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**CAPITAL ASSISTANCE PAPER**

**Proposal and Recommendations  
For the Review of the  
Development Loan Committee**

**BRAZIL: PASSO REAL HYDROELECTRIC PROJECT**

512-0281

A.I.D.  
Reference Center  
Room 1656 NS

100-100/1-720

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

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AID-ILC/P-729  
June 14, 1968

MEMORANDUM FOR THE DEVELOPMENT LOAN COMMITTEE

SUBJECT: Brazil: Passo Real Hydroelectric Project

Attached for your review are the recommendations for authorization of a loan in an amount not to exceed \$27,400,000 to the Companhia Estadual de Energia Eletrica of the State of Rio Grande do Sul to assist in financing the United States dollar costs of the Passo Real Hydroelectric Project, related transmission and distribution facilities, and U.S. consulting engineering and training services.

This loan proposal is scheduled for consideration by the Development Loan Staff Committee at a meeting on Thursday, June 20, 1968.

Rachel C. Rogers  
Assistant Secretary  
Development Loan Committee

Attachments:

Summary and Recommendations  
Project Analysis  
ANNEXES I-VII

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June 14, 1968

BRAZIL - CIA. ESTADUAL DE ENERGIA ELETRICA (CEEE)  
PASSO REAL HYDRO-ELECTRIC PROJECT

Table of Contents

	<u>Page</u>
SUMMARY AND RECOMMENDATIONS	i-vii
SECTION I BACKGROUND OF THE PROJECT	1-3
A. Introduction: The Loan Application	1
B. The Power Sector: Brazil, South Brazil, and Rio Grande do Sul	2
C. Priority of the Project; Place of the Loan in the Program	3
SECTION II DESCRIPTION OF THE BORROWER	
Ownership and Management	4
SECTION III THE RIO GRANDE DO SUL POWER MARKET AND ESTIMATED LOAD GROWTH	5-7
A. The economy of Rio Grande do Sul	5
B. Historical Power Growth Rates	5
C. CEEE and CANAMBRA Load Growth Estimates; Conclusion	6
SECTION IV THE POWER EXPANSION PROGRAM IN RIO GRANDE DO SUL	8-13
A. Existing System	8
B. Projects under Construction	8
C. Proposed Additions to Generating Capacity	9

UNCLASSIFIED

	<u>Page</u>
<b>SECTION IV (Cont'd)</b>	
D. Proposed Expansion of Transmission & Distribution System	10
E. Load Balance Projections	10
F. Estimated Cost and Financing Plan of Expansion Program	11
G. Conclusions	13
<b>SECTION V THE PASSO REAL PROJECT</b>	14-21
A. Description and Technical Features	14
B. Associated Transmission and Distribution	14
C. Feasibility Studies	15
D. Procurement and Implementation Plan - Section 611	16
E. Cost Estimates and Project Financing Plan	18
F. Source and Assumptions of Cost Estimates	20
<b>SECTION VI ECONOMIC ANALYSIS</b>	22-27
A. Economic Justification of Passo Real in Comparison with Alternatives; Benefit-Cost Calculations	22
B. Importance of Passo Real as a Storage Project	24
C. Justification for Size and Timing of Units	25

	<u>Page</u>
SECTION VI (Cont'd)	
D. Thermal Complementation: the Sotelca Transmission Line and Candiota as Alternatives	26
SECTION VII FINANCIAL ANALYSIS	28-32
A. Tariff Legislation	28
B. Rates and Revenue	28
C. CEEE's Future Rate Policy	30
D. Projected Income Statements	31
E. Projected Balance Sheets	31
F. Cash Flow Forecast; Discussion of Debt Service Capacity and Other Issues	31
SECTION VIII ISSUES AND CONDITIONS ATTACHED TO USAID LOAN	33-35
A. Priority of Passo Real project in the Program; Candiota and Passo Fundo	33
B. Financial commitments to be sought by USAID from CEEE, the State, and the GOB/ELETRONAS	33
C. U.S. Procurement and the Law of Similar	34
D. Supervisory Consulting Engineers	34
E. The BNDE Loan Conditions	35
SECTION IX IMPACT ON U.S. ECONOMY	36

- LIST OF ANNEXES -

- I - Certification pursuant to Section 611 (e) of the Foreign Assistance Act.
- II - Checklist of Statutory Criteria under FAA.
- III - Technical Annexes:
  - Exhibit A - Detailed Passo Real Project Description.
  - Exhibit B - Passo Real - Design Criteria.
  - Exhibit C - Annual Production Costs of Passo Real; Benefit-Cost Analysis of Alternatives
  - Exhibit D - Description of Existing CEEE System
  - Exhibit E - CEEE Maintenance Policies.
  - Exhibit F - System Requirements and Planning.
  - Exhibit G - Land Expropriation, Right of Eminent Domain, and Right-of-Way.
  - Exhibit H - Project Cost Breakdown into Units of Construction.
  - Exhibit I - List of A.I.D. Loan Financed Items.
- IV - Financial Statements:
  - Exhibit A - Actual and Projected Income Statements.
  - Exhibit B - Actual and Projected Balance Sheets.
  - Exhibit C - Projected Statement of Source and Application of Funds.
- V - Other Documents
  - Exhibit A - Letter from ABDIB to CACEX accepting proposed list of imported equipment.
  - Exhibit B - Letter from Governor of Rio Grande do Sul to USAID on priority of project, provision of funds and rate policy.
  - Exhibit C - USAID reply to Governor letter
- VI - Plates
- VII - Draft Loan Authorization

- 1 -

**BRAZIL - CIA. ESTADUAL DE ENERGIA ELETRICA (CEEE)  
PASSO REAL HYDRO-ELECTRIC PROJECT**

SUMMARY AND RECOMMENDATIONS

1. **BORROWER:** Companhia Estadual de Energia Elétrica (CEEE)  
  
A state owned company responsible for the generation, transmission and distribution of approximately 98% of public power in the State of Rio Grande do Sul.
2. **GUARANTOR:** The Federative Republic of Brazil acting through the Ministry of Finance.
3. **AMOUNT OF A.I.D. LOAN:** US\$27.4 million to finance the importation of U.S. goods and services.
4. **HOST COUNTRY CLEARANCE:** COCAP (the Coordinating Commission for the Alliance for Progress) has approved this project.
5. **PROJECT DESCRIPTION:**

The Passo Real project includes the construction of a dam and earthfill dike on the River Jacui providing a reservoir with storage of about 2,300 million cubic meters. The powerhouse will contain provision for installation of 4 units of 32.5 MW of which 2 units will be installed as part of this project for a total of 125 MW. The project also includes 2 transmission lines of 220 KV to link the plant with the substation serving Porto Alegre as well as expansion and improvement of transmission and distribution facilities associated with the project. Necessary engineering services are also included.

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6. TOTAL COST AND FINANCING OF PROJECT: (US\$millions)

a) Cost Estimate

<u>Item</u>	<u>Local Currency (US\$equivalent)</u>	<u>AID Loan (US\$)</u>	<u>Total (US\$)</u>
Passo Real hydro-electric plant incl.construction equip.and materials for 2 units of 62.5 MW ....	43.0	11.1	54.1
Associated transmission and distribution equipment & materials .....	25.2	12.0	37.2
Engineering, administration and training .....	10.0	1.8	11.8
Provision for contingencies & price escalation <u>1/</u>	<u>7.9</u>	<u>2.5</u>	<u>10.4</u>
Total Project Cost ....	86.1	27.4	113.5

b) Financing Plan

Proposed A.I.D. Loan		27.4	27.4
BNDE Loan <u>2/</u>	34.4		34.4
CEEE internal cash generation & contributions of the state of R.G.do Sul,& other sources	<u>51.7</u>		<u>51.7</u>
Total .....	86.1	27.4	113.5

1/ Approximately 10%, including estimated U.S.inflation of 4% p.a. on the undisbursed balance of the proposed A.I.D.loan.

2/ The BNDE loan is for NCr\$110 million equal to US\$34.4 million at the rate of exchange of NCr\$3.2. The BNDE has committed itself to providing up to an additional NCr\$34 million to maintain the value of the cruzeiro loan.

7. JUSTIFICATION FOR THE PROJECT:

The power market in Rio Grande do Sul grew at an average annual rate of 11.5% during the period of 1952-1967. Owing to a shortage of capacity and a general decline in economic activity in 1965-67, the load growth has declined slightly in recent years. Even under the more conservative projections made by CANAMBRA, the load requirement is expected to grow in Rio Grande do Sul at the rate of nearly 10% for the 1968-1980 period.

The proposed Passo Real addition in the initial capacity of 125 MW is the key project in CEEE's expansion program from 1968 to 1977, particularly because of its large storage feature and the benefits that will accrue to the down stream plant in Jacui. About 35% of energy production in the Rio Grande do Sul power system, unlike the systems in South-Central Region of Brazil, is from high cost thermal power sources. The Passo Real, with an installed capacity cost of US\$280 per KW (exclusive of transmission) will assist in reducing the present high cost of power service in the State. The project has been thoroughly studied by CEEE and its consultants and has received the full endorsement of CANAMERA.

8. PLACE OF LOAN IN THE PROGRAM:

Despite the excellent progress in the Brazilian power sector, Brazil continues to require external financial assistance to complete its high priority power development program. This is particularly true in the south of Brazil and in Rio Grande do Sul, where little external financing has been obtained. With the carrying out of comprehensive power development studies in the south of Brazil by the firm of CANAMBRA (which established an excellent reputation performing a similar study in the South-Central Region) a sound planning base has been established in Rio Grande do Sul which now permits external lenders to consider financing.

The A.I.D. program for Brazil in FY 68 for project and sector lending is estimated to amount to US\$100 million. This program gives priority attention to the areas of education, agriculture and health. The proposed loan of US\$27.4 million thus represents less than 1/3 of total loans for this fiscal year. This does not appear to be a disproportionate allocation to the power sector.

9. OTHER FREE WORLD FINANCING:

The IBRD, IDB and Ex-Im Bank have expressed no interest in financing this project (see AIDTO CIRCULAR LA-38, September 29, 1967).

10. STATUTORY CRITERIA:

Satisfied (see Annex II)

11. ISSUES:

See Section VIII. There are 3 major issues:

a) Maintenance of adequate power rates: in the past, the company has not maintained a rate level sufficient to cover operating costs, depreciation and provide a return on capital. As indicated in Section VII the company has recently adjusted its rates to the maximum level permitted by Brazilian legislation (based on revaluation of assets through 1966) and is prepared to maintain adequate rate levels in the future. The proposed loan will include such a commitment.

b) The company has proposed to construct a 100 MW thermal plant (Candiota) and a 220 MW hydro project (Passo Fundo) within the same construction period provided for Passo Real, maintaining that the power market will grow at 12% per annum. A.I.D. has adopted the more conservative 10% p.a. load growth projection by CANAMBRA, and has informed the company that the Candiota Project and the second unit at Passo Fundo must be deferred until there

is evidence of higher rate of load growth and provision for financing of these projects is available. A.I.D. has received assurances from the Governor of the State that Passo Real will be given first priority within the company's power program.

c) The proposed A.I.D. loan contemplates the financing of imported equipment, materials, and services which cannot be supplied by Brazilian sources. However, the loan will finance the imported materials and components of Brazilian turbines, generators and other equipment. In the case of turbines, the company will seek joint-venture proposals with U.S. and Brazilian firms under which approximately 50% by value of the turbines will be procured from local sources. A.I.D. considers this a reasonable solution and ABDIB (Association of Brazilian Heavy Equipment Suppliers) has also agreed.

12. RECOMMENDATIONS:

It is recommended that A.I.D. authorize a loan of US\$27.4 million to the CEEE with the guarantee of the GOB to finance the project described above under the following terms and conditions:

- (1) Repayment in dollars in 25 years including 5 years of grace;
- (2) Interest 6% in dollars p.a.
- (3) The usual two-step provision to be applied;
- (4) Consulting engineering services satisfactory to A.I.D.;
- (5) All procurement limited to U.S. sources;
- (6) Prior GOB/CACEX approval of proposed imported goods and services;

- (7) The Borrower shall apply for and the state shall support power rates at the maximum level permitted by Brazilian legislation unless the Borrower can satisfy USAID that such rate levels are in excess of requirements;
- (8) The Guarantor shall covenant to grant the Borrower rates as specified above. In the event that the Guarantor shall amend Brazilian rate legislation so as to significantly worsen the financial position of the Borrower, this would constitute grounds for default under the Loan Agreement;
- (9) The Guarantor shall provide through ELETROBRAS an over-run commitment to assure the adequacy of cruzeiro funding.
- (10) The Borrower shall covenant not to undertake any major expansion project exclusive of Passo Real and Passo Fundo (110 MW) without prior AID approval.
- (11) The State shall provide a commitment to A.I.D. that the Passo Real project will have first priority in the allocation of State resources and that the State will provide all necessary funds required by the Borrower to complete the project.
- (12) The State shall covenant to re-invest all dividends received from CEEE until completion of the Passo Real project.
- (13) Such other terms and conditions as A.I.D. shall specify.

13. PROJECT COMMITTEE

Loan Officer

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USAID/B - ADCD

Engineer

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June 14, 1968

-1-

## SECTION I - BACKGROUND OF THE PROJECT

### A. Introduction: The Loan Application

The CEEE first approached USAID about the financing of the Passo Real in November 1966. The project received the full support of the Ministry of Mines and Energy and ELEKTROBRAS. In January 1967 USAID presented an IRR to Washington. AID/W initially deferred approval of the IRR pending a re-examination by the Mission of the priority of this project in relationship to the other project and sector loans then under consideration and in line with a possible reduced appropriation for 1968. In view of the political and economic importance of the State of Rio Grande do Sul, the high priority of power development in the State, and the apparent economic justification for the plant proposed, the Mission endorsed the project for consideration under AID's normal lending standards, and the IRR was approved in early May 1967 with the following suggestions: "(1) Full analysis and proper solution of existing inadequacies of administration, planning and rate policies; (2) CANAMBRA's opinion of proposal and alternate power sources, thermal and hydro. Also the project must be coordinated with other regional sources; (3) adequate local financing contribution must be provided; and (4) alternate sources of financing must be explored".

In the Fall of 1967, the BNDE reviewed the project and later signed a loan agreement with CEEE to provide up to NCr\$144.5 million (including NCr\$34.5 million to cover subsequent inflation) to assist in financing the first stage of Passo Real (125 MW). At about this time the company contracted with International Engineering to review the design of the dam, which called for a concrete gravity structure. The consulting firm recommended a modification of the design to provide for a rock-filled alternative which reduced the cost of the project slightly and increased the amount of the construction equipment

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to be included for financing. USAID consulted with CANAMBRA about the priority, timing, and size of the Passo Real project. CANAMBRA has recommended that Passo Real be constructed as a priority project with an initial capacity installation of 125 MW. <sup>1/</sup> A fuller discussion of the CANAMBRA recommendation is included in Section VI.

**B. The Power Sector: Brazil, South Brazil, and Rio Grande do Sul**

The Brazilian Government's three-year plan of investment for the years 1968, 1969, 1970 indicates a required investment in the power sector of the order of NCr\$6.2 billion. Total internal resources are expected to provide 85% of the requirement with the remainder of 15%, amounting to NCr\$1 billion, from external sources. Thus, Brazil continues to require external financial assistance for the completion of its high priority power development program. It is estimated that approximately NCr\$600 million of required resources have not yet been identified. In the past, external financing has tended to be concentrated in the South Central region in view of its major importance in the economy. The South of Brazil, including Rio Grande do Sul, has received a relatively small share of external assistance, yet the area comprising the three states represents an important agricultural and industrial area of Brazil. In line with the increased priority now being accorded by the Government of Brazil to the power development of the South, the firm of CANAMBRA has undertaken a power development study in the area along the lines of the studies carried out in South Central Brazil.

In 1966 the per capita energy consumption measured in terms of kilowatt hours per inhabitant was 184 in the South of Brazil and 185 in Rio Grande do Sul compared to a national average of 313 and a South Central Brazil average of about 600.

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<sup>1/</sup> CANAMBRA originally recommended this. Subsequently, when it appeared that the Passo Fundo plant would be delayed CANAMBRA endorsed the initial installation of an additional 125 MW as the only means of providing the required system capacity. However, with the recent decision to accelerate Passo Fundo, the additional two units need not be installed initially.

C. Priority of the Project: Place of the Loan in the Program

The proposed loan for the Passo Real project will represent less than 1/3 of the proposed project and sector loan program for FY 1968. Considering the high priority given to the Passo Real project itself and the economic and political significance of Rio Grande do Sul, the inclusion of this project in the AID lending program appears justified.

AID financing of the Passo Real project also appears appropriate, given AID's already heavy investment in the South Central Region and the apparent preference of other external lenders for major power projects in this area.

## SECTION II - DESCRIPTION OF BORROWER: OWNERSHIP AND MANAGEMENT

The CEEE is an autonomous state-owned public utility company responsible for the provision of generation, transmission and distribution throughout the State of Rio Grande do Sul. The company is owned largely by the State (96%) with a minor part by ELEKTROBRAS (4%) and municipalities. The management of the company until the change of Government in the spring of 1964 was clearly deficient. The company was under the political control of Governor Brito the brother-in-law of former Brazilian President Goulart. The State at that time followed a policy of subsidized power rates and constructed plants with supplier credits without adequate planning. During the Brito days, for example, the company contracted for the 60 MW Alegrette plant in the interior of the State with clearly inadequate markets to absorb the output of the plant. Another example was the construction of the Jacuf plant down-stream from the proposed Passo Real project under conditions of inadequate stream flow to support the number of units being installed.

With the transformation of CEEE from a state authority to an autonomous corporation, and especially following the change of government in 1964, the management gained a new degree of independence from State politics. While clearly the CEEE company cannot be classified in the same category as LUSIAS and CEMIG, its planning for this project and its responsible attitude towards adequate power tariffs and financial administration give evidence that the management of the company is at least satisfactory. With the assistance of consulting engineers, it is USAID's judgement that the company will be able to construct the Passo Real project and carry out the balance of its program.

**SECTION III - RIO GRANDE DO SUL POWER MARKET AND  
ESTIMATED LOAD GROWTH.**

**A. The Economy of Rio Grande do Sul**

Rio Grande do Sul, the southern-most state of Brazil, has a population of 6.7 million and in 1960 accounted for roughly 7% of the GNP. The economy of the State is based largely on agriculture and agro-industry. The major part of the State's industry is located in and around the capital city of Porto Alegre (population 800,000) and Caxias do Sul. The city of Porto Alegre, which will be served by the proposed Passo Real project, has had a population growth of 5.6% per annum during the 1950-1960 period, while population for the State as a whole has grown at the rate of approximately 2.7%.

**B. Historical Power Growth Rates**

The record of gross power generation in the State from 1947 through 1967 is shown below. With the exception of two sharp depressions in 1950 and 1965, this record indicates a fairly consistent rate of growth. For the entire 19-year period, the growth averaged 10.8% per year, and for the 14-year period, uninterrupted by the depressions, it averaged 12.4% per year.

For projections of consumption and peak demand, the methodology employed in the CANAMBRA Market Study of March, 1968 includes these factors: (1) extrapolation of historic trends by zone and category of consumer; (2) population and urbanization growth rates; (3) industry sampling; (4) studies of residual and integrated auto producers; (5) analysis of electrical losses and load factors; and (6) the assumption that future economic performance will be generally consistent with past record.

State of Rio Grande do Sul  
Comparison of increases in installed capacity and gross generation  
1947 - 1967

<u>Year</u>	<u>Percentage increase in installed capacity</u>	<u>Percentage increase in gross generation</u>
1947	-	-
1948	2.4	9.3
1949	7.5	7.6
1950	3.9	3.0
1951	1.0	11.3
1952	13.9	8.9
1953	14.4	12.7
1954	1.1	15.2
1955	14.7	16.1
1956	28.7	8.8
1957	5.3	13.9
1958	1.3	18.4
1959	0.4	9.3
1960	0.4	9.4
1961	15.7	11.0
1962	56.4	14.5
1963	2.0	13.7
1964	0.3	9.7
1965	(5.2)	3.5
1966	-	9.7
1967	-	6.6

C. CEEE and Canabira Load Growth Estimates: Conclusions

On the basis of the historical trends indicated above, and on the basis of past experience indicating that load growth rises sharply with the installation of new facilities, the CEEE has projected a load growth for the next decade of 12% per annum. This tendency to absorb new capacity is noted in the table above.

Previous market studies by Gibbs and Hill and ELETROCONSULT generally accepted the CEEE projected growth rate of consumption of 12% for the 10-year period 1965-1975, given no restrictions on supply.

In their initial studies of the power market completed in early 1967, Canambra forecasted the following energy consumption rates:

1967 through 1970	12% per annum
1971 through 1975	11% per annum
1976 through 1980	10% per annum

However, after further studies completed in March of 1968, Canambra revised its forecasts for the annual growth of energy consumption as shown below:

Projection of Annual Growth of Consumption (Kwh) - Statewide

	<u>High</u>	<u>Low</u>
1967 through 1970	11.2%	10.0%
1971 through 1975	10.6%	10.3%
1976 through 1980	8.7%	8.9%

As the proposed project will serve the North system, and since in this area the greatest deficiency is in capacity and not in energy production, the following table giving growth rates by Canambra for peak demand in the North system is particularly relevant.

Projection of Annual Growth of Peak Demand (MW) - North System

	<u>High</u>	<u>Low</u>
1967 through 1970	12.4%	11.4%
1971 through 1975	10.8%	10.0%
1976 through 1980	8.0%	8.2%

Given our preference for conservative financial analysis, the company agreed to adjust its revenue forecasts on the basis of Canambra's low consumption projection. Accordingly, the financial statements discussed in Section VII are based on a load growth of approximately 10% per annum, while the power expansion program is based on the 12% projection by the CEEE.

#### SECTION IV. .. THE POWER EXPANSION PROGRAM IN RIO GRANDE DO SUL.

##### A. The Existing System

Total generating capacity in the State amounts to 360 MW and gross energy produced in 1966 was 1,410 million KWH. CEEE itself was responsible for 84% of this generation which served 800 localities and more than 550,000 consumers. The present installed capacity under control of CEEE amounts to approximately 300 MW. About 54% of this is hydro capacity and the remaining 46% thermal, much of which is over-age and inefficient.

The CEEE system is not yet fully integrated. It consists of three separate systems: the North, West and South systems. There are also small localities served by isolated diesel generator units. The North system is by far most important of the three, serving about 80% of the population and most of its industries. The major generating plants in this system are the Jacuí Hydro Plant of 100 MW and the Charqueadas Thermal Plant of 54 MW.

A more complete description of the existing system can be found in Annex III Exhibit D.

##### B. Projects Under Construction

In the North system, construction is underway for a 50 MW addition to the Jacuí Plant downstream from the proposed Passo Real plant, an 18 MW addition to the Charqueadas Plant and the proposed NUTEPA plant in Porto Alegre of 24 MW., for a total increase of 92 MW in the North system. In the West system the major plant under construction is the 66 MW plant at Alegrette. In the South system construction is underway on the Rio Grande diesel station (12 MW) and the Pelotas Thermal Plant (12 MW).

C. Proposed Additions to Generating Capacity

The proposed additions to the State's power system from 1968 through 1977 (including plants presently under construction) and the year of expected completion are shown below.

<u>Plant</u>	<u>System</u>	<u>Capacity (MW)</u>	<u>Status 1/</u>	<u>Estimated Year of Completion</u>
Alegrete (thermal)	West	66	UC	1968
Jacuí (hydro)	North	75	UC	1968
NUTEPA (thermal)	North	24	UC	1968
Diesel Rio Grande (thermal)	South	12	UC	1968
Pelotas (thermal)	South	12	UC	1968
Charqueadas (thermal)	North	16	P	1970
Interconnection with SOLTECA (Santa Catarina thermal)	North	40	P	1971
Passo Fundo (hydro)	North	110	UC	1972
	North	110	P	1973
Passo Real (hydro)	North	125	P	1973
Candiota (thermal)	South	100	P	1972
	South	125	P	1976
Itauba (hydro)	North	100	P	1976
	North	100	P	1977

As indicated earlier, the proposed expansion program is based on CEEE's load growth forecast of 12% per annum; whereas a lower growth rate of 10% may be more probable. As noted in Section VIII USAID will require CEEE to defer initiation of the Candiota plant (100 MW) and the second unit at Passo Fundo (110 MW) until there is evidence of sufficient demand and availability of financing.

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1/ UC - Under construction; P - Planned

D. Proposed Expansion of Transmission and Distribution System

The CEEE plans major expansion and interconnection of its transmission and distribution facilities to absorb the additional generating capacity to be constructed. The most important transmission additions will be: Passo Fundo - Passo Real - Porto Alegre; Passo Real - Porto Alegre; SOTELCA - Porto Alegre (by ELETROBRAS); and Alegrete - Porto Alegre. On completion of the major hydro projects (Passo Fundo and Passo Real) the CEEE North system will be converted from 50 to 60 cycle power.

E. Load Balance Projections

The North system is the critical system. The table below for the period 1968-1977 compares the forecast demand in MW with the capacity proposed to be installed by CEEE in the North system and indicates the surplus or deficit in capacity for each of the years under the various load assumptions of CANABRA and CEEE.

NORTH SYSTEM DEMAND BALANCE (MW)

1968 - 1977

Year	FORECAST			Installed Capacity	LOAD BALANCE			
	Canambra Low	Canambra High	CEEE		(A) Total	(B) Reserve	(C) Can Low	(D) (B-C)
1968	312	323	330	345	+15	-10	-1	+9
1969	359	364	370	378	+9	-16	-6	+10
1970	400	411	414	434	+20	-5	+9	+14
1971	434	465	364	424	+21	-19	+10	+29
1972	474	511	512	524	+72	-34	+12	+46
1973	528	563	580	768	+182	+72	+150	+72
1974	580	615	650	763	+113	+8	+72	+70
1975	644	689	726	767	+41	-69	+13	+32
1976	692	742	813	863	+50	-60	+55	+155
1977	757	800	911	958	+47	-63	+31	+154

The load forecasts by Canabira (low and high) and by CEEE are those based on the load projections in Section III. The installed capacity represents the CEEE's proposed program based on their 12% load growth forecast. The Load Balance columns indicate the following: Column A is the balance between the CEEE forecast of demand and the installed capacity. Column B represents the same balance with provision for spinning reserve, represented by the largest unit in the system <sup>1/</sup>. Column C represents the load balance using the Canabira low forecast and providing for the spinning reserve. Column D shows the difference between the CEEE load balance (Column B) and the Canabira low load balance (Column C). The load balance for 1967-1977 is graphically illustrated in Annex VI. Column D above indicates the increasing surplus capacity to be installed by the CEEE if the Canabira low load forecast were to prevail. This suggests that CEEE might have to defer the second unit of 110 MW at Passo Fundo now scheduled for 1973, or make other adjustments in its present program.

