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Report No. T.O. 203a

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

APPRAISAL OF THE GUADALUPE HYDROELECTRIC PROJECT

OF THE

EMPRESAS PUBLICAS DE MEDELLIN

COLOMBIA

May 12, 1959

Department of Technical Operations

Public Disclosure Authorized

CURRENCY EQUIVALENTS

U.S. $1	-	7.5 Pesos
1 Peso	-	U.S. $0.133
1 Million Pesos	-	U.S. $133,000

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SUMMARY

i. The Bank has been asked to consider a loan to cover the foreign exchange cost of the Guadalupe hydroelectric scheme in the neighborhood of the city of Medellin, Colombia. The project would have a capacity of 96 MW and its total cost would be about $20 million of which $12 million would be in foreign currencies. This total cost is equivalent to $200 per kilowatt. This cost is low and compares favorably with the investment cost of a thermal plant.

ii. Empresas Publicas de Medellin (EPM), which would be the borrower, is an autonomous public entity independent from the municipality of the city of Medellin and from the Government. EPM has four departments dealing with power supply, telephone, water supply and sewage. Each department is administered independently and maintains separate accounts. The project would be built and operated by the Power Department. The local expenditures would be financed by retained earnings and by short-term loans.

iii. The project would comprise the diversion of two small rivers into the Guadalupe river, the construction of an earthfill dam, the development of 96 MW in two different power stations, transmission facilities and the expansion of the Medellin distribution system.

iv. EPM's management is competent and its staff, which already includes good engineers is in the process of being strengthened. Several consulting firms have participated in the design of the various structures and arrangements are being made to ensure proper coordination and supervision of construction. In addition, EPM has retained the services of an expert of international reputation who has investigated the sedimentation problem in the Guadalupe river and its tributaries. This expert has made recommendations to alleviate this problem and EPM has undertaken to carry them out.

v. The economic justification of the project is well established. The present capability of EPM's facilities is already fully utilized and EPM will have to ration power until the start of operation of the project. Thereafter, this enlarged capability will be absorbed within one or two years. Therefore, EPM is in the process of completing the studies and designs of another hydroelectric project on the Nare river and will take all steps necessary to start its construction as soon as possible.

vi. The present financial position of EPM's four departments is sound. The Bank has received assurances that the assets of the Power Department would not be used by the other departments and that all departments would continue to be maintained in a sound financial position.

vii. An increase in the rates of EPM's Power Department was authorized on July 1, 1958, which will result in an increase of the average revenue per kwh of 32%, or from 3.4 centavos to 4.47 centavos per kwh. This reflects relatively low average rates. A further rate increase of about 5 or 6% per year during the next six years has been assumed by EPM. EPM has agreed

to take all necessary steps not less often than once every two years to obtain such adjustments in the rates charged for the services of each of its four departments as will cover all operating expenses including realistic depreciation charges and assure a reasonable return on the total investment. EPM has further agreed that power rates should be set at such a level which would permit at least 30% of new investment in power facilities to be financed from retained earnings.

viii. The financial prospects of the Power Department during the next six years (1959-64) appear to be good. During this period the return on net fixed assets would probably average about 8% and cash receipts from operations would cover debt service about 1.9 times as an average.

ix. The estimates of the cost of the project are reasonable. The project is sound and suitable as a basis for a Bank loan in the amount equivalent to $12 million for a term of 25 years including a period of grace of four years on amortization payments.

I. INTRODUCTION

1. The Empresas Publicas de Medellin (EPM) has asked the Bank to consider a loan to finance the foreign exchange cost of a power expansion program. This program consists of the development of 96 MW of hydroelectric power on the Guadalupe river, 70 km of transmission lines and the expansion of the distribution system in the city of Medellin. The total cost is estimated to be the equivalent of $19.3 million of which $12 million would be in foreign exchange.

2. Medellin first approached the Bank in 1954 for assistance in financing its electric power program. At that time the power undertaking was owned by and operated as part of the municipality. The Bank recommended that the power undertaking be established as an organization having an independent financial and administrative status before further consideration could be given to the loan application. Permissive legislation to this end was enacted by the Central Government and on August 6, 1955 the municipality established an independent agency known as the Empresas Publicas de Medellin to operate the municipal power, telephone, water and sewage undertakings under a common management. EPM's charter was approved by the Governor of the Department of Antioquia on November 25, 1955, and became effective January 1, 1956. Later in 1956 a technical mission was sent to appraise the expansion program. However, before the mission's report could be considered the Bank decided to defer further lending in Colombia until the economic situation of the country had improved. Since then EPM has attempted to carry out its power expansion program but has been hampered by the limited funds at its disposal.

II. THE BORROWER

3. EPM not only owns and operates the electrical power supply, but also a telephone system, water supply and sewage. It is therefore divided into four departments which are administered independently of each other. The cost of services within EPM common to the four departments is apportioned among them and this results in about 55% of such costs being charged to the Power Department.

Organization and Management

4. EPM's four departments, although operated separately, are administered by one general manager who is responsible to a board of directors.

5. The Board of Directors consists of seven members, appointed for a period of two years. Three of the members are appointed by the municipality and the remaining four represent banks, industries and commerce.

6. The general manager is the chief executive officer of EPM. He is appointed by the Board for a term of one year. This is too short for continuity and the possibility of lengthening the period of office is being explored. However, the present general manager has been retained in office since May 1954 and has recently been reappointed for another year.

7. Each of the four operating departments has a supervisor who deals with the day-to-day problems of his department. Managerial decisions of importance are, however, referred to the general manager.

8. Planning, engineering, finance and administration are under the direct supervision of the general manager or of one of his assistants.

Ability to Carry out Project

9. The present general manager is competent with experience in the operation of public utility enterprises. His staff includes several well qualified engineers. As the general manager and his principal engineers are overworked, EPM is taking measures to strengthen its staff.

10. On the basis of its past performance it can be assumed that EPM would be capable of carrying out the present project with the assistance of qualified consulting firms.

Facilities of EPM's Power Department

11. At present the Power Department owns and operates four hydro plants with a total capacity of 136.5 MW: Rio Grande (75 MW), Guadalupe I (40 MW), Guadalupe II (10 MW) and Piedras Blancas (11.5 MW). The transmission system totals about 150 miles of 120 KV circuits.

III. THE POWER MARKET

Area Served

12. The power system serves one of the major population centers in Colombia. The service area comprises the modern and rapidly growing city of Medellin, and a number of smaller municipalities adjacent to the Rio Grande and Rio Guadalupe plants (see Map A attached). Between 1938 and 1956 the population of the city of Medellin increased from 170,000 to 420,000, or at an average annual rate of 5.5%. This report assumes a continued increase of the population of the city and suburbs but at a slower annual rate of growth of about 3%. EPM also plans to connect, in the future, a few other small towns and villages. Accordingly, the population of the service area, which was 600,000 in 1956 and 710,000 in 1958, should reach one million in 1964 and 1.2 million in 1968.

13. The Medellin area is relatively advanced industrially and has important textile mills. However, for the past several years, the power supply deficiency has interfered with the industrial growth. Existing industries hesitate to increase their consumption and it has been common practice to have standby diesels. The two most important textile mills have recently constructed their own power plants, totalling 30 MW.

Past Growth

14. EPM has good power statistics covering the past 30 years showing number of consumers, peak loads, production and consumption for different classes of consumers. The record for the past ten years is illustrated on the charts presented in Annexes 1 and 2. The abnormal conditions which have occurred since 1956 make it advisable to consider the period 1948-56 separately.

Growth of the Peak Load and Consumption During the Period 1948-56

	1948	1956	Average Annual Rate of Growth
Peak load (in MW)	42.7	117.1	13.5%
Consumption (in million kwh)			
Residential	142.1	367.9	12.5%
Industrial	69.5	121.3	7%
Total	211.6	489.2	11%

These figures show that:

(i) The general trend of growth was very rapid in spite of years of serious power shortage, and

(ii) Residential consumption was growing more rapidly than industrial consumption. Industrial consumption, which had been about 33% of the total in 1948, the same as in previous years, declined to 25% of the total in 1956. This was due to lack of confidence by industry in the public power supply.

Conditions Occurring During the Past Two Years

15. It can be assumed that in 1957 and 1958 peak loads and total consumption would have continued to increase at approximately the same rates as in the past if all needed power had been available. However, limitations of generating capacity prevented this growth until the Quebradona Dam on the Rio Grande river and the 11.5 MW unit of the Piedras Blancas plant reached completion in the middle of 1958. As a result, the increase in the peak load during 1957 and 1958 has been much lower than in the previous period, as shown below, although consumption has held up somewhat better by a more intensive use of existing facilities.

Growth of the Peak Load and Consumption During the Period 1956-58

	1956	1957	1958	Average Annual Rate of Growth
Peak load (in MW)	117.1	125	137.1	8%
Consumption (in million kwh)				
Residential	367.9	413.6	445	10%
Industrial	121.3	134.5	137	6%
Total	489.2	548.1	582	9%

The peak load of 137.1 MW has already risen above the total capacity of EPM's system (136.5 MW) and the small excess has been supplied by an industrial thermal plant.

