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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
INTERNATIONAL DEVELOPMENT ASSOCIATION

C. V. G. ELECTRIFICACION DEL CARONI, C. A.
(EDELCA)
GURI HYDROELECTRIC PROJECT
VENEZUELA

September 4, 1963

Department of Technical Operations

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CURRENCY EQUIVALENTS

US \$1 = Bs 4.54
US \$220,000 = Bs 1 million
US mills 2.2 = 1.0 centimo

VENEZUELA

CVG Electrificación del Caroni, CA

(EDELCA)

GURI HYDROELECTRIC PROJECT

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VENEZUELA

GURI HYDROELECTRIC PROJECT

SUMMARY

- i. The Government of Venezuela has applied to the Bank for a loan to finance the foreign exchange costs of a Project consisting of the first stage of the proposed Guri hydroelectric development on the Caroni River. The Project has been soundly planned by Corporacion Venezolana de Guayana (CVG), a government development authority, with the assistance of consulting engineers. It will consist of a dam, a power plant with a capacity of 350 MW, and 80 km of 230-kv transmission line to a substation at Matanzas which serves the Macagua hydroelectric plant. CVG already owns and operates Macagua, situated about 90 km downstream from the Guri site. CVG has formed a wholly-owned subsidiary, CVG Electrificacion del Caroni CA (EDELCA), to construct Guri, and to own and operate both plants.
- ii. The proposed Borrower would be EDELCA. The estimated cost of the Project is equivalent to US\$137 million including interest during construction, of which US\$85 million would be foreign exchange. The Project would be financed 62% by the proposed Bank loan, and 38% by planned national budget appropriations and cash from operations.
- iii. CVG is engaged in general industrial development in the Guayana area of the State of Bolivar, and owns and operates an integrated steelworks; is establishing an aluminium plant; and is developing the new city of Santo Tome de Guayana. The government-owned Compania de Administracion y Fomento Electrico owns and operates generation, transmission, and distribution facilities serving some 500 communities throughout the country. The capital city of Caracas is served by the privately-owned C.A. La Electricidad de Caracas. Agreement in principle has been reached to interconnect the facilities of these two entities with those of EDELCA, thus assuring an adequate market for EDELCA power.
- iv. The staff of the electric power division of CVG is capable, and will be transferred to EDELCA. Based on reasonable assumptions, projected operating results and financial performance should be satisfactory. By 1973, the sixth full year of operations, return on net plant in service should reach 8%, and debt service coverage should approach 2 times.
- v. Subject to satisfactory agreement on the conditions stipulated in Section VIII, EDELCA would be a suitable borrower for a Bank loan of US\$85 million. For this Project, a term of 25 years, including a grace period of $4\frac{1}{2}$ years would be appropriate.

VENEZUELA

GURI HYDROELECTRIC PROJECT

I. INTRODUCTION

1. The Government of Venezuela has decided to construct a Project, consisting of the first stage of the Guri hydroelectric development on the Caroni River and has asked the Bank to assist by financing the foreign exchange cost. The estimated cost of the first stage is equivalent to US\$137 million, including interest during construction, of which US\$85 million would be the foreign currency component.
2. The Project proposed for Bank financing would consist of a dam and a power plant with a capacity of 350 MW. Also included would be 80 km of 230-kv double-circuit transmission from the Guri power plant to the Guayana substation which already serves the existing Macagua hydroelectric plant, also located on the Caroni River, about 90 km downstream of the Guri site.
3. Planning of the Guri Project has so far been carried out by Corporacion Venezolana de Guayana (CVG) with the assistance of their consulting engineers, Harza Engineering Company International (Harza). CVG also owns and operates the Macagua plant which has a 365 MW installed capacity. A wholly-owned subsidiary of CVG is now being formed, to be called Compania Anonima Electrificacion del Caroni (EDELCA), which will be responsible for constructing Guri, as well as owning and operating both Macagua and Guri. It is proposed that EDELCA be the borrower.
4. In 1962, at the request of the Government of Venezuela, the Bank carried out a preliminary review of the Guri Project to advise the Government on its technical and economic justification. The findings of that review were presented in the accompanying report.
5. This report contains an appraisal of the Project; it is based on information gained from comprehensive reports prepared by Harza, on a report on cost estimates prepared by Coopers & Lybrand for the Bank, and on field visits to Venezuela by Bank missions in 1962 and 1963.

II. BACKGROUND

6. The Government of Venezuela has long recognized the possibility of developing large amounts of hydroelectric energy on the Caroni River, the principal tributary of the Orinoco. The 365 MW Macagua power station was completed in 1961, and is the first installation in the development of the Caroni River. The hydrology and power potential of the River have been studied at various times by consulting engineers, firstly for Macagua; in 1960 by Electricite de France (EDF) in connection with an overall survey of Venezuelan power resources; and in 1962 by Harza when making a specific feasibility and general layout study of the Guri Project as it is now proposed.
7. The Harza report's recommendation that construction of the first stage of Guri would be the next logical step in the development of power resources in Venezuela is in agreement with the findings of EDF. The first stage of Guri is scheduled to be in operation in 1968 with an installed capacity

of 350 MW. This capacity could be expanded to 1,750 MW, in a second stage by the installation of 8 additional generating units without further increase in the height of the dam. Harza has estimated that by two increases in the height of the dam and the installation of further generating units an ultimate capacity of 6,000 MW could be developed at the Guri site.

8. At present, power supply in Venezuela is provided from a number of Government-owned systems, several privately-owned systems, and a number of "captive" plants owned by industry. The Government-owned Compania de Administracion y Fomento Electrico (CADAPE) serves some 500 communities through a number of regional systems and small isolated plants. The largest CADAPE systems are in the central region serving the public water supply load of Caracas, the areas adjacent to Caracas and Valencia, Maracay and Puerto Cabello; and the eastern region serving Puerto La Cruz, Cumana, Carupano, El Tigre and Maturin. (See Map.)

9. The Guayana area is served from Macagua, and several isolated privately-owned companies. The area includes the new city of Santo Tome de Guayana, which will incorporate the existing towns of Puerto Ordaz, and San Felix. CVG is developing the area, and is already operating a large steelworks at Ciudad Guayana, and is planning several power-intensive industries, including aluminium, ferro-alloys, and fertilizers.

10. The largest privately-owned system is C.A. La Electricidad de Caracas (La Electricidad) which serves the capital city of Caracas and the seaport of La Guaira. This system will be a major consumer of Caroni River power when the Project is completed.

11. These systems at present are not interconnected, but a 230-kv transmission line is now being constructed by CADAPE from Ciudad Guayana to Caracas, and will make available to these systems bulk supplies of EDELCA power.

12. La Electricidad's system is operating at a frequency of 50 cycles and its interconnection with the other systems will require conversion to 60-cycle operation. Agreement has now been reached to convert La Electricidad's system to 60 cycles and a commission consisting of representatives of La Electricidad, CADAPE, and CVG has prepared a detailed analysis of the costs involved in the conversion, the advantages of the conversion and system interconnection, and the overall load growth of the interconnected systems.

III. THE BORROWER

13. CVG under the powers conferred on it by decree of Government No. 430 of December 29, 1960, has formed a wholly-owned subsidiary, EDELCA, to take over and operate the existing Macagua power plant and to build and operate the proposed Project. Macagua was previously operated by the electric power division of CVG. The staff of this division is being transferred to the new company and will form the nucleus of its organization. In view of their

satisfactory record at Macagua, they should be capable by 1968 of competently operating EDELCA. In the meantime Harza's consulting engineering services would be available to assist with the construction of Guri.

14. The broad delegations of policy laid down in the decree establishing CVG, and the charter and by-laws of EDELCA, have been reviewed in draft by the Bank, and found generally acceptable, subject to clarification of certain clauses relating to qualifications and tenure of the President and Board. They should enable EDELCA to take any action necessary for the success of the Project, and should allow it the freedom necessary to conduct its affairs in accordance with sound public utility practices. The charter and by-laws provide for a Board, consisting of a full-time President, a Vice President and three other members, and for the appointment of such officers as would be necessary to construct and operate the Project.

