ブラジル連邦共和国

スアッペ臨海工業開発計画

資料No. 4

TOME IV - VOLUME 3

PART 4 - ELECTRICAL SYSTEM

PART 5 - COMMUNICATION SYSTEM

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1.0 - PRELIMINARY SURVEY OF THE POWER CONSUMER MARKET

PART 4 ELECTRICAL SYSTEM

1.0 PRELIMINARY SURVEY OF THE POWER CONSUMER MARKET

The Suape Industrial Complex , to be implanted by the Government of the state of Pernambuco , will entail the installation of a number of multiple-concern industries . These industries will utilize the benefits of the implantation in an area gifted with important infra structural facilities , which are envisaged by the state for that complex , apart from the port itself.

Suape's localization in the south of Recife , and in an area not far from that large northeastern city , makes easy Suape's search for small and medium-sized industrial concern . On the other hand , the large - sized facilities to be laid down there shoul also serve as a pattern to attract the big industrial concerns of the Electric-Metal lurgic or Petrochemical type .

Such installations will mirror the outstanding position of the city of Recife as the economic center of gravity in the Northeastern Region , interconnected with all of the principal regional centers and provided with facilities at Suape , which will favour the implantation of these large manufacturing units , in a similar way to the fate given to the district of Aratu , in the Salvador region .

Apart from the port facilities , these large industrial installations, today possible to envisage , will make Suape a large electric power consumer center in the CHESF system .

As a comparative figure , the Industrial District of Aratu was given in 1967 , a defining planning for final demand of energy in the range of 600 MW .

It will be a long time before the implantation phase takes place for the industries earmarked to that area since only recently was initiated the construction of the heavy-industry section in the area fit to them , and the corresponding port (CABÔTO) is still under poor stage of development. Notwithstanding, seven years later, the Aratú Industrial District corresponds now to an energy Market of about 150 MW, roughly 25% of the final charge planned.

It becomes evident that the energetic necessities for the Suape Industrial Complex will extend to the same amounts of those planned for the Aratú Industrial District. However, the actual evaluation will have to make an allowance for the utilization of the plots intended for the implantation of light, medium or heavy Industries, all according to the type of consumers to which they will relate, and other special factors such as the physiographic characteristics which may be found , the nature and the concentration of the activities in the new port under planning, etc.

For the time being, taking into consideration the natural evolution of the project, one must bear in mind the sizeability of the energy market that may become of it. A fair comparison vis-a-vis Aratú yields the figures of about 600MW for the commum charges, e.g., those non-characterized by electrolitical processes of large consumption of energy.

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2.0

2.0 - POWER AVAILABILITY UP TO
THE END OF 1974

2.0 POWER AVAILABILITY UP TO END OF 1974

2.1 SUPPLY IN THE SOUTH OF THE CITY OF RECIFE, AT SUAPE'S INTEREST .

The power supply at the south of Municipal Recife is effected by CHESF through the Pirapama Substation , located at the municipe of Cabo and at the load-center of the Industrial District which was implanted in that area since 1961.

The Suape area , which is shown in figure 2-1 , is located in a region close to the City of Cabo , about 5 Km away from CHESF's Substation at Pirapama .

2.1.1 POWER NETWORKS

The transmission system in the area is comprised by CHESF and CELPE's networks . CHESF's network , operating under 230 KV , is made up by a double circuit that feeds the Pirapama Substation through a shunt in the trunk-circuit in the transmission , which exists between Angelim and Recife .

From the 230/69/13,8 KV substation at Pirapama , the CELPE's network , operating under 69 KV and 13,8 KV , is fed by CHESF, in these voltages .

CELPE's 60 KV network , which is created at Pirapama by shunting , is interconnected to the 69 KV systems , which are created at Bongi and Mirueira , through the Pirapama-Cabo- Juçaral-Jaboatão-Várzea and Pirapama-Jaboatão-Varzea circuits , as shown in figure 2-1 .

CELPE's 13,8 KV distribution network , in the area ,is backed up by CHESF's 69/13,8 KV substations at Pirapama , and at Cabo , of their own .

Of the primary feeders comprising the network , only one services the multiple populational aggregate existing in the area where the Industrial Complex will be installed , same is shown in figure 2/II .

2.1.2 TRANSFORMER SUBSTATIONS

The transforming capacity of 69/13,8 KV for supplying the distribution network of CELPE in this area , reaches 10,000 KVA at Pirapama and 5,000 KVA at Cabo .

The single-wire diagrams of these two substations are shown respectively in figures 2-III and 2-IV where are indicated the respective transforming capacities , the existing feeders of 69 KV and 13,8 KV , the available means of voltage control and other details of these installations.

2.1.3 DEMANDS OBSERVED AT THE SUBSTATION

The maximum demand at the substation of Cabo is of 4,900 KW. At Pirapama this maximum demand is of approximately 5,000 KW. So , there exists feeding availability of more than 5,000 KW at Pirapama , considering the present installations .

2.1.4 POSSIBILITY OF ENLARGING THE SUBSTATIONS

It is appropriate to note that both the Cabo substation and the one of Pirapama can easily have their transforming capacity of 69/13,8 KV enlarged by adding new units . At Pirapama, the project permits an increase of the capacity to 30,000KVA and at Cabo to 10,000 KVA by the implantation of an additional transforming unit of 5,000 KVA already foreseen in the original lay-out .

2.2 GENERATING CAPACITY OF THE CHESF SYSTEM

At the end of 1973 , CHESF system had an effective generating capacity of 1,761,000 KW cpmprising :

- Paulo Afonso I, II and III (12 units)	1,446,000 KV
- Boa Esperança	108,000 KW
- Floating Thermal Plant Salvador	121,000 KW
- Hydro-Electric Plants and Auxiliary Thermo-Electric	86,000 KW

Out of this total , Boa Esperança was not inter-connected to CHESF System and only served the states of Piauí and Maranhão . For this reason , the CHESF System , which served other seven states , had a generating capacity of 1,653.000 hW, in 1973 .

Even though Boa Esperança started operation simultaneosly with the other plants of the system , there was not any noticeable increase of this generating capacity , inasmuch as Boa Esperança remained reserved to serve the areas of Piauí and Maranhão on a priority basis , its share in other areas being small and expressionless , except in the region of Sobral in Ceará , which normally resorts to that power source for the supply of its needs , as an alternative supply coming from Paulo Afonso .

Still in the year 1974 the generating capacity evolved to 1,893,000 KW , by the addition of 240,000 KW corresponding to the no. 13 generator of Paulo Afonso II plant .

2.3 SINGLE-WIRE PLAN OF PAULO AFONSO GENERATING INSTALLATION .

The Paulo Afonso operation plan achieved the greatest flexibility of maneuvers and inter-connections early Dec.73.

when the new Paulo Afonso substation (substation III) started operating .

Indeed , the referred substation has three sectionable principal piers , enabling the inter-connection and any operational arrangement desired among the generating plants I , II and III and the distribution of lines of 230 KV which serve Recife , Salvador and Fortaleza .

The simplified single-wire plan of these installations at Paulo Afonso is presented on Figure 2-V . It can be observed the great flexibility and greater dependability acquired by CHESF System , by means of separation of generating blocks corresponding to the generating plants of Paulo Afonso ,which come to be inter-connected at substation III as if they were separated tens of kilometers , with total operational inter-dependence . This independence results in a lesser risk of occurring stoppage at the plants due to consecutive defects, caused by the existence of inter-dependent links among these ..

Another important aspect which should be stressed is the short-circuit capacity limitation that CHESF charge outflow may have , in function of the flexibility of the generating plants inter-connection and the line transmission of 230 KV to the footings of substation III .With this availability , the CHESF charge outflow may act in order to maintain , at any charge condition , the maximum level of 10 GVA in the short-circuit capacity under 230 KV at Paulo Afonso , consequently limiting the risks and damages due to circulation of high short-circuit intensity current in the 230 KV System.

2.4. 230 KV TRANSMISSION NETWORK BETWEEN PAULO AFONSO AND PIRAPAMA .

A substantial reinforcement was received by the CHEFS transmission network to the Great Recife area , with the conclusion of the fourth 230 KV (line N 4) between Paulo Afonso and Angelim .

At present the network operates with four circuits between Paulo Afonso and Angelim (N1 , N2 , N3 , N4) and three between Angelim and Recife (N 1 , N2 , N3) . From Angelim two circuits at 230 KV follow to Campina Grande where a transmission ring under 230 KV involving the connections to the substations of Goianinha , Mirueira , Recife and Pirapama closes . This constitutes a substantial addition to the capacity and dependability of inter-connection between Angelim and the area of Recife .

The simplified single-wire plan shown on figure 2-VII ,represents the situation of the system up to the end of 1974.

The simplified diagram shows the circuits already in operation as well as the connections effected and the 230 KV circuit-breakers of each circuit .

The regulation of the 230 KV network between Goianinha, Mirueira , Recife and Pirapama will be effected as from 1975 when the new Recife II substation of 500/230 KV starts operating . At that sector of the system some circuits were prepared in antecipation of connections , which will only be ready when the Recife II substation starts operation and is connected to the network .

2.5 ANALYSIS OF GENERATION AVAILABILITY IN 1974

At this end of 1974 the CHESF System has generation availability of 1,893.000 KW , considering the installations fo Paulo Afonso (plants I , II and II) the Salvador Thermal Plant and the auxiliary thermo and hydro-electric units .

The above installed capacity undergoes a reduction when any recess discharge , recess flood or high level flood occur at Paulo Afonso .

At Paulo Afonso the installed capacity at the three plants , which is 1,686,000 KW , may be reduced in proportion to the discharges limitations of São Francisco River , at the time of recess (June- October of each year) . More recent studies of the operation of the Tres Marias reservoirs , following the great 1971 drought , determined a minimum discharge of 1,000 m^3/s at Paulo Afonso , with a 98 % probability .

This minimum discharge , considering the daily regulating effect of the present adduction basin of Paulo Afonso , makes possible the operation of 1,280,000 KW at the three plants , which represents a reduction of about 24% over the installed capacity .

On the other hand , in the normal floods (with maximum discharge up to 9,000 m^3/ s) , the servicing capacity of Paulo Afonso may be reduced by the diminution of the falls as a consequence of the water level elevation at the canyon down the Plant . However this effect was greatly reduced with the steps CHESF has taken when the bed of the canyon was straightened , so that the point servicing capacity at Paulo Afonso during the flood period , only undergoes an insignificant reduction (5%) .

It is worth mentioning as an important element that for 1975 CHESF foresees to start the filling of the Mocotó reservoir, which will make feasible to overcome the problems of minimum and maximum discharges at Paulo Afonso.

The multi-weekly regulating action, which Mocotó will make possible, will allow the operation of the full installed capacity of Paulo Afonso I, II and III even during the drought with 1,000 m^3/s of minimum discharge. The available " pondage " at Mocotó will guarantee about 17 weeks of operation, which period is longer than the duration of minimum discharge of São Francisco River. Besides that, it will be possible to act with the Mocoto embankment, in order to retain, during the river's flood seasons, a substantial discharge at the daytime period during the point of charge in the system. The convenient operation at the Mocotó sluices will guarantee the passage of the flood discharge to Paulo Afonso, after the point hours, when the lower charge of the system at dawn hours, already admits the reduction of the maximum capacity at Paulo Afonso, without damaging effects to the servicing of the CHESF network.

The evaluation of the consumer market growth of Northeast region made conjointly by CHESF, ELETROBRÁS, and state distribution companies has defined expressive results when it was concluded in 1972. It is expected that the demand growth of the CHESF system, which has kept an average value of 14% per year during the last ten years, will evolve to about 18% for the period - 1972-1975, due to the great industrial boom manifested in the region. In fact, these value have been confirmed by the rates observed in 1973, when the maximum demand of the CHESF system grew in about 19%, in relation to the values observed in 1972.

According to observations made in the course of the January-September 1974 period , in respect of Dow Quimica , SIBRA and COPENE , marked growth in the respective commitment demand re - quests with CHESF were defined . Undoubtedly as the case describes representative consumers of the Northeastern market , it may be admitted that this will be able to overcome the perssures which were made in 1972 and accounts for a growth rate of 20% per year , approximately for the 1972-1975 period .

This high growth may also be visualized by means of a month -by- month confrontation of the maxi- mum demands in the period January-October 1973 and 1974 , when the growths fluctuated between 16% and 26% approximately . At any way , the market forecast to 1974 admits a maximum demand of 1420 MW to CHESF system and which must be reached at the final period of the year (.... October-December) .

A non-existance of the regularization that would result from the Moxotó reservoir , the influence of the necessary generating reserve and the occurence of yearly maximum demand during the month of December (time of the floods at Paulo Afonso) make it possible to determine the power balance for 1974 . It is proper to note that in October , limit of the drought season in the São Francisco River , the peak of the system is of 98% of the yearly maximum demand , reason why this condition was also verified at the power balance .

Power Balance of the last quarter of 1974.

	October -74	Dec-1974
	1,390	1,420
- Peak of the System(MW)		
- Generating Capacity Instal- led (MW)		

At Paulo Afonso	1,686	1,686
Thermal-Gas Plants	121(1)	121(1)
Auxiliar Plants	86	86
- Peak-servicing Capacity(MW)		
At Paulo Afonso	1,280(2)	1,370(3)
Thermal-Gas Plants	100(A)	100(4)
Auxiliary Plants	86	86
Total	1,466	1,556
- Power Balance (MW)		
(Balance or deficit)	76(5)	136(5)

NOTES:

1) It was only considered the Floating Thermo-electric Plant at Salvador (Aratu), since the Recife Plant is scheduled for late 1975 .

2) Value calculated for minimum discharge is 1.000 m^3/s .

3) Value calculated with a 5% reduction in the installed capacity, of which it was only deducted the amount of 240 MW corresponding to the greatest generating unit of the system, which remains as a reserve .

4) Calculated value allows a unit at Salvador 21 MW Plant, under maintenance condition-

5) Balance corresponding to the difference between the total amount and the peak of the system .

It is observed that the available balance to attend the peak of the system even with the generating reserve made possible at Paulo Afonso at the time of recess (drought) and of 136 MW at the flooding period .

2.6 ANALYSIS OF THE TRANSMISSION AVAILABILITY FOR THE PIRAPAMA AREA IN 1974 .

Considering the single-wire simplified plan of the transmission network for the Recife and the Pirapama area, the analysis of the availability of the transmission from Paulo Afonso to that area will be effected in function of the maximum capacity foreseen for the transmission circuits.

This maximum capacity is function of the voltage regulation admitted at the network planning and, as a consequence, of the reactive supply which is obtainable with the compensation of the voltage regulation and with other conditionings of the transmission line itself.

For the 230KV circuits of CHESF, the normal condition is attended with a voltage regulation equal to 10% .A higher regulation is admitted under emergency conditions (15 to 20%) due to the disconnection of a transmission circuit. Such ranges of regulation are attainable due to the radial nature of the CHESF system itself, with no large-sized interconnections.

Considering the compensation of reactives and the characteristics of the transmission lines, for the Recife planning system, CHESF laid down the following limits of maximum charge for the distances involved:

MAXIMUM CHARGES (MW) IN EACH CIRCUIT

Tipo of 230 kV TL	Normal
N1, N2 or N3 (1 x 636 MCM)	150
N4 (2x636 MCM)	160

the installation of an industrial center coherent with the develop ment of the North-East.

The small transforming capacity of the two substations already located in the area, and the servicing of Pirapama made exclusively by line nº 1 , constitute a defficiency which is about to desappear as planned by CHFSF.

Based on these maximum charges indicated and considering charges flow between Paulo Afonso and Recife area, simplifief plans of 2-VII and 2-VIII can be prepared, which plans present the conditions of the area transmission system, in 1974.

As it is possible to observe, the power supply of Pirapama up to 50MW is assured both under normal circumstances and in an emergency, this being istsb lished when we consider circuit N4 disconnected , which is the most unlikely defect ot the system trans mission.

However, it is observed that Pirapama supply, such as it is foreseen at present, becomes dependent on Recife supply by the trunk-axis Angelim-Recife (N1).

Analysing this trunk-axis focusing the Pirapama supply, and taking into account the normal limit of the maximum transmission chage (150MW) and keeping the same 60MW for Recife, 90MW will be left, which may be destined to Pira pama, which corresponds to an expressive increase to the present chage.

This being the case, a transmission reserve will become assured by means of circuits N2 and N3, through Recife (substation of Bongi), with the consequent inversion of the charge flow .

This situation will be kept until the new Great Recife area supply plan starts operation, based on the inter-connection of Recife II substation 500/230KV to the net work.

The analysis of the power availability up to the end of 1974 served to make apparent some insufficient resources to be conquered in the sector, in order to make feasible

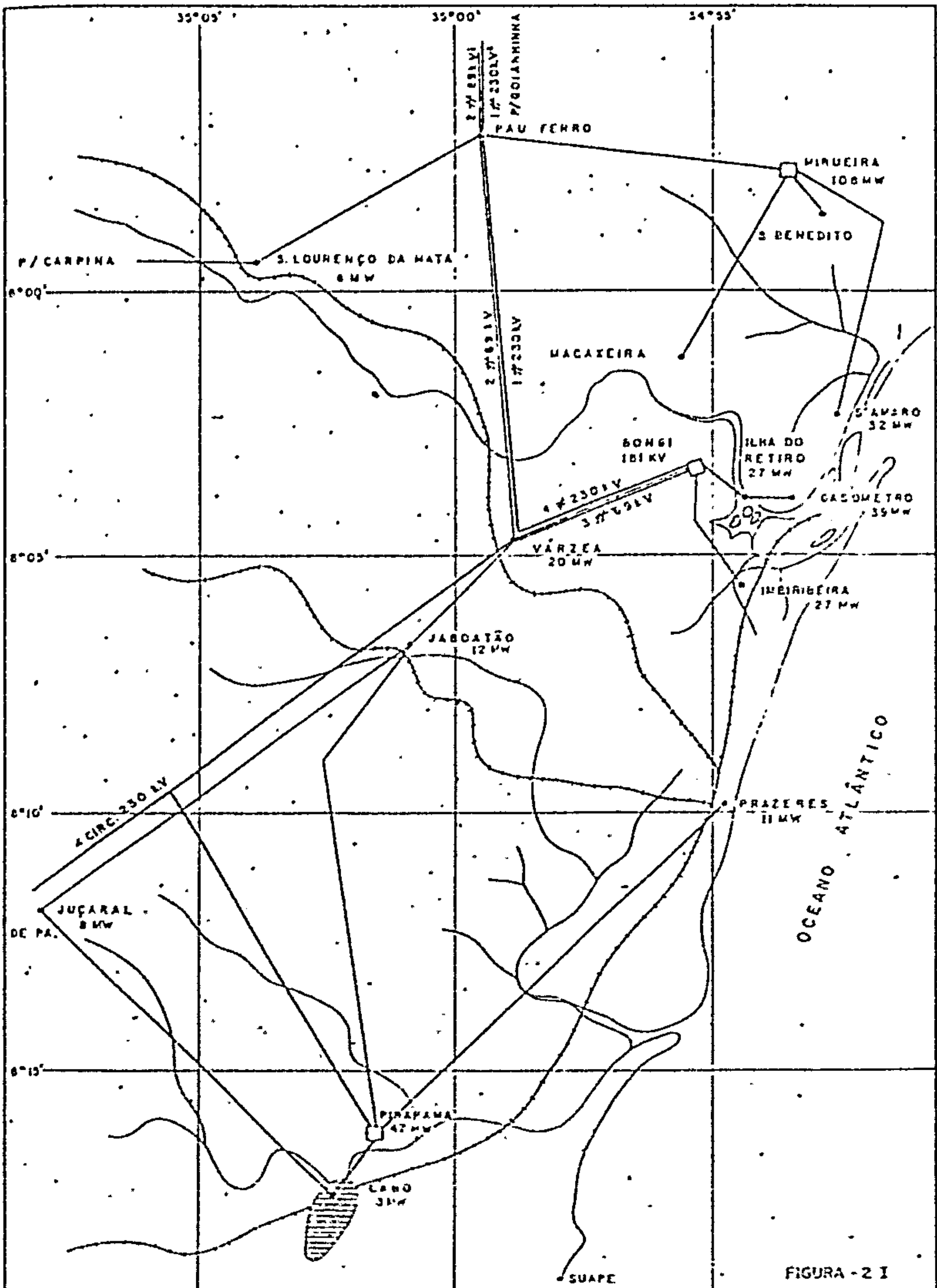

FIGURA - 2 I

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TRASCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO – PAAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

