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STAFF APPRAISAL REPORT

COLOMBIA

GUADALUPE IV HYDRO POWER PROJECT

May 16, 1980

Projects Department
Latin America and the Caribbean Regional Office

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CURRENCY EQUIVALENTS

Currency Unit	=	Colombian Peso (Col\$)
Col\$1	=	100 Centavos (ctv)
Col\$42.06 (1979 appraisal assumption of average)	=	US\$1
Col\$1,000	=	US\$23.78 (1979 average)
Col\$1,000,000 (MCol\$)	=	US\$23,776 (1979 average)
MUS\$1	=	US\$1,000,000

WEIGHTS AND MEASURES

1 meter (m)	=	3.281 feet (ft)
1 square kilometer (km ²)	=	0.386 square mile (mi ²)
1 cubic meter (m ³)	=	35.315 cubic feet (ft ³)
	=	264.2 gallons (gal)
	=	6.290 barrels (bbl)
1 kilogram (kg)	=	2.206 pounds (lb)
1 ton (t;metric;1,000 kg)	=	1.100 short tons (sh. tons)
1 kilowatt (kW)	=	1,000 Watts (10 ³ W)
1 Megawatt (MW)	=	1,000 kW (10 ³ kW = 10 ⁶ W)
1 Gigawatt (GW)	=	1,000 MW (10 ⁶ kW = 10 ⁹ W)
1 kilowatt-hour (kWh)	=	1,000 Watt-hours (10 ³ Wh)
	=	830.3 kilocalories (kcal)
1 Gigawatt-hour (GWh)	=	1,000,000 kWh (10 ⁶ kWh)
1 Terawatt-hour (TWh)	=	1,000 GWh (10 ⁹ kWh)
1 kilovolt (kV)	=	1,000 Volts (V)
1 kilovolt ampere (kVA)	=	1,000 Volt amperes (10 ³ VA)
1 Megavolt ampere (MVA)	=	1,000 kVA (10 ⁶ VA)
1 Megavolt ampere re- active (MVA _r)	=	1 Megavolt ampere reactive power (cos ϕ = 0°)
1 kilocalorie (kcal)	=	3,968 British thermal units (Btu)
1 Hertz (Hz)	=	1 cycle/second
...per...;...per second	=	.../...;.../s
...per hour; ...per day;	=	.../h;.../d
...per month;...per year	=	.../m;.../a

GLOSSARY OF ABBREVIATIONS

EPM	=	Empresas Públicas de Medellín
ISA	=	Interconexión Eléctrica S. A.
EEEB	=	Empresa de Energía Eléctrica de Bogotá
EMCALI	=	Empresas Municipales de Cali
CHEC	=	Central Hidroeléctrica de Caldas
CHIDRAL	=	Central Hidroeléctrica del Río Anchicaya S. A.
CORELCA	=	Corporación Eléctrica de la Costa Atlántica
CVC	=	Corporación Autónoma Regional en el Valle del Río Cauca
ICEL	=	Instituto Colombiano de Energía Eléctrica
NPD	=	National Planning Department
JNT	=	Junta Nacional de Tarifas
FONADE	=	Fondo Nacional de Desarrollo
IDB	=	Inter-American Development Bank
KfW	=	Kreditanstalt für Wiederaufbau

Fiscal Year = Calendar Year

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This report is based on the finding of an appraisal mission, which visited Colombia during November/December 1979, comprising Messrs. W.F. Küpper, M. Linder and J. Gorrió.

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MAPS

Main Generation and Transmission System	IBRD 14880
Transmission System of Antioquia	IBRD 14882

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EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

1. THE SECTOR

Energy Resources

1.01 Colombia's main indigenous commercial energy resources are hydropower, coal, gas and oil. Potential hydropower appears to be the most promising at some 100 GW of capacity and 250-300 TWh of annual energy capability, as shown by the preliminary investigations made by the Government. Colombia is also endowed with very large coal and gas deposits. Over 1970-77 crude oil output declined at an average rate of 6.5%/a. Over the same period, consumption of petroleum products increased by 5.5%/a. As a result, Colombia, since 1977, is a net importer of crude oil and prospects are for imports to rise sharply in the early 1980s unless additional reserves are discovered and developed quickly. Measures are being taken to deal with this problem and to develop alternative energy sources. In the case of coal, there have been various obstacles to more adequate utilization of the existing potential: low prices compared with those prevailing on international markets, the competition of low-priced petroleum, fragmentation of production among a large number of very small mines with low output and productivity levels, and lack of efficient marketing and transport infrastructure. However, the Government is currently taking action to address these problems (1.03). With respect to natural gas, a previous decline in known reserves and output has been dramatically reversed with the discovery of large deposits in the Atlantic Coast region. These reserves (estimated at over 5×10^{12} ft³) will provide energy and petrochemical feedstock to this rapidly industrializing region.

1.02 Production of primary energy during 1965-77 (see table next page) has not kept pace with overall economic expansion. It increased only 3.6%/a during 1965-70, when it reached its peak at 690×10^{12} Btu, and then declined to 637×10^{12} Btu in 1977, mainly due to falling crude oil output. In contrast to the declining energy output, final energy consumption grew by 8.9%/a during 1965-70, and 8.5%/a during 1971-73, when economic growth was high and energy prices declined sharply in real terms. During 1974-77, the economic downturn and increase in real energy prices had a dampening effect on consumption, which now has settled at a growth of about 4.5%/a compared with a GDP growth of some 6%/a in recent years.

1.03 The Government's development strategy is aimed at achieving a more favorable balance between domestic energy supply and use, by increased utilization of domestic sources which are in abundant supply, i.e. hydropower, natural gas and coal. The Government is planning a large-scale development of high grade coal deposits for export to help offset oil imports by

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Energy Output and Consumption

-----Primary Energy Output /1; /2-----							
		1965		1970		1978	
		Heat		Heat		Heat	
		Equiva-		Equiva-		Equiva-	
		lent /3		lent /3		lent /3	
	<u>Unit</u>	<u>Quantity</u>	<u>10¹² Btu</u>	<u>Quantity</u>	<u>10¹² Btu</u>	<u>Quantity</u>	<u>10¹² Btu</u>
Hydro power	GWh	3,649	38.3	6,212	65.2	11,981	125.8
Crude oil	10 ⁶ bbl	73.2	410.0	80.1	448.3	47.8	267.1
Natural gas	10 ⁹ ft ³	65.7	65.7	105.0	105.0	135.5	135.5
Coal	10 ⁶ t	2,230	64.0	2,500	71.7	4,225	121.2
Total			578.0		690.2		650.2
-----Final Energy Consumption /1; /2-----							
		1965		1970		1978	
		Heat		Heat		Heat	
		Equiva-		Equiva-		Equiva-	
		lent /3		lent /3		lent /3	
	<u>Unit</u>	<u>Quantity</u>	<u>10¹² Btu</u>	<u>Quantity</u>	<u>10¹² Btu</u>	<u>Quantity</u>	<u>10¹² Btu</u>
Electricity	GWh	4,790	50.3	7,538	79.1	13,972	146.7
Petroleum Product	10 ⁶ bbl	23.5	131.6	33.8	189.3	46.5	260.4
Natural gas	10 ⁹ ft ³	12.1	12.1	84.8	84.8	110.3	110.3
Coal	10 ⁶ t	2,700	76.9	2,100	61.6	3,850	110.5
Total			270.9		415.0		627.9

/1 Fire wood and other plant fuel (e.g. bagasse) is an important source of energy in Colombia, but its use has not been quantified.

/2 The difference between primary energy output and final energy consumption, expressed in heat equivalent, constitutes the approximate sum of total losses and exports.

/3 Calculated at: 11,500 Btu/kWh for power, 5.6 MBtu/bbl for oil and its products, 1 MBtu/10³ft³ for gas and its products and 28.69 MBtu/t for coal and coke.

high priority to developing for export the thermal coal deposits at El Cerrejon (reserves 600 Mt and production target 10 Mt/a) near Riohacha in the department of La Guajira on the Atlantic Coast under CARBOCOL's responsibility in cooperation with foreign investment. The Government also intends to step up surveys of identified coal fields in the departments of Santander and Antioquia and to study the feasibility of using low grade coal for firing large thermal plants required in the early nineties when potential hydro sites are expected to be increasingly more costly to develop (1.27). Small private firms which own coal mines are pursuing plans to expand output in order to supply fuel for heat intensive industrial processes and both in-plant and public power generation. In order to expand potentially viable mines, a well-coordinated Government program is needed to provide a more rational price structure, improvements in mine safety, credit facilities and support for marketing and infrastructure. Such a program would need substantial technical and capital assistance from abroad. The Bank has been providing guidance to the Government in the preparation of a proposed coal engineering project, which was pre-appraised in February 1980, and of the proposed El Cerrejon Project.

1.04 In the hydrocarbon sector, the Government has taken action to stimulate investment in exploration and field development, which had declined after 1971 because the prices paid to the producers for domestic sales were below economic value. Currently, the prices paid for oil produced by increasing yields from existing fields and from new fields have been raised, the latter now being close to world market levels, and the discriminatory exchange rate for petroleum has been eliminated. Moreover the Government is encouraging foreign participation in exploration and development on the basis of association contracts with ECOPETROL (the Government oil agency). As a result, interest among foreign petroleum companies to expand or start operations in Colombia has been intensified and an upturn in exploration has taken place. A Bank petroleum project is being considered for secondary oil recovery, surveys and follow-up discoveries.

1.05 Plans are underway to explore the country's uranium potential and the Government has contracted with the French Minatome group for such exploration. The development of any uranium potential that might exist would provide the country with another long-term energy option.

Sector Organization

1.06 Electricity is the fastest growing form of energy use in Colombia; its share in overall energy consumption has grown from 14% in 1960 to 23% in 1978. This process has been assisted by the gradual consolidation of isolated facilities into regional systems and the interconnection of these systems to facilitate development of Colombia's low-cost hydro resources. The main systems are the Central System, covering the interior and the Pacific coast, and the Atlantic (or Northern) system covering the northern part of the country. The proposed EPM project is located in the Central System. Also located in the Central System are the Mesitas (1628-CO) and San Carlos I and II hydro projects (1582-CO and 1725-CO) for which Bank loans totalling MUS\$282 were approved in 1978 and 1979 (Annex 1.1). By 1982/83 a national grid will have been established with the completion of a 500-kV line interconnecting the Atlantic and the Central systems, for which a Bank loan of MUS\$50 (1583-CO) was approved in 1978.

1.07 Public electricity service is presently provided by:

- (a) municipally-owned companies, independent of the Central Government, of which the largest are Empresa de Energia Electrica de Bogota (EEEB), Empresas Publicas de Medellin (EPM), and Empresas Municipales de Cali (EMCALI);
- (b) national enterprises such as Instituto Colombiano de Energia Electrica (ICEL), and Corporacion Autonoma Regional del Cauca (CVC), and the Corporacion Electrica de la Costa Atlantica (CORELCA);
- (c) a large number of local subsidiaries of ICEL, CORELCA and CVC 1/; and
- (d) a generating and transmission company, Interconexion Electrica S.A. (ISA), the shareholders of which are EEEB, EPM, CVC, ICEL and CORELCA.

1.08 Colombia has a number of public entities known as Regional Autonomous Corporations with a range of functions related to development of the regions under their jurisdiction, including legal capacity to generate, transmit and distribute electricity. CVC is the largest of these entities. The Ministry of Mines and Energy owns part of the sector directly through ICEL and CORELCA. EEEB and EPM, currently the largest utilities, are controlled by autonomous municipal governments. CVC reports to the National Planning Department (NPD) as do some other regional development corporations. ISA was established in 1967 to provide a rational framework for sector development by interconnecting the systems of its shareholders, thus creating a national grid capable of sustaining large hydroelectric developments. By pooling their financial resources through ISA (under the recent Bank loans mentioned above in 1.06), its shareholders have been able to undertake much larger and more economical projects than would have been feasible under the previous arrangements for independent growth.

Regulation, Planning and Coordination

1.09 The Ministry of Mines and Energy is charged with formulating a national policy for the generation, transmission and distribution of electricity although it shares responsibility with the National Planning Department (NPD) in defining investment priorities. The Ministry, which is responsible for coordinating and supervising power sector planning, discharges its functions through its Electric Energy Division. This division is small and does not have the powers assigned to similar agencies in other countries (issuance of licenses, regulation of tariffs, approval of expansion programs) to enforce its policies and programs. Public utility retail tariffs (including those for electricity) are regulated by the Junta Nacional de Tarifas de Servicios Publicos (JNT) which forms part of the NPD. JNT has customarily approved requests from the companies for rate increases, but utilities are free to set tariffs at levels lower than those approved by the Junta and have done so in the past. EPM (as decided by the Municipal Council) did so during the past year by decreasing the allowed

1/ In most cases, the ownership of these subsidiaries is shared with local Governments.

monthly increase of 2.2% to 1.5% for residential consumers and 1.8% for all other consumers (2.12). Although the Government cannot enforce its policies directly on the municipally controlled power companies, a mechanism for reaching agreement on major issues affecting the sector is provided by ISA, in which the Government has a major although not controlling interest.

1.10 Sector planning and coordination have improved markedly in recent years, as illustrated by the following:

- (a) in line with its bylaws, ISA defines the generation and transmission expansion program for the interconnected system. On the basis of studies carried out by it and its shareholders, ISA executes simulation studies and ranks plant in order of economic merit. After approval by its Board, this becomes the national expansion program. The bylaws specify that all plants requiring a joint effort of all its shareholders be constructed, owned and operated by ISA. Plants of regional interest may be built by one or several shareholders, subject to ISA's approval of such regional plants. Under these arrangements, ISA is, in effect, responsible for an important part of sector regulation and planning; only a small number of minor utilities which do not participate directly in ISA and the national enterprises, other than CVC, are not covered by its decisions. Voting arrangements in ISA have been restructured to require the concurrence of four of its five major shareholders in all important decisions, thus protecting the interests of the municipal utilities and encouraging a positive participation in its deliberations;
- (b) as part of the San Carlos I loan, ISA and its shareholders agreed to prepare and present to the Government and the Bank for comments by December 31, 1979, a Power Sector Development Master Plan. This plan is to cover the period 1980-1990 in detail and 1991-2000 in general terms and consolidate the programs for generation and transmission expansion. Similarly, ISA's shareholders undertook, under the coordination of the Ministry of Mines and Energy, to prepare and present, as part of ISA's Master Plan, to the Government and the Bank for comments by December 31, 1979, a 1980-2000 Sector Development Master Plan for Distribution consolidating all existing and future programs for distribution and covering the period 1980-1985 in detail. ^{1/} Overall, the Master Plan is expected

^{1/} The generation master plan has suffered a delay of at least 6 months. Moreover, it has become apparent that completion of the distribution study will be delayed considerably, until end-1980. No Government action has been taken to coordinate the study and no information has reached the Bank from ICEL and CVC as to study progress. ISA, however, is engaging consultants for coordinating the execution of the study and the presentation of a single report. CORELCA is expected to have soon a draft report available. EPM's part of the study will not be completed before mid-1980 and EEEB will have the study executed by the same consultants to be engaged under the recently approved Distribution Project; it would be completed by end-1980.

to provide a valuable framework for long-range decisions on sector-financing, pricing and rural electrification which have in the past been based on partial and uncoordinated information;

- (c) as agreed under the San Carlos I loan, a tariff study based on marginal costing is underway covering the most important supply areas in the country. With Bank guidance, this study is being carried out through a committee in which experts from the Government, ISA and its shareholders participate;
- (d) also under the aegis of San Carlos I, a study is being executed by consultants to assess the extent and causes of losses in the main power systems down to the level of distribution with the objective of identifying and carrying out actions which would minimize such losses; and
- (e) as agreed under the San Carlos II loan, a study on a uniform system of accounts and financial planning for the sector will be carried out by consultants with full time participation by at least one professional from ISA and each of its shareholders.

Present Developments

1.11 In recognition of the power sector's important role in Colombia's development process, in the mid-1970s the Government and the main power companies established a framework, the "Sochagota" Agreement, for orderly and efficient sector expansion. To enable equitable sharing among the regions of the financial burden of the large investments contemplated, to foster least-cost development of high priority generating plants, and to assure that adequate supply from these plants would reach all regions, the Agreement envisaged that ISA would be responsible for planning, building and owning all plants of national interest. Since then, ISA has functioned on this basis. However, in 1979, the shareholders of ISA expressed reservations about the concentration of almost 70% of planned expansion in generating facilities through 1985 in the national company and the associated loss of parity among themselves in relative generating capacity. Another worrisome aspect was that ISA's construction capacity is nearly fully committed over the next few years with works in progress (1,910 MW of hydro plant, numerous 230-kV lines and a 500-kV line). These reservations have given rise to a proposal that the four plants in ISA's 1980-85 Investment Program (Betania 500 MW, Guavio 1,000 MW, Playas 240 MW and Urra 1,000 MW) be constructed, owned and operated by individual shareholders. Although these plants represent less than 1% of the hydroelectric resources that Colombia will develop over the next 20-30 years, the Government and the Bank feel that a sound pattern of development and use of the country's electric energy resources should be maintained. In accordance with this view, the Government has confirmed in principle that (a) ISA would have ownership of a substantial portion of total sector capacity sufficient to enable it to function effectively as the planning, coordinating and future dispatch agency for the national system, (b) the regions would continue to share, through investments in ISA, in the cost and benefits of relatively

low-cost hydro-electric resources, which are geographically concentrated in only a few regions, and (c) viable financing plans would precede the undertaking of any major plant investments. The Bank has been working closely with the Government and the companies in defining the specific long-term arrangements that would enable Colombia to make further progress along the lines reflected in the Sochagota Agreement, while taking due account of the realities attendant upon the heavy investments planned. It is expected that such arrangements would be formalized shortly.

1.12 Another matter under discussion between the Government and the Bank is the rapid growth in overdue payments to ISA by the largely rural-based ICEL, which depends in part upon national budgetary resources to meet its financial obligations to ISA (1.34). The Government realizes that, if not resolved, this problem could constrain the sector's development capacity. Thus, in seeking means to overcome it, it is considering the establishment of an Electricity Development Fund to finance the sector's expansion (a surtax on electricity use would be the principal source of revenues of the Fund).

World Bank Participation in the Sector

1.13 Since 1950, the Bank has made 23 loans to Colombia's power sector, totalling US\$769 million (Annex 1.1). In addition, the Bank is currently supporting rural electrification under the Integrated Rural Development Project (1532-CO, 1977).

1.14 Between 1973 and 1978 the Bank was unable to participate in sector development through lending because of institutional and financial difficulties. The municipal utilities were reluctant to relinquish their independent role in generation and also experienced severe financial constraints (because of the Government's reluctance to press for rate increases under inflationary conditions) which reduced the availability of funds to ISA. Decisions on system expansion required protracted negotiations among the shareholders and the Government. These negotiations were further complicated by the original shareholders' reluctance to allow the incorporation of CORELCA into ISA. Throughout these negotiations, the Bank continued to support the concept of centralized planning, construction and operation of the national grid and resisted proposals that would weaken ISA. Because of the time required by the shareholders to arrive at decisions on these fundamental issues, Bank consideration of San Carlos I, the 500-kV Interconnection and EEEB's Mesitas hydroelectric project, all of them urgently needed to avoid power rationing in Colombia, suffered considerable delays. A solution finally evolved after extensive discussions between the Bank, the Government and the shareholders, and four loans were made in 1978 and 1979 (1.06) and one in 1980 (Bogota Distribution, 1807-CO).

1.15 Overall Bank operations through 1970 have been reviewed by the Operations Evaluation Department (OED) in 2 reports 1/, which concluded that Bank financing had been successful in assisting the power companies to develop

1/ "Operations Evaluation Report: Electric Power" (Report No. Z-17, dated March 10, 1972) and "Bank Operations in Colombia - An Evaluation" (Report No. Z-18 dated May 25, 1972).

hydroelectric plants at lower unit cost than they otherwise would have been able to do. This permitted greater urban coverage as well as cheaper and more reliable electricity supply to industry. OED also commended Bank efforts in the establishment of the central interconnected system which facilitated further power sector development. In addition, OED identified as important considerations for possible future loans in the Colombian power sector: the need to give greater attention to power distribution; the need for improvement of financial recording and financial planning capabilities; and the need to give more attention to public utility tariff structures.

1.16 OED additionally reviewed 4 other projects ^{1/}. The most recent report (575-CO/681-CO), which pertains to ISA, concludes that the projects underwent engineering, physical, financial and institutional difficulties. The estimation of operational and investment requirements for an institution so financially dependent as ISA, without provision for price contingencies in an inflationary environment led to severe financial difficulties. The shareholders had to redefine their role in the sector and, in the process, execution of the projects was delayed although they were successfully implemented. The experience gained under these projects has had a considerable impact on the shaping of Bank policy for further lending in Colombia. Adequate provisions for price contingencies have been introduced; local financing is being secured through long-term financial commitments of the shareholders to ISA; improved financial planning was instituted by ISA and its shareholders, as well as continuous monitoring of their financial performance.

1.17 The recent developments in the sector (1.10) indicate that a reasonable balance between regional and national interest would be maintained, thus providing a sound basis for continued Bank participation. The further objectives are in general: coordinated sector planning, efficient organization and operation, and sound financial management; within the general scope of these objectives, specific attention in the short term should be given to: least-cost operations, rational urban and rural distribution developments, improvement in financial recording and financial planning capabilities and development of adequate tariff structures and levels based on common concepts throughout the country.

Power Market and Supply

1.18 Sector. In 1978 electricity requirements in Colombia totalled about 17.4 TWh. Electricity generation increased by an average of 9.5%/a over the period 1960-70 and about 9.7% on average until the end of 1978. Per

^{1/} - Third Medellin Power Project - Loan 639-CO (1964; Report No. 450, May 24, 1974).

- Third (EEEE) Power Expansion Program - Loan 537-CO (1968; Report No. 536, June 29, 1977).