Forecast of Growth

16. The Bank sponsored an extensive study of the Power Market in Colombia in 1954 which was presented in the "National Electrification Plan for Colombia". Since then several studies of the Medellin area have been made by different consultants and by EPM itself. Different methods have been used but they all agreed that a high growth rate will continue for the next few years. The forecasts were based on the following factors:

i) A continued increase in the number of consumers is expected as the result of the rapid population growth in the service area. Since electric power supplied by EPM is the cheapest source of energy and no gas is available, the increase in the number of consumers should be closely related to the increase in population.

ii) The per capita consumption per annum which is now about 1,000 kwh is expected to continue to increase but at a lower rate per annum than occurred in the past. With the increase in the standard of living in Medellin there has been a growing use of appliances, especially electric cooking and this should continue.

iii) A rapid increase in industrial expansion is forecast once an adequate power supply becomes available.

The projected growth used in this report is somewhat lower than that forecast in the various studies. It results nevertheless in rates of increase for the peak load and total consumption, once unsatisfied demand has been met, of about 11% until 1960, then about 9% to 1964 and 7% to 1968. The detailed figures are given below and are compared with the actual results for 1958:

Forecast of Growth of Peak Loads and Consumption

	1958	1964	1968
Peak loads (in MW)	137.1	285	370
Consumption (in million kwh):			
Residential	445	855	1,085
Industrial	137	385	560
Total	582	1,240	1,645

17. This forecast shows that it is necessary to double the present capability of 136.5 MW before 1964 and to triple it by 1968.

IV. LONG RANGE POWER PROGRAM

18. A long-range program, of which the proposed project is the first phase, has been formulated by EPM to overcome the present shortage of power as soon as possible. This program envisages the installation of 246 MW in hydro plants on the Guadalupe and the Nare rivers between 1959 and 1964. It will consist of:

i) commissioning 80 MW in a new power plant on the Guadalupe river known as Guadalupe III in the first half of 1961;

ii) completing Troneras dam on the Guadalupe river to provide weekly regulation for the new and existing plants on this river and commissioning 16 MW in the Troneras power station early in 1962;

iii) commissioning the first 37.5 MW unit in the Guatape plant on the Nare river early in 1963 and installing a second unit of the same size shortly thereafter in order to provide the system with a standby unit. This plant will be the first to be built on the Nare river and will include the construction of a dam impounding about one billion cubic meters;

iv) commissioning two more units of 37.5 MW each in the Guatape plant between 1963 and 1964, as required to keep pace with the growth of demand.

19. After 1964, the capacity of each of the three plants (Guadalupe III, Troneras and Guatape, aggregating 246 MW) could be doubled with relatively small expenditures. The regulated available flows would be sufficient for such extensions and the additional civil works could be limited to the addition of penstocks and the extension of the existing powerhouse buildings.

20. This program is suitable and economical. The average investment required for Guadalupe III, Troneras dam and Troneras power station, which are included in the present project, with the associated transmission facilities, is about $200 per kw or US3¢ per annual kwh. Work can start immediately (see Section V). The capital cost per kw for the Guatape plant, which would be in a later stage of the program, is also expected to be low.

21. The plans for hydroelectric development of the Nare river show the adequacy of this scheme but are still preliminary and incomplete. In order that the construction of these facilities takes place as scheduled in the long-range program, work which has been discontinued on the preliminary designs is to be resumed immediately. Among the more important investigations to be made are additional borings and more detailed surveys. The hydrological study is to be supplemented by an examination of the new data available.

V. THE PROJECT

Description of the Project

22. The project which the Bank has been asked to assist in financing would increase the generating capacity at EPM by 96 MW and the amount of energy delivered annually to Medellin by about 540 million kwh. It would include transmission facilities and the expansion of the distribution system in Medellin. It would consist of:

a) Works to divert the flow of the Concepcion and Tenche rivers into the Guadalupe river, thereby increasing its minimum daily flow from 8 to 12 cubic meters per second.

b) The construction of the Troneras earthfill dam on the Guadalupe river two kilometers upstream from the intake of the existing Guadalupe I plant. This dam, which would be about 37 m. high, would create a reservoir with a useful storage capacity of about 32 million cubic meters and provide a minimum regulated daily flow of 20 cubic meters per second.

c) The construction of the Troneras power plant below the Troneras dam. The powerhouse would be designed for two units of 16 MW each, but only one unit would be installed initially.

d) The construction of the Guadalupe III power plant below Guadalupe Falls and close to Guadalupe I. The powerhouse would be designed for six units of 40 MW each, but only two would be installed initially. The gross head on the turbines would be 550 meters. (The same as on Guadalupe I). A new switchyard would be provided.

e) The erection of approximately 70 km of double circuit 120 kv transmission line from the new switchyard to Medellin and tie lines to the existing plants and to the new Troneras plant.

f) The enlargement of substations in Medellin, the addition of transformer capacity and the extension of primary and secondary distribution circuits.

g) Studies on the Nare scheme to provide data adequate for final planning of the project. They are necessary before starting any work on the Guatape plant and they should be carried out during the current year.

Annex 3 presents additional details on the project and on the plants already in existence on the Guadalupe river.

23. Flow records for the Guadalupe river are available from the operation of the first plant built at this site in 1932. They provide a satisfactory basis for planning the project. A thorough investigation of the power potential of this river was made in 1955 by OLAP, a Colombian firm associated with TAMS from New York. The general layout of the new Guadalupe facilities was established in the course of this study. Guadalupe III will be built a few meters distance from Guadalupe I and the geology of this site is well known. In addition, adequate geological surveys and borings have been made at the Troneras site.

Sedimentation in Troneras Reservoir

24. Sedimentation in Troneras Reservoir was recognized to be a serious problem, and EPM therefore retained Dr. L. G. Straub, an international authority on sedimentation, to evaluate this problem and recommend measures to be taken.

25. Dr. Straub visited the site in April 1959 and made a number of recommendations to EPM with the object of prolonging the useful life of the reservoir. As recommended by Dr. Straub EPM will:

a) Change the design of the intake structure of the Troneras dam so as to raise the height of the intake and thereby increase the dead storage in the reservoir, thus delaying the encroachment of sedimentation on the live or useful storage.

b) Increase the height of the dam, if necessary, to maintain a useful storage of not less than 32 million cubic meters, and

c) Take a number of measures to alleviate sedimentation in the reservoir.

26. These measures should assure a useful life of the reservoir commensurate with the useful life of the power facilities to be installed in the project.

Design and Supervision of Construction

27. For the final designs and detailed working drawings EPM has retained several Colombian and foreign engineering firms:

i) CONALIN, a Medellin firm, made the original drawings of the diversion of the Tenche and Concepcion rivers.

ii) INTEGRAL, a Medellin civil engineering firm, associated with GANNETT-FLEMING from Harrisburg (USA), designed the Troneras dam and power station. GANNETT-FLEMING prepared the preliminary design and advised INTEGRAL on the preparation of the construction specifications and on the detailed engineering.

iii) INTEGRAL, associated with CANCGU, a Medellin electrical and mechanical firm, and EDISON from Milan (Italy), designed the Guadalupe III

power plant. (CANOGU is a small firm qualified for mechanical and electrical studies.) EDISON made the preliminary design for the powerhouse and assisted INTEGRAL and CANOGU in preparing specifications and detailed engineering. EDISON will also supervise construction and the testing of the equipment in manufacturers' plants in Europe.

iv) Mr. Robert N. Allen, a U.S. consulting engineer who also designed the 115 kv transmission lines between Anchicaya and Cali, designed the transmission line.

v) The studies for the substations in Medellin and the improvements of the distribution system are being carried out by EPM's own engineers.

28. These various consultants are adequately qualified to discharge the respective tasks which have been assigned to them. However, the division of the engineering work among so many different firms, coupled with the limited staff of EPM raised a question as to the proper coordination among the various phases of the work and as to effective supervision of construction. To overcome these deficiencies, EPM has agreed to strengthen its own staff and to make new arrangements with its consultants for the supervision of the construction work. The Consortium of INTEGRAL and GANNETT-FLEMING will supervise the construction of the diversion works on the Tenche and Concepcion rivers as well as the Troneras dam and Troneras power station. The Consortium of INTEGRAL, CANOGU and EDISON will supervise the construction of the Guadalupe III power station. Supervision of the work on the transmission lines will be under the control of Mr. Robert N. Allen. These arrangements are satisfactory.

Present Status of Work on the Project

29. The civil engineering works, with the exception of access roads and preparation of the site of the Guadalupe III powerhouse, have not yet been started. Orders totalling US$ 2.5 million have already been placed on the basis of international bidding for penstocks, turbines, valves, generators, transformers and control equipment.

Schedule of Construction

30. EPM has agreed to follow the normal procedures for the selection of contractors and general conditions of contracts acceptable to the Bank. EPM plans to begin the main works as soon as the financing of the project is secured. Three years are estimated to be required for building Troneras dam. About two years are sufficient for the completion of the diversion of the Tenche and Concepcion rivers, for the civil works of Guadalupe III and for the transmission line. As the main equipment of Guadalupe III is being manufactured at the present time and is scheduled to be delivered in 1959 and 1960, this plant could be put into operation early in 1961. Thus, Guadalupe III would be operated as a run-of-river plant until the completion of Troneras dam in the first half of 1962. Troneras power station is scheduled to be put into operation at the time of the completion of the dam.

