DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
Washington, D.C. 20523

CAPITAL ASSISTANCE PAPER

Proposal and Recommendations
For the Review of the
Development Loan Committee

BOLIVIA - RURAL ELECTRIFICATION II

AID-DLC/P-2013

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

UNCLASSIFIED

AID-DLC/P-2013

October 17, 1973

MEMORANDUM FOR THE DEVELOPMENT LOAN COMMITTEE

SUBJECT: Bolivia - Rural Electrification II

Attached for your review are the recommendations for authorization of a loan in an amount not to exceed $6,400,000 to the Government of Bolivia to assist in financing the United States dollar and local currency costs of the rural electrification program administered by the Empresa Nacional de Electricidad, S.A. ("ENDE").

This loan proposal is scheduled for consideration by the Development Loan Staff Committee meeting on Wednesday, October 31, 1973.

Development Loan Committee
Office of Development
Program Review

Attachments:
Summary and Recommendations
Project Analysis
ANNEXES I - V

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BOLIVIA: RURAL ELECTRIFICATION - PHASE II

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PART ONE: SUMMARY AND RECOMMENDATIONS October 17, 1973

1. Borrower

The Government of Bolivia (GOB) will be the borrower. The executing agency will be the Empresa Nacional de Electricidad S.A. (ENDE), an autonomous public corporation created for the purpose of developing and implementing a national plan to electrify Bolivia.

Four sub-borrowers will participate in the project: 1) The Instituto Nacional de Electrificación Rural (INER); 2) The Cooperativa Eléctrica de Sucre, S.A. (CESSA); 3) The Servicios Eléctricos de Potosí, S.A. (SEPSA); and 4) The Servicios Eléctricos de Tarija, S.A. (SETAR).

2. Amount and Terms of the Loan

Up to $6.5 million, repayable over 40 years including a grace period of ten years on principal and with interest at 2% per annum during the grace period and 3% per annum thereafter. An estimated 30% of the A.I.D. loan will be converted to Bolivian pesos to meet projected local currency requirements.

3. Purpose

The purpose of the loan is to improve the economic and social conditions of the inhabitants of the rural areas in four departments of Bolivia by providing them with electrical distribution and connection services on a self supporting basis. The loan will seek to achieve the following objectives:

a) To provide a backbone distribution system (in areas of population concentration) which will be capable of future expansion;

b) To enable the presently urban oriented sub-borrowing entities to expand their operations into rural areas and acquire the additional technical capability and financial resources necessary for future expansion;

c) To promote economic development of rural areas by providing energy (1) for more intensive agriculture through irrigation and (2) for agro-industrial uses.

d) To improve the quality of rural life.

4. Project Description

The project to be supported by A.I.D. loan financing consists of the construction of electrical distribution and connection facilities in rural

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Exchange rate: US$1.00 = $b 20.00 unless otherwise indicated.

areas adjacent to the cities of La Paz, Sucre, Potosí and Tarija and the town of Villamontes.

Also included in the project are the construction of related facilities and the purchase of auxiliary equipment, as well as the provision of necessary consulting engineering services and technical assistance.

Total project cost is $8.7 million, with $6.5 million to be provided by the proposed loan. The project will be administered by ENDE, who will contract for necessary consulting engineering and technical assistance services and will see the construction through to completion in collaboration with the sub-borrowers.

Loan funds will be passed on at concessional terms to the respective sub-borrowing entities for foreign exchange and local currency costs of the individual sub-projects listed below. The concessional terms are necessary to enable the sub-borrowers to expand to rural areas. (See Sec. II E7).

a) The La Paz Sub-Project

The sub-borrower will be the Instituto Nacional de Electrificación Rural (INER), an agency of the GOB which has been assigned the responsibility for electrical distribution in the rural areas of the Department of La Paz. The $3,359,900 subproject with an estimated $2,333,100 to be provided by the proposed loan consists of the construction of distribution lines in three different climatic regions, the Altiplano area near Lake Titicaca, the semi-tropical valley area of Los Yungas, and the high dry valley of Rio Abajo south of La Paz. A 50 kilometer 69 KV transmission line from the City of La Paz to serve the Los Yungas distribution system and related step-down substations will be constructed with Bolivian funds as part of the total sub-project. The new distribution facilities will have the capacity to serve an expected 14,000 residential, small commercial, and industrial consumers and 28 large industrial consumers, as well as an estimated 14,000 MWH of irrigation load within the ten year period.

The La Paz sub-project will consist of 605 kilometers of 14.4/24.9 KV distribution lines, 1450 street light installations and 10,000 house connections plus related distribution transformers, meters and protective equipment. Also included is $100,000 for tools and work equipment from AID loan funds plus an additional $143,500 from local contributions to equip INER for utility operations.

The Altiplano area to be served under the sub-project is the most densely populated rural region of the country which is a reflection

of the quality of the land and the life on it, evaluated in a historical sense. By modern standards life there is harsh and dreary. Compared, however, with the regions of the Altiplano further from the lake, the areas to be served are relatively prosperous; the climate is better in that there are more frost-free days and rainfall is relatively more abundant, especially during the rainy season. The target population is primarily the residents and commercial establishments of the villages throughout the area that serve the small-farm population around them. In addition, rural residents along the route of distribution lines will be encouraged to switch to electricity. A controlled water supply could be an important productive factor for 4,000 to 7,000 hectares of altiplano land suitable for irrigation. A number of small mines are found in the area, especially along the north shore of Lake Titicaca and along the route to Sorata, as well as several existing small boat (4) and brick factories (3).

The semitropical villages in Los Yungas to the north of La Paz are warm and humid and produce much of the country's coffee, cacao, and many tropical fruits, especially for the La Paz market. High world prices plus devaluation of the peso Boliviano have raised the income of producers of the export crops (coffee, cacao) and expansion of area under cultivation of these crops is taking place. At the present time virtually all of the preliminary processing of these commodities takes place in La Paz. With electric power, a gradual movement of these operations toward the primary production region is expected, with consequent improvement in rural employment and income and savings in transport costs. Within Los Yungas, the sub-project will supply about 5,000 KW annually to the Chojlla mine. Existing industries with energy requirements also include saw mills (9), cereal mills (10) and bottling plants (3).

The Rio Abajo area is a warm dry valley lying immediately to the south of La Paz along the La Paz river. With irrigation, most of the region will support double cropping. Principal outputs of the region are vegetables, fruits, milk and meat all destined for La Paz market. Irrigation load projections for the La Paz sub-project are based upon estimates from the Rio Abajo region.

b) The Chuquisaca (Sucre) Sub-Project

The sub-borrower will be the Cooperativa Eléctrica de Sucre S. A. (CESSA) a mixed corporation which is responsible for electrical

distribution in the Department of Chuquisaca. The $1,551,000 sub-project with an estimated $1,247,700 to be provided by the proposed loan consists of the construction of a principal distribution line from the city of Sucre to the towns of Padilla to the east and Mamahuasi to the northwest. This will provide CESSA with the capacity to serve an expected 10,500 residential, small commercial-industrial consumers, 9 large industrial consumers plus an estimated 2,250 MW of irrigation load within the ten year period.

The AID financed sub-project will consist of 365 kilometers of 14.4/24.9 KV distribution lines, 1,000 street light installations and 5,000 house connections, plus related distribution transformers, meters and protective equipment. Approximately $60,000 in tools and work equipment and 7500 KVA in step-down substation capacity will be financed through local contributions.

The Chuquisaca sub-project area is within Bolivia's sub-Andean, High Valley region. The target population will be the small villages (up to 5,000 residents) and accessible rural inhabitants along the paths of the distribution lines. Principal crops in the sub-project region are potatoes, wheat, aji and corn. Pigs, sheep and goats are also raised. Existing industries with energy requirements include a pork processing plant, a livestock feed plant, flour mills, sawmills, carpentry shops, and a goat-leather factory.

Irrigation projections are more limited than in the other sub-project regions because of the reliance on river-gravity methods.

c) The Tarija Sub-Project

The sub-borrower will be the Servicios Eléctricos de Tarija, S.A. (SETAR), a mixed corporation which is responsible for electrical distribution in the Department of Tarija. The $2,277,800 sub-project with an estimated $1,730,300 to be provided by the proposed loan calls for the construction of new distribution facilities with the capacity to serve an expected 21,500 residential, small commercial-industrial consumers and 24 large industrial consumers. 16,000 MW of irrigation load is projected within the ten year period.

The AID financed sub-project will consist of 475 kilometers of 14.4/24.9 KV distribution lines, 850 street light installations and 9,000 house connections plus related distribution transformers, meters and protective equipment. Approximately $60,000 in tools and work equipment and 20,000 KVA in step-down substation capacity will be financed through local contributions.

The Tarija sub-project includes distribution lines in two distinct geographical areas: 1) The Valley region in the rural area surrounding the city of Tarija; and 2) the dry tropical flat land to the east of the Andean valleys to the north and south of the town of Villamontes.

The distribution lines radiating from the city of Tarija will bring reliable electric service to a potentially rich agricultural valley. The Tarija valley is very dry however, and agriculture depends on irrigation for its productivity. A recent survey indicated that at present 2,000 hectares (ha.) are irrigated by gravity methods and that a potential 5,000 ha. could possibly be irrigated by pumping water from the river below, or from deep wells.1/ Drilling of wells and construction of dikes to form lagoons have begun in the area. Given that there is substantial unemployment (19% according to the Planning Ministry) lack of irrigation would appear to be a major constraint to large scale expansion of output and income in the area. Regional planning authorities estimate that a ha. of land can be irrigated from river water for $250 per year running cost if electric, and for $500 per year if gasoline or diesel powered pumps are utilized, the difference being in fuel efficiency and maintenance costs. Further, the capital investment for the electric pump is considerably less than for the gasoline or diesel equivalent.

Irrigated land in the Tarija valley can yield a net value added of at least $2,000 per ha. in the cultivation of grapes. Because of ideal conditions for the cultivation of garlic, yields of $3,000 to $5,000 per ha., (according to a UNICEF assisted study) are possible. Both of these products have export markets, the grapes in the form of wine. Other crops grown in the region, are corn, wheat, potatoes, barley and various fruits.

Within the Villamontes area, principal agricultural crops are cotton, soya beans, tannin, peas, beans, and lumber which is utilized largely for railroad ties. Cattle production is also important. Long-term contracts for railroad ties and the current high price of cotton have caused a mini-boom in the region. A planning official calls Villamontes the new Santa Cruz.

Agriculture- related demand for energy will come primarily from existing sawmills (14) and from the processing of cotton, cotton seed and soy beans. In addition, power presently generated by the Corporacion

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1/ Tarija Public Works Committee.

Boliviana de Fomento (CBF) for the Villamontes irrigation system will now be served by the project. CBF is also presently installing a soybean and cottonseed oil extraction plant in Villamontes which will utilize sub-project power when complete. The existing sawmills are currently using old truck motors for power and are greatly in need of a reliable energy source. The lumber industry is expanding rapidly at the present time as a result of large long term contracts for supply of railroad ties to Argentina. The industry is also actively seeking additional contracts. With electric power we expect that entry into this industry will be cheaper in capital cost, and thus a significant expansion of employment and output should occur.

d) The Potosí Sub-Project

The sub-borrower will be the Servicios Eléctricos de Potosí, S.A. (SEPSA) a mixed corporation which is responsible for electrical distribution in the Department of Potosí. The $1,496,500 sub-project with an estimated $1,149,800 to be provided by the proposed loan calls for the construction of new distribution facilities with the capacity to serve an expected 5800 residential, small commercial-industrial consumers plus some 5400 MW of irrigation load within the ten year period.

The AID financed sub-project will consist of 335 kilometers of 14.4/24.9 KV distribution lines, 850 street light installations and 4,900 house connections plus related distribution transformers, meters and protective equipment. Approximately $60,000 in tools and work equipment and 7500 KVA in step down substation capacity will be financed through local contributions.

The Potosi sub-project includes distribution lines in two Valley areas between Betanzos and Equiri -Rancho to the southeast of the city of Potosi and in the area of Camargo. The characteristics of the Betanzos area are similar to the Chuquisaca sub-project area, while Camargo is similar to the Tarija Valley. Irrigation demand will be concentrated in the Camargo area.

5. Summary of Benefits

Each sub-project has a benefit/cost ratio greater than unity utilizing the presumed opportunity cost of capital of 12%, as follows: La Paz 2.94, Potosi 1.2 Chuquisaca 2.06, and Tarija 3.14. The entire project as a whole has a B/C ratio of 2.54.

In addition, the project has a stream of non-quantifiable economic and social benefits. These include improved health and educational services, a favorable indirect balance of payment effect and substantial direct as well as indirect employment effects.

SUMMARY OF RURAL CONSUMERS TO BE SERVED

FIRST AND TEN YEAR ESTIMATES

Consumer	La Paz (INER)		Chuquisaca (CESSA)		Potosí (SEPSA)		Tarija (SETAR)		Villa Montes (SETAR)		Total	
	1st.	10th.	1st.	10th.	1st.	10th.	1st.	10th.	1st.	10th.	1st.	10th.
Residential 1/	4,740	5,325	2,550	4,284	2,300	2,384	2,795	6,885	1,242	2,925	13,627	21,803
Farm Families 2/	3,877	6,507	1,700	4,641	1,880	2,608	3,415	7,760	311	736	11,183	22,252
Small Commercial 3/	1,520	2,090	750	1,575	740	380	095	2,585	275	645	4,380	7,775
Industrial 4/	18	28	4	9					15	24	37	61
Irrigation systems		200		31	5	75	108	220	1	1	114	527
Street Lighting Syst.	50	70	12	25	12	35	8	25	4	19	86	174
Total Projected	10,205	14,220	5,016	10,565	4,937	5,982	7,421	17,475	1,848	4,350	29,427	52,592
Consumers now using power	5,070		2,500		2,460		3,653		915		14,598	
New Consumers	5,135		2,516		2,477		3,768		933		14,829	

1/ Households in small towns with an average of five members per family.

2/ Small farmers tilling adjacent plots of land with an average of five persons per family.

3/ Small shops, schools, hospitals, etc.

4/ Factories, processing plants, mills etc.

6. Proposed Use of Loan Funds and Financial Plan.

a. It is estimated that 56% of all project funds, including the loan and local contribution, will be used for foreign exchange expenditures for materials, equipment, engineering services and technical assistance. It is expected that most foreign exchange expenditures will come from the loan, which represents about 70% of all loan funds. 1/ Such procurement will be from A.I.D. 941 sources.

U.S. suppliers are competitive in the types of materials and equipment needed for the project. It is probable that a major portion of all imports financed under the loan will be from U.S. suppliers, with other purchases from the neighboring countries such as Argentina and Brazil. It is also most likely that technical assistance will be procured from the U.S.

b. It is estimated that 44% of all project funds will be spent to finance the local currency costs of the project. Included will be approximately 30% of loan funds which will be converted into Bolivian pesos. The loan portion of local costs will be disbursed for locally produced materials (primarily poles), construction services, local expenditures for the consulting engineers and the technical assistance group and for off-the-shelf purchases in accordance with A.I.D. procurement regulations.

c. The Bolivian contribution of 26% of total project costs is substantial when viewed in comparison to both Phase I rural electrification (11%) and other externally financed development projects in Bolivia.

The following three tables show the project cost breakdown by components and area (Table I), by Foreign exchange and local costs (Table II) and by sources of financing (Table III).

1/ Foreign exchange costs of the transmission line in the La Paz project will come from GOB funds.

TABLE I

PROJECT COST BREAKDOWN BY COMPONENT AND AREA

US$

Component	La Paz INER	Chuquisaca CESSA	Potosi SEPSA	Tarija SETAR	Total
AID LOAN					
Distribution Facilities and Equipment	1,689,700	988,500	902,500	1,382,300	4,963,000
Engineering	100,000	-	-	-	100,000
Technical Assist.	149,400	85,300	82,000	134,800	451,500
Contingency	225,000 1/	75,000	75,000	75,000	450,000
	169,000	98,900	90,300	138,200	49,400
Sub-Total	2,333,100	1,247,700	1,149,800	1,730,300	6,460,900
LOCAL CONTRIBUTIONS					
Transmission	500,000	-	-	-	500,000
Substations	172,500	87,200	132,000	299,000	690,700
ENDE Administration	49,800	28,400	27,000	44,900	150,100
Other Adm. Costs	100,000	100,000	100,000	100,000	400,000
Facilities and Equipment	143,500	60,000	60,000	60,000	323,500
Int. During Const.	61,000	27,700	27,700	43,600	160,000
Sub-Total	1,026,800	303,300	346,700	547,500	2,224,300
TOTAL	3,359,900	1,551,000	1,496,500	2,277,800	8,685,200

1/ $25,000 of the $225,000 Technical Assistance money for INER is reserved for preparation, distribution and tabulation of survey questionaires that will provide base line data for all 4 sub-borrowers.

TABLE II

PROJECT COST BREAKDOWN BY FOREIGN EXCHANGE AND LOCAL COSTS

Component	Dollar Costs	Local Costs	Local Contrib.	Total
Materials	3,391,800	516,400	1,056,200	4,964,400
Construction	-	1,054,800	134,500	1,189,300
Vehicles & Equip.	100,000		323,500	423,500
Engineering	180,600	270,900	-	451,500
Technical Assist.	450,000	-	-	450,000
Contingency	339,300	157,100	-	496,400
Project Administr.	-	-	-	-
a. ENDE	-	-	150,000	150,000
b. Sub-Borrowers	-	-	400,000	400,000
Interest During Construction	-	-	160,000	160,000
TOTAL	4,461,700	1,999,200	2,224,300	8,635,200

TABLE III

PROJECT COST BREAKDOWN BY SOURCE OF FINANCING

US$

	AID Loan				
	Foreign Exchange	Local Currency	Total	Local Contrib.	Total
INER	1,659,500	673,600	2,333,100	1,026,800 1/	3,359,900
CESSA	894,600	403,100	1,247,700	303,300	1,551,000
SEPSA	780,300	369,500	1,149,800	346,700	1,496,500
SETAR	1,177,300	553,000	1,730,300	547,500	2,277,800
TOTAL	4,461,700	1,999,200	6,480,900	2,224,300	8,685,200
Percent of Project Cost	51%	23%	74%	26%	100%

1/ It is estimated that $450,000 of the local contribution of the INER sub-project will be disbursed for foreign currency costs, (transmission line). The overall project foreign exchange component is estimated at 4,911,700 or 56%.

d) Basis for the Amount of the Loan.

The proposed $6.5 million amount of the loan is based upon a study conducted by NRECA engineer Gilbert Moon and published in September, 1973 under the title "Engineering Feasibility Study in the Departments of La Paz, Chuquisaca, Potosi and Tarija", and in consultation with the GOB and sub-borrowers during intensive review in August and September, 1973.

7. Background.

Although Bolivia has a great potential for hydroelectric generating capacity, the country has suffered from a chronic shortage of delivered energy and has the lowest per capita consumption of electricity in South America. The GOB, through ENDE, has developed short range (1971-1980), medium range (1981-1990) and long range (1991-2000) plans for national electrical energy development. The international lending agencies, primarily the World Bank Group (IDA), the Interamerican Development Bank (IDB) and the Agency for International Development (A.I.D) have coordinated their programs. IDA and IDB have emphasized the construction of large electrical generating facilities, primarily hydroelectric projects, with related transmission lines. A.I.D. has concentrated on assistance to cooperatives and rural areas, as well as on feasibility studies for projects which have subsequently been financed by other lenders.

The first A.I.D. loan for electrification (511-L-031, $4.75 million, authorized in June 1966) was made to ENDE with the participation of CRE, for the construction of electrical generating and related transmission and distribution facilities in the Santa Cruz area. This loan was well executed, and efficiencies resulted which allowed the purchase and installation of an additional generating unit within authorized loan funding. The benefits to the Santa Cruz area from the A.I.D. loan have been demonstrated by the rapid increase in new industries within the service area and by the rapid rise in electrical consumption.

On the basis of the outstanding success of the Santa Cruz loan, and the increased demand for electrical services countrywide, the Mission has been working with the GOB since 1970 to develop a rural electrification project that would include, in addition to Santa Cruz, the Departments of Cochabamba, La Paz and the three southern Departments of Chuquisaca, Potosi and Tarija. This original plan was later modified to include Santa Cruz, Cochabamba and La Paz. The La Paz sub-project was dropped from the project during intensive review, and a loan for $10.8 million for the areas of Santa Cruz and Cochabamba was authorized in July, 1973. The project constitutes the second phase of the original plan and includes rural electrification systems for the area of La Paz and the three southern departments of Chuquisaca, Potosí and Tarija.

All loan funds will be disbursed for distribution systems in rural areas.

The project as proposed conforms to GOB priorities and complements other Mission undertakings particularly in rural community development.

8. Loan Implementation Plan

In view of the high priority that the GOB assigns this project, and the excellent collaboration shown during intensive review, and in view of the fact that this project is a continuation of Phase I, no unusual delays in implementation are anticipated. An estimated implementation schedule from the time that the loan is authorized is as follows:

Negotiate and sign loan agreement	2 months
Meet conditions precedent to disbursement and select an contract consultant (concurrently)	3 months
Design phase	12 months
Receipt of bids and award construction contracts	3 months
Construction phase	18 months

It should be noted that energy is available for all sub-projects and that all conditions precedent could be met through direct GOB action with none being dependent upon third party actions or commitments.

Standard A.I.D. procurement and disbursement procedures will be followed. ENDE, the executing agency for the GOB, is familiar with A.I.D. requirements and has demonstrated capacity to rapidly and effectively implement A.I.D. financed projects. The present Bolivian government has also demonstrated its capacity to rapidly negotiate and implement A.I.D. loans. Therefore, no delays in disbursement or project implementation are anticipated.

The loan will be reviewed annually in order to: a) compare actual progress against the projected implementation plan; b) evaluate the changes within the communities served within project areas attributable to the provision of rural electrification, against base line data now being collected (September, 1973); and c) establish that the GOB's plan to supply sufficient energy in all project areas to meet the demand of the proposed distribution system is progressing satisfactorily.

9. Other Sources of Funds.

The Export-Import Bank, the World Bank Group (IDA) and the Interamerican Development Bank (IDB) have stated that they are not interested in financing this project.

10. Statutory Criteria.

All statutory criteria have been met (See Annex I).

11. Priority of Project and Views of Country Team.

The present Government of Bolivia gives high priority to this project, which will enable them to continue recent accomplishments in expansion of electrical services to rural agricultural areas.

As indicated in the FY 1973 country program submission which was approved at the AID/W review in August 1972, assistance to the agricultural and rural development sector has high priority within the proposed U. S. Assistance program. The project, through agricultural production, agro-industrial, and social service linkages (see section I. B. 3), is directly supportive of the GOB and Mission strategy for rural development.

In addition to its significant economic and social impact, the proposed loan program will also complement other A.I.D. activities in the agricultural and rural development sector. This includes the 6.0 million dollar Agricultural Production and Marketing loan signed in November 1971, the 3.0 Million dollar Rural Community Development loan signed in September 1972 and the continuing program of A.I.D. financed agricultural technical assistance by Utah State University.

12. Issues.

The project as conceived is devoid of any issues or problems that could impede the progress of its implementation or keep it from achieving its projected goals.

13. Power Supply

An issue at the time of the IRR which has since been resolved is that of adequate power supply for project areas. Intensive review indicated that such energy is available to feed the proposed rural electrification nets in all project areas through the year 1980. The GOB has firm and definite plans to expand the country's energy requirements through the 1980's and 1990's. The power supply question is discussed in technical detail in the engineering analysis of the project.

Although the GOB opted to meet the requirements set forth in the IRR approval cable through the provision of thermal generated energy in each project area, completion of the national transmission grid remains one of its priorities. It would have been unrealistic, however, to meet the requirements of the approval cable as it relates to the financing of transmission lines into project areas due to the time element. Nevertheless, the Capital Project

Committee believes that ENDE will obtain financing and will construct these transmission lines probably within three or four years. Thermally generated energy is expected to cost ENDE approximately $0.02 per KWH during the first year in the life of the project, with this cost remaining the same through introduced production effeciencies over the following ten years. Energy available from hydroelectric plants in the Cochabamba area, however, could be transmitted into the southern departments at a cost of $0.01 per KWH, with this cost declining to $0.003 per KWH in ten years. The project is economically and financially viable with a thermal power supply but ENDE will have a strong incentive to complete the transmission grid as soon as possible.

14. Recommendations.

On the basis of the conclusions of the Capital Assistance Committee that the project is technically, economically and financially justified, it is recommended that a loan to the Government of Bolivia for an amount not to exceed $6.5 million be authorized subject to the following terms and conditions:

a. Interest and Terms of Repayment. Borrower shall repay the Loan to A.I.D. in United States dollars within forty (40) years from the date of the first disbursement under the Loan, including a grace period not to exceed ten (10) years. Borrower shall pay to A.I.D. in United States dollars on the outstanding balance of the loan interest at the rate of two percent (2%) per annum during the grace period and three percent (3%) per annum thereafter.

b. Other Terms and Conditions.

(i) Goods, services (except for ocean shipping) and marine insurance financed under the loan shall have their source and origin in Bolivia and countries included in Code 941 of the A.I.D. Geographic Code Book. Marine insurance may be financed under the loan only if it is obtained on a competitive basis and any claims thereunder are payable in freely convertible currencies. Ocean shipping financed under the loan shall be procured in any country included in A.I.D. Geographic Code 941.

(ii) United States dollars utilized under the loan to finance local currency costs shall be made available pursuant to procedures satisfactory to A.I.D.

(iii) Prior to the first disbursement or the issuance of any commitment documents under the loan, the Borrower will submit to A.I.D. in form and substance satisfactory to A.I.D.:

a) A detailed description of the department established within ENDE for administering the Project including staff qualifications and proposed administrative and operating procedures.

b) A time phased implementation plan for execution of the project including an identification of such technical assistance requirements and a plan for the recruitment and utilization of technical assistance.

c) Certification from the Direccion Nacional de Electricidad (DINE) that the participating sub-borrowing entities have been granted a sufficiently long term electric service concession for their respective sub-project areas of operation.

(iv) Prior to any disbursement or issuance of any commitment documents under the Loan for any purpose other than to finance consulting engineering or technical assistance services, the Borrower will submit to A I.D., in form and substance satisfactory to A I.D.:

a) Evidence of an overall plan detailing how the energy requirements of the proposed distribution systems will be met in each of the project regions in 1977 (the first year of operations). Additional long-range plans detailing how the energy requirements of the entire system will be met beyond the year 1980, shall be submitted to A.I.D. in form and substance satisfactory to A.I.D.

b) The terms and conditions of the sub-loan agreement between the Borrower and the participating sub-borrowing entities. A.I.D. will reserve the right to approve the individual sub-loan agreements prior to their execution.

c. Evidence that the proposed whoesale and retail rate schedules for the various sub-project systems will be adequate to provide a return to the sub-borrowers sufficient to cover operating costs, maintenance, administration, taxes, assessments, depreciation, expansion reserves, and a positive rate of return on the rate base.

d) Evidence that ENDE and the participating sub-borrowers will provide necessary local contributions on a timely basis.

e) Evidence of professionally prepared and supervised baseline date for each of the project regions, which baseline data shall be adequate for evaluations of the projects' operation, and for future socio-economic evaluations and planning.

f) A training plan for the employees of the participating sub-borrowers and a time-phased plan for the acquisition of the additional staff necessary to enable these institutions to operate and maintain their respective sub-project facilities in an efficient manner.

g) A detailed description of a promotion plan to attract rural consumers (including instruction in the potential benefits and use of electricity) to be implemented by the various sub-borrowers.

(v) Except as AID may otherwise agree, the borrower shall covenant:

a) To maintain a rate structure adequate for the continued viability and growth of the system.

b) To ensure the availability of an adequate supply of energy for the distribution systems in the sub-project regions.

c) To review the progress of the Project annually with A.I.D., throughout the life of the project, giving particular attention to the success of efforts to ensure the availability of energy, the sufficiency of local contributions to the project, and the implementation of the training, staff acquisition, and promotion plans. The review shall also include a discussion of the rates charged or to be charged by ENDE and the sub-borrowers to their various categories of customers.

d) That, in selecting the final paths for the lines of distribution, Borrower shall, within such constraints as may be imposed by technical, cost and engineering considerations, take into account such factors as population coverage and support for other rural development programs.

(vii) The loan shall be subject to such other terms and conditions as A.I.D. may deem advisable.

15. Composition of the Capital Assistance Committee

Hasan A. Hasan	- Deputy General Engineering Officer, USAID/Bolivia, Project Manager
Carl H. Leonard	- Capital Development Officer, USAID/B
R. Jesse Moffett	- Chief, Rural Development Div. USAID/B
Julius Schlotthauer	- Economist, USAID/Ecuador
Morris Whitaker	- Agriculture Economist - USAID/B
Everett Wallace	- Electrical Engineer, AID/W
William J. Hillier	- Financial Analyst, USAID/B
Robert K. Clark	- Financial Analyst, USAID/B
Norman Williams	- Regional Legal Advisor, USAID/Peru
Luis Montero	- Accountant, USAID/B
Joaquin Aguilar	- Engineer, USAID/B
Gilbert Moon	- NRECA Rural Electrification Specialist

Drafted by: All of the above contributed to the drafting of the CAP.

Coordinators: Carl H. Leonard and Hasan A. Hasan.

Reviewed by: Arthur W. Mudge, DD, and Parke D. Massey, Senior Asst. Dir.

Approved by: John R. Oleson, Director, USAID/B.

PART TWO: PROJECT

SECTION I. Nature of the Project

A. Project Description

1. Purpose

The purpose of the project is to improve the economic and social conditions of the rural population in the areas to be served by providing them with electric power for domestic, commercial, industrial and agricultural uses on an increasingly self-supporting basis. By so doing, the project should accelerate the rural development process, and thereby contribute to the overall development of Bolivia. Specifically, the loan will seek to achieve the following objectives:

(a) To provide a backbone distribution system (in areas of population concentration) which will be capable of future expansion;

(b) To enable the presently urban-oriented sub-borrowing entities to expand their operations into rural areas and acquire the additional technical capability and financial resources necessary for future expansion;

(c) To promote economic development of rural areas by providing energy for (1) more intensive agriculture through irrigation and (2) for agro-industrial uses.

(d) To improve the quality of rural life, as measured by such indicators as the expanded utilization of evening hours, increased evening commercial activity, the improved performance of basic household functions, greater satisfaction with life, increased mass media exposure, and better health and educational services.

The proposed skeletal system consists of several small distribution nets radiating from densely populated areas and reaching at this initial stage, into areas of growth potential. These nets should then grow and expand in an orderly manner in the direction of developing demand. This expansion will come gradually over the years, and will require a level of capital investment which ENDE and the local electric companies should be able to meet from their own resources or commercial borrowing without any further external concessional financing.

2. Focus of the Project

The project continues the recent accomplishments in bringing electricity to the rural areas of Bolivia through the construction of electrical distribution facilities to expand electric service to rural areas in four of the country's nine departments. With its implementation, all major departments of the country, with the exception of the sparsely populated Beni and Pando, will have in operation a basic rural electrification system.

The GOB, through ENDE, has developed short range (1971-1980), medium range (1981-1990) and long range (1991-2000) plans for national electrical energy development. 1/ In the short run (1971-1980), the GOB strategy calls for the distribution of existing power to the many segments of the population now denied a reliable electric supply system. Over the medium and long term (1980-1990-2000), the GOB plans to complete the national interdependent electric grid as well as develop and expand its hydroelectric generating capacity to meet the expected growth in national demand. This project forms an integral part of the short range strategy.

The international lending agencies, primarily the World Bank Group (IDA), the Interamerican Development Bank (IDB), and the Agency for International Development (AID) have coordinated their programs to be mutually complementary within the overall development framework. AID has tended to support projects such as rural electrification, where the economic rate of return is lower, but where the social benefits may be more significant than in more conventional projects. This project is the logical next step in the GOB/ENDE electrification plan.

Once the limitations on the availability of AID resources were known, the basic criteria for the selection of the program components were (1) population density, (2) economic potential, and (3) availability of complementary infrastructure (roads, schools, health facilities, etc.). The distribution network to be established will follow the path of greatest population concentration in the respective rural areas, generally in the rural areas surrounding departmental capitals, major population centers or in the case of La Paz, on the

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1/ ENDE, Departamento de Planificación, Informe N° 12.

relatively densely populated shores of Lake Titicaca (see for example Annex IV). From a social viewpoint, the completion of the project will bring previously unavailable or prohibitively expensive power to the inhabitants of these rural areas. From an economic standpoint, available power should facilitate both the introduction of irrigation systems necessary for increasing agricultural productivity and agro-industrial undertakings providing employment opportunities where previously mining and small scale farming were the principal employment sources. Within the proposed project paths, basic road networks exist to facilitate construction and maintenance of the distribution systems as well as development of the areas served. Moreover, the proposed distribution net will bring service to existing schools and health posts (see Annex IV).

With the planned expansion of electric service it is expected that 52,000 rural residential, small commercial and small industrial users will be receiving electric service by 1986, the 10th year of operation of the new facilities. These 52,000 rural consumers, or 260,000 residents, plus an additional 32,000 urban consumers, or 160,000 residents, will be located in areas totalling approximately 10,000 square kilometers. The systems will also be designed to have the capacity to serve large industrial and commercial loads which can be expected to develop and have combined loads of 76,000 MWH/year. Irrigation loads totalling 38,000 MWH/year are also expected to develop.

A map showing the location of each sub-project and its respective service area is included in Annex III.

3. Major Project Components

The project as envisioned consists of distribution lines, 14.4/24.9V or smaller, including the necessary stepdown transformers to 380/220 volt lines in selected rural areas in the departments of La Paz, Chuquisaca, Potosí and Tarija. The major components of the project for which loan funds will be disbursed and the sub-borrowing enterprises that will be responsible for their operation are as follows:

(a) La Paz (INER)

The La Paz sub-project consists of the expansion of electric service to the densely populated areas of the shores of Lake

Titicaca, to the Los Yungas areas northeast of the city, and to the area of Rio Abajo south of La Paz. With the exception of a 50 kilometer, 69 KV transmission line between La Paz and Aspiazu in Los Yungas (which will be financed with local funds as a part of the project), the work planned for each area consists of the construction of distribution lines, substations and consumer house connections including meters, and street lighting systems.

(b) Chuquisaca (CESSA)

This sub-project consists of the construction of a principal distribution line between the city of Sucre and the towns of Padilla to the east and Mamahuasi to the northwest, in the department of Chuquisaca. Included also will be household connections for new consumers, and street lighting.

(c) Potosí (SEPSA)

The SEPSA sub-project consists of distribution lines in two areas -- between Betanzos and Esquiri-Rancho to the southeast of the city of Potosí and in the area of Camargo. Work is limited to the construction of distribution lines to serve these areas and includes house connections to new consumers, and pueblo lighting.

(d) Tarija (SETAR)

The Tarija (SETAR) sub-project is the most ambitious of the three southern provinces and includes two separate undertakings: (1) extension of electric service to the rural areas immediately adjacent to the city of Tarija to the north, south, and east, and (2) initiation of these services in the area to the north and south of the town of Villa Montes. In both cases, the work is also limited to distribution lines in the areas and to house connections for new consumers, and street lights.

(e) Empresa Nacional de Electricidad (ENDE)

Although ENDE will not have a sub-project similar to those discussed above, it will act as the executing agency for the overall project and will be responsible to the Government of Bolivia for its implementation. Among its duties in undertaking this task will be processing of sub-loans, contracting of engineering and construction services, procurement of materials, approval of disbursements, coordination of all project documentation and reports, and the maintenance of liaison with USAID.

ENDE is now providing technical assistance to all four sub-borrowers and will continue to do so during the life of the project and afterwards. By mutual agreement with these sub-borrowers, ENDE will oversee the actual construction of the different sub-projects. Completed distribution systems would then be turned over to the four sub-borrowers for operation.

(f) Technical Assistance and Consulting Services

Two major components of the project which will be required for the implementation of all sub-projects are technical assistance in technical, administrative and financial management and consulting engineering services. Technical assistance will be provided to improve the sub-borrowing institutions and to advance their capability to administer their respective systems. Engineering consultants will be retained by ENDE for the design of the individual systems, preparation of documentation for the procurement of materials, equipment, and construction services, recommendations for the awarding of contracts and supervision of construction.

4. Basis for the Size of the Loan

The project is based upon a feasibility report prepared by NRECA engineer Gilbert Moon in August-September, 1973. Mr. Moon, a rural electrification specialist with long experience in his field and a registered professional electrical engineer, developed his report, Engineering Feasibility Study in the Department of La Paz, Chuquisaca, Potosí and Tarija from information provided by the participating organizations and from his own observations and research.

An intensive review request (IRR) in the amount of $2.0 Million was approved in August 1970, and included components at the time in Chuquisaca (Sucre), Potosí, Tarija, La Paz, Cochabamba and Santa Cruz. There was little progress subsequent to the IRR approval until the present GOB took office in August, 1971. Thereafter, AID funded NRECA technicians, AID/W engineers on TDY, and the USAID/Bolivia staff resumed work with the GOB on project preparation. As a result of these indepth assessments, which identified a greatly increased project cost, it was decided to concentrate the initial project, now known as Phase I, within the La Paz, Cochabamba and Santa Cruz areas. Another report, also issued by Moon in October, 1972 (titled Outline for Rural Electric Development in Bolivia) recommended a project for these three areas at a cost of $16.8 Million.

The proposal was reduced to what the GOB considered a more manageable project and an IRR for a total of $12.0 Million was approved by AID/W in November, 1972. It was decided during intensive review to postpone the La Paz area sub-project for an expected subsequent electrification project. With the elimination of the La Paz area, the revised project was reduced in cost to $10.8 Million and was authorized in July 1973.

Another IRR was submitted to Washington in August, 1973 which included rural electrification systems in La Paz, Oruro, Chuquisaca, Potosí and Tarija. This request included transmission elements in addition to distribution nets at an estimated total cost of $13.0 Million in loan funds. The Development Assistance Executive Committee in considering the IRR advised that AID is not interested in financing electrification infrastructure in developing countries, but that it was receptive to AID's participation in distribution facilities if it could be demonstrated that such facilities would have a marked impact on rural development in the project areas. A new IRR was prepared in accordance with these guidelines and approved by AID/W in August, 1973 at the level of $6.0 Million.

B. Rural Development and Project Linkages.

1. Problems Retarding Development of the Rural Sector.

The Government of Bolivia has put a relatively low level of resources into the development of the rural sector. This has resulted in a lack of public services in support of social welfare, agricultural production and marketing. As a result, the population is largely illiterate, with high birth rates, high infant mortality, low incomes and low levels of productivity. Agricultural production is based on very primitive techniques, and the population is increasingly concentrated on productive land bases so small that part of the population must either move or reduce the already low level of subsistence consumption. The lack of social infrastructure (education, health services, potable water and sewage, electricity, and other energy sources, etc.), production infrastructure (extension and research), and marketing infrastructure (transportation-especially secondary roads, communications, market reporting, storage, etc.) has directly contributed to the backwardness of the rural sector of Bolivia. The provision of electrical energy in the project areas, along with other social, production and marketing infrastructure will attack the underdeveloped social and economic conditions of those areas.

Specifically, the problems contributing to retardation could be listed as follows:

a. Lack of Means to Deliver Improved Social Services.

As a result of low level of public investment, there is relatively little infrastructure or the administrative mechanism necessary to support improvement in social welfare in the rural areas. Public resources directed to community development have been very limited. There are relatively little health or welfare services in the rural sector. With the exception of the Santa Cruz region, where rural electrification has been developed, most rural areas lack a reliable electric power source. Finally, while education has received a great deal of government emphasis, it is apparently misguided, given the relatively high dropout rate among rural primary students.

b. Lack of Infrastructure to Increase Production and Marketing of Agricultural Products.

Prospects for rapid increases in agricultural production and improved marketing are also seriously handicapped by the relatively low level of public investment in infrastructure. Although some resources have been directed toward the Altiplano and Valleys, research and extension efforts have been extremely limited.

The Extension Service has limited operating budgets for vehicles and gasoline, repairs, etc. Such low salaries are paid to professionals in Agriculture that the best qualified and most talented people are forced to seek employment in other sectors or in the international market.

Investment to improve the efficiency with which products and factors flow through market systems is practically non-existent. Market reporting services, storage facilities, grading, standard weights and measures, credit programs for campesinos, etc. are inadequate. With the exception of the main North-South and East-West highways, transportation, especially in secondary roads, is deficient.

2. Strategy for Accelerating Growth and Development of the Rural Sector.

a. Basic Sector Goals

The GOB now gives every indication of recognizing the problems impeding development of Bolivia's rural sector and appears ready to undertake the shifts on priority attention necessary to their resolution. The GOB has developed, with Mission support and encouragement, three interdependent basic goals. The first is to increase the per capital income of the rural population as rapidly as possible, based on increased productivity of the sector. While couched in economic terms, this goal encompasses concern for health, education and other basic needs of the population. The second goal is to try to assure that increases in income are not concentrated in the hands of few individuals. This goal is concerned (a) with broadening and deepening the internal market by further integrating the relatively poor campesinos into the market economy, utilizing the production potential of small farmers as part of the basis for more rapid economic growth, and (b) with minimizing the possibility of social and political conflict. The third goal is to improve quality of life of the rural sector by seeking means to deliver low-cost, yet effective, health and educational services on a more wide-reaching scale. To the extent possible the desire of the Mission is to allocate its resources so that these goals which both we and the GOB support can be addressed simultaneously: i.e., direct a significant portion of our inputs to increasing the per capita incomes and social welfare in the large but relatively poor campesino sector.

b. General Strategy for Rural Development

The general strategy for development described above, of the rural sector, is supported by the initial findings of the agriculture, health, and education sector assessments.

There are four main parts to the strategy to foster rural development and achieve the general goals outlined above:

1) Develop public infrastructure in the rural sector to directly increase agricultureal production, both through use of new lands and more modern techniques of production; 2) Increase the efficiency with which factors and products are combined and move through the market system; 3) Encourage the development of import substitution industries with linkage into agriculture (e.g. food processing, fertilizer production); and 4) Develop methods to deliver improved, cost-effective social services in rural areas.

As already indicated carrying out the strategy, will require a realignment of those government policies which have, in the past, tended to neglect the rural sector and increase government budget commitments to development of the sector.

c. Probable AID Participation.

In addition to on-going programs such as Community Development, Agricultural Production and Marketing, Rural Roads, and Rural Electrification loans, the Mission expects to develop two agricultural loans 1/ and new technical assistance during FY 1974 to help implement segments of parts 1, 2 and 3 of the strategy. The implementation of parts 1, 2 and 3 of the strategy will also require investment to improve the delivery of social services, as well as investment directly affecting production and marketing. The agricultural loans and technical assistance contracts for the implementation of parts 1, 2 and 3 will be closely coordinated with the new loans and contracts arising from the health and education sector assessments to implement part four (provision of social services) of the overall strategy.

d. The Need for a Dual Focus.

Given the regional difference in resource endowments, a dual focus (strategy) for development of the rural sector is necessary. One part of the strategy to increase production must be directed to the Altiplano and high valleys, where labor is abundant and land is scarse. The increased use of traditional inputs is not possible since the land base is so limited. The only viable alternative is through the use of more modern techniques of production which save the relatively scarce land by raising its productivity (i.e., chemical biological innovations).

On the other hand, the expansion of traditional factors, and/or use of more modern techniques can be utilized to increase production and raise incomes in the Oriente (eastern lowlands). The expansion of traditional inputs in the Oriente is possible if labor can continue to be induced to move from the Altiplano and Valleys to the relatively elastic supply of available land. On the other hand innovations in production should be directed to saving the scarce labor by increasing its productivity (i.e. mechanical innovations).

1/ New Lands Development and Basic Agricultural Products.

3. Impact and Role of Rural Electrification.

The Mission strategy for development of the rural sector is concerned with investment in both productive and social service infrastructure. The focus is on increasing the level and relative income position of the small farmer as well as his access to improved social services. The emphasis is on increased productivity in basic agricultural products, and subsequent industrialization and/or commercialization, recognizing the important role of both production and social services infrastructure. The Phase II rural electrification loan is directly supportive of the general Mission strategy outlined above. Following is a brief discussion of various project linkages:

a. Agricultural Production Linkages.

The provision of distribution lines in the rural areas near La Paz, Potosi, Tarija and Sucre is directly complementary to the research-extension strategy of chemical-biological innovation in these Altiplano and Valley regions. A basic ingredient to this type of technical change is a controlled water supply. An example is potatoes, perhaps the most important staple in the local diet. While experimental results suggest that with improved seed (which is available), fertilizer, and controlled water, yields of 27,000 kilos/hectare are possible, the present average yield is only 7,000 kilos/hectare due mainly to a lack of controlled water.

Another example is alfalfa production. On the newly developing Challapata irrigation project near Oruro (on the Altiplano), 3,000 hectares are producing two crops per year at an average yield (dry weight) of 5 tons/hectare. Experimental yields have reached as high as 8 tons/hectare. A ready market exists for chopped and bagged alfalfa at $us. 80/ton for the dairy industry in Cochabamba.

Ground water supplies are not a serious problem in the project area near La Paz. However, when considering the combination of suitable soils and available water there are only about 4,000 hectares that can be economically irrigated on the North Altiplano 1/. However, these estimates assumed the use of diesel pumps. The provision of electricity, it is estimated, would allow 6 to 7,000 hectares to be irrigated. There are adequate groundwater supplies and suitable soils in the other project areas. While irrigation will yield high returns to all project areas, the quickest gains are likely to come from the Tarija area where plans are currently in existence to promote irrigated agriculture on a large scale through pumping surface water from impoundments.

b. Industrialization Linkages.

Industrialization of basic agricultural production will require increasing amounts of energy. In the Sucre (Chuquisaca), Tarija region alone, plans already exist for industrialization of citrus, grapes, sugar, oilseeds, meat, leather products, and textiles. The following table illustrates existing and projected industries in project areas of the three southern departments.

1/ Interview on Sept. 20 with FAO specialists, based on their test wells on the Altiplano.

PRESENT AND FUTURE INDUSTRIES WITH ENERGY REQUIREMENTS IN THE SOUTHERN DEPARTMENTS

TARIJA		POTOSI		CHUQUISACA	
Existing [1]	Future [2]	Existing [1]	Future [2]	Existing [1]	Future [2]
Vegetable & Fruit Canning & preserves.	Dairy industry	Metallic and non-metallic mineral processing.	Industrialization of Salar de Uyuni. (Sodium chloride, carbonates, borates, cyanides, etc.) for petrochemical products.	Pork processing plant.	Enlargement of pork processing plant.
Bakeries(Bread).	Garlic and Onion industries.		Borax and Sulfur mines industries.	Livestock feed plant.	Enlargement of flour mills.
Noodles and Pastas.	Wine industry.		Ceramics.	Flour mills.	Enlargement of beer industry.
Bottling plants.	Slaughter house.		Metallic and non-metallic mineral processing.	Beer industry.	Enlargement of livestock feed plant.
Leather and Shoe factory.	Wells for irrigation purposes.		Dairy.	Hats industry.	Calcium carbide.
Textiles.	Poultry.		Wine processing.	Ribbon industry.	Cyanide of Calcium.
Saw Mills.			Piretro industry (for insecticide products).	Ceramics.	Poultry.
Wood products.			Wells for irrigation purposes.	Candy industry	Forest industries.
Chemicals (Tanning, etc.).				Sawmills.	Well drilling for irrigation purposes.
Processing of non-metallic minerals.				Workshops.	Enlargement of the existing cement plant.
Well drilling for irrigation.				Carpentry.	
Poultry.				Wood industries.	
Goat raising (leather).				Goat raising (leather).	
Dairy.				Cement plant.	

[1] Field survey, USAID/Bolivia, Sept. 1973.

[2] Projections by Public Works Committees.

While high energy demanding industrialization possibilities are relatively more limited in the Lake Titicaca region of the La Paz sub-project area, the Los Yungas region offers substantial potential in semi-tropical agro-industry such as fruits and coffee. Meat and pork processing also offer potential as viable business ventures with electrification requirements.

Morever, all areas will likely experience increased demand for energy from other production sectors especially private services. Plans for the development of lodging/visitor service facilities are already in existence in several of the regions. A proposed hotel in Camargo and an artisan exposition center in Chuquisaca are typical examples. The need for energy for service stations, garages, carpenter shops, radio stations, etc. is also expected to grow.

c. Social Service Linkage.

The effectiveness of the planned and on-going social services program (which will provide such amenities as potable water, health posts, schools, etc.) depends to a large degree on the availability of an inexpensive and reliable power supply. Without such a power supply, the quality of these services is either greatly reduced or eliminated.

Demonstrated effects of rural electrification in Costa Rica, for example, indicate an increase of 30% in the grade point average of most rural pupils 1/. The preservation of certain medical supplies and serums is enhanced through a reliable power source. Likewise, a potable water source such as a deep well is largely dependent on electrically-powered efficient pumping. Finally, power facilitates night time emergency medical care and evening adult literacy programs.

The proposed distribution nets to be established will bring a reliable source of power to existing health posts and rural schools in the project regions (see Annex IV).

d. Cultural and Social Aspects.

The provision of electricity should expand the cultural and social horizons of the rural sector of Bolivia. Electricity can be substituted for candles and kerosene at a comparable cost, and the way of life made more pleasant and productive. Long kept apart from the mainstream of economic life, great potential exists in the rural sector. Rural electrification provides not only a cheap source of power for direcly productive activities in agriculture, commerce, services, industry, and social service, but

1/ Conversations with Mr. Gilbert Moon, NRECA Rural Electrification Specialist; regarding Los Santos Cooperative, Costa Rica.

opens a new way of life for the members of rural society and is a key factor in integrating them into the mainstram of society. NRECA studies in Ecuador, Nicaragua and Colombia concluded that from the consumer's point of view. the two most often cited benefits derived from reliable power were (1) the expanded usefulness of electrically lighted evening hours for social interchange and for reading, with enhanced opportunities for self-education as well as enjoyment.and (2) the marked increase in night business activity 1/. Moreover. the availability of power has a psychological impact on rural residents as well. The initial findings of the effects of rural electrification on economic and social change in Costa Rica and Colombia indicate a correlation between electricity usage and satisfaction with life 2/. Surveys were conducted asking rural users of electricity and non-users to compare their present life situation with (a) that of their father; (b) their own five years earlier, (c) that of their neighbors, (d) that which they expected for their children, and (e) their expected life situation five years into the future. In both Costa Rica and Colombia electricity users score substantially higher on a total satisfaction with life situation scale than non-users.

1/ "Energy for Rural Communities" by Dr. Thomas M. Venables; address to the Science and Men in the Americas Meeting, Mexico City, June-July, 1973.

2/ Rural Electrification: An Evaluation of Effects on Economic and Social Changes in Costa Rica and Colombia; Chapter 1, August, 1973; see for example pp. 6, 13

C. Project Background.

1. History of Rural Electrification in Bolivia.

Rural electrification first took root in Bolivia as an extension of municipal electrification systems in the country's major population centers. Cochabamba started a municipal system in 1908 and the city of La Paz followed in 1909, but both were essentially urban oriented systems and the only rural beneficiaries were those located at the fringes of these cities.

Another activity that brought a rural electrification system of sorts into the country was the intensive mining operations that flourished during the following decades. Companies requiring energy for their mining operations installed and operated isolated power plants in their areas and extended service from these plants to their employees and other villagers living nearby. This was especially true in the Altiplano area and in Potosi.

This was essentially the state of rural electrification in the country for a half century, although the aforementioned elements of rural electrification were supplemented with isolated small diesel operated generators. Rural electrification, however, remained the province of the private sector with little or no Government interest or support. Early in the 1960's the GOB took note of rural electrification in its ten year development plan, and began to channel limited encouragement and support to fledging cooperatives all over the country. The first and largest cooperative was established in the city of Santa Cruz in 1962 and combined several small operations in the area. As a result of this interest by the GOB, the Bolivian Power Company in La Paz expanded its service into the outlying areas in 1966. ELFEC, in Cochabamba, followed in 1967 by establishing four pilot cooperatives.

In 1970, the National Institute for Rural Electrification (INER) was created by the GOB to coordinate and provide Government interest and support in rural electrification. It was charged with providing electrical services to small communities countrywide through small self-contained power plants and distribution systems. Fifty-one such systems are now in the final stages of construction funded through a $2.45 million loan from the Spanish Government.

It was only during the past ten years that the GOB began to take active part in the electrification of the country, including the rural areas. During this decade, however, the GOB's involvement and interest have been intense. The intensity of this interest is demonstrated in the following table showing previous and projected international loans for electrification:

Date	Lending Agency	Borrowing or Executing GOB Entity	Project	Amount US$ Million
1964	IDA	ENDE	Corani Plant	10.0
1964	IDB	ENDE	Corani Plant	3.5
1965	IDA	Bolivian Power Co.	Chururaqui Plant	5.0
1966	AID	ENDE/CRE	Santa Cruz Power	6.32 1/
1968	Export Dev. Corp. Canada	BPC	La Paz Transm. & Distribution	0.50 2/
1968	French Gov't	CESSA 3/	Central Plant Ruffo & High tension line Ruffo-Sucre	0.50
1969	IDA	ENDE	Sta. Isabel Hydroelectric Plant	7.34
1969	IDB	ENDE	Sucre Plant & Sucre Potosi Transmis.	5.65
1969	Spanish Gov't	INER	Electrific. of 51 Rural Communities	2.45
1973	AID	ENDE/ELFEC/CRE	Rural Electrification Coch-Sta.Cruz	10.8
1973	IDA	ENDE	Generation Sta. Cruz La Paz	6.0
			Total Nine Years...	58.06

Following is a table showing projected electrification project over the next few years:

Lending Agency	Borrowing Executing GOB Entity	Project
AID	ENDE	Rural Electrification - La Paz Sucre, Potosi & Tarija.
IDA	ENDE	Cochabamba and Caracollo - Corocoro-La Paz Transm. line.
Not decided	ENDE	Completion of National Transmission Grid: Cochabamba-Santa Cruz, Catavi-Potosi, Tupiza-Tarija-Villamontes.
Not decided	ENDE	Expansion of the Corani and Santa Isabel generation plants.
Not decided	ENDE	Expansion of the Sucre generating plant.