- Power Interconnection Project (1968) Loan 575-CO and Chivor Hydroelectric Project (1970), Loan 681-CO (Report No. 2720, October 29, 1979).

capita electricity generation was about 667 kWh/a, which is below the average for Latin America (about 780). Installed capacity at the end of 1978 was 3,930 MW, including self-production. Hydro stations accounted for 69% of total energy generation. The following table summarizes installed capacity and energy generated in Colombia in 1978:

	Public Service				Self-Producers				Total			
	MW	%	GWh	%	MW	%	GWh	%	MW	%	GWh	%
Hydro, Subtotal	2,642	67	11,893	69	20	1	88	-	2,662	68	11,981	69
Steam	717	18	2,928	17	162	4	851	5	879	22	3,779	22
Gas Turbine	285	7	1,191	7	39	1	188	1	324	8	1,379	8
Diesel	43	1	115	1	22	1	96	-	65	2	211	1
Thermal, Subtotal	<u>1,045</u>	<u>26</u>	<u>4,234</u>	<u>25</u>	<u>223</u>	<u>6</u>	<u>1,135</u>	<u>6</u>	<u>1,268</u>	<u>32</u>	<u>5,369</u>	<u>31</u>
Total	3,687	93	16,127	94	243	7	1,223	6	3,930	100	17,350	100

Public utilities accounted for 94% of total electricity supply; the rest was provided by self-production. EEEB generated 18%, EPM 19%, CORELCA 14%, CVC 12%, CEL 13%, and ISA 18% of total supply. Self-suppliers (mainly oil refineries, petro-chemical plants, steel mills and cement works) owned 6.2% of the country's installed capacity; most of these plants are also connected to the public electricity service. The public-service labor force totalled 13,445 at the end of 1977 when installed capacity was 3,552 MW, including 6,690 manual workers; this gave ratios of 262 kW/employee and 162 subscribers/employee for that year.

1.19 Colombia has about 2.3 million electricity subscribers with an average of 7 beneficiaries per subscriber in an estimated total population of 25.2 million; 88% of these subscribers are residential, and electricity service reaches 62% of the population. Studies by the Bank's Development Policy Staff indicate that Colombia has been able to provide electricity service to a very high proportion of its urban population (with the connection rate exceeding 90% in the larger cities). However, only 36% of the families in small towns (500-2,500 inhabitants) and 16% of other rural families had service in 1976. Of the electrified municipalities, about 90% have continuous service, while the remaining have service only during certain hours of the day. In many towns the quality of the service is unsatisfactory because of lack of funds which results in poor of maintenance (and large arrears in payments to the supply companies).

1.20 Residential consumers were responsible for the largest share of electricity sales by the public utilities in 1978, followed by industry 1/:

<u>Category</u>	<u>Sales</u>		<u>Clients</u>	
	<u>GWh</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Residential	5,725	44.4	2,047,352	87.8
Industrial	4,131	32.1	28,730	1.2
Commercial	1,741	13.5	224,750	9.9
Others	<u>1,274</u>	<u>10.0</u>	<u>25,979</u>	<u>1.1</u>
Total	12,871	100.0	2,331,811	100.0

1/ Source: ISA

1.21 In the interconnected system, the 1972 and 1978 market statistics for ISA's shareholders are as follows:

	<u>1972</u>	<u>1978</u>	<u>Average Annual Growth %</u>
Gross Generation (GWh)	9,380	16,127	9.5
Maximum Demand (MW)	1,810	2,994	8.8
Total Sales (GWh)	7,600	12,871	9.2
Of which consumption percentages:			
Residential	39%	44%	11.5
Commercial	12%	14%	10.8
Industrial	35%	32%	7.8
Others	14%	10%	3.3
Losses <u>1/</u>	19%	20%	-

1/ Includes station use, transmission and distribution losses, and thefts.

During 1972-78 gross production of electricity increased at an annual average rate of about 9.5% compared with a GNP growth rate of 6%. Growth of sales, which averaged 9.2%/a, varied from 7.7%/a for the EPM system to 11.2% for ICEL's system. Apart from an upward trend in the share of residential consumption, the pattern of supply and demand has not changed materially; the share of each system in the market has hardly varied. Commerce and industry together had practically the same share in 1978 as in 1972. The main change is the increase of the share of residential consumption by 5 percentage points while "others" declined by 4 percentage points. EMP's historical growth is shown in paragraph 3.02.

Interconnected System Forecasts

1.22 Demand and Energy. Projected 1979-85 demand and gross energy requirements are based on ISA and its shareholders' analysis of past consumption and on a study of the correlation between power sector growth and growth of GNP. Gross energy requirements in the interconnected system are expected to increase at an average annual rate of about 10.8%.

<u>YEAR</u>	<u>EEEEB</u>	<u>EPM</u>	<u>CVC</u>	<u>ICEL</u>	<u>CORELCA</u>	<u>Total</u>	<u>Coincident Maximum Demand</u>
	-----TWh-----						MW
1978	4.4	3.7	2.3	3.2	2.5	16.1	2,994
1980	5.3	4.5	2.8	4.8	2.9	20.3	3,908
1983	7.1	5.7	3.6	6.2	4.7	27.3	5,628
1985	8.6	6.7	4.3	7.3	6.2	33.1	6,412

1.23 Supply. In order to meet forecast requirements for the interconnected system, an additional 4,261 MW (Annex 1.2) is planned to be added by 1985 to the 1978 capacity of 3,687 as follows:

	<u>1978</u>	<u>1980</u>	<u>1983</u>	<u>1985</u>
<u>Requirements</u>				
Maximum demand (MW)	2,994	3,908	5,268	6,412
Gross generation (TWh)	16.1	20.3	27.3	33.1
% Hydro	72	69	66	71
% Thermal	28	31	34	29
<u>Effective Capacities (MW)</u>	3,687	4,899	7,106	7,948
% Hydro	72	70	76	75
% Thermal	28	30	24	25

Rural Electrification

1.24 About 36% of the population lives in areas classified as rural. Although most of the rural villages with electricity service are close to the urban centers, connection density is modest (1.19). The lack of comprehensive data with respect to ongoing and expected rural electrification efforts is expected to be remedied through preparation of the Master Plan (1.10).

1.25 Nevertheless, substantial rural electrification programs are currently underway in a number of regions in the country. Among the most important are:

- (a) the ongoing electrification subproject of an Integrated Rural Development Program supported by IDB, Canadian International Development Agency and Bank financing (Loan 1352-CO) through which an estimated 15,000 rural families will acquire electricity service;

- (b) the electrification program in the department of Choco financed by the Netherlands Government;
- (c) the electrification program in the coffee-growing areas, financed by coffee sector resources; and
- (d) a recently approved IDB rural electrification project for ICEL which will provide service to about 130,000 households by 1982.

Sector Investment Program and Studies

1.26 The total 1978-85 investment program of ISA and its shareholders (except for ICEL for which reliable information is not available), excluding interest during construction in mid 1979 was estimated to amount to about Col\$340 billion in current prices (about US\$4.2 billion in mid-1979 prices), with a foreign component of about 60%. Of the total, 65% pertains to ISA, 16% to EEEB, 9% to CORELCA, 7% to EPM and 3% to CVC. 1/ Some 70-75% of total investments would pertain to generation, which is extremely high (a range of some 40-60% would be the norm). Because the new generating capacity would be of little use without a network path to the consumers, upward adjustments in investments for subtransmission and distribution can be expected and it is therefore probable that the estimated cost of Col\$340 billion is understated. The Master Plan for power development being prepared by ISA and its shareholders (1.10) is expected to provide a basis for firmer total investment estimates. ISA is now regularly updating its study of economic ranking of projects which indicates that the 1984-88 portion of this program, on which decisions still have to be taken (the program up to 1984 is being executed), would be the least-cost alternative for system expansion.

1.27 The introduction of large thermal plant later in the century is expected to play an important role in ISA's planning for the sector in the next few years (lead time for mine development and power station construction may aggregate some 10 years). Even the large hydro potential of some 100 GW (1.01) would be completely utilized by about year 2020 and the use of the country's large coal reserves for firing of thermal plant may become more economic than hydro well before that time. The Government is aware of this scenario 2/ and the Government agencies involved together with the Bank, are addressing it. It is expected that the Government will survey, inter alia, two areas in relation to coal for domestic use: Tasajero in North Santander and Bolombolo in Antioquia. The use of coal for thermal plant firing and the substitution of coal for oil would be the primary objectives.

1/ This was prior to the discussion of plant ownership reallocation (1.11); no revised estimate is available awaiting formal arrangements for plant allocation.

2/ Disponibilidad de capacidad hidroelectrica y su influencia en la generacion termica en el futuro (Departamento Nacional de Planeacion, noviembre 1978).

1.28 The generation investment program is imposing a heavy financial burden on ISA and its shareholders. To ensure that only sound projects are undertaken, assurances have been obtained under the San Carlos loans that except for plants in the agreed National Expansion Program, ISA and its shareholders would not undertake construction of any generating plants of more than 200 MW (ISA) and 100 MW (shareholders) capacity prior to completion of San Carlos unless satisfactory evidence has been presented to the Bank that it is economically justified and that adequate financing is available to carry it out without jeopardizing the project.

Finances and Tariffs

1.29 Except for EEEB and EPM, which have histories of adequate cash generation, the power sector has relied heavily on borrowings and budgetary contributions to finance its investments. EEEB and EPM operate low-cost systems and cover the most affluent markets in the country; they have, therefore, been able to finance their investments with an appropriate balance of borrowings and cash generation while charging relatively low rates. Because there has been no mechanism to obtain financial transfers within the sector from the more affluent areas to the less affluent, CVC, ICEL and CORELCA, which operate high-cost systems in lower income areas than EEEB and EPM, have had to rely on budgetary contributions from the Government and subsidies. In recent years, however, the opportunity of sharing in low-cost investments through ISA has provided an indirect transfer mechanism.

1.30 Over most of 1971-77 rate adjustments lagged considerably behind yearly inflation. The developments were the followings:

Year	Average rates at current prices <u>1/</u>		Average inflation <u>2/</u>	Average rates at 1970 constant prices
	Col\$/kWh	%Change	%	Col\$/kWh
1970	0.202	-	-	0.202
1971	0.205	1.6	11.8	0.183
1972	0.220	7.1	13.8	0.173
1973	0.243	10.2	22.0	0.153
1974	0.277	14.2	25.0	0.143
1975	0.355	28.2	23.6	0.148
1976	0.423	19.2	20.0	0.147
1977	0.665	57.2	29.0	0.179

1/ For the relevant information on EPM see paragraph 2.13.

2/ On the basis of the consumer price index.

The positive trend in rate setting which began in 1977 is expected to continue as a result of the agreements reached under the San Carlos I and II, Mesitas and the Bogota distribution loans and under the proposed loan to EPM. In view of the importance to economic growth of adequate electricity service, the Government has adopted a policy calling for adequate rates in order to ensure that the sector generates internally a reasonable portion of the funds required.

1.31 In view of the considerable imbalances that exist in the structure of tariffs and rates in the power sector, the Government and ISA's shareholders are executing under San Carlos I (Loan 1582-CO) a country-wide tariff study with a view toward assessing the cost of supply to each consumer category (1.10). The study has suffered delays because of the time necessary for the Colombians, who are carrying out the study, to become familiar with the principles of marginal costing. On the basis of preliminary findings, a successful seminar on electricity pricing in Latin America (75 participants representing 21 countries and 3 international institutions) was held in Medellin in October/November 1979, under the aegis of the Bank. The basic study is now expected to be completed by about September 1980.

Constraints on Sector Development

1.32 In the past, the large number of entities associated with the power sector, the lack of adequate regulation, coordination and planning at the national level and low electricity rates constrained the sector's ability to make rational use of Colombia's abundant hydroelectric resources. The regionalized nature of the sector, reflecting the political and economic decentralization of Colombia, engendered difficulties in coordinating investment allocation; decisions were made on a local basis without due regard to overall country planning for power development. This situation together with the lack of funds, resulted in recurring power shortages. The most recent developments (1.11) highlight the difficulties of effecting basic changes in a strong historical pattern in response to the requirements of an increasingly sophisticated and rapidly developing economic situation.

1.33 The successful long-term execution of Colombia's power development is contingent upon the availability of sufficient cash generation by the individual entities, and domestic and external sources of financing. Detailed discussions on this subject are the focus of considerable Government attention at this time. The dimensions of this are further enlarged by the sector's organization, which has precluded the usual practice of channeling resources within the sector from well-developed urban markets to support service in the poorer regions of the country, particularly rural areas (1.29), except indirectly by investments of the shareholders in ISA's generating and transmission plant which may provide supply to these areas.

1.34 ICEL's financial requirements have grown at a much more rapid pace than its capabilities. The problem derives mainly from overdue accounts for electricity purchased from ISA by ICEL's subsidiaries some of which do not have the capacity to pay due to high operating cost and/or insufficient rates. A smaller portion of arrears is related to investment contributions to ISA, which are covered by national budgetary allocation. The arrears are a matter of serious concern to the Government, ISA and the other shareholders. To date ISA's construction program appears not to have been affected but if arrears would continue to accumulate, ISA's program may be slowed, which would affect all the shareholder's ability to meet electricity requirements. In addition to the immediate corrective action under consideration by the Colombian authorities (1.12), a long-term solution is being sought by the Government and the Bank, which would form part of the arrangements to be made under the proposed Guavio hydro power project, taking also into account ICEL's proposal to finance in part the Betania hydro plant.

1.35 The Government has recently taken a number of positive measures to address the sector's institutional constraints. In 1975, it eliminated the jurisdictional overlap between ICEL and CORELCA on the Atlantic Coast by transferring control over the electricity distribution companies in that region to CORELCA. Another positive measure was the reorientation of ICEL, which basically is responsible for electricity development in rural and semi-rural areas, where the Government will continue to subsidize the service since ICEL cannot be financially self-supporting in those areas.

1.36 With the addition of CORELCA as an ISA shareholder, most of the sector is represented directly or indirectly in ISA's Board and coordination of power sector planning in Colombia has improved. ISA's effectiveness in maintaining this coordination, however, will depend on its ability to sustain a sound consensus among its shareholders.

2. THE BORROWER

General

2.01 In 1955 the Government of Colombia authorized the municipality of Medellin to organize Medellin's municipal services as administratively autonomous units, with the objective of providing energy, telephone, water and sewerage services to Medellin, and to other municipalities which requested such provision from Medellin. In its Order No. 58 of 1955, the Medellin municipality established Empresas Publicas de Medellin (EPM)--the autonomous company created in accordance with Decreto 1816 of 1955. All assets related to these public services were transferred from the municipality to EPM. The three branches of EPM are operated as financially independent departments with separate accounts. EPM operates power facilities in Antioquia, and gives electricity service to Medellin and to numerous other adjacent urban and rural areas under the jurisdiction of their respective municipalities and to the Electrificadora de Antioquia, an ICEL subsidiary, in the remaining territory of the province (3.01).

Previous Bank Lending

2.02 The Bank has made 4 loans, totalling MUS\$135, to EPM for generation (which assisted in financing about three-quarters of EPM's present installed capacity of 779 MW); 250-CO in 1959, 282-CO in 1961, 369-CO in 1964 and 874-CO in 1973. The fourth loan is helping to finance the almost completed expansion of the Guatape hydro facilities, which raised the dam of the Santa Rita reservoir--not only to increase EPM's generation but also to allow optimum design of the downstream San Carlos hydro plant - and added 4 units to the Guatape I power station (financed by loan 369-CO). The Guatape II project has been delayed by about 2 years due to resettlement problems of the village of El Penol, geological difficulties in tunnelling, welding problems in the penstock lining and design problems in the turbine and generators. All of these problems have been resolved and the plant is now being commissioned. In early 1980, the Bank also extended a loan (MUS\$44) to EPM for part of its telecommunication program.

Organization

2.03 EPM is administered by a 7-member Board of Directors appointed at the same time for a renewable term of 2 years, with the Mayor of Medellin as Chairman. A ruling was passed on October 31, 1979, by the Consejo del Estado, that the Mayor of Medellin (rather than the Mayor and the Municipal Council) has the authority to appoint and dismiss, without limitation as to his prerogatives of doing so, all board members of municipal entities, including EPM. The ruling became effective in March 1980, and the Mayor is expected to proceed to select new Board members before the term of the present members expires by the end of this year. Prior to this change the municipality dominated EPM's Board and voting in this Board on decisions already taken in the Municipal Council was a mere formality. This has led to some actions which appear not to have been in the best interests of EPM; appropriate tariff actions (2.12, 5.18) and improved investment limitations (5.23),

are expected to avoid such actions in the future. The existing agreement (874-CO) specifying that a change in EPM's statutes or that new legislation be adopted by the Municipal Council, adversely affecting the management and operations of EPM, would be an event of default, would be repeated for the proposed loan.

2.04 The General Manager who is appointed by the Board and has a term renewable each year, is responsible for EPM's day-to-day management. He oversees directly the work of (a) four managers, responsible for technical matters, operations, finance and administration; (b) the secretary general in charge of legal affairs and archives; and (c) a planning director in charge of planning and coordination. Below the level of the managers, the organization is to the extent possible separated administratively into EPM's 3 branches of utility services: Water and Sewerage, Telephone, and Power. Each branch works fairly independently of the others, and separate financial statements are prepared. EPM's Board of Directors, however, receives a consolidated financial statement for all of EPM's services. EPM's organizational chart is shown in Annex 2.1.

2.05 The organizational arrangements for the power branch are generally satisfactory, except that the financial responsibilities of the Planning Construction and Supervision Divisions appear to be too limited. This is in part due to the computerization in the Financial Department of cost-accounting and financial forecasts, which tend to shift the financial responsibility from the engineer to the accountant. EPM is aware of the problem and is studying methods to redefine responsibilities more efficiently.

Personnel

2.06 EPM, as of December 1979, had 3,618 employees of which about 1,700 pertain to its power branch. Personnel working directly for power numbered 846 (56 in planning and design, 33 in power station construction, 489 in power stations and substation operation, 268 in distribution). In addition, about an equal number of staff can be assumed to work principally for power in finance, administration and general services. By the end of 1979 EPM had an installed capacity of 979 MW (including Guatape II nearing completion) generating some 4,130 GWh for about 270,000 consumers of electricity. The power station personnel ratio, therefore, is about 2 MW/employee, the overall staff production ratio 2.9 GWh/employee, or 6 employees for 1,000 connections, which is considered reasonable. Turnover also appears reasonable; in the first 11 months of 1979, 348 people terminated employment, including 27 who retired on pension; on this basis average employment is about 10 years per person. The pay scales appear generally attractive ranging from Col\$7,000-8,000/m for the lowest graded workers (US\$166-190/m) to Col\$16,000-37,000/m (US\$380-880/m) for professionals, to which almost 3 months in pay is added in fringe benefits. This does not take into account EPM's contributions toward the retirement plan. Through the 1980s, increase in personnel directly employed in power is estimated at some 300, of which about 130 would be required for plant operation (Guadalupe IV, Playas) and the remaining for transmission and distribution and general power services. The overall manpower efficiency for EPM power service (although expected to remain about equal to the present figures) is difficult to forecast because of common use of financial and administrative personnel by all of EPM's service branches.

2.07 EPM's engineering and planning staff is well qualified, is competent and has considerable experience in project management and operation. This would enable it to manage and operate efficiently the considerable expansion of facilities during 1980-86, including the project. EPM's finance and management staff is also generally well qualified and capable.

Training

2.08 EPM is constructing a new training center to continue giving courses to administrative and operational personnel of all its branches. Building construction is well advanced and the center is expected to be in operation by end-1980. Regular courses would be given to train new staff and existing staff would receive refresher courses. At present, EPM trains existing and new plant maintenance staff. The 1979 training program resulted in about 950 participants, each obtaining about 60 hours of instruction. The training arrangements are satisfactory. However, EPM's professional staff requires some post-graduate work in highly specialized areas. A training component for this purpose has been included in the loan (4.14).

Accounting and Auditing

2.09 EPM's has an accrual accounting system which is appropriate, and tabulations and reporting are carried out effectively with the aid of a small computer. Monthly financial statements and budget reports are available promptly and, apart from minor inconsistencies expected to be eliminated resulting from the study on a uniform system of accounts for the sector (1.10), contain the information necessary for management review. EPM's internal audit is also adequate. The auditor is appointed by the Municipal Council of Medellin and reports directly to EPM's Board and the Municipality. The annual internal audit report is issued within three months after the end of the fiscal year. In accordance with agreements reached under loan 874-CO (Guatape II), EPM engaged independent external auditors to audit the accounts of all its operations, and their reports have been acceptable. The existing covenant related to accounting and auditing, including the requirement to submit the audited accounts and the auditors report to the Bank not later than 4 months after end of each fiscal year, would be repeated under the proposed loan but for the time limit which would be extended to 5 months to bring it into line with historic performance.

Billing and Collections

2.10 EPM's billing and collection procedures are satisfactory. Billing is computerized and subscribers are billed monthly. Bills become due about ten days after being received by the subscriber. While a consolidated bill for water and sewerage, electricity and telephone services is prepared, the charge for each service is shown separately. If the subscriber does not settle the account within three months, all utility services to the subscriber are disconnected. As a result of this rigid disconnection policy the level of outstanding and overdue accounts is generally low (5.05).

Insurance

2.11 EPM's power assets were not adequately insured, but it has recently made arrangements satisfactory to the Bank for such insurance. EPM has also expressed its intention to seek expert advice on the insurance of large civil works under construction in relation to the Guadalupe IV project. The existing insurance covenant would be repeated for the proposed loan.

Tariff and Rates

2.12 EPM historic costs, particularly capital costs, have been low and as a result, its average rate is one of the lowest in the country, if not in the world: 65.3 centavos/kWh (US¢1.65 kWh) at the end of 1978 (estimated to average US¢1.95 in 1979). Under the San Carlos loans, EPM had obtained the necessary authorization from JNT, and had instituted a 2.2% monthly rate increase in order to reach the agreed rates of return of 7% in 1978, 6% in 1979 and 9% in 1980 and subsequent years. However, in January 1979 EPM's Board decreased the monthly rate increase to 1.5% for residential consumers and to 1.8% for all other consumers, with the intention to raise them again to the level of 2.2%/m after the municipal elections (March 1980). EPM's Board has recently reinstated the 2.2% monthly increase, effective April 1, 1980. Further tariff action is required for EPM to maintain a satisfactory financial position (5.18, 5.19).

