CHAPTER 10

CONSTRUCTION COST

CHAPTER 10 CONSTRUCTION COST

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CHAPTER 10 CONSTRUCTION COST

10.1 Basic Conditions

10.1.1 General

The construction cost for the Project was estimated based on wage rates and commodity prices as of the beginning of 1979 taking into consideration the natural conditions of the project sites, regional conditions, project scale and the engineering level which can be counted on at present.

The construction cost was compiled allocating domestic currency for the costs of items procurable in Colombia, with all other items considered as requiring foreign currency.

10.1.2 Scope of Construction Cost Calculation

The scope of construction cost calculations covers Julumito Power Station, a transmission line of approximately 10 km from the power station to New Popayan Substation, and telecommunication facilities to be installed between Julumito Power Station and New Popayan Substation.

Besides the above direct costs, all other costs necessary for executing the construction of the Project are included as shown in Table 10-4.

However, regarding the cost of electric power for construction, it was assumed that the power would be supplied by ICEL without charge and is not included in the construction cost.

10.2 Particulars of Construction Cost

10.2.1 Civil Works Cost

(1) Work quantities were calculated based on the design drawings attached to Chapter 8, "Preliminary Design." The work quantities by type of work are shown in Table 10-3.

(2) Of the basic unit prices, those in the domestic currency portion for materials to be procured in the Republic of Colombia and for labor, were taken from data received from ICEL and CEDELCA, and in addition, data published by government agencies of the Republic of Colombia.

Under the foreign currency portion, CIF prices based on domestic prices in Japan were adopted for imported materials, while for imported machinery, prices adding ocean freight and overland transportation costs to FOB Japan prices were adopted. The principal unit prices adopted are shown below.

Basic Unit Prices Adopted

Unit: US$

Item	Unit	Unit Price	Currency Classification
Labor Costs			
Foreign manager	day	93.02	Foreign, incl. various allowances
Manager	"	5.61	Domestic, incl. various allowances
Driver	"	4.88	- Ditto -
Mechanic	"	4.88	- Ditto -
Blacksmith	"	3.90	- Ditto -
Reinforcement worker	"	4.88	- Ditto -
Carpenter	"	4.39	- Ditto -
Tunnel worker	"	4.88	- Ditto -
Laborer	"	2.93	- Ditto -
Materials Costs			
Cement	t	52.44	Domestic, incl. transportation
Reinforcing steel	"	468.29	- Ditto -
Gasoline	kl	103.10	- Ditto -
Light oil	"	96.66	- Ditto -
Steel (general)	t	570.73	- Ditto -
Dynamite	kg	1.35	- Ditto -
Lumber (milled)	m^3	65.85	- Ditto -
Bit (ø65)	m	1.55	Foreign, incl. transportation
Rod	"	4.82	- Ditto -

(3) Unit construction costs were estimated based on the previously-mentioned construction schedule, construction scheme, and basic unit prices, taking into consideration recent performances in hydro-electric power station construction in Colombia and Japan, and adding the regional conditions of the Julumito site.

The principal unit construction costs are shown below.

(4) Principal work quantities are as shown in Table 10-1

Principal Unit Construction Costs

Unit: US$

Work	Unit	Total	Foreign Currency	Foreign Currency
Dam embankment				
Core	m^3	6.87	4.23	2.64
Filter	"	10.68	7.07	3.61
Rock	"	9.50	6.26	3.24
Open earth excavation				
Dam	m^3	2.79	1.79	1.00
Cauca Waterway	"	2.90	1.64	1.26
Open rock excavation				
Dam	m^3	8.76	5.27	3.49
Tunnel excavation				
Headrace tunnel	m^3	41.74	19.29	22.45
Palace Waterway	"	65.94	25.26	40.68
Concrete				
Spillway chute	m^3	93.09	39.71	53.38
Intake	"	87.31	38.29	49.02
Powerhouse	"	79.91	34.80	45.11
Cauca Waterway	"	88.22	38.59	49.63
Headrace tunnel lining	"	104.84	43.74	61.10
Palace Waterway lining	"	110.69	47.81	62.88
Reinforcement	t	850.60	196.94	653.66
Mortar injection	m^3	100.50	27.83	72.67
Drilling and grouting				
Dam curtain	m	101.88	53.45	48.43
Headrace tunnel	m	100.39	50.95	49.44
Hydraulic equipment				
Intake facilities	t	3,898.14	3,088.37	809.77
Penstock	"	3,287.59	2,604.65	682.94

Table 10-1 Summary of Principal Work Quantities

Description	Unit	Quantity
(I) Civil Work		
1. Dam (including care of river)		
1-1 Common Excavation	m^3	163,900
1-2 Rock Excavation	"	63,000
1-3 Embankment		
i) Core Zone	m^3	177,000
ii) Filter Zone	"	113,000
iii) Rock Zone	"	964,000
2. Spillway		
2-1 Excavation (Common and Rock)	m^3	73,100
2-2 Concrete	"	5,090
3. Outlet (including access tunnel)		
3-1 Excavation (Common and Rock)	m^3	1,300
3-2 Tunnel Excavation	"	6,610
3-3 Concrete	"	3,560
4. Dike (Dike No. 1 and Dike No. 2)		
4-1 Excavation (Common and Rock)	m^3	19,800
4-2 Embankment	"	47,500
5. Intake		
5-1 Excavation (Common and Rock)	m^3	256,700
5-2 Concrete	"	10,400
6. Headrace		
6-1 Tunnel Excavation	m^3	42,440
6-2 Concrete	"	15,870
7. Surge Tank		
7-1 Excavation (Common and Rock)	m^3	4,850
7-2 Tunnel Excavation	"	1,730
7-3 Concrete	"	3,830
8. Penstock		
8-1 Excavation (Common and Rock)	m^3	92,600
8-2 Tunnel Excavation	"	2,130
8-3 Concrete	"	2,830
9. Powerhouse and Tailrace Tunnel		
9-1 Common Excavation	m^3	15,300
9-2 Rock Excavation	"	61,600
9-3 Concrete	"	10,070

Description			Unit	Quantity
	10.	Rio Cauca Diversion Dam		
		10-1 Excavation	m^3	24,600
		10-2 Concrete	"	9,830
	11.	Cauca Waterway		
		11-1 Excavation	m^3	128,900
		11-2 Tunnel Excavation	"	4,790
		11-3 Concrete	"	11,860
	12.	Rio Palace Diversion Dam		
		12-1 Excavation	m^3	2,700
		12-2 Concrete	"	1,460
	13.	Palace Waterway		
		13-1 Tunnel Excavation	m^3	8,840
		13-2 Concrete	"	3,180
	14.	Rio Blanco Diversion Dam		
		14-1 Excavation	m^3	2,900
		14-2 Concrete	"	1,090
	15.	Blanco Waterway		
		15-1 Tunnel Excavation	m^3	46,840
		15-2 Concrete	"	16,040
	16.	Switchyard		
		16-1 Concrete	m^3	150
(II)	Hydraulic Equipment			
	1.	Gate		
		1-1 Spillway, outlet	t	67
		1-2 Intake	"	40
		1-3 Others (Tailrace and Diversion Dams)	"	86
	2.	Screen	t	102
	3.	Penstock	t	695
(III)	Material			
	1.	Reinforcement	t	1,820
	2.	Cement	t	29,400
	3.	Sheet Pile	t	320

10.2.2 Costs of Hydraulic Equipment and Electrical Equipment

It was assumed that hydraulic equipment such as principal gates and penstock pipe, electrical equipment such as turbines, generators, transformer and transmission line materials would all be manufactured abroad and supplied, and were calculated including ocean freight, insurance, landing costs, overland transportation costs in Colombia, and field installation costs.