Present situation of the Electric Power Supply

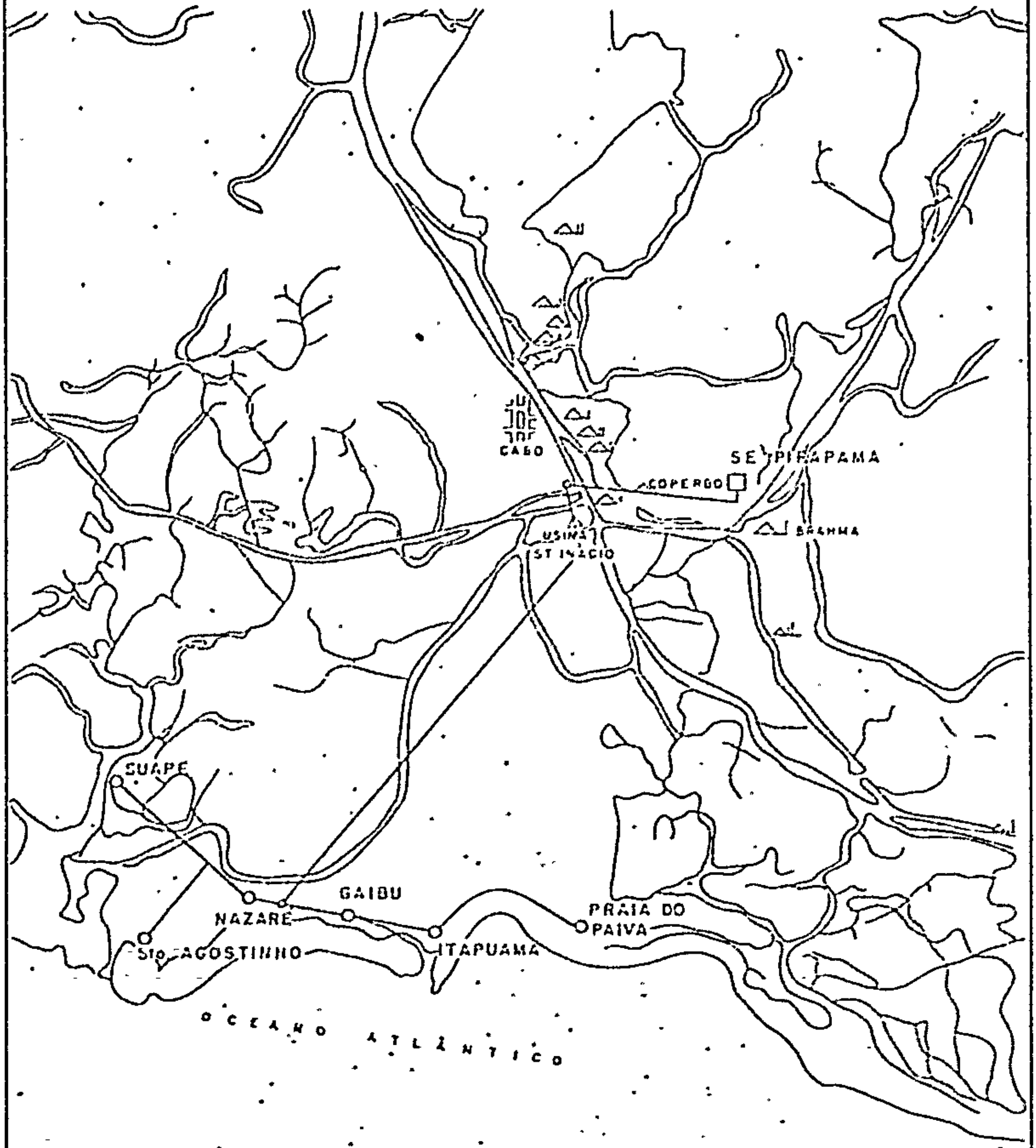

FIGURA -2 II

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TRANSCON S.A

COMPLEXO INDUSTRIAL DE SUAPE

CELPE's 13,8 kV feeder at Suape Area

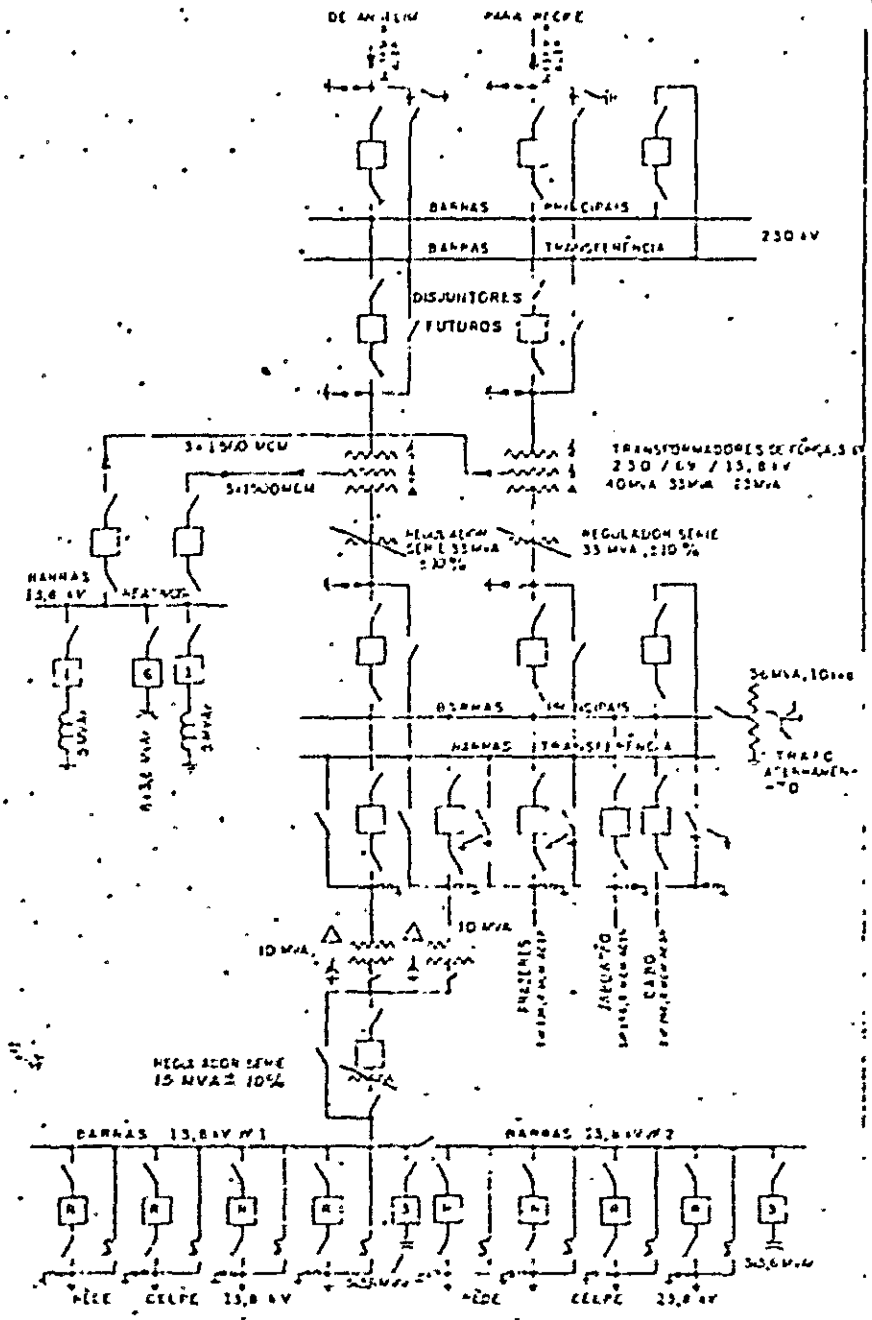

FIGURA 2-III

GOVERNO DO ESTADO DE PERNAMBUCO - PNAC
COMPANHIA DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

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TRASCON S.A.

Single - Wire Diagram Pirapama Substation

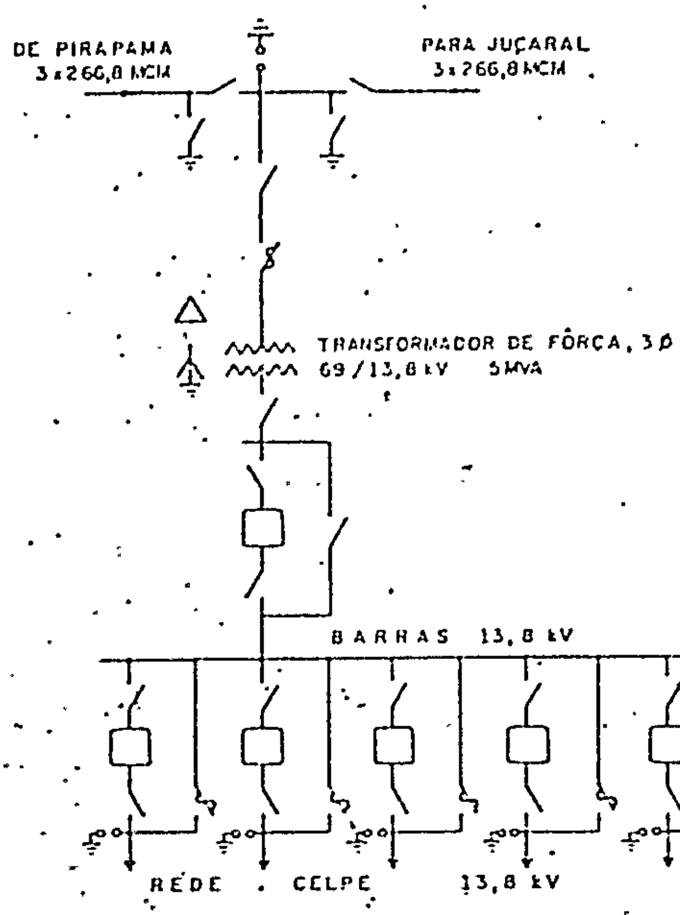

FIGURA 2-IX

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TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO
DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

Single-Wire Diagram
Cabo Substation

12/74

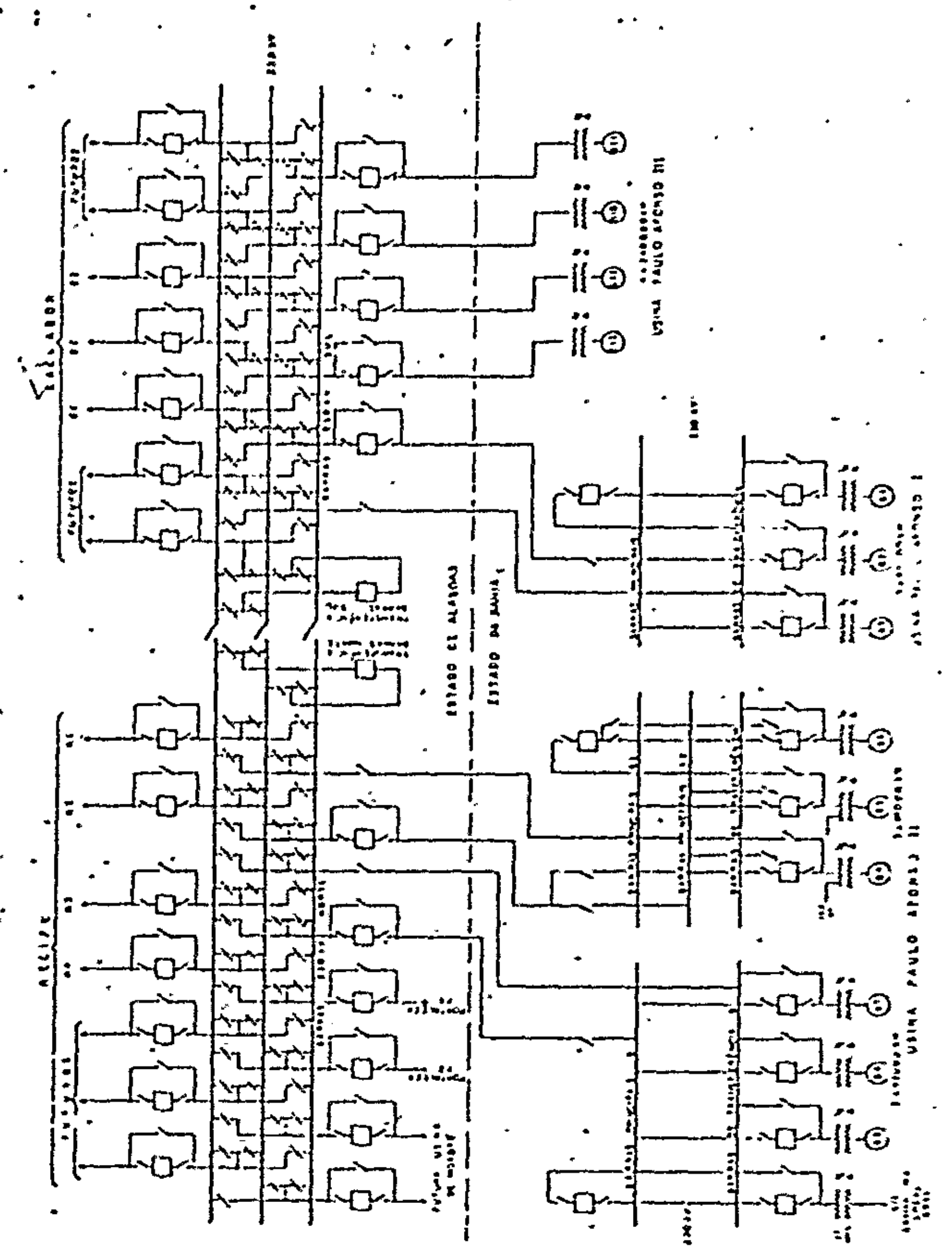

FIGURA 2-I

Paulo Afonso I, II & III Plants. Simplified Single-Wire Diagram of the Interconnections with the new Alagoas Substation.	diper TRANSCON S.A.	GOVERNO DO ESTADO DE PERNAMBUCO DE PERNAMBUCO COMPLEXO INDUSTRIAL DE SUAPE

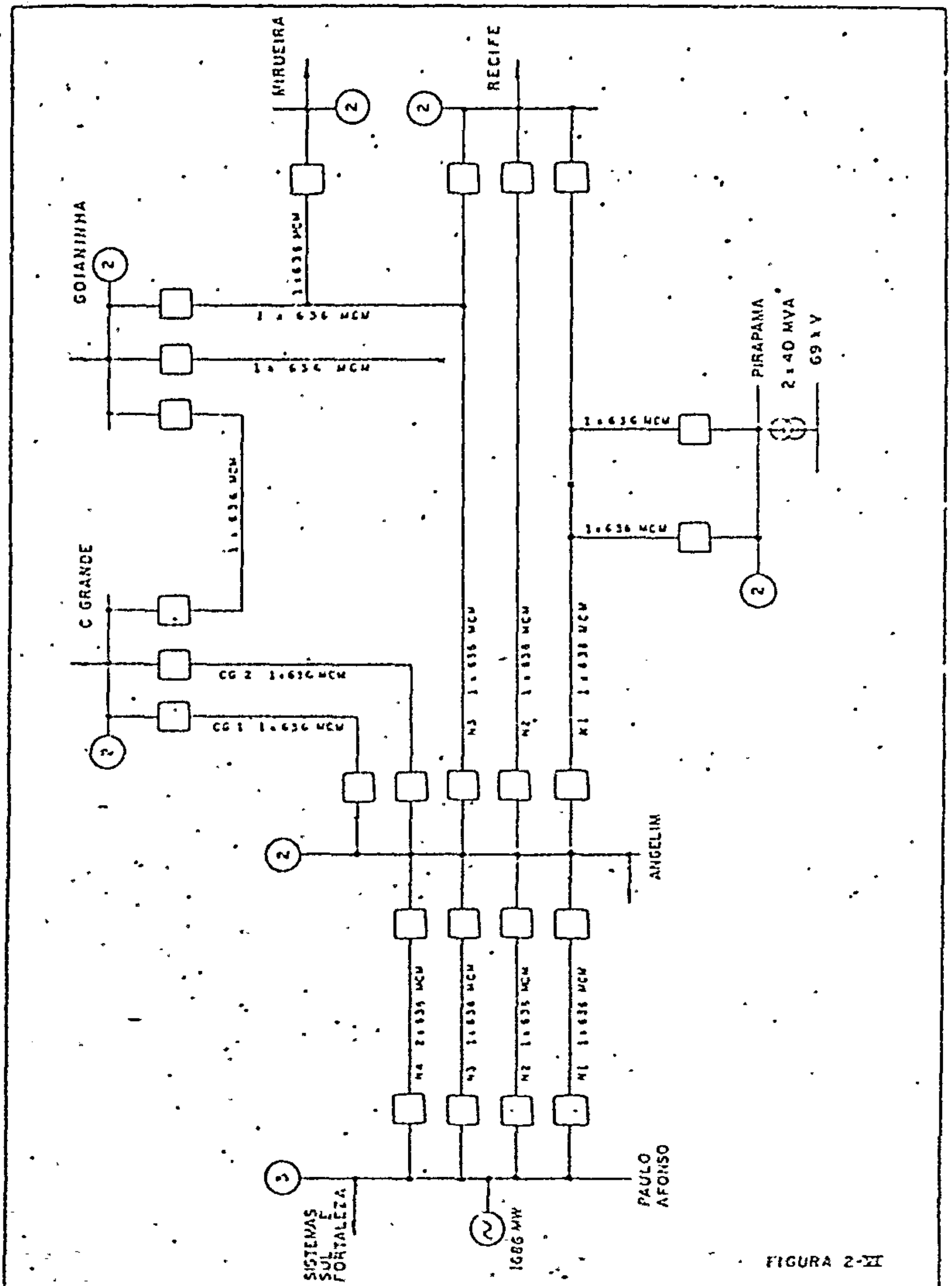

FIGURA 2-XI

Paulb Afonso-Recife 230 kV Transmission System.

Simplified Single-Wire Diagram at the end of 1974

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TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

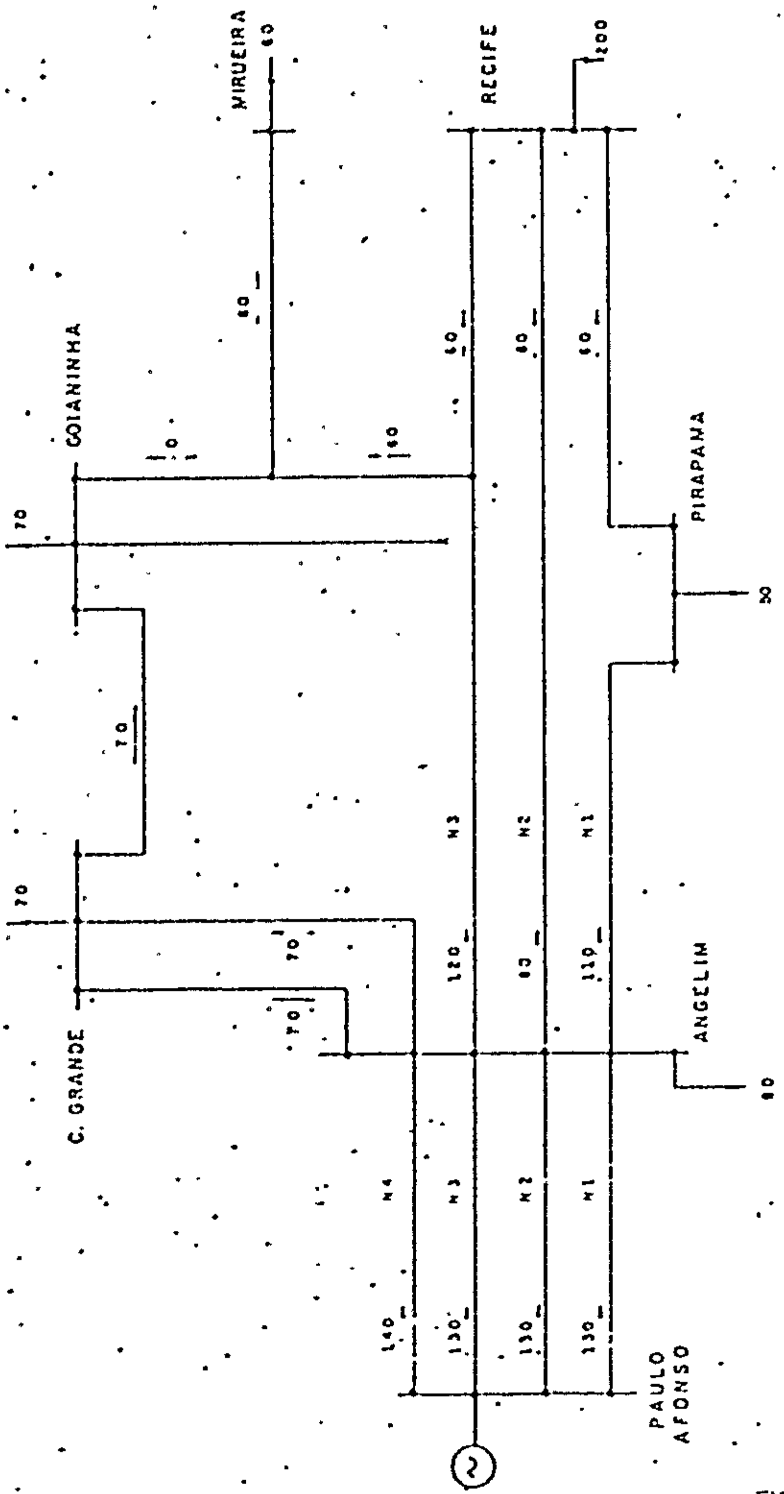

FIGURA 2-XI

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TRASCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO - [illegible]
[illegible] DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

Normal Condition of the Transmission System 1974 Charges

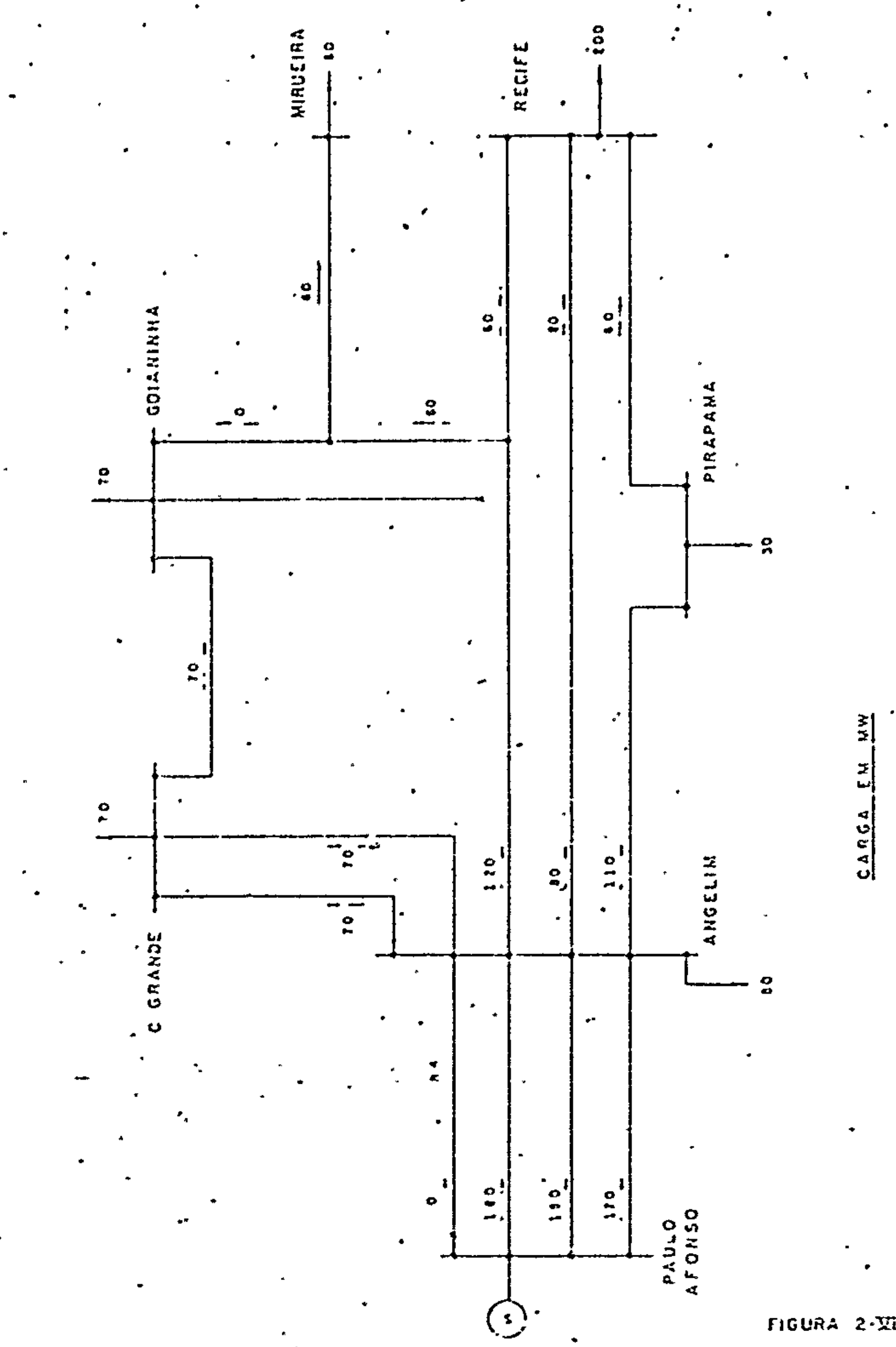

FIGURA 2-VIII

Pirapama Area Transmission System. Emergency Condition.

No. 4 Line - Paulo Afonso-Angelin Disconnected. 1974 Charges

diper

GOVERNO DO ESTADO DE PERNAMBUCO
DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

TRANSCON S.A.

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3.0 - STUDY ON THE CONSUMER MARKET

3.0 STUDY ON THE CONSUMER MARKET

The Basic Economic Studies define the feasibility and the stature both initial and future of the different types of consumers forecast to be established in the Industrial Complex of Suape as from 1980, constituting a pioneer nucleus.

The specif power consumer market starts in this way to get form, consisting of :

- Oil Destillery
- ''Clinquer'' Mill
- Fertilizer Complex
- Aliminum Plant
- Port Facilities
- Urban Areas

Based on the figures utilized for the industrial projection growth, was defined the power consumer market evolution until 1985.

As a result of the big sized industries which could be installed at suape, the CHSF system availabilities until 1985 were equally evaluated.

3.1 INITIAL CHARGES EVALUATION

The maximum initial demands , appearing on Schedule 3.1 were evaluated with basis on the data contained at Basic Economic Studies or taken from similar installations , the charge factors being defined according each type of consumer .

In the case of the oil destilleries , however , the annual charge factors , from the point of view of the power acquired from the concessionaire , may present extremely low values , since they are much more influenced by the process technology and by the dependability of the power supply than by the regime of work and kind of consumer.

The consideration of these elements , as well as the characteristics of serving by CHESF , allow to estimate in 60% the share of energy to be acquired and in 50% the charge factor of the refinery of the complex .