F. Estimated Cost and Financing Plan for Expansion Program

During the period 1968-1973, corresponding to the execution period of the Passo Real project, the company will carry out a construction program estimated, in 1968 cruzeiros, at NCr\$890 million, equivalent to approximately \$290 million. The financing plan for this program <sup>2/</sup> during this period, shows that the company will also have to make debt service payments of NCr\$240 million, equivalent to US\$79 million, and intends to pay dividends and interest of NCr\$31 million, equivalent to approximately US\$10 million. The total applications during the 1968-1973 period amount to approximately NCr\$1,200 million or US\$ 370 million.

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<sup>1/</sup> The spinning reserve allows for outage of the largest unit in the system.

<sup>2/</sup> See Annex IV Exhibit C.

Shown below are the sources of funds for the financing of the program during this period.

NCr\$ Millions

<u>Source</u>	<u>Amount</u>	<u>Percentage</u>
1. CEEE internal cash generation (net income + depreciation)	424	36%
2. Long-term domestic loans:		
BNDE	110	9%
DNOS	115	10%
Ministry of Mines and Energy & INDA	42	4%
Other sources	<u>30</u>	<u>2%</u>
	297	25%
3. Long-term foreign loans:		
Proposed AID loan	88	7%
Supplier credit	<u>101</u>	<u>9%</u>
	189	16%
4. Equity contributions:		
ELETROBRAS	43	
Imposto Unico	37	
State Investment Fund (ICM tax)	175	
Additional State contributions in the form of special credits	<u>21</u>	
	276	23%
Grand Total	1,186	100%

Financial aspects of the CEEE are more fully discussed in Section VII and are shown in Annex IV.

G. Conclusions

Except as noted below, the proposed expansion program appears to be sound and within the financial and managerial capability of CEEE. In the case of the South system, USAID has recommended to the company that Candiota not be initiated at this time pending further justification of the market for this power and demonstration that the company will be able to finance it without prejudicing the remainder of its program. CEEE has accepted this condition.

In the North system the load balance discussed in paragraph E above suggests that the second unit of Passo Fundo (110 Mw) might need to be deferred if the Canabira load forecasts develop. The company had agreed not to install the second unit at Passo Fundo without AID's approval. Since the second unit at Passo Fundo would not be installed before 1973, after the completion of Passo Real, no problem is expected. However, should Passo Fundo be further accelerated, the installation of the second unit at Passo Fundo could prejudice the completion of Passo Real.

In response to USAID's request, the Governor of the State of Rio Grande do Sul has confirmed in writing to USAID (See Annex V attached) that the State will give the Passo Real project first priority in the State's power development program.

## SECTION V - THE PASSO REAL PROJECT

### A. Description and Technical Features

The Passo Real hydroelectric project with an initial capacity of 125 MW (plus provision for an additional 125 MW) will be located on the Jacui River in the northern part of the State of Rio Grande do Sul. It will be approximately 15 kilometers upstream from the present 100 MW Jacui plant, and about 210 kilometers from the state capital, Porto Alegre (See Annex VI).

Jacui and Passo Real are in fact to be operated as a single plant, since the main storage is to be provided by the new Passo Real reservoir, serving both. Jacui storage has a useful capacity of only 300 million cubic meters. Based on the driest year of record this would produce only 25.2 average megawatts of primary power. One of the basic advantages of building Passo Real is the marked increase in Jacui's primary power, that will be raised to 75.4 average megawatts.

The Passo Real project consists of a dam, reservoir, power house and transmitting substation and includes associated transmission lines and upgrading of the distribution system. The dam will be of the fill type throughout, containing the spillway, power house, intakes and penstocks, impounding a lake of 2,300 million cubic meters of useful water (See Annex VI).

The powerhouse will house four 70 Mva umbrella type generators of which two only to be installed in the first stage, driven by 138 rpm Kaplan turbines, developing rated power under heads of from 48 to 35 meters. Single-phase transformers instead of three-phase units will be used, because of transportation limitations.

### B. Associated Transmission and Distribution

The substation is planned to be built 150 meters downstream from the power house. Five transmission lines will originate from the substation: two 138 Kv,

15 kilometers lines to establish interconnection with the neighboring Jauí plant; one 138 Kv, 100 kilometers line leading to the city of Passo Fundo, to interconnect in the future with the planned Passo Fundo hydroelectric plant; two 220 Kv, 270 kilometers lines to deliver Passo Real, Jacuí, and Passo Fundo power to the Cidade Industrial Substation in Porto Alegre (See Annex VI).

In association with the Passo Real project, CEEE also intends to construct, with its own resources, other 138 and 69 Kv transmission lines and substations, to allow transmission of the new block of power to the various consumption centers.

In addition to the plant and associated transmission lines, the project also includes associated sub-transmission and distribution facilities as well as the financing of construction equipment and services of consulting engineers.

A detailed technical description of the project may be found in Annex III, together with a project chronogram, showing the first unit of Passo Real going on the line during the third quarter of 1972, followed by the second unit two months later.

### C. Feasibility Studies

CEEE has submitted to A.I.D. four supporting studies for the Passo Real project. The first of these is a feasibility study prepared by ELETROCONSULT, of Milan, Italy, completed in 1965 and presented to CEEE on January 20, 1966 with the endorsement of Gibbs & Hill, Inc. of New York, N.Y. which also participated in the preparation of the study and in the review of data on which the study was based. The second supporting report was prepared by CEEE's technical staff, and consists of a meticulous study of three possible alternative solutions to Passo Real. The third study, also prepared by CEEE, develops in detail the required expansion of CEEE system, covering the period of 1967-1977. Finally, the fourth document summarizes the findings of International Engineering Co. of San Francisco, contracted by CEEE in joint-venture with its local subsidiary, Companhia Internacional de Engenharia e Construções, to complete

the field surveys required, and make final recommendations on the selection of the project layout and dam type. This report was completed in December 1967.

The detailed design for Passo Real was originally prepared by ELETROCONSULT. This design was based on a mixed-type dam with the center river section of the concrete gravity type. It was recognized by the engineer that additional field work was required to survey for proper fill materials, at economical hauling distance, which might result in savings by adopting a throughout fill-type dam.

The joint venture of the two International engineering companies was hired for this purpose; and in their December 1967 report they presented a comparative study of three types of dam: fill, concrete gravity, and concrete buttress. For each of these types, estimated costs were computed, also considering the alternatives of diversion by tunnels or on the river bed. The solution shown to be the most economical was the fill-type dam with diversion in tunnels. This conclusion was arrived at after the engineers were satisfied with the availability of the required fill materials in the immediate vicinity of the project (See Annex III, Exhibit B).

D. Procurement and Implementation Plan - Section 611

Equipment, materials, and services to be procured in the U.S. are those which are not yet manufactured or available in Brazil. All prices for local procurement are also indicated in equivalent U.S. dollars. Construction and erection work will be supplied by local contractors, and engineering services from a joint-venture of American and Brazilian firms.

Due to the long lead time required for some imported equipment, it is expected that the corresponding production contracts will include escalation provisions. For local manufacture, price adjustments to compensate for currency devaluation are standard in all contracts. An allowance of 10% for contingencies was included over and above the total dollar cost estimate.

Conditions of reasonableness of cost estimate for the U.S. Government assistance to this project, as required from Section 611 of FAA, is met by the Passo Real construction program. A basic design is available, and details still subject to further modification do not involve A.I.D. funds. As previously stated in Section V, and also in Annex III field surveys and office studies have been conducted to ascertain the economies that can be obtained by substituting a throughout fill dam for the originally adopted design containing a concrete gravity dam section.

CEEE is already doing preliminary construction work at Passo Real. Access roads have been built, and work was started on the encampment for the labor force. This work is being done to date by force account.

For the implementation of Passo Real project, CEEE will engage the services of an experienced engineering organization to detail the existing design, and to perform the engineering, procurement, inspection, and training required. The Borrower has shown interest in retaining the same engineers to perform this work, and so has followed A.I.D.'s recommended procedures in the process of advertising, pre-qualifying, and selecting for the preliminary work the firm of International Engineering and its local subsidiary.

The schedule for plans and specifications will be timed to the project requirements. The basic engineering design is completed. Bidding plans and specifications will be scheduled to meet procurement and construction requirements, over the implementation period.

Construction will be carried out under the general direction of CEEE, assisted by the consulting engineers. To insure that the best coordination is obtained, CEEE will create a special management team to carry out the supervisory function. This company is well staffed and experienced to undertake this responsibility. Assisted by consultants, they should be able to complete the assignment without undue difficulty.

Construction work will be performed by Brazilian contractors. There are experienced civil construction and equipment erection organizations available in Brazil. They will be selected on the basis of pre-qualification and competitive bids, according to A.I.D. approved procedures. All such contracts will be financed from other than A.I.D. funds.

Construction of the project is to be carried under two separate contracts, one for civil construction and the other for equipment installation. It is estimated that an average work force of 800 men, with a possible peak of 1,000 will be required at construction site. The bulk of the labor force is to be recruited in the State of Rio Grande do Sul, with about one half of the technical personnel coming from other areas.

The civil construction contractor will be responsible for the supply of labor, materials, and equipment required for the execution of civil works. Construction equipment will be provided by CEEE after procurement in the U.S. with A.I.D. funds of those not available in Brazil. For this purpose a provision of \$5,505,000 is included in the loan amount.

The suppliers of major equipment will be required to provide erection specialists to supervise work done by the equipment installation contractor, and to assist in the initial stages of testing and operation.

A tentative schedule for the main items in the project is shown in the form of bar chart, in Annex VI . There is great urgency in getting the project underway as soon as possible. Initial river diversion must be coordinated with the beginning of the rainy season in February 1969.

E. Cost Estimates and Project Financing Plan

Total cost of the project is estimated to be US\$113.5 million. The proposed A.I.D. loan of US\$27.4 corresponds to 24% of the total investment and represents the required importation of goods and services. The proposed A.I.D. loan will finance only U.S. goods and services.

The following breakdown tabulation shows the imports to be financed by A.I.D. and the local cost expenditures to be financed by BNDE, CEEE, and the State of Rio Grande do Sul.

<u>Item</u>	<u>Financing Sources and Costs</u>		
	<u>Local Sources</u>	<u>AID</u>	<u>Total</u>
Passo Real Hydroelectric Plant	43,007	11,125	54,132
Assoc. Transm., Subst., and Distribution .....	25,279	11,976	37,255
Engineering, Administration and Training .....	9,950	1,800	11,750
Project Cost less Contingencies	78,236	24,901	103,137
Provision for Contingencies (about 10%) .....	7,864	2,499	10,363
Total Estimated Cost .....	86,100	27,400	113,500
% of Local and Import Components	75.9	24.1	100.0

Local cost dollar equivalents have been converted at the prevailing official exchange rate of NCr\$3.20 per dollar. The "Local Sources" indicated above include the already approved BNDE loan for NCr\$110.0 million (US\$34.4 million), CEEE's internal cash generation 1/, and State revenues from the State Investment Fund 2/.

The following measures have been taken to preserve the value of the Financing Plan in the face of probable price escalation during the period of project construction.

1. The AID Loan contains a 10% contingency provision which should cover inter alia probable U.S. inflation.
2. The BNDE loan contains an amount of NCr\$34.4 million (US\$10.8 million equivalent) over and above the base loan of NCr\$110.0 million which will be applied against cost increases. Since the heaviest drawdowns from the BNDE loan are expected during the early years of the project 1968-70 this allowance for cruzeiro depreciation appears adequate.
3. The other "Local Sources", CEEE and the State Investment Fund, should maintain their relative values given the ability of the former to make compensating rate adjustments based on annual revaluations of assets and monthly adjustments of variable costs such as wages, fuel, etc.; and since, with the latter, the State Investment Fund is based on sales tax revenues which reflect rising prices.

1/ See Exhibit C, Annex IV for details.

2/ See Page 32 for estimated future State Investment Fund levels.

Millions U.S.\$

I.	Powerhouse & Permanent Equipment	
	1. Construction equipment .....	5.5
	2. Imported component of powerhouse equipment, including turbines and generators .....	3.1
	3. Other powerhouse equipment, materials and misc. ....	2.5
II.	Equipment and Materials for trans- mission lines and distrib.system	
	1. Transmission line .....	1.4
	2. Cidade Industrial substation..	4.0
	3. Porto Alegre substation .....	3.5
	4. Distribution & raw materials..	3.1
III.	Engineering and Training .....	1.8
		<u>24.9</u>
IV.	Provision for Contingencies(10%)	2.5
	Total .....	<u>27.4</u>

F. Source and Assumptions of Cost Estimates

Cost estimates are based on studies carried out by International Engineering, Gibbs and Hill, and Electroconsult, and reviewed by CEEE and USAID engineers.

A detailed cost breakdowns in units of construction and A.I.D. financed items are presented in Exhibits H and I, Annex III.

Evaluation of the dollar component was made under the following assumptions: (1) the list of equipment for import from the U.S.A. was approved by the "Associação Brasileira para o Desenvolvimento de Base" (ABDIB) in May 1968 and submitted to the "Carteira de Comercio Exterior (CACEX, the Brazilian Federal Government foreign trade regulatory agency) for prior approval.

The letter of approval from ABDIB is attached as Annex V, Exhibit A ; (2) turbines will be built by a joint-venture of U.S.A. and Brazilian manufacturers, under the technical responsibility of the former. A minimum of 50% by value must be of Brazilian origin. Bids will be taken in the U.S.A. The American manufacturers will furnish those parts only which are normally imported by the Brazilian manufacturers, viz., the shaft, runner, wicket gates, bearings, controls and regulator. USAID engineers estimate that the total cost will be evenly divided between the U.S.A. and Brazilian manufacturers; (3) the alternators will be built in Brazil. Imports from the U.S.A. will be limited to materials (copper, silicon steel, insulation) and the cooling and fire-protection systems, which are normally imported by Brazilian manufacturers; (4) engineering services will be provided by a joint-venture of American and local firms, to prepare detail designs for the Passo Real project, complete required surveys, and investigate additional system requirements. Supervision of the project, as well as training of the Borrower's staff, will also be performed by the consultant.

SECTION VI - ECONOMIC ANALYSIS

A. Economic Justification of Passo Real in Comparison with Alternatives: Benefit-Cost Calculations

In considering alternatives to the proposed 105 MW (first stage) Passo Real hydroelectric plant, it should be borne in mind that Passo Real is primarily a storage project. In many respects similar to FURNAS plant, it will provide important benefits to the existing downstream plant of Jacuf and the proposed downstream plant of Itauba, both of which will rely on the Passo Real storage and river regulation. These benefits are discussed later in paragraph B.

Since Itauba, a downstream site with a slightly lower cost per MW installed than Passo Real, is not a feasible alternative because of the time limitations, the only real alternatives to the Passo Real project which could satisfy 1973 power requirements, would be a coal-fired or oil-fired thermal plant of equivalent capacity.

The table below shows the cost in mills per kilowatt hour of Passo Real in comparison with equivalent coal-fired and oil-fired thermal plants.

Passo Real:

Driest year record	2.12
Average water year	6.73

Coal-Fired plant:

77.7 average MW	11.90
94.3 average MW	11.35

Oil-Fired plant:

77.7 average MW	11.90
94.3 average MW	9.94

The details of these calculations are shown in Annex III Exhibit C . The following conclusions can be drawn from the above table.

Jusco Real although designed for a final capacity of 250 MW, even with an initial capacity installation of only 105 MW, can deliver power cheaper than coal or oil-fired plants of equivalent capacity in both dry and average water year.

In comparison with the alternatives shown the Benefit-Cost ratio is approximately 1.4 to 1.5 to 1 as indicated in Annex III, Exhibit C.

B. Importance of Passo Real as a Storage Project

The gross generation computed for the project consists of the energy to be provided by Passo Real itself plus the additional energy that can be generated at the downstream Jacuf plant with the benefit of the Passo Real reservoir. Canabira in its Preliminary Appraisal (Rio Grande do Sul Power Study), measured an increment which would accrue to the Jacuf plant and the two other downstream sites proposed for development: mainly, Itauba and Dona Francisca. The following table illustrates the dependable energy in the driest cycle and the index cost per kilowatt of the Passo Real, Jacuf, and other downstream developments.

<u>Project</u>	<u>Av. Net Head</u> m.	<u>Depend-able Energy in Driest Cycle</u> Av.mw.	<u>Index Capacity (55% C.F.)</u> Mw.	<u>Estimated Capital Cost (1)</u> Millions US\$	<u>Index Cost US\$/kw</u>	
					<u>Separate</u>	<u>Cumulative</u>
Passo Real						
- at site	40	32.5				
- at Jacuf	94	50.2				
- total	134	82.7	150	42	220	280
Site "B"	83	79.1	144	30	220	250

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"C" - Itauba

"A" - Dona Francisca

(1) Exclusive of costs of step-up substations.

The above table demonstrates that the Passo Real storage will enable an additional generation at the Jacuí plant of 50.2 MW in the driest year. The average water year with this additional generation at Jacuí amounts to 59.3 MW per year.

Thus, it can be seen that Passo Real is primarily a storage project, like the FURNAS dam, which will permit the development of addition downstream sites that otherwise would not be as feasible.

C. Justification for Size and Timing of Passo Real Units

Initially the CEEE requested AID to consider financing of four 62.5 MW units for a total installed capacity of 250 MW. After further studies by CEEE and its consultants, it became apparent that it might not be possible to fill the Passo Real reservoir with sufficient live storage to effectively utilize the third and fourth units within the time limitations, taking into account the water requirements of the downstream Jacuí plant. CEEE and the State, with the support of ELETROBRAS and DNOC, decided, therefore, to accelerate the Passo Fundo plant and defer the third and fourth units of Passo Real until the late 70's.

The federal government through the Ministry of the Interior and DNOC has promised to supply the resources necessary for completion of the Passo Fundo plant by 1972/1973. Since Passo Fundo is an excellent project with an index cost of US\$275 per kilowatt (compared to US\$290 per kilowatt for Passo Real), since it is already under construction by DNOC, and since its completion is not expected to present any significant engineering problems, the decision of the company and State to proceed with 125 MW at Passo Real and acceleration of Passo Fundo appears sound.

Moreover, the installation of two units at Passo Real rather than the four originally proposed is consistent with the lower load growth projections prepared by Canabrua and adopted by USAID.

D. Thermal Complementation: SOLTECA Transmission Line and Candiota as Alternatives

Pôrto Alegre is presently suffering from a shortage of power during the peak hours and rationing (an estimated 8% of actual demand) is now in effect. In order to meet the deficiency of peaking between now and the completion of Passo Real in 1973, the company will require an additional source of thermal power.

The CEEE has planned to construct the 100 MW expansion of the Candiota coal burning plant in the South system with interconnection to the North as a means of covering this deficit. Candiota is located in the Southern part of the State in a region where there are adequate supplies of low grade but readily accessible coal reserves. The estimated cost per kilowatt of index capacity of such an expansion would be US\$428 lower than the cost of comparable coal-fired thermal plants elsewhere in the State of Rio Grande do Sul, but slightly higher than an oil-fired plant of equivalent capacity located in Pôrto Alegre. The CEEE's interest in building the Candiota plant is in part explained by the growing demand in the South system and in part by the signing of an international treaty between Uruguay and Brazil under which Brazil would supply power to Uruguay from the Candiota plant. USAID is not yet satisfied that arrangements for power sales to Uruguay will actually be consummated; and, therefore, the Candiota plant could only be justified by an interconnection with the North system, some 270 kilometers away.

The SOLTECA coal-fired thermal plant in Santa Catarina offers a more likely alternative for meeting north system energy requirements. At the initiative of ELETROBRAS, arrangements have been made to construct a transmission line from the SOLTECA plant to the substation at Pôrto Alegre. The transmission line could be completed within 18 months and, therefore represents the most rapid means of supplying power to the Pôrto Alegre area. In connection with the proposed transmission link between SOLTECA and Pôrto Alegre, ELETROBRAS has convinced the State of Rio Grande do Sul to begin conversion from 50 to 60 cycle power in the North system. The proposed Passo Real and Passo Fundo

plants will be built for 50/60 cycle or 60 cycle operation.

The State's decision to convert to 60 cycle power will have long-term benefits since it will enable the State to be interconnected with the South-Central system at a future date. USAID concurs with ELETROBRAS that the SOLTECA solution is the most feasible one for supplying additional power to the North system over the next several years.

## SECTION VII - FINANCIAL ANALYSIS

### A. Tariff Legislation

The Brazilian tariff legislation has been fully described in the loan paper entitled "Brazil: FURNAS (Santa Cruz Thermal Plant Expansion)", dated June 1, 1967. Briefly, this legislation is based on the maintenance of power rates such that the full cost of service is covered and a return on re-invested capital provided. Power companies are entitled to earn 10% per annum on their annually re-valued rate base, to cover all operating and administrative costs, and to provide for depreciation at the rate of 5% for hydro plants and 8% for thermal plants. An additional optional provision known as reversion or amortization in the amount of 3% is also available.

In addition to the tariff charged by the power companies, Brazilian legislation also provides for tax collection by ELETROBRAS of up to the equivalent of 50% of the tariff itself. The resulting rate to consumer is one of the highest in the world and is justified by the very heavy investment requirements of Brazil's power expansion program.

Currently some revisions in the rate legislation are under consideration by government authorities, e.g., power intensive industries will be afforded a preferential power rate. It is also anticipated that power companies will have the option to charge depreciation at 3% per annum on hydro plants and 5% on thermal plants, allowances more in accord with the useful life of the plant.

### B. Rates and Revenue

As indicated in Annex IV , Exhibit A , from 1964 through 1966 the company suffered a net loss or barely covered its expenses. Rates did not provide for adequate depreciation on plant and the return on the rate base was negative. In 1967 the company increased its rate substantially although not to the full levels permitted by the legislation. The deficit of

of approximately NCr\$2 million at the end of 1966 was replaced at the end of 1967 by a positive NCr\$6 million balance in reserves. However, it was not until 1968 that the company increased its power rates to a level necessary to assure a positive net income.

In the past 12 months the CEEE has received three rate increases: the last of these was issued in March to become effective May 1. It provides for an average rate per kilowatt hour of NCr\$0,102, equivalent to 32 mills (an increase of over 30%). Taking into account the average kilowatt hour from January 1968 of NCr\$0,074, the weighted average rate per kilowatt hour for the year 1968 will be NCr\$0,090, equivalent to approximately 29 mills.

The rate of NCr\$0,102 per Kwh represents the full 10% remuneration on the rate base (re-valued through the year 1966), plus all operating costs and depreciation on re-valued assets at a flat rate of 5%. Owing to the one year lag in the re-valuation of the rate base, the return on the rate base for 1968 will be roughly 8% in real terms.

The courageous action of the company in raising its rates to such high levels is an indication of the responsible attitude which the company and State have adopted in the management of the State Power Development Program. Moreover, the latest increase in rates was made in the face of a forthcoming municipal election later this year.

A comparison of the rates in effect in the State of Rio Grande do Sul with those charged by other major power entities is shown below:

COMPARATIVE POWER RATES  
(NCR\$ per 1000 Kwh)

<u>Company</u>	<u>Secondary Service</u> 1/	<u>Primary Service</u>	
		<u>(2.3 - 13.2 KV)</u> at 50% L.F. 2/	<u>(33 KV)</u> at 50% L.F.
CEEE	125.00	66.10	51.80
CEMIG	65.00	42.00	34.00
Rio/S.Paulo Lght	76.59	44.00	34.80
CHESF	44.28	31.50	26.00
COPEL	75.00	61.30	57.00

As will be noted from the table above CEEE's rates will be higher than those of any other major power system in Brazil

C. CEEE's Future Rate Policy

CEEF has agreed to adjust its tariffs annually to the maximum level permitted by Brazilian power rate legislation unless they can satisfy USAID that such level would be in excess of their requirement. This is the standard rate clause applied by USAID on power loans including the FURNAS, Santa Cruz Expansion and the Mascarenhas project. The Governor of Rio Grande do Sul has confirmed (See Annex ) the State's intention to support CEEE's rate policy.

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1/ Covers residential and small commercial service.

2/ Equal to a load having 50% utilization of maximum monthly demand.

D. Projected Income Statements

With the application by the CEEE of the above mentioned rate policy, a marked improvement will occur in the net revenue position of the company from 1968 through 1973. During this period it is expected that the company will generate from internal sources (net income and depreciation) a total of NCr\$424 million, representing about 36% of the company's investment, debt servicing and dividend requirement during this period.

E. Projected Balance Sheets

Actual projection balance sheets are shown in Annex V Exhibit B. At the end of 1967 the company had a net investment in plant and property of NCr\$220 million and working capital and advances of NCr\$83 million, making total assets of NCr\$303 million. The company's capital and reserves at that time amounted to NCr\$203 million and its long-term debt to NCr\$100 million. The debt/equity ratio was, therefore, about one to two during the year 1967, and it is expected to continue in the same proportion through the 1968/73 period.

F. Cash Flow Forecast: Discussion of Debt Servicing Capacity and other Issues

A projected statement of source and application of funds and cash flow of the company is shown in Annex V Exhibit B. This cash flow indicates that the company should be able to carry out its program and service its debt comfortably provided rates are maintained in accordance with the policy discussed earlier and that contributions are received as required from DNOS (NCr\$115 million), the Ministry of Mines and Energy and INDA (NCr\$42 million) and other long-term lenders (NCr\$30 million). Furthermore, the cash flow indicates equity contributions of NCr\$276 million must be made by the State during this period, as discussed in Section IV . The bulk of these equity contribution

is expected to come from the State Investment Fund which receives a share of state sales taxes. Shown below is an estimate of the schedule receipts in the State Investment Fund available to make the equity contribution for this project and comparison with the amounts pledged by the Governor in his letter of May 13, 1968.

	(NCr\$ millions)					
	1968	1969	1970	1971	1972	1973
Governor's letter	26	31	36	43	-	-
Sales tax receipts (4%/annum growth)	450	496	516	536	558	580
State Investment Fund (20% of Sales Tax)	90	99	103	107	112	160

Notwithstanding these specified sources, A.I.D. has requested and received from the Governor a written commitment that the State will supply all funds necessary for the completion of the Passo Real project. These funds would be provided for the Passo Real project as a matter of priority by the State.