2.13 EPM's tariff structure is seriously imbalanced, with residential and block rates (to other municipalities and the ICEL subsidiary - see paragraph 3.01) significantly lower than industrial and commercial ones, and over recent years this gap has been widening. This can be illustrated by comparing average 1973 and 1978 rates, expressed in US¢ per kWh, after inflating 1973 average rates by the cost of living index (using 1973 as a base) and using the average 1978 rate of exchange:

	<u>Average Rate Per kWh</u>		<u>Increase</u>
	<u>1973</u>	<u>1978</u>	<u>(Decrease)</u>
	<u>US\$ c/kWh</u>		<u>%</u>
Residential	1.40	1.26	(10.0)
Commercial	2.39	3.44	43.9
Industry	1.61	2.32	44.1
Block	0.82	0.71	(13.4)
Other <u>1/</u>	0.82	1.15	40.2
Total	1.46	1.65	13.0

1/ Together representing in 1973: 3.5% of revenue and 6.4% of sales; in 1978: 3.4% of revenue and 4.8% of sales.

While the cost of supply in low voltage networks, (i.e. largely for supply to households) in general exceeds the cost of supply in the high voltage networks (i.e. to most industrial consumers), industry paid about 15% more than residential consumers in 1973, but 84% more in 1978. Residential rates, in real terms, decreased by 10%, while industrial rates increased by 44%. This increasing imbalance is unsatisfactory, even taking into account that in real terms the overall average rate increased 13% over the period.

2.14 The ongoing tariff study under San Carlos I (1.10) is expected to identify for the main supply centers in Colombia, the marginal cost of supply to the various consumer groups at the various points of supply and in time of the season, week and day. This study is expected to assist the sector and the Government in coming to grips with the problem of unbalanced tariff structures and seeking corrective actions through gradual adjustments. However, the study has suffered delays and is not expected to be completed before September 1980. Awaiting the outcome of the study, EEEB agreed (Loan 1807-CO) to prepare and institute an interim program which would gradually adjust rates during a two year period by apportioning future rate increases among the major categories of consumers in such a way as to gradually reduce the imbalance.

Likewise, EPM has agreed to prepare by March 31, 1981, a program satisfactory to the Bank of gradual revisions of its tariff structure and rates for its power services, taking into account the conclusions of the ongoing tariff study and put into effect such program by May 31, 1981. In the event, however that EPM would be unable to prepare such program because of further delays in completing the tariff study, it has agreed to prepare by March 31, 1980, an interim program satisfactory to the Bank, covering the period from May 31, 1981 through May 31, 1983, for the same purpose as the above program and institute such interim program by May 31, 1981. When the tariff study becomes available, EPM would prepare a program as referred to above; this program would replace the interim program. The program would also take into account the income redistribution policies of the government benefitting the lowest-income consumers.

3. EPM'S MARKET

Supply Area, Access to Electricity

3.01 EPM's statutory service area is the municipality of Medellin. However, service can be given under separate contracts to any area in the Department of Antioquia. Accordingly, EPM supplies directly 15 small municipalities (i.e., it owns the networks in the villages and bills for the service), sells in block to 10 other municipalities having their own distribution services, and sells indirectly (through supply to the Electrificadora de Antioquia, an ICEL subsidiary) to 67 municipalities. Thus, of the 116 municipalities in the province, 92--or about 80%--are directly or indirectly supplied with electricity by EPM. The total population of Antioquia is estimated at 3.4 million, of which an estimated 2.2 million--or 65%--have access to electricity. EPM supplies directly to about 270,000 consumers of which about 90% is residential. The Electrificadora de Antioquia has about 100,000 consumers. Antioquia accounted for about 22% of national gross electric energy requirements in 1977/78.

Historic Development

3.02 The 1975-78 consumption and supply data are shown in Annex 3.1, including the energy EPM purchased from and supplied to ISA. EPM's consumer data for 1968, 1973, 1978 is the following:

<u>Sales</u>	<u>1968</u>		<u>1973</u>		<u>1978</u>		<u>Annual</u>
	<u>GWh</u>	<u>%</u>	<u>GWh</u>	<u>%</u>	<u>GWh</u>	<u>%</u>	<u>Growth</u>
Residential	608	50	980	46	1,346	44	8.3
Commercial	87	7	161	8	225	7	10.0
Industrial	358	29	664	32	893	30	9.6
Block	61	5	164	8	426	14	21.5
Government	18	2	32	1	53	2	11.4
Others	87	7	103	5	92	3	-
	<u>1,219</u>	<u>100</u>	<u>2,104</u>	<u>100</u>	<u>3,035</u>	<u>100</u>	<u>9.6</u>
Losses	<u>479</u>	<u>(28)</u>	<u>484</u>	<u>(19)</u>	<u>604</u>	<u>(17)</u>	
Total requirements EPM	1,698		2,588		3,639		7.9
Supply to (from) ISA	-		-		(454)		
EPM generation	1,698		2,588		3,185		
Maximum demand (MW)	327		505		700		7.9
Number of consumers	140,766		207,450		261,273		6.4

The major change in the consumers' share of the market over the 10-year period was in the block sales to municipalities and the electrificadora, which increased an average of 21.5%/a and accounted for 14% of sales in 1978. Excluding this supply from the comparison indicates that the consumption pattern for the other classes of consumers decreased fractionally for residential consumers and commensurately increased for commerce and industry,

i.e, the overall pattern remained about the same. The residential consumers showed the lowest growth rate, which is surprising (saturation is not apparent, since 1970 consumption per residential connection increased about 1.6%/a to 475 kWh/m and the number of consumers rose by 6.1%/a) in view of the fact that the rates for these consumers are very low, US¢1.26/kWh in 1978 at the then current rate of exchange. The rapid increase in block supply may in part be due to the extremely low rate charged by EPM for this service, in 1978 amounting to US¢0.71/kWh equivalent. Overall growth in sales during the period was 9.6%/a, but it should be noted that average growth was considerably lower during the last 5 years (7.3%/a) than the previous 5 years (11.5%/a). Growth of total energy requirements and maximum demand was substantially lower due to the decrease in losses from 28% in 1968 to 17% in 1978. Losses, however, are still relatively high for EPM's 100% hydro system (losses, unaccounted for, including thefts, are probably in the order of 7%). This problem is presently being studied throughout the sector (1.10) and remedial action is expected to be instituted as a result of the study. Gross per capita consumption in EPM's supply area in 1978 was in the order of 1,000 kWh, probably the highest area consumption in the country (in Bogota, annual per capita consumption is in the order of 850 kWh).

3.03 Captive Plant. The total installed self generating capacity in factories in Antioquia is about 70 MW or 10% of EPM's installed capacity. About 35 MW pertains to two large textile factories, 18 MW to two cement plants, 13 MW to a mining company and the remaining to various small factories. Only one of the cement plants and the mining company are not connected to EPM's supply facilities. Supply figures (i.e., GWh for self-use) are not available.

3.04 Forecasts. EPM's sales are expected to grow at an average of 9%/a over 1978-86 and gross energy requirements in its system by 8.5%/a (Annex 3.1). This forecast was prepared essentially on the basis of historic trends. EPM uses simple exponential models for both energy consumption (for the various consumer categories and totals) and demand, deriving trend curves for forecasting requirements through 1986. Because the historic results compared with forecasts made with these simple models were generally in good agreement, EPM did not study alternative models. (However, ISA is presently studying the applicability of socio-economic multi-regression models throughout the sector.) The present forecasts are considered adequate. The following table summarizes the results:

Sales	1978		1982		1986		Annual
	GWh	%	GWh	%	GWh	%	Growth
Residential	1,346	44	1,808	42	2,406	40	7.5
Commercial	225	7	350	8	511	8	10.8
Industrial	893	30	1,368	31	1,962	33	10.3
Block	426	14	561	13	853	14	9.1
Government	53	2	66	2	79	1	5.1
Others	92	3	183	4	229	4	12.1
	<u>3,035</u>	<u>100</u>	<u>4,338</u>	<u>100</u>	<u>6,040</u>	<u>100</u>	9.0
Losses	<u>604</u>	(17)	<u>774</u>	(15)	<u>960</u>	(14)	
Total requirements EPM	3,639		5,112		7,000		8.5
Supply to (from) ISA (A)	<u>(454)</u>		<u>334</u>		<u>896</u>		-
EPM generation	3,185		5,446		7,896		12.0
Acquired rights in ISA (B)	-		989		2,036		
Total Surplus (A) + (B)	-		1,323		2,932		
Maximum EPM demand (MW)	700		984		1,345		

3.05 Residential consumers are expected to continue decreasing slightly their share in the market at about the modest growth rate of the last 5 years (3.02). Commerce and industry would commensurately increase their share of the market at a growth rate of about 10-11%. Because, for as yet unidentified reasons, the rapid increase in block supplies decreased to practically zero in 1979, and no consumer information is available, EPM decided to conservatively assume a 9% annual growth. This appears appropriate in the light of the necessity to adjust the block charges together with all other rates in the near future (2.13). It appears possible (discussions are underway) that EPM will take over several networks from independent municipalities and bill consumers directly because these municipalities are unable to maintain or improve the networks and to pay EPM for the supply. The number of consumers is expected to increase by about 4%/a to about 360,000 by 1986. Total energy requirements would grow less than sales in view of the expected lower losses due to the actions to be taken against thefts (3.02). The load factor is expected to remain about 59% during the period.

3.06 The generation forecast has been based on the average water availability in the rivers on which EPM's plants are located. Additionally, by investing in ISA plant (Chivor, San Carlos, Jaguas) EPM has obtained rights to a portion of the generation capabilities and capacities of these plants. The energy rights are shown in the above table together with the average surplus that could be generated by EPM plant. The total surplus would be available in the interconnected system for sales to other shareholders. For purposes of revenue forecasts, EPM, on the basis of a simulation study prepared by ISA, has made assumptions for the portion of the energy and commensurate capacity surplus that, on average, is expected to be sold in the interconnected system

as firm and secondary energy during the period to other shareholders which cannot meet their own requirements and depend on ISA and its other shareholders having surpluses (presently only EPM). The total (available 95% of the time) amounts to about 65% of this surplus, which appears conservative.

4. THE PROGRAM AND THE PROJECT

The Program

4.01 EPM has prepared a power development program for 1980-88, of which the 1980-86 portion is discussed here, to meet gross energy requirements expected to grow at 8.5% from 3,639 GWh in 1978 to 7,000 GWh in 1986 (3.04). The number of consumers would increase from about 270,000 in 1979 to about 360,000 in 1986, at an annual growth rate of 4% (3.05). These growth rates are similar to those experienced in the previous decade. The expansion pertains mainly to the urban area of Medellin and the Aburra valley in which this city is located. Modest expansion is planned in the remaining area of the province of Antioquia (largely the supply area of the Electrificadora de Antioquia, an ICEL subsidiary), mainly in transmission lines and substations. EPM also assists the Electrificadora by constructing some distribution networks which, upon completion, are transferred to the Electrificadora as an equity contribution, for which it obtains shares in the company.

4.02 EPM's 1980-86 development program (Annex 4.1) excluding contributions to ISA and excluding interest during construction, is estimated to cost MUS\$665 at current prices, with a foreign component of MUS\$385 (58%). Its main components are:

- (a) ongoing works in generation, i.e., the almost completed Guatape II hydro plant (Loan 874-CO), a small hydro plant (19 MW) at Ayura, the diversion of 3 small rivers to the Troneras reservoir (the reservoir supplying the Troneras and Guadalupe I-III plants); the Guadalupe IV hydro plant to be financed by the proposed loan and the Playas hydro plant for which construction has not yet started;
- (b) some ongoing works in transmission and substations and a substantial expansion program to be financed by EPM, from a recently obtained loan of MUS\$32 from the Bank of America and by the proposed loan; the latter would also finance special metering equipment; construction and maintenance vehicles; and
- (c) studies of potential hydro developments in Antioquia, partially financed by FONADE (Loan 971-CO), a transmission network study, and training to be financed by the proposed loan.

The Project

4.03 Objectives - The objectives of the project are to assist EPM to meet incremental power requirements in the rapidly expanding urban area of Medellin, expand the supply system to the rural areas (which, inter alia, would allow replacing some costly and unreliable supply from individual diesel plants), and improve reliability of supply in existing networks. The project would also assure completion of EPM's regional control center as part of the dispatch system in the integrated network. Additionally the objective would be to raise EPM's rates as necessary to ensure sufficient internal cash generation for investment and introduce an adjustment in the rate structure to remove gradually the existing imbalances.

4.04 Description - The project comprises:

- (a) The Guadalupe IV hydro plant. The plant, the construction costs of which is estimated at about MUS\$150 (US\$700/kW) at current prices, will be located immediately downstream from the existing Troneras (36 MW) hydro plant and the Guadalupe I (25 MW) and Guadalupe III (270 MW) power stations which are hydrologically in parallel, replacing the obsolete Guadalupe II plant. It would operate under a gross head of 417 m, and generate an average of 1,077 GWh/a. It consists of:
- infrastructure, including 7.5 km of access roads;
 - a compensating concrete tanque of 22,000 m³, immediately draining into a vertical well, 57 m deep;
 - the first part, 2.6 km long, of a horizontal (1% incline) concrete lined power tunnel with a diameter of 4.5 m, which leads to a second well, 131 m deep in order to assure adequate overburden under a canyon crossing the tunnel;
 - the second part of the power tunnel, about 3.9 km long with an incline of 0.5%;
 - a surge tank of the restrictive orifice type near the end of the second part of the power tunnel;
 - two surface penstocks about 540 m long with a diameter of 2.80/2.60 m; the last part will cross the Guadalupe river and for this purpose be sunk in a trench in the riverbed (for this and the construction of the powerhouse, the river will be diverted through a 350 m long diversion channel);
 - a surface power station suitable to install 4 turbine generator units of which 3 will be installed initially;
 - 3 vertical Frances turbines, designed for 22 m³/s at 74 MW and 514.3 rpm, each coupled to 71-MW generator at 13.8 kV and a power factor of 0.9;
 - a substation adjacent to the power station with 2 banks of 3 single phase transformers of 59 MVA each (one bank for 2 turbine-generator units) for stepping up the voltage to 230 kV;
- (b) EPM's 1982-1984 transmission line development program (which constitutes about 65-70%--expressed in base cost--of EPM's 1980-86 transmission line program) comprising 10 km of single circuit 44-kV lines, 30 km of single circuit and 15 km double circuit 110-kV lines and 93 km of double circuit 230-kV lines;

- (c) expansion of 5 or 6 existing and construction of 4 or 5 new substations (constituting about 35%--expressed in base cost--of EPM's 1980-86 substation program, about 60% of which would be financed by a Bank of America loan), together comprising about 420 MVA in transformer capacity;
- (d) construction of EPM's control center;
- (e) the 1982-84 portion of EPM's 1980-86 renovation and expansion program in distribution overhead and underground networks (constituting about 55%--expressed in base cost--of EPM's 1980-86 program), comprising about 129 km of 13.2-kV overhead lines, 41 km of 13.2-kV underground cables, 22 km of 44-kV overhead lines, 111 km LT lines, 11 MVA in distribution transformers and special metering equipment such as a cable fault locator, current sensors (2,900) and power registering meter systems (16), cable laying vehicles (2), pole erecting vehicles (2), three cutting vehicles (1), maintenance vehicles (2), line and cable tools, mobile phones (30) and manhole ventilators (2); and
- (f) a specialized training program for EPM's professional staff consisting of about 8 scholarships each year during 1981-84 plus special training for the staff of the power planning department.

4.05 Cost - The total cost of the project is estimated at MCol\$13,374 (MUS\$228.3) including a foreign component of MCol\$9,161 (MUS\$155.2), equivalent to 68% of total project cost. Project costs, which are shown in detail in Annex 3.2, are summarized as follows:

	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u>	<u>Total</u>
	-----MCol\$-----			-----MUS\$-----		
Guadalupe IV hydro station	1,163	2,389	3,552	28.5	58.3	86.7
Transmission lines	127	315	442	3.0	7.5	10.5
Substations	89	423	512	2.1	10.1	12.2
Control Center	14	246	260	0.3	5.9	6.2
Distribution	101	420	521	2.4	10.0	12.4
Special utility equipment	-	44	44	-	1.1	1.1
Training	12	34	46	0.3	0.8	1.1
Subtotal	1,506	3,871	5,377	36.5	93.7	130.2
Engineering, administration, study	361	85	446	8.8	2.1	10.9
Contingencies:						
Physical	279	509	788	6.8	12.1	18.9
Price	2,067	4,696	6,763	21.0	47.3	68.3
Subtotal	2,345	5,213	7,567	28.0	59.6	87.6
Total Project Cost	<u>4,213</u>	<u>9,161</u>	<u>13,374</u>	<u>73.1</u>	<u>155.2</u>	<u>228.3</u>

4.06 The project cost is based on estimated December 1978 prices which, for Guadalupe IV, are based on recent contracts and offers for hydro stations (San Carlos, Janguas) being constructed in Colombia and, for transmission and distribution based on EPM's experience with equipment procurement. The project costs are considered reasonable. EPM is exempt from custom duties on imported goods, and any taxes on procured goods. The physical contingencies correspond to the risks intrinsic to the various project components. For Guadalupe IV civil works they vary from 15% (surface work) to 20% (underground work) and for equipment between 10% (generators, turbines) and 15% (small equipment, penstock); for the other components of the project they vary from 10% (foreign equipment) to 15% (local equipment and labor). These percentages are considered appropriate in view of the status of design. A price contingency has been added as follows: local cost inflation was assumed to decrease from 26% in 1979 to 15% in 1982 and subsequent years; foreign cost 12% in 1979, 10.5% in 1980, 9% in 1981 and one percentage point lower each year for each subsequent year until 1986.

4.07 Financing - A Bank loan of MUS\$125 is proposed for the Guadalupe IV project, representing about 80% of the foreign exchange component of MUS\$155.2 (19% of the total cost of EPM's 1980-1986 development program), as follows:

	<u>MUS\$</u>
Guadalupe IV	71.2
Transmission lines	11.2
Substations	15.6
Control Center	10.3
Distribution	13.7
Special utility equipment	1.6
Transmission study	0.2
Training	<u>1.2</u>
	<u>125.0</u>

Suppliers credits and external commercial borrowings would finance up to MUS\$30.2 of the foreign cost for the Guadalupe IV turbines and generators and the remaining foreign costs, mainly for distribution and transmission, not financed by manufacturers (which were assumed to finance 85% of the cost of equipment to be supplied by them). EPM would finance the local cost (MUS\$73.1) from its own resources, mainly internally generated funds.

Engineering, Studies, Training

4.08 Guadalupe IV - The feasibility study for the hydro plant (June 1979) particularly with respect to plant design, was found to be generally acceptable, except that the tunnel level (second part) was not optimized and the cost estimate could be improved. A rush drilling program was instituted in September 1979 in order to assess the depth of the so called Antioquian batholite, which would allow to locate the second part of the power tunnel in substantially solid rock, thus decreasing requirements for concrete lining of the tunnel. In view of the local geological conditions it

however, become obvious that the project would suffer a delay of at least half a year if preparation of bid documents would await the results of the drilling. Because of the obvious benefits to the interconnected system of completing the Guadalupe plant as soon as possible (delays in plant completion and in initiating construction of new plants have caused two costly emergency programs and it appears that even these will not remove the considerable risks of curtailments throughout the eighties), it was agreed with EPM (a) to locate the tunnel of the optimum depth - i.e. 50m lower than designed - assuming a completely lined tunnel, (b) to continue the drilling in order to assess whether adjustments will have to be made and (c) to prepare bid documents allowing adjustments to such changes. Because it appears probable that a large section of the tunnel will be in solid rock (decreasing lining cost) the cost estimate is deemed to be sufficiently conservative to allow for some design changes during execution.

4.09 EPM will continue to employ its consultants for the Guadalupe plant, Consultores Tecnicos Ltda y Mejia y Millan Ltda. (Colombia), for final design and supervision. Its contract with EPM is being financed by a FONADE loan of MCol\$30. This contract, which terminates in March 1982, is also acceptable to the Bank and the proposed loan would finance the remaining part of the contract once the FONADE funds have been exhausted, which is expected in early 1982. EPM would sign not later than April 30, 1982 a new contract acceptable to the Bank with the same consultants for the continuation of their services until completion of Guadalupe IV. The proposed loan would finance this contract. The loan would finance 100% of the foreign cost of foreign consultants and 50% of the local cost of local consultants. The estimated base cost of the services to be financed in part by the loan is MUS\$5 in which general cost (surveys, drilling, test, etc.) is estimated at MUS\$1. The consultants are paid on the basis of the cost of all personnel assigned from time to time to the project, including salary costs, social benefits and profit margin. Their present average salaries are about US\$1,100/month. It is estimated that some 3,200 m.m. of such services will be required.

4.10 Transmission, Distribution - Under the Guatape II loan (874-CO) EPM, with the assistance of Westinghouse executed a study for the expansion of its sub-transmission and distribution system, particularly with respect to optimum size and location of substations, capacity and length of lines, and standardization of line components and transformers. The results were used by EPM for the design of the network included in its 1980-86 program. The network design is technically simple and follows American standards, except in the underground portion of the network in the center of Medellin where a 3-phase 4-wire 208/110-V system was installed many years ago, and which would be extremely costly to change. Present practices are adequate and will be continued, with emphasis on standardization throughout the network. As in the past, the work will largely be executed by local contractors under supervision of EPM, assisted by consultants, which is satisfactory. It should be noted that EPM itself would construct only about one fifth (some 260 km) of the total required low voltage distribution networks; four-fifths would - as in the past - be constructed by

developers in accordance with EPM's standards. On completion, these networks are transferred to EPM at no cost for incorporation in EPM's assets. Consequently, the cost of such networks (some MUS\$8) have not been shown in EPM's investment programs.

4.11 The development of Medellin's network has been from within, i.e., 110-kV lines have been extended following the development of the city in the rather narrow valley. Line and substation congestions are rapidly developing and, although the outline of a 230-kV ring around the city is becoming apparent, no comprehensive study has been made with respect to the future high voltage supply system. During appraisal this was discussed with EPM, and the carrying out of a study of EPM's high voltage transmission system was agreed upon. Consultants would be engaged by December 31, 1981 under acceptable terms and conditions. The cost of this study, which should be completed by September 30, 1982, is estimated at MUS\$0.4 of which about half would be financed by the proposed loan.

