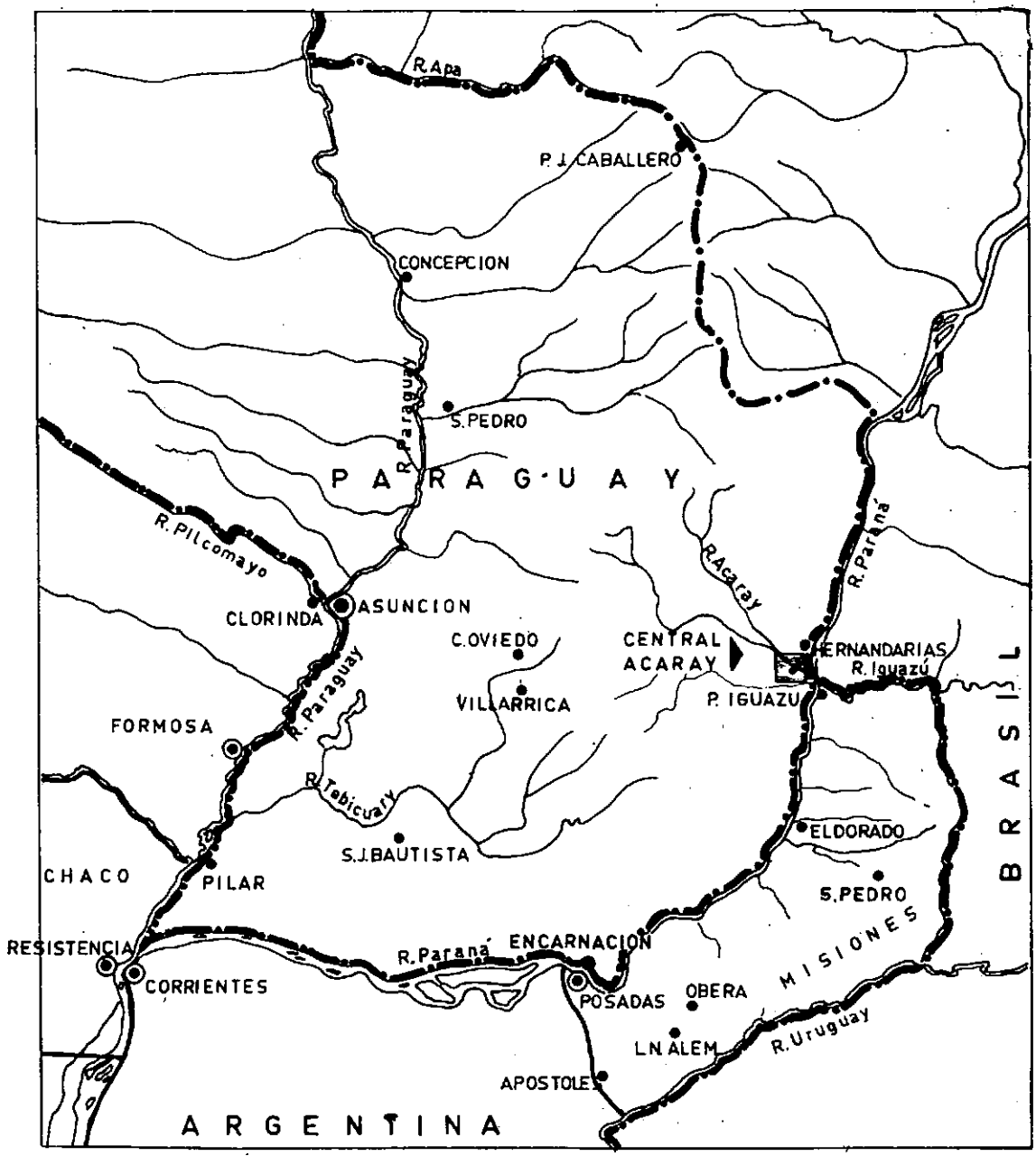
ARGENTINE REPUBLIC
CONSEJO FEDERAL DE INVERSIONES

ACARAY - MISIONES INTERCONNECTION FEASIBILITY REPORT

1965 KENNEDY AND DONKIN
CONSULTING ENGINEERS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R.Uruguay
APOSTOLES
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Buenos Aires, July 21st. 1965

Al Señor
Secretario General del
Consejo Federal de Inversiones
Sr. Luis Rotundo
Buenos Aires
REPUBLICA ARGENTINA.

In compliance with the contract subscribed with the Consejo Federal de Inversiones on February 10th. 1965, we have pleasure in submiting our feasibility report on the Acaray -Misiones interconnection project.

The report demonstrates that, within the basic economic conditions foreseen for the purchase and sale of electrical energy, as well as on the availability of power and energy in Acaray for Misiones, this project offers attractive features. Furthermore, the execution of this project, even if it is used during a limited period for receiving power from Paraguay, provides for the installation of an interconnected system linking the main centres of the Misiones province, which will facilitate subsequent larger developments of hydro or thermal projects.

We wish to express our acknowledgment for the cooperation given during the preparation of the report by the Government of the Province of Misiones, Intermaerican Development Bank, Consejo Federal de Inversiones and the Administración Nacional de Electricidad del Paraguay.

Yours faithfully,

KENEDY AND DONKIN

Ing. Mario A. Wiegers

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I. PURPOSE AND SCOPE

The present study has been carried out in order to establish the technical and economic feasibility of supplying electric power to the Province of Misiones through and interconnection with Acaray' s hydroelectric power station, in Paraguay, the construction of which is just - about to start and is expected to be commissioned by the end of 1968. Civil works, as well as the supply of a 45 MW unit, have already been bidded and adjudicated; eventually, a second similar unit could be inmediatly ordered, thus increasing the installed capacity up to 90 MW. Under these conditions, Acaray could supply up to 26 MW to the Province of Misiones between 1969 and 1975, decreasing later this figure down to 10 MW in 1978, by which year Paraguay could continue the supply but not guarantee firm power until the installed capacity in Acaray is extended, which is already planned for the future.

Even though firm power is not guaranteed, the interconnection between Argentina and Paraguay shall provide a reserve for both countries and shall allow a better utilization of the installed generation capacity in their respective systems.

The argentine legislation limits to 10 years the validity period for international power exchange agreements, although an extension of such period can be provided for in its clauses.

The report involves a survey of the present conditions of power supply in Misiones, in order to determine the areas that would be covered by the interconnection, as well as a forecast of future electric power demands in such areas during the 1965-1978 period.

The different power supply alternative solutions considered to cover the estimated demand have been duly examined. These solutions contemplate hydroelectric projects, the extension of the capacity of thermal power stations and the interconnection with Acaray.

For this purpose, the characteristics of the hydroelectric projects existing for the province were examined and their costs actualized. A plan for thermal generation based on the extension of some existing power stations was also prepared.

For the Acaray interconnection, the characteristics and scroute of the line, the location and equipment for the transformer sub-stations the construction schedule and the integration with existing systems were - studied. Complementary transmission and subtransmission works, necessary

to improve the Misiones electric market development were outlined.

A comparison of estimated investments and expenses involved in the most feasible solutions was carried out. For the Acaray interconnection project an economic and financial plan was prepared which is based on joint financing by the Inter-American Development Bank, the National Government and the Provincial Government.

Finally, the institutional and legal aspects on which the creation of a provincial enterprise was to be based, were studied. This enterprise would undertake the construction of the interconnection and its further operation. The basis for an agreement covering power exchange with Paraguay were also formulated.

GENERAL DESCRIPTION OF THE AREA

A general description of the area follows:

Paraguay: The Republic of Paraguay, with a total area of 406.752 sq. kms. and a present population of about 1.850.000 inhabitants, is situated in the southern-center zone of South America. Its capital, Asunción, located on the Paraguay river banks, has a population of 320.000 inhabitants. The economy of the country is based on the utilization of its forestal resources and agricultural exploitation; 29% of the total area of the country being covered by forest.

Electric power public services are provided by thermal power stations, the largest one being located in Asunción, with a total installed capacity of 27.000 kW.

Hydroelectric resources are particularly concentrated in the southern -eastern area of the country. The first hydroelectric project to be developed will be on the Acaray River, where a dam will be built at a site located 16 kms. from the Argentine border.

The main consumer market for the Acaray project is the capital of Paraguay, Asunción, situated at a distance of 300 km. Apart from Asunción, at present there are no other important areas in Paraguay which could justify economically the convenience of supplying energy from Acaray.

An area offering good prospects for future economic

development, is that determined by an imaginary triangle, with its appexes approximately situated in the towns of Asunción, Presidente Franco and Encarnación. The first two appexes would be supplied from the Acaray power station - in the neighbourhood of Presidente Franco and also by means of a step-down transformer substation, in Asunción. The other appex of the triangle does not represent a reasonably developed market to justify the installation of a transmission line from Acaray through the forest in that area.

The available energy from the Acaray dam is large enough to allow partial exportation to other markets while the local market is being developed. An attractive alternative could be the possibility of supplying part of the energy during a certain period to Misiones, a bordering Argentina province; this would allow a better utilization of the project.

This would imply the construction of a high voltage transmission system that could be used at the same time to supply power - from Posadas to the southern appex of the aforementioned triangle, that is, the city of Encarnación.

These are the general terms under which an interconnection through the Argentine-Paraguayan border has been planned.

Acaray project: The particular conditions of the Acaray river are very convenient for the construction of a dam. A few kilometers upstream its mouth, the Acaray river nears the Paraná river to a distance of 300 meters, maintaining, however, a water-level difference of approximately 70 mts. At this point, that is 16 kms. north of the Paraguayan-Argentine border, the construction of a hydroelectric power station has been planned, bidded and adjudicated. The first stage of this project consists in the construction of a regulation dam and a hydraulic power station for the installation of two 45 MW turbine units. In the first stage only one unit will be installed and eventually the second unit, according to the inmediate possibilities of the market. By means of the construction in the future of a regulating dam upstream, and another power station, the capacity of the scheme could be increased up to 180 MW.

Power will be generated in the power station at 13,8 kV, stepped up to 220 kV by means of three single phase transformers. The substation has been planned to allow extension and interconnections with future plants to be developed in Paraguay. Five-220 kV and six-66 kV supply connections have been foreseen. One of the 220 kV connections will be built in the first stage in order to supply to Asunción. Should the interconnection with the Province of Misiones be decided upon, another 220 kV connection must be built.

Province of Misiones: The Province of Misiones is situated in the north-eastern area of the Argentine Republic, bordering with Paraguay, Brazil and the Province of Corrientes, and covers an area of approximately 29.000 sq. kms. According to the Provincial Bureau of Statistics, in 1964 it had a total population of 448.826 inhabitants, with a sustained demographic development rate during the last years of 3,4% per annum. Its capital, Posadas, located on the Paraná river facing the paraguayan city of Encarnación, has at present 97.000 inhabitants. Other main cities are Eldorado, 230 kms. north of Posadas, on the same river, and Oberá, an inland town in the southern part of the Province, 85 kms. from Posadas.

The economic resources of the Province are based on the production of yerba mate. (Paraguayan tea), tea, tobacco, citrus, pineapple, manioc, soybean, cotton, rice and other less important products. The development of forest and reforestation is also important on account of the marketing of rolling logs, timber, lumber, laminated wood and paper pulp. Cattle raising activities are very limited.

The rate of demographic development is very high. This is basically due to the fact that over the last decades agrarian and forestal production conditions have been more favourable than in many other areas of the country, offering attractive settlement conditions. The colonization of the Province was very intensive after World War II, and a large number of european emigrants arrived.

A large proportion of the lands in the Province is subdivided into rural properties ranging from 25 to 40 hectares, allowing a relatively high percentage of settlers.

Distances between settlements are short and the type of intensive agriculture has brought prosperity to these relative small agrarian units. Likewise, the need for industrialization of the farms products (yerba mate, tea, tung, manioc, etc.) in nearby zones called for the establishment of a high large number of small industrial plants; such as mate and tea drying plants, sawmills and plywood factories.

There is, however, a relatively important zone comprising the entire central and north-eastern area that has not been so far subdivided, and that is almost entirely dedicated to forestal production. On the contrary, the Paraná riverside zone and the southern area of the Province concentrate the largest urban and rural population, and consequently, in these areas the main electric power consumption centers have developed.

II. ELECTRIC POWER MARKET SURVEY

ELECTRIC POWER SERVICE: The public service has been very limited and restricted for long time, and practically developed only during the last ten years. In 1955 electric power consumption from public service was 24 kWh per capita, and in 1964 it reacherd to 50 kWh.

There are thirty towns covered by electric public services, as detailed in Chart II-1. Most of them are being operated by cooperative bodies. Municipal and Provincial services are only found in some very small towns.

The National Hydraulic and Energy Board of the Province, which depends from the Ministry of Economy and Public Works, is an entity in charge of planning and controlling the electric power services and undertakes the operation of some power stations, the most important of these being a 2.000 kW "emergency" station in Posadas. It is also now in charge of the construction of the new 11.000 kW Posadas power station.

Most of the industries established in the Province had to install their own generation plants, mainly due to present lack of generation or transmission capacity. At present there are many generating sets in operation and it is estimated that their production exceeded 12.000.000 kWh in 1965, i.e., over 50% of the amount generated by public services.

The development of public services is gradually absorbing this self-generation. It is expected that the supply from public services will increase, provided reliable conditions and attractive tariffs are offered.

Practically all the generation is by means of Diesel power stations with small size units. The largest sets installed up to the present are of 700 kW capacity. In some private establishments there is power generation by steam, but almost no hydraulic power generation in spite of the favourable conditions of the provincial rivers.

The fuel utilized is Diesel-oil which is transported by ship to Posadas, and distributed from there by railway and trucks. Steam power stations usually burn wood.

Only one direct current service is still in operation in the Province, which will be converted to alternating in the near future. Li

general the demands are not satisfied and the prospects of development are good. The increase in consumption during the last years has been above 10% per year, and it is expected it will not decline.

TABLE II-1

LOCALITIES WITH PUBLIC
ELECTRIC SERVICES EXISTING OR IN CONSTRUCTION

Locality	Installed Capacity	Energy Sold (1964)	Observations
	kW	MWH	
Puerto Iguazú		150 (x)	
Libertad		20 (x)	
Wanda	70	100	
Esperanza	110	150	
Eldorado	1.144 550	2.326	(1): Interconnected industrial powerstations
V. Hermoso-9 de Julio		75	Interconnected to Eldorado
Piray	160	50 (x)	
Montecarlo	777	808	
San Alberto-Garuhapé			Interconnected to Pto. Rico
Puerto Rico	566	808	
Jardín de América	124	200	
Corpus	62	43	
Gob. Roca	62	38	
San Ignacio	292	148	
Santa Ana	84	25	
Candelaria			Network under construction
Posadas	6.200	12.400	
San José	94	94	
Apóstoles	491	746	
Concepción	259	100 (x)	
San Javier	191	170	
Alba Posse	60	50	
El Soberbio	180	30	
Cerro Azul		80	Recently interconnected with L. N. Alem
Andrade	30	20	

Locality	Installed Capacity	Energy Sold(1964)	Observations
	kW	MWH	
L. N. Alem	930	987	
Pda. López			The line is under construction
Guaraní			Recently interconnected with Oberá.
Oberá	1,870	2,799	
Arístóbulo del Valle			Partially in service since 2 months ago.
2 de Mayo			Service facilities under construction.
San Pedro	64	35	
Bdo. de Irigoyen	69	35	
TOTAL	14,439	22,487	

(x) Estimated figures.

Market Area: The electric market had as prime object, the definition of the areas of the Province that could be supplied by means of a transmission line from Acaray, and to determine the locations for step-down transformer substations. (Chart N° 1).

For the Misiones market, even if it is not interconnected with Paraguay, the concentration of electric power development in well defined areas is advisable, owing to its special characteristics. As above outlined these areas, located in the central and southern parts of the Province, in which Eldorado, Posadas and Oberá are the main towns, represent the largest proportion of electric power consumption.

These areas, being developed by the installation of small Diesel generating sets, can be more easily and logically supplied from a conveniently located single supply center. The three areas could be supplied from the towns of Posadas, Oberá and Eldorado by means of medium voltage transmission lines (33 and 13,2 kV). Should the interconnection with Acaray be made, step-down transformer substations would be installed in these towns.

In Chart II-2, the towns have been grouped following

this criterion. By comparison with Chart II-1, it can be seen that with its present structure, 91,8% of the provincial electric power market falls within the three areas mentioned above and only 8,2% remains in the rest of the Province.

Although an important portion of the total population of the Province, i. e. 38,2%, is not included in the areas under consideration this is due to the fact that the respective locations and power demands do not justify, for the time being, the installation of lines for supply from the system under consideration.

The area of Puerto Rico, at present in full development from an electric power viewpoint, has also been excluded, since the demands are still low and could not, within the next few years, justify the construction of a transmission line of the required length of a transformer substation for stepping-down from a high voltage line corssing the area (i.e. Acaray interconnection).

A comparison of these three areas shows that the Posadas zone is the best supplied with electric power, with a comsumption rate of 92 kWh per annum and per capita, followed by Eldorado with 67 kWh and Oberá with 46 kWh. From a point of view of installed capacity, Posadas and Eldorado are at present in better conditions than Oberá. Taking into account the total inhabitants of the three areas, it can be observed that a 52,4% is to be found in Posadas, 30,2% in Oberá and 17,4% in Eldorado.

TABLE II - 2

LOCALITIES IN THE MARKET AREAS

LOCALITY	N° of inhabitants	Installed capacity	MAXIMAM DEMAND 1964	ENERGY SOLD 1964
		kW	kW	10^3 x kWh
Eldorado area				
Eldorado	28.586	1.694	850	2.326
V.Hermoso - 9 de Julio	5.864	-	-	75
Pto.Piray	4.837	160	62	50
Montecarlo	9.160	777	320	808
TOTAL IN THE AREA	48.447	2.631	1.232	3.259
Posadas area				
San Ignacio	9.441	292	140	148
Santa Ana	2.273	84	50	25
Candelaria	3.364	-	-	-
Garupá	5.335	-	-	-
Posadas	97.721	6.200	3.500	12.400
San José Munic.	3.781	94	80	94
Apóstoles	16.207	491	380	746
Concepción	7.039	128	100	100
TOTAL IN THE AREA	145.161	7.289	4.250	13.513
Oberá area				
Cerro Azul	5.163	-	20	80
Andrade	3.407	40	20	20
Leandro N.Alem	11.419	930	340	987
Oberá	21.436	1.870	1.025	2.799
Picada López	3.529	-	-	-
Guaraní	6.097	-	-	-
General Alvear	4.675	-	-	-
Col.Alberdi	4.004	-	-	-
Campo Viera	4.569	-	-	-
Campo Ramón	7.716	-	-	-
Los Helechos	6.433.	-	-	-
San Martín	5.080	-	-	-
TOTAL IN THE AREA	83.528	2.840	1.405	3.886
TOTAL OFTHE THREE AREAS	276.866	12.760	6.887	20.658

Taking the market as a whole, it may be seen that in general it has considerable under-average consumption rates as compared to regularly supplied areas. This shows that in case of unlimited availability of power, a considerable increase would occur during the first years. The same has been observed in all underdeveloped areas, and happened in Misiones before.

The aforementioned reasons justify the limitation of the demand analysis to these three areas, which would represent the main consumer market for Acaray.

PRESENT CONDITIONS OF THE ELECTRIC POWER SERVICE

PUBLIC SERVICE

The existing installations and characteristics of the power supply in the localities of the market area selected are described below.

Table II-3 gives a summary of present conditions. Graphs N° 2 through 13 indicate some of the historical and present data available for the most important power services, which were taken into account for the market study.

ELDORADO AREA

Eldorado:

The power is supplied by one electric cooperative that owns a Diesel-electric power station which is in operation since 1951.

The following diesel-generator sets are installed at present: one-100 kW MAN set, one-200 kW MAN set, one-300 kW MWM set and one-535 kW set. Power is generated at 380/220 V, and is stepped-up in a transformer substation for supplying a primary 13,2 kV distribution system.

The primary system is also supplied from other two power stations owned by the Cooperatives that industrialize tung. One of these cooperatives supplies up to 400 kW from a steam power station, and the other supplies up to 150 kW. Since these industrial power stations burn vegetal residues, the cost of energy is low and operate to provide base load to the system.

The primary distribution is by means of a 13,2 kV line, 42 km. long, and distribution branches which also supplies the electric cooperatives of Valle Hermoso and 9 de Julio. In the Eldorado area thisline has centrifuged concrete structures at all heads, angles, strain poles and transformer substations. This line was built 10 years ago, and is in good condition.

The line to Valle Hermoso - 9 de Julio was built 3 years ago; all on wood poles.

Electric power is distributed at low voltage by meansof a 380/220 V network.

In general, the electric service at Eldorado is eficient although there are some voltage drops due to the low capacity of the 13,2 kV line.

Puerto Piray:

This locality, situated at only 5km. distance from Eldorado, has an electric cooperative. At present the cooperative has one-62 kW generating set installed, and the public service is precarious. A paper pulp mill installed in this locality has its own 3800 kW power station.

Montecarlo:

An electric cooperative owns a power station vith the - following diesel generating sets installed" one - 167 kW Mirrless set, one-80 kW Otto Deutz set and one-535 kW Fiat set. A.C. power is generated at 380/220 V. A 13,2 kV primary network utilizing wood poles is under construction.

POSADAS AEREA

Santa Ana:

There is a small power station operated by the Province Gobernment. Only one 84 kW generating set is installed, and this capacity largely exceeds the maximum existing demand. The 380/220 V network is in precarious condition and the service is deficient.

Candelaria:

This locality has a municipal public utility which recently

ceased to operate. At present, a distribution cooperative has under construction a low voltage network and a 13,2 kV line for transmission of power from the power station belonging to the Penal Institute, which is located at 5 km. distance from the locality.

San Ignacio:

An electric cooperative owns a power station equipped with one-40 kW set, two-62 kW sets and one-128 kW set, this last one installed recently. The installed capacity is sufficient to meet the demand.

The power station is located in-town and therefore distribution is at low voltage, with the exception of a small 3,3 kV line to the Gendarmería Nacional Barracks. However, in order to supply to some distant areas, the cooperative plans the construction of a 13,2 kV line.

Generally, the condition of the network is satisfactory. The Provincial Power Authority (Dirección Provincial de la Energía) plans an extension of the power station in order to supply the nearby towns of Gobernador Roca, Corpus and Santo Pipó, by means of a 13,2 kV line, 15 km. long.

Garupá:

This is a small town built around the Railway Station, which is the shipment point for the production of the centre and northern zones of Misiones. Some industries, mainly citrus plants, have established taking advantage of the above facility.

No public electric service is available. The distance to the nearest point receiving electrical supply from Posadas is 5 km. A line for supplying from Posadas and its related low voltage network is planned.

Posadas:

In 1954 the electric public service was transferred by the Municipality to an electric cooperative.

At present there are two power stations in operation and another one under construction.

One of the operating power stations is owned by the cooperative and its condition is unsatisfactory. The other operating power

station, the so-called "emergency" station, is owned by the Provincial Government and sells the energy in block to the cooperative. The power station now under construction is expected to be commissioned at the end of 1965 and is also owned by the Provincial Government.

The cooperative's network is not sufficient to meet the demand and is also in bad condition. Therefore, the service is unsatisfactory. On a total of 6.930 consumers already connected, there are about 3.500 pending connection requests in the waiting list.

Cooperative's power station

The following diesel-generating sets are installed: Four-500 kW Mirrless sets; two-700 kW General Motor sets; one-450 kW Wuman-Krupp, and one-450 kW Baldwin set. The Baldwin set generates direct current. Three mercury arc rectifier equipments are also installed. The total installed capacity is 4350 kW and the estimated effective capacity is 4070 kW. The condition of the generating sets is satisfactory, but their number and arrangement in the station renders an uneconomic and complex operation and maintenance, and the same applies to the auxiliary services. Room available is small and the control and operation switchboards lack adquate coordination.

Emergency power station:

The power station is located at a far end of the city, near the river on grounds allocated to the new Posadas power station. It was built in 1960 by the Provincial Government to sell power in block to the Cooperative.

The "emergency" qualification derives from the fact that it was built to cover urgent power deficits and because it was equipped with three-535 kW Fiat sets that were readily available. There is also one transportable 500 kW National set leased from Agua y Energía Eléctrica de la Nación (National Water and Power Board). Generation is at 380 V which is stepped-up to 13, 2 kV to supply the distribution system of the city.

The general condition and arrangement of the power station is satisfactory.

Posadas New Poser Station:

This power station, originally designed and bidded by the Cooperative, was afterwards taken over by the Provincial Government

which has at present the responsability for its construction.

The power station has a modern building where three-3000 kW and one-2000 kW Sulzer-Oerlikon Diesel sets are being installed totalizing a 11000 kW capacity. The engine house has room for the future installation of other two additional 3000 kW sets.

Power is generated at 13,2 kV to supply directly the primary network. The estimated cost of this power station amounts to u$s 2.370.000.- considering a U.S. dollar rate of m$n.173.- argentine pe

It is expected that this station will be commissioned at the end of 1965.

Posadas distribution network:

The service voltage is 380/220 V A.C. a small area of the city still being supplied with direct current.

Until 1955 all the electric service was in direct current. In that year conversion of part of the city to alternating current commenced, and a 13,2 kV ring was built to be supplied from the cooperative's Power Station at two points. This ring and branch lines that have been later added utilize centrifuged concrete poles. Wood poles are utilized only in some suburban branch lines. As mentioned before, the condition of the low voltage network is deficient and its capacity is much below the demand requirements. At present, the 13,2 kV system is being modified and extended and also a low voltage A.C. network and a public lighting network are being constructed. Once these modifications and extensions are completed, it will be possible to connect 100% of the pending requests.

It is estimated that these works will be completed in 1967.

San José:

Electric service is provided by a Municipal Power Station, that is equipped with two Meadow generating sets, one rated 32 kW and the other 62 kW, which cover the maximum existing demand. The 380/220 V A.C. network must be improved in order to cover future requiriments.

Apóstoles:

This is the only direct current service existing in the

Province. It belongs to a Cooperative that has decided on conversion to A.C. and on the installation of a new power station in another location in-town. At present three Diesel generating sets are installed: one-200 kW Otto Deutz set; one-206 kW Mirrless set and one-85 kW Otto Deutz set. The maximum demand is 380 kW. The network is in good condition although at the far ends the voltage drops considerably during peak-hours. The new power station project includes the installation of some lines for supplying nearby towns and to a group of rural consumer.

Concepción de la Sierra:

A Municipal power station has a 250 kW installed capacity, which is sufficient to easily supply the maximum demand. The 380/220 V A.C. low voltage network is in good condition.

OBERA AREA

Cerro Azul:

A distribution cooperative has been recently formed and has taken over the Municipal network. The existing power station was shut down and the energy is supplied from Leandro N. Alem by means of a 13,2 kV line, 23 km. long. The network is being reconditioned.

Olegario V. Andrade:

This is a small town located at 15 km. distance from Cerro Azul, and is supplied by a Municipal power station with 40 kW installed capacity. The 380/220 V A.C. network is new and in good condition.

Leandro N. Alem:

A cooperative owns a power station with an installed capacity of 930 kW in diesel-generating sets. The station was built 5 years ago and the sets are in good condition. The latest 535 kW set was installed in 1964. Alem is the center of a zone with rural consumers that is beginning to develop. A line has already been constructed to supply to the Cerro Azul distribution cooperative. A 13,2 kV line, 18 km. long, is under construction to supply the rural area ending in Gobernador López.

Guaraní:

Electric power was generated until 1964 by a small

TABLE II - 3

MAIN CHARACTERISTICS OF THE SERVICES IN AREAS TO BE SUPPLIED FROM THE SYSTEM

LOCALITY	SERVICE BY	TYPE OF CURRENT	SERVICE HOURS	DISTRIBUTION VOLTAGE	Quantities of consumers				
					Residential	Commercial	Industrial	Official	Connection Requests
Eldorado	Cooperative	A.C.	24 h.	13,2-380/220	1.536	199	103	51	40
V.Hermoso- 9 de Julio	Cooperative	A.C.	24 h.	13,2-380/220	100	10	-	-	-
Pto. Piray	Cooperative	A.C.	10 to 14 h.	220/380 V	-	-	-	-	30
Montecarlo	Cooperative	A.C.	24 h.	6,6and13,2 kV.	321	70	46	20	-
San Ignacio	Cooperative	A.C.	5 to 2 h.	3,3 kV.	130	79	10	10	-
Santa Ana	Municipality	A.C.	18 to 24 h.	380/220 V.	70	-	-	-	30
Candelaria	Cooperative	Installations under construction		380/220 V.					
Garupá	Has no electric service			-					
Posadas	Cooperative	A.C.andD.C.	24 h.	13,2 kV 380/220 V. C.C.440/220 V.	6.100	930(incl.ind)(x)	-	-	3.500
San José	Provincial	A.C.	5 tu 16 h:	380/220 V.	135	20	5	7	50
Apóstoles	Cooperative	D.C.	24 h.	C.C.440/220 V.	1.027	-	-	-	10
Concepción	Municipality	A.C.	24 h.	380/220 V.					
Cerro Azul	Cooperative	A.C.	24 h.	-					
Andrade	Municipality	A.C.	8 h.	380/220 V.					
L.N.Alem	Cooperative	A.C.	24 h.	13,2 kV.	890	-	-	-	-
Oberá	Cooperative	A.C.	24 h.	33 kV-13,2 kV	1.587	265	89	-	-
Guaraní	Cooperative	A.C.	24 h.	380/220 V.					
Gral. Alvear	Coop.in formation	Installations under construct.		-		-	-		
Campo Viera	Cooperative	Installations under construction		380/220 V.					
Col.Alberdi	Coop.in formation	-	-	-					
Campo Ramón	Coop.in formation	-	-	-					
Los Helechos	Coop.in formation	-	-	-					
San Martín	Coop.in formation	Has no electric service		-					
Gob.Roca	Municipality	A.C.	18tu 24 h,and 8tu 14 h.	380/220 V	48	20	2	-	60
Corpus	Municipality	A.C.	18 tu 24 h.	380/220 V	65	21	3	7	-
Santo Pipó	Has no electric service	-	-	-	-	-	-		
Est.Apóstoles	Cooperative	A.C.	24 h.	380/220 V.	60	25	2	6	3
Bonpland	Municipality	A.C.	-	380/220 V.					
Campo Grande	Cooperative	Installations under construction							
A.del Valle	Cooperative	A.C.	-	380/220 V.					
Zona 30Ha.(Oberá)	Has no electric service								

(x) At present in Posadas there are no different rates for commercial industrial and

private power station. At present power is supplied from the Oberá power station. This line and the 380/220 V low voltage distribution network are controlled by a Cooperative.

Oberá:

Oberá is the most important city in the area. A power station equipped with two-300 kW MWM sets and one-200 kW Mirrless set was commissioned in 1961. Two-535 kW Fiat sets were installed later, one in 1963 and the other in 1964. At present, a 850 kW Fiat generating set is being installed.

The power is distributed by means of a primary 13,2 kV network utilizing concrete poles. The 380/220 V low voltage distribution network was purchased by the cooperative to its private owner a few years ago. It is deficient and although it is being extended, the demand requirements cannot be met.

A project is under way to supply from Oberá to a group nearby towns and rural areas by means of 13,2 kV and 33 kV lines. The first one, which is the 13,2 kV Oberá-Guaraní line, is already in service. A 33 line is presently under construction for supplying Campo Viera, Campo Grande and Aristóbulo del Valle.

In accordance with the existing plans, the towns sorrounding Oberá that will be supplied from Oberá power station are Guaraní, Gral. Alvear, Alberdi, Campo Viera, Campo Grande, Aristóbulo del Valle, Los Helechos and Picada San Martín. All these towns have at present cooperatives that will undertake the electric distribution in their corresponding zone.

TARIFFS:

Table II-4 attached shows the tariffs in force at the end of 1964 in the principal services of the Province.. As it is evident, there is no uniformity in the basis on which the utilities, most of them cooperatives, have established their tariff systems.

The smaller and medium sized utilities usually have single tariffs and lower rates for public lighting. In all cases the billing is based on kilowatt-hours consumed. The usual rate is about m$n 10.- argentine pesos per kWh, and in the 9 de Julio Distribution Cooperative the rate is m$n 13.- kWh.

Posadas has differential tariffs for the different types of consumers. The minimum rate is m$n 8.90 per kWh for public lighting and the maximum rate is m$n 13.20 per kWh for public offices, the residential rate being m$n 9.40 per kWh.

The oberá's Cooperative has the lowest rate, which is m$n 7.50 per kWh for all type of consumers, except public lighting with a rate of m$n 6.50 per kWh and a special rate of m$n 6.- per kWh for large consumers using more than 40.000 kWh monthly.

The rates indicated above correspond to February 1965. Increases by collective labour agreements (26%) took effect after the rates were established; also, the general costs of fuels, spares and others materials augmented.

TABLE II-4

T A R I F F S

(argentine pesos per kWh)

Locality	Residential	Comercial	Industrial	Public Offices	Public Light	Others
Eldorado	0,045	0,045	0,045	0,045	0,045	
9 de Julio	Single Tariff: 0,075					
Piray (x)	2,89	4,33	5,78			
Montecarlo	Average: 0,050					
Puerto Rico		"	0,051			
San Alberto		"	0,060			
Gdor. Roca	0,058	0,058	0,058	0,058	0,058	
Corpus	0,053	0,064	0,040	0,053		
Santa Ana	0,052	0,052	0,05			
Jardín de América	Single Tariff: 0,058					
Posadas	0,054	0,080	0,058	0,076	0,051	
San José	0,052	0,052	0,40	0,052	0,052	
Apóstoles	0,061	0,061	0,061	0,061	0,052	
L. N. Alem	Up to 300 kWh/month $ 0,058, up to 1000 kWh/month $ 0,054, above 1000 kWh/month $ 0,049					
Oberá	0,043	0,043	0,043	0,043	0,037	0,035
Concepción	0,046	0,046	0,058		0,029	

(x) Fixed monthly charge independent of kWh consumed.

SELF-GENERATION

Self-generation in the province of Misiones has developed greatly due to the lack of generation and distribution capacity in the public services, and in some cases due to the particular characteristics of the industries that require steam for process or burn cheap by-products.

Most of the establishments that self-generate are related to the industrialization of yerba mate (paraguayan tea) tea, tung, and wood, According to investigations made and the existing data, it is estimated that self-generation of electrical energy in 1964 was equivalent to 50% of the local electrical energy generated by public utilities.

The electrical energy consumption of the establishments in 1964 was as follows:

Yerba mate drying	3.640.000 kWh
Yerba mate grinding	450.000 kWh
Tea industrialization	3.000.000 kWh
TOTAL	7.090.000 kWh

The wood industries - sawmills, carpentries and plywood manufacturers are large consumers of electric power. Although in very small sawmills power is self-generated utilizing wood residues as fuel, the larger sawmills consume from the public service as this becomes available.

The total electrical energy self-generated in this industry in 1964 was estimated in 3.000.000 kWh.

Other industries related to wood, tung, meat packing etc. consumed much less electrical energy.

In Misiones there is a large number of plants for processing of yerba mate. Some plants, mainly in the Eldorado area, are supplied from the public electric utility, and it is foreseen that more of them will purchase electrical energy from the utility once adquate distribution installations are completed.

The plants that self-generate utilize diesel-generator

sets, and the average installed capacity is 12 kW. The yearly utilization factor is low since the plants are of seasonal operation Many plants also use direct driving equipment, and do not generate electric power.

Most of the tea drying plants are located in the Oberá area, where above 70% of the total production of the Province is processed. Few of these plants are supplied from the public utility, mostly due to the lack of medium voltage transmission lines for supplying them.

These plants operate seasonally during 7 or 8 months of the year.

A large number of yerba mate and tea plants would purchase electrical energy from the utility, provided the tariffs are attractive and the supply is reliable.

There are some other types of industrial plants in the Province, such as a cellulose plant in Piray with a 3800 kW installed generating capacity, which is unlikely to purchase electrical energy from the public utility, at least during the near future.

In Posadas there are two plywood plants, a door - manufacture plant and a saw mill with installed capacities of about 100 - 150 kW in each plant, which could be supplied from the public utility if the conditions offered are sufficiently attractive. A very important plant in Posadas has an installed capacity of about 800 kW; however, only a small portion of this total could be supplied from the public utility, since the industrial process requires steam that is simultaneously used for self-generation.

Some wood establishments in the Eldorado and Oberá areas could gradually be supplied from the public utility system.