10.2.3 Preparatory Works Costs

As preparatory works costs, the cost of further investigation works required for detail designing, the costs of construction of access roads and repairs of existing roads required to be done prior to starting the main work, and the costs of the building for the project supervision office of the Engineer and appurtenant facilities were calculated.

The cost of relocation of steel towers which is to be done at ICEL's responsibility in case of implementing the Project since the existing 115-kV transmission line from Popayan Substation to Cali will pass inside Julumito Reservoir are not included in this construction cost.

10.2.4 Engineering Costs

As engineering costs, the foreign currency required for detail designing and the cost of project supervision by engineers of a foreign consultant and ICEL or a local consultant were included.

10.2.5 Compensation Cost

As acquisition costs of land required for the Project such as for the reservoir area and structures, 60,000 Colombian peso/ha were budgeted.

10.2.6 Contingency Cost

Amounts corresponding to 10% of the civil works construction cost and 5% of the hydraulic and electrical equipment costs were included as the contingency cost.

10.2.7 Interest During Construction

As interest on funds required for construction, [Cumulative Funds required by Previous Year of Each Year x 8%] + [Fund of Pertinent Year x 50% x 8%] was budgeted.

10.2.8 Escalation of Construction Cost

Since the oil crisis of 1973, commodity prices have shown a trend of constant rise, and with a construction cost estimated at present prices remaining unaltered, a shortage of funds will arise in case of a project requiring a long construction period. Inflation is seen in all free countries of the world, and the raising of oil prices at the end of March may further accelerate escalation of commodity prices in advanced and developing countries alike. (At the extraordinary plenary meeting of the Organization of Petroleum Exporting Countries (OPEC) held in Geneva it was decided that Arabian Light, the standard petroleum grade, would be raised from US$13.34/bbl to US$14.54/bbl from April 1st. This increase corresponds to 14.5% compared with the price at the end of 1978.)

According to "Statistical Yearbook, 1977" published by the United Nations, the trends in prices of manufactured products in the world from 1970 to 1976 were the following:

Manufactured goods wholesale price index (1970 = 100)

	1976 Index	Annual Av. Increase Rate
Japan	157	7.8%
U.S.A.	154	7.5%
France	160	8.1%
West Germany	142	6.0%
Average	153	7.3%

The wholesale and consumer price indices in Colombia are as shown below.

Wholesal prices (1970 = 100) in Colombia

	Index in 1976	Annual increase (%)
General	354	23.5
Raw material	404	26.2
Finished goods	317	21.2
Farm products	368	24.3
Domestic goods	367	24.2
Imported goods	345	22.9
Exported goods	489	30.3

Consumer price (1970 = 100) in Colombia

	Index in 1976	Annual increase (%)
All items	281	18.8
Food	329	22.0

As indicated in the table above, the increases in commodity prices in Colombia are severe. The greatest problem of the Colombian economy is inflation, and although the government target for 1978 of 10% increase in the consumer price index is not thought to have been achieved, it is said that the inflation is gradually quieting down.

Meanwhile, the report of the World Bank of March 1975 had predicted what inflation would be from 1979 to 1987, according to which it is suggested that prices of equipment would rise at an annual rate of 8 - 7%, civil works at 12 - 10%, and engineering at 10%.

Based on the above, in estimation of the construction cost of this Project, it will be considered that there will be annual escalations of the direct construction cost of 1978 of 7.0% for the foreign currency portion and 10.0% for the domestic currency portion. The engineering fee for the Project will be considered as escalating 10.0% annually.

10.3 Summarization of Construction Cost

The construction cost of this Project determined from the construction schedule, construction scheme and estimation conditions of construction cost previously described is shown in Table 10-1. The total construction cost will be US$75,900,000 of which the amount paid in foreign currency will be US$45,592,000 and that in domestic currency US$30,308,000.

The power generating facilities construction cost out of the total construction cost will be US$56,464,000 of which the foreign currency portion will be US$34,702,000 and the domestic currency portion US$21,762,000.

The transmission line and transformation facilities construction cost will be US$553,000 of which the foreign currency portion will be US$405,000 and the domestic currency portion US$148,000.

The expense required for preparatory works such as access roads will be US$887,000 of which the foreign currency portion will be US$44,000 and the domestic currency portion US$843,000.

Other than the above, the indirect construction costs such as engineering cost, compensation cost, contingency cost and interest during construction will be US$17,996,000 of which the foreign currency portion will be US$10,441,000 and the domestic currency portion US$7,555,000.

Table 10-2 Summary of Estimated Construction Cost

As of Jun. 1979 (Unit: U.S. $)

	Item	Total Cost	Foreign Currency	Local Currency
A.	Generating Facility	56,464,000	34,702,000	21,762,000
A.1	Civil Works	42,111,000	21,550,000	20,561,000
	(1) Diversion Dam	1,884,000	941,000	943,000
	(2) Waterway	9,652,000	3,754,000	5,898,000
	(3) Dam	17,216,000	10,576,000	6,640,000
	(4) Dike	712,000	429,000	283,000
	(5) Intake	1,973,000	1,009,000	964,000
	(6) Headrace Tunnel	4,971,000	2,106,000	2,865,000
	(7) Surge Tank	799,000	330,000	469,000
	(8) Penstock Foundation	967,000	529,000	438,000
	(9) Powerhouse Building	2,644,000	1,194,000	1,450,000
	(10) Switch Yard	19,000	7,000	12,000
	(11) Miscellaneous	1,274,000	675,000	599,000
A.2	Hydraulic Equipment	3,756,000	2,976,000	780,000
	(1) Gate	926,000	926,000	0
	(2) Penstock	1,448,000	1,448,000	0
	(3) Miscellaneous	7,000	7,000	0
	(4) Installation Cost	1,375,000	595,000	780,000
A.3	Electrical Equipment	10,597,000	10,176,000	421,000
	(1) Turbine	3,789,000	3,789,000	0
	(2) Generator	2,970,000	2,970,000	0
	(3) Transformer	430,000	430,000	0
	(4) Miscellaneous	2,355,000	2,355,000	0
	(5) Installation Cost	1,053,000	632,000	421,000
B	Transmission Line	553,000	405,000	148,000
B.1	Transmission Line	373,000	233,000	140,000
B.2	Communication System	180,000	172,000	8,000
C	Preparation Work	887,000	44,000	843,000
C.1	Access Road	572,000	0	572,000
C.2	Electrical Equipment for Construction	64,000	44,000	20,000
C.3	Engineer's Office	112,000	0	112,000
C.4	Surveying	139,000	0	139,000
	Total Direct Cost (A+B+C)	57,904,000	35,151,000	22,753,000
D	Engineering Fee	3,431,000	2,600,000	831,000
E	Compensation	870,000	0	870,000
F	Contingency	4,925,000	2,810,000	2,115,000
G	Interest during Construction	8,770,000	5,031,000	3,739,000
	Total Indirect Cost (D+E+F+G)	17,996,000	10,441,000	7,555,000
	Total Construction Cost as of Jun. 1979	75,900,000	45,592,000	30,308,000
* -1				
	Escalation(1979 ~ '84)	27,300,000	14,066,000	13,234,000
Total Construction Cost Including Escalation		103,200,000	59,658,000	43,542,000

See 10.28

10.4 Funding Plan

The fund requirements by year obtained based on the previously-described construction cost and construction schedule are as shown in Table 10-4.

In this case, the terms of payment of the contract amount in the case of civil works is to be an advance of 20% of the contract amount in the month following the award of contract with the remainder paid at a rate of 80% of the monthly work accomplished.