4.12 Control Center - The basis for the dispatch system in the interconnected network was planned by ISA in coordination with its shareholders and with the assistance of consultants (Systems Control of USA in cooperation with Sistecom of Colombia). It envisions the construction of a national dispatch center in Medellin (ISA) and, initially, 3 regional control centers. ISA's dispatch center is in execution, CORELCA has signed the contract for supply and erection and both EEEB and EPM are coordinating the preparation of terms of reference for engineering consultant services for final design, preparation of bid documents and supervision of execution of their respective control centers. The basic concepts for all regional centers are equal, they differ only to the extent required in view of operational requirements and physical differences of plant. In order to realize the full benefits of operating the interconnected system at least cost as soon as possible, EPM has decided to complete its control center, which would be financed by the proposed loan, without delay. It is estimated that already both EEEB's and the EPM's center will lag behind the completion of the ISA and CORELCA centers, by almost 2 years.

4.13 EPM has obtained a loan from FONADE for the relevant consulting services and it would engage the services of consultants for the execution of its control center not later than September 30, 1980 under acceptable terms of reference (already agreed with the Bank). The services would be in 2 phases: (a) final design, preparation and issue of bid documents (April 30, 1981) and award (October 30, 1981), and (b) supervision of execution.

4.14 Training - As is common in the Colombian power sector, EPM's practice is to use local engineering firms to assist its staff as needed for detailed design, procurement, and supervision of construction. Although this has worked reasonably well in the past, ISA and its shareholders have been studying the obvious drawbacks of this system in relation to rapidly growing construction responsibilities: how to adequately supervise in the future performance of consultants while reducing reliance on outside services where possible. Funds have been included in the most recent loan to ISA (San Carlos II, loan 1725-C0) for specialized graduate training in specific areas required by the sector, such as hydrology, soil and rock mechanics, geomorphology, seismology, energy planning and dispatch, protection and specialized equipment and civil

works. The proposed loan would complement this effort by financing 8 scholarships per year during 1989-84 at a cost of about US\$1,200/m each. In addition, the proposed loan would finance the foreign cost of specialized training of the staff in the power planning, which would consist of 3-4 group missions of these professionals to other public utilities of Latin America and elsewhere to update their expertise. The foreign cost of these missions is estimated at about US\$100,000/a each for the same period. The graduate training program would be carried out in coordination with ISA as the latter will execute its study of manpower requirements to identify the areas of required training for its own staff (similar to EPM's) and the programs and resources through which the training can be obtained.

Execution

4.15 Implementation Schedule - The implementation schedule, of which the key dates are shown in Attachment 4.3, would be used to monitor project progress during the construction period. The main project component, the Guadalupe IV station is expected to be completed by mid-1984, and transmission and distribution components by the end of that year.

4.16 Procurement - Procurement of goods and services to be financed by the proposed loan (other than consulting services and training) would be through international competitive bidding under Bank guidelines for procurement. Colombian manufacturers would receive a preference of 15%, or applicable duties, whichever is lower, for purposes of bid evaluation. The cost estimates assume that local manufacturers would supply conductors, constructional steel, towers and miscellaneous distribution equipment, with an estimated cost of some MUS\$10, the ex-factory cost (net of taxes) of which would be financed by the loan.

4.17 Disbursements - Funds from the proposed loan would finance the foreign cost of (a) 52% of total expenditures for the civil works for the Guadalupe IV hydro plant, (b) 100% of foreign expenditures for directly imported equipment and 94% of the ex-factory cost of locally produced materials and equipment, (c) 100% of foreign expenditures for foreign consultants and 50% of local expenditures for local consultants, and (d) 100% of foreign expenditures for training. All disbursements requests would be fully documented. Annex 4.4 shows the estimated loan disbursements. The closing date would be June 30, 1985.

Retroactive Financing

4.18 In order to avoid delays in its construction program, EPM may have to award some small contracts prior to loan signing. For this reason retroactive financing is proposed, not exceeding MUS\$ 0.5.

4.19 Environmental Aspects - Because the Guadalupe IV hydro plant would use the existing water conveyance system, the environmental impact would be limited to those inherent to the construction of new access roads and the new power station including penstocks. The latter will be founded almost completely

on residual soil materials which will be more stabilized than it is now through adequate surface drainage and revegetation of bare portions of the terrain and disturbed sections. Because the power station site is uninhabited and not used for any agricultural purposes, there would be no displacement of people. EPM has carried out previous transmission and distribution projects with due regard to environmental factors. Under the project the 230-kV line will be of a design consistent with minimal effects on land usage. Line routes, for 44 kV and 110 kV have been selected to follow existing rights of way, adjacent to highways and roads, so that clearing of land will be kept to a minimum.

4.20 EPM has a study in execution of the sedimentation of its reservoirs, the results of which will be made available to the Bank upon completion expected before the end of 1980. Loan 874-CO (Guatape II) provided for the usual dam monitoring which, however, was restricted to the San Rita reservoir and water works. The undertaking would be extended, under the proposed project, to all of EPM's dams and waterworks pertaining to power.

4.21 Project Risk - The Guadalupe IV part of the project is subject to the risks normally associated with civil works in difficult terrain and heavy rain during the wet season, which may cause landslides in disturbed earth and cause temporary work stoppage. However, since the surface work is limited to the compensating tank, the penstock and the power stations (the latter is on a flat piece of terrain, where no land slides can interfere with the works) the physical risks are mainly due to stability problems to be solved for the foliated and steep rocks adjacent to the compensating tank, and for tunneling. Although it has been assumed that the tunnel would be largely constructed in metamorphic rock, the possibility is high that, in effect, some sections will be in the solid rock of the Antioquian batholite (4.08). No undue difficulties are expected. The probable critical path of the project is the completion of the dispatch center; the construction period of 3 years appears tight.

4.22 The procurement and construction schedule for the transmission and distribution facilities is reasonable; no unusual delays are expected. Timely completion of the main components of these facilities will depend largely upon appropriate use of local consultants for assistance on detailed design and procurement activities and upon the ability of local construction firms to maintain schedules.

4.23 Project File - Reference is made to Annex 4.5 for the contents of the Project File.

5. FINANCE

Summary

5.01 Except for 1974 and 1975, EPM has maintained a satisfactory financial position through its 21-year relationship with the Bank. The extra-fiscal measures taken under recent agreements with the Bank, including revaluation of assets for monitoring financial performance, have considerably strengthened EPM's financial structure. The investments of EPM's Power Department for the period 1980-1986 are forecast at MCol\$60,405, of which MCol\$16,228 (27%) correspond to the proposed Guadalupe IV Hydro Power Project. Net internal cash generation would finance MCol\$35,940 (60% of total) and the remaining MCol\$24,551 (40%), would be covered by loans; the proposed loan amounts to MCol\$7,379 (MUS\$125). The present financial projections are based on a plan of tariff increases and on external and domestic inflation assumptions. The net operating income with the above plan is expected to produce annual rates of return on fully revalued assets ranging from 8% in 1980 to 16% in 1983 and the company is expected to maintain an adequate financial position throughout the projection period.

Consolidated Financial Performance

5.02 EPM's consolidated financial position as well as that of each of its various departments (Power, Telephone, and Water and Sewerage) have been satisfactory. During 1977-1979, the consolidated annual debt service coverage ratio exceeded 2.0. The following table summarizes EMP's consolidated financial performance during this period (Annex 5.1).

Fiscal Year Ending December 31:	1977	1978	1979
	-----MCol\$-----		
Operating Revenues	2,425.8	2,907.0	4,169.3
Operating Expenses	1,426.2	2,131.7	2,819.9
Operating Income	999.6	775.3	2,369.4
Operating Ratio (%)	59	73	68
Debt/Equity Ratio	57/43	57/43	52/48
Current Ratio	1.4	1.7	1.1
Debt Service Coverage (times)	2.6	2.1	2.3

5.03 The projected flow of funds of each department (Telephone, Water and Sewerage, Power) through 1984 has also been reviewed and, on this basis, EPM's forecast future finances have been found satisfactory; annual debt service coverage for each of these departments will not be less than 1.5 (Annexes 5.2 and 5.7). Each department is operated financially independently of the other. EPM's current projections show that the future development program of each department will not impose any financial constraints on the

other departments. However, the implications of an eventual deterioration of the financial situation of any department on EPM's overall financial situation as a whole or on the Power Department, have been examined and, where necessary, appropriate covenants have been included in the proposed loan agreement to ensure financial independence (5.19 through 5.24). EPM retains all its profits because statutorily it is not required to pay dividends. Instead, each department pays an annual contribution to the municipality of Medellin based on the following percentages (fixed since 1955) of sales: Power, 4.425%; Telephone, 3.420%; Water; 1.993%; and Sewerage, 2.473%. Since EPM's accounts and budgets are maintained and audited separately for each department, a detailed analysis has been made only for the Power Department. Unless otherwise indicated, the following paragraphs relate only to the Power Department.

Earnings History

5.04 Except for 1974 and 1975 EPM's Power Department has had a history of satisfactory financial performance. Since 1976, its internal cash generation has complemented adequately its financial requirements, fluctuating from 18% in 1976 to 57% in 1979 of its investment needs, including substantial recent contributions to ISA. This may be attributed in large part to the high density of its market and low-cost facilities, given the area's geographic advantages for hydro generation. The balance of the company's investment funds has been obtained through borrowings, generally at reasonable cost; no subsidized government funding has been required.

5.05 Over 1973-1979, EPM's average rate increased in real terms by 13%. Due to a program of fixed monthly increases instituted in 1978, rates are expected to average US\$2.28/kWh in 1980. The rate of return achieved in 1978 and estimated for 1979 of 7.6% and 7.8% are higher than covenanted rates of return of 7% and 6%. At the end of 1979, EPM's estimated debt/equity ratio was 36/64, calculated on the basis of revalued assets, and the debt service coverage ratio (including investments in ISA) was 1.6. The company's cash and working capital have been adequate in recent years; the current ratio has exceeded 1.5 since 1976 and reached 3.3 in 1978. On average, accounts receivable as a percentage of annual sales has not exceeded 19.2%.

Rate Base

5.06 For public accounting purposes, Colombia's public utility regulatory law does not allow full revaluation of fixed assets but only adjustments to match the revaluation of outstanding foreign debt. To reflect international and domestic inflation, a fixed value of EPM's assets and accumulated depreciation as of December 31, 1976 was estimated and agreed with the Bank (under loan 1582-CO), to monitor the financial performance of the company. From this date EPM revalues its assets quarterly by the Colombian cost of living index to monitor its rate of return.

Tariff Structure

5.07 Although EPM's average rate is expected to continue to improve, its tariff structure lacks appropriate balance among various major components. The spread between average residential and average industrial/commercial charges further widened because in 1979 the 2.2% across-the-board monthly rate increases, in effect since 1978, was reduced to 1.5% for residential and 1.8 for all other consumer categories. Reinstatement of the 2.2% became effective in April 1980, and a program of adjustments would be implemented (2.14).

Financial Structure

5.08 The extra-fiscal measures taken since the San Carlos loans, including revaluation of assets for monitoring financial performance, have strengthened EPM's financial structure. As of December 31, 1979, the estimated capitalization of EPM's Power Department was:

	<u>MCol\$</u>	<u>%</u>
Capital	43	-
Donations	513	2
Accumulated Surplus	4,328	18
Capital Revaluation	<u>10,967</u>	<u>44</u>
Total Equity	<u>15,851</u>	<u>64</u>
Long-Term debt	7,392	30
Pension and Other		
Liabilities Reserves	<u>662</u>	<u>3</u>
Total Long-Term Liabilities	8,054	33
Current Liabilities	790	3
Total	<u><u>24,695</u></u>	<u><u>100</u></u>

5.09 The principal creditor of EPM's Power Department is the Bank; in 1979, debt under its first three loans from the Bank amounted to MCol\$5,430 equivalent to 73% of total long-term debt. The second largest creditor is Chase Manhattan Bank with 7%, followed by Brown Boveri and KfW with 4% and 3%. The remaining 13% is composed of debt from various local banks. Audited figures for 1978 are given in Annex 5.3 The pension and other liability reserves (noncurrent and contingent liabilities) are estimated at MCol\$790 (3% of total capitalization).

Investment and Financing Plans

5.10 EPM's 1980-86 investment program, including construction, investments in ISA, interest during construction and requirements for working

capital, amounts to MCol\$60,405, of which MCol\$16,228 (27%) correspond to the proposed project. The future Playas hydro power project, assumed to be constructed and owned by EPM in this financial projection (1.11), is the largest component of the investment program, requiring MCol\$22,972 (39% of total). The capital and bonds contributions to ISA, regarded as fixed financial obligations, are considered part of EPM's debt service and amount to MCol\$6,070 (10% of total). The proposed financing plan for EPM's investment program is summarized on the next page.

5.11 EPM's net internal cash generation would finance MCol\$35,940 (60% of total) and the remaining MCol\$24,551 (40%) would be covered by loans (Annex 5.5). Of this figure, MCol\$178 comes from undisbursed proceeds of existing loans. The proposed loan for the Guadalupe IV Hydro Power Project would amount to MCol\$7,379 equivalent, the balance of MCol\$2,554 is planned to be covered by: (a) MCol\$1,266 as part of the MCol\$1,578 loan which EPM contracted with Bank of America in February 1980 to finance part of its investment program, (b) MCol\$1,187 from suppliers credits and/or external commercial banks, and (c) MCol\$101 in local currency from FONADE. Borrowings required for the Playas project, amounting to MCol\$12,782, are assumed to be covered by MCol\$9,959 from IDB or other external sources and MCol\$2,823 from suppliers credits.

5.12 The remaining MCol\$1,658 of required borrowings are planned to be covered by MCol\$362 from local banks, government and municipal loans for financing local components of the construction program, MCol\$486 from FONADE to finance the cost of studies for future projects and MCol\$810 of short term loans through local commercial banks for financing part of the long-term debt service in 1980 and 1981, in order to increase the availability of the local currency requirements.

5.13 It is reasonable to expect that EPM will be able to obtain the financing estimated above in view of its satisfactory financial position, expected tariff increases, and the interest that domestic and external commercial lenders are showing in EPM operations. Resulting from the agreements reached under the Bank loan to EEEB for the Bogota Distribution project, and from the San Carlos and 500-kV Interconnection loans, the Government has confirmed that arrangements satisfactory to the Bank will be made to provide the sector as a whole with the additional funds required for the adequate and timely financing of the various projects under execution which include Guadalupe IV. Effectiveness of the proposed loan would be conditional upon receiving evidence that EPM has made satisfactory arrangements for financing the balance of its requirements for the period 1980-1982.

5.14 The proposed Bank loan is assumed at an interest rate of 8.25% per year plus a commitment charge of 3/4 of 1% with a repayment period of 17 years including 4 years grace. The terms of other foreign and local borrowing related to the proposed and future projects (Annex 5.3) are in line with the general terms for EPM's current external and domestic borrowings. Disbursement and debt service schedules of existing and future loans are given in Annexes 5.8 through 5.10.

Proposed Financing Plan 1980-1986

(in current prices)

<u>REQUIREMENTS OF FUNDS</u>	<u>MCol\$^{1/}</u>	<u>Percentages</u>	<u>MUS\$</u>
<u>Construction Program</u>			
Existing projects	1,793	3	37.6
Guadalupe IV	16,228	27	279.1
Playas	22,972	39	329.7
General Plant	485	1	7.6
Studies	530	1	9.9
Other	<u>10,150</u>	<u>16</u>	<u>133.3</u>
Sub-Total:	52,158	87	797.2
Interest during construction	<u>4,645</u>	<u>8</u>	<u>69.0</u>
Total construction program	56,803	95	866.2
Other investments	282	-	3.2
Increase (Decrease) in Working Capital	<u>3,318</u>	<u>5</u>	<u>53.4</u>
TOTAL REQUIREMENTS	<u><u>60,405</u></u>	<u><u>100</u></u>	<u><u>922.8</u></u>
<u>SOURCES</u>			
<u>Internal Cash Generation</u>			
Net income before interest	40,814	67	620.3
Depreciation	15,544	26	236.4
Amortization (Studies and Training)	554	1	8.0
Reserve Accounts	<u>2,567</u>	<u>4</u>	<u>39.7</u>
Gross Internal Cash Generation	59,479	98	904.4
Less: Debt Service (Excluding interest during construction)	17,469	28	269.5
Investments in ISA ^{2/}	<u>6,070</u>	<u>10</u>	<u>101.9</u>
Net Internal Cash Generation	35,940	60	533.0
<u>Borrowings</u>			
Existing	178	-	3.9
Guadalupe IV: Proposed IBRD	7,379	12	125.0
Other	2,554	4	47.7
Playas	12,782	21	179.5
Other	362	1	7.5
Studies	486	1	8.9
Refinancing 1980-1981	<u>810</u>	<u>1</u>	<u>16.6</u>
Total Borrowings	24,551	40	389.1
Cash Surplus Variation	<u>(86)</u>	<u>-</u>	<u>0.7</u>
TOTAL SOURCES	<u><u>60,405</u></u>	<u><u>100</u></u>	<u><u>922.8</u></u>

^{1/} In current Col\$

^{2/} Regarded as fixed financial obligations.

May 8, 1980.

Liability Reserves

5.15 EPM maintains reserve accounts for its pension and severance liabilities according to Colombian law, and pays directly from these accounts to employees who leave the company. Annual provisions for these reserves are determined from an actuarial study carried out in 1978. Other liability reserves are EPM's self insurance fund, and a yearly reserve of MCol\$100 to cover most of the MCol\$850 balloon payment of local loans maturing in 1983 (5.20); since estimated cash generation in 1983 is sufficient to cover said balloon payments, this yearly reserve is assumed to be used to make up for 1980-1981 cash shortfalls. The 1980-86 net increase in these reserves amounts to 4% of total financing sources.

5.16 In addition to low-cost housing loans which EPM provides for its employees, individual shares in the severance funds can be used by employees for purchasing residential housing. As required by law, EPM pays interest on the severance reserve in line with rates charged for similar arrangements in other companies. These arrangements apply to all EPM's departments.

Future Finances

5.17 Forecast financial statements for 1980-86 are presented in Annex 5.4 through 5.6. A summary of financial indicators is given below:

<u>For Calendar FY's</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Operating revenues (MCol\$)	4,098	5,803	8,641	10,664	11,745	14,097	18,297
Operating costs (MCol\$)	2,394	2,976	3,671	4,508	5,394	7,082	8,433
Operating income (MCol\$)	1,704	2,827	4,970	6,156	6,351	7,015	9,864
Operating ratio (%)	58	51	42	42	46	50	46
Rate of Return on Revalued Assets (%)	8.0	10.5	15.5	16.2	12.2	10.2	10.1
Current ratio (times)	1.8	1.7	1.9	1.9	1.9	2.0	1.8
Debt/Equity Ratio (%)	33/67	33/67	34/66	33/67	33/67	32/68	29/71
Debt Service Coverage (times) ^{1/}	1.5	1.8	1.9	2.2	2.6	2.2	2.4
Accounts Receivable (days)	70	70	70	70	70	70	70
Self Financing ratio (%)	47	45	49	52	57	59	83

^{1/} Gross internal cash generation divided by: Debt service including interest during construction not financed by loans and investments in ISA.

5.18 Projected revenues provide for the effects of expected local and external inflation (4.06), exchange rate devaluation (increasing from Col\$42.06 in 1979 to Col\$81.17 per US\$ in 1986) and are based on the following tariff program:

- (a) Reinstatement in April 1980 of the 2.2% monthly rate increase as approved by the JNT and EPM's Board;

- (b) Continuation of the 2.2% monthly rate increase, and one lump increase to achieve rates of return of 9% in 1980, 1/ and 10.5% in 1981, based on the present forecast such lump increase would amount to 10% in June 1981. These increases would reduce EPM's local cash deficits during 1980 through 1982 down to MCol\$810 (about MUS\$16 - expected to be covered by short-term loans); without these increases local cash deficits would accumulate to MCol\$1,900 (about MUS\$38). Although EPM's present debt/equity ratio, and repayment potential would allow it to incur most of this debt, this sum is considered excessive for the local capital market which is already hard pressed to finance similar cash shortfalls of the other power sector utilities;
- (c) Continuation through 1983 of monthly rate increases of up to 2.2%; and
- (d) Starting in January 1984, the monthly increase could be adjusted downward to give minimum yearly rates of return of 10%.

5.19 EPM has agreed to increase its rates by 10% before June 1981, or take equivalent actions to obtain the same funding in 1981, and continue its monthly rate increase of up to 2.2% through 1983.

5.20 EPM's net operating income with the above plan is expected to produce annual rates of return on fully revalued assets ranging from 8% in 1980 to 16% in 1983 compared with no less than 9% covenanted under the San Carlos loans. 1/ The increase comes from additional local cash requirements resulting from the assumption that EPM, instead of ISA, will construct the Playas Hydro Power Plant, and from balloon payments due in 1982 and 1983 of local loans contracted by EPM during 1977-1978 to refinance the whole of its foreign debt service payments due in those two years 2/. This yearly rates of return covenant would be amended for the proposed loan in order to achieve a minimum of 9% in 1980 3/, 10.5% in 1981, 13% in 1982 and 1983 and 10% in 1984 and thereafter, in line with the present internal cash generation requirements to maintain acceptable levels of debt service coverage, debt/equity and current ratios. The method for calculating the rate of return, and for periodic monitoring and implementing required adjustments of covenanted rates and a debt service coverage ratio of 1.5, agreed under the San Carlos II loan, would be repeated under the proposed loan.

1/ The 1980 rate of return of 8% actually increases to 9% when the 1979 surplus, as covenanted, is carried over to 1980.

2/ This financing operation was carried out to benefit from a low-cost local credit facility provided by the Government to the sector to alleviate the financial burdens of the majority of its utilities.

3/ Including the carry-over from 1979 mentioned in 1/.

Negative Pledge

5.21 The negative pledge, covenanted under loan 874-CO, whose applicability was limited to the assets of EPM's Power Department, would be extended to include EPM's other service departments. As a consequence (i) the covenant under 874-CO regulating debtors to forego rights on EPM's assets would be deleted; (ii) the debt service coverage test of at least 1.5 would be applied to EPM's other departments; and (iii) EPM would, for each of its departments, prepare and furnish to the Bank a yearly report no later than 3 months after the end of EPM's fiscal year, on EPM's financial performance during that year and projected through the following year.