The possibility of developing a steel and an aluminium industry in the Province is presently under consideration. Tests are being carried out in a pilot blast furnace in Posadas, which will have its own self-generating plant with a capacity of about 400 kW. The further development of this industry depends on the results obtained.

The aluminium plant will be installed near the Argentine-Brazil border. The capacity required for this plant is 90.000 kW, and the installation of its own hydraulic power station is foreseen utilizing the energy of the Rio Iguazú waterfalls. The maximum admissible price of electrical energy for an economic operation of this industry is 4 mills per kWh, which

precludes the possibility of supplying from a public utility. However, if the project is carried out, an Iguazú-Posadas transmission line and interconnection could supply energy one way or the other in the event of a breakdown in the public utility or in the aluminium plant.

Based on the existing experience in the Province and on the possibility of supplying from the public utility to industries that presently self-generate by means of the medium and low voltage distribution systems planned it is estimated that 50% of the energy that is now self-generated may be supplied from the public system during the 1965-1980 period.

DEMAND FORECAST

The values of demand forecast have been estimated at the 33 kV and 13,2 kV busbars of the generating power stations, or at the busbars of transformer substations in the case of supplying by means of high voltage (132 kV) lines.

According to the above analysis of the market structure, the estimation of future electrical demands has been first made separately for the three areas considered, which represent above 90% of the total market of the Province. The three areas have afterwards been integrated to form a single system to be supplied from a centralized supply such as the interconnection with Acaray.

The forecast has been made analyzing for each locality the historical evolution of the demand, the pending connection requests and future possibilities based on demographic growth, economic development, etc.

The forecast covers the 1965-1978 period and the demand is analyzed for each type of consumer. Assumption has been made that in 1969, when the possible interconnection with Acaray could be ready, the necessary transmission and sub-transmission systems and improvements in the distribution system will be completed to allow meeting the demand without any restrictions.

Assumption has also been made that the demographic growth of the province will continue at a constant rate and that no sudden changes will occur in its economic structure.

TABLE II - 5

DEMAND FORECAST

YEAR	ELDORADO AREA		POSADAS AREA		OBERA AREA		TOTAL	
	MAXIMUM DEMAND kW	ENERGY DEMAND gWh	MAXIMUM DEMAND kW	ENERGY DEMAND gWh	MAXIMUM DEMAND kW	ENERGY DEMAND gWh	MAXIMUM DEMAND kW	ENERGY DEMAND gWh
1964	1,2	3,8	4,2	16,2	1,4	4,7	6,8	24,7
1965	1,4	4,2	4,6	17,7	1,5	5,1	7,5	27,0
1966	1,7	5,2	5,3	20,3	1,7	5,6	8,7	31,2
1967	1,9	5,7	6,1	22,9	1,9	6,2	9,9	34,8
1968	2,1	6,3	6,6	24,9	2,2	6,9	10,9	38,1
1969	2,3	6,9	7,3	27,2	2,4	7,7	12,0	41,8
1970	2,6	7,6	8,1	30,1	2,8	8,6	13,5	46,3
1971	2,8	8,3	9,1	33,8	3,1	9,6	15,0	51,8
1972	3,1	9,2	10,0	37,2	3,5	10,8	16,6	57,2
1973	3,7	10,1	11,2	40,8	3,9	12,1	18,8	63,0
1974	4,0	11,1	12,2	43,9	4,4	13,5	20,6	68,6
1975	4,3	12,2	14,0	49,6	5,0	15,2	23,3	76,9
1976	4,8	13,4	15,3	53,4	5,6	17,0	25,7	83,8
1977	5,5	14,8	16,8	57,5	6,5	19,0	28,8	91,3
1978	6,0	16,3	19,0	64,5	7,4	21,3	32,4	102,1

Self-generation has been especially considered, taking into account that its future development is rather uncertain. The general criterion adopted is that 50% of the energy that is presently self-generated will be supplied from the utility system within the next 15 years, under the limitations indicated above in the self-generation paragraph.

It is estimated the maximum demand of electrical power and energy will increase suddenly to cover the presently unsatisfied demand, which is higher in the Posadas area, and consequently will have an important bearing on the whole system. Later the average annual growth is estimated at about 11%, slightly higher at the beginning of the period and decreasing afterwards.

The annual load factor is presently very high for the area, considering the characteristics of the market. In Posadas, due to the limited distribution capacity, this factor is 44%. Important improvements are presently being carried out in the network, and therefore it is estimated that this factor will decrease along the period considered, since it will be possible to supply the peak-load without restrictions and rural electrification shall be developed.

The total values of demand and energy are shown in table II-5.

The analysis by areas is as follows:

Eldorado Area: The service conditions in 1964 were as follows:

MAXIMUM DEMAND:	1.232 kWh
ENERGY SOLD:	3.259.000 kWh
ENERGY GENERATED:	3.845.000 kWh
LOAD FACTOR:	32,1 %

The urban areas are presently supplied satisfactorily and it is estimated that most of the electrification would be developed in the near future in suburban and rural areas, which will probably result in a lower load factor.

The transmission and transformation energy losses in

1964 were about 16%, and it is estimated that after the improvements are carried out in the primary and secondary distribution systems the losses will decrease to 12% by 1969.

The evolution of the total demand is indicated in table II-5. An analysis by types of consumers is as follows:

Residential: It is estimated that the residential demand will increase during the forecast period at an annual rate of 11% and that the percentage that this demand contributes to the system peak will be 85%, constant along the forecast period.

Commercial: Considering that this is a rural area and that the incidence of the commercial demand on the total is presently about 25% of the total energy consumed, it has been estimated that the commercial demand will increase at an annual rate of 7% during the forecast period.

Industrial: As mentioned before, the present conditions of industries related to agriculture (yerba mate, tea, tung, wood) and others of secondary importance have been taken into consideration, as well as the limitations in the consumer market imposed by their future development. Besides, many industries have seasonal demands, with a relatively few hours of utilization, and operate in many instances outside the hours of maximum demand. The above reasons and those indicated in the analysis of the industrial demand have been taken into consideration to adopt a load factor of about 23%, to remain constant during the forecast period.

The annual rate of increase shall be somewhat high during the initial years, since many industries that presently self-generate will consume from the public service, and shall be not lower than 12% during the period.

Official: The municipal and provincial entities are relative few and small and their consumption is very low. The annual rate of growth has been estimated at 6%, to cover public service needs originated by the growth of population in the area.

Posadas area: The service conditions in 1964 were as follows:

MAXIMUM DEMAND:	4.250 kWh
ENERGY SOLD:	13.511.000 kWh
ENERGY GENERATED:	16.213.750 kWh
LOAD FACTOR:	43,6 %

These values derive fundamentally from the particular present conditions of the electrical service in the city of Posadas.

The insufficient capacity of the medium and low voltage distribution networks have resulted in a detriment in the service, with voltages much below nominal value at the consumer's entrance, and high distribution losses above 20%.

The total number of consumers in Posadas is 6900 and the waiting list includes 3500 pending connection requests. The power factor in the network is low due to the large number of refrigerators, fans and air conditioners. This situation is to remain unchanged due to the tropical climate in the region.

Important works of improvement and revamping of the primary 13,2 kV distribution system, transformer substations and 380/220 V distribution networks commenced at the beginning of 1965 in Posadas city. Once these works are completed, all pending connection requests will be satisfied within the next two years, and the present losses in the network will be reduced to about 12%, which is to stay constant during the forecast period.

The above mentioned works and the addition of 33 kV and 13,2 kV lines in the area will make possible the supply to a number of small localities and rural areas.

The demand increase resulting from voltage improvement in the city of Posadas and the addition to the network of pending connection also have been considered in the forecast.

The evolution of the demand is indicated in table II-5. An analysis by types of consumers follows.

Residential: The contribution of the maximum residential demand to the system peak is estimated at 80%, to remain constant along the forecast period, and the average annual growth is estimated at 10%, not considering demand additions resulting from voltage improvement and the supply to pending connection requests.

Commercial: Considering the important bearing of the Posadas demand upon the system, the incidence of this type of consumption has been estimated at 10%. The annual growth of demand has been estimated at 9% during the forecast period.

Industrial: It has been estimated that 50% of the present industrial demand will be gradually added to the system during the forecast period. Also, an increase is estimated by the addition of some small agricultural consumers, which leads to an annual rate of increase not lower than 12%.

Official: This is the only area where the official demand is of some importance. It is estimated that its growth will be 7% along the period.

Oberá area: The service conditions in 1964 were as follows:

MAXIMUM DEMAND:	1.405 kW
ENERGY SOLD:	3.896.000 kWh
ENERGY GENERATED:	4.675.000 kWh
LOAD FACTOR:	38 %

The electrical development of this area is somewhat behind in relation to the Eldorado and Posadas areas, because adequate electric public services have been organized only in recent years.

The Oberá area is the largest of the three areas in which the Misiones electrical market has been subdivided, and it expected to develop more rapidly on account of its cultivations and elaboration industries.

The suburban and rural areas have predominance over towns and cities, and therefore it is estimated that a greater electrical development will take place in rural areas, with a consequent reduction on the utilization factor. At present there are no pending connection requests in the urban areas, but the possibility of development of an attractive rural market is noted.

The present energy losses in the distribution systems is about 18% of the energy sold. It is anticipated that the improvement of the networks that will be completed in 1969 will reduce these losses to 12%.

The demand projection has been made considering the characteristics of the industries related to tea, yerba mate, tung, wood and other less important natural products, on which the economy of the area is based.

The demand growth for the different types of consumers has been estimated as follows:

Residential: Average annual growth 12%, with a strong tendency towards the development of suburban electrification.

It is estimated that the contribution of the maximum residential demand to the system peak shall be about 80% during the forecast period.

Commercial: This is mainly a rural area; therefore, the incidence of the commercial demand is low, and it is estimated that it will grow at an annual rate of 8% during the forecast period and that its incidence on the maximum demand shall be about 6%.

Industrial: The economic characteristics of this area are similar to those of the Eldorado area. It is estimated that 50% of the energy presently self-generated will be supplied from the public utility system and that the load factor shall be about 25% with an incidence of 10% on the demand peak, and an annual rate of increase not lower than 12%.

Official: The area has few municipal and provincial entities, and it is estimated that no development will occur in the next future. Therefore, this demand will not have an important incidence on the forecast for the whole market, and its estimated annual growth is about 6%.

Resume: Historical information on many localities that will be supplied from the system is lacking, and the values used for estimating the demand projection have been taken from other similar areas of the Argentine.

For the system to be interconnected it is estimated that the maximum demand, 7,5 MW in 1965, shall increase to 32,4 MW in 1978, and that the power consumption 27,0 GWh in 1965 shall increase to 102,1 GWh in 1978, Graphs N° 14 and 15 show the evolution of these figures, which are indicated in Table II-5. Graphs N° 22, 23 and 24 show different typical daily demand curves for 1965 through 1969 and 1975.

III. ALTERNATIVE SUPPLY PROJECTS

The following three alternative solutions for supplying electrical power to the system under consideration during the 1969-1978 period are considered:

1) Development of hydroelectric projects in the Province.

2) Extension of the existing thermal generating power stations.

3) Interconnection with Acaray power station.

Before this period, until 1969, the existing Diesel generating stations shall have to supply the electrical requirements of the Province. These power stations shall have to be extended in order to meet the growing demands. The extensions should be studied taking into consideration the subsequent solution to be adopted. The alternatives are analyzed hereinafter.

HYDROELECTRIC PROJECTS

The projects under consideration are those of Piray Guazú and Yabebiry, which are the only ones studied in detail up to the present in the Province. A third hydro-project, on the Iguazú river, has been preliminary studied, and was also examined.

Details of these projects which should be studied more thoroughly before deciding upon their execution, are given in the Hydroelectric Projects Annex. It is estimated that the necessary time for studies, engineering design, call for bids and construction would not allow commissioning before 1971 or 1972.

The Piray Guazú, located a distance of about 6 km. from Eldorado, would have a 28 MW capacity and a guaranteed production of 98, GWh. The actualized cost of the project, according to an existing preliminary design, amounts to the equivalent of u$s 13.542.540.- The cost of the - kWh generated based on the above production, would be u$s 0,0103 at the - station busbars, considering a 6% interest rate for the capital.

The Yabebirí project, located at a distance of 62 km. from Posadas, was examined on the basis of a preliminary design made by Agua y Energía Eléctrica. The capacity is 20,7 MW and the guaranteed annual

production is 39 GWh. The actualized cost of this project amounts to the equivalent of u$s 13.675.480. The cost of the kWh generated, based on the above production, would be u$s 0,0258, considering a 6% interest rate for the capital.

The neccesary investment for this project is higher than for the Piray-Guazú project and the energy efficiency is about 40% below.

A very preliminary study of a hydro-project in the Iguazú River, at a distance of 290 km. from Posadas was made by Agua y Energía Eléctrica in 1951. It would consist in a partial development with no regulation i.e., utilizing a constant flow during the 24 hours. The project could provide base load for an interconnected system. Under these conditions, with an estimated capacity of 14 MW, with no reserve, the annual production would be 122 MWh. The actualized cost of this project amounts to about u$s 4.566.200. - Considering the location of the project, it stands as an interesting solution for complementing the supply, once the most important markets of the province are interconnected. This project is mentioned as an illustrative example, and requires a further thorough study.

The execution of some of the projects considered - implies the construction of a high voltage interconnected system in the Province, which raises considerably the necessary initial investments.

Before deciding upon the construction of some of these projects, it is also convenient to review some other possible hydroelectric schemes that could be more attractive in the Province and to make thorough hydrologyc and geologic studies that may modify the existing projects,since the information that was available to the designers at the time seems rather insufficient.

For illustration, a summary is given in the Hydroelectric Projects Annex of some of the possible alternative hydroelectric schemes existing in the Province.

Based on the above comments, the interconnection with the Acaray system or the extension of the existing thermal capacity remain as the inmediate solutions for meeting the demand during the 1969-1978 period.

The project of interconnection with the Acaray system has the advantage that it provides for a high voltage system in the Province that will be available for the future development of a hydro or thermal power station centralizing the electrical energy production.

EXTENSION OF THE THERMAL CAPACITY

Under this alternative, the demand of the different market areas is met during the 1969-1978 period by extending and/or building Diesel power stations in Eldorado, Posadas and Oberá. In each case, a study has been made of the sets that will continue in operation, the new sets to be installed and also the withdrawal of sets on account of low efficiency or absolescence.

This does not exclude the possibility of utilizing other types of thermal generation in connection with development of forest and/or mineral resources, which may become feasible by the utilization of such resources, the development of which is still in a very preliminary stage of study. From the point of view of investments necessary for power generation the Diesel alternative herein considered is similar to any other thermal solution.

A study has also been made on the possibility of supplying the market from a single thermal power station, and interconnecting the three areas, but the necessary additional investments involved renders this solution unattractive for the period under consideration.

In all cases the reserve capacity has been fixed at 15% of the maximum demand or the capacity of the largest unit installed, whichever value is higher.

The analysis for each area is described hereinbelow.

Eldorado Area: The three power stations operating in the area are owned by the Cooperatives of Eldorado, Puerto Piray and Montecarlo. The present total installed capacity is 2,631 kW, and the maximum demand in 1964 was 1,232 kW.

The interconnection of the different localities in the area and the corresponding rural zones by means of 33 kV and 13,2 kV lines is considered and also the concentration of production at the Eldorado power station only.

The following table shows the program of additions and withdrawal of generating sets:

Table 1 DIESEL PROGRAM - ELDORADO AREA

Year	Maximum Demand kV	Capacity to be added kW	Capacity to be withdrawn kW	Installed Capacity kW	Firm Capacity kW
1964	1.232	--	--	2.631	2.092
1965	1.390	--	--	2.631	2.092
1966	1.700	--	--	2.631	2.092
1967	1.980	--	--	2.631	2.092
1968	2.100	1.000	--	3.631	2.631
1969	2.320	--	--	3.631	2.631
1970	2.610	1.500	240 (1)	4.891	3.391
1971	2.890	--	--	4.891	3.391
1972	3.120	--	--	4.891	3.391
1973	3.660	1.500	300 (2)	6.091	4.591
1974	3.980	--	--	6.091	4.591
1975	4.300	--	--	6.091	4.591
1976	4.850	1.500	--	7.591	6.091
1977	5.500	--	--	7.591	6.091
1978	6.050	1.500	--	9.091	7.591

(1) Piray Power station shut down and 80 kW withdrawal from Montecarlo power station.
(2) Withdrawal of 300 kW in small sets at the Eldorado power station.

As shown in the table, all sets to be installed are rated 1500 kW, except the first one to be installed in 1968, and thereby the operation and maintenance of the power stations are simplified.

Graph N° I 6 shows the evolution of the maximum demand the firm capacity and installed capacity, between 1964 and 1978.

Posadas area: The following power stations operate at present in Posadas : the so-called "emergency" station, which is equipped with three 535 kW diesel generating sets and a transportable 500 kW set and the Cooperative's power station which has 8 sets totalling 4.070 kW. The new Posadas power station is under construction and it is expected to be commissioned by the end of 1965.

This station will have three-3000 kW generating sets and one-2000 kW set, totalling 11000 kW installed capacity.

Other power stations that also operate in the area are: San Ignacio (292 kW), Santa Ana (84 kW), San José (178 kW) and Apóstoles (491 kW).

At the end of 1965 the total installed capacity in the area will be 17,720 kW, without taking into account the 500 kW transportable generating set leased from Agua y Energía Eléctrica.

In the program, the new Posadas power station would remain as the only generating station in the area. The thermal reserve of this station would be represented by the three-535 kW sets of the "emergency" power station plus two-530 kW sets of the Cooperative's power station that would be transferred to the "emergency" station.

The other small power stations in the area would be shut down as soon as the system is interconnected.

Provision is made for future extensions of the Posadas power station with 4000 kW generating sets. The mechine room has room for installing at least two sets for this rating.

Graph N° 17 shows the program of additions and retirements of sets, as indicated in the following table.

Table 2 DIESEL PROGRAM - POSADAS AREA

Year	Maximum Demand kW	Capacity to be added kW	Capacity to be retired kW	Installed Capacity kW	Firm Capacity kW
1964	4.250	--	--	6.720	6.185
1965	4.550	--	--	14.725	11.725
1966	5.010	--	--	14.725	11.725
1967	6.050	--	--	14.725	11.725
1968	6.640	--	--	14.725	11.725
1969	7.300	--	--	14.725	11.725
1970	8.100	--	--	14.725	11.725
1971	8.950	--	--	14.725	11.725
1972	10.150	--	--	14.725	11.725
1973	11.200	--	--	14.725	11.725
1974	12.200	4.000	--	18.725	14.725
1975	13.950	--	--	18.725	14.725
1976	15.300	4.000	--	22.725	18.725
1977	16.800	--	--	22.725	
1978	19.020	--	--	22.725	

Oberá area: The following power stations operate in the area: Oberá (1.870 kW) - Andrade (40 kW) and Alem (930 kW). The figures between parenthesis are the installed capacities.

A 840 kW generating set will soon be installed in Oberá and the installation of another similar set is foreseen.

The diesel program provides for concentration of production at Oberá. The smaller sets in Alem would be withdrawn in 1966, and only the 535 kW sets would remain as reserve. The Andrade power station would be shut down in 1969.

Graph N° 18 shows the program of additions and retirements of sets as prepared in the following table.

Table 3 DIESEL PROGRAM - OBERA AREA

Year	Maximum demand kW	Capacity to be added kW	Capacity to be retired kW	Installed Capacity kW	Firm Capacity kW
1964	1.405	--	--	2.840	2.305
1965	1.540	--	--	2.840	2.305
1966	1.740	840	395	3.285	2.445(1)
1967	1.940	--	--	3.285	2.445
1968	2.190	--	--	3.285	2.445
1969	2.450	--	--	3.285	2.445
1970	2.840	840	40	4.085	3.245(2)
1971	3.190	--	--	4.085	3.245
1972	3.550	1.000	--	5.085	4.085
1973	3.970	--	--	5.085	4.085
1974	4.450	1.500	--	6.585	5.085
1975	5.030	--	--	6.585	5.085
1976	5.600	1.500	--	8.085	6.585
1977	6.480	--	--	8.085	6.585
1978	7.390	1.500	--	9.585	8.085

(1) Retirement of 395 kW in Alem power station.

(2) Retirement of 40 kW in Andrade power station.

ACARAY - MISIONES INTERCONNECTION

The Acaray interconnection is based on the possibility of bulk power supply by Paraguay, at the busbars of the Acaray power station.

According to informations obtained from authorities of ANDE (Administración Nacional de Electricidad del Paraguay, which is the national utility of that country, if two 45 MW generating units are installed in Acaray, ANDE can have available for Argentina, at the power station busbars, the capacity exceeding after the maximum demand of the Paraguay system plus 20% reserve are covered.

These conditions would rule the supply between 1969 and 1975. After this year, the power delivered by the Acaray power station would be: 20 MW in 1976, 15 MW in 1977 and 10 MW in 1978.

Based on the above considerations, the following table of available capacities for Misiones has been prepared.

Values	Unit	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Acaray capacity	MW	90	90	90	90	90	90	90	90	90	90
Max. demand Paraguay	"	28,5	32	37	41	45	49	53	-	-	-
20% reserve	"	5,7	6,4	7,4	8,2	9	9,8	10,6	-	-	-
Available capacity	"	55,8	51,6	45,6	40,8	36	31,2	26,4	20	15	10

The total energy available in Acaray for Argentina has been fixed on the basis of a minimum annual billing of 72.700.000 kWh, with the option of supplying additional energy at an agreed price provided the market and hydraulic conditions allow this. Besides, Paraguay requires Argentina to grant a right to pass up to 3 MW through the interconnection system for supplying the locality of Encarnación in Paraguay.

For the interconnection a 132 kV overhead line, single circuit, from Acaray to Posadas would be installed passing through Eldorado, with a derivation at Santa Ana for supplying power to Oberá. Transformer substations of ratio 132/33/13,2 kV would be installed at these three locations, and Encarnación would be supplied from the Posadas substation.

The two countries would undertake the construction of the line portion in its own territory.

The values of demand forecast for the Misiones system during the 1965-1978 period are shown in Graph N° 14.

The capacity available in the Misiones system in the 1969-1978 period, is represented by the power received from the Acaray system less the losses in the transmission line and in the transformer

substations, plus the generating capacities of the Posadas; Oberá and Eldorado power stations that shall remain as reserve. The values thus obtained are shown in graph N° 20. Which also indicates the demand taking into account a 15% plus reserve, that is technically acceptable.

As it is evident, after 1976 it will be necessary to operate the Diesel stations again in order to cover the deficit in the supply, when the energy delivered by the Acaray system is reduced. Under these conditions it will be possible to meet the market demand until 1977, after which year it will be necessary to add generation capacity to the system in order to substitute the supply from Paraguay.

The capacity that will be lacking at that time can be substituted by a new thermal o hydro-power station or the supply from Paraguay could be continued, which would be possible if the Acaray power station is extended. This has already been studied by ANDE and is perfectly feasible. If this solution is adopted it will be necessary to increase the transmission capacity.

In order to meet the increasing market demand after 1978, the installation of 15 MW generating units is foreseen, since this rating considered the most suitable. This last solution could be adopted in case energy is no longer received from Acaray.

TECHNICAL ASPECTS OF THE INTERCONNECTION

Line: The Acaray project comprises the installation of 45 MW units generating at 13,8 kV voltage, each unit being equipped with three single phase transformers for stepping up to 220 kV, at which voltage the power will be transmitted for supplying the Asunción city. The transformer substation has also provisions for supplying to other 220 kV and 66 kV lines.

The transmission line for interconnecting with Misiones would go from Acaray across to Posadas, passing through Eldorado, with a total 308 km. estimated length, of which 17 km. would be in Paraguay territory and 291 km. in Argentina territory. The line would approximately follow the new road N° 12 presently under construction. The supply to Oberá will be made by means of a 45 km. branch line derivated at Santa Ana. Graph N° 21 shows the route of the whole line.

An alternative route has also been considered for the line, as shown in the same graph. This route would go from Acaray across to Eldorado, from there directly to Oberá and from this point to Posadas.

Although this route provides for supply to Oberá from two points and r educes to 328 km. the length of line to be constructed in Argentine territory, the total length of the Acaray-Posadas transmission line would be 345 km., and the electrical stability could be risked; therefore this route has been considered unacceptable.

In the route adopted, the line crosses the Paraná river, near Puerto Iguazú, a few meters upstream of the Monday River mouth. At this place the river is about 350 meters wide, its cliffs are rocky and about 40 meters high. Therefore, there is no difficulty for making an aerial crossing, since it is practically a normal span for this line. (See graph N° 32)

The supply from Posadas toE ncarnación shall be made by means of 33 kV line, with Aldrey type conductors of 70 square millimeters cross section on concrete poles and another river crossing is necessary. The river is too wide at this place and therefore the crossing must be made upstream, facing the Candelaria locality, at 17,5 km. distance from Posadas, where the river is about 600 meters wide.

At this place, the river cliffs are not suitable and a special study will be necessary in the final design. The river is navigable and a minimum free clearance of 35 meters is necessary, whereby the estimated necessary height for the tower is about 70 meters. (See graph N° 31)

The supply to Encarnación by means of a sub-fluvial cable has also been investigated. Although this alternative is feasible, since the distance is about 2.000 meters and there is an intermediate island that facilitates the making of a cable joint, the river bed is not stable and could cause displacements of the cable. The experience already had with a cable layed on the same river between the cities of Corrientes and Resistencia indicates that this solution is not recommendable.

Voltage: For this line length and the power level to be transmitted, the calculations indicated that the most economic transmission - voltage is 132 kV.

The possibility of transmitting at 220 kV over the whole line has also been studied, or transmitting at 220 kV along the first section of the line, from Acaray to Iguazú or Eldorado, and at this point step-down to 132 kV. In this manner, alterations in the Acaray project would by unnecessary, but the costs of these alternatives is considerable higher than transmission at 132 kV over the whole line. Moreover, 132 kV is a standard voltage in Argentina, where there is ample experience on the utilization of this voltage for transmission, and most of the necessary elements for the construction of the

line and transformer substations are already manufactured. Should the 220 kV voltage be adopted, practically all the materials for transformer substations would have to be imported.

Several alternatives have been considered for obtaining the 132 kV voltage at the Acaray power station, as follows:

a) Substitute the station power transformers by 3 winding 13,8/132/220 kV transformers. This solution was discarded since it would deprive the system of regulation flexibility, and the design of the Acaray power station, which is being already bidded, would have to be modified.

b) Installation of an additional 13,8/132 kV step-up transformer supplied from the generator busbars. This solution also deprives flexibility to the operation and modifications to the station design are necessary.

c) Installation of a 220/132 kV transformer. This alternative is the most convenient and has been accepted by the ANDE authorities. Although it implies a double transformation, no modifications to the station design are necessary, and does not cause regulation difficulties. Also, the operation of the line is more independent with this solution. Before adopting this solution, a check was made on the availability of sufficient room in the station for installing the transformer and the necessary switchgear and protection apparatus.

Structures: Wholly galvanized towers, of the delta type ("chat") have been adopted in order to install two ground wires for better protection against atmospheric overvoltages, since the isoceraunic level in the zone is high, and a protection angle of 20° has been adopted.

The preliminary calculations have been made in accordance with the VDE standards. For the mechanical calculation, the load conditions for the zone usually utilized in Argentina have been taken into consideration.

Span: The average economic span has been estimated at 300/330 meters on the basis of lines already constructed having similar characteristics, with conductors of 150 square millimeters cross section. These values will have to be adjusted in the final design.

The minimum clearance of the conductors over the natural ground has been fixed at 7 meters and for the crossings of roads and other obstacles, the normal clearances utilized in Argentina have been considered.

Foundations: Concrete foundations have been considered. The possibility of utilizing alternatively steel anchors was left for study at the final design stage.

Conductors: Aluminium conductors with steel core, of 150 square millimeters cross section have been adopted for all the lines. The cables shall comply with the DIN - VDE 8204 standards.

For the overhead ground wires, a 50 square millimeters cross section has been adopted, formed by 19 galvanized steel wires.

Insulation: Nine - 10" 451 support insulators complying with the IRAM (Instituto Argentino de Racionalización de Materiales) standards have been considered for the suspension strings and two strings of ten insulators each for the strains.

Earthing: Structurs earthing shall be by means of rods or counterpoises according to the characteristics of the ground. It is estimated that the average resistance at each tower foot in normal grounds shall be between 10 and 15 ohms.

Accesories: The suspension clamps shall be of the anti-vibrating type with protection cross horns at the top and guard ring on the bottom, and each shall also be provided with an armor-rod.

Communications: The installation of carrier equipment has been considered.

TRANSFORMER SUBSTATIONS: The transformer substations shall have automatic operation. The site choosen for the Posadas substation is near the point of junction of the N° 12 road with the city, where it will be connected to the primary 13, 2 kV network. In Oberá the substation shall be installed at the existing power station and in Eldorado at a location near the possible future place of the Piray-Guazú dam. The substations shall be equipped as follows.

Eldorado transformer substation: A double set of 132 kV busbars has been considered for the future, with five connections: one for the incoming line, one for the outgoing line, one for feeding the transformer,

one as reserve for the future and one tie for paralleling the busbars. At the first stage only one bus set and a circuit breaker shall be installed for the transformer feeder.

The incoming and outgoing connections of the secondary line shall be equipped with isolators only.

The transformer characteristics shall be as follows:

Rating: 7,5/3/6 MVA

Ratio: 132 + 5% - 20%/34,5/13,8 kV with on-load tap - changing equipment.

Connections: star/star/delta.

The 33 kV bus system and feeders shall be installed outdoors, and the 13,2 kV system with the protection and control equipment shall be installed indoors, in an adjacent building. (Graph N° 25)

Santa Ana tie station: A derivation from Oberá city is provided for at this station. A double set of 132 kV busbars shall be installed in the future, with four connections: three for the 132 kV lines and one for the paralleling of busses.

The protection and control equipment shall be installed in a small building. The necessary supply for auxiliary circuits must be studied later. Isolators with no protection shall be installed for the derivations at the first stage.

Posadas transformer substation: In the future the 132 kV system shall comprise a double set of busbars with five connections: one for the incoming line, one as reserve for the future, two for feeding the transformers and one tie for bus paralleling.

The transformer characteristics shall be as follows:

Rating: 10/6/7,5 MVA

Ratio: 132 + 5% - 20%/34,5/13,8 kV with on-load tap-changing equipment.

Connections: star/star/delta.

At the first stage only one bus set shall be installed, with protection for the two transformer. The incoming line shall be equipped with one isolator only.

The 33 kV bus system and feeders shall be installed outdoors, and the 13,2 kV system with the protection and control equipment and auxiliary service equipment shall be installed indoors, in an adjacent building. (Graph N° 27)

Oberá transformer substation: In the future the 132 kV system shall comprise a double set of busbars with four connections: one for the incoming line, one for feeding the transformer, one as reserve for the future and one tie for bus paralleling.

At the first stage only one bus set shall be installed with protection for the transformer. The incoming line shall be equipped with one isolator only.

The transformer characteristics shall be as follows:

Rating: 7,5/6/3 MVA

Ratio: 132 + 5% - 20%/34,5/13,8 kV with on-load tap-changing equipment

Connections: star/star/delta.

The 33 kV bus system and feeders shall be installed outdoords, and the 13,2 kV system with the protection and control equipment and auxiliary service equipment shall be installed indoors, in an adjacent building. (Graph N° 28).

TRANSMISSION LOSSES: The losses have been calculated for the different load conditions expected in the line during the operation period, on the basis of the equipment proposed.

The estimated values are as follows:

Values	Unit	YEAR 1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Power supplied in Acaray	MW	13,1	14,8	16,6	18,7	21,3	23,9	26,5	20,0	15,0	10,0
Power loss	"	1,1	1,3	1,6	2,1	2,5	3,3	3,2	2,5	1,8	0,9
Energy delivered in Acaray	GWh	45,4	50,5	56,8	63,0	70,1	78,6	88,6	92,8	95,3	86,2
Energy loss	"	3,6	4,2	5,0	5,8	7,1	10,0	11,7	11,5	11,8	10,7

Based on the voltage calculations made, tap-changing has been provided for at the transformer substations in order to maintain normal voltage values at the 33 kV and 13,2 kV busbars.

Stability: Static and dynamic stability calculations have been made for the transmission system under different conditions of operation, and it has been checked that no important alterations will occur even if sudden changes of the load conditions take place.

The critical conditions that would be created in case of load loss at the line end would not cause dangerous contingencies at the Acaray power station or at intermediate transformer substations. The equipment has been divised to absorb any of these conditions.

OPERATION THE INTERCONNECTED SYSTEM

As described in the Administration chapter, an enterprise to be created in the Province shall undertake the construction, operation and maintenance of the high voltage system in the Misiones territory. This enterprise shall receive the energy at the 132 kV busbars of the Acaray power station and shall deliver to the distribution bodies in 13,2 kV or 33 kV busbars of the transformer substations. The enterprise will also undertake the operation of the Posadas power station which would supply the lacking energy in the event of interruptions, or when the Acaray capacity is no longer sufficient to cover the maximum demand of the system.

The Acaray-Misiones interconnection system has been

conceived to render a simple, flexible and safe operation. The transformer substations are of automatic operation, i.e., do not require the attendance by permanent operation personnel. The load dispatch shall be made in Posadas and communications with Acaray shall be made by means of carrier wave equipment.

The voltage regulation shall be made by steps in 132 kV busbars of the Acaray power station following the instructions sent from Posadas and according to the demand requirements. Also, the transformer substations in Posadas, Oberá and Eldorado shall have permanent automatic tap-changing equipment.

The 132 kV system shall be operated by remote control from the Posadas load dispatch center. There will be no remote control for the 13,2 kV and 33 kV systems of the transformer substations, and double reclosure circuit breakers shall be utilized. A remote signalling equipment shall indicate any interruption at the load dispatch center.

Three complete maintenance teams, provided with suitable equipment and materials, shall be in charge of the maintenance of lines and substations. The headquarters of these teams shall be in Posadas and Eldorado.

The energy shall be metered at the outgoing 132 kV connection in Acaray power station, where three metering equipments shall be installed - one belonging to Paraguay, one to the enterprise and one for both parties.

The average of three simultaneous readings shall be utilized for accounting purposes.

The energy supplied from Acaray to Encarnación through the line shall be metered at the 33 kV outgoing connection of the Posadas transformer substation.

COMPLEMENTARY WORKS

As indicated in the demand study, it is convenient to centralize in Posadas, Eldorado and Oberá the supply to the related market areas.

A program of additional works shall be necessary during the 1966-1968 period in order to integrate the market and to obtain the full

electrical development foreseen in the demand studies. These works consist in the installation of 13,2 kV and 33 kV lines and the related transformer substations.

The program here described does not include smaller additional medium and low voltage installations that are necessary in the respective areas, since it is considered that these works will be undertaken by the distribution bodies which shall purchase the energy at high voltage from the enterprise.

The fundamental complementary works also include the metering equipment that must be installed for the related lines.

Energy would be supplied in block from this system to a number of customers which has been estimated as follows: 4 in Eldorado, 8 in Posadas and 12 in Oberá. Most of these customers are distribution cooperatives that already exist or are being formed, or generating cooperatives that would shut down their power stations and would only undertake the distribution.

The complementary works, which are shown in Graph N° 30 and detailed in table IV-4, are the following:

Eldorado area: A 13,2 kV ring shall be installed and also a 13,2 kV branch line up to Piray for supplying this town and replace its existing small power station.

A 33 kV line shall also be installed from the Eldorado transformer substation up to Montecarlo. Important additional 13,2 kV installations shall be necessary in this zone in order to develop the market, which is mainly of rural type. The total capacity of transformer substations to be installed in this area is 2050 KVA.

Posadas area: The distribution bodies must develop the rural system, and a 33 kV line for supplying the locality of Apóstoles must be installed to replace the present direct current system supplied from the existing power station. This line would also supply the intermediate locality of San José and a rural zone presently in the process of development in the vicinity of Apóstoles.

The installation of a 33 kV line to San Ignacio is also considered, which would also supply to the localities of Candelaria, Gobernador Roca, Corpus and Santo Pipó. The rural capacity of transformer substation to be installed in this area is 3650 KVA.

Oberá area: A 33 kV line from Oberá to Aristóbulo del Valle is under construction and must be completed. This line shall supply power at 13, 2 kV to distribution cooperatives of the intermediate localities of Campo Grande and Viera.

In the zone of influence of this line are located rural distribution centers, in which electric distribution cooperatives are being formed. These cooperatives would be supplied from the line by means of 33/13, 2 kV step-down transformer substations.