1/ Includes $1.57 Million in Pesos
2/ Canadian Dollars
3/ Electric Services Cooperative - Sucre.

2. Evaluation of Previous A.I.D. Support for Electrification.

During the past decade, Bolivia has been the recipient of varied A.I.D. support for electrification and electrification-related studies and projects. Following, in chronological order, is a brief description of each, and an evaluation of its implementation and achievements:

a. In 1962, a $289,000 Grant was made in response to the growing demand for electricity in the Santa Cruz area. Three 500 KW generators were grant-funded utilizing the Corporación Boliviana de Fomento (CBF) as the implementing agency. The Empresa Nacional de Electricidad (ENDE) undertook the installation, operation and maintenance of these diesel operated units.

CBF, the implementing agency, met its responsibilities as defined in the grant agreement and the procurement and installation of the three generators was accomplished on schedule. The project achieved its intended objective which was to provide a temporary and rapid solution to the power shortage then existing. ENDE operated and maintained these units to a professional standard.

b. In 1966, the Santa Cruz Electric Power loan was signed authorizing $4.7 Million in U. S. dollar (511-L-031) and 18.81 1/ million in Bolivian Pesos (511-LCL-1001). These funds were used for the expansion of ENDE's generating facilities by 13,200 KW and for the transmission and distribution necessary for this generated power in the Department of Santa Cruz. Also included were 65 kilometers of a 69 KV line between Santa Cruz and the town of Montero, thus providing service to several small towns and settlements in between.

ENDE, the borrower of record, and CRE, the primary beneficiary of project, met all terms and conditions agreed upon with dispatch, and the work was accomplished on schedule and with no difficulties. In fact, efficiencies in project execution allowed the purchase of an additional 3,300 KW generating unit within project funding. The resulting benefits to the region far exceeded those anticipated. CRE's membership expanded from 5,566 consumers in 1965 to 18,000 at present. Such industries as saw mills, carpentry and machine shops, sugar and rice mills, bottling plants and tile and brick factories greatly benefited from the availability of a reliable power source, and their expansion has been dramatic. New industries that have developed in the area over the past few years and that do have high power demand include such agro-industrial plants as vegetable oil extraction (2,600 KW), dairy processing (260 KW), paper manufacturing (1,500 KW), banana dehydration (500 KW), and cotton thread (600 KW) plants.

1/ Rate of exchange $b. 12.00 = $1.00 U. S.

In general, the power generated and distributed has made it possible to satisfy the major portion of household needs, to make more efficient use of existing industrial capital, to induce agriculture related industries, and to increase agricultural activity by powering irrigation systems and facilitating the refrigeration and processing of agriculture produce.

c. In 1967, A.I.D. financed a feasibility studies loan (511-L-010) which included, among others, a feasibility study of electric power requirements for the southern part of Bolivia. The work was undertaken by the Harza Engineering Company in collaboration with Consultora Galindo, a local firm. Total payments to these consultants consisted of US$ 97,790 and $b. 268,000 1/.

Upon completion, the feasibility study was used by the GOB as a basis for inviting international lending agency interest in the region. As a result, a loan for $5.65 million was made by IDB in 1969 to ENDE for the financing of a generation plant at Sucre and the installation of the Sucre-Potosi transmission line. This same study was also utilized during intensive review for the proposed loan.

d. In 1973, AID is currently financing expanded rural electrification in the areas of Santa Cruz and Cochabamba under AID Loan 511-L-046 for $10.8 Million. It is anticipated that this loan will meet the growing demand for electricty in these two regions for domestic as well as agro-industrial uses.

In summary all of these AID financed activities have been or are expected to be efficiently implemented and to either achieve or exceed their intended goals.

3. Relationship to other Mission Programs

As indicated in the FY-1974 Field Budget Submission, submitted to AID/W in August 1972, assistance to the agricultural and rural development sector has high priority within the U.S. assistance program. The submission listed rural electrification in support of the rural development sector as one of the Mission's areas of concentration.

In addition to its significant economic and social impact, the proposed program will also complement other A.I.D. activities in the agricultural and rural development sector. USAID resources in the past 10 years have been directed to development of the rural sector both through increasing productive capability and improving social welfare. A project to speed up titling of land claimed under the agrarian reform has made rapid progress. A rural electrification loan (Phase 1) has been approved for the Santa Cruz and Cochabamba

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1/ Rate of Exchange $b. 12.00 = $1.00 U. S.

region. An $8 Million Agricultural Production and Marketing loan was signed in November, 1971, and a $3 Million Community Development loan in September, 1972. Technical assistance by Utah State University in building institutions for increasing improved wheat, sheep, and forage production has been given since 1965. Moreover, the Phase II rural electrification loan is complementary to and in the basic spirit of mission strategy for rural development outlined in Section I B. The National Community Development Service is actively working in the Phase II project areas. In the Lake Titicaca region, projects are presently being implemented including the construction of 20 schools, 5 health posts, and 5 potable water systems. In the Sucre area, 5 schools, 2 health posts, and 3 potable water systems are under construction. 7 schools and 2 health posts are being constructed in the rural area of Potosí, while in Tarija 13 schools and 5 clinics are being completed. The NCDS has stated that the availability of power in these rural areas would greatly strengthen projects of this nature.

For the target departments, eligible commodities for production financing under A.I.D. loan 511-L-042 (Agricultural Production and Marketing) include wheat in Chuquisaca, Tarija and Potosi; 1/ corn in La Paz and the three Southern Departments; oilseed in Chuquisaca and Tarija; pork in the Southern Departments; poultry in La Paz, Tarija and Chuquisaca, and fruits and vegetables in La Paz, Tarija and Chuquisaca. The Agricultural Rediscount Fund recently completed a winter wheat program in the Tarija area where over 80 sub-loans were extended. In the Villamontes area the Agricultural Rediscount Fund intends to emphasize the cultivation of soya. Both areas would benefit from the availability of electric power for irrigation purposes.

Finally, the rural electrification network resulting from both phases will support sectorally designed projects in agricultural production and in the delivery of health and education services to rural areas. However, there are several reasons why the Phase II project as designed should not be integrated into either the new lands development or agricultural sector (basic products) loan as suggested by the IRR approval cable. The first concerns institutions and their sphere of influence. Implementation responsibility for future agricultural loans will logically be placed with the Ministry of Agriculture or Colonization Institute, whereas it is imperative that ENDE and the sub-borrowing, electric companies be utilized for the proposed project. An umbrella project simultaneously relying on both agricultural and power sector entities could present coordination and management problems. Secondly, the project's design (emphasis on serving areas of population concentration with existing infrastructure) by definition precludes integration into a New Lands Development project. Finally, the agricultural products loan must await completion of the GCB assessment, while the analysis for the rural electrification project has been completed.

1/ In order to illustrate the close relationship between the proposed project distribution systems and the wheat producing area in the Southern Departments reference is made to Annex IV.

4. Review and Recommendations of Country Team.

The Intensive Review Request for this project was approved by AID/W in August, 1973. The USAID/Bolivia's intensive review of the project took place in August and September, 1973, with assistance from an NRECA engineer and TDY from AID/W.

The Country Team supports this loan to finance a project of substantial impact in support of GOB and U.S. objectives. Specifically the proposed electrification should contribute significantly to the economic and social development of the rural areas served. In so doing the project will help to incorporate Bolivia's rural population more closely into the nation politically as well as economically. This is particularly significant in a country whose population is 70% rural. By providing electrical energy needs for increased agricultural production the project will help Bolivia toward realizing its potential in an area given highest priority by the GOB in strengthening its national economy and raising the income of its rural population. By relieving disparities in government services to the various regions of the country and thereby promoting economic and social equity, the project helps to reduce a significant destabilizing factor for a nation whose development has been gravely handicapped by political instability.

We conclude that the project is feasible and sound and that it effectively furthers the overall strategy adopted by the Country Team in terms of development, political and social objectives.

SECTION II - PROJECT ANALYSIS

A. BORROWER AND SUB-BORROWERS

1. Executing Agency

Although the Bolivian Government will be the borrower of record, its Empresa Nacional de Electricidad (ENDE) will be the executing agency for this loan with full responsibility and authority for its implementation. Following is a brief discussion of ENDE's history, organizational structure, experience in loan administration and role in the project:

a. Origin and Legislative History

ENDE was created as a sub-division of the Corporación Boliviana de Fomento (CBF) on February 9, 1962 by Supreme Decree N° 05999. As a result of suggestions by IDA and IDB, ENDE became a self-governing branch of CBF on May 1, 1963, and on June 11, 1964, adopted its own charter and by-laws drafted with the assistance of these international agencies. It was formally recognized as a legal entity through Ministerial Resolution N° 127462, dated February 4, 1965.

The functions of ENDE, as defined by these decrees and resolutions is to develop and control the primary systems of generation and transmission countryside, with the exception of the Department of La Paz and a part of the Department of Oruro.

b. Organization

ENDE is a public Corporation with ownership of shares open to both the private and public sectors. Its articles of incorporation fix its authorized capital at $40 million, divided into 40,000 shares with a nominal value of $1,000 each. To date, 100% of ENDE's shares have been owned by three public entities, the Corporación Boliviana de Fomento(CBF), Yacimientos Petrolíferos Fiscales Bolivianos (YPFB), and the Corporación Minera de Bolivia (COMIBOL). On the other hand, ENDE is a shareholder in the Empresa Luz y Fuerza Eléctrica de Cochabamba (ELFEC), Servicios Eléctricos de Tarija (SETAR), and Servicios Eléctricos de Potosí (SEPSA). Also, ENDE has a representative on the Board of Directors of the Instituto Nacional de Electrificación Rural (INER).

ENDE's management is responsible to a six-man Board of Directors, the powers of which are set forth in detail in its by-laws. The Minister of Energy and Hydrocarbons is ex-officio the chairman of the Board. Of the other five members who are elected by the shareholders, three directors represent CBF, and one director each represents COMIBOL and YPFB. All Board members serve four years and are eligible for reelection. According to ENDE's statutes, the chief executive of the company is a General Manager

d. Experience in External Financing

ENDE has had extensive experience in external loan administration and implementation since its inception as a sub-division of CBF in 1962. It has been the executing agency on one previous AID loan for the aforementioned Santa Cruz project (511-L-031). It has also administered two loans from the Inter-American Development Bank for the Corani hydroelectric plant in 1964 ($3.5 million) and the Sucre-Potosí system in 1969 ($4.65 million). The IDA group has also made two loans for which ENDE has had executing responsibility - the Corani hydroelectric plant in 1964 ($10.0 million), and the Santa Isabel hydroelectric plant in 1969 ($7.34 million). Thus ENDE has administered five loans for a total of $32.91 million in the past ten years. In addition, ENDE will administer the $10.8 million A.I.D. loan for Rural Electrification, Phase I (Santa Cruz and Cochabamba areas), and the $6.0 million IDA loan for increased generation in the Santa Cruz area.

ENDE has administered these loans well and with dispatch, and is considered to have all of the capabilities necessary to implement this loan.

e. Findings of Prior Audit Reports on Loan 511-L-031 and Borrower's Compliance With Terms of Loan Agreement

The last audit of loan 511-L-031 and related local currency loans by the Area Auditor General was issued on June 22, 1971. The report concluded that "the objectives for which the loans were made, namely, the construction of facilities for the generation, transmission, and distribution of electricity and the furtherance of the growth of rural electric cooperatives in the Santa Cruz area, have been achieved. The project will benefit both the industrial and residential sectors of the region and is an important contribution toward the growth and development of the Santa Cruz area" (Audit Report N° 2-511-71-108, June 22, 1971). Two recommendations were issued, one with respect to the timing of the submission of progress reports by consulting engineers and the second with regard to Alliance for Progress emblem marking requirements. Both were subsequently cleared.

Section 4.16 of the A.I.D. Loan Agreement for Loan 511-L-031 included a covenant that ENDE would maintain a wholesale and retail rate structure sufficient to yield an average rate of return of 9% on the rate basis defined in the regulations of the Dirección Nacional de Electricidad (DINE). The Bolivian Electric Code also requires that 9% be calculated as an average over a period of three to five years. The

rate base is defined as the average net fixed assets in operation plus working capital (1/8 of the annual operating revenues) and inventories (up to 3% of the gross fixed assets). Between the initiation of operations in 1967 and 1972, ENDE's net operating income increased by an average of 43.6% annually, resulting in a 6% average annual return. The reason for the lower than permitted return was that during these initial years of operation ENDE's assets, mainly hydro facilities, were expanding faster than could be expected for revenues. ENDE's 1972 rate of return was 9.4%, and projections indicate than an average of 9.0% will be maintained. Therefore, no remedial action with regard to the AID loan covenant is required.

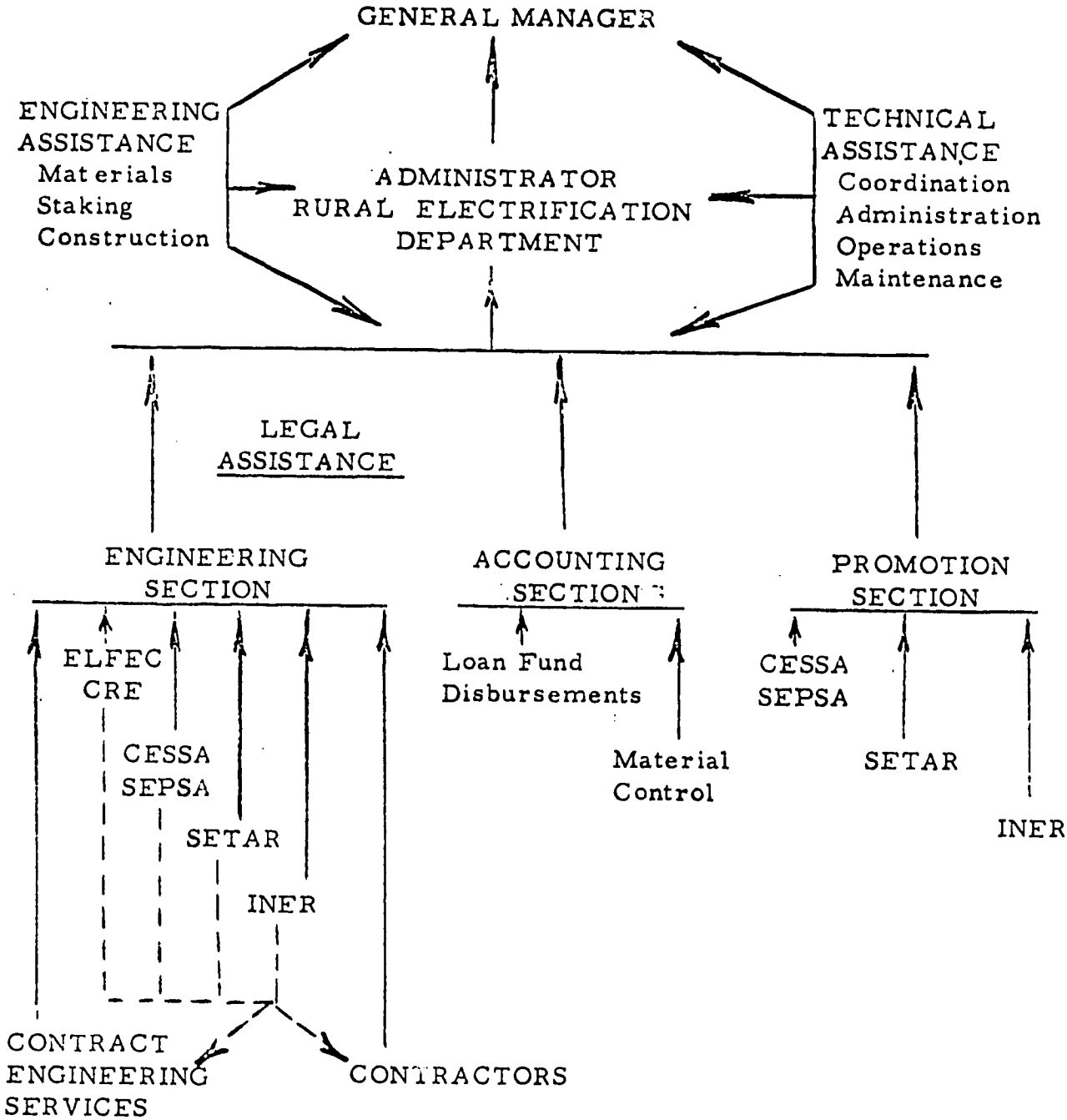
f. Role in Project

ENDE will assume full executive responsibility for all phases of loan implementation. It will set criteria and process all sub-loans. It will contract engineering and construction services, as well as the procurement of all electrical equipment. It will monitor construction on behalf of the sub-borrowers. It will process and approve all disbursements, and will coordinate all project documentation and reports. As the coordinator of technical assistance, ENDE will direct the contracted specialists to the various project regions and sub-borrowers as needs are identified. It will maintain liaison with USAID, and will coordinate all sub-loans and sub-projects to ascertain that the objectives of this loan are met.

In order to fulfill these responsibilities, ENDE has proposed that a special rural electrification department be created within its special projects division for the specific purpose of administering both Rural Electrification Phase I and Phase II. Table 1 illustrates the proposed organization of this department, which is expected to include an administrator, up to six engineers, two accountants, and four promotion specialists.

TABLE 1

ENDE


GENERAL MANAGER
ENGINEERING ASSISTANCE
Materials
Staking
Construction
ADMINISTRATOR
RURAL ELECTRIFICATION
DEPARTMENT
TECHNICAL ASSISTANCE
Coordination
Administration
Operations
Maintenance
LEGAL ASSISTANCE
ENGINEERING SECTION
ACCOUNTING SECTION
PROMOTION SECTION
ELFEC
CRE
CESSA
SEPSA
SETAR
INER
Loan Fund Disbursements
Material Control
CESSA
SEPSA
SETAR
INER
CONTRACT ENGINEERING SERVICES
for
Staking and
Construction Supervision
CONTRACTORS

revenues have not materialized. Consequently, the Ministry of Finance has excused CESSA from any debt service until the technical problem is rectified. 1/

b. SEPSA

The Servicios Eléctricos de Potosí, S.A. is headquartered in Potosí and is responsible for electric power distribution in the Department of Potosí.

Electric power first came to Potosí in 1923 through the Empresa Soux, a private company, which operated the facilities until 1960. From 1961 to 1968 the system was under the management of municipal electrical committee. In 1969 SEPSA was organized as a "Sociedad Anónima".

As a "Sociedad Anónima", SEPSA can accept both private and State shareholders which, at present, include the Potosí Development Committee, the Municipality of Potosí and ENDE. The Board of Directors consists of representatives of the above mentioned shareholders. The general manager's staff consists of an administrative division (10 employees) and a distribution operations division (30 employees) or a total of 40 employees.

SEPSA is now serving 6,700 residential, commercial and industrial consumers in the City of Potosí of which 1,700 were connected during the current year after completion of the new distribution system in the City of Potosí. The number of consumers is projected to increase to 12,000 at the completion of the project in 1977 and to 14,000 consumers by 1986. SEPSA is self supporting with operational funds and the sub-loan debt service requirements will be derived from the sale of electrical energy.

SEPSA's experience in external financing is limited to its association with the GOB-Potosí Development Committee in a US$ 700,000 loan from the Spanish Government in 1968 for the rebuilding of the City of Potosí distribution system. Debt service is on schedule. Repayment is made by the National Treasury which then withholds a portion of its transfers to the Development Committee.

c. SETAR

The Servicios Eléctricos de Tarija, S.A. is headquartered in Tarija and is responsible for electric power distribution in the Department of Tarija.

1/ The technical problem involves a canal which is not delivering an adequate supply of water from a nearby river to the plant. The Chuquisaca water company has obtained a loan to repair the canal (See letter, ANNEX I). With water, the Ruffo plant will generate more than sufficient revenues to service the debt.

Electric power came to Tarija in 1903 through private enterprise, the Compañía Frigerio Calavi, which operated the facilities until 1943. From 1943 to 1962 the system was operated by the municipality, while from 1963-1969 management was under the Corporación Boliviana de Fomento. In 1969 SETAR was organized as a "Sociedad Anónima".

As a "Sociedad Anónima", SETAR can accept both private and State shareholders. At present, private shareholders hold 10%, the Tarija Development Committee owns 36%, the Municipality of Tarija owns 18% and ENDE holds 36%. The Board of Directors consists of representatives of the Development Committee, the Municipality and ENDE. The general manager's staff consists of an administrative division (15 employees), a distribution operations division (7 employees) and a generation operations division (14 employees) for a total of 36 employees.

SETAR is now serving 3,700 residential commercial and industrial consumers in the City of Tarija. The number of consumers is projected to increase to 14,500 at the completion of the project in 1977 and to 34,000 by 1986. SETAR is self supporting with operating funds and debt service requirements will be derived from the sale of electrical energy.

SETAR's experience in external financing is a US$ 85,000 loan with Fiat Concord of Argentina in 1971 for a 420 KW diesel-electric generator. SETAR is meeting debt service requirements on schedule and this servicing was included in the financial forecasts.

d. INER

The Instituto Nacional de Electrificación Rural (INER), headquartered in La Paz, is the most recent addition to the Ministry of Energy Hydrocarbons. Through Public Law Number 9195, dated April 30, 1970, the Central Government was permitted to modify the judicial structures and institutions of the GOB. On November 4, 1970, through Executive Decree Number 09442, INER was created with the object of studying, developing, financing and executing the installation of electric service in rural areas within a cooperative framework.

In three years since its formation, INER has embarked on a program of electrifying some 50 isolated population centers through a US$2,500,000 Spanish line of credit covering 4,250 KW of diesel electric generation, materials for both primary and secondary distribution networks, transportation costs, engineering and overhead. To date, 55 cooperatives have been organized, 32 electric systems are in operation and 6 additional systems are under construction.

Each of the systems have executed sub-loan agreements with INER stipulating a 15 year repayment schedule. Loan payments to the Spanish Government are scheduled over a 10 year period with sub-borrower repayments to the GOB scheduled over a 15 year period. On the basis of its three year life and its administration of this Spanish loan, INER appears capable of being utilized by the Ministry of Energy to fill gaps not otherwise provided for by the power sector

The INER Board of Directors consists of six members presided over by the Minister of Energy and Hydrocarbons. The members are as follows:

Representative of the Ministry of Finance
" " " " Planification
" " " " Housing
" " Cooperative Institute
" " DINE
" " ENDE

The Director of INER acts as secretary with voice but no vote. The Director's staff consists of an administrative department with 10 employees, a technical department with 10 employees and a legal advisor. In addition, INER contracts its construction activities as appropriate.

In undertaking the operation of its sub-project, INER will also, in addition to its statutory duties, form a branch for utility operations, including billing, collection, maintenance sub-offices, etc. In carrying out these additional duties, INER will be assisted by ENDE and with an intensive technical assistance program (see Section II C.6). INER, as well as all sub-borrowers will be required to submit staff acquisition plans prior to the initiation of construction.

B. POWER REGULATORY AGENCY - DIRECCION NACIONAL DE ELECTRICIDAD (DINE)

1. Legal Status

The National Directorate of Electricity (DINE) was created by Supreme Decree N° 05997 dated February 9, 1962. Subsequently, various other decrees were issued defining its authority, responsibility and legal functions. Finally, the Electrical Code was approved by Supreme Decree N° 08438 dated July 31, 1968. The code clearly defined the legal status of DINE.

DINE is a public agency which became a subordinate part of the Ministerio de Energía e Hidrocarburos, upon the creation of this Ministry in 1970. It is charged with the regulation, enforcement and promotion of all activities of the electric power industry in the country.

For its operational expenditures, DINE is empowered by the electric code to collect a surcharge of 3.5 Bolivian pesos for each megawatt-hour generated by all electrical enterprises, public and private, in Bolivia.

2. Duties and Responsibilities

DINE is charged with the establishment of standards of service for the electric power industry and to guarantee national compliance with projected development needs for the country in terms of quantity, quality and price. Within these general areas, its duties and responsibilities could be listed thus:

a. To insure compliance with current laws and regulations and render opinions and issue guidelines.

b. To grant or renew electric service concessions.

c. To act as an arbitrator in electricity related disbutes.

d. To program and control distribution, sales and rationing of electric power consumption.

e. To establish norms of service and uniform technical construction and operation of electrical systems.

f. To continuously prepare and update technical, economical and financial studies of the electric power sub-sector, and based upon these studies, establish appropriate tariffs.

g. To regulate operational budgets and investments programs of the private and public electric entities.

h. In general, to monitor the electrical sub-sector by acting as its coordinator, maintaining statistical records on its activities and preparing an annual report defining its state.

3. Organization

DINE is headed by a director responsible to the Minister of Energy and Hydrocarbons, with a staff of three operating divisions: an administrative department, a division of norms, regulations and concessions, and a division on rates. Currently, its staff consists of 16 employees: 7 engineers, 3 economists, one attorney, and 5 subprofessional, secretarial and service personnel. A detailed organization chart is shown in Annex II.

4. Rate Determination Procedure

Rate determination procedures were established by the electric code. An electric utility entity desiring an adjustment or establishment of a new rate, submits an application to DINE with the following documentation: listing of all tangible and intangible assets, its program for investments, drawdowns and depreciations, operation and maintenance cost breakdown, projections of power sales, calculations of the required rates of return on investment to meet expenditures and calculations showing the rate structure compatible with rate of return.

The application is then studied and analyzed by DINE based upon guidelines established in the electric code, and a provisional rate is fixed for a minimum of three years and a maximum of five years. Such provisional rate is subject to annual adjustments by DINE when actual data is at variance with that submitted by the electric enterprise at the time of its request for the rate determination. In this manner, DINE can effect adjustments of rates upon the request of electric utility companies when an extraordinary revision is required because of factors normally not anticipated.

C. Engineering Analysis.

1. General Description.

The AID financed portion of the project encompasses the planning, design and construction of electrical distribution systems in the rural areas of the Departments of La Paz, Chuquisaca, Potosí and Tarija.

The proposed La Paz sub-project, with the Instituto Nacional de Electrificación Rural (INER), includes both transmission and distribution components as well as related supporting facilities. The distribution component requires the construction of new lines into the presently unserved areas of lake Titicaca, Los Yungas and the area referred to as Rio Abajo south of the city of La Paz. The transmission and substation component, to be financed by the GOB, consists of 50 kilometers of 69 KV, to complement the Los Yungas distribution system, and six step down substations.

The Chuquisaca sub-project with the Cooperativa Eléctrica de Sucre, S.A. (CESSA) envisions only distribution lines with a minimum of supporting facilities requiring the construction of new lines into the presently unserved areas to the northwest and southeast of the city of Sucre. There will be one step down substation, to be financed by the GOB, for the rural areas.

The Potosí sub-project with the Servicios Eléctricos de Potosí S. A. (SEPSA) is also restricted to distribution lines with a minimum of supporting facilities. One step down substation, to be financed by the GOB, will supply power to an area to the southeast of the city of Potosí and a second step down substation, also being financed by the GOB, will supply power to an area broadly described as Camargo approximately midway between the city of Potosí and the city of Tarija.

The Tarija sub-project with the Servicios Eléctricos de Tarija, S.A. (SETAR) will consist of distribution lines in the valley surrounding the city of Tarija and to the north and south of the village of Villamontes to the east of Tarija. Here again, there will be a minimum of supporting facilities. ENDE is under obligation to supply power to both areas through the alternatives of transmission lines, or thermal generation or a power supply from Argentina in Villamontes. There will be two step down substations financed by the GOB.

In all cases, the proposed rural distribution systems will not be integrated in the existing urban systems, and neither will rural lines be extensions of the urban ones. Depending on the source of power, the rural areas will be independently served from 69 KV transmission lines or directly from power houses

The four sub-projects are described in technical detail in Annex III.

2. Studies.

The four sub-projects and sub-project areas have been the subject of several studies of various degree and depth over the past four years. In 1969 the Harza Engineering Company, in Association with Consultores Galindo, studied the Sucre, Potosí and Tarija areas. This study has been supplemented through ENDE Planning office activities. In 1972 the Bolivian Power Company made an in depth study of the La Paz sub-project area which was included in a July-November 1972 report titled "Outline for Rural Electric Development Bolivia".

In order to verify and authenticate the above mentioned analyses, the AID Mission undertook the funding of NRECA technical services for the preparation of a feasibility study. Under PIO/T 511-000-3-40007, Mr. Gilbert Moon, NRECA Rural Electrification Specialist and a Registered Professional Electrical Engineer, was assigned the task of preparing the feasibility study in collaboration with ENDE, the executing agency; INER, CESSA, SEPSA and SETAR the sub-borrowers; and DINE, the GOB electric utility regulatory agency. This study was begun in August 1973 and Moon's report titled "Engineering Feasibility Study in the Departments of La Paz, Chuquisaca, Potosí and Tarija" was submitted to USAID/Bolivia in September 1973.

The above mentioned report covers the scope of the proposed project in detail including:

a. An analysis of the administrative and financial structures of the sub-borrowers and the administrative structures of ENDE, the GOB executing agency.

b. Cost estimates covering materials, labor, engineering and administration.

c. Recommendation on the scope of engineering and other technical services and construction procedures.

d. Implementation plans and schedules.

e. The availability of power in the sub-project areas.

f. Anàlysis of wholesale and retail rates.

The report concludes that the sub-projects are technically and economically sound providing that the sales projections as established by the GOB, and considered obtainable by all project participants, are met.

3. Engineering Plan for Project Execution.

a. Planning.

Preliminary plans for all sub-projects have been completed by ENDE in collaboration with the sub-borrowers. These preliminary plans are complete to the extent that the sub-projects are defined and a reasonable estimate of cost is obtained. They will be further developed and refined by the four sub-borrowers under the coordination of ENDE and will be used as a basis for securing engineering services and the preparation of construction contract documents.

b. Design and Preparation of Contract Documents.

ENDE has, at present, an in house engineering staff which will be utilized to the fullest extent in monitoring the design of the project components, and the preparation of construction plans, technical specifications and other contract documents. No loan funds will be utilized to pay staff salaries or related expenses.

Consulting engineering services will be required. The Consultant's services will include the preparation of final plans, specifications and contract documents; the compilation of material and equipment lists and the preparation of bidding documents for their procurement analyses of bids received and recommendation of award of contract; field engineering, and the inspection of construction.

An engineering consulting firm will be selected to provide these services. The consultant will be selected from among interested and qualified firms. The source of these services will be AID Code 941 countries and Bolivia. The selected firm will be evaluated by AID and will be subject to its approval.

It is anticipated that there will be only one engineering services contract, and that ENDE will be the contracting entity of the GOB. The exact scope of services to be provided for each of the sub-borrowers will be defined in the contract.

The design standards of the Rural Electrification Administration (REA), U.S. Department of Agriculture, will govern all electrical components and civil works under the loan, to the extent practicable.

c. Public Bidding.

Upon completion of the design phase, invitations for bids for materials and construction will be issued to international bidders. Advertising for bids will be published in the Small Business Circular and in the Commerce Business Daily in the United States and in the local press.

d. Construction.

The number of construction contracts to be awarded through competitive bidding will be determined by the requirements of the project during the design phase. In all cases, construction services will be contracted for the sub-borrowers by ENDE, and ENDE will see the work through to completion. The completed systems will then be turned over to the different sub-borrowers for operation. ENDE, however, will coordinate with each sub-borrower all activities in their respective areas, and the sub-borrowers will confirm all payments during construction. Every effort will be made to involve the staff of the sub-borrowers in project activities for their training and familiarization without ENDE surrendering its role for complete project responsibility.

The different contracts will be advertised in the U.S. Local contractors, experienced in this type of construction are available.

No special construction problems are anticipated because of the nature of the work, terrain or climatic conditions, although the prudent scheduling of the different construction activities will be required to take maximum advantage of the dry season.

The consulting engineer will supervise all construction inspection, will be responsible for all related approvals of workmenship and materials, will approve all change orders, additional work orders,

monthly progress payments, and inspect and recommend final acceptance of completed components of the work. In this work, the project participants will be governed by the construction standards of the Rural Electrification Administration (REA) to the extent practicable.

All construction contracts will be approved by AID in writing prior to execution.

An engineering and construction schedule is included in Annex III.

e. Procurement.

In order to obtain the benefits of reduced prices through volume procurement, it is anticipated that most materials and electrical components will be procured through IFB's (Invitation for Bids) which combine sub-borrowers' requirements with the necessary contract stipulations defining CIF (Cost, insurance, freight) and guarantee requirements. Consultants will prepare lists of all off-shore procurement in the early design stages and steps will be taken to ascertain that all delivery schedules are compatible with the time frame of the construction portion of the work. To the maximum extent practicable, project requirements will be coordinated with those of Phase I for the Cochabamba and Santa Cruz areas.

All materials contracts will be approved by AID in writing prior to execution.

f. Time Provisions.

The project is scheduled for completion in three years, allowing for all phases of planning, design, advertising for and receipt of bids and construction. Procurement and prequalification of construction contractors will be done concurrently with other project activities. Following is an estimated time schedule for the work from the time that the loan is signed:

Select and Contract Consultants	3 months
Design Phase: Preliminary Approvals	3 months
Bidding Documents	9 months
Receipt of bids, evaluation and award of construction contract(s)	3 months
Construction	18 months
Total	36 months

For details refere to the engineering and construction schedule included in Annex III.

g. Operation and Maintenance.

Upon acceptance, each sub-borrower will assume the operation and maintenance of the different components of its sub-project. Each entity is now operating similar facilities and no problems are foreseen in the operation and maintenance of the added rural systems, although the effectiveness of each sub-borrower will be enhanced through technical assistance. In anticipation of this added workload, each of these entities is reviewing its staffing requirements. Financial projections and other overhead and organizational support have been budgeted for the years of project operation.,

During the construction period, each entity will have the opportunity to develop its projected staffing needs, through collaboration of their staffs with the consulting engineering firms and other firms to be retained for technical assistance.

4. Technical Feasibility.

a. General Considerations.

It is considered that all facets of the projects are technically feasible. Physical characteristics of the terrain, climatic conditions and technical construction problems pose no special problem for this type of undertaking as verified by the considerable amount of electrification work accomplished in Bolivia over the past decade.

It is expected that all electrical components required for the projects such as wire, transformers, insulators, etc. will be imported from the United States or AID Code 941 countries, where these items are available in adequate supply. No especially manufactured or custom made equipment pieces will be required. All civil works such as pole manufacture and installation, clearing of the right of way, etc. will be accomplished utilizing native materials and labor, both of which are readily available. Supporting facilities such as vehicles , tools and communication equipment are readily available in the U.S. or 941 Code countries.

The four sub-projects have been conceived and planned as modern distribution systems in accordance with the current standard

practice of designing for the projected number of consumers in each area ten years hence. Utility experience in the U.S. has demonstrated that additional initial investment required in such systems is more economical than expanding or replacing these facilities after a short period of time.

An electrification transmission and distribution system is, by its nature, an ever growing network. In that sense, the proposed systems in all sub-project areas lend themselves to further expansion of major or minor proportions without any difficulty.

The distribution voltage of 14.4/24.9 KV is standard for all existing or proposed rural systems in Bolivia. Secondary voltages of 220/380 are also standard contrywide. The transmission voltage of 69 KV is that now in use in sub-project areas and is considered adequate for the expected loads. Standard system frequency is 50 Hz in Bolivia. All of the proposed work contemplates these voltages and frequencies.

b. Power Supply.

Power supply exists in all sub-projects areas to meet the peak demand of the rural electrification components at the time these become operable in 1977 and four years hence, through the year 1980. Such power supply is either available now, is under construction and will come on the line before 1977, or is firmly planned for operation immediately after. Following is a brief discussion of each sub-project area and its power supply.

1) La Paz (INER).

The source of power for the La Paz area sub-project to be undertaken by INER is a complex of Bolivian Power Company owned hydroelectric generating plants on the Rio Zongo, located to the north of the city of La Paz. With the completion of the Cahua hydroelectric generating plant, also on the Rio Zongo, in 1974, the total installed generating capacity[1/] for the La Paz area will be 114,400 kilowatts. The following table illustrates the utilization of this energy through 1980.

1/ All demand shown is peak demand generally between 6:00 - 8:00 PM in all cases except Tarija.

Year	Demand (KW) 1/ Project	Other	Total	Installed Capacity	Remarks
1973	0	67,000	67,000	87,400	Cahua plant with a capacity of 27,000 KW is now under construction and will be operable in 1974.
1977	2,500	84,500	87,000	114,400	
1980	3,000	102,000	105,000	114,400	

The table illustrates that project demands form a small percentage of general area demand, and that project requirements are not likely to go wanting unless the whole area does, which is not probable.

2) Chuquisaca (Sucre) and Potosí (CESSA & SEPSA)

The obvious source of energy at this time for these two sub-project areas are the Corani and Santa Isabel hydroelectric plants in the area of Cochabamba. Delivery of this relatively inexpensive energy to these systems, however, depends upon the completion of the national transmission grid link between Catavi and Potosí. The GOB, through ENDE, is now seeking external financing for this 120 kilometer long 115 kilovolt high tension line.

Cost of energy from this source is estimated at 1.0 ¢ per KWH during the first year of project operation, declining to 0.3 ¢ per KWH ten years hence. These cost figures are derived from amortization and maintenance of transmission facilities since energy available from Corani and Santa Isabel at this stage could be tapped at practically no cost at all.

The alternative source of energy for these sub-projects is the retention of 10,000 KW of thermal generating capacity owned by the mining company (COMIBOL), now scheduled for retirement, an additional 11,000 KW in existing COMIBOL capacity and the newly constructed 10,000 KW thermal generation plant in Sucre. This total installed capacity of 31,000 KW is adequate to meet all area demand through the year 1980. The following table illustrates projected utilization.

1/ All demand shown is peak demand generally between 6:00 - 8:00 PM in all cases except Tarija.

Year	Demand KW 1/ Project	Other	Total	Installed Capacity	Remarks
1973	0	19,000	19,000	21,000	The Sucre thermal plant with a capacity of 10,000 KW is complete and will be operable in late 1973 or early 1974.
1977	2,500	22,000	24,500	31,000	
1980	3,000	27,000	30,000	31,000	

The cost of this thermal energy, however, is estimated at 2.0¢ per KWH during the first year of operation, or 200% the cost of hydro-energy from the Cochabamba area. This cost would remain approximately the same assuming that fuel prices do not increase, and that better load factors compensate for normal appreciation in generating costs such as salaries, etc. This cost would be approximately 700% that of transmitted grid energy during the tenth year of project operation. This excessive cost, however, should only burden the system until such time that transmission facilities are constructed, and the growing difference in the cost of the two sources of supply should be enough to keep pressure on ENDE to secure financing for the transmission facilities at the earliest possible time.

It is again worthy of note that the requirements of the proposed rural system constitute only 10% of the total area demand.

3) Tarija (SETAR).

In Tarija, a different peak demand situation exists in which daytime irrigation requirements are estimated to increase dramatically once the rural electrification system is installed. This demand is estimated at 2,000 KW during the first year of project operation and at 15,000 KW ten years later.

The existing Tarija thermal plant has an installed capacity of 2,000 KW, which will have to be gradually increased to meet this demand. A total of 10,500 KW will be required to meet the demand by the year 1980. ENDE plans to transfer 3,500 KW in diesel generators now available from the Cochabamba area immediately, and to add another 5,000 KW by the year 1978. Following is a utilization schedule for the Tarija area:

1/ Not included in this demand summary is a projected 5,200 KW by COMIBOL for their volatilization plant between 1977 and 1980. A 6,000 KW generation plant is planned by COMIBOL to meet this demand which will be a part of the area system.

Year	Demand (KW) Project	Other	Total	Installed Capacity	Remarks
1973	0	1,300	1,300	2,000	1) 3,500 KW diesel plants to be transferred to Tarija area to be operable before 1977
1977 day	2,000	400	2,400	5,500	
1977 night	1,500	1,700	3,100	5,500	
1980 day	10,000	500	10,500	10,500	2) 5,000 KW diesel plants to be operable in 1979 if grid is not complete.
1980 night	2,300	2,500	4,800	10,500	

In this case, projected project peak demand, especially for irrigation, overshadows other requirements, and ENDE is committed to increase the installed capacity as required. The 3,500 KW capacity surplused from the Cochabamba area after the completion of the hydroelectric plants is readily available. Annex I shows a letter from ENDE acknowledging the need and committing themselves to installing this capacity in the absence of other solutions such as the completion of the national grid.

4) Villa Montes (SETAR)

The peak demand for the Villa Montes area is estimated to be 1,500 KW during the first year of the project operation, increasing to 3,000 KW by the year 1980. ENDE is now negotiating with Argentina to purchase power for this system. Such purchased power would be stepped down and fed to the system at Yacuiba on the Bolivian-Argentina border. Annex I illustrates communications between the two countries over the purchase of such power.

The Corporación Boliviana de Fomento owns a 1,500 KW power plant which it uses exclusively for its operations. Municipal generation facilities at present consist of only 150 KW.

Power from Argentina will most likely supply the system until the completion of the national power grid and the transmission line of Tupiza-Tarija-Villamontes. Excess power in Argentina is available and similar agreements have been previously reached for other border areas.

5) Generation Plans Beyond 1980.

The foregoing discussion demonstrates that currently installed generation capacity, those facilities under construction or firm commitments for additional minor investments in generation by ENDE will meet the peak demand of the proposed distribution system through the year 1980, or essentially during the first four years of the life of the project. It is also obvious that, in the areas of the project, the rural distribution peak demand

is by no means the governing consideration in planning for additional generation capacity since this demand consists of only 10% of the country's overall requirements.

Beyond the year 1980, however, intensive review indicated that Bolivia will require additional investments in generation and transmission on the level of $35-45 million. These funds will be required for the expansion, to the ultimate capacity of several hydroelectric and thermal generation plants and for the interconnection of the national transmission grid system. Additional generating capacity, however, will have to be introduced contrywide in the mid-1980's, above and beyond this currently planned expansion in order to meet the projected national demand.

Present GOB planning to meet this demand could be roughly divided into an intermediate range plan to cover the 1980's and a long range plan to meet the national demand through the year 2000.

To meet the intermediate range plan, the International Development Association (IDA) has included in its Santa Cruz power generation loan, which was approved in September 1973, $910,000 to enable ENDE to carryout the following plans: 1/

1) A study of the interconnection of ENDE's central and northern electric power systems, (i.e. transmission linebetween Cochabamba, Oruro and La Paz).

2) An engineering study of the expansion of ENDE's Corani hydroelectric plant. (This is beyond the Currently planned expansion from 27 MW to 40.5 to 54 MW).

3) Feasibility studies of new power generating facilities for ENDE. (Areas subject to study include Miguelito for 38 MW, Miguilla,for 105 MW, Misicuri for 84 MW, Pachaloca for 27 MW, Ciclo Jahuira for 32 MW, San José for 41 MW, Fuentes Corani for 62 MW).

In addition to the $910,000 included in the IDA loan, ENDE has budgetted $200,000 in local funds for these studies. The conclusions and recommendations thus derived will be utilized to secure external financing for generation facilities to come on the line in 1980-1982.

1/ Source: IDA-GOB Loan documentation, Schedule 2-D.

Long range planning beyond the 1980's is also being undertaken through a series of studies for the expansion of the Bolivian power system and for an inventory of Bolivia's hydroelectric resources to be financed through a grant from the United Nations Development Fund. The GOB has obtained a firm commitment from UNDP for a total grant of $640,000, $40,000 of which has been approved for disbursement. In addition, ENDE is budgetting $400,000 in local funds for these studies and reports.

c) Disposition of Existing Facilities in Project Area.

Existing electrification facilities in sub-project areas not receiving central station electricity consist mostly of privately owned and operated small scale systems with unreliable generating units. Such systemsallow limited electric service to these communities, normally from 6:00 pm. to 10:00 pm. Upon the availability of reliable central station sources from which power could be distributed into these areas, these self contained and inefficient systems will be either abandoned or when feasible, purchased by ENDE for transfer to other areas. Details of the acquisition of these properties will be negotiated during the life of the project.

In summary, from an engineering standpoint, the project is technically feasible. The executing agency, ENDE, has had the experience and expertise to implement the proyect and the sub-borrowers have had ample experience in operating and maintaining such systems. No construction or other technical problems are anticipated during the course of project implementation. The planned expansions are compatible with the existing systems, and the resulting expanded systems lend themselves to further expansion. Power is or will be available for all systems for the first four years of project operation. No problems are anticipated in the disposition of existing facilities.

5. Estimate of Cost.

The estimates of cost of all sub-projects were developed from basic cost data contained in the July-November 1972 Outline for Rural Electric Development Bolivia. These costs were developed from recent prices of materials and equipment in Bolivia and surrounding Latin American Countries. The labor component is based upon wages and social benefits now prevalent in the different sub-project areas.

Force account and contract records of the Bolivian Power Company, Cooperativa Rural de Electrifición Ltda. de Santa Cruz, Empresa Luz y

Fuerza Eléctrica de Cochabamba, S. A. and ENDE were used to the extent possible in verifying the assumed costs.

The estimated costs include escalation allowances to compensate for expected materials and labor prices in the latter half of 1974 with a 10% contingency item to cover unforseen problems and delays. Minor delays in the 1975 construction schedule contained in this project should not materially affect estimated costs. A drastic change in this schedule, however, would very likely render this estimate obsolete and additional funds could be required.

The estimate of cost is shown in detail in Annex III.

Shown below is a summary of the estimate of project costs including local contributions.

PROJECT COST BREAKDOWN BY COMPONENT AND AREA
US$

Component	La Paz INER	Chuquisaca CESSA	Potosí SEPSA	Tarija SETAR	Total
AID LOAN					
Distribution	1,689,700	988,500	902,500	1,382,300	4,963,000
Facilities & Eq.	100,000	-	-	-	100,000
Engineering	149,400	85,300	82,000	134,800	451,500
Tech. Assistance	225,000	75,000	75,000	75,000	450,000
Contingency	169,000	98,900	90,300	138,200	496,400
Sub Total	2,333,100	1,247,700	1,149,800	1,730,300	6,460,900
LOCAL CONTRIBUTIONS					
Transmission	500,000	-	-	-	500,000
Substations	172,500	87,200	132,000	299,000	690,700
ENDE Administr.	49,800	28,400	27,000	44,900	150,100
Other Adm. Costs	100,000	100,000	100,000	100,000	400,000
Facilities & Eq.	143,500	60,000	60,000	60,000	323,500
Int. During Const.	61,000	27,700	27,700	43,600	160,000
Sub-Total	1,026,800	303,300	346,700	547,500	2,224,300
TOTAL	3,359,900	1,551,000	1,496,500	2,277,800	8,685,200

6. Technical Assistance.

The administrative, technical and managerial capacity of each of the sub-borrowers was evaluated during intensive review. The three electric utility companies in the southern departments (SEPSA, CESSA and SETAR) have been in operation for over a half a century in one form or another, but their growth has been limited due to their urban orientation and lack of capital. INER, the sub-borrower for the La Paz sub-project is a new institution with limited experience. As a result, it was decided to charge ENDE with actual project execution in collaboration with all sub-borrowers.

Technical assistance will be required on a large scale during the course of projects implementation for all four sub-borrowers. The goal of this technical assistance would be essentially institution building. The staff of each sub-borrower will be increased and developed to a decree compatible with the functions each will assume upon completion of construction. The areas of need vary with each sub-borrower, but in general terms each needs to improve their management practices, their overall operational efficiency and their accounting procedures. Administratively, such areas as personnel staffing, operating policies, collection procedures, public relations and customer education will be covered. The technical capacity of each sub-borrower will be increased with emphasis on preventive maintenance, safety procedures, continous training programs, planning of system extension and work scheduling. Financial management will be streamlined through improved accounting procedures, budgetting, financial forecasting and reporting and rate evaluation.

These technical assistance services will be exclusively financed with loan funds and will be coordinated and implemented by ENDE through contracts with competent consultants. There is a strong likelihood that technical services for this project will be combined with those of Rural Electrification, Phase I. Such combination will permit ENDE to undertake a more comprehensive program eliminating duplication and allowing better utilization of technical assistance personnel.

The cost estimate for technical assistance were derived in the following manner:

Technical Assistance - Project Manager	1 man for 3 years	= 3.0 Man Years
Management - Specialist	1 man for 2 1/2 years	= 2.5 Man Years
Outside Plant - Specialist	1 man for 2 years	= 2.0 Man Years
Evaluation - Specialist	1 man for $\frac{1}{2}$ year	= .5 Man Years
		8.0 Man Years

Salary	$27,500/year/man		
Overhead	$12,500/year/man		
Housing	$ 4,200/year/man		
Per Diem	$ 5,000/year/man		
	$49,200/year x 8.0 Man Years	=	$393,600
Transp.	$ 5,000 x 4 man x 2 (Round trip)	=	$ 40,000
			$433,600
Home Office Back-up			$ 16,400
Total			$450,000

7. Engineering Conclusions

The engineering reports, feasibility studies, preliminary plans and other data indicate that this is a feasible and sound project. The estimated cost has been realistically developed based upon reliable data and is considered reasonably firm. The power required to electrify the distribution systems to be constructed under the project will be available when the system is completed in all areas. It is the judgement of the Capital Assistance Committee, therefore, that the requirements set forth in Section 611 (a) (1) of the Foreign Assistance Act of 1961, as amended, have been met.

D. Economic Analysis.

1. Introduction and Summary.

This section analyses the project as a whole and its various components from the economic (as opposed to financial) point of view. The benefit/cost ratio for the sub-projects is the basic quantitative tool used to determine economic feasibility of the sub-projects. In addition, non-quantifiable aspects of rural electrification are discussed as they affect the benefit/cost calculation. Finally, the project's effect on specific indicators, such as employment and income distribution as well as education, health, etc., are discussed.

The project as a whole and each of the sub-projects all have benefit/cost ratios greater than one when the future streams of benefits are discounted to the present at the presumed opportunity cost of capital (12%). Since all non-quantifiable economic and social aspects are favorable for the project, the conclusion of this analysis is that the project is economically feasible and should be supported by the proposed A.I.D. loan.

2. Demand Forecasts.

Demand forecast for each sub-project system are shown in detail in Annex V. (with sales projections). Voltage drop sheets and summary tables indicate consumption points and volumes (Annex III). In general, the forecasts are based on survey data of the regions and previous rural electrification experiences in Bolivia, i.e. the electrification of several villages near Cochabamba, the Santa Cruz experience, and the recent electrification of Achacachi by the Bolivian Power Co. Experience of the consultant, NRECA engineer Gilbert Moon, in other Latin American countries was taken into account too. The initial demand level is approximately the amount of energy that can be purchased by the rural consumer for the amount of money presently being spent for kerosene, candles, or intermittent electric service, as the case may be. The average rural consumption is projected to rise in ten years to the level of the urban consumer in 1973. Projections estimate that 14% of the potential consumers in the rural areas of the project will participate in the system in the first year that central electricity is available, and that the percentage will rise to 21% during the next 9 years. When we consider that many of the villages now have intermittent evening electric service, this high initial load is quite reasonable. Note however that there is considerable variation from the average in the different project areas.

The following table illustrates the extent of rural population participation in the system in the different project areas.

RURAL POPULATION AFFECTED BY THE PROJECT
In Thousands

	Total	LA PAZ INER	CHUQUISACA CESSA	POTOSI SEPSA	TARIJA SETAR
Rural Population in area 1971 [1/]	881	484	198	93	106
Rural Population in area 1977	1011	545	233	107	126
Rural Customers first Year (1977)	29	10	5	5	9
Rural Population served in 1977 (at 5 per customer)	145	50	25	25	45
Ratio of rural population served to total area population in 1977	14%	9%	11%	23%	36%
Rural Population in area 1986	1225	628	298	134	165
Rural Customers after 10 years (1986)	52	14	11	6	21
Rural Population served in 1986 (at 5 per customer)	260	70	55	30	105
Ratio rural population served to rural population in area 1986	21%	11%	18%	23%	64%

Source: CONEPLAN and Survey Data.

The various industries now functioning in project areas meet their energy requirements from a variety of sources, none of which is central station power. Future energy requirements of these existing industries, plus the requirements of those that will be initiated in the following years cannot be met through existing facilities. The availability of a reliable power system will stimulate rapid growth, will encourage expansion, and will induce the creation of new industries for two reasons. First, the cost of central station power is much less,

1/ Rural consumers are those living outside the Department Capitals.

and second neither capital investment for generators nor operational funds for fuels are required. New entrants into industry will benefit since less additional borrowing, which usually requires substantial collateral will be required. Utility companies will then in effect, act as a surrogate by acquiring the generating capacity for the new industry, thereby reducing its needs for capital and thus making entry and expansion much easier. This consideration is much more important for small firms with limited resources and little access to the capital market.

With the proposed programs in the areas of population concentration, the sub-borrowers should be able to connect a larger percentage of the potential consumers than that reflected in the financial analysis with little increase in project costs.

In the INER sub-project area, the 18 rural industrial consumers contemplated during the first year of operation include 17 existing loads over 15 KW in the Lake Titicaca, Los Yungas and Rio Abajo areas, plus the Chojlla Mine with an estimated demand of 5000 KW of which approximately 2500 KW will be supplied immediately from the INER system. Ten additional rural industrial consumers projected for the 10th. year (60% growth) are divided between the electrification of existing mines between Achacachi and Sorata and several potential fruit processing plants in the Los Yungas area with an estimated 40% growth in KWH usage.

