38.6	150.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
30	2030	.0	.0	.0	38.6	75.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0

1

ESTRATEGIA NO. 1

F L U J O D E I N V E R S I O N G L O B A L (MIO. DOLAR)

		PLANTAS HIDROELECTRICAS				P L A N T A S T E R M O E L E C T R I C A S						LINEAS DE TRANSMISION			
NO.	ANO	MN	ME	MONCA	MANT	MN	ME	MONCA	MANT	COMB1	COMB2	MN	ME	MONCA	MANT
31	2031	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
32	2032	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
33	2033	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
34	2034	.0	.0	.0	38.6	150.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
35	2035	.0	.0	.0	38.6	150.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
36	2036	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
37	2037	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
38	2038	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
39	2039	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
40	2040	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
41	2041	.0	.0	.0	38.6	150.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
42	2042	.0	.0	.0	38.6	75.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
43	2043	.0	.0	.0	38.6	75.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
44	2044	.0	.0	.0	38.6	150.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
45	2045	.0	.0	.0	38.6	75.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
46	2046	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
47	2047	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
48	2048	.0	.0	.0	38.6	.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
49	2049	.0	.0	.0	38.6	150.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
50	2050	.0	.0	.0	38.6	150.0	.0	.0	24.1	.0	438.7	.0	.0	.0	.0
51	2051	-12.0	.0	.0	.0	-510.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

MN - MONEDA NACIONAL
ME - MONEDA EXTRANJERA
MONCA- MANO DE OBRA NO CALIFICADA
MANT - COSTOS DE MANTENIMIENTO
COMB1- COSTOS DE COMBUSTIBLE EN MONEDA NACIONAL
COMB2- COSTOS DE COMBUSTIBLE EN NONEDA EXTRANJERA

1

EVALUACION TECNICO-ECONOMICA DEL PROYECTO
C.H. Platanal en el SIN
PERIODO 2001-2015

14-12-99 HIDROLOGIA PROMEDIO

ESTRATEGIA NO. 1

EL VALOR PRESENTE POR CADA COMBINACION DE PARAMETROS

ECONOMICOS

TD	TIC	TC	FMON	VALOR PRESENTE
10.000	.000	1.000	1.000	4233.7
11.000	.000	1.000	1.000	3811.5
12.000	.000	1.000	1.000	3459.8
13.000	.000	1.000	1.000	3163.8
14.000	.000	1.000	1.000	2912.2

TD - TASA DE DESCUENTO (0/0)
TIC - TASA DE INCREMENTO ANUAL DE COSTO DE COMBUSTIBLE (0/0)
TC - TASA DE CAMBIO PARA MONEDA EXTRANJERA
FMON- FACTOR PARA PRECIOS SOMBRA DE MANO DE OBRA NO CALIFICADA
VALOR PRESENTE EN MIO. DOLAR

EXPANSION PLAN
WITHOUT PROJECT

HYDROCONDITION : DRY YEAR

```
ESTRATEGIA NO.     2
====================

 SIN, platanal       2 con
1

ESTRATEGIA NO.     2
====================

 SIN, platanal       2 con


PRESENCIA DE LAS PLANTAS HIDROELECTRICAS
========================================

      1   2   3   4   5   6   7   8   9   0
   ----------------------------------------
 0   -99 -99 -99 -99 -99 -99 -99 -99 -99 -99
10   -99 -99 -99 -99 -99 -99 -99 -99 -99 -99
20   -99 -99   3 -99 -99 -99   4
    ----------------------------------------


PRESENCIA DE LAS PLANTAS TERMOELECTRICAS
========================================

      1   2   3   4   5   6   7   8   9   0
   ----------------------------------------
 0   -99 -99 -99 -99 -99 -99 -99 -99 -99 -99
10   -99 -99 -99 -99 -99  -4  -4  -4  -4  -4
20   -99 -99 -99   4   4 -99 -99 -99 -99 -99
30   -99 -99 -99 -99 -99 -99 -99 -99 -99 -99
40   -99 -99 -99 -99   4   4   4   4   4   9
50    12  12  13  14  14  15  99  99  99
    ----------------------------------------


-LOS NUMEROS POSITIVOS INDICAN EN QUE INTERVALO DE
 TIEMPO T LAS PLANTAS O LAS LINEAS DE TRAMSMISION
 SE PONEN EN EXPLOTACION
-LOS NUMEROS NEGATIVOS INDICAN EL INTERVALO DE
 TIEMPO T EN EL QUE LAS PLANTAS EXISTENTES SE
 PARALIZAN
1


NUMERO DE SUBSISTEMAS EN CADA INTERVALO DE TIEMPO T
===================================================

      1   2   3   4   5   6   7   8   9   0
   ----------------------------------------
 0     1   1   1   1   1   1   1   1   1   1
10     1   1   1   1   1
    ----------------------------------------
1
                        PROGRAMA DE EQUIPAMIENTO
                        ========================

              ALTERNATIVA      2  SUBSISTEMA  SIN
              ========================================

       A¥O    DEMANDA    N.    PLANTA      POTENCIA      POTENCIA
                                           INSTALADA    GARANTIZADA
                                             (MW)          (MW)
      ==============================================================

      2001    2897.4         EXISTENTE       4336.3        4216.8
                             T O T A L       4336.3        4216.8

      2003    3348.3         EXISTENTE       4336.3        4216.8
                        23H  YUNCAN           150.0         150.0
                             T O T A L       4486.3        4366.8

      2004    3615.6         EXISTENTE       3873.1        3753.6
                        27H  PLATANAL         270.0         270.0
                        24T  TG CAM1          150.0         150.0
                        25T  TG CAM2          150.0         150.0
                        45T  S_ROSA W         120.0         120.0
                        46T  VEN TG1           90.9          90.9
                        47T  VEN TG2           94.2          94.2
                        48T  VEN TG3          154.3         154.3
                        49T  VEN TG4          153.8         153.8
                             T O T A L       5056.3        4936.8

      2009    4283.8         EXISTENTE       5056.3        4936.8
                        50T  TG CAM3          150.0         150.0
                             T O T A L       5206.3        5086.8

      2012    4775.5         EXISTENTE       5206.3        5086.8
                        51T  TG CAM4          150.0         150.0
                        52T  TG CAM5          150.0         150.0
                             T O T A L       5656.3        5536.8

      2013    4966.0         EXISTENTE       5656.3        5536.8
                        53T  TG CAM6          150.0         150.0
                             T O T A L       5956.3        5836.8

      2014    5164.5         EXISTENTE       5956.3        5836.8
                        54T  TG CAM7          150.0         150.0
                        55T  TG CAM8          150.0         150.0
                             T O T A L       6556.3        6436.8

      2015    5372.0         EXISTENTE       6556.3        6436.8
                        56T  TG CAM9          150.0         150.0
                             T O T A L       6856.3        6736.8
      ==============================================================
          TOTAL SUBSISTEMA   HIDRAULICAS      420.0         420.0
                             TERMICAS        2713.2
      ==============================================================

          TOTAL DEL PAIS     HIDRAULICAS      420.0         420.0
```