15. The principal responsibilities of EDELCA, after it has constructed the Project, will be operation of both the Guri and Macagua power plants, the expansion of Guri, and the sale of energy in bulk, mainly to the existing steelworks at Ciudad Guayana, to the proposed industries in the Guayana area, and to La Electricidad and CADAPE. CADAPE will plan an important role in distributing a sizeable part of the output of the Project, and in connection with a proposed Bank loan has assured the Bank it will reorganize its operations to enable it satisfactorily to undertake its future responsibilities.

16. Load forecasts indicate that it will be necessary to start construction of an extra-high-voltage (EHV) transmission line from the Guayana to the Caracas area before completion of the first stage of Guri, to supplement the 230-kv facilities now under construction by CADAPE. Although ownership of such EHV facilities has not yet been determined, it has been assumed for purposes of this appraisal that they will be owned by EDELCA. The Bank has obtained an assurance from the government that necessary EHV facilities will be constructed when appropriate.

IV. POWER MARKET

17. The market area for EDELCA will consist of:

- (i) the growing industrial area in the Guayana, centered around the new city Santo Tome, which is now served principally by Macagua;
- (ii) the central and eastern systems of CADAPE, now served by gas-fired thermal plants and small, isolated diesel stations; and
- (iii) La Electricidad's system, now supplying the capital city by gas-fired thermal plants.

18. Since these areas are not now interconnected, each system is required to maintain generating capacity sufficient to meet its own demand, as well as provide an adequate margin of reserve. However, with the completion of the Matanzas - Caracas 230-kv transmission line, the interconnection of the CADAPE and La Electricidad systems, and the later construction of EHV transmission from Guri to Caracas, all these systems will be operated on an interconnected pool basis. The mixed hydro-thermal pool will be operated to minimize both

investment in new generating facilities and operating expenses, by scheduling the existing thermal plants principally for peaking service. It is estimated that EDELCA will supply 42% of the interconnected systems' demand in 1965, and 86% in 1979.

The Guayana Area

19. The load in the Guayana where long-range development by CVG is under-way, will be primarily industrial. The integrated steelworks has a capacity of about 600,000 tons per year of finished products, based on nine 200-ton iron ore reducing electric furnaces, open-hearth furnaces, and associated finishing facilities. With the large reserves of high grade iron ore in the Guayana, it is likely that the steelworks' capacity will be increased, but new pig iron production will probably be by conventional blast furnaces rather than electric furnaces. The current connected load of the steelworks is about 220 MW, of which 180 MW is the electric furnaces. CVG estimates that the 40 MW mill load will be increased to about 164 MW by 1979, which with the existing 180 MW load in electric furnaces, would give a total demand of 344 MW. The present annual consumption of energy is about 1,000 million kwh, which would increase to about 2,000 million kwh in 1979.

20. Negotiations are now complete between CVG and Reynolds International, Inc. for the establishment of a jointly-owned company, the Aluminio Caroni Sociedad Anonima (ALCASA), to build an aluminium plant. It is expected that initial production will begin in 1965 with a capacity of 12,500 tons per year, increasing in steps to 25,000 in 1969, 50,000 in 1972, and 100,000 tons per year by about 1975. The power requirements would be about 25 MW and 200 million kwh per year for the first step, and 200 MW and 1,600 million kwh per year for the ultimate installation. The initial 12,500 tons per year plant would be supplied by Macagua.

21. Besides these two major electro-metallurgical consumers, there are other industrial loads in the area, including the Orinoco Mining Company's ore loading operations at Puerto Ordaz, its mining operations at Ciudad Piar, the Bethlehem Steel mines, and The Phillips Petroleum operation. The power requirements of these industries are currently about 10 MW and 50 million kwh per year, and these together with planned new industries are expected to increase to about 125 MW and 625 million kwh per year by 1979.

22. The forecast increases in load in the Guayana over the next two decades are summarized below. They are in substantial agreement with projections for the Guayana area made by the Bank mission which in 1962 evaluated the economic aspects of the Guri Project.

	<u>1965</u>		<u>1968</u>		<u>1973</u>		<u>1979</u>	
	<u>MW</u>	<u>Mill. kwh</u>						
Steelworks	220	1398	220	1398	272	1692	344	2011
ALCASA	25	100	25	200	100	700	200	1600
Industrial	<u>10</u>	<u>50</u>	<u>40</u>	<u>200</u>	<u>80</u>	<u>400</u>	<u>125</u>	<u>625</u>
	<u>255</u>	<u>1548</u>	<u>285</u>	<u>1798</u>	<u>452</u>	<u>2792</u>	<u>669</u>	<u>4236</u>

The CADAPE System

23. By 1965, CADAPE's central and eastern systems will be interconnected with each other and with the Macagua hydroelectric station by the double-circuit 230-kv transmission line now under construction from Caracas to Macagua via Puerto La Cruz. In addition, the city of El Tigre, a private system serving Ciudad Bolivar, and the communities of Puerto Ordaz, San Felix, and Ciudad Guayana would all take bulk supplies of EDELCA power through the CADAPE system. These areas, with a combined load of about 175 MW, are currently served from several thermal plants whose aggregate capacity is about 250 MW, including about 30 MW of isolated diesel stations.

24. The central service area of CADAPE has seen important industrial and commercial development in the past years. Major loads include industrial developments at both Valencia and Maracay, a government-owned petro-chemical plant at Moron, and the Instituto Nacional de Obras Sanitarias (INOS), which supplies water to the city of Caracas. Continuation of general industrial development is expected in this area, as well as increases in the petro-chemical load and the water supply load. Forecasts indicate that the area demand will be about 880 MW and 4,500 million kwh per year in 1979. Growth in the eastern area and in the area between Puerto La Cruz and Macagua will consist largely of increased residential consumption, rural network expansion, and some oil-field load now served by a captive plant. The combined load of these two areas is expected to reach about 200 MW and 900 million kwh per year by 1979. The projected average annual growth in demand for the combined central and eastern areas is thus about 12%. When CADAPE's plans for acquisition after 1965 of existing properties are taken into account, this rate of growth is reasonable. The forecasts for the central and eastern areas are summarized below:

	<u>1965</u>		<u>1968</u>		<u>1973</u>		<u>1979</u>	
	<u>MW</u>	<u>Mill. kwh</u>						
Central	219	1292	347	1724	530	2823	878	4509
Eastern	<u>48</u>	<u>212</u>	<u>73</u>	<u>320</u>	<u>109</u>	<u>480</u>	<u>197</u>	<u>904</u>
	267	1504	420	2044	639	3303	1075	5413

25. Since by about 1966 CADAPE will be short of generating capacity in the central and eastern areas they are currently negotiating with La Electricidad for interim power supply of about 400 million kwh annually between 1966 and 1968, until Guri power is available. CADAPE system planning for 1968 and later is based on the availability of substantial amounts of firm power from EDELCA, and this being the case, it does not contemplate the construction of any major new thermal power plants. In fact, the availability of EDELCA power will enable CADAPE to retire older, less efficient units. Exclusive of any EDELCA energy transmitted for the account of La Electricidad, CADAPE forecasts that it will require some 500 million kwh from EDELCA in 1965 when the 230-kv inter-connection will be in service, and its purchases from EDELCA will increase to 2,800 million kwh per year by about 1972, and reach 5,300 million kwh per year by 1979.

The City of Caracas

26. At present, the electric power demand in the city of Caracas and its environs of 300 MW and 1,500 million kwh per year is supplied from La Electricidad's system which has about 450 MW of capacity in modern gas-fired thermal plants. La Electricidad forecasts that its demand will increase to about 440 MW and 2,100 million kwh per year by 1968 and reach 975 MW and 4,800 million kwh per year by 1979, an average annual increase in system demand of about 7 $\frac{1}{2}$ %. These figures, which agree with the Bank's forecast, are summarized below.