Regarding hydraulic equipment, payments will be made at rates of 10% of the contract amount at the time of award of contract, 80% on completion of installation, and 10% on final acceptance, while regarding electrical equipment the payments will be 10% at the time of award of contract, 75% FOB, and 15% on final acceptance.

Table 10-3 Fund Requirement in Each Year

Unit: 10^3 U.S $

Item	Total Cost	Foreign Currency	Local Currency	1979			1980			1981			1982			1983			1984		
				Total	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C
A. Generating Facility	56,464	34,702	21,762	-	-	-	-	-	-	-	-	-	17,954	9,562	8,392	24,257	15,996	8,261	14,253	9,144	5,109
A.1 Civil Works	42,111	21,550	20,561	-	-	-	-	-	-	-	-	-	16,894	8,544	8,350	16,002	8,121	7,881	9,215	4,885	4,330
A.2 Hydraulic Equipment	3,756	2,976	780	-	-	-	-	-	-	-	-	-	-	-	-	307	243	64	3,449	2,733	716
A.3 Electrical Equipment	10,597	10,176	421	-	-	-	-	-	-	-	-	-	1,060	1,018	42	7,948	7,632	316	1,589	1,526	63
B. Transmission Line	553	405	148	-	-	-	-	-	-	-	-	-	55	40	15	415	304	111	83	61	22
C. Preparation Works	887	44	843	139	0	139	-	-	-	684	0	684	6	4	2	48	33	15	10	7	3
D. Direct Cost (D=A+B+C)	57,904	35,151	22,753	139	0	139	0	0	0	684	0	684	18,015	9,606	8,409	24,720	16,333	8,387	14,346	9,212	5,134
E. Engineering Fee	3,431	2,600	831	-	-	-	571	571	0	149	149	0	711	459	252	1,223	896	327	777	525	252
F. Compensation	870	0	870	-	-	-	-	-	-	870	0	870	-	-	-	-	-	-	-	-	-
G. Contingency	4,925	2,810	2,115	-	-	-	-	-	-	-	-	-	1,053	522	531	2,461	1,465	996	1,411	823	588
H. Interest during Construction	8,770	5,031	3,739	6	0	6	34	23	11	125	52	73	984	481	503	2,912	1,653	1,259	4,709	2,822	1,887
I. Indirect Cost (I=E+F+G+H)	17,996	10,441	7,555	6	0	6	605	594	11	1,144	201	943	2,748	1,462	1,286	6,596	4,014	2,582	6,897	4,170	2,727
J. Total Construction Cost in 1979 Prices	75,900	45,592	30,308	145	0	145	605	594	11	1,828	201	1,627	20,763	11,068	9,695	31,316	20,347	10,969	21,243	13,382	7,861
K. Escalation	27,300	14,066	13,234	-	-	-	43	42	1	371	29	342	5,245	2,281	2,964	11,414	6,324	5,090	10,227	5,390	4,837
L. Total Construction Cost required (L=J+K)	103,200	59,658	43,542	145	0	145	648	636	12	2,199	230	1,969	26,008	13,349	12,659	42,730	26,671	16,059	31,470	18,772	12,698

CHAPTER 11

ECONOMIC ANALYSIS

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CHAPTER 11 ECONOMIC ANALYSIS

11.1 Basic Consideration

Evaluation of the economic effect of a hydro-electric power generation project is done in the form of cost comparison with an alternative project providing "equal service," which moreover, is the cheapest. Generally, a thermal power generating facility is selected as the type of alternative, and in the present case, the generating cost of the alternative thermal will vary depending on the unit capacity adopted, and which of the fuels procurable in Colombia oil, coal, natural gas is selected. Further, the Julumito Hydro-electric Power Project will be connected to the CEDELCA Power System, while the CEDELCA Power System is also connected to the national grid, so that seen from the scale of the Julumito Hydro-electric Power Project, the location of the alternative thermal plant can be anywhere in Colombia if close to a power system of 115 kV or higher, while still further, it would be desirable for the location to be where the fuel transportation cost will be a minimum (close to a petroleum or natural gas pipeline, or a coal production area in Colombia). The type with the minimum power generating cost selected based on such conditions was made the alternative thermal power facility for comparison with the Julumito Hydro-electric Power Project. The cost of the alternative thermal power generating facility selected in this manner is considered as the benefit of the Julumito Hydro-electric Power Project, and the cash flows by year of the Project and the cash flows of the alternative thermal are compared through economic internal rate of return which is the normal criterion for evaluation, and by converting to present values.

In the economic analysis of the Julumito Hydro-electric Power Project, it is thought that the construction cost, operation and maintenance cost, equipment replacement cost and the fuel cost of the alternative thermal are of adequate accuracy, but there can be some amount of variation. In case of variation of these values assumed in evaluation of the Project, a sensitivity analysis can be made as a means of finding the influence on the evaluation of the Project when these predicted values vary. In evaluation of the Julumito Hydro-electric Power Project, the sensitivity analysis is to be made with the construction cost of this Project and the fuel cost of the alternative thermal as parameters out of the number of variable factors.

11.1.1 Unit Capacity and Conditions of Location of Alternative Thermal Plant

The maximum unit capacity of thermal power generating facilities operating in Colombia is 66 MW. The thermal plants presently planned will be mainly of 66 MW units during the first half of the 1980s, and it appears that it will not be until the latter half of the 1980s when thermal units of 150 MW class will be adopted. The Survey Team carried out discussions with ICEL and decided to select a 66 MW steam thermal as the alternative thermal, but the conditions of location will differ depending on the type of fuel adopted.

(1) In case of an exclusively heavy oil-fired thermal power station, it would be located where there is an existing thermal power station and the 3 locations of Barranquilla and Cartagena facing the Caribbean Sea and Buenaventura on the Pacific Ocean coast are conceivable. Assuming that bunker C oil to be the fuel would be supplied from Cartagena Refinery, which is the largest oil refinery in Colombia, Cartagena is selected from among the three candidate sites.

(2) In case of an exclusively natural gas-fired thermal power station, Barranquilla is thought to be optimum as seen from the existing and future gas pipeline laying plans. That is, there is a gas pipeline of 20 inches* (estimated to be 1,600 MW in terms of electric power) from the natural gas production area of Guajira Area A to Barranquilla, and even if the fuel for a 66 MW thermal were to be added to the present demand for gas there would still be ample gas transportation capacity of the pipeline.

(3) In the case of a coal-fired thermal power station, seen from the transportation cost of coal and the present states of existing coal-fired thermal power stations, it is thought reasonable for power generation to be done at a coal-producing area. For the coal-producing area power station, there are several candidate sites which can be thought of, but here it will be considered that the alternative thermal is to be built near the existing Paipa Thermal Power Station where addition of a No. 3 unit is presently in progress.

As described above, the location of the thermal power station was determined by type of fuel, and further, the capacity was made 66 MW. The adoption of a 66 MW thermal to serve as an alternative to the Julumito Hydro-electric Power Station output of 53.0 MW is appropriate for the reasons given below.

In general, thermal power station has a station service ratio and a faulting and scheduled outage ratio which are higher than those of hydro. This means that if "equal service" is to be expected of a thermal power generating facility, it must have a larger capacity compared with hydro. This is a well-known matter, and the correction factor is calculated as shown below.

	Hydro	Thermal (Coal)
Station service loss	0.3%	7.0%
Faulting loss	0.5	5.0
Repair loss	2.0	12.0

* 400 million cu.ft/day, 1,000 BTU/cu.ft.