Fund Utilization Limitation

5.22 The covenants under loan 874-CO limiting the transfer of funds from the Power to the other departments of EPM and their independent operation would be repeated under this proposed loan.

Investment Limitation

5.23 In addition to the limitation covenanted under San Carlos II on investments in generating plants greater than 100 MW (1.28) a covenant would be included in the proposed loan agreement to the effect that, except as the Bank may otherwise agree, EPM would not incur expenditures for investments not included in EPM's 1980-1986 investment program which exceed 1% of revalued net fixed assets in operation 1/, or for investments unrelated to the operations of its three departments.

EPM's Tariffs Requirements

5.24 The covenant under loan 874-CO whereby EPM shall establish and maintain adequate tariff levels for each of its service departments and provide reasonable rates of return and contributions toward new capital investments of each department, would be repeated under the proposed loan.

1/ It would not be necessary to place an additional investment limitation on operational investments to be used in common by two or more departments, because (i) of the similar limitation (MUS\$2 instead of 1% of revalued net fixed assets in operation) covenanted under the recently Bank approved Fifth Telecommunication Project loan to EPM; and (ii) any investments made by EPM for the common use of its departments, has to be allocated to each department in proportion to said use.

6. ECONOMIC ANALYSIS

Least Cost Solution

6.01 ISA annually defines the least cost development program for the sector 1/, which then becomes the national development program for generation and 500-kV and 230-kV transmission. The Guadalupe IV hydro plant is the next plant in the program to be completed for the interconnected system (followed by Betania, Playas and Guavio).

6.02 EPM's transmission, subtransmission and distribution program, including the related part of the project, was designed on the basis of the 1980-86 load forecast by the Westinghouse Study (4.10) which optimized substation and main conductor loading using the discounted cash flow method. Since the objective is to provide electric service to some 12,000-14,000 new consumers each year and to improve service coverage and quality through improving and expanding the existing system, reasonable alternatives for the secondary network are limited to EPM's standard design, which is simple and satisfactory.

Return on Investment

6.03 The return on investment was calculated as the discount rate equalizing the present values of the streams of benefits and costs associated with EPM's 1979-1986 development program of which the Bank project is a part and cannot be reasonably segregated. The cost streams comprise the capital costs of this program and incremental operational and maintenance cost related to the incremental sales associated with the program. These costs were converted to border prices by means of weighted average conversion factors based on conversion factors for individual local cost components (materials, machinery, equipment, labor, consumables etc.). As a proxy for benefits, revenues were used, derived from incremental sales associated with the program and average 1978 rates, adjusted to border prices by the standard conversion factor.

6.04 On this basis, the return on investment is about 7% (Attachment 6.1), compared with the opportunity cost of capital for Colombia, estimated to be 11%. This low rate of return is of little significance as a measure of the economic worth of EPM's program; it only reflects the end 1978 rate level in relation to the cost of the 1980-86 development. However, on the basis of the expected increase in rates of about 50%, calculated on the basis of the present value of revenues derived from forecast sales and the real term annual level of average rates, the return on investment is expected to be 13% (6.05).

6.05 A sensitivity analysis was carried out to measure the impact of major uncertainties underlying the return calculation. The analysis shows the following:

1/ Verificación y actualización del programa de expansión del sistema interconectado, periodo 1984-88; diciembre 1978.

Rate of Return; Sensitivity

<u>Parameters</u>	-----Change from Base (%)-----					
	-20	-10	Base	+10	+25	+50%
	-----Rate of Return (%)-----					
Benefits (Sales or rates)	4.8	6.0	7.2	8.6	10.1	13.4
Capital Cost	9.4	8.2	7.2	6.3	5.3	3.8
Operation and Maintenance	7.7	7.4	7.2	7.0	6.5	6.0

The rate of return is not sensitive to a change in operational cost (including purchases from ISA, which, until 1986, would be rather limited). The sensitivity to capital cost changes is modest, i.e. about 1 percentage point per 10% change in costs. The sensitivity of the rate of return to changes in benefits (sales or rates) is about 1.23 percentage point per 10% change in benefits from the base - i.e. the return on investment would be 13% for a real term increase of 50%.

7. AGREEMENTS REACHED AND RECOMMENDATION

7.01 Agreements have been reached that:

- (a) Power tariff and rates would be restructured as follows:
 - (i) preparation of a program, by March 31, 1981, to gradually adjust structure and rates, and putting such program into effect by May 31, 1981 on the basis of the result of the ongoing national tariff study; and
 - (ii) should the ongoing national tariff study be delayed, EPM would submit satisfactory proposals for an interim program for the same purpose as the above program, by March 31, 1981, for implementation by May 31, 1981 through May 31, 1983; should the tariff study become available, EPM would prepare a program as indicated under (i) above; this program would replace the interim program (2.14);
- (b) EPM would sign, not later than April 30, 1982, a satisfactory contract with the engineering consultants for the Guadalupe IV hydro plant for continuation of their services until plant completion (4.09).
- (c) EPM would engage, not later than December 31, 1981, consultants for carrying out a study of development of its high voltage transmission facilities, which would be completed by September 30, 1982, under acceptable terms and conditions (4.11).
- (d) EPM would engage, not later than September 30, 1980, consultants for final design, issue of bid document, and supervision of construction, of the dispatch center, under acceptable terms of reference (4.13).
- (e) EPM would execute (in coordination with ISA) a satisfactory training program for professional staff; this training program would be completed by December 31, 1984 (4.14).
- (f) EPM would increase its rates by 10% before June 1981, or take equivalent actions to obtain the same funding in 1981, and continue its monthly rate increase of up to 2.2% through 1983 (5.19).

7.02 Agreements have also been reached that the corresponding provisions of Loans 874-CO, 1582-CO (San Carlos I) and 1725-CO (San Carlos II) would be amended as follows:

- (a) to extend the period for submitting external audit reports from 4 to 5 months (874-CO, Loan Agreement, Section 5.02) (2.09);
- (b) to extend the dam and waterworks maintenance covenants (874-CO, Loan Agreement Section 4.04(b)), to cover all of EPM's dams and waterworks (4.20);
- (c) EPM would achieve a rate of return of not less than 9% of 1980, 10.5% in 1981, 13% in 1982 and 1983 and 10% in 1984 and thereafter (1582-CO, 1725-CO, Shareholders' Agreements, Section 5.02(a)) (5.20);
- (d) to extend the lien covenants, now limited to EPM's power department, to include all other service departments, and as a consequence (i) to delete the covenant regulating debtors to forego rights on EPM's assets (874-CO, Loan Agreement Section 5.03(b) and 5.06) (5.21); (ii) extend the debt service coverage test with a ratio of 1.5, to EPM's other departments (1725-CO Shareholders Agreement, Section 5.11) (5.21); and (iii) no later than 3 months after the end of EPM's fiscal year, EPM would, for each of its departments, furnish to the Bank a report showing EPM's financial performance during that year and projected through the following year (874-CO Loan Agreement, Section 5.02) (5.21); and
- (e) The investment limitation covenant would also include: EPM would seek Bank concurrence before committing itself to capital expenditures (i) not directly related to the operation of any of its departments; and (ii) made or to be made in any one fiscal year (excluding those required for the project, payments to ISA and for the investment program) exceeding 1% of the net current value of its fixed assets in operation (1582-CO, 1725-CO, Shareholders' Agreement, Section 5.01) (5.23).

7.03 The following main provision of Loans 874-CO, 1582-CO and 1725-CO would be repeated.

- (a) Amendment, etc. of EPM's statutes and adoption of new municipal legislation, adversely affecting EPM, would be an event of default (829-CO, Loan Agreement, Section 8.08) (2.03);
- (b) Auditing and financial statements (874-CO, Loan Agreement, Section 5.02) (2.09);
- (c) Insurance against risk (874-CO, Loan Agreement, Section 4.02) (2.11);

- (d) Quarterly review of rates of return and adjustment of rates (1727-CO, Shareholders' Agreement, Section 5.02(b) and (c)) (5.20);
- (e) Debt service coverage ratio not less than 1.5 (1725-CO, Shareholders' Agreement, Section 5.11) (5.20);
- (f) Limitation of transfer of funds from the power to the other departments and their independent operation (874-CO, Loan Agreement, Section 5.01) (5.22); and
- (g) EPM to establish and maintain for all of its services adequate tariffs and financing (874-CO, Loan Agreement, Section 5.07(a)) (5.24).

Conditions of Effectiveness

7.04 Prior to declaring the loan effective, evidence would be available that EPM has made satisfactory arrangements for financing the balance of financial requirements for the period 1980-1982 (5.13).

Recommendation

7.05 With the above assurances the project would be suitable for a Bank loan of MUS\$125 equivalent to be made to EPM with the guarantee of the Government of Colombia. The loan would have a repayment period of 17 years, including 4 years of grace.

May 16, 1980

COLOMBIA
EMPRESAS PUBLICAS DE MEDELLIN
GUADALUPE IV HYDRO POWER PROJECT
IBRD Power Loans

Borrowers and Loan No.	Year of Agreement	Project Description	Loan Amount (MUS\$)
<u>GOVERNMENT</u>			
1583-CO	1978	500-kV Interconnection (Central System/Atlantic System)	50.00
<u>ISA</u>			
575-CO	1968	Central System Interconnection (230 kV transmission lines and substations)	18.00
681-CO	1970	Chivor I project (4 x 125 MW hydro)	52.30
1582-CO	1978	San Carlos I (4 x 155 MW hydro)	126.00
1725-CO	1979	San Carlos II (4 x 155 MW hydro)	72.00
<u>EEEE</u>			
246-CO	1960	Laguneta unit 4 (1 x 18.0 MW hydro)	17.60
		Salto II units 1 and 2 (2 x 33.0 MW hydro)	
		Zipaquirá unit 1 (1 x 33.0 MW thermal)	
313-CO	1962	Zipaquirá unit 2 (1 x 37.5 MW thermal)	50.00
		El Colegio units 1, 2, and 3 (3 x 50.0 MW hydro)	
537-CO	1968	El Colegio units 4, 5, and 6 (3 x 50.0 MW hydro)	18.00
		Canoas project (1 x 50.0 MW hydro)	
1628-CO	1978	Mesitas Hydro (El Paraíso 3 x 90 MW; La Guaca 3 x 110 MW; pumping 3 x 10 MHP; Sesquile dam strengthening)	84.00
1807-CO	1980	Bogotá Distribution	87.00
<u>EPM</u>			
225-CO	1959	Troneras unit 1 (1 x 18.0 MW hydro)	12.00
		Guadalupe III units 1 and 2 (2 x 45.0 MW hydro)	
282-CO	1961	Troneras unit 2 (1 x 18.0 MW hydro)	22.00
		Guadalupe III units 3, 4, and 5 (3 x 45.0 MW hydro)	
369-CO	1964	Guatapé I units 1 and 2 (2 x 66.0 MW hydro) ^{1/}	45.00
874-CO	1973	Guatapé II units 1, 2, 3, and 4 (4 x 70 MW hydro)	56.00
<u>CVC/CHIDRAL</u>			
38-CO	1950	Anchicaya units 1 and 2 (2 x 12.0 MW hydro)	3.53
113-CO	1955	Anchicaya unit 3 (1 x 20.0 MW hydro)	4.50
		Yumbo unit 1 (1 x 10.0 MW thermal)	
215-CO	1958	Yumbo unit 2 (1 x 10.0 MW thermal)	2.80
255-CO	1960	Yumbo unit 3 (1 x 33.0 MW thermal)	25.00
		Calima units 1 and 2 (2 x 30.0 MW hydro)	
339-CO	1963	Calima units 3 and 4 (2 x 30.0 MW hydro)	8.80
<u>CHEC</u>			
39-CO	1950	La Insula units 1 and 2 (2 x 10.0 MW hydro)	2.60
217-CO	1959	La Esmeralda units 1 and 2 (2 x 13.3 MW hydro)	4.60
<u>LEBRIJA</u>			
54-CO	1951	Palmas units 1 and 2 (2 x 4.4 MW hydro)	2.40
<u>ELECTRIBOL</u>			
347-CO	1963	Cospique units 2 and 3 (2 x 12.5 MW thermal)	5.00
		Total Loan Amount	769.13

^{1/} Subsequently increased to 4 x 70 MW.

March 27, 1980

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COLOMBIAEMPRESAS PUBLICAS DE MEDELLINGUADALUPE IV HYDRO POWER PROJECTThe National Generation Development Program 1979 - 1985

<u>Year of Commissioning</u>	<u>Entity</u>	<u>Location</u>	<u>Type</u> ^{1/}	<u>Capacity (MW)</u>
1. <u>Under Construction</u> ^{2/}				
1979	EPM	Guatapé II	H	284
	ICEL	Insula	H	12
1980	CORELCA	Barranquilla III/IV	S	132
	CORELCA	Cartagena III	S	66
1981	ISA-EEEEB	Zipaquira (Termozipa) IV	S	66
	ISA	Chivor II	H	500
	ICEL	Paipa III	S	66
	ISA	Chinu	GT	100
1982	ISA-EEEEB	Zipaquira (Termozipa) IV	S	66
	EPM	Ayurá	H	19
	EEEEB	Mesitas (Loan 1628-CO)	H	600
	CORELCA	Cerrejón I	S	157
	ISA	San Carlos I (Loan 1582-CO)	H	620
1983	ISA	San Carlos II (Loan 1725-CO)	H	620
	ISA	Calderas	H	18
	ISA	Jaguas	H	170
Subtotal				3,496
2. <u>New Projects</u> ^{3/}				
1984	ICEL	Tasajero	S	132
	CVC	Salvajina	H	180
	CORELCA	Cerrejón II	S	150
	EPM	Guadalupe IV	H	213
1985	ICEL	Betania	H	167
Subtotal				842
Total Additions				4,338
Retirements				77
Total Net Additions				4,261

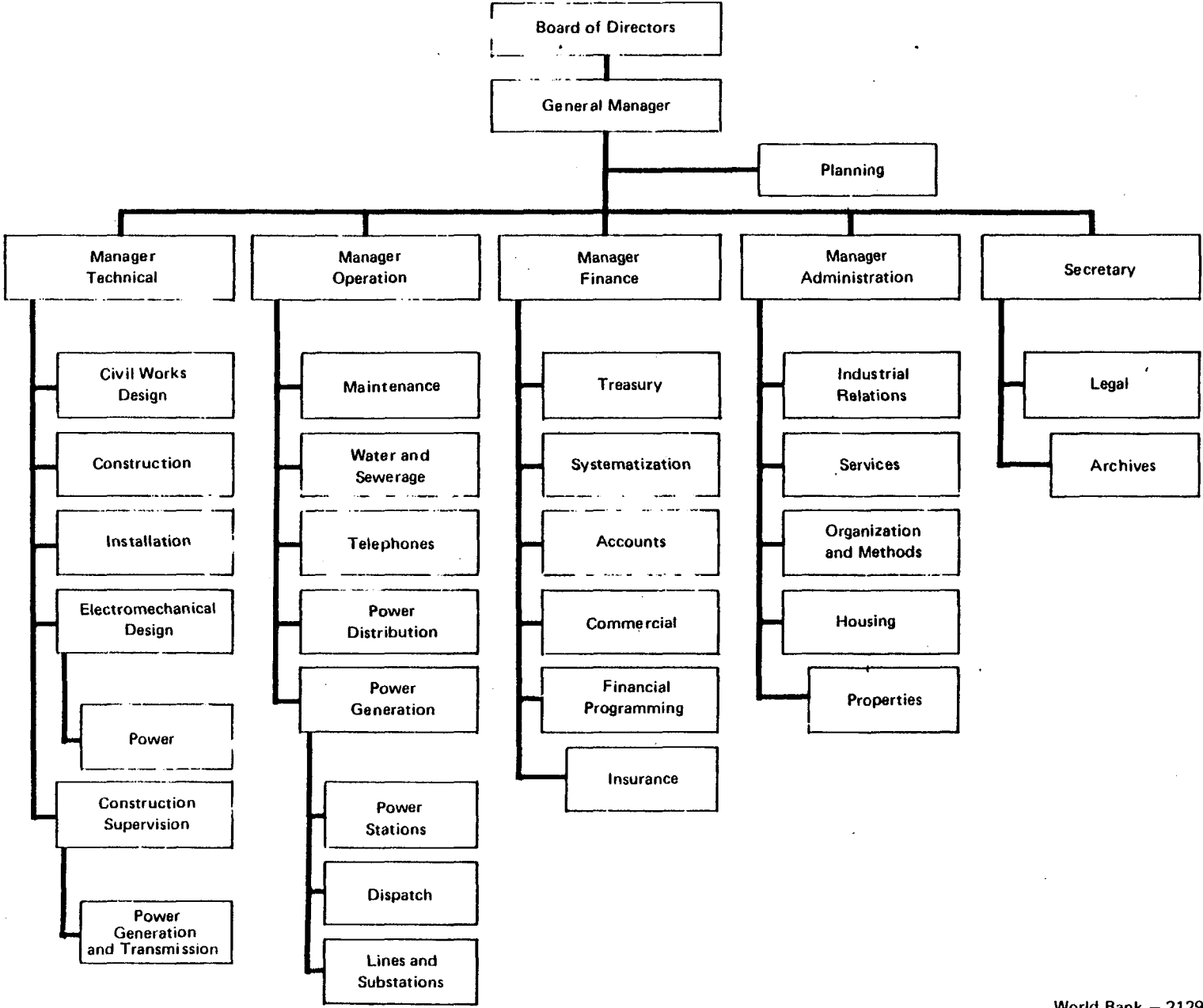
1/ Plant types: H-Hydro; GT-Gas turbine; S-Steam.

2/ Excludes several diversion works for increasing generation.

3/ Feasibility study completed.

May 2, 1980

COLOMBIA
EMPRESAS PUBLICAS DE MEDELLIN (EPM)
Organization Chart



COLOMBIA
EMPRESAS PÚBLICAS DE MEDELLIN
GUADALUPE IV HYDRO POWER PROJECT
Consumption and Supply Data 1975-1986

ENERGY BALANCE (GWh)	-----Historic-----				-----Forecast-----							
	1975	1976	1977 ^{1/}	1978	1979	1980	1981	1982	1983	1984	1985	1986
Sales												
Residential	1,139	1,214	1,157	1,346	1,460	1,567	1,684	1,808	1,942	2,086	2,241	2,406
Commercial	187	198	196	225	265	290	319	350	385	423	464	511
Industrial	710	818	803	893	1,046	1,143	1,250	1,368	1,497	1,638	1,792	1,962
Block	245	290	315	426	417	455	503	561	621	693	772	853
Government	42	51	48	53	57	60	63	66	70	73	77	79
EPM	28	30	31	32	73	32	34	36	38	40	42	44
Others	68	59	59	60	68	126	139	149	160	167	173	185
Total Sales	2,420	2,660	2,609	3,035	3,386	3,673	3,992	4,338	4,713	5,120	5,561	6,040
Losses, station use	527	582	587	604	653	696	734	774	817	868	910	960
Total EPM energy requirements	2,947	3,242	3,196	3,639	4,039	4,369	4,726	5,112	5,530	5,988	6,471	7,000
Energy Supply												
Guadalupe I	39	30	8	10	9	9	9	9	9	9	9	9
Guadalupe II	64	71	70	45	70	70	70	70	70	18	-	-
Guadalupe III	864	1,107	1,080	1,208	1,447	1,447	1,447	1,810	1,810	1,810	1,810	1,810
Troneras	126	151	135	162	218	218	218	273	273	273	273	273
Riogrande	480	502	426	486	475	475	475	475	475	475	475	475
Guatapé	1,747	1,735	1,621	1,271	1,875	2,672	2,672	2,672	2,672	2,672	2,672	2,672
Piedras Blancas	13	32	39	3	35	35	35	35	35	35	35	35
Ayurá	-	-	-	-	-	-	-	102	123	123	123	123
Guadalupe IV	-	-	-	-	-	-	-	-	-	539	1,077	1,077
Playas	-	-	-	-	-	-	-	-	-	-	-	1,422
Total EPM	3,333	3,628	3,379	3,185	4,129	4,926	4,926	5,446	5,467	5,954	6,474	7,896
Import (Export) ISA (A)	(386)	(386)	(183)	454	(90)	(557)	(200)	(334)	63	34	(3)	(896)
Total System	2,947	3,242	3,196	3,639	4,039^{2/}	4,369	4,726	5,112	5,530	5,988	6,471	7,000
Rights in ISA (B)	-	-	243	485	565	565	580	989	1,717	2,036	2,036	2,036
Net surplus (B) - (A) for sale in interconnected system	-	-	426	31	655	1,122	780	1,323	1,654	2,002	2,039	2,932
Maximum Demand EPM (MW)	609	607	671	700	776	841	915	984	1,064	1,150	1,244	1,345
Load Factor (%)	55	61	54	59	59	59	59	59	59	59	59	59
CAPACITY BALANCE (MW)												
Available Capacity												
Guadalupe I	22				22	22						
Guadalupe II	10				10	10						
Guadalupe III	270				270	270						
Troneras	36	699	699	699	36	36	979	979	979	969	969	969
Riogrande	75				75	75						
Guatapé	280				420	560						
Piedras Blancas	6				6	6						
Ayurá	-	-	-	-	-	-	-	19	19	19	19	19
Guadalupe IV	-	-	-	-	-	-	-	-	-	213	213	213
Playas	-	-	-	-	-	-	-	-	-	-	-	240
Total EPM	699	699	699	699	839	979	979	998	998	1,201	1,201	1,441
Rights in ISA:												
Chivor I	-	-	80	80	80	80	80	80	80	80	80	80
Chivor II	-	-	-	-	-	-	50	50	50	50	50	50
San Carlos I	-	-	-	-	-	-	-	137	137	137	137	137
San Carlos II and Jaguas	-	-	-	-	-	-	-	-	175	175	175	175
Subtotal	-	-	80	80	80	80	130	267	442	442	442	442
Total available capacity	699	699	779	779	919	1,059	1,109	1,265	1,440	1,643	1,643	1,883
Plant margin (net surplus over maximum EPM demand available for interconnected system) = Available capacity less maximum demand	90	92	73	(1)	143	218	194	281	376	493	399	538
Plant margin, % of available capacity	13	13	9	0	16	21	17	22	26	30	24	29

^{1/} Dry year with curtailments

^{2/} For preliminary final figures see Annex 5.7

May 7, 1980.