<u>1965</u>		<u>1968</u>		<u>1973</u>		<u>1979</u>	
<u>MW</u>	<u>Mill. kwh</u>						
356	1711	440	2145	636	3137	976	4870

27. Except for a unit now on order and scheduled for operation in 1966, La Electricidad does not propose to increase its plant capacity until 1978 since its additional requirements will be met by purchases from EDELCA. La Electricidad's system, unlike the 60-cycle CADAPE and CVG systems, is now operated at 50 cycles, but all central station equipment is suitable for easy conversion to 60 cycle operation. In order to achieve full interconnection, La Electricidad, CADAPE, and CVG have now reached agreement in principle to convert La Electricidad's system to 60 cycle operation, and the Government has agreed to arrange for financing the costs of converting customers' facilities. Interconnection will initially enable CADAPE to obtain bulk supplies from La Electricidad prior to the completion of Guri, and later enable La Electricidad to purchase substantial amounts of EDELCA power.

Demand for Combined Market Area

28. The following table is a summary of forecast demand and energy requirements of the market area and compares them with existing and projected system generating capabilities.

	<u>Systems' Maximum Demand and Capability</u>							
	<u>MW</u>							
	<u>1965</u>		<u>1968</u>		<u>1973</u>		<u>1979</u>	
	<u>Demand</u>	<u>Cap.</u>	<u>Demand</u>	<u>Cap.</u>	<u>Demand</u>	<u>Cap.</u>	<u>Demand</u>	<u>Cap.</u>
Guayana	255	330	285	705	452	1385	669	2065
CADAPE	267	220	420	207	639	175	1075	175
Caracas	356	495	440	500	636	500	976	755
	878	1045	1145	1412	1727	2060	2720	2995

<u>Total Systems' Sales</u>				
<u>Millions kwh</u>				
	<u>1965</u>	<u>1968</u>	<u>1973</u>	<u>1979</u>
Guayana	1548	1798	2792	4236
CADAFE	1504	2044	3303	5413
Caracas	<u>1711</u>	<u>2145</u>	<u>3137</u>	<u>4870</u>
	4763	5987	9232	14519
<u>EDELCA Sales</u>				
<u>Millions kwh</u>				
	2008	3433	8252	12489
% Total Market Area Sales Supplied by EDELCA	42%	57%	89%	86%

29. The estimated overall growth in demand in the market area, and the program of capacity installation to meet it, are reasonable. The estimated demands, allowing for transmission losses, at the Macagua - Guri complex are shown in more detail in Annex 1, P. 2.

V. THE PROJECT

Description of the Project

30. The Project would be located at Guri, on the Caroni River, about 500 airline kilometers south-east of Caracas and about 90 kilometers upstream of the existing Macagua hydroelectric power station.

31. The Project would comprise the following major elements:

- (i) The main dam consisting of:
 - (a) a concrete gravity type center section, in which initially two sets of intake gates and penstocks would be installed, with provision for the later installation of 8 additional intakes and penstocks;
 - (b) a concrete chute type spillway controlled by nine radial gates; and
 - (c) a rockfill embankment on the left abutment, connected to the center gravity section.

The height of the dam would be about 100 meters above foundation level, and the overall crest length about 1,000 meters.

- (ii) A power station, immediately below the dam, in which would be installed two hydroelectric units of 175 MW each operating under a maximum gross head of 92 meters. Certain foundation works will also be provided for an additional 8 units.
- (iii) An emergency fuse plug spillway and two flood control training dikes in a small valley a short distance from the main river valley.
- (iv) A switching station situated on the left bank of the river about 1,400 meters downstream of the main dam.
- (v) A 230-kv double-circuit steel tower transmission line, about 80 km long, to connect the power plant with the Guayana substation.

32. The total volume of materials to be placed during the construction period would amount to about 1.5 million cubic meters of concrete and about 2.5 million cubic meters of earth and rockfill. About 4 million cubic meters would be excavated.

Geology

33. A very extensive drilling program covering the area of the dam and abutments has shown that foundation conditions should be entirely satisfactory for the type of structure proposed. All main structures would be founded on sound gneiss which should greatly limit the scope of physical contingencies.

Hydrology

34. Although river flow records of the Caroni have only been observed over a period of about 12 years, Harza have been able to establish a satisfactory correlation between these records and long-term records available from adjacent areas which have a rainfall regime similar to that of the reservoir area.

35. The Guri Project is situated in an area which has a pronounced maximum flood season in July/August and a minimum flow in March of each year. The maximum flood recorded was 17,000 cubic meters per second in July 1957. The drainage basin of the Caroni River upstream of the Guri damsite covers an area of 85,500 sq. km. To compute the maximum storm intensities over this large area the consulting engineers have subdivided it into five parts and estimated the possible maximum storm for each area. The storm discharges from all areas were then combined to obtain the probable maximum flood. On this basis Harza have concluded that the spillway should be designed to discharge a maximum peak flood of 50,100 cubic meters per second. This estimate confirms previous calculations made by the designers of the Macagua project.

36. The main spillway has been designed to pass a flood of 35,000 cubic meters per second, twice the recorded maximum flood. If, however, the maximum estimated flood should occur, the earthfill dike has been designed so that it would be breached. The combined spillways would then safely discharge the maximum calculated flood of 50,100 cubic meters per second and provide an adequate margin against the dam being overtopped.

Reservoir Capacity

37. When choosing the optimum height for the first stage of dam construction the consulting engineers have taken into account the usable storage which would be required in the reservoir to provide the regulated flow necessary to maintain full output from the existing Macagua power station, downstream of Guri, and at the same time maintain optimum output from a plant installation at Guri sufficient to meet the anticipated growth of system demand for a period of about ten years. The usable storage volume to maintain the required controlled discharge has been computed on the assumption that two of the lowest recorded years of river flow would occur in succession. The first stage reservoir would thus have a total volume of 17,700 million cubic meters and a usable volume of 11,800 million cubic meters with a surface area of about 900 sq. kms. Sediment tests show that siltation will not be a problem in the reservoir.

Turbo Generator Unit Sizes

38. It has been recognized in the design of the Project that to take full advantage of the 6,000 MW capability of the site it will be necessary to enlarge the reservoir capacity by increasing the height of the dam in two stages.

39. The first stage reservoir would support planned system operations until about 1979 when an increase in height of the dam could be made to accommodate the installation of further hydroelectric units. The turbines and generators will therefore be designed to operate at the higher head corresponding to the first increase in the height of the dam. In fact, they will be designed for a continuous output of 190 MW at the higher head while being capable of operating satisfactorily at the initial head with an output of 175 MW.

Engineering Studies

40. Project design has been based on detailed studies by Harza. Six alternative damsites were investigated and hydraulic model tests of the structure proposed at the selected site have shown that it would operate satisfactorily.

River Diversion During Construction

41. The large river flows to be dealt with during the construction period would make river diversion by means of tunnels prohibitively expensive. Harza have therefore prepared a multiphase diversion scheme in which the river flow would be shifted from one side to the other by means of coffer dams constructed alternately from each river bank. All coffer dam heights have been designed for year-round diversion, to accommodate flows of up to 17,000 cubic meters per second corresponding to the maximum recorded flood.

42. Hydraulic model tests show that closure of the coffer dam can be satisfactorily undertaken with flows as high as 4,000 cubic meters per second and since river flow falls below 1,000 cubic meters per second in each dry season, no undue difficulty should be experienced during coffer dam construction and closure. A flood forecasting system, consisting of stream and rain

gauges reporting automatically by radio, is now being installed to give advance warning of heavy rain and possible floods in the Caroni River basin. This will give time in which to remove construction equipment from the coffer dam area in the event that it may be inundated by an abnormal flood.

Construction Schedule

43. The most critical item of the construction schedule will be the closure and dewatering of the coffer dam. However, the specified requirements for the capacity of construction equipment, to be supplied by the civil engineering contractor, should ensure that placement of the material required for the coffer dam closure could be readily accomplished in the period of low river flow.

