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Electric Power - Chapter 11 - Medellin Power Company [EPM] - Colombia - 1971

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## CHAPTER XI - MEDELLIN POWER COMPANY (EPM) - COLOMBIA

### I - Introduction

1.01 Empresas Publicas de Medellin is an autonomous, municipally-owned entity which provides Medellin, Colombia's largest industrial center, with public services of electricity, domestic water supply, sewerage, and telephone. The four branches are operated as independent departments, except for administrative direction and use of common services. Accounts are kept separately for each department and energy revenues are utilized solely for power purposes. EPM currently supplies electricity directly to the city of Medellin and 13 smaller municipalities and also sells bulk energy to 9 other municipalities and to subsidiaries of the Electrificadora de Antioquia.

1.02 EPM was established by charter in 1955 through powers given to the city of Medellin by national law. Concurrently, the existing municipally operated utility was abolished and its assets and liabilities turned over to EPM. The company has a seven-member Board of Directors of which the Mayor of Medellin is ex-officio chairman. Two members are selected by and from the City Council. The other four are appointed by the Mayor from candidates proposed respectively by the Bank of the Republic, the National Banks of Medellin, the National Association of Industrialists and the Medellin Chamber of Commerce.

1.03 EPM is the second largest supplier of electricity in Colombia with an installed capacity in mid-1971 of 575 MW, of which 438 MW or 76% was partly financed with Bank loans. The abundant rainfall and large mountain ranges in the area have provided Medellin with rich sources of hydroelectric energy which have been partly utilized in all of its seven plants. EPM's installed capacity, which in 1970 represented 21% of the total public sector capacity in the country, has grown at an average annual rate of 13% during the period 1960-1970, while gross generation grew at a rate of 9%.

II - The Association Between the Bank and EPM

2.01 EPM received over the period 1959-1970 three loans from the Bank as follows:

Loan No.	Date of Loan Agreement	Effective Date	Closing Date	Amounts (\$ mln)		a/ Interest	Period (Years)	
				Committed	Disbursed		Grace	Term
225 CO	5/59	7/59	7/63 <u>b/</u>	12.0	12.0	6%	4	25
282 CO	5/61	9/61	3/68 <u>c/</u>	22.0	22.0	5-3/4%	5	25
369 CO	2/64	8/64	- <u>d/</u>	<u>45.0</u>	<u>33.9</u>	6%	5	35
Total				<u>79.0</u>	<u>67.9</u>			

- a/ As of December 31, 1970.  
b/ Extended from December 1962.  
c/ Extended from January 1966.  
d/ Extended from December 1968.

2.02 Contact between the Bank and the City of Medellin first occurred about ten years before the first loan was made to Empresas Publicas de Medellin in May 1959. During that period, the Bank's main concern was the creation of an autonomous apolitical power company to which it could lend. The Empresas, consisting of four independent departments (electric energy, water supply, sewerage and telephone), each with its own manager and Advisory Board, had traditionally been owned and controlled by the City of Medellin. Although the management was generally considered competent, there was substantial duplication of the activities of the four departments. This duplication and the existence of political interference on the part of the City Council were considered by the Bank major obstacles to efficient administration of the Company. A study made in 1953 by Price-Waterhouse concluded that great advantages would be obtained from regrouping the four departments into a single organization with one general manager. Under the proposed arrangement, the four departments were to remain autonomous in their respective fields.

2.03 The Bank was officially approached in October 1954 for assistance in financing the Medellin electric power program. The Bank, however, set two preconditions for serious loan consideration. In the first place, it requested assurance that the expansion of the Medellin power system was part of the national electrification program. Secondly, the Bank requested that the power sector be organized as a separate entity with independent financial and administrative status.

2.04 In August 1955, the municipality established an independent municipally-owned agency known as the Empresas Publicas de Medellin to operate and manage the municipal power, telephone, water and sewerage systems. In December, the assets and liabilities of the existing municipal companies were transferred to this new entity. The new set-up conformed both with the Municipality's organizational wishes and the Bank's request for the financial autonomy of the power department.

2.05 Except for the tariff revision and increase recommended by the Bank in September 1955, all conditions for Bank lending appeared to have been met by 1956, when the Bank decided to suspend further consideration of projects in Colombia because of the country's deteriorating economic situation. Talks resumed in October 1958 when a Bank mission visited EPM to review the Guadalupe project. To the Bank's satisfaction, a tariff increase of 32% had been granted to the company on July 1, 1958. After some deliberation regarding the legal and financial status of EPM and an assessment by the Bank of the company's need for a strengthened technical staff and competent consulting services, the loan was signed on May 20, 1959.

2.06 The Bank accepted EPM's first power development program without fundamentally questioning the choice of the various components of the project. There had been a constant need for expansion of the Company's power facilities since the Company's first loan request had reached the Bank in 1955. Although the generating equipment was operated at its maximum overload capacity, the Company had to curtail consumption and to purchase energy from private industries equipped with

generating plants. In 1960, sections of the city had to be cut off from service on a rotating basis for periods ranging from one half hour to four hours per day. The Company tried to confine the rationing to domestic consumers so as not to impinge upon the industrial growth of the community. In spite of this, several manufacturing industries had to install their own generating plants or to invest in stand-by diesel units. This resulted in a decline of EPM's industrial sales.

2.07 The first loan to EPM (Loan 225 CO) was for the amount of US\$12 million (approximately 50% of the total project cost) to cover the foreign currency component of the following (see map at end of chapter):

- (a) Construction of Guadalupe III hydroplant with an initial capacity of 80 MW.
- (b) Construction of the Troneras reservoir and hydroplant with an initial capacity of 16 MW.
- (c) Diversion of the Concepcion and Tenche Rivers to increase daily flow in the Guadalupe River.
- (d) Erection of new transmission lines, enlargement of sub-stations and extension of primary and secondary distribution circuits.
- (e) Studies of the Guatape scheme.

2.08 As early as February 1960, EPM requested a loan increase of US\$3 million to cover the extra costs that the project was incurring due to internal inflation and higher than expected bids on civil works.

The original estimate of the cost of civil works had been based on the assumption that local contractors would be the successful bidders but the main construction contracts were finally won by foreign contractors who required substantially more foreign exchange than Colombian contractors. A Bank mission, which visited Colombia in March 1960, established that the foreign exchange cost overrun was in fact US\$3.5 million and recommended an interim loan to cover this amount as well as the foreign exchange necessary to finance the second stage of the project. The mission also recommended a loan of US\$22 million for the first stage of the Guatape hydroplant. Six months later, EPM reported to the Bank that a larger interim project and a temporary postponement of Guatape would be advantageous for system expansion. A Bank appraisal mission was sent to Colombia in November 1960 and a US\$22 million loan was signed on May 12, 1961 to cover the cost overrun on the previously financed project, which was estimated at US\$3.8 million and to cover the foreign exchange cost of the project described below:

- (a) Addition of a second 18 MW unit in the Troneras hydro-plant. <sup>1/</sup>
- (b) Installation of three additional 40 MW units at the Guadalupe III hydroplant.
- (c) Construction of the Miraflores dam and reservoir on

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<sup>1/</sup> The first unit was finally 18 MW instead of the originally planned 16 MW.



the Tenche River to further increase daily flow in the Guadalupe River.

- (d) Construction of additional transmission, distribution and sub-station capacity in Medellin.

2.09 In March 1963 EPM applied for a third loan for the amount of US\$43 million to finance the foreign exchange component of the Guatape project. The Bank mission which left for Colombia shortly thereafter reported the project to be economically viable. EPM was anxious to go ahead with the project as soon as possible, but the decision of the Bank was slightly delayed when it appeared that the Colombian Government was nearing its guarantee limit. Colombia's creditworthiness was restored after supplemental legislation had been passed. Negotiations did not pose any major problems and a US\$45 million loan was signed in August 1964 to cover the foreign exchange cost of the following items:

- (a) Guatape I hydroelectric plant (including first two units of 66 MW each).
- (b) 230 kv transmission line from Guatape to Medellin.
- (c) Sub-transmission (110 kv), Medellin sub-stations and distribution.

2.10 All three loans contained covenants in the Loan Agreements and Side Letters which were designed to increase the institutional efficiency and financial viability of EPM. A detailed description and analysis of the covenants is to be found in the sections below on financial performance and institutional development. The most

important of these provisions may be summarized as follows:

Main Provisions in Loans Agreements

(a) Separate Operation of Empresas' Departments

EPM shall operate each of its Departments separately and maintain separate accounts for each Department.

(b) Indebtedness to Equity Ratio

The long-term indebtedness to equity ratio for the Power Department shall not exceed a ratio of 60 to 40; and no other Department shall incur long-term indebtedness unless its revenues will be sufficient to cover operating expenses, including taxes, and all debt service payments.

(c) Debt Incurred

Where Departments other than the Power Department incur debts for more than one year the holder of the debts shall forego any rights he may have to the assets of the Power Department.

(d) Rate Adjustments for all Departments

EPM shall review its rates at least every two years to insure that sufficient money is provided to

- (i) cover operating expenses, including taxes, and contributions to the Municipality of Medellin, adequate maintenance and depreciation and interest;
- (ii) meet repayments on long-term indebtedness but only to the extent that such repayments shall exceed provision for depreciation; and
- (iii) leave a reasonable surplus to finance new investments.

Side Letters

- (a) Letters which provide for the amount of cash to be internally generated by EPM for future capital expenditures (30 percent for Loan 225 CO, 40 percent for last two loans).
- (b) Letters which provide that EPM consult the Bank before it changes any of its statutes and inform the Bank of any legislation, decrees or resolutions affecting its status.

III - Major Issues

Financial Performance

3.01 As explained earlier, EPM not only supplies electricity to Medellin but also has responsibility for the water, telephone and sewerage services of the city. Nevertheless, the four divisions are operated and managed separately and, at the insistence of the Bank, clear lines have been drawn between the electric department's operations and accounts and those of the rest. It is thus possible to examine the performance of the power division alone and the financial analysis which follows refers only to that division.

3.02 Basically, the performance of EPM has been similar to that of EEEB of Bogota (see previous chapter); before the IBRD entered the picture the company had a large potential market, but lacked the necessary capital to carry out the extensive expansion program it needed. The Bank was able to supply a large part of this capital by financing most of the foreign exchange portion of EPM's investments (over 97 percent in the 1959-70 period) but, as in the case of EEEB, the local

currency portion had to be financed mainly from the Empresa's profits. The absence of adequate long term Peso credit facilities in Colombia made this essential to avoid lags in the expansion program. For this reason, as in all other loans to power entities in Colombia, the Bank insisted upon the Empresa's adoption of procedures designed to generate a substantial portion of its own local currency investment costs. From the evidence available it appears that EPM has been successful in improving and expanding its system over the past twelve years and its financial performance has generally lived up to expectations.

3.03 In financial covenants attached to the Loan Agreements, the Bank stipulated that 40 percent (originally 30 percent, but raised in the last two loans to 40 percent <sup>1/</sup>) of investments -- roughly corresponding to the total local currency portion -- should be financed through self-generated funds. Toward this end, it was agreed that the Empresa should review its tariff levels at least once every two years to ensure that revenues were high enough to meet all expenses (including taxes and depreciation), make debt service payments and cover the 40 percent self-financing provision. Performance in this last respect has generally been satisfactory. For the specific five-year period

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<sup>1/</sup> Loan 369 CO specified that EPM should finance 40 percent of its construction expenses in each five-year period subsequent to December 31, 1963, through self-generated funds.