TERMICAS 2713.2

1

ESTRATEGIA NO. 2

F L U J O D E I N V E R S I O N G L O B A L (MIO. DOLAR)

		PLANTAS HIDROELECTRICAS				P L A N T A S T E R M O E L E C T R I C A S						LINEAS DE TRANSMISION			
NO.	ANO	MN	ME	MONCA	MANT	MN	ME	MONCA	MANT	COMB1	COMB2	MN	ME	MONCA	MANT
1	2001	113.2	.0	.0	35.2	.0	.0	.0	12.4	.0	50.3	.0	.0	.0	.0
2	2002	412.0	.0	.0	35.2	.0	.0	.0	12.4	.0	96.8	.0	.0	.0	.0
3	2003	44.8	.0	.0	38.6	150.0	.0	.0	12.4	.0	114.8	.0	.0	.0	.0
4	2004	.0	.0	.0	41.4	.0	.0	.0	13.7	.0	118.9	.0	.0	.0	.0
5	2005	.0	.0	.0	41.4	.0	.0	.0	13.7	.0	141.7	.0	.0	.0	.0
6	2006	.0	.0	.0	41.4	.0	.0	.0	13.7	.0	174.7	.0	.0	.0	.0
7	2007	.0	.0	.0	41.4	.0	.0	.0	13.7	.0	193.9	.0	.0	.0	.0
8	2008	.0	.0	.0	41.4	75.0	.0	.0	13.7	.0	209.7	.0	.0	.0	.0
9	2009	.0	.0	.0	41.4	.0	.0	.0	14.3	.0	268.6	.0	.0	.0	.0
10	2010	.0	.0	.0	41.4	.0	.0	.0	14.3	.0	247.5	.0	.0	.0	.0
11	2011	.0	.0	.0	41.4	150.0	.0	.0	14.3	.0	279.1	.0	.0	.0	.0
12	2012	.0	.0	.0	41.4	75.0	.0	.0	16.3	.0	306.0	.0	.0	.0	.0
13	2013	.0	.0	.0	41.4	150.0	.0	.0	17.6	.0	336.8	.0	.0	.0	.0
14	2014	.0	.0	.0	41.4	75.0	.0	.0	20.2	.0	369.0	.0	.0	.0	.0
15	2015	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
16	2016	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
17	2017	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
18	2018	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
19	2019	.0	.0	.0	41.4	150.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
20	2020	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
21	2021	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
22	2022	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
23	2023	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
24	2024	.0	.0	.0	41.4	75.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
25	2025	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
26	2026	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
27	2027	.0	.0	.0	41.4	150.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
28	2028	.0	.0	.0	41.4	75.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
29	2029	.0	.0	.0	41.4	150.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
30	2030	.0	.0	.0	41.4	75.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0

1

ESTRATEGIA NO. 2

F L U J O D E I N V E R S I O N G L O B A L (MIO. DOLAR)

		PLANTAS HIDROELECTRICAS				P L A N T A S T E R M O E L E C T R I C A S						LINEAS DE TRANSMISION			
NO.	ANO	MN	ME	MONCA	MANT	MN	ME	MONCA	MANT	COMB1	COMB2	MN	ME	MONCA	MANT
31	2031	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
32	2032	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
33	2033	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
34	2034	.0	.0	.0	41.4	150.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
35	2035	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
36	2036	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
37	2037	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
38	2038	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
39	2039	.0	.0	.0	41.4	75.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
40	2040	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
41	2041	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
42	2042	.0	.0	.0	41.4	150.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
43	2043	.0	.0	.0	41.4	75.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
44	2044	.0	.0	.0	41.4	150.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
45	2045	.0	.0	.0	41.4	75.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
46	2046	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
47	2047	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
48	2048	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
49	2049	.0	.0	.0	41.4	150.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
50	2050	.0	.0	.0	41.4	.0	.0	.0	21.5	.0	402.8	.0	.0	.0	.0
51	2051	-28.2	.0	.0	.0	-365.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

MN - MONEDA NACIONAL
ME - MONEDA EXTRANJERA
MONCA- MANO DE OBRA NO CALIFICADA
MANT - COSTOS DE MANTENIMIENTO
COMB1- COSTOS DE COMBUSTIBLE EN MONEDA NACIONAL
COMB2- COSTOS DE COMBUSTIBLE EN NONEDA EXTRANJERA

1

EVALUACION TECNICO-ECONOMICA DEL PROYECTO
C.H. Platanal en el SIN
PERIODO 2001-2015

14-12-99 HIDROLOGIA PROMEDIO

ESTRATEGIA NO. 2

EL VALOR PRESENTE POR CADA COMBINACION DE PARAMETROS

ECONOMICOS

TD	TIC	TC	FMON	VALOR PRESENTE
10.000	.000	1.000	1.000	4067.3
11.000	.000	1.000	1.000	3681.6
12.000	.000	1.000	1.000	3360.5
13.000	.000	1.000	1.000	3090.3
14.000	.000	1.000	1.000	2860.8

TD - TASA DE DESCUENTO (0/0)
TIC - TASA DE INCREMENTO ANUAL DE COSTO DE COMBUSTIBLE (0/0)
TC - TASA DE CAMBIO PARA MONEDA EXTRANJERA
FMON- FACTOR PARA PRECIOS SOMBRA DE MANO DE OBRA NO CALIFICADA
VALOR PRESENTE EN MIO. DÓLAR