Another 33 kV line shall interconnect Oberá with the locality of Alem, which is at a 25 km. distance and shall substitute the production of the power station existing there.

13, 2 kV lines from Alem to Cerro Azul and Gobernador López are already installed.

13, 2 kV lines for supplying from Oberá to Los Helechos, Campo Ramón and Picada San Martín are included in the complementary works. Some of these localities have cooperatives already existing or being formed. The total capacity of transformer substations to be installed is 7450 KVA.

Types of construction: All the lines shall be of the type standardized in Argentina by Agua y Energía Eléctrica de la Nación (National Water and Power Board). The poles are made of treated wood and the crossarm are made of hard wood. The conductors shall be of Aldrey type aluminium alloy, with the cross sections as required for the transmission capacities of the different lines.

The 13, 2 kV lines shall not be provided with ground wires. The 33 kV lines shall have a ground wire formed by a galvanized steel cable of 6 square millimeters cross section.

The transformer substations shall be mounted directly on poles or on pole supported platforms, according to the capacity.

SUPPLY OF MATERIALS:

A study has been made on which of the materials needed for the construction of the lines and transformer substations shall be made in Argentina, and which must be imported. Aluminium ingot shall be imported for drawing in Argentina to produce the conductors. The necessary protection apparatus, such as lightning arresters and relays shall also be imported. The structures hardware and isolators can be obtained of local production.

For the transformer substations the following apparatus must be imported: on-load tap changing equipment for the 132/33/13,8 kV transformers, 132 kV circuitbreakers, instrument transformers and protection elements. Cooper ingot is to be imported, for local manufacture of the transformers.

For the complementary transmission 13,2 kV and 33 kV lines, only the material for the conductors shall be imported, since all the other equipment shall be of local manufacture.

For cost estimations assumption has been made that the imported equipment and material shall be free of import surcharges.

The budget for this project and a discrimination of costs in Argentine and foreign currency are included in Chapter IV.

EXECUTION OF THE WORKS

The works necessary for the interconnection with Acaray comprise the 132 kV high voltage overhead line with the step-down transformer substations and complementary works consisting in the medium voltage lines necessary for delivering power to the distribution bodies (Cooperatives, Municipalities, etc.).

The time for completing the 132 kV line and step-down substations is estimated in two years from the contract date. A minimum period of 15 months is needed for preparing the final designs, bid specifications, call for bids and awarding of the contracts.

A similar process is necessary for the complementary works. It is advantageous to start with these works prior to the 132 kV line, in order to incorporate the different areas to the market, even though initially the supply may be from diesel power stations.

It should be noted that if this alternative is carried out, all the main and complementary works must be completed by the beginning of 1969, by which time the Acaray project is scheduled to start operation. In this manner, a better utilization of the project will be possible and Misiones will not have to make investments in Diesel Plants, which would be necessary for meeting the increasing demands in areas to be later supplied from the interconnection. For these reasons it is most convenient in this alternative to commence as soon as possible with the technical work necessary for carrying out the project.

IV. INVESTMENTS

All the investments have been estimated in U.S. dollars, considering the present official rate of exchange, i.e., 173 argentine pesos per dollar, for the local costs.

INVESTMENTS IN THE THERMAL ALTERNATIVE

According to the projection of the maximum power demand in each of the three market areas, a program for installation of generating sets has been made taking into account the necessary reserves.

The average cost per kW installed utilizing diesel generating sets made in Argentina was estimated at m$n 50.000. - argentine pesos or its equivalent u$s 289. -which value is in accordance with the present experience in this country. This cost includes civil works, electrical and mechanical installations, auxiliary equipment and erection.

The total investments necessary for this program are indicated in table IV-1.

INVESTMENTS IN THE ACARAY INTERCONNECTION ALTERNATIVE

Table IV-2 indicates the cost estimation of one kilometer of 132 kV line, with a discrimination of those materials and equipment to be imported and those of local manufacture.

It has been estimated that it will be necessary to import 415 tons of aluminium at a price of u$s 690. - per ton.

The structures, insulators and hardware can be manufactured in Argentina. A total of 2.318.tons of steel shall be used, which has been considered at u$s 907.40 per ton.

It is also foreseen that the 132 kV protection and metering equipment and the 132 kV circuit breakers for the transformer substations shall be imported.

The resulting cost of the line is u$s 14.300. - per kilometer and the total is u$s 4.805.800. -

The total costs of the transformer substations are as

follows: Eldorado u$s 274.000.- Oberá u$s 268.000.- and Posadas u$s 641.500.- Tables IV-3 a, b and c give discriminations of these costs.

Since the Acaray interconnection alternative provides for the supply of 3000 kW to the paraguayan locality of Encarnación, the cost of a 17,5 km. long 33 kV line on concrete poles between the Posadas 132/33 kV step-down transformer substation and the point of river crossing situated infront of Candelaria town has been taken into account. The cost of the land plot at this point, where the tower shall be erected for the crossing of the Paraná River allowing navigation, has also been included. The total cost of this line is estimated at u$s 110.880.-

Some other complementary investments that are necessary have been taken into account, as follows:

Equipment for automatic control of the transformer substations and for metering the energy purchased and supplied, amounting to about u$s 150.000.-

For the maintenance of the line and substations, vehicles with the necessary tools and equipment, and also vehicles for supervising, amounting to about u$s 116.000.-

The possibility of paying rights-of-way has also been considered; and also indemnizations for damages on existing cultivations. For estimating purposes, the value of the hectare cultivated with typical products of the zone was taken into account. In forest areas the value of wood and timber obtained in the clearings was considered. Based on these considerations, a total of u$s 100.000.- was estimated.

The engineering expenses include the services required for preparing all the designs and technical specifications necessary for the call for bids, study of the proposals, contracting, inspection and acceptance of the materials and the supervision of the works. The total engineering expenses amount to 6% of the value of the works and is distributed during the three years foreseen. The highest percentage corresponds to the first year, when it will be necessary to prepare the complete design and the bid specifications.

The direct investment in works and maintenance equipment amounts to u$s 7.541.316, including general expenses and unforeseeables. For the engineering expenses a total of u$s 460.000.- has been considered.

Therefore, the cost of the project, without considering interest charges, including direct investments in works and equipment engineering expenses, rights-of-way and indemnizations amounts to u$s 8.101.316.- adding the additional financing charges, the total amounts to u$s 8.681.316.- Table IV-5 shows the investments, discriminating material and foreign currency during the 3 years estimated for completing the works.

For calculating the additional financing charges in this table, the following has been assumed:

The total amount of u$s 8.681.316.- shall be financed basically in equal portions by the Argentine National Government and the Interamerican Development Bank plus a contribution of u$s 500.000.- by the Provincial Government which shall be partly used for the necessary expenses for setting up the new provincial enterprise which will undertake the construction and operation of the interconnection. This contribuition which shall not be reimbursed by the enterprise to the Province, shall cover the necessary expenses on buildings, office work, own technical and administrative personnel, etc. during the construction.

The interest during construction has been included only for the portion of the loan granted by the I.D.B., at an annual rate of 6%. No interest during construction have been included for the contribution by the National Government since it is assumed that these funds shall be obtained under the same current conditions of loans granted by the Special Fund for Electrical Development of the Interior (FEDEI) which does not bear said interest.

A commitment commission of 1% has been considered for the I.D.B. loan, which applies for funds committed and not used.

COMPLEMENTARY WORKS: Table IV-4 indicates the line lengths, corresponding voltages and the capacity estimated for transformer substations. A discrimination is given of total annual investments required for accomplishing this program during 1966-1967 and 1968, year in which the interconnection would be commissioned.

The costs of the imported raw material necessary for the local manufacture of the conductors are indicated separately. It is expected that he conductors shall be made of Aldrey type aluminium alloy.

The cost of the 13,2 kV line with wood poles has been estimated at u$s 1.735.- per kilometer and for the 33 kV line the estimated

cost is u$s 2.890.- per kilometer. Tables IV-6 and IV-7 give a discrimination of these costs.

The execution of these works can commence in 1966 in order to create a market that is to be supplied from the interconnection.

COMPARISON OF ALTERNATIVES

Tables IV-8 and 9 have been prepared for comparison of the two supply projects analyzed. Since the investments are related to programs that do not coincide chronollogically, the total capital plus operation and maintenance expenses for both alternatives have been first determined year by year and have then been actualized to 1969 utilizing an annual interest rate of 6% in the actualizing formula. The cost of the new Posadas power station has been included for both alternatives, since it forms a part of the systems, whether in operation or remaining as reserve.

For calculating the operation and maintenance expenses in the Diesel alternative, the cost of operation of a typical station was analyzed, for each of the three market areas and operation and maintenance expenses for each year were obtained making use of the curve of energy demand obtained in the market study chapter.

The following premises were adopted for this calculation:

The fuel considered was Diesel-Oil at a cost of u$s,34,7 per ton and the average consumption was estimated at 300 grams per kWh generated. Other operation expenses related to personnel for operation, maintenance and administration, spares and general expenses were taken into consideration based on the values estimated for the new Posadas power station and for power stations equipped with 1000 and 1500 kW sets, as it is assumed shall operate in the other areas if this alternative is carried out.

The costs of energy for the three areas average 23 mills per kWh along the period, including capital costs.

For the Acaray interconnection alternative calculations were made under the same procedure, taking into account that all the investments shall have been made by 1969. The direct expenses of operation and maintenance have been estimated on the basis of the experience in Argentina, and it has been assumed that the value shall remain constant along the period. For both alternatives, the same value of complementary investments

was added since these installations are to be made under any alternative, as prevously stated.

For the comparison, the marketing expenses that are common to both alternatives were not added.

Tables IV-8 and IV-9 show the total annual investments for the Diesel program and for the Acaray interconnection and although the economic comparison somewhat favors the Diesel alternative, in this one the value of the hydraulic energy that may be supplied even after 1978 has not been considered.

This energy represents for the interconnected system an economy on the equivalent fuel necessary for generating the same production by means of thermal power stations in Misiones. An estimation could be made on the basis of 40 GWh (half of the Acaray supply for 1978) with a generating cost of 10 mills kWh for thermal generation and 6,53 mills/kWh for hydro-generation, i.e., a difference of 3,47 mills/kWh, which represents an annual saving of u$s 139.000.- Moreover, it should be noted that the interconnection provides a reciprocal reserve of power for both systems.

TABLE IV - I

INVESTMENT PROGRAM - DIESEL ALTERNATIVE

(amounts in U.S. dollars)

YEAR	POSADAS	OBERA	EL DORADO	TOTAL
1968	-	-	289.000	289.000
1969	-	-	-	-
1970	-	243.000	433.000	676.000
1971	-	-	-	-
1972	-	289.000	-	289.000
1973	-	-	434.000	434.000
1974	1.011.000	434.000	-	1.445.000
1975	-	-	-	-
1976	1.011.000	434.000	434.000	1.879.000
1977	-	-	-	-
1978	-	433.500	433.500	867.000
TOTALS	2.022.000	1.833.500	2.023.500	5.879.000

TABLE IV - 2

INVESTMENTS - IGUAZU - POSADAS - OBERA LINE

(amounts in Thousand U.S. dollars)

DESIGNATION	COST PER KILOMETER.	TOTAL COST	NATIONAL CURRENCY		FOREING CURRENCY
			MATERIALS AND EQUIPMENT	OTHER EXPENSES	RAW MATERIAL.
1) 2318 Tons of Steel structures	6.260	2.103.360	2.103.360		
2) 690 Tons of al/ Copper conductor	2.216	744.576	458.976		285.600
3) 250 Tons of Steel cables for Ground Wire	433	145.488	145.488		
4) 43000 Iram type insulators	474	159.264	159.264		
5)Hardware	310	104.160	104.160		
6) Minor Materials	285	95.760	95.760		
7) Foundations	715	240.240	240.240		
8) Transportations	3.440	1.155.840		1.155.840	
9) Labour	170	57.120		57.120	
TOTALS	14.303	4.805.808	3.307.248	1.212.960	285.600

VOLTAJE: 132 kV
LENGTH: 336 Km.
CONDUCTOR: Al/Ac of 3 x 150 mm^2
GROUND WIRE: 2 x 50 mm^2 Steel

NOTE: The cost per kilometer includes imforeseeables and general expenses.

TABLE IV - 3-a

TRANSFORMER SUBSTATIONS

ELDORADO SUBSTATION - 7,5 MVA

(amounts in U.S. dollars)

	Designation	In Foreign Currency			In National Currency			
		Equipment	Raw Material	Total	Materials and Equipment	Other Expenses	Total	Total General
1	132 kV equipment	36.000		36.000	19.000		19.000	55.000
2	13,2 kV and 33kV equipment and Auxiliary Services				62.000		62.000	62.000
3	Relays	10.000		10.000				10.000
4	Transformers	10.000	35.000	45.000	47.000		47.000	92.000
5	Building and Civil works				30.000		30.000	30.000
6	Erection					25.000	25.000	25.000
	TOTAL			91.000			183.000	274.000

TABLE IV - 3-b

OBERA SUBSTATION - 7,5 MVA
(amounts in U.S. dollars)

	Designation	In Foreign Currency			In National Currency			Total General
		Equipment	Raw Material	Total	Materials and Equipment	Other Expenses	Total	
1	132 kV equipment	30.000		30.000	19.000		19.000	49.000
2	13,2 kV and 33 kV equipment and auxiliary services				62.000		62.000	62.000
3	Relays	10.000		10.000				10.000
4	Transformers	10.000	35.000	45.000	47.000		47.000	92.000
5	Building and Civil works				30.000		30.000	30.000
6	Erection					25.000	25.000	25.000
	TOTAL			85.000			183.000	268.000

TABLE IV - 3-c

POSADAS SUBSTATION - 20 MVA
(amounts in U.S. dollars)

	Designation	In Foreign Currency			In National Currency			Total General
		Equipment	Raw Material	Total	Materials and Equipment	Other Expenses	Total	
1	132 kV equipment	131.000		131.000	19.000		19.000	150.000
2	13,2 kV and 33 kV equipment and auxiliary				80.000		80.000	80.000
3	Relays	24.000		24.000				24.000
4	Transformers	25.000	80.000	105.000	110.000		110.000	215.000
5	Building and Civil works				40.000		40.000	40.000
6	Erection						25.000	25.000
7	Reserve Transformer(10MVA)	12.500	40.000	52.500	55.000	25.000	55.000	107.500
	TOTAL			312.500			329.000	641.500

TABLE - IV - 4

INVESTMENTS IN COMPLEMENTARY INSTALLATIONS

Designation	Voltage KV	Length KM	Investment in lines U$S	Transformer Subst. capacity U$S	Investment in Substation U$S	Investment in metering equipment U$S	Total Investment U$S	Total annual investments 1966 - 1968					
								1966		1967		1968	
								F.C. U$S	N.C. U$S	F.C. U$S	N.C. U$S	F.C. U$S	N.C. U$S
Eldorado area													
Eldorado city	13.2	12	20.820	1.000(xx)	17.350	-	38.170	2.400	35.770				
Line to Piray	13.2	7	12.145	300	5.205	4.000	21.350	1.450	19.900				
Line to Montecarlo	33	22	63.580	750	13.012	7.000	83.592			4.500	39.092	-	40.000
Oberá area													
Oberá area	13.2	15	26.025	1.000	17.350	4.000	47.375	1.100	10.275	1.100	16.900	1.100	16.900
Line to A.del Valle	33	66	(x) 124.270	1.000	17.350	14.000	155.620	3.000	47.000	3.000	52.620	2.700	47.300
Line to L.N.Alem	33	25	77.250	750(xx)	13.012	7.000	92.262	5.000	40.000		47.262		
C.Grande area	13.2	10	17.350	800(xx)	13.880	-	31.230			1.100	13.900	1.100	15.130
C.Viera area	13.2	20	34.700	1.500(xx)	26.025	-	60.725	1.500	18.500	1.500	19.225	1.500	18.500
Line to C. Ramón	13.2	15	26.025	1.000(xx)	17.350	4.000	47.375	1.600	13.400	1.600	13.400		17.375
Line to P.San Martín	13.2	15	26.025	700	12.145	4.000	42.170			1.600	18.400	1.600	20.570
Line to Los Helechos	13.2	15	26.025	700	12.145	4.000	42.170	1.600	18.400	1.600	20.570		
Posadas area													
Line to San Ignacio	33	58	167.620	750	13.012	7.000	187.632			12.000	48.000		127.632
Line to Santo Pipo	13.2	20	34.700	500	8.675	4.000	47.375					4.300	43.075
Line to Apóstoles	33	60	173.400	1.000(xx)	17.350	7.000	197.750			12.000	98.000		87.750
San José area	13.2	10	17.350	700	12.145	-	29.495					2.200	27.295
Apóstoles area	13.2	20	34.700	700	12.145	4.000	50.845.					3.500	47.345
TOTAL		208(33) (x) 159.(13.2)	876.985	13.150	228.151	70.000	1.175.136	17.650	203.245	40.000	387.369	18.000	508.872

(x) Investments already made have been deducted.
(xx) Include 33/13.2 kV and 13.2/0,38 kV transformers

References : F.C.: Foreign currency
N.C.: National currency

TABLE IV - 5

INVESTMENT PROGRAM

ITEM	DESIGNATION	YEAR 1966			YEAR 1967			YEAR 1968			TOTALS		
		Foreign Currency	National currency	Total U.S	Foreign currency	National currency	Total U.S.	Foreign currency	National currency	Total U.S.	Foreign currency	National currency	Total U.S.
1)	Iguazú-Posadas-Oberá 132 kv.line 336 km.	-	-	-	285.600	1.473.600	1.759.200	-	3.046.600	3.046.600	285.600	4.520.200	4.805.800
2)	Transformer substations Eldorado, Posadas, Oberá	-	-	-	252.000	307.000	559.000	236.500	388.000	624.500	488.500	695.000	1.183.500
3)	Special equipment (metering communications, etc)	-	-	-	12.000	-	12.000	108.000	30.000	138.000	120.000	30.000	150.000
4)	Equipment for maintenance of lines and transformer substations.	-	-	-	-	58.000	58.000	-	58.000	58.000	-	116.000	116.000
5)	Line to Encarnación	-	-	-	3.880	15.000	18.880	-	92.000	92.000	3.880	107.000	110.880
6)	33 and 13,2 kv complementary installations (x)	17.650	203.245	220.895	40.000	387.369	427.369	18.000	508.872	526.872	75.650	1.099.486	1.175.136
	Sub Total	17.650	203.245	220.895	593.480	2.240.969	2.834.449	362.500	4.123.472	4.485.972	973.630	6.567.686	7.541.316
7)	Engineering expenses	200.000	120.000	320.000	20.000	50.000	70.000	20.000	50.000	70.000	240.000	220.000	460.000
8)	Rights-of-way and indemnization	-	15.000	15.000	-	60.000	60.000	-	25.000	25.000	-	100.000	100.000
9)	Cost of the project with no interest charges	217.650	338.245	555.895	613.480	2.350.969	2.964.449	382.500	4.198.472	4.580.972	1.213.630	6.887.686	8.101.316
10)	Interest charges during construction	9.000	2.000	11.000	59.000	8.000	67.000	156.000	16.000	172.000	224.000	26.000	250.000
	Sub Total	226.650	340.245	566.895	672.480	2.358.969	3.031.449	538.500	4.214.472	4.752.972	1.437.630	6.913.686	8.351.316
11)	Commitment Commission	37.800	-	37.800	21.400	-	21.400	-	-	-	59.200	-	59.200
12)	General expenses of the ENTE.	-	110.000	110.000		110.000	110.000	-	110.000	110.000	-	330.000	330.000
13)	Total Investment.	264.450	450.245	714.695	693.880	2.468.969	3.162.849	538.500	4.324.472	4.862.972	1.496.830	7.243.686	8.740.516

(X)- Rounded figures.

TABLE IV - 6

13,2 kV LINE UTILIZING WOOD POSTS

(cost per kilometer)

(Estimated in argentine currency and indicated in U.S. dollars)

DESIGNATION	Quantity	Unit cost	Total cost	Total
		arg.pesos x 1000	arg.pesos x 100	U$S
Wood posts - height: 10 metres	12,5	13	162	
Aldrey conductor - 50 Sq..mm.	3.03	202	612	
Cross arms 1 = 1.80	12.5	3.4	42	
Arms	25	0.6	15	
Insulators	38	2.5	95	
Pins	38	1.8	68	
Various			87	
Labor			247	
Transport			151	
				1.479
Percentage of special structures (2%)			30	
				1.509
Unforeseen and projit (15%)			226	
				1.735

TABLE IV - 7

33 kV LINE UTILIZING WOOD POSTS

(Cost per kilometer)

(Estimated in argentine currency and indicated in U.S.dollars)

DESIGNATION	Quantity	Unit cost arg.pesos x 1.000	Total cost arg.pesos x 1.000	Total U$S
1) Wood posts - height: 12 metres	12,5	17,35	217	
2) Aldrey conductor-50 Sq.mm.	3,03 km	202	612	
3) Steel cable - diam: 6 mm.	1010 m	0,16	162	
4) Cross arms 1 = 2,4 m	12,5	4,13	52	
5) Arms	25	0,81	20	
6) Insulators	38	3,87	147	
7) Pins	38	2.31	88	
8) Descending cables	156	0,81	126	
9) Various			116	
10) Labor			577	
11) Transport			347	
				2.464
12) Percentage of special structures (2%)			49	
				2.513
13) Unforeseen and profit and general expenses (15%)			377	
				2.890

TABLE IV - 8

INVESTMENTS AND ACTUALIZED EXPENSES

ACARAY ALTERNATIVE

(Amounts in thousands of U.S. dollars)

Designation	YEAR										
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	TOTAL
Investments in power stations	2.370	676	-	289	434	1.445	-	1.878	-	868	7.960
Medium voltage complementary works	1.339(x)	-	-	-	-	-	-	-	-	-	1.339
Maintenance expenses-medium voltage transmission	30	30	30	30	30	30	30	30	30	30	300
Annual costs of power generation	756	836	907	988	1.063	1.158	1.266	1.372	1.478	1.643	11.467
TOTAL	4.495	1.542	937	1.307	1.527	2.633	1.296	3.280	1.508	2.541	21.066
Actualized Value	4.495	1.455	834	1.097	1.210	1.968	913	2.181	946	1.504	16.603

(x) The original amount of U$S 1.175.136 for these investments was increased in 40% in order to take into account engineering expenses, interests during constructions and commitment commission

TABLE IV - 9

ACTUALIZED INVESTMENTS AND EXPENSES

ACARAY ALTERNATIVE

(Amounts in thousands of U.S. dollars)

Designation	YEAR										
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	TOTAL
Investments according to table IV - 5	8.740	-	-	-	-	-	-	-	-	-	8.740
Posadas Power station	2.370	-	-	-	-	-	-	-	-	-	2.370
New Thermal station	-	-	-	-	-	-	-	-	-	3.480	3.480
Operation and maintenance expenses	117	117	117	117	117	117	117	181	235	489	1.723
Energy purchased to ANDE	475	475	475	475	475	513	578	606	622	563	5.257
TOTAL	11.702	592	592	592	592	630	695	787	857	4.532	21.590
Actualized value	11.702	558	527	497	469	471	490	523	538	2.843	18.618

V. ESTIMATION OF OPERATING RESULTS AND PROFITABILITY OF THE ACARAY-MISIONES PROJECT

Estimation of the operating results: Based on the operation data estimated for the system, a projection of the operation results has been made as shown in table V-1.

The necessary amount of energy to be generated in Diesel power stations for complementing the Acaray supply from 1976 to 1978 has been estimated on the basis of the duration and integrated system load curves prepared for the interconnected system. For economic calculations, it has been assumed that all this necessary energy will be generated in the new Posadas power station.

One of the most important points considered is the price to be payed for the energy received from Acaray. According to what has been stated, ANDE must receive a minimum annual income of u$s 475.000.- along the entire period of supply (1969-1978).

Based on the total energy estimated to be purchased from ANDE during the entire period, which amounts to 727.300.000 kWh, and considering the minimum income of u$s 4.750.000 required during the ten years, the average resulting price of the kWh at Acaray power station supply point shall be 6,53 mills. Consequently, a basic supply quota of 72.700.000 kWh has been estimated, which corresponds to the annual income of u$s 475.000.- taking into account the above mentioned price of 6,53 mills per kWh. Any amount of energy above this basic quota shall be payed at the rate of 6,53 mills per kWh. The operating annual expenses of the transmission and subtransmission system have been estimated at u$s 180.000.-, which value is expected to remain stable along the period. The costs of generation by Diesel sets have been taken on the basis of estimations made for the new Posadas power station.

The marketing and administration expenses of the ENTE during the 1969-1975 period are expected to remain constant and to start increasing in 1976, by which year it is necessary to start the operation of the Posadas Diesel power station.

The selling price of energy in 33 or 13,2 kV busbars has been estimated taking into consideration the operation data obtained from the utilities already existing in the province.

The cost of generation estimated at 13,2 kV busbars of the typical power stations considered in the alternative Diesel program is 23 mills per kWh although the present average cost of generation in Misiones is not below 29 mills per kWh. Consequently, an average selling price of 26 mills per kWh has been adopted for the period (m$n 4,50/kWh).

Aside from the strictly economic criterion used for choosing this selling price, the capability of the probable energy consumers for absorbing it has been investigated.

The answer has been affirmative in most of the cases. An estimation of the depreciation allowance for the interconnection installations has also been made, as detailed in table V-2.

The cost of the system energy at 13,2 kV and 33 kV busbars has also been calculated based in financial criterion i.e., considering as capital cost the financing commitments plus direct operation expenses, as shown in table V-3.

Table V-4 gives a calculation of the fixed investment, to be used for determining the profitability of the system. In this table, the value of the new Posadas power station has been added to the total investment necessary for the interconnection project, since this will be the only Diesel generating station to be owned by the ENTE, and shall be included in the fixed assets.

The funds needed for operating the interconnection have been estimated at u$s 230.000.- per year, to cover the cost of the materials required for maintenance of the interconnected system and a reserve to cover fuel and the necessary elements for operating the Diesel power station. The necessary working capital for the ENTE is also included.

Profitability: A calculation of the annual profitability of the project is given in table V-1. As it can be appraised, the value of -0,13% for the profitability in 1969 is negative, but increases steadily along the period up to + 12,72% in 1977 which is considered satisfactory.

The cost of operation of a 15 MW thermal unit added to the system and its related incidence on the fixed investment and depreciation has been included, in order to appraise the influence that the substitution in 1978 of energy received from Acaray would have on the profitability. Under these conditions, the profitability amounts to + 9,63%. This value gives an optimistic outlook for the substitution of the Acaray supply by other thermal or hydraulic energy sources in the event that the Acaray supply ceases after 1978.

TABLE V - 1

PROJECTION OF THE OPERATION RESULTS

	UNIDAD	AÑO 1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
I- OPERATION DATA											
1 Maximun demand in the system.	MW	12,0	13,5	15,0	16,6	18,8	20,6	23,3	25,7	28,8	32,4
2 Power supply needed from Acaray	MW	13,1	14,8	16,6	18,7	21,3	23,9	26,5	20,0	15,0	10,0
3 Thermal power Supply	MW	-	-	-	-	-	-	-	8,2	15,6	23,3
4 Energy purchased to Acaray.	10^6 kWh	45,4	50,5	56,8	63,0	70,1	78,6	88,6	92,8	95,3	86,2
5 Hydroelectric energy sold by the ENTE.	10^6 kWh	41,8	46,3	51,8	57,2	63,0	68,6	76,9	81,3	83,5	75,5
6 Energy Delivered by thermal power stations.	10^6 kWh	-	-	-	-	-	-	-	2,5	7,8	26,6
7 Total energy sold by the ENTE.	10^6 kWh	41,8	46,3	51,8	57,2	63,0	68,6	76,9	83,8	91,3	102,1
II DIRECT OPERATION EXPENSES											
1 Energy purchased to ANDE	10^3 u$s	475	475	475	475	475	513	578	606	622	563
2 Fixed costs-thermal power stations.	" "	17	17	17	17	17	17	17	55	55	263
3 Variable costs-thermal generation	" "	-	-	-	-	-	-	-	26	80	126
SUB-TOTAL	" "	492	497	492	492	492	530	595	687	757	952
4 Transmission and sub-transmission operation and maintenance expenses.	" "	100	100	100	100	100	100	100	100	100	100
5 Administration and Marketing expenses	" "	80	80	80	80	80	80	80	81	82	85
6 Total direct expenses	" "	672	672	672	672	672	710	775	868	939	1137
7 Depreciation	" "	430	430	430	430	430	430	430	430	430	568
8 Total operation expenses	" "	1.102	1.102	1.102	1.102	1.102	1.140	1.205	1.298	1.369	1.705
III -OPERATION REVENUE											
1. Selling of energy - 26 mills per kWh rate	" "	1.087	1.204	1.347	1.487	1.638	1.783	1.999	2.179	2.374	2.654
2 Net operation revenue	" "	-15	102	245	385	536	643	794	881	1.005	949
IV- FIXED INVESTMENT	" "	11.340	10.910	10.480	10.050	9.620	9.190	8.760	8.530	7.900	10.920
V PROFITABILITY	%	-0,13	0,93	2,34	3,83	5,57	7,00	9,06	10,33	12,72	8,69

TABLE V - 2

ESTIMATION OF THE DEPRECIATION

	USUFUL LIFE.	INVESTMENT	DEPRECIATION
	years	u$s x 1000	u$s x 1000
LINES AND SUBSTATIONS	30	7.120	234,9
COMPLEMENTARY LINES	20	1.491	74,5
MAINTENANCE EQUIPMENT	5	129	25,8
DIESEL POWER STATIONS	25	2.370	94,5
TOTAL		11.110	430

TABLE V - 3

COST OF ENERGY AT 33 AND 13,2 kV BUSBARS

FINANCING CRITERION

	Unit	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
FINANCING COMMITMENTS	u$sx10^3	211	421	849	849	849	849	849	849	849	1.204
DIRECT OPERATION EXPENSES	u$sx10^3	672	672	672	672	672	710	775	868	939	1.137
TOTAL EXPENSES	u$sx10^3	883	1.093	1.521	1.521	1.521	1.559	1.624	1.717	1.788	2.341
ENERGY SOLD	GWh	41,8	46,3	51,8	57,2	63	68,6	76,9	83,8	91,3	102,1
COST OF THE KWHR	u$sx10^3	21,1	23,6	29,4	26,6	24,1	22,7	21,1	20,5	19,6	22,9

TABLE V - 4

FIXED INVESTMENT

(in thousand U.S. dollars)

Designation	YEAR									
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
132 kV System and complementary installations	8740	8740	8740	8740	8740	8740	8740	8740	8740	8740
Posadas-Diesel Power Station	2370	2370	2370	2370	2370	2370	2370	2370	2370	2370
New Thermal investments	--	--	--	--	--	--	--	--	--	3480
Total fixed assets	11110	11110	11110	11110	11110	11110	11110	11110	11110	14590
Accumulated depreciation		430	860	1290	1720	2150	2580	3010	3440	4010
Net fixed assets	11110	10680	10250	9820	9390	8960	8530	8100	7670	10580
Working Capital	230	230	230	230	230	230	230	230	230	340
Fixed investment	11340	10910	10180	10050	9620	9190	8760	8530	7900	10920

VI. FINANCING

The financing plan for the interconnection and complementary works has been prepared on the basis of a loan to be granted by the Interamerican Development Bank and on the funds to be provided by the National and Provincial Governments to the enterprise that undertakes the construction and operation (Graph N° VI-1)

The total program of investments amounts to the equivalent of u$s 8.740.516.-, of which u$s 1.496.830 shall be in foreign currency and u$s 7.243.686.- in national currency.

This amount shall cover investments in works and interests, as follows:

Direct project investments	u$s 8.431.316.-
Interest during construction	" 250.000.-
Commitment Commission	" 59.200.-
Total necessary investment	u$s 8.740.516.-

The amount of direct project investments includes u$s 330.000.- to cover expenses for setting up the provincial enterprise which, as aforementioned, will be contributed by the Province. As above mentioned, interest during construction is only considered for the I.D.B. loan.

The national and provincial contributions do not carry interests because in Argentina there are not neither imputable nor returnable.

The financing program foreseen for the project is as follows:

I.D.B.	u$s 4.094.000.-
National Government	" 4.146.516.-
Provincial Government	" 500.000.-
Total Project	u$s 8.740.516.-

The amount corresponding to the Provincial Government would be a non-returnable contribution to be made during the 1966-1968 period.

The portion of the loan requested to the I.D.B. for the works amounts to u$s 3.844.000.- and the portion for covering the interest of this same loan amounts to u$s 250.000.-, therefore the I.D.B. would include these interest within the amount of repayments.

The repayment would be made in 30 six monthly installments, with an annual interest rate of 6%. The installments including amortization plus interest charges would be constant.

The first installment is to be made in the second semester of 1969, six months after the installations have been completed and commissioned. Assumption has been made that the National Government shall pay the commitment commission for this loan, amounting to 1% of the funds committed but not utilized.

The I.D.B. loan shall cover all the foreign currency expenses estimated at u$s 1.213.500.- and a portion of the argentine currency expenses up to u$s 2.630.500.-

The total amount of the loan to be granted by the I.D.B. for works shall be repayed during the three years 1966-1968. In accordance with present regulations in Argentina, loans of this nature must be repayed by furnishing to the financing institution. The amount in dollars corresponding to the portion of foreign currency necessary for payments outside the country. In this case this portion amounts to u$s 1.213.500.-

For the portion of the I.D.B. loan to be utilized in national currency for the project, the Bank would furnish 25% in national currency and the balance in foreign currency. This total portion amounts to u$s 2.630.500.-

Table VI-2 indicates the credit supply and use for the I.D.B. loan.

The criterion adopted for the portion corresponding to the National Government is the one followed generally for the credits granted by the Dirección Nacional de la Energía (National Energy Board) with resources from the Special Fund for Electric Development of the Interior (Fondo Especial de Desarrollo Eléctrico del Interior (FEDEI). This does not imply that all the funds are to be provided by the FEDEI, since the possibility of direct

supply of some funds from the National Treasury is also foreseen. In any case, the loan terms should be similar, as follows: 15 year repayment period and 6% annual interest rate, with equal annual installments, or with better conditions.

A two years grace period after the installations are completed must be granted in order to avoid deficit in the cash flow during the initial years. Therefore, the repayment of the National Government Credit must begin in 1971.

The commitment commission mentioned above amounts to u$s 59.200.- and provides for the commitment by the I.D.B. on the availability of the loan during the construction period. Since this commission must be payed by the National Government during said period the total amount to be furnished by the National Government is as follows:

For works in national currency	u$s 4.087.316.-
For commitment commission in foreign currency	" 59.200.-
	u$s 4.146.516.-

Based on the foregoing, the cash flow for the 1966-1968 period has been prepared in Table VI-3.

A thermal power station with a 15 MW generating unit of an estimating cost of u$s 3.480.000.- must be in operation in 1978 for covering the power deficit once the period for the guaranteed Acaray supply has expired. The cash flow indicates from 1975 on, the requirements for the construction of this thermal station. It has been assumed that the payment terms for this unit shall be 15 years with an interest rate of 6%.

As it can be appreciated, with the above mentioned financing conditions, there are no difficulties in the cash flow during the initial years, and improves steadily in later years enabling with no difficulties future repayments for the national and the I.D.B. credits.

The financing commitments related to a new unit in 1978 have been included in order to demonstrate that the funds available shall provide for the substitution of Acaray by another source of power with no problems.