Estimated Cost

31. The cost of the principal items of the project has been estimated as follows:

	Foreign Exchange Costs (Mill. US$)	Foreign Exchange Costs (Mill.Ps.) equiv. (US$ = 7.5 Ps.)	Local Currency Costs (Mill.Ps.)	Total Expenditures (Mill.Ps.)
Diversion of Concepcion and Tenche rivers			4.93	4.93
Troneras Dam and Power Station	1.03	7.73	18.13	25.86
Guadalupe III Power Station	3.65	27.38	10.34	37.72
Transmission line	0.97	7.26	2.00	9.26
Substations and Distribution System in Medellin	2.13	15.98	3.40	19.38
Roads and Construction Equipment	0.80	6.00	2.13	8.13
Engineering and Supervision for Guadalupe	0.32	2.40	3.10	5.50
Contingencies	0.95	7.13	9.77	16.90
Engineering for the Nare Scheme	0.15	1.12	1.20	2.32
Subtotal	10.00	75.00	55.00	130.00
Interest during Construction	2.00	15.00	----	15.00
Total (expressed in million pesos)		90.00	55.00	145.00
(expressed in million US$)	12.00		7.35	19.35

32. The estimates of the cost of the civil works are based on unit prices prevailing in the Medellin area during the middle of 1958 and the quantities have been based on fairly detailed drawings. The estimates are realistic. About one-fourth of the equipment has been ordered and EPM has already obtained proposals for most of the remaining equipment. Physical contingencies have been estimated at about 12% for the civil works and 7% for the equipment which is reasonable under the circumstances. At the present time construction costs appear to be stable in the Medellin area. However, since most of the works will take about two years for execution, and even three for the Troneras dam, it is reasonable to expect some increases in the cost of labor and materials. To provide for such increases, additional amounts have been included, raising the contingency allowance to 20% for civil works and 10% for the equipment.

Economic Justification

33. The cost of the project, excluding the step-down substation and distribution system expansions in Medellin, amounts to about US$ 200 per KW installed. Annex 12 shows that the cost of power from the project, delivered at the Medellin step-down substation, will be 2.95 centavos (about 4 US mills) per kwh. The low cost is due to the unusually favorable site, the short distance of the site from Medellin and the low cost of construction and labor in the Department of Antioquia. This cost per KW installed compares favorably with the investment that would be required for a thermal plant of comparable size. No alternative thermal development in the Medellin area could, therefore provide the power obtainable through the Guadalupe project at as low a cost.

34. EPM was recently allowed an increase in tariffs of 32%, which went into effect on July 1, 1958, increasing average revenue from 3.4 centavos (4.5 US mills) to 4.47 centavos (6.0 US mills) per kwh. This is still a very low average rate, one of the lowest in Colombia.

35. The tariffs of public utilities, both privately and publicly-owned, are subject to the approval of the "Ministerio de Fomento" after having been considered by its agency, the "Instituto de Electraguas". "Instituto de Electraguas" is aware that EPM's rates are low and that in the future they will have to be adjusted on the basis of over-all costs, including all operating and maintenance expenses, depreciation, taxes and an adequate return on investment. Electraguas has indicated its willingness to consider new increases of about 5% per year.

36. On the basis of the foregoing, EPM has tentatively assumed average revenues of 5.2 centavos (6.9 US mills) per kwh during the years 1960 through 1962 and 6 centavos (8.0 US mills) per kwh during the years 1963 and 1964. (These average revenues are equivalent to rate increases of about 5% per year.) EPM's figures of 5.2 and 6 centavos have been used in the preparation of the financial forecasts given below in Section VII and in Annex 9.

VII. FINANCIAL ASPECTS

37. As indicated above (see paragraph 3), EPM owns and operates not only the electric power system, but also the telephone, water supply and sewage systems of Medellin. Each of the four departments is independently administered with separate and independent accounts. On December 31, 1955 the title to the assets and liabilities of the four departments was transferred with no change in their book value by the Municipality of Medellin to EPM. The municipality received no consideration for this transfer except that by agreement with EPM the municipality was relieved of 85% of the debt service on its 3% US dollar bonds due 1978. These were issued as a result of a reorganization operation in the amount of $4.98 million in July 1948. About $4.3 million remained outstanding at the time of the 1955 transfer. The law establishing the present EPM provides that in case EPM ceases to exist, its properties would revert to the municipality.

38. As the accounts of EPM are separately maintained, there is no consolidated balance sheet. There is a balance sheet for each of the four departments but they do not reflect the capitalized value of the amount of the Medellin municipal debt that was assumed, as the servicing of this obligation is deducted from operating revenues similar to a tax. When EPM became independent the assumed 85% of the service to the municipal debt was apportioned among its four departments. The Power Department assumed 70%, Water Supply 8%, Telephones 5% and Sewage 2%. On September 30, 1958, the municipal debt assumed by EPM amounted to about $3.5 million, of which the Power Department's quota was $2.9 million, equivalent to about Ps. 21.5 million. The annual debt service on this municipal debt is approximately $220,000, of which the Power Department's quota is $154,000. Payments are

made directly to the Banco de la Republica. In the recent past these 3% bonds have been purchased by a sinking fund at substantial discounts.

39. Although the charter of EPM stipulates that the assets of one department cannot be used for the benefit of any of the other departments, the Telephone Department, between 1955 and 1957, contributed Ps. 1.1 million toward the capital expenditures of the Water Supply Department. During negotiations the Bank received assurances that the assets of the Power Department would not be used by the other departments. EPM agreed that no other Department would incur long-term indebtedness unless its revenues cover operating expenses and debt service and unless holders of such debt explicitly forego any rights against the assets or revenues of the Power Department.

40. As the Power Department was the only department which has prepared a reasonably firm long-range expansion program, and as the other departments had only tentative programs (which are described in Annex 4) it was decided to appraise the financial prospects of the Power Department alone.

41. Historical financial data pertinent to the departments other than Power, are, however, included in this report. Annex 5 shows condensed income statements of EPM's Telephone, Water Supply and Sewage Departments for the period 1955-58. During this period all of the Departments reported good profits and a satisfactory return on the investment. Annex 6 shows condensed balance sheets of the Telephone, Water Supply and Sewage Departments as of December 31, 1956, 1957 and 1958. As of December 31, 1958 the Sewage Department had no debt outstanding, the Water Supply Department had a debt/equity ratio of 57/43 and the Telephone Department a debt/equity ratio of 65/35. It is noted that the aggregate of these departments is becoming ralatively smaller than the power department. The financial forecast below indicates a continuation of this trend.

Present Financial Position of the Power Department

42. Annex 7 shows condensed balance sheets of EPM's Power Department for the period December 31, 1955-58 inclusive. Net fixed assets as of December 31, 1958 totalled Ps. 120.8 million as follows:

	Million Pesos
Fixed Assets	
Power Plants	69.3
Transmission and Distribution	26.7
Land and Buildings	10.0
Other	4.0
Gross Fixed Assets	110.0
Less Depreciation Reserve	14.8
Net Fixed Assets	95.2
Work in Progress	25.6
Net Fixed Assets (including work in progress)	120.8

43. These fixed assets include write-ups in 1957 and 1958 of an aggregate of about Ps. 16 million to offset the devaluation of the peso insofar as the Power Department's dollar and other foreign debts were concerned. The ratio of total debt, Ps. 52.9 million, to net fixed assets, Ps. 120.8 million is 44%. The ratio of total debt to gross fixed assets less work in progress, Ps. 110 million is 48%.

44. On December 31, 1958 total funded debt, including installments on loans due within one year, was Ps. 52.9 million. The equity (consisting only of accumulated surplus) was Ps. 73.5 million and the debt/equity ratio was 42/58. The total surplus consisted of the accumulated surplus at the time of the transfer, Ps. 41.1 million, plus the earned surplus for the four years ended December 31, 1958 amounting to Ps. 32.4 million. The funded debt comprised:

	Million Pesos
7% Bonds due 1966 and 1969	3.3
6% Bonds due 1961 and 1962	.7
7% Bonds due 1973	7.3
Subtotal	11.3
6% Notes of Banco de la Republica and Fondo de Establizacion due 1962	3.0
7% Loan from Association Nacional de Industriales due 1959	.6
8-10% Loans from local institutions	4.1
Notes from local suppliers	.4
Subtotal	8.1
Total Peso Debt	19.4
4½% Notes of Ex-Im Bank due 1967	13.4
6-7% Notes of Foreign Manufacturers	20.1
Total foreign debt	33.5
Total funded debt	52.9

Note: The due dates in the foregoing table are the final years of maturities in the case of serial issues or issues with a sinking fund.

45. Much of the funded debt has relatively early maturities. One internal issue runs to 1973 and one to 1969. The Ex-Im Bank loan extends to 1967. Twenty percent of the maturities, i.e. Ps. 10.7 million, comes due within 12 months.

46. The first item in the above table represents two public issues made in 1946 and 1949, totalling Ps. 5.7 million, for the financing of the initial construction of the Rio Grande plant. Substantial additional funds needed to complete the project were obtained by requiring the electric consumers to pay double the amount of their electric bills during two years - 1951 and 1952. Consumers received 6% 10-year bonds. The following year, 1953, the holders of these 6% bonds were offered 7% 20-year bonds par for par in exchange. Ps. 8.4 million of the 7% bonds were issued of which Ps. 7.3 million were outstanding at December 31, 1958. There were also outstanding at that time Ps. 0.7 million of the unexchanged 6% bonds.

47. In 1953 new 6% loans were obtained from three institutions in the aggregate amount of Ps. 11.4 million. The amounts outstanding September 30, 1958, were Ps. 3 million of 6% notes due the Banco de la Republica and the Stabilization Fund, both having a final maturity in 1962 and Ps. 0.6 million due the Association Nacional de Industriales and maturing this year.