VIII - ISSUES AND CONDITIONS ATTACHED TO PROPOSED USAID LOAN

A. Priority of Passo Real Project in the Program:  
Candiota and Passo Fundo

The company and the State have given a written assurance that the Passo Real project will be accorded first priority in the State Power Development Program. At the same time, the company's power expansion program is very ambitious and will require a tremendous financial effort by the company and the State in order to be carried out. This is particularly true of the Passo Fundo project which depends partially on federal resources and partially on State resources. There will be pressure on the State to provide funds for the rapid completion of Passo Fundo and a danger exists that the Passo Real project would be prejudiced as a result. Moreover, the CEEE is anxious to carry out the Candiota project and has accepted a temporary postponement of this project with some reluctance. In fact, the company has invited international lenders for turn key financing of the Candiota plant. While it is unlikely that foreign suppliers will provide 100% of the financing, it is possible that the offers made to the company will be very attractive. However, USAID has requested and received assurances from the company and the State regarding the possible postponement of Candiota and the second unit of Passo Fundo and it is believed that the precautions taken are sufficient under the circumstances.

B. Financial Commitments to Be Sought by USAID from  
CEEE, the State, and GOB/ELETROBRAS

The company will be required to maintain power tariff at the maximum level permitted by Brazilian legislation and will be required to give first priority to the Passo Real project in its Power Development Program. The State has also been required to give first priority to Passo Real, to support the CEEE's tariff policy, and to provide all funds necessary to complete the project. The CEEE and the State will further commit themselves to reinvest all earnings from the company in its investment program. In the Guarantee Agreement the Government of Brazil, acting through ELETROBRAS, will be required to grant to the company the maximum rates permitted under the legislation and to provide an over-run commitment

in the event that additional funds should be required in order to complete the project.

C. U.S. Procurement and the Law of Similarars

All procurement will be of U.S. source and origin and all imports will have either no Brazilian similars or deminimus similars, considering timing and quality requirements. The Government of Brazil, through CACEX, will give as a condition precedent to disbursement under the loan prior approval to the list of imported equipment and materials. In the case of the Kaplan turbines, the company has agreed with the national industry that joint Brazilian/U.S. bids will be obligatory under an arrangement whereby essential imports and technical services will be supplied by the U.S. manufacturer and equipment and services produced or available in Brazil will be supplied by the Brazilian firm. This agreement with national industries provides that 50%, by value, of the turbines must be of Brazilian origin. It is estimated by USAID engineers that approximately half of the value of the turbines will have to be imported; and, therefore, the arrangement appears reasonable. While there may be some commercial dislocation with this type of procurement since most of the Brazilian manufacturers are affiliated with European firms, the local manufacturers have raised no specific objections to the proposed arrangement and believe it can be worked out successfully.

D. Supervisory Consulting Engineers

As mentioned earlier, the management of the company is not as strong as that of other power utilities in Brazil such as FURNAS or CEMIG. However, the company's management will be satisfactory with the assistance of the consulting engineers. USAID believes that the company is capable of carrying out its expansion program and operating the proposed project without difficulty. The company has already engaged the firm of International Engineering together with its local subsidiary, to perform the necessary engineering and supervisory services related to the Passo Real Project.

The proposed A.I.D. loan, however, will finance only U.S. engineering consulting services which are eligible for dollar payment.

E. BNDE Loan Conditions

The BNDE loan of NCr\$110 million was made under very strict conditions including the right to withhold the semi-annual release of funds in the event that the company had not completed certain transmission and distribution works by specific dates. USAID has discussed these conditions with the company which is confident that it can complete these works on schedule. The BNDE has agreed with USAID that it will consult with us prior to invoking the right to withhold release under its loan. The USAID loan will contain an event of default should the BNDE loan be suspended.

SECTION IX - IMPACT ON THE U.S. ECONOMY

Since the proposed U.S.\$27.4 million AID loan will finance goods and services exclusively of U.S. source and origin, it may be said that the impact of the loan on the U.S. economy will be favorable.

Moreover, without the proposed AID financing, the imported equipment and materials required for the project might have come from other competitor countries.

UNCLASSIFIED  
AID-DIC/P-729  
ANNEX I - Page 1 of 1  
June 14, 1968

CERTIFICATION PURSUANT TO SECTION 611 (e)  
OF THE FOREIGN ASSISTANCE ACT OF 1961,  
AS AMENDED

Re: BRAZIL - Capital Assistance - Passo Real Hydroelectric Project

Having taken into account, among other things, the maintenance and utilization of projects in Brazil previously financed or assisted by the United States, I certify that in my judgment Brazil has the financial capability and the human resources capability to effectively utilize the proposed loan to the Companhia Estadual de Energia Elétrica for the Passo Real Hydroelectric Project.

This judgment is based primarily on the facts developed in the Capital Assistance Paper for the proposed loan of \$27.4 million which discusses in detail the capabilities of the Borrower and the State of Rio Grande do Sul, and finds that they possess adequate financial and human resources capability to effectively maintain and utilize the project. The relationship between this proposed loan and other projects financed by the United States is reviewed in a memorandum from the Assistant Director for Capital Development dated May 27, 1968, attached hereto.

  
\_\_\_\_\_  
Director

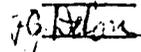
MAY 29 1968

\_\_\_\_\_  
Date

Drafted by:  
ADCD:LVPerez

Clearances:

DDOM:HKleine

LGS:FDe Rosa 

UNCLASSIFIED

June 14, 1968

CHECK LIST OF STATUTORY CRITERIA

(Alliance for Progress)

In the space provided under each item, summarize for each item the information or conclusion requested or make reference to the section(s) of the Capital Assistance Paper, or other clearly identified and available document, in which the matter is clearly discussed.

The following abbreviations are used:

FAA - Foreign Assistance Act of 1961, as amended by the Foreign Assistance Act of 1967.

App.- Foreign Assistance and Related Agencies Appropriations Act, 1968.

NA - Not Applicable.

Country Performance

Progress Towards Country Goal

1. FAA Sec. 208; Sec. 251(b) (1), Sec. 251(b)(5), Sec. 251(b)(6).  
Extent to which country is:
  - (a) making appropriate efforts to increase food production and improve means for food storage and distribution;
  - (b) creating a favorable climate for foreign and domestic private enterprise and investments;
  - (c) increasing the public's role in the developmental process;
  - (d) allocating expenditures to development rather than to unnecessary military purposes or intervention in other free countries' affairs;
  - (e) willing to contribute funds to the project or program;

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Borrower is making appropriate efforts to:

(a) increase food production and improve means for food storage and distribution; (b) encourage private enterprise and investment as is clearly evidenced by the present Administration's policies; (c) increase the public's role in the developmental process; (d) allocate expenditures for development rather than for unnecessary military purposes and is not intervening in other free countries' affairs; (e) contribute funds to this program; (f) make economic, social and political reforms. (Such as tax collection improvements and changes in land tenure arrangement, 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 enterprises). And (g) adhere to the principles of the Act of Bogota and Charter of Punta del Este and respond to the vital economic, political and social concerns of its people, and demonstrate a clear determination to take effective self-help measures.

For specifics see comments in AID-DLC/P-668 of January 23, 1968, containing Negotiating Instructions for Proposed Program Loan 1968. For: (a) page 6.11; (b) page 2.11; (c) page 2.11; and (d) page 7.1; (f) page 1.2B; (g) page 1.2B. For (e) see page iii item 8 of this loan paper.

2. FAA Sec. 251(b). Information and conclusion on country's efforts to repatriate capital invested in other countries by its own citizens.

Brazil's efforts to stabilize the value of the cruzeiro through measures to counter inflation, including the last devaluation and recent measures to control the parallel market, contribute to the return of capital invested in other countries by its citizens.

#### Relations with United States and Other Nations

3. FAA Sec. 620(c). If assistance to a government, existence of indebtedness to a U.S. citizen for goods or services furnished or ordered where such citizen has exhausted available legal remedies, debt is not denied or contested by such government or indebtedness arises under an unconditional government guaranty.

Brazil is not known to be indebted to any U.S. citizen for goods or services furnished or ordered where such a citizen has exhausted available legal remedies or where the debt is not denied or contested by the Borrower or the indebtedness arises under an unconditional guaranty of payment by the Borrower.

4. FAA Sec. 620(d). If assistance for any productive enterprise which will compete in the United States with U.S. enterprise, existence of agreement by the recipient country to prevent export to the United States of more than 20% of the enterprise's annual production during the life of the loan.

Not applicable.

5. FAA Sec. 620(e)(1). If assistance to a government, extent to which it (including government agencies or subdivisions) has, 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.

Neither the Government of Brazil nor any governmental agency or subdivision thereof, has on or after January 1, 1962, nationalized, expropriated, or seized ownership or control of property of any U.S. citizen of firm, taken steps to repudiate or nullify contracts with such citizens or firms, or impose or enforce discriminatory taxation or other exactions of restrictive conditions, or taken other actions having the effect of nationalizing, expropriating or otherwise seizing ownership or control of property owned by U.S. citizens or firms, as specified in this section of the Act, without taking appropriate steps to discharge its obligations, as specified in this section of the Act.

6. FAA Sec. 620(i). Information whether the country permits, or fails to take adequate measures to prevent, the damage or destruction by mob action of U.S. property.

The country is taking adequate measures to prevent the damage or destruction by mob action of U.S. property.

7. FAA Sec. 620 (l). Consideration which has been given to denying assistance to a government which after December 31, 1966, has failed to institute the investment guaranty program for the specific risks of inconvertibility and expropriation or confiscation.

Brazil has signed such an agreement and instituted an active program.

8. FAA Sec. 620(o). 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, which has been given to denying assistance.

Brazil has not seized or imposed any penalty or sanction against any U.S. fishing vessel in international waters.

9. FAA Sec. 620(q). Existence of default under any FAA loan to the country.

No such default exists.

10. FAA Sec. 620(t). Prohibition on aid if country has severed diplomatic relations with United States, unless agreements have been negotiated after resumption of relations.

Brazil maintains satisfactory diplomatic relations with the U.S.

11. FAA Sec. 620(u). Status of the country on delinquent U.N. obligations.

Brazil is not delinquent with respect to dues, assessments or other obligations to the U.N.

12. FAA Sec. 209. Information about multilateral assistance being furnished to the country.

AID assistance is being closely coordinated with that of the International agencies. (For specifics see comments AID-DLC/P-668 of January 23, 1968, containing Negotiating Instructions for the 1968 Program Loan, pages 3.1-3.3.)

13. FAA Sec. 620(a); App. Sec. 107(a) and (b). Compliance with prohibitions against assistance to Cuba and any country (a) which furnishes assistance to Cuba or failed to take appropriate steps by February 14, 1964, to prevent ships or aircraft under its registry from carrying equipment, materials, or supplies from or to Cuba; or (b) which sells, furnishes, or permits any ships under its registry from carrying items of primary strategic significance, or items of economic assistance to Cuba.

No assistance will be furnished under this loan to the present Government of Cuba, nor does Brazil furnish assistance to the present Government of Cuba. Brazil has taken appropriate steps to prevent ships or aircraft under its registry from engaging in any Cuban trade.

14. FAA Sec. 620(b). If assistance to a government, existence of determination it is not controlled by the international Communist movement.

The Secretary of State has determined that Brazil is not controlled by the international Communist movement.

15. FAA Sec. 620(i). Information on representation of the country at any international conference when that representation includes the planning of activities involving insurrection or subversion against the United States or countries receiving U.S. assistance.

There has been no Brazilian Government representation nor any private Brazilian representation with Brazilian Government sanction at any international conference in which that representation includes the planning of activities involving insurrection or subversion against the U.S. or countries receiving U.S. assistance.

16. FAA Sec. 620(n); App. 107(b) and 116. Compliance with prohibition against assistance to countries which traffic or permit trafficking with North Viet-Nam.

Brazil does not traffic or knowingly permit trafficking with North Viet-Nam.

#### Military Expenditures

17. FAA Sec. 620(i). Existence of determination that the country is engaging in or preparing for aggressive military efforts.

The President has not determined that Brazil is engaging in or preparing for aggressive military efforts.

18. FAA Sec. 620(s). Information and conclusion whether country is devoting unnecessary percentage of budget for military purposes and using foreign exchange for military equipment.

Reference: Airgram A-414 - Brazilian Military Expenditures December 18, 1967.

19. App. Sec. 119. Information on reduction in assistance by amounts spent by country for the purchase of sophisticated military equipment.

As of the date hereof, Brazil has not spent any amounts on the purchase of sophisticated weapons systems as described in this Section. See also Airgram A-414, Brazilian Military Expenditures of December 18, 1967.

Conditions of the Loan

General Soundness

20. FAA Sec. 201(d). Information and conclusion on legality (under laws of country and United States) and reasonableness of lending and relending terms of the loan.

The proposed loan is consistent with the laws of Brazil and the United States and the terms are considered reasonable by both the Borrower and A.I.D.

21. FAA Sec. 251(b)(2); Sec. 251(e). Information and conclusion on activity's economic and technical soundness, including information on availability of an application together with assurances to indicate that funds will be used in an economically and technically sound manner.

The project has received the endorsement of the Ministry of Mines and Energy, Eletrobrás, and the Ministry of Planning. Sufficient information and assurances have been provided to indicate that the funds will be used in an economically and technically sound manner.

This activity has been found economically and technically sound. See the respective Sections of this Loan Paper.

22. FAA Sec. 251(b). Information and conclusion on capacity of the country to repay the loan, including reasonableness of repayment prospects.

The concessional terms of the proposed loan (40 years, including: 10 years grace period (2%) 30 (2 1/2%) are within the country's debt servicing capacity.

23. FAA Sec. 611(a)(1). Information and conclusion on availability of engineering, financial, and other plans necessary to carry out the assistance and of a reasonably firm estimate of the cost to the United States of the assistance.

Necessary technical and financial planning has been completed. See Sections IV, V, and VII.

24. FAA Sec. 611(a) (2). Necessary legislative action required within recipient country and basis for reasonable anticipation such action will be completed in time to permit orderly accomplishment of purposes of loan.

No legislative action is required.

25. FAA Sec. 611(e). Compliance with requirement that Mission Director certify, with respect to projects estimated to cost over \$1 million, as to the country's capability effectively to maintain and utilize the project.

The required certification is made in the letter of transmittal.

(See Annex I).

26. FAA Sec. 251(b). Information and conclusion on availability of financing from other free-world sources, including private sources within the United States.

Other free world financial lenders have been approached and have indicated that they are not interested in the project.

Loan's Contribution Towards Achievement of Country and Regional Goals

27. FAA Sec. 207; Sec. 251 (a). Extent to which assistance reflects appropriate emphasis on:
- (a) encouraging development of democratic, economic, political and social institutions;
  - (b) self-help in meeting the country's food needs;
  - (c) improving availability in the country of trained manpower;
  - (d) programs designed to meet the country's health needs;
  - (e) other important areas of economic, political and social development, including industry; free labor unions, cooperative and voluntary agencies; transportation and communication; planning and public administration; urban development; and modernization of existing laws.
- (a) Not applicable.
- (b) Not generally applicable.
- (c) The loan will provide for technical assistance and training.
- (d) Not applicable.
- (e) The formulation of this project has already made a contribution to the planning of the Rio Grande do Sul Power Expansion Program. The project's significant contribution to the availability and dependability of electric energy service in the State will have an obvious and pervasive influence on the economic and social development of the area.

28. FAA Sec. 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 project will have a basic significance for the State of Rio Grande do Sul's development activities, and will play an essential part in the realization of long-range objectives in the national power sector.

29. FAA Sec. 251(b)(7). Information and conclusion on whether or not the activity to be financed will contribute to the achievement of self-sustaining growth.

The project, and more particularly, the rate policy covenanted in the Loan Agreement will contribute to the achievement of the company's self-sustaining growth.

30. FAA Sec. 281(a). 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 developing countries, through the encouragement of democratic private and local governmental institutions.

The loan will make such a contribution by assisting in supplying needed electric power services, strengthening the management and finances of the Company, and requiring consumers to bear the full cost of service, heretofore subsidized.

31. FAA Sec. 281(b). 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 is supportive of civic education and training in governmental skills.

Program satisfies need for essential public utility service.

32. FAA Sec. 601(a). Information and conclusions 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.

The project may indirectly increase the flow of international trade and foster private initiative and competition. It will improve the technical efficiency of industry, agriculture, and commerce.

33. FAA Sec. 619. Compliance with requirement that assistance to newly independent countries be furnished through multilateral organizations or plans to maximum extent appropriate.

Not applicable. Brazil is not a newly independent country.

34. FAA Sec. 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 review of national development activities.

The loan is consistent with the findings and recommendations of the Inter-American Committee for the Alliance for Progress in its review of national development activities.

35. FAA Sec. 251(g). Information and conclusion on use of loan to assist in promoting the cooperative movement in Latin America.

Not applicable to this loan.

36. FAA Sec. 209, Sec. 251(b)(8). Information and conclusion whether assistance will encourage regional development programs, and contribute to the economic and political integration of Latin America.

Not generally applicable.

Loan's Effect on United States and A.I.D. Program

37. FAA Sec. 251(b)(4), Sec. 102. Information and conclusion on possible effects 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.

There will be no adverse effect on the U.S. economy as a result of this project; in fact, it will benefit the U.S. economy through purchases of U.S. products.

38. FAA Sec. 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).

All of the \$27.4 million proceeds under this loan will be used to procure U.S. commodities, equipment, and services from U.S. private enterprise.

39. FAA Sec. 601(d). Conclusion and supporting information on compliance with the Congressional policy that engineering and professional services of U.S. firms and their affiliates are to be used in connection with capital projects to the maximum extent consistent with the national interest.

An estimated \$1.8 million will be used from the proceeds of this loan to finance U.S. engineering and professional services.

40. FAA Sec. 602. Information and conclusions whether loan will permit U.S. small business to participate equitably in the furnishing of goods and services financed by it.

Where appropriate, U.S. small business may participate equitably in the furnishing of goods and services financed by the Loan.

41. FAA Sec. 620(h). Compliance with regulations and procedures adopted to insure against use of assistance in a manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of the Communist-bloc countries.

Assistance provided by this loan will not be used in a manner which, contrary to the best interests of the U.S., promotes or assists the foreign aid projects or activities of the communist-bloc countries.

42. FAA Sec. 621. Information and conclusion on how the loan in providing technical assistance will utilize to the fullest extent practicable goods and professional and other services from private enterprise on a contract basis. If the facilities of other Federal Agencies will be utilized, information and conclusion on whether they are particularly suitable, are not competitive with private enterprise, and can be made available without undue interference with domestic programs.

It is contemplated that all technical assistance financed by the loan will be provided by U.S. private enterprise.

43. FAA Sec. 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.

All loan's proceeds (\$27.4 million) will go to U.S. private enterprise.

Loan's Compliance with Specific Requirements

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

The Loan Agreement will provide that the Borrower will procure U.S. Government-owned excess property to the maximum extent practicable.

45. FAA Sec. 604(a); App. Sec. 108. Compliance with restriction of commodity procurement to United States except as otherwise determined by the President and subject to statutory reporting requirements.

All goods and services purchased under this loan will be of United States origin.

46. FAA Sec. 604(b). Compliance with bulk commodity procurement restriction to prices no higher than the market price prevailing in the United States at time of purchase.

This section will be enforced by application of Reg. 1.

47. FAA Sec. 604(d). Compliance with requirement that marine insurance be purchased on commodities if the host country discriminates, and that such insurance be placed in the United States.

This section will be enforced by application of Reg. 1.

48. FAA Sec. 604(e). Compliance with requirement that funds not be used for procurement of any agricultural commodity or product thereof outside the United States when the domestic price of such commodity is less than parity.

Funds will not be so used.

49. FAA Sec. 611(b); App. Sec. 101. If water or water-related land resource construction project or program, information and conclusion on benefit-cost computation.

A benefit-cost computation has been performed. See Section VI or Annex III, Exhibit C.

50. FAA Sec. 611(c). Compliance with requirement that contracts for construction be let on competitive basis to maximum extent practicable.

Competitive bidding procedures will be followed for construction contracts.

51. FAA Sec. 620(f); App. Sec. 109. Compliance with prohibitions against assistance to any Communist country.

Assistance provided under this loan will not be furnished to any Communist country.

52. FAA Sec. 620(g). Compliance with prohibition against use of assistance to compensate owners for expropriated or nationalized property.

Assistance provided by this loan will not be used to compensate for expropriated or nationalized property.

UNCLASSIFIED  
ANNEX II  
Page 16 of 17

53. FAA Sec. 612(b) and 636 (h). Appropriate steps that have been 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 United States are utilized to meet the cost of contractual and other services.

The proceeds of this loan will be spent entirely in the U.S.

54. App. Sec. 102. Compliance with requirement that payments in excess of \$25,000 for architectural and engineering services on any one project be reported to Congress.

Will be complied with.

55. App. Sec. 104. Compliance with bar against funds to pay pensions, etc., for military personnel.

Funds obligated by the loan will not be used to pay pensions, annuities, etc.

56. App. Sec. 106. If country attempts to create distinctions because of their race or religion among Americans in granting personal or commercial access or other rights otherwise available to U.S. citizens generally, application which will be made in negotiations of contrary principles as expressed by Congress.

No attempts by Brazil to create distinctions because of race or religion among Americans in granting personal or commercial access or other rights otherwise available to U.S. citizens generally are known. If Brazil attempts to create such distinctions application will be made in/ negotiations of contrary principles as expressed by Congress.

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57. App. Sec. 111. Compliance with requirements for security clearance of personnel

Security clearance of U.S. funded personnel will be obtained to extent required by Manual Orders and U.S. policy.

58. App. Sec. 112. Compliance with requirement for approval of contractors and contract terms for capital projects.

Will be complied with as required.

59. App. Sec. 114. Compliance with bar against use of funds to pay U.N. assessments, etc.

Loan funds will not be used to make any payment to U.N. members.

60. App. Sec. 115. Compliance with regulations on employment of United States and local personnel for funds obligated after April 30, 1964 (Regulation 7).

Not applicable.

61. FAA Sec. 636(i). Prohibition on financing non-U.S. manufactured motor vehicles.

Not applicable.

62. App. Sec. 401. Compliance with bar against use of funds for publicity or propoganda pruposes within United States not nere- tofore authorized by Congress.

Loan funds will not be used for publicity or propoganda purposes within the United States.

63. FAA Sec. 620(k). If construction of productive enterprise where aggregate value of assistance to be furnished by United States will exceed \$100 million, identification of statutory authority.

Not applicable.

UNCLASSIFIED  
AID-DLC/P-729  
ANNEX III  
June 14, 1968

A N N E X    I I I    -    T E C H N I C A L    A N N E X E S

DETAILED PASSO REAL PROJECT DESCRIPTION

The design for Passo Real was prepared by ELC - Electric-consult of Milan, Italy and reviewed by Gibbs and Hill of New York in December, 1965. On September 11, 1967 CEEE contracted the International Engineering Co., Inc. of San Francisco, in joint-venture with Companhia Internacional de Engenharia e Construções of Rio de Janeiro, as their consultants to conduct the necessary field investigations and office studies to arrive at the best technical and economic solution, among the open alternatives. On December of the same year the consultants presented a report titled "Selection of Project Layout and Dam Type", containing the analysis and selection of the optimized layout, with cost estimate and complete construction equipment list.

The Passo Real project will be located on the Jacui river, about 15 kilometers upstream from the Jacui (Maia Filho) dam, and 210 kilometers distant from the state capital city Porto Alegre. (See Annex VI).

The Jacui plant is the largest in the CEEE system, with a present operating capacity of 100 Mw, and 50 Mw installation for commissioning in 1968. Jacui and Passo Real are in fact to be operated as a single development, since the former has only pondage, and the main storage is to be provided by the new upstream reservoir. Whereas the ultimate capacity of the Maia Filho pondage is 30 million cubic meters, the Passo Real lake will contain a live storage of 2.3 billion cubic meters.

Based on the driest year of record\* the dependable energy from Jacui is 25.2 ave. Mw. With construction of the new reservoir this figure will be up-graded to 75.4 ave. Mw, whereas Passo Real proper will be able to generate 32.5 ave. Mw.

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\* Accurate hydrological records for this region of the Jacui river have been kept since 1915, the driest year having been 1943-1944.

The Passo Real project consists of:

- a. A dam of the fill type throughout containing in its main section the power house intakes and penstocks, and a spillway located about 1.8 kilometers upstream of the main part of the dam and power house, on the left abutment where the foundation conditions appear favorable. This dam will impound a lake of 2.3 billion cubic meters of live storage.
- b. A power house equipped in this initial first stage with two generator sets, with a total capacity of 125 Mw, and provisions for the installation of two more units of the same size, located immediately downstream from the dam.
- c. A transmitting substation located on the left bank, immediately downstream from the powerhouse, with provisions for two 220 Kv, three 138 Kv and two 22 Kv transmission lines.
- d. The associated transmission system, and the required enlargement of distribution systems.

Selection of the proposed site for this project was based on the favorable reservoir conditions, good accessibility, and use of the maximum water level in the downstream Maia Filho reservoir.

The river at this site is about 150 meters wide between banks which are from 55 to 70 meters above normal river level. The area of the dam is completely underlaid by a basalt formation. Railroad transportation is available from Porto Alegre, all the way up to Cruz Alta about 60 kilometers from the project site. Construction of unpaved access roads have already been made.

Previous geological investigations made by CEEE and Electroconsult, in connection with their original study of a concrete dam and powerhouse scheme, included more than 130 drill holes. Additional drill holes and foundation test pits were required for International Engineering Co.'s study of an alternate earth-rockfill design, which was finally adopted.

Additional field investigations undertaken by International have defined rock conditions along the proposed spillway and diversion tunnel alignments. Also several potential quarry sites have been investigated. Field work which is still underway will firm up details regarding excavation conditions in the vicinity of portals and open cuts, rock permeability in maximum head river channel sections and spacing of some vertical joints. Exploration of natural sand aggregate and earth-fill materials sources are being conducted as of this date.

It has been estimated that excavation-structures will require working 2,200,000 cubic meters, embankments 3,500,000 cubic meters, aggregate production will amount to 450,000 and concrete works 133,000. The main dam will be 450 meters long, with a maximum height of 60 meters, and a volume of 2.5 million cubic meters. The dikes will have an aggregate length of 3,300 meters, with a maximum height of 15 meters, and a volume of 1.5 million cubic meters.