1964-68 covered by the Side Letter under Loan 369 C0, the self-financing rate was 40.6 percent (Loan 369 C0 Appraisal Report forecast was 42.0 percent). <sup>1/</sup> This was an improvement over the 1961-65 period covered by the Side Letter of Loan 282 C0 when the rate was 33.7 percent (Loan 282 C0 Appraisal Report forecast was 39.1 percent), below the agreed 40 percent. During 1959-1963, when the Side Letter of Loan 225 C0 specified a 30 percent self-financing rate, the rate was 36.4 percent. Performance during the last two years 1969-1970 has averaged 38.5 percent, with 1970 showing 44.9 percent. EPM's inability to contribute more to its investment program from self-generated resources during the 1961-1965 period resulted from a failure to adjust tariffs in a timely manner.

1/ The method which the Bank employed to calculate EPM's self-financing rate differs from that used elsewhere in this study in the treatment of interest during construction. The following shows the difference in definition:

<u>IBRD Appraisal Report on EPM:</u>	<u>Present Evaluation Report:</u>
Gross Internal Cash Generation	Gross Internal Cash Generation
Less: Debt Service plus dividends to Municipality ( <u>Excluding</u> interest during construction)	Less: Debt Service plus dividends to Municipality ( <u>Including</u> interest during construction)
Plus: Appropriation to Reserve for Employee Benefits	Plus: Appropriation to Reserve for Employee Benefits
Equals: Net Internal Cash	Equals: Net Internal Cash
 Self-financing Rate = <u>Net Internal Cash</u>	 Self-financing Rate = <u>Net Internal Cash</u>
<u>Total Construction Expenditures</u> ( <u>Including</u> interest during construction)	<u>Total Construction Expenditures</u> ( <u>Excluding</u> interest during construction)

3.04 EPM's rate increases have been largely neutralized by inflation, and tariffs expressed in real terms have only just managed to keep up with rising real costs; in the 1959-69 period, unit revenues in real terms grew at an average annual rate of 3.4 percent, close to the increase in real costs per unit of 3.1 percent yearly over the same period (see Table I). As in the case of EEEB, one of EPM's main difficulties has been to maintain a balanced relationship between the two. But EPM has managed to maintain a generally steadier balance, with real unit revenues rising from 12 centavos per kwh in 1959 to 17 in 1969 (both in 1968 prices). This is probably mainly due to the fact that tariff increases are easier to obtain in Medellin than in Bogota. Per capita incomes are somewhat higher in Medellin and the impact of a rate increase upon the average family budget is probably less noticeable. Also Bogota, being the capital city, is more likely to be influenced by political considerations in operations, than in the case of industrial Medellin.

3.05 Tariff rate increases were a major issue between the Bank and EPM during 1961-1963, when the tariff covenant of Loan 282 CO was in force, providing that internally generated cash should cover 40 percent of investment expenditures over the period 1961-1965. The Bank employed various means to encourage the Company to press for a rate increase. For instance, it indicated that reimbursement of the sum paid to a contractor from Loan 282 CO could be envisaged only after the presentation of concrete evidence supporting the timing and extent

of a rate increase. EPM complained about the high tariff increase required, given the inflationary conditions in Colombia, for the company to comply with the Bank's condition regarding self-generated investment funds. The Company also argued that pressing for such an increase was likely to imperil its autonomy. An increase of about 60% was finally granted in March 1963.

3.06 In spite of the many revisions they have been subjected to, electricity tariffs in Medellin, as in Colombia in general, have been among the lowest in the world. It was only in 1968 that the Government created the Public Service Tariff Board with a view to encouraging the adoption of standard criteria on the national level for establishing tariff levels and structure. All utility tariff increases have to be approved by the Board. The latter has set as its major objective the restructuring and adjustment of tariffs so that they would cover expenditures and provide a reasonable return on revalued assets, thereby permitting orderly financing of system expansion. The impact of the recommendations made by the Board is only beginning to be felt and Colombia's utility tariff structure today is still far from conforming with the proposed policy. EPM is one of the very few companies which now has tariffs sufficient to yield a rate of return of more than 9% on net fixed assets, and this is a development of the last two years.

3.07 Due to rather disappointing internal cash generation in 1967 (28.1%) and 1969 (32.7%), and local cost overruns on Guatape, EPM had

to rely to a greater extent than expected on other sources of funds, including an extraordinary government contribution of Ps 9.25 million in 1967 (covering 6 percent of total Application of Funds) and a special loan of Ps 20.0 million from the national budget through the Instituto de Fomento Industrial (IFI) in 1969.

3.08 It should be observed that factors other than finance are involved in determining the level of tariffs and it may be that the rates charged by EPM were the highest politically feasible. In addition, as mentioned before, EPM has been affected by very considerable distribution losses in the form of stolen energy, which have increased from 1.0 percent of total generation in 1960 to 15.7 percent in 1969 (see Section IV below). If all this energy had been sold to, rather than stolen by, the so-called "pirate" unconnected areas, EPM would have realized additional gross revenues (amounting to some 37 million pesos in 1969), which would have reduced the Empresa's need to seek outside investment financing.

Project Implementation: Delays and Cost Overruns

3.09 As in the case of the Bogota Power Company, preliminary negotiations between the Bank and EPM dragged on for years before a final agreement could be reached. The major point of friction again concerned the company's legal and financial status. The Bank insisted that the power section of EPM be organized as a separate entity with independent financial and administrative status. The new charter of the company, drawn up in 1955, conformed with the Bank's basic requirement of



financial separation and insulation from political interference, even though not with the Bank's original proposal of total independence of power from all other services. The legal status of the Empresas has remained an issue, with the Municipality expressing on several occasions its desire to exercise stronger control over the company (see Section VI below), but it seems that, after the first loan was negotiated, the issue no longer contributed to slow down operations. The embargo imposed on lending to Colombia between 1956 and 1958 obviously extended the pre-negotiation period between the Bank and EPM. The tariff issue, although sometimes difficult, does not seem to have hindered the progress of project implementation in a significant way.

3.10 Project preparation was generally adequate and the Bank has not really intervened in the company's investment decisions. Initially, the Bank felt that the supervisory qualifications of EPM's staff were rather weak. During negotiations, it was agreed that EPM would hire special consultants who would have total responsibility for supervising and directing the contractors; the consultants' duties were to cover all technical matters in connection with the project, including items related to costs and schedules.

3.11 Delays in the commissioning of the various plants and units are given in the table below:

Table 11.1

EPM: Expected and Actual Commissioning Dates of Generating Plants

<u>Generating Plants and Units</u>	<u>Expected Date of Commissioning</u>	<u>Actual Date of Commissioning</u>	<u>Delay</u>
<u>Loan 225 CO</u>			
Troneras u <sub>1</sub> (H)	Mid 1962	Dec. 1964	2 years 6 mos.
Guadalupe III u <sub>1</sub> (H)	Early 1961	Aug. 1962	1 year 6 mos.
Guadalupe III u <sub>2</sub> (H)	Early 1961	Nov. 1962	1 year 10 mos.
<u>Loan 282 CO</u>			
Troneras u <sub>2</sub> (H)	Sept. 1963	Feb. 1965	1 year 5 mos.
Guadalupe III u <sub>3</sub> (H)	Oct. 1964	Oct. 1965	1 year
Guadalupe III u <sub>4</sub> (H)	Apr. 1965	March 1966	11 mos.
Guadalupe III u <sub>5</sub> (H)	Dec. 1965	May 1966	5 mos.
Guadalupe III u <sub>6</sub> (H)	<u>a/</u>	Sept. 1966	<u>a/</u>
<u>Loan 369 CO</u>			
Guatape I u <sub>1</sub> (H)	Dec. 1968	Sept. 1971 (exp.)	2 years 9 mos.
Guatape I u <sub>2</sub> (H)	Mid 1969	Sept. 1971 (exp.)	2 years 3 mos.
Guatape I u <sub>3</sub> (H)	<u>a/</u>	End 1971 (exp.)	<u>a/</u>
Guatape I u <sub>4</sub> (H)	<u>a/</u>	End 1971 (exp.)	<u>a/</u>

a/ Units not included in the original list of goods; attractive financial arrangements on the equipment resulted in savings which were used to purchase one additional unit for Guadalupe III and two additional units for Guatape.

The table shows that construction delays have generally been considerable. Delays and cost overruns on each of the projects are analyzed below in greater detail. Total project costs (as well as unit cost per kilowatt of installed capacity), forecast and actual, are compared in Table III.

Loans 225 and 282 are treated together since the latter merely financed completion of the expansion program initiated by the former. It should also be recalled that the second loan included the amount of \$3.8 million to cover the foreign exchange cost overrun on the first loan.

Loans 225 CO and 282 CO

3.12 The construction delays which occurred in connection with these two loans were due mainly to the fact that the contractors were under-equipped, poorly directed, and had been handicapped by price increases in imported equipment occasioned by the Government's import restriction policy. This affected mainly progress on the Concepcion and Tenche diversion works, construction of the Troneras plant, and work on the Miraflores dam. Foreign and local cost overruns occurred on all major construction works and equipment covered by the loan, with the notable exception of the three units of the Guadalupe plant provided for in the second loans; the sixth unit of Guadalupe was purchased with the savings realized on units 3, 4 and 5, leaving a final foreign currency cost underrun of US\$1.45 million on the Guadalupe plant. The table below gives in detail the forecast and actual expenditures.

3.13 The table shows that the foreign currency contingency allowance was almost entirely used to cover the excess cost of the Troneras

dam and power station, and that the remaining overrun was partly covered through a reduction in the amount required to cover interest during construction. Local currency cost overruns, on the other hand, turned out to be drastically higher than forecast, amounting to nearly six times the contingency allowance. The only reduction was a 42% cut in expenditures on distribution. It is interesting to point out that extra expenditures on engineering and supervision amounted to more than 10% of total cost overruns. It is important to note, however, that in spite of these cost overruns, the final cost per KW installed was

**Table 11.2**

EPM - Loans 225 CO and 282 CO - Forecast and Actual Cost of Project

	Foreign Exchange Component (\$ million)			Local Currency Component (\$ million equiv.)			Total Cost of Project (\$ million equiv.)		
	Forecast	Actual	Overrun	Forecast	Actual	Overrun	Forecast	Actual	Overrun
<b>Loans 225 CO and 282 CO</b>									
Roads and Construction Equipment	0.80	0.80	-	0.28	0.92	0.64	1.08	1.72	0.64
Diversion of Concepcion and Tenche Rivers	-	0.77	0.77	0.66	1.30	0.64	0.66	2.07	1.41
Troneras Dam and Power Station	1.97	4.74	2.77	2.54	6.11	3.57	4.51	10.85	6.34
Suadalupe III <sup>a/</sup>	11.77	10.32	(1.45)	3.12	7.66	4.54	14.89	17.98	3.09
Miraflores Dam	1.14	3.19	2.05	1.50	4.12	2.62	2.64	7.31	4.67
Transmission Lines	0.97	1.65	0.68	0.26	1.11	0.85	1.23	2.76	1.53
Substations and Distribution System	4.88	6.35	1.47	3.06	1.78	(1.28)	7.94	8.13	0.19
Engineering and Supervision	1.01	0.91	(0.10)	1.57	3.93	2.36	2.58	4.84	2.26
Engineering for Guatemala	0.15	0.86	0.71	0.16	0.79	0.63	0.31	1.65	1.34
Interest and other charges during Construction	5.30	4.37	(0.93)	-	-	-	5.30	4.37	(0.93)
Contingencies <sup>b/</sup>	3.01	-	-	2.49	-	-	5.50	-	-
Additional Foreign Exchange for Loan 225-CO	3.00	-	-	-	-	-	3.00	-	-
<b>Total</b>	<b>34.00</b>	<b>33.96</b>		<b>15.64</b>	<b>27.72</b>		<b>49.64</b>	<b>61.68</b>	

<sup>a/</sup> While forecast figure was for 3 units, actual figure also includes costs of a fourth unit bought with savings realized on the first three.