48. Short-term loans of Ps. 4.5 million are outstanding from local banks and suppliers in the form of revolving credits. The interest rate was increased last year from 7% to 8-10% due to the tightness of credit now prevailing in Colombia. These credits run to 1962.

49. The 15-year Ex-Im Bank loan ($2.6 million) was obtained in 1952; as of December 31, 1958 it had been reduced to about $1.8 million. A number of medium-term loans from foreign manufacturers were contracted in 1956 and 1957 for financing various additions to the system and in 1958 for financing equipment for the Guadalupe Project. The interest rate is in part 6% and in part 7%. The longest maturity is 1964. These loans aggregated Ps. 20.1 million equivalent on December 31, 1958.

50. The balance sheets show sharp reductions in working capital in 1957 and 1958. At the end of 1956 net current assets stood at Ps. 5.0 million. This fell to Ps. 2.5 million at the end of 1957 and became a deficit of Ps. 4.7 million by December 31, 1958 - a net decline in working capital in the period of nearly Ps. 10 million. This was due to (a) the recent devaluation of the peso which tripled the quota payable on the 3% municipal dollar debt service and the debt service on its own foreign loans; and (b) necessary payments on the contracts for the Quebradona dam and the Piedras Blancas plant.

Recent Earnings Record

51. Condensed income statements of the Power Department for the past six years (1953-1958) are shown in Annex 8. During the six-year period annual gross revenues from sales increased from Ps.11.1 million to Ps. 23 million or 109%. Sales of electricity increased 61% from 362 million kwh to 582 million kwh during the same period that is at an average annual rate of about 11% compounded.

52. The average revenue in centavos per kwh increased from 3.06 (4.1 US Mills) in 1953 to 3.95 (5.3 US Mills) in 1958, reflecting the very low price of energy.

53. Net income from operations, after depreciation and tax equivalents but before interest, increased from Ps. 6.6 million in 1953 to Ps. 12.1 million in 1958 or 83%. The annual return on average net fixed assets ranged between a high of 13.8% and a low of 10.6%. In 1958 it was 11.3%. Interest payments were covered 3.1 times in 1953 and around 6.5 times in 1956, 1957 and 1958.

54. The income statements show relatively large annual net profits after all payments including interest. These profits have also been an important source of cash for plant expansion.

Program of Future Expansion

55. Future planned additions to the Power Department's capacity during the next six years, in addition to the proposed project, include the first four units of the Guatape plant of 150 MW to be completed in 1964, utilizing the Nare River. This program, including the present project, should bring the installed capacity of the system to 382 MW by the end of 1964. The estimated cost of this program, including interest during construction, is Ps. 410 million ($54.7 million) spread over the years 1958-64.

56. The construction cost of the project, now proposed to the Bank for financing, amounting to Ps. 145 million, is expected to be incurred in the years through 1962. The expected sources of funds are as follows:

	Million Pesos
Proposed IBRD Loan ($12 million)	90
Local Capital	
Local Short-term loans	8
Retained earnings	47
Total Peso Requirements	55
Grand Total	145

57. For the purpose of calculation the proposed Bank loan has been taken at 6% interest and a term of 25 years including a grace period of four years, during construction. Amortization is calculated with equal semi-annual payments of combined principal and interest and is assumed to begin in 1963 and end in 1983. During the construction period EPM expects to borrow from local banks an amount of Ps. 8 million on a short-term basis; which includes a rolling-over of Ps. 4.1 million presently outstanding.

58. No definite plans for financing the Nare river program have been made In order to obtain an evaluation of the Power Department's future financial position, EPM made the assumption, which is used in this report for purposes of illustration, that of the total estimated expenditures of the program (including the present project) of Ps. 410 million ($55.0 million), the estimated foreign currency requirements in excess of the presently proposed Bank loan of Ps. 90 million ($12 million) would be Ps. 109 million ($14.5 million). This amount would be provided by a foreign currency loan made in 1961 bearing 7% interest and running for a period of 25 years including four years of construction. About Ps. 95 million, or 23% would be provided through retained earnings and about Ps. 116 million, or 28% by new local loans. Of the latter, Ps. 11 million would be in the form of short-term loans bearing 7% interest for the financing of the present project, and Ps. 105 million would be in the form of four 10-year loans bearing 7% interest and having nine years of amortization. Due to the tight credit conditions in Colombia, however, there are some doubts about the possibility of EPM borrowing all this local currency.

59. Expenditures, including interest and other charges during construction for the years 1957-64 inclusive for the Power Department's overall program are estimated to be:

	Estimated Expenditures for 1957-64 Program (in millions of Pesos)		
	Present Project	Nare Project	Total Construction Program
Foreign Currency	90	109	199
Local Currency	55	156	211
Total	145	265	410

Financial Forecasts

60. Statements of earnings, estimated sources and application of funds, are given in Annexes 9 and 10. The statements are based on the Power Department's estimates, modified where necessary in agreement with EPM. For the purpose of the forecasts, it has been assumed that the construction program will be completed by the end of 1964.

61. It has been assumed that:

a) the kwh sales would increase to 1,240 million kwh by 1964 as indicated in paragraph 16 above.

b) The present average price per kwh would be increased by about 15% for the three-year period 1960-62 and by another 15% thereafter as discussed in Section VI above.

c) Cost of operation, maintenance and administration would grow in proportion to the growth in plant and sales as indicated by past experience, remaining about 27-30% of total revenue.

d) Depreciation will continue at the present rate of 3% of the average value of the plant (at historical cost) in service during each year.

e) The Power Department will pay as a tax to the City of Medellin 4.425% of its total revenue and that it will continue to pay its 70% quota of the municipal foreign debt service to the Central Bank.

62. On the basis of these assumptions, the financial position during the next six years would be as follows:

a) Net income from operations, after depreciation but before interest, should increase from Ps. 15.7 million in 1959 to Ps. 25.1 million in 1962 and to Ps. 36.8 million in 1964, representing a return on net fixed assets of 10.4% in 1959, 7.2% in 1962 and 8% in 1964.

b) Net profit after interest charges would rise from Ps. 13.4 million in 1959 to Ps. 19.9 million in 1962 and Ps. 25.3 million in 1964.

c) Cash generated out of power operations should cover debt service 1.7 times in 1959, would fall to 1.6 times in 1962 due to large amortization of short-term loans, and should rise to 1.9 times in 1964.

d) The debt/equity ratio would be 46/54 the end of 1959, 53/47 the end of 1960 and around 60/40 for the next four years. (See Annex 11).

63. A debt limitation of 50/50 such as the Bank has required in many of its loans would be too restrictive in the case of EPM's Power Department. The equivalent of a 15% rate increase next year has been assumed (para. 61) which together with another increase of the equivalent of 15% three years later should result in a substantial contribution towards the cost of the overall program being provided through retained earnings. A debt/equity ratio of approximately 60/40 would permit the construction of the Nare development, which is considered to be the logical power supply for Medellin following the completion of the present project. EPM has agreed that power rates will be set at a level which would permit at least 30% of new investment in power facilities to be financed from retained earnings. EPM has also agreed that the Power Department will not incur additional debt if thereby the proportion of long-term indebtedness to equity for that Department would exceed 60/40.

64. Fixed assets of EPM have been written up as a result of the devaluation of the peso only insofar as foreign loans are concerned. The 3% annual depreciation that the Department now charges reflects only partially the depreciation of its fixed assets. The rate is high for a purely hydroelectric system and to a certain extent offsets the incomplete valuation of the assets.

65. EPM has agreed to take all necessary steps not less often than once every two years to obtain such adjustments in the rates charged for the services of each of its four departments as will assure a reasonable return on the total investment and provide revenue sufficient:

a) to meet all operating, maintenance and administrative expenses, including taxes, if any, interest charges, depreciation and if possible, reserve for replacement of assets;

b) to meet repayments on long-term indebtedness but only to the extent that such repayments shall exceed provision for depreciation;

c) to create a surplus which would meet a reasonable part of the cost of the expansion of the enterprise.

VIII. CONCLUSIONS

66. The reorganization of EPM on an autonomous basis has improved its efficiency. The present management is well qualified and the staff includes good engineers. The agreements reached during negotiations give assurance that EPM will be able to carry out the project satisfactorily.

67. The present backlog of demand, the forthcoming power restrictions, and the forecast of growth in the Medellin area justify a rapid expansion of EPM's system. For this purpose, EPM's long-range program appears to be economical and suitable, though additional studies of the Nare scheme are necessary. The Guadalupe project, which is proposed for Bank financing, is very economical.