TABLE VI - 1

PROJECT FINANCING

(Amonuts in thousand U.S. dollars)

	1966			1967			1968			TOTAL		
	F.C.	N.C.	Total	F.C.	N.C.	Total.	F.C.	N.C.	Total	F.C.	N.C.	Total.
IDB LOAN												
For installations	217,5	148,5	366	613,5	897,5	1511	382,5	1584,5	1967	1213,5	2630,5	3844
Interest charges	9	2	11	59	8	67	156	16	172	224	26	250
IDB Sub-total	226,5	150,5	377	672,5	905,5	1578	538,5	1600,5	2139	1437,5	2656,5	4094
NATIONAL GOVERNMENT												
For installations		133,9	133,9		1396,5	1396,5		2556,9	2556,9		4087,3	4087,3
Commitment commission	37,8		37,8	21,4		21,4				59,2		59,2
National Govt. Sub-total	37,8	133,9	171,7	21,4	1396,5	1417,9		2556,9	2556,9	59,2	4087,3	4146,5
PROVINCIAL GOVERNMENT												
For installations		56	56		57	57		57	57		170	170
For ENTE expenses		110	110		110	110		110	110		330	330
Provincial Govt. Sub-total		166	166		167	167		167	167		500	500
TOTAL	264,3	459,4	714,7	693,9	2469	3162,9	538,5	4324,4	4862,9	1496,8	7243,7	8740,5

F.C. :Foreign currency
N.C. :National currency

TABLE VI - 2

IDB CREDIT SUPPLY - AND USE

(Amounts in thousand U.S. dollars)

	1966			1967			1968			TOTAL		
	F.C.	N.C.	Total	F.C.	N.C.	Total	F.C.	N.C.	Total	F.C.	N.C.	Total
I - LOAN SUPPLY												
For installations	335	31	366	1332	179	1511	1650	317	1967	3317	527	3844
For interests	9	2	11	59	8	67	156	16	172	224	26	250
TOTAL	344	33	377	1391	187	1578	1806	333	2139	3541	553	4094
II - LOAN USE												
For installations	217,5	148,5	366	613,5	897,5	1511	382,5	1584,5	1967	1213,5	2630,5	3844
For interests	9	2	11	59	8	67	156	16	172	224	26	250
TOTAL	226,5	150,5	377	672,5	905,5	1578	538,5	1600,5	2139	1437,5	2656,5	4094

F.C.: Foreign currency.
N.C.: National currency.

TABLE VI - 3

CASH FLOW

(Amounts in thousand U. S. dollars)

DESIGNATION	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
I - Available funds													
For construction	-	-	-	-	-	-	-	-	-	100(1)	124(1)	124(1)	
From the IDB loan	377	1.578	2.139	-	-	-	-	-	-	-	-	-	-
From the National Govt. credit	171,7	1.417,9	2.556,9	-	-	-	-	-	-	-	-	-	-
Non returnable Provincial credit	166,6	166,7	166,7	-	-	-	-	-	-	-	-	-	-
Sub-Total	714,7	3.162,9	4.862,9										
Operation net revenue	-	-	-	-15	102	245	385	536	643	794	881	1.005	949
Depreciation	-	-	-	430	430	430	430	430	430	430	430	430	568
Total available funds	714,7	3.162,9	4.862,9	415	532	675	815	966	1.073	1.324	1.435	1.559	1.517
II - Expenditures													
For construction	714,7	3.162,9	4.862,9	-	-	-	-	-	-	100(2)	124(2)	124(2)	
IDB loan repayment	-	-	-	211	421	421	421	421	421	421	421	421	421
National Govt. credit repayment	-	-	-	-	-	428	428	428	428	428	428	428	428
Repayment-loan for new energy source	-	-	-	-	-	-	-	-	-	-	-	-	355
Total Expenditures	714,7	3.162,9	4.862,9	211	421	849	849	849	849	949	973	973	1.204
III - Annual balance				204	111	-174	-34	117	224	375	462	586	313
Accoumulated balance	-	-	-	204	315	141	107	224	448	823	1.285	1.871	2.184

(1) Investments for construction of the new energy source

(2) Expenditures for construction of new energy source

VII. ADMINISTRATIVE, INSTITUTIONAL AND LEGAL ASPECTS

General preliminary considerations: Electric power supply in Argentina has been channelled in latest years through government enterprises. The functions inherent to the Government on this matter have been delegated to these enterprises and are exercised in compliance with national or provincial laws.

These enterprises - a modern creation of Administrative legislation - undertake the supply of public services and also the study, planning and execution of the works necessary for generating, transmitting and distributing electric power, in order to meet present and future social needs, thus constituting the actual responsibles for electric power development within their area of influence.

The legal structure on which these provincial and national government enterprises are based usually provides them with a greater operative independence than that of other decentralized bodies, basically due to their commercial and industrial nature. However, for said bodies, their legal and accounting administrative actions are subject to the control of the Administrative Power by means of the pertinent organizations foreseen in the basic legislation. It should be noted that this control - of an unquestionable origin - must be clearly ruled and exercised with caution by the respective bodies, in order to avoid any distorsion in the legal nature of the enterprise.

It is evident that the success of the actions of these government enterprises depends on the interaction of various elements, the most important being: financial solvency, technically skilled human elements, basic information on their jurisdiction area and a dynamic management for planning and establishing priorities, the study which should be justified with the necessary documentation, and full assumption of responsability for decisions, similarly as private enterprises. The purpose of the egoing is to optimize efficiency for the benefit of the community.

It must be bornein mind that there is always an electric power policy closely connected with social needs which is part of the government's duty and is carried out through these public enterprises.

The execution of the works considered in this report, its operation and maintenance, and the need for expanding the power consumer market in urban and rural centers, call for the establishment of a state type enterprise in order to conciliate these objectives.

A law for creation of an enterprise of this nature should contemplate the whole electric power problem and its future projection, endeavouring to avoid any possible omissions in the legislation, which could bring doubtful interpretations. To this end, the actions should be based on the following basic premises:

a) Maximum autarchy based on a full legal capacity to act whithin the sphere of public and private law.

b) Own government with wide decision-making power.

c) Sufficient financial resources to allow positive action and financial autonomy.

d) An adequate contracting system.

e) Full jurisdiction throughout the provincial area.

f) Adequate control of legal and accounting actions through specific bodies created by the basic legislation.

The Government of the Province of Misiones, should also include in its annual budgets the funds required for the operation of the enterprise.

Legal nature of the Enterprise and basic aspects to be considered in its Organic Law

The legal characteristics and functional aspects detailed below, are included within the Provincial legislation. National, provincial and foreign laws, rules and regulations related to this subject have also been consulted.

On the other hand, based on the experience of similar institutions, the correction of deficiencies that are common has been sought, in order to improve the functionality.

Legal Nature - Object - Powers

1. The new body will follow the form at a Provincial State enterprise and will maintain relations with the Provincial Government through the Ministry of Economy and Public Works of the Province, adjusting its performance to the regulations of its creating law and the organic chart

that should be approved by the Provincial Government to which should be submitted.

2. The enterprise will be self-determining, with legal capacity to act in the fields of public and private law, within the rights and obligations established by law. It will exercise its own administrative, industrial, commercial and financial government, based on a modern structure, enabling it to operate in a flexible and dynamic manner.

3. The legal address of the enterprise will be the Capital of the Province, but it will be entitled to send delegations, have agencies or representations in the interior of the Province or in other places of the country Consequently, it will have full jurisdiction throughout the entire Province of Misiones for fulfilling its specific objects.

4. The entity's structure will be based on the General Hydraulic and Energy Bureau, created by provincial decree N° 2331/59, and will take over all the functions related to electric power supply. The Provincial Government shall pass on to a new body to be created all those aspects regarding general use and development of water resources for purposes other than the generation of electric power.

5. The object of the provincial enterprise will be:

   a) Study, design, construct, administrate and operate electric power stations, transmission lines, transformer sub-stations, distribution networks and complementary and/or related works.

   b) The purchasing and selling of electric power energy to Argentina and/or foreign entities and the responsibility for electric public services.

   c) Coordinate with cooperatives that undertake the supply of electric power public services in relation to their technical operation projects and plans of works, in accordance to the provincial electrical development plans.

   d) Prepare an electric provincial plan, and keep it up to date. This provincial plan should coordinate with national plans on the subject.

   e) Operations of load dispatch corresponding to the high and medium voltage transmission systems.

f) Promotion of rural electrification.

g) Creation of schools and technical training institutions for its personnel.

h) Represent the Province before national and international, provincial or municipal bodies related to its activities.

i) Any other kind of functions related to the fulfillment of its objectives.

6. In order to fulfill its duty the entity can:

Engage in obligations and enter into any necessary contracts and acts regarding projects and services, barters, rent and purchase and sale of goods and properties, and the constitution of real rights thereupon, i.e., the widest legal capacity to act within the field of private and public law.

Carry out any kind of banking and financial operations with joint or private, national, provincial, municipal or private credit institutions, and request loans from private or public national or international credit institutions necessary for the performance of its function extensions, and purchase of machinery and equipment.

Form part of, and constitute any kind of civil, commercial, industrial or financial, private or joint civil societes, even cooperatives, provided their purposes coincide with those of the government enterprise, and subscribe the necessary capital quotas, with contributions in cash, rights or goods.

Sign agreements with provinces, municipalities and other government entities on matter related to electrical services. Sign contracts with foreign countries, private and public organizations, provided said contracts are not in opposition with the regulations established by the Provincial - and National Government that refer to electric power and foreign relations. Enter into individual contracts for electric power supply.

Fix rates for the services rendered or developed, and set, upon municipality request, a tariff system for the cooperatives or private utilities in the Province.

Make contributions and grant loans and financial aid to electric cooperatives with legal status, provided these contributions, loans and financial aids derive from the Provincial budget or any other national or provincial source. These contributions and loans would be granted only to

cooperatives, for the execution of new projects and/or expansion of existing services subject to prior approval of these projects by the provincial enterprise, in coordination with provincial plans.

Fix salaries, indemnities, premiums and benefits for its personnel, as well as allowances, exemptions and/or special tariffs for their private consumption of electric power.

Perform whichever other acts may be considered necessary in order to achieve its objectives in accordance with special and general legislation applicable to the fulfillment of its purpose.

7. Management

The management and administration of the enterprise will be exercised by its Board of Directors formed by a President, a Vicepresident and three members appointed by the Provincial Government. One of the members would be appointed upon suggestion of the electric cooperatives of the province and another by the local Electric Power Union.

The members of the Board of Directors, apart from the requirements to be fulfilled for their nomination, of their general qualifications and possible incompatibilities, will serve for fixed terms that can be four years. The terms of the members will be stepped in order to have one nomination per annum. All members may be reelected for further terms, holding their post on a permanent basis, provided they do not incur in serious faults duly attested by means of an official inquiry called by the Government, the intervention of the Provincial prosecuting attorney being advisable in such cases.

The law should also determine the duties of the Board of Directors, i.e., the obligation to hold periodic meetings, quorum, voting, decisions procedure, etc.

8. Powers: The Board of Directors will be entitled to:

a) Carry out such acts and operations, sign contracts and agreements as specified in point 6 of this chapter, as well as any such other acts related to the specific functions of the enterprise or that constitute a natural consequence of its activities.

b) Approve the organic and functional structure of the enterprise based on four main departments namely Engineering, Operation, Accountancy

and Legal, which should be headed by professional experts with University degree specialized in the corresponding fields.

c) Establish its own internal regulations covering the departments under its jurisdiction.

d) Establish rules regarding payments, purchases, construction, contracts and other general investments or expenditures and determine the accounting system of the enterprise.

e) Regulate and control the production, distribution, transmission, marketing and consumption of the electric power generated, imported or exported in the Province.

f) Examine and approve working plans, annual reports and balance sheets submitted by the corresponding departments.

g) Prepare and carry the provincial electricity plan, submit it to the approval of the Provincial Government, keep it up to date, establish priorities based on the respective documentation and order its execution in accordance with the approved budget.

h) Prepare every year its operation plan and budget for the period and submit them to the consideration of the Provincial Government. The plan must detail the projects to be financed through the resources of the Provincial Treasury, the Special Fund for Electric Power Development in the Interior, the Fund for Provincial Electrification or the own resources of the enterprise.

i) Appoint special and general attorneys. Hire technicians, professionals and other type of personnel, establishing their fees and salaries.

j) Appoint, promote, transfer, informe disciplinay messures, accept resignations and dismiss personnel under their jurisdiction, in accordance with the regulations of the Organic Chart or the rules and regulations established to this end.

k) Act directly before national, provincial and municipal public powers as well with decentralized or autarchic institutions.

l) Establish salaries and wages for the personnel and approve labour agreements accepted by the President of the enterprise or his representatives, as well as establish the participation of the personnel on the benefits.

ll) Fix the tariff system to be applied for the electric services provided. Prepared for the consideration and approval of the Provincial Government a penalty system against infringements to the regulations for services.

m) Establish regulations on the utilization, safety, and standardization of the installations, equipment, works and services under control of the enterprise.

n) Prepare the Organic Chart for the enterprise and submit it to the consideration and approval of the Provincial Government.

ñ) Perform any other act as necessary for the fulfillment of its objectives,

9. Capital and resources

The capital of the provincial enterprise will be formed by the fixed assets, reserves, accumulated benefits and nonreceivable contribution of the Provincial Treasury or special funds, and those arising from natural of legal status persons.

The capital will be formed by contributions, of the Provincial Government, in goods and cash, the amount of which shall be determined in the balance sheet to be prepared on the date of its constitution. The capital may be increased by future contributions that the Provincial State may decide to make and by means of the transfer of other items belonging to the budget of the enterprise.

Consequently, all installations for electric power generation, transmission and distribution, whether goods or properties, belonging at present to the Province, as well as the projects under construction and the pertinent budget items, shall be transfered to the enterprise.

10. Resources will include.

a) Income from tariffs.

b) Income from penalties applied in accordance with the corresponding regulations.

c) Funds provided by the Provincial Treasury.

d) Contributions and loans from the Special Fund for Electric Power Development of the Interior. (Law 15336)

e) Funds from the Provincial Electrification Fund (Fiscal Code of the Province of Misiones).

f) Credit funds.

g) Cash donations, subsidies and financial aid received from public and private entities.

h) The produce of the sale of materials, goods, implements and materials of no commercial value and of properties constituting assets which are retired from public service.

i) Amounts perceived from damages affecting the enterprise, and any such other incomes arising from the execution of contracts, or from the exercise of any other legal rights it may have.

j) Any other income arised from the fulfillment of its objectives.

The aforementioned resources shall be administered by the Board of Directors in accordance with the rule established in its organic chart.

The Government will make provisions in the provincial budget fot the necessary items to cover deficits arising from promotional services operated by the enterprise. Likewise, the works and installations made to this end, shall also be financed by the Provincial Treasury.

11. Contracting System

The sales and purchase of goods, and contracting of works and services will be made by the enterprise on the basis of calls for bids and price competition, adjusting to the rules established in its organic chart. Public and private bids, private price inquiries and direct contracts shall be made in accordance with what is established by the Board of Directors. Records of contractors, manufacturers and suppliers will be kept up to date.

On the basis of the contracting system established in the organic chart, the Board of Directors will set the conditions for the calls, for bids, the price adjustments, presentation of proposals, awarding procedures, guarantees to be submitted by the bidders and contractors and any act related to the contracting in order to ensure that the interests of the enterprise and of third parties are preserved.

The Board of Directors will also establish the basis for the calls for bids, giving approval to their general and specific conditions and the particular specifications; also, the necessary documentation setting forth the related internal procedures, and setting the responsibilitis of the officials and departments involved.

The Accounting Law (Decree-Law N° 1213/60) and Public Works System (LAW N° 83) will apply in every case that is not covered in the above mentioned regulations.

12. Government control

The Government control on the administrative and accounting actions of the enterprise can be exercised by an accountant-delegate from the Province Treasury, as established in Chapter VIII of the Provincial Accounting Law, its functions being ruled by the stipulations of the organic chart of the enterprise, implemented by the Accountancy and Public Works Laws.

The duties of delegate would be:

a) Report to the Ministry of Economy and Public Works on the financial situation of the enterprise, as well as on the effects of the development of the enterprise upon the Provincial Treasury.

b) Control the development of the annual operation plans and budget in connection to the use of estimated investments and the availability of legal credits, as well as to make the controls he may judge advisable in the economic and financial aspects.

c) Check the negotiations carried out by the enterprise, directly or indirectly affecting the Provincial Treasury, as well as any modification on its assets.

d) Report on the annual balance sheets produced by the Board of Directors.

e) Report to the General Accountancy of the Province on any act or omission in opposition to the organic chart of the enterprise and relevant regulations.

f) In general, verify that the activities of the authorities and officials of the enterprise are in accordance with its organic chart and relevant regulations.

Likewise, the enterprise will have to submit annual balance sheets to the consideration of the Account Court of the Province, and afterwards to the Provincial Government.

Distribution of profits, benefits, premiums etc. that are based on the results of the operating results of the enterprise, will only be accorded once they have been fulfilled and arise from approved balances.

13. The organic chart should also provide other common regulations, as follows:

a) Declaration of public necessity on whatever goods and properties that that may be necessary for the development of its operation and subject to expropiation.

b) The power of the enterprise to cut - off the supply in the event of non payment and the right to carry out judicial compulsion in order to collect.

c) Tax exemptions.

d) The right to use and occupy the ground, underground and aerial space belonging to the provincial government and to establish rights-of-way in public and private properties.

TENTATIVE TERMS AND CONDITIONS OF AN ELECTRIC POWER SUPPLY CONTRACT BETWEEN MISIONES AND THE REPUBLIC OF PARAGUAY

Legal aspects from the standpoint of Argentine Law

Preliminary consideration - National Jurisdiction: National Law N° 15.365, ruling the legal aspects of the electric power industry in Argentina, states that energy generation, transformation and transmission fall under national jurisdiction, whenever they "entail electric power negotiations with a foreign nation". (Art. 6, par. f).

This will precisely be the inmediate purpose of the works analized in this report: the exchange of electric power - import and export - with the Republic of Paraguay. Hence, and as long as the works accomplish this end, they will fall under national jurisdiction.

This jurisdiction is exclusively aimed at the control and vigilance of the technical and economic aspects of the works and installations, and it further extends to the development and operation of the system, in accordance with article N° 11 of the aforementioned law which states that "Within the national jurisdiction scope referred to in article 6, and to the ends of this law, the National Government shall grant, prior opinion by the Federal Power Counsel, which should be produced within the term fixed in the respective by-laws, the permissions and authorizations, and shall exercise control and any other attributes inherent to jurisdictional power".

Consequently, nothing prevents the ownership of the installations and equipment by the Province of Misiones, i.e., by the provincial enterprise, as well as its responsibility for the operation and development.

In accordance with the procedures set forth by law, the projects related to the mentioned works and services should be submitted to the approval of the National Government, duly accompanied by the pertinent documentation justifying its technical and economic advantages, Prior to the decision, the National Government shall request the opinion of the Federal Power Counsel regarding the corresponding jurisdiction, which shall be produced within 90 days as from the date of presentation of the corresponding documentation. Should the Counsel not produce an opinion within the 90 days term, the National Government may act directly, unless it grants an extension upon request. (Articles 2 and 4 of Decree N° 2073/61, which regulates law 15.336).

Legal aspects of the Contract: The proposed contract for the interconnection

of the provincial electric power system with the Paraguayan system, must cover two aspects of the interconnection; imports and right-of-way for electric power This implies that the purchase of power and the operation of the operation of the system will be covered by the same contract.

In accordance with the legal powers granted to the provincial enterprise by its organic bhart, this will be entitled to enter into the aforementioned contract with the paraguayan ANDE utility, the execution of which, within argentine jurisdiction, will be subject to previous authorization by the National Government. National Power Law N° 15,336, through articles 22 and 23, regulates the import and export of electric power.

Article 22 states: "The National Government is entitled to authorize the import and export of electric power, prior definition on the maximum amount of energy to be imported or exported. The authorization will be subject to conditions and guarantees regarding the use of energy and the sale or resale prices".

Article 23 states: The authorization will have a 10-year maximum validity period, which can be extended, and can be cancelled at any time, whenever the circumstances prevailing at the time it was granted dissapear, or grave problems concerning public interest arise. Repeal will take place in case no use is made of the authorization, or nonobservance of the conditions set for the grant".

In accordance with the foregoing, the electric power exchange contract will have to contemplate the following basic requirements, in connection with argentine legislation:

a) Definition on the maximun amounts of power to be imported and/or exported, andc haracteristics of the supplying.

b) Specific indications on the use to be given to the power, i.e., whether it will be for industrial, rural and/or public service.

c) The prices of purchase, sale and resale, specifying whether these are fix or variable; in this latter case the adjustment procedure shall be defined.

d) The contract period shall not exceed 10 years; an extension may be granted upon request.

e) The National Government is entitled to revoke the authorization granted, in the following events:

1. Disappearance of the circumstances prevailing at the time it was granted;

2. Whenever grave public interests are at stake;

3. Whenever the contract is not executed and the authorization not used;

4. Transgression of the conditions agreed upon at the time the permission was granted.

The National Government is empowered by law to authorize the contracts and negotiations entered into connection with the project, national tax, exemptions (Law 15.366, art.11), according to the circumstances.

Likewise, article 12 of this law states that: "the works and installations of generation, transformation and transmission of electric power under national jurisdiction, as well as the energy generated or transported are not subject to taxation or contributions and local legislation which could limit or hamper the free operation. This exemption does not include the contributions for local services and improvements".

The contract covering the proposed interconnection, apart from the requirements established by law Nº 15.336 as detailed above - shall include other basic conditions, such as:

1. Commitment by the parties to execute the works and installations that are technically necessary for the interconnection project, within a period to be fixed.

2. The bulk supply of power generated by the Acaray Hydroelectric station, to the Misiones interconnected system, as required by the provincial enterprise, shall be used for electrical public services.

3. Establish the validity period for the contract which shall not exceed 10 years, and the possibility of extension upon request of one of the parties. Clauses contemplating the additional supply of power, according to the respective legislation in force in each country should be included.

4. The commitment by ANDE to supply power with no interruptions at the last structure of the 132 kV line located on paraguayan territory

and the Paraná river bank, in spite of labour problems, strikes and any kind of social disturbances within paraguayan territory; the supply will be in accordance with the annual figures given below, which are adjustable to cover the market development.

YEAR	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Maximum demand (MW)	14	15	17	19	22	24	26,5	20	15	10

The system load factor will be determined by the market demand prevailing conditions.

A reference power factor of 0,8 will be set for the Acaray busbars. Compensation for variations on this value will be agreed upon between the parties.

5 ANDE's commitment to maintain a constant frequency, as close as possible to 50 cycles within maximum variations of ± 1%.

6. The normal voltage of the supply at Acaray busbars shall be 132 kV, and will be adjustable between 130 and 145 kV, by steps not exceeding ±1,7% in accordance with instructions given by the enterprise.

7. Establish as point of supply the 132 kV terminals of the 220/132 kV transformer in Acaray Station. ANDE will undertake the installation and maintenance of this equipment and the transmissión line up to the last tower installed in the Paraná river bank (Paraguay side), which will be crossed at a point to be mutually agreed upon.

8. The ANDE supply will be metered in the Acaray 132 kV busbars, by means of three metering equipment, one belonging to ANDE, one belonging to the enterprise and another one for both parties.

Each metering and recording equipment for kWh, kW and KVA will be of an accuracy to be agreed upon between both parties. Reading dates and procedures shall be agreed upon.

9. ANDE will have the right of way to transmit up to 3 MW to the city of Encarnación through the Misiones interconnected system to be built by the enterprise.

The power delivered to Encarnación will be deducted from the power received by the enterprise at 132 kV Acaray busbars. To this end, metering equipment similar to the mentioned in paragraph 8 will be installed at the 33 kV feeder of the Posadas transformer substation.

10. The enterprise shall guarantee the right of way for the power supply to Encarnación, notwithstanding labour conflicts, strikes and any kind of social commotions or disturbances within Argentine territory.

11. Establishs as force majeure causes for the interruption of services, major damages and accidents on the machinery and installations, as well as earthquakes and other natural phenomena, duly verified by both parties.

Since any interruption in the transmissión through the interconnection power generation should be substituted by the reserve power stations of the system, a cost of u$s 0,025 per kWh will be established for thermal generation.

Interruptions by causes not considered as force majeure, will be subject to penalities based on a fixed charge per kW not available and another charge per kWh not supplied to be agreed upon the parties. To this end, the daily consumption for the same day one week before the interruption will be taken as reference.

The parties shall commit to repair, within the shortest possible time, damages that may occur in the installations of their respective areas, which may affect the normal service of the other party.

12. Establish rules and methods for the efficient operation of the system, including procedures for operation in parallel of the thermal reserves stations in Misiones whenever technically advisable.

13. Ownership of the installations shall be definited by the international borders of the respective countries. The span of the 132 kV line crossing the Paraná river will belong to the enterprise and the 33 kV crossing to Encarnación, will be owned by ANDE.

14. Creation of a joint arbitration technical committe for the interpretation

and solution of problems arising from the fulfillment of the contract, or resulting from interconnection operations.

15. In accordance with ANDE's declaration a minimum amount of u$s 475.000 will have to be payed per year, which will give the right to consume up to 72.700.000 kWh, Any additional power will be payed at a rate of 6,35 mills per kWh.

16. Payment for the energy supplied will be due monthly within 30 days after each reading. Delays in payment will draw interests, the rates of which shall be agreed upon.

17. The currency to be used for payments will be U.S. dollars. Paraguayan currency (Guaraní) can also be used up to 20% of the billing, at an agreed rate of exchange.

18. In the event of cancellation of the contract by one of the parties, the legislation in force in both countries shall be applicable.

VIII. COMMENTS

The present report demonstrates the feasibility of the Acaray-Misiones interconnection on the basis of the conditions set for investments, estimated power costs and prices and financial resources contemplated.

Chart V-1 shows attractive profitability figures that increase steadily along the period, except the negative result expected for the first year. Furthermore, cash-flow shown in Chart VI-3 presents no major difficulties provided the funds are supplied as foreseen.

The other alternative studied for the supply, based on the development of a diesel generating program, requires somehat lower investment during the period considered.

Nevertheless, experience in many countries has shown that local diesel generation does not promote good electrical development. It tends to fulfill inmediate needs of the areas leaving the less prosperous zones unattended, and the burden of the capital cost and upkeep of diesel plants falls heavily on small generating bodies or cooperatives with limited financial resources, thus restricting wide-spread developments.

The hydroelectric generation alternative carried out through the Yabebirí or Piray-Guazú projects examined, does not offer advantages over the above mentioned projects, owing to the high initial investments required and/or the limited existing market to ensure economical operation within the period considered. Besides, it is advisable that before a decision is made on any of these projects, further geological and hydrologic surveys should be carried out, and also examine other interesting hydro resources in the Province.

The Acaray-Misiones interconnection project offers the advantage that a high voltage interconnected system linking the most important electric power markets of the Province is built. This facilitates the future development of a centralized generation based on a hydroelectric or thermal project.

The period considered for the interconnection has been ten years, in order to take into account the availability of power in Paraguay and the limitations imposed by argentine legislations. Notwithstanding, the hydro resources and existing plans in Paraguay for a group of rivers which

are tributaries of the Paraná may render convenient the extension of the interconnection period, since this would bring benefits for both countries.

The development in the future of other hydro resources and thermal power stations on both sides of the Paraná river implies undoubtly greater safety in operation for the interconnected systems, since even if there is no permanent interchange of power, the maintenance of the interconnection means reciprocal availabitility of installed power reserve and also diminishes investments in reserves that would be necessary should the systems operate separately.

Considering that the hydraulic power cost is much lower than the thermal power cost, it is advantageous for Misiones to consider the possibility of receiving power after 1978, even if it not under a guaranted basis. On the other hand, the Argentine legislation which limits to 10 years the validity for interconnection agreements allows extensions by consecutive agreements.

It should be remarked that if a decision is made in the execution of this interconnection project, inmediate steps must be taken to cover the technical, administrative and legal aspects examined in this report, in order to complete the works before the Acaray power station is commissioned, and thus save unnecessary investments by Misiones on Diesel power stations to cover its increasing electric market.

ANNEX - HYDROELECTRIC PROJECTS

I. GENERAL

1. River regime: The rivers in Misiones are exclusively originated by rainfalls, since there are no snow embankments in the area. The catchment areas are relatively small but very active; their retention capacity is low due to the usual reduced depth of the rock layers. These reasons lead to the conclusion that the interflows and groundwaters contribute during short periods to the superficial drainage; consequently the chronological flow diagrams show large variations. Although no correlations have been made between flow rates and rainfalls due to limited or lack of adequate data, it is estimated that these correlations give high values.

   The superficial course of the rivers is generally very sinous and the length is in some cases double than the corresponding to a straight line, the great irregularity being the most remarkable characteristc; therefore, for any water development, works with high regulation capacity for lessening the irregularity are necessary needing important investments.

2. General geology: The geologic strata of the subsoil are constituted by melaphyres of the higher Triassic and associated sandstones, and the soils were originated directly by the chemical and physical descomposition of these strata.

   Geologic surveys carried out in adjacent countries demonstrate that this subsoil with melaphyres (actually included under the general denomination of basalts) extends over an area of about 1.000.000 square kilometers comprising vast areas of Brazil, Uruguay and Paraguay.

   In these countries there are many hydraulic works with foundations upon this typical basalt stratum, the stability and safety of which has been widely proven. Some of these works are: Rincon del Bonete, in Uruguay, and the dams on the upper Paraná River which have been designed by Brazil.

   The geologyc data of the subsoil derive from drillings and test pits made at different places and times. Many of these drillings made for surveys have produced coincident data which constitute an appropiate guide for the general research work.

This subsoil, which is of volcanic origin, is now almost wholly covered by a superficial layer of red earth or laterite. Its brown colour is characteristical of the decomposition of rocks with a high content of iron ores.

Rocky outcrops originated by erosion are common, and the erosion action is particularly noticeable in river basins where the waters have excavated the bedrocks in soft rocks and even in rocks of modern formation.

3. Climate: The climate all over the area is warm-moderate and humid, with noted summers and winters. The average temperature in the coldest month is about 14 degrees centigrade and in the warmest month is about 25 degrees centigrades; however, frosts with temperatures below zero degrees centigrades have been recorded, especially in the plateau and at mediterranean borders. Rains amount to above 1.000 millimeters per year inland; in the marginal zones (Sierra del Imán) rains are heavy - between 1.400 and 2.200 millimeters.

The weather Charts of the National Meteorologyc Bureau show that the rainfalls occur when hot masses of air from N.E. encounter cold winds from the south; usually the collision is down south, over the provinces of Corrientes and Santa Fé, and the wind fronts rotate around a center situated in Brazil or in the Atlantic Ocean.

The information that was available on weather and rate of flows when the preliminary designs were carried out, was taken from records of about 50 rainfall gauging stations belonging to the Weather Bureau, some of which have already been shut down and others suffer interruptions during long periods.

Agua y Energía Eléctrica de la Nación (National Water and Power Board) has installed a permanent stream-gauging station in Colonia Mártires and twelve hydrometric stations which make occasional gaugins.

4. Objects of the Hydraulic developments: Present conditions in Misiones justify the appraisal of possible developments of hydraulic power for electric generation.

The development of hydraulic works for irrigation has not been considered up to present, although it does not mean that this is not feasible.

Future agricultural-economic studies may show the convenience of such developments for present types of cultivations or others of different kind.

It is also possible that drinkable water could be obtained from the works, even if these are mainly intended for other purposes.

Other objects, such as flood control, navigability, tourism, fishing etc., have not been considered economically feasible up to the present, which does not mean that these objects may become important in the future.

Consequently, for the time being, the cost of hydraulic works must be charged to power production only. Future considerations may vary this criterion.

II. PIRAY-GUAZU PROJECT

1. Basic Data: The basic data for this project is as follows: Location: On the Piray-Guazú river, 6 kilometers south of Eldorado town - Province of Misiones.

Present conditions: Advanced preliminary design by INCONAS (Associated Consulting Engineers) - Córdoba.

Date of the preliminary design: August, 1962

Object: Hydroelectric development exclusively

General characteristics:

Catchment area: 2,390 square kilometers
Average flow: 33,8 cubic meters/sec
Maximum recorded flow: 2,420 cubic meters/sec (April 4, 1956)
Volume of the reservoir: 757 cubic hectometers.
Area of the reservoir: 4,247 Hectares
Sidementation: Has been calculated in 2 kilograms per cubic meter, using same figures as for the Yabebirí project.
Evaporation looses: Have been calculated in 1,230 millimiters per year, using theoretical formulas. Annual volume: 1,67 hectometers.

Dam: Buttress type with flat deck, Ambursen type. Buttresses spaced 12 meters appart.
Maximum height over the river bed: 72 meters.

Length of the top: 444 meters.
Foundation grounds: Basaltic rocks of modern formation.
Spillway: Separate from the dam, located 1700 meters northwards. Creager section designed for maximum flood of 2.480 cubic meters per second. Spillway capacity 975 cubic meters per second with nappe of 2.44 meters. El 167 meters.

Materials for the construction of the dam: Coarse crushed aggregate of basaltic rock from quarries adjacent to the dam site. Possibly also some material from the foundation works. Sand from possible deposits in the Paraná river, which is at a distance of about 30 kilometers from the dam site. Cement from the mill located in Paraná (Entre Ríos).

Volume of concrete: 234.000 cubic meters.

Hydraulic power station: Located at the foot of the dam.
Installed capacity: 35 MVA including reserves.
Francis turbine with vertical shaft
Annual production capacity: 115 GWH
Annual energy delivered (at 13.2 kV busbars of distributing bodies): 98 GWH
Maximum gross head: 71 meters.
Annual average head: 65 meters.

Intake and forced ducts: The intake is situated on the deck, with sliding gates. The two forced steel ducts are of 2,500 and 2.200 milimetres diameter and are embedded in the concrete between two buttresses.

Total cost: Actualized to February 1965 of all the civil works, power house, electrical and mechanical equipment up to the 13,2 kV busbars excluding the transformer equipment but including 8% for Management and Inspection: u$s 13.542.540.-

2. Considerations: For the existing preliminary desing, the criterion used has been to generate maximum power under acceptable economic conditions, rather than obtaining lowest cost of kWh generated.

For determining the rates of flow, the designers had not available direct gauge measurements but on the other hand limnimetric records existed - corresponding to the crossing of road N° 12 with the river, from July 1951 through January 1961. By means of longitudinal and transversal sections made by the designers and using hydraulic equations, the flows corresponding to different depths were calculated, relating them afterwards

to the readings of the scale. The flows for 1953 through 1958 where thus calculated, since for these years the available data was complete. A mean flow of 31,8 cubic meter per second was determined. The design of the project and estimation of power production has been based on the data for these six years.

The diagram of chronological flows was made, which shows the remarkable irregularity of the river, with flows of 0,200 cubic meters per second in some months and monthly maximums of 128 cubic meters per second. These values correspond to the place of the scale, while at the dam site the mean flow is somewhat higher (33,8 cubic meters per second).

Unfortunately, the lack of meteorological data has not allowed to made correlations with rainfalls in order to obtain a wider range of flows.

The maximum flood was determined by application of the value of maximum probable rainfall obtained by means of empirical formulas. The most unfavourable rainfall was determined by approximate calculation for 12 hours, obtaining a total of 270 millimeters which were distributed in a triangular configuration with a maximum after 2 hours.

The rational method was used for determining spill surfaces and drainages, drainage coefficients and finally the flows, which were traced graphically obtaining a maximum of 2.650 cubic meters per second. It should be noted that the calculation of the spillway for the flood was dividied in periods of 4 hours each, during which the flow is assumed constant and equal to the average. For this reason the maximum value determined by this method was 2.480 cubic meters per second.

Evaporation: No direct measurements were made, but by application of the Lugeon and Meyer formulas, a corrected average value of 1.230 millimeters per year was obtained, which would mean a loss of 43 cubic Hectometers per year (for reservoir at El. 65 meters head), equivalent to 4% of the volume of annual contribution.

Sedimentation: No direct measurements were made, and the value of 2 kilograms per cubic meter estimated for the Yabebirí project was adopted, which gives an annual volume of 1,67 hectometers, and 167 Hectometers in 100 years, which would be the dead storage capacity of the reservoir.

The geological surveys determined the existence of basaltic rocks (melaphyres) suitable for the foundation of the dam. Chemical

and microscopic analyses of rock samples were made, which confirmed its good characteristics Test drillings were made at the dam site, to depths about 3 meters until encountering the rock.

No geologic faults have been determined at the selected site for the dam.

No surveys have been made at this stage on underground waterflows or determinations on the permeability of the reservoir which should be determined later.

Selection of the type of dam: The following alternatives were considered:

a) Rock-fill dam: discarded-considering that the rocks for the core could desintegrate due to the action, of atmospheric agents.

b) Earth dam" discarded-due to the lack of suitable materials for the construction.

c) Masonry dam-or-Arch dam: discarded-since the chord-height ratio did not comply with values recommended by the practice.

d) Gravity dam: discarded-due to the large volume of material needed for the construction.
Finally, the Ambursen type was chosen as the most convenient solution.

With an annual flow of 30 cubic meters per second and an average useful head of 65 meters, the calculated gross annual production of energy is 129 GWH. The net energy delivered to the power station busbars will be 115 GWH.

The following values of gross production result from the gauge data available for the aforementioned period of six years.

Maximun gross production" 188 GWH (44 cubic meters per sec.)
1,46 times the production calculated
Weighted average production" 121 GWH (28,44 cubic meters per sec.)
0,94 times the production calculated.
Maximum gross production: 98 GWH (23 cubic meters per sec.)
0,76 times the production calculated.