<sup>b/</sup> Includes contingencies for price increases of Ps 0.83 million.

Source: EPM  
IBRD

\$ 162.8 for the completed 270 MW Guadalupe III plant, one of the lowest unit costs of all the projects examined in this study.

Loan 369-C0

3.14 The construction of the Guatape hydroplant is especially interesting, not only because of the spectacular nature of the project, but also because of the various technical problems encountered in its implementation. The plant, which is entirely underground, utilizes the flow of the Nare river and the head created by diverting its water to the adjacent Guatape valley, some 850 m below. The first stage of the Guatape project, as financed through Loan 369-C0, includes a small diversionary dam on the Nare river, an inlet pressure tunnel of about 4.7 km, an inclined penstock tunnel of approximately 1.2 km, a powerhouse cavern excavated for four 66 MW units <sup>1/</sup> and a free flow tailrace of about 4.7 km. The vehicular access tunnel to the power plant cavern has a total length of nearly 2,000 meters. The powerhouse cavern, which is located at a depth of about 680 meters below ground level, was, as of 1969, the deepest underground powerhouse in the world. The first stage of the project will utilize a net hydraulic head of about 780 meters which will be in-

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1/ The second stage of Guatape (Guatape II) will provide for the expansion of the existing powerhouse and the installation of four additional 66 MW units.

creased to nearly 810 meters after the second stage dam is built.

3.15 The scope of the project has obviously brought with it several technical difficulties. These resulted in a total delay of almost three years. The main problems arose in connection with the excavation of the vehicular access tunnel, the tailrace tunnel, the penstock tunnel, and the powerhouse. Large quantities of water encountered while digging the access tunnel made it necessary to establish a complex pumping system, while, in the case of the tailrace tunnel, the excavation was slowed down due to the existence of a large rock fault. These two difficulties delayed the overall project by nearly 9 months. The rock on the walls of the powerhouse required a lengthy special lining treatment which delayed the initiation of work on the penstock tunnel. A major accident which occurred during the excavation of the latter resulted in the death of several workers requiring a change in building methods, which involved the construction and subsequent enlargement of a pilot tunnel. The construction of the pressure tunnel was carried out more efficiently than anticipated, in spite of minor problems which arose in connection with the concrete lining.

3.16 Other elements unrelated to specific technical difficulties encountered in the civil works also contributed toward retarding the progress of operations. These concerned mainly design revision suggested by the new foreign consultants appointed to the project. Furthermore, the original plans for the water intake structure underwent major alterations; the final scheme provided for the diversion of the Nare river

by a tunnel rather than an open channel as initially planned. Finally, some complications arose as a result of a delay in the shipment of various pieces of equipment, and the Company complained about the difficulty of coordinating the orders made to the large number of suppliers. It is difficult, at this stage, to assess the exact cost overruns on the various parts of the project since it has not been fully completed yet; about \$ 10 million still had to be disbursed from the Bank loan account as of December 31, 1970. Actual expenditures up to that date are shown in the table below.

Table 11.3

EPM - Loan 369 C0 - Forecast and Actual Cost of Project<sup>a/</sup>

Loan 369-C0	Foreign Exchange Component (\$ million)			Local Currency Component (\$ million equiv.)			Total Cost of Project (\$ million equiv.)		
	Forecast	Actual	Overrun <sup>b/</sup>	Forecast	Actual	Overrun <sup>b/</sup>	Forecast	Actual	Overrun <sup>b/</sup>
Land, access roads, etc.	-	-		2.24	3.64	1.40	2.24	3.64	1.40
Civil works	16.61	16.21	(0.40)	13.26	16.56	3.30	29.87	32.77	2.90
Power plant equipment <sup>c/</sup>	8.94	6.72	(2.22)	0.67	1.41	0.74	9.61	8.13	(1.48)
Transmission and Distribution System	4.77	4.56	(0.21)	3.91	0.95	(2.96)	8.68	5.51	(3.17)
Engineering	1.00	1.07	(0.07)	2.22	4.97	2.75	3.22	6.04	2.82
Interest and other charges during Construction	5.00	5.59	0.59	0.46	4.32	2.16	9.91	8.21	2.75
Physical contingencies	5.59			4.32					
Provisions for price increases	3.09			3.38			6.47		
<b>Total</b>	<u>45.00</u> <sup>d/</sup>	<u>34.15</u>		<u>30.46</u>	<u>30.15</u>		<u>75.46</u>	<u>64.30</u>	

a/ Actual figures are as of 12/31/70

b/ Final overruns and/or underruns are not available as projects are not yet completed

c/ While forecast figure was for two units only, actual figure also includes cost of two additional units bought with savings realized on the first two.

d/ US \$3.0 million were cancelled in August 1970.

Source: EPM  
IBRD

3.17 Indications are that some savings are likely to appear on the foreign currency component of the project. As indicated earlier, the original loan provided for the installation of only two generating units at Guatape, but especially attractive offers from the suppliers induced

the company to include four units in the contract. Local costs, on the other hand, will probably turn out to be much higher than originally anticipated. This will mainly be the case for civil works and engineering, for reasons previously cited. Once again, it appears more than likely that distribution will suffer in order to cover the overruns on the other items of the project. It should also be recalled that in 1969, EPM received a credit of Ps 20 million from the Central Budget through IFI to complement the local currency financing of Guatape. In addition, the company intends to float a Ps 100 million bond issue in the near future to cope with the constant threat of a peso shortage.

#### IV - Load Forecasting, Investment Planning and System Development

4.01 Installed capacity in the Medellin system grew at a very low rate between 1955 and 1962. There was no expansion of generation facilities at all between 1958 and 1962, and from 1959 on, although the system was operated at its maximum overload capacity, shortages began to appear, involving major rationing of the residential supply and forcing manufacturing industries to install their own generating facilities.

The Company attempted to deal with this critical situation by purchasing energy from a large neighboring textile factory, but this remained insufficient to cope with prevailing demand.

4.02 The situation improved substantially when the first two units of Guadalupe III were put into operation at the end of 1962, yielding an increase in peak supplied of about 35 percent. Energy sales to the industrial sector, which had been subject to major fluctuations since



1954 (with a downward trend in 1956), experienced a continuous average growth of 10.5 percent per annum after 1961. However, it appears that the rate of growth of electricity sales to industry did not increase as much as would have been expected during the 1962-1968 period after the improvements in the public electricity supply were effected; this has probably been partly the result of the traditionally heavy reliance upon self-generation by the textile industry, Medellin's major industrial branch, as well as the slower than expected growth of the overall economy in the period. Also, Medellin, seems to have always attempted to give priority to industrial development and has caused the burden of electricity shortages to be borne by residential consumers. Finally, the price of coal in Medellin has always been low and the motivation of industries to switch to public electricity has probably not been as strong as in other places. On the other hand, there have been some instances of delays in industrial investment due to deficiencies of public power supply. For instance, the Futec foundry which had been planned since 1961-62, was only built in 1964 when improvement in public electricity supply was imminent. Residential consumption, which had been increasing regularly between 1951 and 1960, declined slightly in 1961 and caught up again in 1962.

4.03 The three expansion programs carried out by EPM between 1962 and 1971 have resulted in a large increase in system capacity, growing from 137 MW in mid-1962 to 575 MW by mid-1971 -- an average annual rate of 17.3 percent. Over the same period, peak demand increased by about

11.5 percent per year, leaving a relatively large gross reserve capacity margin. The expansion of the sub-transmission and distribution systems, although taking place at a slower relative rate than the expansion of generating facilities, generally kept pace with the growth of the city's economic activity and, seemingly, did not curtail load growth notably. It should be noted, however, that Medellin has suffered major electricity thefts in the past and that the official connection of the pirate areas to the network would probably have contributed to increasing system demand (see table below). The rapid growth of power theft by residents of marginal areas was mainly due to the refusal of the City Council to allow extension of Company services beyond the city limits and to incorporate the marginal areas within the city. In recent years, however, the company has undertaken a systematic electrification program in the "pirate" areas and significant reductions in losses are expected.

Table 11.4

EMPRESAS PUBLICAS DE MEDELLIN (EPM)  
LOSSES IN THE ELECTRIC SYSTEM - BREAKDOWN BY ORIGIN

Year	Total Generation		Losses in Transmission and Transformation		Losses in Primary Distribution Networks		Losses in Distribution Transformers		Losses in Secondary Distribution Networks		Losses in Meters		Meter Reading Errors		Stolen Energy		Total Losses	
	(Mwh)		(Mwh)	%	(Mwh)	%	(Mwh)	%	(Mwh)	%	(Mwh)	%	(Mwh)	%	(Mwh)	%	(Mwh)	%
1960	824123		28801	3.49	33577	4.07	14753	1.79	10950	1.33	1779	0.22	13213	1.60	8257	1.00	111330	13.50
1961	851232		37953	4.46	31272	3.67	15455	1.82	9303	1.09	1873	0.22	13441	1.58	13183	1.55	122480	14.39
1962	936848		39078	4.17	32670	3.49	17508	1.87	10494	1.12	1972	0.21	14513	1.55	33001	3.52	149296	15.93
1963	1100442		33576	3.05	45232	4.11	20105	1.83	12211	1.11	2058	0.19	17055	1.55	66079	6.00	196316	17.84
1964	1236019		42389	3.43	57616	4.66	21592	1.75	13893	1.12	2161	0.18	18589	1.50	97275	7.87	253515	20.51
1965	1373309		53882	3.92	57948	4.22	23578	1.72	16618	1.21	2289	0.17	19932	1.45	148067	10.78	322314	23.47
1966	1478420		47132	3.19	69443	4.70	24881	1.68	18550	1.25	2383	0.16	21579	1.46	159630	10.80	343558	23.24
1967	1597009		53022	3.32	85196	5.33	26217	1.64	20901	1.31	2415	0.15	22578	1.41	199073	12.47	409402	25.63
1968	1698389		47369	2.79	70290	4.14	27351	1.61	23636	1.39	2506	0.15	23291	1.37	278999	16.43	473442	27.88
1969	1829074		55303	3.02	68960	3.77	26993	1.48	24466	1.34	2730	0.15	25517	1.40	287780	15.73	491749	26.89

Source: EPM

4.04 Installed capacity has been greatly in excess of actual peak demand since the end of 1966 when unit 6 of Guadalupe III was put into operation. Reserve capacity reached a maximum of about 150 MW at that time but declined to about 75 MW at the end of 1970; the capacity of the largest unit in service over the period being 45 MW. Forecast demand, as projected in the first two loan appraisal reports (see Tables II-A.1 and II-A.2) were for the most part substantially higher than actual demand, while projections for the third loan were much more accurate with only slight overestimations (see Table II-A.3). The variations observed between forecast and actual reserve capacity were the results of delays in commissioning the various generating units as well as the lower than expected load. The necessity of temporarily removing some units from operation for repair and maintenance purposes substantially lowered the actual spare capacity during the critical years 1963-66 (see Table II-A.2 and II-A.3, line 9, Effective Peak Spare Capacity).