68. The measures which EPM has agreed to take in regard to sedimentation in the Troneras reservoir are satisfactory.

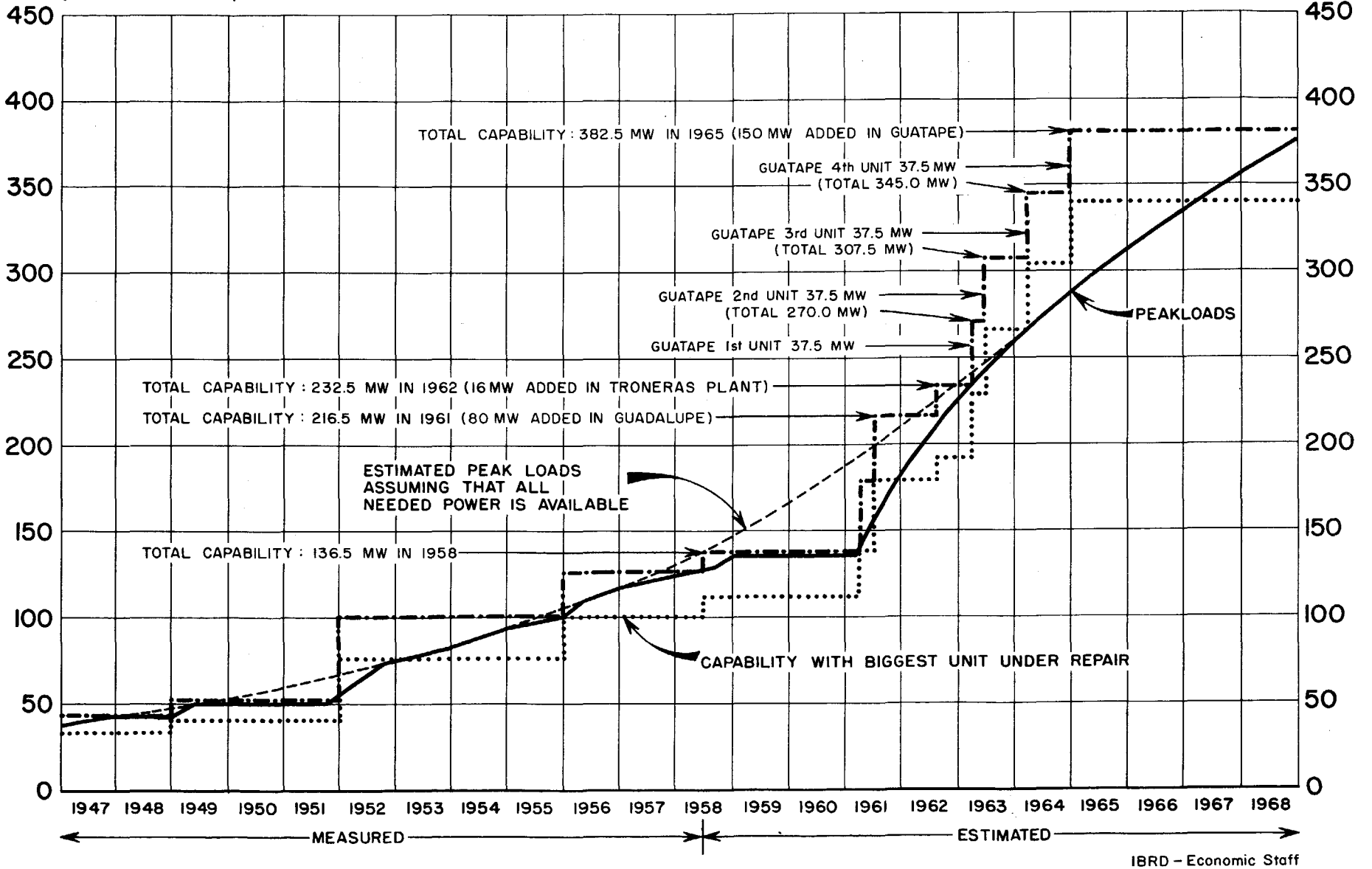
69. Satisfactory arrangements are being made by EPM for engineering services to ensure proper coordination and effective supervision of construction.

70. In spite of the low rates charged at present to the consumers, EPM's financial position is fundamentally sound.

71. The estimates of the cost of the project are reasonable. The project is sound and suitable as a basis for a Bank loan in the amount equivalent to $12 million for a term of 25 years including a grace period of four years on amortization payments.

COLOMBIA: PEAK LOADS and CAPABILITIES AT MEDELLIN

(MEGA WATTS)



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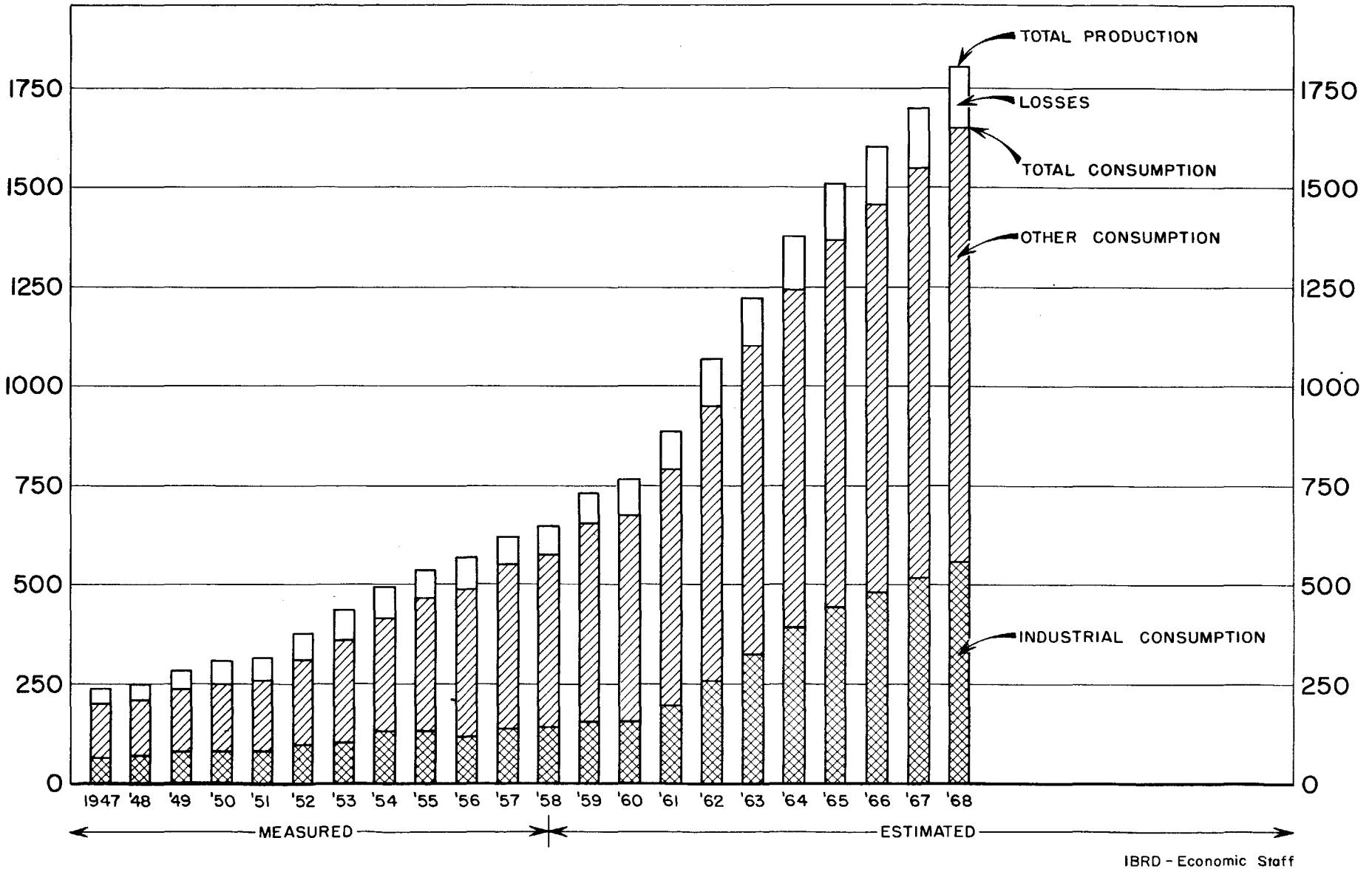
ANNEX 1

COLOMBIA: ANNUAL ENERGY REQUIREMENTS AT MEDELLIN

(MILLION KWH)



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ANNEX II

DESCRIPTION

OF THE GUADALUPE SCHEME

(See Map B)

The power development of the Guadalupe river began in 1932 at Guadalupe Falls, located about 70 km northeast of Medellin.

A. EXISTING PLANTS

The two existing plants have a total capacity of 50 MW. A small dam located at the top of the falls impounds 350,000 cubic meters of water and serves to divert water to the intakes. As the minimum flow of the river is 8 m^3/sec. and the total installed capacity requires 10.5 m^3/sec., this small storage permits only to operate the plants with a load factor close to 0.8. Thus the annual guaranteed output of these plants is 350 million kwh.

The main features of the existing facilities are:

Guadalupe I

- gross head - 555 m.
- maximum flow utilized 10.5 m^3/sec.
- intake and tunnel 55 m. long, diameter 2 m.
- 3 penstocks, 960 m. long, for 2 of them average diameter 0.77
  for 1 of them average diameter 1 m.
- powerhouse with 5 units (Pelton horizontal shaft)
  totaling 40 MW (2 of 5 MW, 3 of 10 MW) 60 cycles

Guadalupe II (in series with Guadalupe I)

- gross head - 160 m.
- maximum flow utilized - 10 m^3/sec.
- tunnel 1040 m. long, diameter 1.83 m.
- penstock 520 m. long, diameter 1.75 and 1.65
- power plant with one 10 MW unit, 60 cycles
  (Francis, horizontal shaft, two wheels)

Substation (for the two plants)

Located at the foot of the falls close to Guadalupe I, elevates the voltage to 120 Kv and is connected to the Medellin double-circuit 120 Kv transmission line.