44. It will be important to award the civil engineering contract by December of 1963 to allow the contractor to mobilize equipment and complete the coffer dam during the second low water season following the award. Provided this is done, the estimated construction schedule is reasonable. If the schedule is maintained, work should be sufficiently advanced for first commercial deliveries of power to be made by January 1968.

Cost Estimates

45. Because of the size of the Project, cost estimates prepared by Harza were independently reviewed at Bank expense by Coopers & Lybrand, a firm of accountants with considerable experience in the costing of large projects. In making this review, the possible inflationary effect on local costs and prices of the considerable activity represented by the Project was taken into account. The resulting estimate, subsequently modified to reflect definite bids received after international competition for the civil engineering contract, is substantially the same as Harza's original estimate. This estimate is set out briefly in the following table and in greater detail in Annex 2.

	<u>Local Currency</u> Bs Millions	<u>Foreign Exchange</u> US\$ Millions	<u>Total Equivalent</u> US\$ at Bs4.54=\$1
Access & Camps	25.0	4.5	10.0
Civil Works	142.3	39.0	70.4
Power Plant Equipment	8.2	11.6	13.4
Transmission Lines & Switchyard	<u>5.0</u>	<u>3.1</u>	<u>4.2</u>
	180.5	58.2	98.0
Contingencies	36.1	11.5	19.4
Engineering & Supervision	19.4	3.5	7.8
Interest on Bank loan during construction	<u> </u>	<u>11.8</u>	<u>11.8</u>
Total	<u>236.0</u>	<u>85.0</u>	<u>137.0</u>

46. The overall contingency allowance is equivalent to about 20% of the estimated total cost of the civil engineering items and the electrical and mechanical equipment. This allowance is adequate in view of the bids received and the detailed design on which the estimate is based. The total estimated cost of the Project is considered to be realistic.

47. For the initial capacity of 350 MW, the estimated cost of the Project is about US\$392/kw installed. This cost includes civil engineering works which would be required for the installation of the remaining 8 generating units, except for unit foundations and power house extensions. The incremental cost of the remaining units is estimated to be about US\$66/kw installed, and the total cost of the 1,750 MW project when completed would be about US\$131/kw installed. These costs compare favorably with possible alternative developments in Venezuela.

VI. ECONOMIC ASPECTS

48. A detailed study of the economics of the Guri Project was made by the Bank in 1962. In brief, this study concluded that from economic, engineering and operating viewpoints, the Project would be justified provided that power supply frequency in Caracas be unified, that the Caracas load be included in the market area, and the first stage of aluminium development be undertaken. These conclusions are essentially unaffected by the small increase in the estimated cost.

49. Since the Bank's studies were made, a Commission consisting of technical representatives of La Electricidad, CADAPE and CVG was formed to study in detail the problem of frequency unification, system load forecasts and the most economic scheduling for the combined operation of the thermal plants in conjunction with the Project. Resulting from the work of the Commission the management of La Electricidad has agreed to convert its system to 60 cycle operation by 1968, and detailed planning to accomplish this is now underway.

50. The economic evaluation of the Project was based on a comparison of the costs to develop and operate alternative power systems to supply the demand of the EDELCA market area. Two alternatives were studied: one in which the Guri Project would be added to existing facilities; and the other in which only new thermal plant would be added. The present worth of all annual investments, operating expenses, and fuel expenses associated with each alternative was compared over the full physical life of the Project.

51. The economic yield on the additional investment required by hydroelectric development vis-a-via alternative thermal development was estimated to be of the order of 8% for a load forecast then considered to be somewhat optimistic, particularly in the later years. As a result of recent specific

arrangements for industrial development and the inclusion of additional market areas in the CADAPE system, the Commission has developed estimates of demand which are slightly higher, in the early years, than those used in the economic study and somewhat lower than the more optimistic of the two forecasts made for the later years. These new estimates are considered to be reasonable and are those presented in Chapter IV. In addition, the phasing of the installation of units 3 through 10 at Guri (at a relatively low incremental cost) is now likely to be more rapid than envisaged earlier. These factors would raise the indicated economic yield ~~somewhat~~ above the 8% originally calculated.

VII. FINANCIAL ASPECTS

Past Operations

52. The Macagua plant was constructed with national government funds. With the creation of EDELCA and the transfer of all CVG power operations to it, CVG's initial and subsequent investments in power will be evidenced by ownership of EDELCA's common stock. Macagua was conceived primarily as the source of power for the steelworks, and although the power plant was placed in operation during the latter half of 1961, it has not yet reached full production owing to delays in completion of the steelworks. Operating results for 1961-1962 are not significant, and appraisal of the financial condition of EDELCA has therefore been limited to reviewing projected operations in 1963 and later years. The Macagua plant had been carried in the CVG property accounts at Bs204 million, its original cost with foreign exchange costs included at the rate of exchange of Bs3.35 = US\$1 obtaining during the construction period. CVG has agreed to revalue this account in accordance with the present exchange rate of Bs4.54 = US\$1, so that the initial plant account of EDELCA will be Bs223.1 million.

Construction Expenditures and Sources of Financing

53. The first stage of Guri, the Project for which Bank financing is proposed, will be completed by the end of 1967. The second stage, during which an additional 8 units will be installed would be completed by 1977, and fully loaded by 1979. Estimated investment requirements are therefore reviewed below for the initial construction period 1963-1967, and the first seven years of operation and continued construction 1968-1974. Construction expenditures during the period 1963-1974 are shown in Annex 3.

First Stage Period, 1963-1967

54. Harza's most recent estimate of initial commercial operation of the first two units at Guri is January 1968. The total investment required in all facilities and the plan for financing it is summarized below:

Millions of Bs 1963-1967

Construction Expenditures

Guri First Stage ^{1/}	568.3	
Interest during construction ^{2/}	<u>53.5</u>	621.8
EHV and other transmission ^{3/}		<u>67.7</u>
		<u>689.5</u>

Sources of Financing

Macagua Operations		97.8
CVG Investment ^{1/}		159.9
Proposed Bank Loan ^{4/}		385.8
Future External Financing ^{5/}		<u>46.0</u>
		<u>689.5</u>

The construction expenditures for the dam and units 1 and 2 are based on the estimates discussed in paragraph 45. The estimate for the 230-kv Guri - Matanzas line is based on recent bid prices for the Matanzas - Caracas line. The expenditures on EHV transmission are for initiation of construction of a double-circuit line from the Guayana to Caracas provisionally planned for 400-kv operation in 1969. The estimated cost of the line was developed by the technical commission of CVG - CADAPE - La Electricidad which carried out the frequency unification studies. The estimate is based on earlier studies made by Harza and is reasonable. It has been assumed that EDELCA will own the EHV facilities.

55. The proposed US\$85 million Bank loan would represent 62% of the cost of the first stage of the Guri Project alone, exclusive of the EHV facilities.

Second Stage Period, 1968-1974

56. The load-capacity studies recently completed by the technical commission on frequency unification indicate that optimum economic operation of all three electric power undertakings (EDELCA, CADAPE, and La Electricidad)

-
- ^{1/} Includes Bs8.1 million in 1962 for site preparation.
 - ^{2/} On proposed Bank loan only.
 - ^{3/} Not included in Project proposed for Bank financing.
 - ^{4/} Including capitalized interest
 - ^{5/} It has been assumed that EDELCA will borrow the foreign currency costs of the EHV facilities and additional generating units.

will require installation of an additional Guri unit each year 1970-1977, when the full capacity of 10 units would be installed. During this period, the EHV line will be completed (1969) and additional small investments in transmission will be required. Total investments required, and projected sources of financing are summarized below.

	<u>Millions of Bs 1968-1974</u>	
<u>Construction Expenditures</u>		
Guri Units 3-9 ^{1/}	340.4	
EHV and other Transmission	<u>67.1</u>	<u>407.5</u>
<u>Sources of Financing</u>		
Power Operations ^{2/}	92.0	
CVG Investment ^{3/}	7.3	
Future External Financings ^{4/}	<u>308.2</u>	<u>407.5</u>

If Guri Dam is to be raised in 1980 to develop additional capacity, an additional amount of approximately Bs 400 million will have to be spent during 1977-1979.