4.05 While there has been very considerable excess capacity since 1966, computer simulation of the operation of the system shows that excess energy has been much more limited. A potential energy generation analysis was carried out, based on actual river flows and showing how much energy could have been generated by the different plants with these river flows. The table below shows the percentage that gross capacity reserves have represented of peak demand for each year since 1965 and equally the percentage that excess energy (i.e. corresponding to water-spill) has represented of actual system generation over the same period.

Table 11.5

EPM Reserve Supply Capacity 1965-70

	<u>Generating Capacity</u>		<u>Energy Production</u>	
	<u>Gross Reserves (MW)</u>	<u>Gross Reserves as % of Peak Demand</u>	<u>Excess Available (Gwh)</u>	<u>Excess as % of Actual System Generation</u>
1965	41.0	15.4	165.8	12.1
1966	154.0	53.3	170.5	11.5
1967	133.2	43.0	223.4	14.0
1968	116.0	35.5	162.3	9.5
1969	93.5	26.8	101.8	5.6
1970	72.2	19.5	260.9	13.3

The sharp rise in excess energy available in 1970 was due to exceptionally good stream flows in that year. The analyses undertaken indicate that additional energy generating capacity is required (as is being provided this year by completion of Guatape) but that the last two units of Guadalupe III have barely yet fulfilled an essential role -- although they will become useful as peaking units when loads are greater and there is more base load capacity in the form of Guatape. The fifth unit at Guadalupe might have been postponed two years and the sixth unit much longer, into the early 1970s, without adversely affecting energy supply; but these units were obtained at relatively low marginal cost (apparently some \$ 2.0 - 2.5 million equivalent in total) along with units 3 and 4 in 1963 so that it was probably preferable to install them simultaneously, in 1965-66, as was done.

4.06 Energy sales forecasts were overestimated in all three loan appraisal reports by approximately the same margins (see Tables II-A.1,

II-A.2 and II-A.3) and this in turn resulted in an overestimation of net revenues (see Section V). Discrepancies between forecast and actual energy sales were greater for the residential sector than for the industrial, and they are partially accounted for by the rising energy thefts.

#### V. - Forecasting the Financial Aspects

5.01 Comparison of forecasts and actual figures in Tables II-A.1, II-A.2, II-A.3 and II-B clearly show that forecasts of EPM's financial performance for all three loans have been optimistic. The most notable contrast between forecast and actual performance can be seen in the trend of operating income (which determines the extent to which the company can finance its investments itself, i.e., affect the self-financing rate) and the rate of return, particularly for the third appraisal report projections for 1964-68. While the fact that operating income fell behind projections (by about 40% for 1965-67) is in part related to the fact that (a) inflationary pressures (estimates of which, unlike in the first two loans, were explicitly included in the projections of Loan 369-C0) were stronger than expected, and (b) tariff increases did not occur as planned, it is also quite significant that energy sales were overestimated and that sales have been more weighted toward low tariff consumers in actuality than in the forecasts.

5.02 Colombia experienced high rates of inflation in the period 1950-70, with the price level increasing about six fold. Although EPM partially revalued its assets between 1967 and 1970 (revalued the foreign component of its assets to allow for devaluations of the Colombian Peso

since the loans had been contracted and plants built), further revaluation calculations have been made for this study in order to assess the actual financial performance of the company over the whole period in which the Bank has been associated with the company. Detailed explanation of how these revaluation calculations were made is found in Annex I. The financial rates of return for EPM based on revalued assets fall considerably below both forecasts and the partially re-valued EPM "actual" rates of return. For the years 1965-68 the rate was below 8 percent, the level that the Bank generally considers to be a minimum for utilities to maintain.

5.03 EPM is often considered to be the most efficient power entity in Colombia. It is true that it has among the lowest average production costs in the country, but this is partly due to its relatively large size and the existence of attractive hydroelectric sites in the area. EPM's sales per employee have risen significantly over the last seven years and are much higher than those for any other Colombian utility for which data are available. However, it is hard to say whether this reflects real superiority in performance -- resulting from greater efficiency and the advantages of the unified utility set-up -- or whether it reflects exclusion of some administrative personnel (classified in general management under the unified set-up), absence of thermal plants from the system and/or the more serious failure in Medellin to keep up with requirements for expansion of the distribution system in marginal areas.

5.04 It is surprising that real costs per unit sold should have

shown such a sharp upward trend over the last ten years when the system has expanded so dramatically and it would consequently have been expected that significant economies of scale would have been attained with resultant lower average unit costs. Unit costs per kwh sold have grown in real terms at an average of some 3 percent per annum over the 1960s. An important part of the reason for this is the large quantity of energy stolen. Costs per kwh sold and stolen were 6.8 centavos in 1969 compared with 8.3 centavos per kwh sold. 6.8 centavos is only about 10 percent above the 1959 level. Analysis of the composition of EPM's operating costs suggests that the most important factors accounting for higher real costs today than ten years ago, after allowance for the stealing problem, are depreciation provisions -- due to the rapid growth of the system itself -- and administration expenses. Costs of the latter have increased in real terms at an average annual rate of 18 percent over the last ten years, whereas total operating costs (including depreciation) have increased at 11 percent. This large increase in administrative costs has been primarily due to the rather steep climb of total wages, salaries and social benefits (16 percent per annum) over the 1959-69 period. Although EPM has been since 1966 steadily reducing the absolute number of its employees and the rate of annual increase in personnel costs has declined to 4.2 percent over the last five years (with energy sales per employee rising faster than wages per employee) wages, salaries, and social benefits represented what appears to be a somewhat high 45 percent of 1970 total operating costs (47 percent in 1960 and 54 percent in 1965). This compares

to 38 percent for EEEB. Average wages per employee for EPM in 1970 were 60 percent above those for EEEB, placing them in the top 5 percent of the national Colombian income scale.

#### VI - Institutional Development

6.01 EPM has passed through two phases and experienced a series of reorganizations since its founding. During its first seven years its priorities were technical -- the expansion of its power system. Beginning about 1962 it entered its second phase, characterized by more concern with operational and administrative improvement. This concern was manifest in the small reorganization of 1962 and the major reorganization of 1965. Since then the company has been concerned with the 1965 reorganization and has largely succeeded in implementing it. In essence, the organization has become more rationalized and specialized as the Company has consolidated its technical achievements.

6.02 With its first loan to EPM (225-CO of 1959) the Bank recommended the elevation of a small technical unit to the status of the technical department, and in side letters to the Loan Agreement it required the hiring of an engineering adviser to the director of the newly proposed technical department, and the hiring of an additional 11 engineers for the planning and engineering staff. Both recommendations were adopted by the borrower and, in addition, an engineering consultant was hired in early 1960 to help integrate the added engineers into the technical apparatus of the company. These measures supported the company's own priorities which were geared to improve its technical capabilities. The Bank



also indicated that the general manager's term of office, which was one year, should be lengthened in order to insure greater continuity of management. Although this recommendation was not a loan condition, it was accepted.

6.03 The second stage, concerned with administrative improvement of the company, began in 1962. Examination of the administrative structure, personnel policies, and labor relations led to the major reorganization of 1965. Under the reorganization scheme two new departments, financial and administration, were created. The creation of the two departments, and their later staffing with competent professionals resulted in overall improved personnel policies and practices and a greater focus on the training needs of the entity. The financial department has computerized its work, developed a modern budgeting system, created a commercial division and increased its planning capabilities.

6.04 At the time the Bank made its first loan in 1959, the costs of common services were apportioned among the four main departments of EPM, the Power Department's share in 1959 being 55 percent. The Bank sought assurances that EPM would operate each of its departments separately and would not use the assets and revenues of the Power Department to help other departments, and second, that no other department would incur long-term debt unless its revenues covered both operating expenses and debt service and unless the lender waived any rights to obtain satisfaction of his debt from the revenues or assets of the Power Department. These assurances were included in the provisions of the Loan Agreement.

6.05 At the time of the second loan in 1961, these restrictions were again included in the terms of the loan, with an understanding that there might be one exception to the previous complete separation. It had been discovered that it was impractical for the several departments to borrow from local banks to meet temporary needs for cash when EPM had cash available in its general fund. It was therefore arranged that each department could draw on these funds, subject to limits as to time (three months) and amount (Water Department 1.5 million pesos, Sewerage Department 0.5 million pesos, Power Department 5.0 million pesos, Telephone Department 2.0 million pesos). At the time the third loan was being appraised in 1963, the Power Department had an interdepartmental overdraft of 3 million pesos.

6.06 To comply with a loan condition that the company retain the services of internationally recognized auditors to prepare annual audits, the company hired in 1960 the firm of Deloitte, Plender, Haskins and Sells as external auditors. In addition to preparing their annual report the auditors have made a number of suggestions concerning accounting procedures. An internal auditor, appointed by the City Council but independent of the organization, performs both pre- and post-audit functions. Also, at the Bank's recommendation, the company hired Price Waterhouse in 1957 as consultants on reorganization and inventory, and in 1967-69 the company retained the services of Arthur Andersen to assist in a modernization program which included data processing, installation of a new computer and training.

6.07 After the promulgation of EPM's charter, pressures continued to exist in the City Council for changes in the composition of the Board of Directors of EPM to bring it under greater control of the Council. The first attempt toward changing the Board took place late in 1960. The purpose of the change was to give the Council the authority to appoint a majority of the Board's members. The Bank stated unequivocally that it "continued to be of the opinion that if the present organizational structure is altered, ..... the EPM would not be considered an acceptable borrower under the Bank's operating procedures. This would then preclude further Bank lending to the EPM." The attempted change, which was not supported by the Mayor, failed.

6.08 Another attempt, whose results are still being contested in the courts, was made in 1970 when the Municipal Council of Medellin, now controlled by the opposition party ANAPO, passed two decrees modifying the statutes of EPM. One of these decrees gives the head of the Municipal Planning Department a voice in the Board of Directors of the Corporation. The other would modify the composition and the powers of the Board as well as the procedures by which it is selected. One of the most disturbing changes, as far as the Bank is concerned, is an amendment which subjects the Board's resolutions on tariffs to the final approval of the Municipal Council.