The reservoir will have a total length of 40 kilometers and a maximum width of about 14 kilometers. The right of eminent domain will be exercised over an area of about 230 million square meters. Maximum water level at the reservoir is set at 327 meters, equivalent to a total storage capacity of 3.65 billion cubic meters. Corresponding gross head is 48 meters, and the full live storage of 2.3 billion cubic meters will correspond to a maximum drawdown of 14 meters.

One of the two diversion tunnels will be provided with one 150 in. butterfly valve, and one 138 in. hollow Bunger valve required for the downstream Jacui plant operation.

The powerhouse structure will be located on the present left bank of the river, with its upstream concrete wall serving as a retaining wall for the dam fill, to reduce the length of the power conduits. It will house four 70 Mva umbrella type synchronous generators, driven by 87,800 hp and 138.5 rpm Kaplan turbines, under maximum gross head of 48 meters. Size of generator sets was dictated by transportation limitations and spinning reserve considerations.

The intake structure and conduits are located into the abutment, to minimize the amount of concrete required for the intake tower, and to assure entrenchment of the conduits into sound rock. There will be individual intakes for each turbine, plus a small one for the auxiliary turbine-generator groups (two), all of them provided with stop-logs and trash racks. The individual concrete penstocks will be steel lined, and directly connected to the spiral casings. They will be fully imbedded in the dam section, with a total length of about 90 meters, those for the main turbines having a 6.9 meter diameter, and that for the two auxiliary groups being 0.8 meter in diameter. The steel lined concrete draft tubes will be about 25 meters long.

The step-up transformers will be located on a concrete deck over the draft tubes. Single phase 3 x 23.24 Mva 13.8/220 Kv transformer banks will be used. The substation is to be located 150 meters downstream from the powerhouse on the left river bank, with controls located in the powerhouse. The 220 Kv section will be of the double operating bus system, feeding two 230 kilometer long transmission lines to the Cidade Industrial substation (on the outskirts of Porto Alegre); the 138 Kv section is fed from the 220 Kv bus bars through a bank of three 46.67 Mva single-phase auto-transformers, giving origin to

three lines: two for interconnection with the Jacui plant, which are only 15 kilometers long, and one 100 kilometers long to the city of Passo Fundo.

River diversion procedure was studied by International engineers, considering construction of concrete conduits, or tunnels as an alternate solution. The former solution was rejected since it would be more expensive and would require increased construction time.

The proposed diversion procedure will include construction of two 8 meter diameter horseshoe-shaped tunnels through the left abutment, about 500 meters from the river crossing. These two parallel tunnels will be about 450 meters long, with an outlet channel of approximately equal length. It was estimated for cost computations that 50% of the tunnels will have to be concrete lined.

From previous studies it was considered the desirability of providing for a diversion flow of not less than 2,500 cu. meter/sec., which would require two 12 meter diameter tunnels. To minimize excavation and construction time it was decided to adopt the 8 meter tunnels, with a total capacity of about 1,400 cu. meter/sec., and to provide also an open-cut channel on the right abutment to handle excess flows. This 50 meters wide and 450 meters long channel, together with the tunnels will have a total diversion capacity of about 2,600 cu. meter/sec. Upstream and downstream cofferdams will be constructed, and the diversion system will be capable of carrying 2,900 cu. meter/sec. before the upstream cofferdam is overtopped by the river. Drill logs indicate that practically all the excavated material is suitable for use in the cofferdams and main dam.

One of the tunnels will be provided with a butterfly valve, installed immediately downstream from its concrete plug, and a 135 meter long penstock to provide a permanent

low-level river outlet, required for operation of the present and future downstream plants. The penstock will be provided at the downstream end with a hollow Bunger conical diffusion valve placed in the downstream portal structure.

Discharge capacity through these valves will be about 125 cu.meter/sec., at the maximum draw-down level. This is sufficient to supply four of the six Jacui plant units the remaining two drawing water from the plant's own reservoir, when operated for peaking purposes. After the third unit is installed in Passo Real, in the course of the second phase of its construction, the tunnel outlet will be used only infrequently.

Tunnel closure will be accomplished in two steps, the first involving the installation of closure gates in the tunnel that will provide the permanent outlet. It is expected that in about two months work for installation of valves will be completed, allowing then the closure gates to be removed to the other tunnel. The second step will consist of permanently concrete plugging the second tunnel.

In association with the Passo Real project CEEE will also construct other 138 Kv and 69 Kv lines and substations to allow the transmission of the new block of power available to the various consumption centers and improve their distribution systems. This program of transmission improvements, to be completed in five stages, is presented in the feasibility study in the form of five separate plates, representing the complete North System and the improvements corresponding to each phase. The following lengths of transmission lines are projected for completion as part of the Passo Real project:

220 Kv lines - 520 Km  
138 Kv lines - 363 Km  
69 Kv lines - 184 Km

The 220 Kv transmission lines will interconnect Passo Real with the Cidade Industrial substation, near Porto Alegre (one circuit), and from there to the SEPA VI substation in Porto Alegre (double circuit line). From Cidade Industrial there will be two lines to Cachoeirinha, one with single and another with double circuits. The interconnection between SEPA VI and SEPA II substations, both within the Porto Alegre city area, will be by a 69 Kv underground cable.

The Cidade Industrial substation will be provided with one 150 Mva, 220/133/13.8 Kv transformer, one 50 Mva, 220/22 Kv transformer and two 50 Mva synchronous condensers. The SEPA VI substation will be provided with transformers of the same ratings, the larger being for 220/66 Kv and the smaller for 220/13.2 Kv.

The SEPA II and SEPA IV substations will be upgraded with one additional transformer each, rated 25 Mva, 66/13.2 Kv. The SEPA O substation will receive a somewhat larger new unit for 30 Mva, and same voltages.

Seventeen new substations will be built within the scope of this project, namely:

SEPA VII	.. 2 transformers	- 25 Mva	- 66/13.2 Kv
Guaporé	.. 1 transformer	- 15 Mva	- 138/22 Kv
Camaquã	- 1 transformer	- 15 Mva	- 138/22 Kv
Taquara	- 1 transformer	- 7.5 Mva	- 138/13.8 Kv
Vasconcelos	- 1 transformer	- 7.5 Mva	- 138/22 Kv
Caxias do Sul	- 1 transformer	- 15 Mva	- 69/13.8 Kv
Faxinal do Soturno	- 1 transformer	- 10 Mva	- 69/22 Kv
Montenegro	- 1 transformer	- 10 Mva	- 69/22 Kv
São Luiz Gonzaga	- 1 transformer	- 7.5 Mva	- 69/22 Kv
Campo Novo	- 1 transformer	- 7.5 Mva	- 69/22 Kv
Caçapava	- 1 transformer	- 7.5 Mva	- 69/22 Kv
Taquari	- 1 transformer	- 5 Mva	- 69/22 Kv
São Sepé	- 1 transformer	- 3.75Mva	- 69/22 Kv
Sobradinho	.. 1 transformer	- 3.75Mva	- 69/22 Kv
São Marcos	- 1 transformer	- 3.75Mva	- 69/22 Kv
Carazinho	- 1 transformer	- 5.00Mva	- 44/13.8 Kv

PASSO REAL - DESIGN CRITERIA

Rainfall

Rainfall data has been collected in 12 stations for 14 continuous years of observation. The basic figures are:

Average annual precipitation	-	1,763	millimeter
Dry period (Autumn)	"	410	"
" " (Winter)	"	415	"
Wet " (Spring)	"	430	"
" " (Summer)	"	460	"

Hydrology

Continuous observations of river flow in the Jacuí river's Salto Grande Station are available since 1940, although random measurements exist since 1929.

The 1940-1961 average river flow was 137.8 cu.meter/sec. Including previous measurements this figure becomes 139.6 cu.meter/sec. The most common flows vary from 50 to 120 cu. meter/sec. Flows over 1,500 cu.meter/sec. occur only exceptionally. In 6,210 daily observations this last flow was exceeded only 18 times.

Evaporation

Measurements have been made for 17 years at the Passo Fundo and Cruz Alta meteorological stations. The characteristic figures are:

Average annual evaporation	-	919	millimeters
Maximum annual evaporation	-	1,161	"
Maximum monthly evaporation	-	166	"

Floods

Any flow equal to or over 600 cu.meter/sec. was classified as a flood flow. A representative figure of an average flood flow is 1,450 cu.meter/sec. corresponding to the average of 23 maximum

yearly flood flows measured from 1939 to 1960. The maximum daily flow during this period was 3,380 cu. meter/sec. equivalent to 2.33 times the above average. This was also the worst flood of record with discharges over 2,260 cu. meter/sec. for a period of six days, and was classified as having 100-year probability.

The computations to establish spillway capacity were carried over by three independent methods (empirical formulae, probability computations, and graphs) and gave substantially equivalent results. The flow with a 1,000-year probability was established as 6,750 cu. meter/sec. International Engineering Co. is designing the river diversion procedure around the figure of 2,600 cu. meter/sec. maximum flow during the construction period.

#### Geological Investigations

The first investigations at the proposed dam site were conducted in the beginning of 1962, and consisted of 41 borings along three lines perpendicular to the river bed, spaced by 50 meter intervals, attaining a maximum depth of 57 meters. At the request of the design engineers a second investigation was performed in November 1962, consisting of 27 additional borings and 19 shallow excavations for soil surface exploration. Also a borrow area for the earth dam sections was surveyed. Results of these investigations showed that the site is underlaid by a basaltic lava formation which, in the dam and powerhouse area, is disposed in either horizontal or slightly inclined layers. The riverbed contains no appreciable amounts of alluvial deposits. On the right bank a 12 meter thick blanket of earth covers the 7 to 8 meter thick layer of weathered basalt. On the left bank this earth cover is only 5 meters thick. On the whole geological studies and soil tests, including those recently conducted by International Engineering Co., have shown that the site is well suited for the earth-rockfill dam, whereas exploration of natural sand aggregate and earth-fill material sources are still under investigation. Based on previous experience with the Ernestino and Jacuf ponds in the same river, no silting problems are expected. In fact from a total storage capacity for the Passo Real reservoir of 3.65 billion cubic meters only 2.3 are considered as live storage.

Access

Total highway distance from Porto Alegre is 360 kilometers. Of these 350 kilometers represent the normal means of access to the existing Jacuí plant. The other 10 kilometers are accounted for by the road between Jacuí and the Passo Real site. Although these are unpaved roads, they present no special transportation problems.

A one-meter gage railroad connects Porto Alegre with the city of Cruz Alta. There is also an unpaved highway connecting Cruz Alta with Passo Real.

Dam

Dam alignment must follow a jagged line to take advantage of soil conditions, with gently sloping abutments on each side of the river. International Engineering Co. investigated the feasibility and economies of the following alternative solutions for the type of dam to be chosen:

<u>Dam type</u>	<u>Estimated Cost Civil Works (US\$ million)</u>
Fill, diversion in tunnels	23.0
Fill, diversion in river	24.7
Concrete gravity, diversion in tunnels	30.2
Concrete gravity, diversion in river	27.0
Concrete buttress, diversion in tunnels	28.0
Concrete buttress, diversion in river	24.3

The above tabulation shows the fill-type dam with diversion in tunnels as the most economical solution. Due to foundation conditions, the moderate height, and the considerable extension of the abutment portions of the dam, these must necessarily be of earth and rock materials. With a construction organization suitable to build these abutments it becomes economically advantageous if, other conditions being met, the main dam in the river valley is also

UNCLASSIFIED

ANNEX III - Page 11 of 62

Exhibit B

Page 4 of 7

constructed of fill material, so that full advantage is made of the construction equipment.

Typical dam sections are shown in Annex VI. For estimating purposes, it has been assumed that all material in the transition zones will be manufactured from quarried rock; it is, however, admitted that graded and compacted basalt which is readily available, may be used. Except for the material in the impervious core and the transition zones, most of the material required for the dam will be available from required excavation. The upstream cofferdam for river diversion may become a part of the permanent dam, considering the clean river bottom conditions, indicated by the drill logs.

The main dam will be 450 meters long, with a maximum height of 60 meters, and a volume of 2.5 million cu.meters. The dikes will have an aggregate length of 3,300 meters, with a maximum height of 15 meters, and a volume of 1.5 million cu.meters. International Engineering Co., in their report "Selection of Project Layout and Dam Type" of December 1967 have recommended this type of dam based on the following considerations:

a. Suitability of Site

Gently sloping abutments allow easy access for earth moving equipment. The oxbow curve in the river makes a tunnel diversion convenient, and provides an excellent spillway site away from the main dam and powerhouse.

b. Geological Considerations

The depth of overburden and extensive weathering of the underlying rock make fill-type wing dams the only practical solution. With a construction organization equipped to build these extensive wing dams, it becomes logical to consider additional utilization of this equipment for building the main dam.

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c. Availability of Materials

Preliminary field investigations have indicated abundant existence of suitable materials within economical hauling distances.

d. Brazilian Constructor's Skill

Recent advances of the local construction industry in capacity and use of the most modern construction techniques in embankment earthwork makes fill-type construction particularly advantageous for the Passo Real site.

e. Minimum Cost

Comparative cost estimates based on preliminary designs show that an all-fill type dam will cost about five million dollars less than a gravity dam, and about 1.0 million dollars less than a massive head buttress type dam, both having the added difficulty of staged diversion in the river channel.

Power Intake and Conduits

The power intake structure is located back from the toe of the dam (See Annex VI) and provides retaining walls to contain the fill. With this arrangement the power conduits are reduced in length, and better economy and regulation of the power units are obtained.

The water intake for the four main penstocks will be provided with gates and trash racks. The gates may be electrically or manually operated, and under emergency conditions may be closed by gravity. An emergency stoplog operated by a traveling crane is also provided for use in any of the four water intakes. Aeration is obtained by means of a vertical one-meter diameter tunnel, which can also be used for inspection.

The penstocks comprise two distinct sections: the initial one, matched to the water intake, establishes the transition between the water intake rectangular section, and the following one which has a circular section. Total length is about 90 meters, with an inside diameter of 6.9 meters and a 3/4-inch thick steel liner encased in concrete and founded on adequate rock to avoid differential settlement.

Maximum water flow through each penstock will be 210 cu.meter/sec. to which will correspond a maximum water speed at the spiral casing of 5.6 meter/sec. The excess pressure created by fast shutdown in seven seconds will not exceed 12%.

#### Spillway

The maximum flood discharge through the spillway was studied under the assumptions of the reservoir filled to its maximum normal level at 327 meters at the start of the flood, the water inflow to the reservoir being at the rate of 6,750 cu.meters/sec. which corresponds to the probability of once in 1,000 years, and one of the six tainter gates inoperative during the flood.

Under the above conditions the water level in the reservoir will raise 1.1 meter above the maximum normal level, the freeboard will still be maintained at 1.9 meters, and the spillway will discharge at a satisfactory rate of 5,100 cu.meters/sec.

The spillway has been located about 1.8 kilometers upstream of the main dam and powerhouse, on the left abutment, where foundation conditions appear favorable. Its crest will be 100 meters long, and will contain six 14.5 x 9.0 meters tainter gates. It is estimated that about 35,700 cu.meters of concrete will be required. The spillway channel has been assumed to have uniform width, with its longitudinal axis aligned with the direction of the river downstream. It will be concrete lined for a distance of 240 meters from the gate structure, with a ski-jump type terminal.

It is intended to use a scale model for determining the final detailed design of the spillway. During the project design stage, an economic comparison will be made with a scheme using larger size gates, as has been suggested by CANAMBRA.

#### Powerhouse

A powerhouse cross-section is shown in Annex VI. Its reinforced concrete upstream wall will serve as a retaining wall for the dam fill, to reduce the length of the power conduits.

The turbines will be the vertical shaft Kaplan type, capable of delivery 87,800 hp at 138.5 rpm under gross water heads from 48 to 35 meters gross heads. Below 35 meters the maximum power will progressively decrease, until at the minimum operable reservoir level the power is reduced to 75,500 hp with a 32 meter head. The maximum water rate corresponding to 48 and 35 meters gross head will be respectively 160 and 210 cu.meter/sec.

Presently planned generators will be of the umbrella type, rated 70 Mva at 0.9 power factor. CANAMBRA in their interim report has recommended that consideration be given to installing generators capable of developing full turbine output at normal maximum reservoir level. This should be an economical way of providing incremental capacity for eventual displacement of fuel from thermal plants.

Annual Production Costs of Passo Real  
Benefit-Cost Analysis of Alternatives

I - Annual Production Costs of Passo Real Plant (125 Mw)

General

All production cost factors used in the following computations were derived from the report "Power Study of South Central Brazil, December 1966" (CANAMBRA Engineering Consultants Ltd.). Underlying assumptions for hydroelectric systems are:

Fixed Charges

Interest and capital repayment	9.12% per year
Service Life (plant, substation and lines)	50 years
Interim replacement (sinking fund) allowances:	
Power plant	0.2% per year
Substations	0.5% per year
Transmission lines	0.1% per year

The use of these figures lead to the following factors for computing Fixed Charges:

Power plant	9.52% per year
Substations	9.62% per year
Transmission lines	9.22% per year

O&M and A&G Charges

For computation of Operation and Maintenance (O&M) the following charges are adopted:

		<u>\$/Year</u>
Power Plant:	125 Mw size	1,200/Mw
Substations:	125 Mva size	210/Mva
Transmission Lines:	220 Kv (single circuit)	80/r

Administration and General (A & G) expenses are computed as fixed percentages of the O & M costs:

Power plant - 55% of O & M  
 Substations - 20% of O & M  
 Transmission lines 20% of O & M

Adding up O & M and A & G the charges become:

		<u>\$/year</u>
Power Plant:	125 Mw size	1,620/Mw
Substations:	125 Mva size	252/Mva
Transmission lines:	220 Kv (single circuit)	95/Km

For computing costs of the operation of incremental capacity (peak) in an existing plant the figure \$900/Mw-year is used to cover O & M and A & G expenses. For incremental energy from existing plants no charges are assessed.

The following assumptions have been made in the cost computations below:

1. Production costs are computed for energy delivered up to the sub-transmission system. This is required so that costs of sub-transmission and distribution are excluded, as being part of the system requirements in general. This will also permit a more specific cost comparison with alternate solutions.
2. From previous computation it was established that the estimated cost for the Passo Real hydroelectric plant, with two generating units installed, aggregating 125 Mw was \$54,152,000.

3. According to the explanation given in Section 1 above, the only transmission line costs introduced in the following computations are those of the 220 Kv, 270 kilometers long, single-circuit line from Passo Real to Pôrto Alegre (Cidade Industrial and SEPA VI substations), which will deliver power to the subtransmission system. Total cost of this line based on most recent information available is \$5,500,000.
  
4. The salable energy computed for the project consists of the energy to be generated by Passo Real, plus the additional energy that can be generated at Jacuí with the benefit of the Passo Real reservoir. Computations were carried through for the driest year of record and for an average hydrological year. Figures adopted from the project feasibility study and having CANAMBRA's endorsement are:

	<u>Driest Year</u>	<u>Average Year</u>
Passo Real generation	32.5	40.5
Additional Jacuí Generation	<u>50.2</u>	<u>59.8</u>
Total generation	82.7	100.3

5. Transmitting losses along the 220 Kv line are assumed to be:

Loss of peaking capacity - 3%  
 Loss of energy - 6%

TABLE I

Production Costs, Passo Real with 125 Mw installed  
 (energy cost at the high tension bars of Cidade  
 Industrial and SEPA VI Substations)

1. <u>Fixed Charges</u>	<u>\$/Year</u>
Power Plant - 54,132,000 x 0.0932	5,020,000
Transm. Line - 3,500,000 x 0.0922	<u>323,000</u>
	5,343,000
2. <u>O &amp; M and A &amp; G Costs</u>	
Power Plant - 125 x 1,620	202,000
Transm. Line - 260 x 96	<u>25,000</u>
	227,000
Total Annual Cost for Passo Real	5,570,000
3. <u>Operation in Driest Year</u>	
Total Annual Cost for Passo Real:	
(0,94 x 32.5 = 30.5 ave.Mw)	5,570,000
Additional Annual Cost for Jacuf:	
(0,94 x 50.2 = 47.2 ave.Mw)	0
Total Annual Cost for 77.7 ave. Mw delivered	<u>5,570,000</u>
Cost of energy delivered -	$\frac{5,570,000}{77,700 \times 8,760} = \$0.00818/\text{Kwh or}$
	8.18 mills/Kwh

4. Operation in Average Year

Energy delivered by Passo Real -  $0.94 \times 40.5 = 38.0$  ave. Mw  
Additional energy delivered by Jacuí -  $0.94 \times 59.8 = 56.3$  ave. Mw  
Total energy delivered  $94.3$  ave. Mw  
Cost of energy delivered -  $\frac{5,570,000}{94,300 \times 8,760} = \$0.00673/\text{kwh}$  or  $6.73$  mills/kwh

5. Conclusions

The results of the two cases computed above can be summarized as follows:

	<u>Cost of Energy</u> <u>Mills/Kwh</u>
Passo Real in dry year	8.18
Passo Real in average year	6.73

The above costs may look high by U.S. Standards. It is important to note that they were affected by the high factors adopted for fixed charges (above 9% per year). These reflect the high cost of money in Brazil. No allowance was made in the present computations for the lower rates of the AID Loan. This loan would roughly represent 24% of the total investment. So, in practice, these costs must be lower than the above figures. As for the operating costs, these are lower than for an equivalent installation in the U.S., due to lower wages in Brazil.

It is important also to consider that practically all the civil construction is done in this first stage of the project. The installation of the third and fourth generating units, corresponding to the second stage, will double the plant capacity (125 to 250 Mw) at an additional cost estimated to be only \$11,000,000.

II - Annual Production Costs of Alternatives

Annual production costs are presented for two possible alternative solutions to Passo Real, viz.:

- (1) A coal fired plant in the best available location in the Rio Grande do Sul, capable of carrying the same peak requirements of Passo Real with its intended installed capacity (125 Mw).
- (2) An oil fired plant under the same above conditions.

For both alternatives computations are made for comparison with Passo Real under two operating conditions= driest year of record, and average water year.

All production cost factors used in the following computations were derived from the report "Power Study of South Central Brazil, December 1966" (CANAMBRA Engineering Consultants Ltd.). Underlying assumptions for steam-electric systems are:

Fixed Charges

Interest and capital repayment (plant)	10.18% per year
Interest and capital repayment (system)	9.12% per year
Service Life: Plant	25 years
Substations and Transmission Lines	50 years *

Interim Replacement (sinking fund) allowances:

Power Plant	0.35% per year
Substations	0.5 % per year
Transmission lines	0.1 % per year

\* CANAMBRA assumes a 25-year life for the system associated with the steam electric plant. In the present computations this life was extended to 50 years to match figures used with Passo Real, and so favoring the thermal plant alternatives.

The use of these figures lead to the following factors for computing Fixed Charges:

Power Plant	10.53% per year
Substations	9.62% per year *
Transmission Lines	9.22% per year *

O & M and A & G Charges

For computation of Operation and Maintenance (O&M) the following charges are adopted:

	<u>\$ / year</u>	
	<u>Oil-Fired</u>	<u>Coal-Fired</u>
Power plant: 125 Mw size (2 units)	3,130/Mw	3,600/Mw
	<u>Both Types</u>	
Substations: 125 Mva size	210*/Mva	
Transmission Lines: 133 Kv (single circuit)	61*/Km	
220 Kv (single circuit)	80*/Km	

Administration and General (A&G) expenses are computed as fixed percentages of O&M costs:

Power plant	- 16% of O&M
Substations	20%* " "
Transmission Lines	20%* " "

---

\* Same as for hydro-electric associated system.

Adding up O&M and A&G, the charges become:

	<u>\$ / Year</u>	
	<u>Oil-Fired</u>	<u>Coal-Fired</u>
Power Plant: 125 Mw size (2 units)	3,600/Mw	4,140/Mw
	<u>Both Types</u>	
Substations: 125 Mva size	252*/Mva	
Transmission Lines: 138 Kv (single circuit)	73*/Km	
220 Kv (single circuit)	96*/Km	

The following assumptions have been made in the cost computations below:

1. Production costs are computed for energy delivered up to the sub-transmission system. This is required so that costs of sub-transmission and distribution are excluded, as being part of the system requirements in general. This will also permit a more specific cost comparison among alternate solutions.
2. The coal fired plant included in this analysis would require oil-firing facilities, which are needed when the plant is operated for system thermal complementation. Also, since this plant was assumed to be built in an inland location, cooling towers would have to be installed. Operation of this plant would also require an investment in coal mining facilities, with a cost factor of the order of \$4.0 per ton-year.
3. Cost of coal at the plant was taken as \$1.31 per million kilocalories (\$0.33 per million Btu). This coal has an average heat content of 3,700 Kcal/Kg (6,650 Btu/lb) and up to 45% of ashes. This is the cheapest coal that can be mined in the State of Rio Grande do Sul, in the Candiota mines, where a strip-mining operation exists.

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\* Same as for hydro-electric associated system.

The above cost figure is quoted by the State Government, and was endorsed by CANAMBRA. CANAMBRA has sub-contracted with John T. Boyd Co., U.S. coal mining consultants, an evaluation of this natural asset of the Rio Grande do Sul, this evaluation to include the expected cost indexes for power production. Their findings, in the form of a report, were submitted at the end of 1967.

4. Cost of Bunker C fuel oil at a plant situated in the neighborhood of Porto Alegre was taken as \$2.20 per million kilocalories (\$0.565 per million Btu). This price does not include taxes, but includes delivery costs to the plant.

5. The following Brazilian current index prices for transmission lines were used in the present computations:

	<u>\$ / Km</u>
138 Kv, single circuit	12,300
220 Kv, single circuit	13,000
220 Kv, double circuit	17,000

6. Transmitting losses on long transmission lines are assumed to be:

Loss of peaking capacity	8%
Loss of energy	6%

7. The energy computed to establish a basis of comparison with the Passo Real project has been explained. The figures used throughout the benefit-cost analysis were 82.7 ave. Mw at the plant, and 77.7 ave. Mw at the sub-transmission terminals, obtainable in the driest 12 month period of record (firm power), and respectively 100.3 and 94.3 ave. Mw in an average water year.

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ANNEX III - Page 24 of 62  
Exhibit C  
Page 10 of 19

A. Coal Fired Plant

General

As previously mentioned, there exists one coal fired steam-electric plant rated 20 Mw in the town of Candiota (southern part of the Rio Grande State), where very favorably conditions prevail for coal strip mining, producing the cheapest coal in the whole State. It was also referred that CEEE intends to build additional generation in Candiota, taking advantage of the low cost fuel. An inter-connection with the CEEE North System is planned for 1971 by means of a 330 kilometer long transmission line.