EXPANSION PLAN

WITH PROJECT

HYDROCONDITION : AVERAGE YEAR

1

EVALUACION TECNICO-ECONOMICA DEL PROYECTO
C.H. Platanal en el SIN
PERIODO 2001-2015

14-12-99 HIDROLOGIA SECA

CARACTERISTICAS DEL SISTEMA
==========

DURACION DEL PERIODO DE PLANIFICACION = 15

DURACION DEL PERIODO DE ANALISIS = 50

NUMERO DE SUBDIVISIONES ANUALES EN LOS QUE SE OPTIMIZA LA OPERACION = 4

NUMERO TOTAL DE PLANTAS HIDROELECTRICAS = 27

NUMERO TOTAL DE PLANTAS TERMOELECTRICAS = 59

NUMERO TOTAL DE LINEAS DE TRANSMISION = 0

NUMERO TOTAL DE SUBSISTEMAS INICIALES = 1

EL A¥O CERO = 2000

EL A¥O DESDE EL QUE LA DEMANDA SE CONSIDERA CONSTANTE = 2016

A¥O DESDE EL QUE SE CALCULAN COSTOS DE COMBUSTIBLE
Y MANTENIMIENTO PARA LAS PLANTAS = 2001

1

CARACTERISTICAS DE LOS SUBSISTEMAS INICIALES
==========

SUBSISTEMA D = 1 SIN

NO. TOTAL DE PLANTAS HIDROELECTRICAS = 27
NO. TOTAL DE PLANTAS TERMOELECTRICAS = 59
DMAXJ(D) = 27 DMAXI(D) = 59

DEMANDA DE POTENCIA Y ENERGIA
==========

NO.	A¥O	PMAX (MW)	PMIN (MW)	ENERGIA (GWH)	PMAX+RES (MW)
1	2001	2873.3	1561.0	4872.9	3160.7
2	2001	2905.0	1421.2	4862.8	3195.5
3	2001	2904.1	1640.8	4970.6	3194.5
4	2001	2897.4	1510.9	5006.6	3187.2
5	2002	3130.5	1754.1	5366.7	3443.6
6	2002	3165.0	1605.4	5355.6	3481.5
7	2002	3164.1	1841.2	5474.4	3480.5
8	2002	3156.8	1707.5	5514.0	3472.4
9	2003	3320.4	1896.1	5730.8	3652.5
10	2003	3357.0	1740.8	5718.9	3692.7
11	2003	3356.0	1988.6	5845.7	3691.6
12	2003	3348.3	1852.1	5888.1	3683.1
13	2004	3585.5	2099.5	6244.7	3944.0
14	2004	3625.0	1935.5	6231.7	3987.5
15	2004	3623.9	2199.7	6369.9	3986.3
16	2004	3615.6	2059.9	6416.0	3977.1
17	2005	3725.9	2179.8	6487.1	4098.5
18	2005	3767.0	2009.2	6473.7	4143.7
19	2005	3765.9	2283.8	6617.3	4142.5
20	2005	3757.2	2138.3	6665.2	4132.9
21	2006	3911.9	2302.8	6826.3	4303.1
22	2006	3955.0	2124.6	6812.1	4350.5
23	2006	3953.8	2412.1	6963.2	4349.2
24	2006	3944.7	2261.4	7013.6	4339.2
25	2007	4029.6	2360.9	7019.5	4432.5
26	2007	4074.0	2176.6	7004.9	4481.4
27	2007	4072.8	2473.4	7160.3	4480.1
28	2007	4063.4	2316.5	7212.2	4469.8
29	2008	4128.5	2408.7	7180.9	4541.4
30	2008	4174.0	2219.2	7166.0	4591.4
31	2008	4172.8	2524.0	7325.0	4590.0
32	2008	4163.1	2361.8	7378.0	4579.5
33	2009	4248.2	2839.5	7779.6	4673.0
34	2009	4295.0	2669.2	7763.4	4724.5
35	2009	4293.7	2959.3	7935.6	4723.1
36	2009	4283.8	2845.8	7993.0	4712.2
37	2010	4366.9	2525.3	7571.2	4803.6
38	2010	4415.0	2323.3	7555.5	4856.5
39	2010	4413.7	2647.2	7723.1	4855.0
40	2010	4403.5	2472.3	7779.0	4843.9
41	2011	4553.8	2613.7	7874.0	5009.2
42	2011	4604.0	2401.7	7857.6	5064.4
43	2011	4602.6	2740.7	8031.9	5062.9
44	2011	4592.0	2555.4	8090.0	5051.2
45	2012	4735.8	2718.6	8189.1	5209.4
46	2012	4788.0	2498.1	8172.1	5266.8
47	2012	4786.6	2850.6	8353.4	5265.2
48	2012	4775.5	2658.0	8413.8	5253.1
49	2013	4924.7	2827.8	8516.6	5417.2
50	2013	4979.0	2598.6	8498.9	5476.9
51	2013	4977.5	2965.1	8687.4	5475.3
52	2013	4966.0	2764.9	8750.3	5462.7
53	2014	5121.6	2941.0	8857.2	5633.7
54	2014	5178.0	2702.7	8838.8	5695.8
55	2014	5176.5	3083.8	9034.9	5694.1
56	2014	5164.5	2875.6	9100.3	5681.0
57	2015	5327.3	3057.9	9211.7	5860.0

58	2015	5386.0	2809.9	9192.5	5924.6
59	2015	5384.4	3206.4	9396.4	5922.8
60	2015	5372.0	2989.7	9464.4	5909.2

1

CARACTERISTICAS DE LAS PLANTAS HIDROELECTRICAS

NO.	PLANTA	L	CON	IS	W	P	PG	E.PUNTA	POTENCIA (MW) / ENERGIA (GWH)			
1	MANTARO	0	0	1	8.73	580.0	580.0	2.900	580.0	580.0	580.0	580.0
									997.1	816.8	977.5	700.8
2	RESTITU	0	0	1	3.13	200.0	200.0	1.000	200.0	200.0	200.0	200.0
									340.7	270.0	322.9	229.7
3	HUINCO	0	0	1	2.00	240.0	240.0	1.200	240.0	240.0	240.0	240.0
									227.4	152.5	197.2	165.0
4	MATU	0	0	1	1.55	120.0	120.0	.360	120.0	120.0	120.0	120.0
									173.5	163.7	149.0	179.2
5	CALLA	0	0	1	1.00	68.0	68.0	.340	68.0	68.0	68.0	68.0
									105.3	101.5	118.7	116.6
6	MOYOP	0	0	1	.84	80.0	80.0	.400	80.0	80.0	80.0	80.0
									101.8	120.6	119.5	117.4
7	HUAMP	0	0	1	.50	27.0	27.0	.135	27.0	27.0	27.0	27.0
									26.1	35.2	41.7	38.0
8	CAHUA	0	0	1	.70	40.0	40.0	.000	40.0	40.0	40.0	40.0
									81.7	68.6	48.9	63.5
9	CARHUA	0	0	1	1.20	87.0	87.0	.261	87.0	87.0	87.0	87.0
									133.1	113.1	73.7	145.4
10	CA¥ON	0	0	1	2.00	218.3	105.5	.000	218.3	205.0	105.5	210.0
									471.5	364.0	233.3	363.5
11	OROYA	0	0	1	.20	9.0	9.0	.027	9.0	9.0	9.0	9.0
									12.5	11.0	8.6	11.4
12	PACHA	0	0	1	.20	12.0	12.0	.036	12.0	12.0	12.0	12.0
									9.9	6.3	8.5	9.1
13	YAUPI	0	0	1	1.70	100.0	100.0	.300	100.0	100.0	100.0	100.0
									204.9	172.5	160.7	185.0
14	GALLITO	0	0	1	.40	33.7	33.7	.169	33.7	33.7	33.7	33.7
									30.9	28.3	7.7	7.0
15	CURUMUY	0	0	1	.20	10.0	10.0	.000	10.0	10.0	10.0	10.0
									8.8	17.4	8.5	3.1
16	ARI1-2	0	0	1	.61	33.4	33.4	.097	33.4	33.4	33.4	33.4
									27.0	27.2	27.3	27.2
17	CHAR123	0	0	1	.30	6.8	4.4	.000	5.0	4.9	4.4	4.5
									10.6	5.9	6.0	7.1
18	CHAR46	0	0	1	.45	23.4	23.4	.070	23.4	23.4	23.4	23.4
									27.8	14.0	14.3	17.5
19	CHAR5PC	0	0	1	1.20	135.0	135.0	.405	135.0	135.0	135.0	135.0
									97.0	48.7	50.3	61.0
20	SGII	0	0	1	1.56	105.0	105.0	.315	105.0	105.0	105.0	105.0
									226.8	167.0	89.0	203.0