Therefore, the kW correction factor is calculated as follows:

$$\frac{(1-0.003)(1-0.005)(1-0.02)}{(1-0.07)\ (1-0.05)\ (1-0.12)} = 1.251$$

In other words, the output of the Julumito Hydro-electric Power Project of 53 MW may be considered to have equal value to a steam thermal power generating facility of 66 MW.

Further, in the vicinities of the thermal power stations of 66 MW selected by type of fuel there are existing transmission lines of 115 kV or higher so that there will be no problem for any one of them as an alternative thermal power station for the Julumito Hydro-electric Power Project in transmitting to the CEDELCA and CEDENAR power systems.

11.1.2 Total Costs of Julumito Hydro-electric Power Project and Alternative Thermal

The "total cost"* used in economic comparison means all costs related to the Project, namely, investigation and design costs, construction cost, operation and maintenance costs, equipment replacement cost, fuel cost, etc. Among costs, what must be paid attention to are various taxes (import duties on equipment, business tax, water utilization tax, etc.) which comprise transfers of costs and are not included in the total cost. As will be described in 11.1.3, the costs of fuels in Colombia, petroleum, natural gas and coal, are all extremely low compared with international prices, but if it were assumed that they would not be used as fuel for the alternative thermal, there is a possibility for them to be sold to other countries at international prices, so they are to be evaluated at international prices (corresponding to "opportunity costs" used in economic analyses). As for the coal to be used for the coal-fired thermal, however, seen from the locations of producing mines, it is not a product that can be exported and is to be evaluated at the domestic price.

The problem of inflation is a great one in evaluation of a project. Normally, in economic comparison of two projects, the effects of inflation will be felt by both benefits and costs, and are considered as being permissible to be ignored, but in case of hydro and thermal projects where the service lives of the two differ and it is expected with a fair degree of accuracy that fuel costs will continue to rise in the future, inflation will have a great influence on the conclusions arrived at in economic analysis. Consequently, similarly to the construction cost of the Julumito Hydro-electric Power Project described in 11.2.1, the influence of inflation will be considered in calculation of "total cost."

* Since the total cost is converted to present values by the discount rate, capital costs such as interest during construction is not included.

11.1.3 Fuel Cost of Alternative Thermal

(1) Petroleum Price

The proportion of bunker C oil to be the fuel for the alternative thermal is small in the consumption of petroleum products in Colombia. The petroleum product prices at principal locations in Colombia, including bunker C oil, are shown in Table 11-1. These prices are separated into those at supply plants and retail prices for sales to consumers in general.

Table 11-1 Fuel Price of Petroleum as of Oct. 1978

	Regular gasoline Col. $/gallon	Extra gasoline Col. $/gallon	Querosin Col. $/gallon	A.C.P.M (Diesel oil) Col. $/gallon	Bunker C oil Col. $/gallon
at supply plants					
Bogota	15.35	19.00	14.00	14.02	-
Medellin	15.35	19.00	14.00	14.02	-
Cali	15.35	19.00	14.00	14.02	-
Cartagena	15.35	19.00	14.00	14.02	-
Barranquilla	15.65	19.30	14.30	14.32	9.50
Buenaventura	15.35	-	-	14.57	10.61
at stands					
Bogota	16.00	20.00	15.00	15.00	-
Medellin	16.00	20.00	15.00	15.00	-
Cali	16.00	20.00	15.00	15.00	-
Cartagena	16.00	20.00	15.00	15.00	-
Barranquilla	16.30	20.30	15.30	15.30	-
Buenaventura	16.00	20.55	15.55	15.55	-

Note: Col. $/ 41.0 = 1.00 U.S.$, 1 Gallon = 3.785 liters

The price of bunker C oil would be 8.96 Colombian peso/gal (US$0.219/gal) if purchased directly at the refinery in Cartagena.

Since the price (CIF) of bunker C oil purchased from Venezuela and others by countries facing the Caribbean Sea is estimated to be US$0.341/gal from April of this year, the price at the Cartagena Refinery is 36% lower compared with the international price. This is a price set by state policy, and it may be considered that the difference between the international price and the domestic price is being supported by a government subsidy.

Therefore, of the types of steam thermal, for the alternative thermal using bunker C oil as fuel, it is to be evaluated at the international price of US$0.341/gal (13.97 Colombian peso/gal).

(2) Natural Gas Price

Part of the natural gas produced in Colombia is already being utilized for power generation. The price is US$0.50/1,000 cu. ft. (US$17.00/1,000 m^3) as stated in 3.1.1 (3). This price, when evaluated converted to petroleum (bunker C oil) is US$0.067/gal (2.75 Colombian peso/gal) and is one fifth compared with the international price of US$0.341/gal.

In general, regarding the international price of natural gas, the price at the entrance of the liquefied natural gas plant to be constructed in the producing country is roughly equal to the FOB price of petroleum of the petroleum-producing country. Based on the above, the fuel cost of the alternative thermal power station utilizing natural gas is to be US$2.50/ 1,000 cu. ft.

The price of natural gas as fuel for power generation in Colombia is very low seen from the international price, since the electricity charge is low compared with other countries, it may be said to be a policy price for the purpose of holding down electricity charges.

(3) Coal Price

The coal used at Paipa Coal-Fired Thermal Power Station is being supplied by mines in the vicinity at the prices below. (Variation from 4,920 kcal/kg to 6,430 kcal/kg.)

Paipa Mine	Col. $375/ton
Topaga Mine	Col. $470/ton
Socha and Tasco Mines	Col. $489/ton
Samaca Mine	Col. $600/ton

The international price of coal generally is said to be CIF US$30.0/ton (6,200 kcal/kg), and comparing this price with the prices of coal supplied to Paipa Coal-Fired Thermal Power Station from the mines around the city of Paipa, the price at Paipa Coal-Fired Thermal Power Station is about one third to one fifth.

The quantities of coal usable at the alternative thermal should be determined by mine from which the weighted average should be obtained to determine the coal price, but since this was difficult because of a lack of adequate data, the coal price of Paipa Mine of 375 Colombian peso/ton based on which the economic evaluation would be lower was used as the fuel price for the alternative thermal.

In the above, the prices as of April 1979 of petroleum, natural gas and coal have been discussed, but energy costs are expected to continue to rise sharply in the future as already stated. Although it is extremely difficult to estimate the increase rate over a long period, it is assumed that the inflation rate of industrial products of advanced nations will be equal to an annual 7.0%. (Seen from the side of oil-producing nations, this means that the industrial products of advanced nations can be purchased with an equal quantity of petroleum in the future also.)

11.2 Total Cost of Julumito Hydro-electric Power Project

The "total cost" of the Julumito Hydro-electric Power Project consists of investigation and design costs, construction cost, operation and maintenance costs and equipment replacement costs. These costs are converted to present values at the beginning of 1979.

These costs converted to present values are compared with the cost of the alternative thermal and the superiorities or inferiorities are judged, but in this case there will be a great difference between hydro of large initial investment and thermal which will be forced to disburse fuel expenses annually during its service life depending on how the discount rate is taken. In general, the internal rate of return of a hydro project is between 10% and 20% so that the discount rates to be used for comparison with the alternative thermal are taken to be 10% and 20% and the total cost in terms of present values is to be calculated.

As a result of study, the total cost of the Julumito Hydro-electric Power Project in terms of present values will be as indicated in Table 11-2. The service life of the Julumito Hydro-electric Power Project is 50 years, but with regard to electrical equipment, it was considered that replacements would be made 25 years after start of operation.