In the INER sub-project area, irrigation estimates were restricted to the Rio Abajo area which supplies the vegetable requirements for the City of La Paz. The Agricultural Experimental Station near Achacachi (Belén) also contemplates some irrigation on the Altiplano which could increase the demand estimates contemplated in the financial analysis.

In the CESSA sub-project area the 4 rural industrial consumers will have an estimated individual demand of from 50 KW to 100 KW with a 130% increase during the first 10 years of operation. Numerically, however, the large power estimates are only a token contribution to the feasibility of the project area. Irrigation also contributes a minimal percentage to CESSA feasibility and is, at this time, a somewhat uncertain factor in the economy of the area.

In the SEPSA sub-project area, no large industrial consumers have been identified. The small industrial projections shown in Annex V are those identified as small commercial in the INER, CESSA and SETAR forecasts. The increases in this classification are consistent with increases in the residential-commercial classification and, in our judgement, are reasonable.

SEPSA irrigation estimates are substantial and reflect GOB-Development Committee plans for irrigation projects in the Camargo Service area. In discussions with the GOB-Development Committee, it appeared that the these estimates were overly optimistic from an implementation standpoint although the irrigation program is technically and economically feasible over a longer period of time. Therefore we have spread the Development Committee's 1974-1977 load estimates over the 1974-1986 period.

In the SETAR sub-project area the 14 rural industrial consumers projected for the first year of operation are existing industries or industries now under construction in the Villa Montes area. Demand estimates are based on actual demand data and hours of use. The ten additional rural industries for the 10th year (71% growth) include new cotton gins, additional oil processing plants, etc.

As with SEPSA, irrigation estimates are substantial and reflect GOB-Development Committee plans for irrigation projects in the immediate area of the City of Tarija. The Development Committee's estimates were reduced to a conservative 50% during the 10th year of operation.

3. Methodology.

The quantitative evaluation of benefits and costs made here is based on the model developed by Marcelo Selowsky for the IBRD 1/. This model evaluates the marginal benefits that accrue to the national economy from an investment in a rural electric distribution system. The benefits are identified as the resource saving due to the replacement of an alternative source of energy (kerosene in lamps or small diesel generators) by an efficient source of energy (i.e. central station electricity), plus the consumer surplus or net value added that accrues to the customers when they expand consumption of electricity for old or new purposes. The annual benefits for the assumed life of the project (33 years) are discounted to a present value using 12% as the opportunity cost of capital to the economy. The denomination of the benefit/cost ratio is simply the present value of the distribution investment, discounted at the same rate. A detailed discussion of this methodology is shown in Annex IV.

4. Benefit/Cost Calculations.

Analyses of the relative direct economic benefits to users of the proposed rural electrification program were prepared in accordance with the methodology discussed previously. At present, according to survey data, rural residents not served by electricity

1/ Available in LA/DR, AID/Washington.

spend $7.50 per year for lighting service equivalent to a 10 W bulbs or approximately $0.70 per kwh equivalent. This cost value would nearly double if shadow pricing of government controlled commodities were applied. The relative cost reduction resulting from the introduction of electricity as one alternative, and from the continuation of candles or kerosene lamps as another alternative, are estimated. Also estimated are the elasticities of demand relevant to each alternative. Conservative estimates of this elasticity demand were made from scattered evidence from price changes both up and down in various electric systems in Bolivia and from comparison of consumption and cost levels between systems. An elasticity of 3 is estimated of household consumers, 1.5 for firms now with service whatever the source, 2 for residential commercial currently with service and 4 for irrigation.

Estimates of cost reduction coefficients and elasticity of demand for the different consumer classes are shown in Annex IV. The expansion benefit effect, i.e. those benefits derived from the elasticity of the system, are expressed as a percentage of the resource saving benefit for the sake of simplyfying computations. The benefit per KWH that the economy perceives from the use of electricity is quantified for any year by adding the demand expansion benefit to the marginal cost of power multiplied by the cost reduction percentage.

The benefit per KWH is then applied to the consumption projections to obtain benefits per year by class of consumer. These calculations are shown in detail for each of the sub-projects in Annex IV. The present value of the investment, by project is calculated in the following table:

PRESENT VALUE AS OF JANUARY 1, 1974 OF INVESTMENT IN RURAL ELECTRIFICATION PROJECTS
US$ (000)

	PW Factor	INER	SEPSA	CESSA	SETAR Tarija	SETAR Villamontes
1974	1.00	102	60	50	36	31
1975	0.89	1,857	793	833	420	799
1976	0.80	1,376	619	643	346	621
Present Value		2,855	1,261	1,306	687	1,230

The ratio of benefits to costs is then calculated, and is shown in the following table:

SUMMARY OF PROJECT BENEFITS AND COSTS

Project	Present Value Benefits	Costs	B/C Rates
INER	8,382,000	2,850,000	2.94
SEPSA	1,533,000	1,261,000	1.22
CESSA	2,694,000	1,306,000	2.06
SETAR Total	6,054,000	1,926,000	3.14
Tarija Sub-Project	3,920,000	687,000	5.71
Villamontes Sub-Project	2,134,000	1,239.000	1.72
TOTAL	18,663,000	7,343,000	2.54

The entire project has a benefit cost ratio of 2.54 to 1. All the separable components have marginal B/C ratios greater than unity. The lowest is that for the SEPSA project, 1.22, while the SETAR Tarija sub-project has a high 5.71 B/C ratio. The high B/C ratio for the Tarija project is due to the high density of population in the region which keeps distribution investment to a minimum. Intensive irrigation plans also contribute to the benefits but even without any irrigation taking place the B/C ratio would be quite high.

The conclusion of the benefit-cost analysis is that the project is economically feasible and highly beneficial to the economy and should be undertaken.

5. Health and Education.

The provision of reliable 24 hour electric service will improve the quality of health care in rural areas by powering hospital and clinic equipment in the areas to be served for a full day and night. Probably the most significant impact in this area will be upon the morale of the doctors assigned to after-graduation duty in the rural hospitals. These doctors, trained in modern medicine in the city, find it professionally distasteful to practice under backward conditions, and frequently abandon their post or otherwise neglect their duties. Twenty-four hour power in the hospital will do much to improve their morale and their ability to offer quality medical service in rural areas. Specific examples of the kind of improvement expected is the use of X-ray machines,

sterilizers and diagnostic equipment. Similarly, we expect rural electrification to improve the life and morale of the rural teacher, making the job at least somewhat more attractive. In rural areas the school is the community center, and its lighting will enable it to be used for night educational efforts or simply as a meeting place.

6. Income Distribution.

The project will bring electricity to a neglected sector of the population whose income is well below the Bolivian average. The project has as its goal the raising of the living standards of the rural population. It will achieve this by providing them with electricity at a low price, essentially marginal cost to the system as a whole rather than average cost (plus profit) as is usually charged by utilities. The project reaches only a fraction of the campesinos and certainly does not by itself undo the injustices of the present system of distribution. It should be noted that, within the rural sector, this and previous rural electrification efforts have tended to concentrate on more densely settled regions where distribution costs could be held within reason; these more densely settled regions are of course the more productive lands with relatively higher rural income. It would clearly be prohibitively costly to electrify isolated, poor campesino houses at the present time, and it is doubtful that such isolated, poor campesinos could afford to pay even the small monthly charges for the service in densely populated areas, much less the marginal cost of isolated distribution.

7. Balance of Payments.

Rural electrification will have a small but positive effect on the balance of payments. The project will directly use a significant share of imported materials (51%) of total project cost, or $4,361,700. Once in place, the project permits the savings of imports of kerosene lamps and related materials but will require, eventually, increased import of electrical appliances. Note however that light bulbs are manufactured in Bolivia. The replacement of kerosene by more efficient thermal or by hydro-energy will make more petroleum available for export.

The indirect effects on the balance of payment are more important but longer run in nature. We expect an increase in exportable agricultural production such as cotton, lumber, wine, garlic as well as of products presently being imported such as edible oils and wheat.

8. Employment Effect.

Employment effects are direct and indirect. The implementation of the project will require 5,293 man years of labor of which 50% will be unskilled and available without resource cost to the economy from the unemployed and underemployed reserve. The remainder will be skilled and professional jobs, candidates for which cannot correctly be called underemployed. The project cost per man year of employment is US$ 1,621. The average cost per man year of employment compares favorably with experience under the Program Loan. That loan had as its objective the employment of people without jobs, and its average cost was $1,317 per man year. In the rural electrification project we have a large imported materials component which raises cost per man year. However, there is also a large requirement for unskilled labor for such tasks as digging post holes and pulling wire.

If we consider the employment generated in relation to the local costs, the cost of a man year of employment is much lower. Local costs are estimated at 49% of total project cost, or $4,223,000. The employment cost per man year in relation to local costs is US. $798.

The most important employment effect is in the creation of agricultural and agriculture-related employment. The transformation of barren land into highly productive land through irrigation is the primary source of job creation. We assume each hectare irrigated will provide 2 man years of employment on the farm each year as long as present techniques continue to be used in production, and that the processing of agricultural output increases due to irrigation account for another additional 1 man/year of employment per ha. Thus employment in the Tarija region alone could well expand by 15,000 full time jobs.

The following table illustrates the employment generation effect of the project.

EMPLOYMENT GENERATION CALCULUS

Component	Cost Breakdown %	$	Effective Cost %	$	Salary Man/ Year $	Employment Cost per man/year $
On site labor	15	1,307,000	100	1,307,000	424	3,083
Material Derivative	69	5,927,000	10	593,000	360	1,647
Eng.Adm.& Other	16	1,351,000	10	1,351,000	2400	563
Total:	100	8,585,000	--	3,251,000	-	5,293

Average cost per man/year: $\frac{8,585,000}{5,293} = \$1,621$

E. Financial Analysis

1. Summary Cost Estimate and Financial Plan

(U S $)

Utilization of Project Funds	Sources: AID Loan	Local Financing	Total
Distribution	4,963,000		4,963,000
Facilities and Equipment	100,000		100,000
Engineering	451,500		451,500
Technical Assistance	450,000		450,000
Contingency Allowance	496,400		496,400
Transmission		500,000	500,000
Sub-Stations		690,700	690,700
ENDE Administrative Costs		390,100	390,100
Sub-Borrower Admin. Costs		160,000	160,000
Facilities and Equipment		323,500	323,500
Interest Capitalized During Construction		160,000	160,000
Total	6,460,900	2,224,300	8,685,200

2. Analysis of Elements included in Financial Plan

a. The following table presents reasonably firm estimates, prepared by the NRECA Consultant and ENDE, of the component cost of the project for the participating sub-borrowers:

(US$ 000's)

Component	(La Paz) CRE	(Potosi) SEPSA	(Sucre) CESSA	(Tarija) SETAR	Total
Right of way clearing	5.0	7.5	10.0	15.0	37.5
Poles and fixtures	755.4	410.9	459.2	579.0	2,213.5
Overhead conduit	251.9	140.0	153.0	193.3	738.1
Line transformers	101.7	48.5	52.8	91.3	293.6
Services	149.7	71.6	78.0	135.0	433.6
Meters	232.3	111.6	121.4	210.1	675.4
Interior wiring	110.1	52.9	57.6	99.6	320.2
Sectionalizing	27.1	19.0	19.0	27.5	92.6
Street lights	58.0	31.5	37.5	31.5	158.5
Engineering	149.4	82.0	85.3	134.8	451.5

(US$ 000's)

Component	(La Paz) INTR	(Potosi) SEDCA	(Sucre) CESSA	(Tarija) SETAR	Total
Technical assistance	225.0	75.0	75.0	75.0	450.0
Tools and equipment	100.0	-	-	-	100.0
Contingencies	169.0	90.3	98.9	138.2	496.4
Sub-Total	2,333.1	1,149.8	1,247.7	1,730.3	6,460.9
Transmission	500.0	-	-	-	500.0
Sub-stations	172.5	138.0	87.2	293.0	690.7
Tools and equipment	143.5	60.0	60.0	60.0	323.5
ENDE administrative Costs	109.3	97.0	88.4	104.9	390.1
Sub-borrower Admin. costs	40.0	40.0	40.0	40.0	160.0
Capitalized Interest	61.0	27.7	27.7	43.6	160.0
Sub-Total	1,062.8	346.7	303.3	547.5	2,224.3
Total	3,359.9	1,496.5	1,551.0	2,277.8	8,610.2

b. The following table presents the estimated cost breakdown between U.S. Dollar costs and local currency utilization of the proposed AID loan:

(US$ 000's)

	U.S. Dollar Costs	Local Currency Costs	Total
Materials	3,391.8	516.4	3,908.2
Construction		1,054.8	1,054.8
Vehicles and equipment	100.0		100.0
Engineering	180.6	270.9	451.5
Technical assistance	450.0		450.0
Contingencies	339.3	157.1	496.4
	4,461.7	1,999.2	6,460.9

3. Proposed Schedule of AID Loan Disbursements

(US$)

	1974	1975	1976	Total
Materials	116,400	2,860,000	931,800	3,908,200
Construction		354,800	700,000	1,054,800
Vehicles and equipment	100,000	-	-	100,000

	(US$)			
	1974	1975	1976	Total
Engineering	150,000	181,500	150,000	451,500
Technical assistance	110,000	170,000	170,000	450,000
Contingencies	-	-	496,400	496,400
	476,400	3,536,300	2,448,800	6,460,900

4. Sub-Loan Terms

The GOB through its executing agency, ENDE, will pass on the concessional AID loan terms to the Sub-Borrowers by separate loan agreements. Project costs incurred by ENDE for the Sub-Borrowers will be funded on a grant basis.

5. Appraisal of ENDE Financial Condition and Financial Projections

The financial statements of ENDE for the year ended December 31, 1972 are presented in Annex V. The financial statements of ENDE are audited annually by the Bolivian offices of Arthur Young and Co. The audited statements from 1969 thru 1971 have been reviewed as well as the auditors' certifications. The auditors have in past years taken exception to the valuation of receivables due from customers, the provision for taxes, as well as the capitalization of profits and revenues. However, for 1972 the auditors certificate took no exceptions to the accounting practices of ENDE which indicates that ENDE is now following generally accepted accounting principals in their financial activities.

Long term debt as reflected in the 1972 statements was as follows:

	($b)	(US$ Equiv.)
IDB 41/ST-BO	53,842.050	2,692,103
USAID/B	105,888,650	5,294,432
CBF-BID	3,683,357	184,168
BID 4/UK-BO	4,713,544	235,677
IDA 148/BO	119,635,514	5,981,776
Comité OO.PP. Santa Cruz	1,855,761	92,788
BID 221/ST-BO	22,778,386	1,138,919
	312,397.272	15,619,863

The capital and revenues of ENDE totaled $16,128,360 at December 31, 1972. Their debt/equity ratio is less than 1: 1 which reflects a conservative use of leverage.

The results of operations for 1972 disclose that ENDE enjoys a 55% profit margin on operating income, and a 9.4% rate of return in accordance with the required criteria of the Bolivian electric code. At December 31, 1972 ENDE had $11,480,662 invested in plant expansion construction in progress, of which $9,910,707 relates to the Santa Isabel plant which was recently completed.

The projected cash flow statements prepared by ENDE are based on historical performance infused with their expansion plans and they indicate that ENDE will continue to function on a sound financial basis and will be fully capable of meeting their long-term debt servicing responsibilities.

6. Appraisal of Sub-Borrower Financial Condition and Financial Projections

The balance sheets as of December 31, 1972 for the four proposed Sub-Borrowers are presented in Annex V, and the sales projections, income statement projections, and cash flow projections are presented in Annex V.

The historical financial picture of the Sub-Borrowers has been one of operating losses or break-even activities. This has been previously due to the necessity for purchasing and/or generating power at costs which are excessive in comparison to retail rates imposed by the GOB. In addition the load factors for these companies have been relatively low in the past which caused a high cost per KWH. Overcoming these problems combined with the improved proposed rate structure will have a very favorable future impact on the financial conditions of these companies as is reflected in the statements illustrated in Annex V.

Cooperativa Eléctrica de Sucre, S.A. (CESSA)

The financial statements for CESSA have been reviewed for the years 1971 and 1972. The review indicated that the

company has been operating at a loss since inception mainly due to a power rate structure imposed by the GOB while operating costs are inordinately high. The major factor contributing to CESSA's poor financial picture is the excessive overhead cost resulting from overstaffing. CESSA presently carries 60 employees on their payroll while the other two companies (SETAR and SEPSA) employ 40 personnel. During our discussion with CESSA management we were informed that the Cement factory (TAMCESA) was partially burned down in 1968 and as a result has operated at around 10% capacity until 1972. At that point the Cement plant has been rebuilding and reorganizing in an effort to meet a planned production expansion in the Cement industry scheduled for 1977 by the GOB. Our Sales Projections and profit and loss projections reflect a substantial increase in revenue from 1976 to 1977 in the urban area. This is not a response to the AID loan but a result of the on line/higher production of the Cement factory which accounts for nearly 80% of the CESSA power sales.

Servicios Eléctricos Potosí, S.A. (SEPSA)

The financial statements of SEPSA were reviewed and analyzed for the years 1971 and 1974. The problem of frozen retail rates (in SEPSA's case they were lowest of the three power companies US$.0225) accounts for the operating losses previously experienced and projected until 1978. At the time the proposed project effects increased distribution in the rural area, commencing in 1975, the financial picture of SEPSA proceeds to improve. The effect of the proposed wholesale and retail rates coupled with a more favorable load factor that will result from increasing rural consumer demand projects SEPSA into a profitable position in 1979.

Servicios Eléctricos Tarija, S.A. SETAR)

Of the three power companies proposed as sub-borrowers under this loan, SETAR is the only one which has operated from break-even to a minimal profit. This is mainly due to the subsidy they are receiving from the Comité de Desarrollo y Obras Públicas de Tarija. The Comité is committed to furnishing the fuel and oil required for electricity generation free of charge to SETAR until 1977. This commitment was made in an effort to avoid retail rate increases. However, in June 1973 the company was granted permission

by the GOB to increase retail rates 5% semi-annually. The additional revenue generated from these rate increases is paid by SETAR to the Comité for generating fuel. It was estimated by the SETAR manager that SETAR will have the financial capability to pay for all generating fuel costs by 1975, but since the Comité subsidy commitment does not expire until 1977, the projections provide for the subsidy until then.

Instituto Nacional de Electrificación Rural (INER)

Due to the limited operations of INER at present, a financial analysis was not performed on this company. INER, at this point merely administers and implements a $2,500,000 Spanish line of credit for the purpose of electrifying approximately 50 isolated population centers. They loan the money to small electric cooperatives who in turn repay the loans directly to the GOB Treasury. Thus INER has no financial operations per se. The 1972 balance sheets for all four companies have been included in Annex V , and cash flow projections provided from 1974, and profit and loss projections from 1977 which reflect the effects of the proposed AID loan.

7. Justification for AID Loan Terms

For purposes of determining repayment terms on the AID loan, projections were made extending into the principal amortization period of the AID loan. The projections indicate that to impose harsher repayment terms would necessitate a reduction in the expansion and development plans presently contemplated by ENDE and the Sub-Borrowers who will participate in the concessional AID loan terms.

Another factor which argues for the AID loan terms is that the Borrower is the Government of Bolivia and the executing agency ENDE is a government owned organization which proposed to subsidize the rural electrification activities of the four Sub-Borrowers by providing energy at close to cost. If harsher terms should be passed on to the Sub-Borrowers it would inhibit their efforts to obtain self sufficiency for further rural electrication capital and plant expansion programs.

Furthermore, every possible incentive should be given these sub-borrowers since they are the designated vehicles for expansion in the areas of the project.

The Capital Assistance Project Committee therefore considers that the granting of AID's most concessional terms to be a vital element in the proposed rural electrification program.

Sub-Borrowers will bear the maintenance of value responsibility for repayment of the AID Dollar loan.

8. Financial Analysis of Proposed Rate Structure

At the present time the electric companies responsible for the distribution of electrical energy in Potosi, Sucre and Tarija are either purchasing or generating electricity at US$ .02 or more and retailing for less than US$ .03. The GOB has indicated that a proposed rate structure of US$ .01 wholesale price for rural power purchases and US$ .02 for urban purchases with an average retail rate of US$ .03 to Residential, small commercial and small industrial consumers would be desirable for this project. This was the premise upon which the sales forecasts and ensuing profit and loss and cash projections were based. Each of the utility companies (SEPSA, SETAR and CESSA) were visited and the proposed rates reviewed with the respective management. Each concurred that the rates were both reasonable and desirable for the stimulation of rural development. They further felt that the rural inhabitants were capable of purchasing power at the proposed rates as a substitution for their present sources of illumination and heat at no appreciable increase in cost.

SECTION III - LOAN ADMINISTRATION

A. Target Dates

The following plan indicates the sequence of actions which must occur in order to meet initial conditions precedent and other covenants of the loan and proceed with the implementation of the project in a timely manner.

Action	Target Date
1. Loan Authorization	October 1973
2. USAID/GOB Loan Negotiations	Nov-Dec. 1973
3. Sign Loan Agreement	(A) Expected January, 1974
4. Planning and Organizational Activities Related to Meeting Initial Set of Conditions Precedent	(A) + 3 months
5. Select Contract Consultants	(A) + 3 months
6. Design Phase Preliminary approvals	(A) + 6 months
Bidding Documents	(A) + 15 months
7. Receipt of Bids, Evaluation and Award of Construction Contract(s)	(A) + 18 months
8. Construction	(A) + 18 to 36 months
9. Annual Review	(A) + 12 and 24 and 36 months
10. Socio-Economic Evaluation	(A) + 36 months + 72 months

B. Final Selection of Distribution of Line Paths

The distribution line paths shown in Annex III, page 34-A were developed by ENDE, the individual companies and the local development committees. USAID representatives participated in some of the discussions which led to the finalizing of the project distribution nets. The paths were selected on the basis of several criteria including technical considerations largely involving the potential future development and expansion of the entire power net, cost, number of potential customers to be served and the development potential of the areas of influence of the distribution line. We do not expect major changes in the distribution path alignments. Nevertheless, the Borrower, through ENDE, will have to submit a final plan of the distribution net for our approval. Implementation Letter No. 1 will advise the Borrower that the time-phased disbursement shall contain a description of the process that will be followed in making the final selection of distribution paths. This letter will also instruct the Borrower to describe the criteria used in path selection and how they were considered. We will stress the necessity to demonstrate how, within technical, cost and engineering constraints, the factor of population and support of other rural development programs in health, education, agricultural and agro-industry were taken into consideration. The Borrower will be required to indicate the alternate paths which were considered and the reasons for their rejection.

C. Disbursement Procedures

No deviation from A.I.D. established disbursement procedures is anticipated. Materials and equipment procured in the United States or other Code 941 countries and the foreign exchange costs of engineering, construction, and technical assistance contracts will be paid through A.I.D.'s standard letter of commitment/letter of credit procedure. Requests to open letters of commitment will contain appropriate certification that the items listed are required for the project and are eligible for financing under the loan. Disbursement for approved local currency costs will be made from a U.S. government owned RDO account in the Central Bank.

D. Procurement Procedures

Goods and services procured under the loan shall have both their source and origin in countries included in Code 941 of the A.I.D. Geographic Code Book and Bolivia and procurement should be made in accordance with standard A.I.D. procedures. Appropriate reports will be required from ENDE concerning compliance with procurement requirements such as source and origin, 50/50 shipping, etc.

Specifications for procurement will be prepared by the consulting engineers and ENDE and reviewed by USAID engineers. When appropriate, AID/W assistance with specifications and procurement will be requested.

E. USAID Monitoring Responsibilities

Monitoring will be exercised by the Mission through the review and approval of procurement lists and selected specifications, construction plans and specifications, contracts, reports, periodic site inspections, and annual reviews. Frequent contact will be maintained with ENDE, the consulting engineers, and technical assistance specialists to ensure full compliance with the Loan Agreement and implementation letters, and to identify and resolve any implementation or policy problems which may arise.

The USAID/Bolivia Engineering and Transportation Division will have primary monitoring responsibility within the Mission. The Office of Capital Development, the Controller's Office, and the Regional Legal Advisor will also assist with monitoring as appropriate.

Annual review meetings will be held between Mission personnel and representatives of ENDE, DINE, the sub-borrowers, and the GOB Ministries of Energy and Hydrocarbons and Finance. These meetings will review the physical progress of the project, the current status of rate structure and return on rate base, and the progress of the GOB toward fulfilling

their commitment to provide sufficient energy for the project distribution systems.

In addition to these annual reviews, a socio-economic evaluation of the project's impact on the target regions will be made utilizing, as a baseline, data collected prior to disbursements for construction (see section F. below). Given the time lag involved, it is felt that meaningful evaluation can be made at the end of the construction period and two years after the completion of the project.

F. Reports

The following reports will be required:

1. Audited annual financial statements, prepared by an independent auditor acceptable to AID, will be submitted yearly to USAID/Bolivia for ENDE and the sub-borrowers.

2. Quarterly shipping and financial reports will be required from ENDE.

3. Monthly progress reports will be required from the consulting engineering firms and from the technical assistance advisors.

4. Other reports which may be required as appropriate will be specified in implementation letters.

G. Evaluation

The IRR approval cable indicated that a condition precedent should be the collection of appropriate baseline data in participating communities to enable subsequent evaluation of changes attributable to the provision of rural electrification. In response to this requirement, USAID, through the regional Comites de Obras Públicas and ENDE, distributed 2,000 questionnaires for a sample survey in the target regions. The questionnaire was patterned after the model developed by Dr. James Ross, an NRECA consultant, for his analysis of the Phase I project regions. Collection, tabulation, and analysis of the questionnaires will be required as a condition precedent to disbursement for construction costs, and should serve as a benchmark for future socio-economic evaluations (at the end of construction and three years 1/ thereafter).

It should also be noted that early in 1972, AID initiated a long range study to develop a methodology for determining the socio-economic impact of rural electrification in developing countries. AID contracted with the University of Florida to carry out the first phase of this

1/ Loan funds will be made available for technical assistance in sample design and reviewing the questionnaires and conducting the evaluation at the end of the construction period. The evaluation cost thereafter will be borne by the Borrower.

study, and the analysis has been completed in Costa Rica and Colombia. The Florida team is under the direction of Dr. Ross. If the conclusions reached in the first phase require revision in the Bolivian data, the cost should be minimal- possibly not more than two man months of service by a U.S. consultant who would enlist and utilize local sources of expertise such as university personnel interested in such research.

H . Conditions and Covenants

In addition to the standard conditions and covenants of A.I.D. lending the Loan Agreement should include the following:

1. Conditions

a) Prior to the first disbursement or the issuance of any commitment documents under the Loan, the Borrower will submit to A.I.D. in form and substance satisfactory to A.I.D.:

i) A detailed description of the department established within ENDE for administering the Project including staff qualifications and proposed administrative and operating procedures.

ii) A time phased implementation plan for execution of the project including an identification of technical assistance requirements and a plan for the recruitment and utilization of technical assistance.

iii) Certifications from the Dirección Nacional de Electricidad (DINE) that the participating sub-borrowing entities have been granted a sufficiently long term electric service concession for their respective sub-project areas of influence.

b) Prior to any disbursement or issuance of any commitment documents under the Loan for any purpose other than to finance consulting engineering or technical assistance services, the Borrower will submit to A.I.D., in form and substance satisfactory to A.I.D.:

i) Evidence that the Borrower's plan to supply sufficient energy in the project regions to meet the demand of the proposed distribution systems is progressing satisfactorily.

ii) The terms and conditions of the sub-loan agreements between the Borrower and the participating sub-borrowing entities. A.I.D. will reserve the right to approve the individual sub-loan agreements prior to their execution.

iii) Evidence that the proposed wholesale and retail rate schedules for the various sub-project systems will be adequate to provide a return to the sub-borrowers sufficient to cover operating costs, maintenance, administration, taxes, assessments, depreciation, expansion reserves, and a positive rate of return on the rate base.

iv) Evidence that ENDE and the participating sub-borrowers will provide necessary local contributions on a timely basis.

v) The baseline data for the project regions necessary for future socio-economic evaluations.

vi) A training plan for the employees of the participating sub-borrowers and a time-phased plan for the acquisition of the additional staff necessary to enable these institutions to operate and maintain their respective sub-project facilities in an efficient manner.

vii) A detailed description of a promotion plan to attract rural consumers (including instruction in the potential benefits and use of electricity) to be implemented by the various sub-borrowers.

2. Covenants

Except as AID may otherwise agree, the Borrower shall covenant:

i) To maintain a rate structure adequate for the continued viability and growth of the system.

ii) To ensure the availability of an adequate supply of energy for the distribution systems in the sub-project regions.

iii) To review the progress of the Project annually with A.I.D., throughout the life of the project, giving particular attention to the success of efforts to ensure the availability of energy, the sufficiency of local contributions to the project, and the implementation of the training, staff acquisition, and promotion plans. The review shall also include a discussion of the rates charged or to be charged by ENDE. and the sub-borrowers to their various categories of customers.

iv) That, in selecting the final paths for the lines of distribution, Borrower shall, within such constraints as may be imposed by technical, cost and engineering considerations, take into account such factors as population coverage and support for other rural development programs.

3. The loan shall be subject to such other terms and conditions as A I.D. may deem advisable.

SECTION IV - ENVIRONMENTAL CONSIDERATIONS.

A. General.

The project, as a rural electrification project limited to the construction of distribution nets and house connections, with no thermal generation elements, has no potential for significant adverse environmental effects. The potential for these effects, however, will be addressed, examined and answered herein.

B. Assessment of Potential Impact.

1. Short Term Effects.

Short term effects are essentially those effects imposed on the environment during the construction stages of the project. Since construction activities will be limited to the installation of poles and wire in rural areas, no significant adverse impact is anticipated. Existing physical land characteristics and foliage will be little disturbed, and there will be little chance of affecting native ecological systems.

2. Long Term Effects.

To the extent that the proposed electrical service will stimulate the growth of industry, these industries will be relatively small with a limited potential for pollution; and will be so widely dispersed in sparsely populated areas such that the environment can absorb the resulting impact without notable damage.

The service is also expected to stimulate the growth of agriculture by facilitating systematic irrigation and better water control and usage. This would tend to minimize adverse effects on soil such as erosion, and to preserve existing land contours. This, in itself, is a positive environmental effect.

The electric distribution lines themselves may be viewed as unsightly and thusadisturbance to the countryside. This, however, must be considered a relatively low price to pay for the quantum of economic and social benefits to be realized from the system.

C. Commitment of Resources.

National resources irreversibly committed during the implementation of the project are limited to lands in rural areas that will serve as a right-of-way of distribution lines. The land area thus committed will consist of long, narrow strips of land that could be actually exploited for agricultural purposes between poles.

LEGAL EXHIBITS

TABLE OF CONTENTS

CERTIFICATION PURSUANT TO SECTION 611 (e) OF THE

FOREIGN ASSISTANCE ACT OF 1961, AS AMENDED

I, John R. Oleson, the principal officer of the Agency for International Development in Bolivia, having taken into account among other factors the maintenance and utilization of projects in Bolivia previously financed or assisted by the United States, do hereby certify that in my judgement Bolivia has both the financial capability and human resources capability to effectively maintain and utilize the capital assistance project: RURAL ELECTRIFICATION, Phase II.

John R. Oleson
Director USAID/Bolivia

TRANSLATION

PRESIDENCIA DE LA REPUBLICA
Bolivia

September 25, 1973

Mr. John R. Olesson
Director, USAID Mission to Bolivia
La Paz

Mr. Director:

Through this letter, it is a pleasure for us to reiterate, on behalf of the Republic of Bolivia, the request for a loan to the Ministry of Energy and Hydrocarbons, for six million four hundred thousand american dollars (US$ 6,400,000), assigned to Phase II of the Rural Electrification Program.

The borrower would be the Government of Bolivia and the sub-borrower the Instituto Nacional de Electrificación Rural (INER), the Empresa Servicios Eléctricos de Potosí (SEPSA), the Empresa Servicios Eléctricos de Tarija (SETAR), and the Cooperativa Eléctrica de Sucre (CESSA).

The above mentioned subloans will be granted by our Government under the conditions established by USAID, except for a small differential of interest, assigned exclusively to cover the administrative costs of the project. On this point, we make it clear that the administration, execution, supervision and control of the project will be handled by the Empresa Nacional de Electricidad (ENDE), an institution with broad experience in this type of operations.

We will appreciate it if you transmit this request to the AID offices in Washington.

Very truly yours,

S/Lic. Armando Pinell
Ministry of Finance
Vicepresident of the National
Council of Economy and
Planification.

S/Eng. Julio Prado Salmón
Ministry Secretary
National Council of Economy
and Planification.

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TRANSLATION

Ministry og Energy and Hydrocarbons
Bolivia

No. 715-73

La Paz, September 21, 1973

Mr. Arthur W. Mudge
Acting Director
USAID Mission to Bolivia
La Paz

Mr. Director:

I have received your kind letter dated September 5, 1973, through which you let me know that AID/Washington has recently authorized the USAID Mission to Bolivia to proceed with the intensive review of Phase II of the Rural Electrification Project in order to accomplish its financing.

In this respect, it is the judgment of this office to consider the project in its entirety, which comprises rural electrification in La Paz, Potosí, Chuquisaca and Tarija, to be financed with a loan of approximately 6 [illegible] n U.S. dollars.

In connection with this project, the Ministry of Energy and Hydrocarbons, through the Empresa Nacional de Electricidad (ENDE) and according to scheduled plans, will guarantee the availability of electric energy covering the demand in the mentioned areas. This guarantee of supply will be possible with the normal enlargement of the generating capacity as well as with the future interconnection of the electric systems, to which, this Ministry is giving priority within the plan of national electric development.

Giving thanks to that Mission for its cooperation for the attainment of this loan, I am pleased to remain,

Very truly yours,

S/Eng. Roberto Capriles
Ministry of Energy and Hydrocarbons

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TRANSLATION

EMPRESA NACIONAL DE ELECTRICIDAD
(Inc.)
4574, 14 de Enero Ave.
COCHABAMBA - BOLIVIA

Phones
5809-5209-4163-4880
P. O. Box No. 565

Cables:
"ENELECTRIC"

La Paz, September 21, 1973

GG 682/3

Mr. Arthur W. Mudge
Acting Director
USAID Mission to Bolivia
La Paz

Mr. Director:

The Ministry ofEnergy and Hydrocarbons, has advised us that, as a condition for the approval of the loan for the Program of Rural Electrification, Second Phase, USAID requires an indication from ENDE in connection with the program of additional generation in the area of Tarija.

In this respect it is a pleasure to inform you, in general terms, that the ENDE's mission is to take care of the electric energy requirements in the systems under its jurisdicion.

In the specific instance of Tarija, ENDE will be able to take care of their energy demands, which are estimated to be an additional 3.5 MW for 1976, through the transfer of generating groups presently in operation in other centers of consumption. Between 1977 and 1980, the Tarija System will have at its disposal an additional 5 MW from additional Diesel groups or from other sources if economic and technical viewpoints indicate better solutions.

Very truly yours,

S/Eng. Oscar Morales
General Manager

TRANSLATION

Ministry of Energy & Hydrocarbons
BOLIVIA

No. 740-73

La Paz, September 25, 1973

Mr. Arthur W. Mudge
Acting Director
USAID Mission to Bolivia
La Paz

Mr. Director:

I have the pleasure to refer to the conversation held with officials of that Mission about the loan for Phase II of the Plan for Rural Electrification and the financial difficulties apparently faced by the Cooperativa Electrica Sucre S. A. (CESSA).

According to the analysis carried out by the Dirección Nacional de Electricidad (DINE), a branch office of this Ministry, it follows that the above-mentioned Cooperative is not operating the Ruffo Hydroelectric Plant at its projected capacity due to the fact that the water supply on the part of ELAPAS, is inadequate.

With the purpose of solving this problem, ELAPAS has obtained a loan from PADES which is being used to improve the whole system of water supply. When accomplished in the near future, this will guarantee the availability of sufficient water to permit CESSA, to operate the Ruffo Central hydroelectric plant at full capacity. At that time, its financial situation will be substantially improved permitting it to cover the Ruffo loan obligations as well as those emerging from the normal development of its electric system obligations among which would be the loan for rural electrifications.

Very truly yours,

S/Eng. Jorge Zamora Mujía
Under Secretary of Energy and
Hydrocarbons

FREE
TRANSLATION

Ministry of Energy and Hydrocarbons
BOLIVIA

TELEX

La Paz, July 27, 1973

WATERS AND ENERGY
FOR ENGINEER ALVAREZ
CONTROL MANAGER
TELEX 012/1889 BAIRES

43-73 GOOD MORNING AND IT IS A GREAT PLEASURE TO GREET YOU, ENGINEER ALVAREZ. WE ARE INTERESTED IN PROVIDING ELECTRICITY TO A CENTER OF DEVELOPMENT IN THE VILLAMONTES AREAS AND WISH YOUR ADVICE RELATIVE TO THIS MATTER. WE WOULD LIKE TO KNOW AS SOON AS POSSIBLE WHETHER OR NOT AGUAS Y ENERGIA (WATER AND ENERGY) WOULD BE ABLE TO PROVIDE ENERGY FROM POCITOS TO VILLAMONTES TO SUPPLY A DEMAND OF APPROXIMATELY 3000 TO 5000 KW STARTING IN 1975. TRANSMISSION LINES AND OTHER FACILITIES WILL BE BUILT BY US. WE CAN DISCUSS PRICES AND CONTRACT TERM IN A TIMELY MANNER AS WAS OUR PLEASURE IN A SMALLER SCALE FOR VILLAZON LA QUIACA. OUR TELEX IS BX 5366. I AVAIL MYSELF OF THIS OPPORTUNITY TO SEND SINCERE GREETINGS TO THE COLLEAGUES OF "AGUA Y ENERGIA" AND PARTICULARLY TO YOU. SINCERELY.

S/ENG. ZAMORA
UNDER-SECRETARY
FOR ENERGY & HYDROCARBONS

BX LA PAZ BOLIVIA
Mr. SECRETARY FOR ENERGY ENG. ZAMORA MUJIA IN PRINCIPLE READY TO COOPERATE SUPPLY ENERGY VILLA MONTES SUBJECT TO CONDITIONS TO BE SPECIFIED. WAITING YOUR LETTER OF SPECIFICS. CARLOS VICTOR PORTARRIEU ACTING CONTROL MANAGER WATER AND ELECTRIC ENERGY.

CHECKLIST OF STATUTORY CRITERIA

(Alliance for Progress)

The following abbreviations are used:

FAA - Foreign Assistance Act of 1961, as amended.

App. - Foreign Assistance and Related Agencies Appropriations Act. 1972

MMA - Merchant Marine Act of 1936 as amended.

COUNTRY PERFORMANCE

Progress Towards Country Goals

1. FAA 208; 251 (b)

A. Describe extent to which country is:

(1) Making appropriate efforts to increase food production and improve means for food storage and distribution.	Bolivia is making appropriate efforts with respect to food production, storage, and distribution. AID Loan 511-L-042 will contribute to these efforts.
(2) Creating a favorable climate for foreign and domestic private enterprise and investment.	The GOB program emphasized creation of a favorable climate for selected foreign and domestic private enterprise and investment. They are seeking special exemptions within the Andean Common Market for certain investments.
(3) Increasing the public's role in the developmental process.	The Government continues to take an active role in the developmental process, and in so doing to increase popular participation.
(4)(a) Allocating available budgetary resources to development.	The Government appears to be allocating as much as it is able to development.
(b) Diverting such resources for unnecessary military expenditure (See also Item No. 17) and intervention in affairs of other free and independent nations. (See also Item No. 14)	The government does not make unnecessary military expenditures and does not intervene in the affairs of other nations.

(5) Willing to contribute funds to the project or program.	GOB contribution consists of support for ENDE and other participating agencies. See Section II. E for a description of the Bolivian contribution.
(6) Making economic, social and political reforms such as tax collection improvements and changes in land tenure arrangements and making progress toward respect for the rule of law, freedom of expression and of the press and recognizing the importance of individual freedom, initiative, and private enterprise.	The government is making these efforts.
(7) Adhering to the principles of the Act of Bogotá and Charter of Punta del Este.	The government adheres to these principles.
(8) Attempting to repatriate capital invested in other countries by its own citizens.	Bolivia has urged repatriation of capital invested in other countries by its own citizens, and is considering active measures to accomplish such repatriation.
(9) Otherwise responding to the vital economic, political, and social concerns of its people and demostrating a clear determination to take effective self-help measures.	The government appears to be doing this in an increasingly effective manner.
B. Are above factors taken into account in the furnishing of the subject assistance?	Yes.

Treatment of U.S. Citizens

2. FAA. 620(c). If assistance is to government, is the government liable as debtor or unconditional guaranter on any debt to a U. S. citizen for goods or services furnished or ordered where (a) such citizen has exhausted available legal remedies and (b) debt is not denied or contested by such government?	The government is not known to be indebted under these circumstances to any U.S. citizen for goods or services furnished or ordered.

3. FAA. 620(e)(1). If assistance is to a government, has it (including government agencies or subdivisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities?	The previous government of Bolivia nationalized two United States mining firms. However, steps have been or are being taken to realize prompt, adequate and effective compensation to the former owners.
4. FAA. 620(o); Fishermen's Protective Act. 5. If country has seized, or imposed any penalty or sanction against, any U. S. fishing vessel on account of its fishing activities in international waters.	Not applicable.
a. has any deduction required by Fishermen's Protective Act been made?	
b. has complete denial of assistance been considered by AID administrator?	
Relations with U. S. Government and Other Nations.	
5. FAA. 620(d). If assistance is for any productive enterprise which will compete in the U.S. with U.S. enterprise, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?	Not applicable.
6. FAA. 620(j). Has the country permitted, or failed to take adequate measures to prevent, the damage or destruction by mob action of U. S. property?	The government of Bolivia has taken adequate measures to prevent the damage or destruction by mob action of U. S. property whenever possible.
7. FAA. 620(l). If the country has failed to institute the investment guaranty program for the specific risks of expropriation, in convertibility or confiscation, has the AID administration within the past year considered denying assistance to such government for this reason?	The government has instituted the investment guarantee program.

8.	FAA. 620(q). Is the government of the recipient country in default on interest or principal of any AID loan to the country?	Bolivia is not in default in payment of principal and interest on any AID loan within the meaning of FAA 620(q).
9.	FAA. 620(t). Has the country severed diplomatic relations with U. S.? If so, have they been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption?	Bolivia has not severed diplomatic relations with U. S.
10.	FAA. 620(u). What is the payment status of the country's U. N. obligations?	Bolivia paid $53,405 to the U.N. in September, 1973. According to the contributions officer of the U.N. Offic of Financial Services, it is not presen delinquent within the meaning of Articl 19 of the U.N. Charter and FAA 620 (u).
	If the country is in arrears, were such arrearages taken into account by the AID Administrator in determining the current AID Operating Year Budget?	Yes.
11.	FAA. 620(a). Does recipient country furnish assistance to Cuba. or fail to take appropriate steps to prevent ships or aircraft under its flag from carrying cargoes to or from Cuba?	No, the recipient country does not furnish assistance, nor fail to take appropriate steps to prevent ships or aircraft under its flag from carrying cargoes to or from Cuba.
12.	FAA. 620(b). If assistance is to a government, has Secretary of State determined that it is not controlled by the international Communist movement.	Bolivia is not controlled by the international Communist movement according to the Secretary of State.
13.	FAA. 620(f). Is recipient country a communist country?	No. Bolivia does not have a Communist government
14.	FAA. 620(i). Is recipient country in any way involved in (a) subversion of, or military aggression against, the U.S. or any country receiving U.S. assistance, or (b) the planning of such subversion or aggression?	No. Bolivia is not engaged in these activities.

15. FAA. 620(n). Does recipient country furnish goods to North Viet-Nam or permit ships or aircraft under its flag to carry cargoes to or from North Viet-Nam?

No, the recipient country does not furnish goods to North Viet-Nam nor permit ships or aircraft under its glag to carry cargoes to or from North Viet-Nam.

16. FAA. 481. Has the government of recipient country failed to take adequate steps to prevent narcotic drugs and other controlled substances (as defined by the Comprehensive Drug Abuse Prevention and Control Act of 1970) produced or processed, in whole or in part, in such country, or transported through such country, from being sold illegally within the jurisdiction of such country to U.S. Government personnel or their dependents, or from entering the U. S. unlawfully?

The government is actively cooperating with USAID public safety advisors, BNDD representatives and other international agencies to take such steps as may be necessary to control drug trafic in Bolivia.

Military Expenditures

17. FAA. 620(s). What percentage of country budget is for military expenditures? How much of foreign exchange resources is spent on military equipment? How much is spent for the purchase of sophisticated weapons system?

15.8% of FY 73 (Calendar year 1973) GOB budget is designated for military expenditure. An estimated $900,000 was targeted for equipment expenditure, but we have no figures on how much of that represented foreign exchange expenditure. There were no purchases of sophisticated weapons systems.

(Consideration of these points is to be coordinated with the Bureau for Regional Coordinators and Military Assistance Staff (PPC/RC)).

CONDITIONS OF THE LOAN

General Soundness

18. FAA. 201(d). Information and conclusion on reasonableness and legality (under laws of country and U. S.) of lending and relending terms of the loan.

The loan terms are reasonable and consistent with United States and Bolivian laws.

19.	FAA. 251(b)(2), 251(e). Information and conclusion on activity's economic and technical soundness. If loan is not made pursuant to a multilateral plan, and the amount of the loan exceeds $100,000, has country submitted to AID an application for such funds together with assurance to indicate that funds will be used in an economically and technically sound manner?	The borrower has made an application for loan funded assistance in this activity and there have been assurances that the funds will be used in an economically and technically sound manner.
20.	FAA. 251(b). Information and conclusion on capacity of the country to repay the loan including reasonableness of repayment prospects.	There are reasonable prospects of repayments.
21.	FAA 611(a)(1). Prior to signing of loan will there be (a) engineering, financial, and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?	The basic engineering, financial and other plans necessary to carry out the assistance have been prepared. Some detailed engineering, to be financed by the loan, remains to be done. Reasonably firm cost estimates have been established.
22.	FAA 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purposes of loan?	No further legislative action in Bolivia is required for implementation of this project.
23.	FAA. 611(e). If loan is for capital assistance and all U.S. assistance to project now exceeds $ 1 million has Mission Director certified the country's capability effectively to maintain and utilize the project?	Yes
24.	FAA. 251(b). Information and conclusion on availability of financing from other free-world sources, including private sources within the United States.	Financing for this activity is not available from other free-world sources, including private sources within the Unites States, on reasonable terms.
	Loan's Relationship to Achievement of Country and Regional Goals	
25.	FAA. 207; 251(a). Extent to which assistance reflects appropriate emphasis on: (a) encouraging develop-	This loan will contribute directly to the objectives reflected in items (a), (b), (c) and (d).

ment of democratic, economic, political and social institutions; (b) self-help in meeting the country's food needs; (c) improving availability of trained manpower in the country; (d) programs designed to meet the other important areas of economic, political, and social development, including industry; free labor unions, cooperatives, and voluntary agencies; transportation and communication; planning and public administration; urban development; and modernization of existing laws.	
26. FAA. 209. Is project susceptible of execution as part of regional project? If so why is project not so executed?	This project could not be carried out as part of a regional project since it is designed specifically to promote Bolivian local electrical distribution systems.
27. FAA. 251(b)(3). Information and conclusion on activity's relationship to, and consistency with, other development activities, and its contribution to realizable long-range objectives.	This activity has broad significance with regard to the long-range objectives of integrating the rural areas into national economic, social and political life, and of strengthening the economy.
28. FAA. 251(b)(7). Information and conclusion on whether or not the activity to be financed will contribute to the achievement of self-sustaining growth.	This project will contribute to the achievement of self-sustaining growth.
29. FAA. 281(a). Describe extent to which the loan will contribute to the objective of assuring maximum participation in the task of economic development on the part of the people of the country, through the encouragement of democractic private, and local governmental institution.	Not directly applicable.

30	FAA. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civic education and training in skills required for effective participation in governmental and political processes essential to self-government.	The program directly recognizes and utilizes the needs, desires and capacities of the rural population.
31.	FAA. 601(a). Information and conclusion whether loan will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c) encourage development and use of cooperatives, credit unions, and savings and loan associations; (d) discourage monopolistic practices (e) improve technical efficiency of industry, agriculture, and commerce; and (f) strengthen free labor unions.	This loan should do all of these things with the exception of items: (a), (c), and (f).
32.	FAA. 619. If assistance is for newly independent country, is it furnished through multilateral organizations or plans to the maximum extent appropriate.	Not applicable.
33.	FAA. 251(h). Information and conclusion on whether the activity is consistent with the findings and recommendations of the Inter-American Committee for the Alliance for Progress in its annual review of national development activities.	Activity is consistent with such findings and recommendations.
34.	FAA. 251(g). Information and conclusion on use of loan to assist in promoting the cooperative movement in Latin America.	Not applicable.
35.	FAA. 209; 251(b)(8). Information and conclusion whether assistance will encourage regional development programs, and contribute to the economic and political integration of Latin America.	By strengthening the economic base of the rural population in the areas to be served the capacity of Bolivia to participate in regional activities should be enhanced.

Loan's Effect on U. S. and AID Program

36.	FAA. 251(b)(4); 102. Information and conclusion on possible effects of loan on U.S. economy, with special reference to areas of substantial labor surplus, and extent to which U.S. commodities and assistance are furnished in a manner consistent with improving the U. S. balance of payments position.	The loan will have no foreseeable unfavorable effect on the United States economy. Some U.S. products will be imported.
37.	FAA. 601(b). Information and conclusion on how the loan will encourage U.S. private trade and investment abroad and how it will encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).	There will be U.S. private sector participation in this project to the extent that some of the loan proceeds will be used to buy materials from U.S. sources or U.S. professional advisory services.
38.	FAA. 601(d). If a capital project, are engineering and professional services of U.S. firms and their affiliates used to the maximum extent consistent with the national interest?	Professional advisory services of U.S. firms will be utilized to the maximum extent consistent with the needs of the project.
39.	FAA. 602. Information and conclusion whether U.S. small business will participate equitably in the furnishing of goods and services financed by the loan.	U.S. small business will be invited to participate when appropriate.
40.	FAA. 620(h). Will the loan promote or assist the foreign aid projects or activities of the Communist-Bloc countries?	No, the loan will not promote or assist the foreign aid projects or activities of the Communist-Bloc countries.
41.	FAA. 621. If technical assistance is financed by the loan, information and conclusion whether such assistance will be furnished to the fullest extent practicable using goods and professional and other services from private enterprise	Technical assistance and consulting services will most likely be provided by private sector groups.

on a contract basis. If the facilities of other Federal agencies will be utilized, information and conclusion on whether they are particularly equitable, are not competitive with private enterprise, and can be made available without undue interference with domestic programs.

42. FAA. 252(a). Total amount of money under loan which is going directly to private enterprise, is going to intermediate credit institutions or other borrowers for use by private enterprise, is being used to finance imports from private sources, or is otherwise being used to finance procurement from private sources.

It is likely that most of the procurement will be from private sources.

Loan's Compliance with Specific Requirements

43. FAA. 201(d). Is interest rate of loan at least 2% per annum during grace period and at least 3% per annum thereafter?

Yes

44. FAA. 608(c). Information on measures to be taken to utilize U.S. government excess personal property in lieu of the procurement of new items.

The Mission will ensure that the Borrower is apprised of the availability of excess U.S. Government property and that the Borrower purchases that property which fits its needs.

45. FAA. 604(a). Will all commodity procurement financed under the loan be from U.S. except as otherwise determined by the President?

Yes. Code 941 and Bolivian sources will be used for procurement.

46. FAA. 604(b). What provision is made to prevent financing commodity procurement in bulk at prices higher than adjusted U.S. market price?

Any bulk commodites which may be procured will be subject to the bid procedure.

47. FAA. 604(d). If the host country discriminates against U.S. marine insurance companies, will loan agreement require that marine insurance be placed in the U.S. on commodities financed by the loan?

In the unlikely event that Bolivia discriminates against any U.S. marine insurance company, commodities purchased with loan funds will be insured against risks with a U.S. company as defined by this section.

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48.	FAA. 604(e). If off-shore procurement of agricultural commodity or product is to be financed is there provision against such procurement when the domestic price of such commodity is less than parity?	Not applicable.
49.	FAA. 611(b); App. 101. If loan finances water or water-related land resource construction project or program, is there a benefit-cost computation made, insofar as practicable, in accordance with the procedures set forth in the Memorandum of the President dated May 15, 1962.	Not applicable.
50.	FAA. 611(c). If contracts for construction are to be financed, what provision will be made that they be let on a competitive basis to maximum extent practicable?	This requirement will be met by adherence to AID and Bolivian regulations concening procurement of contractor services.
51.	FAA. 620(g). What provision is there against use of subject assistance to compensate owners for expropriated or nationalizad property.	Assistance will not be used to compensate owners for expropriated or nationalized property.
52.	FAA. 612(b); s 636(h). Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services and foreign currencies owned by the U.S. are utilized to meet the cost of contractual and other services.	No Bolivian pesos owned by the U.S. are available for financing this project. An effort was made during intensive review to ensure that Bolivian sources contributed local currency to the maximum extent possible. (See Section II. E.)
53.	App. 104. Will any loan funds be used to pay pensions, etc., for military personnel.	No loan funds will be used to pay pensions for military personnel.
54.	App. 106. If loan is for capital project, is there provision for AID approval of all contractors and contract terms?	Yes.
55.	App. 108. Will any loan funds be used to pay U.N. assessments?	No.