B. THE PROJECT

The works included in the project will increase the capacity of the system by 96 MW. They will consist of:

a) Diversion of the Concepcion and Tenche rivers

The purpose of these works is to increase the minimum flow of the Guadalupe river from 8 to 12 m^3/sec. They include:

i) a gravity dam on the Concepcion river

- height: 11.5 meters above excavations
- volume of concrete: 11,300 m^3
- storage capacity: negligible

ii) a conduit from Concepcion to Tenche river

- concrete pipe - 125 m. long, diameter 2.20
- tunnel - 514 m. long, diameter 2.20
- canal - 270 m. long
- total capacity 12 m^3/sec. (provided for diversion of other small streams)

iii) a gravity dam on the Tenche river

- height: 10 m. above excavations
- volume of concrete: 7,000 m^3
- storage capacity: negligible

iv) a conduit from the Tenche river to the San Pablo Gorge

- tunnel: 1,418 m. long, diameter 2.40
- canal: 176 m. long
- total capacity - 18 m^3/sec. (provided for diversion of other small streams)

b) Troneras Dam

This dam will be located just below the confluence of the Guadalupe river and the "Quebradona de la Herradura" of which "Quebradone San Pablo" is a tributary. The main features of Troneras Dam are:

- type: earthfill dam
- height: 46 m. above excavations
  37 m. above streambed
- length: 365 m.
- total capacity of the reservoir: 38 million cubic meters
- useful capacity of the reservoir: 32 million cubic meters
- drainage area: 424 sp. kilometers
- spillway: overflow chute type, capacity 690 m^3/sec. located in the right bank
- control tower with an outlet capacity of 50 m^3/sec.
- outlet tunnel in the left bank, length 460 m., diameter 4 m.

c) Troneras Plant

This plant is located at the downstream end of the outlet works of the dam. The powerhouse is designed for two units but only one will be provided in this stage:

- maximum gross head: 88 meters
- minimum gross head: 74 meters
- 16 MW unit, 60 cycles (Francis vertical shaft) controlled from Guadalupe III powerhouse.

d) Guadalupe III Power Plant

This plant is located at the Guadalupe Falls close by Guadalupe I. This new plant is designed for six 40 MW units but will be built at this stage for two 40 MW units (with only the exception of the intake and the tunnel). The main features are:

- gross head: 555 m.
- maximum flow utilized 18,3 m^3/sec. (for 80 MW)
- intake entrance for 59 m^3/sec.
- pressure tunnel: 200 m. long, 4 m. diameter
- valve chamber: at the head of the penstock
- one penstock (for 80 MW) 880 m. long, average diameter 2.1 m.
- powerhouse with two 40 MW units 60 cycles (Pelton vertical shaft, 4 water jets, 450 r.p.m.)
- transformer bank with a set of three single-plase 13.8/120 Kv transformers by unit plus a set of 6.6/120 Kv transformers for the total generating capacity of Guadalupe I.
- control board for both Guadalupe III and Guadalupe I.

e) Transmission Lines

The existing 120 Kv switchyard will be removed and a new one built near the intakes. This switchyard will be connected to:

- Guadalupe I by one 120 Kv circuit from the new 6.6/120 Kv transformers
- Guadalupe II by one 120 Kv circuit
- Guadalupe III by one 120 Kv circuit for each unit
- Troneras plant by one 13.2 Kv line
- Medellin by the old double-circuit 120 Kv line and by a new double-circuit 120 Kv line.

ANNEX 4

EMPRESAS PUBLICAS DE MEDELLIN

EXPANSION PROGRAM FOR THE TELEPHONE, WATER SUPPLY AND SEWAGE DEPARTMENTS

EPM has the following tentative expansion programs for the Telephone, Water Supply and Sewage Departments:

a) Telephone - At present there are 40,000 lines in Medellin. An additional 13,000 lines have already been contracted with Erickson of Sweden. This expansion program should be sufficient for the next three years. Its foreign currency cost of about $2.6 million would be financed, as in the past, by supplier credit for a period of 4-5 years with 2 years of grace. Telephone tariffs had an increase of 40% in January 1958 and a further increase of 18% in July 1958.

b) Water Supply - The system is sufficient for present needs. EPM is studying a development program (Rio Negro Project) which is being designed by INTEGRAL and which would give better future supply of water to Medellin. The cost of this project would be about Ps. 30 million ($4 million). EPM has asked the Development Loan Fund (DLF) to finance it. If DLF would not be able to finance the project, the necessary funds should come from local sources. A tariff increase of 28% will be effective on January 1, 1960.

c) Sewage - The system is sufficient for present needs. EPM has a general development plan for Medellin and other towns in the Medellin Valley which would cost about Ps. 15 million ($2 million) up to 1975. In EPM's opinion, the Central Government should finance this project. Sewage tariffs are half of the tariff charged for the first 30 m^3 of water supply.

EMPRESAS PUBLICAS DE MEDELLIN

INCOME STATEMENT FOR THE TELEPHONE, WATER SUPPLY AND SEWAGE DEPARTMENT

(In millions of Pesos)

	Telephones				Water Supply				Sewage			
	1955	1956	1957	1958	1955	1956	1957	1958	1955	1956	1957	1958
Gross Revenues	3.62	4.02	4.59	8.31	3.90	4.17	4.51	5.07	1.05	1.09	1.16	1.29
Other Income	.77	1.09	1.24	.97	1.11	1.43	1.73	1.67	-	.10	.16	.14
Total Revenue	4.39	5.11	5.83	9.28	5.01	5.60	6.24	6.74	1.05	1.19	1.32	1.43
Cost of Operations												
Operating Expenses	1.51	1.72	2.06	2.36	2.22	2.55	3.14	3.51	.57	.51	.71	.61
Depreciation	.72	.79	1.07	1.59	.60	.90	.84	.97	.04	.03	.10	.12
Total	2.23	2.51	3.13	3.95	2.82	3.45	3.98	4.48	.61	.54	.81	.73
Operating Profits	2.16	2.60	2.70	5.33	2.19	2.25	2.26	2.26	.44	.65	.51	.70
Less: Payment to the City of Medellin	.17	.15	.15	.32	.09	.10	.10	.13	.03	.03	.03	.04
Quota for Service on External Debt of Medellin	.03	.03	.05	.09	.06	.05	.08	.14	.01	.01	.02	.03
Payment to Other Municipalities	-	-	-	-	-	-	-	-	-	-	-	-
Total	.20	.18	.20	.41	.15	.15	.18	.27	.04	.04	.05	.07
Net Income from Operations	1.96	2.42	2.50	4.92	2.04	2.10	2.08	1.99	.40	.61	.46	.63
Less: Interest	-	-	-	.53	.69	.70	.93	1.21	-	-	-	-
Net Profit 1/	1.96	2.42	2.50	4.39	1.35	1.40	1.15	.78 2/	.40	.61	.46	.63

ANNEX 5

1/ Between 1955 and 1957 the Telephone Department has contributed Ps. 1.1 million for the capital expenditures of the Water Supply.

2/ Water Supply rates will be increased by 28% in January 1960.

EMPRESAS PUBLICAS DE MEDELLIN

BALANCE SHEETS FOR THE TELEPHONE, WATER SUPPLY AND SEWAGE DEPARTMENTS

(In millions of Pesos)

	Telephones			Water Supply			Sewage		
	Dec. 31 1956	1957	1958	Dec. 31 1956	1957	1958	Dec. 31 1956	1957	1958
ASSETS									
Fixed Assets	22.1	35.3	55.5	30.8	35.0	37.3	3.7	4.4	4.9
Less Depreciation	4.4	5.4	7.0	3.7	4.6	5.6	.1	.2	.3
Net Fixed Assets	17.7	29.9	48.5	27.1	30.4	31.7	3.6	4.2	4.6
Current Assets	2.4	4.2	9.7	6.8	4.2	3.3	.2	.2	.2
Miscellaneous	-	-	.1	.4	.6	.6	-	-	-
Total Assets	20.1	34.1	58.3	34.3	35.2	35.6	3.8	4.4	4.8
LIABILITIES									
Capital and Surplus	12.7	15.0	19.4	13.0 1/	14.4 1/	15.1	3.6	4.1	4.7
Long-Term Debt									
a) In local currency	.4	.4	-	18.8	19.2	19.7 4/	-	-	-
b) In foreign currency	6.0	16.8	36.3 3/	-	-	-	-	-	-
Total Long-Term Debt	6.4	17.2	36.3	18.8	19.2	19.7	-	-	-
Current Liabilities	.8	1.8	1.7	2.2	1.4	.6	.1	.2	-
Miscellaneous	.2	.1	.3	.3	.2	.2	.1	.1	.1
Total Liabilities	20.1	34.1	58.3	34.3	35.2	35.6	3.8	4.4	4.8
Debt/Equity Ratio	34/66	53/47	65/35	59/41	57/43	57/43	-	-	-
Return on the Net Fixed Assets	13.7	8.4	10.0	7.7	6.8	6.4 2/	16.9	11.0	13.7

1/ Includes capital contributions from telephone.

2/ Water supply rates will be increased by 28% in January 1960.

3/ Supplier's credit from Erickson (Sweden) repayable in five years starting in 1959. EPM has pledged the Telephones revenues (after operating expenses, depreciation and taxes) as a guarantee for servicing this debt.

4/ Includes a Ps 17 million loan from the Banco de la Republica repayable in 10 years starting in 1959. EPM has pledged the Water Supply revenues (after operating expenses, depreciation and taxes) as a guarantee for servicing this debt.