Proposed Bank Financing

57. The proposed Bank loan would finance all the foreign exchange costs of the Project. The principal amount of the loan would be US\$73.2 million to be disbursed during 1963-1967,^{5/} plus interest on the loan during construction, of US\$11.8 million. The terms of the loan have been assumed to be 5½%, repayable in 25 years including a 4½-year grace period. Disbursements were estimated in accordance with Project construction requirements as developed by Harza.

<u>Year</u>	<u>U.S. \$ Millions</u>		
	<u>Annual Disbursement</u>	<u>Capitalized Interest</u>	<u>Outstanding Amount at Year End</u>
1963	8.0	0.8	8.8
1964	15.4	1.4	25.6
1965	24.0	2.5	52.1
1966	14.1	3.4	69.6
1967	<u>11.7</u>	<u>3.7</u>	85.0
	73.2	11.8	

^{1/} Units 8 and 9 in service 1975 and 1976 respectively.

^{2/} After service on proposed Bank loan, and future external financings.

^{3/} See paragraph 58.

^{4/} For completion of EHV facilities and units 3-9.

^{5/} Construction should be completed at the end of 1967, and commercial operation should be achieved in 1968.

Proposed CVG Financing

58. The national government has projected annual appropriations in its recently-published Four Year Plan adequate to cover all local currency expenditures for the Project. Since the construction of Guri and associated transmission, and the operation of all power facilities will be carried out by EDELCA, it has been assumed in this analysis that all monies made available to CVG from the government budget will be invested in the subsidiary in the form of common stock. All government investment therefore has been shown as "Capital" in the projected statements of EDELCA. Total government financing of Bs 159 million in local currency would be required during 1963-1968.

Reinvested Earnings

59. It has been assumed that all EDELCA's earnings during the construction period and the first year of operation of Guri will be retained. Thereafter, 1969-1974, payment of dividends to CVG has been assumed at a level which would allow EDELCA to finance from earnings local currency construction expenditures associated with completion of the second stage of Guri. Dividends in any given year were assumed to be payable from that year's earnings only. The assumption of dividend payments at this level would require that the cost of raising the dam after 1979 be financed by external sources. (See Paragraph 70.)

Costs of Operation

Depreciation

60. In calculating depreciation charges all new investments have been assumed to be on the books for the full year in which they first come into service. The following effective lives and corresponding rates of depreciation were assumed:

<u>Facility</u>	<u>Life - Years</u>	<u>Rate</u>
Guri Dam	100	1.00%
Guri Units	33	3.00%
Macagua (all plant)	46.5	2.15%
Transmission	35	2.86%

The above assumptions result in an average life for the Guri Project of 48.5 years, or a composite straight-line annual depreciation rate of 2.06%.

Operating Expenses and General Expenses

61. CVG has had one full year's experience in the operation of Macagua, where direct operating expenses in 1962 were about Bs 1.9 million. Estimated future expenses are Bs 2.0 million annually. Direct operating expenses at Guri have been estimated by Harza. This annual expense item increases from Bs 1.6 million when two units are in service, to a maximum of Bs 4.7 million when

all ten units are in operation. Annual operation and maintenance expenses of the transmission facilities associated with the Macagua - Guri complex have been estimated at 1% of the original cost of plant in service. General and overhead expenses have been estimated at Bs 1.2 million per year. All the above estimates are reasonable.

Rates and Revenues

62. EDELCA plans to charge rates for power sales as discussed below. Although these rates will be based on demand and energy charges, they are stated here in terms of centimos per kwh.

(i) CVG steelworks

The rates now in existence for sales of Macagua power to the steelworks will be maintained. Although at the present time power billings are intra-corporate transactions between two divisions of CVG, all sales to the steelworks by EDELCA will be paid for in cash. The rates are 1.2 centimos per kwh for furnace power, and 2.5 centimos for mill power (equivalent to 2.6 and 5.5 U.S. mills, respectively).

(ii) ALCASA

CVG's power agreement with ALCASA fixes at 1.0 centimo per kwh (equivalent to 2.2 U.S. mills) the rate for power sales up to full use of 55 MW demand. ALCASA must pay a minimum billing equivalent to an average 40% use of the established demand. Provision is made for an additional 50 MW if requested and available at a rate not higher than 1.0 centimo per kwh. The ALCASA contract will be assigned to EDELCA by CVG.

(iii) Industries in Guayana

Rates for sales to the mining and petroleum operations now average 5.0 centimos per kwh (equivalent to 11 U.S. mills) and EDELCA plans to maintain these rates at present levels. Rates for electro-metallurgical and chemical industries now planned for operation beginning in the late 1960's have been tentatively set at an average of 3.0 centimos per kwh (equivalent to 6.6 U.S. mills).

(iv) La Electricidad

At present the generating capacity of this all-thermal system is adequate to serve its own requirements, and with the completion in 1966 of the new 60 MW unit now on order, capacity will continue to be adequate until about 1969. In that year, the EDELCA EHV transmission from the Guayana to Caracas is scheduled to be in service, and La Electricidad will begin to purchase EDELCA energy. EDELCA plans to charge two rates for these purchases:

- (a) 3.8 centimos per kwh (equivalent to 1.8 U.S. mills) for hydro-energy purchased to reduce thermal plant production during off-peak hours. This price was determined on the basis of the average fuel cost to La Electricidad;
- (b) 2.0 centimos per kwh (equivalent to 4.4 U.S. mills) for supplies to meet La Electricidad's growing peak demand. This price was determined on the basis of the estimated fixed and operating costs of new thermal plant.

Both rates are reasonable, and while subject to more extensive study and final negotiation when bulk supply contracts are drawn up, they are generally acceptable to La Electricidad, and are suitable for the purposes of this analysis.

(v) CADAPE

CADAPE will begin the purchase of EDELCA energy in 1965 when the Matanzas - Caracas 230-kv transmission line is in service.^{1/} CADAPE plans to rely upon EDELCA for increasing bulk supplies instead of building new thermal plant, and will also retire certain high-cost diesel capacity. EDELCA plans to charge two rates to CADAPE, similar to the rates to La Electricidad. These rates will be 0.6 centimos per kwh (equivalent to 1.3 U.S. mills) for hydro-energy purchased to reduce thermal plant production during off-peak hours, and 1.5 centimos per kwh (equivalent to 3.3 U.S. mills) for supplies to meet CADAPE's growing peak demand. These prices are lower than the proposed rates to La Electricidad, reflecting CADAPE's lower gas costs, and the fact that CADAPE will own and operate the 230-kv transmission facilities. These prices are also reasonable, and suitable for use in this analysis.

63. The effect of all the above rates will be to produce an average revenue for all energy sold by EDELCA of about 1.5 centimos per kwh (equivalent to 3.3 U.S. mills).

64. It would not be reasonable to expect that contracts for bulk supplies by EDELCA to La Electricidad and CADAPE be drawn up now. However, based on the achievement of agreement in principle to unify frequency and the progress in planning for integrated operation to achieve optimum efficiency among the several systems, it can reasonably be assumed that suitable contracts will in fact be entered into at appropriate times. The rates set forth above and the sales discussed under Power Market should produce satisfactory operating revenues.

65. During the period of construction of the Project, 1963-1967, the steelworks will continue to be EDELCA's major customer, producing 71% of all revenues. After the completion of the Project, sales to La Electricidad and CADAPE will account for 22% and 31% respectively of all revenues during 1968-

^{1/} During 1966-1968, CADAPE will also purchase energy from La Electricidad.

1974. In this period, sales to the steelworks will produce 26% of all revenues, while aluminium operations are forecast to account for not more than 5%. The balance of 16% represents sales to mining, petroleum, other electrometallurgical, and electrochemical operations. Sales figures appear in detail in Annex 1, page 1.