Due to this set of circumstances Candiota seems to be the place in which a future coal fired plant may be built. Based on this assumption the ensuing study was made, of an alternative to the Passo Real project consisting of a coal fired plant built in Candiota (although this location is 330 kilometers away from the main load center) capable of providing the same peaking and energy requirements as the Passo Real project.

Candiota Coal-Fired Plant Production Costs (delivering 77.7 ave. Mw)

1. Power Supply

Losses of 8% peak capacity and 6% energy are assumed. Since these losses also apply to the Passo Real project the net peaking capability required for comparison purposes with Passo Real, must be the sum of Passo Real and Jacuf additional capacity in driest year (firm power) which equals 82.7 ave. Mw. The average plant factor then will be approximately:

$$\frac{82.7}{125} = 66\%$$

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For this figure of 66% an auxiliary power consumption of 8% of average load must be assumed. So, for full load:

$$\text{Plant rated capacity: } \frac{125}{1.00 - 0.08} = 136 \text{ say } 140 \text{ Mw}$$

Energy to be delivered to the sub-transmission system, as with Passo Real, is:

$$0.94 \times 82.7 = 77.7 \text{ ave. Mw}$$

Energy to be generated at the plant then is:

$$\frac{82.7}{1.00 - 0.08} = 90 \text{ ave. Mw}$$

The amount of coal required on a yearly basis, considering a net station heat rate of 2800 Kcal/Kwh, for the average plant factor of 66%, and with a specific heat content of 3700 Kcal/Kg, will be:

$$\frac{90,000 \times 8760 \times 2800}{3700 \times 1000} = 593,000 \text{ metric tons}$$

## 2. Capital Costs

This must be a 2 x 70 = 140 Mw plant, and an index cost of \$250/kw (including the step-up substation) may be assumed. Also, this plant will require cooling towers (\$1,800,000 each) and oil-firing facilities (\$750,000 each). The transmission line will be similar to the Passo Real (single circuit) and 330 kilometers long instead of 270. So the same index cost as for Passo Real may be used (\$3,500,000 for 270 kilometers).

Power plant	140,000 x 250	=	\$35,000,000
Cooling towers	2 x 1,800,000	=	3,600,000
Oil-firing facilities	2 x 750,000	=	<u>1,500,000</u>
Total for Power Plant		=	\$40,100,000
Transmission Line - $\frac{330}{270}$	x 3,500,000	=	\$ 4,280,000

Coal Mining Facilities

Although the fixed charges for this equipment are included in the cost of coal used in the following computations, it must be demonstrated here the capital requirements implied. It can be estimated from figures given by the Brazilian Ministry of Mines and Energy that an investment of \$4.00 (\$2.00 of which for imports) is required to mine one ton of coal per year. The capital outlay then would be:

Cost of Coal mining equipment = 4,00  $\therefore$  593,000 = \$2,372,000

3. Production Costs

<u>Fixed Charges</u>	<u>\$ /Year</u>
Power plant (140 Mw) - 40,100,000 x 0.1053	: 4,220,000
Transm. line (1 circuit)- 4,280,000 x 0.0922	: <u>395,000</u>
	4,615,000

O&M and A&G Costs

Power plant (140 Mw) - 140 x 4,140	: 579,000
Transm. line (1 circuit)- 330 x 96 say	: <u>31,700</u>
	610,700

Coal Costs

$\frac{593,000 \times 3,700 \times 1.31}{1,000}$	2,880,000
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4.	<u>Total Annual Cost</u>	<u>\$ / Year</u>
	Fixed Charges:	4,615,000
	O & M and A&G:	610,700
	Coal Costs:	2,880,000
		<u>8,105,700</u>

5. Energy (delivered) Cost

$$\frac{8,105,700}{77,700 \times 8760} = \$0.0119/\text{Kwh or } \underline{11.9 \text{ mills/Kwh}}$$

Candiota Coal-Fired Plant Production Costs (delivering 94.3 ave. Mw)

This is a repetition of the previous computation, substituting 100.3 ave. Mw at the plant and 94.3 ave. Mw at the sub-transmission terminals for respectively 82.7 and 77.7 ave. Mw. The average factor becomes:

$$\frac{100.3}{125} = 80\%$$

For this figure of 80% an auxiliary power consumption of 6.5% of average load must be assumed. So, for full load:

Plant rated capacity:  $\frac{125}{1.00 - 0.065} = 134$  say, the same 140 Mw

Energy to be delivered:  $0.94 \times 100.3 = 94.3$  ave. Mw

Energy to be generated at the plant:  $\frac{100.3}{1.00 - 0.065} = 107$  ave. Mw

Coal required on a yearly basis, considering a net station heat rate of 2700 Kcal/Kwh for the average plant factor of 80%:

$$\frac{107,000 \times 8760 \times 2700}{3700 \times 1000} = 685,000 \text{ metric tons}$$

\$ / Year

Coal costs:  $\frac{685,000 \times 3700 \times 1,31}{1000} = 3,320,000$

Total Annual Cost then becomes:

	<u>\$ / Year</u>
Fixed Charges (same as before) :	4,615,000
O&M and A&G (same as before) :	610,700
Coal Costs :	3,320,000
	8,545,700

Energy (delivered) Cost will be:

$$\frac{8,545,700}{94,300 \times 8760} = \$0.01035/\text{Kwh or } 10.35 \text{ mills/Kwh}$$

B. Oil Fired Plant

General

Another alternative to the Passo Real project would be an oil fired plant built near the city of Porto Alegre, close to the load center, and capable of providing the same peaking and energy requirements as the Passo Real project. It can then be assumed that this plant would be connected to the sub-transmission system through a single circuit 138 Kv and 40 kilometers long transmission line. Transmitting losses may be disregarded in this case.

Oil-fired Plant Production Costs (delivering 77.7 ave. Mw)

1. Power Supply

With negligible transmission losses in this case, the net peaking capability at the plant would have to be the same as from Passo Real at the sub-transmission. So:

$$\text{Net peaking capacity at plant} - 0.92 \times 125 = 115 \text{ Mw}$$

The energy capability required for comparison purposes with Passo Real must be the sum of Passo Real and Jacu' additional capacity in driest year (firm power) delivered to the sub-transmission system which equals 77.7 ave. Mw. The average plant factor then will be approximately:

$$\frac{77.7}{115} = 68\%$$

For this plant factor we may assume an auxiliary power consumption rate of 5% of plant average load. The required figure for rated capacity then must be:

$$\text{Plant rated capacity: } \frac{115}{1.000 - 0.05} = \underline{121 \text{ Mw}}$$

Energy to be generated at the plant is:

$$\frac{77.7}{1.000 - 0.05} = 82 \text{ ave. Mw}$$

UNCLASSIFIED

ANNEX III - Page 30 of 61

Exhibit C

Page 16 of 19

## 2. Capital Costs

This must be a 2 x 60 Mw plant, and an index cost of \$210/Kw (including oil handling equipment and step-up substation) may be assumed. The transmission line will be of 138 Kv single circuit type, and its index cost may be taken as \$12,300 per kilometer

Power plant	-	120,000 x 210	:	\$25,200,000
Transmission line	-	12,300 x 40		492,000
				<u>\$25,692,000</u>

## 3. Production Costs

### Fixed Charges

				<u>\$/Year</u>
Power plant (120 Mw)	25,200,000	x 0.1053	:	2,650,000
Transm. line (1 circuit)	492,000	x 0.0922	:	45,000
				<u>2,695,000</u>

### O&M and A&G Costs

Power plant (120 Mw)	120	x 3,600	:	432,000
Transm. line (1 circuit)	40	x 75	:	3,000
				<u>435,000</u>

### Oil Costs

Assuming a net station heat rate of 2,750 Kcal/Kwh corresponding to the average plant factor of approximately 60%, the annual oil costs are:

				<u>\$/Year</u>				
82,000	x	8,760	x	2,750	x	2.20		4,350,000
		<u>1,000,000</u>						

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4. Total Annual Cost

	<u>\$/Year</u>
Fixed Charges	2,695,000
O & M and A & G	435,000
Oil Costs	<u>4,350,000</u>
	7,480,000

5. Energy (delivered) Cost

$$\frac{7,480,000}{77,700 \times 8760} = \$0.0110/\text{Kwh} \text{ or } \underline{11.0 \text{ mills/Kwh}}$$

Oil Fired Plant Production Costs (Delivering 94.3 ave. Mw)

This is a repetition of the previous computation, substituting 94.3 ave. Mw at the sub-transmission terminals for 77.7 ave. Mw.

The average plant factor becomes:

$$\frac{94.3}{115} = 82\%$$

For this figure of 82% an auxiliary power consumption rate of 4% of plant average load may be assumed. The energy to be generated at the plant is:

$$\frac{94.3}{1.00 - 0.04} = 98.3 \text{ ave. Mw}$$

Oil required on a yearly basis, considering a net station heat rate of 2,680 Kcal/Kwh corresponding to the average plant factor of approximately 82%, the annual oil costs are:

$$\frac{98,300 \times 8,760 \times 2,680 \times 2.20}{1,000,000} = \underline{5,080,000} \text{ } \frac{\$/\text{Year}}$$

Total Annual Cost then becomes:

	<u>\$/Year</u>
Fixed Charges (same as before) :	2,695,000
O&M and A&G (same as before) :	435,000
Oil Costs :	<u>5,080,000</u>
	8,210,000

Energy (delivered) Cost will be:

$$\frac{8,210,000}{94,300 \times 8,760} = \$0.00994/\text{Kwh or } \underline{9.94 \text{ mills/Kwh}}$$

Conclusions:

Results of the two alternatives, computed under two different conditions, combined with the Passo Real production costs are summarized as follows:

<u>Project and Alternates</u>	<u>Rates (mill/Kwh)</u>	<u>Annual Benefit (\$1,000)</u>	<u>Annual Cost (\$1,000)</u>	<u>Benefit Cost Ratio</u>
Passo Real, dry year	8.18	-	5,570.0	-
Passo Real, ave. year	6.73	-	5,570.0	-
Coal Plant, 77.7ave.Mw	11.90	8,105.7	-	1.46/1.00
Coal Plant, 94.3ave.Mw	10.35	8,545.7	-	1.52/1.00
Oil Plant, 77.7 ave.Mw	11.00	7,480.0	--	1.35/1.00
Oil Plant, 94.3 ave.Mw	9.94	8,210.0	-	1.48/1.00

The following conclusions can be derived from this table:

1. Passo Real, although built for a final capacity of 250 Mw, even with only one half of this final capacity installed can deliver power cheaper than a coal or oil-fired plant of 125 Mw. This holds true for both a dry and an average water year.

2. The oil plant would generate power at a slightly smaller cost than the equivalent coal-fired plant. But here consideration must be given to the fact that Brazil is an importer of crude oil, which represents a heavy burden in the balance of foreign trade. In the evaluation of Passo Real against oil-fired plants, this must be considered as an additional benefit.

UNCLASSIFIED

ANNEX III - Page 34 of 62  
EXHIBIT D

Page 1 of 7

DESCRIPTION OF THE EXISTING CEEE SYSTEM

Among the three separate systems into which the CEEE plant is presently divided, the North System is by far the most important. Plans are being prepared for the inter-connection with the West and South Systems.

The basic figures for the present electric power plant of Rio Grande do Sul, serving a population of 6,700,000 in an area of 280,600 square kilometers, are as follow:

(Figures for the year 1966)

<u>Installed Capacity:</u>	CEEE-Hydro	-	152.4 Mw (54.0%)
	Steam	-	65.9 " (23.4%)
	Diesel	-	<u>63.8 " (22.6%)</u>
	Total for CEEE	-	282.1 Mw (80.5%)
	Total for others-	-	<u>69.5 " (19.5%)</u>
	Total for State-		351.6 Mw

<u>Energy Produced, 1966:</u>	CEEE-Hydro	-	786,841 Mwh (66.2%)
	Steam	-	299,440 " (25.2%)
	Diesel	-	<u>102,755 " ( 8.6%)</u>
	Total for CEEE	-	1,189,036 Mwh (84.4%)
	Total for others-	-	<u>220,461 " (15.6%)</u>
	Total for State-		1,409,497 Mwh

Number of CEEE Consumers - 550,000

<u>Number of Localities served by CEEE:</u>	Townships	-	195
	Villages	-	<u>605</u>
	Total	-	800

UNCLASSIFIED

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UNCLASSIFIED

ANNEX III - Page 35 of 62  
EXHIBIT D

Page 2 of 7

<u>Transmission Lines Operated by CEEE:</u>	138	Kv	-	948	km
	69	Kv	-	643	km
	44	Kv	-	630	km
	22	Kv	-	2,716	km
	13.2	Kv	-	<u>1,808</u>	km
	Total		-	6,745	km

#### The North System

The North System accounts for about 80% of the energy consumption in the State. Its geographic boundaries include more than 80% of the total population and most of the industrial towns of Rio Grande do Sul.

The backbone of this system is a 138 Kv radial system originating at the Jacui hydroelectric plant (100 Mw in operation, 50 Mw in installation) which extends from the Argentine border to the Atlantic Ocean. It is supplied by the following generating plant:

	<u>Capacity in Mw</u>		<u>Total</u>
	<u>Operating</u>	<u>Construction</u>	
<u>Hydroelectric Plants</u>			
Jacui	4 x 25	2 x 25	150.0
Canastra	2 x 21.25	-	42.5
Bugres	1 x 11.2	-	11.2
Ernestina	1 x 4.8	-	4.8
Small Plants	<u>18.3</u>	-	<u>18.3</u>
	176.8	50	226.8

UNCLASSIFIED

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UNCLASSIFIED

ANNEX III - Page 36 of 62  
EXHIBIT D

Page 3 of 7

	<u>Capacity in Mw</u>		
	<u>Operating</u>	<u>Construction</u>	<u>Total</u>
<u>Steam Plants</u>			
Charqueadas (1)	3 x 18	1 x 18	72.0
São Jeronimo	(2 x 5 1 x 10)	-	20.0
Gasômetro (2)	4 x 4/6	-	19.6
Porto Alegre (NUTEPA)	-	3 x 8.0	24.0
	<u>93.6</u>	<u>42.0</u>	<u>135.6</u>
<u>Diesel Plants</u>			
Caxias do Sul	2 x 3.5		7.0
Small Plants	<u>27</u>	<u>-</u>	<u>27.0</u>
	34.0	-0-	34.0
Total for System:	304.4	92.0	396.4

- (1) This plant belongs to ELETROBRAS  
(2) This plant is ready for retirement.

During the 14 year period of 1951 through 1964 the annual load factor of the North System varied from a low of 51.5% in 1957 to a high of 60.6% in 1961. Both CEEE and CANAMBRA have adopted a load factor of 55% for demand forecast computations assuming no restrictions on supply. Under this, and the other preceding assumptions, the projections of power requirements are:

<u>Year</u>	<u>Generating</u> (ave. Mw)	<u>Peak</u> (Mw)
1970	210	411
1975	346	689
1980	521	1,012

UNCLASSIFIED

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UNCLASSIFIED

ANNEX III - Page 37 of 62  
EXHIBIT D

Page 4 of 7

Presently the peak capacity of the system is evaluated as 291 Mw, and the dependable energy in average megawatts is equivalent to 166 ave.Mw for the driest year of record (stream flow measurements available since 1930), and 193 Mw for the second driest year.

The new generating units showed as under construction in the preceding tabulation, are expected to become operational in the following order: (1) the new steam-electric plant NUTEPA of Porto Alegre at the middle of this year (1968) with 24 Mw capacity; (2) the 50 Mw of the second stage of Jacui hydro-electric plant in the end of 1968; and (3) the fourth 18 Mw of the Charqueadas steam-electric plant before the end of 1969. Furthermore it is expected that by the middle of 1969 the interconnection with the Western System will be completed, and up to 27 Mw may be transferred from the Alegrete plant to the North System. Under these conditions the system peak capacity will be increased to 423 Mw, and the dependable energy will be equivalent to 220 ave. Mw in driest year, and 248 Mw in second driest year.

From the figures shown above the following conclusions were derived by CANAMBRA, which are in close agreement with CEEE thinking: (1) the present power supply is satisfactory with respect to energy but deficient in peaking capacity; (2) it is expected that peaking capacity will become adequate by mid-1968 and will so remain until early 1970; (3) rationing of peak may occur in 1970, and the shortage of capacity will become highly critical thereafter, unless new power supplies are added to the system; (4) after the end of 1970 the supply of electric energy will become rapidly precarious, unless new supplies are introduced in the system.

UNCLASSIFIED

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ANNEX III- Page 38 of 62  
EXHIBIT D

Page 5 of 7

The other two CEEE systems are of a lower order of magnitude and have limited relationship to the Passo Real project, so that they need be only briefly described here.

#### The West System

This new system covers the least developed part of the State, comprising farmlands with virtually no industries. Present power sources are isolated Diesel-electric plants aggregating 18 Mw, and one 3.3 Mw steam-electric plant in Uruguiana.

A 66 Mw oil fired steam-electric plant is being built by ELETROBRAS as a pioneer development, in the city of Alegrete located in the center of this Western area. This plant will be the hub of a system with over 1,000 kilometers of transmission lines serving 14 counties, and in 1969 will become interconnected with the North System.

The interconnection will be obtained by means of a 138 Kv and 200 kilometer long line between the Alegrete plant and the town of Santa Maria, which is already linked with the Jacui plant ( and so with the North System), by a 100 kilometer line, operating on the same voltage. Present plans call for a transmitting capacity of only 30 Mva.

Projections of power requirements for the West System are:

<u>Year</u>	<u>Generation</u> (ave. Mw)	<u>Peak</u> (Mw)
1970	9.2	18.5
1975	14.4	29.9
1980	20.8	42.2

UNCLASSIFIED

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UNCLASSIFIED

ANNEX III - Page 39 of 62  
EXHIBIT D

Page 6 of 7

In the course of 1966 total energy sales in the area of this system amounted to only 5.0 ave. Mw, equivalent to 4.1% of the corresponding figure in the North System.

These figures indicate that, even discounting the operation of isolated Diesels and the small Uruguaiana plant, there still will be enough capacity from the Alegret: plant to send from 27 to 30 Mw to the North System, until 1975.

#### The South System

In the southern part of the State the two most important towns are Pelotas, provided with a 4 Mw steam-electric plant belonging to ELETROBRAS, and the seaport of Rio Grande with another small steam-electric plant rated 3 Mw.

Miscellaneous small Diesel-electric plants in this system have an aggregate capacity of 17.7 Mw. One coal fired steam-electric plant rated 20 Mw was built in the town of Candiota, where very favorable conditions exist for coal strip mining, allowing the coal to be delivered to the plant at a cost of \$1.31 per million kilocalories.

CEEE has plans to increase the use of this cheap source of energy, by building a second plant in Candiota. This would be a two 50 Mw unit plant, with the first unit available for operation four years after construction start and the second in the following year.

UNCLASSIFIED

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UNCLASSIFIED

ANNEX III - Page 40 of 62  
EXHIBIT D

Page 7 of 7

ELETROBRAS also is planning to move to Pelotas a small oil-fired plant ( one 6 and one 8 Mw unit) they own in Fortaleza (State of Ceará) which has been shut down since that city was converted to 60 cycle operation.

The eventual interconnection with the North System is planned.

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CEEE - Maintenance Policies

Maintenance

Maintenance of the CEEE plant is performed by two CEEE departments: (a) the Production Department, responsible for the operation and maintenance of the larger generating plants, such as Jacui, Canastra, Bugres, Sao Jeronimo and Candiota, and (b) the Technical Services Department, responsible for the maintenance of transmission lines, transmission substations, and smaller generating plants.

Routine maintenance of the smaller generating plants is performed by Regional Administrations, assistance being provided by Technical Assistance Centers for major overhaul.

The Production Department includes two workshops, namely: (a) The Diesel Maintenance Shop (large engines) located in Sao Leopoldo, and (b) the Diesel Maintenance Shop (small engines) in Porto Alegre.

For performing maintenance of the larger generating plants the Production Department relies on local maintenance crews, in general divided into mechanical and electrical groups. These plants are also provided with machine shops equipped and staffed according to the specific needs of each plant and warehouses for spare parts and supplies.

The Technical Services Department has as its primary responsibility the maintenance of transmission lines and substations. To perform its functions the Department is provided with four Technical Assistance Centers, located respectively in Sao Leopoldo, Passo Fundo, Santa Maria and Rio Grande. Each of these Centers comprises a Substation, Transmission Line and Production Maintenance Section.

The Substation Maintenance Section is responsible for all the equipment within the substations. The Transmission Line Section makes routine patrols along the lines, and maintenance work, keeping in touch with its Center by means of VHF radio. Finally the Production Maintenance Section takes care of

UNCLASSIFIED

ANNEX III - Page 42 of 62

Exhibit E

Page 2 of 2

the small generating plants, specially the Diesel plants, being provided with repair groups ready to move to any plant within the Center's jurisdiction.

The Electro-Mechanical Workshops provide repair work for generators, transformers, motors and pumps, including coil changes and rewindings. Diesel engines are repaired in the Diesel Maintenance Shops (large engines in São Leopoldo, and small ones in Pôrto Alegre).

Numbers of personnel staffing these facilities are:

<u>Location</u>	<u>Substation</u>	<u>Line</u>	<u>Production</u>	<u>Total</u>
São Leopoldo Center	5	14	2	21
Passo Fundo Center	12	14	5	31
Santa Maria Center	4	-	16	20
Rio Grande Center	8	15	10	33
Transformer Shop(S.Leopoldo)	-	-	-	36
Diesel Shop (São Leopoldo)	-	-	-	28
Electro-Mechanical Shop "	-	-	-	14
Diesel Shop (Pôrto Alegre)	-	-	-	8
Totals	<u>29</u>	<u>43</u>	<u>33</u>	<u>191</u>

CEEE so far has a good record of maintenance of its facilities. The present maintenance organization seems adequate. As described above all the routine maintenance is done by force account. The amount of \$400,000 was included in the A.I.D. loan to provide training to the CEEE staff, including maintenance training.

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System Requirements and Planning

As previously indicated, there are no foreseeable demand problems in the West and South Systems. On the other hand a deficit of reserve peak capacity may be expected to begin in the North System in 1970. to be followed by a deficit of energy in 1971.

Based on past performance it can be stated that in Brazil about one to two years are needed to complete the engineering and financial studies and the financial negotiations which are required to prepare a power project. To this must be added the construction time which runs about four years for a medium-size hydroelectric plant and three years for a medium-size steam-electric plant.

From this discussion it becomes evident that there is no realistic prospect of commissioning a new hydro or steam-electric plant before the second half of 1972. Hence other measures must be sought to relieve the situation before Passo Real or Passo Fundo could be commissioned.

Disregarding the possibilities of power transfers from the West to the North system, by mid 1971 the deficit of peak demand of the latter is forecasted to be about 40 Mw. If a 10 percent allowance for reserve is added, the deficit increases to about 85 Mw.

This would be a serious situation indeed and would call for emergency action. Present plans will allow the transmission of up to 27 Mw generated at the Alegrete plant (West system) to the North. Increasing the capacity of the projected transmission interconnection to correspond more nearly to the full capacity of the Alegrete plant, would permit the delivery of 40 Mw.

Projects under Consideration

A. The Passo Fundo Project

This is a combined power and storage development, located about 350 kilometers distant by transmission line length from the system load center (Porto Alegre). The Passo Fundo river will be dammed creating a reservoir with a live storage volume of 1.4 billion cubic meters.

The water will be conducted to a power station on the adjacent Erechim river, where it will be used through a maximum gross head of 262.6 meters. An installation of two 110 Mw units is presently contemplated.

Construction of the civil works was started by the Departamento Nacional (Federal) de Obras e Saneamento (DNOS) on a small scale and a limited budget. Present DNOS plans seem to call for the completion of the river diversion, first tunnel adit and core trenches under the earth dams. There is no financing available as yet for equipment, and the State Government is negotiating with the Ministry of Mines and Energy and Eletrobrás a joint commitment to expedite the project, so that the first 110 Mw unit could be on the line at the beginning of 1972.

It is planned that the output of Passo Fundo will be transmitted over 350 kilometers of 220 Kv transmission lines to Porto Alegre, via the towns of Passo Fundo and Caxias do Sul. Due to this long transmission distance to the load center, this plant would be uneconomical for peaking purposes.

At the average net head of 245 meters the dependable energy in the driest cycle (the reservoir has capacity for a 10-year cycle of minimum streamflow regulation) would be 68.4 average Mw. Total estimated cost for this project, exclusive of step-up sub-station and transmission system, is \$35 million.

B. The Passo Real Project

This is a combined power and storage development, located 210 kilometers distant by transmission line length from the system load center, in Porto Alegre (See Annex VI).

The Jacuí river will be dammed 15 kilometers upstream from the present Jacuí (Maia Filho) dam, creating a reservoir with a live storage of 2.3 billion cubic meters, with a drawdown of 14 meters on a 46 meter maximum gross head. This reservoir will have enough capacity to regulate the river over the driest four-year cycle of record.

The full value of Passo Real can only be determined if the total river development downstream of the Jacuí plant is included in the study. The CANAMBRA engineers have accordingly examined that part of the river and found that there are two sites available for cascade development.

These are the Itaúba (Site C) and Dona Francisca (Site B) projects (See Annex VI). Itaúba is particularly attractive with an average net head of 83 meters that could be developed across the narrow neck of a loop in the river by construction of a single earth dam. Dona Francisca would require a conventional concrete dam with flanking earth fills to develop an average net head of 39 meters.

The dependable energy in driest cycle to be obtained from the four cascaded projects then would be:

Passo Real	32.5 ave. Mw
Jacuí (present)	25.2 ave. Mw
Jacuí (additional)	50.2 ave. Mw
Itaúba	79.1 ave. Mw
Dona Francisca	42.2 ave. Mw
Total	<hr/> 229.2 ave. Mw

It is important to observe that the largest immediate benefit to be derived from the construction of Passo Real is the increment of energy of 50.2 ave. Mw made available at the Jacuí plant, as a result of the Passo Real storage.

If the financing for Passo Real could be completed by the end of the first semester of 1968, and construction subsequently prosecuted with utmost vigor, it might be possible to commission the first unit by the second half of 1972, in time to help meet the peak load of the North System for that year.

At the same time the construction schedule could be arranged to make stored water available for the Jacuí plant in 1971, in order to increase the supply of dependable energy in that year.