Table 11-2 Total Present Value of Julumito Project at Beginning of 1979

Unit: 10^3 U.S.$

Discount rate 10 %	
Construction cost	60,144
Operation & maintenance	27,420
Replacement	6,569
Total	94,133
Discount rate 20 %	
Construction cost	41,018
Operation & maintenance	4,109
Replacement	451
Total	45,578

The method of calculation of the total cost above is described in detail below.

11.2.1 Construction Cost

The construction cost was calculated based on 1979 prices calculated as shown in Table 10-1 with US$67,130,000 excluding interest during construction as the basis. Table 11-3 shows the construction cost of the Julumito Hydro-electric Power Project in terms of present value as of the beginning of 1979. In calculation of present value, inflation rates of 7.0% for the foreign currency portion and 10.0% for the local currency portion were considered for cases of discount rates of 10% and 20%.

The scope of the Project is to be up to the outdoor outgoing steel structure of New Popayan Substation, with the 115 kV switching facilities of that substation not included.

Table 11-3 Present Value of Construction Cost of Julumito Project at Beginning of 1979

Unit: 10^3 U.S.$

	Discount Rate	
	10 %	20 %
Foreign currency	34,888	23,550
Local currency	25,256	17,468
Total	60,144	41,018

Annual disbursement of the construction cost was estimated by 1979 prices as shown below.

Unit: 10^3 U.S.$

Year	Foreign currency	Local currency	Total
1979	0	139	139
1980	571	0	571
1981	149	1,554	1,703
1982	10,587	9,192	19,779
1983	18,695	9,709	28,404
1984	10,559	5,975	16,534
Total	40,561	26,569	67,130

11.2.2 Operation and Maintenance Cost

The operation and maintenance cost may be broadly divided into personnel cost (including administrative expenses) of the operation and maintenance staff, and maintenance and repair cost of facilities.

(1) Personnel Cost

Since a one-man control system is to be adopted for Julumito Hydro-electric Power Station, operation can be done with a relatively small number of people. For Julumito Dam and Blanco and Palace diversion dams, routine inspection is to be done by power station maintenance personnel and permanent staff will not be stationed. It is estimated that the operation and maintenance staff will consist of the following:

Power station manager	1
Operator chief	4
Operators	4
Equipment repair chief	1
Technician	3
Driver	1
Odd-job man	2
Total	16

It is estimated that the cost per person including administrative expenses and social insurance cost levied on enterprises by the government (not tax, but considered a part of wages) will be US$9,900/yr.

(2) Maintenance and Repair Cost

The maintenance and repair cost generally is expressed as a percentage of direct construction cost (US$57,904 in case of the Julumito Hydro-electric Power Project). In case of hydro-electric power stations this is 0.8 - 1.0% in many countries as seen in statistics. For the Julumito Hydro-electric Power Project 1.0% will be applied. Of the repair cost it will be assumed that approximately 60% will be taken up by imported materials for repair.

Based on the above conditions, the total annual amount of the operation and maintenance cost of the 53.0-MW Julumito Hydro-electric Power Project (including the 115-kV transmission line, 1 cct, 10 km) is calculated to be the following:

Unit: US$$10^3$

	Foreign Currency	Local Currency	Total
Personnel cost	-	157	157
Operation & maintenance cost	347	232	579
Total	347	389	736

Considering annual inflation rates of 7.0% for the foreign currency portion and 10% for the local currency portion for the cases of discount rates of 10% and 20%, the present values of the above cost as of the beginning of 1979 are as shown in Table 11-4. Disbursement of the operation and maintenance cost has been converted to present value from the median of the year. The calculation formula is given in Appendix – IV.

Table 11-4 Present Value of Operation and Maintenance Costs of Julumito Project at Beginning of 1979

Unit: 10^3 U.S.$

	Discount Rate	
	10 %	20 %
Foreign currency	7,970	1,510
Local currency	19,450	2,599
Total	27,420	4,109

11.2.3 Equipment Replacement Cost

The average service life of hydro-electric power stations is 50 years. Excepting civil structures, the legally-designated service lives of hydraulic equipment (gates, penstocks and the like)* and electrical equipment (turbines, generators, outdoor equipment, etc.) are 25 to 30 years in most countries. In the economic analysis it will be assumed that the above hydraulic equipment and electrical equipment are to be replaced in the 25th year after start of operation which will be the median year of the average service life.

According to Table 10-1, the hydraulic equipment and electrical equipment at 1979 prices are as shown below.

* In Chapter 12, Financial Analysis, calculations are made with service lives of gates and the penstock as being 30 years.

Unit: 10^3 U.S.$

	Foreign currency	Local currency	Total
Hydraulic equipment	2,976	780	3,756
Electrical equipment	10,176	421	10,597
Total	13,152	1,201	14,353

Considering annual inflation rates of 7.0% for the foreign currency portion and 10.0% for the domestic currency portion of the above costs, the present values as of the beginning of 1979 at discount rates of 10% and 20% are shown in Table 11-5.

Table 11-5 Present Value of Replacement Cost of Equipment and Machinary of Julumito Project at Beginning 1979

Unit: 10^3 U.S.$

	Discount Rate	
	10 %	20 %
Foreign currency	4,222	295
Local currency	400	28
Total	4,622	323

However, disbursements for replacement costs at 1979 prices were assumed to be made as shown below.

Unit: 10^3U.S.$

Year	Foreign currency	Local currency	Total
2008	1,018	42	1,060
2009	7,875	380	8,255
2010	4,259	779	5,038
Total	13,152	1,201	14,353

11.3 Total Cost of Alternative Thermal by Type

The total costs of oil-, natural gas- and coal-fired thermal each consist of construction cost, operation and maintenance cost, fuel cost, and equipment replacement cost. These costs will be converted to present values as of the beginning of 1979. In this case, the economic effects of steam thermal power stations using oil and natural gas for which the construction costs will be lower compared with coal-fired thermal, and coal-fired thermal for which the construction cost will be comparatively high but which has a lower fuel cost will vary depending on the discount rate adopted. As stated in 11.2, the economic internal rate of return of a hydro-electric project is between 10% and 20% so that in selection of an alternative thermal, the pure present values at discount rates of 10% and 20% are calculated, and an alternative thermal of the equipment type that results in the minimum present value of total cost in every case is to be selected.

As a result of study, the present values of total costs of the three equipment types as of the beginning of 1979 are as shown in Table 11-6. The service life of the Julumito Hydro-electric Power Project is 50 years while that of a thermal power generating project is 25 years, so it was assumed that all of the thermal equipment would be replaced 25 years after start of operation of Julumito Hydro-electric Power Station.

Table 11-6 Total Present Value of Alternative Thermal Power Plants by Type at Beginning of 1979

Unit: 10^3 U.S.$

	Oil-fired steam P.P	N. gas-fired steam P.P	Coal-fired steam P.P
Discount rate 10 %			
Construction cost	33,026	30,962	41,282
Operation & maintenance	58,830	55,154	73,538
Replacement cost	18,714	17,544	23,392
Fuel cost	171,318	182,936	34,116
Total	281,888	286,596	172,328
Discount rate 20 %			
Construction cost	22,596	21,184	28,245
Operation & maintenance	9,002	8,439	11,252
Replacement cost	1,340	1,256	1,675
Fuel cost	32,495	34,699	6,471
Total	65,433	65,578	47,643

Calculation of the total cost of a coal-fired thermal has been described. The basic thinking in calculation of total costs of oil-fired and natural gas-fired thermal power stations is the same and the major difference in the costs is in the fuel costs as shown in Table 11-6.

11.3.1 Construction Cost

According to data obtained from ICEL, the construction cost of the No. 3 unit (66 MW) of Paipa is as shown below. (A contract was signed with a contractor in March 1979.)