1

NO.	PLANTA	L	CON	IS	W	P	PG	E.PUNTA	POTENCIA (MW) / ENERGIA (GWH)			
21	YANANGO	0	0	1	1.00	38.0	38.0	.000	38.0	38.0	38.0	38.0
									79.2	65.5	39.6	61.8
22	CHIMAY	0	0	1	3.50	142.0	142.0	.426	142.0	142.0	142.0	142.0
									303.7	207.6	104.0	221.0
23	YUNCAN	50	1	0	3.35	150.0	150.0	.450	150.0	150.0	150.0	150.0
									205.7	187.4	182.1	196.0
24	MACHU	0	0	1	1.56	107.0	104.6	.000	106.6	106.0	104.6	104.6
									230.3	231.4	230.9	230.9
25	PARIAC	0	0	1	.30	5.6	3.7	.000	4.2	5.1	3.7	5.7
									9.2	11.1	8.0	12.3
26	MALPASO	0	0	1	.40	44.0	44.0	.220	44.0	44.0	44.0	44.0
									50.1	41.0	38.0	36.2
27	PLATANAL	50	3	0	2.80	270.0	270.0	1.350	270.0	270.0	270.0	270.0
									281.3	237.0	163.2	139.6

L - DURACION DE VIDA (A¥OS)
IS - SI = 0 PLANTA PROYECTADA
SI = 1 PLANTA EXISTENTE
CON - SI IS=0 A¥OS DE CONSTRUCCION
SI IS=1 A¥O DEL PERIODO DE PLANIFICACION
QUE EMPIEZA A OPERAR
W - COSTOS ANUALES DE MANTENIMIENTO (MIO. DOLAR)
P - POTENCIA INSTALADA (MW)
PG - POTENCIA GARANTIZADA EN EL ANO SECO (MW)
HPUNTA ENERGIA EN HORAS DE PUNTA (GWH/DIA)
Q - POTENCIA (MW)
H - ENERGIA (GWH)

1

FLUJO DE INVERSION ANUAL (MIO. DOLAR)

NO.	PLANTA	EN MONEDA NACIONAL	EN MONEDA EXTRANJERA	PARA MANO DE OBRA NO CALIFICADA
23	YUNCAN	300.00		
		.00		
		.00		
27	PLATANAL	113.20	112.00	44.80
		.00	.00	.00
		.00	.00	.00