The production at full utilization is 288 GWH, i.e., 1,78

times the production calculated, which value represents an utilization factor of 0,56.

Influence of the Paraná River floods: The site chosen for the hydroelectric power station, on the Paraná River, near the mouth of the Piray-Guazú river, is situated in a zone of the river which is directly influenced by the floods of the tributary river. According to data available for the 1901-1958 period the average of maximum floods is 80 centimeters above the river bed at the site. The maximum flood recorded was 12,40 meters in 1905.

The works shall be duly protected against these over-floods and it is foreseen that the average production of power will not be affected.

The cost of the project has been actualized to February 1, 1965, taking into account the prices for materials, labour, transports, fuel and lubricants, indirect expenses, spares, etc.

COST OF THE POWER

In order to calculate the cost of power, the investments on civil works, expropiations and electrical and mechanical installations were taken into account. A useful life of 50 years was considered for the civil works and 35 years for the installations. The operation and maintenance expenses were estimated at 0,5% for the civil works and 2% for the installations. An interest rate of 6% and an annual production of 98 GWH have been considered.

The investments are:

Cost of the civil works	u$s 8.493.063.-
Cost of expropiations	" 733.321.-
Cost of electrical and mechanical equipment	" 4.317.740.-

Using the above values, the resulting annual cost of power is u$s 1.012.066.- and a unit cost of 0,0103 u$s/kWh.

III. YABEBIRI DEVELOPMENT

1. Basic data: The basic data for this project is as follows:
Location: 2,3 kilometers downstream of the confluence of the Chapas and Yabebirí rivers, at a distance of 27 kilometers from Oberá and 62 kilometers from Posadas.
Antecedents: Preliminary design by Agua y Energía Eléctrica
Date of the preliminary design: July 1958
Object: Hydroelectric development exclusively.
General characteristics:

Catchment area: 630 square kilometers at the dam, and 650 square kilometers at the gauge station.
Average flow: 11,986 cubic meters per sec. for the period 1952-1962
Maximum instantaneous flow: 280 cubic meters per sec. (September 3, 1964).
Maximum daily flow; 256 cubic meters per sec. (June 13, 1955) -
Volume of the reservoir: 478 cubic Hectometers; useful volume 400 cubic Hectometers.
Surface of the reservoir: 4.150 Hectares at top level and 3.660 at storage level.
Sedimentation" Maximum value-0,436 kilograms per cubic meter.
Value adopted for calculations: 2 kilograms per cubic meter.
Evaporation looses: have been disregarded.

a) Front sealing of 1.203 meters by means of two gravity dams - one at each end - of 119 meters and 75 meters. Maximum height - 6 meters above the foundation - 115 elements of round-heads and buttress - distance between axes - 9 meters. Maximum height over foundations : 49 meters.

b) Creager type spillway between the Nº 3 and Nº 4 round - heads - 5 - openings of 7 meters each with gates of 2,80 meters height - Sole piece - level 161,5 meters - Spill capacity at El. 166,73 meters: - 890 cubic meters per sec.

c) Top at El. 167 meters - 4,40 meters wide with a 3 meter wide path. In order to enable better transit, 2 short sections of 6 meters width, in the zone of the dam with round-heads are considered.

d) Minimum El. 148 meters - with 78 Hectometers storage capacity. Maximum normal storage capacity at El. 164 meters: 480 Hectometers.

e) Intake on right enbankment. Opening of 3 meters by 4,50 meters protected by means of screens and a gate.

f) Tunnel - 5 meters diameter, 654 meters long. It divides in 3 tunnels of 2,90 meters diameter up to acumulative distance of 720 meters - Protected by steel tubing in a total length of 151 meters.

g) Surge tank at 570 meters acumulative distance. Differencial type.

Foundation grounds: Basaltic rocks of modern formation.

Materials for the construction of the dam: Coarse crushed aggregate of basaltic rocks from quarries adjacent to the dam site. Possibly also some material from the foundation works. Sand from possible deposits in the Paraná river, which is at a distance of about 30 kilometers from the dam site. Cement from the mill located in Paraná (Entre Ríos).

Volume of concrete: 255.000 cubic meters.

Total cost: The total cost has been actualized to February, 1965, for the civil works, power house, electrical and mechanical equipment up to 13,2 kV busbars, exclusing transformer equipment, but including 8% for Management and Inspection: u$s 13.675.480.-

2. Considerations: For the existing preliminary design the criterion used has been to generate the maximum power utilizing the waters of the Yabebirí river, at a reasonable cost.

For determining the rate of flow the designers had available hydrometric observations and stream-flow gaugins made at the Agua y Energía Eléctrica station in Colonia Mártires between July 1951 and May 1958, calculating the volumes discharges fortnightly.

With the data obtained, the diagram of chronological flows was made, which shows two periods of floods (autumn and spring) and two periods of low waters (summer and winter) with remarkable irregularity: fortnightly minimums of 1 cubic meter per sec. and maximums of 77 cubic meters per sec.

For the 1952/1957 period, the resulting mean flow was 14,232 cubic meters per sec.

Data obtained from the Agua y Energía Eléctrica gauge

station for 1952/62 give a mean flow of 11,986 cubic meters per second.

The designers compared the annual mean flows obtained for the 1952 - 1958 period with the rainfall gauge records of several stations in the south of the province during the 1935 - 1957 period, finding for the coincident period of years a reasonable concordance. The gauge period was the one with less rainfalls.

Data on a sufficient number of floods was not available in order to determine directly the maximum probable flow by application of the usual statistical methods. On the basis of records from 10 rainfall - gauging stations, a value of 1.450 cubic meters per sec. was obtained.

Evaporation: No direct determinations were made, and the figure adopted was 4 milimeters per day.

Sedimentation: Some measurements were made with low floods. The maximum value obtained was 0,436 kilograms per cubic meter. A value of 2 kilograms per cubic meter was adopted in order to take into account contributions floods over 100 cubic meters per sec. The value of 2 kilograms per cubic meter gives an annual volume of 0,7633 cubic Hectometers per year and 76,33 cubic Hectometers in 100 years.

Geology: The dam foundation shall be on melaphyres of very good - characteristics. The facing ramified diaclases (diaclasas de enfrentamiento ramificadas) do not extend downwards and will beperfectly sealed by injection. Horizontal planes of diaclases that could facilitate sliding are not considered probable, according to the samples extracted from the drillings. The survey in the zone for the tunnel indicate the existence of a zone of columner melaphyre of transition columnar-cavernous. The foundation of the power house shall be on columnar melaphyre and the spillway on melaphyre rock.

The survey in the quarry indicated the existence of columnar melaphyre of very good characteristcs which shall produce stones of suitable dimensions.

In general the geologyc conditions in the site are very good. Apparently there are no faults or outcrops that could bring special problems.

Alternatives considered: Four possible sites were - studied in a river section 18 kilometers downstream the confluence - of the Chapa and Yabebiri rivers. Finally, the site located at 3,1 km. was chosen.

Storage capacities of 100, 200, 300, 400 and 500 useful cubic Hectometers were studied at the chosen site.

The storage capacity of 400 Hectometers was finally - chosen. Selection of the type of dam: The following alternatives, were considered:

a) Earth dam: Discarded-since the large volume of material (4.000.000 cubic meters) that would be necessary for the construction, should be transported from other zones. (There are no suitable materials in the zone).

b) Rock-fill: Discarded-because the diaclases would break easily on - throwing the rocks, producing large quantities of flagstones.

c) Gravity concrete dam: Discarded-since the width is too large.

d) Concrete dam: A concrete dam, of the round-head type was selected, due to economic reasons.

Power production: For the design, assumption has been made that 75% of the total power will be produced with a discharge equal to the regulated mean flow (average power production 39,649 GWH) and 25% with 60 cubic meters per sec. (power production 37,083 GWH). The resulting annual average power production is 39 GWH.

The power at normal maximum level is 20.784 kW and at normal minimum level is 13.104 kW.

Actualization of costs: The criteria used for the Piray Guazú project was al- also used.

Cost of the power: (Yabebirí) Using the same coefficients as for the Piray Guazú project, the costs for the Yabebirí project are as follows;

Cost of the power

Using the same figures as for Piray-Guazú, and with the following costs:

Cost of civil works	u$s 10.407.583.-
Cost of expropiations	" 100.485.-
Cost of electrical and mecha- nical equipment.	" 3.266.914.-

for an annual production of 39 GWH the resulting unit cost is 0,0259 u$s/kWh.

IV. IGUAZU HYDROELECTRIC POWER STATION

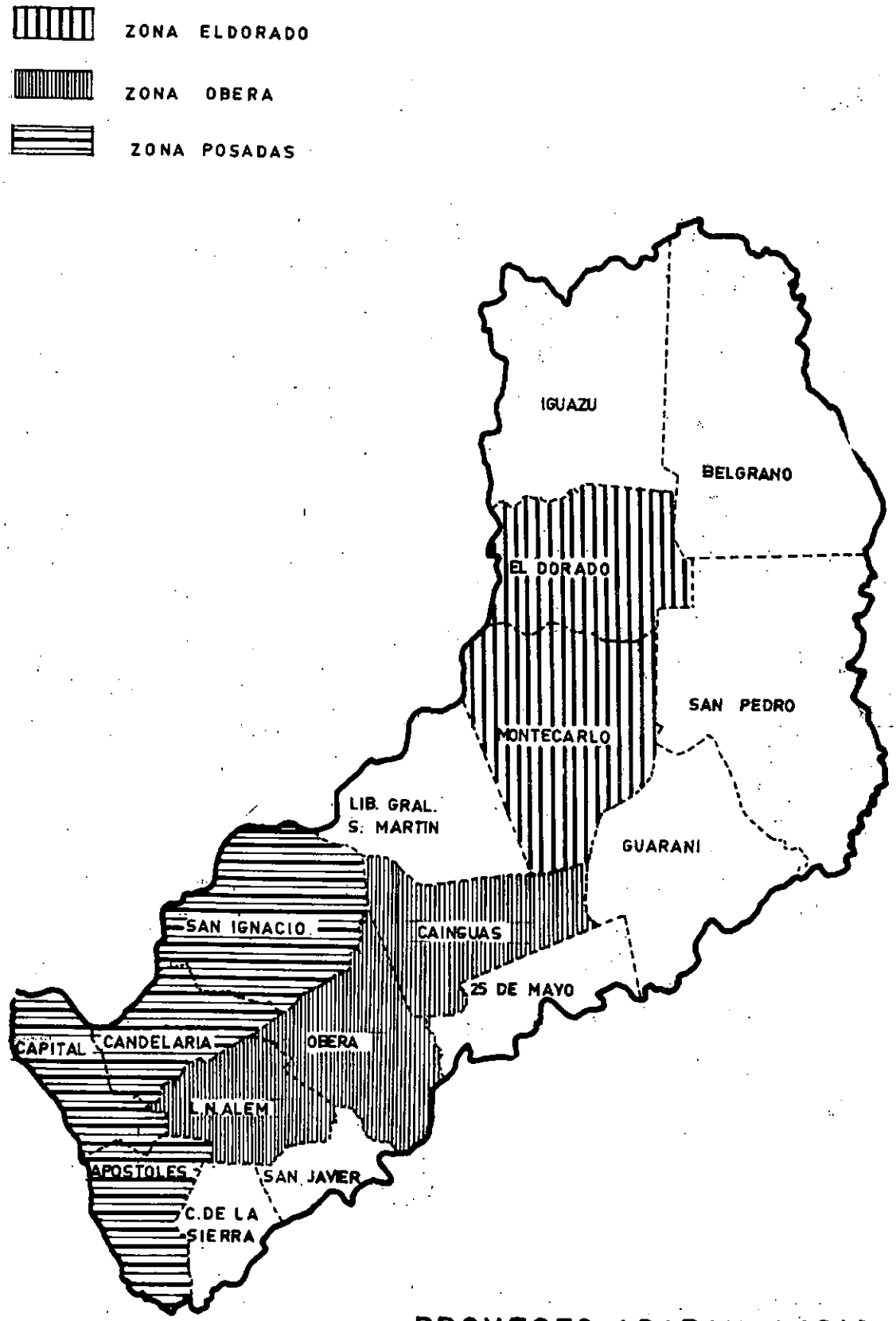
There is a preliminary design for a non-regulated hydroelectric power station located near the Iguazú waterfalls, using 60 cubic meters per sec. (15% of the minimum minimorum) flow. The actualized cost would be about u$s 4.566.200.-, with an installed capacity, without reserve of 14 MW and an annual base production of 122 GWH (Production calculated for 8760 hours per year).

This preliminary design was prepared by Agua y Energía Eléctrica in 1951 and will require a thorough study if it is carried out, and a relocation of some installations will be necesary since some other works, like an airport, have been built in the place.

Use of this river flow can be made taking into consideration the interests of Brazil.

V. OTHER SOURCES FOR HYDROELECTRIC GENERATION

Other possible hydro developments are indicated in the table attached.



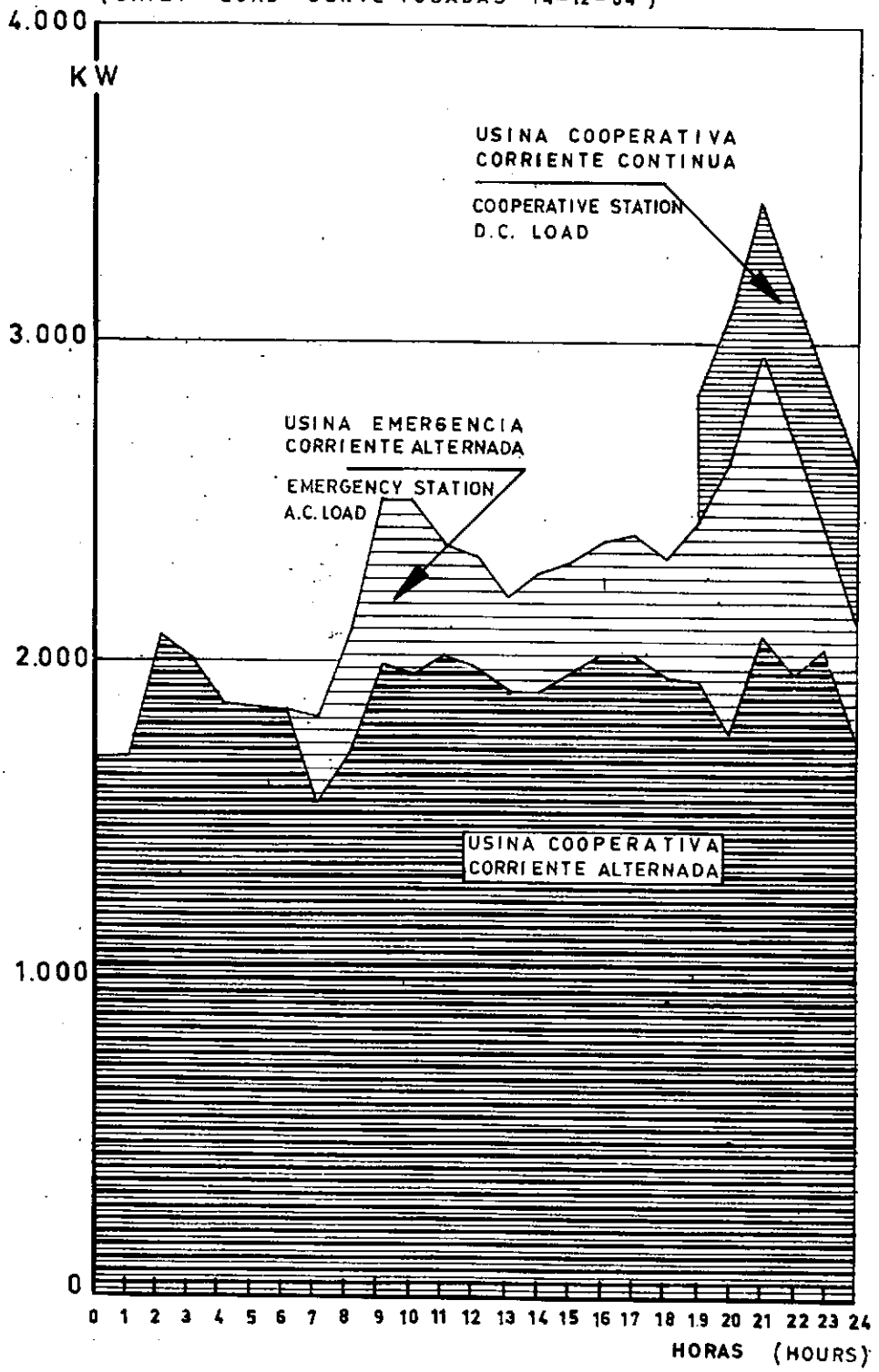
PROYECTO ACARAY - MISIONES

DEPARTAMENTOS INCLUIDOS EN EL MERCADO

(AREA OF POWER SUPPLY)

DIAGRAMA DE CARGA TOTAL DE POSADAS CORRESPONDIENTE AL 24-12-64

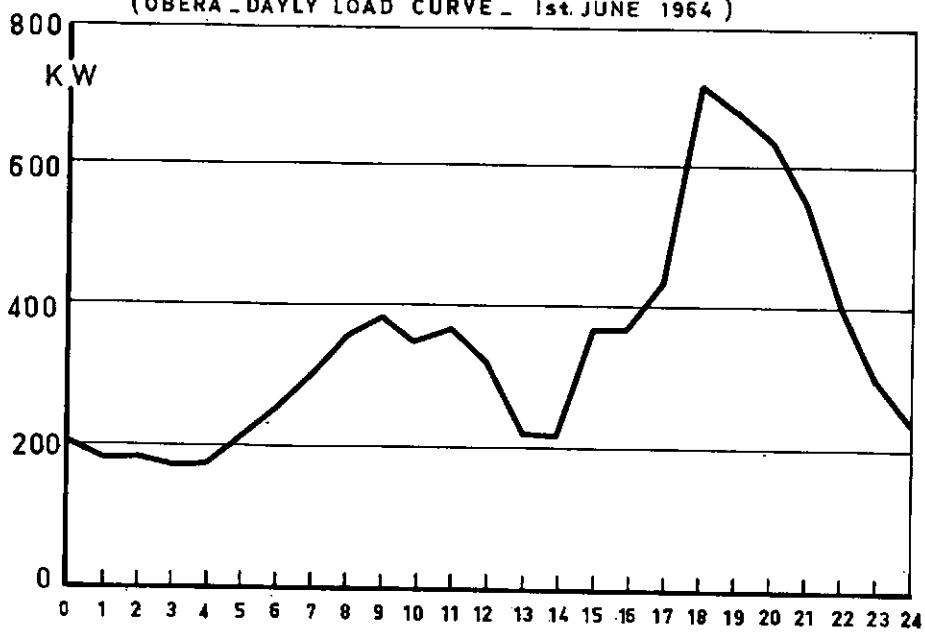
(DAILY LOAD CURVE POSADAS 14-12-64)



COOPERATIVA ELECTRICA _ OBERA

DIAGRAMA DE CARGA DEL 1º DE JUNIO-1964

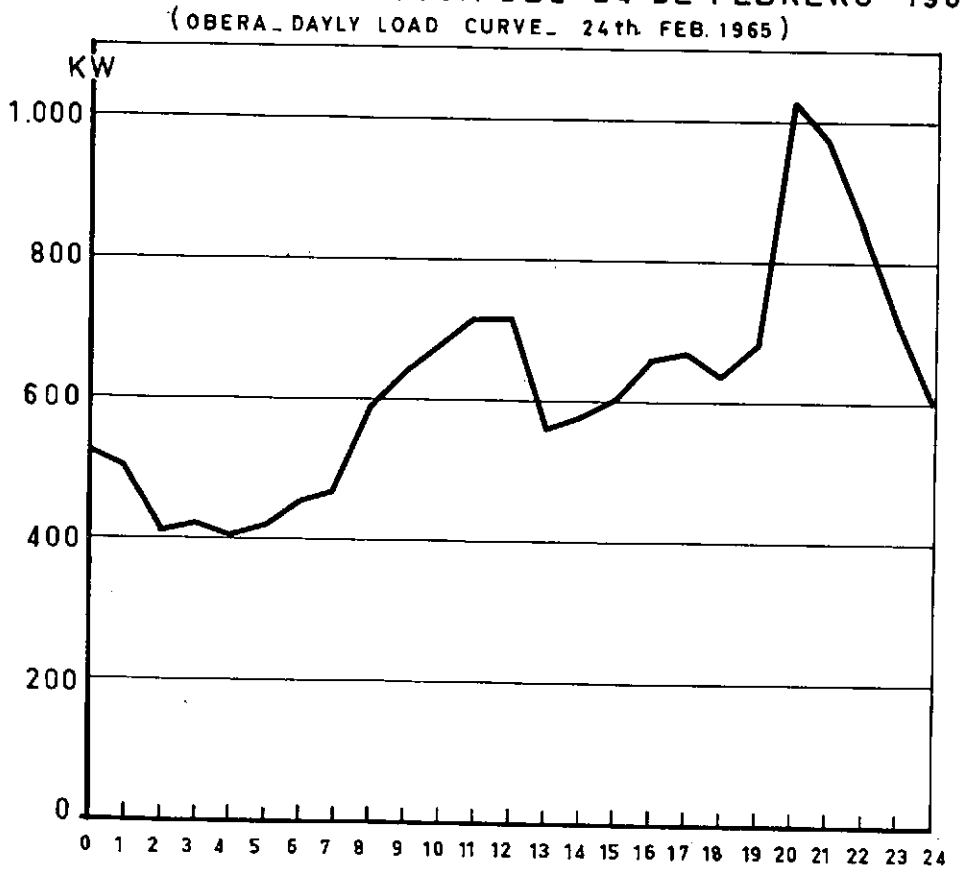
(OBERA _ DAYLY LOAD CURVE _ 1st. JUNE 1964)



COOPERATIVA ELECTRICA_ OBERA

DIAGRAMA DE CARGA DEL 24 DE FEBRERO - 1965

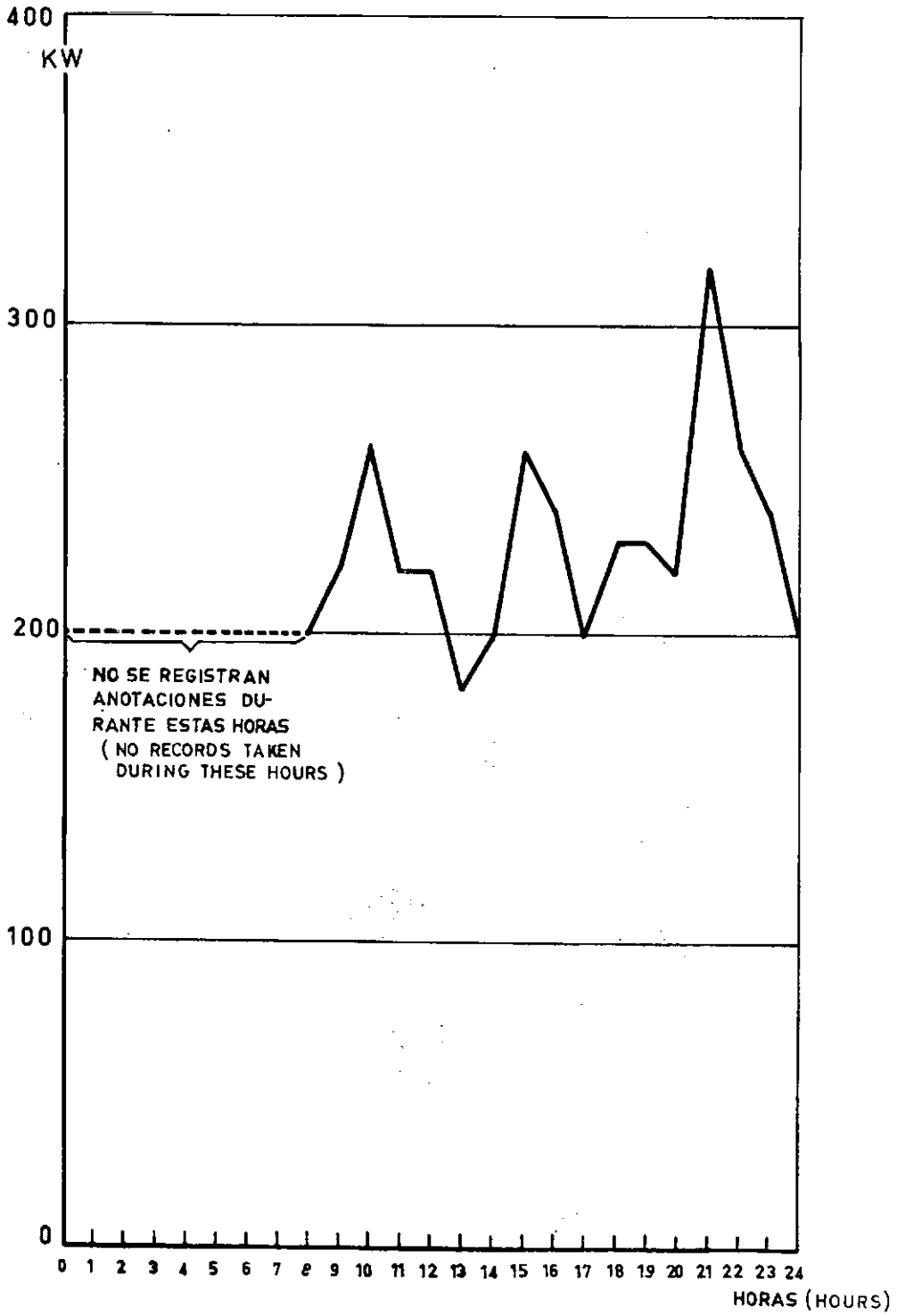
(OBERA _ DAYLY LOAD CURVE _ 24th FEB. 1965)



COOPERATIVA ELECTRICA L.N. ALEM

CURVA DE DEMANDA CORRESPONDIENTE AL DIA 10 - 2 - 65 (MIERCOLES)

(ALEM _ DAILY LOAD CURVE _ 10th. FEB. 65. WEDNESDAY)



EVOLUCION DE LA POBLACION PROVINCIA DE MISIONES

(POPULATION _ MISIONES PROVINCE)

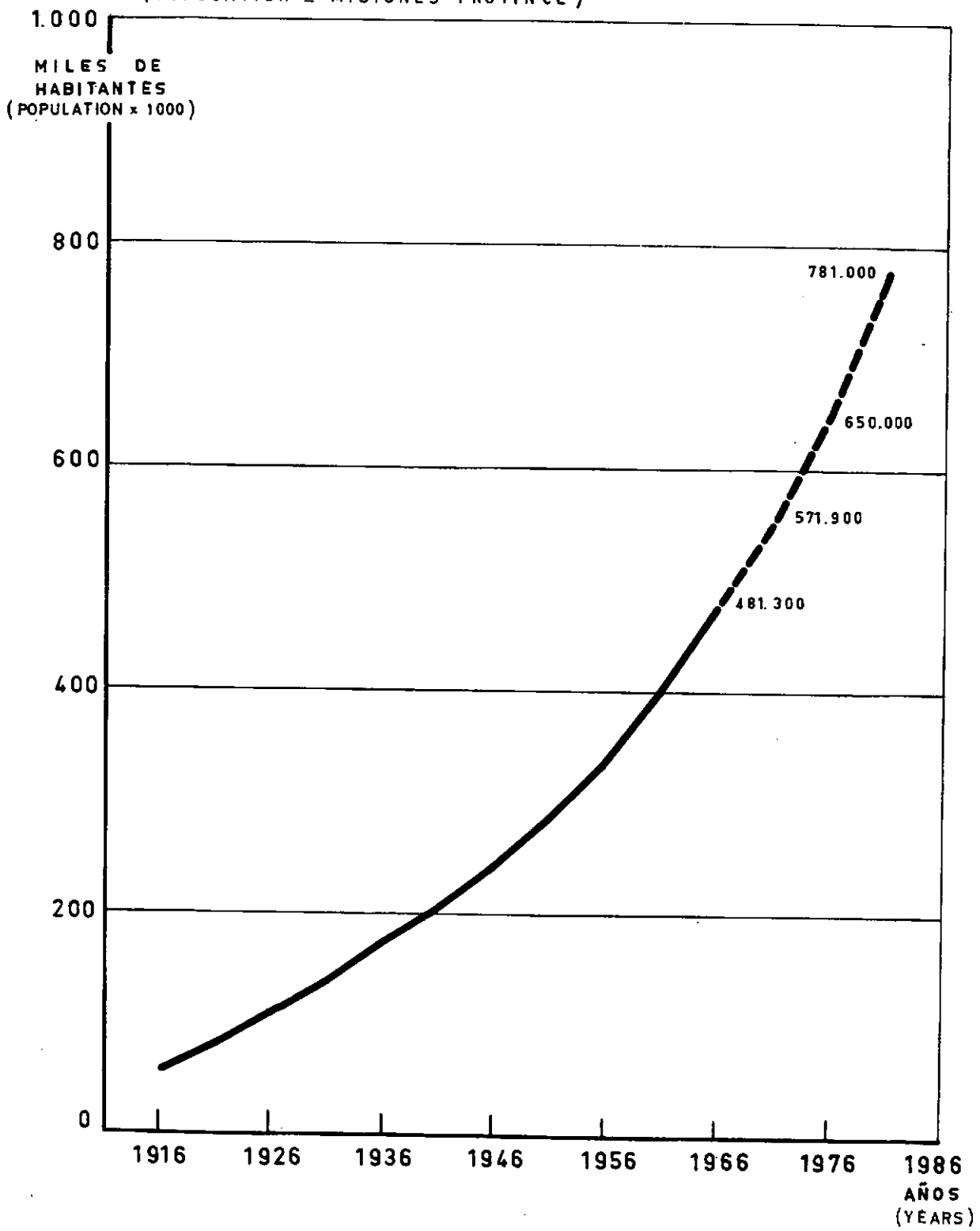


GRAFICO Nº

EVOLUCION DE LA DEMANDA HISTORICA DE ENERGIA ELECTRICA EN MISIONES

(ENERGY CONSUMPTION_ MISIONES PROVINCE)

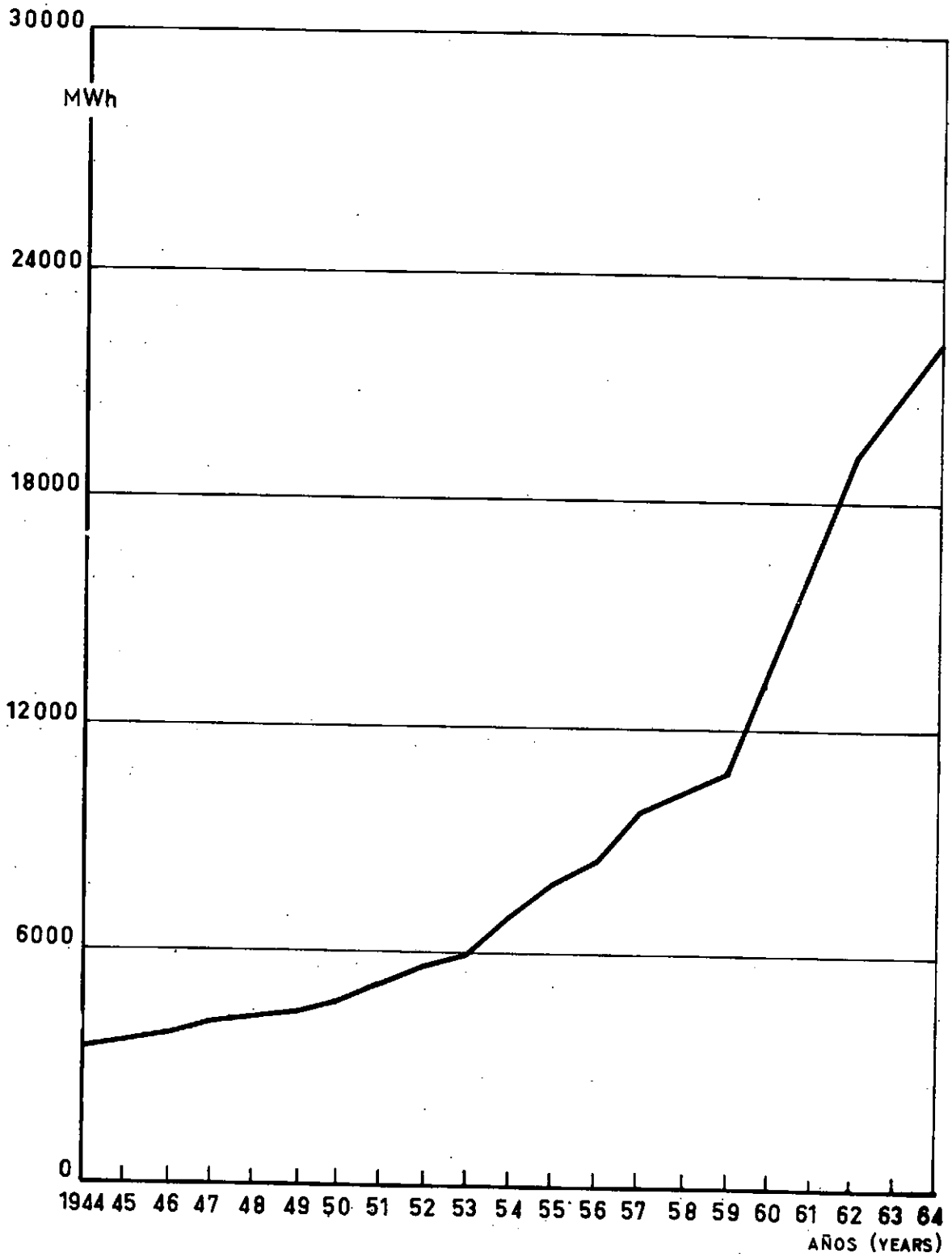


GRAFICO Nº 7

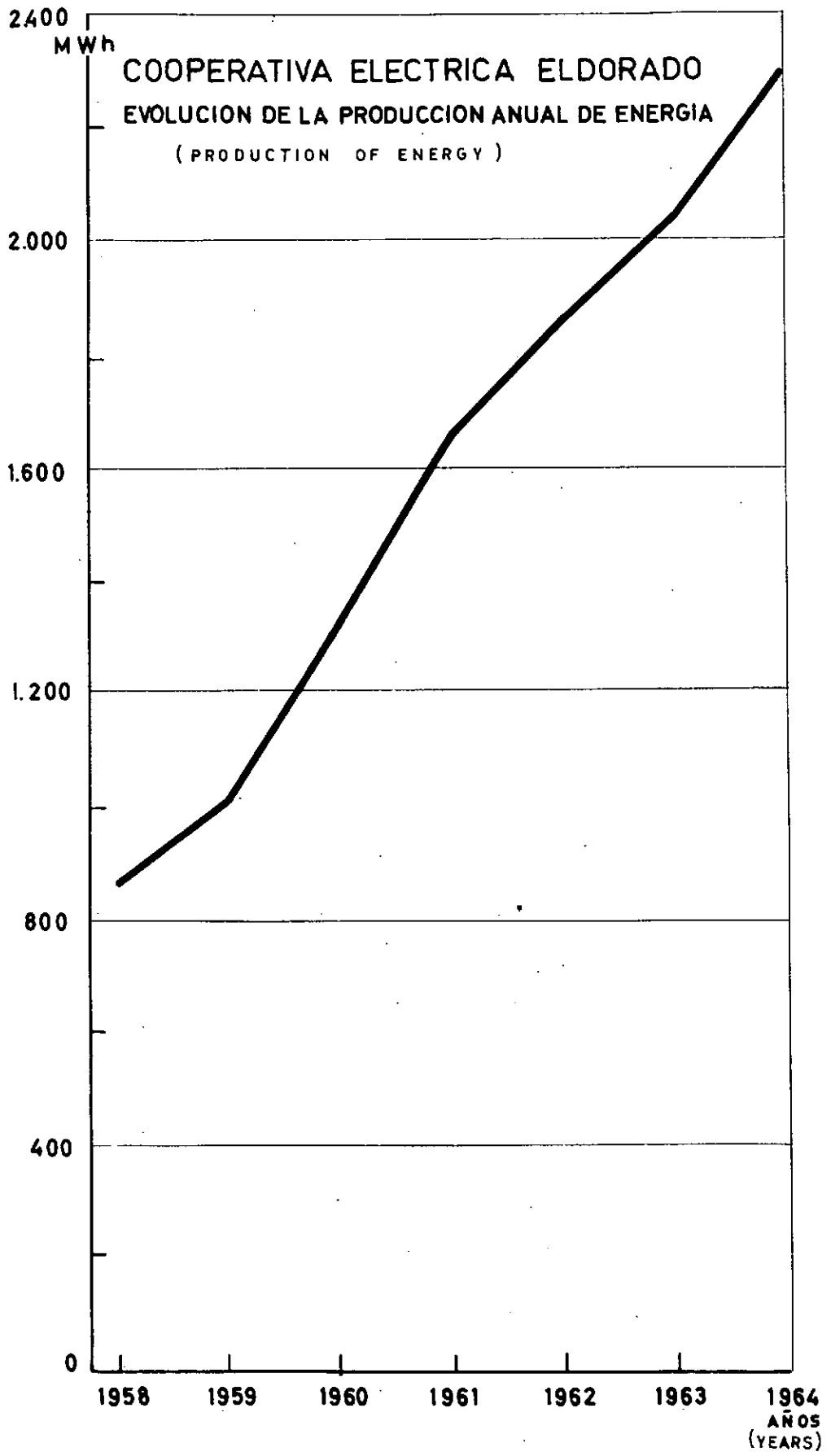

2400
MWh
COOPERATIVA ELECTRICA ELDORADO
EVOLUCION DE LA PRODUCCION ANUAL DE ENERGIA
(PRODUCTION OF ENERGY)
2.000
1.600
1.200
800
400
0
1958
1959
1960
1961
1962
1963
1964
AÑOS
(YEARS)