6.09 There were two reasons for these changes. First, the company was organized by a group of entities such as the National Industrial Association and the local banks from which it had received loans. In 1968,

when the loans granted by the local banks were amortized and the company became self-financing, the Municipal Council felt that these financial institutions lost any right they might have had to be represented on the Board. The second reason is political. Several groups in Medellin thought it would be necessary to have wider representation from professional associations and from the unions, which previously were unrepresented. The new members are to be chosen from lists drawn by these groups as well as the commercial, industrial and banking groups.

6.10 In 1971 the issue was in the courts. With the change of the statutes a new Board was immediately elected. The old Board questioned the legality of the new statutes and thus of the election of a new Board. Subsequently, two cases have been presented to the Tribunal of Administrative Contention, one on the legality of the new statutes, the other on the issue of which Board is legally capable of acting. In the meantime the acting General Manager is working within the uncontested section of the statutes, consulting with the Mayor who is always the Chairman of the Board.

6.11 The changes have raised a number of interesting legal questions with regard to the status of the Bank vis-a-vis the company. According to the Bank's Legal Department the Bank acquired no right to determine the particular setup of the borrower's management and has no right to object to the proposed amendments of the borrower's charter. The Bank, in a supplemental letter, obtained the right to be promptly informed of any such proposal but not the right to object to it.

6.12 If the proposed changes, whenever they may be implemented, result in insufficient tariff levels the Bank would be entitled, pursuant to the quoted provisions and the supplemental letters, to demand that those levels be reached. The proposed change dealing directly with the tariff was, however, only an extra administrative step in the mechanism to determine tariffs. The Bank had no legal basis to object to it. With this legal advice at hand the Bank limited itself to an "exchange of views" with EPM.

#### VII - Conclusion

7.01 EPM has managed to improve the quality and capacity of its power supply to a considerable degree during the 1960s, keeping pace with the industrial growth of the city. The experience of the late 1950s and early 1960s suggests that, had the Bank not been able to provide the large amounts of capital required to exploit the attractive hydroelectric sites of the area, the company might have had to adopt less economic short-run solutions to its problems of shortage of power.

7.02 The main provisions of the Bank's three loans to EPM were designed to create and sustain an autonomous, efficiently operated and financially viable utility capable of meeting the load growth of Medellin. The organization has strengthened considerably over the years, and its financial performance, the best of the Colombian utilities which have borrowed from the Bank, has generally conformed to the covenants agreed with the Bank, though it was weak in the early and middle 1960s. EPM appears also to be a reasonably efficient entity. A question arises about the failure of unit costs to decline with such a large expansion of the system, the very

rapid increase in the wage bill, and the apparently very high average salaries paid. The other particularly weak aspects of performance is in the expansion of the distribution system and connection of marginal barrios, with the latter being apparently more the result of deficiencies in municipal planning than of shortcomings on the part of EPM itself. It is surprising that the Bank appears never to have given serious attention to either of these points.

7.03 Although the major projects which the Bank helped finance experienced considerable delays and involved significant cost overruns, these do not seem to have resulted in serious failures to meet demand (after the backlog was overcome by 1963) -- mainly due to slower than expected load growth -- nor to have affected the overall economic justification of the projects. In the cases of both Guadalupe III and Troneras, the Bank complied with EPM's requests for assistance without seriously questioning the economic validity of the steps proposed, which was rather plain. The Medellin System shows prima facie evidence of considerable excess capacity over the last five years but system simulation indicates that the energy margin has sometimes been narrow, due to limited river flows. The last unit, and probably the last two units at Guadalupe III, could have been omitted from the investment program without curtailing EPM's ability to meet system load to date, but they were obtained at rather low marginal cost in connection with the contract for the preceding two units, and it appears that the decision to install them at that time (in 1966) was probably wise; they should come to play an important role when the system has additional base-load capacity.

7.04 The 264 MW hydro site at Guatape was considered the cheapest alternative means of expanding EPM's generating facilities, following Guadalupe III, to meet both the long-term needs of Medellin as an isolated market and of the Central Interconnected System as a whole; construction of the plant is now nearly completed and it appears that the cost per KW installed will probably be reasonably close to the forecast figure of \$ 243. The plant will provide large amounts of firm capacity, a very fundamental and necessary feature for EPM, given the limited amount of energy available in its own system. The plant is also almost certainly the most appropriate major expansion in the context of the interconnected system, now nearing commissioning.

7.05 In overview, the fact that EPM has managed to expand and improve its services to meet the growing demands of Medellin reasonably well should be considered an achievement in view of the economic and political difficulties in the financing and management of such growth in Colombia.

COLOMBIA: EMPRESAS PUBLICAS DE MEDELLIN (EPM)  
ELECTRICITY DEPARTMENT

TABLE I

	UNIT																					Average Annual Increase Rate (%) m/				
		1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1950/60	1960/65	1965/70	
<b>OPERATIONS</b>																										
1. Installed Capacity (year end)																										
Hydro (no thermal)	MW	51.5	51.5	100.0	100.0	100.0	100.0	125.5	125.5	137.0	137.0	137.0	137.0	227.0	227.0	248.0	308.0	443.0	443.0	443.0	443.0	443.0	443.0	443.0	443.0	443.0
Total as % of total in country <sup>a/</sup>	%	na	na	na	na	na	na	23.0	25.0	21.0	22.0	21.0	20.0	27.0	22.0	22.0	24.0	28.0	26.0	26.0	23.0	21.0	21.0	21.0	21.0	21.0
2. Peak Demand	MW	53.8	52.4	77.9	83.7	96.8	101.2	117.1	125.4	137.1	147.5	149.9	148.3	199.6	215.8	231.5	267.0	289.0	309.8	327.0	349.5	370.8	370.8	370.8	370.8	
3. Gross Reserves	MW	-2.6	-0.9	22.1	16.3	3.2	-1.2	8.4	0.1	-0.1	-10.5	-12.9	-11.3	27.4	11.2	16.5	41.0	154.0	133.2	116.0	93.5	72.2	72.2	72.2	72.2	
Reserves as % of Peak Demand	%	-5.0	-1.7	28.4	19.5	3.3	-1.2	7.2	0.1	-0.1	-7.1	-8.6	-7.6	13.7	5.2	7.1	15.4	53.3	43.0	35.5	26.8	19.5	19.5	19.5	19.5	
4. Effective Peak Spare Capacity <sup>b/</sup>	MW	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	
5. Generation Sent Out	GWh	310.22	317.94	376.20	434.63	494.65	536.78	570.95	622.58	622.03	724.30	824.12	851.23	936.48	1100.44	1236.02	1373.31	1478.42	1597.01	1698.39	1829.07	1829.07	1829.07	1829.07	1829.07	
6. Net Purchases from other systems <sup>c/</sup>	GWh	-	-	-	-	-	-	-	-	2.65	15.87	15.10	19.07	11.55	0.21	1.42	-	-	-	-	-	-	-	-	-	
7. Total Sales to Customers	GWh	250.39	256.86	309.31	361.55	418.81	464.57	489.20	548.16	581.74	644.26	710.27	724.51	779.40	901.23	979.18	1045.27	1131.83	1182.78	1219.12	1331.00	1496.00	1496.00	1496.00	1496.00	
8. Number of Customers	000's	4,846	51.30	54.34	68.08	73.44	78.43	82.58	85.39	89.09	95.09	99.91	105.34	110.73	114.80	122.07	127.80	133.29	137.74	143.59	153.40	174.54	174.54	174.54	174.54	
9. Number of Employees	No.	na	na	na	na	na	na	na	na	na	na	na	na	na	na	877	927	939	929	876	860	802	802	802	802	
<b>FINANCE</b>																										
10. Sales Revenues (current prices)	Ps (mln)	na	na	na	na	na	16.20	16.92	18.81	22.98	29.24	37.76	44.27	46.61	73.33	95.01	103.46	130.77	157.32	197.20	244.67	279.34	279.34	279.34	279.34	
11. Operating Costs <sup>d/</sup> (current prices)	Ps (mln)	na	na	na	na	na	6.73	7.55	9.16	9.54	13.96	16.04	20.17	24.90	36.39	41.54	50.58	66.29	82.15	95.31	101.33	113.08	113.08	113.08	113.08	
12. Average revenue/kwh sold (current prices)	Ps	na	na	na	na	na	0.03	0.04	0.03	0.04	0.05	0.05	0.06	0.06	0.09	0.10	0.10	0.12	0.13	0.16	0.18	0.19	0.19	0.19	0.19	
13. Average revenue/kwh sold (constant 1968 prices)	Ps	na	na	na	na	na	0.14	0.15	0.11	0.11	0.12	0.13	0.14	0.13	0.15	0.14	0.13	0.14	0.14	0.16	0.17	0.16	0.16	0.16	0.16	
14. Average costs/ kwh sold based on revalued assets (in constant 1968 prices)	Ps	na	na	na	na	na	na	na	na	0.05	0.06	0.06	0.07	0.07	0.08	0.07	0.08	0.09	0.10	0.10	0.8	na	na	na	na	
15. Average revenue/kwh sold	USd(1)	na	na	na	na	na	0.89	0.95	0.69	0.70	0.76	0.82	0.87	0.80	0.93	0.90	0.84	0.85	0.91	1.01	1.06	1.01	1.01	1.01	1.01	
16. Average costs/ kwh sold	USd(1)	na	na	na	na	na	na	na	na	0.31	0.38	0.36	0.41	0.44	0.49	0.45	0.48	0.54	0.59	0.62	0.52	na	na	na	na	
17. Net revenues in current prices (10 - 11)	Ps (mln)	na	na	na	na	na	9.47	9.37	9.65	13.44	15.28	21.72	24.10	21.71	40.94	53.47	52.88	64.48	75.17	101.89	143.34	166.26	166.26	166.26	166.26	
18. Net revenues in current prices based on revalued assets	Ps (mln)	na	na	na	na	na	na	na	9.65	12.85	14.54	20.82	22.99	20.79	36.27	47.66	44.75	47.64	58.71	87.30	124.91	na	na	na	na	
19. Gross fixed investment (current prices)	Ps (mln)	na	na	na	na	na	na	9.60	18.89	34.91	28.31	21.97	60.42	106.91	61.18	144.55	149.72	174.21	166.31	180.19	343.02	267.16	267.16	267.16	267.16	
20. Gross Fixed investment (1968 prices)	Ps (mln)	na	na	na	na	na	na	36.29	60.83	99.14	75.59	54.05	137.15	227.72	105.84	215.38	203.62	205.57	181.28	180.19	315.58	224.41	224.41	224.41	224.41	
21. Average net fixed assets in operation	Ps (mln)	na	na	na	na	na	na	na	na	89.27	108.46	117.33	122.49	205.37	297.96	337.34	426.00	531.27	578.50 <sup>k/</sup>	585.14 <sup>k/</sup>	591.85 <sup>k/</sup>	na	na	na	na	
<b>MANAGEMENT INDICATORS</b>																										
22. Rate of return on Electricity Sales (17 as % of 21)																										
(1) non-revalued assets	%	na	na	na	na	na	na	na	na	15.1	14.1	18.5	19.7	10.6	13.7	15.8	12.4	12.1	13.8	19.1	25.9	na	na	na	na	
(2) revalued assets <sup>e/</sup>	%	na	na	na	na	na	na	na	na	12.2	11.4	11.8	15.3	8.8	8.7	9.9	7.2	5.4	6.0	8.2	11.0	na	na	na	na	
23. Financial rate of return <sup>f/</sup>																										
(1) non-revalued assets	%	na	na	na	na	na	na	na	na	13.6	13.6	18.3	19.9	11.0	13.9	16.0	12.6	12.2	13.7	18.4	25.4	na	na	na	na	
(2) revalued assets <sup>e/</sup>	%	na	na	na	na	na	na	na	na	10.9	11.0	14.6	15.5	9.2	8.8	10.0	7.3	5.5	5.9	7.9	10.7	na	na	na	na	
24. Self-financing rate <sup>g/</sup>	%	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	
25. Debt Service Coverage <sup>h/</sup>	Times	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	
26. Debt/Equity ratio	%	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	
27. Energy Sales per Employee	Mwh	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	
28. Distribution and Transmission losses <sup>i/</sup>	%	19.3	19.2	17.8	16.8	15.3	13.5	14.3	12.0	6.9	13.0	15.4	16.8	17.8	18.1	20.9	23.7	23.4	25.9	28.2	27.2	23.9	23.9	23.9	23.9	
29. Average capacity out of service as % of installed capacity <sup>j/</sup>	%	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	
30. EPM's investment as % of fixed investment in country	%	na	na	na	na	na	na	0.3	0.6	1.0	0.7	0.5	1.1	1.7	0.8	1.6	1.6	1.5	1.2	1.1	1.8	na	na	na	na	
31. Accounts receivable as % of Total Sales Revenue	%	na	na	na	na	na	na	na	8.3	na	9.0	12.0	11.5	12.2	13.2	12.5	12.3	15.1	15.6	16.7	15.0	16.1	16.1	16.1	16.1	