Projected Operating Results

66. Projected Income Statements, Sources and Applications of Funds, and Balance Sheets are included as Annexes 4-6.

Earnings

67. During the first stage construction period, 1963-1967, return will increase from 3.7% on net plant in service in 1963, to 11.5% in 1967. In 1968, the first year of operation of Guri, return will fall to 4.6% on net plant in service. This will be due to an increase of nearly 4 times in the plant account. The return will reach 8% in 1973, the sixth full year of operation.

68. The above forecasts assume that EDELCA will be exempt from taxes on income. CVG itself is specifically exempt under its charter, and it is expected that EDELCA, as a wholly-owned CVG subsidiary, will be accorded the same treatment.

Construction Financed Internally

69. Cash from Macagua operations will finance about 14% of all construction expenditures during 1963-1967. Based on the assumption that the foreign currency costs of the EHV facilities and additional generating units will be borrowed, EDELCA could finance about 23% of all 1968-1974 construction from net internal cash generation.

Dividends to CVG

70. As noted in paragraph 59, it has been assumed that all net earnings of EDELCA will be retained until 1969. The Venezuelan Government will have made a substantial investment in EDELCA, and it is considered reasonable that a return on this investment be paid as soon as the cash position of EDELCA warrants. This position should be achieved by 1969, at which time the investment will be over Bs 500 million.^{1/} In projecting the operating results, it has been assumed that a token dividend will be paid in 1968, increasing to annual dividend payments of about 8% on the investment by 1974.

Debt Service and Interest Coverage

71. Under the assumed terms of the proposed Bank loan, debt service would begin in 1968. Repayment of the first of the assumed series of future borrowings

^{1/} Composed of Macagua's revalued cost, contributions to construction of Guri and transmission, and reinvested earnings from power operations.

for EHV facilities and additional generating units would start in 1969, although it has been assumed that interest on these borrowings during the construction period would be paid from operations. Internal cash generation from operations will cover the total annual service requirements 1.4 times in 1968, and increase to over 2 times by 1974. As to interest alone, coverage by operating income will be 1.5 times in 1968, increasing to over 3 times in 1974.

Debt/Equity Ratio

72. At the end of 1967 when the proposed Bank loan will be fully drawn down, EDELCA's debt/equity ratio will be 48/52, and will reach 51/49 for the period 1970-1974. These ratios would of course be lower if all earnings were retained and dividends foregone.

Indicated Financial Operating Results

73. From the viewpoint of the three meaningful measures of financial performance -- return on investment, coverage of debt-service requirements, and ability to finance a reasonable portion of construction expenditures internally -- the indicated operating results of EDELCA are satisfactory.

Proposed Financial Covenants

Rates

74. It would be appropriate to require EDELCA to agree to maintain its average rates at such levels so as to produce revenues not lower than those assumed in this appraisal, and in any event to achieve and maintain not later than 6 years after initial commercial operation of Guri a return of not less than 8% on net plant in service.

Debt Limitation

75. In view of the large investment (equivalent to about US\$90 million) which will be required during 1968-1974 to continue the second stage plant installation, EDELCA has agreed not to incur, without the approval of the Bank, any debt additional to the proposed Bank loan during the construction of the Project; and after completion of construction not to incur any new debt unless service on all debt in any given year will be covered not less than 1.4 times by internal cash generation during the twelve months preceding the date on which the new debt would be incurred after adjusting internal cash generation to take account of any rate increases effective at the date of such incurrence.

Accounts and Audits

76. EDELCA will maintain corporate accounts in a form similar to that prescribed by the United States Federal Power Commission. CVG's accounts are subject to audit by the national government's Controleria de la Nacion, as will be the accounts of EDELCA. EDELCA has agreed to retain independent auditors acceptable to the Bank for annual reviews of its accounts.

VIII. CONCLUSIONS

77. The Guri Project has been soundly planned and engineered. The cost estimates are reasonable, and their adequacy has been confirmed by Coopers & Lybrand, and subsequently by the international bids received for the civil works. Reasonable contingency allowances have been included. The work can be completed within the time scheduled, provided the main civil engineering contract is awarded before December 1963. (Paragraphs 40, 44, 46.)

78. CVG staff, which will be transferred to the new electric power subsidiary, is capable, and provides a suitable nucleus on which to build the full organization of EDELCA by 1968 (paragraph 13).

79. Projected operating results are satisfactory. An 8% rate of return on net plant in service should be reached during the sixth year of operation (paragraph 67). During the first stage construction period 1963-1967, about 15% of all construction expenditures could be derived from operations. Thereafter, net cash generation from operations after debt service should be adequate to finance a reasonable portion of the cost of continuing the second stage, as well as pay dividends to CVG (paragraph 69). Coverage of service on the proposed Bank loan plus assumed additional borrowings would be adequate, rising from almost 1.5 times in the first year of operations to over 2 times in the seventh year (paragraph 71).

80. The Project would provide a suitable basis for a loan to EDELCA of US\$85 million, including interest during construction, for 25 years including a grace period of $4\frac{1}{2}$ years. It has been agreed with the Bank that:

- (i) the national government and CVG will treat all investment, past and future, in EDELCA as equity;
- (ii) the national government will carry out a program of frequency unification, and has given an undertaking that it will finance the costs of converting to 60 cycle operation the facilities of the customers served by La Electricidad;
- (iii) the national government will make promptly available to EDELCA adequate local currency required to carry out the Project on schedule;
- (iv) the national government will ensure that the necessary EHV facilities will be constructed by EDELCA, when appropriate;
- (v) any contracts entered into by CVG on behalf of EDELCA will be obligations of EDELCA, and will be reflected in its accounts;
- (vi) the services of consulting engineers, acceptable to the Bank, will continue to be employed until construction is completed and the Project is placed in operation;

- (vii) the statutes of EDELCA ;
 - (a) provide that its President and Board may not be removed for other than cause;
 - (b) provide that the President shall be of proven executive experience and capacity, and competent to manage EDELCA; and
 - (c) will not be substantially changed without the agreement of the Bank;
- (viii) EDELCA will consult with the Bank prior to the appointment of its President;
- (ix) EDELCA will take steps to insure that staff adequate to competently operate the expanded power facilities will be available by the time the Guri Project comes into operation;
- (x) EDELCA will maintain its average rates at such levels so as to produce revenues not lower than those assumed in this appraisal, and in any event to achieve and maintain not later than 6 years after initial commercial operation of Guri a return of not less than 8% on net plant in service;
- (xi) during the construction of the Project, EDELCA will not, without the approval of the Bank, incur any debt additional to the proposed Bank loan; after completion of construction, EDELCA will not incur any new debt unless service on all debt in any given year will be covered not less than 1.4 times by internal cash generation during the twelve months preceding the date on which the new debt would be incurred after adjusting internal cash generation to take account of any rate increases effective at the date of such incurrence;
- (xii) EDELCA will not undertake prior to completion of the Project proposed for Bank financing any major works, other than the Project, except with the agreement of the Bank;
- (xiii) EDELCA will not pay dividends during 1963-1967, and thereafter only if a reasonable surplus would remain to finance new investment after payment from revenues of all operating costs, interest, depreciation, amortization payments to the extent not covered by depreciation, taxes if any and dividends, as well as maintain adequate working capital; and
- (xiv) EDELCA will retain a firm of independent auditors, acceptable to the Bank, to review its accounts annually.