GRAFICO Nº 8

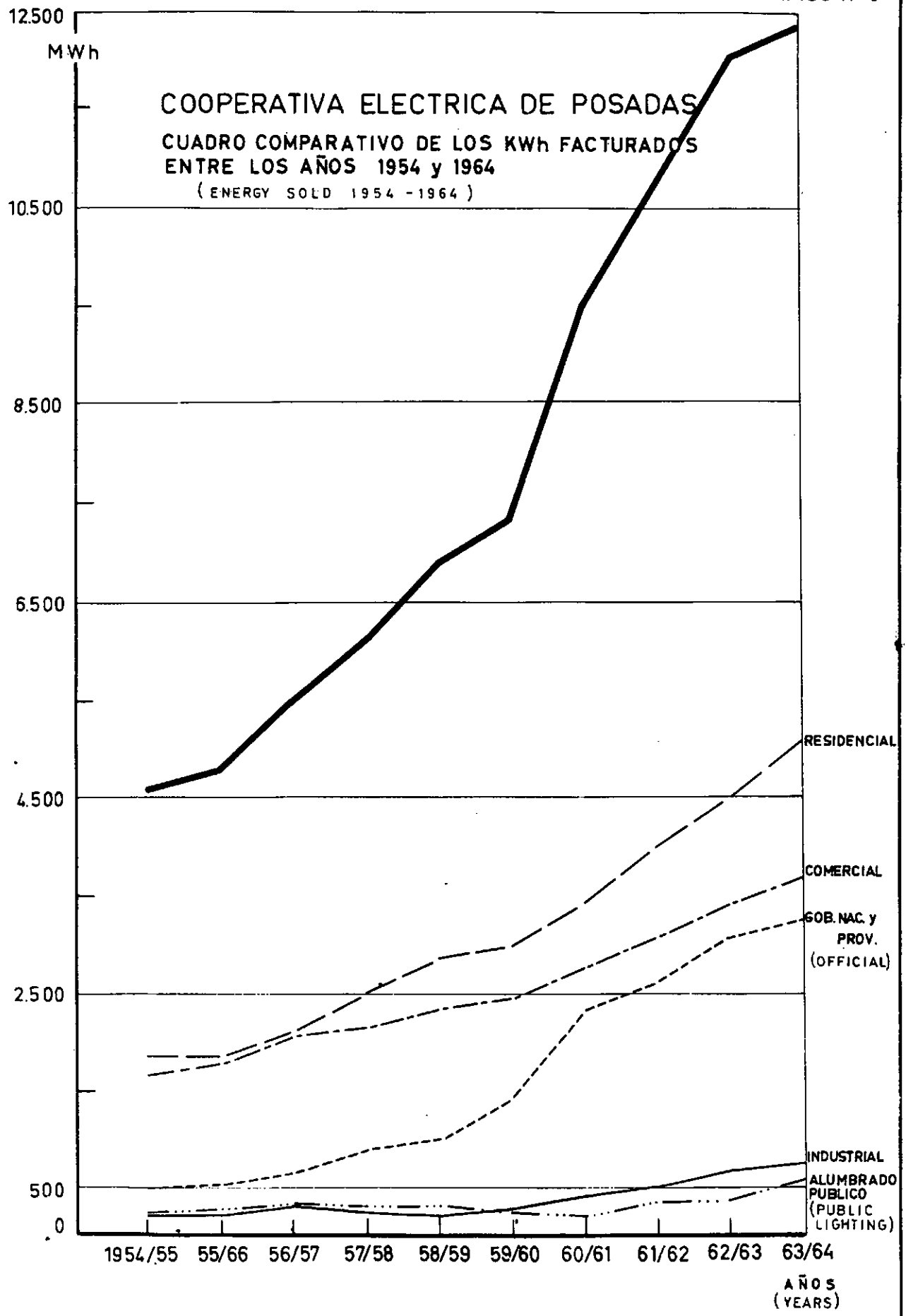

12.500
MWh
COOPERATIVA ELECTRICA DE POSADAS
CUADRO COMPARATIVO DE LOS KWh FACTURADOS
ENTRE LOS AÑOS 1954 y 1964
(ENERGY SOLD 1954 - 1964)
10.500
8.500
6.500
4.500
2.500
500
0
RESIDENCIAL
COMERCIAL
GOB. NAC. y PROV. (OFFICIAL)
INDUSTRIAL
ALUMBRADO PUBLICO (PUBLIC LIGHTING)
1954/55
55/66
56/57
57/58
58/59
59/60
60/61
61/62
62/63
63/64
AÑOS
(YEARS)

GRAFICO Nº 9

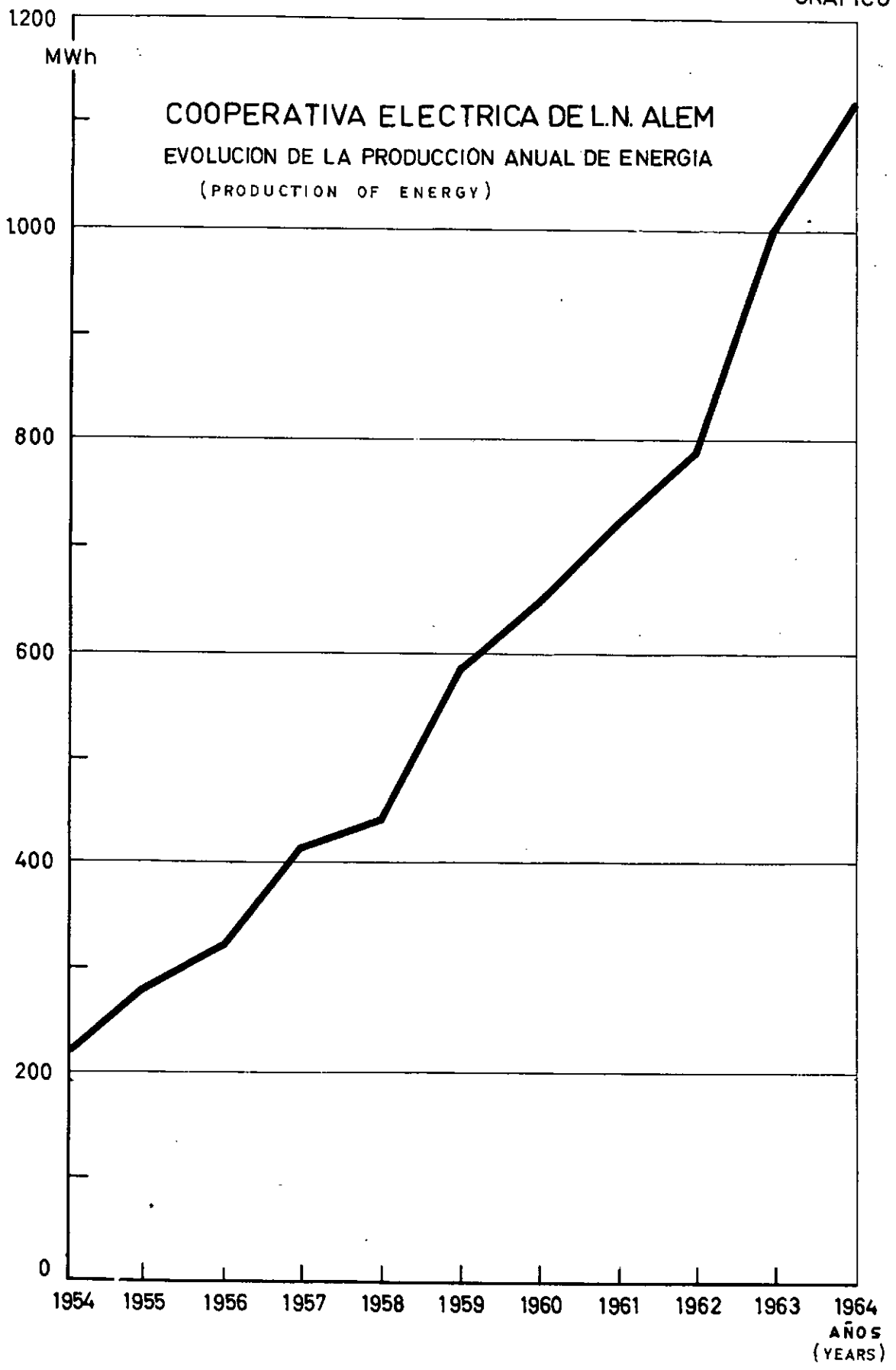
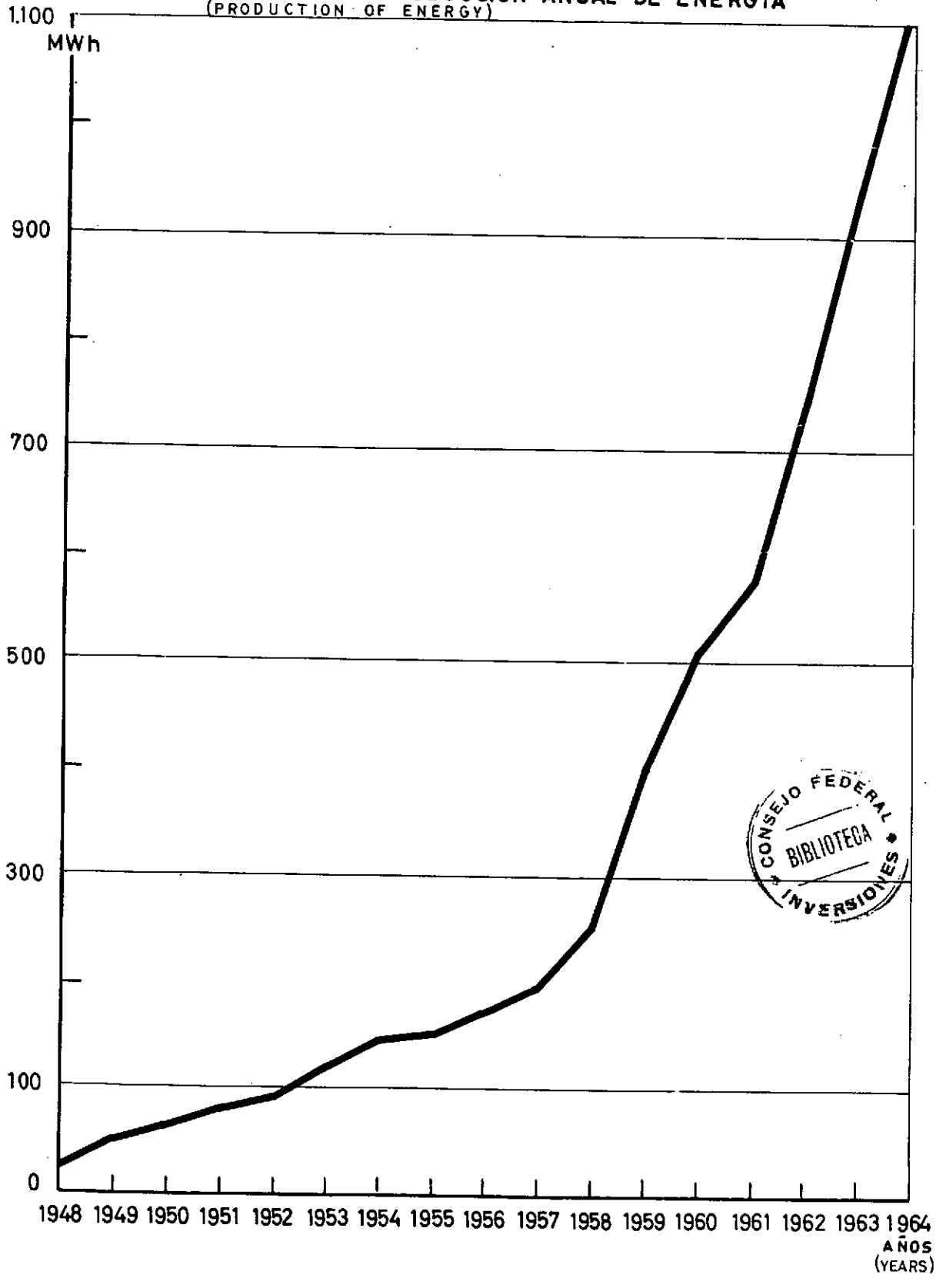

1200
MWh
COOPERATIVA ELECTRICA DE L.N. ALEM
EVOLUCION DE LA PRODUCCION ANUAL DE ENERGIA
(PRODUCTION OF ENERGY)
1000
800
600
400
200
0
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
AÑOS
(YEARS)

GRAFICO Nº 10

COOPERATIVA ELECTRICA DE MONTECARLO

EVOLUCION DE LA PRODUCCION ANUAL DE ENERGIA

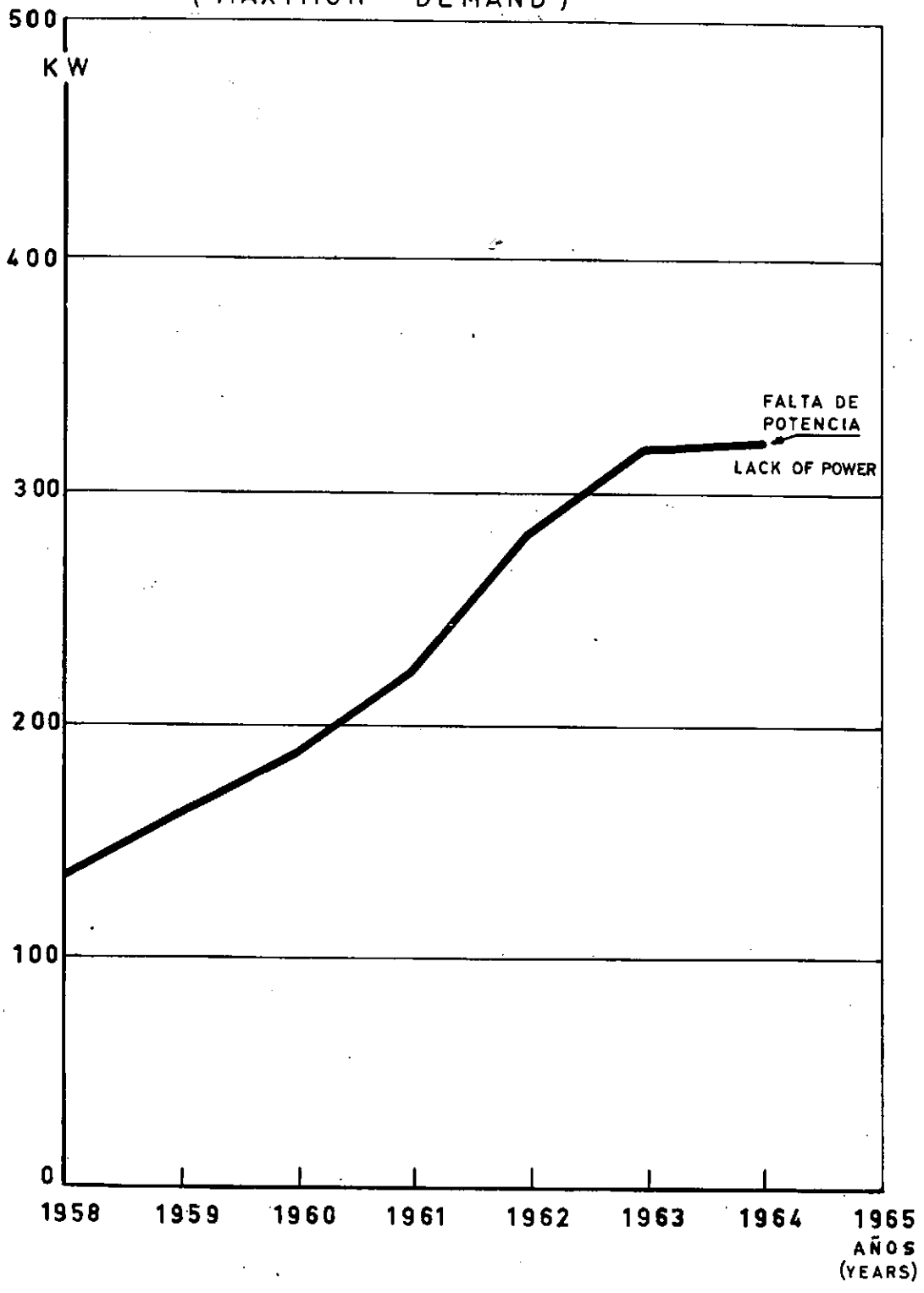
(PRODUCTION OF ENERGY)



COOPERATIVA ELECTRICA MONTECARLO

EVOLUCION DE LA DEMANDA MAXIMA ANUAL DE POTENCIA

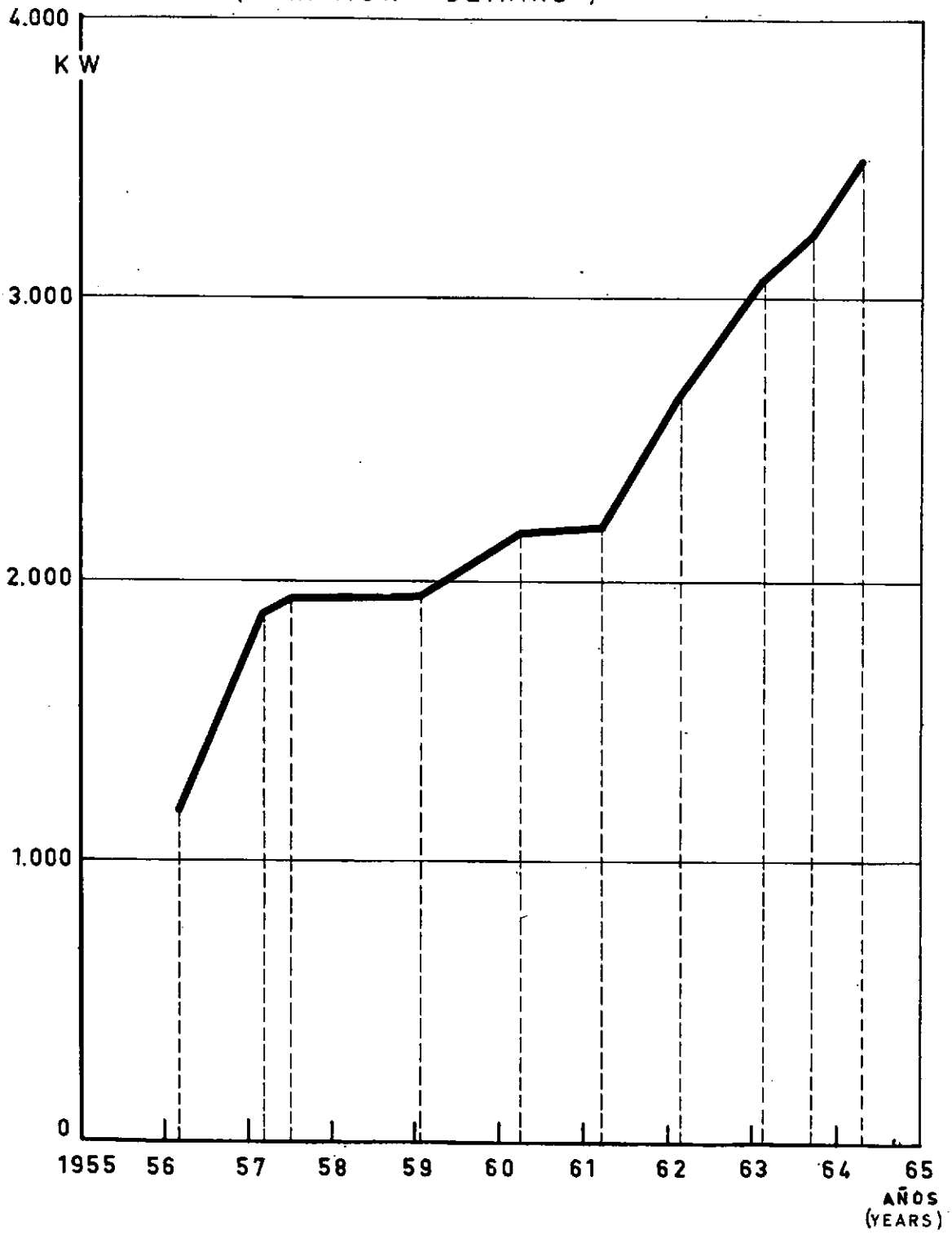
(MAXIMUM DEMAND)



COOPERATIVA ELECTRICA POSADAS

EVOLUCION DE LA DEMANDA MAXIMA ANUAL DE POTENCIA

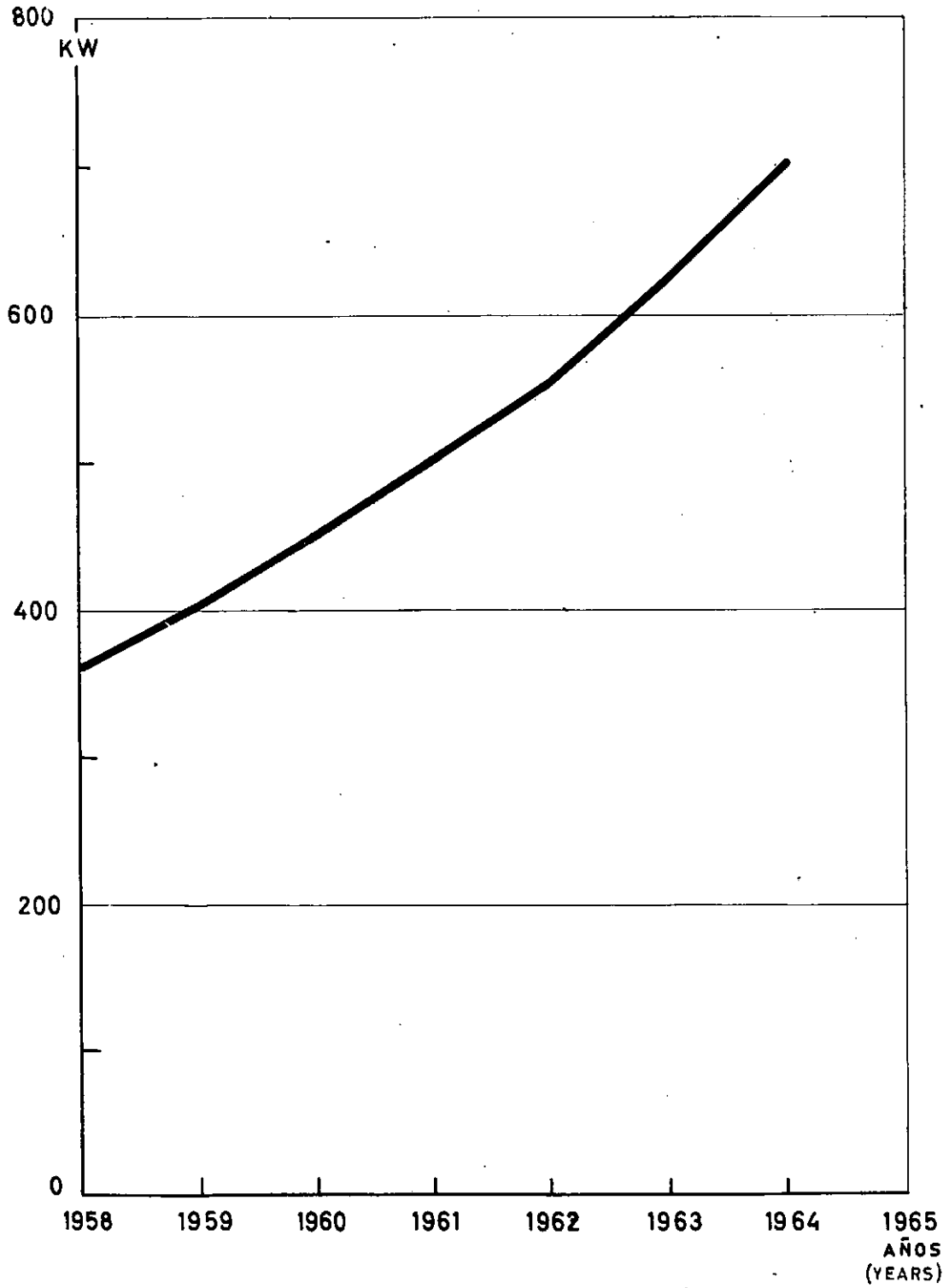
(MAXIMUM DEMAND)



COOPERATIVA ELECTRICA ELDORADO

EVOLUCION DE LA DEMANDA MAXIMA

(MAXIMUM DEMAND)



SISTEMA INTERCONECTADO · MISIONES GRAFICO Nº 14

MISIONES INTERCONNECTED SYSTEM

PROYECCION DE LA DEMANDA DE POTENCIA

(ESTIMATES OF MAXIMUM LOAD)

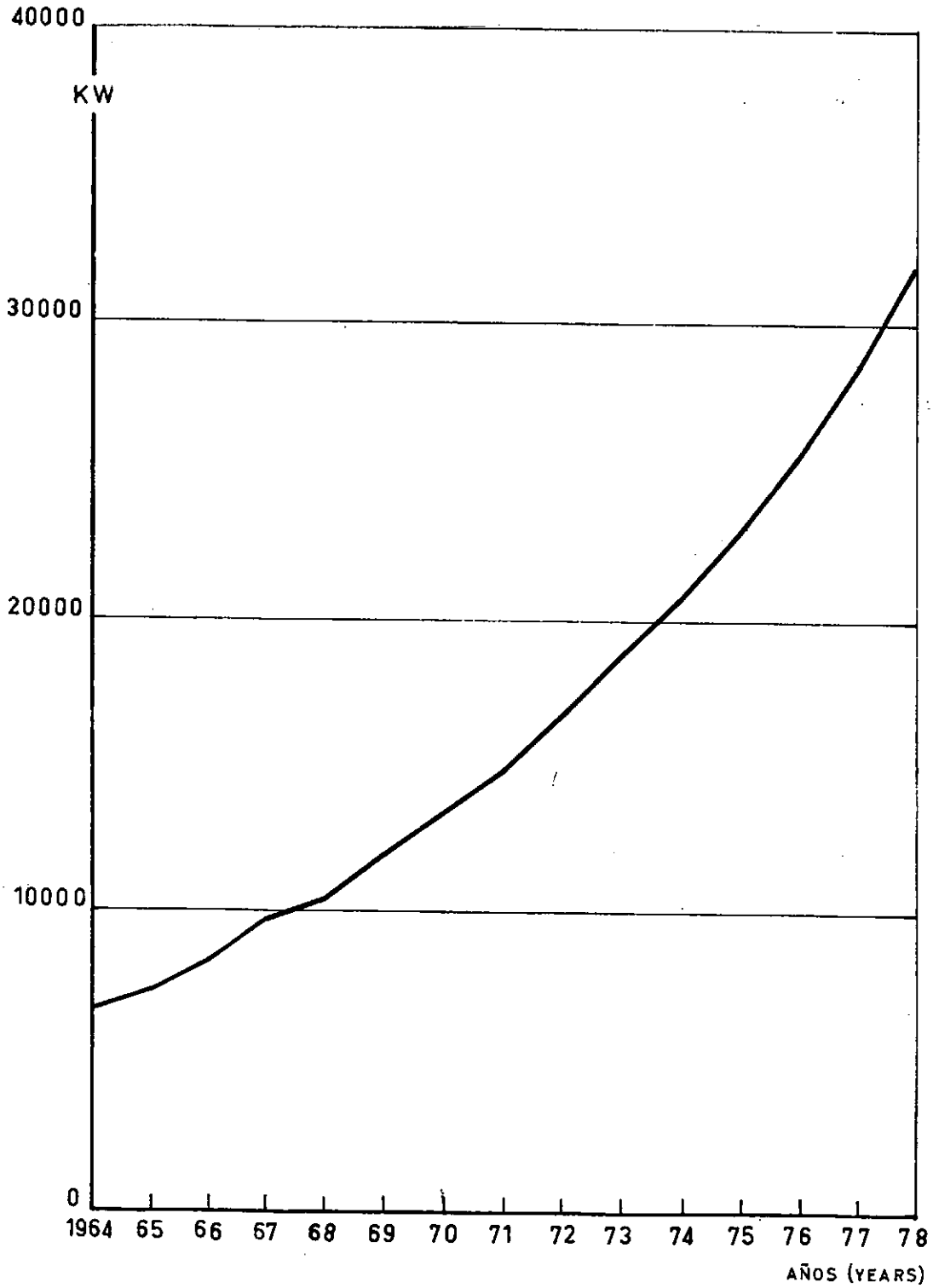


GRAFICO Nº 15

PROYECCION DE LA DEMANDA DE ENERGIA

(ESTIMATED DEMAND OF ENERGY)

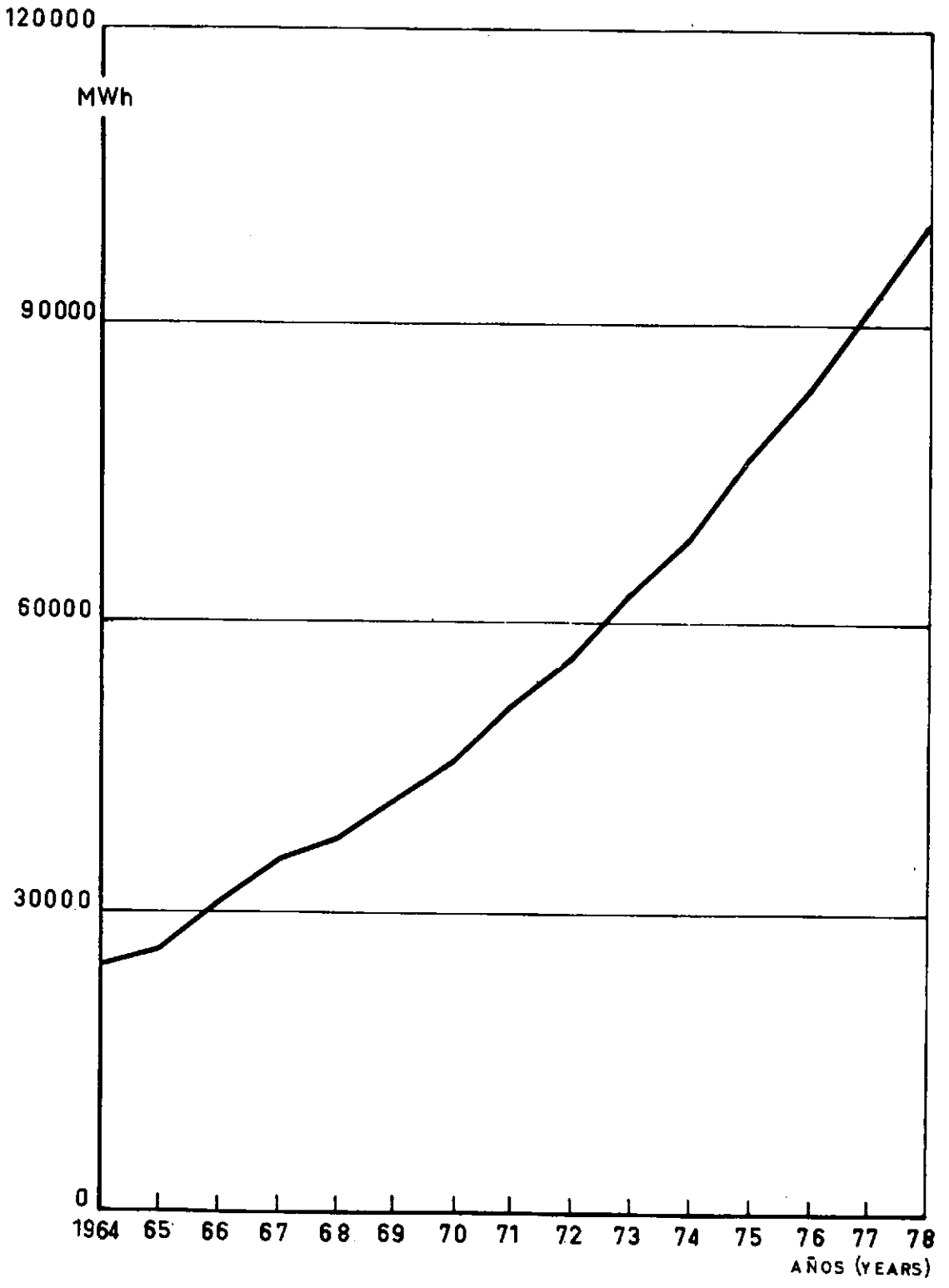
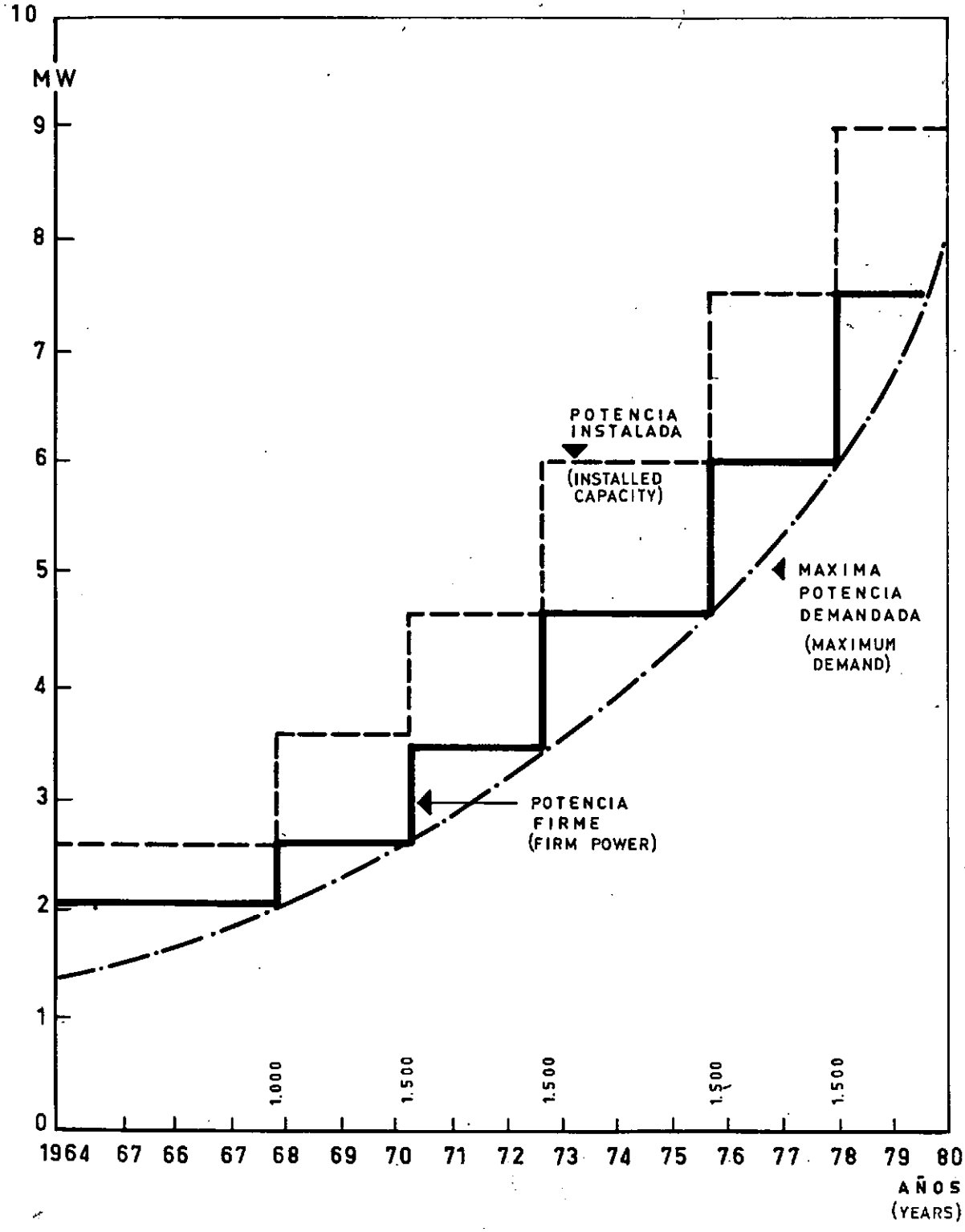