\* Financial calculations carried out in this table do not account for revaluation of assets except where specified (revaluation of assets is treated in further detail in Annex I.)

<sup>a/</sup> Does not include captive plants

<sup>b/</sup> Effective Peak: Peak load at the critical time in the year when the margin between demand and available capacity is minimum, or load shedding maximum (excluding short-term outages.)

<sup>c/</sup> Bought from Coltejer - a private industrial concern with its own thermal generating plant.

<sup>d/</sup> Including depreciation but excluding interest and direct taxation.

<sup>e/</sup> Revaluation of assets computation as calculated by IBRD in Annex I.

<sup>f/</sup> Net revenues after taxes as % average net fixed assets in operation.

<sup>g/</sup> Net internal cash generation as % of Gross Fixed Investment.

<sup>h/</sup> Times debt service was covered by operating income and depreciation.

<sup>i/</sup> Generation sent out, including energy purchased from Coltejer (see footnote c) less sales to EPM's customers, as % of generation sent out (including energy purchased from Coltejer).

<sup>j/</sup> Capacity out of service for maintenance and repairs.

<sup>k/</sup> Excluding company's own revaluation for changes in exchange rate.

<sup>l/</sup> Converted from 1968 pesos to dollars by 1968 exchange rate of Ps. 15.9 = US \$ 1.00.

<sup>m/</sup> Rates of increase for figures in current pesos have been calculated using national GDP deflator to obtain real growth rates bases on constant prices.

<sup>n/</sup> Average annual increase rate for 1965-1969.



COLOMBIA: EMPRESAS PUBLICAS DE MEDELLIN - ELECTRICITY DEPARTMENT  
 LOAN 225-00 (May 12, 1959)

TABLE II-A.1

	1959	1960	1961	1962	1963	1964	Average Annual Increase Rate (%) 1959-1964
<u>LOAD FORECASTS (Mw)</u>							
1. Installed Capacity	137	137	217	233	308	345	20.5
2. Annual Peak Demand	137	137	217	233	233	285	15.8
3. Gross Reserve Capacity (1-2)	0	0	0	0	75	60	
<u>ACTUAL LOAD (Mw)</u>							
4. Installed Capacity	137	137	137	227	227	245	12.4
5. Annual Peak Demand	148	150	148	200	216	232	9.4
6. Gross Reserve Capacity (4-5)	-11	-13	-11	27	11	13	
7. Effective Peak Capacity <sup>a/</sup>	n.a.	n.a.	n.a.	n.a.	177	221	
8. Effective Peak Demand <sup>a/</sup>	n.a.	n.a.	n.a.	n.a.	192	231	
9. Effective Peak Spare Capacity (7-8)	n.a.	n.a.	n.a.	n.a.	-15	-10	
<u>LOAD FORECAST ACCURACY<sup>b/</sup></u>							
10. Installed Capacity	100	100	158	103	136	141	
11. Annual Peak Demand	93	91	147	117	108	123	
12. Gross Reserve Capacity	-	-	-	-	682	462	
<u>SALES FORECAST (Gwh)</u>							
13. Total Sales	655	675	790	950	1100	1240	13.6
<u>ACTUAL SALES (Gwh)</u>							
14. Sales: Residential	366	413	407	433	502	524	7.5
Industrial	157	177	185	212	246	283	12.5
Commercial	54	59	61	66	70	73	6.2
Government	28	20	n.a.	n.a.	44	59	16.0
Bulk	39	41	n.a.	n.a.	39	40	0.5
Total	644	710	725	779	901	979	8.8
<u>SALES FORECAST ACCURACY<sup>b/</sup></u>							
15. Total Sales	102	95	110	122	122	127	
<u>RETURN FORECAST (Col. Pesos mln.)</u>							
16. Operating Revenues <sup>c/</sup>	30.9	36.7	42.9	51.4	68.2	75.8	20.0
17. Less: Operating Costs <sup>d/</sup>	15.2	17.8	21.9	26.3	32.9	40.1	21.5
18. Operating Income	15.7	18.9	21.0	25.1	35.3	36.7	18.5
19. Financial Rate of Return on Av. Net Fixed Assets in Operation (%) <sup>e/</sup>	11.2	10.6	8.6	7.9	9.1	8.3	
<u>ACTUAL RETURN (Col. Pesos mln.)<sup>e/</sup></u>							
20. Operating Revenues <sup>c/</sup>	30.6	36.4	39.7	39.8	53.0	58.3	13.8
21. Less: Operating Costs <sup>d/</sup>	15.9	16.7	19.0	21.8	26.0	28.1	6.8
22. Operating Income	14.7	19.7	20.7	18.0	27.0	36.2	19.8
23. Financial Rate of Return on Av. Net Fixed Assets in Operation <sup>f/</sup> (1) non-revalued assets (%) (2) revalued assets (%) <sup>g/</sup>	13.6 11.0	18.3 14.6	19.9 15.5	11.0 9.2	13.9 8.8	16.0 10.0	
<u>RETURN FORECAST ACCURACY<sup>b/</sup></u>							
24. Operating Revenue	101	101	108	129	129	132	
25. Operating Costs	96	107	115	121	127	181	
26. Operating Income	107	96	101	140	131	101	

a/ Effective Peak: The critical time in the year when margin between demand and available capacity was least or load shedding greatest (excluding short-term outages).

b/ Defined by the ratio Forecast/Actual.

c/ Total Revenues, excluding indirect taxes.

d/ Including depreciation and direct taxation on utility, but excluding interest.

e/ All current or historic pesos have been converted to 1959 constant pesos for the purpose of comparison with the Loan 225-00 Appraisal Report Forecasts, using the national GDP deflator.

f/ Net Revenues after taxes as % of average net fixed assets in operation.

g/ Revaluation of assets computations as calculated by IBRD in Annex I.

COLOMBIA: EMPRESAS PUBLICAS DE MEDELLIN - ELECTRICITY DEPARTMENT  
LOAN 282-CC (April 27, 1961)

TABLE II-A.2

	1961	1962	1963	1964	1965	1966	1967	1968	Average Annual Increase Rate (%) 1961-1968
<b>LOAD FORECASTS (Mw)</b>									
1. Installed Capacity	136	216	292	292	332	372	422	472	19.5
2. Annual Peak Demand	208	212	250	266	285	343	363	440	11.3
3. Gross Reserve Capacity (1-2)	-72	4	2	26	47	29	59	32	41.5 <sup>b/</sup>
<b>ACTUAL LOAD (Mw)</b>									
4. Installed Capacity	137	227	227	245	308	443	443	441	18.2
5. Annual Peak Demand	118	200	216	232	257	289	310	327	11.9
6. Gross Reserve Capacity (4-5)	-11	27	11	13	41	154	133	116	27.5 <sup>b/</sup>
7. Effective Peak Capacity (4-5)	n.a.	n.a.	177	221	242	302	418	443	20.0 <sup>b/</sup>
8. Effective Peak Demand	n.a.	n.a.	192	231	243	260	295	327	11.5 <sup>b/</sup>
9. Effective Peak Spare Capacity (7-8)	n.a.	n.a.	-15	-10	-1	42	123	116	
<b>LOAD FORECAST ACCURACY<sup>b/</sup></b>									
10. Installed Capacity	99	95	111	119	108	84	95	99	
11. Annual Peak Demand	141	106	116	115	107	119	117	135	
12. Gross Reserve Capacity	-	15	18	200	115	19	44	28	
<b>SALES FORECAST (Gwh)</b>									
13. Sales: Industrial	190	210	250	300	320	370	410	440	12.7
Others	570	640	700	750	840	910	990	1110	10.0
Total	760	850	950	1050	1160	1280	1400	1550	10.7
<b>ACTUAL SALES (Gwh)</b>									
14. Sales: Residential	407	433	503	594	562	592	609	620	6.2
Industrial	185	212	246	283	300	320	340	358	9.9
Commercial	61	55	70	73	79	86	90	95	6.7
Government	n.a.	n.a.	44	59	66	92	101	104	18.6 <sup>b/</sup>
Bulk	n.a.	n.a.	39	40	41	47	43	44	2.1 <sup>b/</sup>
Total	725	779	901	979	1048	1137	1183	1222	7.7
<b>SALES FORECAST ACCURACY<sup>b/</sup></b>									
15. Sales: Industrial	103	99	102	106	107	116	121	123	
Others	106	113	107	108	112	111	117	128	
Total	105	109	105	107	111	113	118	127	
<b>RETURN FORECAST (Col. Pesos min.)</b>									
16. Operating Revenues <sup>d/</sup>	47.8	53.4	59.6	65.9	72.8	80.3	87.9	97.2	10.7
17. Less: Operating Costs <sup>d/</sup>	20.8	23.8	27.3	31.0	35.0	38.0	43.3	51.0	13.7
18. Operating Income	27.0	29.6	32.3	34.9	37.8	42.3	44.6	46.2	8.0
19. Financial Rate of Return on Av. Net Fixed Assets in Operation (1) <sup>f/</sup>	17.5	12.5	11.0	10.0	9.3	10.0	8.4	7.2	
<b>ACTUAL RETURN (Col. Pesos min.)<sup>d/</sup></b>									
20. Operating Revenues <sup>d/</sup>	46.7	46.8	61.9	65.0	65.4	71.2	78.8	89.1	9.5
21. Less: Operating Costs <sup>d/</sup>	22.4	25.6	30.4	29.9	33.2	37.6	42.9	45.9	10.5
22. Operating Income	24.3	21.2	31.5	35.1	32.2	33.6	35.9	43.2	8.8
23. Financial Rate of Return on Av. Net Fixed Assets in Operation <sup>f/</sup>									
(1) non-revalued assets (%) <sup>g/</sup>	19.9	11.0	13.9	16.0	12.6	12.2	13.7	18.4	
(2) revalued assets (%) <sup>g/</sup>	15.5	9.2	8.8	10.0	7.3	5.5	5.9	7.9	
<b>RETURN FORECAST ACCURACY<sup>b/</sup></b>									
24. Operating Revenue	102	114	96	101	111	113	112	109	
25. Operating Costs	93	93	90	104	105	101	101	111	
26. Operating Income	111	140	103	99	117	125	124	107	

a/ Effective Peak: The critical time in the year when margin between demand and available capacity was least or load shedding greatest (excluding short-term outages).

b/ Defined by the ratio Forecast/Actual.

c/ Total Revenues, excluding indirect taxes.

d/ Including depreciation and direct taxation on utility, but excluding interest.

e/ All current or historic pesos have been converted to 1961 constant pesos for the purpose of comparison with the Loan 282-CC Appraisal Report Forecasts, using the national GDP deflator.

f/ Net Revenues after taxes as % of average net fixed assets in operation.

g/ Revaluation of assets computations as calculated by IRRD in Annex I.

h/ Average annual rate of increase over 1962-1968.

i/ Average annual rate of increase over 1963-1968.