56. App. 109. Compliance with regulations on employment of U. S. and local personnel for funds obligated after April 30, 1964 (Regulation 7).	Will comply.
57. FAA. 636(i). Will any loan funds be used to finance purchase, long-term lease, or exchange of motor vehicle manufactured outside the United States, or any guaranty of such a transaction?	No. Any motor vehicles needed, if any, will be imported from the United States, unless other procurement is authorized.
58. App. 401. Will any loan funds be used for publicity or propaganda purposes within U.S. not authorized by the Congress?	No funds will be used for publicity purposes within the U. S.
59. FAA. 620(k). If construction of productive enterprise, will aggregate value of assistance to be furnished by U.S. exceed $100 million?	No.
60. FAA. 612(d). Does the U. S. own excess foreigh currency and, if so, what arrangements have been made for its release?	U. S. does not own excess foreign currency in Bolivia
61. MMA. 901.b. Compliance with requirement that at least 50 per centum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed with funds made available under this loan shall be transported on privately owned U.S. flag commercial vessels to the extent that such vessels are available at fair and reasonable rates.	Regulation will be complied with.

D R A F T

LOAN AUTHORIZATION

Provided from: Alliance for Progress Funds
BOLIVIA: Rural Electrification II

Pursuant to the authority vested in the Deputy U. S. Coordinator, Alliance for Progress, by the Foreign Assistance Act of 1961, as amended, and the delegation of authority issued thereunder, I hereby authorize the establishment of a loan ("Loan"), pursuant to Part I, Chapter 2, Title VI, Alliance for Progress, to the Government of Bolivia ("Borrower") of not to exceed six million, four hundred thousand United States Dollars ($6,400,000) to assist in financing the United States dollar and local currency costs of the rural electrification program administered by the Empresa Nacional de Electricidad, S. A. ("ENDE"). The Loan shall be subject to the following terms and conditions:

1. Interest and Terms of Repayment

Borrower shall repay the Loan to A.I.D. in United States dollars within forty (40) years from the date of the first disbursement under the Loan, including a grace period of not to exceed ten (10) years. Borrower shall pay to A.I.D. in United States dollars on the outstanding balance of the Loan interest at the rate of two percent (2%) per annum during the grace period and three percent (3%) per annum thereafter.

2. Other Terms and Conditions

(a) Goods, services (except for ocean shipping) and marine insurance financed under the Loan shall have their source and origin in Bolivia and countries included in Code 941 of the A.I.D. Geographic Code Book. Marine insurance may be financed under the Loan only if it is obtained on a competitive basis and any claims thereunder are payable in freely convertible currencies. Ocean shipping financed under the loan shall be procured in any country included in A.I.D. Geographic Code 941.

(b) United States dollars utilized under the Loan to finance local currency costs shall be made available pursuant to procedures satisfactory to A.I.D.

(c) Prior to the first disbursement or the issuance of any commitment documents under the Loan, Borrower shall submit to A.I.D., in form and substance satisfactory to A.I.D.:

(i) A detailed description of the department established within ENDE for administering the Project, including staff qualifications and proposed administrative and operating procedures;

(ii) A time-phased implementation plan for execution of the Project, including identification of technical assistance requirements;

(iii) Certifications from the Dirección Nacional de Electricidad ("DINE") that the sub-borrowing entities have been granted sufficiently long electric service concessions for their respective sub-project areas.

(d) Prior to any disbursement or issuance of any commitment documents under the Loan for any purpose other than to finance consulting engineering or technical assistance services, Borrower will submit to A.I.D., in form and substance satisfactory to A.I.D.:

(i) Evidence that Borrower's plan to supply sufficient energy in the Project regions to meet the demands of the proposed distribution systems is being implemented satisfactorily;

(ii) The terms and conditions of the sub-loan agreements for the sub-borrowing entities. A.I.D. will reserve the right to approve the individual sub-loan agreements prior to their execution;

(iii) Evidence that the proposed wholesale and retail rate schedules for the various sub-project systems will be adequate to provide a return to the sub-borrowers sufficient to cover operating costs, maintenance, administration, taxes, assessments, depreciation, and a positive rate of return on the rate base;

(iv) Evidence that ENDE and the participating sub-borrowers will provide necessary local contributions on a timely basis;

(v) Baseline data for the Project regions for use in future socio-economic evaluations; and

(vi) A plan for training the employees of the sub-borrowers and a time-phased plan for the acquisition of the additional staff necessary to enable these entities to operate and maintain their respective sub-projects efficiently.

(e) Borrower shall covenant to ensure the availability of an adequate supply of energy for the distribution systems in the sub-project regions.

(f) The Loan shall be subject to such other terms and conditions as AID may deem advisable.

_____
Deputy U.S. Coordinator

_____
Date

ORGANIZATION OF PARTICIPATING ENTITIES

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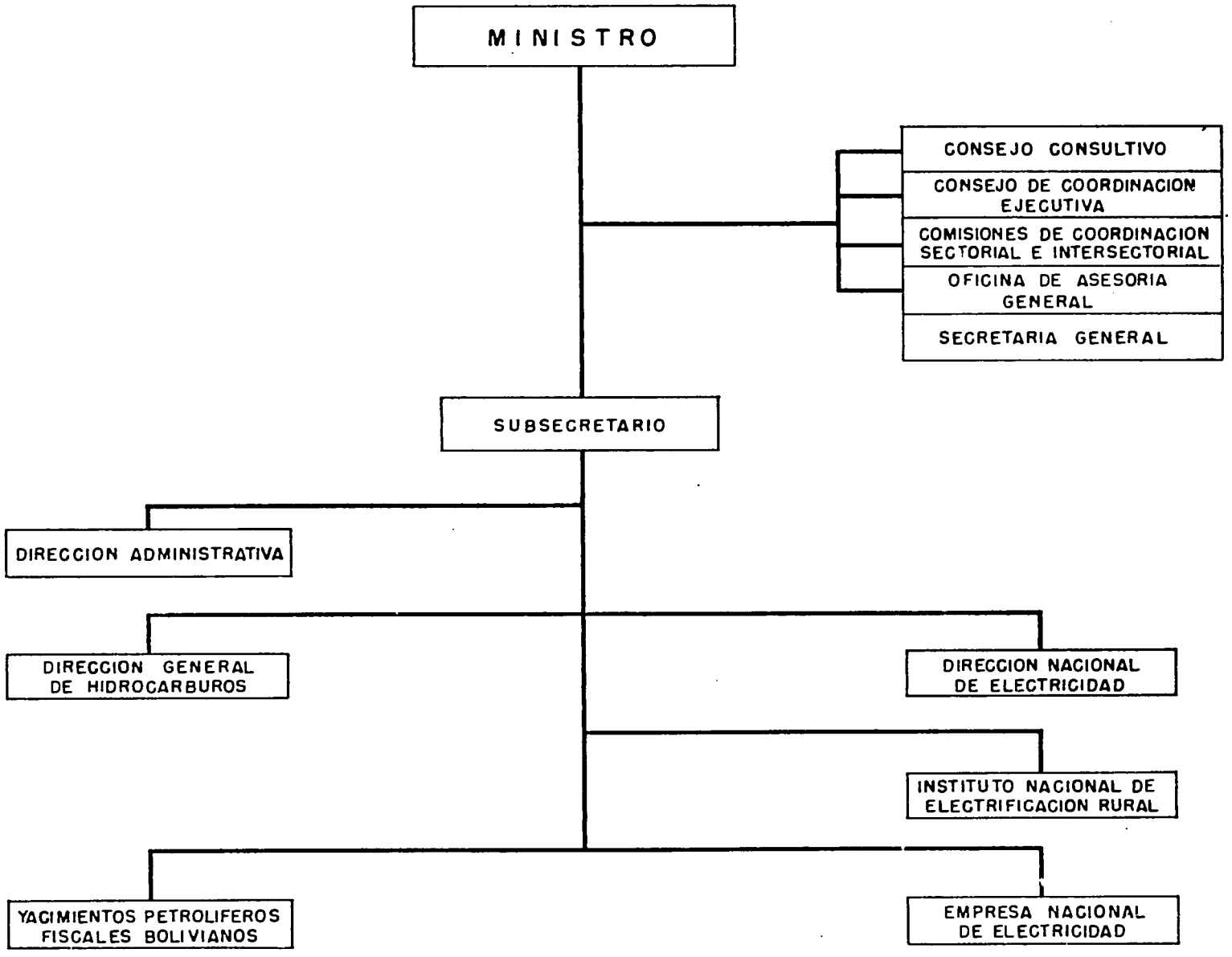
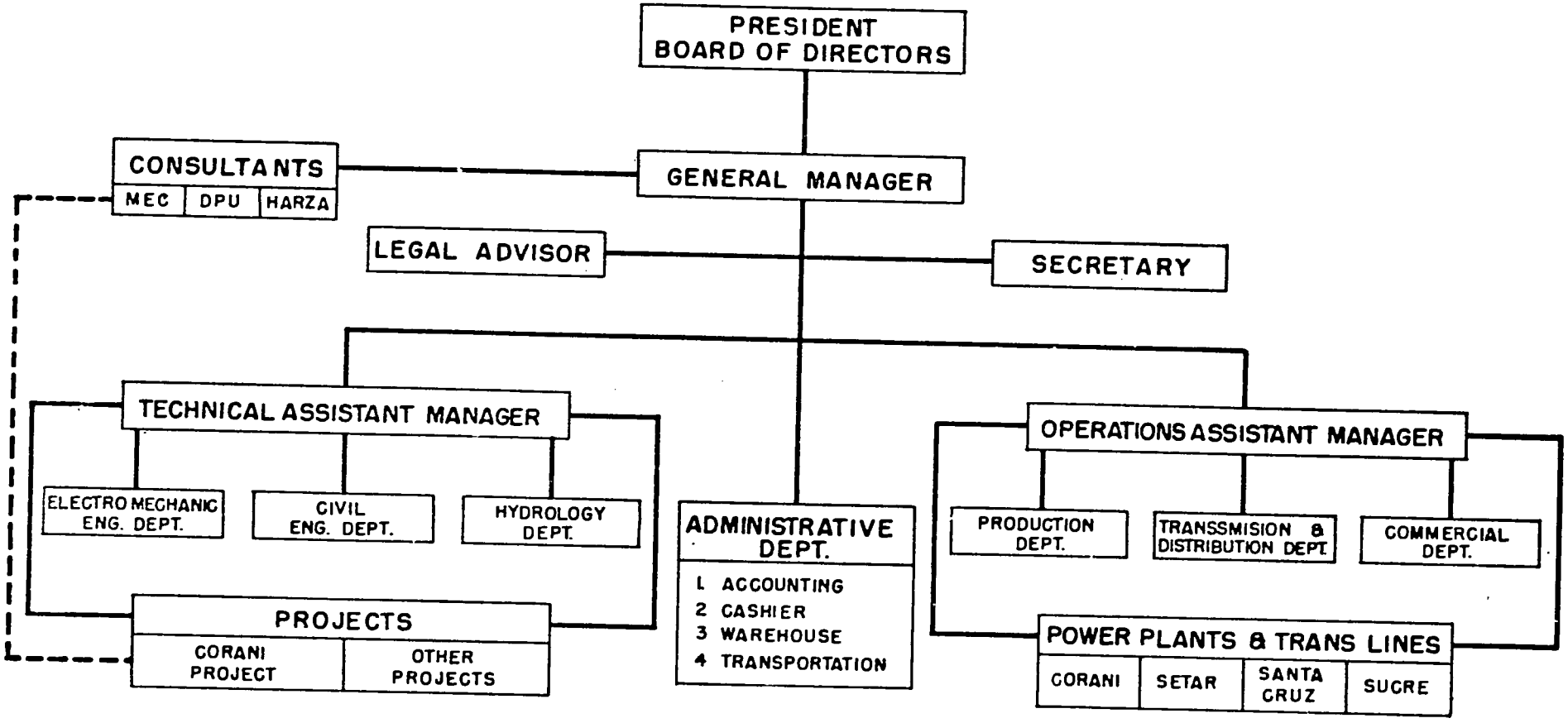
MINISTERIO DE ENERGIA E HIDROCARBUROS



EMPRESA NACIONAL DE ELECTRICIDAD

ORGANIZATION CHART



3. ENDE - PERSONNEL CURRICULUM VITAE

a. Oscar A. Morales M.

Education: Mechanic Engineer and Electrician

Professional Experience:
-ENDE General Manager, July 1971 up-to-date
-ENDE Operations Under-Manager, 1969/1971
-ENDE Coordinator and Directorate Secretary, 1965/1968
-Corporación Boliviana de Fomento, La Paz, Bolivia. Engineer from Engineering Division, 1960/1964.
-Sociedad Boliviana de Cemento, La Paz, Bolivia. Chief Electrical Shop in Viacha, Jan/July 1960.
-Compañía Introductora de Buenos Aires. Jefe Técnico de la Fábrica Beneficiadora de Sal, San Luis, Argentina, 1956/1959.

b. Bernardo Abela Ruiz

Education: Electro-Mechanic Engineer, Universidad Nacional de La Plata, Argentina.

Professional Experience:

-Simultaneously General Manager from ELFEC S.A. and Chief, Studies and Projects Division from ENDE, 1962 up-to-date.
-Corporación Boliviana de Fomento, Chief, Energy Division, 1960/1962.
-Metropolitan Vickers Co. Ltd. (Now Associated Electrical Industries). 1958/1960.
-Scolarchip awarded by Instituto Cultura Hispánica for working in "Unión Eléctrica Madrileña", Madrid, 1957/1958.
-Corporación Comercial Boliviana S.A. (COBANA), (Electrical Division), 1956/1957.
-Corporación Minera de Bolivia (COMIBOL), 1953/1956
Private electrical works, 1951/1953.

c. Claude Bessé Arze

Education: Electro-Mechanic Engineer. Universidad Nacional de Córdoba, Argentina.

Professional Experience:
-ENDE from 1963 up-to-date
-DINE, as Engineer for the Studies and Projects Department

d. Eduardo Rodriguez Arauco

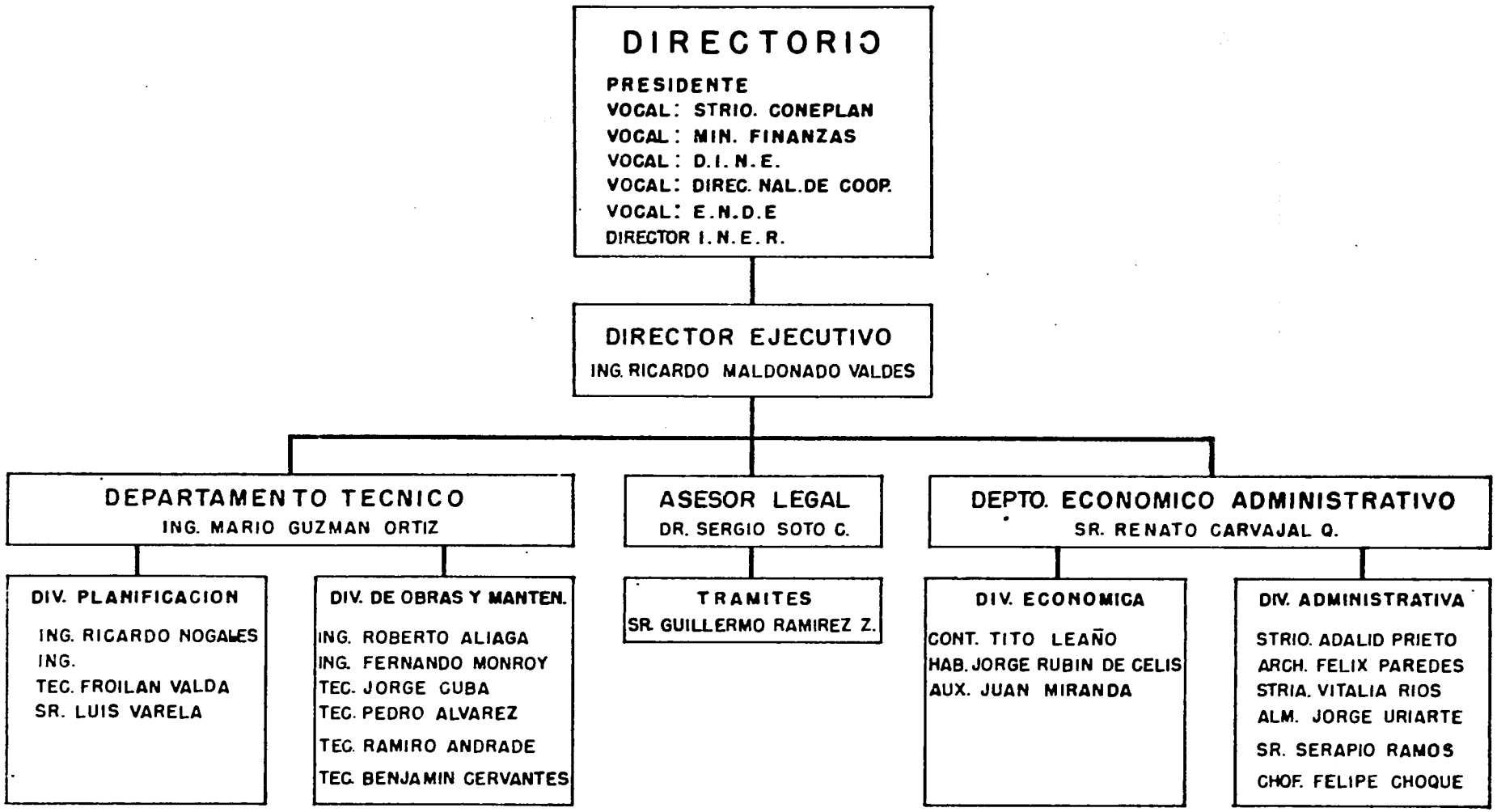
Education: Electro-Mechanic Engineer. Facultad de Ingeniería de La Plata, Argentina

Professional Experience:
-ENDE, 1963 up-to-date
-YPFB, Instruments Engineer, 1962/1963

MINISTERIO DE ENERGIA E HIDROCARBUROS

INSTITUTO NACIONAL DE ELECTRIFICACION RURAL

O R G A N I G R A M A



5. INER - PERSONNEL CURRICULUM VITAE

a. Ricardo Maldonado Valdés

Education:
-University Mayor de San Simón, Cochabamba
-College of San Mateo, California
-California State Polytechnic
-Heald Engineering College - San Francisco, California,
B.S. in electrical engineering.
-University Mayor de San Andrés, La Paz
-Electric Power Development, Tokio, Japan
-Economic and Technical Aspects of Energy Planning, Germany.

Professional Experience:
-Director INER - 1970 to present.
-Ministry of Public Works and Transportation; Director of the Department of Electricity and Water Resources - 1967/1970.
-Corporación Boliviana de Fomento - Manager of SETAR and Advisor to the Central Energy Office - 1962-1967
-Pan Geo Atlas Corporation; Operating Engineer - 1959/1961
-YPFB (Camiri) Santa Cruz Electrical Engineer, 1957/1959
-Municipality of La Paz, 1957
-Bolivian Power Co., 1956/1957
-Southern Pacific Railway - Engineering Division; 1955/1956

b. Mario Guzmán Ortiz

Education:
-University Mayor de San Andrés, La Paz
-Maintenance and Electronics at the University of San Andrés
-Project Evaluation - UNESCO
-Electrical Engineering and Business Administration, Sweden

Professional Experience:
-Chief of the INER Technical Division (Previously Department of Electricity and Water Resources) 1966 to present.
-University of San Andrés, 1960/1966.

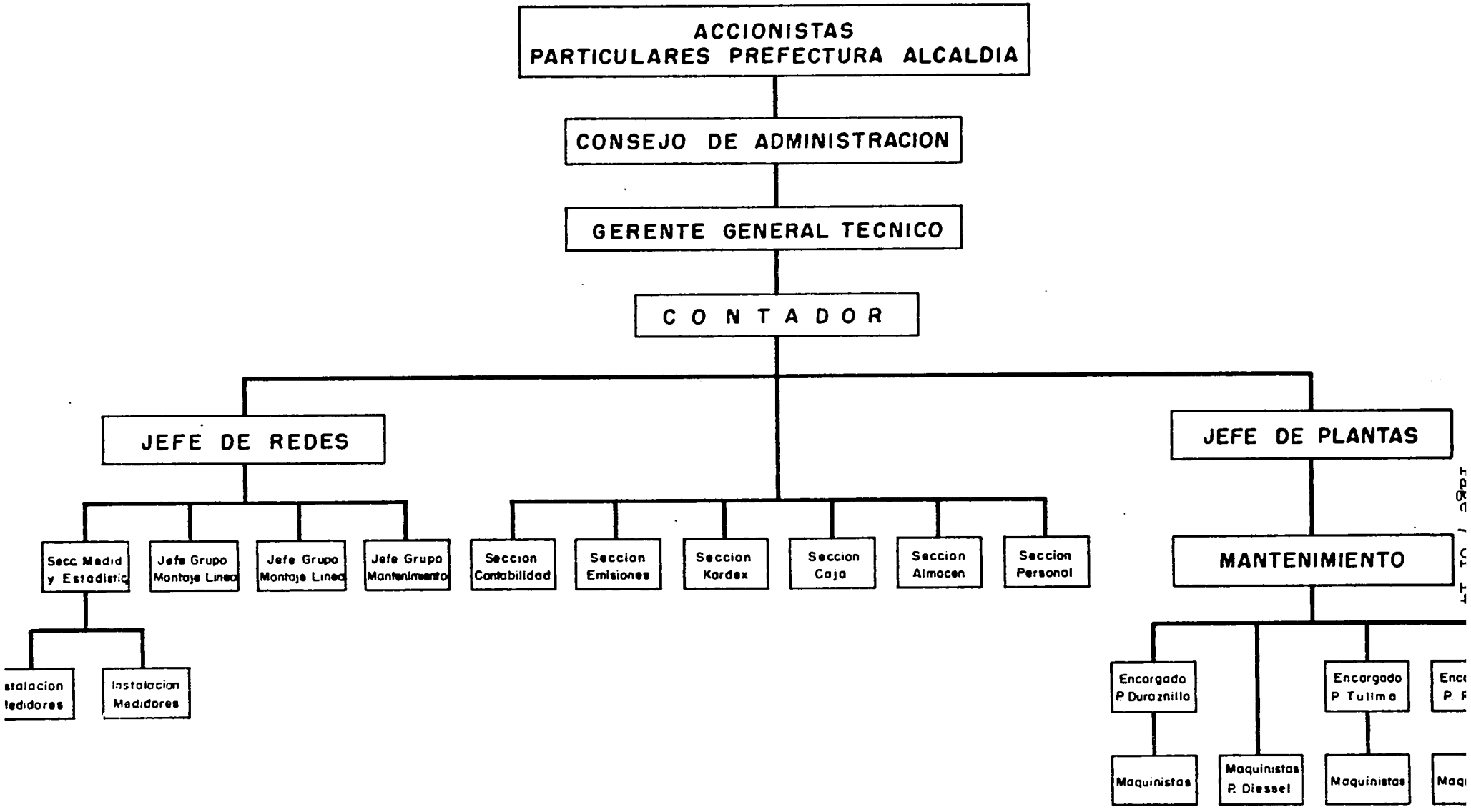
c. Renato Carvajal Quiroga

Education:
-University Mayor de San Simon, Cochabamba
-Busines Organization - Buenos Aires, Argentina

Professional Experience:
-Chief of the INER administrative department (Previously Dept. of Electricity and Water Resources), 1970 to present.
-University of San Simon. Administrator of Administrative Sec. 1964/69
-Fabrica de Aceites "Cristal", Administrator - 1961/1963
-Fabrica de Jabones "Cristal", Administrator - 1959/1960
-National Arms School; Secretary of Studies and Services - 1959.

COOPERATIVA ELECTRICA SUCRE S. A.

ORGANIGRAMA



7. CESSA - PERSONNEL CURRICULUM VITAE

a. Roberto Ampuero Rivera

Education: B. S. in Electrical Engineering - University of Texas, Arlington, Texas

Professional Experience:

-General Manager CESSA; 1972 to present.
-Costal Plains Inc., Dallas, Texas. Electro-Mechanical designer; 1970/1971
-Fischbach and Moore International, Dallas, Texas Project Engineer - Santa Cruz, 1969/1970
-Blum Herman, Dallas, Texas; Electrical Designer; 1969
-Condry, Buford & Assoc., Dallas, Texas Electrical Designer, 1968/1969

b. Delfin Sotar Quiroga

Education:

-South American International Correspondence School, Buenos Aires, Argentina.
-National Correspondence School, Los Angeles, California

Professional Experience:

-CESSA - Chief of Generation Department, 1955 to present.
-Empresa Minera Aramayo Mines and COMIBOL; Chief of Generation Plant - 1943/1955
-Sociedad Anónima Boliviano-Argentina; Machine Assembler, 1941/1943
-Cia. Huanchaca de Pulacayo; First Class Mechanic, 1940
-Bolivian Armed Services, 1938-1939
-Sociedad Minera Pirquitas, Pichetti y Cia.; Maintenance Mechanic 1936-1937

c. Juan Wayar Rivera

Education:

-American Institute of Electricity, Buenos Aires Argentina Diploma in electricity by correspondence.
-National Correspondence School, Los Angeles, California Diploma in electricity

Professional Experience:

-CESSA, Chief of Distribution Department; 1953 to present
-Cia. Minera y Agrícola Oploca de Bolivia; Electrician - 1947/1953
-Sociedad Boliviano-Argentina; Mechanics helper - 1942/1947
-Cia. Minera y Agrícola Oploca de Bolivia; Contractor - 1940/1942.

d. Gastón Querejazu Calvo

Education: Registered Accountant # 252

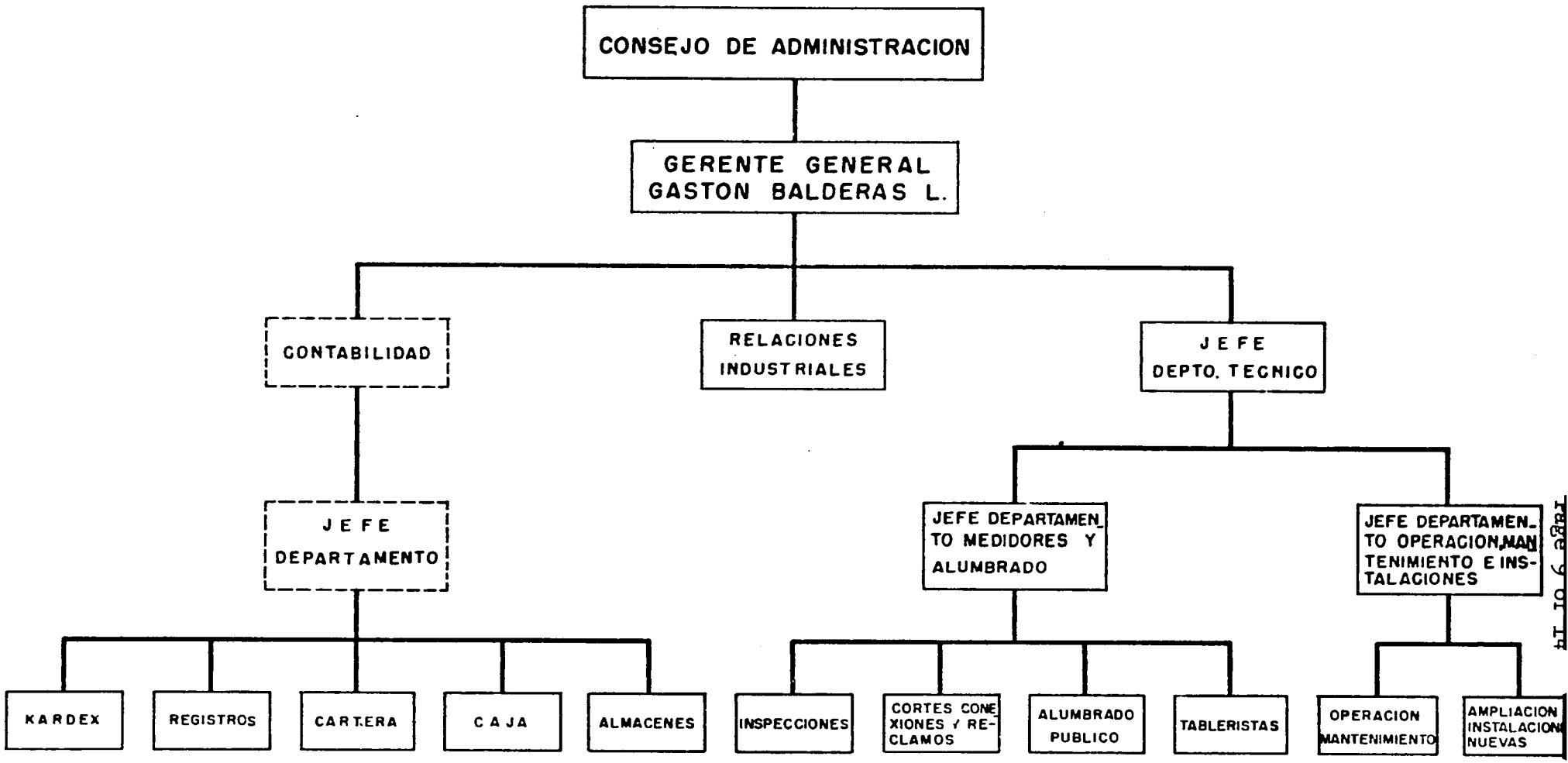
Professional Experience:

-CESSA - Accountant; 1959 to present.
-Comercial Costa & Cia. Ltda., Manager - 1956/1959
-Santa María Ltda., Sucre; Accountant - 1949/1956
-Macdonald & Cia., Potosí; Agent - 1942/1949
-C. F. Gundlach, Agency Sucre, Accountant, 1935/1949

SERVICIOS ELECTRICOS POTOSI S. A.

S. E. P. S. A.

ORGANIGRAMA



9. SEPSA - PERSONNEL CURRICULUM VITAE

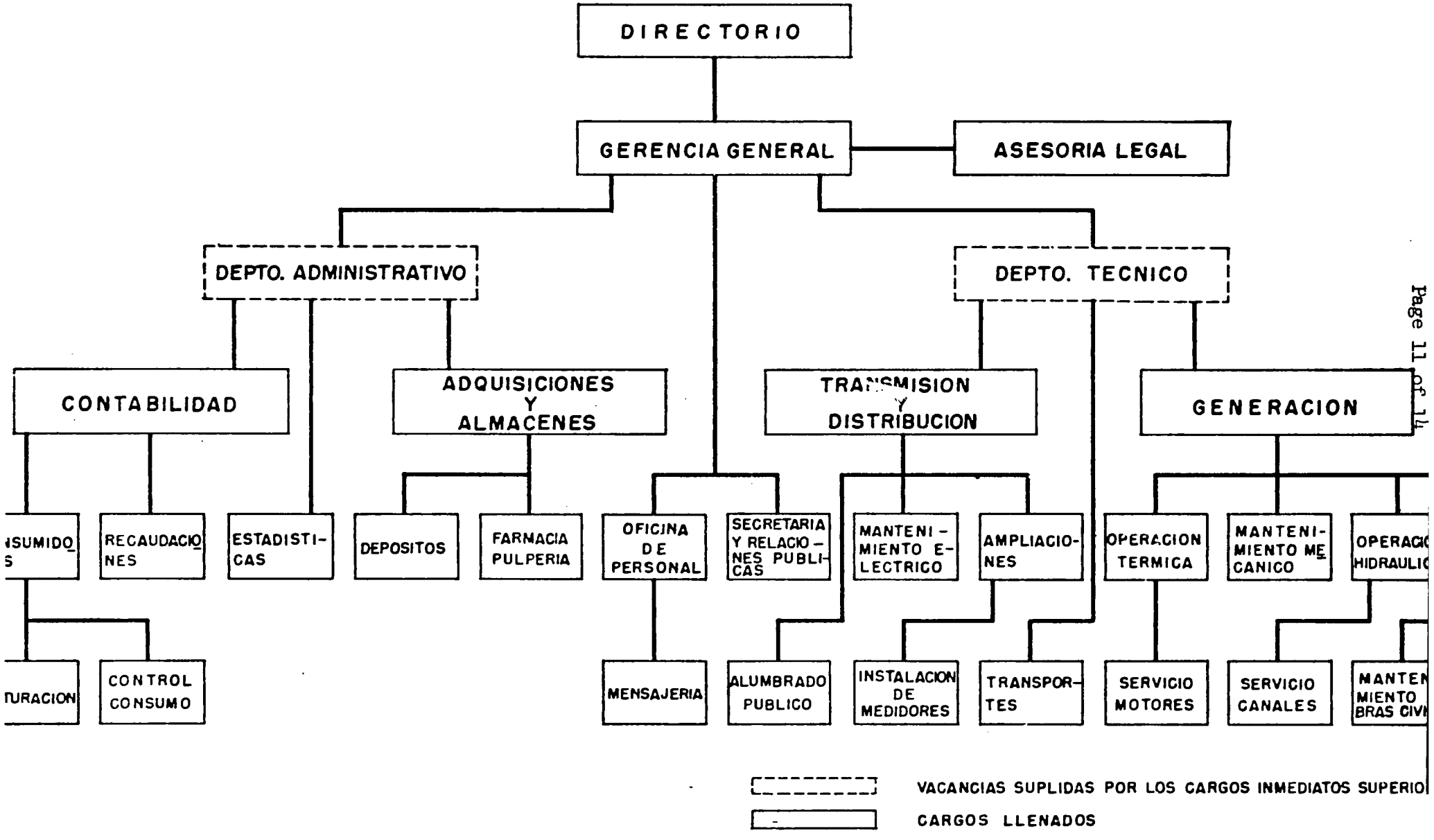
a. Gastón Balderas Lopez
Education:
-Technical University of Oruro
-Tomas Frias University of Potosí
Professional Experience:
-General Manager SEPSA and predecessor Company -1961 to present.
-Obras Públicas de Potosí - Chief Engineer, 1960.
-Potosí 4th Century Committee Chief Engineer; 1953/1959.

b. Hernan Waldo Rocabado Cruz
Education:
-Engineering University, La Plata, Argentina
Professional Experience:
-Chief of the SETAR Technical Section - 1972 to present.

c. Tomas Rojas Moncayo
Education: Tomas Frias University of Potosi
Professional Experience:
-SETAR - Industrial Relations, 1971 to present
-Empresa Minera "Montalvo", Sub-Manager Administrative Department - 1969/1971
-Mayor of Potosi- 1967/1969
-Cia. Minera Unificada del Cerro de Potosí - Sub Chief and Chief of various departments - 1943/1967.

SERVICIOS ELECTRICOS TARIJA S. A.

ORGANIGRAMA



11. SETAR - PERSONNEL CURRICULUM VITAE

a. Mario Antonio Kisen Brieger

Education:

-Electrical-Mechanical Engineer, National University of Córdoba, Arg.
-Airplane Fabrication, National University of Córdoba, Argentina
-Institute of Metallurgical Investigation, National University of Córdoba, Argentina.

Professional Experience:

-General Manager - SETAR; 1971 to present.
-Corporación Boliviana de Fomento, Chief Engineer, Bermejo Sugar Refinery - 1969/1970
-ENDE and ELFEC - 1968

b. Ramón Alfonso Zamora Piñeiro

-Education:

Technical Mechanic, National University of Córdoba, Argentina

Professional Experience:

-SETAR, Chief of the Generation Department - 1970 to present.
-University Juan M. Saracho, Tarija, Professor - 1970/1971
-Corporación Boliviana de Fomento, Chief of Various Mechanical Departments - 1962/1969.
-Servicio Nacional de Caminos, Tarija District; Resident Mechanic - 1960/1962

c. Eugenio Frigerio Cortéz

Education: Technical Training in ENDE

Professional Experience:

-SETAR, Chief of the Transmission Distribution Department, 1957 to present.
-Before 1957 employed by the predecessors of SETAR.

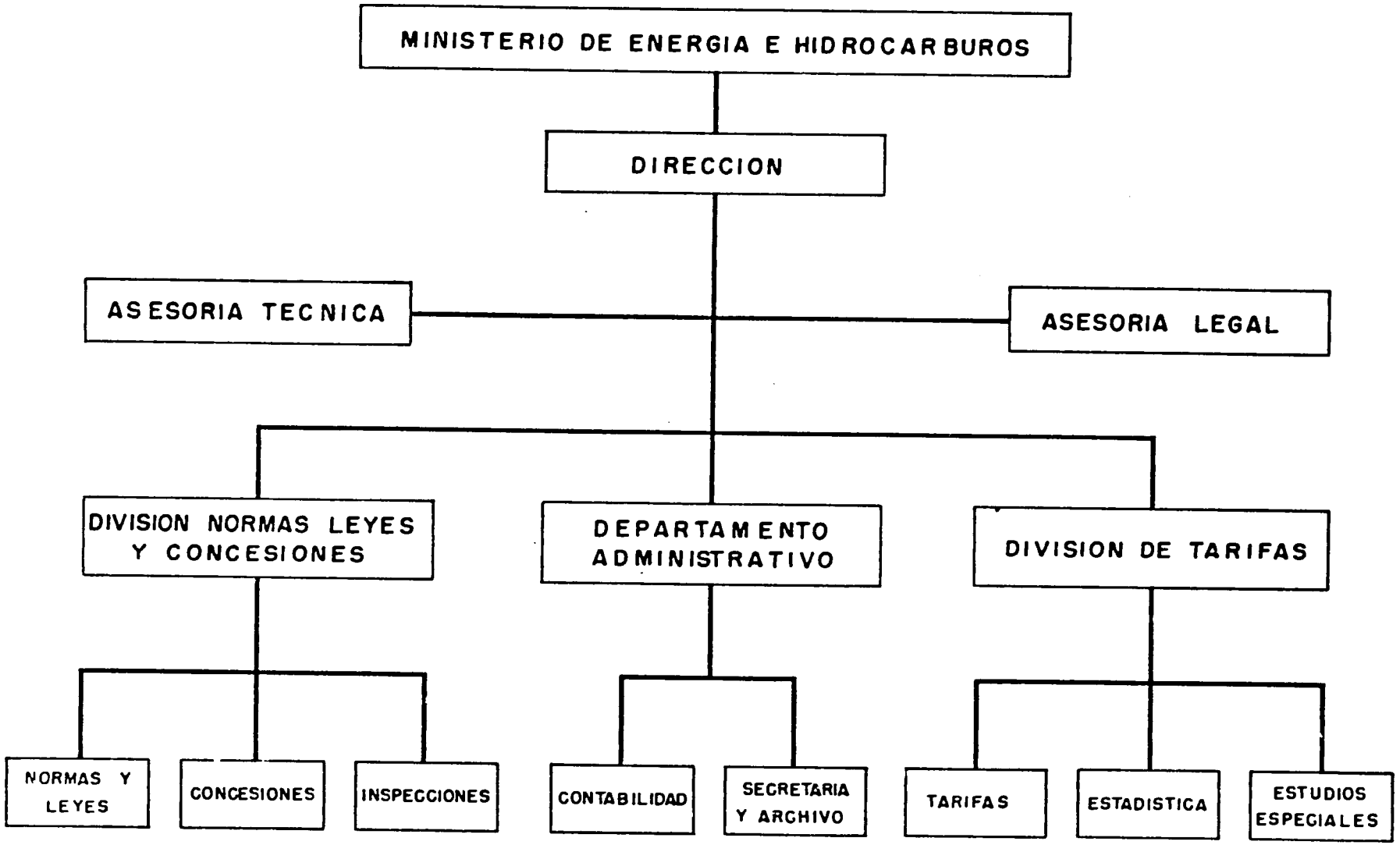
d. Juan Choque Maldonado

Education: International Accounting Academy; General Accountant.

Professional Experience:

-SETAR, Accountant.
-Diario "La Nacion" Accountant.
-Diario "La Tarde" Administrator
-Dirección General de Obras Públicas - Jefe de Almacene
-Mayor of Tarija, 1955
-President-Treasurer Chamber of Commerce, Tarija.
-Treasurer-Accountant Sports Committee, Tarija.

DIRECCION NACIONAL DE ELECTRICIDAD



13. DINE - PERSONNEL CURRICULUM VITAE

a. Renán Arce M.

Education:
-Ecòle-Polytechnique Federale, Suiza; Electric Engineer
Professional Experience:
-Dirección Nacional de Electricidad - Chief Division and Director - Fare Division.
-Motor Columbus S.A. - Design Engineer, 1970/1971
-Prudencio Claros y Asociados - Ingenieros Consultores; Project Engineer - 1969.

b. Roger Levy Sanjines

Education:
-Electro-Mechanical Engineering; Universidad Mayor de San Andrés
-Economic Development Course by CEPAL
-Training in a Factory - Belgium. ACEC Factory
-Training in Ecuador - Preparation and Evaluation of Projects
Professional Experience:
-Dirección Nacional de Electricidad - Chief Division of Standard Regulations and Concessions - 1969 to present
-Banco Industrial - Deputy Chief Technical Division 1966/1969
-Dirección Nacional de Electricidad - Project Engineer, 1963/1966
-Junta Nacional de Planificación, Projects Evaluation, 1962

c. Jorge Zamora Mujía

Education: Civil Engineering, Universidad Técnica de Oruro

Professional Experience:
-Acting Under-Secretary, Ministerio de Energía e Hidrocarburos on loan from the Dirección Nacional de Electricidad
-Director - Dirección Nacional de Electricidad, 1967/1971
-Chief of Energetic - Secretaría de Planificación, 1962/1967
-Director-Engineer; Fábrica de Cemento, Sucre, - 1953/1959.

October 17, 1973

ENGINEERING AND CONSTRUCTION ANALYSIS

Table of Contents

DESCRIPTION OF THE PROJECT

The physical properties of this project will consist of the construction of electric distribution facilities from USAID loan funds and the construction of related transmission and substation facilities from sources of capital other than USAID loan funds to provide electric service to areas broadly described as the Lago Titicaca Altiplano, Los Yungas, Rio Abajo south of La Paz and selected areas to the south east of Sucre, southeast of Potosí. Camargo in the Department of Chuquisaca, the valley surrounding Tarija and Villamontes. There will also be some supporting facilities such as vehicles and work equipment for both office and field staffs.

As mentioned else where in this report CESSA, SEPSA and SETAR, have the responsibility for distributing electric energy within their Respective Departments. However, lines of communications and more efficient system operations and maintenance suggested that the entire Camargo service area be assigned to SEPSA even though part of it is within the CESSA area of responsibility and the entire Villamontes area be assigned to Tarija even though part of this is also within the CESSA area of responsibility. Later the Tupiza - Villazón area should also be assigned to Tarija even though it is within the SEPSA area of responsibility. These suggested boundaries were first discussed with ENDE and later with CESSA, SEPSA and SETAR and everyone is in accord

For this reason the Table I - Project Cost Breakdown for CESSA, SEPSA and SETAR in the "Bolivia IRR Rural Electrification Loan Phase II" bear no relation to project cost breakdowns in this study; except in global amounts.

Taking each project separately:

a. INER

350 kilometers of 14.4/24 9KV three-phase distribution lines
55 kilometers of 14.4 KV single-phase distribution lines
50 kilometers of secondary underbuild
150 kilometers of secondary on secondary poles
3367 KVA of distribution transformer capacity
10100 service and meter installations
5050 interior house wiring installations
2000 street light installations
Recloser and Sectionalizing devices as required
50 kilometers of 66 KV transmission line
8500 KVA of 69KV to 14.4/24.9KV substation capacity.

b. CESSA

225 kilometers of 14.4/24.9 KV three-phase distribution lines
35 kilometers of 14.4KV single - phase distribution lines
30 kilometers of secondary underbuild
75 kilometers of secondary on secondary poles
1760 KVA of distribution transformer capacity
5280 service and meter installations
2640 interior house wiring installations
1500 street light installations
Recloser and sectionalizing devices as required
7500 KVA of 69 KV to 14.4/24.9KV substation capacity.

c. SEPSA

205 kilometes of 14.4/24.9 KV three-phase distribution lines
30 kilometers of 14.4KV single-phase distribution lines
30 kilometers of secondary underbuild
70 kilometers of secondary on secondary poles
1617 KVA of distribution transformer capacity
4850 service and meter installations
2425 interior house wiring installations
1250 street light installations
Recloser and sectionalizing devices as required
7500 KVA of 69 KV to 14.4/24.9KV substation capacity

d. SETAR

250 kilometers of 14.4/24.9KV three-phase distribution lines
40 kilometers of 14.4KV single-phase distribution lines
50 kilometers of secondary underbuild
135 kilometers of secondary on secondary poles
3044 KVA of distribution transformer capacity
9130 service and meter installations
4565 interior house wiring installations
1250 street light installations
Recloser and sectionalizing devices as required
20000 KVA of 10 KV to 14.4/24.9 KV substation capacity

Maps of the service areas, circuit diagrama, voltage drop sheets and cost details follow as exhibits.

TOTAL COST OF THE PROJECT

The total cost of the project is estimated at US$ 8,585,200 of which US$ 6,360,900 are foreign costs in dollars and pesos and US$ 2,224,300 are local participant currency expenditures.

Following are the individual cost breakdowns per participant as well as global project cost breakdowns.

LA PAZ

INER

CAPITAL COST AND INVESTMENT

US$

ITEM	USAID F/C	USAID L/C	LOCAL CONTRIB.	TOTAL
Distribution				
a. R of W Clearing		5000		5000
b. Poles & Fixtures	400400	355000		755400
c. Overhead Conduc.	201400	50400		251800
d. Line Transform.	92500	8500		101000
e. Services	98500	50500		149000
f. Meters	202000	30300		232300
g. Interior Wiring	94900	15200		110100
h. Sectionalizing	25600	1500		27100
i. Street Lights	43500	14500		58000
Sub Total	1158800	530900		1689700
Contingency	115900	53100		169000
Engineering	59800	89600		149400
Technical Assistance	225000 ~~200000~~			225000 ~~200000~~
Tools & Work Eqpt.	100000			100000
Sub Total AID Loan	1659500 ~~1634500~~	673600		2333100 ~~2308100~~
Local Contribution				
a. Transmission			500000	500000
b. Substations			172500	172500
c. Tools & Work Eqpt.			143500	143500
d. ENDE Admin.			49800	49800
e. INER Admin.			100000	100000
f. Int. During Const.			61000	61000
Sub Total Local Contri.			1026800	1026800
Total Project Cost	1659500 ~~1634500~~	673600	1026800	3359900 ~~3334900~~

CHUQUISACA

CESSA

CAPITAL COST AND INVESTMENT

US$

ITEM	USAID F/C	USAID L/C	LOCAL CONTRIB.	TOTAL
Distribution				
a. R of W Clearing		10000		10000
b. Poles & Fixtures	243400	215800		459200
c. Overhead Cond.	122400	30600		153000
d. Line Transform.	48400	4400		52800
e. Services	51600	26400		78000
f. Meters	105600	15800		121400
g. Interior Wiring	49700	7900		57600
h. Sectionalizing	17500	1500		19000
i. Street Lights	30000	7500		37500
Sub Total	668600	319900		988500
Contingency	66900	32000		98900
Engineering	34100	51200		85300
Tech. Assistance	~~75000~~ 50000			~~75000~~ 50000
Sub Total AID Loan	844600 ~~819600~~	403100		1247700 ~~1222700~~
Local Contribution				
a. Substations			87200	87200
b. Tools & Work Eqpt			60000	60000
c. ENDE Admin.			28400	28400
d. SETAR Admin.			100000	100000
e. Int. During Const.			27700	27700
Sub Total Local Cont.			303300	303300
Total Project Cost	844600 ~~819600~~	403100	303300	1551000 ~~1526000~~

POTOSI

SEPSA

CAPITAL COST AND INVESTMENT

US$

ITEM	USAID F/C	USAID L/C	LOCAL CONTRIB.	TOTAL
Distribution				
a. R of W Clearing		7500		7500
b. Poles & Fixtures	222100	197800		419900
c. Overhead Cond.	112000	28000		140000
d. Line Transf.	44500	4000		48500
e. Services	47600	24000		71600
f. Meters	97000	14600		111600
g. Interior Wiring	45600	7300		52900
h. Sectionalizing	17500	1500		19000
i. Street Lights	25000	6500		31500
Sub Total	611300	291200		902500
Contingency	61200	29100		90300
Engineering	32800	49200		82000
Tech. Assistance	~~25000~~ ~~50000~~			~~75000~~ ~~50000~~
Sub Total AID Loan	780300 ~~755300~~	369500		1149800 ~~1124800~~
Local Contribution				
a. Substations			132000	132000
b. Tools & Work Eqpt.			60000	60000
c. ENDE Admin.			27000	27000
d. SEPSA Admin.			100000	100000
e. Inter. During Const.			27700	27700
Sub Total Local Cont.			346700	346700
Total Project Cost	780300 ~~755300~~	369500	346700	1496500 ~~1471500~~

TARIJA

SETAR

CAPITAL COST AND INVESTMENT
US$

ITEM	USAID F/C	USAID L/C	LOCAL CONTRIB.	TOTAL
Distribution				
a. R of W Clearing		15000		15000
b. Poles & Fixtures	306900	272100		579000
c. Overhead Cond.	154600	38700		193300
d. Line Transf.	83700	7600		91300
e. Services	89300	45700		135000
f. Meters	182700	27400		210100
g. Interior Wiring	85900	13700		99600
h. Sectionalizing	25000	2500		27500
i. Street Lights	25000	6500		31500
Sub Total	953100	429200		1382300
Contingency	95300	42900		138200
Engineering	53900	80900		134800
Tech. Assistance	~~50000~~ 25000			~~50000~~ 25000
Sub Total AID Loan	1177300 ~~1152300~~	553000		1730300 ~~1705300~~
Local Contribution				
a. Substations			299000	299000
b. Tools & Work Eqpt.			60000	60000
c. ENDE Admin.			44900	44900
d. SETAR Admin.			100000	100000
e. Int. During Const.			43600	43600
Sub Total Local Contr.			547500	547500
Total Project Cost	1177300 ~~1152300~~	553000	547500	2277800 ~~2252800~~

TABLE I

PROJECT COST BREAKDOWN BY COMPONENT AND AREA

US$

Component	La Paz INER	Chuquisaca CESSA	Potosí SEPSA	Tarija SETAR	Total
AID LOAN					
Distribution	1689700	988500	902500	1382300	4963000
Facilities & Equipt	100000	-	-	-	100000
Engineering	149400	85300	82000	134800	451500
Technical Assist.	~~208000~~ 225600	~~58000~~ 75600	~~58000~~ 75600	~~50000~~ 25800	~~374000~~ 358800
Contingency	169000	98900	90300	138200	496400
Sub Total	~~2308100~~ 2333100	~~1222700~~ 1247700	~~1124800~~ 1149800	~~1705300~~ 1730300	~~6360900~~ 6446900
LOCAL CONTRIBUTIONS					
Transmission	500000			-	500000
Substations	172500	87200	132000	299000	690700
ENDE Administr.	49800	28400	27000	44900	150100
Other Adm. Costs	100000	100000	100000	100000	400000
Facilities & Eqpt.	143500	60000	60000	60000	323500
Int. During Const.	61000	27700	27700	43600	160000
Sub Total	1026800	303300	346700	547500	2224300
TOTAL	~~3334900~~ 3359400	~~1526000~~ 1551000	~~1471500~~ 1496500	~~2252800~~ 2277800	~~8585200~~ 8685200

TABLE II

PROJECT COST BREAKDOWN BY FOREIGN EXCHANGE AND LOCAL COSTS

US$

Component	Dollar Costs	Local Costs	Local Contrib.	Total
Materials	3391800	516400	1056200	4964400
Construction		1054800	134500	1189300
Vehicles & Eqpt.	100000		323500	423500
Engineering	180600	270900		451500
Technical Assist.	450000 ~~350000~~			450000 ~~350000~~
Contingency	339300	157100		496400
Project Administr.				
a. ENDE			150000	150100
b. Sub Borrowers			400000	400000
Interest During Const.			160000	160000
TOTAL	4461700 ~~4361700~~	1999200	2224300	8685200 ~~8585200~~

TABLE III

PROJECT COST BREAKDOWN BY SOURCE OF FINANCING

US$

	Foreign Exchange	Local Currency	AID Loan	Local Contrib.	Total
INER	1659500 ~~1634500~~	673600	2333100 ~~2308100~~	1026800	3359900 ~~3334900~~
CESSA	844600 ~~819600~~	403100	1247700 ~~1222700~~	303300	1551000 ~~1526000~~
SEPSA	780300 ~~755300~~	369500	1149800 ~~1124800~~	346700	1496500 ~~1471500~~
SETAR	1177300 ~~1152300~~	553000	1730300 ~~1705300~~	547500	2277800 ~~2252800~~
TOTAL	4461700 ~~4361700~~	~~1999200~~	6460900 ~~6360900~~	2224300	8685200 ~~8585200~~
Percent of Proj. Cost	51%	23%	74%	26%	100%

TABLE IV

INER, CESSA, SEPSA, SETAR
LOAN FUND DISBURSEMENT TABLE - DRAW DOWN SCHEDULE

	1st Year		2nd Year		3rd Year		TOTAL
	F/C US$	L/C US$	F/C US$	L/C US$	F/C US$	L/C US$	
Materials		116,400	2,660,000	200,000	731,800	200,000	3,908,200
Construction				354,800		700,000	1,054,800
Vehicles & Eqpt.		100,000					100,000
Engineering	90,000	60,000	90,000	61,500	90,000	60,000	451,500
Technical Assistance	~~90,000~~		~~130,000~~		~~130,000~~		~~350,000~~
Contingency					339,300	157,100	496,400
TOTAL	~~180,000~~	276,400	~~2,880,000~~	616,300	~~1,291,100~~	1,117,100	~~6,360,900~~
LOCAL CONTRIBUTIONS BY PARTICIPANTS AS REQUIRED							2,224,300
TOTAL							~~8,585,200~~

COST ESTIMATES

The following material cost estimates were taken from the July-October 1972 "Outline for Rural Electric Development - Bolivia" which were previously developed from 1970-1971 material invoices for a recently completed rural electrification project in Nicaragua adjusted for inflation and transportation factors.