3.2 MARKET EVOLUTION

The evolution of the electric power consumer market at the Industrial Complex of Suape , due to its characteristics , was evaluated ,whenever possible , in function of the growth defined at the Basic Economic Studies, for each type of industry to be implanted there .

3.2.1 OIL DESTILLERY

The beginning of the oil destillery projected is scheduled to start operation in 1980 . Its daily capacity of 126,000 barrels will consume about 260,000 MWh/year. Out of this energy it is expected that 160,000 MWh/year will be acquired , the rest remaining ascribable to the generating process itself .

SCHEDULE 3/1

MAXIMUM YEARLY DEMANDS

CONSUMER	ACQUIRED POWER (MWh/year)	CHARGE FACTOR %	MAXIMUM DEMAND(MW)
Oil Destillery	160,000	50	35,00
Clinquer Mill	94,000	85	12,00
Fertilizer Complex	13,400	60	2,50
Aluminium Factory	3,500,000	80	514,00
Port Facilities			
Colective Port	900	28	0,40
Oil Terminal	5,300	44	1,38
Urban Area	3,600	50	0,80

Initial Year : 1980

The refining capacity of North-east in the 1975-1980 five-year period must grow at a yearly rate of 9% , approximately ,reaching a slightly higher value than the foreseen demand .

It may then be admitted that at least the same rate of 9% be kept in the 1980-1985 period , so raising the oil refining capacity to about 200,000 BLDO .

Oil destilleries of this size acquire an average of 250,000 MWh/year under a demand of 60 MW approximately.

3.2.2 CLINQUER MILL

This is an assembly destined to the grinding of ensilage and shipment of cement in bulk .

At the 1980-1985 period the programmed installations will have a capacity to move 2 million tons /year of cement , and must double this capacity at the 1985-1989 five-year term .

The confrontation of facilities like capacity moves feasible the evaluation of the initial consumption and the demands and their respective evolution as well as can be seen hereunder :

	1980-1984	1985
Consumption (MWh/year)	94,000	186,000
Demand (MW)	12	24

3.2.3 COMPLEX OF FERTILILIZERS

According to information deriving from economic studies, the production of the complex of fertilizers , in its various stages , is expected to develop in the following way :

		Production t/year	
Phase	Period	Phase	Accumulated
1st	80-83	215,000	215,000
2nd	84-85	300,000	515,000
3rd	beyond 1987	486,000	1,001,000

The unit power consumption is in the vicinity of 62 KWh/ton of fertilizer , which entails an overall consumption close to 13,400 KWh/year at the first phase and 32,100 KWh/year at the second . This accrued growth of 13,3 % must occur in the 1980-1986 period ; if the same growth is kept in the 80-85 period , the consumption and the demand of power must evolve as indicated at the table below :

Period	Consumption MWh/ year	Demand
1980/ 83	13,400	2,5
1984/ 85	28,300	5,4

3.2.4 ALUMINUM PLANT

The installation of a producing unit is envisaged, making 200,000 tons/year of aluminum , obtainable through alumina .

The above total producing capacity , which comprises both primary and secondary production , is expected to reach an annual growth of 9% during the 1980-1985 five - year period..

Should such forecast be confirmed , the aluminum production will reach in 1985 the 310,000 t figure , with a corresponding increase in the annual consumption of electric power of 5,600,000 MWh ,for an approximate maximum demand of 800 MW .

3.2.5 PORT FACILITIES

The Suape port turnover will be attainable with the use of several private terminals and a collective Port .

The privates ones , totalling 4 in 1980 , will be made available to Petrobrás Distillery , Clinquer Mill , fertilizers Complex and the Aluminum Plant . Through the three latter there must be a 5,701 x 10^3 tons/year turnover in 1985 , lacking in miner demand and for this very reason already considered at the charges of the respective users .

Should the same consideration also prevail in connection with the Distillery Mill it would be necessary to launch a 10 Km long private feeder from the Distillery's substation passing accros a region which gives hopeful expectations to the appearance of new consumers . It would seem , therefore , more sensible to look at the terminal as an independent Distillery consumer and power it from the network distribution .

It is forecast for 1980 the turnover of 11,245 x 10^3 tons/year through the terminal , which will consist of crude oil and derivatives . Comparing similar facilities it is acceptable to admit a 5,300 MWh under a 1.38 MW demand. For 1985 it is foreseen a reduction in the port turnover, which must be around 11,152 x 10^3 tons/year , the power consumption and demand maintaining values around 5,240 MWh and 1.36 MW , respectively .

Through the collective port will pass 1814 x 10^3 ton /year in 1980 and 3255 x 10^3 ton /year in 1985 . Comparing these data with the ones referring to Guanabara state port, it has been possible to estimate in 900 MWh the 1980 consumption and in 1600 MWh for 1985 , and calculate for maximum demands 0.4 and 0.7 MW , respectively .

3.2.6 URBAN AREA

The consumer market at the urban area , as a result of the implantation of the Complex , covering the residential and commercial classes , public consumption , rural and public lighting was analysed with basis on studies physical and territorial planning , and with basis on publications by the Ministry of Mines and Energy -Market and Energy Studies for the Northeast area , 1970-1985 period , Volumes I and II , June 1972 publication - which focuses the Recife area .

In this way , employing the data available from different topics of interest , consumption and demand appearing on table 3.2 were avaluated .

3.2.7 SYNTHESIS OF MARKET EVOLUTION

Table 3.3 presents the synthesis of the power consumer period , showing a cumulative growth of 9% per year approximately .

It should be remarked that the study of this market growth in the Suape Industrial Complex , has been practically limited to the enterprises listed on the Size Indicators.

However , it is expected that many other enterprises with different features and sizes will be installed in the region attracted by the high rate growth of the Northeastern Economy .

Taking into account that there exists a certain Industrial Nucleus at the location called Cabo , where CHESF and CELPE already have substations, it is admissible to conclude that these ventures will be situated near these subs - tations , contributing to the growth of the consumer market located outside of the Complex area.

TABLE 3/2

URBAN CONSUMER MARKET

Aggregate Consumption

Year	Number of Residential consumers	Annual Aggregate con - sumption (MWh)	
		Per residential consumer	Total
1980	566	3.12	1,766
1985	1,434	3.60	5,162

Camping Consumption

Year	Number of Inhabitants.	Annual Consumption(MWh)	
		Per Inhabitant.	Total
1980	7,500	.25	1,875
1985	7,000	.29	2,038

Maximum Annual Demand

Year	Global Consumption(MWh)	Charge Factor(%)	Demand (MWh)
1980	3,641	50	.8
1985	7,192	55	1.5

TABLE 3/3

DEVELOPMENT OF THE POWER CONSUMER MARKET

CONSUMER	1980		1985	
	Yearly consumption(MWh)	Maximum Demand(MW)	Yearly consumption(MWh)	Maximum Demand(MW)
Oil Distillery	160,000	36.00	250,000	60.00
Clinquer Mill	94,000	12.00	188,000	24.00
Fertilizer Complex	13,400	2.50	28,300	5.40
Aluminum Plant	3,600,000	514.00	5,600,000	800.00
Port Facilities				
Collective Port	900	0.40	1,600	0.70
Oil Terminal	5,300	1,38	5,240	1.36
Urban Area	3,600	0.80	7,200	1.50
TOTAL	3,677,200	-	6,090,340	-

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4.0 - POWER AVAILABILITY IN THE 1975-1977 TRIENNIAL

4.0 POWER AVAILABILITY IN 1975 - 1977 TRIENNIAL

4.1 GENERATING CAPACITY OF CHESF SYSTEM IN THE TRIENNIAL .

In the period from 1975 to 1977 , CHESF electric system will be greatly enlarged to serve the tremendous charges already foressen for the Northeast region .

So,at the end of 1975 the operation of Recife's thermo-electric plant must be considered,which will alleviate the transmission system with its 150 Kw capacity .

Still in the generation line there will be completed instal lation of four 110 MW generating units at Moxotó , increasing by 440 MW the availability of Paulo Afonso - Moxotó Hydro Electric Complex .

Besides that , for 1977 it is forecast the conclusion of the Sobradinho dam , which will make possible the regulation of the São Francisco River , in order to assure 2.200 m^3/s of minimum outflow for top utilization of hydro-electric downstream .

The works of the initial phase of the construction works of Paulo Afonso IV Plant , will also be under completion , whose first 375 MW unit must start operation in the course of 1978 .

Therefore , installed CHESF generating capacity in MWs will develop as indicated below :

P L A N T	1975	1976	1977
Paulo Afonso I, II and III	1686	1686	1680
Moxotó	-	440	440
Aratu and Recife(Thermal)	271	271	271
Auxiliary......................	86	86	86
TOTAL	2043	2483	2483

Considering the necessary generating reserves, the available capacity in MWS, for peak servicing must be:

PLANTS	1975	1976	1977
Paulo Afonso I,II,III	1446	1446	1446
Moxotó	-	440	440
Aratu and Recife(thermal)	220	220	220
Auxiliary	86	86	86
TOTAL	1752	2192	2192

This available capacity for peak servicingin the period , wheo· com pared with the charges foreseen in the North-eastern Market , will present the following balance:

	1975	1976	1977
- Peak of CHESF System (MW).......... (1972 forecast corrected)	1630	1956	2347
- Generating capacity to attend the peak of CHESF system (MW).....	1752	2192	2192
- Balance (MW).....................	122	236	(155)

Only in the year 1975 and 1976 will materialize the possible disposability of balances which could be utilized to serve the complex, if CHESF had not a already made commitments for demand reserves requested by several of its consumers.

Besides, it ought to be stressed that that a 155 MW defict , probably occuring in 1977, will restrain still more the possibility to attend the Complex within the 1975-1977 triennial.

4.2 TRANSMISSION CAPACITY

In the transmission of power to the Great Recife Area, stands out the implantation of the extra-high voltage, under 500KV, between Paulo Afonso and the new 500/230 KV substation, denominated Recife II and located in the vicinity of Jabotão. The following new circuits will be put into operation in the area:

For 1975 - 500 KV TL Paulo Afonso-Angelim-Recife II(N5)
- 230 KV TL Recife II-Varzea(double Circuit)
- 230 KV TL Recife II-Parapama Shunting (double Circuit)
- 230 KV TL Recife II - Pau Ferro
- 230 KV TL Pau-ferro- Mirueira(double Circuit)

For 1976 - 500 KV TL Paulo Afonso-Angelim- Recife II (N6)

For the EAT system under 500 KV to be put into operation, it will be necessary to build in 1976 the Paulo Afonso and the Angelim sectioner .

In Recife II, already since 1975 will be operating the 230 KV definitive yard, through which , in 1977 the 500/230 KV-1200 MVA transformer will become inter-connected to the existing system. At the Pirapama substation in the course of 1976, the system will count with a 200 MVA capacity.tp transform 230/69 KV.

Starting in 1975, the thermo-electric Recife plant will be made available to emergency substitution, its capacity being equivalent to the maximum normal change of one of the N1, N2 or N3 transmission circuits .

Besides, the operation along the area charges, will alleviate the transmission system even if circuit N4, which has the greatest capacity, is disconnected the single-wire transmission system plans to the area, corresponding to 1976-1977, are represented in figures 4I and 4-II , respectively.

CHESF transmission system as soon as Recife II, foreseen for 1977 is equipped to supply up to 1.500MW and can be enlarged under 50 KV to attend much greater demands, through adequate series compensation and /or the installation of new circuits from Paulo Afonso to the area.

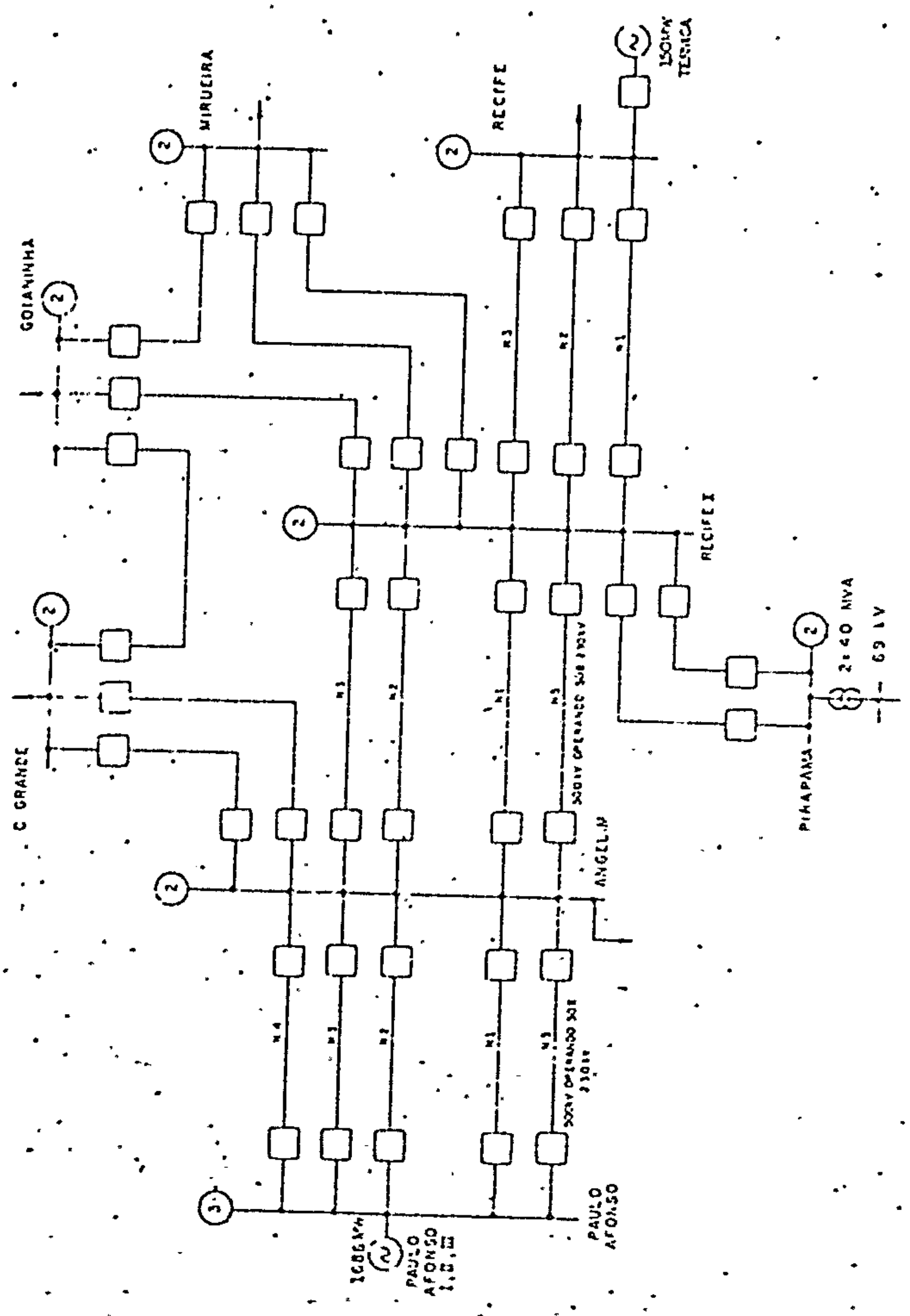

FIGURA 4-I

Paulo Afonso-Recife Transmission System.

Single-Wire Plan Foreseen For 1973

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COMISSÃO DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

TRANSCON S.A.

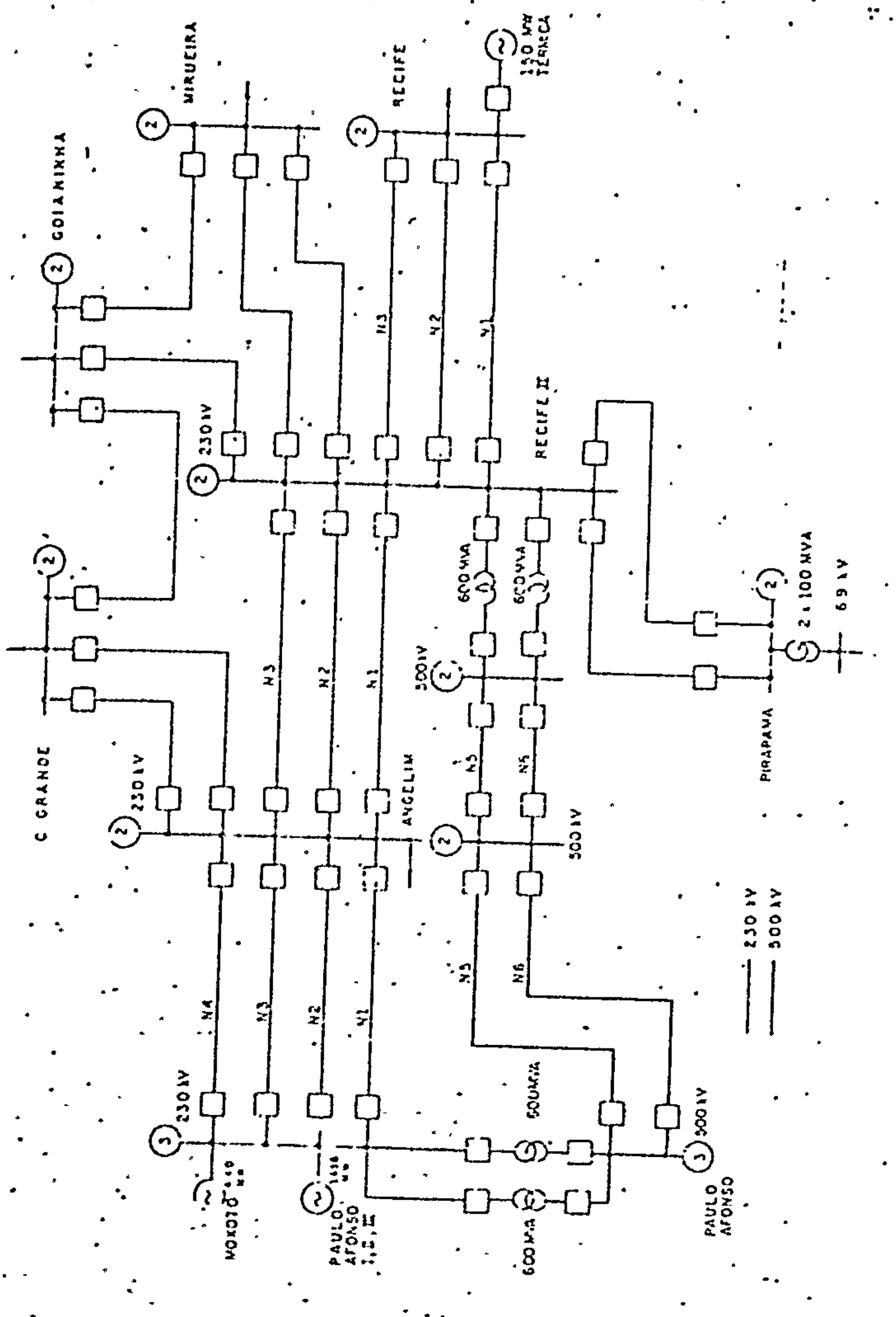

FIGURA 4-II

Paulo Afonso-Recife Transmission System.

Single-Wire plan foreseen for 1976/1977

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COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

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5.0 POWER AVAILABILITY IN THE 1978-1985 PERIOD.

5.0 POWER AVAILABILITY IN 1978-1985 PERIOD

5.1 Generating Capacity

As indicated preciously it is expected that the demand growth of CHESF system will reach 20% per year in the great industrial development occuring in the region , it is admissible to consider an accumulative growth of approximately 16% to the 78-85 period.

Should this-occur, the demand in the system may develop from 2347 MW to 7700 MW

In the planning for the enlargement of the CHESF system within the 1978-1980 triennial, its is foreseen the cons trection of the first stage of each one of the Paulo Afonso IV and Sobradinho, comprising respectively 375MW generators and 4 175 MW generators.

In this way, the effective installed generating capacity of CHESF will increase to 5433 MW at the and of 1980. And, keeping the usual generating reserves, the available capacity for peak servicing should be around 5.000 MW.

In the 1981-1985 period, the available generating capacity must evolve at a cumulative average yearly rate of 9% in order to meet the growing demand, all according to forecasts now available.

Such a requirement is consistent with the power disposability at CHESF concession Works. The plants currently under ex - ploitation were already mentioned here , as well as those ear-marked to enter into operation until 1980. Other exploits should be mentioned which may still be utilized :

Sobradinho (2 nd stage)	350 MW
Ibó	440 MW
Orocó	440 MW
Itaparíca	1.400 MW
Paulo Afonso IV (2nd Stage)	2.250 MW
Xingó	1.100 MW
Pão de Açucar	400 MW

It should be stressed that these values were estimated and allow for a low charge factor.

5. 2 Transmission Availability

Each 500KV transmission line of CHESF system can supply, normally and without series compensation instalation, about 600 KV between Paulo Afonso and Recife II. Under emergency circumstances it may be supplied up to 400 MW for one of the 500KV circuits, In this way , the firm transmission capacity from Paulo Afonso to RecifeII ~~are~~ reaches about 1.500MW.

Between Recife II and Pirapama the 230V seat will have a firm transmission capacity of 100MW, which capacity may be enlarged with the construction of new 250KV circuits in this stretch.

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6.0 POWER SUPPLY

The analysis of the consumer market , resulting from the implantation of the enterprises , which is now possible to predict , indicate that the charges expected for the Alumi num Plant and for the Oil Distillery must reach , respecti vely , about 514 MW and 36 MW in 1980 , developing to 800MW and 60MW in 1985 , as shown on Table 3/3 .

Depending on the respective separation of the supply source and on their charges amounts , the consumers may be connect ed in different voltages . So , those having charge over 50MW may be connected with 230 KV , the consumers whose charges are situated between 3 and 50 MW may be connected with 69KV ,leaving for the consumers with the lowest charges the 13,8 KV supply . In the case of the Oil Distillery the initial demand would make possible to attend with 69 KV , changing to 230 KV only in 1985 . For economic reasons it was preferred to feed the Oil Distillery in 230 KV already in 1980 .

230, 69 and 13.8 KV tensions are available at Pirapama subs tation located few kilometers away from Recife II substation. The small distance between them permits a steady transmission of 180 MW per 230 V per circuit . This would make possible to attend adequately the growing charges at SUAPE area , through Pirapama , should this substation have an area large enough to permit it to expand until attain conditions of at least , become compatible with the port demand forecast for 1980 . However , Pirapama substation does not offer such an expansion possibility .

That being the case , a new 230/69/130 KV transformation fed by Recife II , has to be implanted ; Pirapama may be utilized as a support to attend charges to be installed in its vicinity . Besides that , the construction of a 230KV tie interconnecting Pirapama to SUAPE substation , will pro vide an exchange of resources between them .

Therefore , the complex attendance plan , to be in a condition to keep up with the evolution of the charges in the 1980-1985 period , is expected to comprehend CHESF 230KV network enlargement and the installation of a new 230/69/ 13.8 KV substation at SUAPE , in the interior of the area covered by the COMPLEX .

Figure 6-I and 6-II show single-wire simplified diagrams referring to 1980 and 1985 , respectively .

The new substation , whose situation appears on Annex no.1 is expected to be fed by two twin conductors circuits (2x 636 MCM) , with a capacity to attend the evolution of the demand forecast to occur at the 1980-1985 period .

At the start of the period , that is , in 1980 , when Pirapama substation will be able to have transforming capacity of 200 MVA , it may still be fed by just one of the two circuits , with the other reserved to attend an emergency . Should one of the feeding circuits of SUAPE substation fail , the remaining circuit will be in a condition to carry 500MW , which represents about 90% of the requested charge ; through the " tie " Pirapama may contibute with the remaining 40 MW , provided its two circuit are in operation .