1

CARACTERISTICAS DE LAS PLANTAS TERMOELECTRICAS

NO.	PLANTA	L	CON	IS	W	NU	PE	PMB	HRBASE	HRINC	HR100%	TC	PCOMB	PGAS	OMV	DISP	OMVT	REND
1	MALACASD2	0	0	1	.25	1	46.0	10.00	329.00	329.0	329.00	1	1.165	.000	4.00	.94	60.82	.25
2	TALARAGN	0	0	1	.50	1	96.6	20.00	11.60	11.6	11.60	3	.00029	.300	2.25	.94	22.24	.25
3	CHIMBO TG	0	0	1	.25	1	58.7	15.00	346.00	346.0	346.00	1	1.165	.000	2.70	.94	63.56	.24
4	TRUJI TG	0	0	1	.15	1	19.9	5.00	346.00	346.0	346.00	1	1.165	.000	2.70	.94	63.18	.24
5	PIURA TG	0	0	1	.17	1	20.4	5.00	319.00	319.0	319.00	1	1.165	.000	2.70	.94	57.50	.26
6	PIURA D2	0	0	1	.10	1	12.1	4.00	234.00	234.0	234.00	1	1.165	.000	7.11	.94	47.31	.35
7	PIURA R6	0	0	1	.10	1	10.2	2.00	245.00	245.0	245.00	2	1.048	.000	7.04	.94	39.99	.35
8	CHICLA N	0	0	1	.08	1	6.0	1.00	239.00	239.0	239.00	1	1.165	.000	7.04	.94	48.51	.35
9	CHICLA O	0	0	1	.18	1	18.0	3.00	263.00	263.0	263.00	2	1.048	.000	7.04	.94	41.91	.33
10	SULLA GD	0	0	1	.10	1	7.6	2.00	241.00	241.0	241.00	1	1.165	.000	7.30	.94	49.47	.34
11	PAITA GD	0	0	1	.10	1	7.9	2.00	241.00	241.0	241.00	1	1.165	.000	7.54	.94	50.20	.34
12	PACAS SU	0	0	1	.10	1	7.4	2.00	247.00	247.0	247.00	2	1.048	.000	7.04	.94	34.23	.35
13	PACAS GD	0	0	1	.03	1	1.5	.50	228.00	228.0	228.00	2	1.048	.000	7.04	.94	38.09	.38
14	S_ROSA N	0	0	1	.50	1	103.2	20.00	287.00	287.0	287.00	1	1.165	.000	7.07	.94	58.04	.29
15	S_ROSA V	0	0	1	.30	1	36.6	5.00	472.00	472.0	472.00	1	1.048	.000	6.31	.94	90.23	.18
16	S_ROSA W	0	0	1	.60	1	120.0	20.00	266.00	266.0	266.00	1	1.165	.000	4.10	.94	51.34	.31
17	VEN TG1	0	0	1	.60	1	90.9	20.00	280.00	280.0	280.00	1	1.165	.000	3.32	.94	52.99	.30
18	VEN TG2	0	0	1	.60	1	94.2	20.00	275.00	275.0	275.00	1	1.165	.000	3.32	.94	52.10	.30
19	VEN TG3	0	0	1	.75	1	154.3	25.00	230.00	230.0	230.00	1	1.165	.000	4.00	.94	44.85	.36
20	VEN TG4	0	0	1	.75	1	153.8	25.00	232.00	232.0	232.00	1	1.165	.000	4.00	.94	45.20	.36
21	TV TRUPAL	0	0	1	.05	1	11.0	3.00	549.00	549.0	549.00	2	1.048	.000	8.00	.94	63.01	.16
22	TV SHOUGE	0	0	1	.30	1	54.6	2.00	346.00	346.0	346.00	2	1.048	.000	2.00	.94	36.67	.25
23	TG AGUAYT	0	0	1	.65	1	155.5	25.00	11.88	11.9	11.88	3	.00029	.300	2.89	.94	16.91	.24
24	TG CAM1	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
25	TG CAM2	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
26	TACNA GD	0	0	1	.03	1	2.5	1.00	248.00	248.0	248.00	1	1.165	.000	6.80	.94	52.42	.33
27	CHILINA CC	0	0	1	.10	1	20.0	6.00	290.00	290.0	290.00	1	1.165	.000	3.20	.96	55.88	.29
28	CHILI TV2	0	0	1	.18	1	8.0	2.00	474.00	474.0	474.00	2	1.048	.000	2.60	.96	48.20	.18
29	CHILI TV3	0	0	1	.18	1	10.0	2.00	438.00	438.0	438.00	2	1.048	.000	2.60	.96	44.74	.20
30	AREQ GD	0	0	1	.11	2	5.2	2.00	226.00	226.0	226.00	2	1.048	.000	6.60	.94	30.10	.38
31	MOLL GD	0	0	1	.50	3	10.0	2.00	217.00	217.0	217.00	2	1.048	.000	6.60	.94	26.40	.40
32	GD TACNA	0	0	1	.50	3	6.4	1.00	217.00	217.0	217.00	2	1.048	.000	6.30	.94	28.75	.40
33	DOL-PATA	0	0	1	.12	6	2.0	1.00	273.00	273.0	273.00	1	1.165	.000	6.80	.94	69.36	.30
34	GD JULI	0	0	1	.17	2	2.2	1.00	263.00	263.0	263.00	1	1.165	.000	6.80	.94	63.59	.31
35	GD PUNO	0	0	1	.19	1	2.3	1.00	263.00	263.0	263.00	1	1.165	.000	6.80	.94	66.41	.31
36	GD PUNO	0	0	1	.19	2	1.8	1.00	263.00	263.0	263.00	1	1.165	.000	6.80	.94	66.41	.31
37	ILO TV2	0	0	1	.10	1	21.0	15.00	4536.00	4536.0	4536.00	1	1.043	.000	3.80	.99	8.79	.02
38	ILO TV3	0	0	1	.20	1	55.0	35.00	298.00	298.0	298.00	2	1.048	.000	3.80	.97	24.33	.29
39	ILO TV4	0	0	1	.30	1	56.0	25.00	339.00	339.0	339.00	2	1.048	.000	3.80	.95	33.34	.26
40	ILO GD1	0	0	1	.05	1	3.3	1.00	205.00	205.0	205.00	1	1.165	.000	3.80	.95	38.30	.40

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NO.	PLANTA	L	CON	IS	W	NU	PE	PMB	HRBASE	HRINC	HR100%	TC	PCOMB	PGAS	OMV	DISP	OMVT	REND
41	ILO TG1	0	0	1	.15	1	37.0	10.00	285.00	285.0	285.00	1	1.165	.000	3.80	.95	51.76	.29
42	ILO TG2	0	0	1	.15	1	40.0	10.00	225.00	225.0	225.00	1	1.165	.000	6.00	.95	43.87	.37
43	ILO TV5	0	0	1	1.00	1	125.0	50.00	364.00	364.0	364.00	4	.000	.000	3.00	.95	19.38	.37
44	ILO TV6	0	0	1	1.00	1	125.0	50.00	364.00	364.0	364.00	4	.000	.000	3.00	.95	19.38	.37
45	S_ROSA W	15	1	0	.65	1	120.0	20.00	10.75	10.8	10.75	3	.00029	.300	3.00	.94	24.50	.27
46	VEN TG1	15	1	0	.65	1	90.9	20.00	10.75	10.8	10.75	3	.00029	.300	3.00	.94	24.50	.27
47	VEN TG2	15	1	0	.65	1	94.2	20.00	10.75	10.8	10.75	3	.00029	.300	3.00	.94	24.50	.27
48	VEN TG3	15	1	0	.65	1	154.3	25.00	10.75	10.8	10.75	3	.00029	.300	3.00	.94	24.50	.27
49	VEN TG4	15	1	0	.65	1	153.8	25.00	10.75	10.8	10.75	3	.00029	.300	3.00	.94	24.50	.27
50	TG CAM3	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
51	TG CAM4	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
52	TG CAM5	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
53	TG CAM6	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
54	TG CAM7	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
55	TG CAM8	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
56	TG CAM9	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
57	TG CA10	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27
58	TV1-CO	25	3	0	1.00	1	125.0	50.00	364.00	364.0	364.00	4	.000	.000	3.00	.95	19.38	.37
59	TG CA11	15	1	0	.65	1	150.0	25.00	10.75	10.8	10.75	3	.00029	.300	2.25	.94	23.75	.27