Labor is estimated at 25% of material prices; engineering is based on approximately 9% of labor and material prices; ENDE administration is based on 2% of labor and material prices in accordance with ENDE estimates; and there is a 10% contingency based on labor and material prices.

BASE COST PER KILOMETER
14.4/24.9 KV

Main 3Ø Feeders
3#1/0 ACSR
1# 4 ACSR

Quantity	Description	US$/UNIT Material Cost	Extended Material Cost	US$ Labor Cost
7	10 m. Pole	18.50	129.50	32.38
3	12 m. Pole	23.00	69.00	17.25
6	VC-1	31.66	189.96	47.49
1	VC-2	66.47	66.47	16.62
1	VC-3	48.13	48.13	12.03
1	VC4-1	94.47	94.47	23.62
1	VC-8	115.28	115.28	28.82
3000 m.	D-1/0 ACSR	0.20	600.00	150.00
1000 m.	D-4 ACSR	0.10	100.00	25.00
3	VEI-2	7.68	23.04	5.76
2	E2-2	12.51	25.02	6.26
1	VE6-2	15.90	15.90	3.98
5	F2-2	5.03	25.15	6.29
10	VM2-11	4.83	48.30	12.08
10	VM-10-15	1.23	12.30	3.08
			1,562.52	390.66
				1,953.18

N O T E : ALL DRIVEN GROUNDS ARE INCLUDED WITH EQUIPMENT INSTALLATIONS AND SECONDARY DEAD-ENDS.

BASE COST PER KILOMETER
14.4/24.9 KV

3Ø Taps
4# 4 ACSR

Quantity	Description	US$/Unit Material Cost	Extended Material Cost	US$ Labor Cost
8	10 m. Pole	18.50	148.00	37.00
8	12 m. Pole	23.00	184.00	46.00
4	VC-1	31.66	126.64	31.66
4	VC-2	66.47	265.88	66.47
2	VC-3	48.13	96.26	24.07
2	VC4-1	94.47	188.94	47.24
4	VC-7	68.41	273.64	68.41
2	VC-8	115.28	230.56	57.64
4000 m.	D-4ACSR	0.10	400.00	100.00
8	VEI-2	7.68	61.44	15.36
1	E2-2	12.51	12.51	3.13
6	VE6-2	15.90	95.40	23.85
20	F2-2	5.03	100.60	25.15
12	VM2-11	4.83	57.96	14.49
16	VM10-15	1.23	19.68	4.92
			2,261.51	565.36
			2,826.87	

NOTE: ALL DRIVEN GROUNDS ARE INCLUDED WITH EQUIPMENT INSTALLATIONS AND SECONDARY DEAD-ENDS QUANTITIES ARE BASED ON 2 TAPS/KILOMETER.

BASE COST PER KILOMETER
14.4/KV

1Ø TAPS
2# 4 ACSR

QUANTITY	Description	US$/Unit Material Cost	Extended Material Cost	US$ Labor Cost
12	10 m. Poles	18.50	222.00	55.50
3	12 m. Poles	23.00	69.00	17.25
8	VA-1	7.98	63.84	15.96
2	VA-2	16.38	32.76	8.19
1	VA-3	16.78	16.78	4.20
1	VA-4	32.47	32.47	8.72
3	VA-5	15.69	47.07	11.77
1	VA-6	31.58	31.58	7.90
2000 m.	D-4 ACSR	0.10	200.00	50.00
5	VEI-2	7-68	38.40	9.60
1	E2-2	12.51	12.51	3.13
5	F2-2	5.03	25.15	6.29
11	VM2-11	4.83	53.13	13.28
15	VM10-14	0.69	10.35	3.77
			855.04	214.96
			1,070.60	

NOTE: ALL DRIVEN GROUNDS ARE INCLUDED WITH EQUIPMENT INSTALLATIONS AND SECONDARY DEAD-ENDS QUANTITIES ARE BASED ON 3 TAPS/KILOMETER.

BASE COST OF CSP TRANSFORMERS - 14.4 KV
1 Ø INSTALLATIONS

Quantity	Description	US$/Unit Material Cost	US$ Labor Cost	US$ Total Cost
1 - 5 KVA	VG105-VG106	200.81	20.00	220.80
1 - 10 KVA	VG105-VG106	222.33	25.00	247.33
1 - 15 KVA	VG105-VG106	275.65	30.00	305.65
1 - 25 KVA	VG105-VG106	344.91	35.00	379.91

BASE COST OF CONVENTIONAL TRANSFORMERS - 14.4/24.9KV
3 Ø INSTALLATIONS

Quantity	Description	US$/Unit Material Cost	US$ Labor Cost	US$ Total Cost
3 - 5 KVA	VG312-15KVA	601.41	90.00	691.41
3 - 10 KVA	VG312-30KVA	685.49	105.00	791.41
3 - 15KVA	VG312-45KVA	822.77	125.00	947.77
3 - 25KVA	VG312-75KVA	1042.88	150.00	1,192.88
3 - 37.1/2KVA	VG312-112.5KVA	1371.99	180.00	1,551.99
3 - 50KVA	VG312-150KVA	1489.63	225.00	1,714.63
	Platform	250.00		
3 - 100KVA	Platform Mount	2600.65	525.00	3,125.65
3 - 167KVA	Platform Mount	3456.97	655.00	4,111.97
3 - 250KVA	Platform Mount	4578.40	855.00	5,433.40

NOTE : CSP Transformer unit costs include driven grounds and primary and secondary jumpers and connectors.
Conventional transformer unit costs also include the installation of lighting arresters and fuse cutouts.

BASE COST PER KILOMETER
SECONDARY UNDERBUILD

3 Ø - 220/380 VOLTS
1/0 ACSR

Quantity	Description	US$/Unit Material Cost	Extended Material Cost	US$ Labor Cost
36	J - 5	1.17	42-12	10.53
12	J - 6	2.07	24.84	6.21
12	J - 7	2.07	24.84	6.21
3000 m.	D-1/0 ACSR	0.20	600.00	150.00
4	VEI-2	7.68	30.72	7.68
4	F2-2	5.03	20.12	5.03
4	VM2-12	6.01	24.04	6.01
			766.68	191.67
			958.35	

BASE COST PER KILOMETER
SECONDARY UNDERBUILD

3 Ø - 220/380 VOLTS
#4 ACSR

Quantity	Description	US$/Unit Material Cost	Extended Material Cost	US$ Labor Cost
36	J - 5	1.17	42.12	10.53
12	J - 6	2.07	24.84	6.21
12	J - 7	2.07	24.84	6.21
3000 m.	D-4ACSR	0.10	300.00	75.00
4	VEI-2	7.68	30.72	7.68
4	F2-2	5.03	20.12	5.03
4	VM2-12	6.01	24.04	6.01
			466.68	116.67
			583.35	

BASE COST PER KILOMETER
SECONDARY UNDERBUILD

1 ϕ. - 220 VOLTS
1/0 ACSR

Quantity	Description	US$/Unit Material Cost	Extended Material Cost	US$ Labor Cost
12	J - 5	1.17	14.04	3.51
4	J - 6	2.07	8.28	2.07
4	J - 7	2.07	8.28	2.07
1000 m.	D-1/0 ACSR	0.20	200.00	50.00
4	VEI-2	7.68	30.72	7.68
4	F2-2	5.03	20.12	5.03
4	VM2-12	6.01	24.04	6.01
			305.48	76.37
			381.85	

BASE COST PER KILOMETER
SECONDARY UNDERBUILD

1 ϕ - 220 VOLTS
4 ACSR

Quantity	Description	US$/Unit Material Cos	Extended rial Cost	US$ Labor Cost
12	J - 5	1.17	14.04	3.51
4	J - 6	2.07	8.28	2.07
4	J - 7	2.07	8.28	2.07
1000 m.	D-4ACSR	0.10	100.00	25.00
4	VEI-2	7.68	30.72	7.68
4	F2-2	5.03	20.12	5.03
4	VM2-12	6.01	24.04	6.01
			205.48	51.37
			256.85	

BASE COST PER KILOMETER
SECONDARY

3Ø-220/380 Volts
1/0 ACSR

Quantity	Description	US$/Unit Material Cost	Extended Material Cost	US$ Labor Cost
30	10 m. Poles	18.50	555.00	138.75
96	J 5	1.17	112.32	28.08
24	J 6	2.07	49.68	12.42
40000 m.	D-1/0 ACSR	0.20	800.00	200.00
6	VEI-2	7.68	46.08	11.52
6	F2-2	5.03	30.18	7.55
6	VM2-12	6.01	36.06	9.02
			1,629.32	407.34
			2,036.66	

BASE COST PER KILOMETER
SECONDARY

3Ø - 220/380 Volts
#4 ACSR

Quantity	Description	US$/Unit Material Cost	Extended Material Cost	US$ Labor Cost
30	10 m. Poles	18.50	555.00	138.75
96	J 5	1.17	112.32	28.08
24	J 6	2.07	49.68	12.42
4000 m.	D-4 ACSR	0.10	400.00	100.00
6	VEI-2	7.68	46.08	11.52
6	F2-2	5.03	30.18	7.55
6	VM2-12	6.01	36.06	9.02
			1,229.32	307.34
			1,536.66	

BASE COST PER KILOMETER — 1 Ø - 220 Volts
SECONDARY — # 1/0 ACSR

Quantity	Description	US$/Unit Material Cost	Extended Material Cost	US$ Labor Cost
30	10 m. Poles	18.50	555.00	138.75
48	J 5	1.17	56.16	14.04
12	J 6	2.07	24.84	6.21
2000 m.	D-1/0 ACSR	0.20	400.00	100.00
6	VEI-2	7.68	46.08	11.52
6	F2-2	5.03	30.18	7.55
6	VM2-12	6.01	36.06	9.02
			1,148.32	287.09
				1,435.41

BASE COST PER KILOMETER — 1 Ø - 220 VOLTS
SECONDARY — # 4 ACSR

Quantity	Description	US$/Unit Material Cost	Extended Material Cost	US$ Labor Cost
30	10 m. Poles	18.50	555.00	138.75
48	J 5	1.17	56.16	14.04
12	J 6	2.07	24.84	6.21
2000 m	D-4 ACSR	0.10	200.00	50.00
6	VEI-2	7.68	46.08	11.52
6	F2-2	5.03	30.18	7.55
6	VM2-12	6.01	36.06	9.02
			948.32	237.09
				1,185.41

BASE COST OF SERVICE INSTALLATION

Quantity	Description	US$/Unit Material Cost	US$ Labor Cost	US$ Total Cost
100'	2 # 6 Duplex	9.53	5.24	14.77
100'	2 # 4 Duplex	14.50	7.98	22.48
100'	2 # 1/o Duplex	22.05	12.13	34.18
100'	4 # 6 Quadruplex	17.95	9.87	27.82
100'	4 # 4 Quadruplex	27.90	15.35	43.25
100'	4 # 1/o Quadruplex	41.90	23.05	64.95
100'	4 # 3/o Quadruplex	63.50	34.93	98.43

Note: Materials common to all 2 Wire Service Installations

2-Split bolt connectors	$ 1.47
1-Swinging Clevis	$ 1.33
1-Wire holder	$ 0.41
2-Dead-End Grips	$ 0.76
	$ 3.97

Materials common to all 4-Wire Service Installations

4-Split bolt connectors	$ 3.43
1-Swinging Clevis	$ 1.33
1-Wire Holder	$ 0.44
2-Dead-End grips	$ 0.96
	$ 6.17

BASE UNIT COST OF METERS

Description	US$/Unit Material Cost	US$ Labor Cost	US$ Total Cost
Watthour Meter-Class 100 Socket, Type R-2 2 W - 220 Volt - 50 Hz	20.00 (Includes Socket)	3.00	23.00
Watthour Meter-Class 200 Socket, type R-2 2W - 220 Volt - 50 Hz	20.00 (Includes Socket)	3.00	23.00
Watthour Meter-Class 200 Socket, Type SV-60 3 Element - 220 Volt 50 Hz	100.00 (Includes Socket)	5.00	25.00
Current Transformers 200/5 - 600/5 800/5	 35.00 40.00	 3.00 3.00	 38.00 43.00
Watthour Meter-Class 10 Socket, Type SV-60 3 Element - 220 Volt	100.00 (Includes Socket)	5.00	25.00

BASE UNIT COST OF INTERIOR HOUSE WIRING

Quantity	Description	US$/Unit Material Cost	Extended Material Cost	US$ Labor Cost
1	Panel Box 2-10A Breakers	7.29	7.29	
60'	#14 TW (nonmetallic flat)	0.05	3.00	
60'	#12 TW (nonmetallic flat)	0.06	3.60	
60	Staples	0.01	0.60	
3	Wall Receptacles	0.54	1.62	
3	Light Sockets with pull chains	0.90	2.70	
			18.81	3.00
			21.81	

BASE COST FOR PUBLIC STREET LIGHTS

Description	US$/Unit Material Cost	US$ Labor Cost	US$ Total Cost
BPCo. standard suburban street light fixture 50/100 W Incandescent Cast Base Acrylic Reflector Support Arm	10.00	5.00	15.00
Photo-electric cell	5.00		5.00

DESIGN AND CONSTRUCTION STANDARDS

1. Distribution Design

The distribution line design and construction standards for the four service areas should follow those of REA, the Rural Electrification Administration, U.S. Department of Agriculture. The CRE and ELFEC rural distribution systems utilize 14.4/24.9 KV voltage levels and ENDE proposed that INER, CESSA, SEPSA and SETAR also adopt this voltage for the rural areas for standardization. For altitudes over 10,000 feet this will necessitate 34.5 KV insulation levels which will affect only that equipment using insulators.

2. Transmission Design

The Bolivian Power Company utilized a single wood pole structure design for their 66 KV transmission line to the Mina Matilde which follows very closely the Rural Electrification Administration standards with no apparent operating problems. ENDE is also utilizing an H-Frame wood pole structure design for their 66 KV transmission line between Sucre and Potosi. Since REA transmission line design and construction standards cover all voltage levels now being considered by ENDE, it is recommended that REA wood pole designs be adopted by ENDE for all proposed transmission line facilities.

3. Substation and Switching Structure Design

ENDE substation structures for service to the rural areas should consist of the following:

1. A fenced area, cleared of brush, graded for proper drainage and adequately grounded in accordance with REA standards with a gravel surface.
2. High voltage structures of either wood or steel with gang operated disconnect switches, either fuses or adequate backup protection and lightning arresters.
3. Steel or wood low voltage structures with provisions for oil circuit reclosers; station demand, KWH and KVAR metering; and lightning arresters for each outgoing line.

4. Three-phase automatic tap changing under load substation transformers or single-phase substation transformers with single-phas voltage regulators to provide a regulated bus bar voltage.

   Switching structures should comply with the above-mentioned specifications where applicable.

4. Construction Standards

Although specific recommendations on construction specifications are usually not warrented in an Engineering-Feasibility study, discussions with participants responsible for the development of rural electrification in Bolivia indicate a need for guidance during the period of loan negotiations. Since these specifications involve costs, a through understanding amongst the lender, borrower and those responsible for direct implementation may eliminate follow-up misunderstandings.

a. Poles

In the Department of Santa Cruz, CRE is now utilizing a specie of wood called Cuchi. This is an extremely durable wood with a reported life of centuries without treatment. Although no tests have been made, the tensil strength appears to be adequate. For example, there was no evidence of pole bending in the entire CRE service area where this specie of wood is being employed and, in fact, unguyed strains seem to rake the pole in its entirety. At this point in our discussions, the use of Cuchi appears to be acceptable where ever it can be found.

In the Department of Cochabamba, existing ELFEC construction utilizes untreated Eucalyptus and Black Palm species of wood. Untreated, both are believed to be short lived species for use as wood poles in spite of contrary information from other sources. Mr. James Taylor, a timber specialist of renouned reputation in the United States, has suggested treating Eucalyptus which grows in abundance in the Cochabamba area. This solution has been accepted by ELFEC and, if the final report from Mr. James Taylor substantiates his preliminary conclusions, the use of Eucalyptus appears acceptable in all four project areas of Phase II - Rural Electrification.

b. Conductor

In order to reduce a multiplicity of conductor sizes which will complicate warehose stocks and overall maintenance and oper-

ations procedure, the following is recommended:

1. For main three-phase feeders utilize 1/0-6/1 ACSR with 4-7/1 ACSR as the neutral conductor. Anything larger requires heavy construction standards with related additional costs and, if heavier construction is required in the 10 year period of analysis, a second 1/0 ACSR feeder should be considered in order not to place "all of our eggs in one basket". Anything smaller has a direct effect on system continuity of service. Main feeders affect all of the consumers and, therefore, a cost slightly in excess of the most economical wire size is justified. For example: number 1/0 ACSR posesses better strength requirements and, therefore, is more versatile for economical placement of poles in main feeders; number 1/0 ACSR has better reliability standards for lightning strokes; the added circumference distributes the heat associated with connectors causing less problems with connectors; if there is a connector problem, it is better to burn down a number 4 ACSR tap then to burn down a main feeder; if there is a main feeder outage, system personnel know immediately what type of repair materials to carry to the field without reference to system maps or researching system files if maps are not available.

2. For all taps, except where loads necessitate a larger conductor, use number 4 ACSR for both the primary and neutral conductor for simplicity of warehousing and operations and maintenance procedures.

3. For secondaries, match 1/0 ACSR and 4 ACSR with transformer capacities supplying the secondary systems.

4. For service drops, use ACSR duplex and quadruplex in order not to mix material types.

c. Connectors, Splices and Dead-ends

By minimizing the number of sizes of conductors, one also minimizes the number of sizes of connectors, splices and dead-ends which must be maintained in stock thereby simplifying operations and maintenance activities.

In order to minimize connector problems, generally caused by faulty construction practices during original installation, the following procedures are recommended:

1. Use compression connectors for all connections to ground to minimize radio and television interference and to assure voltage stability.

2. Use compression connectors for all tap connections, recloser by-pass switches, etc. where conductors are subject to large current carrying capacities.

3. Use hot line clamps only for transformer jumper connections to the primary lines.

4. Use split bolt connectors only for service wire connections to the secondary system.

For splices and dead-ends, there are companies which provide inexpensive divices for every conceivable application which would, again, reduce warehousing problems.

d. Ground rods and Anchor rods

In order to minimize below the ground corrosion problems, galvanized steel ground rods and anchor rods are recommended.

e. Transformers

DINE published standards for Bolivia stipulate secondary voltages of 220/380 volts which is a European standard and encourages the use of three-phase transformers. However, on either 7.2/12.5 KV or 14.4/24.9 KV distribution voltages, standard U.S. manufactured single-phase transformers with a 220/440 volt secondary rating can be used. For universal usage, the transformer secondaries can be connected in parallel and hung singly for 220 volt single-phase service (estimated at 95% of transformer installations) or three transformers connected in Wye will provide the DINE stipulated 380 volts three-phase service.

Should a consumer purchase a USA standard 220 volt of 440 volt three-phase appliance the secondary windings can be used in either parallel or series and two or three transformers can be connected in open delta or closed delta for three-phase service. It is recognized that 440 volts three-phase service is not a DINE standard but, if the transformers are adaptable to meeting a non standard Bolivian voltage, this is a plus factor which is not available in standard European design three-phase transformers.

All transformer orders should stipulate aluminum systems so that aluminum to copper terminal connections can be supplied by the manufacturer.

f. Meters

The prejudice in Bolivia against using U.S. manufactured socket type meters is apparently based on first cost without consideration being given to some obvious advantages. All Class 10, 100 and 200 socket type meters are designed for outside installations which eliminates the necessity for constructing a weather proof box to shelter the meter. They are also amongst the finest meters in the world for trouble free operation under severe climatic conditions for long periods of time. A fringe benefit which is seldom considered is the ease of performing disconnects for non payment of bills. In lieu of disconnecting the service wires from the secondary which necessitates a lineman, the mater can be isolated from the socket by means of a plastic cap costing less than US$ 0.01 per pair and is an operation that can be safely performed on the ground by any electric utility employee.

5. Material Specifications

Any waiver of REA design or construction standards should not compromise the quality of materials purchased under the USAID loan. Therefore, REA material specifications should apply throughout the project and those materials listed in the latest edition of the "REA Approved List of Materials for Use by REA Electric Borrowers" should be the minimum acceptable specifications.

IMPLEMENTATION PLAN

The proposal for ENDE to administer and implement Phase II of the Bolivian rural electrification program has apparently been accepted by INER, CESSA, SEPSA and SETAR with no reservations. Probably because each recognizes that:

1. Each entity with its own established procedures requires a central clearing office.
2. USAID/B obviously cannot deal with each entity on a separate basis.
3. Inexperience on the part of each entity in satisfying USAID - Manual Orders procedures regarding project implementation.
4. The recognition that engineering and technical assistance cannot be monopolized by any one entity.

A tentative Engineering and Construction Schedule follows. The schedule assumes that the USAID loan will be authorized during calendar 1973, signed by January 31, 1974 and that Conditions Precedent will be met by April 30 1974. The schedule contemplates immediate and simultaneous inititation of several activities as soon as the loan is authorized.

The first order of business is to prepare Information for Bidders for the ordering of distribution materials. In the writers viewpoint, coordination of material deliveries, in order to obtain the maximum advantages of quantity ordering, poses th first problem. If each entity is responsible for its material ordering, evaluation and ultimate execution of contracts, USAID/B would be involved in administrative approval procedures with INER, CESSA, SEPSA and SETAR. Since all distribution materials will be of similar design and specifications, uniform insulation levels (with the exception of areas over 10,000 feet which only adds another line to specifications for equipment containing insulators or bushings) and shall meet REA standards, the most logical approach would be for ENDE to prepare the Information for Bidders, order the materials on the basis of each entities material estimates, advertise, open bids, prepare the bid evaluation and execute material contracts with the suppliers in joint coordination with the project participants. The suppliers, in turn, will identify the materials destined for each entity by name and a color code and, at this point, ENDE would officially turn the material over to their respective owners for delivery to the construction sites.

Simultaneous with the preparation of Information for Bidders for distribution materials.

1. INER, CESSA, SEPSA and SETAR, with technical assistance will determine the exact location of all distribution lines.
2. ENDE will prepare plan and profile drawings for the exact ordering of 69KV transmission line material and specifications for the ordering of substation material since the lead time for substation transformers may be as long as eighteen months.
3. ENDE will be preparing information for bidders for the ordering of tools and work equipment.

Hopefully, distribution material contracts will be executed by October 31, 1974 for delivery during the first quarter of 1975 so that construction can commence no later than June 30, 1975 for completion by December 31, 1976.

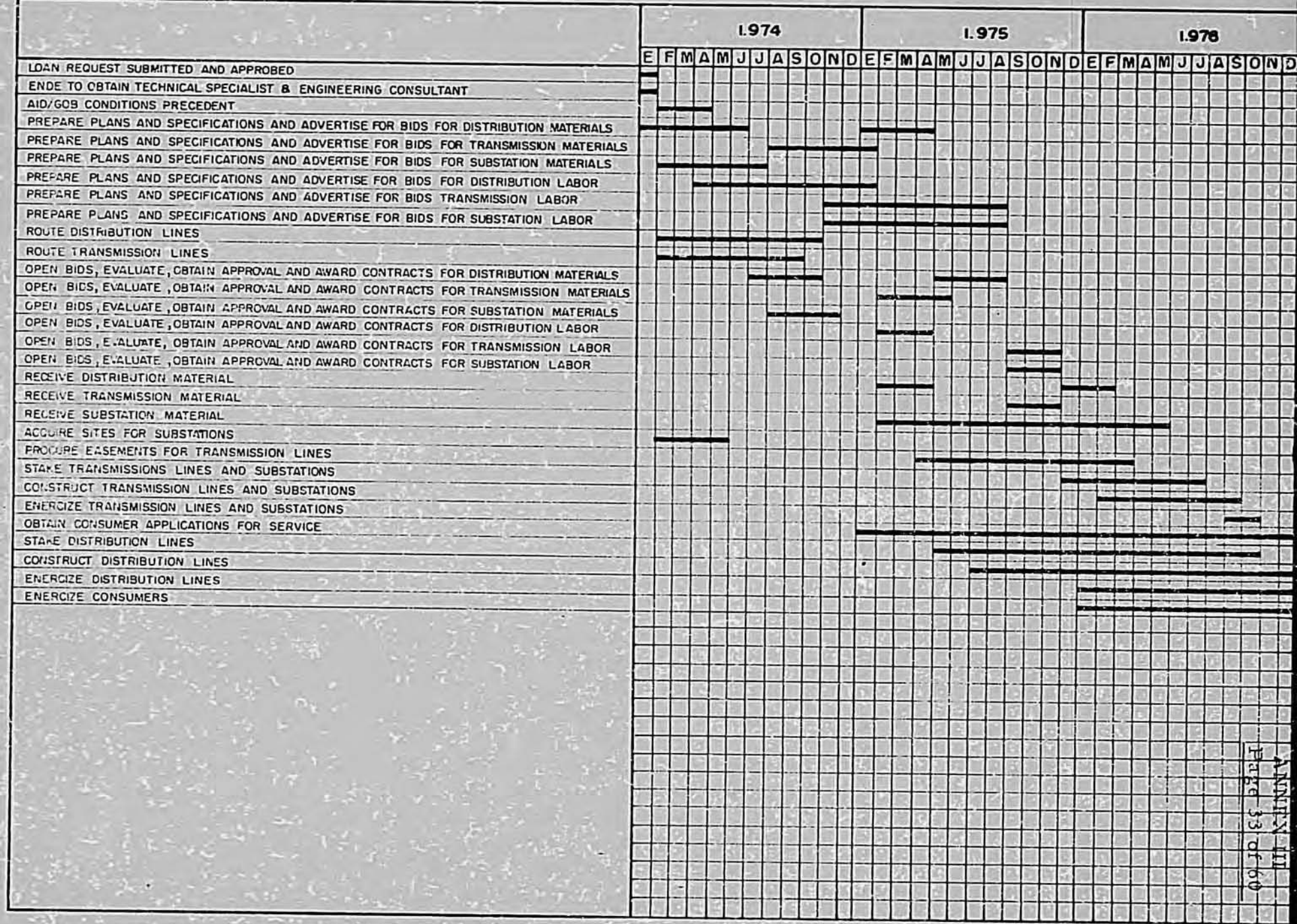
Information for Bidders for distrib ution labor will be started early in 1974 in order to assure having contractors available immediately upon the receipt of sufficient materials to sustain full scale construction. Estimated no later than June 30, 1975.

Preparation of Information for Bidders for transmission and substation construction can be delayed until the last quarter of 1974 since material ordering of transmission line material cannot proceed until after routing of the transmission lines and because of the long lead time necessary for the substation transformers. Construction of the ENDE 69KV transmission lines and substations is scheduled to begin no later than January 31, 1976, two months after receipt of the transmission line materials, with completion in eight months.

The first order of distribution materials will be for the bulk of project requirements. Then, after full scale field investigations, scheduled for completion by October 31, 1974, there will be a second material order to make up material deficiencies. This is scheduled for the first quarter of 1975 with delivery scheduled during the first quarter of 1976.

In summary: On the assumption that the loan will be signed by Jan. 31, 1974, program participants could expect sufficient materials to be on hand during the first quarter of 1975 to begin construction no later than June 30, 1975 and to have all work completed and energized by December 31, 1976.

ENGINEERING AND CONSTRUCTION SCHEDULE

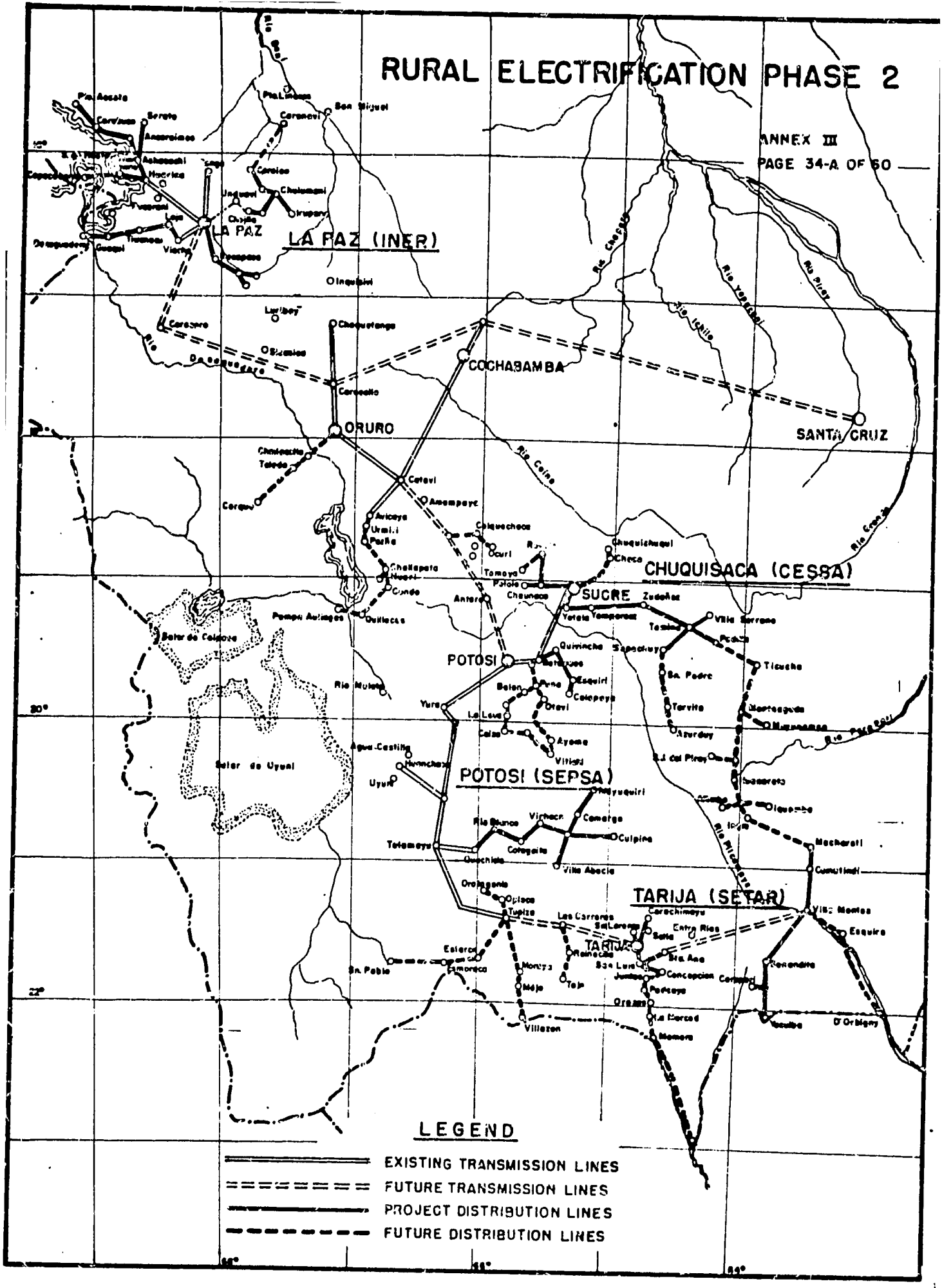


OPERATION AND MAINTENANCE

With the exception of INER, the operation and maintenance of the distribution systems should pose no problems since each entity is, at present, an operating utility. INER has the basic engineering background and during implementation of the program they will be trained in rural electrification operations and maintenance procedures. Not only for facilities being constructed under this program but for its existing properties financed under the Spanish line of credit.

During the 1975 - 1976 period, the service areas of each entity will be growing at a fairly rapid rate. However, energization will not occur on a large scale before 1976 which will give each entity sufficient time to plan, employ and train personnel for the job ahead.

Technical assistance assigned to this project must have the qualifications to advise and guide each entity in arriving at final decisions for operation and maintenance of the rural portions of the electrical facilities being financed under the proposed loan.


RURAL ELECTRIFICATION PHASE 2
ANNEX III
PAGE 34-A OF 60
LA PAZ
LA PAZ (INER)
COCHABAMBA
ORURO
SANTA CRUZ
CHUQUISACA (CESSA)
SUCRE
POTOSI
POTOSI (SEPSA)
TARIJA (SETAR)
TARIJA
Salar de Coipasa
Salar de Uyuni
Rio Grande
Rio Pilcomayo
LEGEND
EXISTING TRANSMISSION LINES
FUTURE TRANSMISSION LINES
PROJECT DISTRIBUTION LINES
FUTURE DISTRIBUTION LINES

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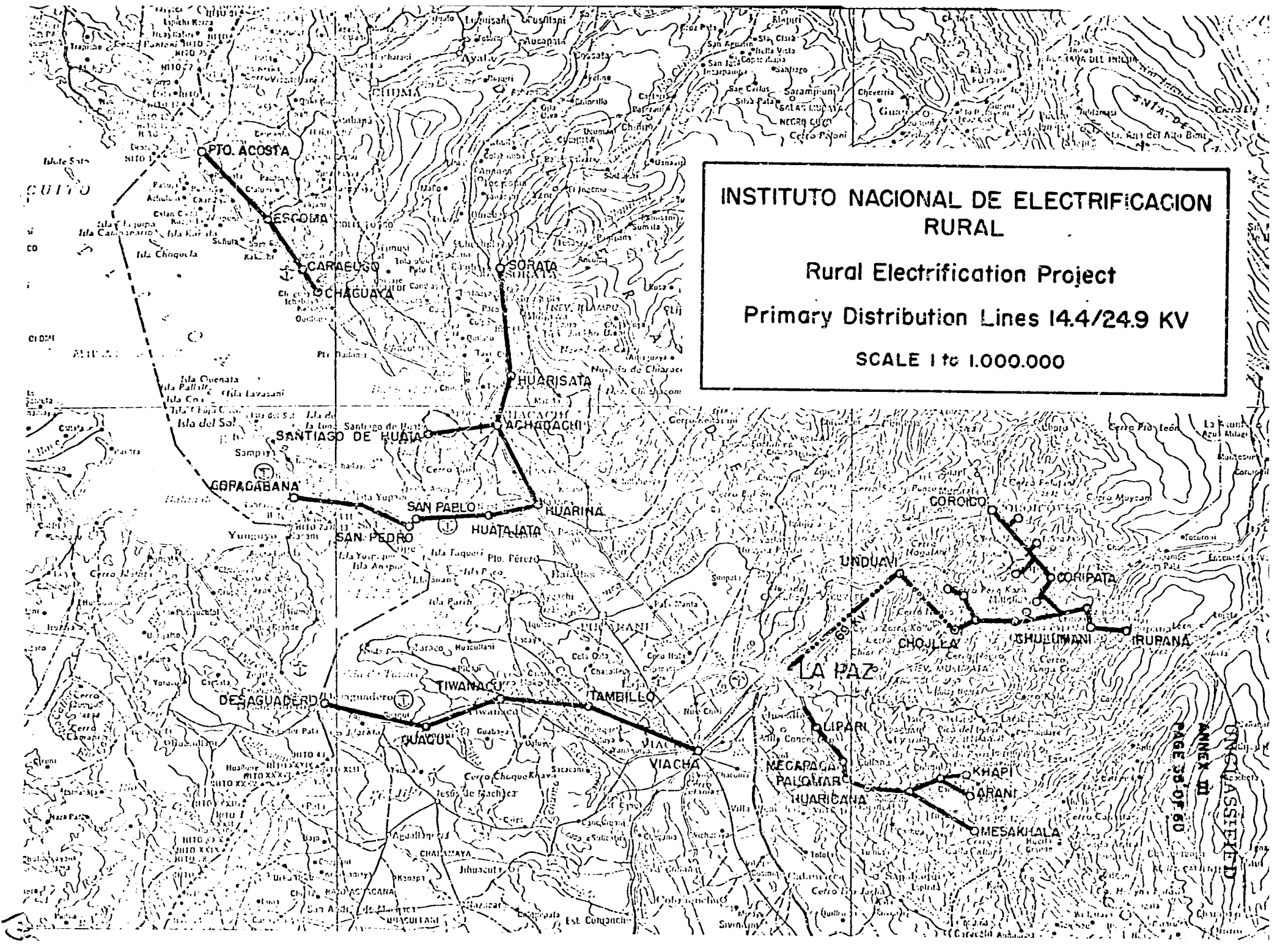
INSTITUTO NACIONAL DE ELECTRIFICACION RURAL
Rural Electrification Project
Primary Distribution Lines 14.4/24.9 KV
SCALE 1 to 1.000.000
PTO. ACOSTA
ESCOMA
CARAVUCO
CHAGUAYA
SORATA
HUARISATA
ACHACACHI
SANTIAGO DE HUATA
COPACABANA
SAN PABLO
HUARINA
SAN PEDRO
HUATAJATA
Isla del Sol
COROICO
CORIPATA
UNDUAVI
CHULUMANI
IRUPANA
CHOJLLA
LA PAZ
60 KV
TIWANACU
DESAGUADERO
TAMBILLO
GUACUI
VIACHA
LIPARI
MECAPACA
PALCOMAYO
HUARICANA
KHAPI
ARANI
OMESAKHALA
ANNEX III
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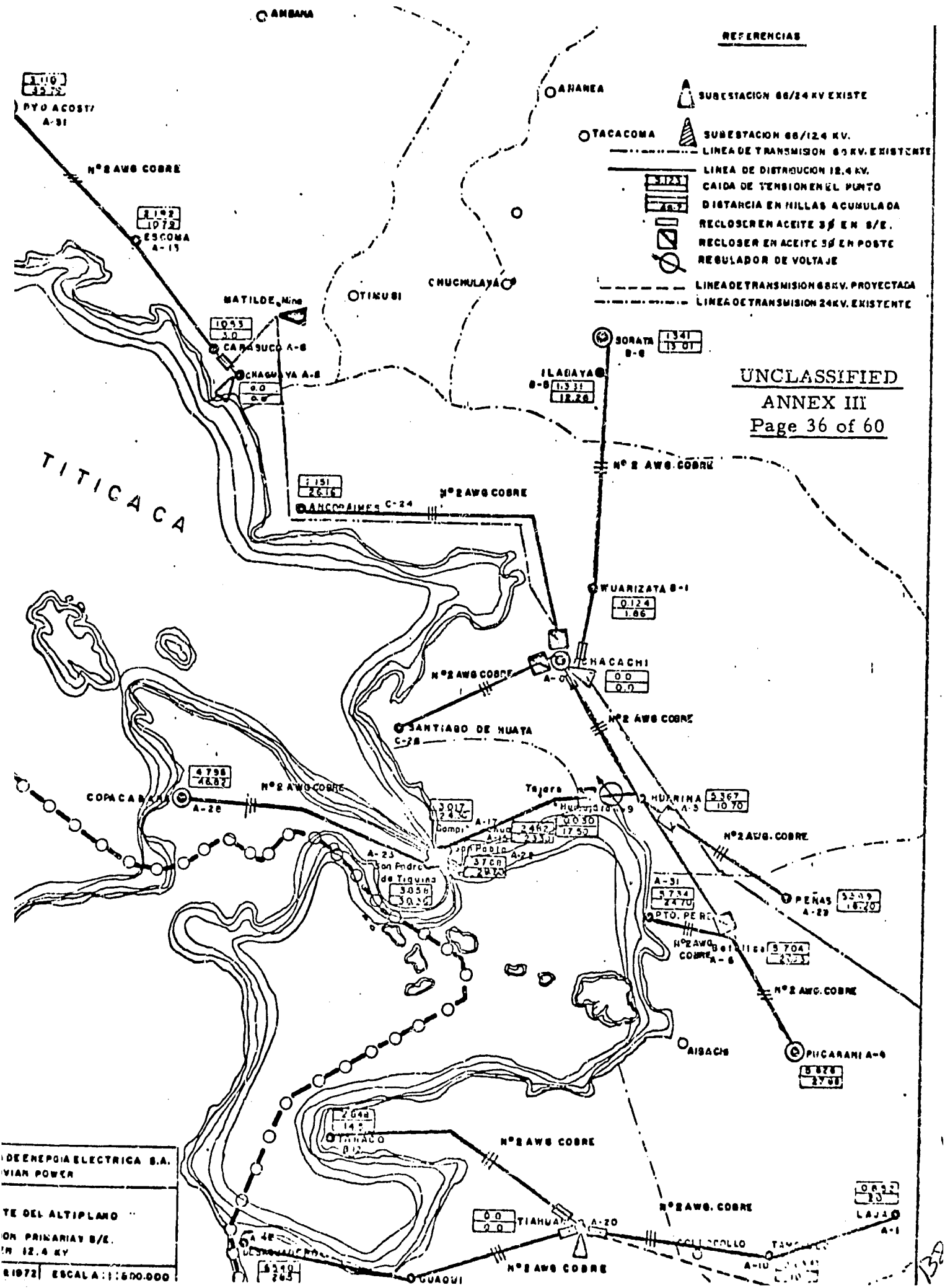
UNCLASSIFIED


REFERENCIAS
SUBESTACION 66/24 KV EXISTE
SUBESTACION 66/12.4 KV.
LINEA DE TRANSMISION 66 KV. EXISTENTE
LINEA DE DISTRIBUCION 12.4 KV.
CAIDA DE TENSION EN EL PUNTO
DISTANCIA EN MILLAS ACUMULADA
RECLOSER EN ACEITE 3Ø EN S/E.
RECLOSER EN ACEITE 3Ø EN POSTE
REGULADOR DE VOLTAJE
LINEA DE TRANSMISION 66 KV. PROYECTADA
LINEA DE TRANSMISION 24 KV. EXISTENTE
ANSARA
ANANEA
TACACOMA
PYO ACOSTA A-31
ESCOMA A-19
MATILDE Mine
CHUCHULAYA
TINUSI
CARABUCO A-8
CHAGUAYA A-8
SORATA B-6
ILABAYA B-8
TITICACA
BANCO MINERO C-24
HUARISATA B-1
CHACACHI A-0
SANTIAGO DE HUATA C-28
COPACABANA A-26
Tajora
HUARINA A-5
PEÑAS A-29
PTO. PEREZ
PUCARANI A-6
AISACHI
TIAHUANACO B-12
TIAHUANACO A-20
GUAQUI
LAJA A-1
UNCLASSIFIED
ANNEX III
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DE ENERGIA ELECTRICA S.A.
VIAN POWER
TE DEL ALTIPLANO
ON PRIMARIA S/E.
N 12.4 KV
ESCALA 1:500.000

Hoja 1 de 4

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION:

SYSTEM ENGINEER: COBEE

SUBSTATION: ACHACACHI

CIRCUITS: PUCARANI - S/E ACHACACHI

SYSTEM DESIGN: 50 KWH/MO/CONS

DATE: 12-9-72

SECTION		LOAD									LINE							VOLTAGE DROP	
		CONSUMERS					CONCENTRATED												
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES		THIS SECTION	TOTAL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19
A-7	A-8	40	0	20	50	5.52	-	-	-	5.52	2	3	7.2	0.97	4.65	25.67		0.025	5.826
A-6	A-7	5	40	42	50	10.30	-	-	-	10.30	2	3	7.2	0.97	3.10	31.93		0.097	5.801
A-5	A-6	160	45	125	50	27.00	-	-	-	27.00	2	3	7.2	0.97	4.80	129.60		0.126	5.704
A-4	A-5	20	205	215	50	44.00	-	-	-	44.00	2	3	7.2	0.97	0.93	40.92		0.040	5.578
A-3	A-4	20	225	235	50	47.60	-	-	-	47.60	2	3	7.2	0.97	3.7	176.12		0.171	5.538
A-2	A-3	3101	245	1795	50	339.00	-	-	-	339.00	2	3	7.2	0.97	4.15	1381.95		1.341	5.367
A-1	A-2	10	3346	3351	50	633.00	-	-	-	633.00	2	3	7.2	0.97	4.55	2880.15		2.794	4.026
A-0	A-1	20	3356	3366	50	635.00	-	-	-	635.00	2	3	7.2	0.97	2.00	1270.00		1.232	1.232
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		0.000	0.000
										Long = 27.88		Millas	=	44.85	Km.				
NOTE: Point A-0 is the place the Achacachi Substation where will be located																			
A-27	A-28	300	0	150	50	318	-	-	-	31.8	2	3	7.2	0.97	5.6	178.08		0.173	13.110
A-26	A-27	40	300	320	50	63.3	-	-	-	63.3	2	3	7.2	0.97	3.7	234.21		0.227	12.937
A-25	A-26	50	340	365	50	71.4	-	-	-	71.4	2	3	7.2	0.97	3.4	242.76		0.235	12.710
A-24	A-25	40	390	410	50	79.8	-	-	-	79.8	2	3	7.2	0.97	1.56	124.49		0.124	12.475
A-23	A-24	20	430	440	50	85.4	-	-	-	85.4	2	3	7.2	0.97	2.2	187.88		0.183	12.354
A-22	A-23	25	450	462	50	88.0	-	-	-	88.0	2	3	7.2	0.97	1.06	93.28		0.090	12.172
A-21	A-22	25	475	487	50	93.7	-	-	-	93.7	2	3	7.2	0.97	1.00	93.70		0.091	12.082
A-20	A-21	192	500	596	50	115.00	-	-	-	115.00	2	3	7.2	0.97	1.00	115.00		0.116	11.991
A-19	A-20	192	692	788	50	151.50	-	-	-	151.50	2	3	7.2	0.97	1.00	151.50		0.147	11.875
A-18	A-19	192	884	980	50	187.00	-	-	-	187.00	2	3	7.2	0.97	1.00	187.00		0.181	11.728
A-17	A-18	192	1076	1172	50	223.00	-	-	-	223.00	2	3	7.2	0.97	1.00	223.00		0.216	11.547
A-16	A-17	192	1268	1364	50	258.00	-	-	-	258.00	2	3	7.2	0.97	1.00	258.00		0.250	11.331
A-15	A-16	192	1460	1556	50	294.00	-	-	-	294.00	2	3	7.2	0.97	1.00	294.00		0.285	11.081
A-14	A-15	192	1652	1748	50	330.00	-	-	-	330,00	2	3	7.2	0.97	1.00	330.00		0.320	10.796
A-13	A-14	192	1844	1940	50	368.00	-	-	-	368.00	2	3	7.2	0.97	1.00	368.00		0.357	10.476
A-12	A-13	192	2036	2132	50	403.00	-	-	-	403.00	2	3	7.2	0.97	1.00	403.00		0.391	10.113
A-11	A-12	192	2228	2324	50	439.00	-	-	-	439.00	2	3	7.2	0.97	1.00	439.00		0.426	9.723
A-10	A-11	192	2420	2516	50	475.00	-	-	-	475.00	2	3	7.2	0.97	1.00	475.00		0.461	9.302
A-9	A-10	192	2612	2708	50	512.00	-	-	-	512.00	2	3	7.2	0.97	1.00	512.00		0.497	8.841
A-8	A-9	192	2804	2900	50	548.00	-	-	-	548.00	2	3	7.2	0.97	5.6	3068.80		2.977	8.344
NOTE: On point A-9 will be located a voltaje regulator for diminish voltaje drop on these branch																			5.367
											Long	= 36.12	Millas	= 58.11	Km.				

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION:

SUBSTATION: ACHACACHI

SYSTEM DESIGN: 50 KWH/MO/CONS

SYSTEM ENGINEER: COBEE

CIRCUITS: SOBATA - ACHACACHI

DATE: 12-9-72

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED			TOTAL	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KW									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	2
B-5	B-6	100	0	50	50	12.0	-	-	-	12.0	2	3	7.2	0.97	0.83	9.95	0.010	1.341	B-(
B-4	B-5	50	100	125	50	27.0	-	-	-	27.0	2	3	7.2	0.97	0.95	25.6	0.024	1.331	B-5
B-3	B-4	150	150	225	50	45.9	100	-	-	145.9	2	3	7.2	0.97	8.4	1162.0	1.112	1.307	B-4
B-2	B-3	6	300	303	50	55.4	-	-	-	55.4	2	3	7.2	0.97	0.02	11.06	0.011	0.195	B-3
B-1	B-2	6	306	309	50	61.0	-	-	-	61.0	2	3	7.2	0.97	1.03	62.60	0.060	0.184	B-2
A-0	B-1	80	312	352	50	69.6	-	-	-	69.6	2	3	7.2	0.97	1.86	129.20	0.124	0.124	B-1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.000	A-(

Long = 13.09 Millas = 2106

where

NOTE: Point A-0 is the place / Achacachi S/S will be located.

ANNEX III
Page 38 of 40

RA FORM 239 REV. 3-67

DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION:

SYSTEM ENGINEER: COBEE

SUBSTATION: ACHACACHI

CIRCUITS: ANCORAIMES - ACHACACHI

SYSTEM DESIGN: 50 KVA/KM/0.01 KS.

DATE: 12-9-72

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED												
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	AT POINT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C-23	C-24	40	0	20	50	5.52	-	-	-	5.52	2	3	7.2	0.97	0.85	4.75	0.005	1.151	C-24
C-22	C-23	10	40	45	50	10.9	-	-	-	10.9	2	3	7.2	0.97	0.85	9.20	0.009	1.146	C-23
C-21	C-22	10	50	55	50	13.0	-	-	-	13.0	2	3	7.2	0.97	0.85	9.94	0.010	1.137	C-22
C-20	C-21	15	60	67	50	15.5	-	-	-	15.5	2	3	7.2	0.97	1.25	19.40	0.018	1.127	C-21
C-19	C-20	15	75	82	50	18.6	-	-	-	18.6	2	3	7.2	0.97	1.25	26.30	0.025	1.009	C-20
C-18	C-19	30	90	105	50	23.1	-	-	-	23.1	2	3	7.2	0.97	1.56	36.20	0.030	0.984	C-19
C-17	C-18	10	120	125	50	27.0	-	-	-	27.0	2	3	7.2	0.97	1.66	50.02	0.049	0.954	C-18
C-16	C-17	10	130	135	50	28.9	-	-	-	28.9	2	3	7.2	0.97	3.10	93.00	0.090	0.907	C-17
C-15	C-16	30	140	155	50	32.7	-	-	-	32.7	2	3	7.2	0.97	1.86	68.80	0.067	0.817	C-16
C-14	C-15	6	170	173	50	36.0	-	-	-	36.0	2	3	7.2	0.97	2.8	100.20	0.097	0.750	C-15
C-13	C-14	6	172	175	50	36.5	-	-	-	36.5	2	3	7.2	0.97	0.68	24.82	0.024	0.653	C-14
C-12	C-13	6	178	181	50	37.9	-	-	-	37.9	2	3	7.2	0.97	0.31	11.45	0.011	0.629	C-13
C-11	C-12	6	184	187	50	39.3	-	-	-	39.3	2	3	7.2	0.97	0.20	7.63	0.007	0.618	C-12
C-10	C-11	10	194	199	50	30.7	-	-	-	40.7	2	3	7.2	0.97	0.52	21.20	0.020	0.611	C-11
C-9	C-10	15	204	211	50	43.1	-	-	-	43.1	2	3	7.2	0.97	0.56	24.25	0.023	0.591	C-10
C-8	C-9	6	219	221	50	45.2	-	-	-	45.2	2	3	7.2	0.97	0.40	18.20	0.017	0.568	C-9
C-7	C-8	6	225	228	50	46.3	-	-	-	46.3	2	3	7.2	0.97	0.93	43.00	0.042	0.551	C-8
C-6	C-7	10	235	240	50	48.6	-	-	-	48.6	2	3	7.2	0.97	0.52	25.30	0.024	0.509	C-7
C-5	C-6	10	245	250	50	50.0	-	-	-	50.5	2	3	7.2	0.97	0.25	12.60	0.012	0.486	C-6
C-4	C-5	20	265	275	50	55.0	-	-	-	55.0	2	3	7.2	0.97	0.73	40.20	0.093	0.473	C-5
C-3	C-4	10	275	280	50	55.9	-	-	-	55.9	2	3	7.2	0.97	0.41	22.81	0.022	0.434	C-4
C-2	C-3	10	285	290	50	57.8	-	-	-	57.8	2	3	7.2	0.97	1.24	71.85	0.068	0.412	C-3
C-1	C-2	170	455	540	50	104.0	-	-	-	104.0	2	3	7.2	0.97	2.25	233.65	0.200	0.344	C-2
A-0	C-1	496.4	625	873.3	50	766.0	-	-	-	166.0	2	3	7.2	0.97	0.93	152.00	0.144	0.144	C-1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.000	A-0
										Long.	= 26.16 Miles			= 42.09 Km.				

NOTE: Point A-0 is the place where Achacachi S/S will be located.

C-27	C-28	13.2	0	6.6	50	2.16	-	-	-	2.16	2	3	7.2	0.97	1	2.16	0.002	0.650	C-28
C-26	C-27	13.2	13.2	19.8	50	5.38	-	-	-	5.38	2	3	7.2	0.97	1	5.38	0.005	0.648	C-27
C-25	C-26	100.0	26.4	76.4	50	17.50	-	-	-	17.50	2	3	7.2	0.97	1.42	24.8	0.024	0.643	C-26
C-2	C-25	20.0	126.	156.4	50	29.50	-	-	-	29.50	2	3	7.2	0.97	7.6	224.0	0.275	0.619	C-25
C-0	C-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.344	0.344	C-0
															Long = 11.02 Miles	= 17.73 Km.			

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION:

SUBSTATION: HUATAJATA - ACHACACHI

SYSTEM DESIGN: 50 Kwh/No/Con.