In 1985 , 850 MW charges at SUAPE substation and 300 MW at Pirapama substation are foreseen . At the latter it is impossible to attend the charge should one of the feeding circuits fail .

The launching of a third feeding circuit for the PE substation , from Recife II , even in a single 636 MCM condutors) at SUAPE substation in the case of the loss of [illegible] one of the two feeding circuits at Pirapama .

Should one of SUAPE feeding circuits be at fault besides the ones transportable by the remaining feeder , it will have 230 MV through the third circuit , of a single conductor , coming from Recife II and 120 MV from Pirapama through the " tie " totalling around 850 MW . However it is quite probable that the power consumer market in 1985 , due to its characteristics , will make economically feasible the launching of a third circuit also with 636 MCA twin conductors.

Starting in 1985 , it is estimate that the Fertilizer Complex demand will reach 5.4 MW , making it possible to operate at 69 KV .

The Fertilizer Complex situation . located at an area available specially to the medium sized industries , justifies the launching of 69 KV line , even if it starts its operation attending only the [illegible] MW Fertilizer demand, forecast for 1980 .

Depending on the development of future charges , the dependability of the supply to [illegible] substation may also be improved , by means of its interconnection with the 60 KV bus- bar of SUAPE substation .

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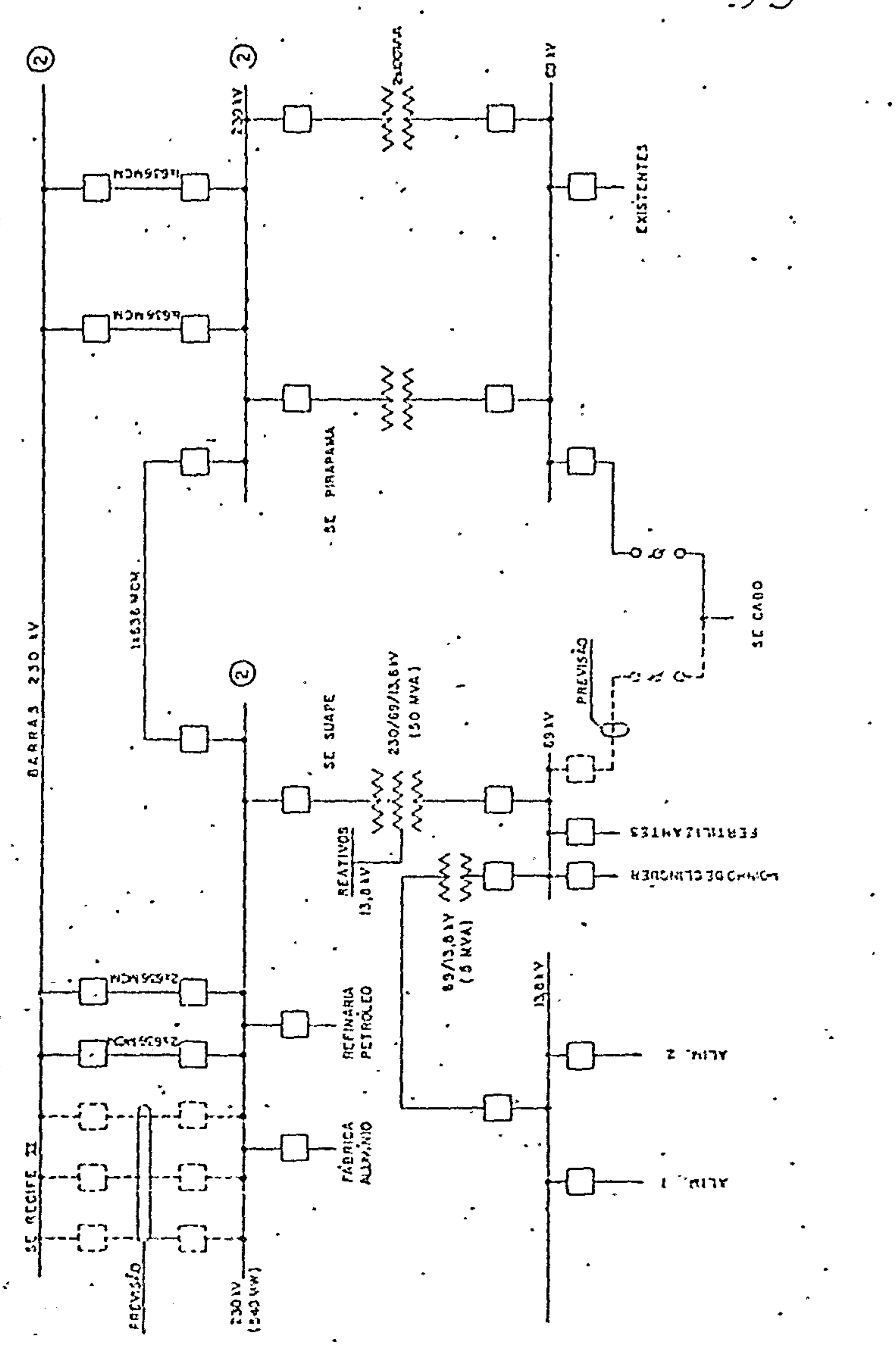

FIGURA 6-I

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GOVERNO DO ESTADO DE PERNAMBUCO - PRAC

COMPLEXO INDUSTRIAL DE SUAPE

Simplified Single-Wire Diagram

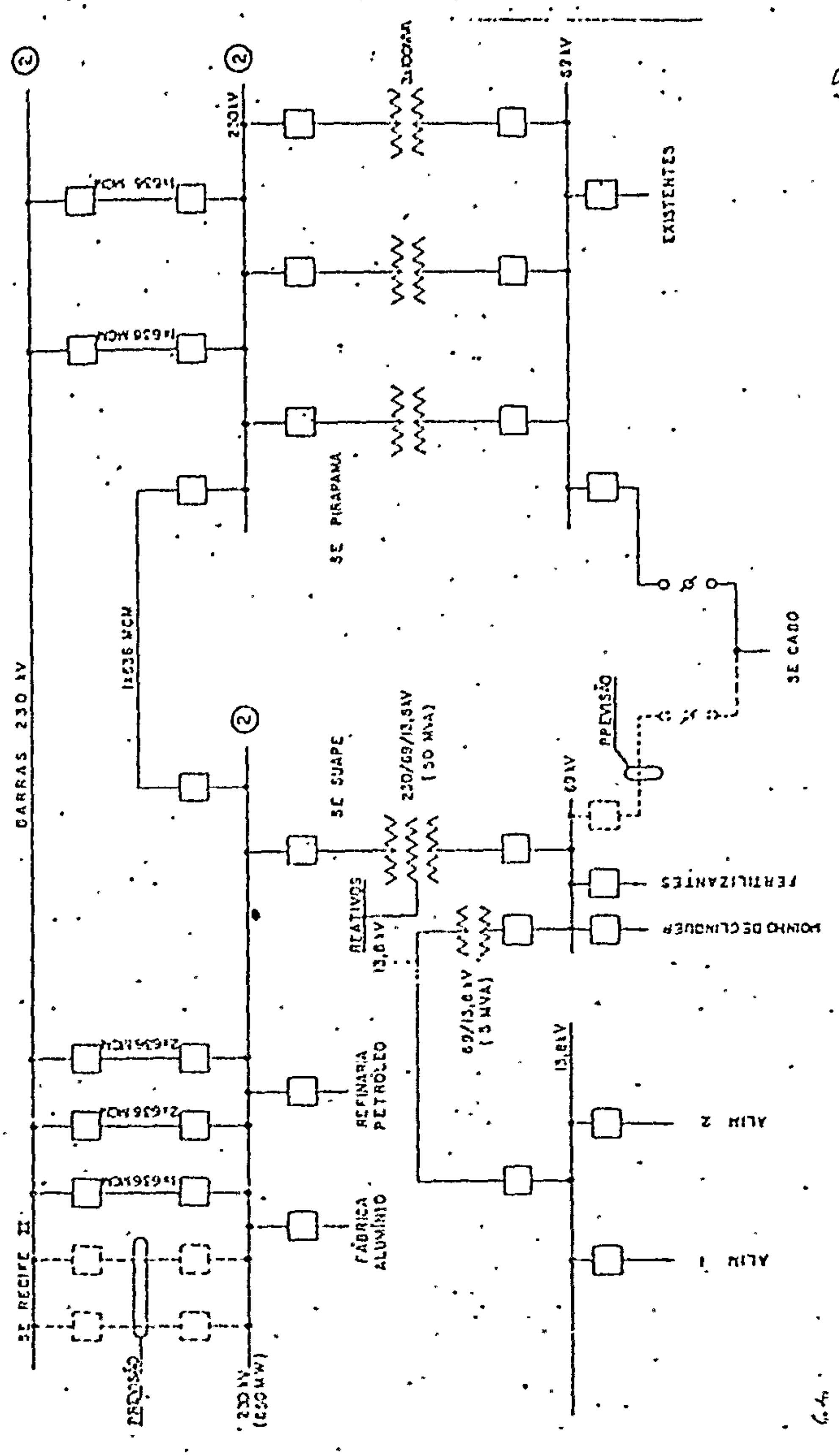

FIGURA 6-II

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TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO-PRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

Simplified Single-Wire Diagram

1985 - Forecast

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7.0 SUBSTATION

7.0 SUBSTATION

7.1 GENERALITIES

The substation purpose is to attend SUAPE INDUSTRIAL COMPLEX and the increase of the demand in the area. It is to be installed at a tract with the approximate area of 223 m x 125 m , located as shown on Drawing Annex 1 .

7.2 PRINCIPAL CHARACTERISTICS

Voltage : 230-69-13.8 KV

Frequency: 60 Hz

Transforming Capacity : 230/69KV-50MVA,LN/VF/VF,
69/13.8KV - 5 MVA .

7.3 FEEDING CIRCUIT AND FEEDERS

The substation will be fed by five 230 KV circuits , which will interconnect it to Recife II and Pirapama substations . Also at 230 KV , it will have 4 feeders to Aluminum Plant , 1 to the Oil Distillery and 1 will be kept as a spare .

At 69 KV tension , two feeders will come out , one to the Clinquer Mill and another to the Fertilizer Complex; there will also be an allowance for a spare .

The transformer of auxiliary services, reactors and capacitors banks , as well as seven feeders to the local distribution will be connected to the 13.8 KV bus-bar . Two of these feeders will be utilized in the attendance of 1980 charges .

The reactors , connected to the tertiary of the main transformer , will consist of capacitors bank and reactor , the powers of which were estimated in function of similar parts installations . Its perfect definition will depend on details studies of CHESF system .

7.4 TRANSFORMERS

The power transformer will be of the three-phase type, 60 Hz , LN/VF/VF - 230/KV /13.8 KV ; five-point-earth connection with under-charge voltage commutation .

Tho 60 KV system must be connected to the ground by means of an earthing transformer , zig-zig , with TC in all bushos .

The auxiliary services will be attended by a three - phase transformer , with 13.800/220V tensions , triangle - star connection , with a steadily earthed neuter.

7.5 CIRCUIT BREAKERS

230 V circuit breaker , totalling thirteen , will have a SF6, 1,600 V , 10GVA interrupting capacity .

The six 69KV circuit breakers will have an oil-reduced volume at 1200 A , with a 2.5 GVA -

The nine 15 KV circuit breakers , making part of the armoured cabinets , will be magnetic blow operated , at 1200 A , with a 500 MVA interrupting capacity .The VCR interrupting keys and the circuit breaker connected to the reactive bus-bar will similarly be of 15 KV. The capacitor bases will be protected by oil keys , VCR 300A 20 KA interupting capacity . The reactor protetion will be attended by a magnetic blow operated circuit breaker, to be installed in the out-doors , 1,200A with a 500MVA interrupting capacity .

The protection system of the substation is shown on drawing Annex 2 .

7.6 DRAWINGS

The drawings making up this substation pre-planning consist of the following :

- Area Location
- Basic Single-Wire Diagram
- External Equipment Arrangement - Blueprint
- External Equipment Arrangement - Details (AA,BB,FF)
- External Equipment Arrangment - Details CC (DD and EE)

7.7 ESTIMATED BUDGET

The overall cost of the substation , which also comprise workmanship , and fringe benifits , was estimated in Cr$33,011,256.00 distributed as indicated below :

Equipment	Cr$20,625,200.00
Poles and concrete beams	Cr$ 772,540.00
Insulators and conductors	Cr$ 713,516.00
Sundries	Cr$10,900,000.00

Details of the estimate are given hereafter .

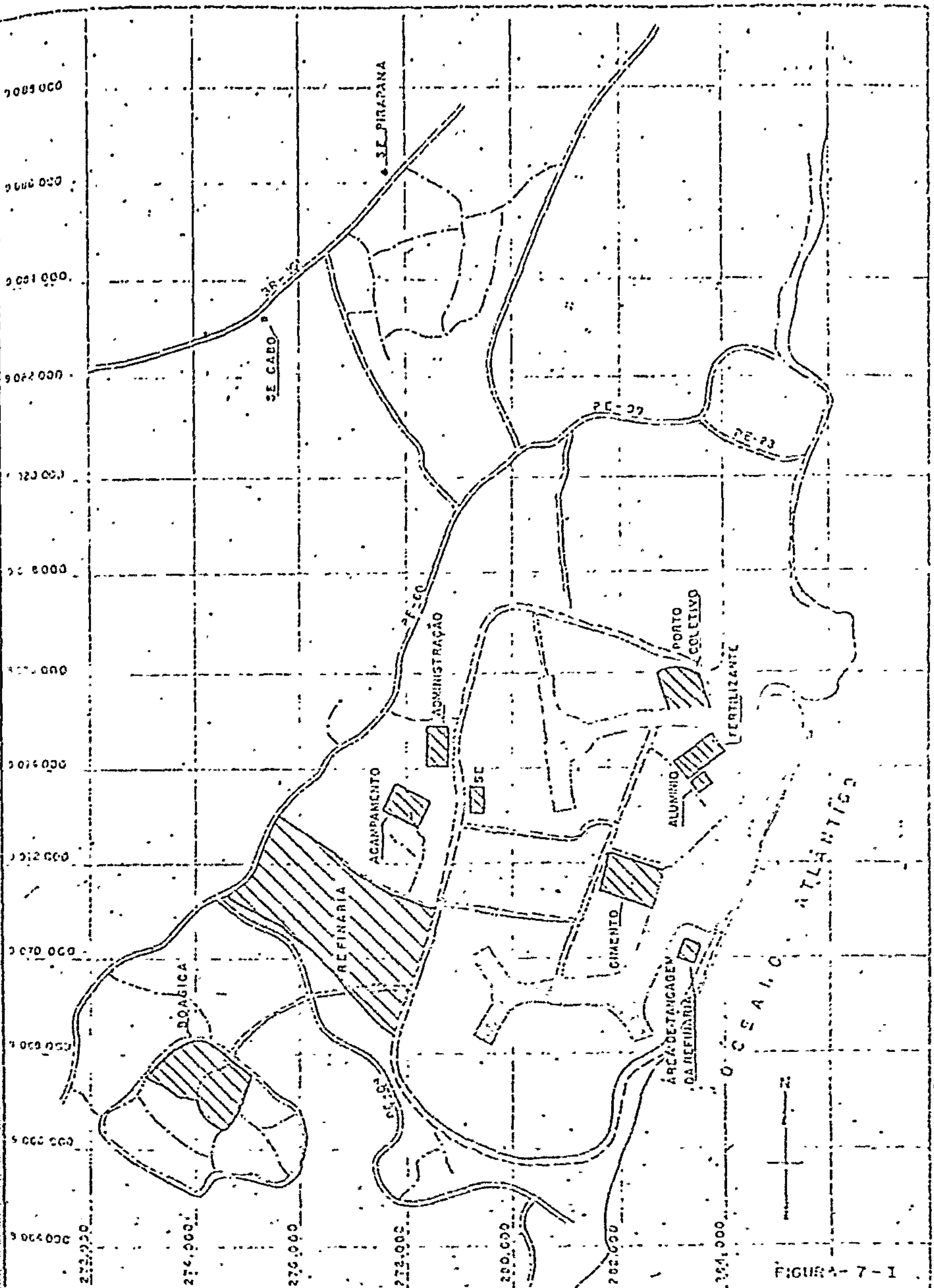

FIGURA - 7 - I

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Situation and Location of the Substations

THE PLAN FOR SUBSTATIONS AND THEIR ARRANGEMENTS ARE SHOWN IN THE DRAWINGS TOME

TOMO III
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8.0 250 KV TRANSMISSION LINES

8. 230 KV TRANSMISSION LINE

8.1 OBJECTIVE

The objective of the present study refers to the project for the implantation of transmission lines necessary to the power transport available at the SE bus-bar of Recife II to the bus-bar of SUAPE's SE , in the state of Pernambuco .

8.2 PRINCIPAL CHARACTERISTICS

a) Number of circuits : see item 8.1.3-a

b) Lenght of lines : estimated in 50 Km

c) Estimated maximum power to be transmitted:

In 1980- 540 MW

In 1985- 850 MW

d) Voltage available at Recife II , SE bus-bar - 230 KV

e) Conductor cable : see item 8.1.3- b

f) Structure types : see item 8.1.3 - C

g) Working life period of the lives : 20 years

h) Charge Power Factor : 0.85 inductive

i) Frequency : 60 Hz

8.3 CONSIDERATIONS

The following considerations will be established , first of all:

a) Number of circuits : Two hypothesis will be under study:
   Hypothesis 1 - Utilization of 2 single-wire double three phase circuits .
   Hypothesis 2 - Utilization of 2 twin wire (duplex) single three - phase circuits .

b) Conductor cable : The aluminum conductor with steel bore (AC- SR) 636 MCM is the minimum gange fixed by CHESF for consumers transmission lives at 230 KV,same being also the most utilized conductor in its line for this voltage . This study will start at this gange .

c) Structures : In accordance with the 4th Expansion Plan of CHESF the following conditions will be fixed :
   1- For the three-phase lines of double circuits with single cables: utilization of metallic structures (vertical arrangement)

   2- For three-phase lines of single circuits with twin cable : utilization of concrete structure (horizontal arrangement).

Consequently the present work will consider hypothesis 1 as having two double three-phase circuits , fixed in metallic structures and hypothesis 2 as two single three-phase circuits of twin (duplé) cables , fixed in structures of reinforced concrete .

8.4 ELECTRICAL CALCULATION

8.4.1 INTRODUCTION

For the two hypothesis established in the preceeding item, various working conditions will be developped for the transmission lines , taking into consideration the Powers (540MW in 1980 and 850MW in 1985) , as well as the conductor cables , where the 636 MCM - 26/7 will be considered as the ideal one , since same is largely utilized by CHESF .

8.4.2 STUDIES CONDITION

The following conditions will be studied for hypothesis 1 and 2 :

a) Hypothesis 1 :

Condition 1 : Utilization of two double circuits with 636 MCM - 26/7 cable , for the power estimated for 1980 , operating with a double circuit , the fourth line being out of work , already due to defect , maintenance or non-launching of the conductor cable .

Condition 2 : Utilization of just one double circuit , with 636-26/7 cable, for the power foreseen for 1980; the second double circuit being out of operation , or for not being constructed , either for defect/maintenance .

Condition 3 : Utilization of two double circuits , with 636 MCM -26/7cable for the power foreseen in 1985, the four lines being in operation .

Condition 4 : Utilization of two double circuits , with 795 MCM -26/7 cable for the power foreseen in 1980 , operating a double circuit and just one of the lines of the second double circuit , the fourth circuit being out of operation, either for defect, or maintenance or non-launching of the conducting cable .

Condition 5 : Utilization of two double circuits, with 795 MCM -26/7 cable , for the power foreseen to 1985 , the four lines being in operation .

Condition 6 : Utilization of just one double circuit , with 795 MCM 26/7 cable ,for the power foreseen for 1980, the second double circuit being out of operation , either for non-construction , or defect on maintenence .

Condition 7 : Utilization of two double circuits , with 795 MCM 26/7 cable , for the power foreseen to 1985 , with a double circuit and just one of the lines of the second double circuits , the fourth line being out of operation , either by defect or maintenence .

b) Hypothesis 2:

Condition 1 : Utilization of two single circuits, with two 636 MCM -26/7 cables per phase . for the power foreseen to 1980 , both lines being in operation.

Condition 2 : Utilization of two single circuits , with two 636 MCM 26/7 cables per phase , for the power foreseen to 1980 , one of these circuits being out of operation , either by non-construcion or defect or maintenance .

Condition 3 : Utilization of two double circuits , with 636 MCM -26/7 cable for the power foreseen to 1985 , both lines being in operation .

8.4.3 RESULTS OF THE OPERATION

For the conditions of operation mentioned above , the following value :

a) Hypothesis 1

Conditions	1	2	3	4	5	6	7
Voltage drop (%)	6,66	11,34	8,69	6,75	10,64	8,15	10,97
Regulation (%)	7,56	12,80	9,50	7,24	11,91	8,88	12,33
Assemby Loss (%)	6,60	7,20	10,84	5,22	2,64	8,52	8,73
Current per Conductor (A)	495,0	777,2	597,3	502,5	771,5	594,3	815,0
Temperature Elevation °C	18°	52°	27°	13°	36°	20°	40°

b) Hypothesis 2

Condition	1	2	3
Voltage drop (%)	5,13	8,69	6,58
Regulation (%)	5,40	9,42	7,05
Assemby Loss (%)	6,20	3,31	5,00
Current per Conductor(A)	365,5	744,7	374,3
Temperature Elevation°C	10°	50°	23°

The ACSR 636 MCM cable utilization, 26/7 formation as conductor, in the case of utilizing two double circuits in metallic structures is not convenient, (see table-hypothesis 1, condition 3) , since for the power foreseen to 1985, there would be a loss of 10.84%, which value is considered excessive.

In view of the foregoing, conditions 1, 2 and 3 for hypothesis 1, utilizing as conductor the cable ACR 795 MCM 26/7, are perfectly acceptable, since:

-In 1980 a double circuit be in condition to operate and the other, having at least one of its lines operating(condition 4 of hypothesis 1).

-In 1985 both double circuits be in operation (condition6 of hypothesis 1).

It is convenient, however, should hypothesis 1, be adopted, that in 1980 the four lines are already in operation,because the cost increase would be only that of the conductor and the respective launching , in compensation, in the 1980-1985 period there would be four lines as reserve.

The analysis of the operation lines, in accordance with condition 5, shows that, in case one of the double circuits is not constructed for the power foreseen for 1980, or in case both are construted, but one of these be out of operation for defect, the conditions will not be very satisfactory, as the drop tension values, regulation and tempetature elevation of the conductor cables, may be considerably high.

The results obtained in the study of the operation of condition 7, that is , one of the lines out of operation for the power foreseen for 1985, show that this condition is not feasible in permanent regime, since through the three line at work, the values of drop voltage, regulation and temperature elevation would be too high.

The operation conditions of hypothesis 2, utilizing as conductor cable ACR 636 - MCM- 26/7 are perfectly feasible for the powers forecast for 1980 and 1985 (conditions 1 and 3).

The study made for condition 2 of hypothesis 2, shows that it would not be possible to supply the power required for 1980, in normal regime, through just one of the circuits.

8.5. ECONOMICAL CALCULATION FOR THE CONDUCTOR

8.5.1 INTRODUCTION

The economical ascertainment of the conductor cable will be developed in such a way as to present a comparative study, having in mind the better determination of the variations that occur.

Since the conductor established at electrical studies for hypothesis 1 was the 795 MCM 26/7 , a comparative study between this one and the 945 MCM -54/7 will be developed while for hypothesis 2 , conductors 636 MCM -26/7 ,795 MCM - 26/7 and 954 MCM - 54/7 will be confronted .