		US$ Equivalent
Yen portion:	¥3,683 x 10^6	17,130 x 10^3
US$ portion:	US$10,312 x 10^3	10,312 x 10^3
Colombian peso portion:	Col$767 x 10^6	18,707 x 10^3
Total :		46,149 x 10^3

Note: ¥215 = US$1.00, Col$41.0 = US$1.00

The boiler is to be supplied by DISTRAL, a Colombian manufacturer.

The scope of work covered by the above construction cost is up to the 115-kV outdoor substation. In estimating the construction cost of the alternative thermal, the above installation cost of the Paipa No. 3 unit is directly applied. In effect, the total construction cost of the alternative thermal is US$46,149,000 of which the foreign currency portion is US$27,442,000 and the domestic currency portion US$18,707,000. Considering annual inflation rates of 7.0% for the foreign currency portion and 10.0% for the domestic currency portion, present values as of the beginning of 1979 in the cases of discount rates of 10% and 20% are shown in Table 11-7.

Table 11-7 Present Value of Construction Cost Alternative Thermal Power Plants at Beginning of 1979

Unit: 10^3 U.S.$

	Discount Rate	
	10 %	20 %
Foreign currency	23,466	16,109
Local currency	17,816	12,136
Total	41,282	28,245

However, annual disbursements of the construction costs in terms of 1979 prices were estimated to be as shown below. The disbursement for each year is to be the median of the year.

Unit: 10^3 U.S.$

Year	Foreign currency	Local currency	Total
1981	1,744	1,741	3,485
1982	7,546	4,677	12,223
1983	9,606	5,612	15,218
1984	8,546	6,677	15,223
Total	27,442	18,707	46,149

11.3.2 Operation and Maintenance Cost

The operation and maintenance cost may be broadly divided into personnel costs (including administrative expenses) and operation and maintenance costs of facilities.

(1) Personnel Cost

The number of operation and maintenance personnel of a power station will differ considerably depending on the degree of automatic control for the station, but if the number of generator units is increased the number of operation and maintenance personnel per unit will be decreased. In the case of the coal-fired thermal power station of 66-MW class assumed, if there were to be two units, about 120 persons would generally be required. As the number of operating personnel for the alternative thermal 70 persons will be considered, and the personnel cost per person including administrative expenses and social insurance cost levied on enterprises by the government (not tax, but considered as part of wages) is calculated as US$9,800/yr.

(2) Maintenance and Repair Cost

The maintenance and repair cost is generally expressed as a percentage of construction cost (US$46,149,000 in the case of the Paipa No.3 Unit Project). Seen from statistics, this is 3.0% in case of coal-fired thermal power stations in many countries, so this percentage will be applied. It is assumed that approximately 80% of the repair cost will be made up of imported materials for repair.

Based on the above conditions the total annual amount of the operation and maintenance cost of the 66-MW steam thermal is calculated to be the following:

Unit: US$$10^3$

	Foreign Currency	Local Currency	Total
Personnel Cost	-	686	686
Maintenance & Repair Cost	1,108	276	1,384
Total	1,108	962	2,070

Considering annual inflation rates of 7.0% for the foreign currency portion and 10.0% for the domestic currency portion of the above cost, the present values at discount rates of 10% and 20% will be as shown in Table 11-8. The disbursements of maintenance and repair costs are converted to present values from the median of the year. The calculation formula is shown in Appendix -IV.

Table 11-8 Present Value of Operation and Maintenance Cost Alternative Thermal Power Plants at Beginning of 1979

Unit: 10^3 U.S.$

	Discount Rate	
	10 %	20 %
Foreign currency	25,438	4,821
Local currency	48,100	6,431
Total	73,538	11,252

11.3.3 Equipment Replacement Cost

The service life of a thermal power station is 25 years and there is no replacement of major equipment such as boilers, steam turbines and generators during that time. It is assumed that all equipment including auxiliary equipment will be replaced in the 25 year of the service life, but it is considered that foundations of the equipment and the building will continue to be used. In general, of the construction cost of a thermal power station, it is said about 20% is taken up by the foundation construction cost of main equipment and the building construction cost. Therefore, the equipment replacement cost is taken to be 80% of the total construction cost described in 10.3. In effect, the equipment replacement cost will be a total of US$36,921,000 of which the foreign currency portion will be US$21,954,000 and the domestic currency portion US$14,967,000.

Considering annual inflation rates of 7.0% for the foreign currency portion and 10.0% for the domestic currency portion, the present values as of the beginning of 1979 at discount rates of 10% and 20% are as shown in Table 11-9.

Table 11-9 Present Value of Replacement Cost of Equipment and Machinary Alternative Thermal Power Plants at Beginning of 1979

Unit: 10^3 U.S.$

	Discount Rate	
	10 %	20 %
Foreign currency	9,138	648
Local currency	14,254	1,027
Total	23,392	1,675

However, disbursements of the replacement costs were estimated at 1979 prices as shown below. The disbursement of each year is at the median of the year.

Year	Foreign currency	Local currency	Total
2007	1,195	1,993	3,188
2008	6,037	3,742	9,779
2009	7,684	4,490	12,174
2010	7,038	4,742	11,780
Total	21,954	14,967	36,921

11.3.4 Fuel Cost

The fuel cost of the coal-fired thermal power station selected as the alternative thermal compared with prices of the other fuels, natural gas and bunker C oil, are the followings:

Bunker C oil : US¢0.929/1,000 kcal (international price)
Natural gas : US¢0.992/1,000 kcal (" ")
Coal : US¢0.185/1,000 kcal (domestic price)

As indicated above, the fuel cost of the alternative coal-fired thermal is one fifth compared with the prices of bunker C oil and natural gas. On the other hand, this means that the price per calorie is the same as that of natural gas being utilized in Colombia for power generation as described in 11.1.3 (2).

The available energy production by year possible at Julumito Hydro-electric Power Station is as shown below.

Unit: GWh

n	Year	Firm energy	Secondary energy	Total
1	1985	259.4	47.6	307.0
2	1986	259.4	47.6	307.0
3	1987	259.4	47.6	307.0
4	1988	259.4	47.6	307.0
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
49	2033	259.4	47.6	307.0
50	2034	259.4	47.6	307.0

The fuel cost of the alternative thermal power station corresponding to the above available energy production by year possible at Julumito Hydro-electric Power Station is calculated below.

(1) Fuel Cost Corresponding to Firm Energy

Assuming the operating thermal efficiency (transmission end) of a 66 MW power station to be 31.3%, the fule cost per kWh at the 1979 price is calculated as follows:

US¢0.185/1,000 kcal x 860 kcal/kWh x 1/0.313 = US¢0.508/kWh

(2) Fuel Cost Corresponding to Secondary Energy

In general, the evaluation of secondary energy of hydro is lower than that of firm energy. The Survey Team will evaluate it by the adjustment factor of 0.7 used internationally. In effect, the calculation is as follows:

US¢0.508/kWh x 0.7 = US¢0.356/kWh

Using the above unit fuel prices and considering an escalation annually of 7.0%, the present values as of the beginning of 1979 in the cases of discount rates of 10% and 20% are as shown in Table 11-10.

Table 11-10 Present Value of Fuel Cost Alternative Thermal Power Plants at Beginning of 1979

Unit: 10^3 U.S.$

	Discount Rate	
	10 %	20 %
Firm energy	30,227	5,733
Secondary energy	3,889	738
Total	34,116	6,471

However, disbursements of the fuel costs were estimated at 1979 prices as shown below. The disbursement for each year is at the median of the year.