The Passo Real project is a relatively low head project, with a loss of 30% of this head at time of maximum reservoir drawdown. For this reason it seems that it would be more economical to install extra capacity for satisfying the system peaking requirements at Itaúba which has twice the head.

Passo Real with only two units installed would have a total capacity of 125 Mw and the combined capacity factor with Jacuí would be about 37%. With its final capacity of 250 Mw the capacity factor becomes 27%.

#### C. Steam-Electric Projects

Computations made by CANAMBRA to ascertain the economy of coal-fired plants operating on base load in the State of Rio Grande do Sul, started from the most favorable conditions, assuming a coal-fired steam plant in Candiota, equipped with 50 Mw units, and burning the lowest cost coal in the State delivered at \$1.31 per million kilocalories.

These computations show that hydro power from sites located at similar distances from Porto Alegre, such as the Jacuí river plants, would be competitive up to a maximum index cost of about \$425 per Kw, when operated on a 55% capacity factor, against 85% for the coal plant. Even with 200 Mw units in the steam plant, hydro would still be competitive up to a maximum index cost of about \$350 per Kw.

The estimated index costs for the Jacuf river plants are:

Passo Real	\$280 per Kw
Itaúba	250 per Kw
Dona Francisca	265 per Kw

This set of figures show that CEEE should give serious consideration to the development of the Jacuf river potential, before starting construction of a new coal plant. Even if they disregarded these considerations and proceeded immediately with the steps required to build the new Candiota steam-electric plant, there would be no realistic prospects of having it commissioned before 1972.

One project that stands a good chance of being completed before the onset of the expected 1970-1971 crisis is the transmission line from the SOTELCA plant (property of the Sociedade Termoelétrica de Capivari S.A., a mixed capital corporation principally owned by the Federal Government) to the State of Rio Grande do Sul.

This installation consists of two steam driven and coal fired 50 Mw units. Coal used in the plant is a by-product of processing the nearby mine ore for production of blast furnace coke. This residual coal has a caloric content averaging 4,300 kilocalories per kilogram and is burned in the plant at the average rate of 0.6 kilogram per Kwh.

The basic economical justification for the SOTELCA plant has been the use of the growing stockpile of residual coal. In the course of the 1967 this residue was accumulating at the rate of 285,000 tons per year. It is estimated that at the end of the 1967 the stockpile available at SOTELCA amounted to 1,435,000 tons. Even the most optimistic forecasts recognize that with the present capacities installed in SOTELCA and in the nearby CSN plant (also a coal fired plant rated 24 Mw, owned by the National Steel Mills) this stockpile will continue to grow.

The SOTELCA plant is presently delivering power to the State of Santa Catarina (where it is located) and to the northern neighboring Paraná. In 1966 SOTELCA sold in Santa Catarina 137,240 Mwh,

of total state sales of 603,751 Mwh. Cost of SOTELCA bulk power delivered to the state utility (CELESC) was from 16.5 to 18.0 mills per Kwh. CELESC claims this to be an unreasonably high rate since they generate their own hydro power at from 9.0 to 10.0 mills per Kwh. In the computation of SOTELCA tariff the fuel is valued at \$11.85 per ton (approximately 7 mills per Kwh). This is an arbitrary price set up by the Commission of the Plan of National Coal (CPCAN) and represents, for all practical purposes, a subsidy to the steel industry, to partly compensate for the legal requirement of using in their blast furnaces a fixed percentage of the Santa Catarina coal, which is produced at higher than international prices. Forecasts of peak demand increase in Santa Catarina lead to the assumption that by 1971 the present SOTELCA capacity may be required for this State.

In August 1967 the SOTELCA system became interconnected also with the State of Paraná through a 220 Kv 120 kilometer long Joinville to Campo Comprido (Curitiba) transmission line, built for a transmitting capacity of 25 Mw. This line is presently supplying the Paraná's capital city Curitiba, but is not synchronized with the State of Paraná grid (owned by COPEL). Present peak demand is 17 Mw and monthly energy sold has averaged 10,000 Mwh. It is doubtful if SOTELCA power will still be needed by the State of Paraná after their 230 Mw hydro-electric plant Capivari-Cachoeira is commissioned in 1969.

The future transmission line from the SOTELCA and CSN plants to the State of Rio Grande do Sul is being designed by a local engineering organization. This design envisages a 220 Kv and 300 kilometer long line, with a transmitting capacity of 100 Mw. The estimated cost for the line is \$18 million. Substations may be assumed to cost about \$2.5 million.

ELETROBRAS intends to finance construction of this transmission line. It is also their intention to include this financing in a package deal that will establish SOTELCA as a subsidiary company of ELETROBRAS.

Plans for expanding the SOTELCA capacity are not clear yet. The present SOTELCA-CSN capabilities are limited now to 124 Mw and 750,000 Mwh, based on a 70% capacity factor. SOTELCA's plans call commissioning the Rio Grande do Sul line by 1970 with an initial annual supply of 180,000 Mwh. Depending on the installation of an additional generating unit, this supply could then be increased up to 250,000 Mwh, until power from the Passo Real plant could be made available. At this date there seems to be no definite plans yet for enlarging the SOTELCA generating facilities, although the need for such additional facilities would be felt by 1971.

Land Expropriation, Right of Eminent Domain and  
Right-of-Way

1. Passo Real Plant and Reservoir

According to completed topographical surveys, the Passo Real development (plant and reservoir) will include a total of 58,135 acres of land, as follows:

Cruz Alta County	-	31,000	acres
Ibirubá County	-	8,670	"
Espumoso County	-	18,270	"
Tapera County	-	195	"
		<hr/>	
Total		58,135	acres

A total of 1,600 rural properties will be affected and of these 700 will be totally expropriated. Classification of this land is:

Cultivated land	-	23,500	acres
Grazing land	-	23,500	"
Forest land	-	11,135	"
		<hr/>	
Total		58,135	acres

On August 28, 1967 a protocol was signed by CEEE and IBRA (The Brazilian Institute of Agrarian Reform) establishing procedures to be adopted for these areas.

Either:

1. IBRA will provide for the property owners who want to be relocated on other lands. They will receive new tracts of land given by IBRA, in accordance with special legislation ("Estatuto da Terra"). CEEE will pay IBRA the value of land dispossessed, and those funds will be used for relocation of the displaced families. A survey is being made of those who want to be relocated, and it is estimated that about 600 families will qualify.

Or:

1. CEEE will buy directly from those other property owners who would rather sell. As of January 1968 CEEE had already purchased 21,000 acres, which represent more than 35% of the total required, at a cost equivalent to \$478,000.

It is estimated that the cost of remaining land, including payments to IBRA, will amount to close to \$1,000,000. Additional costs such as notary and legal fees, transportation of displaced families, indemnization of property, construction of 120 kilometers of roads, clearing the reservoir site, and administrative costs may raise the total outlay to \$2,600,000.

In the Passo Real cost estimate, the full figure of \$2,600,000 was included for the purpose of land acquisition, access and site preparation. CEEE intends to spend the equivalent of \$580,000 in the purchase of land, before the project starts.

2. Transmission Line Passo Real - Cidade Industrial

In the case of transmission lines the right-of-way has been established by a State decree. For this project right-of-way agreements have already been obtained from all interested parties, for a strip 70 meters wide. Problems of indemnization are restricted to small areas in the two towns involved. CEEE estimates that these will not exceed the equivalent of \$50,000.

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ANNEX III - Page 52 of 62  
EXHIBIT H

Page 1 of 5

Project Cost Breakdown into Units of Construction

	<u>ESTIMATED COSTS (\$1,000)</u>		
	<u>LOCAL</u>	<u>IMPORTS</u>	<u>TOTAL</u>
1. <u>Passo Real Hydroelectric Plant</u>	<u>43,007</u>	<u>11,125</u>	<u>54,132</u>
1.1 <u>General Expenses:</u>	<u>14,153</u>	<u>6,155</u>	<u>20,308</u>
Preliminary Engineering	615	--	615
Land and Right of Way	2,615	--	2,615
Access and Site Preparation	2,380	--	2,380
Offices and Housing	300	--	300
Construction Equipment	2,260	5,505	7,765
Permanent Construction Materials (cement, steel)	2,472	23	2,495
Construction Materials (other) and supplies	3,511	627	4,138
1.2 <u>Dam and Reservoir:</u>	<u>17,512</u>	<u>358</u>	<u>17,870</u>
Diversion Tunnels, civil construction	3,720	--	3,720
Diversion Tunnels, equipment	429	358	787
Cofferdams-Care of River, civil construction	870	--	870
Dikes (lateral dams), civil construction	2,110	--	2,110
Main Dam, civil construction	1,820	--	1,820
Main Dam, equipment	48	--	48
Power Intake and Penstocks, civil construction	2,620	--	2,620
Power Intake and Penstocks, equipment	1,780	--	1,780

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ANNEX III - Page 53 of 62  
EXHIBIT H

Page 2 of 5

1.2 Dam and Reservoir(cont.):

	<u>ESTIMATED COSTS(\$1,000)</u>		
	<u>LOCAL</u>	<u>IMPORTS</u>	<u>TOTAL</u>
Spillway,civil construction	3,280	--	3,280
Spillway, equipment	835	--	835
1.3 <u>Powerhouse:</u>	<u>8,826</u>	<u>3,144</u>	<u>11,970</u>
Civil Construction	2,920	---	2,920
Two Turbines(Kaplan 87,800 hp, 138.5 rpm)	1,514	1,510	3,024
Two Generators(Umbrella 70,000Kva 138.5 rpm)	1,773	759	2,532
Seven Transformers(Single-phase 23,3 Mva, 13.8/220 Kv)	1,314	--	1,314
Three Bridge Cranes(150;150 and 25 ton)	412	--	412
Three Draft Tube Gates (5.0 x 6.7 meter)	365	--	365
Two Auxiliary Hydro Generators (500 Kw)	260	--	260
Auxiliary Equipment,mechanical	171	100	271
Auxiliary Equipment,electrical	39	775	814
Workshop Equipment	58	--	58
1.4 <u>Switchyard:</u>	<u>2,176</u>	<u>816</u>	<u>2,992</u>
Civil Construction	900	--	900
Four Auto-Transformers(Three- phase,70,000 Kva,220/138 Kv)	1,000	--	1,000
220 Kv Switching Equipment	88	485	573
138 Kv Switching Equipment	42	331	373
All Other Equipment	146	--	146
1.5 <u>Carrier Wave Equipment</u>	<u>340</u>	<u>577</u>	<u>917</u>

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ANNEX III - Page 54 of 62  
EXHIBIT H

Page 3 of 5

	<u>ESTIMATED COSTS (\$1,000)</u>		
	<u>LOCAL</u>	<u>IMPORTS</u>	<u>TOTAL</u>
1.6 <u>Data Processing Equipment</u>	--	<u>75</u>	<u>75</u>
2. <u>Associated Transmission Lines, Substations and Distribution</u>	<u>25,279</u>	<u>11,976</u>	<u>37,255</u>
2.1 <u>Transmission Lines:</u>	<u>6,540</u>	<u>2,443</u>	<u>8,983</u>
Civil Construction and Erection (Six Lines)	2,192	--	2,192
220 Kv Lines, Equipment (Two Lines)	2,845	--	2,845
138 Kv Lines, Equipment (Three Lines)	348	--	348
69 Kv Underground Line, Equipment (One Line)	1,155	1,443	2,598
2,000 Metric Tons of Aluminum Ingots	--	1,000	1,000
2.2 <u>Substations:</u>	<u>11,489</u>	<u>7,393</u>	<u>18,882</u>
Civil Construction and Erection (22 substations)	4,328	--	4,328
Transformers (25 units aggregat- ing 410 Mva)	5,580	4,490	10,070
Two Synchronous Condensers (50 Mva)	--	1,347	1,347
220 Kv Equipment	171	1,216	1,387
138 Kv Equipment	85	340	425
All Other Equipment	1,325	--	1,325
2.3 <u>Distribution:</u>	<u>7,250</u>	<u>2,140</u>	<u>9,390</u>
Civil Construction	2,650	--	2,650
Equipment	4,600	1,090	5,690
400 Metric Tons of Copper Ingots	--	1,050	1,050

UNCLASSIFIED

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UNCLASSIFIED

ANNEX III - Page 55 of 62  
EXHIBIT H

Page 4 of 5

	<u>ESTIMATED COSTS (\$1,000)</u>		
	<u>LOCAL</u>	<u>IMPORTS</u>	<u>TOTAL</u>
3. <u>Engineering, Administration and Training</u>	<u>9,950</u>	<u>1,800</u>	<u>11,750</u>
3.1 <u>Engineering, Survey and Design</u>	1,250	1,500	2,750
3.2 <u>Administration, Supervision and Training</u>	8,700	300	9,000
Project Cost Less Contingencies	78,236	24,901	103,137
4. <u>Provision for Contingencies (about 10%)</u>	<u>7,864</u>	<u>2,499</u>	<u>10,363</u>
<u>TOTAL ESTIMATED PROJECT COST</u>	<u>86,100</u>	<u>27,400</u>	<u>113,500</u>

REMARKS:

- A. All costs of equipment and materials are based on the best available information, as of December 1967, and include all expenses for delivery, at the construction site, and manufacturer's erection costs.
- B. For more details on imported equipment see ANNEX Part , List of AID Loan Financed Items.
- C. Estimated residual value of the construction equipment is:
- |                      |   |              |
|----------------------|---|--------------|
| Imported Equipment   | - | \$ 2,600,000 |
| Local Equipment      | - | \$ 400,000   |
| Total Residual Value | - | \$ 3,000,000 |

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ANNEX III - Page 56 of 62  
EXHIBIT H

Page 5 of 5

REMARKS (cont.):

C. (Continuation)

The depreciated value of this equipment = \$2,505,000 has been pro-rated and deducted from estimated costs of the different items of civil construction, since the equipment is intended to be rented to the construction contractors.

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ANNEX III - Page 57 of 62  
Exhibit I  
Page 1 of 6

LIST OF A.I.D. LOAN FINANCED ITEMS

	<u>Costs in \$1,000</u> (as of Dec. 1967)	
<u>Passo Real Hydroelectric Plant</u>		
1.1 <u>Construction Equipment</u> (1)		5,505
Automotive	60	
Earthwork	2,942	
Drilling & Shooting	465	
Sand haul	212	
Crushing plant	656	
Batch & Mix plant	267	
Concrete placing	322	
Drilling & Grouting	38	
General yard & Warehouse	39	
Freight & Handling	504	
1.2 <u>Miscellaneous Construction Materials &amp; Supplies Level</u>		
<u>Permanent Construction Materials</u>	23	650
Other Construction Materials & Supplies .....	627	
1.3 <u>Tunnel Gates &amp; Outlet</u>		
150" Butterfly valve	216	358
138" Hollow Bunger valve	142	
1.4 <u>Powerhouse Equipment</u>		3,144
87,880 hp Kaplan Turbines (partial, 2 units) (2)	1,510	
70,000 Kva Alternators (partial, 2 units) (3)	759	
Powerhouse auxiliary equipment (mechanical) (4)	100	
Powerhouse auxiliary equipment (electrical) (5)	775	

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1.5	<u>Step-up Substation</u>		816
	220 Kv Switching, measuring and protection equipment (6)	485	
	138 Kv Switching, measuring and protection equipment (6)	331	
1.6	<u>Carrier Communications Equipment</u>		577
1.7	<u>Data Processing Equipment</u>		75
	<u>Imported Equipments and Materials, Less Contingencies</u> .....		11,125
	<u>Provision for Contingencies (about 10%)</u>		1,125
	<u>Total for Passo Real Hydroelectric Plant:</u>		12,250
2.	<u>Associated Transmission and Distribution</u>		
2.1	<u>Transmission Line</u>		1,443
	69 Kv Underground cable (7)	1,443	
2.2	<u>Cidade Industrial Substation</u>		3,946
	150 Mva 220/133/13.8 Kv Transformer .....	1,497	
	50 Mva Synchronous Condensers (2 units) .....	1,347	
	220 Kv Switching, measuring and protection equipment (8)	762	
	138 Kv Switching, measuring and protection equipment (8)	340	
2.3	<u>Porto Alegre No. 6 Substation (SEPA-VI)</u>		3,447
	150 Mva 220/66 Kv Transformers (2 units) .....	2,993	
	220 Kv Switching, measuring and protection equipment (8)	454	

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ANNEX III - Page 59 of 62  
Exhibit I  
Page 3 of 6

2.4	<u>Distribution</u>		1,090
	Reclosers, capacitors, misc. equipments .....	1,090	
2.5	<u>Raw Materials</u>		2,050
	2,000 Metric Tons Aluminum ingots for ACSR .....	1,000	
	400 metric tons Copper ingots for distribution .....	1,050	
	<u>Imported Equipments and Materials, Less Contingencies .....</u>		11,976
	<u>Provision for Contingencies (about 10%)</u>		1,174
	Total for Associated Transmission and Distribution .....		13,150
	Total for Imported Equipment and Materials		25,400

NOTE: Figures inside a parenthesis refer to explanations given below under "REMARKS,C".

REMARKS:

- A. The above list of equipment for import from the U.S.A. was approved by the Associação Brasileira para o Desenvolvimento de Industria de Base (ABDIB, the Brazilian manufacturers association for infra-structure development) in May 1968. This does not apply to construction and raw materials (aluminum and copper ingots), since these are outside ABDIB's jurisdiction, and their import is regulated by the Law of Similar (Brazil's Federal Law No. 3244 of August 14, 1957)

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ANNEX III - Page 60 of 62  
Exhibit I  
Page 4 of 6

- B. All costs are based on the best available information, as of December 1967, and include all dollar expenses for delivery at the Brazilian port of entry, and manufacturer's erection costs.
- C. The following numbered remarks correspond to numbers inside a parenthesis, appearing in the tabulation above:
- (1) See following tabulation for specification of the construction equipment.
  - (2) Turbines will be built by a joint-venture of U.S.A. and Brazilian manufacturers under the technical responsibility of the former. Bids will be taken in the U.S.A. The American manufacturers will furnish those parts only which are normally imported by the Brazilian manufacturers, viz, the shaft, runner, wicket gates, bearings, controls and regulator. It is estimated that the total cost will be evenly divided between the U.S.A. and Brazilian manufacturers.
  - (3) The alternators will be built in Brazil. Imports from the U.S.A. will be limited to materials (copper, silicon steel, insulation) and the cooling and fire-protection system, which are normally imported by the Brazilian manufacturers.
  - (4) The mechanical auxiliary equipment include units, components and parts which are not locally manufactured in Brazil such as special pumps, valves, etc.
  - (5) The electrical auxiliary equipment to be imported consists of 13.8 Kv cubicles, bus-ducts, control boards, relays, metering equipment, lightning-arresters, instrument transformers, frequency control and remote control equipment, not produced in Brazil.

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ANNEX III - Page 61 of 62  
Exhibit I  
Page 5 of 6

- (6) Imported step-up substation equipment includes five 220 Kv and five 138 Kv three-phase circuit breakers, nine 220 Kv and eighteen 138 Kv lightning arresters, twelve 220 Kv and fifteen 138 Kv current transformers and twelve 220 Kv and fifteen 138 Kv potential devices.
- (7) The 69 Kv underground cable will interconnect substations No. Six, Seven and Eight within the limits of the City of Porto Alegre.
- (8) Imported step-down substation equipment includes eleven 220 Kv and six 138 Kv three-phase circuit breakers, eighteen 220 Kv and twelve 138 Kv lightning arresters, thirty three 220 Kv and fifteen 138 Kv current transformers and twenty one 220 Kv and six 138 Kv potential devices.

3. Detailed List of Construction Equipment Procured in the U.S.A.  
(Breakdown of Item 1.1 of the preceding table)

<u>Item Description</u>	<u>Qty.</u>	<u>CIF Costs incl. Spares</u>	
		<u>Unit</u>	<u>Total</u>
<u>Automotive:</u>			<u>60,400</u>
100 Ton trailer(off highway)	1	23,000	23,000
Tractor for trailer	1	37,400	37,400
<u>Earthwork:</u>			<u>2,941,980</u>
Shovels, 3 1/2 cu.yd.combination with dragline equipment	4	180,000	720,000
Bottom dump haul units 35 ton	14	72,900	1,020,600
Euclid rear dump trucks 22 ton	10	55,600	556,000
D-8 Tractors-Dozers	9	57,900	521,100
Rock rake attachment	1	9,100	9,100
Ripper attachments (D-8)	2	10,400	20,800
Water wagon (off highway,4,000 gal.)	3	21,060	63,180
Rome plow (heavy duty disc)	3	10,400	31,200

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ANNEX III - Page 62 of 62  
 Exhibit I  
 Page 6 of 6

<u>Drilling &amp; Shooting</u>			<u>464,840</u>
Air Track Drills 4 1/2-4 3/4 piston	8	29,380	235,040
Compressors, Diesel 1,200 cfm	4	57,200	228,800
Galvanometers-batteries	set	1,000	1,000
<u>Sand Haul</u>			<u>212,201</u>
977 Caterpillar Loader	1	45,500	45,500
Euclid 15 cy. (22 ton) dumper	3	55,567	166,701
<u>Crushing Plant</u>			<u>655,460</u>
200 ton per hr, complete	1	655,460	655,460
<u>Batch &amp; Mix Plant</u>			<u>267,450</u>
75 cu. meter per hr, complete	1	267,450	267,450
<u>Concrete Placing</u>			<u>322,080</u>
30/35 ton crane with jib	2	73,500	147,000
15 ton flat-bed trucks	3	52,361	157,080
Concrete buckets, air oper. 4 cy.	2	4,500	18,000
<u>Drilling &amp; Grouting</u>			<u>38,000</u>
Diamond drill (CP 65)	1	8,000	8,000
Grout pumpers & mixers	2	12,000	24,000
Pressure pumps (up to 1,000 psi)	2	3,000	8,000
<u>General Yard &amp; Warehouse</u>			<u>39,000</u>
20 ton truck crane	1	39,000	39,000
<u>Freight &amp; Handling</u>			<u>504,000</u>
Total for Construction Equipment:			5,505,411

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AID-DLC/P-729  
ANNEX IV  
June 14, 1968

A N N E X    I V    -    F I N A N C I A L   S T A T E M E N T S

ACTUAL AND PROJECTED INCOME AND RETAINED EARNINGS STATEMENTS - CEEE

(Millions of NCr₹)

	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
1,000 Kw hour sales (6wh)	981	1,017	1,125	1,203	1,326	1,491	1,685	1,885	2,076	2,341
Average rate per Kwh	18	30	56	74	90	102	105	100	90	99
Gross revenue	18	31	63	89	119	152	177	189	187	232
Less: Operating and Adm. Costs	20	29	58	85	81	106	124	137	118	115
Operating income before depr.	( 2)	2	5	4	38	46	53	52	69	117
Less: Depreciation	1	2	3	7	11	13	14	14	29	48
Net Operating Income	( 3)	-	2	( 3)	27	33	39	38	40	69
Plus: Other income	-	1	1	5	6	7	8	8	9	11
Net income before interest	( 3)	-	3	2	33	40	47	46	49	80
Less: interest	-	3	3	2	2	2	2	3	3	3
Net income	( 3)	( 2)	-	-	31	38	45	43	46	77
Less: dividends	-	-	-	-	1	1	2	3	4	5
reserves	-	-	-	-	2	2	2	2	2	4
Retained earnings	( 3)	( 2)	-	-	28	35	41	38	40	68
Balance at 1/1	( 3)	( 6)	( 4)	( 2)	-	28	63	104	142	182
Deduction from monetary correction	-	4	2	2	-	-	-	-	-	-
Balance at 12/31	( 6)	( 4)	( 2)	-	28	63	104	142	182	250

Actual and Projected Balance Sheets - CEEE

(Millions of NCr\$)

	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
<u>Assets</u>										
Working Capital	2	9	19	21	23	25	28	31	35	46
Advances to Contractors and Long Term Notes Receivable	7	14	45	62	62	62	62	62	62	62
Plant and Property										
In Operation	33	36	129	172	216	263	274	281	620	1,036
Work in Progress	38	48	37	61	100	216	396	616	418	87
Fixed Assets	71	84	166	233	316	479	670	897	1,038	1,123
Less: Depreciation	1	3	5	13	24	37	51	65	94	142
Net Plant and Property	70	81	161	220	292	442	619	832	944	981
<b>TOTAL ASSETS</b>	<b>79</b>	<b>104</b>	<b>225</b>	<b>303</b>	<b>377</b>	<b>529</b>	<b>709</b>	<b>925</b>	<b>1,041</b>	<b>1,089</b>
<u>Liabilities and Stockholders Equity 36</u>										
Long Term Debt	44	47	78	100	137	208	297	377	370	346
Stockholder's Equity										
Capital	41	61	149	197	204	248	296	392	473	473
Reserves	-	-	-	6	8	10	12	14	16	20
Retained Earnings	(6)	(4)	(2)	-	28	63	104	142	182	250
<b>TOTAL EQUITY</b>	<b>35</b>	<b>57</b>	<b>147</b>	<b>203</b>	<b>240</b>	<b>321</b>	<b>412</b>	<b>548</b>	<b>671</b>	<b>743</b>
<b>TOTAL LIABILITIES AND STOCKHOLDER'S EQUITY</b>	<b>79</b>	<b>104</b>	<b>225</b>	<b>303</b>	<b>377</b>	<b>529</b>	<b>709</b>	<b>925</b>	<b>1,041</b>	<b>1,089</b>
Debt/Equity Ratio	1.3	.8	.5	.5	.6	.7	.7	.7	.6	.5

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Projected Statement of Source and Application of Funds - CEEE Page 1 of 1  
(Millions of NCr\$)

	1968	1969	1970	1971	1972	1973	1968-73 Total	% of Total
<u>Source of Funds</u>								
Internal Source:								
Net Income before int.&div.	33	40	47	46	49	80	295	24.9
Depreciation	11	13	14	14	29	48	129	10.8
Total Internal Source	44	53	61	60	78	128	424	35.7
<u>External Source</u>								
Long Term Loans:								
National:BNDE	16	28	43	23	-	-	110	9.3
DNOS	19	27	24	28	10	7	115	9.7
MME & INDA	7	7	7	7	7	7	42	3.5
Other	-	-	-	-	11	19	30	2.5
Total National	42	62	74	58	28	33	297	25.0
Foreign: A.I.D.	14	10	9	23	24	8	88	7.4
Foreign Suppliers	-	19	33	36	8	5	101	8.6
Total Foreign	14	29	42	59	32	13	189	16.0
TOTAL LONG TERM LOANS	56	91	116	117	60	46	486	41.0
Equity Contributions	7	44	48	96	81	-	276	23.3
TOTAL SOURCE OF FUNDS	107	188	225	273	219	174	1,186	100.0
<u>Application of Funds</u>								
Construction: Passo Real	39	72	65	81	70	23	350	29.5
Passo Fundo	24	44	52	64	39	14	237	20.0
Candiota	-	25	49	46	10	5	135	11.4
Itaúba	-	-	-	5	15	35	55	4.6
Normal	15	11	5	2	2	1	36	3.0
Cap.Interest	5	11	20	29	5	7	77	6.5
TOTAL CONSTRUCTION	83	163	191	227	141	85	890	75.0
Working Capital(except cash)	1	1	2	2	3	3	12	1.0
Debt Service: National	18	19	26	32	50	52	197	16.6
Foreign	1	1	1	5	17	18	43	3.6
TOTAL DEBT SERVICE	19	20	27	37	67	70	240	20.2
Dividends	1	1	2	3	4	5	16	1.4
Interest	2	2	2	3	3	3	15	1.3
TOTAL APPLICATION OF FUNDS	106	187	224	272	218	166	1,173	98.9
Cash Surplus during the year	1	1	1	1	1	8	13	
Cash at beginning of year	10	11	12	13	14	15	10	
Cash at end of year	11	12	13	14	15	23	23	

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AID-DIC/P-729  
ANNEX V

June 14, 1968

A N N E X V - OTHER DOCUMENTS

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ANNEX V - Page 1 of 5  
EXHIBIT A

Page 1 of 2

To  
Carteira de Comércio Exterior do  
Banco do Brazil - CACEX  
Av. Rio Branco, 65  
Rio de Janeiro - GB

Dear Sirs:

As you know, the State Company of Electrical Energy - CEEE, is planning to build the Passo Real Hydroelectric Station in the State of Rio Grande do Sul, with a substantial part of its machines and equipment financed by USAID.