SYSTEM ENGINEER: CCBCE

CIRCUITS: HUATAJATA - COPACABANA

DATE: 12/9/72

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED												
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	AT POINT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A27	A28	500	0	150	50	318	–	–	–	31.8	2	3	7.2	0.97	5.6	178.08	0.173	4.796	A28
A26	A27	40	500	320	50	63.3	–	–	–	63.3	2	3	7.2	0.97	3.7	234.21	0.227	4.623	A27
A25	A26	50	340	365	50	71.4	–	–	–	71.4	2	3	7.2	0.97	3.4	242.76	0.235	4.396	A26
A24	A25	40	390	410	50	79.8	–	–	–	79.8	2	3	7.2	0.97	1.56	124.49	0.121	4.161	A25
A23	A24	20	430	440	50	85.4	–	–	–	85.4	2	3	7.2	0.97	2.2	187.88	0.182	4.040	A24
A22	A23	25	450	462	50	88.0	–	–	–	88.0	2	3	7.2	0.97	1.06	93.28	0.090	3.858	A23
A21	A22	25	475	487	50	93.7	–	–	–	93.7	2	3	7.2	0.97	1.00	93.70	0.091	3.768	A22
A20	A21	100	500	596	50	115.00	–	–	–	115.0	2	3	7.2	0.97	1.00	115.00	0.116	3.677	A21
A19	A20	100	692	788	50	151.50	–	–	–	151.5	2	3	7.2	0.97	1.00	151.50	0.147	3.561	A20
A18	A19	100	884	980	50	187.00	–	–	–	187.0	2	3	7.2	0.97	1.00	187.00	0.181	3.414	A19
A17	A18	100	1076	1172	50	223.00	–	–	–	223.0	2	3	7.2	0.97	1.00	223.00	0.216	3.233	A18
A16	A17	100	1268	1364	50	258.00	–	–	–	258.0	2	3	7.2	0.97	1.00	258.00	0.250	3.017	A17
A15	A16	100	1460	1556	50	294.00	–	–	–	294.0	2	3	7.2	0.97	1.00	294.00	0.285	2.767	A16
A14	A15	100	1652	1748	50	330.00	–	–	–	330.0	2	3	7.2	0.97	1.00	330.00	0.320	2.482	A15
A13	A14	100	1844	1940	50	368.00	–	–	–	368.0	2	3	7.2	0.97	1.00	368.00	0.357	2.162	A14
A12	A13	100	2036	2132	50	403.00	–	–	–	403.0	2	3	7.2	0.97	1.00	403.00	0.391	1.805	A13
A11	A12	100	2228	2324	50	439.00	–	–	–	439.0	2	3	7.2	0.97	1.00	439.00	0.426	1.414	A12
A10	A11	100	2320	2516	50	475.00	–	–	–	475.0	2	3	7.2	0.97	1.00	475.00	0.461	0.988	A11
A9	A10	100	2612	2708	50	512.00	–	–	–	512.0	2	3	7.2	0.97	1.00	512.00	0.497	0.527	A10
A9A	A9	100	2804	2900	50	548.00	–	–	–	548.0	2	3	7.2	0.97	0.06	32.88	0.030	0.030	A9
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5.54	–	0.000	0.000	A9ax
																	5.567	–	A3

NOTE: On point A9 a volt regulator will be placed this voltage drop calculation of the Copacabana Huatajata branch replaces this one made on page 1 to 4, without voltage regulator.

UNCLASSIFIED
ANNEX III
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Hoja 1 de 2

U.S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION:

SYSTEM ENGINEER: COBEE

SUBSTATION: CHAGUAYA

CIRCUITS: CHAGUAYA-PTO. ACOSTA

SYSTEM DESIGN: 50 Kcb/Kb/con.

DATE: 4/9/72

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED												
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	Ø	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	AT POINT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-[illegible]	A-39	50	0	25	50	6.60	-	-	-	6.60	2	3	7.2	0.97	1	6.60	0.006	3.235	A-38
A-38	A-37	15	50	57	50	13.50	-	-	-	13.50	2	3	7.2	0.97	1	13.50	0.013	3.229	A-37
A-37	A-36	15	65	72	50	16.60	-	-	-	16.60	2	3	7.2	0.97	1	16.60	0.016	3.216	A-36
A-36	A-35	15	80	87	50	19.50	-	-	-	19.50	2	3	7.2	0.97	1	19.50	0.018	3.200	A-35
A-35	A-34	15	95	102	50	22.50	-	-	-	22.50	2	3	7.2	0.97	1	22.50	0.021	3.182	A-34
A-34	A-33	15	110	117	50	25.50	-	-	-	25.50	2	3	7.2	0.97	1	25.50	0.024	3.161	A-33
A-33	A-32	15	125	132	50	28.36	-	-	-	28.36	2	3	7.2	0.97	1	28.36	0.027	3.137	A-32
A-32	A-31	15	140	147	50	31.20	-	-	-	31.20	2	3	7.2	0.97	1	31.20	0.030	3.110	A-31
A-31	A-30	15	155	162	50	34.00	-	-	-	34.00	2	3	7.2	0.97	1	34.00	0.032	3.080	A-30
A-30	A-29	15	170	177	50	36.86	-	-	-	36.86	2	3	7.2	0.97	1	36.86	0.035	3.048	A-29
A-29	A-28	15	185	192	50	39.58	-	-	-	39.58	2	3	7.2	0.97	1	39.58	0.038	3.013	A-28
A-28	A-27	15	200	207	50	42.50	-	-	-	42.50	2	3	7.2	0.97	1	42.50	0.041	2.975	A-27
A-27	A-26	15	215	222	50	45.36	-	-	-	45.36	2	3	7.2	0.97	1	45.36	0.043	2.934	A-26
A-26	A-25	15	230	237	50	48.00	-	-	-	48.00	2	3	7.2	0.97	1	48.00	0.046	2.891	A-25
A-25	A-24	15	245	252	50	49.50	-	-	-	49.50	2	3	7.2	0.97	1	49.50	0.048	2.845	A-24
A-24	A-23	15	260	267	50	53.66	-	-	-	53.66	2	3	7.2	0.97	1	53.66	0.052	2.797	A-23
A-23	A-22	15	275	282	50	56.30	-	-	-	56.30	2	3	7.2	0.97	1	56.30	0.054	2.745	A-22
A-22	A-21	15	290	297	50	58.96	-	-	-	58.96	2	3	7.2	0.97	1	58.96	0.057	2.691	A-21
A-21	A-20	15	305	312	50	61.76	-	-	-	61.76	2	3	7.2	0.97	1	61.76	0.059	2.634	A-20
A-20	A-19	15	320	327	50	64.49	-	-	-	64.49	2	3	7.2	0.97	1	64.49	0.062	2.575	A-19
A-19	A-18	15	335	342	50	67.28	-	-	-	67.28	2	3	7.2	0.97	1	67.28	0.065	2.513	A-18
A-18	A-17	15	350	357	50	39.99	-	-	-	39.99	2	3	7.2	0.97	1	39.99	0.038	2.448	A-17
A-17	A-16	15	365	372	50	72.76	-	-	-	72.76	2	3	7.2	0.97	1	72.76	0.070	2.410	A-16
A-16	A-15	15	380	387	50	75.63	-	-	-	75.63	2	3	7.2	0.97	1	75.63	0.073	2.340	A-15
A-15	A-14	15	395	402	50	78.26	-	-	-	78.26	2	3	7.2	0.97	1	78.26	0.075	2.267	A-14
A-14	A-13	325	410	572	50	110.40	-	-	-	110.40	2	3	7.2	0.97	0.75	82.80	0.080	2.192	A-13
A-13	A-12	80	755	775	50	149	-	-	-	149	2	3	7.2	0.97	1.8	268.20	0.260	2.112	A-12
A-12	A-11	6	815	818	50	156.60	-	-	-	156.60	2	3	7.2	0.97	1	156.60	0.151	1.852	A-11
A-11	A-10	6	821	824	50	157.80	-	-	-	157.80	2	3	7.2	0.97	1	157.80	0.153	1.703	A-10
A-10	A-9	14	827	834	50	167.80	-	-	-	167.80	2	3	7.2	0.97	1	167.80	0.162	1.549	A-9
A-9	A-8	10	841	846	50	141.20	-	-	-	141.20	2	3	7.2	0.97	1	141.20	0.136	1.387	A-8
A-8	A-7	[illegible]	[illegible]	[illegible]	50	164.60	-	-	-	164.60	2	3	7.2	0.97	1.24	[illegible]	0.197	1.251	A-7
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	[illegible]	-	-	-	166.50	2	3	7.2	0.97	1	[illegible]	0.161	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	[illegible]	-	-	-	78.00	2	3	7.2	0.97	1	[illegible]	[illegible]	[illegible]	[illegible]

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U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION:

SUBSTATION: CHAGUAYA

SYSTEM DESIGN: 50 Kwh/MO/CON

SYSTEM ENGINEER: COBEE

CIRCUITS: CHAGUAYA – PTO. ACOSTA

DATE: 4-9-72

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED												
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	Φ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	AT POINT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-3	A-4	10	925	930	50	178	–	–	–	178	2	3	7.2	0.97	0.50	89	0.086	0.722	A-4
A-2	A-3	20	935	945	50	941	–	–	–	941	2	3	7.2	0.97	0.50	470.50	0.456	0.636	A-3
A-1	A-2	30	955	970	50	185.50	–	–	–	185.50	2	3	7.2	0.97	0.75	139.12	0.134	0.180	A-2
A-0	A-1	14	985	992	50	190.60	–	–	–	190.60	2	3	7.2	0.97	0.25	47.65	0.046	0.046	A-1

NOTE: Point A-0 is the place where will be situated the Substation Chaguaya

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U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION:

SUBSTATION: TIAWANAKU

SYSTEM DESIGN: 50 KVE/KO/CONS

SYSTEM ENGINEER: COBEE

CIRCUITS: DESAGUADERO TIAWANAKU

DATE: 8/8/72

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED												
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	AT POINT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-41	A-42	70	0	35	50	5.8	-	-	-	8.8	2	3	7.2	0.97	1	8.8	0.009	6.540	A-42
A-40	A-41	75	70	107	50	24.0	-	-	-	24.00	2	3	7.2	0.97	1	24.00	0.023	6.508	A-41
A-39	A-40	75	145	182	50	38.40	-	-	-	38.40	2	3	7.2	0.97	1	38.40	0.037	6.508	A-40
A-38	A-39	75	220	257	50	51.40	-	-	-	51.40	2	3	7.2	0.97	1	51.40	0.050	6.471	A-39
A-37	A-38	75	295	332	50	65.00	-	-	-	65.00	2	3	7.2	0.97	1	65.00	0.063	6.421	A-38
A-36	A-37	75	370	407	50	78.00	-	-	-	78.00	2	3	7.2	0.97	1	78.00	0.075	6.358	A-37
A-35	A-36	75	445	482	50	93.00	-	-	-	93.00	2	3	7.2	0.97	1	93.00	0.090	6.283	A-36
A-34	A-35	75	520	557	50	107.00	-	-	-	107.00	2	3	7.2	0.97	1	107.00	0.104	6.193	A-35
A-33	A-34	75	595	632	50	122.00	-	-	-	122.00	2	3	7.2	0.97	1	122.00	0.118	6.089	A-34
A-32	A-33	75	670	707	50	135.00	-	-	-	135.00	2	3	7.2	0.97	1	135.00	0.131	5.971	A-33
A-31	A-32	75	745	782	50	150.00	-	-	-	150.00	2	3	7.2	0.97	1	150.00	0.145	5.840	A-32
A-30	A-31	75	820	857	50	165.00	-	-	-	165.00	2	3	7.2	0.97	1	165.00	0.160	5.695	A-31
A-29	A-30	461	895	1070	50	185.00	-	-	-	185.00	2	3	7.2	0.97	3	555.00	0.540	5.535	A-30
A-28	A-29	90	1004	1119	50	205.00	-	-	-	205.00	2	3	7.2	0.97	1	205.00	0.200	4.995	A-29
A-27	A-28	242	1235	1466	50	278.00	-	-	-	276.00	2	3	7.2	0.97	4	1.105.00	1.080	4.795	A-28
A-26	A-27	66	1537	1570	50	354.00	-	-	-	354.00	2	3	7.2	0.97	1	354.00	0.344	3.715	A-27
A-25	A-26	66	1603	1636	50	365.00	-	-	-	365.00	2	3	7.2	0.97	1	365.00	0.355	3.371	A-26
A-24	A-25	66	1939	2002	50	582.00	-	-	-	382.00	2	3	7.2	0.97	1	382.00	0.371	3.016	A-25
A-23	A-24	66	2005	2068	50	385.00	-	-	-	385.00	2	3	7.2	0.97	1	385.00	0.375	2.645	A-24
A-22	A-23	66	2101	2134	50	402.00	-	-	-	402.00	2	3	7.2	0.97	1	402.00	0.390	2.270	A-23
A-21	A-22	545	2167	2589	50	486.00	-	-	-	486.00	2	3	7.2	0.97	1	486.00	0.472	1.880	A-22
A-20	A-21	122	3012	3073	50	580.00	-	-	-	580.00	2	3	7.2	0.97	1	1450.00	1410	1.410	A-21
A-19	A-20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.000	A-20

Long. Total = 28.50 Millas = 45.85 Kms.

Point A-20, is the place the Substation Tiwanaku where will be situated.

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION:

SUBSTATION: TIAWANAKU

SYSTEM DESIGN: 50 KWH/MO/CONS

SYSTEM ENGINEER: COBEE

CIRCUITS: SAN JOSE - GUARAYA

DATE: 8/8/72

SECTION		LOAD									LINE								
		CONSUMERS					CONCENTRATED										VOLTAGE DROP		
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN Mi.	KW MILES	THIS SECTION	TOTAL	AT POI
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
-17	A-18	30	0	15	50	4.29	-	-	-	4.29	2	3	7.2	0.97	1	4.29	0.004	3.001	B-
-16	B-17	30	70	85	50	19.10	-	-	-	19.10	2	3	7.2	0.97	1	19.10	0.019	2.997	B-
-15	B-16	30	100	115	50	25.10	-	-	-	25.10	2	3	7.2	0.97	1	25.10	0.024	2.978	B-
-14	B-15	30	130	145	50	30.80	-	-	-	30.80	2	3	7.2	0.97	1	30.80	0.030	2.954	B-
-13	B-14	30	160	175	50	36.50	-	-	-	36.50	2	3	7.2	0.97	1	36.50	0.035	2.924	B-
-12	B-13	30	190	205	50	42.10	-	-	-	42.10	2	3	7.2	0.97	1	42.10	0.041	2.889	B-
-11	B-12	30	210	225	50	45.90	-	-	-	45.90	2	3	7.2	0.97	1	45.90	0.045	2.848	B-
-10	B-11	84	240	282	50	57.40	-	-	-	57.40	2	3	7.2	0.97	1	57.40	0.056	2.803	B-
-9	B-10	6	324	327	50	64.50	-	-	-	64.50	2	3	7.2	0.97	1	64.50	0.063	2.747	B-
-8	B-9	6	330	333	50	65.30	-	-	-	65.30	2	3	7.2	0.97	1	65.30	0.063	2.684	B-
-7	B-8	6	336	339	50	65.80	-	-	-	65.80	2	3	7.2	0.97	1	65.80	0.064	2.621	B-
-6	B-7	6	342	345	50	67.70	-	-	-	67.70	2	3	7.2	0.97	1	67.70	0.066	2.557	B-
-5	B-6	40	348	368	50	70.70	-	-	-	70.70	2	3	7.2	0.97	1	70.70	0.069	2.491	B-6
-4	B-5	25	388	400	50	77.98	-	-	-	77.98	2	3	7.2	0.97	1	77.98	0.076	2.422	B-5
-3	B-4	25	413	425	50	82.60	-	-	-	82.60	2	3	7.2	0.97	1	82,60	0.080	2.346	B-4
-2	B-3	277	438	576	50	111.20	-	-	-	111.20	2	3	7.2	0.97	1	111.20	0.108	2.266	B-3
-1	B-2	25	715	727	50	140.00	-	-	-	140.00	2	3	7.2	0.97	1	140.00	0.136	2.158	B-2
-21	B-1	25	740	752	50	144.40	-	-	-	144.40	2	3	7.2	0.97	1	144.40	0.140	2.022	B-1
-22	A-22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.472	1.882	A-2
-20	A-21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.410	1.410	A-2

Long. Total = 18 Millas = 28.96 Km.

Note: Point A-20, is the place the Substation Tiwanaku where will be situated.

FORM 239 REV 3-57

UNCLASSIFIED
ANNEX III
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U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION:

SUBSTATION: TIAWANAKU

SYSTEM DESIGN: 50 KVH/KO/CONS

SYSTEM ENGINEER: COBEK

CIRCUITS: LAJA - TIAWANAKU

DATE: 8/8/72

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED			TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	P
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
A-2	A-1	60	0	30	50	7.69	-	-	-	7.69	2	3	7.2	0.97	1	7.69	0.007	0.852	A
A-3	A-2	17	60	68	50	15.70	-	-	-	15.70	2	3	7.2	0.97	1	15.70	0.015	0.845	A
A-4	A-3	17	77	85	50	19.20	-	-	-	19.20	2	3	7.2	0.97	1	19.20	0.018	0.830	A
A-5	A-4	17	94	102	50	22.50	-	-	-	22.50	2	3	7.2	0.97	1	22.50	0.022	0.812	A
A-6	A-5	17	111	119	50	25.90	-	-	-	25.90	2	3	7.2	0.97	1	25.90	0.025	0.790	A
A-7	A-6	17	128	136	50	29.14	-	-	-	29.14	2	3	7.2	0.97	1	29.14	0.028	0.765	A
A-8	A-7	17	145	153	50	32.34	-	-	-	32.34	2	3	7.2	0.97	1	32.34	0.031	0.737	A
A-9	A-8	17	162	170	50	35.50	-	-	-	35.50	2	3	7.2	0.97	1	35.50	0.034	0.706	A
A-10	A-9	17	179	187	50	38.76	-	-	-	38.76	2	3	7.2	0.97	1	38.76	0.037	0.672	A
A-11	A-10	33	196	212	50	43.46	-	-	-	43.46	2	3	7.2	0.97	1	43.46	0.042	0.635	A
A-12	A-11	15	229	236	50	47.06	-	-	-	47.06	2	3	7.2	0.97	1	47.06	0.046	0.593	A
A-13	A-12	15	244	251	50	50.68	-	-	-	50.68	2	3	7.2	0.97	1	50.68	0.049	0.547	A
A-14	A-13	15	259	266	50	54.02	-	-	-	54.02	2	3	7.2	0.97	1	54.02	0.052	0.498	A
A-15	A-14	15	274	281	50	55.40	-	-	-	55.40	2	3	7.2	0.97	1	55.40	0.054	0.446	A
A-16	A-15	15	289	296	50	5878	-	-	-	58.78	2	3	7.2	0.97	1	58.78	0.057	0.392	A
A-17	A-16	15	304	311	50	61.59	-	-	-	61.59	2	3	7.2	0.97	1	61.59	0.060	0.335	A
A-18	A-17	15	319	326	50	64.32	-	-	-	64.32	2	3	7.2	0.97	1	64.32	0.062	0.275	A
A-19	A-18	15	334	341	50	67.08	-	-	-	67.08	2	3	7.2	0.97	1	67.08	0.065	0.213	A
A-20	A-19	15	349	356	50	69.82	-	-	-	69.82	2	3	7.2	0.97	1	69.82	0.068	0.148	A
A-21	A-20	122	364	425	50	82.74	-	-	-	82.74	2	3	7.2	0.97	1	82.74	0.080	0.080	A

Long. Total = 20 Millas = 32.18 Km.

Note: Point A-20. is the place the Substation Tiwanaku where will be situated.

ANNEX III
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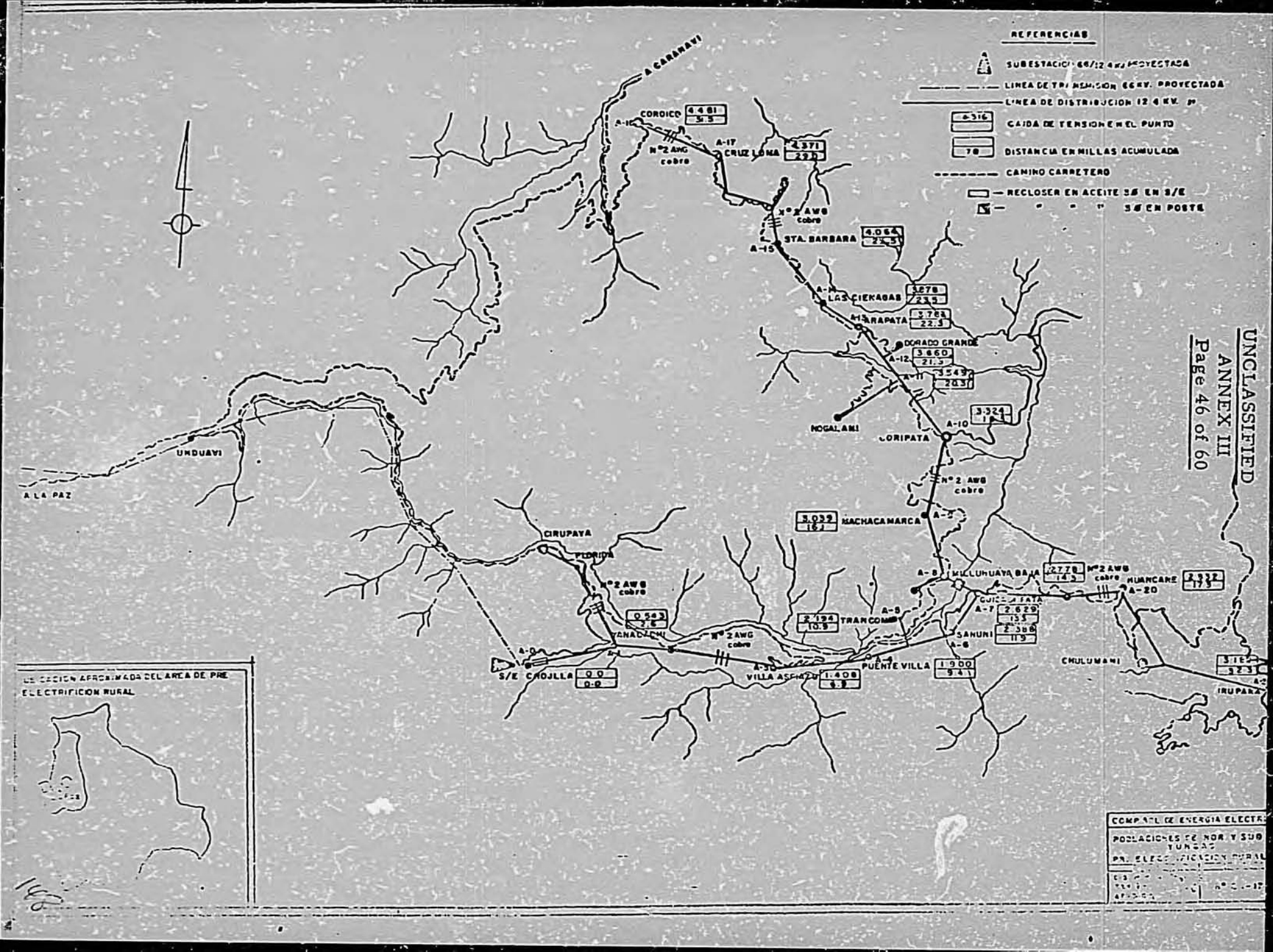
RCA FORM 239 REV 2-57


REFERENCIAS
SUBESTACION 66/12.4 KV. PROYECTADA
LINEA DE TRANSMISION 66 KV. PROYECTADA
LINEA DE DISTRIBUCION 12.4 KV. EN
CAIDA DE TENSION EN EL PUNTO
DISTANCIA EN MILLAS ACUMULADA
CAMINO CARRETERO
RECLOSER EN ACEITE 3Ø EN S/E
3Ø EN POSTE
A CARANAVI
CORDICO
4.481
5.5
A-16
A-17
CRUZ LOMA
4.371
29.0
N°2 AWG cobre
N°2 AWG cobre
STA. BARBARA
4.064
25.5
A-15
A-14
LAS CIENAGAS
3.878
23.5
MARAPATA
3.783
22.5
DORADO GRANDE
A-12
3.660
21.5
3.549
20.5
3.324
NOGALANI
A-10
CORIPATA
UNDUAVI
A LA PAZ
N°2 AWG cobre
3.032
16.1
MACHACAMARCA
A-9
CIRUPAYA
FLORIDA
N°2 AWG cobre
A-8
MILLUHUAYA BAJA
2.778
14.5
N°2 AWG cobre
HUANCANE
A-20
3.922
19.5
0.563
2.6
2.194
10.5
TRANCOMA
A-5
A-7
2.629
13.5
2.388
11.9
SANUNI
A-6
N°2 AWG cobre
A-4
A-3
A-2
S/E CANOJILLA
0.0
0.0
A-1
A-0
1.408
6.3
PUENTE VILLA
1.900
9.4
CHULUMANI
IRUPARA
UBICACION APROXIMADA DEL AREA DE PRE ELECTRIFICION RURAL
COMPAÑIA DE ENERGIA ELECTR
POBLACIONES DE NOR Y SUD YUNGAS
PR. ELECTRIFICACION RURAL

U.S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION:

SUBSTATION: CHOJLLA

SYSTEM DESIGN: 75 KWH/MO/CONS

SYSTEM ENGINEER: COBEE

CIRCUITS: CHOJLLA - COROICO

DATE: 12-9-72

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED			TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	Φ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	AT POINT
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A-17	A-18	300	-	150	75	45.4	-	-	-	45.4	2	3	7.2	0.97	2.5	113.50	0.110	4.481	A-18
A-16	A-17	30	300	315	75	89.15	-	-	-	89.15	2	3	7.2	0.97	2.5	222.87	0.216	4.371	A-17
A-15	A-16	5	330	332.5	75	93.57	-	-	-	93.57	2	3	7.2	0.97	1.0	93.57	0.091	4.155	A-16
A-14	A-15	12	335	341	75	95.87	-	-	-	95.87	2	3	7.2	0.97	2.0	191.74	0.186	4.064	A-15
A-13	A-14	10	347	352	75	98.84	-	-	-	98.84	2	3	7.2	0.97	1.2	118.60	0.115	3.878	A-14
A-12	A-13	50	357	482	75	106.60	-	-	-	106.60	2	3	7.2	0.97	1.0	106.60	0.103	3.763	A-13
A-11	A-12	10	407	412	75	114.60	-	-	-	114.60	2	3	7.2	0.97	1.0	114.60	0.111	3.660	A-12
A-10	A-11	15	417	424	75	116.20	-	-	-	116.20	2	3	7.2	0.97	2.0	232.40	0.225	3.549	A-11
A-9	A-10	100	432	482	75	133.40	-	-	-	133.40	2	3	7.2	0.97	2.2	293.48	0.285	3.324	A-10
A-8	A-9	20	532	542	75	149.40	-	-	-	149.40	2	3	7.2	0.97	1.8	268.92	0.261	3.039	A-9
A-7	A-8	15	552	559	75	153.70	-	-	-	153.70	2	3	7.2	0.97	1.0	153.70	0.149	2.778	A-8
A-6	A-7	158	567	646	75	177.50	-	-	-	177.50	2	3	7.2	0.97	1.4	248.50	0.241	2.629	A-7
A-5	A-6	8	725	729	75	200.25	-	-	-	200.25	2	3	7.2	0.97	1.0	200.25	0.194	2.388	A-6
A-4	A-5	6	733	736	75	202.00	-	-	-	202.00	2	3	7.2	0.97	1.5	303.00	0.294	2.194	A-5
A-3	A-4	2	739	740	75	203.00	-	-	-	203.00	2	3	7.2	0.97	2.5	507.50	0.492	1.900	A-4
A-2	A-3	25	741	753	75	206.25	-	-	-	206.25	2	3	7.2	0.97	3.0	618.75	0.600	1.408	A-3
A-1	A-2	5	766	768	75	210.40	-	-	-	210.40	2	3	7.2	0.97	1.3	273.52	0.265	0.808	A-2
A-0	A-1	30	771	786	75	215.50	-	-	-	215.50	2	3	7.2	0.97	2.6	560.30	0.543	0.543	A-1
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.000	A-0

NOTE: Point A-0 is the place the Substation CHOJLLA where will be situated

A-20	A-21	150	-	75	75	24.5	-	-	-	24.5	2	3	7.2	0.97	15	367.500	0.356	3.185	A-21
A-19	A-20	30	150	165	75	49.4	-	-	-	49.4	2	3	7.2	0.97	1.5	74.100	0.070	2.852	A-20
A-7	A-19	10	180	185	75	54.8	-	-	-	54.8	2	3	7.2	0.97	2.5	137.000	0.133	2.782	A-19
																		2.629	A-7

ANNEX III
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REFERENCIAS

LINEA DE TRANSMISION 6.6 KV. EXISTENTE

LINEA DE TRANSMISION 6 6KV.

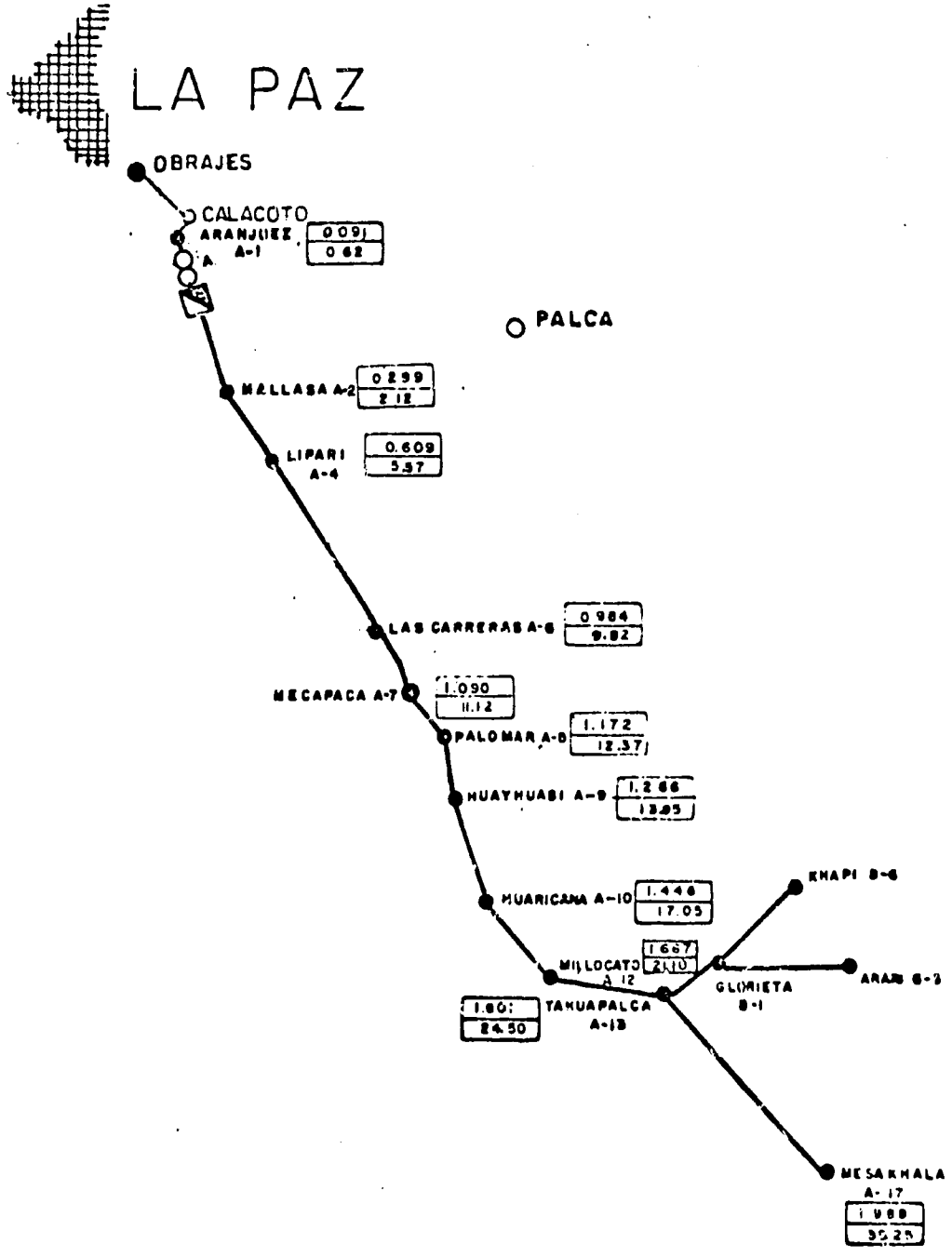
LINEA DE DISTRIBUCION 12.4 KV.

1.173 — CAIDA DE TENSION EN EL PUNTO

12.57 — DISTANCIA EN MILLAS ACUMULADA

AUTO TRANSFORMADOR

RECLOSER ENACEITE 34' EN POSTE



NA DE ENERGIA ELECTRICA S.A.
ILIVIAN POWER

RIO ABAJO
BUCION PRIMARIA
EN 12.4 KV.

RE 1972 ESCALA: 1:250.000

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION:

SYSTEM ENGINEER: COBEE

SUBSTATION: CALACOTO

CIRCUITS: CALACOTO - CAHONI

SYSTEM DESIGN: 100 KWH/KO/CSMo.

DATE: 12-9-72

SECTION		LOAD									LINE								
		CONSUMERS					CONCENTRATED											VOLTAGE DROP	
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	P
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
A-16	A-17	-	-	-	100	-	50	-	25	25	2	3	7.2	0.97	2	50	0.049	1.988	A
A-15	A-16	30	0	15	100	7.90	-	-	-	7.90	2	3	7.2	0.97	1.9	15.01	0.016	1.939	A
A-14	A-15	-	30	30	100	14.20	-	-	-	14.20	2	3	7.2	0.97	3.75	53.25	0.052	1.923	A
A-13	A-14	35	30	47.50	100	23.40	-	-	-	23.40	2	3	7.2	0.97	3.10	72.54	0.070	1.871	A
A-12	A-13	70	65	100.00	100	40.70	-	-	-	40.70	2	3	7.2	0.97	3.40	138.38	0.134	1.801	A
A-11	A-12	8	135	139.00	100	54.88	-	-	-	54.88	2	3	7.2	0.97	0.95	52.14	0.051	1.667	A
A-10	A-11	6	141	144.00	100	56.42	-	-	-	56.42	2	3	7.2	0.97	3.10	174.90	0.170	1.616	A
A-9	A-10	5	146	148.50	100	59.76	-	-	-	59.76	2	3	7.2	0.97	3.10	185.26	0.180	1.446	A
A-8	A-9	8	154	158.00	100	61.22	-	-	-	61.22	2	3	7.2	0.97	1.58	96.73	0.094	1.266	A
A-7	A-8	15	169	176.50	100	67.71	-	-	-	67.71	2	3	7.2	0.97	1.25	84.64	0.082	1.172	A
A-6	A-7	50	219	244.00	100	90.84	-	-	-	90.84	2	3	7.2	0.97	1.20	109.01	0.106	1.090	A
A-5	A-6	10	229	234.00	100	87.36	-	-	-	87.36	2	3	7.2	0.97	2.50	218.40	0.212	0.984	A
A-4	A-5	10	239	244.00	100	90.84	-	-	-	90.84	2	3	7.2	0.97	1.85	168.05	0.163	0.772	A
A-3	A-4	5	244	246.50	100	91.61	-	-	-	91.61	2	3	7.2	0.97	1.55	142.00	0.138	0.609	A
A-2	A-3	5	249	251.50	100	93.44	-	-	-	93.44	2	3	7.2	0.97	1.90	177.54	0.172	0.471	A
A-1	A-2	100	349	399.00	100	142.70	-	-	-	142.70	2	3	7.2	0.97	1.50	214.05	0.208	0.299	A
A-0	A-1	50	399	424.00	100	151.60	-	-	-	151.60	2	3	7.2	0.97	0.62	93.99	0.091	0.091	A
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.000	A

LONG. Total = 35.25 Millas = 56.71 Km.

NOTE: On Point A-0 will be situated an Autotransformer of 6.9 kv to 12.4 kv

REA FORM 7-7 REV 3-57

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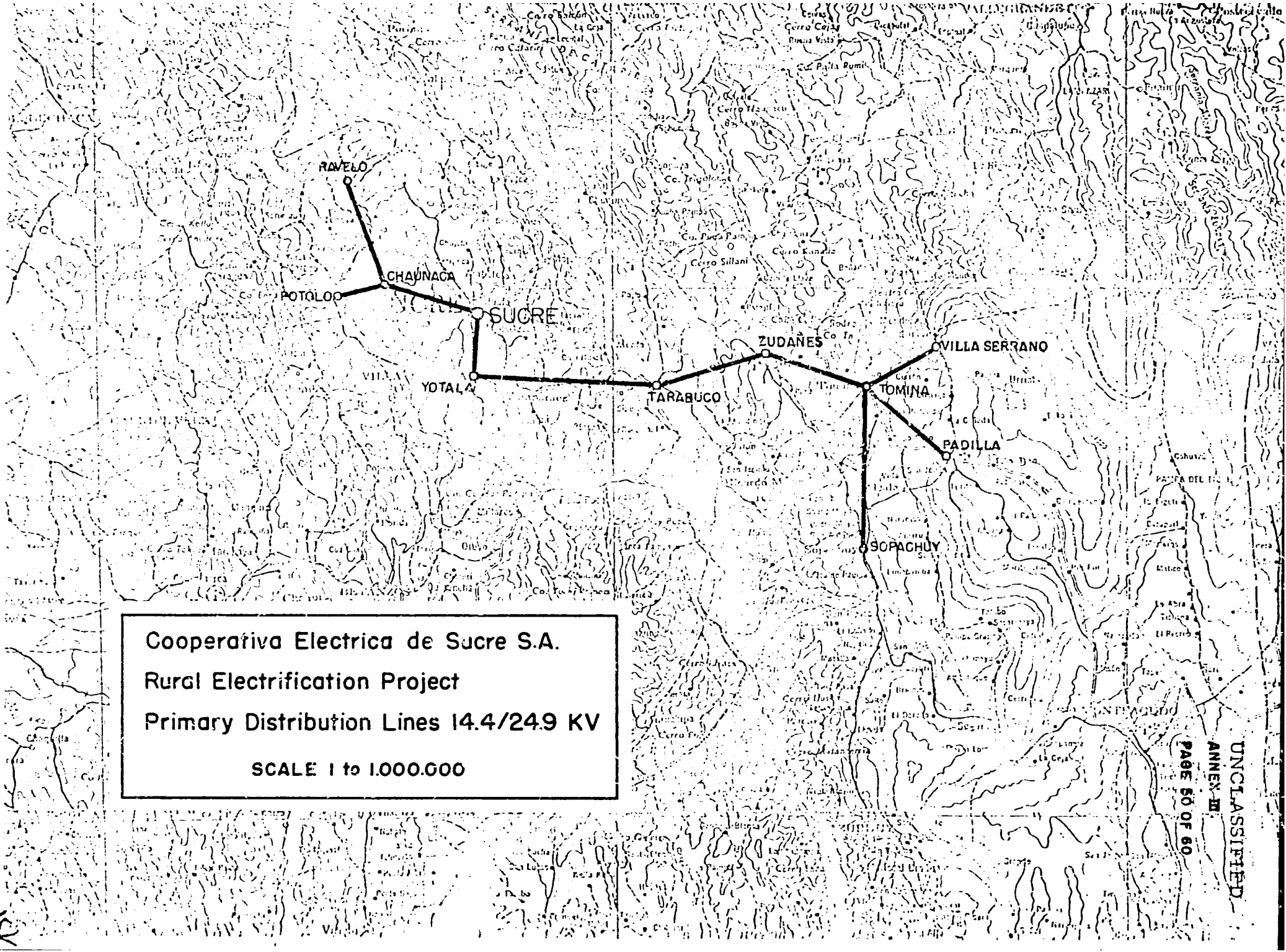

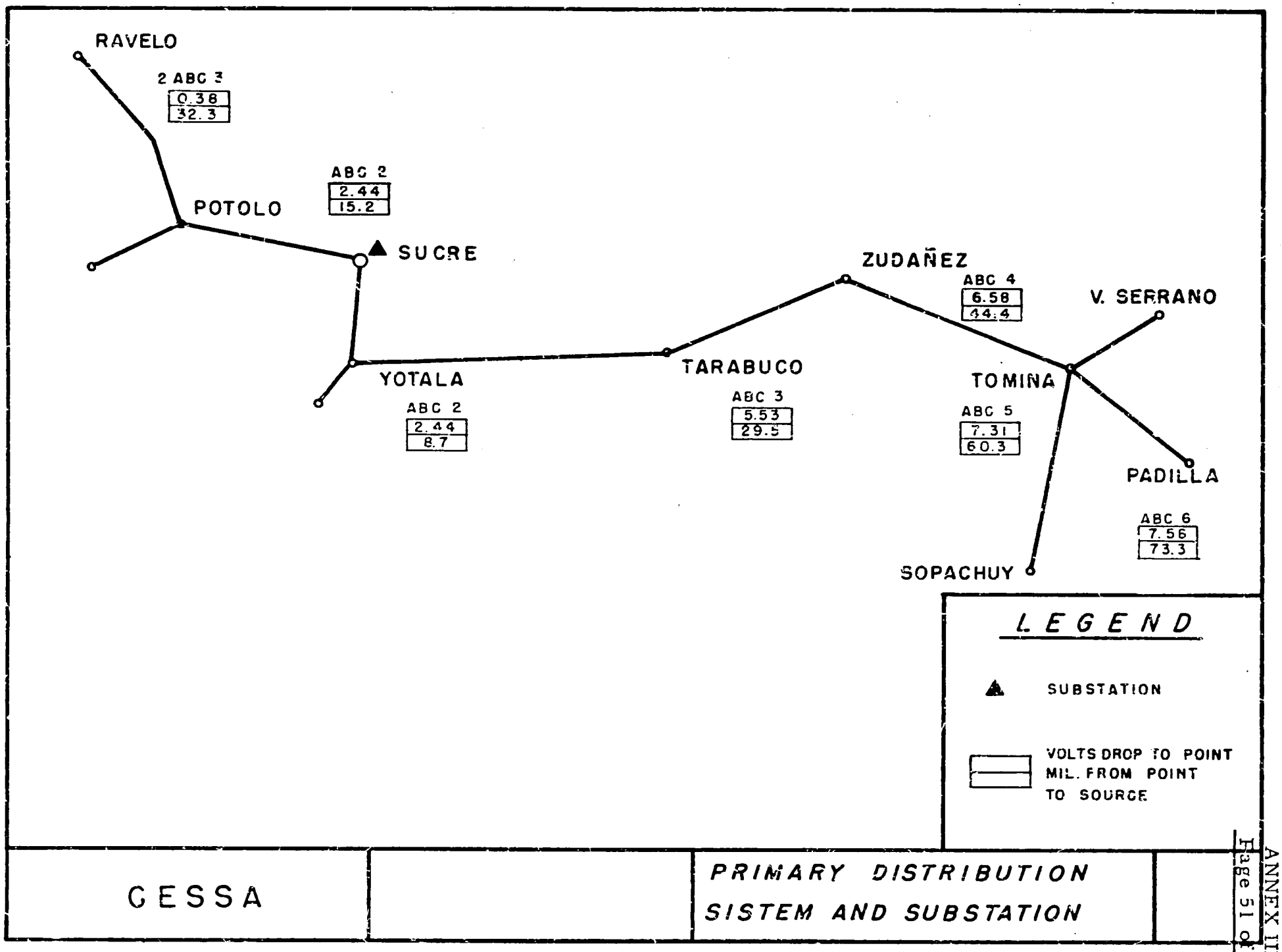
RAVELO
2 ABC 3
0.38
32.3
POTOLO
ABC 2
2.44
15.2
SUCRE
YOTALA
ABC 2
2.44
8.7
TARABUCO
ABC 3
5.53
29.5
ZUDAÑEZ
ABC 4
6.58
44.4
V. SERRANO
TOMINA
ABC 5
7.31
60.3
PADILLA
ABC 6
7.56
73.3
SOPACHUY
LEGEND
SUBSTATION
VOLTS DROP TO POINT
MIL. FROM POINT
TO SOURCE
CESSA
PRIMARY DISTRIBUTION
SISTEM AND SUBSTATION

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION: CESSA

SYSTEM ENGINEER:

SUBSTATION: SUCRE

CIRCUITS: 1 & 2

SYSTEM DESIGN: 56 KWH/MO./CON

DATE: 09-6-73

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED			TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	A PO
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	2
ABC 5	ABC 6	100	400	450	50	87.3				87.3	2	3	14.4	.241	13.0	1135	0.27	7.58	ABC
ABC 4	ABC 5	200	900	1000	50	191.				191.	2	3	14.4		15.9	3040	0.73	7.31	ABC
ABC 3	ABC 4	300	1400	1550	50	293				293	2	3	14.4		14.9	4360	1.05	6.58	ABC
ABC 2	ABC 3	900	2800	3250	50	615				615	2	3	14.4		20.8	12800	3.09	5.53	ABC
ABC 1	ABC 2	1100	5600	6150	50	1162				1162	2	3	14.4		8.7	10120	2.44	2.44	ABC
AT SUBSTATION			6700		50	1266				1266	2	3	14.4						
2 ABC 2	2 ABC 3	600	1500	1800	50	340				340	2	3	14.4	.241	17.1	582	0.14	0.38	2 AB
2 ABC 1	2 ABC 3	700	3100	3450	50	662				662	2	3	14.4	.241	15.2	1005	0.24	0.24	2 AB
AT SUBSTATION			3800		50	718				1266	2	3	14.4						

SUMMARY: 10500 FARM, SMALL TOWN & SMALL COMMERCIAL CONSUMERS @ 50 KWH/MO: 1934 KW PEAK
SMALL INDUSTRIAL TOTALLING 1300 KW AND IRRIGATION LOAD 1200 KW; COMBINED DAY-TIME LOAD: 1900. KW (OFF-PEAK).

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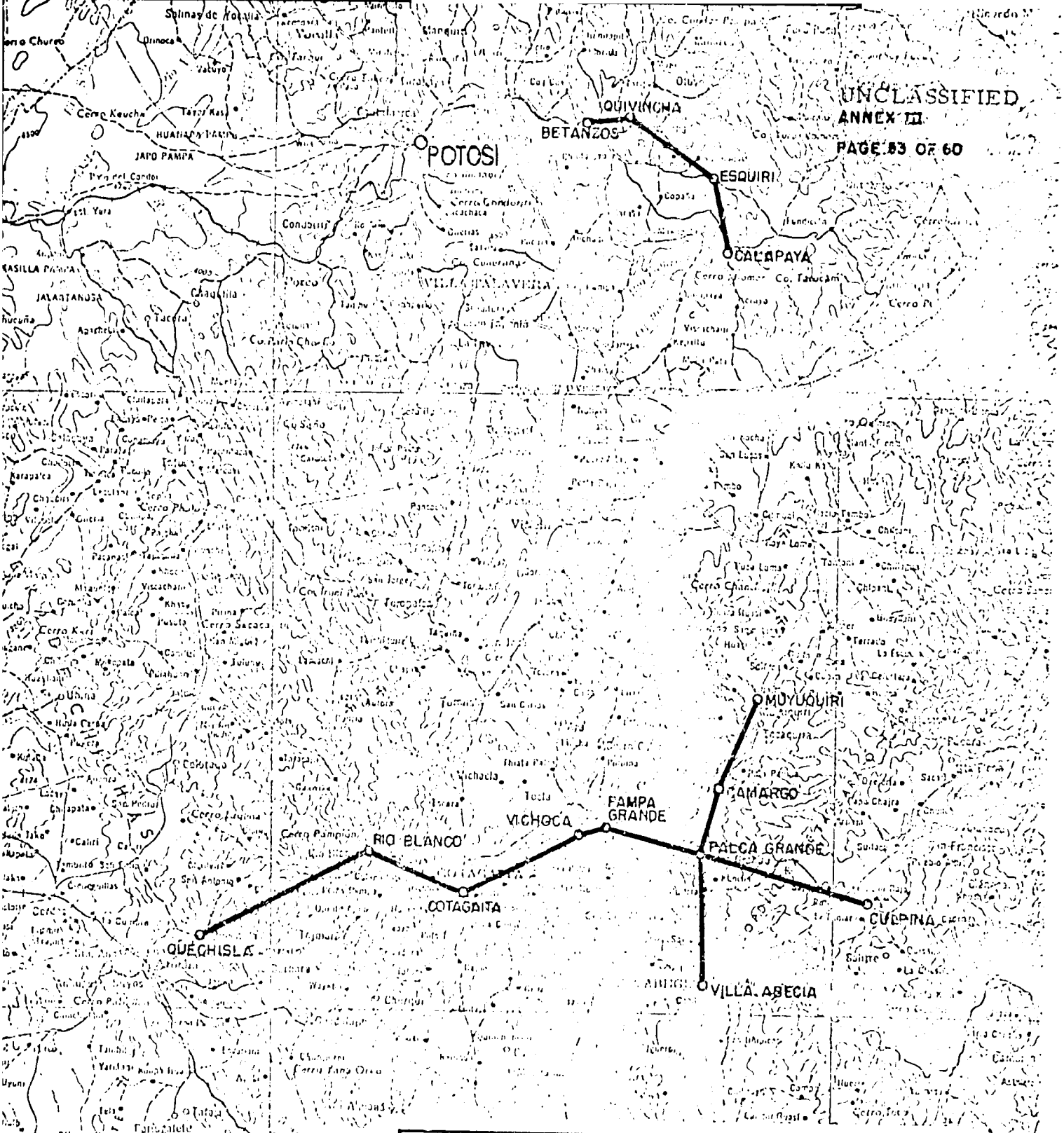
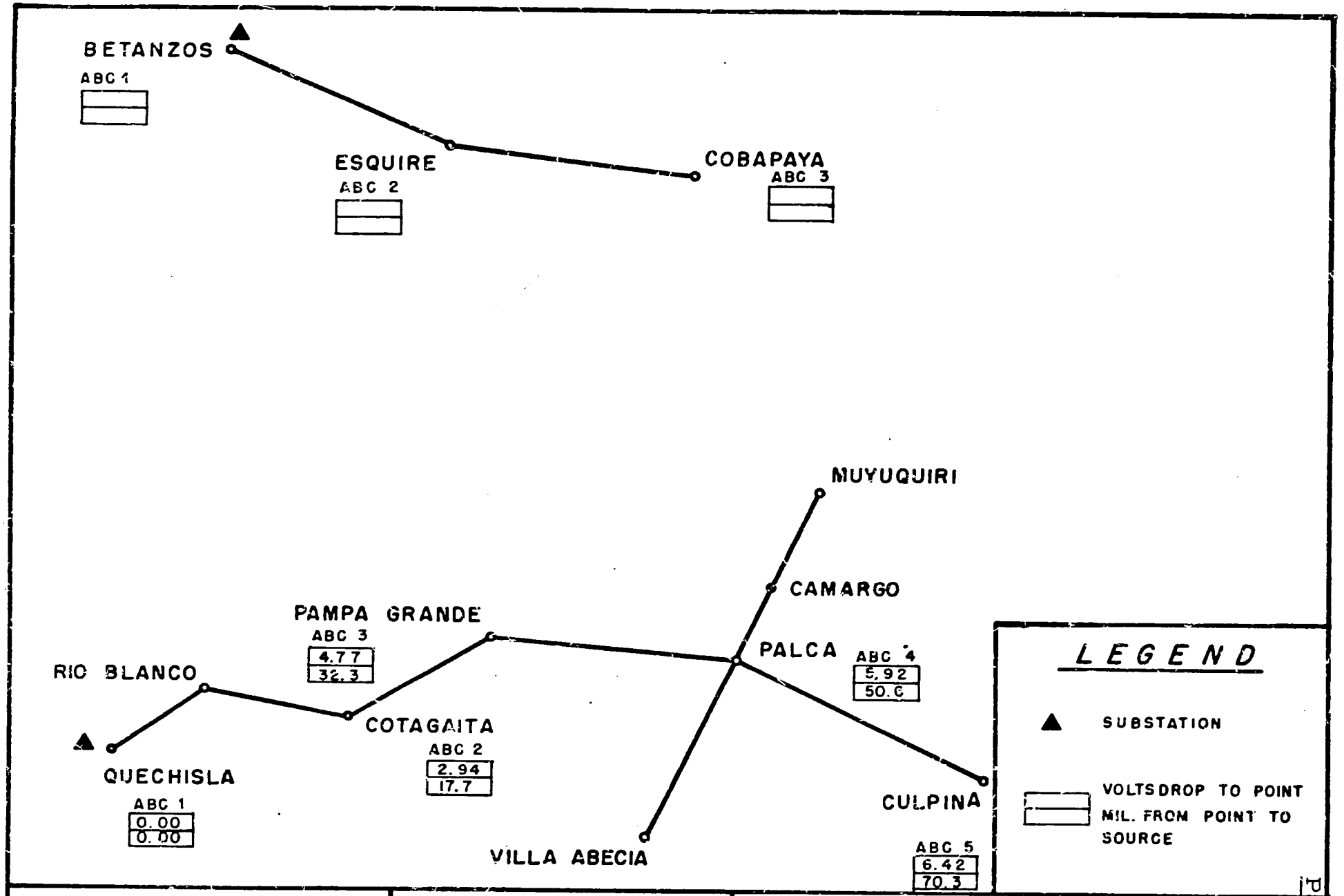


Servicios Electricos de Potosi S.A.