COLOMBIA

EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

1979-1986 Investment Program Cost Estimate
(Millions of current Col\$)

Local Cost	1979	1980	1981	1982	1983	1984	1985	1986	Total
Generation									
Guatape II	424	8	-	-	-	-	-	-	432
Ayura	1	39	95	9	-	-	-	-	144
River diversions	39	683	613	-	-	-	-	-	1,335
Guadalupe IV	15	164	696	837	1,069	390	-	-	3,171
Playas	22	71	559	693	1,593	2,492	2,776	1,541	9,747
Subtotal	501	965	1,963	1,539	2,662	2,882	2,776	1,541	14,829
Transmission									
Lines	-	11	31	108	190	77	5	6	428
Substations	15	82	100	121	126	73	23	15	555
Control center	-	4	8	13	43	28	-	-	96
Subtotal	15	97	139	242	359	178	28	21	1,079
Distribution									
Network	-	52	246	147	110	82	108	108	853
Special equipment	-	-	-	-	-	-	-	-	-
Subtotal	-	52	246	147	110	82	108	108	853
General Plant	497	36	43	59	53	138	76	67	982
Training	-	-	5	6	6	7	-	-	24
Studies	21	135	109	90	111	52	-	-	518
Investments in Electrificadora	49	25	-	-	-	-	-	-	74
Total local cost	1,083	1,310	2,505	2,074	3,303	3,339	2,988	1,757	18,359 (MUS\$305.1)
Foreign Cost									
Generation									
Guatape II	244	94	-	-	-	-	-	-	338
Ayura	-	31	221	-	-	-	-	-	252
River diversion	-	-	-	-	-	-	-	-	-
Guadalupe IV	-	163	787	2,285	1,569	596	254	-	5,654
Playas	1	18	143	478	1,012	4,362	4,986	2,248	13,248
Subtotal	245	306	1,151	2,763	2,581	4,958	5,240	2,248	19,492
Transmission									
Lines	-	58	21	288	438	41	10	-	856
Substations	19	250	634	350	636	240	22	221	2,372
Control center	-	5	8	113	528	79	-	-	733
Subtotal	19	313	663	751	1,602	360	32	221	3,961
Distribution									
Network	-	71	124	610	193	98	167	111	1,374
Special equipment	-	-	21	52	20	-	-	-	93
Subtotal	-	71	145	662	213	98	167	111	1,467
General Plant	-	-	-	-	-	-	-	-	-
Training	-	-	12	16	19	21	-	-	68
Studies	-	16	6	6	5	1	-	-	34
Investments in Electrificadora	-	-	-	-	-	-	-	-	-
Total foreign cost	264	706	1,977	4,198	4,420	5,438	5,439	2,580	25,022 (MUS\$391.4)
Total Cost									
Generation	746	1,271	3,114	4,302	5,243	7,840	8,016	3,789	34,321
Transmission	34	410	802	993	1,961	538	60	242	5,040
Distribution	-	123	391	809	323	180	275	219	2,320
General Plant	497	36	43	50	55	138	76	87	982
Training	-	-	17	22	25	28	-	-	92
Studies	21	151	115	96	116	53	-	-	552
Investments in Electrificadora	49	25	-	-	-	-	-	-	74
Total MCol\$	1,347	2,016	4,482	6,272	7,723	8,777	8,427	4,337	43,381
Rate of Exchange	42.06	45.42	49.96	55.96	62.68	68.32	74.47	81.17	
Total MUS\$	32.0	44.4	89.7	112.1	123.2	128.5	113.2	53.4	696.5

COLOMBIA
EMPRESAS PUBLICAS DE MEDELLIN
GUADALUPE IV HYDRO POWER PROJECT
Project Cost Estimate 1/

	Local Cost	Foreign Cost	Total Cost	Local Cost	Foreign Cost	Total Cost
	-----	MCd\$-----	-----	-----	MUS\$-----	-----
<u>Guadalupe IV Hydro Station</u>						
Infrastructure	106	59	165	2.6	1.4	4.0
Civil works	934	1,029	1,963	22.8	25.1	47.9
Equipment	123	1,301	1,424	3.0	31.8	34.8
Subtotal	1,163	2,389	3,552	28.4	58.3	86.7
<u>Transmission Lines</u>						
44 kV (10 km)	3	8	11	0.1	0.2	0.3
110 kV (45 km)	21	46	67	0.5	1.1	1.6
230 kV (93 km)	103	261	364	2.4	6.2	8.6
Subtotal	127	315	442	3.0	7.5	10.5
<u>Substations</u>						
Rio Negro, expansion, 230/110 kV	13	42	55	0.3	1.0	1.3
Barbosa, expansion, 230/110 kV	22	136	158	0.6	3.2	3.8
Bello, expansion, 110/44/13.2 kV	5	36	41	0.1	0.9	1.0
Colombia, expansion, 110/44/13.2 kV	6	46	52	0.1	1.1	1.2
Cerromatoso, expansion, 110 kV	5	54	59	0.3	1.3	1.6
Las Vegas, new, 110/44/13.2 kV	13	54	67	0.3	1.3	1.6
Villa Hermosa, new, 110/44/13.2 kV	14	8	22	0.1	0.2	0.3
Caucasia, new, 110/44/13.2 kV	6	28	34	0.2	0.6	0.8
Puerto Nare, new, 110/44/13.2 kV	5	19	24	0.1	0.5	0.6
Subtotal	89	423	512	2.1	10.1	12.2
<u>Control Center</u>						
Building modifications	4	-	4	0.1	-	0.1
Equipment	8	234	242	0.2	5.6	5.8
Erection	2	12	14	-	0.3	0.3
Subtotal	14	246	260	0.3	5.9	6.2
<u>Distribution 1982-1984</u>						
Cable ring Medellin Center	19	296	315	0.4	7.0	7.4
Underground cable network 13.2 kV	40	66	106	1.0	1.6	2.6
Overhead network 13.2 kV	15	10	25	0.3	0.3	0.6
Overhead network 44 kV	9	6	15	0.2	0.1	0.3
LT network	16	18	34	0.4	0.4	0.8
Transformers	1	23	24	0.1	0.5	0.6
Special connections	1	1	2	-	0.1	0.1
Subtotal	101	420	521	2.4	10.0	12.4
<u>Various Equipment</u>						
Special metering	-	12	12	-	0.3	0.3
Erection, maintenance equipment	-	32	32	-	0.8	0.8
Subtotal	-	44	44	-	1.1	1.1
<u>Training</u>						
	12	34	46	0.3	0.8	1.1
Total Base Cost (1978)	1,506	3,871	5,377	36.5	93.7	130.2
<u>Engineering, Administration</u>						
Guadalupe IV	260	44	304	6.3	1.1	7.4
Transmission lines, study	29	8	37	0.7	0.2	0.9
Substations	7	-	7	0.2	-	0.2
Control Center	24	33	57	0.6	0.8	1.4
Distribution	41	-	41	1.0	-	1.0
Subtotal	361	85	446	8.8	2.1	10.9
<u>Physical Contingencies</u>						
	279	509	788	6.8	12.1	18.9
<u>Price Contingencies</u>						
	2,067	4,696	6,763	21.0	47.3	68.3
<u>TOTAL PROYECT COST</u>						
	4,213	9,161	13,374	73.1	155.2	228.3

1/ Discrepancies are due to roundings.

COLOMBIAEMPRESAS PUBLICAS DE MEDELLINGUADALUPE IV HYDRO POWER PROJECTProject Implementation ScheduleKey Dates

<u>Item</u>	<u>Issue Bids</u>	<u>Contract Award</u>	<u>Start Construction or Contract</u>	<u>Complete Construction or Contract</u>
<u>Guadalupe IV</u>				
Access roads	12/79	5/80	6/80	1/81
Civil works	7/80	2/81	3/81	10/84
Turbines	9/80	5/81	5/81	10/83
Generators	9/80	5/81	5/81	10/83
Penstocks	7/80	2/81	2/81	10/83
<u>Transmission Lines</u>				
Group I	12/80	3/81	4/81	2/82
Group II	10/81	1/82	2/82	12/82
Group III	11/82	2/83	3/83	1/84
<u>Substations</u>				
Group I	8/80	4/81	5/81	11/82
Group II	6/81	2/82	3/82	8/82
Group III	8/82	6/83	7/83	12/84
Control Center	9/81	4/82	5/82	4/84
<u>Distribution Equipment</u>				
Group I	2/82	7/82	8/82	12/82
Group II	2/84	7/84	8/84	12/84
Group III	10/80	6/81	7/81	12/82
Group IV	5/80	11/80	12/80	5/82
Group V	4/82	11/82	13/82	7/83
<u>Distribution Transformers</u>				
Group I	2/82	7/82	8/82	12/82
Group II	2/84	7/84	8/84	12/84
<u>Services</u>				
Transmission study	7/80	12/80	1/81	6/81
Control center	3/80	6/80	7/80	12/84
Training	-	-	1/81	12/84

NOTE

Transmission Lines

Group I	Ayurá-Ancón Sur Sub Central - (Castilla-Guayabal) San Diego (Miraflores-Guayabal) Girardota (Barbosa-Central)	Group II	Miraflores - Ancón Sur Cerromatoso-Caucasia Rionegro-(Guatapé-Envigado) Guadalupe IV - Barbosa Rionegro 220-Rionegro 110 kV
Group III	Barbosa (Miraflores-Guatapé) Barbosa (Línea No. 5 Guadalupe) Las Vegas (Guayabal-Envigado) Pto. Inmarco-Pto. Nare Villa Hermosa - (Piedras Blancas-Miraflores)		

Substations

Group I Rionegro 220 kV, Rionegro 110 kV, Cerromatoso, Caucasia, 110/44, 44/13.2 kV.

Group II Barbosa, Las Vegas I, Bello II, Colombia II, Puerto Nare.

Group III Villa Hermosa I.

Distribution Equipment

Group I Equipment for 1982, 1983 for 44 kV, 13.2 kV and secondary networks.

Group II Ditto for 1984 and 1985 for 44 kV, 12.3 kV and secondary networks.

Group III Underground cables.

Group IV Transformers and equipment for underground network.

Group V Other materials for outgoing cables in substations.

May 2, 1980

COLOMBIA

EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

Loan Disbursement Schedule
(MUS\$)

Assumptions

Loan signing: July 1980
Effective Date: October 1980
Closing Date: June 1985

<u>IBRD Fiscal Year and Semester</u>	<u>Disbursements During Semester</u>	<u>Cumulative Disbursements End of Semester</u>
<u>FY81</u>		
December 31, 1980	0.7	0.7
June 30, 1981	7.0	7.7
<u>FY82</u>		
December 31, 1981	10.3	18.0
June 30, 1982	20.0	38.0
<u>FY83</u>		
December 31, 1982	23.5	61.5
June 30, 1983	25.0	86.5
<u>FY84</u>		
December 31, 1983	25.5	112.0
June 30, 1984	6.0	118.0
<u>FY85</u>		
December 31, 1984	6.0	124.0
June 30, 1985	1.0	125.0

January 17, 1980

COLOMBIA

EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

Contents of Project File

1. Guadalupe, Troneras, Ayurá Project Reports
 - (a) Generación eléctrica adicional en Guadalupe, Troneras Ayurá; Consultores Técnicos Ltda., Noviembre 1976
 - (b) Solicitud de crédito para el proyecto Guadalupe, Troneras, Ayurá, EPM, Mayo 1977
 - (c) Costo de ampliaciones de subestaciones para el Valle de Aburrá 1977-1982, EPM, Mayo 1977
2. Sistema de Generación (Actual, Proyectos), Junio 1977
3. Distribution Planning Study, Westinghouse, June 1979
4. Guadalupe IV, Factibilidad/Evaluación, June/Sept. 1979
 - (a) Factibilidad, Consultores Técnicos Ltda., y Mejia y Millan Ltd., Junio de 1979
 - (b) Report on technical evaluation, Douglas R. Piteau
September 28, 1979
5. Guadalupe IV, Ambiente, Geología, Generación en el sistema August/Febr/Dec. 1979
 - (a) Declaración del efecto ambiental del proyecto, EPM 22-79
Agosto de 1979
 - (b) Estudio geológico, informe preliminar, Geominas Ltd., Febrero de 1979.
 - (c) Generación, información adicional, Diciembre 1979

6. Guadalupe IV, Información General, Nov./Dec. 1979
 - (a) Generalidades, EPM No. 35-79, Noviembre 1979
 - (b) Información general adicional, EPM No. 47-79, Diciembre 1979
7. Guadalupe IV, Planeación Transmisión 1978/79
 - (a) Plan decenal de transmisión, EPM No. 30-78, Septiembre 1978
 - (b) Plan de expansión de transmisión, EPM No. 37-79, Noviembre 1979
 - (c) Transmisión, información adicional, EPM No. 45-79, Diciembre 1979
8. Guadalupe IV, Planeación Distribución, 1975-79
 - (a) Población futura para el Valle de Aburrá, EPM Julio 1975
 - (b) Estudio de demanda de energía para el Valle de Aburrá 1976-86, ampliaciones de subestaciones, EPM No. 3-7 (A), Marzo 1977
 - (c) Plan de expansión de distribución, EPM No. 38-79, Noviembre 1979
 - (d) Distribución - Información adicional, EPM No. 46-79, Diciembre 1979
9. Guadalupe IV, Electrificación Rural, EPM No. 39-79, Noviembre 1979
10. Guadalupe IV, Plan de ejecución del Programa Guadalupe IV
EPM No. 40-79, Noviembre 1979
11. Metas físicas de la empresa de energía 1980-1989.
EPM No. 32-79, Noviembre 1979
12. Estudio del planeamiento y la operación del sistema eléctrico,
EPM Agosto 1976
13. Disposición para la prestación de los servicios EPM, Noviembre 1974
14. Normas de construcción y operación energía primarias, secundarias
y alumbrado público (no date)
15. Pronósticos de los estados financieros
16. - 18. Working Papers Volumes 1-3.

March 28, 1980

COLOMBIA

EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

Actual (FY77-FY78) and Provisional (FY79)

Historic Financial Statements
(Million of current Col\$)

For Fiscal Year Ending December 31	Power			Telephone			Water and Sewerage			Consolidated EPM		
	1977	1978	1979 ^{1/}	1977	1978	1979 ^{2/}	1977	1978	1979 ^{1/}	1977	1978	1979 ^{1/}
Income Statements												
Operating revenues	1,508.4	1,787.1	2,736.2	429.4	504.1	589.5	488.0	615.8	843.6	2,425.8	2,907.0	4,169.3
Operating expenses ^{2/}	866.9	1,353.0	1,822.8	259.8	363.5	436.3	299.5	415.2	560.8	1,426.2	2,131.7	2,819.9
Operating income	641.5	434.1	913.4	169.6	140.6	153.2	188.5	200.6	282.8	999.6	775.3	2,369.4
Other income (net)	103.4	238.8	284.7	(21.1)	(18.0)	26.7	5.1	23.1	(58.3)	87.4	243.8	253.1
Net income after interest	744.9	672.9	1,198.1	148.5	122.6	179.9	193.6	223.7	224.5	1,087.0	1,019.1	2,622.5
Balance Sheets												
Assets												
Total net fixed assets ^{3/}	7,081.5	8,886.4	10,149.4	1,267.9	1,318.4	1,606.4	1,549.7	1,975.4	2,564.3	9,899.1	12,180.2	14,320.1
Current assets	1,095.7	1,253.4	1,185.2	221.1	510.3	601.5	213.2	386.2	390.7	1,530.0	2,149.9	2,177.4
Other assets	1,105.8	1,684.8	2,392.5	2.1	3.0	3.0	38.6	53.3	263.6	1,146.5	1,741.1	2,659.9
Total Assets	9,283.0	11,824.6	13,727.1	1,491.1	1,831.7	2,210.9	1,801.5	2,414.9	3,218.6	12,575.6	16,071.2	19,156.6
Liabilities												
Equity	3,272.9	3,979.4	4,883.6	621.2	753.7	933.6	714.5	1,087.9	1,574.1	4,608.5	5,821.0	7,391.3
Long-term debt	5,022.0	6,620.9	6,846.5	273.5	268.0	300.0	732.6	874.9	1,103.0	6,028.1	7,763.8	8,249.5
Current liabilities ^{4/}	657.3	732.2	1,335.4	247.4	321.3	354.4	177.5	207.6	256.1	1,082.2	1,261.1	1,945.9
Other liabilities	330.8	492.1	661.6	349.0	488.7	622.9	176.9	244.5	285.4	856.7	1,225.3	1,569.9
Total Liabilities	9,283.0	11,824.6	13,727.1	1,491.1	1,831.7	2,210.9	1,801.5	2,414.9	3,218.6	12,575.6	16,071.2	19,156.6
Funds Flow Statements												
Sources of Funds												
Net income before interest	975.8	1,084.8	1,668.7	191.4	166.3	217.0	235.6	269.1	282.8	1,402.8	1,520.2	2,168.5
Depreciation ^{2/}	146.2	166.4	275.6	78.8	110.5	118.1	52.1	74.1	91.2	277.1	351.0	484.9
Other	69.4	117.8	276.8	28.0	42.6	51.5	38.8	57.4	109.8	136.2	217.8	388.1
Gross Internal Cash Generation	1,191.4	1,369.0	2,171.1	298.2	319.4	386.6	326.5	400.6	483.8	1,816.1	2,089.0	3,041.5
Borrowings	980.0	1,923.9	556.4	36.9	131.2	182.3	247.8	206.7	254.6	1,264.7	2,261.8	993.3
Other	12.7	79.8	-	78.5	103.5	82.7	11.7	159.9	-	102.9	343.2	82.7
Total Sources	2,184.1	3,372.7	2,727.5	413.6	554.1	651.6	586.0	767.2	738.4	3,183.7	4,694.0	4,117.5
Applications of Funds												
Construction expenditures	1,404.7	1,971.3	1,472.8	89.9	160.9	381.9	342.2	499.8	602.4	1,836.8	2,632.0	2,457.1
Debt service:												
Amortization	153.7	325.0	517.5	119.7	115.4	137.7	110.9	64.5	104.1	384.3	504.9	759.3
Interest	230.9	411.9	470.6	42.9	43.8	37.1	42.0	45.4	58.3	315.8	501.1	566.0
Total Debt Service	384.6	736.9	988.1	162.6	159.2	174.8	152.9	109.9	162.4	700.1	1,006.0	1,325.3
Increase in working capital	194.8	82.8	477.6	161.2	232.9	94.9	88.4	138.0	(26.4)	444.4	453.7	(409.1)
Other	200.0	581.7	744.2	(0.1)	1.1	-	2.5	19.5	-	202.4	602.3	744.2
Total Applications	2,184.1	3,372.7	2,727.5	413.6	554.1	651.6	586.0	767.2	738.4	2,283.7	4,694.0	4,117.5
Ratio Analysis												
Operating Ratio	57	76	67	61	72	74	61	67	66	59	73	68
Current Ratio ^{4/}	1.7	1.7	0.9	0.9	1.6	1.7	1.2	1.9	1.5	1.4	1.7	1.1
Debt/Equity Ratio ^{5/}	61/39	62/38	54/46	31/69	26/74	24/76	51/49	45/55	41/59	57/43	1.4/3	52/48
Debt Service Coverage	3.1	1.8	2.3	1.8	2.0	2.2	2.1	3.6	3.0	2.6	2.1	2.3

^{1/} Based on EPM's estimates, November-December 1979.

^{2/} Includes interest charged to operations.

^{3/} Revalued per Decree 444/67.

^{4/} Includes the current portion of term debt.

^{5/} Without taking account of full revaluation of fixed assets.

May 9, 1980

COLOMBIA

EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

Summary of Projected Financial Performance 1980-1984 1/

of Telephone and Water/Sewerage Departments
(Million of current Col\$)

Fiscal Year Ending Dec. 31	1980	1981	1982	1983	1984
<u>Telephone Department</u>					
Operating Revenues	913	1.264	1.621	2.114	2.649
Operating Expenses	538	650	889	1.157	1.482
Operating Income	375	614	732	957	1.167
Operating Ratio (%)	59	51	55	55	56
Current Ratio (%) <u>2/</u>	1.1	1.0	1.2	0.8	1.1
Debt Service Coverage (times)	3.1	4.3	3.3	4.0	2.1
<u>Water and Sewerage Department</u>					
Operating Revenues	1.138.1	1.393.4	1.779.2	2.200.2	2.588.4
Operating Expenses	696.6	844.1	1.057.0	1.303.4	1.548.8
Operating Income	441.5	549.3	722.2	896.8	1.039.6
Operating Ratio (%)	61	61	59	59	60
Current Ratio (%)	1.3	1.0	1.4	0.9	0.8
Debt Service Coverage (times)	4.3	4.4	4.3	5.0	3.2

1/ Based on separate projections prepared by EPM on November /December 1979.

2/ Including the current portion of long-term debt.