CEEE requested us by letter CEEE-Rio No. 68/049, dated 4/18/68, to enter into negotiations with the local manufacturers to determine which equipment should be imported and which should be manufactured in Brazil.

After negotiations with the local industry and CEEE were completed, this Association determined which equipments should be bought in Brazil and those which, in spite of their possibility of being manufactured in Brazil, the industry should allow to be imported in order to meet the requirements of USAID and the present power deficit in the south of the country.

Thus, CEEE, by letter CEEE-Rio No. 68/069, dated 5/8/68, submitted to us the attached List of Electric Mechanic Equipments.

Through this agreement, which is now entered into, about US\$32,935,000 (59%) including construction equipment will be bought in Brazil, and about US\$22,423,000 (41%) will be imported.

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ANNEX V - Page 2 of 5  
EXHIBIT A  
Page 2 of 2

Therefore, the national industry, through this Association, does not object to the importation of the equipment mentioned in the attached list which has been duly initialed by ABDIB and CEEE. 1/

In accordance with the provisions of Decree No. 61,574, dated 10/20/67, which regulates Decree Law No. 37 regarding the concept of national similars, we send you this letter submitting it to your consideration and eventual approval.

Very truly yours,

Eng. H.J. Pimentel Duarte da Fonseca  
Director Vice President  
Associação Brasileira para o  
Desenvolvimento das Indústrias  
de Base

NOTE: The attached list includes a detailed breakdown of both national and U.S. imported equipment. For the two Kaplan turbines it foresees a 50-50% split corresponding to the amount, by value, of components which Brazil must import since said components are not yet manufactured in Brazil.

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Letter of Commitment from the State of  
Rio Grande do Sul on priority of project,  
provision of funds and rate policy

UNCLASSIFIED  
ANNEX V - Page 3 of 5  
Exhibit B  
Page 1 of 2

(Free Translation)

Rio de Janeiro, May 13, 1968

Of.GE/100/68

Mr. Louis V. Perez  
Asst. Director for  
Capital Development and Industry  
USAID - Rio de Janeiro, GB

Dear Director:

With reference to your letter addressed to the President of CEEE, dated March 20, 1968, in which you request a declaration from the State Government, that it will guarantee to supply of all and any resources for the "Passo Real" project, in addition to those coming from BNDE, from USAID (being negotiated) and those deriving from funds of CEEE, I hereby wish to declare that this Government will specifically reserve to the first portion of that enterprise, the following annual amounts:

Years:	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>
NCr\$(thousands)	25,990	30,680	36,110	42,760

The above mentioned amounts represent portions of the State Investment Fund reserved in accordance with the pluriannual investment plan of the State which gives the project the highest priority, in agreement with the schedule concluded between BNDE and CEEE, in the respective financial contract and which table is attached.

Notwithstanding, in case such portions become insufficient, the State Government assumes, as of this time, the obligation of increasing the respective appropriations or of providing the resources through the CEEE's own funds.

Additionally, although my Government has decided to accelerate the works of the Passo Fundo Hydroelectric Central (considering it also indispensable to the future supply of energy to the State), I wish to declare that all funds reserved to this work, will, in no way, prejudice to the above mentioned, Passo Real Hydroelectric Project.

/...

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UNCLASSIFIED

ANNEX V - Page 4 of 5

Exhibit B

Page 2 of 2

I also declare that the State Government will give all support to CEEE in its efforts to obtain from the proper federal authorities rates be gradually adjusted in order to achieve the full remuneration of investment and the full depreciation allowed by the appropriate legislation, in accordance with the increasing scale elaborated by BNDE. The recent increase of rates (Portaria No. 9, dated March 12, 1968) is the third increase which has been effected within a period of 12 months and it represents a sincere effort to give the CEEE a full return on its capital within a reasonable time.

Taking this opportunity, I wish to present to your Excellency my sincerest regards.

(sgd.) Walter Peracchi Barcellos  
Governor of the State of  
Rio Grande do Sul

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ANNEX V - Page 5 of 5  
Exhibit C  
Page 1 of 1

May 17, 1968

Excellency:

Thank you very much for your letter received here on May 13, 1968 (OF.GE/100/68) concerning the provision of funds by the State of Rio Grande do Sul for the financing of the Passo Real and other power programs of the Companhia Estadual de Energia Elétrica.

I appreciate receiving your assurances concerning the special priority in the funding of Passo Real and your explicit support of CEEE's plans to gradually increase its power tariff to adequate levels. Since the conclusion of the agreement between CEEE and the BNDE last year, the company's power program has been expanded considerably by the acceleration of Passo Fundo, with the result that power rates had to be increased recently to the full extent permitted by federal legislation. The financial plan presented to us by CEEE is now predicated on the maintenance of power rates at this maximum level, rather than at the gradually increasing levels agreed earlier with the BNDE. Consequently, I trust that your Excellency will inform me in the event that the State should not be in conformity with the maintenance of the rate policies proposed by CEEE in the financial plans presented to USAID.

USAID is completing final discussions with representatives of CEEE in the expectation of presenting a loan proposal to Washington for consideration early in June.

Please accept, Excellency, renewed assurances of my highest regard and esteem.

Sincerely yours,

Louis V. Perez  
Assistant Director for  
Capital Development and Industry

cc. CEEE, Secretary of Energy (RS), ELETROBRAS, BNDE  
His Excellency  
Dr. Walter Peracchi Barcellos  
Governor of the State of Rio Grande do Sul

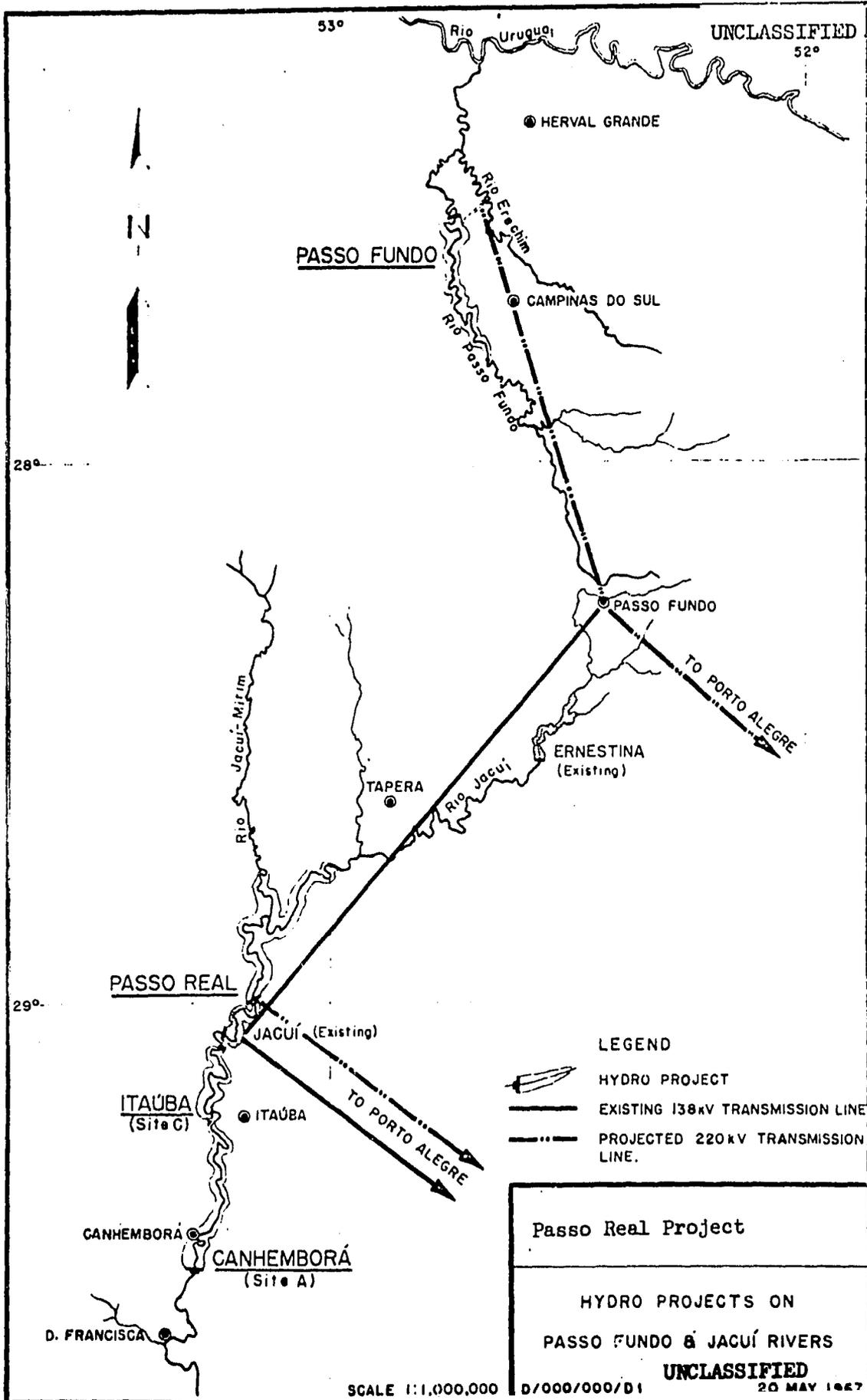
UNCLASSIFIED

UNCLASSIFIED  
AID-DLC/P-729  
ANNEX VI  
June 14, 1968

A N N E X VI - P L A T E S

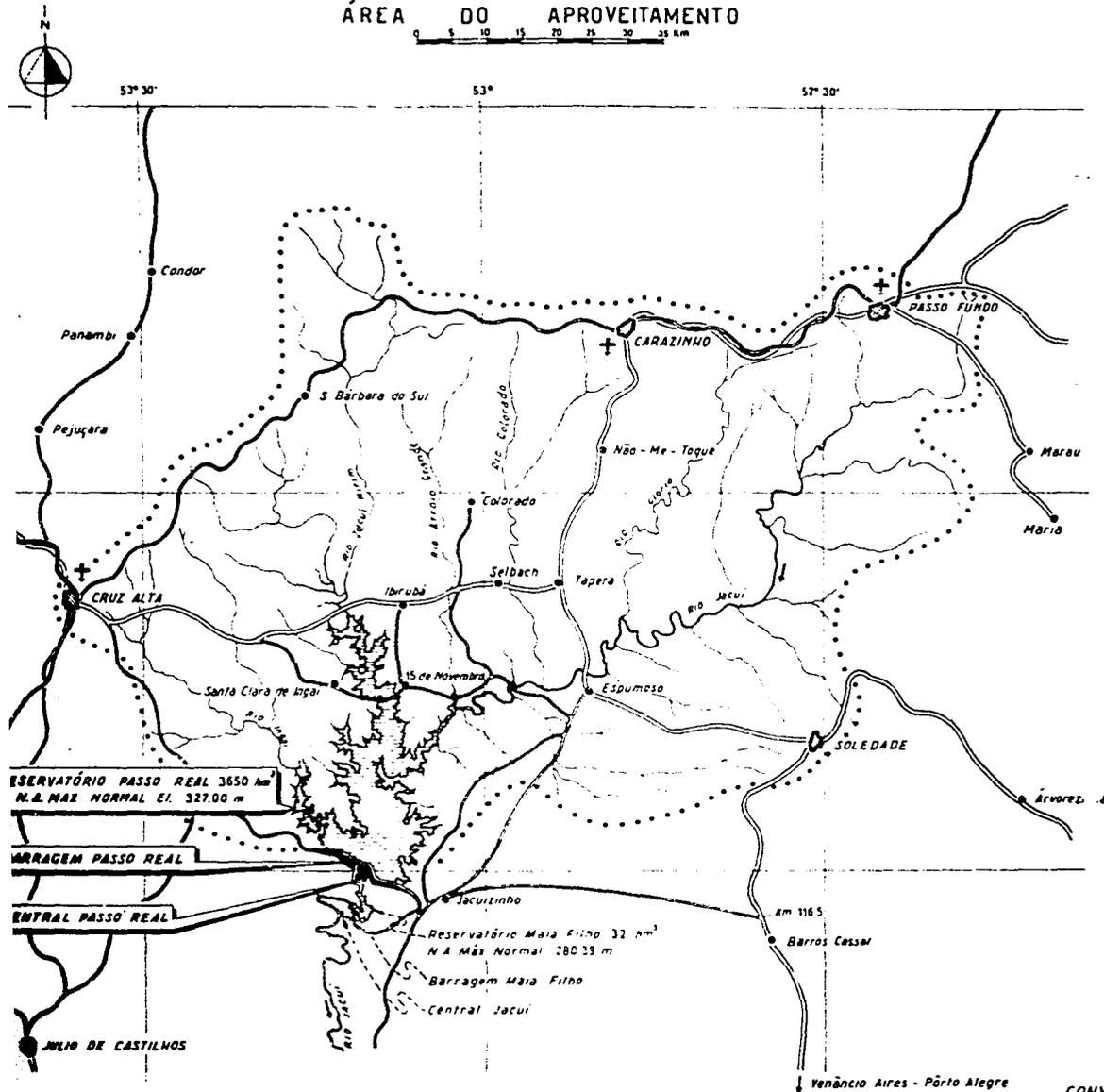


Plan 3



# ÁREA DO APROVEITAMENTO

0 5 10 15 20 25 30 km



RESERVATÓRIO PASSO REAL 3650 hm<sup>3</sup>  
N. A. M. A. N. M. E. I. 327.00 m

BARRAGEM PASSO REAL

CENTRAL PASSO REAL

Reservatório Maia Filho 32 hm<sup>3</sup>  
N. A. M. A. N. M. E. I. 280.39 m

Barragem Maia Filho

Central Jacu

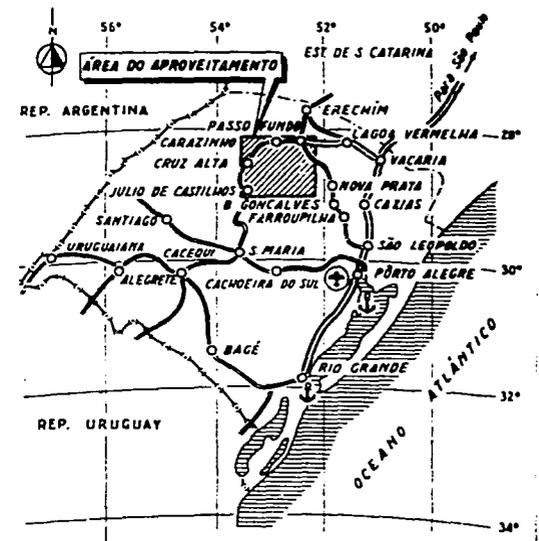
Venâncio Aires - Porto Alegre

## CONVENÇÕES :

- Localidades principais
- " menores
- Ferrovia
- == Estrada de rodagem estadual
- " " municipal
- ..... Limite da Bacia Hidrográfica
- ✈ Aeroporto

# ESTADO DO RIO GRANDE DO SUL

0 50 100 150 200 250 km



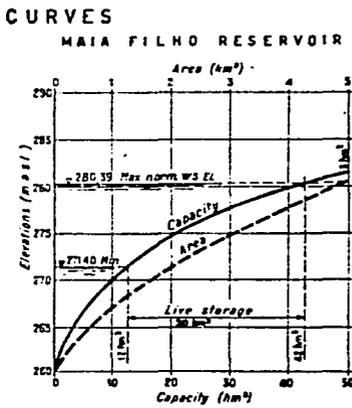
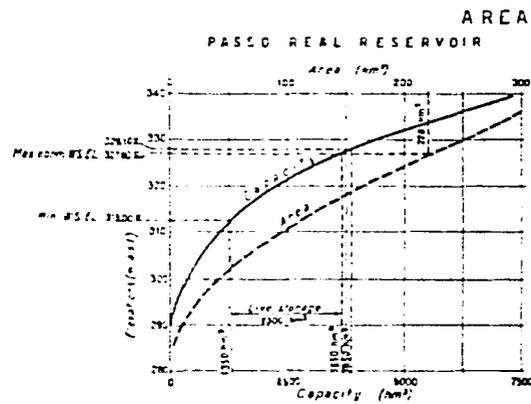
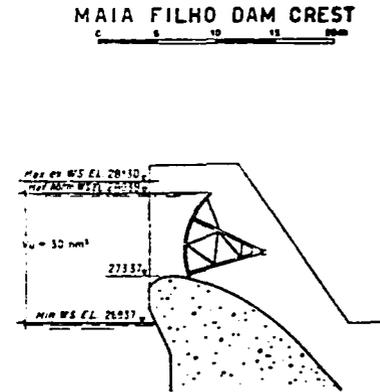
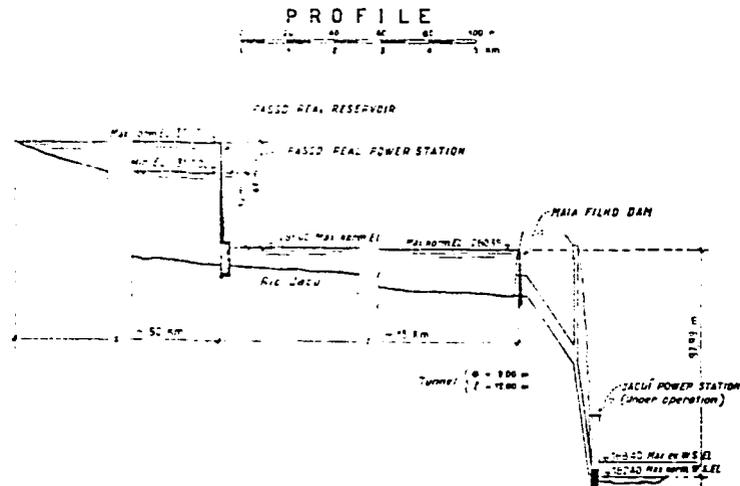
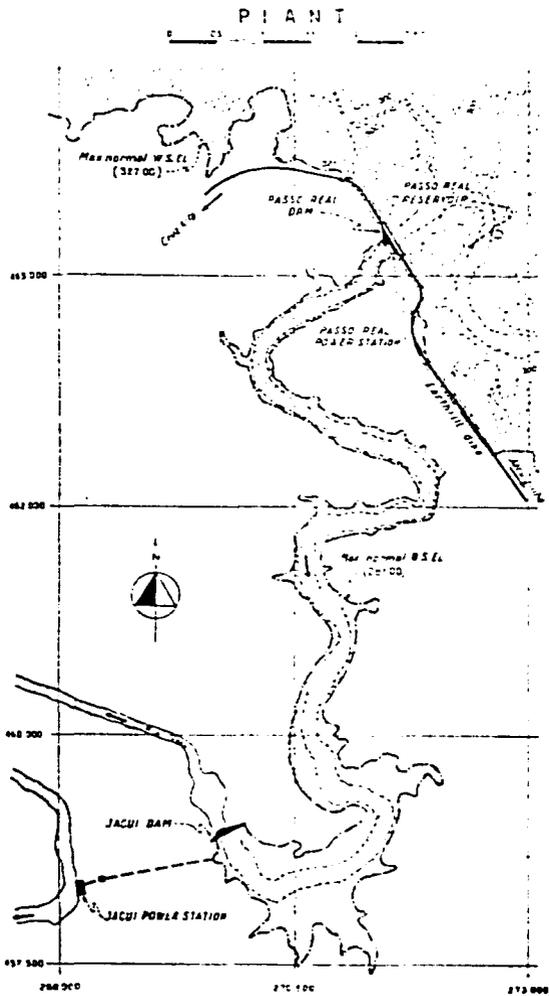
## CONVENÇÕES :

- Localidades principais
- Limite internacional
- " interestadual
- Ferrovia
- == Estrada de rodagem federal
- == Estrada de rodagem estadual
- ✈ Aeroporto internacional
- ⚓ Porto de atracção para navios grandes

THIS DRAWING HAS BEEN REPRODUCED FROM ELECTROCONSULT DRAWING PR 1001

COMPANHIA ESTADUAL DE ENERGIA ELÉTRICA - C. E. E. E.  
PASSO REAL PROJECT  
LOCATION MAP  
INTERNATIONAL ENGINEERING COMPANY, INC.  
SAN FRANCISCO, CALIFORNIA

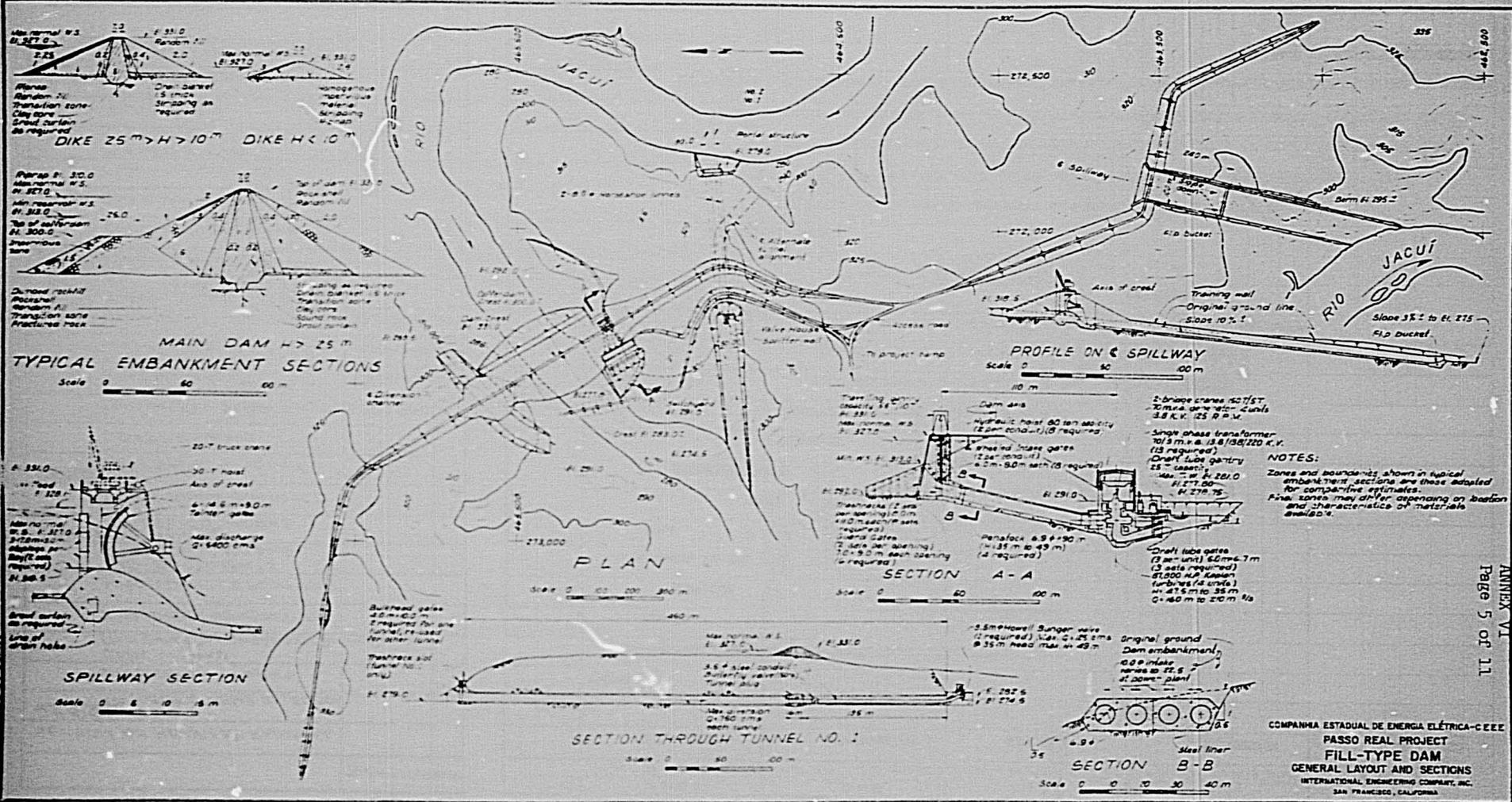
ANNEX VI  
Page 3 of 11  
UNCLASSIFIED



UNCLASSIFIED  
ANNEX VI  
Page 4 of 11

COMPANHIA ESTADUAL DE ENERGIA ELÉTRICA (CECEL)		PR
APROVEITAMENTO HIDRELÉTRICO DO PASSO REAL		1122
FEASIBILITY REPORT		
PASSO REAL-JACUI SYSTEM		
30/1	1969 DEC	ele

UNCLASSIFIED



**NOTES:**  
Zones and boundaries shown in typical embankment sections are those adopted for comparative estimates.  
Final zones may differ depending on location and characteristics of materials available.