Rural Electrification Project

Primary Distribution Lines 14.4/24.9 KV

SCALE 1 to 1.000.000



SEPSA

PRIMARY DISTRIBUTION SISTEM AND SUBSTATION

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION: SEPSA
SYSTEM ENGINEER:
SUBSTATION: QUECHISLA
CIRCUITS: 1
SYSTEM DESIGN: 50 KWH/MO./CON
DATE: 09-6-73

SECTION		LOAD									LINE							
		CONSUMERS					CONCENTRATED										VOLTAGE DROP	
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW * MILES	THIS SECTION	TOTAL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ABC 4	ABC 5	300	400	550	50	106				106	2	3	14.4	241	19.7	2082	0.503	6.423
ABC 3	ABC 4	200	1700	1800	50	340				340	2	3			18.3	5215	1.150	5.920
ABC 2	ABC 3	100	2700	2750	50	520				520	2	3			14.6	7600	1.830	4.770
ABC 1	ABC 2	100	3600	3650	50	689				689	2	3			17.7	12200	2.940	2.940
AT SUBSTATION			3700		50	699				699	2	3						

SUMMARY: 3700 FARM, SMALL TOWN & SMALL COMMERCIAL CONSUMERS @ 50 KWH/MO: 699 KW PEAK
SMALL INDUSTRIAL TOTALLING 500 KW AND IRRIGATION LOAD 400 KW; COMBINED DAY-TIME LOAD: 680 KW (OFF-PEAK)

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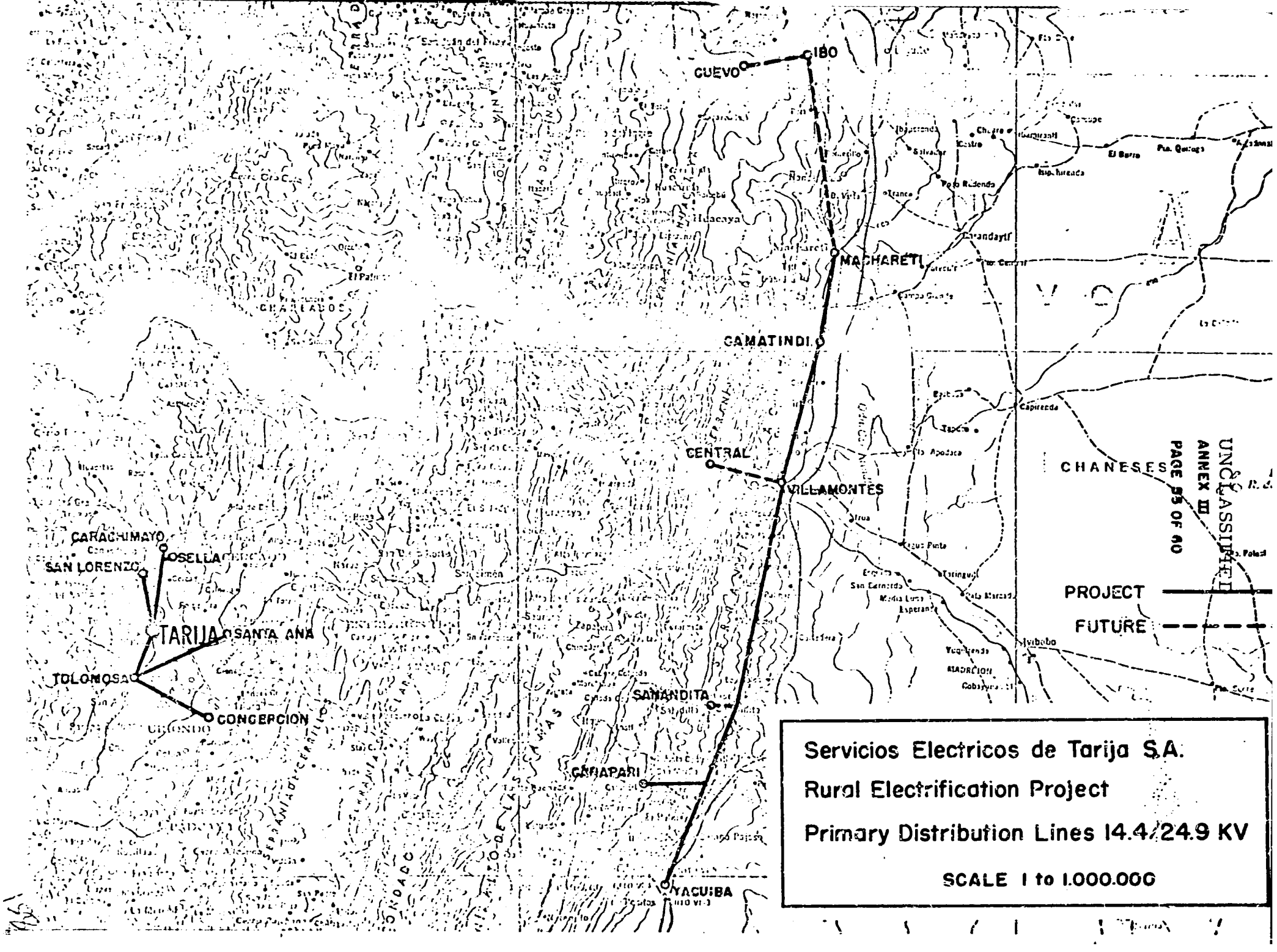
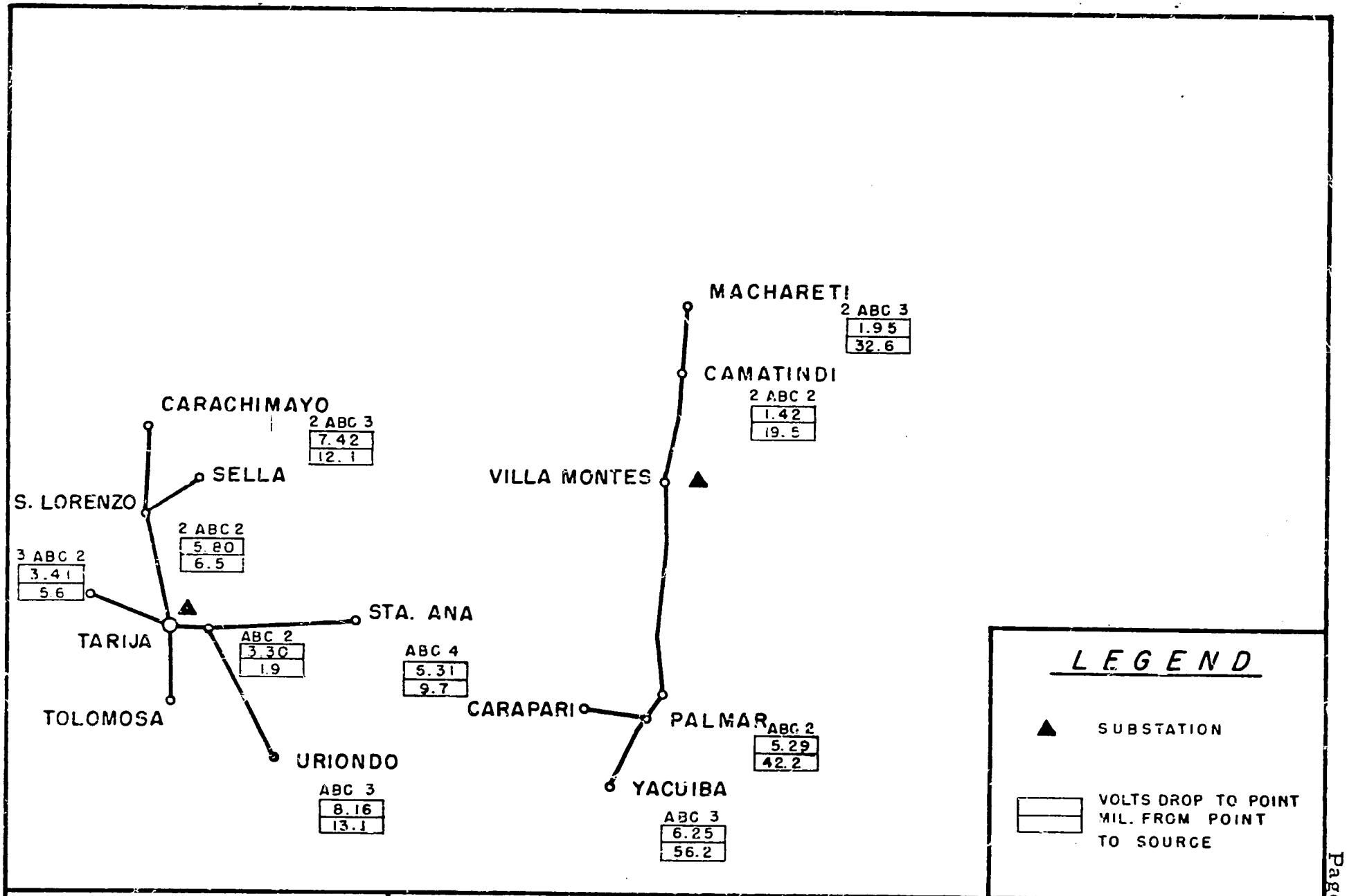

CUEVO
CIBO
MACHARETI
CAMATINDI
CENTRAL
VILLAMONTES
CHANESES
CARACHIMAYO
SAN LORENZO
OSELLA
TARIJA
SANTA ANA
TOLOMOSA
CONCEPCION
SAMANDITA
CAIPARI
YACUIBA
PROJECT
FUTURE
UNCLASSIFIED
ANNEX III
PAGE 35 OF 40
Servicios Electricos de Tarija S.A.
Rural Electrification Project
Primary Distribution Lines 14.4/24.9 KV
SCALE 1 to 1.000.000


MACHARETI
2 ABC 3
1.95
32.6
CAMATINDI
2 ABC 2
1.42
19.5
CARACHIMAYO
2 ABC 3
7.42
12.1
SELLA
S. LORENZO
2 ABC 2
5.80
6.5
3 ABC 2
3.41
5.6
VILLA MONTES
STA. ANA
TARIJA
ABC 2
3.30
1.9
ABC 4
5.31
9.7
TOLOMOSA
CARAPARI
PALMAR
ABC 2
5.29
42.2
URIONDO
ABC 3
8.16
13.1
YACUIBA
ABC 3
6.25
56.2
LEGEND
SUBSTATION
VOLTS DROP TO POINT
MIL. FROM POINT
TO SOURCE
SETAR
PRIMARY DISTRIBUTION
SISTEM AND SUBSTATION

U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

VOLTAGE DROP SHEET

SYSTEM DESIGNATION: SETAR

SYSTEM ENGINEER:

SUBSTATION: TARIJA & VILLAMONTES

CIRCUITS: 1 2 & 3 TARIJA; 1 & 2 VILLAMONTES

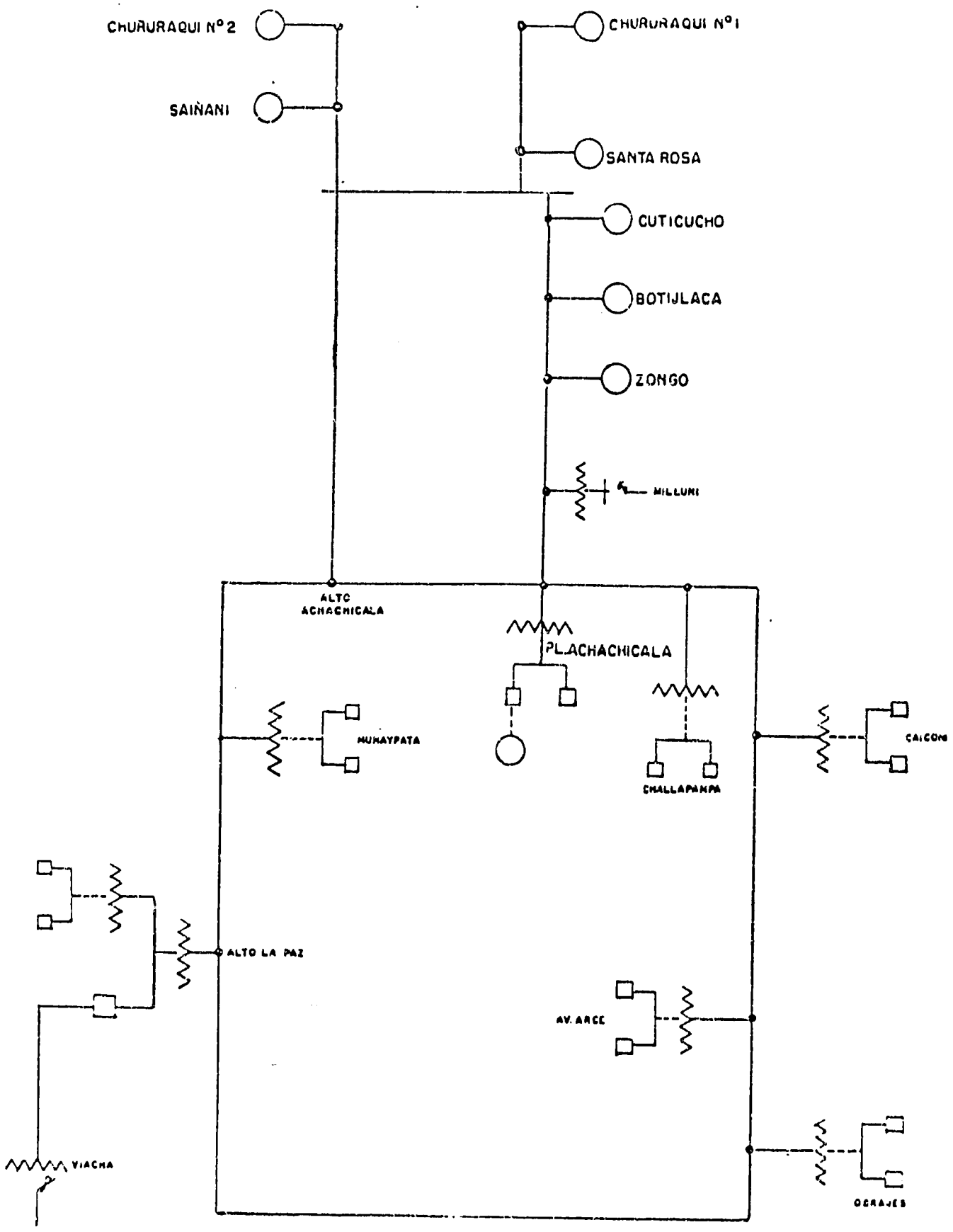
SYSTEM DESIGN: 54 KWH /MO./CONS

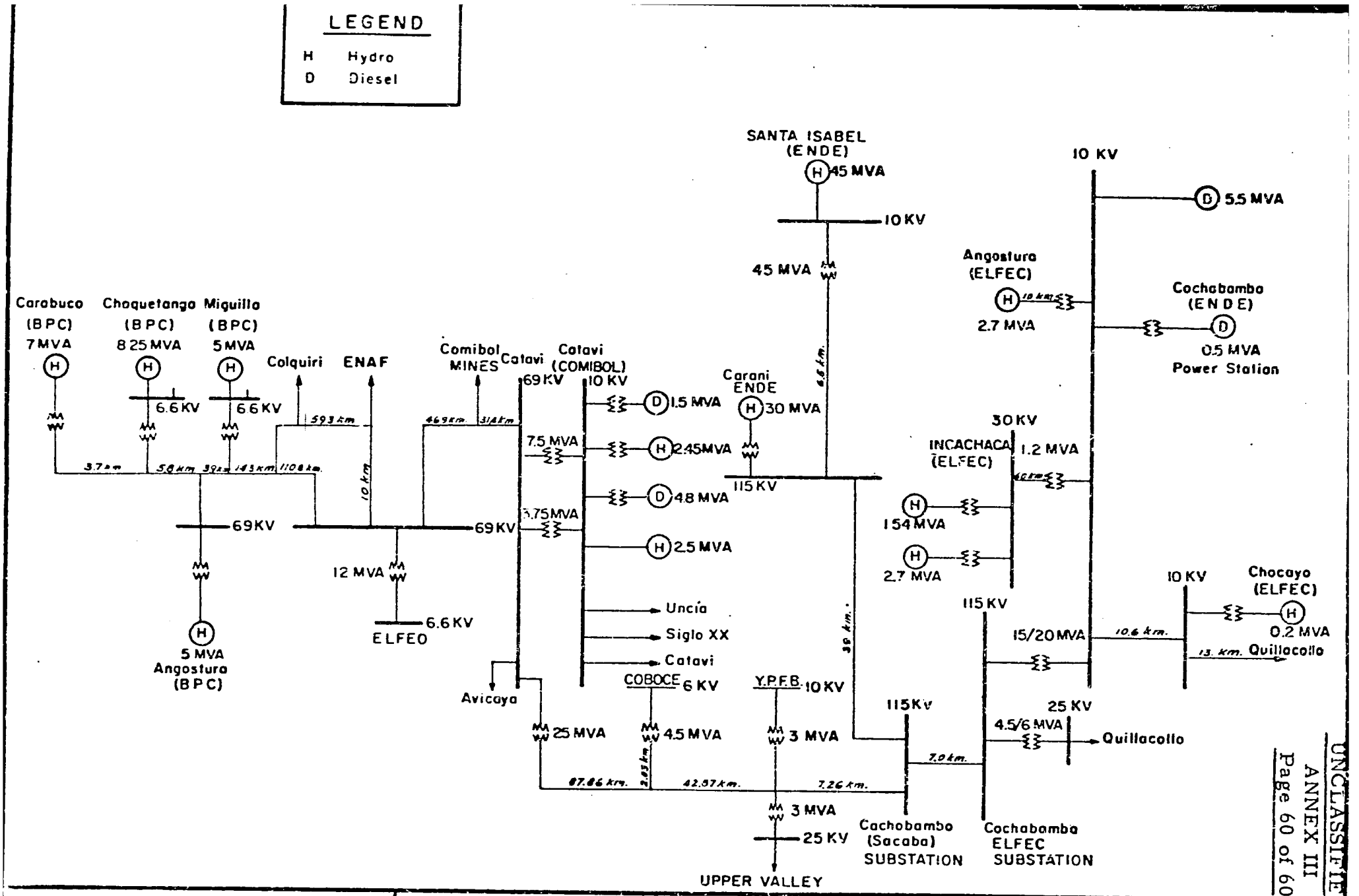
DATE: 09 – 7 –73

SECTION		LOAD									LINE						VOLTAGE DROP		
		CONSUMERS					CONCENTRATED			TOTAL KW	CONDUCTOR SIZE CU. EQUIV.	ϕ	KV	VOLTAGE DROP FACTOR	LENGTH OF SECTION IN MI.	KW MILES	THIS SECTION	TOTAL	AT POIN
SOURCE END	LOAD END	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION	KWH PER MONTH	PEAK KW	WITHIN THIS SECTION	BEYOND THIS SECTION	EQUIV. THIS SECTION										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
							(TARIJA SUBST.)												
ABC2	ABC3	700	1.200	1550	50	293	3.600	—	1600	1600	2	3	14.4	.241	11.2	20200	4.85	8.16	ABC
ABC2	ABC4	400	800	1000	50	191	3.200	—	1600	1600	2	3	14.4	.241	7.8	12500	3.01	6.31	ABC
ABC1	ABC2	100	3 100	3150	50	596	800	6800	7200	7200	2	3	14.4	.241	1.9	13700	3.30	3.30	ABC
AT SUBSTATION			3 200		50	605		7600											
2ABC2	2ABC3	300	900	1050	50	200	2400	—	1200	1200	2	3	14.4	.241	5.6	6720	1.62	7.42	2 ABC
2ABC1	2ABC2	300	2600	2750	50	520	2600	2400	3700	3700	2	3	14.4	.241	6.5	24100	5.60	5.80	2 ABC
AT SUBSTATION			2900		50	548		5000											
3ABC2	3ABC1	200	600	700	50	135	2.400	—	1200	1200	6	3	14.4		5.6	6720	3.41	3.41	3 ABC
AT SUBSTATION			900		50	153		2400											
SUMMARY:	6900 FARM, SMALL TOWN & SMALL COMMERCIAL CONSUMERS @ 50 KWH/MO: 1300 KW; 1500 KW IRRIGATION (PEAK); 1200 KW SMALL INDUSTRIAL																		
							(VILLAMONTES SUBST.)												
ABC2	ABC3	400	1300	1500	50	284				284	2	3	14.4	.241	14.0	3980	0 96	6.25	ABC
ABC1	ABC2	500	2500	2750	50	520				520	2	3	14.4	.241	42.2	21950	5.29	5.29	ABC
AT SUBSTATION			3000		50	567													
2ABC2	2ABC3	300	800	950	50	182				182	2	3	14.4	.241	12.1	2200	0.53	1.95	2 ABC
2ABC1	2ABC2	400	1400	1600	50	302				302	2	3	14.4	.241	19.5	5890	1.42	1.42	2 ABC
AT SUBSTITUTION			2000		50	378													
SUMMARY:	5000 + 900 = 5900 FARM, SMALL TOWN & SMALL COMMERCIAL CONSUMERS @ 50 KWH/MO : 1115 KW PEAK																		
	1200 KW INDUSTRIAL (LINE) + 3600 INDUSTRIAL AT SUBSTATION SITE (DAY-TIME LOAD)																		

ANNEX III
Part 58 of 60

SISTEMA DE LA PAZ





E.L.F.E.C.

COCHABAMBA — BOLIVIA

ONE LINE DIAGRAM OF THE CENTRAL SYSTEM

Designed	Drawing	Cheked	Date
	C.D.S.		9-IX-72

UNCLASSIFIED

ANNEX III

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ECONOMIC ANNEX

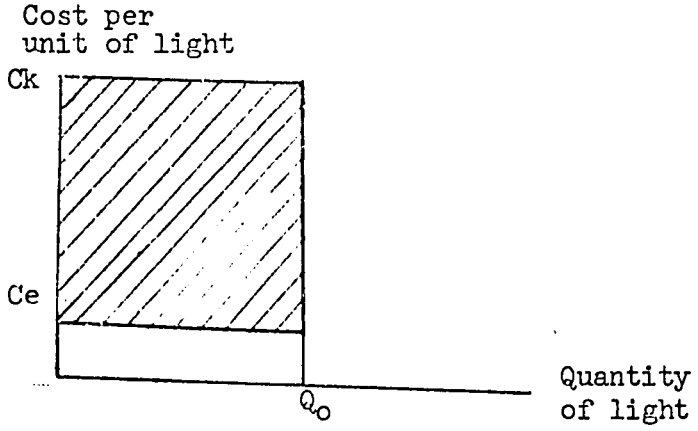
1. Methodology

The quantitative evaluation of benefits and costs made here is based on the model developed by Marcelo Selowsky for the IBRD.

This model evaluates the marginal benefits that accrue to the national economy from an investment in a rural electric distribution system. The benefits are identified as the resource saving due to the replacement of an alternative source of energy (kerosene in lamps or small diesel generators) by an efficient source of energy (i.e. central station electricity), plus the consumer surplus or net value added that accrues to the customers when they expand consumption of electricity for old or new purposes. The annual benefits for the assumed life of the project (33 years) are discounted to a present value using 12% as the opportunity cost of capital to the economy. The denominator of the benefit/cost ratio is simply the present value of the distribution investment, discounted at the same rate.

A brief graphical exposition of the source of benefits will make the calculation task easier to understand. Consider a rural resident who does not have access to any form of electric power (except batteries). Lighting of the house is by a kerosene lamp or two. The kerosene lamp(s) delivers a given quantity (and quality) of light which we call Q_o in figure I below, at a resource cost to the economy of C_k (which includes depreciation of the lamp, etc.)

Figure I

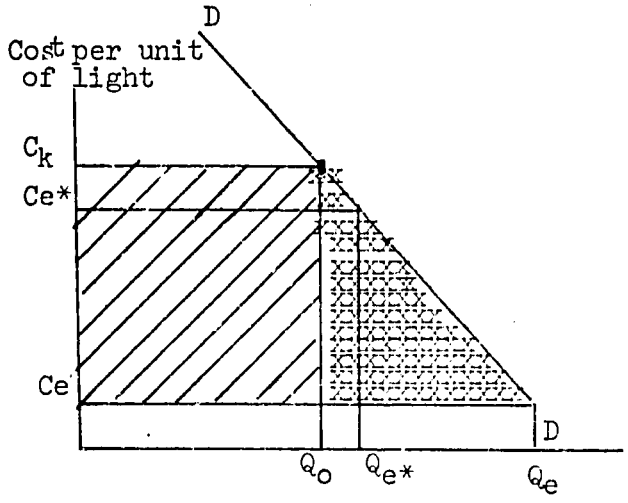


Now, if the same quantity of light can be supplied by electricity

(including bulbs, etc.) at a resource cost to the economy of C_e (lower than C_k) then the conversion saves resources with a value equal to the shaded area of figure I, or $C_k Q_o - C_e Q_o$. That is, the annual resources saved are equal to the percentage reduction in cost multiplied by the amount spent on the given quantity of light in any year. The same analysis applies to replacement of high cost locally generated energy by central station electricity.

A second order benefit is also attributable to providing cheaper more reliable power. Consider the same rural resident as above. Given that there is meaningful reduction in the cost of satisfying his previous level of light services (Q_o), he experiences an increase in real income which he can be expected to spend on a variety of things, including more lighting services. The demand curve DD in Figure II represents the amount he will consume as the price of electricity varies, ceteris paribus.

Figure II



If the price reduction is small, say to Ce* in Figure II, his expansion of energy consumption will be small, to Q_e*, and he will feel that his new consumption of energy gives him a benefit measured by the small triangle.

The larger the price reduction the larger the triangle. The triangle, cross-hatched, represented graphically as (C_kD, C_eQ_o, Q_eD) measures the increase in welfare of the consumers due to the new lower price of energy. Assuming the demand curve to be linear, this triangle, in economic terms, is measured by the price change (C_k-C_e) multiplied by 1/2 the percentage response in quantity demanded by electricity per unit percentage change in its price (i.e. the elasticity of demand.) For industrial uses, the demand curve is in fact the marginal value product of electricity in the manufacturing process. For certain dry land, this demand, derived from the demand for irrigation water can be very large.

The specific formula for calculating the B/C ratio (from Selowsky) is:

$$\frac{B}{C} = \sum_{t=1}^{t=33} \frac{\left\{ \sum_i K_{ti} \left(\delta_{ti} + \tfrac{1}{2} \delta_{ti}^2 + \sum_j \frac{1}{\eta_j} K_{tj} \right) \right\}}{(1+r)^t}}{\frac{I_t}{(1+r)^t}}$$

The symbols used in the formula are:

r: opportunity cost of capital, 12%

t: time (in years), i.e. life of the project; in this case t=3 years of construction and 30 years of service, or 33 years.

K_{ti}: expenditure on substitutes for electricity (e.g.kerosene) that would have been used in year t for service i (e.g. lighting)

δ_{ti}: percentage difference between the cost of the equivalent substitute for electricity and one KWH of electricity in the provision of service i in year t.

η_i: elasticity of demand for electricity for the i^{th} service, in absolute value.

When the subscript j is used in place of i , the service for which electricity provides the energy is one which, for practical purposes (in the technical sense) cannot be supplied by any other energy source (e.g. television).

Note that in this formulation, the ti coefficient includes, in the numerator, the stream of costs in the t years of the project, inasmuch as we are dealing with a cost reduction. For purpose of this analysis we do not attempt to quantify the benefits deriving from provision of electric energy for such electric specific uses as television, vacuum cleaners and other similar household appliances. Our reasoning is that television transmission in these areas is not likely in the foreseeable future, although it may be within the 33 year of life of the project. Further both the income situation of the rural population plus the likelihood that household labor cost will remain relatively low compared with appliance costs argue that there will be little or no effective demand for electricity to operate these kinds of appliances. Of course, to the extent that our omission of this class of benefits is incorrect, our calculated benefit/cost ratio is understated.

The Selowsky formula applies when the total long run resource cost of electricity can be characterized as approximately constant in real terms. This is the case for these projects in the regions being considered in Bolivia. In fact, the long run cost of electricity will probably decline in real terms. Thus, we are able to use for each sub-project evaluation, a marginal running cost (including depreciation allowance and opportunity cost of capital return) to evaluate benefits. The reasons for this are that the sub-projects will be fed from large systems characterized by considerable hydro capacity, and the sub-projects themselves are relatively small users of power in relation to the total system so their consumption does not affect in a significant way the system decisions regarding generation and transmission. In particular, the La Paz, Sucre, and Potosí, sub-projects are to be supplied from substations connected to inter-regional transmission systems. The Tarija project will be supplied from the Tarija city generating system in the early year of the project (1971 - 1980) until transmission lines connect Tarija with the COMIBOL-ENDE interconnected transmission system (probably about 1980). Additional capacity as needed in the short term will be provided by diesels made surplus by the new Sucre thermal plant and the transmission line to Potosí. The Villamontes system will initially buy all power from Argentina (at the frontier town of Yacuiba) and since the load curve of this sub-project is dominated by off-peak industrial and irrigation customers, it is expected that a wholesale price in the range of 1 ¢ to 1.5¢ (US) can be negotiated.

The methodology requires the use of the opportunity cost (i.e. the shadow price) of goods and factors of production in evaluating benefits

and costs. The lower marginal running cost for off-peak irrigation energy is an example of pricing at opportunity cost. A major adjustment is required to "correct" the price of kerosene and diesel fuel oil. BOLIVIA exports crude petroleum after meeting its domestic needs. To the extent that "inefficient" uses of petroleum products are replaced by efficient (i.e. large scale) thermal generation or perhaps more importantly by hydro generation, more petroleum will be exportable from the country. At present these substituble petroleum products are sold domestically at low prices as part of the government's program of keeping the cost of living down. Since world market crude petroleum prices have risen substantially in the past few years and are expected to rise further in the future, the magnitude of this distortion is large.

For example, the retail price of kerosene throughout the country is $b0.30 per liter, or US$0.054 per gallon. The correct price, in late 1973 should certainly be some 4 to 6 times as high, or say, in the range of US$0.20 to $0.32. In a similar manner, regular gasoline, selling for $b0.90 per liter, or US$0.16 per gallon, should have a shadow price of at least twice that amount.

It is often argued that the shadow wage rate for unskilled labor is much lower than the observed wage rate and therefore unskilled labor costs should be scaled down to reflect this difference. At the present time in Bolivia, however, we believe this adjustment is small since devaluation probably came close to equalizing the observed and shadow wage rates. Within the project areas, there is substantial variation in wage rates and unemployment rates. A regional planning official estimates the following

	Daily Wage	Unemployment Rate %
Villamontes-Yacuiba	30	5
Tarija	20	10
Sucre	8	20
Potosí	10	10

which seems to suggest wage flexibility in response to demand conditions. Further, the role of unskilled labor in construction of the project is not large, and therefore we do not adjust the investment cost on this account. Note that not adjusting the investment costs in this way tends to result in a lower estimate of the B/C ratios as herein calculated.

2. Benefit/Cost Calculation

There are six basic classes of rural consumers whose use of electricity will generate benefits under the project. They are:

(1) rural customers not presently served by any electric source (including street light benefits).

(2) rural customers now receiving intermitent service (usually 6 pm to 9 or 10 pm, including street light benefits).

(3) industrial plants now generating non-electric energy (e.g. sawmills operating with truck engines).

(4) industrial plants now generating their own electricity.

(5) irrigation by gasoline motor driven pump.

(6) irrigation by electric pump using self-generated electricity.

For each of the six classes of users, the reduction in resource costs with and without the project (δ), the energy consumed without central station electricity, and elasticity of demand for electricity, are estimated and tabulated . (See enclosed table). Page 7 of 19 .

At present, according to survey data, rural residents not served by electricity spend $b10 to $b12 per month (US$0.50 to US$0.60) for kerosene and/or candles for lighting. Converted to units of light (see 511-L-046, Annex IV.A. - Exhibit 3) this is a cost of US$0.004 per Foot Lamberts. The equivalent lighting by electricity requires a 10 watt bulb. Put another way, it costs the rural Bolivian about US$7.50 per year to get that much lighting as he would get from 12 kwh of electricity; that is, at market prices, kerosene lighting costs almost US$0.70 per khw equivalent. Since in the market kerosene is priced at US$0.054 per gallon, shadow pricing would require the fuel cost to be raised at least to four or five times its present market price. Further, as fuel is over half the observed cost of illumination by kerosene the opportunity cost per khw equivalent is surely in excess of US$1.50 khw. The benefit of such a substitution is intuitively obvious. We understate the benefits in our calculations however, by using the market price of kerosene inasmuch as we feel it more predictive to evaluate this input into the lamp at the price as seen by the campesino in order to not exagerate the response expected by that group to the availability of electricity.

The enclosed table summarizes our estimates of δ , the cost reduction coefficient, and η , the elasticity of demand, for the six customer classes. For computational convenience, we express the demand expansion benefit effect as a percentage of the resources saving benefit. The ratio of the demand expansion benefit to the resource saving benefit is given by:

$$R = \frac{1/2\ \delta^2\ K\eta}{K} = 1/2\ \delta\gamma$$

UNIT BENEFIT PER KILOWATT-HOUR COMPUTATION

Customer Class	Present Consumption	Central Electricity replacement	Cost reduction coefficient δ	Elasticity of demand for use η_i	Ratio of demand expansion benefit to cost red. benefit.	Estimated marginal running cost	Benef. per KWH ($)
1. Resid/com. without electricity	$b10-12 pesos month kerosene/US$ 7.50 Yr.	12 KWH/Yr.	.96	3	1.43	.04	.10
2. Resid/com. with evening service	4.5 kwh/mo. intermittent local power/estimated cost to economy of 9¢ kwh	60 KWH/Yr	.67	2	.67	.03	.03
3. Industry, without electricity	typically 100-150 HP gasoline engines US$ 9¢ per kwh equiv.	100 KVA motor	.67	1.5	.50	.03	.03
4. Industry now self-generating	typically diesel motor generator sets 100-200 KVA US$ 4¢ per kwh	purchase equivalent	.5	1.5	.37	.02	.015
5. Pump-irrigation, non-electric	small gasoline, diesel pumps US$ 8¢ per kwh equivalent	submergible pumps	.75	4	1.12	.02	.03
6. Self generated electric pump irrigation	typically, 300-400 KW motor-gen. sets US$ 4¢ per KWH(only at Villamontes)	purchase equivalent	.50	4	.25	.02	.015

Then, taking into account that K_{it} is the amount spent in any year (t) on energy for use (i), we separate the quantity K_{it} into the quantity of energy (KWH or MWH) and the cost component. We get a factor (F) that is the marginal running cost per KWH of electricity multipled by the cost reduction percentage plus the demand expansion benefit rates (R); this factor (F) then is the amount of benefit per KWH that the economy perceives from use (i) of electricity.

The estimates of the elasticity of demand for household consumption of electricity are made from scattered evidence from price changes both up and down in various electric systems in Bolivia, and from comparison of consumption and cost levels between systems. An elasticity of 3 (actually -3) is probably a low estimate (in absolute value) and in the longer run we would expect it to be somewhat higher. For firms now generating their own electricity we have an estimate of 1.5 reflecting the relatively small share of total costs that is accounted for electricity, and therefore the relative unresponsiveness of quantity demand to changes in price. On the other hand, irrigation demand should be quite responsive to power price reductions in view of the large share of total cost that electricity will account for, and thus an elasticity of 4 is estimated.

The following tables indicate the calculation of the present value of benefits by class of consumer for each sub-project area and the sub-project benefit/cost ratios.

INER, Calculation of Present Value of Benefits by Class of Consumer and Project Benefit/Cost Ratio *

Year	Present worth factor	Resid/Comm. not presently served		Resid/Comm. now w/evening service		Irrigation substitute for non-electr./energy		Industry substitute for non electric energy		Industry replace self-generation		Total Annual Benef.	Prese value Benef
		MWH	Benefit*	MWH	Benefit*	MWH	Benefit*	MWH	Benefit*	MWH	Benefit*		
1977	0.71	2156	216	2157	65	-		8920	268	10900	164	713	506
1978	0.64	2422	242	2422	73	1600	32	9520	286	10900	164	797	510
1979	0.57	2712	271	2713	81	3200	64	10400	312	10900	164	892	508
1980	0.51	3035	304	3035	91	4800	96	11200	336	10900	164	991	505
1981	0.45	3394	339	3394	102	6400	128	12660	380	10900	164	1113	501
1982	0.40	3795	380	3796	114	8000	160	13160	395	10900	164	1213	485
1983	0.36	4236	424	4237	127	9600	192	13840	404	10900	164	1311	472
1984	0.32	4765	476	4766	143	11200	224	14340	430	10900	164	1437	460
1985	0.29	5275	528	5276	159	12800	256	15360	461	10900	164	1568	455
1986	0.26	5886	589	5887	177	14400	288	16100	483	10900	164	1701	442
1987-2006	≤ 2.08											1701	3538

Present value of Benefit 8382
" " Costs 2855
B/C ratio 2.9

* Benefits and costs expressed in thousands of U.S. dollars.

CESSA, Calculation of Present Value of Benefits by Class of Consumer and Project Benefit/Cost Ratio *

Year	Present worth factor	Resid/Comm. not presently served		Resid/Comm. now w/evening service		Irrigation substit. for non-electric energy		Industry substit. for non-electric energy		Industry replace self-generation		Total Annual Benef.	Present value of Benef.
		MWH	Benef. *	MWH	Benef. *	MWH	Benef. *	MWH	Benef. *	MWH	Benef. *		
1977	0.71	1050	105	1050	32	-	-	-	-	960	14	151	107
1978	0.64	1390	139	1390	42	1000	20	180	5	960	14	220	141
1979	0.57	1705	170	1705	51	1850	37	300	9	960	14	281	160
1980	0.51	1985	199	1985	60	1900	38	580	17	960	14	328	167
1981	0.45	2230	223	2230	67	2000	40	650	20	960	14	364	164
1982	0.40	2470	247	2470	74	2100	42	720	22	960	14	399	160
1983	0.36	2710	271	2710	81	2200	44	960	29	960	14	439	158
1984	0.32	3020	302	3020	91	2250	45	1040	31	960	14	483	155
1985	0.29	3245	324	3245	97	2250	45	1040	31	960	14	511	148
1986	0.26	3685	369	3685	111	2250	45	1040	31	960	14	570	148
1987-2006	2.08											570	1186

* Benefits and costs expressed in thousands of U.S. dollars

Present value of Benefits 2694
" " Costs 1306
B/C Ratio 2.0

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SEPSA, Calculation of Present Value of Benefits by Class of Consumer and Project Benefit/Cost Ratio *

Year	Present worth factor	Resid/Comm. not presently served		Resid/Comm. now w/evening service		Irrigation substit.for non-electric energy		Industry substit.for non-electric energy		Industry replace self-generation		Total Annual Benef.	Present value of Benef.
		MWH	Benef.*	MWH	Benef.*	MWH	Benef.*	MWH	Benef.*	MWH	Benef.*		
1977	0.71	675	67	675	20	360	7	-	-	210	3	97	69
1978	0.64	840	84	841	25	540	11	20	1	210	3	124	79
1979	0.57	981	98	981	29	600	12	41	1	210	3	143	82
1980	0.51	1094	109	1094	33	1500	30	64	2	210	3	177	90
1981	0.45	1208	121	1209	36	2100	42	86	3	210	3	205	92
1982	0.40	1330	133	1330	40	2700	54	105	3	210	3	233	93
1983	0.36	1451	145	1452	44	3600	72	125	4	210	3	268	96
1984	0.32	1577	158	1577	47	4200	84	146	4	210	3	296	95
1985	0.29	1712	171	1713	51	4800	96	169	5	210	3	326	95
1986	0.26	1850	185	1850	56	5400	108	193	6	210	3	358	93
1987-2006	2.08											358	745

* Benefits and costs expressed in thousands of U.S. dollars.

Present value of Benefits 1533
" " Costs 1261
Ratio B/C 1.22

SETAR, Tarija Subproject, Calculation of Present Value
of Benefits by Class of Consumer and Project Benefit/Cost Ratio*

Year	Present worth factor	Resid/Comm not presently served		Resid/Comm. with evening service		Irrigation substitute for non-electric generation		Irrigation self-generated electricity		Total Annual Benef.	Present value Benef.
		MWH	Benef.*	MWH	Benef.*	MWH	Benef.*	MWH	Benef.*		
1977	0.71	992	99	993	30	6102	122	73	1	252	179
1978	0.64	1172	117	1172	35	7015	140	73	1	293	187
1979	0.57	1378	138	1378	41	7927	159	73	1	339	193
1980	0.51	1662	166	1662	50	8839	176	73	1	393	200
1981	0.45	1988	199	1989	60	9752	195	73	1	455	205
1982	0.40	2364	236	2364	71	10664	213	73	1	521	208
1983	0.36	2794	279	2795	84	11577	231	73	1	595	214
1984	0.32	3287	329	3287	99	12489	250	73	1	679	217
1985	0.29	3929	393	3929	118	13401	268	73	1	780	226
1986	0.26	4666	467	4667	140	14314	286	73	1	894	232
1987-2000	2.08									894	1859

* Benefits and costs expressed in thousands of U.S. dollars.

Present value of Benefits	3920
" " Costs	687
B/C Ratio	5.71

SETAR, Villamontes Subproject, Calculation of Present Value of Benefits
by Class of Consumer and Project Benefit/Cost Ratio *

Year	Present worth factor	Resid/Comm. not presently served		Res/Comm. with evening service		Irrigation self-generated electricity		Industry substituto for non-electr.generation		Industry replace self-generation		Total Annual Benef.	Prese value benef.
		MWH	Benef.*	MWH	Benef.*	MWH	Benef.*	MWH	Benef.*	MWH	Benef.*		
1977	0.71	493	49	500	15	1752	26	2859	43	2529	38	171	121
1978	0.64	586	59	587	18	1752	26	3187	48	2529	38	189	121
1979	0.57	689	69	689	21	1752	26	3515	53	2529	38	202	115
1980	0.51	830	83	831	25	1752	26	3844	58	2529	38	230	117
1981	0.45	994	99	994	30	1752	26	4172	63	2529	38	256	115
1982	0.40	1181	118	1182	35	1752	26	2501	68	2529	38	280	112
1983	0.36	1397	140	1397	42	1752	26	4829	72	2529	38	318	114
1984	0.32	1643	164	1644	49	1752	26	5158	77	2529	38	354	113
1985	0.29	1965	196	1965	59	1752	26	5486	82	2529	38	401	116
1986	0.26	2423	242	2424	73	1752	26	5815	87	2529	38	466	121
1987-2006	2.08											466	969

* Benefits and costs expressed in thousands of U.S. dollars.

Present value of Benefits 2134
" " Costs 1239
B/C Ratio 1.72

3. Debt Service Capacity

It appears that in general Bolivia's debt servicing capacity will remain within reasonable limits over the next 5 years. The recent improvement in Bolivia's exports and the expected continuance of strong world demand for agricultural commodities and petroleum products should provide Bolivia the necessary export earning to meet external debt service requirements. Minerals exports, which are presently benefitting from higher world prices, will probably lose gradually their relative importance among Bolivia's exports. Based on present trends we expect mineral exports to represent between 50% and 60% of total exports by 1977. The export projection used in this document (inclusive of service payments) is estimated to show a 10% annual growth in the period 1974-1978.

Debt acquisition by the GOB in 1972 showed a substantial increase (US$ 114 million gross) in medium therm borrowing mostly in the form of suppliers' credits. As a result of this increase the IMF in its "Standby" agreement for 1973 included an US$ 18 million limitation on gross new borrowings by GOB of under 15 years. Although this target was exceeded by about US$ 5 million, the debt naturity structure appears to have improved reflecting debt acquisitions with maturities exceeding 25 years.

The debt service real GDP ratio shows an increase in the amount of domestic resources necessary to meet the service requirement through 1975 but through 1978 remaining constant.

It appears that the domestic resource burden is not exceedingly high in comparison to Argentina, Chile, Columbia or Brazil. Moreover, the estimated rate of 6% in real growth in GDP may be somewhat conservative given the expected stimulus to exports.

A. Projected Exports (Net of Services) and External Debt Service (Debt Outstanding as of December 31, 1972).
In Missions of U.S. Dollars)

	Exports (Net of Services)	Debt Service	Debt Service Ratio
1973	238.5	46.6	19.1%
1974	265.0	58.0	21.8%
1975	295.0	65.0	22.0%
1976	325.0	69.0	21.2%
1977	355.0	73.0	20.5%
1978	385.0	77.0	20.0%

Source: Mission estimate.

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B. External Debt Service/GDP (real terms 1968 prices).

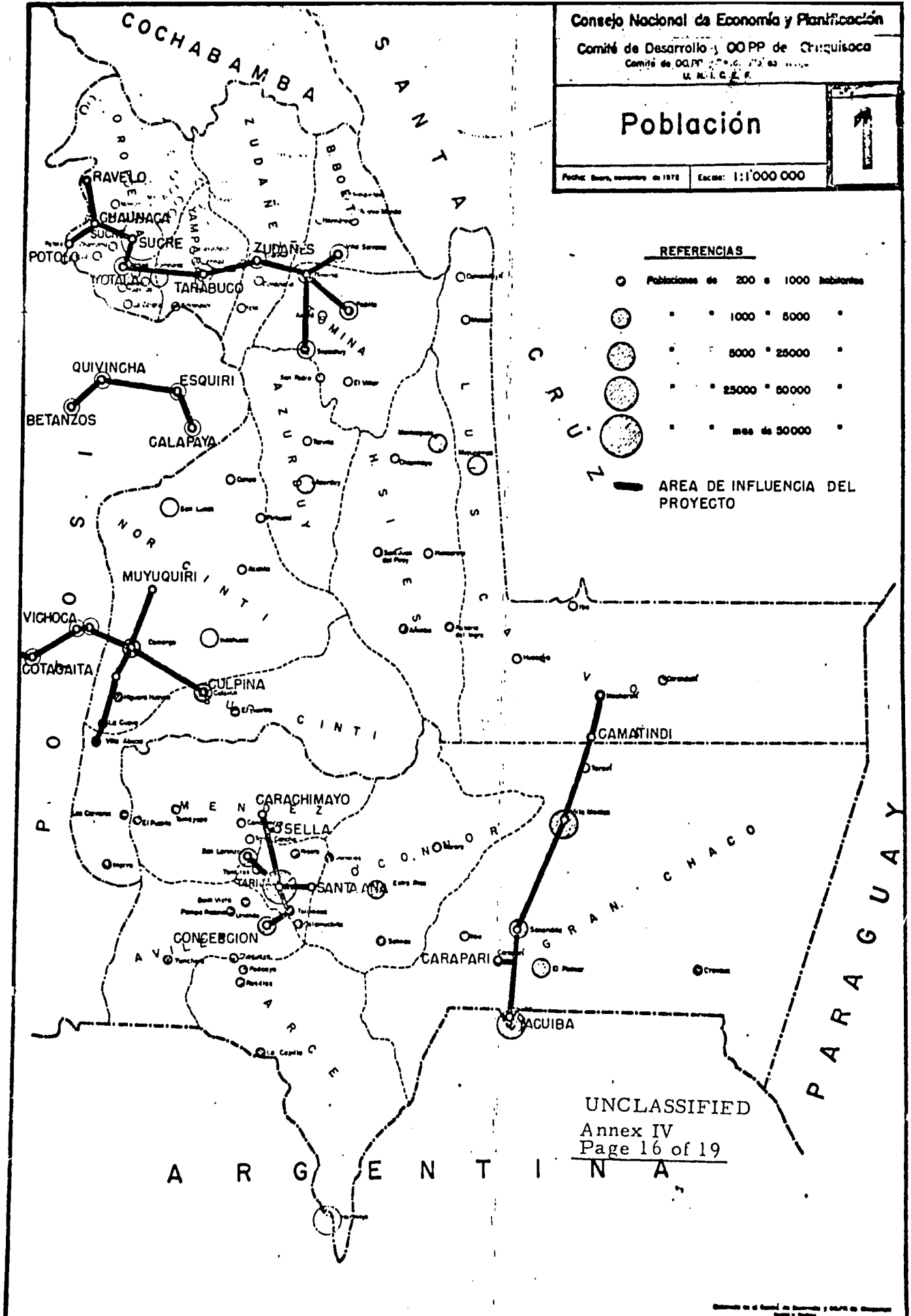
	Debt Service (Millions $b)	GDP (Millions $b)	DS/GDP Ratio
1973	382	13,133	6.3%
1974	1,160	13,921	8.2%
1975	1,300	14,756	8.9%
1976	1,380	15,641	8.8%
1977	1,460	16,579	8.8%
1978	1,540	17,579	8.8%

Source: Mission estimate.

Thus, to the extent that GOB is able to obtain official long term loans, we do not envision any major change in the debt servicing ratio. The need to orient policies toward growth requires the GOB to undertake external borrowing which in the medium term must be primarily met by International Lending Institutions.

4. Population Concentration and Complementary Infrastructure.

The following maps depict the paths of the project distribution lines in the southern departments in relationship to population clusters of at least 200 residents, existing schools and health posts, as well as wheat, grape, sugar cane and pepper producing areas.