April 10, 1980

COLOMBIA

EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

Schedule of existing and proposed debt

LONG-TERM LOANS	Loan Date	Currency	Loan Amount (millions of currency)	Grace period years-months	Amort. Period ^{1/} years-months	Interest rate %	Commitment Fees %	Outstanding 12/31/1978 MCol\$	OBSERVATIONS
Foreign Existing									
IBRD - 225	1959	US\$	12.00	3 9	22	6.0		389.2	^{1/} Excluding grace period.
IBRD - 282	1961	US\$	22.00	4 9	20	5.75		515.7	^{2/} Interest rate was renegotiated in July 1979 at 5/8 over Libor.
IBRD - 369	1964	US\$	45.00	5	30	5.5		1,826.6	
Brown Boveri	1973	US\$	3.89	4 3	10	7.0		135.7	^{3/} Consist of 48 different loans from the Government, financial institution and commercial banks.
IBRD - 874	1973	US\$	56.00	5 3	20	7.25	1/4	2,208.9	
KFW	1974	DM	8.74	4 6	9	6.5		197.0	
Banco Popular	1974	US\$	1.35	3	7	7.0		47.4	^{4/} Although grace period would be 4 years, under Bank practice the effective grace period may be up to 6 months longer.
Chase Manhattan Bank	1976	US\$	12.00	2	5	1.75+libor- ^{2/6/}		403.2	
Other (suppliers)								59.5	
								5,783.2	
<u>Local Existing ^{3/}</u>								1,189.2	^{5/} 5/8 for first 2 years. ^{3/4} thereafter.
Guadalupe IV Loans									
Proposed IBRD	1980	US\$	125.0	4 ^{4/} 6	12	6	8 1/4	3/4	
Bank of America	1980	US\$	25.6	5	5		libor + ^{5/6/}	3/4 & 1/4	
Suppliers	1980	US\$	20.4	4 6	7	6	8.5	-	
Fonade (Studies):									
Guadalupe IV study	1979	Col\$	35.4	2 6	4	6	18	1.5	
Centro de Control	1981	Col\$	35.6	1 6	3	6	24	1.5	
Centro de Control	1983	Col\$	54.2	1 6	3	6	24	1.5	
Future Loans									
Ayura and River Diversions									
Bank of America	1980	US\$	6.4	5	5		libor + ^{5/6/}	3/4 & 1/4	
Playas									
International Institutions	1982	US\$	139.9	4 6	15	6	8.0	1 1/4	
Suppliers	1983	US\$	39.6	4 6	7	6	8.5	-	
Fonade (Studies)	1980-81	Col\$	17.3	2 6	4	6	18	1.5	
Fonade (Future Studies)	1980-83	Col\$	469.1	1 6	3	6	24	1.5	
OTHER LOANS									
Local Banks	1979	Col\$	17.1	5		Balloon	20	-	
Municipal valuation	1979	Col\$	2.7	-		6	12	-	
Government	1979	Col\$	150.0		8	8	16	-	
Municipal Palace Purchase	1979	Col\$	175.8	-		5	24	-	
Debt refinancing (1980) ^{7/}	1980	Col\$	210.0	2		Balloon	24	-	
Debt refinancing (1981) ^{7/}	1981	Col\$	600.0	2		Balloon	24	-	

COLOMBIA
EMPRESAS PUBLICAS DE MEDELLIN
GUADALUPE IV HYDRO POWER PROJECT

Actual and Forecast Income Statements 1976 - 1986
(Millions of current Col\$)

Years ending December 31	ACTUAL			ESTIMATE	FORECAST						
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Energy sales -own system (GWh) <u>a/</u>	-	2,626.8	3,034.9	3,385.6	3,673.4	3,992.1	4,337.9	4,712.9	5,119.9	5,561.1	6,039.7
Average tariff (Col\$/KWh) <u>b/</u>	-	54.7774	65.3332	81.9665	103.07	141.72	190.54	227.8	230.20	253.22	278.54
Average tariff (US\$/KWh)	-	1.48	1.65	1.95	2.28	2.84	3.40	3.63	3.37	3.40	3.43
Total energy sales -own system (MCol\$)	1,120.1	1,438.9	1,982.8	2,775.1	3,786.2	5,657.6	8,265.4	10,736.0	11,786.1	14,081.9	16,823.1
Net Sales (Purchases) to (from) ISA (GWh) <u>a/</u>	422.90	172.0	(472.9)	(218.0)	557.0	199.5	334.5	(63.5)	(31.0)	2.0	716.0
Average Tariff -ISA system (Col\$/KWh) <u>e/</u>	19.0	31.3	42.3	20.0	55.0	69.0	110.0	127.0	166.0	177.0	204.0
Net Sales (Purchases) to (from) ISA (MCol\$)	80.0	53.9	(200.1)	(44.0)	306.4	137.7	368.0	(80.6)	(51.5)	3.5	1,460.6
OPERATING REVENUE											
Energy sales	1,200.1	1,492.8	1,782.7	2,731.1	4,092.6	5,795.3	8,633.4	10,655.4	11,734.6	14,085.4	18,283.7
Other income	10.8	15.6	4.4	5.1	5.8	6.7	7.7	8.8	10.2	11.7	13.5
Total Operating Revenue	1,210.9	1,508.4	1,787.1	2,736.2	4,098.4	5,802.7	8,641.1	10,664.2	11,744.8	14,097.1	18,297.2
OPERATING COSTS											
Generation <u>d/</u>	65.0	79.0	101.6	129.8	156.4	182.9	210.5	246.6	283.7	395.0	454.6
Transmission <u>e/</u>	23.8	25.3	30.8	38.4	46.7	54.0	63.2	73.6	89.4	115.2	132.9
Distribution <u>f/</u>	36.7	48.9	90.0	113.6	148.7	187.8	231.8	285.3	354.8	439.4	530.0
General Plant-Operation <u>g/</u>	27.2	49.6	54.8	123.7	166.7	198.2	231.5	270.6	316.3	369.7	432.3
General Plant-Administration <u>h/</u>	114.7	187.9	299.4	439.1	531.3	648.3	788.3	976.4	1,193.5	1,433.8	1,722.9
National Grid Charges (ISA) <u>i/</u>	50.0	35.4	112.8	109.2	130.4	141.4	158.9	183.8	199.0	206.0	229.0
Depreciation <u>j/</u>	289.5	311.7	370.2	569.6	1,039.6	1,299.9	1,574.0	1,916.2	2,339.0	3,341.2	4,034.1
Amortization (studies and training) <u>k/</u>	-	-	-	-	6.7	13.0	46.8	80.2	96.5	158.8	152.4
Municipal Contribution <u>l/</u>	49.6	63.7	85.3	122.8	167.5	250.3	365.7	475.0	521.5	623.1	744.4
Total Operating Costs	656.5	801.5	1,144.9	1,646.2	2,394.0	2,975.8	3,670.7	4,507.7	5,393.7	7,082.2	8,432.6
Operating Income	554.4	706.9	642.2	1,090.0	1,704.4	2,826.9	4,970.4	6,156.5	6,351.1	7,014.9	9,864.6
Other income <u>m/</u>	53.6	112.4	251.2	298.0	280.1	172.6	205.7	228.1	317.1	342.2	481.5
Other expenses	5.8	9.0	12.4	13.3	12.4	11.4	14.6	14.0	13.9	15.0	21.1
Net income before interest	602.2	810.3	881.0	1,374.7	1,972.1	2,988.1	5,161.5	6,370.6	6,654.1	7,342.1	10,325.0
Total interest	321.0	317.8	589.7	645.6	778.6	1,059.6	1,389.5	1,659.8	1,985.1	2,403.1	2,664.3
Less: Interest during construction	81.9	86.9	177.8	175.0	70.4	250.5	502.4	808.8	1,074.3	830.3	1,108.0
Interest charged to income	239.1	230.9	411.9	470.6	708.2	803.1	887.1	851.0	910.8	1,572.8	1,556.3
Net income after interest <u>n/</u>	363.1	579.4	469.1	904.1	1,263.9	2,185.0	4,274.4	5,519.6	5,743.5	5,769.3	8,768.7

OBSERVATIONS

- a/ See Annex 3.1 for basis of the forecast.
b/ See para.5.18 for proposed plan of rate increases.
c/ Based on ISA's forecast average exchange energy rate.
d/ Based on the 1978 unit cost of Col\$105/installed kW, escalated according to local inflation.
e/ Similar to d/, the forecast was based on the 1978 unit cost of Col\$29/installed km of lines.
f/ Similar to e/ and d/; based on a unit cost of Col\$31/km
g/ As from 1980 includes a yearly insurance premium of MCol\$50 plus a self insurance cost of MCol\$15. The total was escalated according to local inflation plus 3 additional percentage points to account for real growth.
h/ Includes projected actuary costs, reserve for bad debts and other costs. The latter projected similarly as for g/.
i/ Data were supplied by ISA.
j/ Straight line depreciation is used by EPM according to the following rates: Roads and Dam's civil works) 2.0%; Buildings and Transmission lines 3.36%; Distribution networks 3.03%; Substations and Transformers 4.08%; Tools and Office Equipment 14.28%; General equipment and vehicles 20%; Generating plant and Dam equipment 4.08%.
k/ After completion, non-capitalized studies are amortized in 5 years. After Training programs are completed their costs are also amortized in 5 years.
l/ As required by EPM's statutes it is computed at 4.425% of total energy sales of EPM in its own system. EPM is otherwise tax exempt.
m/ Includes interest from short and medium term investments of the various reserves and short term cash surplus, plus income derived from sales of timber from EPM's forestation/deforestation operations. The drop in 1981 reflects the use of MCol\$200 from these reserves to finance cash shortfalls in 1980.
n/ By its statutes EPM is not required to pay dividends, thus, it retains all its profits.

May 9, 1980.

COLOMBIA

EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

Sources and Applications of Funds 1979 - 1986

(Millions of current Col\$)

	Estimated 1979	1980	1981	1982	1983	1984	1985	1986	OBSERVATIONS
SOURCES									
<u>Internal Cash Generation:</u>									
Operating income	1,374.7	1,372.1	2,988.1	5,161.5	6,370.6	6,654.3	7,342.1	10,325.0	a/ Net addition to reserves for pension and severance liabilities, and self insurance fund.
Depreciation	569.6	1,039.6	1,299.9	1,574.0	1,916.2	2,339.0	3,341.2	4,034.1	b/ See details of debt terms, conditions and service. Annexes 5.3, 5.8 through 5.10.
Amortization (Studies and Training)	-	6.7	13.0	46.8	80.2	96.5	158.8	152.4	c/ As calculated in ISA's investment program.
Increase in reserve accounts. a/	226.8	234.6	223.5	264.6	328.0	405.2	498.5	612.5	d/ See forecast loans disbursement in Annex 5.8.
Gross Internal Cash Generation	2,171.1	3,253.0	4,524.5	7,046.9	8,695.0	9,495.0	11,340.6	15,124.0	e/ See construction program 1979-1986 in Annex 4.1.
<u>Debt Service</u>									
Amortization b/	517.5	545.3	638.3	1,253.3	1,892.5	1,269.7	2,114.8	2,469.7	f/ Includes: (i) investment in the self insurance reserve; (ii) until 1979, funds to cover balloon payments of debts due in 1983. The negative value in 1980 reflects the use of MCol\$200 million from this reserve to finance cash shortfalls in 1980; (iii) investments in Electricadora de Antioquia.
Interests	470.6	708.2	803.1	887.1	851.0	910.8	1,572.8	1,556.3	g/ Defined as the sum of current assets (other than cash surplus not required by normal operations) less current liabilities exclusive of the current portion of term debt. See relevant footnotes in Annex 5.6.
Total Debt Service	988.1	1,253.5	1,441.4	2,140.4	2,743.5	2,180.5	3,687.6	4,026.0	
Equity Contributions to ISA c/	228.4	911.3	815.2	1,163.8	1,103.4	399.6	592.6	1,083.6	
Net Internal Cash Generation	954.6	1,088.2	2,267.9	3,742.7	4,848.1	6,914.9	7,060.4	10,014.4	
<u>Borrowings d/</u>									
Existing	236.8	177.8	-	-	-	-	-	-	
Guadalupe IV::Proposed IBRD	-	31.8	864.3	2,423.1	3,165.3	819.8	74.5	-	
Other	24.0	431.2	736.2	983.5	112.8	193.1	96.8	-	
Playas	-	-	-	485.2	1,084.3	4,323.2	4,818.9	2,070.6	
Other	295.6	122.7	239.8	-	-	-	-	-	
Studies	-	-	139.0	65.2	142.6	48.4	-	-	
Refinancing 1980-1981	-	210.0	600.0	-	-	-	-	-	
Total Borrowings	556.4	1,064.7	2,579.3	3,957.0	4,505.0	5,384.5	4,990.2	2,070.6	
TOTAL SOURCES	1,511.0	2,152.9	4,847.2	7,699.7	9,353.1	12,299.4	12,050.6	12,085.0	
<u>APPLICATIONS</u>									
<u>Construction Program e/</u>									
Existing	708.0	855.0	929.0	9.0	-	-	-	-	
Guadalupe IV	49.0	860.0	2,693.0	4,946.0	4,947.0	1,732.0	589.0	461.0	
Playas	23.0	89.0	702.0	1,171.0	2,605.0	6,854.0	7,762.0	3,789.0	
General Plant	497.0	36.0	43.0	50.0	55.0	138.0	76.0	87.0	
Studies	20.8	149.7	115.4	95.5	116.2	53.0	-	-	
Other	-	-	-	200.0	200.0	1,800.0	2,000.0	5,950.0	
Sub-Total:	1,297.8	1,989.7	4,482.4	6,471.5	7,923.2	10,577.0	10,427.0	10,287.0	
Interest during construction	175.0	70.4	250.5	502.4	808.8	1,074.3	830.3	1,108.0	
Total construction program	1,472.8	2,060.1	4,732.9	6,973.9	8,732.0	11,651.3	11,257.3	11,395.0	
Other investments f/	193.0	(141.0)	41.6	50.2	61.2	73.7	88.7	107.3	
Sub-Total:	1,665.8	1,919.1	4,774.5	7,024.1	8,793.2	11,725.0	11,346.0	11,502.3	
Increase (Decrease) in Working Capital g/	(477.6)	395.7	231.0	563.4	602.4	385.9	628.6	511.4	
TOTAL APPLICATIONS	1,188.2	2,314.8	5,005.5	7,587.5	9,395.6	12,110.9	11,974.6	12,013.7	
Surplus (Deficit) of funds	322.8	(161.9)	(158.3)	112.2	(42.5)	188.5	76.0	71.3	
Accumulated	322.8	160.9	2.6	114.8	72.3	260.8	336.8	408.1	

May 9, 1980

COLOMBIA
EMPRESAS PUBLICAS DE MEDELLIN
GUADALUPE IV HYDRO POWER PROJECT

Actual and Forecast Balance Sheets 1976 - 1986

Years ending December 31	-----HISTORIC-----			ESTIMATED a/ 1979	-----FORECAST-----						OBSERVATIONS	
	1976	1977	1978		1980	1981	1982	1983	1984	1985		1986
(Millions of current Col\$)												
ASSETS												
Fixed Assets b/												
Gross fixed assets in service	8,044.0	10,476.9	17,814.5	26,030.2	31,518.1	39,006.4	47,440.0	57,609.7	84,460.1	101,568.4	158,474.9	
Accumulated depreciation	1,779.0	2,623.4	3,480.0	5,083.7	7,140.0	9,653.7	12,675.7	16,493.2	21,306.2	27,843.5	36,053.6	
Net fixed assets in service	6,265.0	7,853.5	14,334.5	20,946.5	24,378.1	29,352.7	34,764.3	41,116.5	63,153.9	73,724.9	122,421.3	
Work in progress	3,148.0	5,131.0	1,664.9	170.5	2,033.3	5,245.6	10,840.1	18,678.3	15,738.3	25,807.9	319.1	
Total Fixed Assets	9,413.0	12,934.5	15,999.4	21,117.0	26,411.4	34,598.3	45,604.4	59,794.8	78,892.2	99,532.8	122,740.4	
Investments c/												
ISA	806.5	1,008.5	1,267.7	1,496.1	2,407.4	3,222.6	4,386.4	5,489.8	5,889.4	6,482.0	7,565.6	
Other investments	23.7	18.2	198.6	377.6	217.6	235.2	255.4	278.6	305.3	336.0	371.3	
Accumulated cash surplus d/	-	-	-	322.8	160.9	2.6	114.8	72.3	260.8	336.8	408.1	
Studies	-	-	33.3	54.1	208.1	345.2	423.7	486.4	478.3	319.5	167.1	
Other	45.8	79.1	185.2	141.9	96.9	96.9	96.9	96.9	96.9	96.9	96.9	
Total Investments	876.0	1,105.8	1,684.8	2,392.5	3,090.9	3,902.5	5,277.2	6,424.0	7,030.7	7,571.2	8,609.0	
Current Assets												
Cash and Banks e/	149.3	167.4	11.4	99.2	131.2	173.6	199.8	265.0	275.9	305.7	316.2	
Committed Funds f/	110.6	373.2	680.7	435.7	347.8	459.9	523.8	690.2	703.0	804.7	826.6	
Accounts receivable g/	155.9	274.2	341.8	360.6	786.9	1,114.0	1,659.1	2,047.5	2,250.0	2,701.0	3,506.0	
Inventory h/	155.6	151.6	151.6	197.3	377.0	567.0	867.0	1,267.0	1,877.7	2,210.9	3,352.4	
Other i/	110.5	129.3	67.9	92.4	112.7	134.1	156.9	183.6	214.8	251.3	294.0	
Total Current Assets	681.9	1,095.7	1,253.4	1,185.2	1,755.6	2,448.6	3,406.6	4,453.3	5,321.4	6,273.6	8,295.2	
TOTAL ASSETS	10,970.9	15,186.0	18,937.6	24,694.7	31,257.9	40,949.4	54,288.2	70,672.1	91,244.3	113,377.7	139,644.6	
EQUITY AND LIABILITIES												
Equity												
Capital and accumulated surplus	2,418.3	2,997.7	2,466.8	4,370.9	5,634.8	7,819.8	12,094.2	17,613.8	23,357.3	29,126.6	37,895.3	
Donations j/	498.7	498.7	498.7	512.7	531.7	556.7	591.3	640.5	707.5	796.3	912.7	
Capital revaluation	3,159.6	5,679.5	7,126.9	10,967.6	14,843.4	18,886.7	23,311.6	29,217.2	37,139.9	47,378.5	60,370.2	
Total Equity	6,076.6	9,175.9	11,092.4	15,851.2	21,009.9	27,263.2	35,997.1	47,471.5	61,204.7	77,301.4	99,178.2	
Long-Term Liabilities k/												
Long-term debt	4,321.3	5,360.9	6,972.4	7,391.8	8,451.0	11,228.7	15,209.0	19,395.4	25,414.0	30,717.3	33,101.2	
Pension and other liability reserves	260.3	330.8	492.1	661.6	832.2	1,030.7	1,260.7	1,539.5	1,877.7	2,287.4	2,783.5	
Total Long-term liabilities	4,581.6	5,691.7	7,464.5	8,053.4	9,283.2	12,259.4	16,469.7	20,934.9	27,291.7	33,004.7	35,884.7	
Less: Current Maturities	153.7	325.0	517.5	545.3	638.3	1,253.3	1,892.0	1,269.7	2,114.8	2,469.7	3,240.7	
Net Long-term liabilities	4,427.9	5,366.7	6,947.0	7,508.1	8,644.9	11,006.1	14,577.7	19,665.2	25,176.9	30,535.0	32,644.0	
Current Liabilities:												
Current maturities	153.7	325.0	517.5	545.3	638.3	1,253.3	1,892.0	1,269.7	2,114.8	2,469.7	3,240.7	
Accounts payable to contractors l/	71.0	72.3	86.4	360.1	441.3	760.4	973.0	1,238.2	1,255.4	1,188.6	874.1	
Interest payable m/	92.0	93.7	112.0	179.8	196.6	263.4	347.4	435.0	496.3	600.8	666.1	
Accounts payable-operations n/	149.7	152.4	182.3	250.2	328.9	403.0	501.0	612.5	745.8	890.1	1,059.2	
Other current liabilities o/	-	-	-	-	-	-	-	-	250.4	392.0	1,982.3	
Total Current Liabilities	466.4	643.4	898.2	1,335.4	1,603.1	2,680.1	3,713.4	3,535.4	4,862.7	5,541.2	7,822.4	
TOTAL EQUITY AND LIABILITIES	10,970.9	15,186.0	18,937.6	24,694.7	31,257.9	40,949.4	54,288.2	70,672.1	91,244.3	113,377.7	139,644.6	

- a/ Based on EPM's internal financial statements of September 30, 1979, including preliminary sales figures for the 3rd quarter of 1979.
- b/ Fully revalued from year of expenditures according to annual change in national consumer price index for Colombian workers (text, para.5.6)
- c/ Cumulative at cost.
- d/ Surplus cash not required by the projected level of operations.
- e/ Equivalent to 10 days of the yearly: (i) investment expenditures in local currency less 10% of the yearly investments in transmission and distribution; (ii) operational expenditures; (iii) debt service and (iv) net investments in ISA.
- f/ Same as for e/ but based on 26.5 days. EPM maintains these stand-by funds in interest bearing daily accounts.
- g/ 70 days of total energy sales including sales to ISA.
- h/ Assumed to grow gradually until 1983. From 1984 growth is assumed at 2% of gross generation and transmission assets in operation and 3% of gross distribution assets in operation.
- i/ Other assets include accounts receivable from employees and non energy transactions. Assumed to grow according to local inflation plus an additional 2% of real growth.
- j/ Net works built by urban land developers which are incorporated into EPM's assets.
- k/ Includes revaluation of foreign debt due to devaluation of the Colombian peso.
- l/ 60 days of investment expenditures in local currency plus 30 days for investment expenditures in foreign currency.
- m/ An average of 25% of yearly interest charges.
- n/ 20% of yearly operational expenditures except for national grid charges by ISA which is taken at 16.7%.
- o/ Operational short-term debt.