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L   - DURACION DE VIDA (A¥OS)
IS  -   SI = 0   PLANTA PROYECTADA
        SI = 1   PLANTA EXISTENTE
CON - SI IS=0  A¥OS DE CONSTRUCCION
      SI IS=1  A¥O DEL PERIODO DE PLANIFICACION
               QUE EMPIEZA A OPERAR
W   - COSTOS ANUALES DE MANTENIMIENTO (MIO. DOLAR )
PE - POTENCIA EFECTIVA (MW)
NU - NUMERO DE UNIDADES
PMB- POTENCIA MINIMA (MW)
HRBASE CONSUMO ESPECIFICO DE CALOR SIN CARGA KG/MWH
HRINC  CONSUMO ESPECIFICO DE CALOR INCREMENTAL KG/MWH
HR100% CONSUMO ESPECIFICO DE CALOR A PLENA CARGA KG/MWH
TC - TIPO DE COMBUSTILE
     1 DIESEL 2
     2 RESIDUAL 6
     3 GAS
     4 CARBON
PCOMB VOLUMEN ESPECIFICO COMBUSTIBLE (L/KG)
      1.156 DIESEL 2
      1.020 RESIDUAL 6
PGAS VOLUMEN ESPECIFICO GAS (PIE CUBICO/KG)
OMV- COSTOS VARIABLE O&M ( DOLAR/ MWH)
DISP DISPONIBILIDAD
OMVT COSTO VARIABLE TOTAL A PLENA CARGA ( DOLAR/ MWH)
REND RENDIMIENTO DE LA CENTRAL TERMICA
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FLUJO DE INVERSION ANUAL (MIO. DOLAR)
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NO.	PLANTA	EN MONEDA NACIONAL	EN MONEDA EXTRANJERA	PARA MANO DE OBRA NO CALIFICADA
24	TG CAM1	75.00	.00	.00
25	TG CAM2	75.00	.00	.00
45	S_ROSA W	.00	.00	.00
46	VEN TG1	.00	.00	.00
47	VEN TG2	.00	.00	.00
48	VEN TG3	.00	.00	.00
49	VEN TG4	.00	.00	.00
50	TG CAM3	75.00	.00	.00
51	TG CAM4	75.00	.00	.00
52	TG CAM5	75.00	.00	.00

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NO.	PLANTA	EN MONEDA NACIONAL	EN MONEDA EXTRANJERA	PARA MANO DE OBRA NO CALIFICADA
53	TG CAM6	75.00	.00	.00
54	TG CAM7	75.00	.00	.00
55	TG CAM8	75.00	.00	.00
56	TG CAM9	75.00	.00	.00
57	TG CA10	75.00	.00	.00
58	TV1-CO	41.25	55.00	41.25
		.00	.00	.00
		.00	.00	.00
59	TG CA11	75.00	.00	.00

ESTRATEGIA NO. 1
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SIN, platanal 2 sin

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ESTRATEGIA NO. 1
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SIN, platanal 2 sin

PRESENCIA DE LAS PLANTAS HIDROELECTRICAS
==========

	1	2	3	4	5	6	7	8	9	0
0	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
10	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
20	-99	-99	3	-99	-99	-99	99			

PRESENCIA DE LAS PLANTAS TERMOELECTRICAS
==========

	1	2	3	4	5	6	7	8	9	0
0	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
10	-99	-99	-99	-99	-99	-4	-4	-4	-4	-4
20	-99	-99	-99	4	4	-99	-99	-99	-99	-99
30	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
40	-99	-99	-99	-99	4	4	4	4	4	5
50	11	11	12	13	14	14	15	99	5	

-LOS NUMEROS POSITIVOS INDICAN EN QUE INTERVALO DE TIEMPO T LAS PLANTAS O LAS LINEAS DE TRAMSMISION SE PONEN EN EXPLOTACION
-LOS NUMEROS NEGATIVOS INDICAN EL INTERVALO DE TIEMPO T EN EL QUE LAS PLANTAS EXISTENTES SE PARALIZAN

1

NUMERO DE SUBSISTEMAS EN CADA INTERVALO DE TIEMPO T

	1	2	3	4	5	6	7	8	9	0
0	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1					

1

PROGRAMA DE EQUIPAMIENTO

ALTERNATIVA 1 SUBSISTEMA SIN

A¥O	DEMANDA	N.	PLANTA	POTENCIA INSTALADA (MW)	POTENCIA GARANTIZADA (MW)
2001	2897.4		EXISTENTE	4336.3	4216.8
			T O T A L	4336.3	4216.8
2003	3348.3		EXISTENTE	4336.3	4216.8
		23H	YUNCAN	150.0	150.0
			T O T A L	4486.3	4366.8
2004	3615.6		EXISTENTE	3873.1	3753.6
		24T	TG CAM1	150.0	150.0
		25T	TG CAM2	150.0	150.0
		45T	S_ROSA W	120.0	120.0
		46T	VEN TG1	90.9	90.9
		47T	VEN TG2	94.2	94.2
		48T	VEN TG3	154.3	154.3
		49T	VEN TG4	153.8	153.8
			T O T A L	4786.3	4666.8
2005	3757.2		EXISTENTE	4786.3	4666.8
		50T	TG CAM3	150.0	150.0
		59T	TG CA11	150.0	150.0
			T O T A L	5086.3	4966.8
2011	4592.0		EXISTENTE	5086.3	4966.8
		51T	TG CAM4	150.0	150.0
		52T	TG CAM5	150.0	150.0
			T O T A L	5386.3	5266.8
2012	4775.5		EXISTENTE	5386.3	5266.8
		53T	TG CAM6	150.0	150.0
			T O T A L	5536.3	5416.8
2013	4966.0		EXISTENTE	5536.3	5416.8
		54T	TG CAM7	150.0	150.0
			T O T A L	5686.3	5566.8
2014	5164.5		EXISTENTE	5686.3	5566.8
		55T	TG CAM8	150.0	150.0
		56T	TG CAM9	150.0	150.0
			T O T A L	5986.3	5866.8
2015	5372.0		EXISTENTE	5986.3	5866.8
		57T	TG CA10	150.0	150.0
			T O T A L	6136.3	6016.8
	TOTAL SUBSISTEMA		HIDRAULICAS	150.0	150.0
			TERMICAS	2263.2	
	TOTAL DEL PAIS		HIDRAULICAS	150.0	150.0
			TERMICAS	2263.2	

1

ESTRATEGIA NO. 1

F L U J O D E I N V E R S I O N G L O B A L (MIO. DOLAR)