COLOMBIA: EMPRESAS PUBLICAS DE MEDELLIN - ELECTRICITY DEPARTMENT  
LOAN 369-00 (January 28, 1964)

TABLE II-A.3

	1964	1965	1966	1967	1968	1969	1970	Average Annual Increase Rate (%) 1964-1970	
<u>LOAD FORECASTS (MW)</u>									
1. Installed Capacity	216	252	342	387	450	450	582	17.9	
2. Annual Peak Demand	248	268	291	318	350	380	418	9.1	
3. Gross Reserve Capacity (1-2)	-32	-16	51	69	100	70	164	34.0 <sup>b/</sup>	
<u>ACTUAL LOAD (MW)</u>									
4. Installed Capacity	245	308	443	443	443	443	443	10.4	
5. Annual Peak Demand	232	267	289	310	327	350	371	8.2	
6. Gross Reserve Capacity (4-5)	13	41	154	133	116	93	72	33.0	
7. Effective Peak Capacity <sup>a/</sup>	221	242	302	418	443	424	443	12.3	
8. Effective Peak Demand <sup>a/</sup>	231	243	260	295	327	343	371	8.2	
9. Effective Peak Spare Capacity (7-8)	-10	-1	42	123	116	81	72	14.1 <sup>b/</sup>	
<u>LOAD FORECAST ACCURACY<sup>b/</sup></u>									
10. Installed Capacity	88	82	77	87	102	102	131		
11. Annual Peak Demand	107	100	101	103	107	109	113		
12. Gross Reserve Capacity	-	-	33	52	86	75	227		
<u>SALES FORECAST (Gwh)</u>									
13. Sales: Residential	570	619	675	737	805	869	952	8.9	
Industrial	265	295	328	364	405	450	500	11.2	
Commercial	66	71	77	83	89	96	104	7.9	
Government	75	83	92	101	113	125	138	10.7	
Bulk	35	37	39	41	43	45	47	5.0	
Total	1011	1105	1211	1326	1455	1585	1741	9.5	
<u>ACTUAL SALES (Gwh)</u>									
14. Sales: Residential	524	562	592	609	620	637	n.a.	4.0 <sup>i/</sup>	
Industrial	283	300	320	340	358	411	n.a.	7.4 <sup>i/</sup>	
Commercial	73	79	86	90	96	108	n.a.	8.1 <sup>i/</sup>	
Government	59	66	92	101	104	132	n.a.	17.5 <sup>i/</sup>	
Bulk	40	41	47	43	44	40	n.a.	0	
Total	979	1048	1137	1183	1222	1331	1496	7.3	
<u>SALES FORECAST ACCURACY<sup>b/</sup></u>									
15. Sales: Residential	109	110	114	121	130	137	n.a.		
Industrial	94	98	103	107	113	109	n.a.		
Commercial	91	90	90	92	93	89	n.a.		
Government	128	126	100	100	108	95	n.a.		
Bulk	88	90	93	95	97	112	n.a.		
Total	103	105	107	112	119	119	116		
<u>RETURN FORECAST (Col. Pesos mln.)<sup>k/</sup></u>									
16. Operating Revenues <sup>d/</sup>	104.1	126.9	153.8	168.4	184.9	-	-	15.4	
17. Less: Operating Costs <sup>d/</sup>	39.5	44.8	53.7	57.9	70.1	-	-	15.4	
18. Operating Income	64.6	82.1	100.1	110.5	114.8	-	-	15.4	
19. Financial Rate of Return on Av. Net Fixed Assets in Operation (%) <sup>e/</sup>	21.3	20.1	20.0	21.9	14.3	-	-		
<u>ACTUAL RETURN (Col. Pesos mln.)<sup>b/</sup></u>									
20. Operating Revenues <sup>d/</sup>	100.0	109.0	137.0	164.2	202.5	252.5	n.a.	19.3 <sup>i/</sup>	
21. Less: Operating Costs <sup>d/</sup>	41.5	50.6	66.3	82.2	95.3	101.3	n.a.	18.1 <sup>i/</sup>	
22. Operating Income	58.5	58.4	70.7	82.0	107.2	151.2	n.a.	16.4 <sup>i/</sup>	
23. Financial Rate of Return on Av. Net Fixed Assets in Operation <sup>e/</sup> (1) non-revalued assets (%) (2) revalued assets (%) <sup>g/</sup>	16.0 10.0	12.6 7.3	12.2 5.5	13.7 5.9	18.4 7.9	25.4 10.7	n.a. n.a.	8.1 <sup>i/</sup> 4.2 <sup>i/</sup>	
<u>RETURN FORECAST ACCURACY<sup>b/</sup></u>									
24. Operating Revenue	104	116	112	103	91				
25. Operating Costs	95	89	81	70	74				
26. Operating Income	110	140	142	135	107				

a/ Effective Peak: The critical time in the year when margin between demand and available capacity was least or load shedding greatest (excluding short-term outages).

b/ Defined by the ratio Forecast/Actual.

c/ Total Revenues, excluding indirect taxes.

d/ Including depreciation and direct taxation on utility, but excluding interest.

e/ In current prices.

f/ Net Revenues after taxes as % of average net fixed assets in operation.

g/ Revaluation of assets computation as calculated by IHRD in Annex I.

h/ Average annual rate of increase over 1966-1970.

i/ Average annual rate of increase over 1964-1968 for non-deflated figures.

j/ Real growth rate over 1964-1968, calculated by using national GDP deflator.

k/ Includes estimated inflation factor

COLOMBIA: EMPRESAS PUBLICAS DE MEDELLIN (EPM) - ELECTRICITY DEPARTMENT  
UTILITY INVESTMENT PROGRAMS PARTLY FINANCED BY IBRD ( US\$ million )

TABLE II-B

SOURCES OF FUNDS	LOAN 225-00(1959) PERIOD 1959-62				LOAN 282-00(1961) PERIOD 1960-66				LOAN 369-00(1964) PERIOD 1963-68			
	FORECAST		ACTUAL	% of Total	FORECAST		ACTUAL	% of Total	FORECAST		ACTUAL	% of Total
	Total	% of Total			Total	% of Total			Total	% of Total		
1. Net Internal Cash Generation	4.14	12 <sup>b/</sup>	9.52	31	24.58	33	26.79	36	37.99	34	26.79	37
2. Domestic Contribution:												
From private sector	12.80	38 <sup>d/</sup>					4.16	6	3.89	3	4.31	6
From public sector			6.12	20			5.18	7			-1.66	-
EPM Reserve Fund							9.34	13			2.65	4
Total Domestic Contribution	12.80	38	6.12	20					3.89	3		
3. Foreign Borrowing:												
IBRD	12.00	35	14.31	48	31.20	42	38.80	50	64.20	58	41.32	56
Other	4.93	15 <sup>d/</sup>	1.28	1	19.18	25 <sup>b/</sup>	.52	1	5.46	5	.73	1
Total	16.93	50	14.59	49	51.00	67	39.32	51	69.66	63	42.12	57
4. Total Sources	33.87	100	30.23	100	75.58	100	75.45	100	111.51	100	71.56	100
APPLICATION OF FUNDS												
5. Total Fixed Investments	33.25	98	32.43	99	75.64	100	79.52	100	104.52	94	74.41	100
6. Change in Working Capital and Cash	.62	2	.19	1	-.06	-	.06	-	7.02	6	.18	-
7. Total Applications	33.87	100	32.62 <sup>a/</sup>	100	75.58	100	79.58 <sup>a/</sup>	100	111.53	100	74.59 <sup>a/</sup>	100

<sup>a/</sup> The discrepancy between actual application of funds and actual sources of funds is primarily due to the unavailability of data on interest during construction which should have been deducted from total Fixed Investments.  
<sup>b/</sup> Revised Bank forecasts made one year after these original appraisal report forecasts show a revised estimate of net internal cash generation for 1959-62 of US\$ 13.89 representing 41% of total sources, a figure more closely corresponding to the side letter provision calling for a self-financing rate of at least 30% over the 1959-64 period.