Unit: 10^3 U.S.$

n	Year	Firm energy	Secondary energy	Total
1	1985	1,318	169	1,487
2	1986	1,318	169	1,487
3	1987	1,318	169	1,487
4	1988	1,318	169	1,487
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
49	2033	1,318	169	1,487
50	2034	1,318	169	1,487

11.4 Benefit-Cost Ratio and Economic Internal Rate of Return

The economic analysis of a project is based on the three techniques below.

(1) Benefit-Cost Ratio (B/C)

$$B/C = \frac{\sum_{n=1}^{n} \frac{B_n}{(1+i)^n}}{\sum_{n=1}^{n} \frac{C_n}{(1+i)^n}}$$

where

i : discount rate

n : n-th year

C_n : cost of n-th year

B_n : benefit of n-th year

(2) Surplus Benefit

$$B - C = \sum_{n=1}^{n} \frac{B_n}{(1+i)^n} - \sum_{n=1}^{n} \frac{C_n}{(1+i)^n}$$

(3) Internal Rate of Return

$$B - C = 0 = \sum_{n=1}^{n} \frac{B_n}{(1+i)^n} - \sum_{n=1}^{n} \frac{C_n}{(1+i)^n}$$

In general, economic evaluations of hydro-electric power stations are often expressed in terms of benefit-cost ratio. In such case, the benefit-cost ratio will vary depending on what kind of value is taken for the discount rate i. In order to avoid such a problem, it is a rule of international financing institutions (World Bank, Asian Development Bank, etc.) to evaluate by internal rate of return. Although the surplus benefit method will indicate the merit of a project by an absolute value, when benefit-cost ratios are the same, the surplus benefit will be larger the scale of the project, so that it is not suitable to evaluate only by surplus benefit.

While the three methods mentioned above all have their merits and demerits, in analysis of the present Project evaluations will be made by the two techniques of benefit-cost ratio and economic internal rate of return.

11.4.1 Benefit-Cost Ratio

If the Julumito Hydro-electric Power Project is realized, it will not be necessary for a coal-fired thermal power station as an alternative to be realized. In other words, since the expenditure for the alternative thermal power station will be avoided as a result of the Project, this may be considered as the benefit of the Julumito Hydro-electric Power Project.

As previously stated in 11.2 and 11.3, escalation of equipment prices, fuel costs, etc. are considered in calculation of the present values of the Julumito Hydro-electric Power Project and the alternative coal-fired thermal. Regarding the present values of the total costs of the Julumito Hydro-electric Power Project and the alternative thermal power, they have already been calculated for discount rates of 10% and 20%. Calculating the present values for discount rates of 12% and 15%, they are as follows:

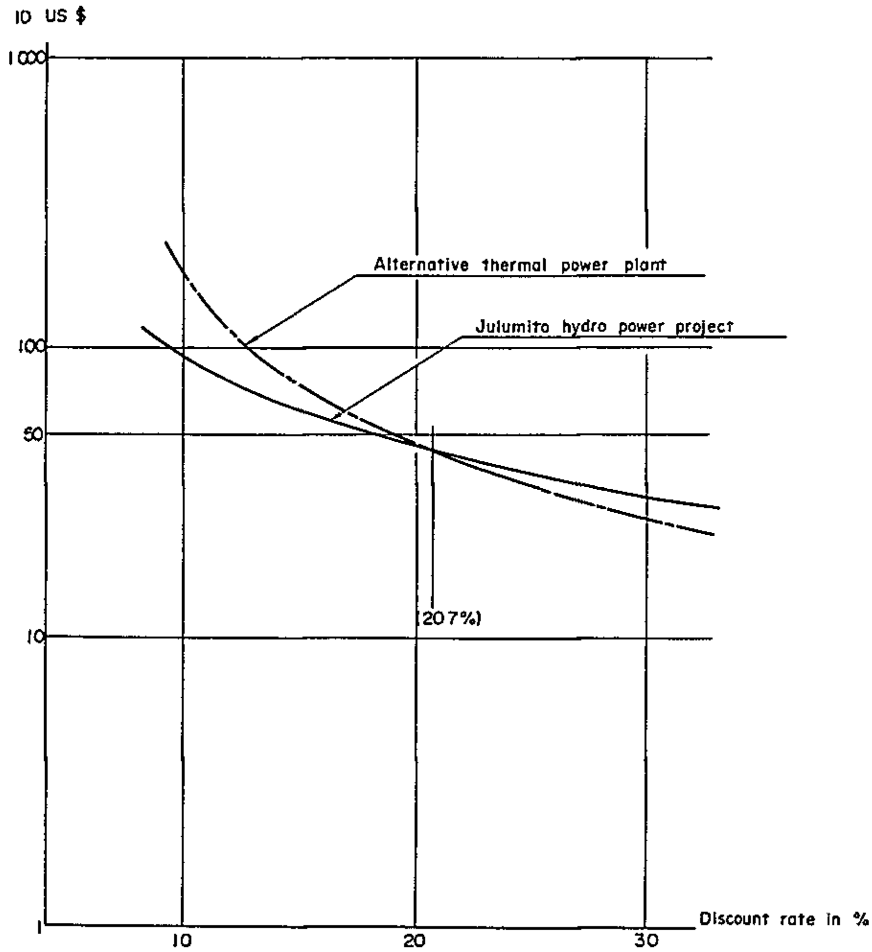
Discount Rate(%)	A Julumito Project (10^3US$)	B Alternative Thermal (10^3US$)	A/B Benefit-Cost Ratio
10	94,133	172,328	1,831
12	75,856	118,869	1,567
15	59,921	77,427	1,292

In economic analyses of projects in Colombia, a discount rate of 12% is normally applied in which case the benefit-cost ratio of the Julumito Hydro-electric Project will be 1.567, and it is judged to be superior to the alternative coal-fired thermal power project.

11.4.2 Economic Internal Rate of Return

With discount rate on the abscissa and present value of total cost on the ordinate, the cost curves of the Julumito Hydro-electric Power Project and the alternative coal-fired thermal power project plotted are as shown in Fig. 11-1, and it is seen that the intersecting point of the two curves correspond to a discount rate of 20.7%. In effect, this interesting point indicates the profit and loss balancing point (economic internal rate of return) of the Julumito Hydro-electric Power Project when compared with the alternative thermal, and if the discount rate is under 20.7%, the Julumito Hydro-electric Power Project will be economically superior to the alternative coal-fired thermal project.

Fig. 11-1 Present Value of Julumito Hydro-Electric Power Project and Alternative Thermal Power Plant



Although the economic internal rate of return of the Julumito Hydro-electric Power Project is high at 20.7%, this means that the Project will be viable in the comparison with the alternative coal-fired thermal power project even on loan conditions of high capital cost (interest, etc.). However, although the calculation was made assuming the expenditure (total cost) of the coal-fired thermal to be the income of the Julumito Hydro-electric Power Project, for example, there will be no revenue matching the construction cost of the alternative coal-fired thermal during the construction period of Julumito Hydro-electric Power Station, while the operation and maintenance cost, and final cost of the coal-fired thermal are not to be the actual revenue after start of operation. Therefore, it will be necessary to pay attention to the fact that this is difficult from the generally-mentioned internal rate of return.

11.5 Sensitivity Analysis

In the economic analysis of the Julumito Hydro-electric Power Project, upon carrying out field investigations, the construction cost of Julumito and the construction cost and fuel cost of the alternative thermal were calculated based on the latest data applying actual unit construction costs from similar projects in Colombia, and the construction cost of the Paipa Thermal No. 3 Unit contracted in March 1979. These are thought to be of fairly high accuracy, but there may be some degree of variation in the predicted values during the several years from now until completion of the power station.