GRAFICO Nº 16

SISTEMA ELDORADO

PROGRAMA DE DESARROLLO EN BASE A GRUPOS ELECTROGENOS DIESEL

(DIESEL GENERATION PLAN)



SISTEMA POSADAS

PROGRAMA DE DESARROLLO EN BASE A GRUPOS ELECTROGENOS DIESEL

(DIESEL GENERATION PLAN)

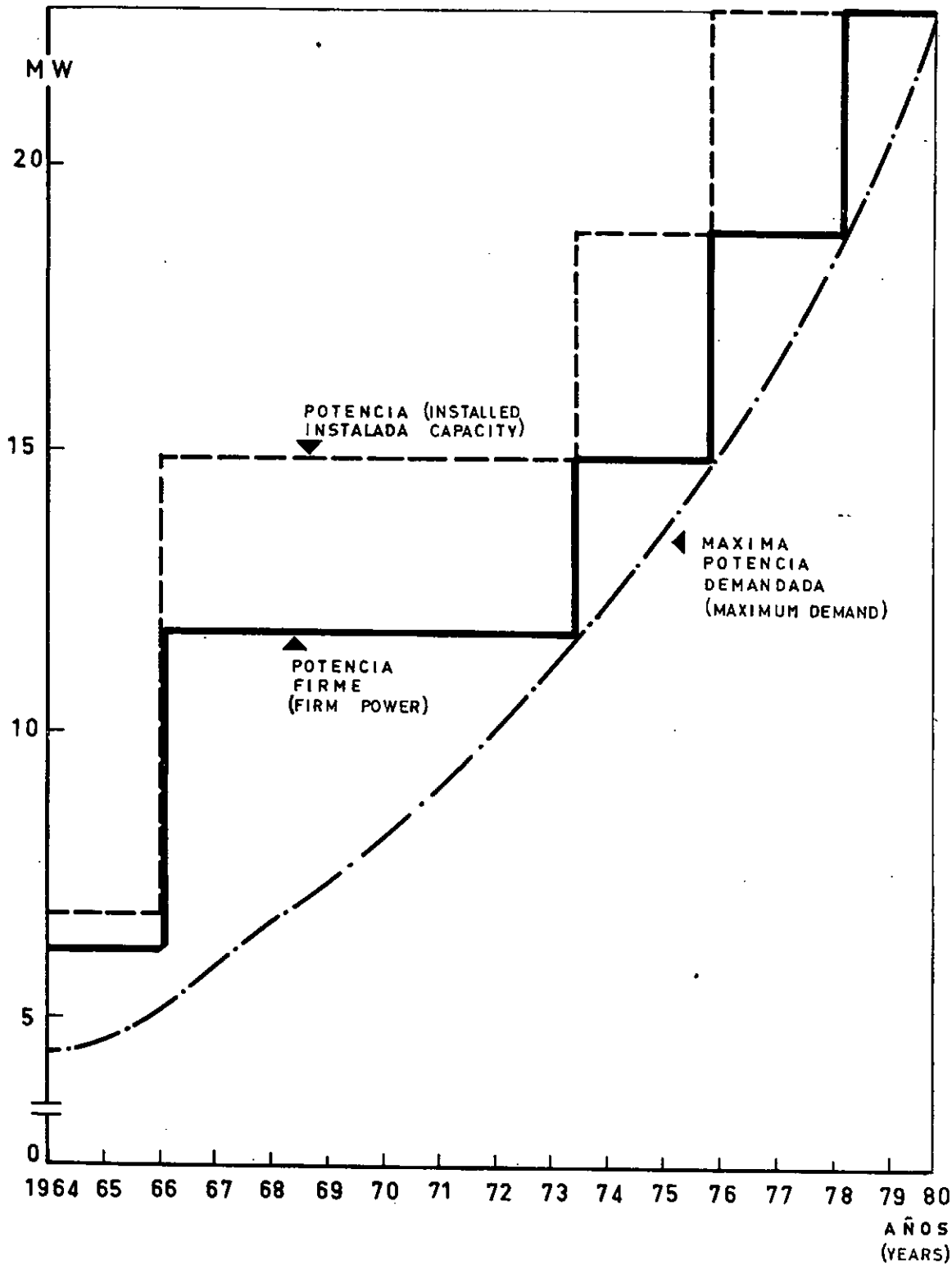
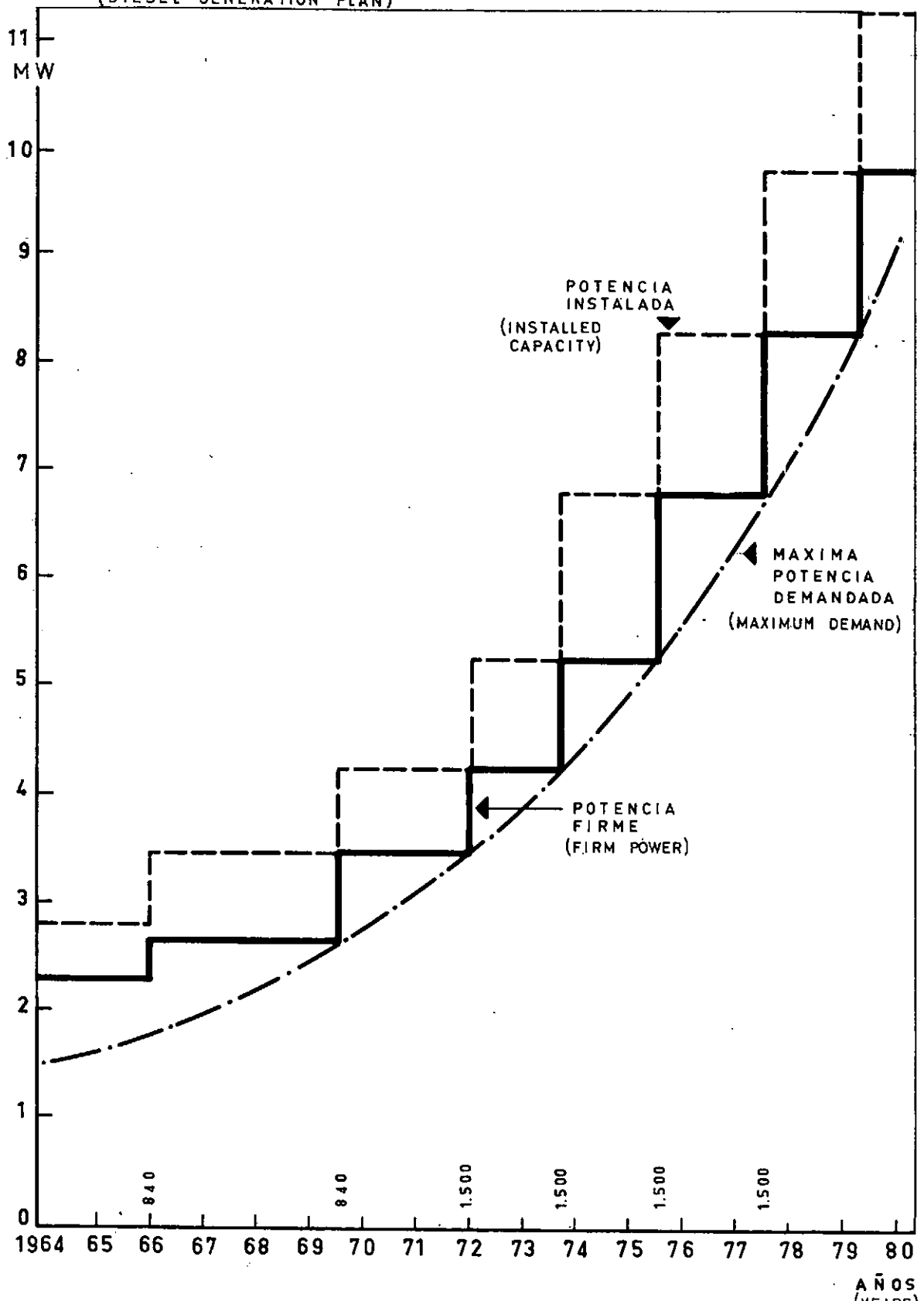


GRAFICO Nº18

SISTEMA OBERA

PROGRAMA DE DESARROLLO EN BASE A GRUPOS ELECTROGENOS DIESEL
(DIESEL GENERATION PLAN)



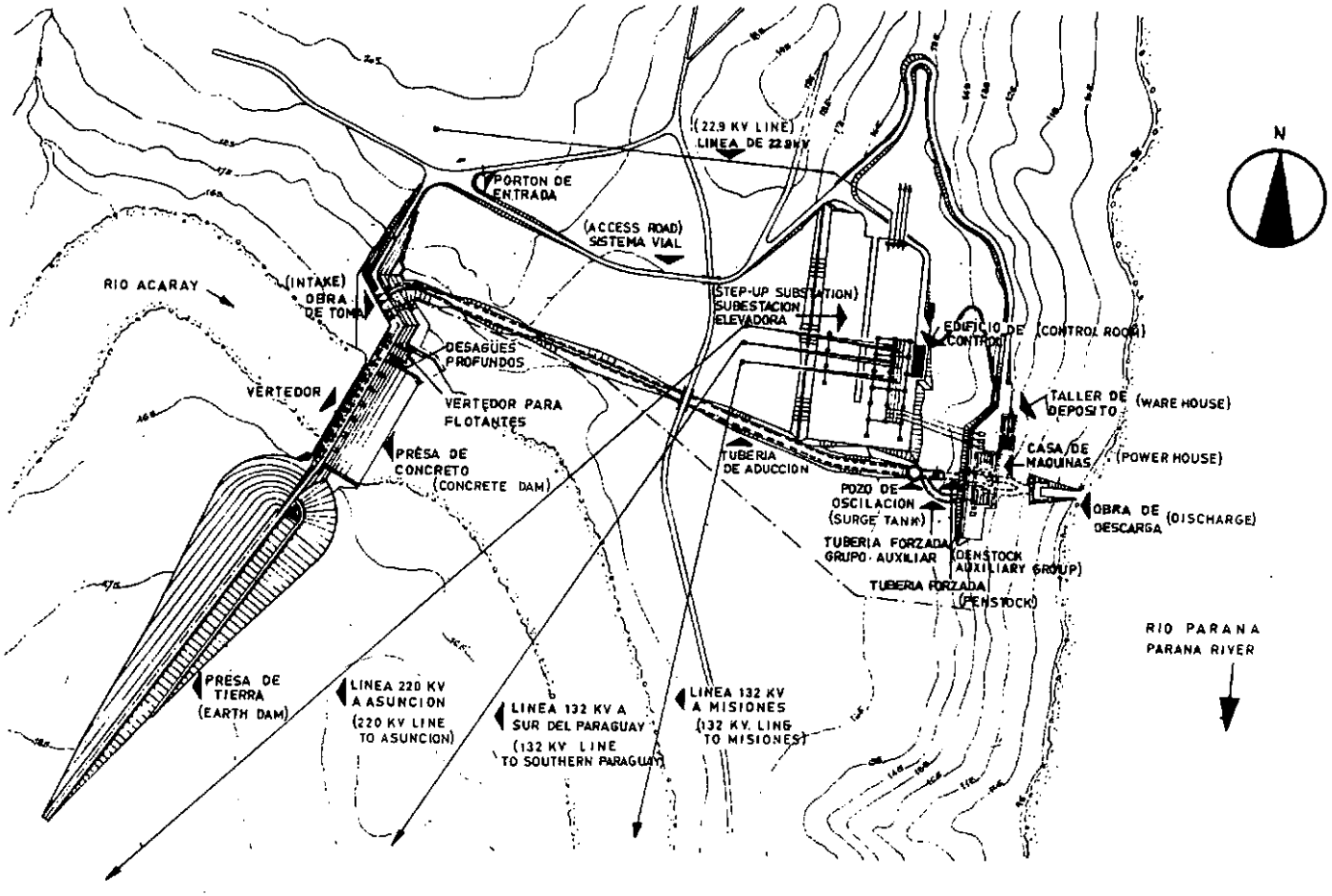


GRAFICO Nº 19

APROVECHAMIENTO HIDROELECTRICO DEL RIO ACARAY

ACARAY PROJECT

GRAFICO Nº 2

① DEMANDA TOTAL DEL SISTEMA
② 1.15 x ①

(MAXIMUM DEMAND - ACARAY SYSTEM)

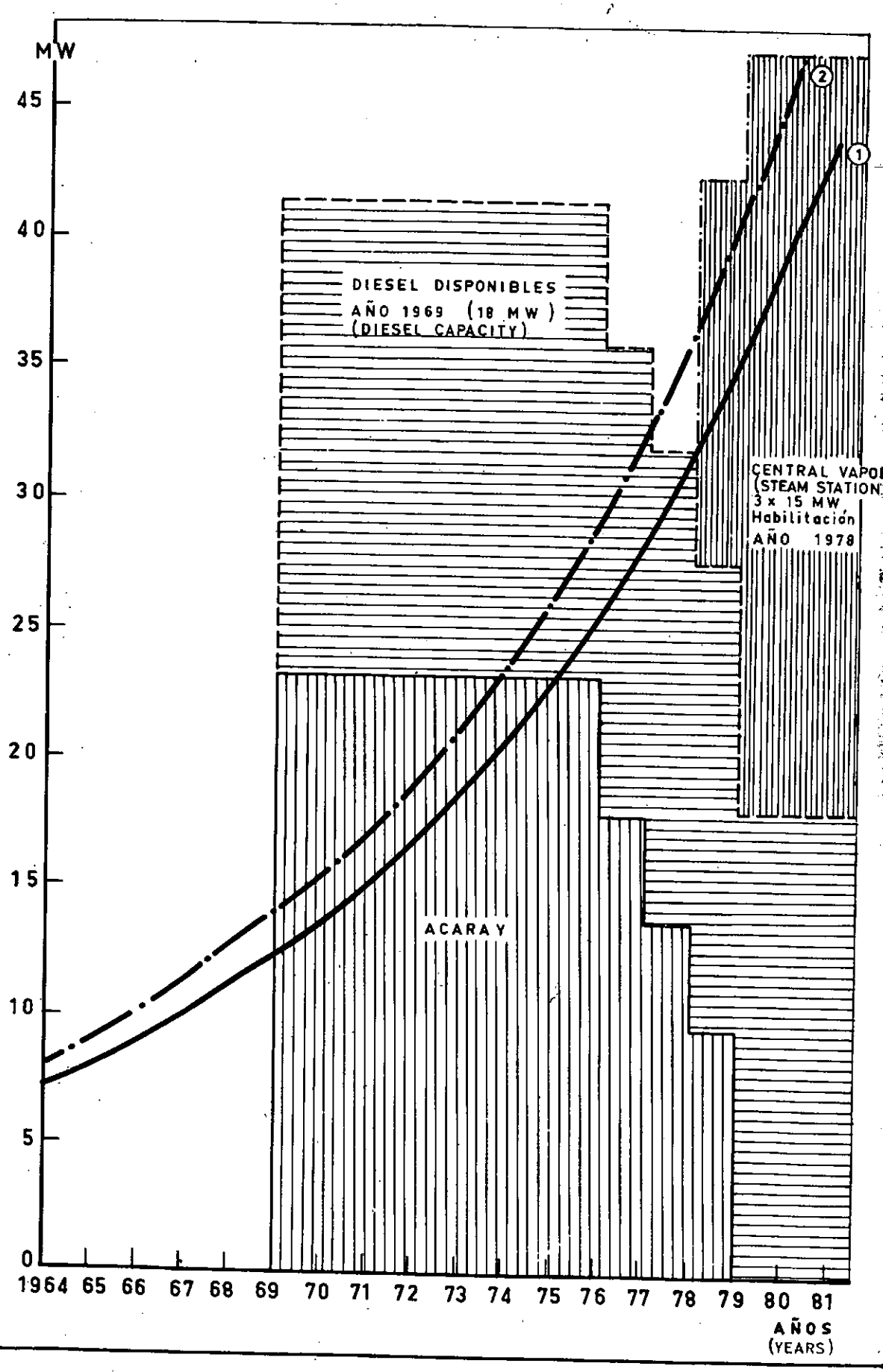


GRAFICO Nº 2

VARIANTE 1

VARIANTE 2

LONGITUD TOTAL EN LINEA DE 132 KV EN TERRITORIO ARGENTINO

(ALTERNATIVE 1) VARIANTE 1 : 336 KM

(ALTERNATIVE 2) VARIANTE 2 : 328 KM

(DIFFERENCE) DIFERENCIA : 6 KM

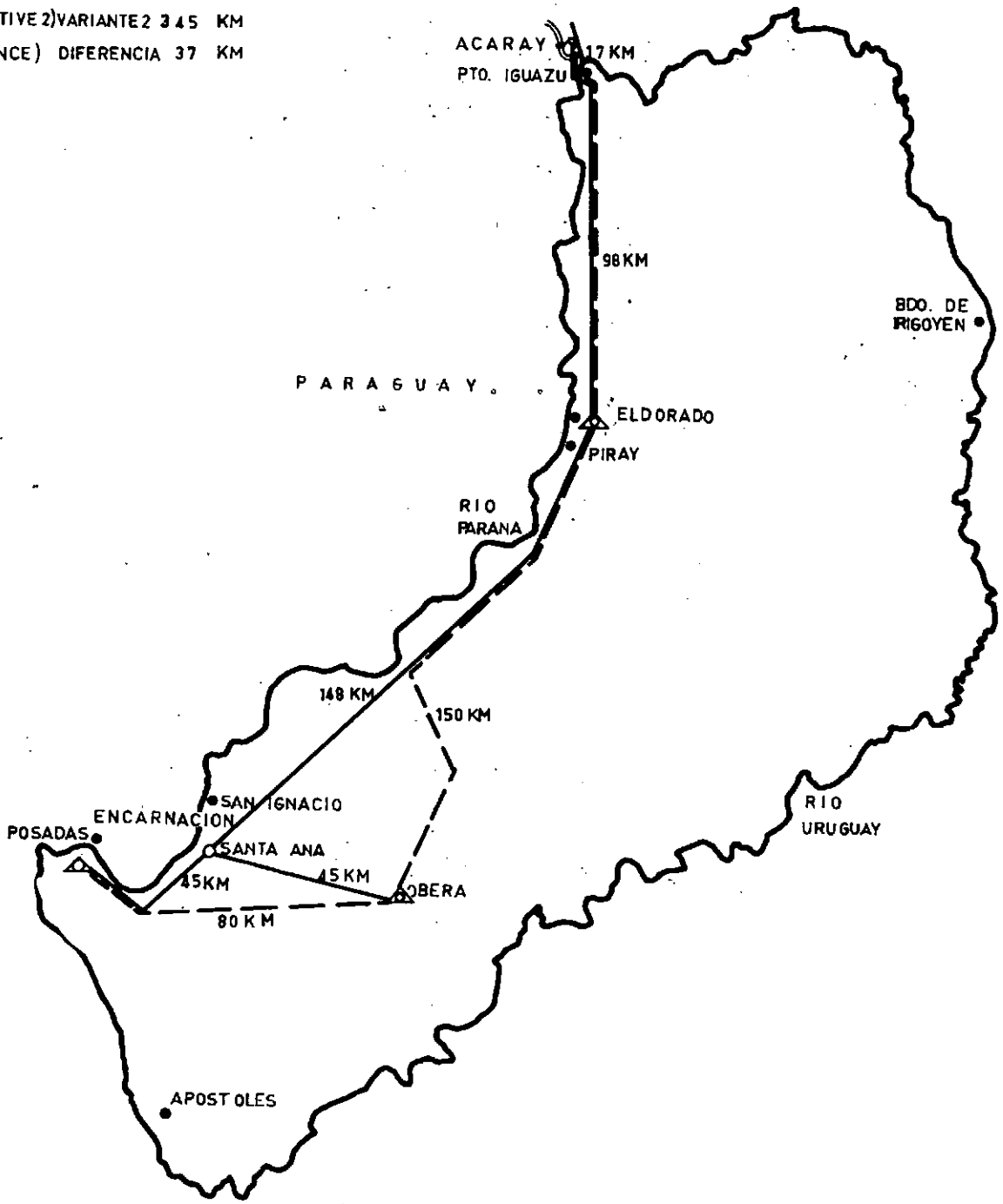
(TOTAL LENGHT 132 KV LINE IN ARGENTINE TERRITORY)

RECORRIDO DE ACARAY A POSADAS: (LINE LENGHT ACARAY - POSADAS)

(ALTERNATIVE 1) VARIANTE 1: 308 KM

(ALTERNATIVE 2) VARIANTE 2 345 KM

(DIFFERENCE) DIFERENCIA 37 KM



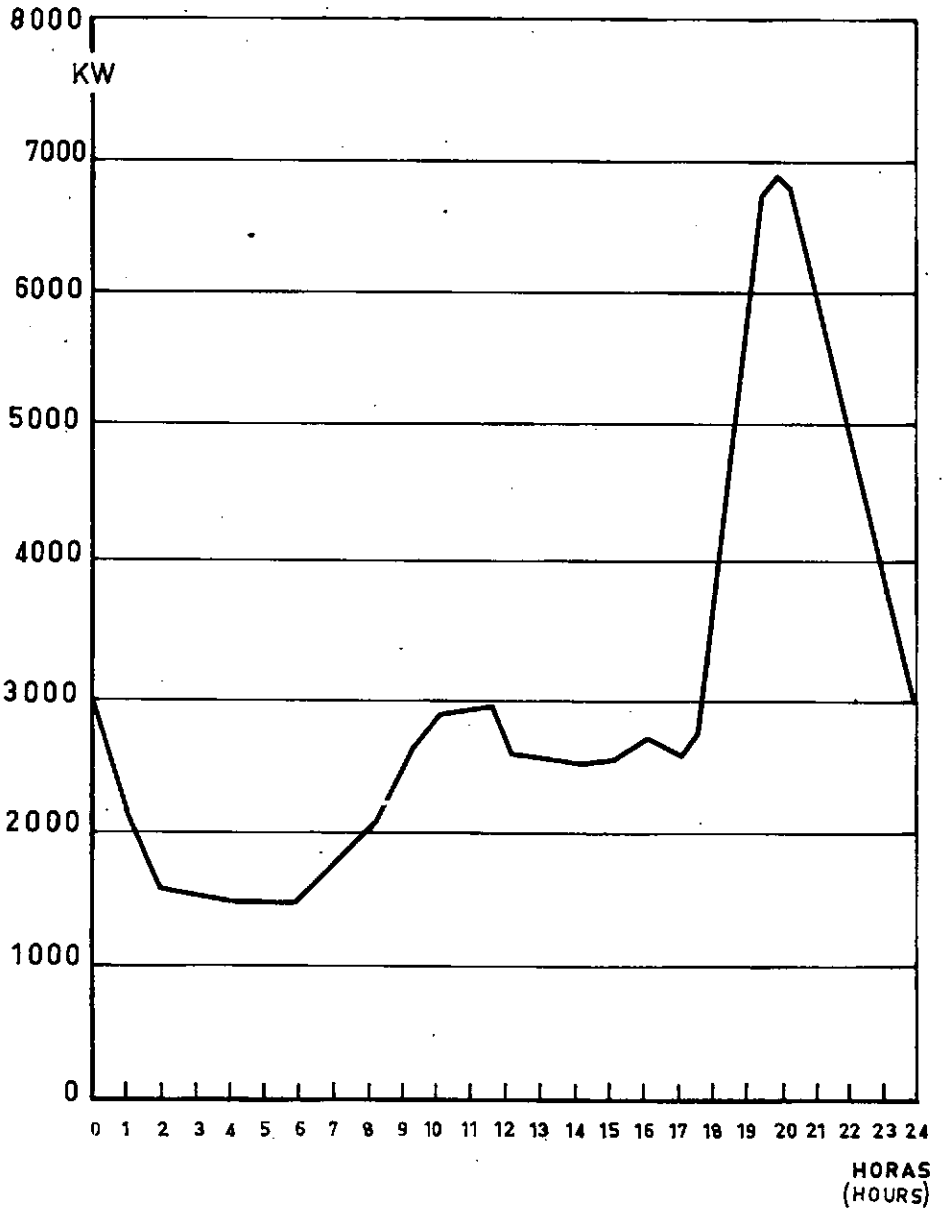
LINEA 132 KV Y ESTACIONES TRANSFORMADORAS

132 KV LINE AND TRANSFORMER STATIONS

SISTEMA INTERCONECTADO DE MISIONES
(MISIONES INTERCONNECTED SYSTEM)

AÑO 1964 DIA DE SEMANA TIPICO
(YEAR. 1964 TIPICAL WEEKLY DAY LOAD CURVE)

DEMANDA MAXIMA 6.800 KW
(MAXIMUM DEMAND)

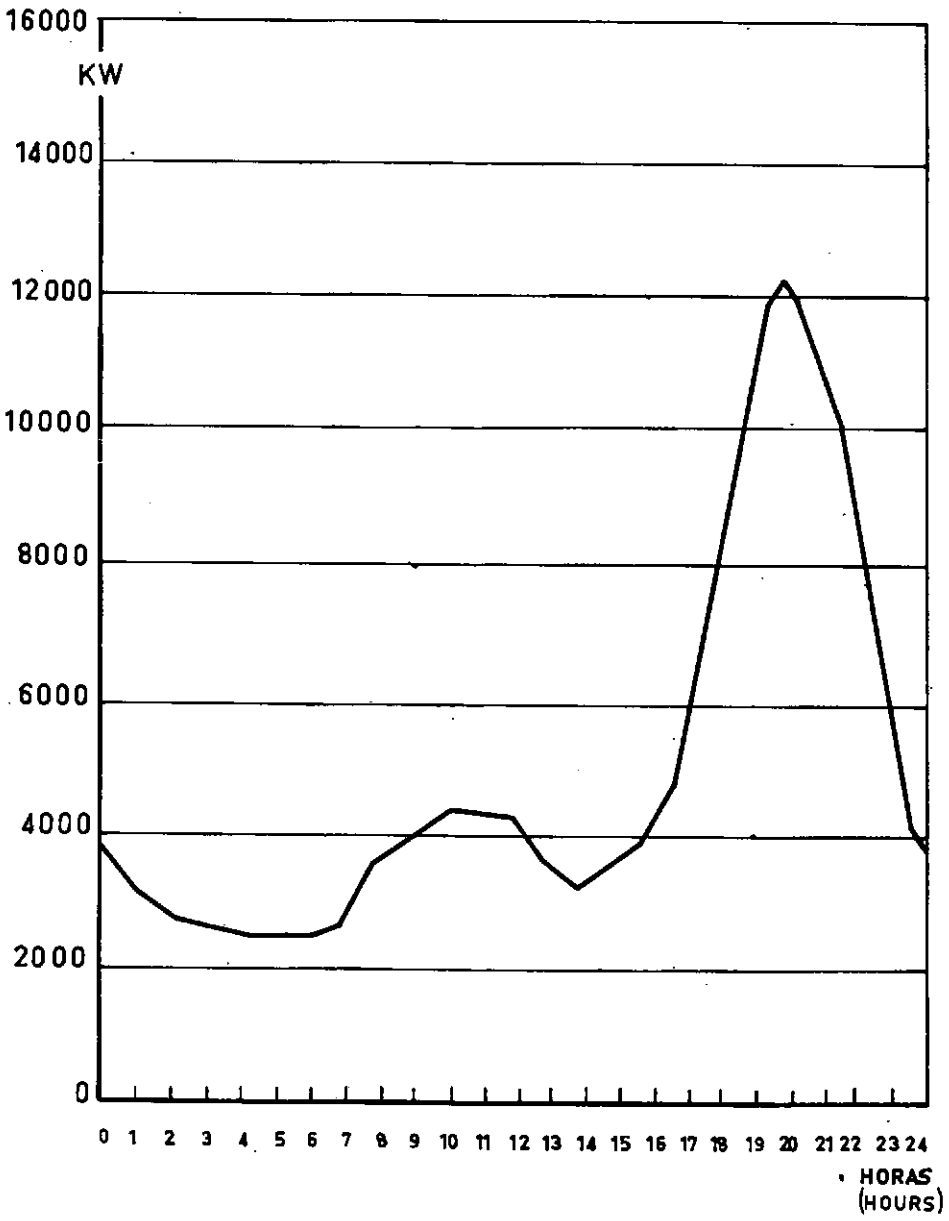


SISTEMA INTERCONECTADO DE MISIONES

MISIONES INTERCCONNECTED SYSTEM

AÑO 1969 DIA DE SEMANA TIPICO
(YEAR 1969 - TIPICAL WEEKLY DAY LOAD CURVE)

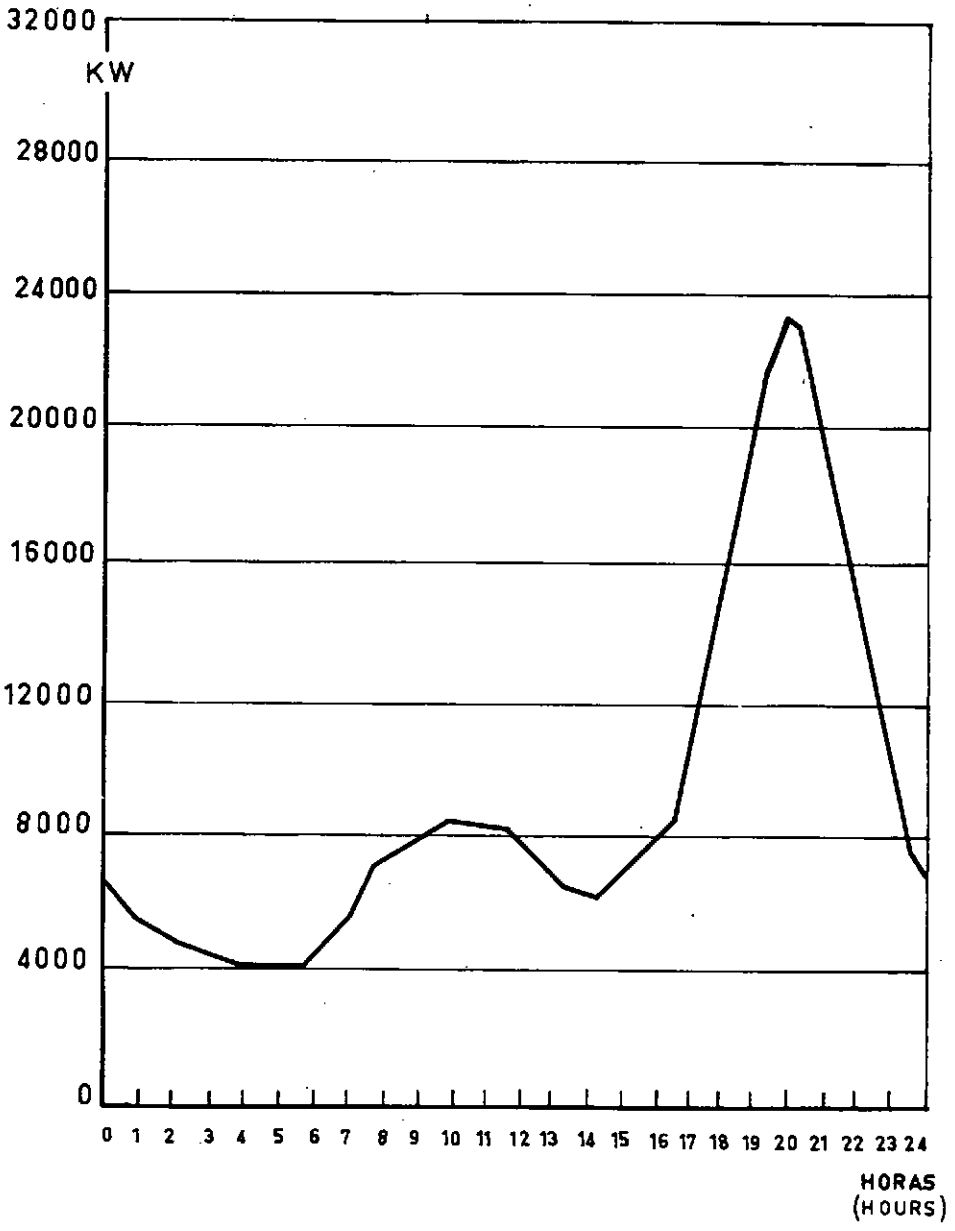
DEMANDA MAXIMA 12.100 KW
(MAXIMUM DEMAND)



SISTEMA INTERCONECTADO DE MISIONES
MISIONES INTERCONNECTED SYSTEM

AÑO 1975 DIA DE SEMANA TIPICO
(YEAR 1975 - TIPICAL WEEKLY DAY LOAD CURVE)

DEMANDA MAXIMA 23.200 KW
(MAXIMUM DEMAND)



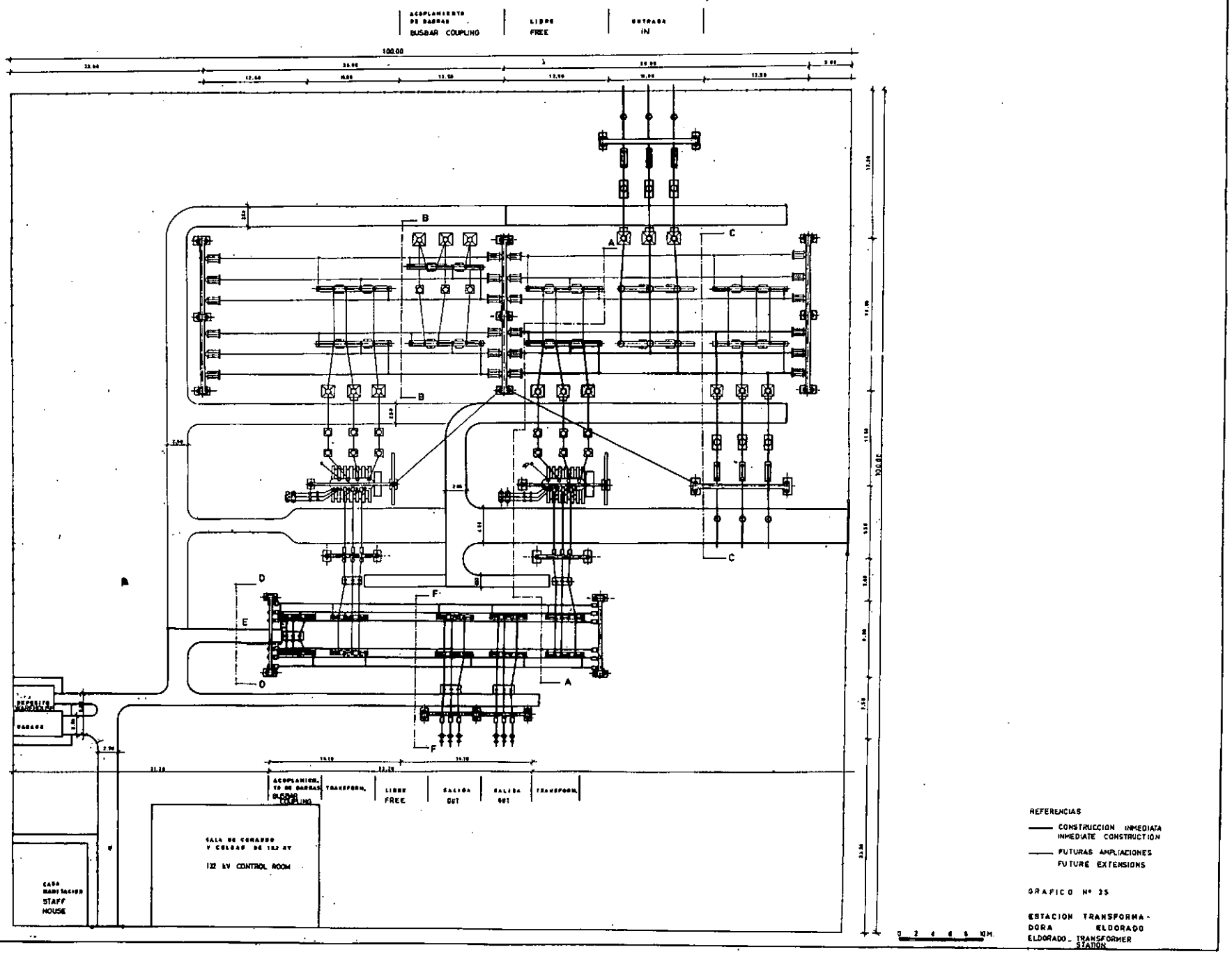
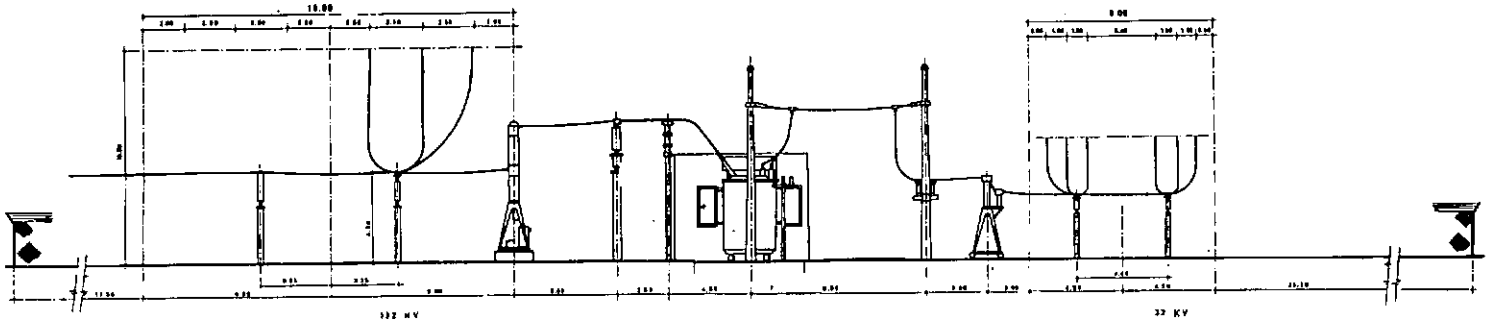
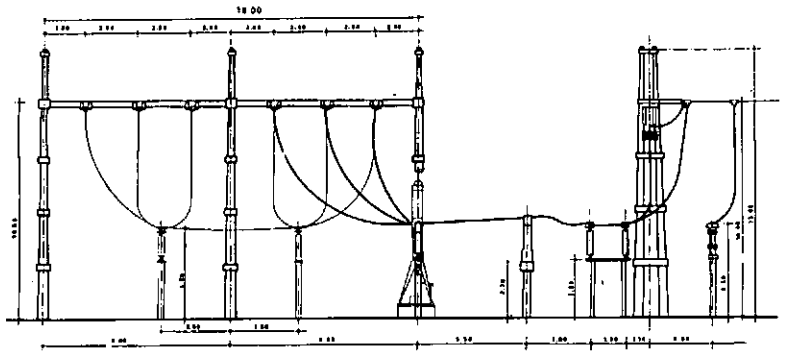