ANNEX 6

Empresas Publicas de Medellin
Empresa De Energia

Condensed Balance Sheets
(in millions of Pesos)

	December 31st			
	1955	1956	1957 1/	1958
ASSETS				
Fixed Assets	72.2	81.8	103.7	135.6
Less: Depreciation	6.6	8.8	11.6	14.8
Net Fixed Assets	65.6	73.0	92.1	120.8
Current Assets	11.3	10.2	8.6	9.0
Deferred Charges and miscellaneous	.6	.1	.2	1.0
Total Assets	77.5	83.3	100.9	130.8
LIABILITIES				
Surplus Beginning of Year	-	47.8	55.5	63.2
Surplus for Period	-	7.7	7.7	10.3
Surplus End of Year	47.8	55.5	63.2	73.5
Debt:				
a) Bonds	13.3	12.7	12.1	11.3
b) Local loans	6.9	5.4	4.1	3.6
c) Foreign Currency Loans	7.8	6.4	16.1	13.4
d) Manufacturers Credits	-	-	-	20.5
e) Medium-term Loans from Local Institutions	-	-	1.5	4.1
Total Indebtedness	28.0	24.5	33.8	52.9
Less Maturities within one year	5.5	3.4	4.5	10.7
	22.5	21.1	29.3	42.2
Current Liabilities	6.2	5.2	7.1	13.7
Miscellaneous	1.0	1.5	1.3	1.4
Total Liabilities	77.5	83.3	100.9	130.8
Debt/Equity Ratio	37/63	31/69	33/67	42/58

1/ The 1957 Balance Sheet has been adjusted to reflect the rate of exchange of Pesos 7.50 to the dollar, the rate used in the projections.

EMPRESAS PUBLICAS DE MEDELLIN
Empresa De Energia

Condensed Income Statements
(in thousands of Pesos)

	1953	1954	1955	1956	1957	1958
Sales in millions of KWH's	362	419	465	489	548	582
Average rate per KWH (centavos)	3.06	3.62	3.57	3.56	3.40	3.95
Gross Revenue from Sales	11,070	15,206	16,585	17,409	18,815	22,977
Other Income	708	300	364	708	1,293	1,376
Total Revenue	11,778	15,506	16,949	18,117	20,108	24,353
Cost of Operations:						
Operating Expenses	3,828	4,555	5,060	5,303	6,506	6,317
Depreciation	458	1,599	1,674	2,248	2,650	3,219
Total	4,286	6,154	6,734	7,551	9,156	9,536
Operating Profit	7,492	9,352	10,215	10,566	10,952	14,817
Less: Payment to the City of Medellin	553	-	737	750	750	1,084
Quota for Service on External Debt of the City of Medellin	368	387	419	398	674	1,185
Payment to other Municipalities	-	219	224	261	313	410
Total	921	606	1,380	1,409	1,737	2,679
Net Income from Operations	6,571	8,746	8,835	9,157	9,215	12,137
Less: Interest	2,099	1,963	2,133	1,419	1,473	1,792
Net Profit	4,472	6,783	6,702	7,738	7,742	10,345

ANNEX 8

EMPRESAS PUBLICAS DE MEDELLIN

Empresa de Energia

Forecast of Income Statement
1959-1964
(thousands of Pesos)

Year ending December 31,	1959	1960	1961	1962	1963	1964
Sales of Energy in millions of KWH	655	675	790	950	1,100	1,240
Average Price for KWH (centavos)	4.50	5.20	5.20	5.20	6.00	6.00
Gross Revenue from Sales	29,475	35,100	41,080	49,400	66,000	74,400
Other Income	1,500	1,600	1,800	2,000	2,200	2,400
Total Revenue	30,975	36,700	42,880	51,400	68,200	76,800
Cost of Operation:						
Operating expenses, including maintenance, Administration, etc.	8,680	10,640	12,870	15,140	17,920	21,060
Depreciation	3,500	3,800	5,500	7,500	10,700	14,300
Total Cost of Operations	12,180	14,440	18,370	22,640	28,620	35,360
Operating Profit	18,795	22,260	24,510	28,760	39,580	41,440
Less: Payment to the city of Medellin						
a) 4.425% of Total Revenue	1,370	1,620	1,900	2,280	3,020	3,400
b) Quota for Service of External Debt	1,190	1,190	1,190	1,190	1,190	1,190
Total Payment to City of Medellin	2,560	2,810	3,090	3,470	4,210	4,590
Payment to other Municipalities	500	600	400	200	50	60
Total Payment to Medellin & Municipalities	3,060	3,410	3,490	3,670	4,260	4,650
Net Income from Operations	15,735	18,850	21,020	25,090	35,320	36,790
Less: Interest						
a) On existing loans	2,091	1,827	1,473	1,257	1,071	895
b) On proposed IBRD Loan	1,837	3,514	4,434	5,215	5,400	5,280
c) 1957/60 local loans	200	600	500	300	-	-
d) 1960/64 new loans at 7%	-	700	3,010	6,065	9,386	12,280
Total Interest	4,128	6,641	9,417	12,837	15,857	18,455
Less: Interest charged to construction	1,837	4,214	6,194	7,690	4,700	7,000
Total Interest charged to Operations	2,291	2,427	3,223	5,147	11,157	11,455
Net Profit	13,444	16,423	17,797	19,943	24,163	25,335
Cumulative Profits	23,207	39,630	57,427	77,370	101,533	126,868

ANNEX 9

EMPRESAS PUBLICAS DE MEDELLIN

EMPRESA DE ENERGIA

FORECAST OF CASH FLOW

(In thousands of Pesos)

Year Ending December 31,	1959	1960	1961	1962	1963	1964
Receipts						
Net Income from Operations	15,735	18,850	21,020	25,090	35,320	36,790
Depreciation	3,500	3,800	5,500	7,500	10,700	14,300
Cash Receipts from Operations	19,235	22,650	26,520	32,590	46,020	51,090
Borrowing						
a) Proposed IBRD Loan	46,087	19,514	16,434	7,965	-	-
b) Local loans 1958-60 7%	3,000	8,000	-	-	-	-
c) New Loans 1960-64 - Local 7%	-	20,000	40,000	25,000	20,000	-
d) New Loans 1961-64 - Foreign 7%	-	-	11,000	26,000	48,000	24,000
Total Borrowings	49,087	47,514	67,434	58,965	68,000	24,000
Total Receipts	68,322	70,164	93,954	91,555	114,020	75,090
Expenditures						
Construction						
a) IBRD Project						
Foreign Currency	23,817	19,539	17,019	6,230	-	-
Local Currency	10,000	18,000	22,450	750	-	-
Total IBRD Project [1]	33,817	37,539	39,469	6,980		
b) Other Construction Expenditures 1958/61	200	200	200	-	-	-
c) Future Construction Program	-	19,000	47,000	65,000	87,000	47,000
Total Construction Program	34,017	56,739	86,669	71,980	87,000	47,000
Debt Service						
Amortization						
a) Existing Loans	4,234	3,503	3,053	2,666	2,181	2,237
b) Proposed IBRD Loan	-	-	-	-	2,016	2,136
c) Local Loans 1958-60	4,100	3,000	1,600	6,400	-	-
d) Local Loans 1960-64 (due in 9 years each)	-	-	2,220	6,670	9,450	11,670
e) Manufacturers credits	19,400	-	-	-	-	-
Total Amortization	27,734	6,503	6,873	15,736	13,647	16,043
Interest						
a) Existing Loans	2,091	1,827	1,473	1,257	1,071	895
b) Proposed IBRD Loan	-	-	-	-	5,400	5,280
c) Local Loans 1958-60	200	600	500	300	-	-
d) Local Loans 1960-64	-	-	1,250	3,590	4,686	5,280
Total Interest	2,291	2,427	3,223	5,147	11,157	11,455
Total Debt Service	30,025	8,930	10,096	20,883	24,804	27,498
Total Expenditures	64,042	65,669	96,765	92,863	111,804	74,498
Annual Cash Surplus or Deficit	4,280	4,495	(-)2,811	(-)1,308	2,216	592
Cash Balance Beginning of Year	579	4,859	9,354	6,543	5,235	7,451
Cash Balance End of Year	4,859	9,354	6,543	5,235	7,451	8,043
Debt Service Coverage	1.74[2]	2.54	2.63	1.56	1.86	1.86

1/ Ps. 2.3 million equivalent have already been spent in 1957 and Ps. 24.9 million equivalent in 1958.

2/ Excluding amortization of credits from foreign manufacturers for Ps. 19 million to be repaid out of the proposed IBRD loan.

ANNEX 11

EMPRESAS PUBLICAS DE MEDELLIN

Empresa de Energia

Pro Forma Balance Sheets for the Years 1959-64

(in millions of Pesos)

	1959	1960	1961	1962	1963	1964
ASSETS						
Fixed Assets	169.6	226.3	313.0	385.0	472.0	519.0
Less Depreciation	18.3	22.1	27.6	35.1	45.8	60.1
Net Fixed Assets	151.3	204.2	285.4	349.9	426.2	458.9
Current Assets and Others, Net	9.9	14.4	11.5	10.2	12.4	13.0
Total Assets	161.2	218.6	296.9	360.1	438.6	471.9
LIABILITIES						
Capital and Surplus	86.9	103.3	121.1	141.1	165.3	190.6
Debt						
a) Existing Loans	25.2	21.7	18.6	15.9	13.7	11.5
b) Proposed IBRD Loan	46.1	65.6	82.0	90.0	88.0	85.9
c) Local Currency Loans 1958-60	3.0	8.0	6.4	-	-	-
d) Local Currency Loans 1960-64	-	20.0	57.8	76.1	86.6	74.9
e) Foreign Currency Loans 1961-64	-	-	11.0	37.0	85.0	109.0
Total Debt	74.3	115.3	175.8	219.0	273.3	281.3
Total Liabilities	161.2	218.6	296.9	360.1	438.6	471.9
Debt/Equity Ratio	46/54	53/47	59/41	61/39	62/38	60/40
Return on Investment	10.4	9.2	7.4	7.2	8.3	8.0

CALCULATION OF GENERATING COST

The calculation of the annual cost of operation for the project is based on an estimated investment of 114 million pesos excluding the transmission line and the improvements of substation and distribution system in Medellin.