8.5.2 ANNUAL COST OF THE CABLE

The cost of the kilogram a conductor will be considered as equal to Cr$9,00 and the devaluation rate of 12.5 % per annum will be adopted , which will yield the following situation :

Conductor	Yearly Cost of the Cable	
	Hypothesis 1	Hipothesis 2
636	-	876,825.00
795	1,096,200.00	1,096,200.00
954	1,232,550.00	1,232,550.00

8.5.3 YEARLY COST OF THE CABLE PER JOULE EFFECT

Calculations will be made for maximum power in 1985 , with a loss factor equal to 53% , which will derive from the charge factor (70%) and the price in KWh equal to ..... Cr$0.083 , giving the following situation :

Conductor	Yearly cost of Joule loss	
	Hypothesis 1	Hypothesis 2
636	-	4,210,396.00
795	1,674,471.00	3,353,575.00
954	1,400,376.00	2,000,788.00

In view of the utilization of four circuits in hypothesis 1 , and two circuits in hypothesis 2 , the final resulting table may be presented :

Conductor	Total yearly cost	
	Hypothesis 1	Hypothesis 2
636	-	9,297,617.00
795	7,794,084.00	7,803,350.00
954	6,834,054.00	6,834,126.00

In view of the foregoing , it is concluded that :

- In case of hypothesis 1 , the increase of 12.32 % in the yearly cost of the conductor , compared with the increase of 11.06 % in the weight of the conductor per kilometer , inasmuch as the increase of the conductor entails an increase of stress to the structure, increase of efforts to the foundation and the increase in the numbers of structures per kilometer , justifies the choice of ACSR 795 MCM - 26/7 cable .

- In case of hypothesis 2 , the increase of 26.5 in the annual cost of the conductor as compared with the 28.86 increase in the conductor cable weight per kilometer , in view of all incoveniences presented previously ; justifies the choice of ACSR 636 MCM - 26/7 cable .

8.6 STRUCTURE PATTERNS

8.6.1 INTRODUCTION

On the occasion of the excution of the project of transmission line , the structural design must be effected comprehending the study of several structure alternatives, considering specially :

- inter-phase spaces and the conductors disposition in the the structure .
- insulation level
- minimum distance of the conductor to the carthed parts
- balance angle
- protection angle of the lightening-rod handle and distance from conducting cables ;
- definition of the normal height of the structure, considering the minimum distance from the conductor to the ground and maximum rise ;
- chaining , if necessary ;
- calculation hypothesis material to be utilized , work rates , safety coefficient an- structure contourline;
- details and specification of the structure accessories, of the insulators and of the conductors ;
- complete drawing of structure , with all the necessary details ;
- abacuses utilizable in structures , (balance angle , maximum load , etc)

At the present phase however there are no conditions to define an economical series of structure , applicable to the real needs .

Options will be available to provide conditions for studying electrical calculations utilizable . length estimate and budget , based on structures already utilized in similar cases in the north-east region , whose characteristics are defined below :

8.6.2 METALLIC STRUCTURES

Type A : Alignment Suspension

deflection angle ....0º to 5º

insulating chain ....in suspension

maximum balance angle 45º

mean tower height ....31.00 m

distance between the phases .... 6.70 m

chain lenght .... 3.00 m

maximum average span ....510,00 m

maximum span ....540.00 m

The structure planning is shown on figure 8-I .

Type B : Binding in angle and terminals

deflection angle 5º to45º

insulating chain .... under stress

mean tower height .... 29,30 m

distance between phases .... 6.70 m

maximum average span .... 520.00 m

maximum span .... 575.00 m

The structure planning is shown on drawing 8-II ;

8.6.3 CONCRETE STRUCTURE

Type C : Alignment Suspension

deflection angle .... 0º to 3º

insulator chain .... in suspension

maximum balance angle 40%

mean height of poles ....28.00 m

distances between phases .... 8.00 m

chain lenght .... 3.00 m

maximum span ....330.00 m

distance the axis of the twin

conductors .... 0.400 m

The structure planning is shown on figure 8- III .

Type D : Angle - binding

Deflection angle .... 30°

Insulators chain .... in tension

mean poles height .... 26.00 m

distance between phases .... 8.00 m

maximum average span ....300 ,00 m

span ....500. 00 m

The structure planning is shown on figure 8- IV.

8.7 BUDGET ESTIMATE

8.7.1 PARAMETERS

In the execution of the budget , the following parameters will be used :

Item	Description	Unit	Hypothesis 1	Hypothesis 2
1	Line lenght	Km	50	50
2	Utilizeable Path length	m	70	75
3	Unit Cost of land acre	Cr$	30,000.00	30,000.00
4	Width of the path to be cleared	m	50	55
5	Width of the access roads	m	3	3
6	Lenght of the access roads	Km	12,5	12,5
7	Unit cost of the roads and of the path clearing	Cr$/Km	15000.00	15,000.00
8	Number of structures per Kilometers	Struct/Km	2,06	3,50
9	Weight per structure	Km/Struc	9000	-
10	Cost of steel Kg	Cr$	110.00	-
11	Unit cost of the structure	Cr$	-	20,000.00
12	Weight per kilometer of conductor cable	Kg/Km	1,624	1,300
13	Cost by Kg of the conductor cable	Cr$/kg	9.00	9.00
14	Percentage of suspension structure	%	90	80
15	Percentage of structure anchorage	%	10	20
16	Unit cost of ironware per suspension chain	Cr$	400.00	600.00
17	Unit cost of ironware per anchorage chain	Cr$	850.00	1275.00
18	Number of insulators per suspension chain	Unit	16	16
19	Number of insulator per anchorage chain	Unit	36	36
20	Unit cost of insulator	Cr$	30.00	30.00
21	Unit cost of connecting-rod handle per kilometer	Cr$/Km	4,000.00	4,000.00

22	Unit cost of ironware to the pension	Cr$	80,00	80,00
23	Unit cost of ironware to the fixing of connecting -rod under stress	Cr$	185,00	185,00

Also the following considerations will be made :

- Freight cost , Insurance and Storehouse for the materials, estimated in 12 % of the cost thereof .

- Labor cost , fringe benefits and local transportation of materials , estimated in 30 % of the cost of the materials, lands , access roads and clearing of the paths .

- The direct cost of the line , which should be equal to the sum of the following items :

Land tracts , Upkeep and Duties , Access Road and Clearing of Paths ; Materials , Insurance and Warehousing , Labor , Fringe Benefits and Local Transportation .

- The cost of Engineering and Supervision , estimated in 10% of the cost of the materials .

- The cost of sundries and Administrative expenses estimated in 10% of the direct cost .

- The Lines indirect cost , similar to the total of the items Engineering and Supervision , Sundries and Administrative Expenses ;

- The overall cost of the lines , which equals to the sum of the direct plus indirect costs .

8.7.2 COSTS

Item	Description	Hypothesis 1	Hypothesis 2
1	Lands , upkeep and duties	10.500,000,00	11,250,000,00
2	access roads , clearing of path	750,000.00	750,000.00
3	Matetials	29,922,766.00	17,145,190.00
3.1	Structures and Accessories	18,540,000.00	7,000,000.00
3.2	Conductors cables and Ac - cessories	10,517,368.00	9,222,930.00
3.3	Lightening-Rod handle and accessories	865,398.00	922,268.00
4	Freight, Insurance and Wa rehousing	3.590,731.00	2,057.422,00
5	Labor, fringe , Benefits and Local Transportation	12,351,829.00	8,743,557,00
6	DIRECT COST	--	
6	Engineering and Supervision	2,992,276.00	2,640,206.00
7	General Expenses and Adminis traction	5,711,532.00	3,994,616.00
	INDIRECT COST	8,703,808.00	6,634,822.00
	TOTAL	65,819,134.00	46,580,991.00

8.8. CONCLUSION

The analysis of the powers to be installed in 1980 and 1985 , that is , 540 and 850 MW , in function of the necessary circuits , gives an immediate indication to one of the two types of structures utilized by CHESF , the metal structure in double circuit and the concrete structure for two twin conductors .

The electrical studies allow to confront the alternatives to the conductors , beginning with 636 MCM gange , which is the lowest adopted by CHESF in 230 KV lines .

Hypothesis1 however has eliminated the utilization of 636MCM cable , due to the excessive power loss in the year 1985. It would make necessary the use of 79- MCM conductor , which would eliminate hypothesis 1 as a consequence of the cost confrontation with the operation conditions , by itself already very lower than those obtained with twin conductors, as illustrated on the comparative table below .

Hypothesis	1		2	
YEAR	1980	1985	1980	1985
Conductor for phase	(1x795MCM)	(1x795MCM	(2x636MCM)	(2x636MCM)
no. of circuits	3	4	2	2
V (%)	5.75	8.15	5.13	6.58
Reg.(%)	7.24	8.88	5.40	7.05
T (ºC)	13º	20º	10º	23º
Losses (%)	5.22	8.60	5.20	5.00
Cost(Cr$ x 10^3)	65.819		45.655	

As a consequence of the economical study , it is recommended the adoption of two circuits of 2 twin 636 MCM conductors .

In view of the necessity to attend under emergency conditions , it was verified that , in 1980 , SUAPE substation could be helped by a 230 KV " tie " , coming from Pirapama , utilizing a single 636 MCM per phase conductor , with concrete structure , the cost of which may be estimated in Cr$7,500,000.00 .

The establishment of a single 636 MCM - per - phase conductor , refers to 160 W power , which is the maximum availability existing at Pirapamá , for the emergency attendance of SUAPE substation .

Already in 1975 , besides this " tie " , it will be necessary to launch a third feeder between Recife II and SUAPE substations . This feeder may have the same characteristics as the " tie " and its cost may be estimated in Cr$16,500,000.00 , according to 1974 prices .

It is very likely however that the consumer market growth will indicate the launching of the third feeder , also of the twin conductors type .

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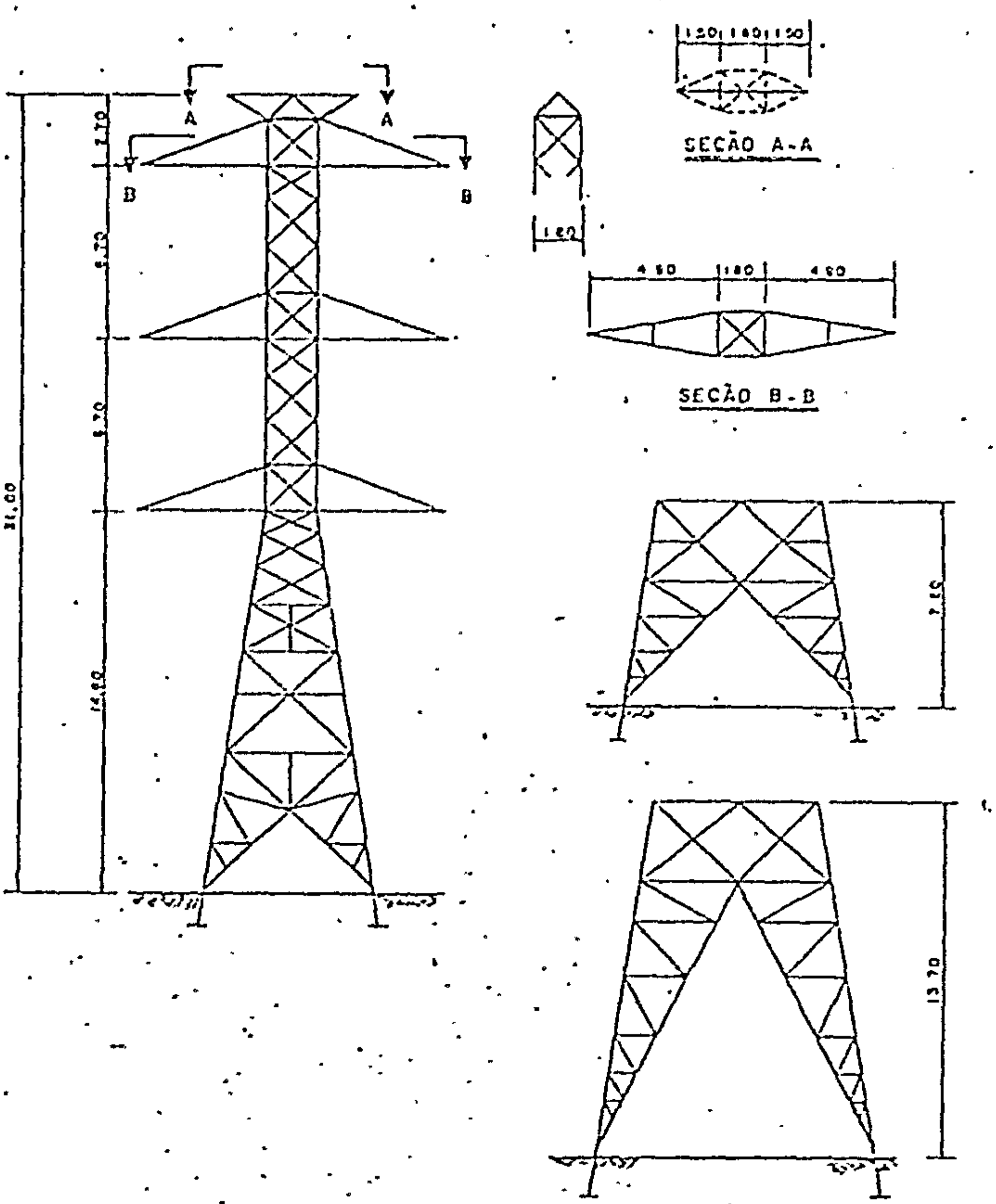

FIGURA 8-1

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GOVERNO DO ESTADO DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

Type ''A'' Tower - 230KV

TRANSCON S.A.

85.

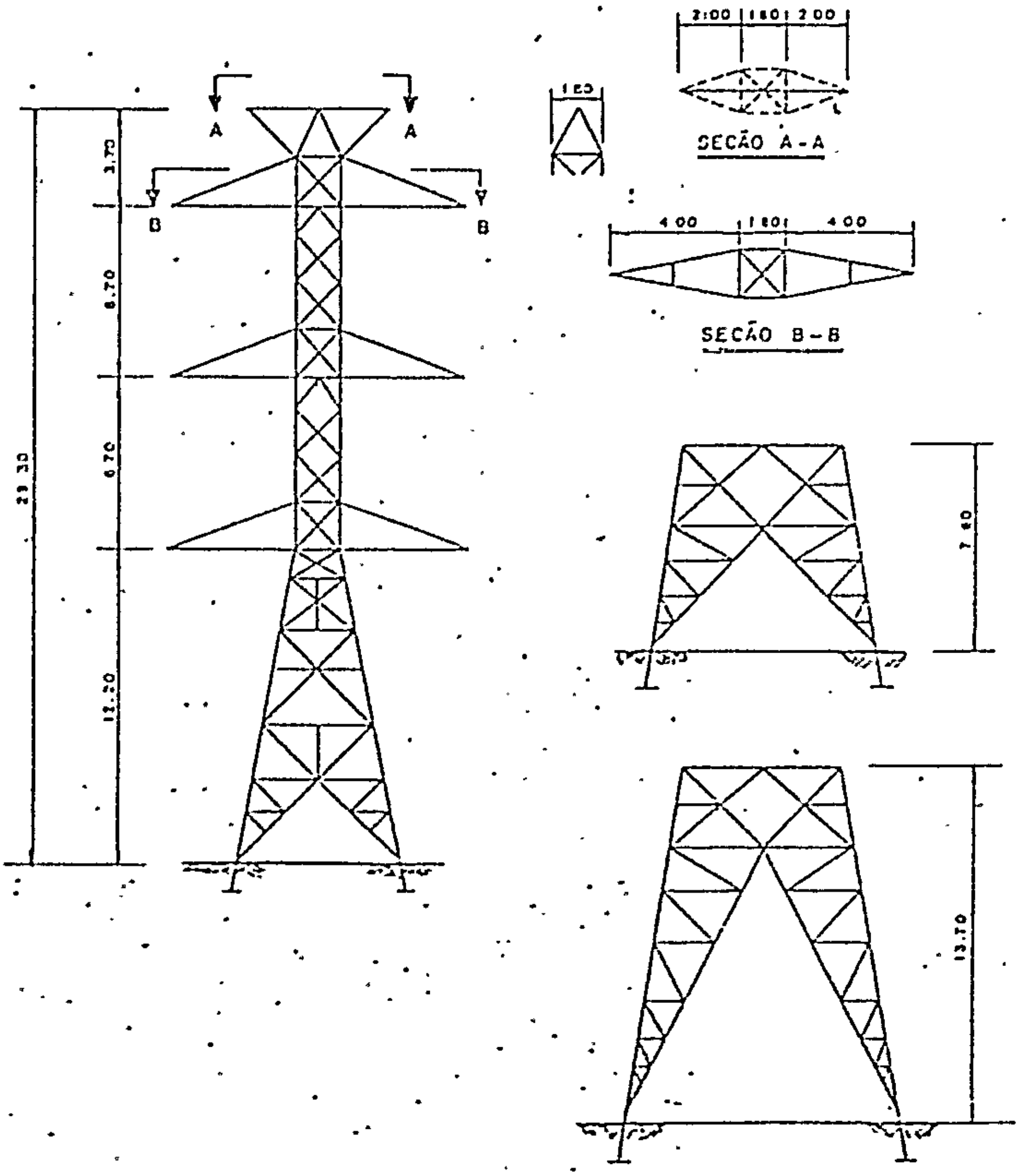

FIGURA 8-II

diper

TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

Type ''B'' Tower - 230 KV

86.

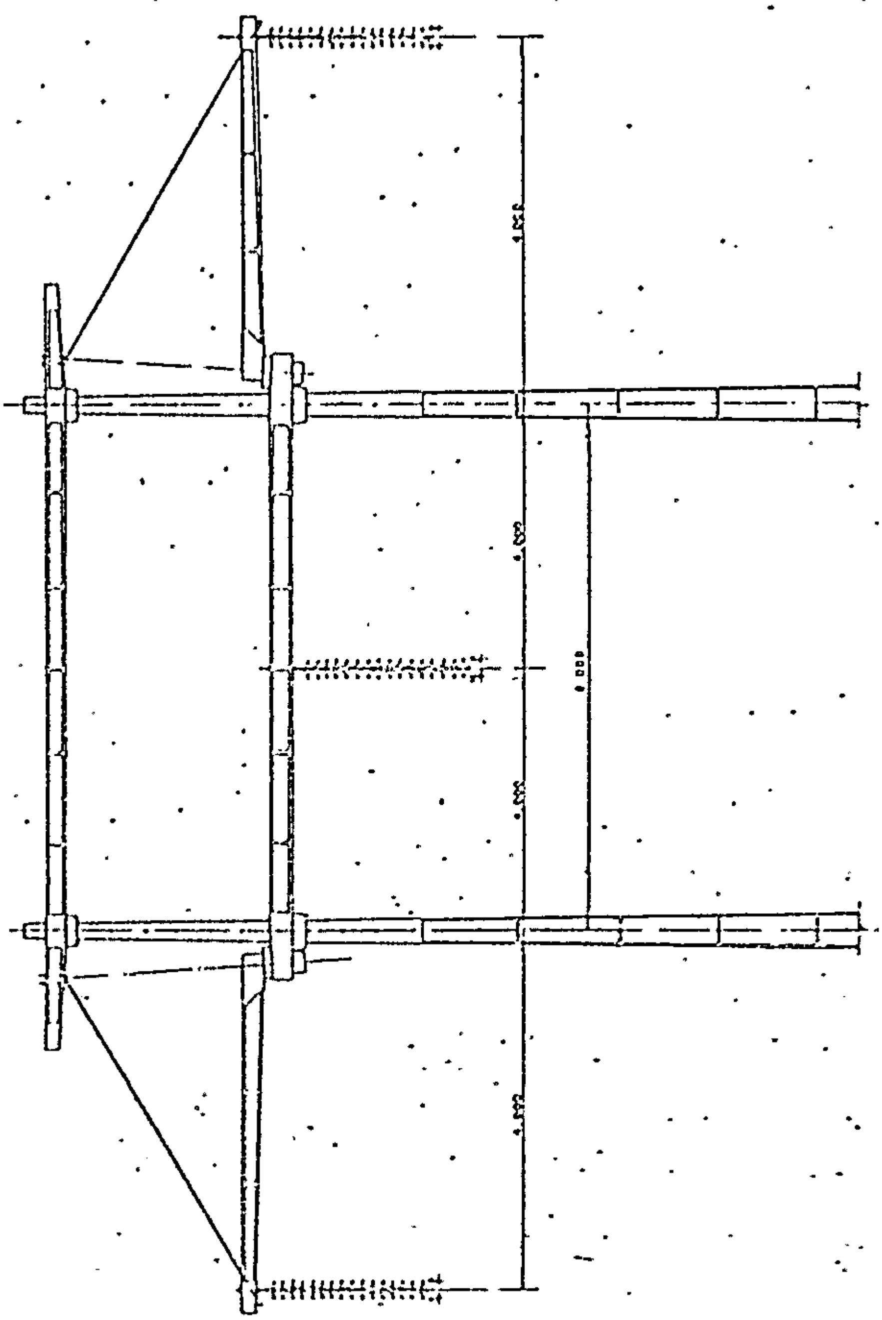

FIGURA 8-III

diper

GOVERNO DO ESTADO DE PERNAMBUCO - FRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

Type ''C'' Structure
230 KV

TRANSCON S.A.

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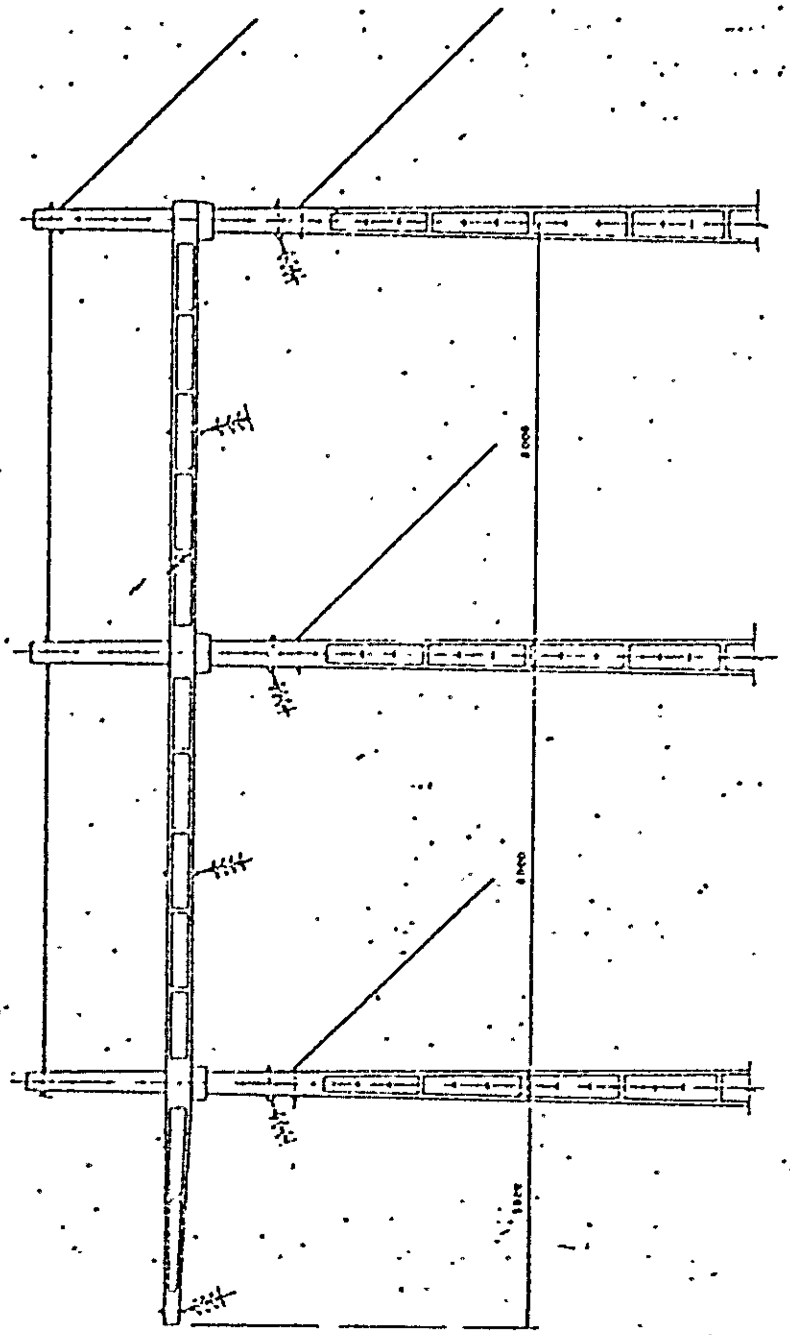

FIGURA 6-IX

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TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

Type ''D'' Structure
230KV

TOMO IV
PARTE 4
VOLUME 3
9.0

9.0 69 KV TRANSMISSION LINES

9.0 69 KW TRANSMISSION LINES

9.1 OBJECTIVE

The objective of the present work refers to the bill for implanting the transmission lines necessary to the feeding of the Fertilizer Complex , as well of the Clinquer Mill at Suape region . The energy will be brought from Suape SE bus-bars , located at the neighboring area .