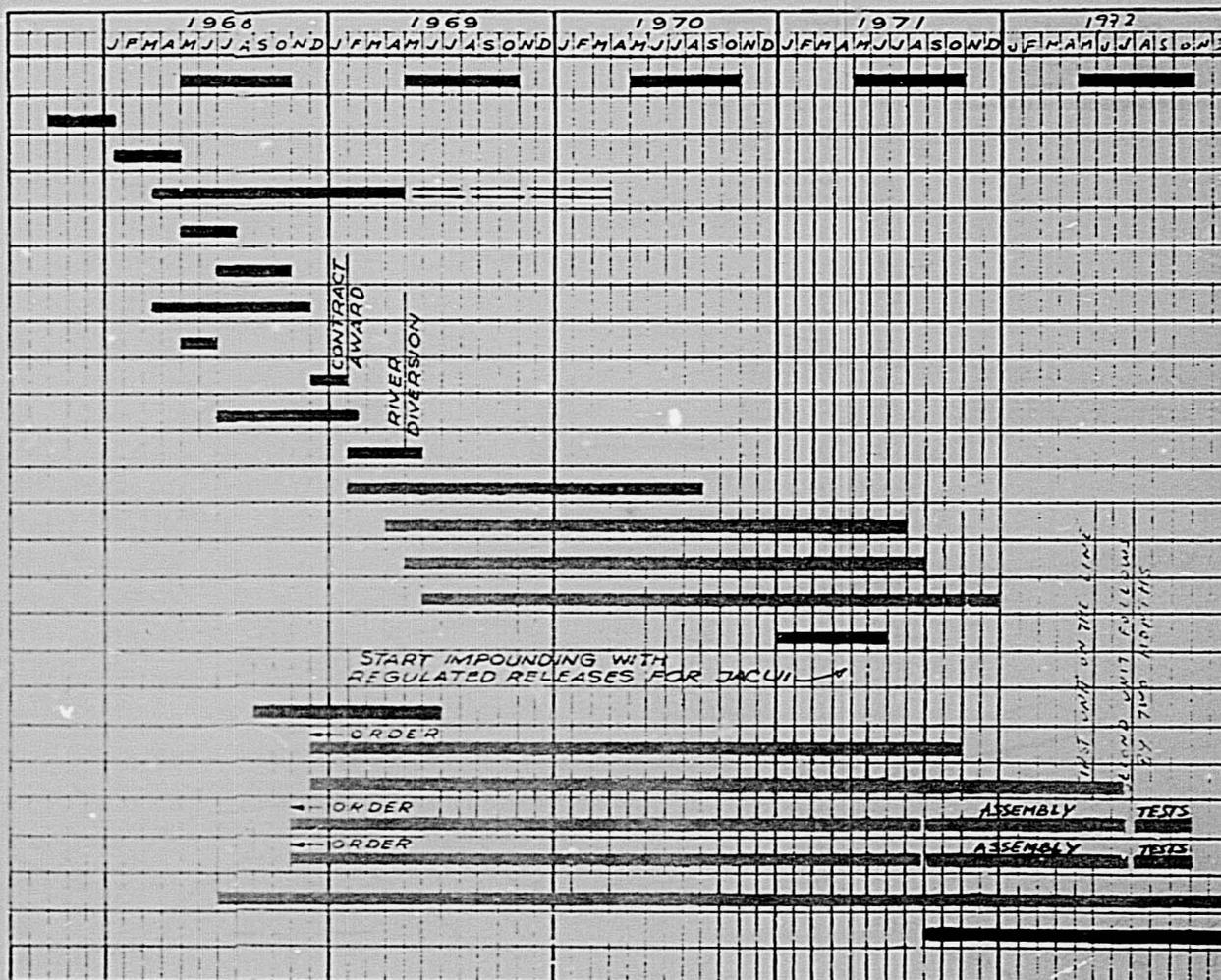
COMPANHIA ESTADUAL DE ENERGIA ELÉTRICA - C.E.E.E.  
PASSO REAL PROJECT  
FILL-TYPE DAM  
GENERAL LAYOUT AND SECTIONS  
INTERNATIONAL ENGINEERING COMPANY, INC.  
SAN FRANCISCO, CALIFORNIA

SCHEDULE

PROJECT PASSO REAL - BRAZIL - 736  
 FOR ROCK & EARTH FILL DAM w/TUNNEL DIVERSION  
 DATE JAN. 1968

TENTATIVE DESIGN & CONSTRUCTION SCHEDULE  
 FILL TYPE DAM

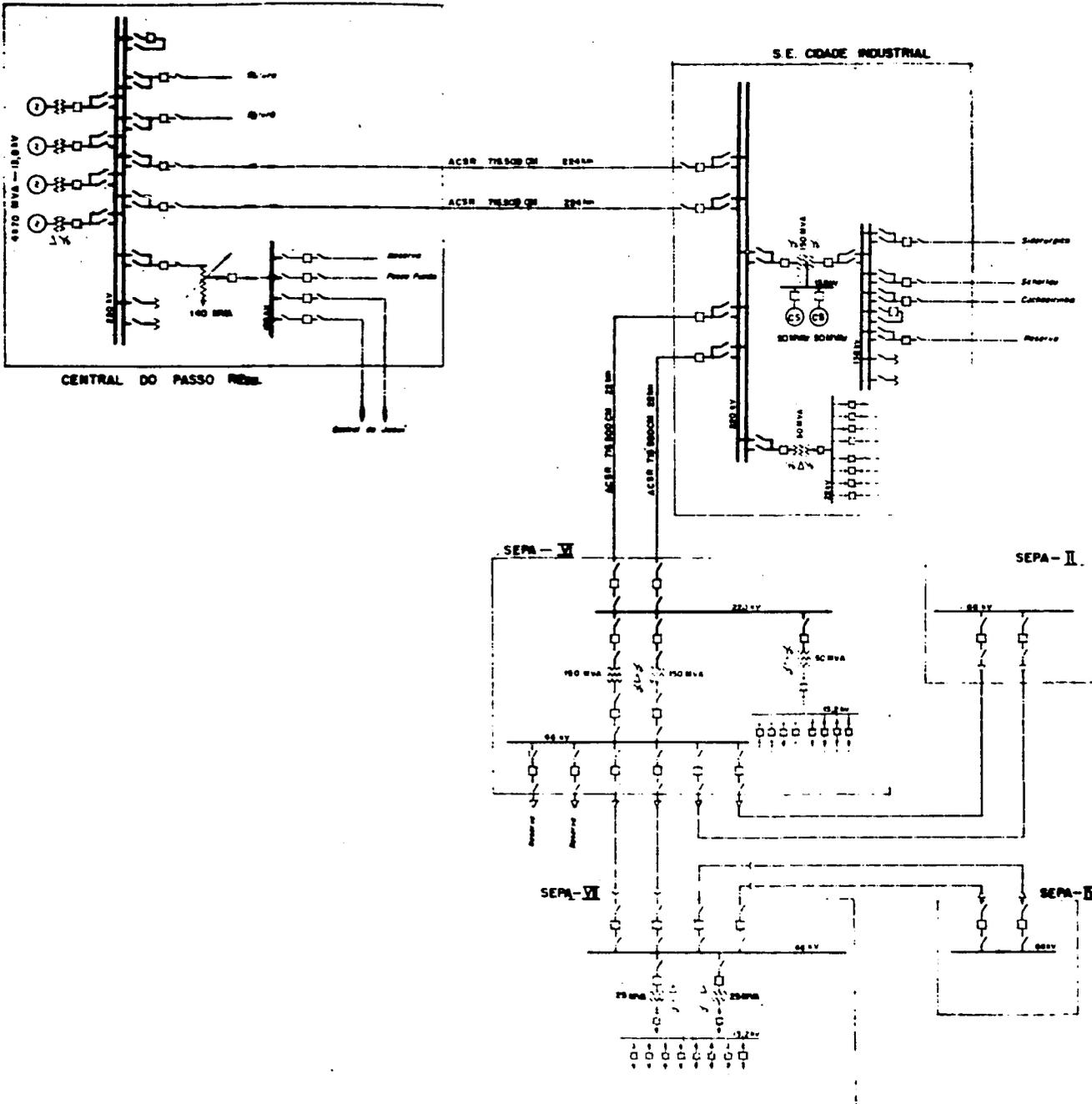
	QUANTITY	UNIT
SEASON OF HEAVIEST RAINFALL		
<b>DESIGN</b>		
PROJECT SCHEME SELECTION		
DIVERSION WORKS		
CIVIL WORKS (Incl. Detail Design & Constr. Drwgs)		
TURBINES & GENERATORS		
MISCELLANEOUS EQUIPMENT		
BID DOCUMENTS & SPECIFICATIONS		
<b>TENDER &amp; AWARD</b>		
DIVERSION WORKS		
CIVIL & PRIME CONTRACT		
<b>CONSTRUCTION</b>		
DIVERSION WORKS		
COFFER DAMS		
EXCAVATION-STRUCTURES	2,200,000	m <sup>3</sup>
EMBANKMENT	3,500,000	m <sup>3</sup>
AGGREGATE PRODUCTION	450,000	m <sup>3</sup>
CONCRETE WORKS	133,000	m <sup>3</sup>
TUNNEL PLUGS & INSTALL. LOW LEVEL OUTLET		
<b>EQUIPMENT-PROCUREMENT &amp; INSTALLATION</b>		
CONSTRUCTION EQUIPMENT		
DIVERSION		
MECHANICAL, MSCL		
GENERATORS & MSCL ELECTRICAL		
TURBINES		
<b>FIELD INSPECTION</b>		
<b>FINAL CLEANUP &amp; MISCELLANEOUS</b>		



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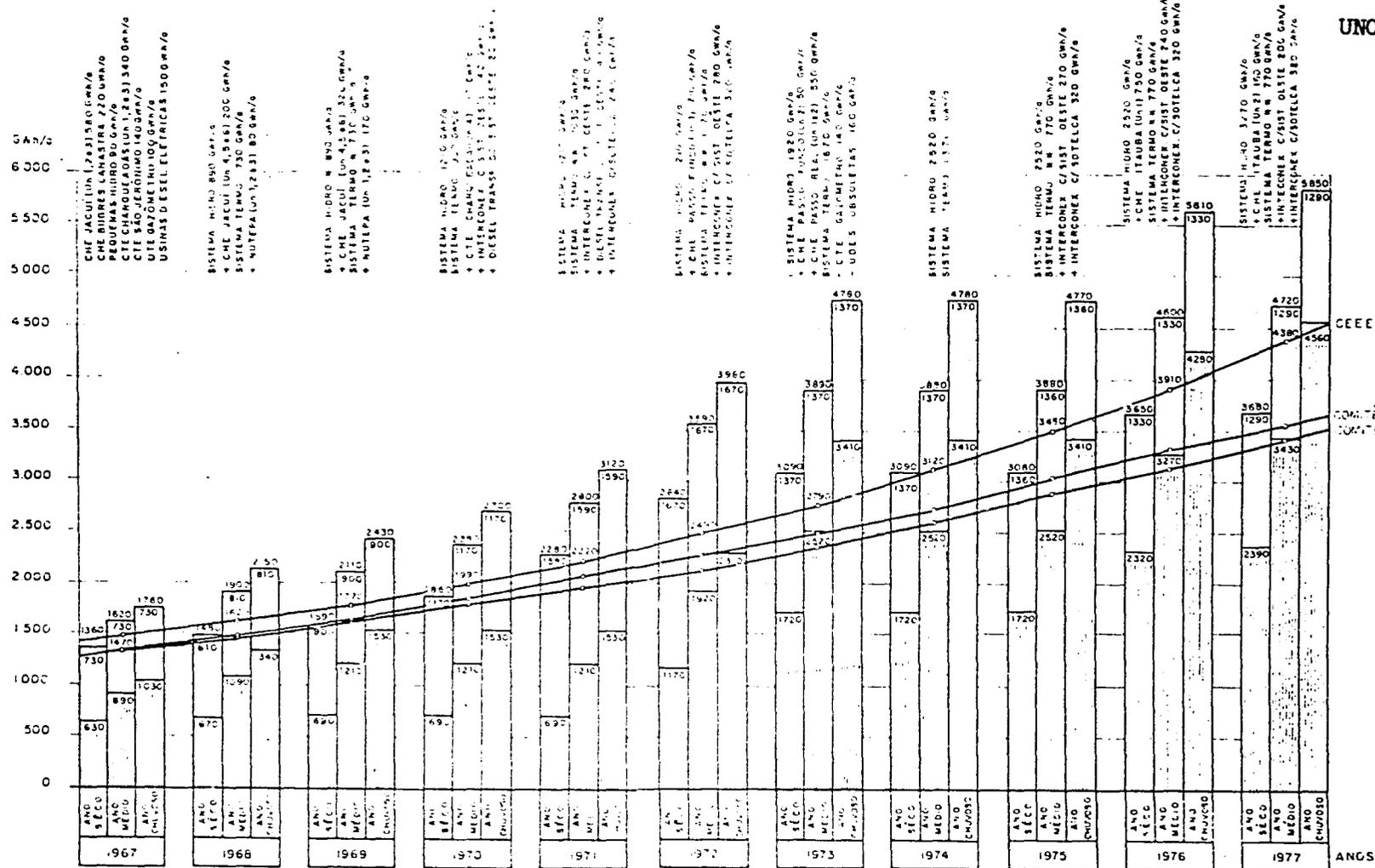




UNCLASSIFIED

Projeto		Emissão	
CCEE		17.202	
Passo Real Proj.			
Passo Real Trans-			
mission System			

UNCLASSIFIED

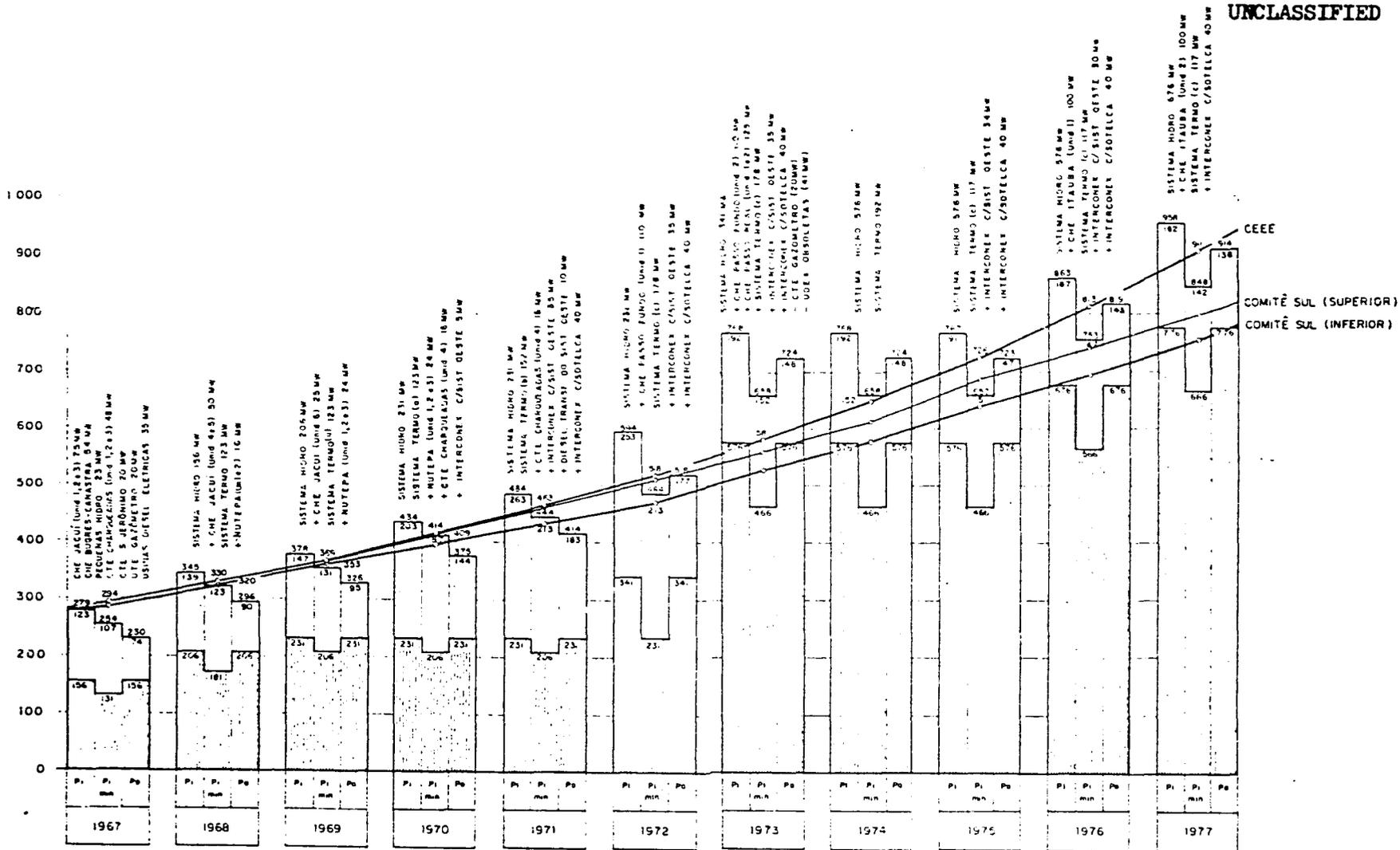


CONVENÇÕES

- HE
- TE
- Exclusive JACUI (Unid. 4,5 e 6) e NUTEPA (Unid. 1,2 e 3)
- Exclusive interconexões

UNCLASSIFIED

Nº Ficha	Man. Escala	Nº Data	Modificação
C.E.E.E.	COMPANHIA SUDAMERICANA DE ENERGIA ELÉTRICA SISTEMA DE ENERGIA ELÉTRICA DO SUL		ESCALA 17.339 312 — 7
Passo Real Project - North System Balance of Energy 1967 - 1977			Proj. <i>[Signature]</i> Des. <i>[Signature]</i> Calc. <i>[Signature]</i> Chefe Sec. <i>[Signature]</i> Chefe Div. <i>[Signature]</i> Chefe DEP. <i>[Signature]</i>



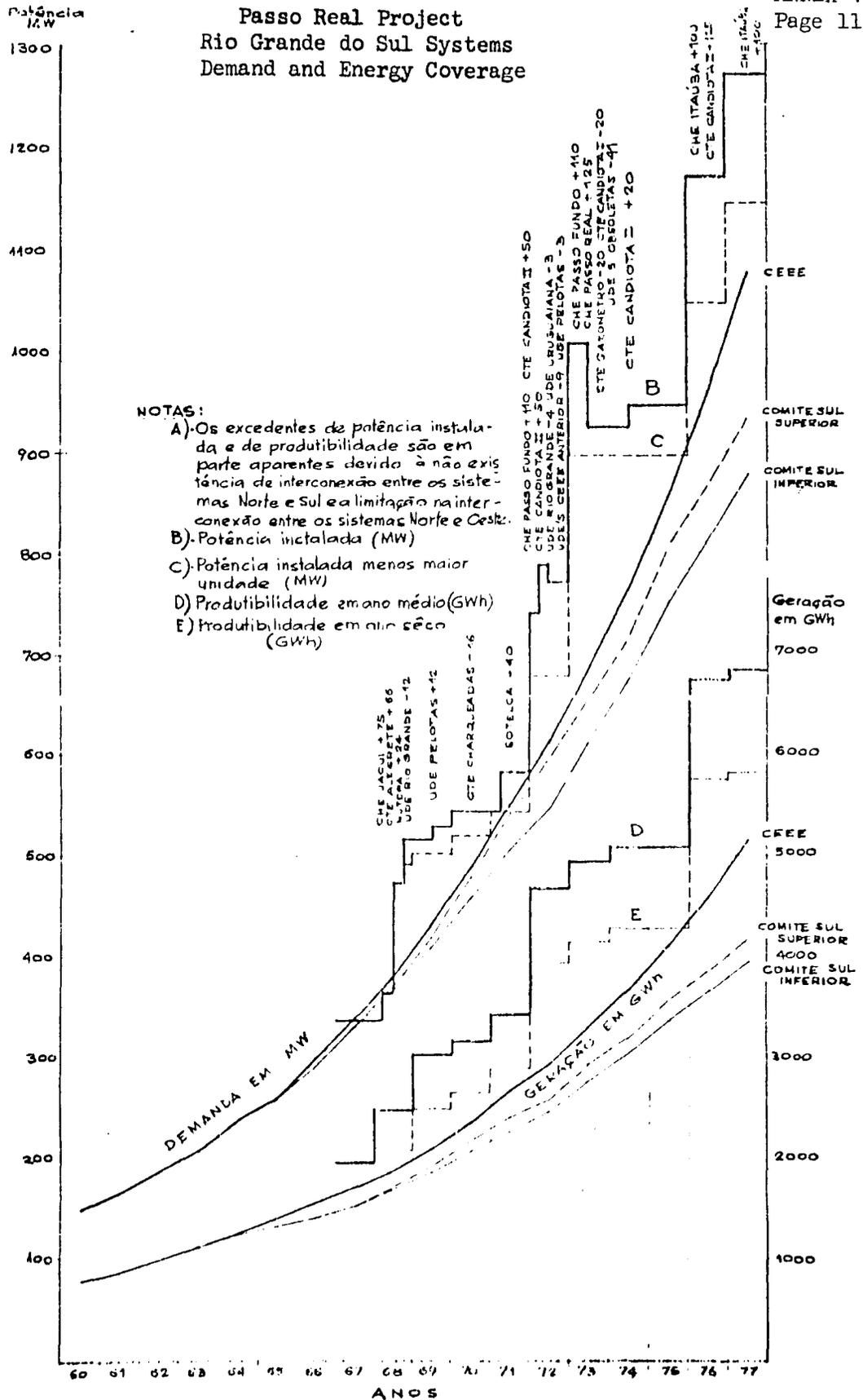
CONVENÇÕES

- ME
- TE
- P<sub>i</sub> - Capacidade instalada
- P<sub>i, m, n</sub> - Capacidade instalada menos a maior unidade do sistema
- P<sub>o</sub> - Capacidade operante, considerando a manutenção das unidades.
- (a) - Exclusive NUTEPA
- (b) - Exclusive CHARQUEADAS (Unid 4) e Interconexões
- (c) - Exclusive Interconexões

UNCLASSIFIED

Nº Data	Modificação	Nº Data	Modificação
C.E.E.E.	COMPANHIA ESTADUAL DE ENERGIA ELÉTRICA ESTADO DO RIO GRANDE DO SUL	ESCALA	17.338 312 — 7
Passo Real Project - North System Balance of Capacity 1967 - 1977		Proj. Des. 2442	Chefe Secção Chefe Div. Chefe

Passo Real Project  
Rio Grande do Sul Systems  
Demand and Energy Coverage



DEPARTMENT OF STATE  
AGENCY FOR INTERNATIONAL DEVELOPMENT  
WASHINGTON 25, D. C.

DRAFT  
LOAN AUTHORIZATION

Provided from: Alliance for Progress Loan Funds  
BRAZIL: Passo Real Hydroelectric Project

Pursuant to the authority vested in the Administrator of the Agency for International Development ("A.I.D.") by the Foreign Assistance Act of 1961, as amended, and the delegations of authority issued thereunder, I hereby authorize the establishment of a loan pursuant to Part I, Chapter 2, Title VI, Alliance for Progress of said Act to the Companhia Estadual de Energia Eletrica ("Borrower") of the State of Rio Grande do Sul, of not to exceed twenty-seven million four hundred thousand United States dollars (\$27,400,000) to assist in financing the United States dollar costs of the Passo Real Hydroelectric Project ("Project"), related transmission and distribution facilities, and U.S. consulting engineering and training services. This loan shall be subject to the following terms and conditions:

1. Interest and Terms of Repayment

- (a) Borrower shall repay the loan to A.I.D. in United States dollars within twenty-five (25) years from the first disbursement under the loan, including a grace period of not to exceed five (5) years. Borrower shall pay to A.I.D. in United States dollars on the disbursed balance of the loan interest of six percent (6%) per annum.
- (b) If prior to the date the first interest payment is due, the government of Brazil ("Government") so elects, Borrower shall fulfill its dollar obligation under the loan by paying to Government in the currency of Brazil the equivalent, determined as of the time and in a manner satisfactory to A.I.D., of the United States dollar amounts payable to A.I.D. under (a) above and in such event the Government shall pay to A.I.D.:
  - (i) the equivalent in United States dollars, determined as of the time and in a manner calculated to obtain repayment of all dollars disbursed plus interest, of all amounts paid to Government as follows:

- (a) all interest immediately upon receipt subject to Government's right to retain all payments in excess of two percent (2%) per annum during a grace period of not to exceed ten (10) years from the first disbursement under the loan ("Government grace period") and all payments in excess of two and one-half percent (2½%) per annum thereafter;
  - (b) principal within forty (40) years, including the Government grace period.
- (ii) interest in United States dollars of two percent (2%) per annum during the Government grace period, and two and one-half percent (2½%) per annum thereafter on all amounts of outstanding principal paid by Borrower to Government from the respective dates of such payments of principal.

## 2. Other Terms and Conditions

- (a) Equipment components which have their source and origin in the United States of America shall also be eligible for financing under the loan.
- (b) The loan shall be guaranteed by Government.
- (c) Prior to first disbursement under the loan: (i) arrangements satisfactory to A.I.D. shall have been made to assure adequate financing for the timely completion of the project; and (b) Borrower shall have retained qualified engineering consultants, satisfactory to A.I.D., to advise and assist in carrying out the project.
- (d) Prior to first disbursement other than to finance the costs of engineering services and training, Government shall have approved for purposes of the Law of Similar, all imports to be financed under the loan.
- (e) (i) Borrower shall covenant to maintain its power rates at the maximum level permitted under Brazilian law, except as A.I.D. may otherwise agree; (ii) the State of Rio Grande do Sul ("State") shall agree to provide its full support to Borrower's rate applications made in accordance with said covenant; and (iii) Government shall agree to authorize adequate power rates for Borrower, in accordance with Brazilian law.
- (f) The State shall agree to: (i) give the project highest priority in the allocation of state resources for power investments; (ii) provide all resources (other than resources to be provided from other sources under financial plans approved by A.I.D.) necessary to complete the project; and (iii) reinvest in Borrower

all dividends received from Borrower until the Project is completed.

- (g) Until the Project is completed, the Borrower shall covenant not to undertake any new major power generating project or expansion without the prior approval of A.I.D.
- (h) The loan shall be subject to such other terms and conditions as A.I.D. may deem advisable.

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Administrator

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Date