September 3, 1963

VENEZUELA - GURI HYDROELECTRIC PROJECT

EDELCA

ESTIMATED ENERGY SALES AND REVENUES

CUSTOMER	ACTUAL	ESTIMATED																
	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
		Millions of kwh Sales																
CVG STEELWORKS	475	1019	1398	1398	1398	1398	1398	1464	1497	1602	1647	1692	1692	1741	1791	1840	1890	2011
AICASA	-	-	-	100	200	200	200	300	350	400	600	700	800	1200	1400	1600	1600	1600
GUAYANA INDUSTRIAL	33	50	50	50	100	150	200	250	300	325	375	400	450	475	500	550	575	625
LA ELECTRICIDAD	-	-	-	-	-	-	-	803	1181	1691	2076	2341	2632	2651	3116	3428	3205	2998
CADAFE	-	-	-	460	220	184	1635	1817	2143	2480	2785	3119	3392	3677	4089	4446	4859	5255
TOTAL SALES	508	1069	1448	2008	1918	1932	3433	4634	5471	6498	7483	8252	8966	9744	10896	11864	12129	12489
		Millions of Bolivares Revenues 1/																
CVG STEELWORKS	6.1	13.5	19.3	19.3	19.3	19.3	19.3	21.0	21.8	24.5	25.6	26.7	26.7	27.9	29.2	30.4	31.7	34.7
AICASA	-	-	-	1.0	2.0	2.0	2.0	3.0	3.5	4.0	6.0	7.0	8.0	12.0	14.0	16.0	16.0	16.0
GUAYANA INDUSTRIAL	1.6	2.5	2.5	2.5	5.0	7.5	10.0	12.5	15.0	15.8	17.2	18.0	19.5	20.3	21.0	22.5	23.3	24.8
LA ELECTRICIDAD	-	-	-	-	-	-	-	8.7	14.1	22.0	26.2	31.3	36.8	40.2	47.1	53.6	50.0	50.0
CADAFE	-	-	-	6.4	3.1	2.6	21.4	20.4	23.5	26.0	30.2	35.1	39.2	43.9	49.6	58.0	63.2	68.2
TOTAL REVENUES	7.7	16.0	21.8	29.2	29.4	31.4	55.7	65.6	77.9	92.3	105.2	118.1	130.2	144.3	160.9	180.5	184.2	193.7

1/ For Rates see Text, Paragraph 62
July 2, 1963

VENEZUELA - GURI HYDROELECTRIC PROJECT

EDSICA

Estimated Maximum Demand at Guri-Macagua Complex
(Megawatts)

	<u>1963</u>	<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>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>
<u>CUSTOMER</u>																	
CVG Steelworks ^{1/}	160	220	220	220	220	220	240	240	272	272	272	274	292	292	312	312	344
ALCASA ^{2/}	-	-	25	25	25	25	50	50	50	100	100	100	200	200	200	200	200
Guayana Industrial	10	10	10	20	30	40	50	60	65	75	80	90	95	100	110	115	125
La Electricidad	-	-	-	-	-	-	50	162	238	300	366	430	364	535	587	460	356
CADAFE	-	-	64	52	60	220	315	345	409	484	550	619	742	764	833	905	950
TOTAL DEMAND	170	230	319	317	335	505	705	857	1034	1231	1368	1513	1683	1891	2042	1992	1975
Number of Guri Units in Operation						2	2	3	4	5	6	7	8	9	10	10	10

^{1/} Steelworks:
Electric Furnaces 180 MW
Finishing Balance

^{2/} ALCASA:
Reduction Capacity - Annual Tons
1965 12500
1969 25000
1972 50000
1975 100000

July 2, 1963

ANNEX 2
July 2, 1963

VENEZUELA

EDELCA

GURI HYDROELECTRIC PROJECT

	<u>Local Currency Bs x 1000</u>	<u>Foreign Currency US\$ x 1000</u>	<u>Total US\$ x 1000</u>
1. Land Acquisition, Camps, Roads	25,015	4,477	9,987
2. River Diversion	9,250	5,500	7,537
3. Tailrace Excavation	9,132	1,110	3,121
4. Spillway	38,060	11,074	19,457
5. Main Dam	56,176	13,032	25,406
6. Rockfill Embankment	12,923	2,674	5,521
7. Dikes	1,983	217	654
8. Intakes, Gates, Guides	5,272	890	2,051
9. Powerhouse excavation	1,450	270	589
10. Turbine Intakes	--	190	190
11. Penstocks	612	1,878	2,013
12. Power Station Building	7,399	2,225	3,855
13. Turbines and Governors	2,200	2,860	3,344
14. Generators and Transformers	2,800	4,580	5,197
15. Misc. Power Plant Equipment	3,200	4,120	4,825
16. Switchyard and Equipment	3,000	1,470	2,131
17. 230-kv Transmission	<u>2,000</u>	<u>1,679</u>	<u>2,119</u>
Total Construction	180,472	58,246	97,997
Contingencies	36,075	11,469	19,415
Engineering and Supervision	<u>19,383</u>	<u>3,493</u>	<u>7,763</u>
TOTAL	<u>235,930</u>	<u>73,208</u>	<u>125,175</u>

VENEZUELA

EDELCA

ANNUAL CONSTRUCTION EXPENDITURES
(Millions of Bolivares)

In Service	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1962-1974
Grid First Stage														
1968														
Local currency	8.1	16.9	27.0	65.0	70.0	49.0								236.0
Foreign exchange	-	36.3	69.9	109.0	64.0	51.1								332.3
	8.1	53.2	96.9	174.0	134.0	102.1								568.3
Grid Second Stage														
Unit 3														
Local currency							5.6	9.9						15.5
Foreign exchange							19.5	29.5						49.0
							25.1	39.4						64.5
Unit 4														
Local currency							-	4.7						4.7
Foreign exchange							11.8	24.1						35.9
							11.8	28.8						40.6
Unit 5														
Local currency								5.6	9.9					15.5
Foreign exchange								19.5	29.5					49.0
								25.1	39.4					64.5
Unit 6														
Local currency								-	4.7					4.7
Foreign exchange								11.8	24.1					35.9
								11.8	28.8					40.6
Unit 7														
Local currency									5.6	9.9				15.5
Foreign exchange									19.5	29.5				49.0
									25.1	39.4				64.5
Unit 8														
Local currency												-	4.7	4.7
Foreign exchange												11.8	24.1	35.9
												11.8	28.8	40.6
Unit 9														
Local currency													5.6	5.6
Foreign exchange													19.5	19.5
													25.1	25.1
Transmission														
115-kv														
Local currency		0.4	0.7				-	-						1.1
Foreign exchange		1.2	2.1				0.1	0.2						3.9
		1.6	2.8				0.1	0.2						5.0
230-kv														
Local currency							0.1	0.3						1.0
Foreign exchange							0.4	0.6						2.5
							0.5	0.9						3.5
EHV														
Local currency					4.4	8.4	11.4							28.7
Foreign exchange					14.0	32.0	34.0			0.7	1.3	0.4	0.6	93.7
					18.4	40.4	45.4			2.2	4.0	1.0	2.0	122.4
Communications														
Local currency							0.2							0.2
Foreign exchange							0.7							0.7
							0.9							0.9
Total - All Construction														
Local currency	8.1	17.3	27.7	65.0	74.4	57.7	17.3	9.9	11.0	11.4	11.1	10.5	11.8	333.2
Foreign exchange	-	37.5	72.0	109.0	78.0	86.3	34.3	41.3	45.8	45.9	45.8	43.3	48.1	707.3
	8.1	54.8	99.7	174.0	152.4	144.0	71.6	51.2	56.8	57.3	56.9	53.8	59.9	1,040.5

July 2, 1963

VENEZUELA

EDELCA

ESTIMATED INCOME STATEMENTS
(Millions of Bolivares)