9.2 PRINCIPAL CHARACTERISTICS

a) Number of circuits : one per line

b) Line Lenght :

T.L SUAPE - fertilizers : estimated in 4.5 Km

T.L SUAPE - Clinquer Mill : estimated in 4.0 Km

c) Estimated maximum power to be transmitted :

- Fertilizers :	1980	2.5 MW
	1985	5.4 MW
- Clinquer Mill:	1980	12 MW
	1985	24 MW

d) Conductor Cable : see items 9.2.2 -a and 9.3.2

e) Types of structures : see item 9.4

f) Period of lines working life : 15 years

g) Charge Power factor : 1.0

h) Frequency : 60 Hz .

9.3 ELECTRICAL CALCULATION

9.3.1 INTRODUCTION

Conditions of the lines operation will be developed , taking into consideration the power transmitted for the years 1980 and 1985 and the distances to be covered as well .

9.3.2 STUDIED CONDITIONS

a) T.L. Suape- Fertilizers

In view of the low value of the powers to be transmitted (2.5 MW in 1980 and 5.4 MW in 1985) a 1/10 ACRs conductor will be established , 6/1 formation , with the ideal conductor , the study of line operation having presented the following values :

PARAMETERS	1980	1985
Voltage drop (%)	0.136	0.288
Regulation (%)	0.135	0.288
Power loss (%)	0.131	0.288
Current per conductor(A)	20.96	45.32
Temperature Elevation (°C)	10°	10°

b) L. T. Suape - Clinquer Mill

2/0 and 4/0 conductors all with 6/1 formation will be established for possible utilization , the study of the line operation presented the following values :

.../...

PARAMETERS	1980			1985		
Conductor	2/0	3/0	4/0	2/0	3/0	4/0
Voltage drop(%)	0.569	0.461	0.378	1.150	0.925	0.756
Regulation(%)	0.573	0.463	0.379	1.160	0.933	0.763
Power losses(%)	0.567	0.457	0.374	1.154	0.923	0.753
Currents by conductor(a)	100,98	100.98	100.79	203.15	202.70	202.35
Temperature Elevation(°C)	<10°	<10°	<10°	25°	17°	13°

9.4 ECONOMIC CALCULATION OF THE CONDUCTOR

9.4.1 INTRODUCTION

It will be developed the economical determination of the conductor cable in order to present a comparative study with a view to better evaluate the variations processed.

Since the conductor established with the electrical studies was 1/10 for L T Suape- Fertilizers thus leaving a reasonable margin , only the economical calculation of conductor to Suape - Clinquer Mill will be studied confronting 2/0 , 3/0 and 4/0 conductors .

9.4.2 TOTAL ANNUAL CONDUCTOR COST

Calculation for maximum forecast power for 1985 , cost of the conductor Kg equal to Cr$9.00 (nine cruzeiros), depreciation rate of 12.5% per year , losses factor equal to 73% originated from 85% charge and the price of KWh equal to Cr$0.096 will be developed , the following arrangement being obtained :

Conductor	Cost of the Conductor(Year)	Yearly Cost of Joule Losses	Yearly Total Cost
2/0	3,673,35	126,285.78	129,959,13
3/0	4,629,15	100,166,02	104,795,17
4/0	5.038,75	79,460.43	85,299.18

In view of the foregoing , it will be decided to utilize ACSR 4/0 cable with arrangement 6/1 for L T Suape Clinqer Mill .

9.5 STRUCTURE PATTERNS

9.5.1 INTRODUCTION

The series of structures to be utilized in the transmission lines are expectnd to be in accordance with Celpe patterns , defined for 69 KV .

Some of the structures of this serie , are characterized below :

9.5.2 PRINCIPAL CHARACTERISTICS

a) Type - C- ARO 66

Utilization ____________ straight alignment
Pole ____________ concrete, type double T
Cross ____________ concrete, type condensed
Defrection angle ____________ 0º - 3º
Insulators Chain ____________ suspended
Maximum angle of balance ___ 74 %
Average height of the poles 17.0 m
Average maximum span ______ 300 m

The structure plan is shown on figure no. 9/1 .

b)-Type - H-ALA 66

Utilization ____________ binding in angle
Poles ____________ concrete , type double T
Crosses ____________ steel
Deflection angle ____________ 3º - 6º
Insulators chain ____________ tension/suspension
Average heigh of the poles __ 14.0 m

The structure sketch is shown on figure 9/2 .

9.6. ESTIMATED BUDGET

9.6.1 PARAMETERS

In the excution of the budget , the following parameters will be considered :

Item	Description	Unit	L.T. Suape Fertilizer	L.T.Suape Clinquer Mill
1	Lenght of lines	Km	4.5	4,0
2	Width of upkeep path	m	30	30
3	Unit cost of land Acre	Cr$	30,000.00	30,000.00
4	Width of Path to be clered	m	25	25
5	Width of the access roads	m	3.0	3.0
6	Lenght of the acces "	m	1.125	1.0
7	Unit cost of the access road and clearing of path	Cr$/Km	3.500.00	3,500.00
8	Number of structures per kilometers	est/Km	5.0	4.7
9	Unit cost of the overhead structures	Cr$	2,750.00	2,990.00
10	Unit cost of the binding structures	Cr$	8,200.00	8,885.00
11	Weight by km of conducting cable	Kg/Km	215.9	432.5
12	Percentage of the suspension structure	%	60	60
13	Cost of the conducting cable (per Kg)	Cr$/Kg	9,00	9.00
14	Percentage of anchorage estructure	%	40	40
15	Unit cost of wares per suspension chain	Cr$	280.00	280.00
16	Unit cost of wares per anchorage chain	Cr$	400.00	400.00
17	Number of insulators per suspension chain	unit	5	5

18	Number of insulators per tension chain	Unit	10	10
19	Unit cost of insulator	Cr$	30,00	30.00

Also the following will be considered:

-Freight cost , insurance and ware housing for materials , estimated in 12% of the cost thereof .

-Labor costs, fringe benefits and local transportation of materials , estimated in 50 % of the cost tereof .

-Direct cost of the lines , the sum of the following i - tems: lots , upkeep and rights , access road and path clearence , cost of materials , freights , insurance and warehousing , labor costs , fringe benefits and local transportation .

- Cost of engineering and supervision , estimated in 10% of the materials cost .

Cost of overhall expenses estimated in 10% .

-Indirect cost of lines , the sum of items engineering supervision , sundries expenses and management ;

Total cost of lines , representing the sum of direct and indirect costs.

ITEM	DESCRIPTION	T.L. Suape Fertilizer	T.L.Suape Clinquer Mill
1	Phots, upkeep and rights	405,000.00	360,000.00
2	Access Roads , path clearing	15,750.00	14,000.00
3	Materials	198,349.00	196,763.00
3.1	Structure and Accessories	110,935.00	100,529.00
3.2	Conducting Cable and Accessories	87,414.00	96,234.00
4	Freight , Insurance and Warehousing	23,801.00	23,859.00
5	Labor cost, fringe benefits and local transportation	99,174.00	99,381.00
	DIRECT COST	?42,074.00	696.003.00
6	Engineering and Supervision	27,932.00	27,992.00
7	General and Management	74,207.00	69,599.00
	INDIRECT COST	102,139.00	97,591.00

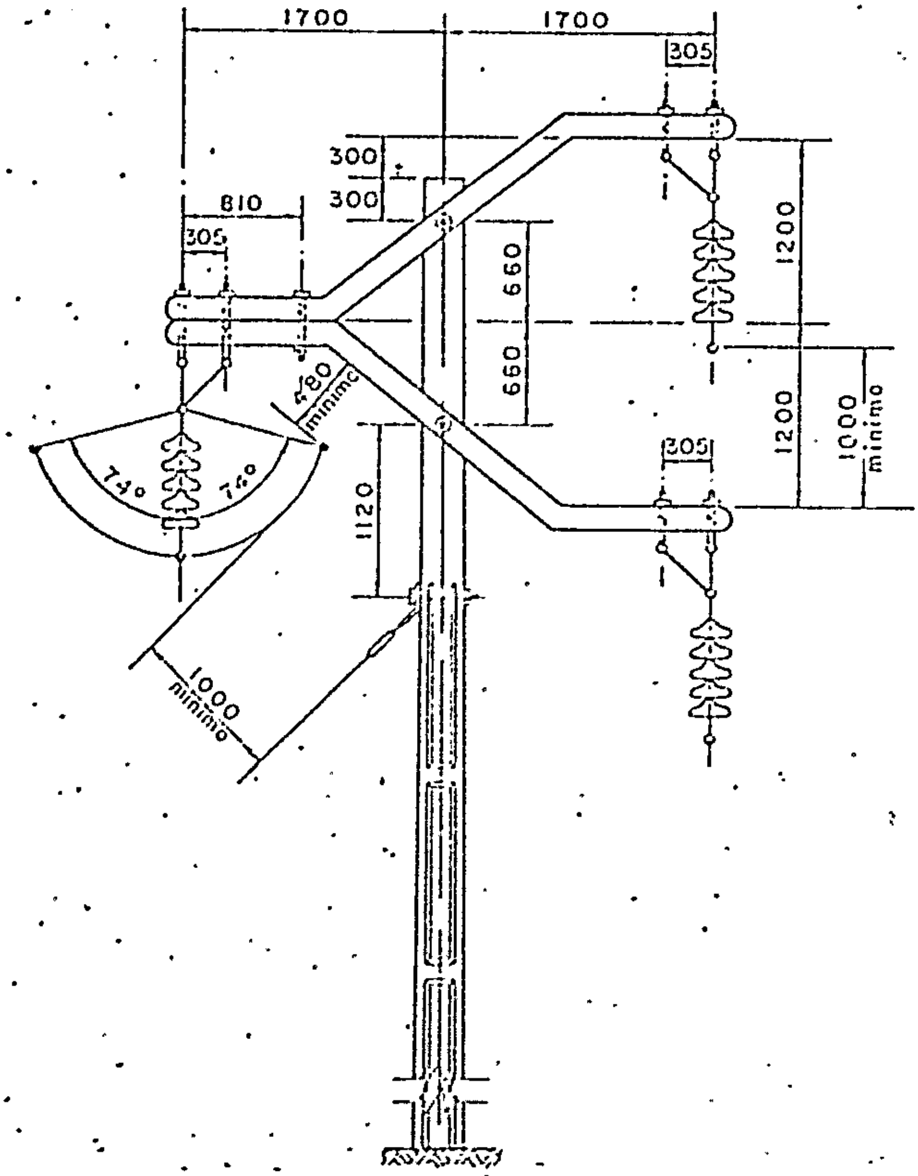

FIGURA 9-1

No scale employed.
dimensions in mm

dipor

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GOVERNO DO ESTADO DE PERNAMBUCO-PRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

Type "G-ARB" 69kV Structure

visto	data	escala	desenho nº	folha
	Dez.74			

98

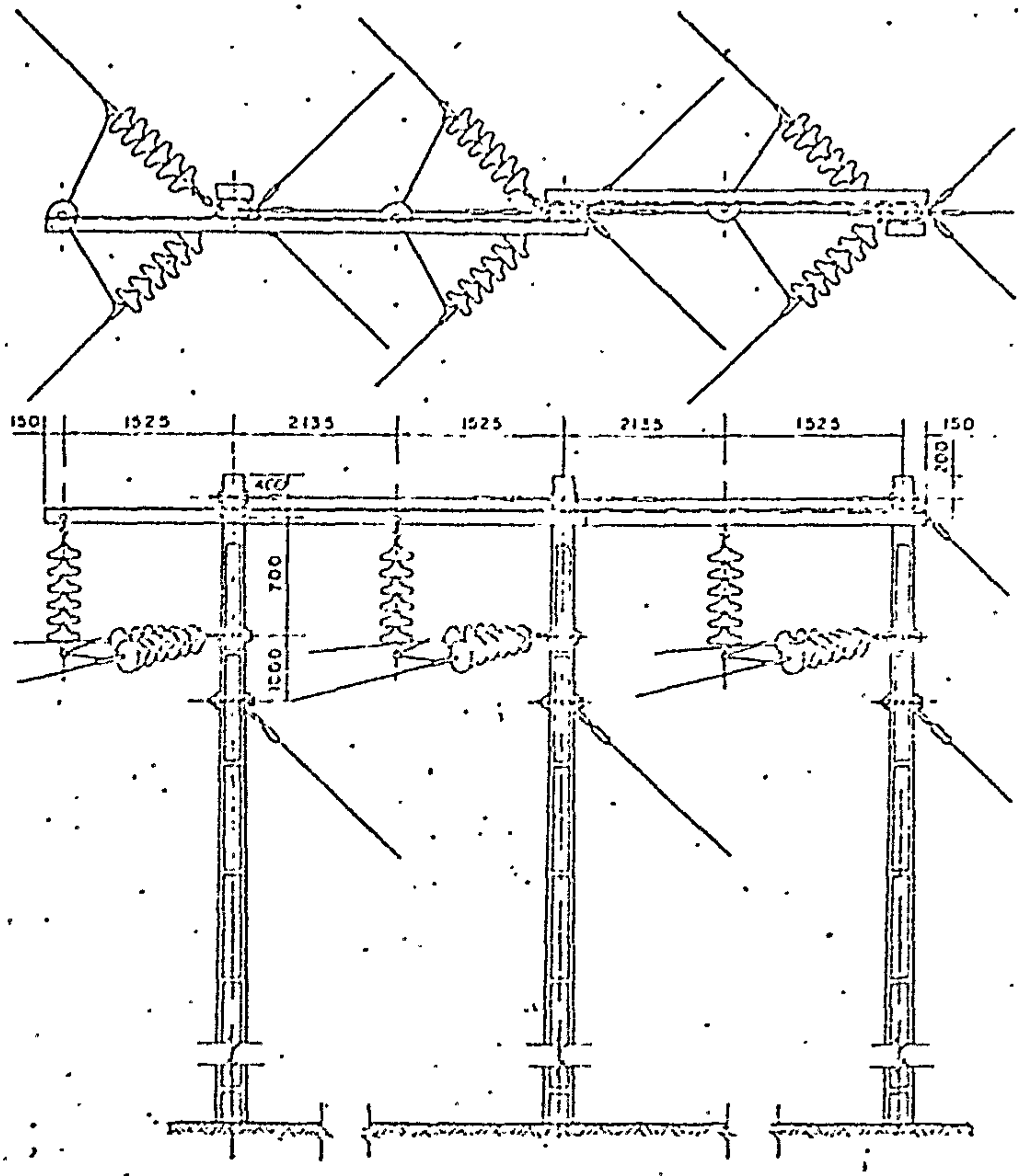

FIGURA 9-II

dipor

GOVERNO DO ESTADO DE PERNAMBUCO - PRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

Type "R-ALA" 69 kV Structure.

TRANSCON S.A.

tendência	data	escala	desenho nº	folha

TOMO IV

PARTE 4

VOLUME 3

10.0

10.0 DISTRIBUITION IN 13.8KV

10.0 DISTRIBUITION IN 13.8 KV

Starting in 1980 the Administration and Complemtary Services , the General Port , the Camping Area , the Residential Area and the Distillory Containerizing Area will be connected to the 13.8 KV network from the charges already foreseen .

With this object feeders nos. land 2 may be irradiated from Suape substation . The former will be intended to attend the Administration and General Port charges , and the latter , the Camping Area , the Containerizing Area and the Residential Area of Boasica .

Figures 10- I and 10-II show , respectively the 13.8KV network single-wire simplified diagrams in 1980 and 1985 . It was immediated verified the charge low density and the long stretch of the feeders . The attendance to these two conditions was made in accordance with CELPE patterns , concrete poles being employed , with maximum spans of 80 m , and CAA aluminium conductor , A/OAMG gange , fixed on normal type structure .

It was verified that the maximum voltage drop , under the charge conditions forecast for 1985 , is not expected to reach 5% . It should be borne in mind , however the absence of convincing elements that permit an evaluation representative enough of the future characteristics of the 13.8KV network operation .

Based on the policies adopted by Eletrobrás , for the appraisal of the distribuition systems cost , the investment needed to the implantation of the two feeders in question may be calculated at Cr$462,000.00.

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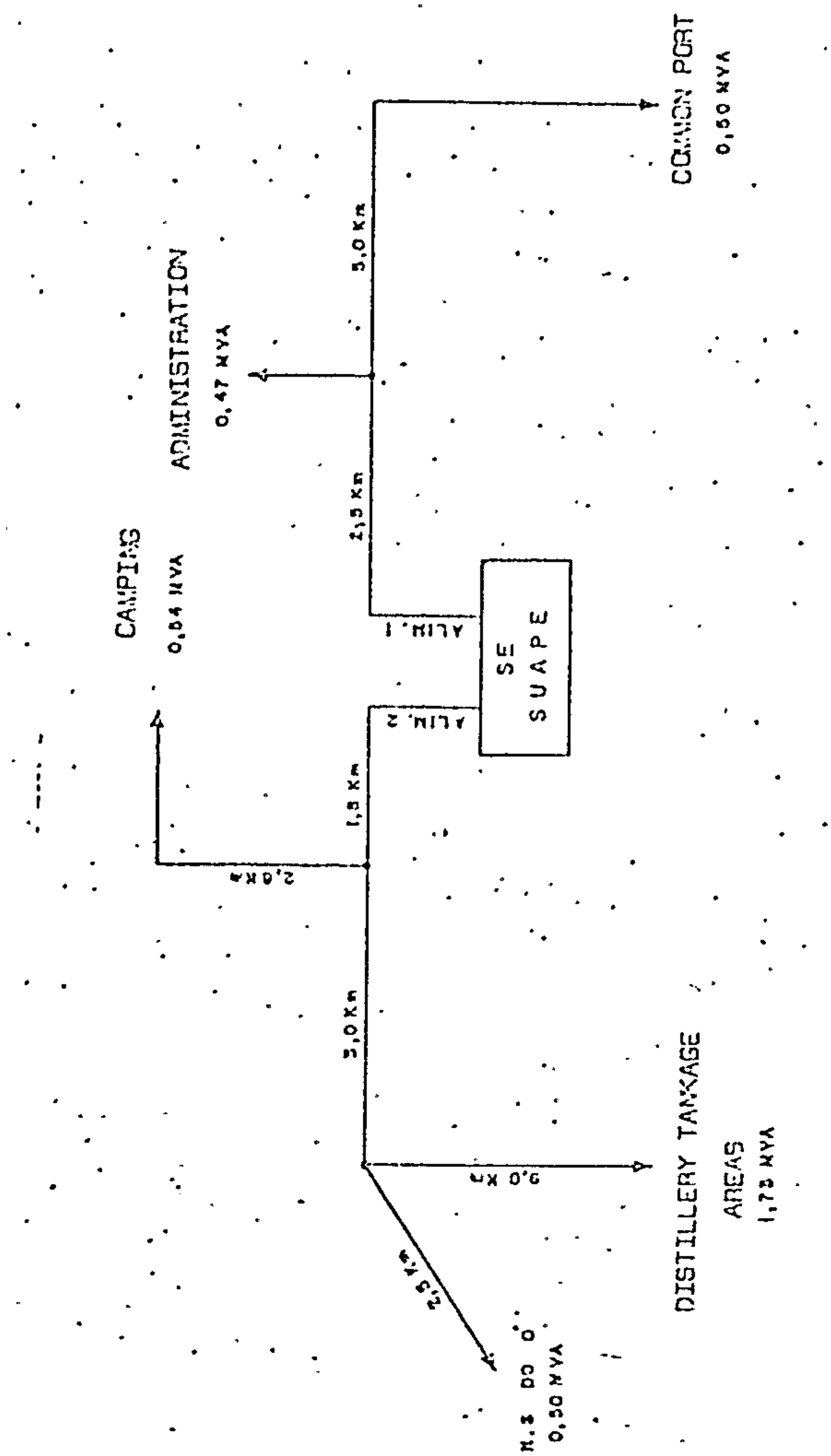

FIGURA 10-I

13,8 KV Distribution Network Simplified Single-Wire Diagram Year 1980	dipor TRANSCON S.A.	GOVERNO DO ESTADO DE PERNAMBUCO - PRAC COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO COMPLEXO INDUSTRIAL DE SUAPE desenhista — data DEZ/7- — escala — desenho nº — folha

102

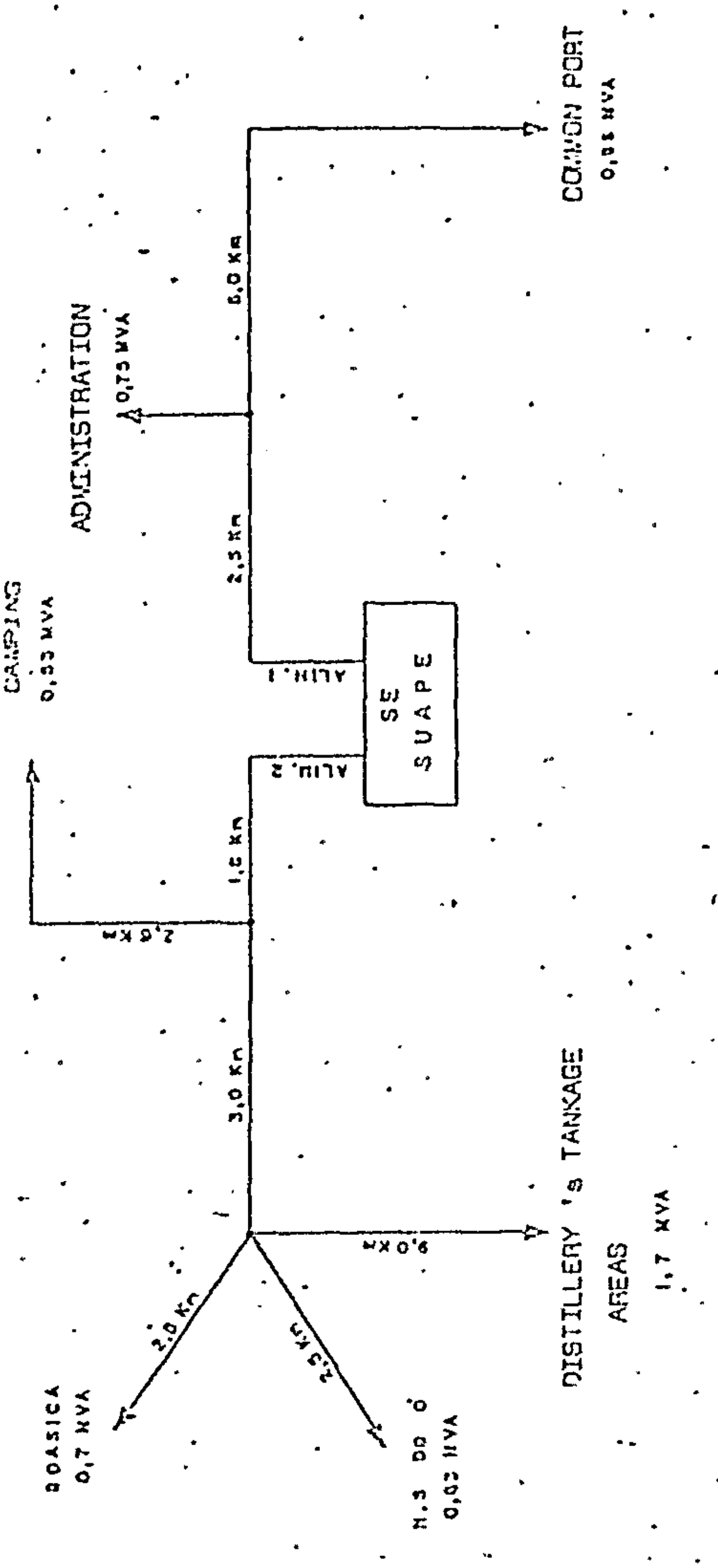

FIGURA 10-II

13,8 kV Distribution Network
Simplified Single-Wire Diagram
Year 1985

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COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

responsável	data	escala	desenho nº	folha
	02/74			

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11.0 TOTAL ESTIMATE BUDGET

11.0 TOTAL ESTIMATE BUDGET

11.1 SUBSTATION

Equipments	20,625,200
Concrete poles and beams	772,540
Insulators and Conductors	713,516
Sundries	10,900,000
SUb- Total	33,011,256