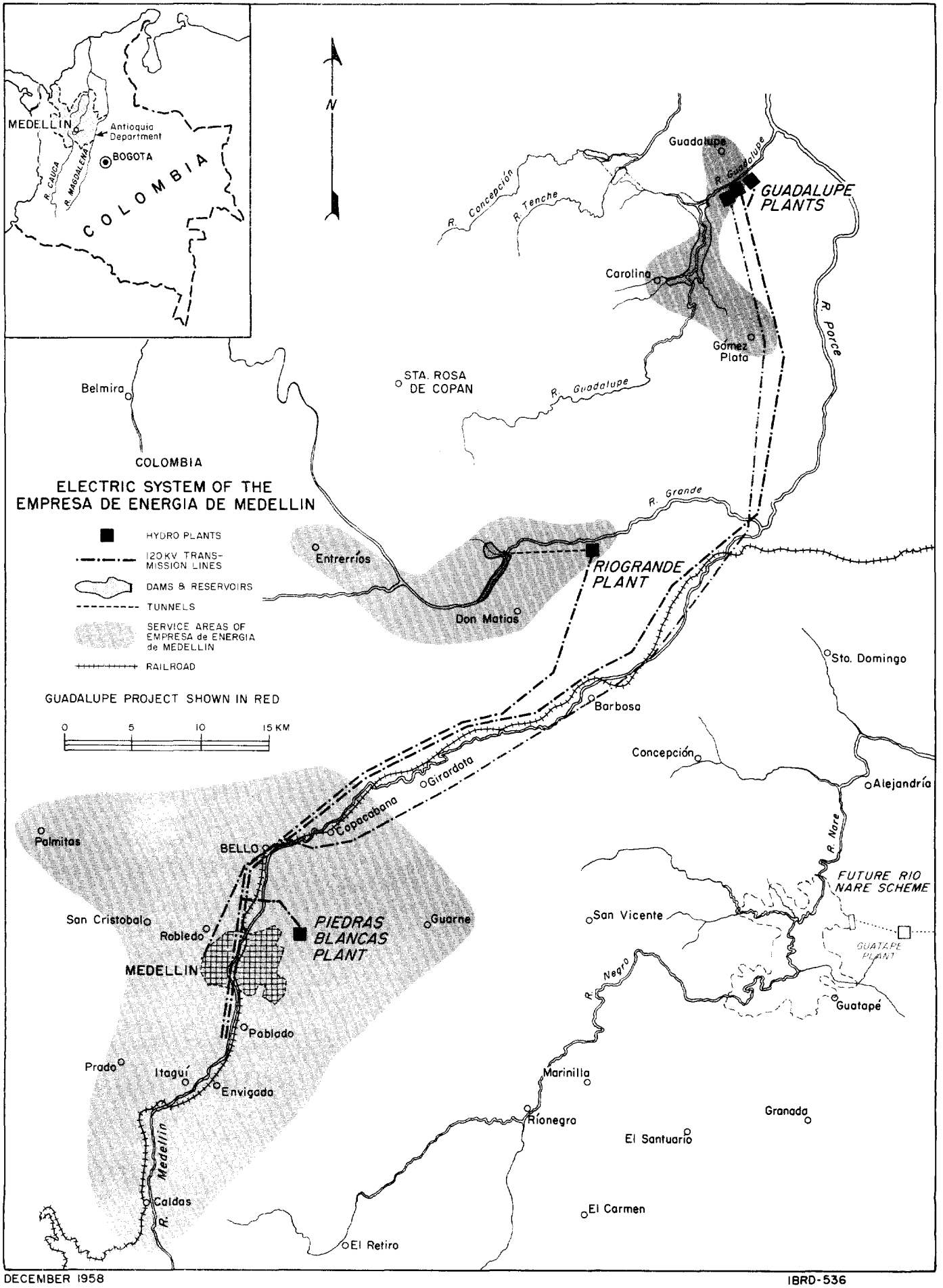
Annual Cost

(Thousand Pesos)

Interest	8,208	- Based on a rate of 7.2% per annum, representing the weighted average of actual expected financing terms.
Depreciation	3,420	- 3% per annum of the investment (which is EPM common practice).
Salaries and Wages	90	- 6,000 pesos per annum x 15.
Maintenance and Overhead	2,440	- 2% of the investment - based on EPM's past experience.
TOTAL	14,158	
Municipal Tax	1,093	- 4.425% of gross revenue
TOTAL ANNUAL COST	15,251	

The flows available and the capacity of storage created by Troneras dam are such that the plants can be operated with a plant factor of 0.7. Thus, the generating capability of Guadalupe III and Troneras power station aggregates 590 million kwh per year. Cost of energy at the plants will be 2.58 centavos per kwh (about 3.4 US mills per kwh).

According to EPM's statistics, the energy provided to the Medellin high voltage system will be about 540 million kwh per year, and cost of energy at the end of the transmission system will be 2.95 centavos per kwh (about 4 US mills per kwh).



DECEMBER 1958

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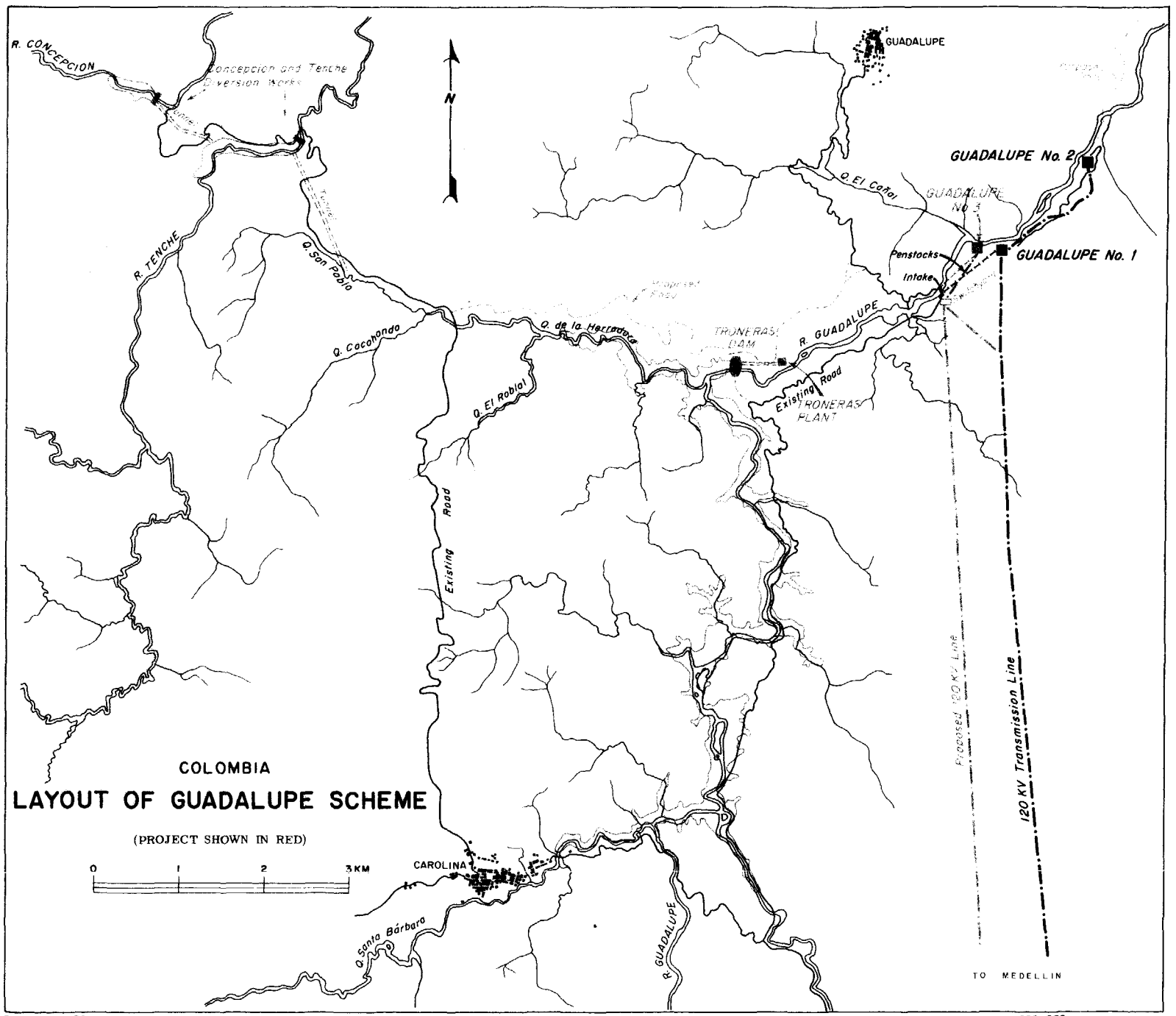

COLOMBIA

LAYOUT OF GUADALUPE SCHEME

(PROJECT SHOWN IN RED)

DECEMBER 1958

IBRD-535

Map B