	Pro Forma	Estimated											
	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Energy Sales - Millions of kwh	508	1069	1448	2008	1918	1932	3433	4634	5471	6498	7473	8252	8966
Average Realization - Centimos	1.5	1.5	1.5	1.5	1.5	1.6	1.6	1.4	1.4	1.4	1.4	1.4	1.5
Operating Revenues	7.7	16.0	21.8	29.2	29.4	31.4	55.7	65.6	77.9	92.3	105.2	118.1	130.2
Operating Expenses													
Operation and Maintenance	1.4	2.0	2.0	2.0	2.0	2.0	3.7	4.7	4.9	5.0	5.6	6.1	6.7
Depreciation	4.2	4.8	4.8	4.9	4.9	5.0	13.5	16.7	18.7	20.0	22.2	23.6	25.7
General Expenses	0.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
	5.8	8.0	8.0	8.1	8.1	8.2	18.4	22.6	24.8	26.2	29.0	30.9	33.6
Operating Income	1.9	8.0	13.8	21.1	21.3	23.2	37.3	43.0	53.1	66.1	76.2	87.2	96.6
Interest	-	3.7	6.4	11.1	16.6	18.7	25.6	27.5	26.4	30.7	29.3	33.2	31.6
Interest Charged to Construction	-	3.7	6.4	11.1	16.6	18.7	4.4	2.5	2.2	2.5	2.2	2.5	2.2
Interest Expense	-	-	-	-	-	-	21.2	25.0	24.2	28.2	27.1	30.7	29.4
Net Income	1.9	8.0	13.8	21.1	21.3	23.2	16.1	18.0	28.9	37.9	49.1	56.5	67.2
Return on Average Net Plant in Service	0.9%	3.7%	6.5%	10.1%	10.3%	11.5%	4.6%	4.7%	5.5%	6.7%	7.3%	8.2%	8.7%

July 2, 1963

VENEZUELA

EDELCA

FORECAST OF SOURCES & APPLICATIONS OF FUNDS

Millions of Bolivares

	<u>1963</u>	<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>1974</u>
<u>SOURCES</u>												
<u>INTERNAL</u>												
Operating Income	8.0	13.8	21.1	21.3	23.2	37.3	43.0	53.1	66.1	76.2	87.2	96.6
Depreciation	4.8	4.8	4.9	4.9	5.0	13.5	16.7	18.7	20.0	22.2	23.6	25.7
	<u>12.8</u>	<u>18.6</u>	<u>26.0</u>	<u>26.2</u>	<u>28.2</u>	<u>50.8</u>	<u>59.7</u>	<u>71.8</u>	<u>86.1</u>	<u>98.4</u>	<u>110.8</u>	<u>122.3</u>
<u>EXTERNAL</u>												
CVG Investment	7.7	14.2	48.0	51.2	30.7	7.3	-	-	-	-	-	-
Proposed IBRD Loan	40.0	76.3	120.1	79.6	69.8	-	-	-	-	-	-	-
Future Financings	-	-	-	14.0	32.0	53.5	41.3	43.6	41.3	43.6	41.3	43.6
	<u>47.7</u>	<u>90.5</u>	<u>168.1</u>	<u>144.8</u>	<u>132.5</u>	<u>60.8</u>	<u>41.3</u>	<u>43.6</u>	<u>41.3</u>	<u>43.6</u>	<u>41.3</u>	<u>43.6</u>
<u>TOTAL SOURCES</u>	<u>60.5</u>	<u>109.1</u>	<u>194.1</u>	<u>171.0</u>	<u>160.7</u>	<u>111.6</u>	<u>101.0</u>	<u>115.4</u>	<u>127.4</u>	<u>142.0</u>	<u>152.1</u>	<u>165.9</u>
<u>APPLICATIONS</u>												
Construction	54.8	99.7	174.0	152.4	144.0	71.6	51.2	56.8	57.3	56.9	53.8	59.9
Interest on IBRD Loan	3.7	6.4	11.1	15.6	16.7	21.2	20.6	20.0	19.4	18.7	18.0	17.3
Interest on Future Financings	-	-	-	1.0	2.0	4.4	6.9	6.4	11.3	10.6	15.2	14.3
	<u>3.7</u>	<u>6.4</u>	<u>11.1</u>	<u>16.6</u>	<u>18.7</u>	<u>25.6</u>	<u>27.5</u>	<u>26.4</u>	<u>30.7</u>	<u>29.3</u>	<u>33.2</u>	<u>31.6</u>
Repayment of IBRD Loan	-	-	-	-	-	10.4	11.0	11.6	12.2	12.9	13.6	14.3
Repayment of Future Financings	-	-	-	-	-	-	2.9	3.1	6.3	6.7	10.2	10.8
	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>10.4</u>	<u>13.9</u>	<u>14.7</u>	<u>18.5</u>	<u>19.6</u>	<u>23.8</u>	<u>25.1</u>
<u>TOTAL DEBT SERVICE</u>	<u>3.7</u>	<u>6.4</u>	<u>11.1</u>	<u>16.6</u>	<u>18.7</u>	<u>36.0</u>	<u>41.4</u>	<u>41.1</u>	<u>49.2</u>	<u>48.9</u>	<u>57.0</u>	<u>56.7</u>
Additions to Working Capital	2.0	3.0	9.0	2.0	(2.0)	4.0	3.4	(0.5)	4.9	(0.8)	5.3	4.3
Dividends to CVG	-	-	-	-	-	-	5.0	18.0	16.0	37.0	36.0	45.0
<u>TOTAL APPLICATIONS</u>	<u>60.5</u>	<u>109.1</u>	<u>194.1</u>	<u>171.0</u>	<u>160.7</u>	<u>111.6</u>	<u>101.0</u>	<u>115.4</u>	<u>127.4</u>	<u>142.0</u>	<u>152.1</u>	<u>165.9</u>
WORKING CAPITAL - YEAR END	4.0	7.0	16.0	18.0	16.0	20.0	23.4	22.9	27.8	27.0	32.3	36.6
TIMES DEBT SERVICE COVERED BY INTERNAL CASH	3.5x	2.9x	2.3x	1.6x	1.5x	1.4x	1.4x	1.7x	1.8x	2.0x	1.9x	2.2x

July 2, 1963

VENEZUELA
EDELCA
BALANCE SHEETS
Millions of Bolivares

	<u>Pro-Forma</u> <u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>ESTIMATED</u> <u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
ASSETS													
Gross Plant in Service	223.1	223.1	223.1	227.5	227.5	228.4	850.2	962.7	1030.0	1072.5	1148.0	1192.9	1264.2
Depreciation Reserve	4.2	9.0	13.8	18.7	23.6	28.6	42.1	58.8	77.5	97.5	119.7	143.3	169.0
Net Plant in Service	218.9	214.1	209.3	208.8	203.9	199.8	808.1	903.9	952.5	975.0	1028.3	1049.6	1095.2
Work in Progress	8.1	66.6	172.7	353.4	522.4	684.2	138.4	79.6	71.3	88.6	72.2	83.6	74.4
Net Fixed Assets	227.0	280.7	382.0	562.2	726.3	884.0	946.5	983.5	1023.8	1063.6	1100.5	1133.2	1169.6
Net Current Assets	2.0	4.0	7.0	16.0	18.0	16.0	20.0	23.4	22.9	27.8	27.0	32.3	36.6
TOTAL ASSETS	229.0	284.7	389.0	578.2	744.3	900.0	966.5	1006.9	1046.7	1091.4	1127.5	1165.5	1206.2
LIABILITIES													
CVG Equity	229.0	236.7	250.9	298.9	350.1	380.8	388.1	388.1	388.1	388.1	388.1	388.1	388.1
Capital Surplus	-	8.0	21.8	42.9	64.2	87.4	103.5	116.5	127.4	149.3	161.4	181.9	204.1
	229.0	244.7	272.7	341.8	414.3	468.2	491.6	504.6	515.5	537.4	549.5	570.0	592.2
Long Term Debt	-	40.0	116.3	236.4	316.0	385.8	375.4	364.4	352.8	340.6	327.7	314.1	299.8
Proposed IBRD Loan	-	-	-	-	14.0	46.0	99.5	137.9	178.4	213.4	250.3	281.4	314.2
Future Financings	-	40.0	116.3	236.4	330.0	431.8	474.9	502.3	531.2	554.0	578.0	595.5	614.0
TOTAL LIABILITIES	229.0	284.7	389.0	578.2	744.3	900.0	966.5	1006.9	1046.7	1091.4	1127.5	1165.5	1206.2
DEBT/EQUITY RATIO	-	14/86	30/70	41/59	44/56	48/52	49/51	50/50	51/49	51/49	51/49	51/49	51/49