11.2 TRANSMISSION IN 230 KV

	Plots , up-keep and duties	11.250,000
	Access Roads, clearing of the path	750,000
	Materials	17,145,190
a	Structure and Accessories	7,000,000
b	Conducting cables and accessories	9,222,930
c	Cables , connecting-rod and accessories	922,260
	Freight, Insurance and Warehousing	2,057,422
	Labor costs,fringe benefits and local transportation	8,743,557
	DIRECT COST	39,946,169
	Engineering and Supervision	2,640,206
	Over-head expenses and Administration	3,994,916
	INDIRECT COST	6,634,822
	Sub- Total	46,580,991

11.3 ENERGIE TIE 230 KV - 1980

Sub total	7,500,000

11.4 3RD. FEEDER

Sub- total	18,500,000

11.5 69 KV TRANSMISSION LINE-FERTILIZERS AND CEMENT (CLINQUER)

		T.L.SUAPE FERTILIZERS	T.L.SUAPE CLINQUER	
	Plots,up-keep and duties	405,000	360,000	
	Materials	198,349	198,763	
a.	Structure and Accessories	110,935	100,529	
b.	Conductor cable and accessories	87,414	98,234	
	Freight , Insurance and Warehousing	23,801	23,059	
	Labor , fringe benefits and local transportation	99,174	99,381	
	DIRECT COST	742,074	696,003	
	Engineering and supervision	27,932	27,992	
	Over-Head expenses and Administration	74,207	69,599	
	INDIRECT COST	102,139	97,591	
	Sub- total	844,213	793,594	1,637,807

11.6 13.8KV DISTRIBUTION

BOASICA N.S.O - ADMINISTRATION

Sub-total ______________________________ 465,946

Total ______________________________ 107,696,000

TOMO II
PARTE 4
VOLUME 3
12.0

12.0 RECOMMENDATIONS

12.0 RECOMMENDATIONS

As a result of what has previously been considered , at this initial stage of Suape study , some important re - commendations regarding the implantation of the electrical system required for the supply of this Industrial Complex .

As far as the definition of power needs is concerned , it is recommended what is indicated hereinafter .

12.1 SPECIFIC CHARACTERISTICS OF THE CHARGES

To obtain characteristics specific for each consumer to be considered or to be defined :

- Yearly or monthly demand , during the implantation stage.

- Absence of charge .

- Power factor .

12.2 CHARACTERISTICS DATA OF MARKET EVOLUTION

To obtain characteristics data on the evolution of the market foreseen there:

- information on the type , proportions and locations of each consumer .
- occasion during which each consumer will start his installation .
- implantation chronogram for each consumer .
- each consumer future increase forecast .

12.3 SELECTION OF ALTERNATIVES

As far as the selection of alternatives to be made for the power supply planning is concerned , a clarifying or even corrective measure is recommended , with a view of :

A Minimization of Inconvenient Aspects .

To consider the minimization of inconvenient aspects in the consumers installations at Suape and the future operation of the network , such as the influx occurrences due to uncontrolled start of big engines frequent oscilations due to the nature of the connected charges , with low power factor not duly compensated , presence of harmonics due to technical insufficiency of the installations of current rectification low charge factors and consequent power cost increase among others .

B Indication of Convenient Technical Condition

Indicate and make sure that the technical requirements will be convenient to the best sizeability condition and to the system operation , such as the adequate types (star in 230 KV and 13.8 KV and delta in 69KV) , connections to land (strictly in 230 system and through zig-zig earthing transformer in 69 KV system) , use of conveniently protected shunts at the outlet for 69KV and 13.8 KV consumers , addition of modern , reliable , protective system for the network and its trunk-lines, in such a way as to consider an adequate protection for the normal and abnormal conditions of the operation,etc.

12.4 INITIAL SETTLEMENTS

Concerning the initial settlements on Suape's implantation and its electric power supply , it is recommended:

A With CHESF's Planning Management

Settlement between Suape's General Management and CHESF's Planning Management , in order to work out with CHESF the initial overall consumption forecast and the energy demand for Suape , giving emphasis to the location , to the special conditions of important consumers there foreseen , etc .

B With the Industries

Settlement between Suape's General Management and the Industries making part of it , in order to well determine the supply scope by Suape or by CHESF and the technical requirements which will be establihed for those industries being benefited by the electrical network under implantation .

C Industries With Charges Over 50 MV

The industries with foreseen charges over 50 MV are called upon to keep in contact with CHESF's Commercial and Planning management so as to establihed the supply conditions under 230 KV within the definitions and requirements now in effect in that enterprise .

D Industries of Minor Importance

That the other industries of minor importance there foreseen maintain similar agreement with Celpe , in what refers to their installations being served by the 69 KV and the 13.8KV networks which will be implanted there by that state concessionaire .

TOME IV - PART 5

TELECOMUNICATIONS SYSTEM

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PART 5 - TELECOMUNICATIONS SYSTEM

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1.0 - PRELIMINARY CONSIDERATI(

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PART 5 - TELECOMUNICATIONS SYSTEM

1.0 PRELIMINARY CONSIDERATIONS

The Industrial Complex area will be basically subdiveded in industrial areas and in port , residential , administration and service areas .

In the face of the activities interdependence developed in these areas , the interrelations must be of intense dynamism.

The industrial area was planned according to four main definitions :

1) functional programme fo each industry in order to attain a determined production ;

2) planned expansion of that production capacity ;

3) optimization of maritime and land accesses .

4) the necessity of allowing an efficient interchange of products between industries of integrated groups .

For location purposes the industries were classified into:

1) industries connected with the Port , not requiring direct maritime access .

2) industries requiring direct maritime access .

The Suape Industrial Complex was panned within the most modern areas interrelations , which predicts a great interest on the part of everybody living in the neighbourhood.Besides through the highway and railway systems a great number of workers from the near cities can be engaged by Suape .

These facts enhance the necessity of an efficient and quick communication system .

Considering the proximity of Recife and the existence of Cabo city , seat of the municipality, in the Complex area , a high interest factor of Suape with those cities and with the rest of the National Telecommunication System is foreseen .

Within the rules published by " Telebrás " , Suape has conditions of entering directly into the National Telecommunications System - DDD , depending only on Embratel's planning which must have a planned route for that purpose . Alternatively Suape may be introduced as any station satellite of " Telpe " , depending also on planning by Pernambuco concessionaire .

The automatic long-distance calls in Suape are extremely necessary , above all due to the affluence of everybody who will transact in the Industrial Complex .

For the 1st. stage of CI implementation , the following areas are considered :

- Residential in ZRI and ZR2
- Distillery
- Cement
- Aluminium
- Fertilizers
- Common Port
- Administration and Complementary Services (ZCA)

The activities nature of the respective areas is indicated below .

AREA	TRADE AND INDUSTRY
RESIDENTIAL	3 Markets
	2 Banks
	3 Athletic Centers
	3 Health Stations
	3 Primary Schools
	3 Secondary Schools
	3 Churches
	1 Police Station
	1 Fire Department
	1 Theatre
	1 Post Office
DISTILLERY	Industry
ALUMINIUM	Industry
CEMENT	Industry
FERTILIZER	Industry
GENERAL PORT	Port System
PORT ADMINISTRATION	Office
	Customs
	Police Port
	Traffic Control
	Canteen
	First Aid
ADMINISTRATION AND COMPLEMENTARY SERVICE	Office
	Trade
	Hotel
	Sanitary Station
	Training School
	Bank
	Post Office

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PARTE 5
VOLUME 3
2.0

2.0 COMMUTATION SYSTEM

2.0 COMMUTATION SYSTEM

2.1 DEMAND EVALUATION

For evaluating the telephone demand , the dynamics of the Complex should be well known , which will only be well defined with the proper functioning of all areas .

Whenever the telephone demand of an area is calculated a close correlation between the mentioned demand and the different factors is observed , such as :

- Power consumption
- Number of vehicles
- Deposits value
- Taxes collection
- Percapita income
- And others .

This correlation is obvious , once such factors are related to the population's purchasing power . All evaluation me - thods of the telephone demand , in some way , tend to re - late it with indicative factors of the purchasing power of a determined population under study .

Normally , when a demand survey of a place is made , its wealthiness rate is evaluated by means of a graph , which will furnish each population with a national wealthiness ra te that later will indicate the terminals number .

In the case of " Suape Complex " , there is no possibility of drawing a curve for the calculus of the "National Wealth iness Rate " , considering that it is an almost uninhabita ble area , which also applies to the majority of the neigh- bouring areas . It was adopted therefore the hypothesis that " Suape Complex " telephone demand follows the adop- ted average in the country (d = 2 term/ 100 inhab .) .

The number of terminals thus calculated , was analysed in comparision with other reference elements of similar nature , being considered quite satisfactory .

The population involved in the CI area , due to the in terest of the system under study , resulted in the fol lowing profile :

AREAS	ESTIMATED POPULATION
Residential	34.535
Distillery	600
Cement	1.500
Aluminium	2.000
Fertilizer	100
Common Port	600
Administration and Complementary Services ,	796
TOTAL	40.131

Based on the population estimated for the areas , for the sake of the study and taking into account the adopted factor which was ascertained according to similar projects , the following terminals'profile was determined :

AREAS	NUMBER OF TERMINALS
Residential	400
Distillery	12
Cement	30
Aluminium	40
Fertilizer	30
Common Port	8
Administration and Complementary Services ,	10
TOTAL	530

The telephone density tends to vary running the time , as a consequence of the " Area " expected growth . This fact , must be given special attention as the data are gathered during the operating period , considering that , one the analysis of the information will depend the future enlargements . Taking such fact into consideration and the stations economic scale , the installation of a 1000 terminals station is advisable .

2.2. TYPES OF TELEPHONE SERVICES

2.2.1 RESIDENTIAL AREA

In this "Area " a population of about 34.500 inhabitants is foreseen , with a 5 people family average . It is supposed that a great majority is formed by workers,who will work in the " Industrial Sector " added to a minority of high level staff (managers , officers etc) .

The population average of this area then will have a low purchasing power .

For this area . communication possibility with the rest is foreseen , as well as with the National Telecommunications Network and mainly with the Capital of the State .

For this , public services are foreseen (telephone booths) for servicing the people lacking residential telephones . These telephones will be blocked to the " Direct Dial Service - DDD " in traditional patterns , identic to the ones used in all National Telecommunications Services .

Besides the public and residential ones , telephones for all types of trade establishments will be installed .

"Service Stations (SP) " will be made available where people lack residential telephones , in order for them to be able to make long - distance calls , through paid taxes at the moment of the call .

2.2.2 Industrial and Administrative Areas

For the Telecommunications System Plan " Administrative and Industrial Areas " are considered to be all those having industries and in a way or another , those having administration organ .

The population of these areas vary from 200 to 2000 people . The areas with a number exceeding 1000 employees must have PABX switchboards , while PBX or PABX's are admitted for the others , depending on each one's planning and dynamism .

In all these areas " direct telephones " must be installed for directors , managers , officers , etc . . with DDD service access . Normally , these " direct telephones " are planned in order to provide a larger success possibility in the call attempts to those people who need quicker and reliable communications .

The PABX must have blocked extensions to DDD service . The extensions long-distance calls must be done with the operator's aid .

Depending on complementary studies , public telephones (fiberglass type) must be placed in the industries neighbourings in order to make the communications easy for the workers who don't have easy access to telephones in their working places .

The telephone services synthesis is indicated below :

RESIDENTIAL	Residential Commercial and Public Telephones
DISTILLERY	PABX/PBX and Direct Telephones
CEMENT	PABX " " "
ALUMINIUM	PABX " " "
FERTILIZERS	PABX " " "
COMMON PORT	Direct Telephones
ADMINISTRATION AND COMPLEMENTARY SERVICES .	PABX/PBX and Direct Telephones

2.3 TELEPHONE SYSTEM DIMENSIONS

The determination of the number of the long-distance and local calls and of the average circuits occupation time can only be obtained safety ofter some observation years and local habit registrations , this part being one of the most difficult of a " Plan " preliminary phase .

Data obtained in practical observations of similar areas were used to solve the problem .

2.3.1 Originated Traffic

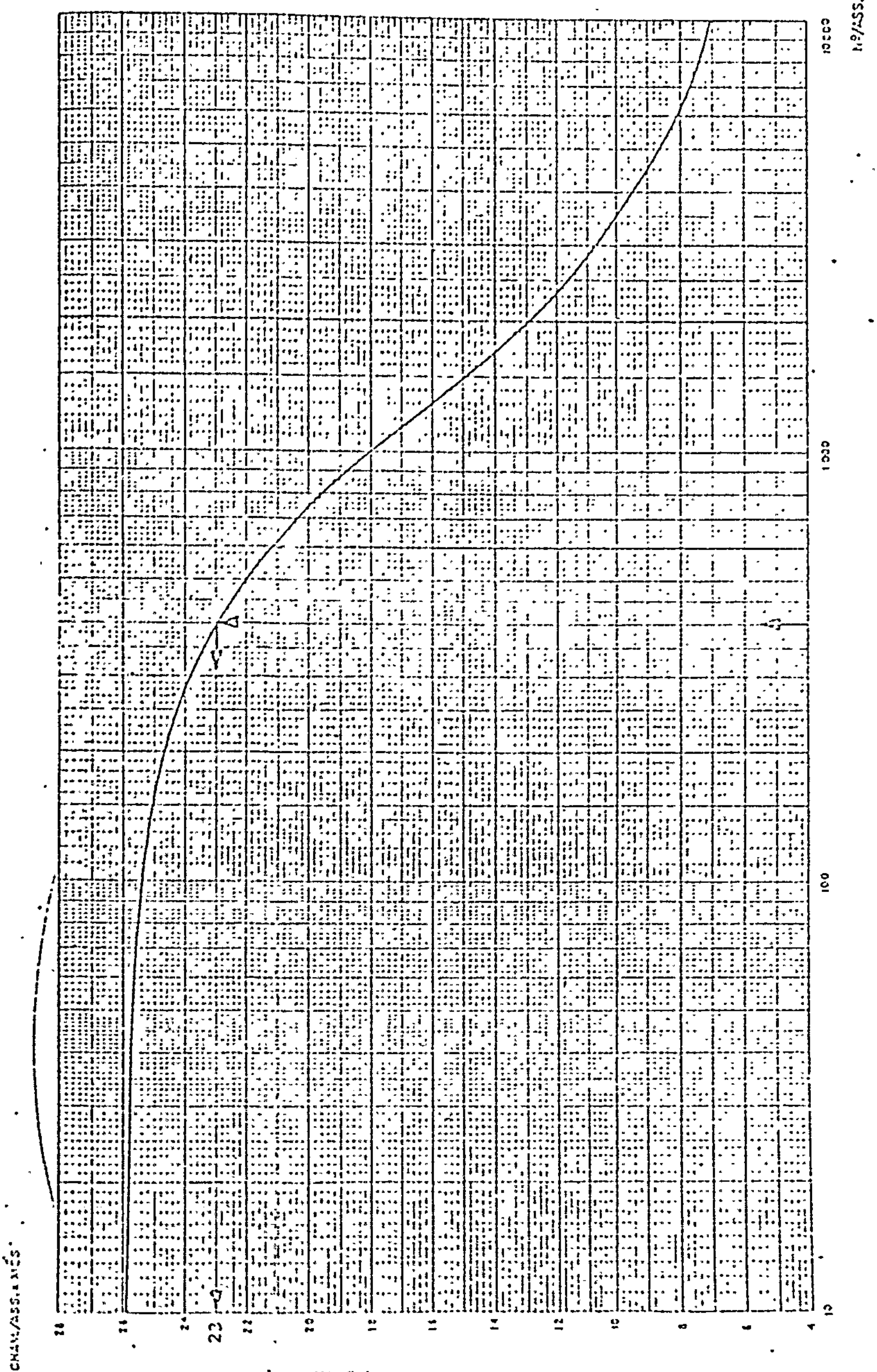
- Local and Long-distance calls number :

Experimental results show that telephone low density places as in the case of " Suape Industrial Complex " indicate subscribers with telephone intense utilization habits . Other countries statistics , with identical areas , show that each subscriber initiates with a 250 local calls per month average .

The long -distance calls estimates are mede within the most elaborate processes . An empirical diagram (graph 2/1) is used for defining the probable traffic volume in each area . Based on that diagram , considering the concentration factor of 15% during the " RHT" , and 26 days per month , the long-distance calls number during the " RHT " (Rush hours time) is estimated.

- Long-Distance Traffic

Once the number of calls is estimated for the " RHT" , that number must be turned into traffic .For this to be accomplished , call occupation time is needed , which comprises the communication time , conversation time , plus a time addition which takes into consideration the incomplete calls . An average 5 - minute call occupation time , was also considered (experimental data obtained in the national network) .



10
100
1000
10000
28
26
24
23
22
20
18
16
14
12
10
8
6
4

2.3.2 INTEREST FACTOR

A great interest of the Complex is estimated for the neighbouring places . Therefore an expressive long - distance traffic was estimated .

2.3.3 Traffic to/from the National Network

Taking the previous considerations as a basis , the share of the originated traffic for Recife and the National Network was evaluated .

Foreseen terminals - No. of terminals = 530 ≅ 600
From graph 2/1 results :
n = 23 calls I U / month subscriber

Days of month : d = 26

Hour concentration factor : fc = 0.15

With the present data resulted N = 79 calls , obtained from the formula :

$$N = \frac{\text{No. of term.} \times n}{d} = fc$$

Considering the Average Conversation Time , the result was :

$$A = \frac{\text{No. ACT}}{60} = 6.0 \text{ E}$$

Where ACT = average

Thus , the traffic originating in Suape , is approximately 6 erlangs , of which 12 trunks are resulted , if a 5% service rate is considered .

Supposing that the greatest interest is related with Recife , the inlet/outlet rate is of 0.70 . In these conditions we would have the necessity of 22 (twenty-two) " IU " trunks , 12 (twelve) to which feed their lines to Recife and National Network , as shown below:

$(A_{IU}) = 0.70\ (A_{IU})o$, where $(A_{IU})o$ = long-distance traffic originated $(A_{IU})o = 0.70 \times 6.0\ E = 4.5\ E$.

The traffic number for the finished IU traffic course is equi to 10, considering a 0.5 service degree .

Trunks total number :

12 (originated IU traffic) + 10 (finished IU traffic) = = 22 .

In synthesis we have :

Terminals number	IU calls number during the RHT	IU traffic RHT	IU trunks number
600	79	60 E	12

National Network(Inlet)Traffic	Traffic National Network (Outlet)
4.5 E	6.0 E

2.4 COMMUTATION PLAN

The interarea traffic must be totally automatic , being led through the telephonic station located in the "Ad - ministration and Complamentaty Services Area ".

The traffic for / from Recife and the national network will also be led through the above mentioned station .

The picture 2 - II depicts the CI commutation plan .

2.5 NUMERATION PLAN

The " Suape Area " must have a compatible numbering with Telpe's plan , consequently , more details about this item will be known later,in contact with the Concessionaire , when the system implantation will take place .

2.6 TRUNK- LINE DIAGRAM

All areas will be connected with the automatic telepho no station by means of underground cables couples . The calls from/ to Recife and the national network will be completed through six-wire connectors , and will be load through Radio System .

. The picture 2 - III illustrates Suape's telephone Station trunk-line diagram .

2.7 SIGNALLING PLAN

The automatic Telephone Station must be identic with so many other ones withe qual terminals number (1000 "MFC" , scheme " 5 C " , standardized for the National System .

2.8 TARIFFING PLAN

Tariffing must follow the Concessionaire standing ru les for " Suape's Area " . The long-distance calls will be ticketed automatically in Embratel's Class I traffic station in Recife .

2.9 CONCLUSIONS

Based on the calculations for Suape's telephone demands, and bearing in mind the attendance of its future necessities, the installation of a typical central station for 1000 (one thousand) terminals is recomended , to be located in the Central Administration building. There should also be made an allowance for a 2.500 m^2 (two thousand and five hundred square meters) in this building .

This station must possess an energy system capable of feeding a 3 KW charge approximately , as well as an emergency system capable of maintaining it functioning till the main energy re-establishment .

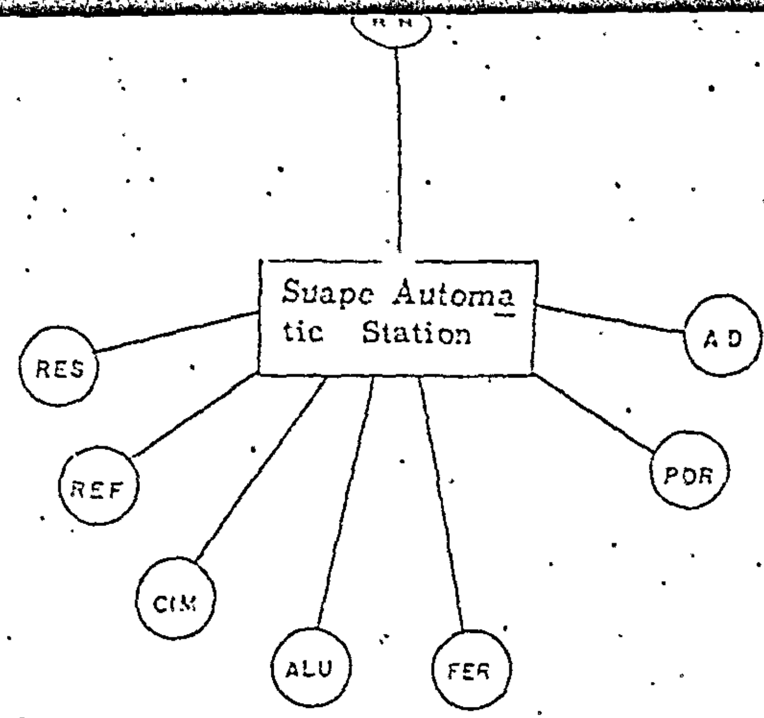
The urban network must be underground , with visiting boxes at the junction points and distant among themselves a maximum of 200 (two hundred) meters . The urban network planning must be done together with the urbanistic and the access ways departments .