Consejo Nacional de Economía y Planificación
Comité de Desarrollo y OO PP de Chuquisaca
Población
Escala: 1:1'000 000
REFERENCIAS
Poblaciones de 200 a 1000 habitantes
1000 a 5000
5000 a 25000
25000 a 50000
mas de 50000
AREA DE INFLUENCIA DEL PROYECTO
COCHABAMBA
SANTA CRUZ
PARAGUAY
ARGENTINA
RAVELO
CHAUNACA
SUCRE
POTOSI
TOTORA
TARABUCO
ZUDAÑES
QUIVINCHA
ESQUIRI
BETANZOS
CALAPAYA
MUYUQUIRI
VICHOCA
COTAGAITA
CULPINA
CAMATINDI
CARACHIMAYO
OSELLA
SANTA ANA
CONCEPCION
CARAPARI
ACUIBA
ZUDAÑEZ
AZURDUY
HERNANDO SILES
CINTI
GRAN CHACO
ALTO PARAPETI

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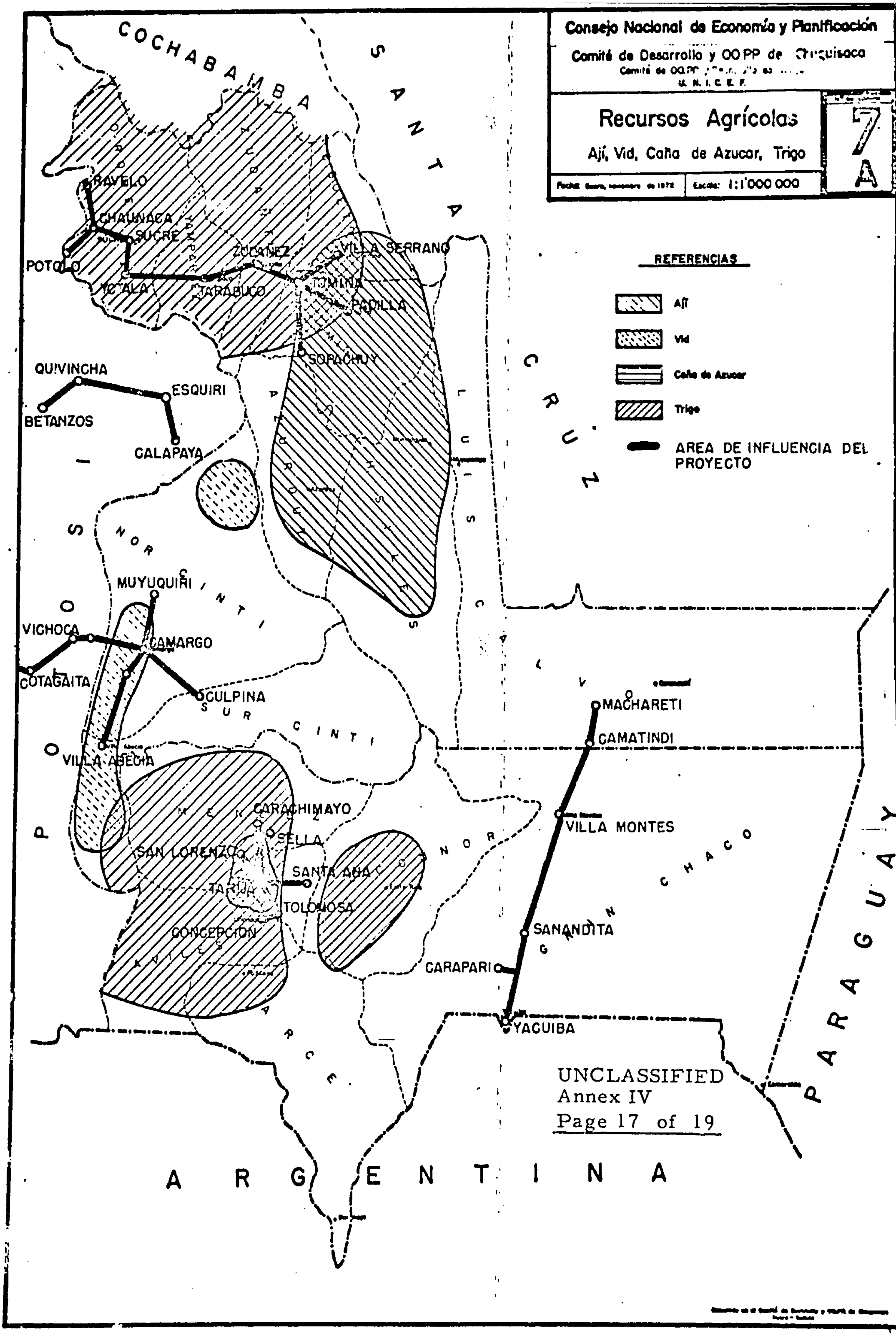

UNCLASSIFIED
Annex IV
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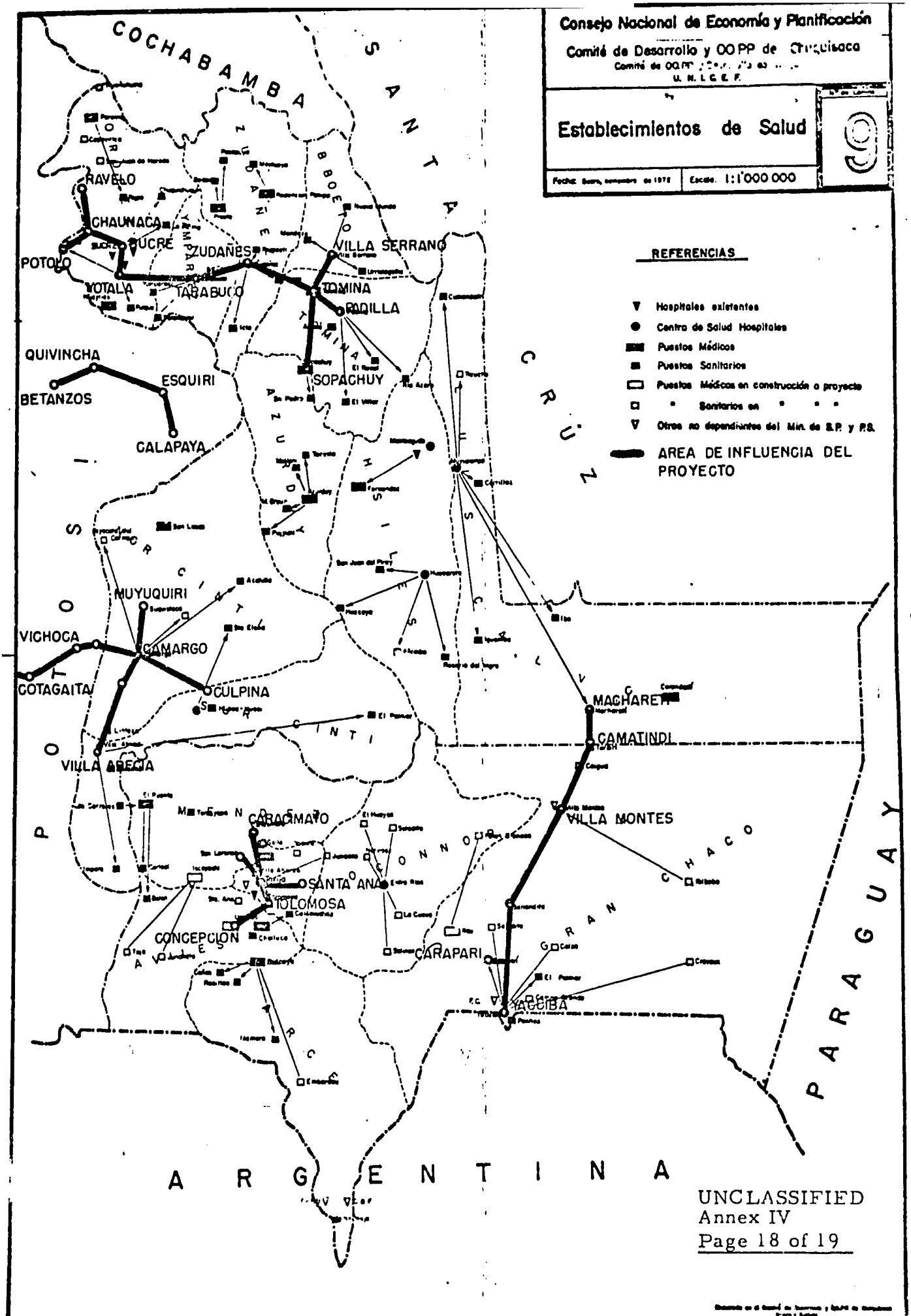
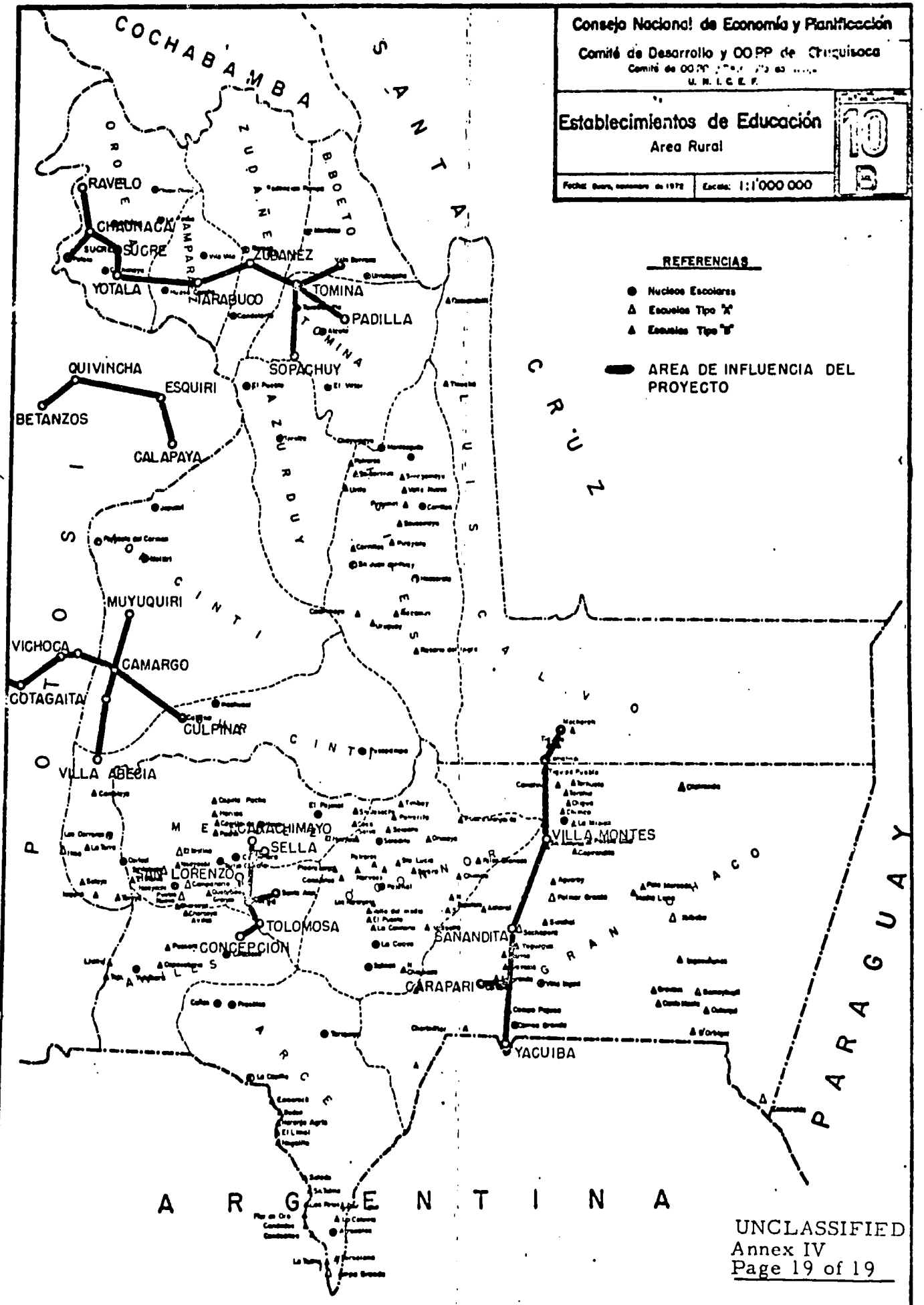

Consejo Nacional de Economía y Planificación
Comité de Desarrollo y OOPP de Chuquisaca
U. N. I. C. E. F.
Establecimientos de Salud
Escala 1:1'000 000
REFERENCIAS
Hospitales existentes
Centro de Salud Hospitales
Puestos Médicos
Puestos Sanitarios
Puestos Médicos en construcción o proyecto
Sanitarios en
Otros no dependientes del Min. de S.P. y P.S.
AREA DE INFLUENCIA DEL PROYECTO
COCHABAMBA
SANTA CRUZ
PARAGUAY
ARGENTINA
RAVELO
CHAUNACA
SUCRE
POTOLO
YOTALA
TARABUCO
ZUDAÑES
VILLA SERRANO
TOMINA
PADILLA
SOPACHUY
QUIVINCHA
ESQUIRI
BETANZOS
CALAPAYA
MUYUQUIRI
VICHOCA
CAMARGO
COTAGAITA
CULPINA
VILLA ABECIA
MACHARETI
CAMATINDI
VILLA MONTES
CARAMAYO
SANTA ANA
TOLOMOSA
CONCEPCION
CARAPARI
YACUIBA
CHACO

180


Consejo Nacional de Economía y Planificación
Comité de Desarrollo y OOPP de Chuquisaca
U. N. I. C. E. F.
Establecimientos de Educación
Area Rural
10
Escala: 1:1'000 000
REFERENCIAS
Nucleos Escolares
Escuelas Tipo "A"
Escuelas Tipo "B"
AREA DE INFLUENCIA DEL PROYECTO
COCHABAMBA
SANTA CRUZ
PARAGUAY
ARGENTINA
RAVELO
CHAUNACA
SUCRE
YOTALA
ZUDAÑEZ
TOMINA
PADILLA
TARABUCO
SOPACHUY
QUIVINCHA
ESQUIRI
BETANZOS
CALAPAYA
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CAMARGO
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CULPINA
VILLA ABECIA
TARACHIMAYO
SELLA
SAN LORENZO
TOLOMOSA
CONCEPCION
VILLA MONTES
SANANDITA
CARAPARI
YACUIBA

EVALUATION QUESTIONEER SUMMARY

Town Questioneers

- N° Hospitals & Clinics; N° Beds
- N° Schools; N° Students
- N° Professionals: ie Drs., Dentists, Teachers
- Municipal Services: ie Potable Water, Electricity, Garbage Collection
- Community Activities: ie Radio Stations, N° Commercial Establishments, N° Banks
- Income Data
- Expense Data
- Savings Data
- Plans for Use of Electricity

Industry Questioneers

- Type of Energy in Use including Demand; Cost/KWH, Types of Motors, Machines, etc.
- Type of Activity and Period of Operation
- Production Data with Unit Prices
- Source Material Data with Unit Prices
- Expansion Plans for comparison with later questioneers

Farm Questioneers

- Type of Energy in use including Demand, Cost, Types of Motors and Periods of Use
- Type of Farm activity
- Production Data
- Expansion Plans for comparison with later questioneers.

October 17, 1973

FINANCIAL EXHIBITS

Table of Contents

B O L I V I A

EMPRESA NACIONAL DE ELECTRICIDAD S. A. (ENDE)

SOURCES AND APPLICATIONS OF FUNDS
(in '000 $b.)

	1972	1973	1974	1975	1976	1977	TOTAL 73-77
SOURCES							
Internal Cash Generation							
Income before Interest charges	23.450	40.355	50.486	57.592	64.233	71.150	283.816
Depreciation	6.455	12.019	19.406	24.666	25.673	27.764	109.528
Amortization of Studies	2.094	1.608	1.608	1.608	2.084	2.084	8.992
Amortization of Intangible Assets	444	708	709	62			1.479
	32.443	54.690	72.209	83.928	91.990	100.998	403.815
BORROWINGS							
Existing Loans	45.266	102.860	5.581				108.441
Proposed IDA Credit		24.657	77.608	15.502	648		118.415
Future Loans				18.814	114.083	79.091	211.988
	45.266	127.517	83.189	34.316	114.731	79.091	438.844
Government Equity Investments	4.931	8.201	8.201	8.201	8.201	8.201	41.005
Contributions							
United Nations		4.000	4.000	4.000	4.000	4.000	20.000
Other Sources							
Repayment on Loans Granted	1.010	1.506	1.519	1.531	1.544	1.559	7.659
Increase in Other Liabilities	4.812		218		1.359	3.559	5.136
	5.822	1.506	1.737	1.531	2.903	5.118	12.795
TOTAL SOURCES	88.462	195.914	169.336	131.976	221.825	197.408	916.459

B O L I V I A

EMPRESA NACIONAL DE ELECTRICIDAD S. A. (ENDE)

SOURCES AND APPLICATIONS OF FUNDS
(in '000 $.)

	1972	1973	1974	1975	1976	1977	TOTAL 73-77
APPLICATIONS							
Construction Program							
Existing Construction							
Foreing Cost	40.018	95.047	5.581				100.628
Local Cost	24.540	29.940	664				30.604
	64.558	124.987	6.245				130.232
Proposed IDA Credit Construction							
Foreing Cost		22.443	73.201	11.192	168		107.004
Local Cost		4.798	11.603	2.386	167		18.954
		27.241	84.804	13.578	335		125.958
Future Construction							
Foreing Cost				30.414	114.832	79.840	225.086
Local Cost				13.750	49.231	43.470	106.451
				44.164	164.063	123.310	331.537
Total Construction Program							
Foreing Cost	40.018	117.490	78.782	41.606	115.000	79.840	432.718
Local Cost	24.540	34.738	12.267	16.136	49.398	43.470	156.009
	64.558	152.228	91.049	57.742	164.398	123.310	588.727
Investments in Studies							
Existing Studies							
Foreing Cost	2.042	2.579					2.579
Local Cost	1.634	907					907
	3.676	3.486					3.486

[illegible]

SOURCES AND [illegible] OF [illegible]
(In '000 [illegible])

	1972	1973	1974	1975	1976	1977	TOTAL 72-77
Proposed IDA Credit Studies							
Foreing Cost	267	2.214	4.407	4.310	480		11.411
Local Cost	287	1.873	2.254	2.542	195		6.864
	554	4.087	6.661	6.852	675		18.275
Future Studies							
Foreing Cost		4.000	4.000	4.400	9.251	9.251	30.902
Local Cost		1.734	1.800	3.937	6.725	7.175	21.371
		5.234	5.800	8.337	15.976	16.426	52.273
Total Investments in Studies							
Foreing Cost	2.309	8.793	8.407	8.710	9.731	9.251	44.892
Local Cost	1.921	4.514	4.054	6.479	6.920	7.175	29.142
	4.230	13.307	12.461	15.189	16.651	16.426	74.034
Other Investments	1.508	1.026	1.530	1.884	2.286	2.322	9.048
Investments in Associated Comp.	255	6.361	6.872	7.382	5.894	5.906	32.415
Other Applications							
March Bonus (Prima)	498	584	733	879	1.050	1.254	4.500
Decrease in Other Liabilities		6.529		4.342			10.871
DEBT SERVICE							
Interest							
Existing Loans	7.478	16.081	17.245	16.882	16.317	17.978	84.503
Proposed IDA Credit		891	4.449	8.016	8.564	8.190	30.110
Future Loans				872	5.132	10.824	16.828
	7.478	16.972	21.694	25.770	30.013	36.992	131.441
mortization							
Existing Loans	3.906	6.997	10.493	14.176	14.548	14.444	60.658
Paid by CRE	(703)	(1.191)	(1.220)	(1.248)	(1.278)	(1.309)	(6.246)
Net Amortization Existing Loans	3.203	5.806	9.273	12.928	13.270	13.135	54.412
Proposed IDA Credit					4.123	8.245	12.368
					17.393	21.380	66.780
Total Debt Service	10.681	22.778	30.967	38.698	47.406	58.372	198.221
Increase in Working Capital	1.849	7.385	7.626	3.531	1.950	1.109	21.601
Total Applications	83.579	210.198	151.238	129.647	239.635	208.699	939.417
SURPLUS (DEFICIT)	4.883	(14.284)	18.098	2.329	(17.810)	(11.291)	(22.958)
CASH AT THE BEGINNING OF PERIOD	27.008	47.740*	33.456	51.554	53.883	36.073	47.740
CASH AT THE END OF PERIOD	31.891	33.456	51.554	53.883	36.073	24.782	24.782

* Due to devaluation.

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EMPRESA NACIONAL DE ELECTRICIDAD (ENDE)

INCOME STATEMENT

FOR THE YEAR 1972
($b)

OPERATING REVENUES	
Electricity sales	37,765,480
Other	315,921
Total Operation Revenues	38,081,401
OPERATING EXPENSES	
Fuel	1,631,259
General and administrative	934,945
Operation and maintenance	5,183,071
Depreciation and amortizations	6,899,521
DINE taxes	623,722
Total Operating Expenses	15,272,518
Net Operating Income	22,808,883
Other Income	2,812,563
Other Expenses	2,170,821
Income before Interest	23,450,625
Interest	2,346,232
Net Income	21,104,393

EMPRESA NACIONAL DE ELECTRICIDAD, S.A. (ENDE)

BALANCE SHEET

AS OF DECEMBER 31, 1972
($b)

ASSETS			
FIXED ASSETS			
Installations in Sucre			
Intangible Assets	2,894,232		
Revaluation	1,540,258	4,434,490	
Amortization	1,912,398		
Revaluation	1,043,983	2,956,381	1,478,109
Tangible Assets	218,181,699		
Revaluation	104,807,580	322,989,279	
Depreciation	32,173,312		
Revaluation	13,968,754	46,142,066	276,847,213
Electric Service Assets			
In progress:			
Planta Santa Isabel		198,214.171	
Grupo Diesel Potosi		679,285	
Planta Técnica Sucre		18,782,062	
Linea Sucre-Potosi		11,936,922	229,612,440
Other Assets and Investments			
Investments in associated companies		80,040,129	
Other investments		75,862	80,115,991
CURRENT ASSETS			
Cash and Banks		13,222,533	
Temporary Investments		34,516,952	
Accounts receivable		13,647,678	
Associated Companies Accounts Receivable		3,094,586	
Materials and supplies		2,688,107	
Materials and supplies in transit		2,085,339	
Advance payments		803,242	70,058,437
OTHER ASSETS			
Interest and dividends receivables			31,828

EMPRESA NACIONAL DE ELECTRICIDAD S.A.

BALANCE SHEET

AS OF DECEMBER 31, 1972
($b)

LIABILITIES		
Paid in Capital		
Common Stock	178,715,075	
Preferred stock	72,000,000	
	250,715,075	
Stock debtors	33,320,338	217,394,737
RESERVES		
Accumulated profits		4,165,168
EARNED SURPLUS		
Exchange difference	79,929,901	
Net profit in 1972	21,104,393	101,007,294
Net equity		322,567,199
LIABILITIES		
Other long term debts:		
IDB 41/SF-BO	55,672,195	
DINE - Technical assistance	(1,830,136)	
	53,842,059	
USAID/B	105,888,650	
CBF-BID Pre-investment	3,683,358	
BID 221/SF-BO	22,778,386	
BID 4/UK-BO	4,713,544	
IDA 148/BO	119,635,515	
Comité Obras Públicas Sta. Cruz	1,855,761	312,397,273
TEMPORARY LIABILITIES		
Long term advances:		
Administration CBF-BID funds	2,506,389	
Social benefits reserve	1,422,090	3,928,479
CURRENT LIABILITIES		
Accounts payable	5,876,109	
Taxes payable	1,164,063	
Interests payable	12,272,124	
Long term debts due within one year	7,104,310	26,416,606
DEFERRED CREDITS		
Other deferred credits		9,040,521
Total liabilities and stock-holders equity		674,350,078

DEFERRED CHARGES		
Studies and investigations	19,820,829	
Provision for write-offs	4,545,569	15,275,[illegible]
Other deferred charges		930,8[illegible]
Total Assets		674,350,07[illegible]

BALANCE SHEETS

AS OF DECEMBER 31, 1972
($b)

	INER (La Paz)	CESSA (Sucre)	SETAR (Tarija)	SEPSA (Potosi)
ASSETS				
Property, plant and equipment	$b 420,518	$b 1,219,877	$b 461,618	$b 1,671,636
Production	-	14,909,752	7,879,320	-
Transmission and d stribution	-	5,485,606	2,705,316	392,807
Other	-	53,700	-	-
	420,518	21,668,935	11,046,254	2,064,443
Less depreciation	36,193	8,257,829	3,538,856	536,667
	384,325	13,411,106	7,507,398	1,527,776
Long-term accounts receivable	24,998,247	3,784,582		3,262,020
Assets under construction		259,440		
Investments		22,088		26,208
CURRENT ASSETS				
Cash and accounts receivable	2,663,012	1,390,154	2,192,169	969,700
Materials and supplies	13,812,123	1,535,364	1,090,488	71,112
Prepaid expenses	12,000	-	754	-
Total current assets	16,487,135	2,925,518	3,283,411	1,040,811
Deferred charges	-	1,506,659	27,959	-
Due by Comité de Desarrollo y OO.PP.	-	-	-	1,324,990
Total Assets	$b41,869,707	$b21,859,392	$b10,818,768	$b7,231,806

BALANCE SHEETS

AS OF DECEMBER 31, 1972
($b)

	INER (La Paz)	CESSA (Sucre)	SETAR (Tarija)	SEPSA (Potosi)
LIABILITIES				
Shareholder's equity				
Capital stock	$b 1,876,424	$b	$b 7,347,975	
Common stock		295,389		
Revalued capital		6,384,072		
Retained earnings		(248,543)		$b (633,025)
1972 Profit or (Loss)	646,467	(555,893)	177,934	38,050
	2,522,891	5,875,025	7,525,909	(594,975)
Long-term liabilities	22,306,405	12,098,464	1,131,684	7,753,666
CURRENT LIABILITIES				
Long-term debt due within one year		398,137		
Accounts payable	4,850,142	1,346,631	740,924	73,115
Customers deposits		2,502	39,805	-
Total current liabilities	4,850,142	1,747,270	780,729	73,115
Due to ENDE		115,675	90,820	
Operation Reserves	12,190,269	1,896,622	141,884	
Contributions from third parties		111,652		
Deferred credit		14,684	1,147,742	
Total liabilities and equity	$b41,869,707	$b21,859,392	$b10,818,768	$b7,231,806

LA PAZ - INER
SALES PROJECTIONS (US$ x 1000)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Rural Resid-Comm-Sm.- Industrial										
No. Consumers	101137	10544	10949	11358	11775	12194	12618	13037	13482	13922
KWH/Year/Consumer	420	454	490	529	571	617	666	720	777	840
Total MWH/Year	4257.5	4787.0	5365.0	6008.4	6723.5	7523.7	8403.6	9458.6	10475.5	11694.5
Revenue (0.03/K WH)	127.7	143.6	160.9	180.2	201.7	225.7	252.1	283.8	314.3	350.8
Rural Industrial										
No. Consumers	18	18	19	19	23	23	24	24	26	28
Total MWH/Year	19820.0	20420.0	21300.0	22100.0	23560.0	24060.0	24.740.0	25240.0	26260.0	27000.0
Revenue (0.027/ KWH)	535.1	551.3	575.1	596.7	636.1	649.6	668.0	681.4	709.0	729.0
Irrigation										
Total MWH/Year	0	1600.0	3200.0	4800.0	6400.0	8000.0	9600.0	11200.0	12800.0	14400.0
Revenue (0.0225/KWH)	-	36.0	72.0	108.0	144.0	180.0	216.0	252.0	288.0	324.0
Rural Street Lights										
Total MWH/Year	54.7	56.5	59.2	61.6	64.0	66.6	69.3	72.0	74.9	77.9
Revenue (10.0% Tax)	12.8	14.4	16.1	18.0	20.2	22.6	25.2	28.4	31.4	35.1
Total Revenue	675.6	745.3	824.1	903.0	1002.0	1077.9	1161.3	1245.6	1342.7	1438.9
MWH Sold	24132.3	26863.5	29924.2	32970.0	36747.6	39650.3	42743.6	45970.7	49610.4	53172.4
MWH Purchased	27752.1	30893.0	34412.9	37915.5	42259.7	45597.8	49155.1	52866.3	57052.0	61148.2

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INSTITUTO NACIONAL DE ELECTRIFICACION RURAL (INER)

CASH FLOW PROJECTIONS

FOR THE YEARS 1974-1980
($b 000's)

	1974	1975	1976				
Cash available at beginning of year	-	334	310	1,186	1,528	3,954	7,06
SOURCES OF CASH							
Net income from operations	-	-	-	4,688	5,316	6,044	6,77
Decrease (Increase in Accounts Receivable)	-	-	-	(1,622)	(166)	(210)	(19
Cash generated from operations	-	-	-	3,066	5,150	5,834	6,58
Other income	200	600	1,200	160	160	160	16
Sale of capital stock	200	400	600	40	40	40	4
AID Loan funds	3,324	25,389	17,449	-	-	-	-
ENDE grant funds	1,175	8,976	6,169	-	-	-	-
Total sources of cash	4,899	35,699	25,728	4,452	6,878	9,928	13,84
APPLICATIONS OF CASH							
AID Loan funds	3,324	25,839	17,449	-	-	-	-
ENDE grant funds	1,175	8,976	6,169	-	-	-	-
Plant expansion	-	-	-	2,000	2,000	2,000	2,00
Debt service							
Interest on AID loan	66	574	924	924	924	924	92
Total application of cash	4,565	35,389	24,542	2,924	2,924	2,924	2,92
Cash available at end of year	334	310	1,186	1,528	3,954	7,064	10,92

INSTITUTO NACIONAL DE ELECTRIFICACION RURAL (INER)

INCOME STATEMENT PROJECTIONS

FOR THE YEARS 1977-1980
($b 000's)

		1977	1978	1979	1980
OPERATING REVENUES					
Urban sales		-	-	-	-
Rural Sales	(1)	13,512	14,906	16,482	18,058
		13,512	14,906	16,482	18,058
OPERATING COSTS					
Electricity generation and maintenance costs	(2)	8,824	9,590	10,438	11,286
Net income from operations		4,688	5,316	6,044	6,772
OTHER INCOME					
Miscellaneous	(3)	946	1,044	1,154	1,264
OTHER EXPENSES					
Depreciation		1,964	2,024	2,084	2,144
Net income before financing charges		3,670	4,336	5,114	5,892
INTEREST EXPENSE					
Interest on AID loan		66	574	924	924
Net income		3,604	3,762	4,190	4,968

NOTES:
(1) See projection table.
(2) Cost of operations maintenance and administration plus purchased power.
(3) Includes revenue from meter rentals and customer installation revenue.

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COOPERATIVE ELECTRICA SUCRE, S.A. (CESSA)

SALES PROJECTIONS

	1972	1973	1974	1975	1976	1977	1978	1979	1980
URBAN:									
No. Consumers	2,511	3,339	4,408	4,468	4,649	8,065	8,360	8,735	8,685
KWH Per Year (000)	8,360	11.120	14,680	14,880	15,480	26,869	28,117	29,380	30,523
Ave. Rate Per KWH ($b)	.50	.50	.50	.50	.50	.50	.50	.50	.50
Revenue ($b 000)	4,180	4,560	7,340	7,440	7,840	13,440	14,120	14,790	15,404
RURAL:									
No. Consumers	-	-	415	415	1,702	5,004	6,306	7,306	8,007
KWH Per Year (000)	-	-	133	133	1,072	3,292	4,920	6,470	7,410
Ave. Rate Per KWH	-	-	.60	.60	.60	.60	.60	.60	.60
Revenue ($b 000)	-	-	80	80	700	1,980	2,960	3,770	4,376
Total Revenue ($b 000)	4,180	4,560	7,420	7,520	8,540	15,420	17,080	18,560	19,780

"C.E.S.S.A."

SALES PROJECTION (ALT 1) (ALT 4)

R U R A L .	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
RESIDENTIAL										
COMMERCIAL										
N° Consumers	5000	6300	7300	8000	8500	8900	9300	9700	10100	10500
KWH/Cons/Year.	380	410	440	470	500	530	560	600	640	680
TOTAL MWH	1900	2580	3210	3760	4250	4720	5200	5820	6260	7140
Revenue US$ x 1000 (0.033/KWH)	62.7	85.1	105.9	124.1	140.3	155.8	171.6	192.1	206.6	235.
GENERAL-INDUSTRIAL										
N° Consumers	4	6	6	7	7	7	8	8	8	9
MWH/Cons/Year.	190	190	210	220	230	240	240	250	260	260
TOTAL MWH	960	1140	1260	1540	1610	1680	1920	2000	2080	2340
Revenue US$ x 1000 (0.032/KWH)	30.7	36.5	40.3	49.3	51.5	53.8	61.4	64.0	66.6	74.
IRRIGATION										
TOTAL MWH		1000	1800	1900	2000	2100	2200	2250	2250	2250
Revenue US$ x 1000 (0.020/KWH)		20.0	36.0	38.0	40.0	42.0	44.0	45.0	45.0	45.
STREET LIGHTING										
TOTAL MWH	150	200	200	210	210	220	220	220	230	230
Revenue US$ x 1000	5.3	7.0	7.0	7.4	7.4	7.7	7.7	7.7	8.0	8.(
TOTALS										
TOTAL MWH	1166.9	1413.7	1625.0	1773.3	1898.7	2019.1	2156.0	2290.5	2412.0	2588.5
TOTAL REVENUE	770.9	854.4	927.7	989.0	1041.7	1092.9	1147.2	1201.2	1251.8	1320.1

"C.E.S.S.A."

SALES PROJECTION

U R B A N .	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
RESIDENTIAL										
Nº Consumers	5900	6100	6330	6550	6770	7000	7200	7400	7630	7850
KWH/Cons/Year.	705	720	735	750	760	770	780	790	800	810
TOTAL MWH	4150	4400	4650	4900	5150	5400	5600	5850	6100	6350
Revenue US$ x 1000 (0.0295/KWH)	122.4	129.8	137.2	144.6	151.9	159.3	165.2	172.6	180.0	187.3
COMMERCIAL										
Nº Consumers	550	560	570	580	590	600	610	620	630	640
KWH/Cons/Year.	1270	1300	1330	1360	1390	1420	1450	1490	1530	1570
TOTAL MWH	700	730	770	790	820	850	885	925	965	1005
Revenue US$ x 1000 (0.0385/KWH)	26.9	28.1	29.6	30.4	31.6	32.7	34.1	35.6	37.2	38.7
INDUSTRIAL										
Nº Consumers	115	120	125	130	135	140	145	150	160	165
MWH/Cons/Year	13.0	13.4	13.7	14.0	14.3	14.6	14.9	15.2	15.5	15.8
TOTAL MWH	1495	1610	1710	1820	1930	2040	2160	2280	2480	2610
Revenue US$ x 1000 (0.0280/KWH)	41.9	45.1	47.9	51.0	54.0	57.1	60.5	63.8	69.4	73.1
GENERAL										
Nº Consumers	1500	1580	1660	1740	1830	1910	2000	2080	2170	2260
KWH/Cons/Year.	1120	1160	1200	1230	1270	1300	1330	1360	1390	1420
TOTAL MWH	1680	1830	1990	2140	2330	2480	2660	2830	3010	3200
Revenue US$ x 1000 (0.0310/KWH)	52.1	56.7	61.7	66.3	72.2	76.9	82.5	87.7	93.3	99.2
STREET LIGHTING										
Total MWH	634	647	660	673	687	701	715	730	745	760
Revenue US$ x 1000	19.4	20.8	22.1	23.4	24.8	26.1	27.4	28.7	30.4	31.8
CEMENT FACTORY										
TOTAL MWH	18200	18900	19600	20200	20800	21400	21900	22400	22900	23400
Revenue US$ x 1000 (0.0225/KWH)	409.5	425.3	441.0	454.5	468.0	481.5	492.8	504.0	515.3	526.5

COOPERATIVA ELECTRICA SUCRE S.A. (CL A)

CASH FLOW PROJECTIONS

FOR THE YEARS 1973-1980
($b 000's)

	1972	1973	1974	1975	1976	1977	1978	1979	1980
Cash available at beginning of year	230	480	1,080	(1,560)	(4,480)	(7,200)	(4,660)	(1,540)	2,200
SOURCES OF CASH									
Net income from operations	640	680	(2,660)	(2,960)	(3,160)	2,420	3,180	3,840	4,420
Decrease in accounts receivable	20	-	-	-	-	-	-	-	-
Cash generated from operations	660	680	(2,660)	(2,960)	(3,160)	2,420	3,180	3,840	4,420
Other income	120	80	100	100	180	220	140	140	140
Sale of Capital Stock	-	-	120	420	900	540	420	300	220
AID loan funds	-	-	1,760	13,440	9,260	-	-	-	-
ENDE grant funds	-	-	212	1,619	1,113	-	-	-	-
Total sources of cash	1,000	1,240	612	11,039	3,813	(4,020)	(920)	2,740	6,980
APPLICATIONS OF CASH									
AID loan funds	-	-	1,760	13,440	9,260	-	-	-	-
ENDE grant funds	-	-	212	1,619	1,113	-	-	-	-
Decrease in accounts payable	380	-	-	-	-	-	-	-	-
Debt service									
Interest on AID loan	-	-	40	300	500	500	500	500	500
Interest on Banco Central loan & other		40	40	40	20	20	-	-	-
Principal on Banco Central loan	100	120	120	120	120	120	120	40	-
Total application of cash	520	160	2 172	15,519	11,013	640	620	540	500
Cash available at end of year	480	1,080	(1,560)	(4,480)	(7,200)	(4,660)	(1,540)	2,200	6,480

COOPERATIVA ELECTRICA SUCRE S.A. (CESSA)

INCOME STATEMENT PROJECTIONS

FOR THE YEARS 1973-1980
($b 000's)

		1972	1973	1974	1975	1976	1977	1978	1979	1980
OPERATING REVENUES										
Urban sales	(1)	4,180	4,560	7,340	7,440	7,840	13,440	14,120	14,800	15,400
Rural sales	(1)	-	-	60	80	700	1,980	2,960	3,760	4,380
Total operating		2,180	2,560	7,420	7,520	5,540	15,420	17,080	18,560	19,780
OPERATING COSTS										
Electricity generation, purchase and maintenance costs	(2)	3,540	3,880	10,080	10,500	11,700	13,000	13,900	14,720	15,360
Net income from operations		640	680	(2,660)	(2,980)	(3,160)	2,420	3,180	3,840	4,420
OTHER INCOME										
Miscellaneous	(3)	120	80	100	100	180	220	140	140	140
OTHER EXPENSES										
Depreciation		740	940	1,260	1,340	1,860	2,440	2,640	2,700	2,760
Net income before financial charges		20	(180)	(3,820)	(4,220)	(4,840)	200	680	1,280	1,800
INTEREST EXPENSE										
Interest on Banco Central loan	(4)	580	40	40	40	20	20	-	-	-
Interest on AID loan		-	-	40	300	500	500	500	500	500
		580	40	40	340	520	520	500	500	500
Net income		(560)	(220)	(3,900)	(4,560)	(5,360)	(320)	180	780	1,300

NOTES:
(1) See sales projection table.
(2) Cost of operations, maintenance and administration plus purchased power.
(3) Includes revenue from meter rentals, customer installation revenue and interest income.
(4) Loan amounts to $b900,000 at 6%.

SERVICIOS ELECTRICOS DE POTOSI, S.A. (SEPSA)
SALES PROJECTIONS

	1972	1973	1974	1975	1976	1977	1978	1979	1980
URBAN:									
No. Consumers	2,091	6,030	6,230	6,430	6,630	6,834	7,031	7,166	7,335
KWH Per Year (000)	3,785	6,407	7,047	7,753	9,762	11,759	13,134	14,568	16,133
Ave. Rate Per KWH ($b)	.55	.55	.55	.55	.55	.56	.57	.57	.58
Revenue ($b 000)	2,082	3,524	3,876	4,264	5,369	6,606	7,460	8,328	9,314
RURAL:									
No. Consumers	-	-	-	2,766	4,610	4,920	5,023	5,126	5,229
KWH Per Year (000)	-	-	-	1,122	1,153	1,920	2,451	2,813	3,962
Ave. Rate Per KWH ($b)		-		.55	.55	.55	.55	.55	.55
Revenue ($b 000)	-	-	-	617	634	1,080	1,356	1,558	2,106
Total Revenue ($b 000)	2,082	3,524	3,876	4,881	6,003	7,686	8,816	9,886	11,420

SERVICIOS ELECTRICOS POTOSI S.A.
SEPSA
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SALES PROJECTION

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
RURAL										
RESIDENTIAL-COMERCIAL										
Nº Consumers	4.850	4.950	5.050	5.150	5.250	5.350	5.450	5.550	5.665.	5.780
KWH/Cons./Year	240	300	348	384	420	456	492	528	564	600
Total MWH	1.160	1.485	1.757	1.978	2.205	2.440	2.681	2.930	3.195	3.468
Revenue US$x1.000 (0.028/KWH	32.5	41.6	49.2	55.4	61.7	68.3	75.1	82.0	89.5	97.1
SMALL INDUSTRIAL										
Nº Consumers	70	73	76	79	82	84	86	88	90	92
KWH/Cons./Year	3.000	3.150	3.307	3.472	3.610	3.750	3.900	4.050	4.210	4.380
Total MWH	210	230	251	274	296	315	335	356	379	403
Revenue US$x1.000 (0.036/KWH)	7.7	8.3	9.1	9.9	10.6	11.4	12.1	12.8	13.6	14.5
IRRIGATION										
Total MWH	360	540	600	1.500	2.100	2.700	3.600	4.200	4.800	5.400
Revenue US$x1.000 (0.023/KWH)	8.1	12.1	13.5	33.7	47.2	60.7	81.0	94.5	108.0	121.5
STREET LIGHTING										
Total MWH	190	196	205	210	212	220	222	224	230	232
Revenue US$x1.000 (0.030/KWH)	5.7	5.8	6.1	6.3	6.4	6.6	6.7	6.8	6.9	7.0
SUBTOTAL MWH	1.920	2.451	2.813	3.962	4.813	5.675	6.838	7.710	8.604	9.503
SUBTOTAL REVENUE	54.0	67.8	77.9	105.3	125.9	147.0	174.9	196.1	218.0	240.1
TOTAL MWH	13.679	15.585	17.381	20.095	22,503	25.116	28.234	31.243	34.568	37.192
TOTAL REVENUE	384.3	440.8	494.3	571.0	639.3	714.2	802.3	888.8	985.3	1.057.7

OS/mrb.

SERVICIOS ELECTRICOS POTOSI S.A.
SEPSA
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URBAN

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
RESIDENTIAL										
Nº Consumers	5.519	5.689	5.798	5.943	6.092	6.244	6.400	6.560	6.725	6.890
KWH/Cons./year	720	750	780	810	840	870	900	930	960	985
Total MWH	3.974	4.268	4.522	4.814	5.117	5.432	5.760	6.100	6.456.	6.787
Revenue US$x1.000 (0.024/KWH)	93.4	100.3	106.3	113.1	120.2	127.6	135.4	143.4	151.7	162.
GENERAL										
Nº Consumers	170	174	178	180	182.	184	186	188	190	191
KWH/Cons./year	12.2	12.4	12.6	12.8	13.1	13.4	13.7	14.0	14.3	14.
Total MWH	2.074	2.158	2.243	2.304	2.384	2.466	2.548	2.632	2.717	2.770
Revenue US$x1.000 (0.031/KWHO	64.3	66.9	69.5	71.6	73.9	76.4	79.0	81.6	84.2	85.
SMALL INDUSTRIAL $ COMERCIAL										
Nº Consumers	1.120	1.140	1.160	1.180	1.200	1.230	1.255	1.270	1.300	1.310
KWH/Cons./year	1.824	2.079	2.370	2.702	1.891	3.080	3.295	3.511	3.728	3.850
Total MWH	2.043	2.370	2.749	3.188	3.469	3.788	4.135	4.459	4.846	5.044
Revenue US$x1.000 (0.036/KWHO	73.5	85.3	98.9	114.8	124.9	136.4	148.9	160.5	174.5	181.
LARGE INDUSTRIAL										
Nº Consumers	25	28	30	32	34	36	38	40	42	43
MWH/Cons./year	100.8	112.9	126.4	141.6	158.6	177.6	198.9	222.8	249.5	269.
Total MWH	2.520	3.161	3.790	4.531	5.392	6.394	7.558	8.912	10.479	11.589
Revenue US$x1.000 (0.027/KWH)	69.1	86.6	103.8	124.1	147.7	175.2	307.1	244.2	287.1	312.
STREET LIGHTING										
Total MWH	1.148	1.177	1.264	1.296	1.328	1.361	1.395	1.430	1.466	3.499
Revenue US$x1.000	30.0	33.9	37.9	42.3	46.7	51.6	57.0	63.0	69.8	74.
SUBTOTAL MWH	11.759	13.134	14.568	16.133	17.690	19.441	21.396	23.533	25.964	27.689
SUBTOTAL REVENUE	330.3	373.0	416.4	465.7	513.4	567.2	627.4	692.7	767.3	817.

OS/mrb.

SERVICIOS ELECTRICOS POTOSI S.A. (SEPSA)

CASH - FLOW PROJECTION

FOR THE YEARS 1973-1980
($'s 000's)

	1972	1973	1974	1975	1976	1977	1978	1979	1980
Cash available at beginning of year	380	200	220	(1,468)	(2,615)	(2,479)	(1,828)	(954)	23
SOURCES OF CASH									
New income from operations	65	-	(1,668)	(1,127)	(304)	791	1,194	1,508	2,03
Decrease (increase) in accounts receivable	(265)	-	-	-	-	-	-	-	-
Cash generated from operations	(200)	-	(1,668)	(1,127)	(304)	791	1,199	1,508	2,03
Other income	20	20	20	40	40	40	40	40	4
Sale of Capital Stock	-	-	-	200	780	200	20	20	2
AID loan funds	-	-	900	12,380	9,220	-	-	-	-
ENDE grant funds	-	-	276	2,112	1,452	-	-	-	-
Total sources of cash	300	220	(272)	12,137	8,573	(1,448)	(574)	614	2,32
APPLICATION OF CASH									
AID loan funds	-	-	900	12,380	9,220	-	-	-	-
ENDE grant funds	-	-	276	2,112	1,452	-	-	-	-
Debt since Interest on AID loan	-	-	20	260	380	380	380	380	38
	-	-	1,196	14,752	11,052	380	380	380	38
	200	220	(1,468)	(2,615)	(2,479)	(1,828)	(954)	234	1,94

SERVICIOS ELECTRICOS POTOSI S.A. (SEPSA)

INCOME STATEMENT PROJECTIONS

FOR THE YEARS 1973-1980
($b 000's)

		1972	1973	1974	1975	1976	1977	1978	1979	1980
OPERATIONS REVENUES										
Urban sales	(1)	2,082	3,524	3,876	4,264	5,369	6,606	7,460	8,328	9,314
Rural sales	(1)	-	-	-	617	634	1,080	1,356	1,558	2,106
Total operating revenues		2,082	3,524	3,876	4,881	6,003	7,686	8,816	9,886	11,420
OPERATING COSTS										
Electricity generation purchase, and distribution costs	(2)	2,017	3,524	5,544	6,008	6,307	6,948	7,622	8,378	9,390
Net income from operations		65	-	(1,668)	(1,127)	(304)	738	1,194	1,508	2,030
Miscellaneous	(3)	33	200	250	400	500	538	527	694	800
		33	200	250	400	500	538	527	694	800
OTHER EXPENSES										
Depreciation		60	927	936	942	948	1,256	1,678	1,802	1,802
		60	927	936	942	948	1,256	1,678	1,802	1,803
Net income before financing charges		38	(727)	(2,354)	(1,669)	(752)	73	43	400	1,028
INTEREST EXPENSE										
Interest on AID loan		-	-	18	266	370	370	370	370	370
		-	-	18	266	370	370	370	370	370
Net income		38	(727)	(2,372)	(1,935)	(1,122)	(297)	(327)	30	658

NOTES:
(1) See sales projection table.
(2) Cost of operations, maintenance and administration plus purchased power.
(3) Includes revenue from meter rentals and customer installation revenue.

SERVICIOS ELECTRICOS TARIJA S.A. (SETAR)
SALES PROJECTIONS

	1972	1973	1974	1975	1976	1977	1978	1979	1980
URBAN:									
No. Consumers	3,378	3,716	4,088	4,498	4,949	5,445	5,988	6,587	7,245
KWH Per Year (000)	2,438	3,477	4,063	4,814	5,545	6,458	7,178	8,254	9,315
Ave. Rate Per KWH ($b)	.55	.55	.55	.55	.55	.55	.55	.55	.55
Revenue ($b 000)	1,341	1,927	2,244	2,651	2,889	3,530	3,931	4,531	5,135
RURAL:									
No. Consumers	-	-	-	-	3 014	9,148	10,062	11,068	12,174
KWH Per Year (000)	-	-	912	1,825	6,173	16,220	18,000	19,858	21,949
Ave. Rate Per KWH ($b)	-	-	.45	.45	.48	.48	.48	.48	.50
Revenue ($b 000)	-	-	410	821	2,990	7,851	8,721	9,632	10,975
Total Revenue ($b 000)	1,341	1,927	2,654	3,472	5,879	11,381	12,652	14,163	16,110

SETAR - TARIJA
SALES PROJECTIONS ($b.)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
URBAN RESIDENTIAL:												
No. Consumers	3727	4100	4510	4960	5457	6002	6603	7263	7990	8789	9668	10635
KWH/Year/Consumer	744	768	792	816	840	864	888	912	936	960	984	1008
Total KWH/Year	2862336	3148800	3571920	3928320	4583880	5185728	5863464	6623856	7478640	8437440	9513312	10720080
Revenue (0.55/KWH)	1416856	1558656	1768100	1944518	2269021	2566936	2902414	3278809	3701926	4176532	4709089	5306439
URBAN COMMERCIAL:												
No. Consumers	729	802	883	971	1068	1175	1292	1421	1564	1720	1892	2082
KWH/Year/Consumer	1788	1872	1968	2064	2172	2280	2388	2509	2640	2772	2904	3060
Total KWH/Year	1303452	1501344	1737744	2004144	2319696	2679000	3085296	3563868	4128960	4767840	5494368	6370920
Revenue (0.60/KHW)	703864	810725	938381	1082238	1252635	1446660	1666060	1913895	2201000	2527393	2896187	3332984
URBAN SMALL INDUSTRY												
No. Consumers	40	44	48	53	58	64	71	78	86	95	104	114
KWH/Year/Consumer	11172	11724	12312	12924	13572	14256	14964	15708	16500	17316	18192	19092
Total KWH/Year	446880	515856	590976	684972	787176	912384	1062444	1225224	1350888	1645020	1891968	2176488
Revenue (0.50/KWH)	201096	232135	265940	308236	354229	410573	478100	551351	607900	740259	851386	979413
URBAN LARGE INDUSTRY												
No. Consumers	2	3	4	4	4	4	5	5	5	5	6	6
Total KWH/Year	175000	350000	525000	525000	525000	525000	700000	700000	700000	700000	1000000	1000000
Revenue (.45/KWH)	78750	15750	236250	236250	236250	236250	315000	315000	315000	315000	450000	450000
URBAN STREET LIGHTS												
Total KWH/Year	26414	29056	31961	35157	38673	42540	46795	51474	56621	62284	68512	75363
Revenue (10.8% Tax)	250756	280964	321021	360179	418596	474570	545030	620358	703169	803972	913319	1038843
RURAL RESIDENTIAL, COMMERCIAL & SMALL IND. — No. Consumers	-	3000	9133	10046	11051	12156	13372	14709	16180	17798	19578	21536
RURAL RESIDENTIAL, COMMERCIAL & SMALL IND. — KWH/Year/Cons.	-	300	324	348	372	408	444	480	516	552	600	648
RURAL RESIDENTIAL, COMMERCIAL & SMALL IND. — Total KWH/Year	-	900000	2959092	3496008	4110972	4959648	5937168	7060320	8348880	9824496	11746800	13955328
RURAL RESIDENTIAL, COMMERCIAL & SMALL IND. — Revenue(0.55/KWH)	-	445500	1464751	1730524	2034931	2727807	2938898	3494858	4132696	4863126	5814666	6907887
RURAL LARGE INDUSTRY:												
No. Consumers	-	14	15	16	17	18	19	20	21	22	23	24
Total KWH/Year	-	2529450	5387400	5715900	6044400	6372900	6701400	7029900	7358400	7686900	8015400	8343900
Revenue (0.45/KWH)	-	1264725	2693700	2857950	3022200	3186450	3350700	3514950	3679200	3843450	4007700	4171950
RURAL IRRIGATION:												
Total KWH/Year	1824762	2737143	7854324	8766705	9679086	10591467	11503848	12416229	13328610	14240991	15153372	16065753
Revenue (0.45/KWH)	821143	1231714	3534446	3945017	4355589	4766160	5176731	5587303	5997874	6408446	6819017	7229589
RURAL STREET LIGHTS:												
Total KWH/Year	-	6000	18900	21000	23100	25400	27951	30746	33821	37203	40923	45015
Revenue (10.8% Tax)	-	48114	158193	186897	219773	294603	317400	377445	446331	525218	627984	746052
TOTAL No. CONSUMERS	4498	7963	14593	16050	17655	19419	21362	23496	25846	28429	31271	34397
KWH Sold	6638844	11717649	22677317	25177205	28111983	31294077	34928366	38701617	42784820	47402174	52924655	58752847
KWH Purchased (ENDE-RURAL)	-	-	18652673	20699554	22836203	25241838	27795922	30517774	33430167	36558028	40199969	44171495
KHW Generated (Hydroelectric)	2000000	2000000	2000000	2000000	2000000	2000000	2000000	2000000	2000000	2000000	2000000	2000000
KWH Generated (Thermal)	4638844	9717649	-	-	-	-	-	-	-	-	-	-
KWH Purchased (ENDE - City)			5426241	6254232	7492577	8746350	10371698	11989085	13772376	15954472	18663384	21394279

SERVICIOS ELECTRICOS TARIJA S.A. (SETAR)

CASH FLOW PROJECTIONS

FOR THE YEARS 1973-1980
($b 000's)

	1972	1973	1974	1975	1976	1977	1978	1979	1980
Cash Available at Beginning of Year	1,627	1,692	2,328	3,357	4,314	6,292	7,784	9,115	11,093
Sources of Cash									
Net income from operations	(251)	137	785	1,108	1,888	2,696	3,167	3,695	4,599
Less - increase in accounts receivable	(178)	-	-	-	-	-	-	-	-
Cash generated from operations	(429)	137	785	1,108	1,888	2,696	3,167	3,695	4,599
Other income	765	756	537	511	612	896	931	1,024	1,126
Sale of capital stock	-	-	-	-	390	798	118	130	144
AID loan funds	-	-	2,492	19,096	13,153	-	-	-	-
ENDE Grant funds	-	-	2,393	2,393	2,393	-	-	-	-
Total Sources of Cash	1,963	2,585	6,535	26,465	32,750	10,682	12,000	13,964	16,962
Applications of Cash									
AID Loan funds	-	-	2,492	19,096	13,153	-	-	-	-
ENDE Grant funds	-	-	2,393	2,393	2,393	-	-	-	-
Capital expenditures	-	-	-	-	-	2,000	2,000	2,000	2,000
Debt service									
Interest on AID Loan	-	-	49	432	695	695	695	695	695
Interest on Fiat Loan	110	96	83	69	56	42	29	15	3
Principal on Fiat Loan	161	161	161	161	161	161	161	161	161
Total Application of Cash	271	257	5,178	22,151	16,458	2,898	2,885	2,871	2,859
Cash Available at End of Year	1,692	2,328	3,357	4,314	6,292	7,784	9,115	11,093	14,103

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INCOME STATEMENT PROJECTIONS

FOR THE YEARS 1973-1980
($b 000's)

		1972	1973	1974	1975	1976	1977	1978	1979	1980
OPERATING REVENUES										
Urban Sales	(1)	1,341	1,927	2,244	2,651	2,889	3,530	3,931	4,531	5,135
Rural Sales	(1)	-	-	410	821	2,990	7,851	8,721	9,632	10,975
Total Operating Revenues		1,341	1,927	2,654	3,472	5,879	11,381	12,652	14,163	16,110
OPERATING COSTS										
Electricity Generation and Maintenance Costs	(2)	1,592	1,790	1,869	2,364	3,991	8,685	9,485	10,468	11,511
Net Income from Operations		(251)	137	785	1,108	1,888	2,696	3,167	3,695	4,599
OTHER INCOME										
Comite P.O.P.P. Subsidy	(3)	540	363	300	350	150	50	-	-	-
Miscellaneous	(4)	225	393	237	261	462	846	931	1,024	1,126
		765	756	537	611	612	896	931	1,024	1,126
OTHER EXPENSES										
Depreciation		333	366	366	366	815	2,504	2,564	2,624	2,684
Amortization of Deferred Charges	(5)	3	3	3	3	3	3	3	3	3
		336	369	369	369	818	2,507	2,567	2,627	2,687
Net Income Before Financial Charges		178	524	953	1,250	1,682	1,085	1,531	2,092	3,038
INTEREST EXPENSE										
Interest on Fiat Loan	(6)	110	96	83	69	56	42	29	15	3
Interest on AID Loan		-	-	22	388	662	682	682	682	682
		110	96	105	457	738	724	711	697	685
Net Income		68	428	848	793	944	361	820	1,395	2,353

NOTES:

(1) See sales projection table.
(2) Cost of operations, maintenance and administration plus purchased power.
(3) Comite agreed to subsidize generating fuel requirements of Setar in order to avoid rate increases. Subsidy ends in 1977. Semi annual retail rate increases of 5% are now in effect with which Setar is now using to pay generation fuel costs.
(4) Includes revenue from meter rentals, customer installation revenue and interest income from savings accounts.
(5) Organizational expenses incurred in 1968 from new plant installation which will be written of over a 10 year period.
(6) 450 KW diesel plant loan from Fiat concord in the amount of US$77,707.