		PLANTAS HIDROELECTRICAS				P L A N T A S T E R M O E L E C T R I C A S						LINEAS DE TRANSMISION			
NO.	ANO	MN	ME	MONCA	MANT	MN	ME	MONCA	MANT	COMB1	COMB2	MN	ME	MONCA	MANT
1	2001	.0	.0	.0	35.2	.0	.0	.0	12.4	.0	142.0	.0	.0	.0	.0
2	2002	300.0	.0	.0	35.2	.0	.0	.0	12.4	.0	220.4	.0	.0	.0	.0
3	2003	.0	.0	.0	38.6	150.0	.0	.0	12.4	.0	250.6	.0	.0	.0	.0
4	2004	.0	.0	.0	38.6	150.0	.0	.0	13.7	.0	240.2	.0	.0	.0	.0
5	2005	.0	.0	.0	38.6	.0	.0	.0	15.0	.0	262.4	.0	.0	.0	.0
6	2006	.0	.0	.0	38.6	.0	.0	.0	15.0	.0	295.9	.0	.0	.0	.0
7	2007	.0	.0	.0	38.6	.0	.0	.0	15.0	.0	315.2	.0	.0	.0	.0
8	2008	.0	.0	.0	38.6	.0	.0	.0	15.0	.0	332.4	.0	.0	.0	.0
9	2009	.0	.0	.0	38.6	.0	.0	.0	15.0	.0	414.7	.0	.0	.0	.0
10	2010	.0	.0	.0	38.6	150.0	.0	.0	15.0	.0	383.4	.0	.0	.0	.0
11	2011	.0	.0	.0	38.6	75.0	.0	.0	16.3	.0	400.4	.0	.0	.0	.0
12	2012	.0	.0	.0	38.6	75.0	.0	.0	16.9	.0	430.8	.0	.0	.0	.0
13	2013	.0	.0	.0	38.6	150.0	.0	.0	17.6	.0	462.3	.0	.0	.0	.0
14	2014	.0	.0	.0	38.6	75.0	.0	.0	18.9	.0	491.4	.0	.0	.0	.0
15	2015	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
16	2016	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
17	2017	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
18	2018	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
19	2019	.0	.0	.0	38.6	150.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
20	2020	.0	.0	.0	38.6	150.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
21	2021	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
22	2022	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
23	2023	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
24	2024	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
25	2025	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
26	2026	.0	.0	.0	38.6	150.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
27	2027	.0	.0	.0	38.6	75.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
28	2028	.0	.0	.0	38.6	75.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
29	2029	.0	.0	.0	38.6	150.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
30	2030	.0	.0	.0	38.6	75.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0

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ESTRATEGIA NO. 1

F L U J O D E I N V E R S I O N G L O B A L (MIO. DOLAR)

NO.	ANO	PLANTAS HIDROELECTRICAS MN	ME	MONCA	MANT	P L A N T A S T E R M O E L E C T R I C A S MN	ME	MONCA	MANT	COMB1	COMB2	LINEAS DE TRANSMISION MN	ME	MONCA	MANT
31	2031	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
32	2032	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
33	2033	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
34	2034	.0	.0	.0	38.6	150.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
35	2035	.0	.0	.0	38.6	150.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
36	2036	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
37	2037	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
38	2038	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
39	2039	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
40	2040	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
41	2041	.0	.0	.0	38.6	150.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
42	2042	.0	.0	.0	38.6	75.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
43	2043	.0	.0	.0	38.6	75.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
44	2044	.0	.0	.0	38.6	150.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
45	2045	.0	.0	.0	38.6	75.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
46	2046	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
47	2047	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
48	2048	.0	.0	.0	38.6	.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
49	2049	.0	.0	.0	38.6	150.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
50	2050	.0	.0	.0	38.6	150.0	.0	.0	19.5	.0	525.6	.0	.0	.0	.0
51	2051	-12.0	.0	.0	.0	-510.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

MN - MONEDA NACIONAL
ME - MONEDA EXTRANJERA
MONCA- MANO DE OBRA NO CALIFICADA
MANT - COSTOS DE MANTENIMIENTO
COMB1- COSTOS DE COMBUSTIBLE EN MONEDA NACIONAL
COMB2- COSTOS DE COMBUSTIBLE EN NONEDA EXTRANJERA

1

EVALUACION TECNICO-ECONOMICA DEL PROYECTO
C.H. Platanal en el SIN
PERIODO 2001-2015

14-12-99 HIDROLOGIA SECA

ESTRATEGIA NO. 1

EL VALOR PRESENTE POR CADA COMBINACION DE PARAMETROS

ECONOMICOS

TD	TIC	TC	FMON	VALOR PRESENTE
10.000	.000	1.000	1.000	5262.2
11.000	.000	1.000	1.000	4764.5
12.000	.000	1.000	1.000	4348.7
13.000	.000	1.000	1.000	3997.6
14.000	.000	1.000	1.000	3698.3

TD - TASA DE DESCUENTO (0/0)
TIC - TASA DE INCREMENTO ANUAL DE COSTO DE COMBUSTIBLE (0/0)
TC - TASA DE CAMBIO PARA MONEDA EXTRANJERA
FMON- FACTOR PARA PRECIOS SOMBRA DE MANO DE OBRA NO CALIFICADA
VALOR PRESENTE EN MIO. DÓLAR

EXPANSION PLAN
WITH PROJECT

HYDROCONDITION : DRY YEAR

ESTRATEGIA NO. 2
==========

SIN, platanal 2 con

1

ESTRATEGIA NO. 2
==========

SIN, platanal 2 con

PRESENCIA DE LAS PLANTAS HIDROELECTRICAS
==========

	1	2	3	4	5	6	7	8	9	0
0	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
10	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
20	-99	-99	3	-99	-99	-99	4			

PRESENCIA DE LAS PLANTAS TERMOELECTRICAS
==========

	1	2	3	4	5	6	7	8	9	0
0	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
10	-99	-99	-99	-99	-99	-4	-4	-4	-4	-4
20	-99	-99	-99	4	4	-99	-99	-99	-99	-99
30	-99	-99	-99	-99	-99	-99	-99	-99	-99	-99
40	-99	-99	-99	-99	4	4	4	4	4	9
50	12	12	13	14	14	15	99	99	99	

-LOS NUMEROS POSITIVOS INDICAN EN QUE INTERVALO DE TIEMPO T LAS PLANTAS O LAS LINEAS DE TRAMSMISION SE PONEN EN EXPLOTACION
-LOS NUMEROS NEGATIVOS INDICAN EL INTERVALO DE TIEMPO T EN EL QUE LAS PLANTAS EXISTENTES SE PARALIZAN