2.10 ESTIMATED BUDGET

The cost evaluation for the commutation system is based on a ARF -102 MFC (ERICSSON) station prices, the cost of which is Cr$9,500,000.00 as discriminat ed below :

1) Equipment -	Cr$2,400,000
2) Civil Works -	Cr$4,000,000
3) Urban Network -	Cr$2,600,000
4) Apparatus -	Cr$ 500,000
Commutation system Total -	Cr$9,500,00

RES	Residential Area
REF	Distillery Area
CEM	Cement Area
ALU	Aluminium Area
FER	Fertilizers Area
POR	Common Port
ADP	Port Administration Area
AD	Administration And Complementary Services Area
RN	National Network



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TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO - PRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

Commutation Plan

visto	data	escala	desenho nº	folha

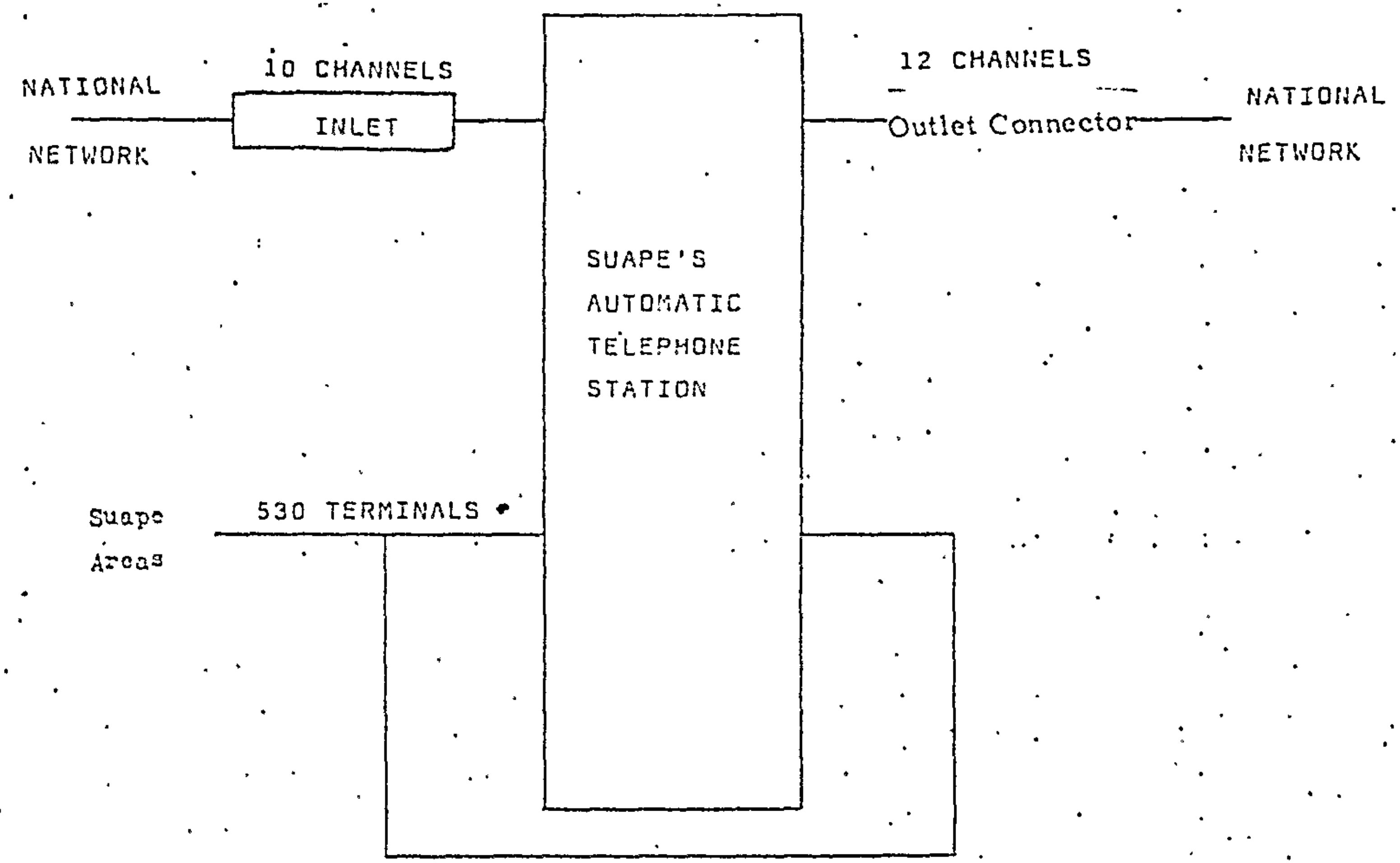

FIGURA – 2-III

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GOVERNO DO ESTADO DE PERNAMBUCO - PRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO
COMPLEXO INDUSTRIAL DE SUAPE

'Suape Telephone Situation'
Trunking Diagram

revisão	data	escala	desenho nº	folha

137

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3.0

3/0 TRANSMISSION SYSTEM

3.0 TRANSMISSION SYSTEM

3.1 PROPOSED SYSTEM

The Suape to Recife or to Cabo city distances imposes a linking via Radio as a solution to the telecommunications problem . We opted for Suape's connection with Cabo , due to its greater proximity and for the fact that TELPE is implanting a Communication System', which among other cities it will link Cabo to Recife, through a high and trustful capacity system .

The suggested transmission system must be formed by an enlacement via Radio , operating on the UHF band and will connect Suape with Telpe's system support station in Cabo , At this station , through a multiplex system the telephone channels coming from Suape will be injected in Telpe's state network in order to be transmitted to Cabo and Recife and from there to the national network .

3.2 RADIO SYSTEM

The Radio System to be installed must possess a maximum capacity of 60 (sixty) voice channels , being projected for obeying the International Radio Consultive Comitee (IRCC) and the National Telecommunication Council .

With this capacity the system may supply future significative expansions that will appear with the Industrial Complex demand growth .

3.3. MULTIPLEX SYSTEM

The multiplex Equipment , which will make the Suape System interconnection with Telpe System possible will be equipped at first with 36 (thirty-six) telephone channels and being capable , by units addition of being expanded to 48 (forty-eight) and 60 (sixty) voice channels , making it compatible with the maximum allowed capacity by the Radio equipment. The multiplex system must obey to the International Telephony and Telegraphy Consultive Commitee(ITTCC).

3.4 DOUBLE CABLE SYSTEM

The double cable system is expected to interconnect the multiplex equipment with Suape's automatic telephone station . This system will be compounded by a double cable with 200 (two hundred) couples capacity , making it possible the 60 voice channels and 6 wires transmission .

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The double cable system is expected to interconnect the multiplex equipment with Suape's automatic telephone station . This system will be compounded by a double cable with 200 (two hundred) couples capacity , making it possible the 60 voice channels and 6 wires transmission .

3.5 JUSTIFICATION

The calculation of Suape telephone demand , has determined that the initial multiplex canalization carry 24 (twenty four) voice chan - nels , making a short-term allowance for 36 (thirty-six) and final capacity for 60 (sixty) channels . Notwithstanding , due to the small difference in the cost of the Radio equipment , for a 24 - 60 channel system (20% of the cost of the radio equipment) and the relatively long time period that it takes for the channels installa- tion to take place , the installation of the latter is recommended, the multiplex system being initially equipped for 36 channels . The choice for the multiplex equipment with 36 voice channels is as cribable to many reasons , some of which are mentioned below :

- The standardization of the mix equipment for multiples of 12 chan- nels .
- Experience has shown that big projects such as Suape , with conse quential progress boom in close liaision with the facilities it places to the users , show a considerably irregular demand growth, mostly often impredictable ;
- There are other services that may be made available to the users , such as aiding radio broadcast , renting private lines , transmis sion of programme channels in Hi-fi for inside music , etc, all of which would require aditional channels .
- It is always wise to keep some spare channels in the system in order to overcome unforeseen situations .

As regards the double-cable system , it is considered appropriate to use same for the maximum capacity of the system (60 channels) , as the extention to the cables at a further occasion would be ex - pensive , apart from being detrimental to the system . Furthermore the cost difference for a cable with a capacity for 36 channels is unimportant (about Cr$20,000.00) if compared with the total cost of the system .

3.6 INTERFACE WITH TELPE SYSTEM

The Suape System will be connected with TELPE system at the aid station in the city of Cabo . The interconnection of the two - system will be effected Superground-wise , that is , a sub-equipped base supergroup , coming from Suape , will be injected at the TELPE system leading for Recife , through its multiplex equipment , with will be available at this station .

From Cabo to Recife , all Suape channels will be considered as originated at Cabo , entering the Recife Automatic Central through the Cabo - Recife System , thus being allowed to enter the natinal network through Direct Dialing .

3.7 RADIO CANALIZATION

The Radio must be dimensioned for carrying 60 voice channels plus the sub-base band .

3.8 MULTIPLEX CHANNELS

There should be initially an allowance for 35 voice channels for Recife , comprising telephone channels , telex , telegraph and channels for rent .

The programme channel is not shown in the channels distribuition, as same could also be effected optionally .

A number of channels may also be envisaged for Cabo , which could be made available through Recife .

3.9 AREA DISIGN FOR THE EQUIPMENTS

The construction of a stayed tower is foreseen to be constructed of Suape which should support the dutenna . The installation of all Commutation and transmission equipment was initially foreseen to occupy a single building , in the Administrative Area . However due to urbanistic problems , it was decided that the installation of the transmission equipment be placed in separate , far around 400 meters from the administrative area . In this building it will be necessary some 20 (twenty) m^2 of utilizable area , with a minimum floor-to-floor distance of 4,0 meters so it may be in a condition to house any type of equipment .

As for the lends , same should be on an even area , corresponding to a square 30 meters in each side , for fixing the tower stays .

At the station inteded for supporting the cable , all TELPE infra-structure will be utilized , including the tower , In this case , the area to be occupied should be object of dismission vis- a - vis TELPE , so that an agreement be reached in respect of the " Lay-out" for the station .

3.10 POWER SYSTEM

Due to the low consumption of the equipments (approximately 250W) , and the facility of same to be fed by AC power , no emergency generators motors group are foreseen , inasmuch as any battery-system of the automobile type will suffice in order to keep the system running until the normal charges become available .

3.11 PRESENTATION

The transmission system is illustrated in the blocks shown in picture 3-I to IV .

3.12 ESTIMATED BUDGET

The overall estimated budget for the transmission system amounts to Cr$1,600,000 , as detailed below :

1)	Radio equipment	Cr$500,000
2)	Tower	70,000
3)	Cable Equipment	70,000
4)	Multiplex Equipment	750,000
5)	Sub-total - Equipment	1,400,000
6)	Civil Works	100,000
7)	Access roads to tower	100,000
8)	Total for the transmission system ...	1,600,000

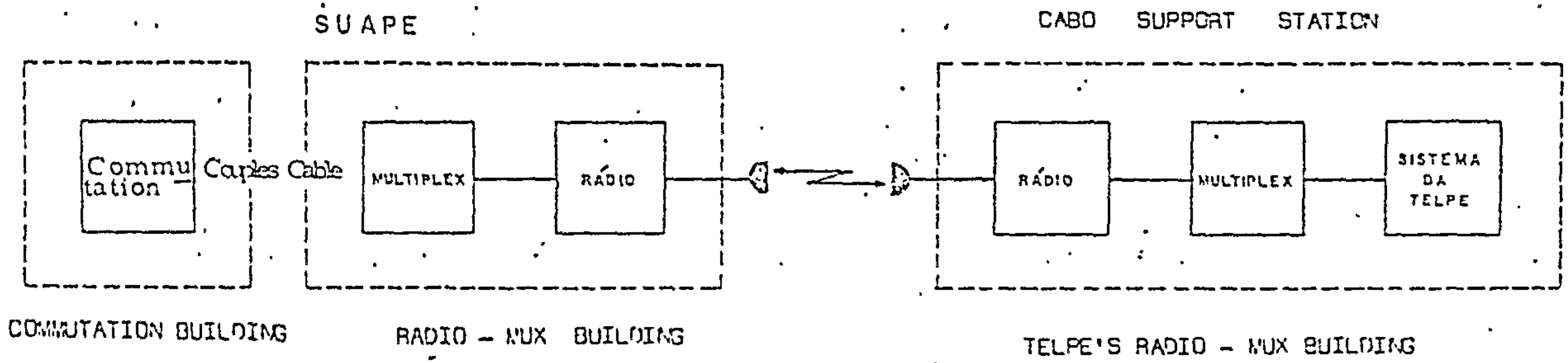

FIGURA - 3-1

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GOVERNO DO ESTADO DE PERNAMBUCO - PRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

Block Diagram for the Transmission System

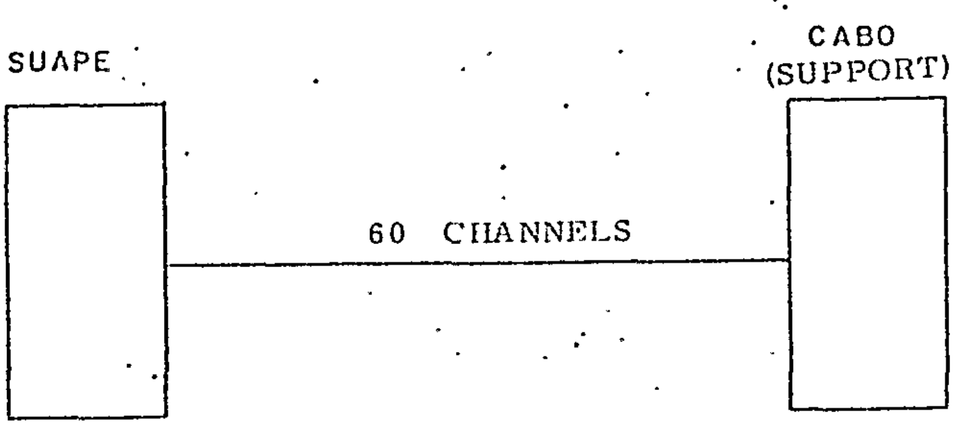

FIGURA - 3-II

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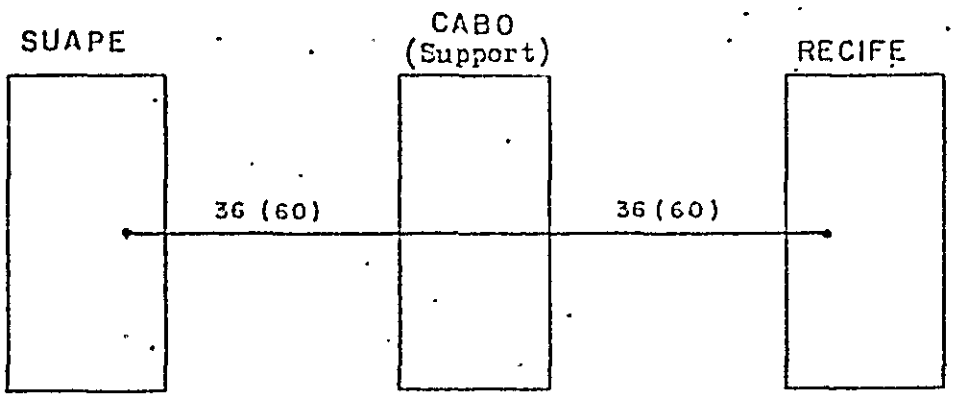
GOVERNO DO ESTADO DE PERNAMBUCO - PRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

RADIO CHANNELLING

TRANSCON S.A.

desenhista	data	escala	desenho nº	folha
	XII 74			



(60) – Maximum capacity

36 – Initial Capacity

Fig.– 3 III

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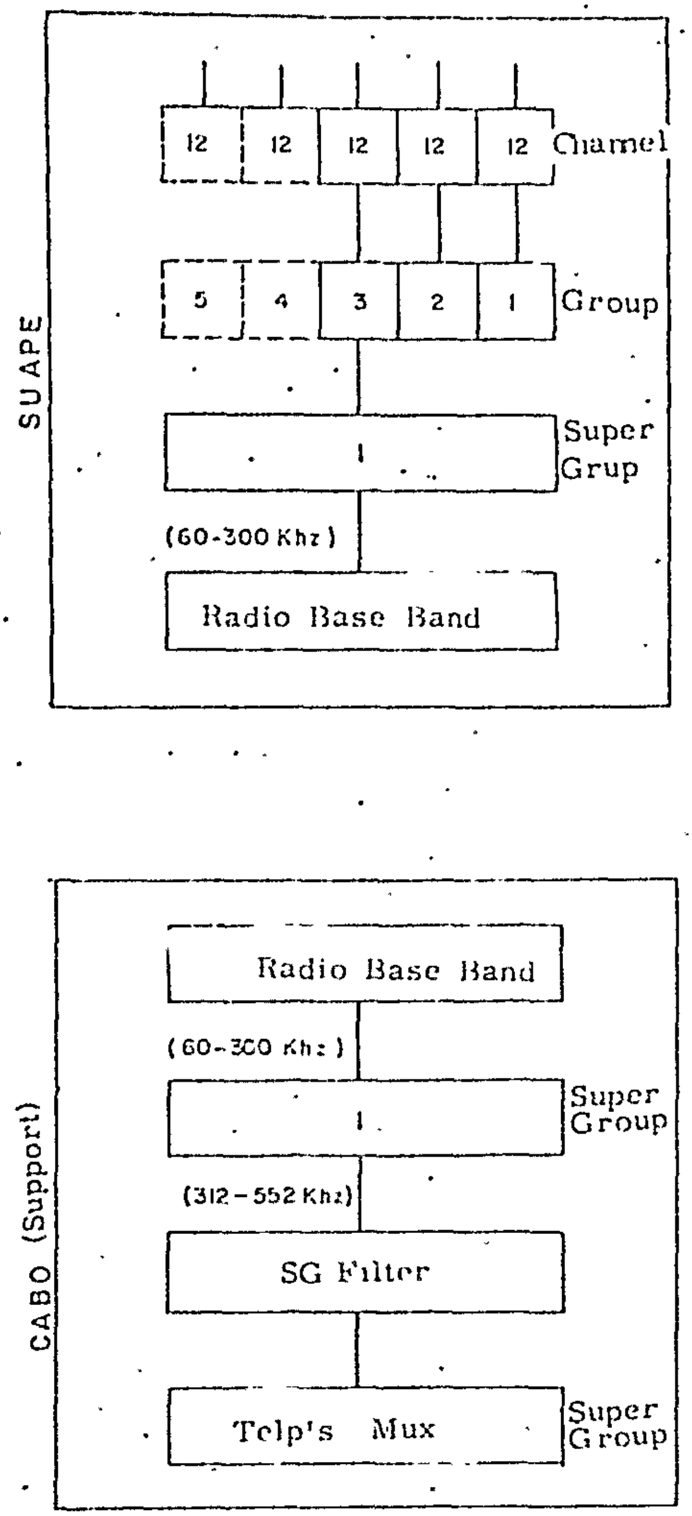
GOVERNO DO ESTADO DE PERNAMBUCO - PRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

Multiplex Channelling

data	escala	desenho nº	folha
DEZ 74			



Picture-3-IV

- To Build
- to be enlarged

dipor

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GOVERNO DO ESTADO DE PERNAMBUCO · PRAC
CONSELHO DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

Composition of the Milti
plex Equipment

desenhista	data	escala	desenho nº	folha
	07.74			

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1:

4.0 TELEGRAPHIC SYSTEM

4.0 TELEGRAPHIC SYSTEM

The first appraisals for the demand of telegraphic channels has shown that there is no large concentration of these services in the region .

Medium - Term-wise , the " Suape Port Industrial Complex " may accommodate the installation of a telegraphic multiplex equipment with capacity for 24 (twenty-four) terminals , no telegraphic central being necessary to be implanted .

The 24 channels intended for Recife and to the National telex Network will be trasmitted to the Central of telegraphic Communication of Recife , through a voice-channel in the Suape - Cabo Recife System .

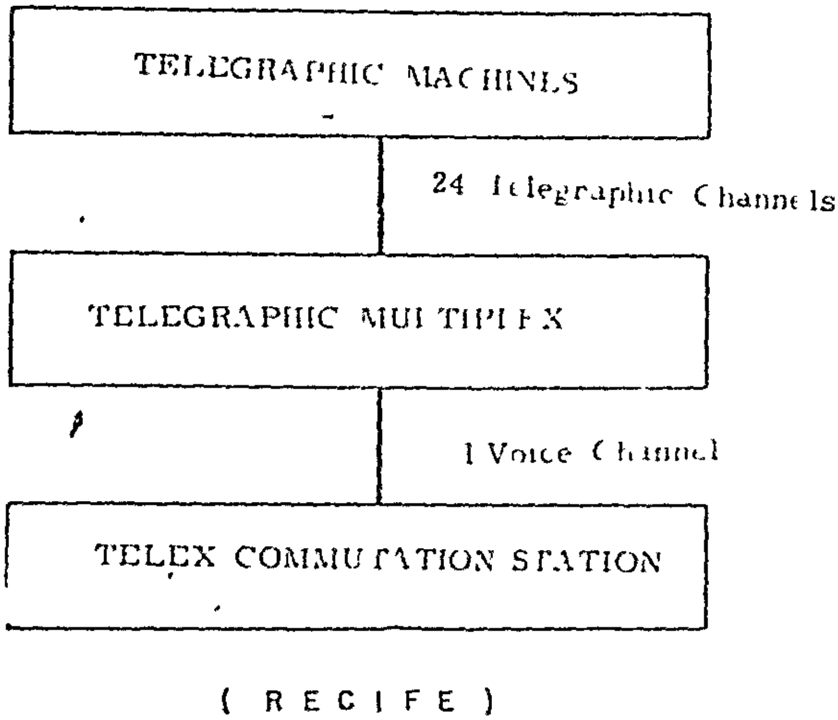
The estimated budget is Cr$160,000 , as detailed below :

1) Mux Equipment (24 channels) - .... Cr$130,000

2) Installation & Transportation 30,000

3) Total cost for the telegraphic system .. Cr$160,000

It should be stressed that this cost does not include the total price of the machinery , as this will depend on the number of users. Only for reference , the unit price for the telex machine is being given , vis. Cr$20,000 .



Picture 4- 1

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TRANSCON S.A.

GOVERNO DO ESTADO DE PERNAMBUCO - PRAC
COMPANHIA DE DESENVOLVIMENTO INDUSTRIAL
DE PERNAMBUCO

COMPLEXO INDUSTRIAL DE SUAPE

Telex Interconnection Diagram

desenhista	data	escala	desenho nº	folha
	DEZ/74			

TOMO IV
PARTE 5
VOLUME 3
5.0

5.0 OTHER SERVICES

5.0 OTHER SERVICES

In addition to the services which will be available at Suape , other facilities may be included , such as the High fidelity programme Chan nel , data transmissio , private lines , (closed television circuit for TV repeaters) , tec , all of which may rely on the system under consideration .

The other services utilizing the telecommunications services should also be given close consideration , among which should be included air and sea traffic control , privately owned communications networks such as Radio and Television , all according to the planning made for the Suape System which shuold also be integrated in the National Telecommunications System .

As regards the air and sea traffic control , there should be possible the installation of approximation radars , the cost of which was calcula ted around US$150,000 (one hundred fifty thousand) dollars .

TOMO IV
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6.0

6.0 OVERALL ESTIMATE BUDGET OF TELECOMMUNICATIONS SYSTEM

6.0 OVERALL ESTIMATED BUDGET FOR THE TELECOMMUNICATIONS SYSTEM

The overall cost estimated for the Suape telecommunications system amounts to Cr$11,260,000.00 .

This cost include the total prices in connection with supply , transportation and installation of the equipments which will make up the Suape System , including the Civil Works .

Itemised Prices :

1	Commutation system	Cr$ 9,600,000.00
2	Transmission system	1,500,000.00
3	telegraphic system	160,000.00
4	overall cost	11,260,000.00
5	radar	150,000.00