COLOMBIA

EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

Forecast Performance and Financial Indicators

	ACTUAL			ESTIMATE	FORECAST							
	1976	1977	1978		1979	1980	1981	1982	1983	1984	1985	1986
<u>Energy (GWh)</u>												
Gross generation	3,628	3,379	3,185	3,775	4,926	4,926	5,446.5	5,467	5,953.5	6,474.0	7,896.0	
Purchases from ISA	54	171	607	464	565	579.5	988.5	1,716.5	2,035.5	2,035.5	2,035.5	
Sales to ISA	439	354	133	266	1,121.9	779.4	1,322.6	1,653.3	2,000.7	2,038.3	2,931.5	
Total	3,243	3,196	3,639	3,973	4,369.1	4,726.1	5,112.4	5,530.2	5,988.3	6,471.2	7,000.0	
Sales without (ISA) (GWh)	2,661	2,610	3,035	3,249	3,673	3,992	4,338	4,713	5,120	5,561	6,040	
Losses (% of total) <u>a/</u>	22	22	20	22	19	18	18	17	17	16	16	
Number of customers (000)	243	252	261	273	286	298	310	323	335	348	360	
Number of employees (000)	1,722	1,693	1,717	1,856	1,918	1,979	2,046	2,124	2,302	2,380	2,445	
Customers per employee	141	149	152	147	149	151	152	152	145	146	147	
Energy sales per employee (MWh) <u>b/</u>	1.545	1.542	1.768	1.751	1.915	2.017	2.120	2.219	2.224	2.336	2.470	
<u>Rate of Return</u>												
Operating income	-	-	642.2	1,090.0	1,704.4	2,826.9	4,970.4	6,156.5	6,351.1	7,014.9	9,864.6	
Revalued net average assets in operation <u>c/</u>	-	-	8,480.0	13,976.5	21,612.4	26,865.4	32,058.5	37,940.4	52,135.2	68,439.3	98,073.0	
Yearly rate of return	-	-	7.6	7.8	8.0	10.5	15.5	16.2	12.2	10.2	10.1	
<u>Debt</u>												
Gross cash generation/Debt service + idc <u>d/</u>	1.6	2.1	1.4	1.6	1.5	1.8	1.9	2.2	2.6	2.2	2.4	
+ investments in ISA												
Debt/Equity ratio <u>e/</u>	45/55	40/60	41/59	36/64	33/67	33/67	34/66	33/67	33/67	32/68	29/71	
Self Financing ratio (%) <u>f/</u>	29	46	24	57	47	45	49	52	57	59	83	
Accounts receivable as % of annual sales	12.99	18.36	19.17	13.20	19.17	19.17	19.17	19.17	19.17	19.17	19.17	
Current ratio <u>g/</u>	2.2	3.4	3.3	1.5	1.8	1.7	1.9	1.9	1.9	2.0	1.8	
<u>Depreciation</u>												
As % of average gross plant in operation	-	3.36	2.61	2.59	3.61	3.68	3.64	3.64	3.29	3.59	3.10	

a/ Station use, losses, and unaccounted for.

b/ Own system.

c/ The rate base was estimated as the average net revalued fixed assets in operation using the weighted yearly average of new plants in their year of commissioning and their full value thereafter. This average is not always equal to the accounting average.

d/ Interest during construction.

e/ Total debt and liability reserves as % of total assets/total equity as % of total assets.

f/ Gross internal cash generation, less debt service, less investments in ISA divided by: total applications of funds including increases in net working capital and excluding investments in ISA.

g/ Current assets divided by current liabilities exclusive of the current portion of term debt.

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COLOMBIA
EMPRESAS PUBLICAS DE MEDELLIN
GUADALUPE IV HYDRO POWER PROJECT

Forecast Loans Disbursement Statement 1979 - 1986
(Millions of current Col\$)

	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>TOTAL</u>
<u>Existing Loans</u>									
IBRD 874	236.8	177.8	-	-	-	-	-	-	414.6
<u>Future Loans</u>									
<u>Guadalupe IV</u>									
IBRD	-	31.8	864.3	2,423.1	3,165.3	819.8	74.5	-	7,378.8
Bank of America	-	363.4	714.4	156.7	31.3	-	-	-	1,265.8
Suppliers	-	63.6	-	805.8	56.4	164.0	96.8	-	1,186.6
Fonade (Studies)	24.0	4.2	21.8	21.0	25.1	29.1	-	-	125.2
Sub-Total	24.0	463.0	1,600.5	3,406.6	3,278.1	1,012.9	171.3	-	9,956.4
<u>Playas</u>									
International Institutions	-	-	-	485.2	754.0	3,267.7	3,739.1	1,713.5	9,959.5
Suppliers	-	-	-	-	330.3	1,055.5	1,079.8	357.1	2,822.7
Sub-Total	-	-	-	485.2	1,084.3	4,323.2	4,818.9	2,070.6	12,782.2
<u>Other</u>									
Bank of America (River Diversion)	-	72.7	239.8	-	-	-	-	-	312.5
Local Banks	17.1	-	-	-	-	-	-	-	17.1
Municipal Valuation	2.7	-	-	-	-	-	-	-	2.7
Government	100.0	50.0	-	-	-	-	-	-	150.0
Municipal Palace	175.8	-	-	-	-	-	-	-	175.8
Debt refinancing (1980)	-	210.0	-	-	-	-	-	-	210.0
Debt refinancing (1981)	-	-	600.0	-	-	-	-	-	200.0
Sub-Total	295.6	332.7	839.8	-	-	-	-	-	1,068.1
Fonade - Studies - Future Projects	-	91.2	139.0	65.2	142.6	48.4	-	-	486.4
Total Disbursements	556.4	1,064.7	2,579.3	3,957.0	4,505.0	5,384.5	4,990.2	2,070.6	24,707.7

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EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

Forecast Debt Amortization Statement 1979 - 1986

(Millions of current Col\$)

	1979	1980	1981	1982	1983	1984	1985	1986
<u>Existing - Foreign Loans</u>								
IBRD 282	63.8	72.9	84.9	100.3	117.9	136.9	157.9	-
IBRD 225	57.3	64.6	76.5	90.3	106.8	124.2	-	-
IBRD 369-1	47.2	53.8	62.5	73.9	86.5	99.7	114.9	132.7
IBRD 369-2	3.5	3.8	4.8	5.6	6.4	7.3	8.6	9.8
Brown Boveri 4782 Additional	2.6	2.8	3.1	3.4	3.8	4.2	4.5	4.9
Brown Boveri 4782	14.2	15.4	17.0	19.1	21.1	23.1	25.2	27.4
Banco Popular	8.2	8.9	9.8	10.9	12.1	13.3	-	-
KFW F 195	24.3	26.4	29.2	32.6	36.2	39.5	43.1	47.0
Chase Manhattan Bank	94.2	102.0	112.6	125.8	61.9	-	-	-
IBRD 874	71.0	82.6	105.1	126.2	150.1	177.0	206.7	241.9
Other	59.5	-	-	-	-	-	-	-
Sub-Total	445.8	433.2	505.5	588.1	602.8	625.2	560.9	463.7
Existing local loans	53.9	66.2	64.7	350.4	551.1	34.1	22.5	22.5
Total Existing Loans	499.7	499.4	570.2	938.5	1,153.9	659.3	583.4	486.2
<u>Future Loans</u>								
<u>Guadalupe IV</u>								
IBRD	-	-	-	-	-	342.7	731.0	796.7
Bank of America	-	-	-	-	-	-	354.4	386.3
Suppliers	-	-	-	-	-	91.4	194.9	212.5
Fonade	-	-	7.1	11.5	16.0	22.8	29.5	18.1
Sub-Total	-	-	7.1	11.5	16.0	456.9	1,309.8	1,413.6
Playas (International Institutions)	-	-	-	-	-	-	-	370.7
<u>Other</u>								
Bank of America (Ayura Diversions)	-	-	-	-	-	-	88.3	96.3
Local Banks	-	-	-	-	-	17.1	-	-
Municipal Valuation	0.2	0.4	0.4	0.5	0.5	0.5	0.2	-
Government	-	10.3	12.0	14.0	16.3	19.0	22.2	25.9
Municipal Palace	17.6	35.2	35.1	35.2	35.1	17.6	-	-
Debt refinancing (1980)	-	-	-	210.0	-	-	-	-
Debt refinancing (1981)	-	-	-	-	600.0	-	-	-
Sub-Total	17.8	45.9	47.5	259.7	651.9	54.2	110.7	122.2
Fonade (studies - Future projects)	-	-	13.5	43.6	70.7	99.3	110.9	77.0
Total Future Loans	17.8	45.9	68.1	214.8	738.6	610.4	1,531.4	1,983.5
Total Amortizations:	517.5	545.3	638.3	1,253.3	1,892.5	1,269.7	2,114.8	2,469.7

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COLOMBIA

EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

Forecast Interest Charges 1979 - 1986

(Millions of current Col\$)

	1979	1980	1981	1982	1983	1984	1985	1986
A. INTEREST CHARGED TO OPERATIONS								
<u>Existing - Foreign Loans</u>								
IBRD 282	28.8	27.0	25.0	22.2	18.1	12.2	4.5	-
IBRD 225	22.1	20.0	17.5	14.2	9.5	3.1	-	-
IBRD 369-1	95.5	100.2	106.9	115.4	123.7	130.4	136.1	141.3
IBRD 369-2	7.8	8.2	8.8	9.5	10.2	10.7	11.2	11.6
Brown Boveri 4782 Additional	1.7	1.6	1.5	1.4	1.3	1.1	0.8	0.5
Brown Boveri 4782	8.1	7.7	7.3	6.8	6.1	5.1	3.9	2.3
Banco Popular	3.2	2.8	2.4	2.0	1.3	0.5	-	-
KFW F 195	12.8	12.2	11.5	10.8	9.7	8.2	6.2	3.7
Chase Manhattan Bank	40.8	33.3	24.9	14.6	2.7	-	-	-
IBRD 874	-	196.6	214.9	231.3	246.8	258.7	267.8	275.5
Sub-Total	220.8	409.6	420.7	428.2	426.7	430.0	430.5	434.9
Existing Loans - Local	221.2	211.3	200.5	160.0	87.5	17.5	9.8	5.7
Total Existing Loans	442.0	620.9	621.2	588.2	514.2	447.5	440.3	440.6
<u>Future Loans</u>								
<u>Guadalupe IV</u>								
IBRD	-	-	-	-	43.9	150.3	677.7	722.4
Bank of America	-	-	5.0	50.4	100.3	205.0	216.0	186.7
Suppliers	-	-	-	-	-	-	104.3	113.6
Fonade	-	-	-	-	-	-	14.3	7.8
Sub-Total	-	-	5.0	50.4	144.2	355.3	1,012.3	1,030.5
<u>Other</u>								
Bank of America (Ayura Diversions)	-	-	-	9.8	47.1	51.4	53.5	47.2
Local Banks	3.1	3.5	3.5	3.5	3.5	0.3	-	-
Municipal Valuation	0.6	0.7	0.5	0.4	0.3	0.1	0.1	-
Government	2.7	23.6	21.9	19.9	17.6	14.5	11.7	8.0
Municipal Palace	22.2	34.5	26.0	17.6	9.1	1.4	-	-
Debt refinancing (1980)	-	25.0	50.0	25.0	-	-	-	-
Debt refinancing (1981)	-	-	72.0	144.0	172.0	-	-	-
Sub-Total	28.6	87.3	253.0	380.0	149.0	67.7	65.3	55.2
Fonade (Studies - Future projects)	-	-	3.0	28.2	43.8	40.3	54.9	30.0
Total Future Loans	28.6	75.3	165.9	302.8	345.6	463.3	1,132.5	1,115.7
Total Interest Charged to Operations	470.6	708.2	803.1	887.1	851.0	910.8	1,572.8	1,556.3
B. INTEREST DURING CONSTRUCTION								
<u>Existing Loans</u>								
IBRD 874 (Guatape II)	172.5	-	-	-	-	-	-	-
<u>Future Loans</u>								
<u>Guadalupe IV</u>								
IBRD	-	22.7	84.9	218.2	420.0	519.2	44.7	-
Bank of America	-	22.7	94.9	106.3	75.2	-	-	-
Suppliers	-	4.6	5.0	39.3	87.8	102.6	7.4	-
Fonade	2.5	4.9	7.5	11.1	13.6	16.7	-	-
Sub-Total	2.5	54.9	192.3	374.9	596.6	638.5	52.1	-
Bank of America (Ayura Diversions)	-	4.5	23.5	32.2	-	-	-	-
International Institutions (Playas)	-	-	-	65.5	171.7	325.2	601.0	849.8
Suppliers (Playas)	-	-	-	-	13.8	75.2	177.2	258.2
Sub-Total	-	4.5	23.5	97.7	185.5	400.4	778.2	1,108.0
Fonade (Studies for Future projects)	-	11.0	34.7	29.8	26.7	35.4	-	-
Total Interest during construction	175.0	70.4	250.5	502.4	808.8	1,074.3	830.3	1,108.0

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COLOMBIA
EMPRESAS PUBLICAS DE MEDELLIN
GUADALUPE IV HYDRO POWER PROJECT

Rate of Return on Development Program ^{1/}

Year No.	Capital Cost			Sub Total (see PV)	EPM	Operational Cost		Total Cost	Revenues			Benefits less Costs
	Generation	Transmission Distribution	General Plant			Power Purchase (from ISA)	Sub total (see PV)		In own System	Sales to ISA	Total (see PV)	
1	1979	674	31	389	123		13		221		99	
2	1980	956	433	21	126		-		409		-	
3	1981	2,086	860	21	129		40		614		-	
4	1982	2,778	1,211	21	133		11		836		39	
5	1983	2,975	1,425	22	181		174		1,076		39	
6	1984	4,221	388	44	174		44		1,337		39	
7	1985	3,996	163	21	200		168		1,620		-	
8	1986	1,680	219	21	393		-		1,927		136	
9	1987			5								
↓	↓			↓	↓				↓		↓	
31	2009	135	31									
32	2010	191	433									
33	2011	417	860									
34	2012	556	1,211									
35	2013	595	1,425									
36	2014	844	388									
37	2015	799	163									
38	2016	336	219									
↓	↓			↓	↓				↓		↓	
48	2026			5	393				1,927		136	

----- Present Values, Unadjusted for Border Prices -----

Discount Rate (%)	Generation	Transmission Distribution	General Plant	Sub Total (see PV)	EPM	Power Purchase (from ISA)	Sub total (see PV)	Total Cost	In own System	Sales to ISA	Total (see PV)	Benefits less Costs
4	16,601	4,924	610	22,135	7,147	476	7,623	29,758	35,672	2,348	38,020	8,262
6	15,342	4,356	574	20,272	5,077	437	5,514	25,786	25,413	1,643	27,056	1,270
8	14,207	3,938	550	18,695	3,797	401	4,198	22,893	19,064	1,211	20,255	- 2,638
10	13,190	3,618	531	17,339	2,963	370	3,333	20,672	14,867	931	15,798	- 4,874
12	12,280	3,362	517	16,159	2,391	340	2,731	18,890	11,992	742	12,734	- 6,156
14	11,465	3,149	506	14,614	1,984	316	2,300	16,914	9,928	609	10,537	- 6,377
16	10,732	2,966	496	14,194	1,683	293	1,976	16,170	8,393	512	8,905	- 7,265

----- Present Values, Adjusted for Border Prices ^{2/} -----

Discount Rate (%)	Generation	Transmission Distribution	General Plant	Sub Total (see PV)	EPM	Power Purchase (from ISA)	Sub total (see PV)	Total Cost	In own System	Sales to ISA	Total (see PV)	Benefits less Costs
4	14,443	3,988	519	18,950	6,504	438	6,942	25,892	32,818	2,160	34,078	9,086
6	13,348	3,528	488	17,364	4,620	402	5,022	22,386	23,380	1,512	24,092	2,506
8	12,360	3,190	468	16,018	3,455	369	3,824	19,842	17,520	1,114	18,634	- 1,208
10	11,475	2,930	451	14,856	2,696	340	3,036	17,892	13,678	856	14,534	- 3,358
12	10,684	2,723	439	13,846	2,176	291	2,476	16,322	11,033	683	11,716	- 4,606

^{1/} In Millions of Colombian Pesos

^{2/} Weighted average conversion factors:

generation	0.87
transmission, distribution	0.81
general plant	0.85
resulting for capital cost	0.86
maintenance cost	0.91
standard (for power supplies)	0.92

COLOMBIA

EMPRESAS PUBLICAS DE MEDELLIN

GUADALUPE IV HYDRO POWER PROJECT

Rate of Return on Development Program

Main Assumptions

Capital Cost

See Attachment 4.1 (Generation, Transmission, Distribution); local and foreign cost have been deflated with assumed price increases, as follows:

	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
<u>Local Cost</u>								
% Price increase	26	20	17	15	15	15	15	15
Deflating factor	0.885	0.722	0.609	0.526	0.475	0.398	0.346	0.301
<u>Foreign Cost</u>								
% Price increase	12	10.5	9	8	7	7	7	7
Deflating factor	0.943	0.848	0.773	0.713	0.663	0.620	0.579	0.541

Conversion Factors

Weighted average for 1979-1986 investment program	0.86
Weighted average for operation and maintenance	0.91
Standard (for sale and purchase of electricity)	0.92

Residual Values

Calculated in accordance with sinking fund depreciation for generation (40 years), transmission and distribution (30 years); general plant was assumed to be replaced for 20% every year.

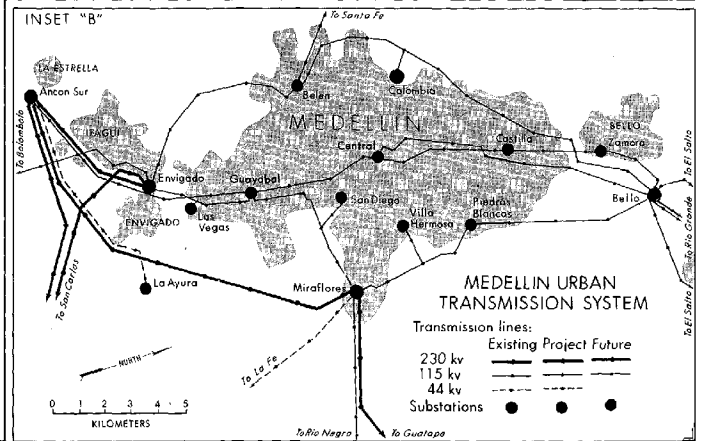
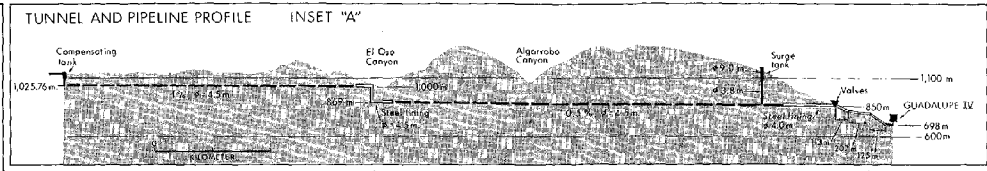
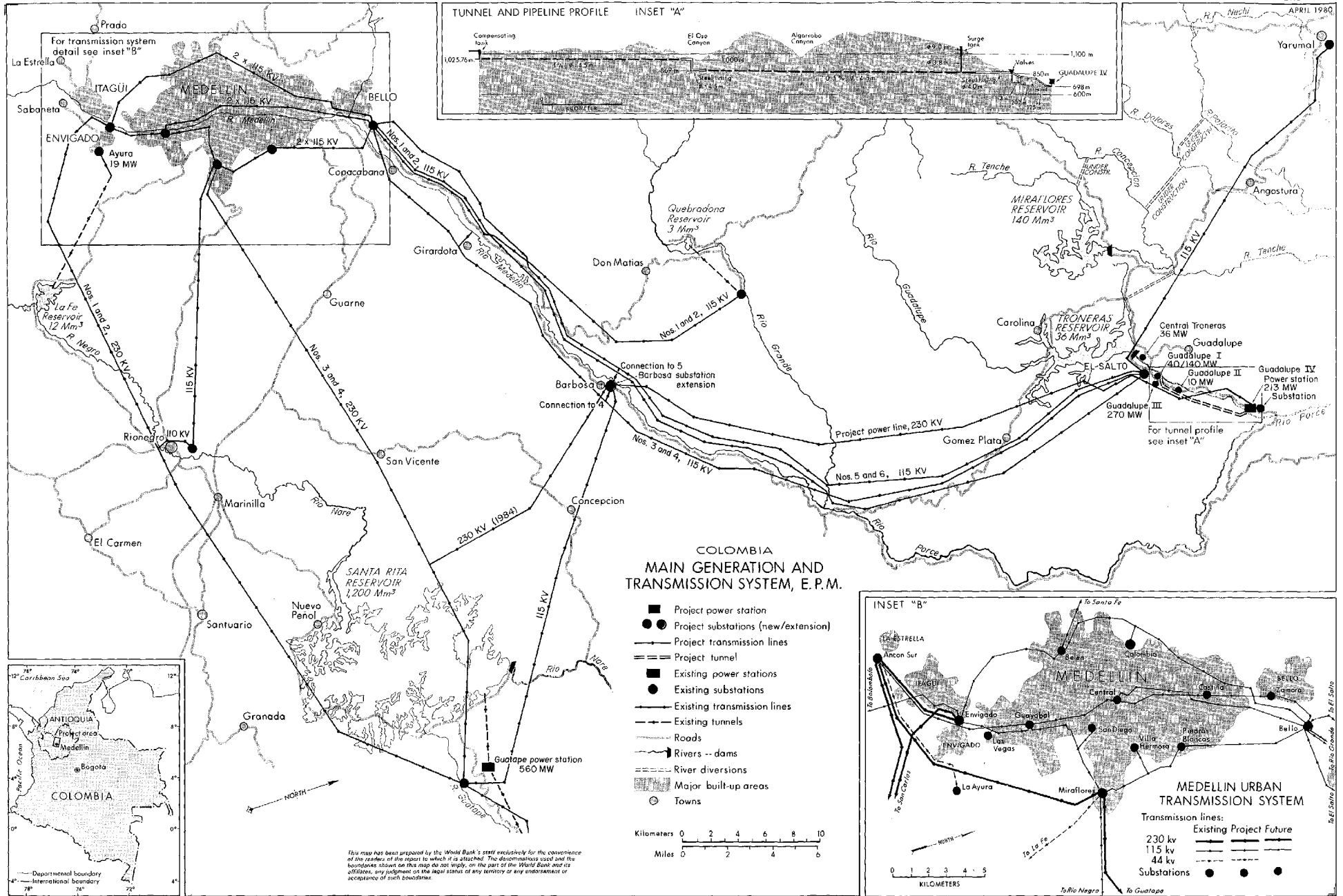
January 28, 1980

		<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
<u>Sales, Purchases</u>									
Incremental Sales in EPM System	GWh	345	638	957	1,303	1,678	2,085	2,526	3,005
Incremental Purchases from ISA	GWh	34	-	103	28	446	421	432	-
Incremental Sales normal energy to ISA	GWh	-	255	-	-	-	-	-	348
Incremental Sales of secondary energy to ISA	GWh	-	-	-	200	200	200	-	-
<u>Tariffs</u>									
		<u>1978</u>							
Average in EPM System MCol\$/GWh	GWh	0.6413							
Purchase from ISA, normal	GWh	0.3900							
Sales to ISA, normal	GWh	0.3900							
Sales to ISA, secondary	GWh	0.1950							

Operation and Maintenance

EPM's forecast incremental total operational cost were deflated using the capital cost delation factors for local cost.

January 28, 1980



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