1

NUMERO DE SUBSISTEMAS EN CADA INTERVALO DE TIEMPO T
==========

	1	2	3	4	5	6	7	8	9	0
0	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1					

1

PROGRAMA DE EQUIPAMIENTO
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ALTERNATIVA 2 SUBSISTEMA SIN
==========

A¥O	DEMANDA	N.	PLANTA	POTENCIA INSTALADA (MW)	POTENCIA GARANTIZADA (MW)
2001	2897.4		EXISTENTE	4336.3	4216.8
			T O T A L	4336.3	4216.8
2003	3348.3		EXISTENTE	4336.3	4216.8
		23H	YUNCAN	150.0	150.0
			T O T A L	4486.3	4366.8
2004	3615.6		EXISTENTE	3873.1	3753.6
		27H	PLATANAL	270.0	270.0
		24T	TG CAM1	150.0	150.0
		25T	TG CAM2	150.0	150.0
		45T	S_ROSA W	120.0	120.0
		46T	VEN TG1	90.9	90.9
		47T	VEN TG2	94.2	94.2
		48T	VEN TG3	154.3	154.3
		49T	VEN TG4	153.8	153.8
			T O T A L	5056.3	4936.8
2009	4283.8		EXISTENTE	5056.3	4936.8
		50T	TG CAM3	150.0	150.0
			T O T A L	5206.3	5086.8
2012	4775.5		EXISTENTE	5206.3	5086.8
		51T	TG CAM4	150.0	150.0
		52T	TG CAM5	150.0	150.0
			T O T A L	5506.3	5386.8
2013	4966.0		EXISTENTE	5506.3	5386.8
		53T	TG CAM6	150.0	150.0
			T O T A L	5656.3	5536.8
2014	5164.5		EXISTENTE	5656.3	5536.8
		54T	TG CAM7	150.0	150.0
		55T	TG CAM8	150.0	150.0
			T O T A L	5956.3	5836.8
2015	5372.0		EXISTENTE	5956.3	5836.8
		56T	TG CAM9	150.0	150.0
			T O T A L	6106.3	5986.8
TOTAL SUBSISTEMA			HIDRAULICAS	420.0	420.0
			TERMICAS	1963.2	
TOTAL DEL PAIS			HIDRAULICAS	420.0	420.0
			TERMICAS	1963.2	

1

ESTRATEGIA NO. 2

F L U J O D E I N V E R S I O N G L O B A L (MIO. DOLAR)

NO.	ANO	PLANTAS HIDROELECTRICAS MN	ME	MONCA	MANT	P L A N T A S T E R M O E L E C T R I C A S MN	ME	MONCA	MANT	COMB1	COMB2	LINEAS DE TRANSMISION MN	ME	MONCA	MANT
1	2001	113.2	.0	.0	35.2	.0	.0	.0	12.4	.0	142.0	.0	.0	.0	.0
2	2002	412.0	.0	.0	35.2	.0	.0	.0	12.4	.0	220.4	.0	.0	.0	.0
3	2003	44.8	.0	.0	38.6	150.0	.0	.0	12.4	.0	250.6	.0	.0	.0	.0
4	2004	.0	.0	.0	41.4	.0	.0	.0	13.7	.0	220.1	.0	.0	.0	.0
5	2005	.0	.0	.0	41.4	.0	.0	.0	13.7	.0	244.3	.0	.0	.0	.0
6	2006	.0	.0	.0	41.4	.0	.0	.0	13.7	.0	281.0	.0	.0	.0	.0
7	2007	.0	.0	.0	41.4	.0	.0	.0	13.7	.0	305.9	.0	.0	.0	.0
8	2008	.0	.0	.0	41.4	75.0	.0	.0	13.7	.0	330.1	.0	.0	.0	.0
9	2009	.0	.0	.0	41.4	.0	.0	.0	14.3	.0	407.7	.0	.0	.0	.0
10	2010	.0	.0	.0	41.4	.0	.0	.0	14.3	.0	373.3	.0	.0	.0	.0
11	2011	.0	.0	.0	41.4	150.0	.0	.0	14.3	.0	427.8	.0	.0	.0	.0
12	2012	.0	.0	.0	41.4	75.0	.0	.0	15.6	.0	431.7	.0	.0	.0	.0
13	2013	.0	.0	.0	41.4	150.0	.0	.0	16.3	.0	463.4	.0	.0	.0	.0
14	2014	.0	.0	.0	41.4	75.0	.0	.0	17.6	.0	480.7	.0	.0	.0	.0
15	2015	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
16	2016	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
17	2017	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
18	2018	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
19	2019	.0	.0	.0	41.4	150.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
20	2020	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
21	2021	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
22	2022	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
23	2023	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
24	2024	.0	.0	.0	41.4	75.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
25	2025	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
26	2026	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
27	2027	.0	.0	.0	41.4	150.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
28	2028	.0	.0	.0	41.4	75.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
29	2029	.0	.0	.0	41.4	150.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
30	2030	.0	.0	.0	41.4	75.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0

1

ESTRATEGIA NO. 2

F L U J O D E I N V E R S I O N G L O B A L (MIO. DOLAR)

NO.	ANO	PLANTAS HIDROELECTRICAS MN	ME	MONCA	MANT	P L A N T A S T E R M O E L E C T R I C A S MN	ME	MONCA	MANT	COMB1	COMB2	LINEAS DE TRANSMISION MN	ME	MONCA	MANT
31	2031	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
32	2032	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
33	2033	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
34	2034	.0	.0	.0	41.4	150.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
35	2035	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
36	2036	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
37	2037	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
38	2038	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
39	2039	.0	.0	.0	41.4	75.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
40	2040	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
41	2041	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
42	2042	.0	.0	.0	41.4	150.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
43	2043	.0	.0	.0	41.4	75.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
44	2044	.0	.0	.0	41.4	150.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
45	2045	.0	.0	.0	41.4	75.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
46	2046	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
47	2047	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
48	2048	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
49	2049	.0	.0	.0	41.4	150.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
50	2050	.0	.0	.0	41.4	.0	.0	.0	18.2	.0	516.2	.0	.0	.0	.0
51	2051	-28.2	.0	.0	.0	-365.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

MN - MONEDA NACIONAL
ME - MONEDA EXTRANJERA
MONCA- MANO DE OBRA NO CALIFICADA
MANT - COSTOS DE MANTENIMIENTO
COMB1- COSTOS DE COMBUSTIBLE EN MONEDA NACIONAL
COMB2- COSTOS DE COMBUSTIBLE EN NONEDA EXTRANJERA

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EVALUACION TECNICO-ECONOMICA DEL PROYECTO
C.H. Platanal en el SIN
PERIODO 2001-2015

14-12-99 HIDROLOGIA SECA

ESTRATEGIA NO. 2

EL VALOR PRESENTE POR CADA COMBINACION DE PARAMETROS

ECONOMICOS

TD	TIC	TC	FMON	VALOR PRESENTE
10.000	.000	1.000	1.000	5320.2
11.000	.000	1.000	1.000	4834.6
12.000	.000	1.000	1.000	4428.7
13.000	.000	1.000	1.000	4086.0
14.000	.000	1.000	1.000	3793.7

TD - TASA DE DESCUENTO (0/0)
TIC - TASA DE INCREMENTO ANUAL DE COSTO DE COMBUSTIBLE (0/0)
TC - TASA DE CAMBIO PARA MONEDA EXTRANJERA
FMON- FACTOR PARA PRECIOS SOMBRA DE MANO DE OBRA NO CALIFICADA
VALOR PRESENTE EN MIO. DOLAR