GRAFICO Nº 25

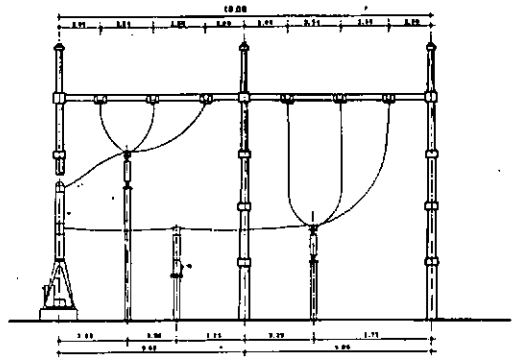
ESTACION TRANSFORMADORA ELDORADO
ELDORADO TRANSFORMER STATION



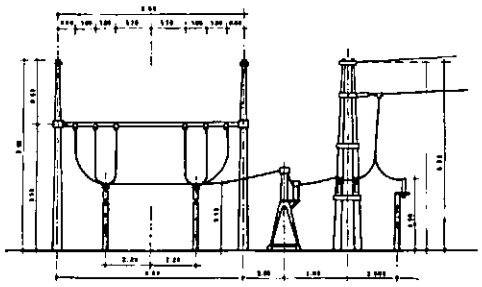
CORTE A-A



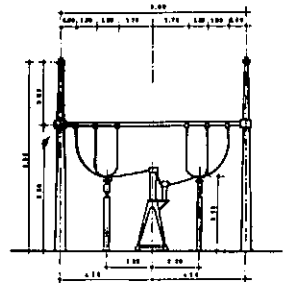
CORTE C-C



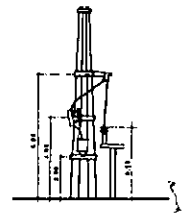
CORTE B-B



CORTE F-F



CORTE D-D



CORTE E-E

GRAFICO Nº 28

CORTES ESTACION TRANSFORMADORA
ELDORADO - TRANSFORMER STATION - SECTIONS

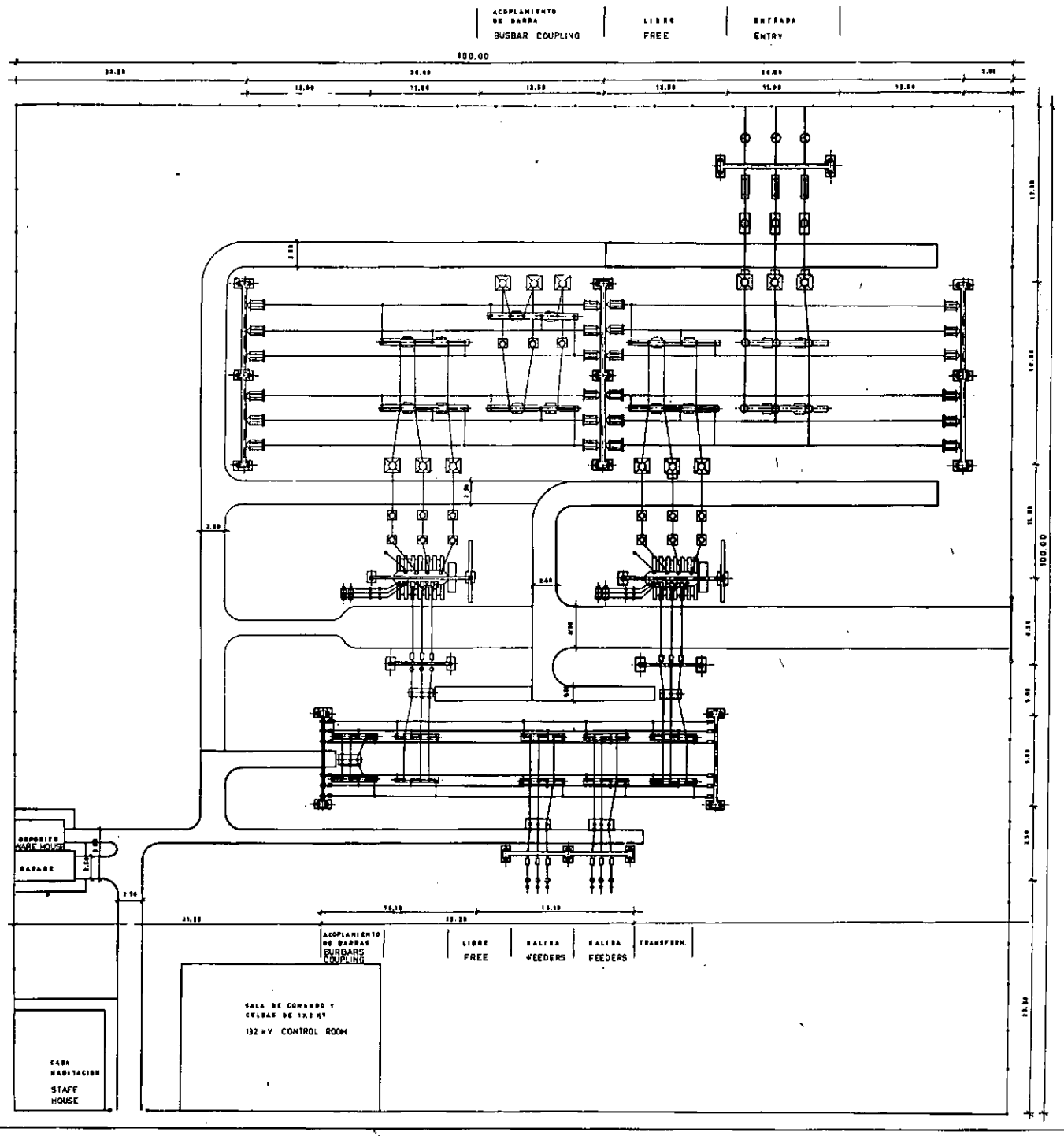


GRAFICO Nº 27

ESTACION TRANSFORMADORA OBERA

OBERA _ TRANSFORMER STATION

0 2 4 6 8 10M

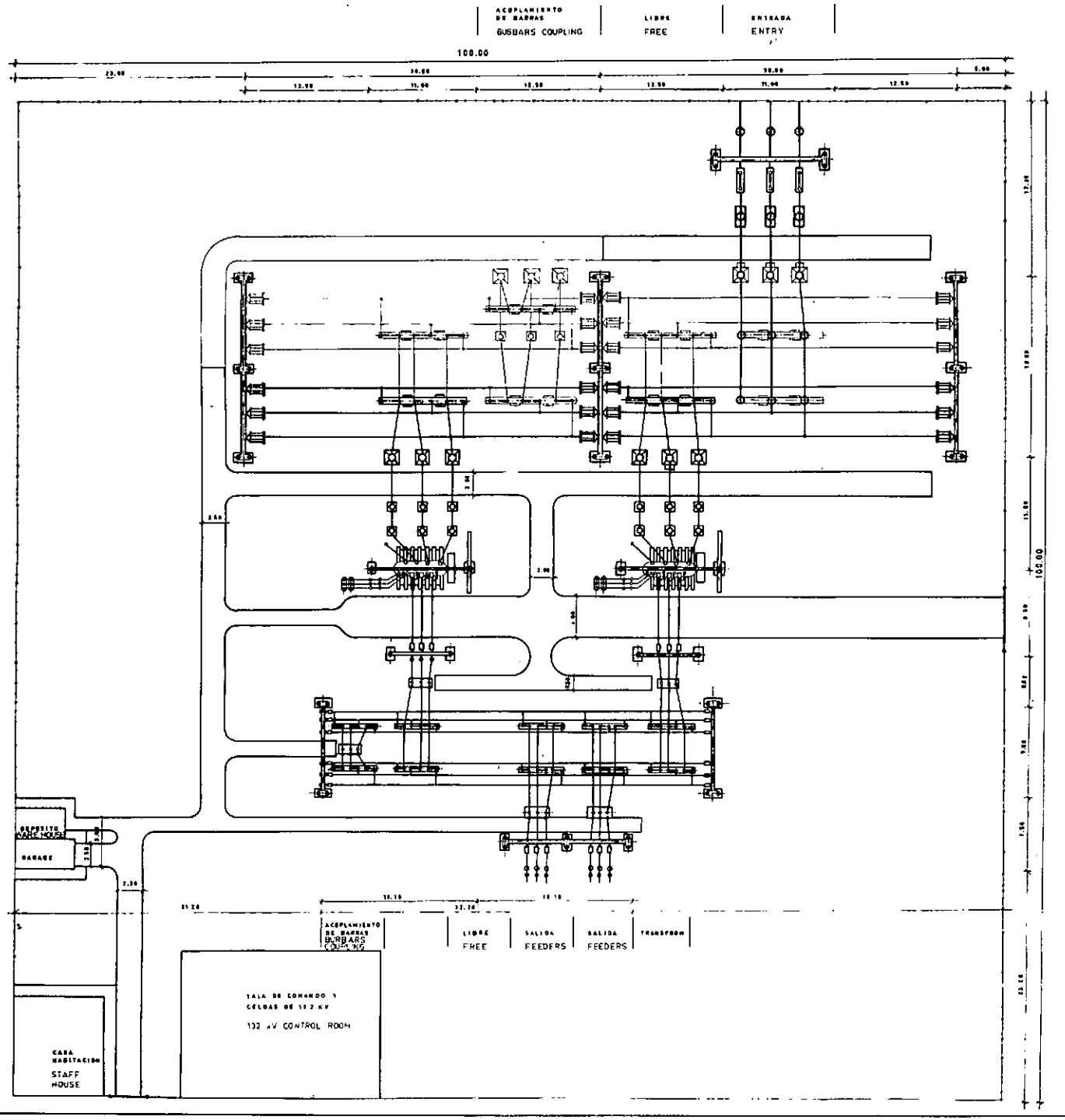


GRAFICO N° 28

ESTACION TRANSFORMADORA POSADAS
POSADAS - TRANSFORMER STATION

0 2 4 6 8 10 M

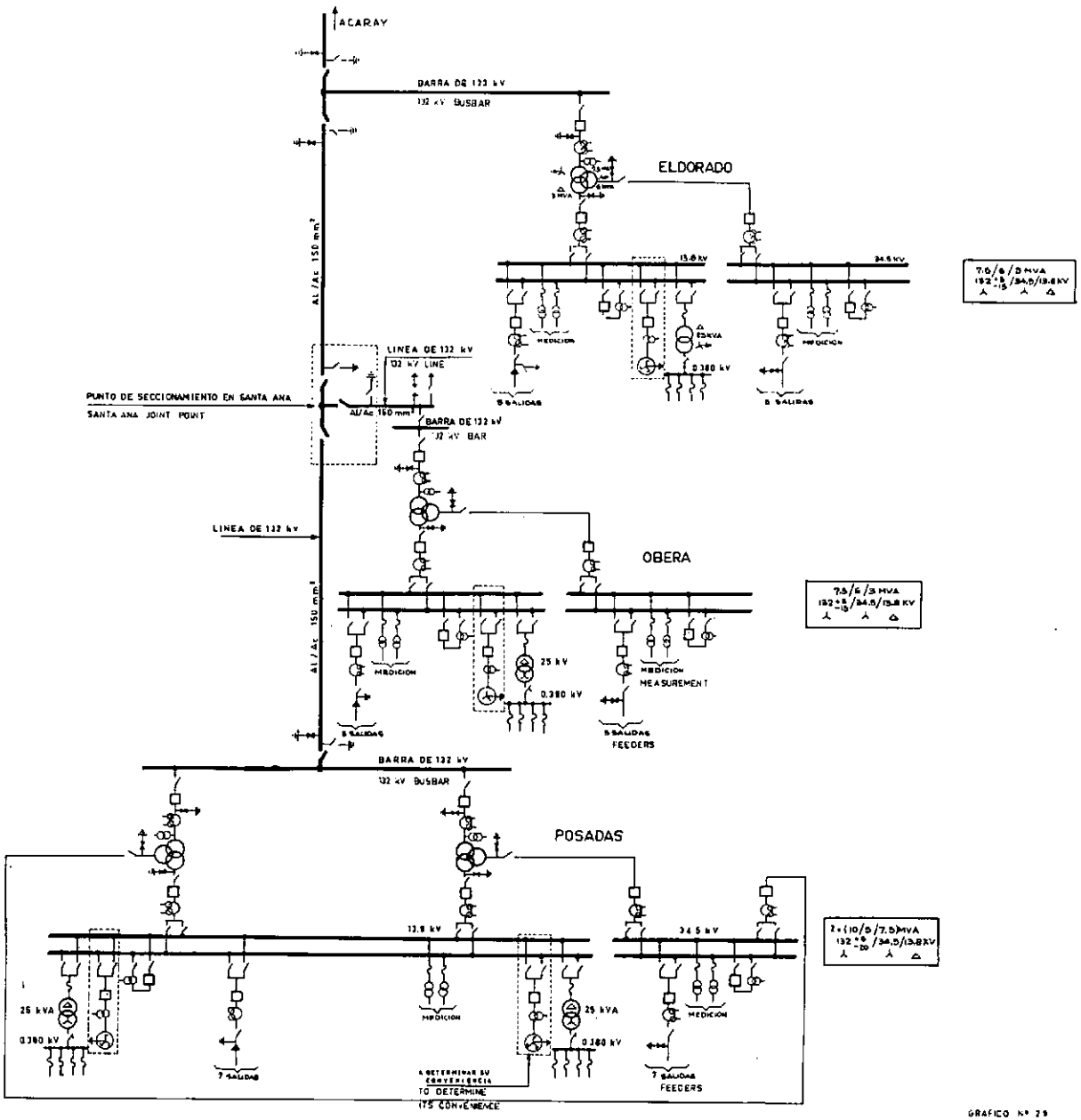


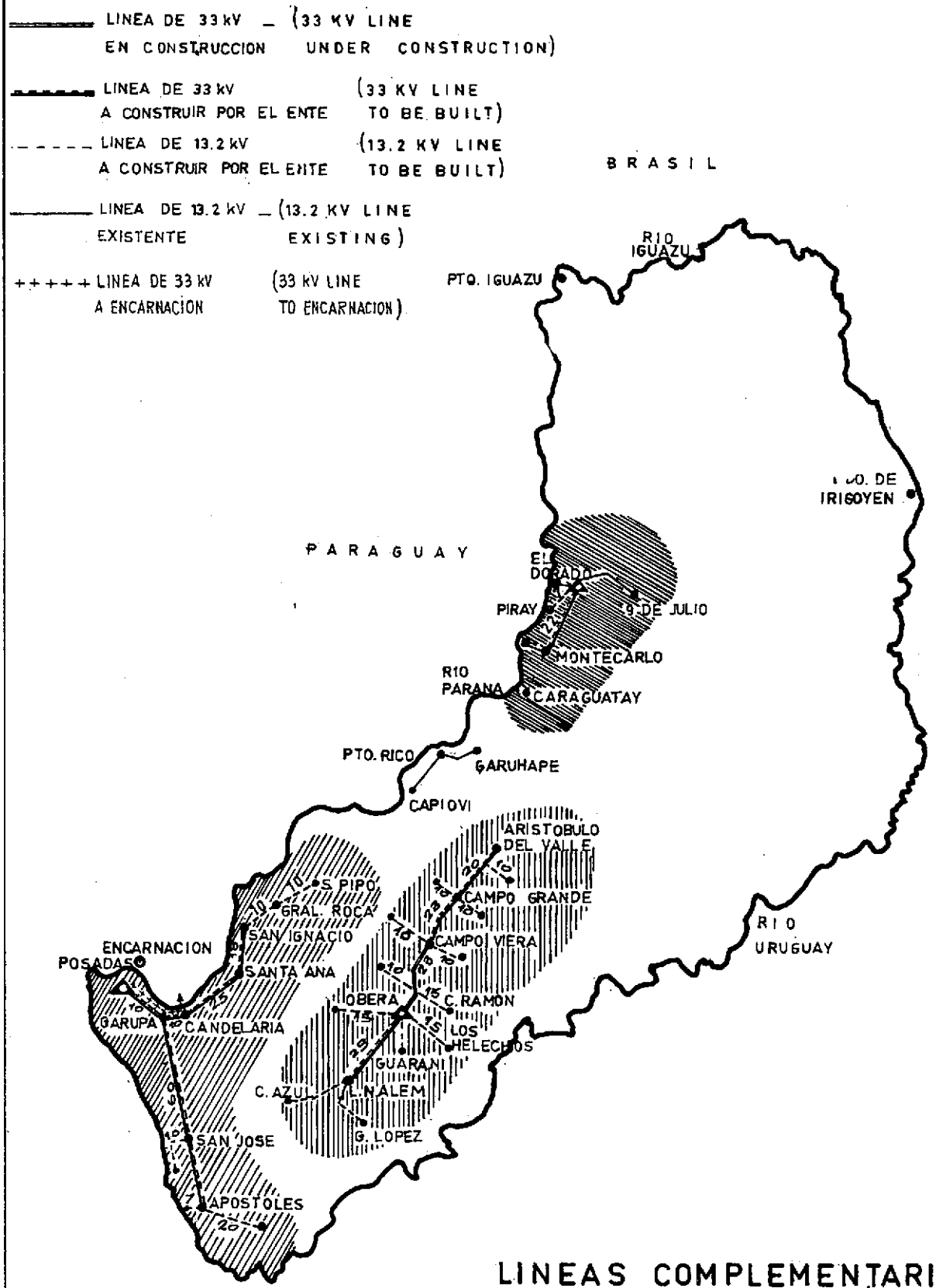
GRAFICO Nº 29

LINEA DE 132 KV y ESTACION TRANSFORMADORA

ESQUEMA UNIFILAR DE CONJUNTO

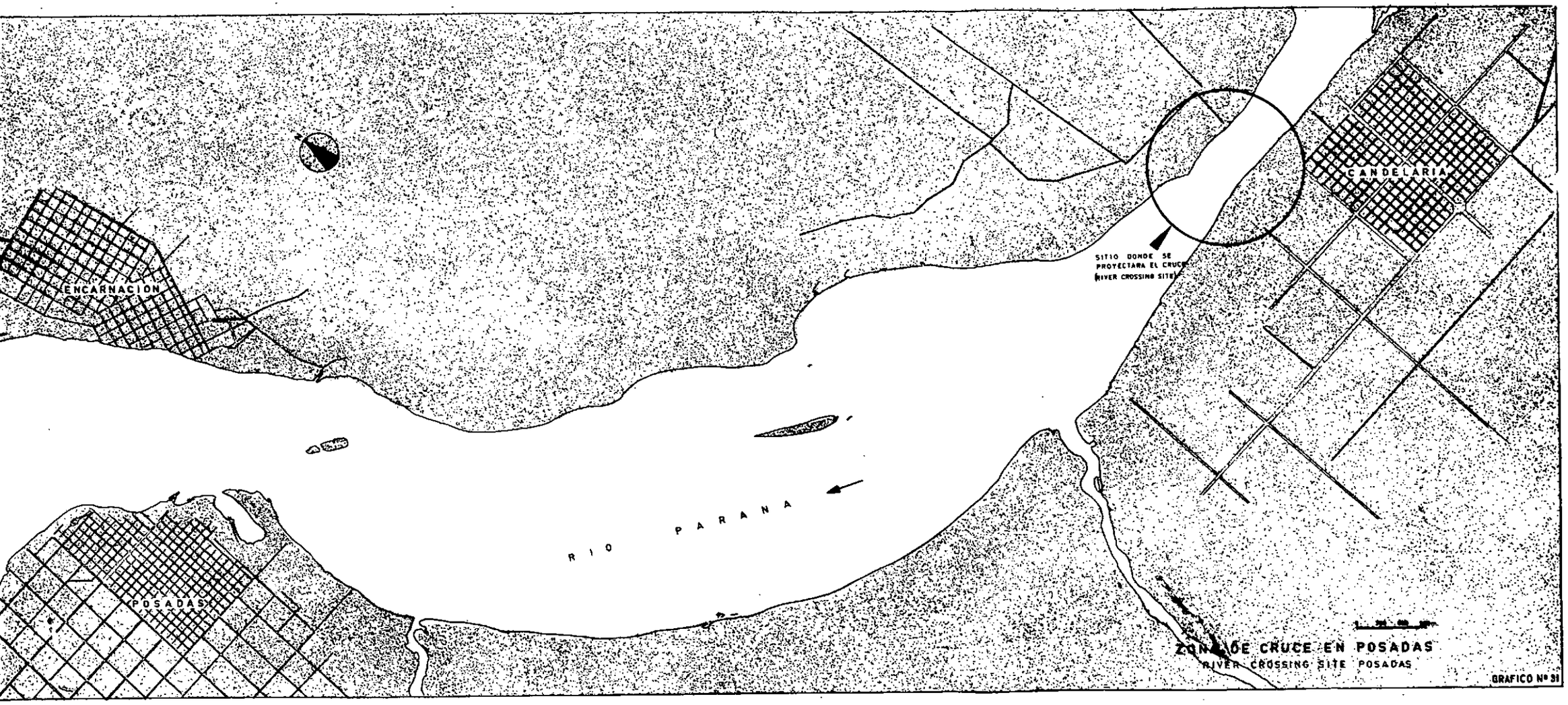
132kV LINE AND TRANSFORMER STATIONS ONE LINE DIAGRAM

GRAFICO Nº 30



LINEAS COMPLEMENTARIAS
33 y 13.2 KV

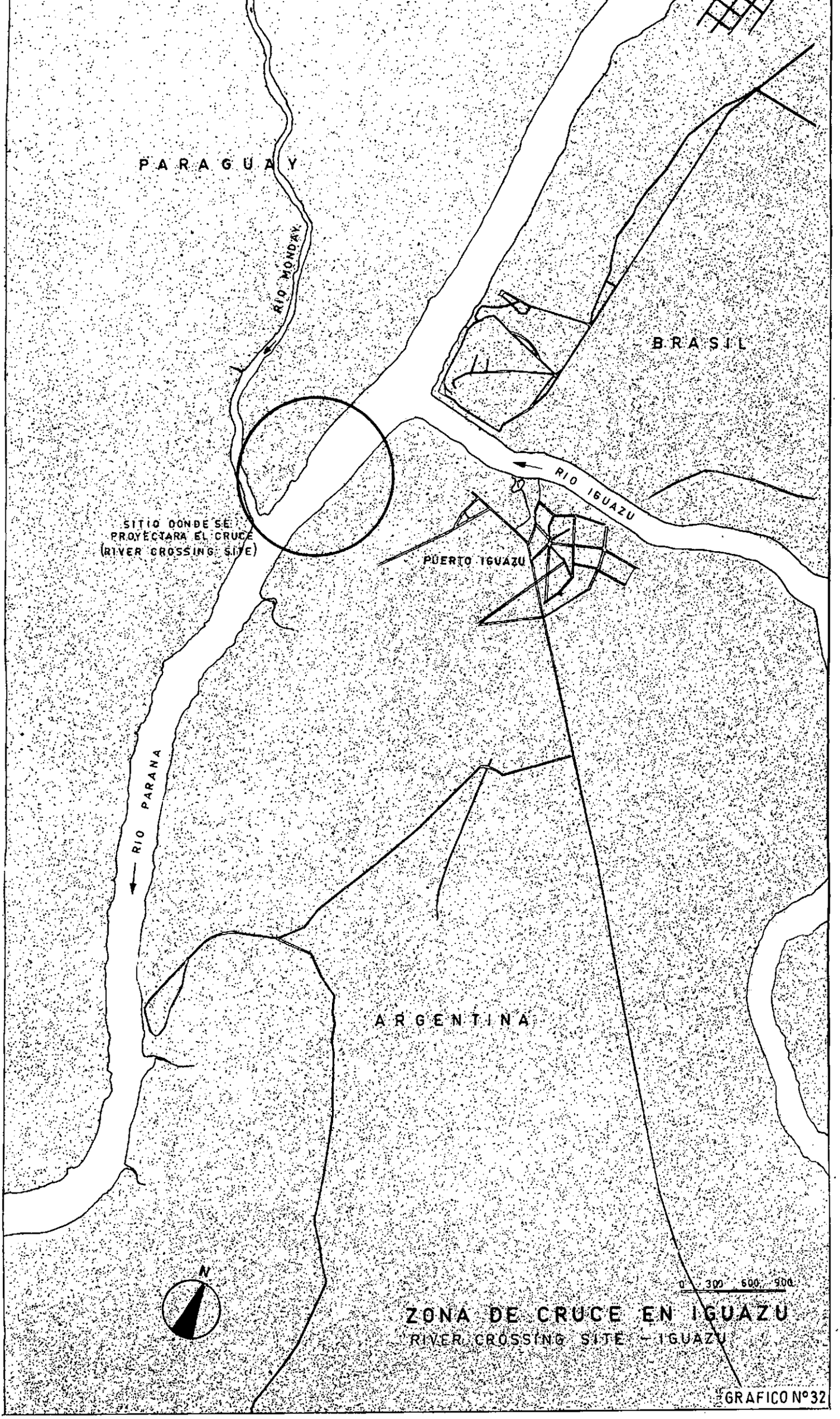
33 Y 13.2 KV COMPLEMENTARY LINES



ZONA DE CRUCE EN POSADAS

RIVER CROSSING SITE POSADAS

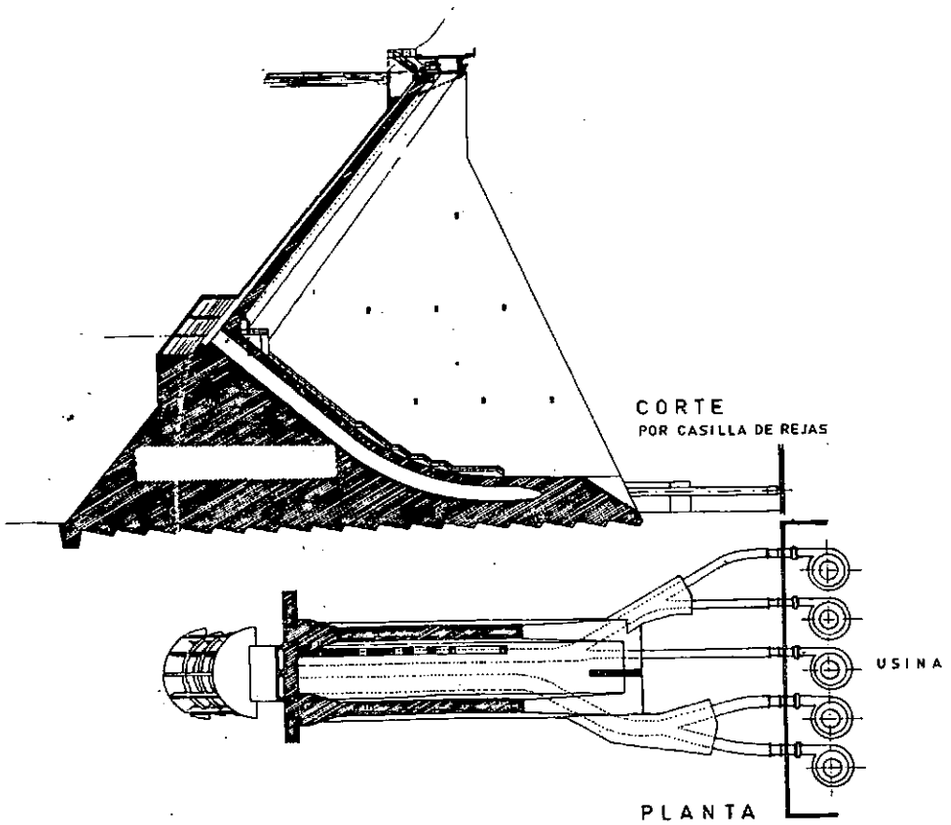
GRAFICO Nº 31

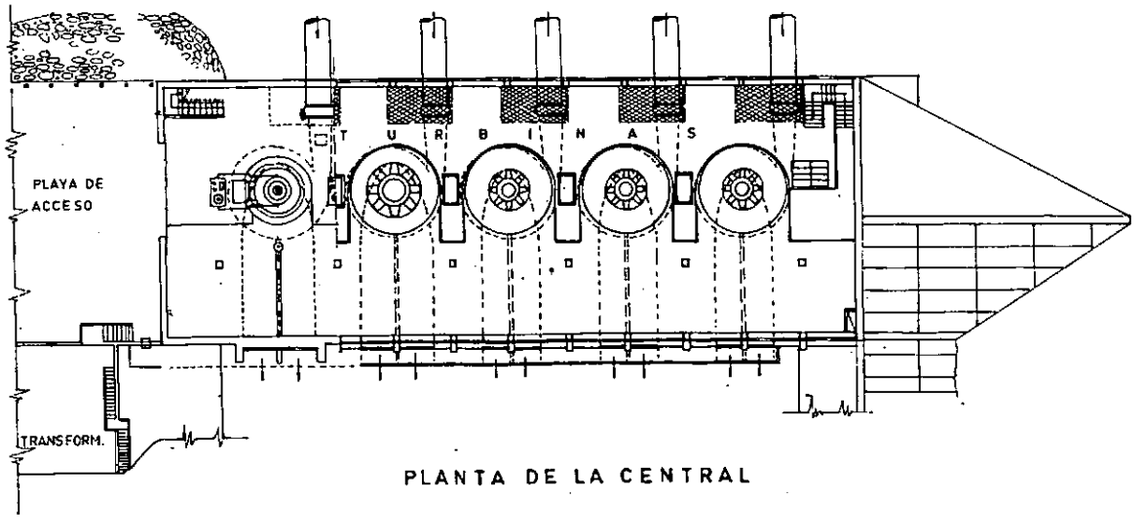


ZONA DE CRUCE EN IGUAZU

RIVER CROSSING SITE - IGUAZU

GRAFICO Nº32

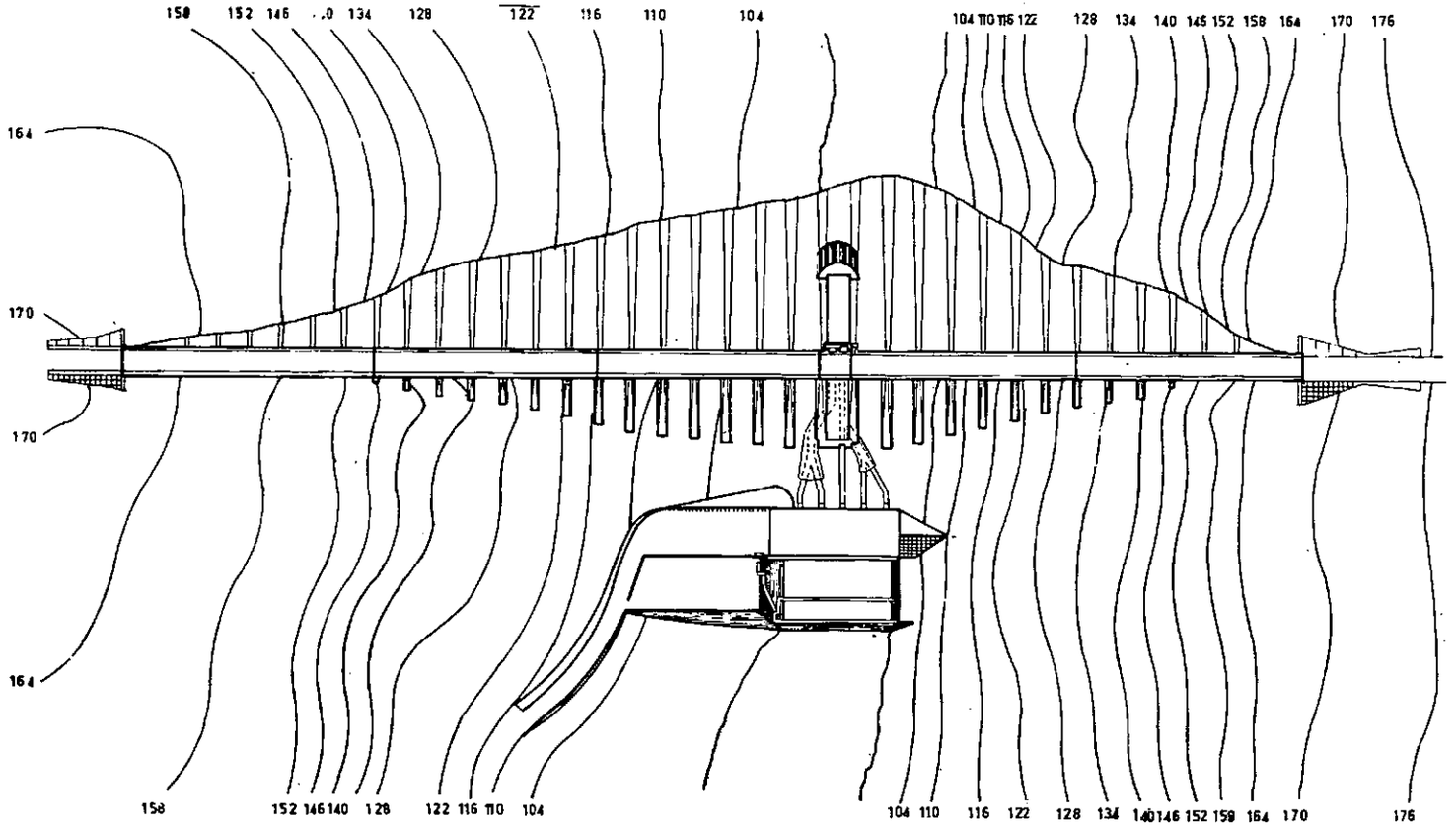




PLANTA DE LA CENTRAL

CENTRAL PIRAY GUAZU

PIRAY GUAZU STATION



PLANTA GENERAL DEL DIQUE Y DE LA CENTRAL PIRAY GUAZÚ

PIRAY GUAZU PROJECT
GENERAL VIEW