Terms of Loans:	Interest (1%)	Amortization (yrs)
<sup>c/</sup> Short-term Local Loans	7.0	n.a.
<sup>d/</sup> Foreign Currency Loan	7.0	25
<sup>e/</sup> Foreign Currency Loan	5.75	25

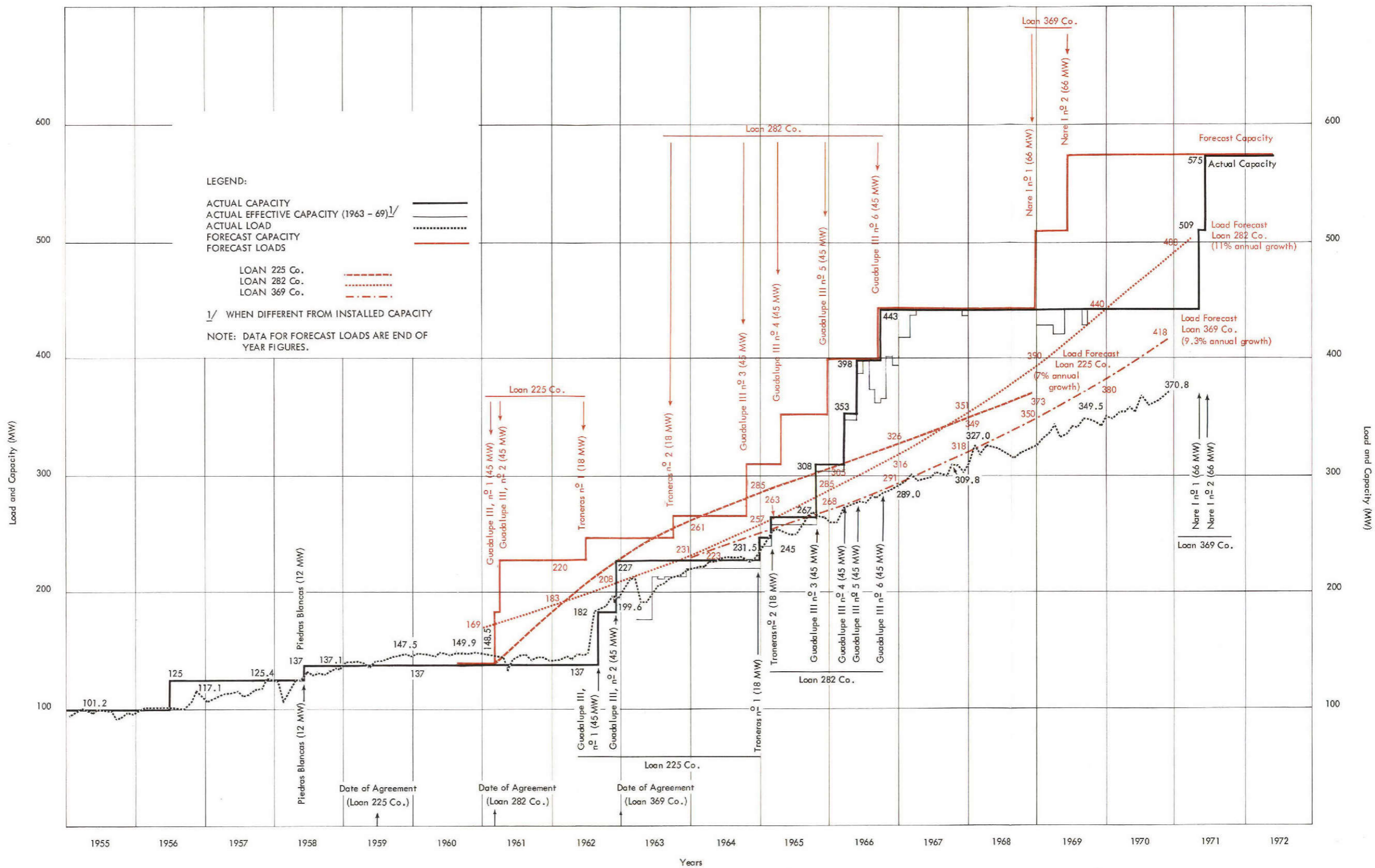
COLOMBIA: EMPRESAS PUBLICAS DE MEDILLIN (EPM) - ELECTRICITY DEPARTMENT  
PROJECTS IMPLEMENTATION

TABLE III

		Start Construction	Commissioning Date	Construction Period (months)	Project	Scope <sup>a/</sup>	Construction Cost <sup>b/</sup> (US\$ million)			Cost/KW US \$					
							L.C. <sup>c/</sup>	F.K.	Total						
<b>LOAN 225-CO (US\$ 12 million)</b> (signed May, 1959)															
Troneras Unit 1 <sup>d/</sup>	Forecast	Mid 1959	Mid 1962	36	1 x 16 MW	Hydro	3.16	1.30	4.46	279.2					
	Actual	Jan. 1960	Dec. 1961	59	1 x 18 MW	Hydro	4.37	1.47	5.84	324.7					
Troneras Unit 1 (including associated transmission) <sup>d/</sup>	Forecast	Mid 1959	Mid 1962	36	1 x 16 MW	Hydro	3.23	1.50	4.73	295.3					
	Actual	Jan. 1960	Dec. 1961	59	1 x 18 MW	Hydro	4.66	2.20	6.86	381.1					
Guadalupe III Unit 1 & 2 <sup>e/</sup>	Forecast	Mid 1959	Early 1961	18	2 x 40 MW	Hydro	3.12	5.12	8.24	103.0					
	Actual	Oct. 1959	Nov. 1962	37	2 x 45 MW	Hydro	4.32	5.78	10.10	112.2					
Guadalupe III Unit 1 & 2 <sup>e/</sup> (including associated transmission)	Forecast	Mid 1959	Early 1961	18	2 x 40 MW	Hydro	3.39	5.09	8.48	117.3					
	Actual	Oct. 1959	Nov. 1962	37	2 x 45 MW	Hydro	5.57	9.21	14.78	164.2					
<b>LOAN 262-CO (US\$ 22 million)</b> (signed May 1961)															
Troneras Units 1 & 2 <sup>k/</sup>	Forecast	Mid 1961	Sept. 1963	26	2 x 18 MW	Hydro	3.58	2.63	6.21	172.5					
	Actual	Early 1962	Feb. 1965	36	2 x 18 MW	Hydro	5.61	2.87	8.48	235.4					
Troneras Units 1 & 2 <sup>k/</sup> (including associated transmission)	Forecast	Mid 1961	Sept. 1963	26	2 x 18 MW	Hydro	4.50	1.91	6.41	200.3					
	Actual	Early 1962	Feb. 1965	36	2 x 18 MW	Hydro	6.08	3.99	10.07	272.7					
Guadalupe III Units 1-6 <sup>m/</sup>	Forecast	Early 1962	Dec. 1965	45	2 x 45 MW	Hydro	7.08	15.26	22.34	109.7					
	Actual	Jan. 1963	Sept. 1966	45	3 x 40 MW 6 x 45 MW	Hydro	16.58	17.60	34.18	126.6					
Guadalupe III Units 1-6 <sup>m/</sup> (including associated transmission)	Forecast	Early 1962	Dec. 1965	45	2 x 45 MW	Hydro	10.00	19.51	29.51	140.5					
	Actual	Jan. 1963	Sept. 1966	45	3 x 40 MW 6 x 45 MW	Hydro	19.33	24.62	43.95	262.8					
<b>LOAN 225-CO &amp; 282-CO</b>															
Distribution System	Forecast	n.a.	n.a.	n.a.	1100 km	13.2 kv	3.06	1.88	4.94						
	Actual	n.a.	n.a.	n.a.			1.78	6.38	8.13						
<b>LOAN 369-CO (US\$ 45 million)</b> (signed Feb., 1964)															
Guatupe Units 1 & 2	Forecast	Mid 1965	Mid 1969	48	2 x 66 MW	Hydro	24.74	33.91	58.65	413.3					
	Actual	End 1966	Sept. 1971	60	2 x 66 MW	Hydro	n.a.	n.a.	n.a.	n.a.					
Guatupe Units 1 & 2 (including associated transmission)	Forecast	Mid 1965	Mid 1969	48	2 x 66 MW	Hydro	25.33	35.20	60.53	456.6					
	Actual	End 1966	Sept. 1971	60	2 x 66 MW	Hydro	n.a.	n.a.	n.a.	n.a.					
Guatupe Units 1-4	Forecast	<sup>e/</sup>	End 1971	<sup>e/</sup>	4 x 66 MW	Hydro	26.24	35.26	61.50	235.6					
	Actual	<sup>e/</sup>	End 1971	<sup>e/</sup>	4 x 66 MW	Hydro	n.a.	n.a.	n.a.	n.a.					
Guatupe Units 1-4 (including associated transmission)	Forecast	<sup>e/</sup>	End 1971	<sup>e/</sup>	4 x 66 MW	Hydro	26.88	37.36	64.24	243.3					
	Actual	<sup>e/</sup>	End 1971	<sup>e/</sup>	4 x 66 MW	Hydro	n.a.	n.a.	n.a.	n.a.					
<b>LOANS DISBURSEMENT PATTERN</b>															
LOAN 225-CO	Forecast:	Amount (US\$mln)	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Undisbursed 12/31/70
		% of total	51.2	21.7	18.3	8.8									
	Cumulative %	51.2	72.9	91.2	100.0										
	Actual:	Amount (US\$mln)	2.67	1.98	1.49	2.82	.01								
	% of total	22.3	16.5	12.4	23.5	0.3									
	Cumulative %	22.3	38.8	51.2	74.7	75.0									
LOAN 262-CO	Forecast:	Amount (US\$mln)		2.03	4.52	6.21	6.50	2.74							
		% of total		9.2	20.5	28.3	29.5	12.5							
	Cumulative %		9.2	29.7	58.0	87.5	100.0								
	Actual:	Amount (US\$mln)		.06	2.73	4.19	6.26	1.94	2.82	.81	.19				
	% of total		0.3	12.4	19.0	28.4	22.5	12.8	3.7	0.9					
	Cumulative %		0.3	12.7	31.7	60.1	82.6	95.4	99.1	100.0					
LOAN 369-CO	Forecast:	Amount (US\$mln)				5.58	7.66	12.74	13.25	5.55					
		% of total				12.4	17.5	28.3	29.5	12.3					
	Cumulative %				12.4	29.9	58.2	87.7							
	Actual:	Amount (US\$mln)				1.36	2.14	4.68	5.84	7.77	6.35	5.70		11.06 <sup>l/</sup>	
	% of total				3.2	5.1	11.1	13.1	18.5	15.1	13.6				
	Cumulative %				3.2	8.3	19.4	33.5	52.0	67.1	80.7				

a/ Project Scope for Generation is Megawatts (MW) of installed capacity and source of energy, data was not available on kilometers of line or transformer capacity of Distribution components.  
b/ Does not include interest during construction; inflationary contingencies were excluded from forecast projections for comparison purposes with deflated actual costs.  
c/ Local costs of projects were computed by converting for each year the Col. Peso expenditure incurred during that year into constant 1965 pesos (GIF deflator) and then converting into US Dollars at the 1968 average annual official exchange rate for imports of goods and services (Ps 15.90=US\$ 1.00).  
d/ Starting date for Unit 2 only.  
e/ Starting date for Unit 3 only.  
f/ Unit 6 was not included in the original list of goods; attractive financial arrangements on the equipment resulted in savings which were used to purchase one additional unit for Guadalupe III.  
g/ Although the original Appraisal Report forecasts projected an additional 2 units to be installed at a later date, Units 3 & 4 were not included in the original project costs or list of goods; however, the actual financial arrangements on the equipment resulted in savings which were used to purchase these 2 additional units.  
h/ Actual final costs are not available due to the recent termination of the project.  
i/ US\$ 3.0 million were cancelled in August 1970.  
j/ Includes 17% of costs of roads, construction equipment and diversion of the Conception and Tenche rivers.  
k/ Includes 12% of cost of Miraflores dam and engineering.  
l/ Includes 87% of costs of roads, construction equipment and diversion of the Conception and Tenche rivers.  
m/ Includes 88% of cost of Miraflores dam and engineering.

# COLOMBIA EMPRESAS PUBLICAS DE MEDELLIN - POWER LOAD AND CAPACITY DEVELOPMENT ACTUAL AND FORECAST (1955-1971)



COLOMBIA

EMPRESAS PUBLICAS DE MEDELLIN  
General Layout of the Electric System

- Hydro plants in operation
- Hydro plant under construction
- Transmission lines
- Rivers
- Dams
- Reservoirs
- - - Tunnels
- + + + Railroad
- Service areas of the Medellin Power Company
- ▭ I.B.R.D projects