Sensitivity analysis is the technique of finding what kind of influence there will be on the evaluation of the Project when these predicted values vary and is an aid for judging whether the Julumito Hydro-electric Power Project should be implemented in the face of future uncertainties.

11.5.1 Influence of Variation in Construction Cost of Julumito Hydro-electric Power Project

The proportion of the construction cost in the total cost of a hydro-electric power station is large compared with that of an alternative thermal. That is, whereas the proportion of the construction cost in the total cost including the operation and maintenance cost, equipment replacement cost and fuel cost disbursed during the service life is 34% in the case of thermal, it is as much as 73% in the case of hydro.

Consequently, increase or decrease in the construction cost of a hydro will have a great influence on the benefit-cost ration.

As shown in Fig. 11-2, if the construction cost of Julumito Hydro-electric Power Station were to be increased by 20%, the benefit-cost ratio will be lowered from 1.567 to 1.292. This, in effect, shows that this Project will be amply economical even if the construction cost were to be increased by 20%.

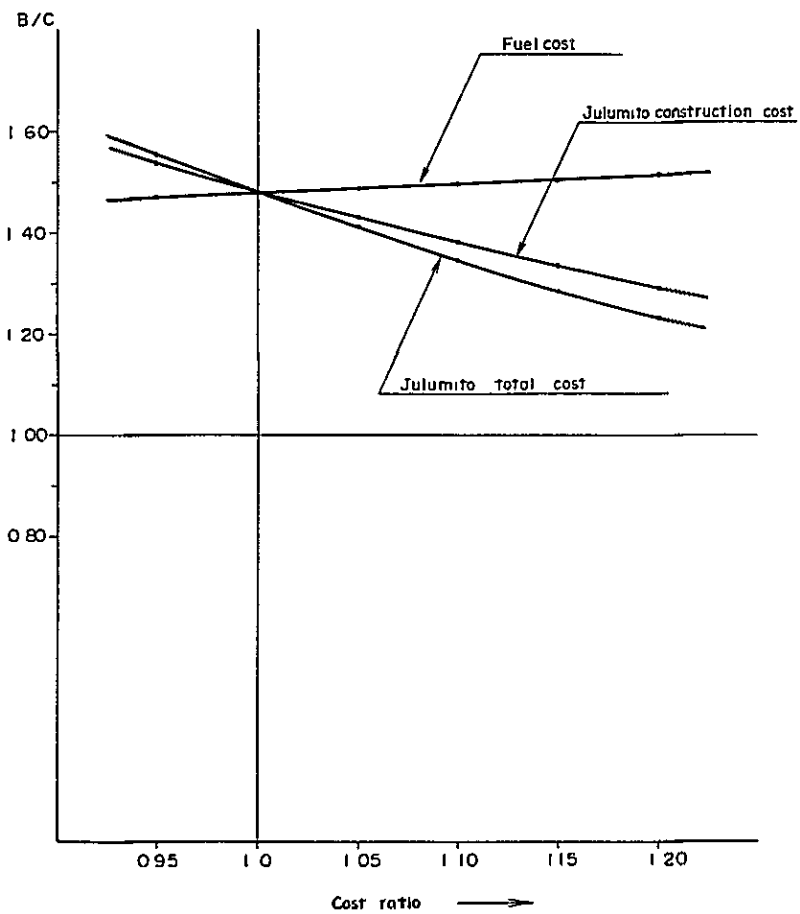
Further, the benefit-cost ratio will be 1.23 even if, after start of operation, the operation and maintenance cost and the equipment replacement cost in the 25th year were to rise by 20%, and it is seen that the increase in the operation and maintenance cost does not carry much weight in the economic analysis of this Project.

11.5.2 Influence of Variation in Fuel Cost of Alternative Thermal

As described in Item 10.2.8, the standard unit price of crude oil in long-term contracts was raised from US$13.34/barrel to US$14.54/barrel from April 1, 1979. Spot prices have shown sharp rises since immediately after this, and there have even been prices seen of more than double the standard unit price. It is thought that petroleum prices will continue to rise in the future reflecting the global shortage of petroleum, and it will be examined what influence there would be of sharp rises in the fuel cost of the alternative thermal on the evaluation of the Julumito Hydro-electric Power Project.

The proportion of fuel cost in the total cost of the alternative thermal is comparatively small at 13%. Accordingly, as shown in Fig. 11-2, the role played by increase in fuel cost in increasing the benefit of the Julumito Hydro-electric Power Project will be comparatively small, and it may be seen that even if the fuel cost were to be increased by 20%, the benefit-cost ratio of the Julumito Hydro-electric Power Project will only rise 0.04 from 1.48 to 1.52.

Fig. 11-2 Sensitivity Analysis of Julumito Project



CHAPTER 12

FINANCIAL ANALYSIS

CHAPTER 12 FINANCIAL ANALYSIS

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CHAPTER 12 FINANCIAL ANALYSIS

Huge investments are required for development of hydro-electric power sources. Even though the investment is made, a construction period over several years will be required and income in return for the investment will only start to come in several years later. The legally-designated service life of the facility for power source will be fairly long compared with service lives of other facilities in general. These factors mean that the repayment of principal and interest from the revenue produced upon making the investment will unavoidably be over a long period of time.

Consequently, it is an indispensable condition for hydro-electric power development for funds to be procured which are of low interest, long deferment period, and moreover, long repayment period.

To procure funds in Colombia is not suitable in consideration of the investment required for the Julumito Hydro-electric Power Project and the interest conditions under present circumstances. Parenthetically, the prime interest rate of city banks for loans is 24% and the interest rate on time deposits of individuals 22%, high compared with the rates of advanced nations, while moreover, there is a limit to the amount per loan. Although it seems that the interest rate in case of loans by financing organs of the Colombian Government is about 2% lower than the interest rate of the above-mentioned city banks, it is still high compared with international interest rates. It is thought such high interest rates reflect the inflation in Colombia.

On the other hand, the electricity charges which constitute the return on investment, are lower than those of other Latin American countries as described in Item 4.1.2 (3).

The Survey Team, taking into consideration the loan conditions and the current electricity tariff rates in Colombia as described above, considered that financial analyses should be made for the two cases of a loan of the entire construction cost required from an international financing institution and a loan based on government-to-government development aid. Further, it is assumed that the costs of preparatory works prior to starting the main works would be met with ICEL's own funds.

12.1 Construction Cost Required

The construction cost required up to 1984, including escalation, is estimated to be a total of US$103,200,000 of which the foreign currency portion will be US$59,658,000 and the domestic currency portion US$43,542,000. The direct construction cost, indirect cost, escalation and total construction cost will be the following:

Unit: 10^3US$

	Foreign currency	Local currency	Total
Direct const. cost	35,151	22,753	57,904
Indirect const. cost	10,441	7,555	17,996
Escalation	14,066	13,234	27,300
Total const. cost required	59,658	43,542	103,200

The above construction cost includes interest during construction, but the financial analysis will consider US$94,430,000 of which US$54,627,000 will be a foreign currency portion and US$39,803,000 a domestic currency portion excluding interest during construction (see Table 12-4).

12.2 Loan Conditions

In the financial analysis of the Julumito Hydro-electric Power Project, the two loan conditions below are to be the bases for study.

Case A

Interest	:	8.0%/yr
Repayment term	:	Within 17 years with 3 years deferment
Commitment charge	:	0.75%/yr
Repayment method	:	Equal installments of principal plus interest

Case B

Foreign Currency Portion

Interest	:	3.5%/yr
Repayment term	:	25 years with 7 years deferment
Repayment method	:	Equal installments of principal

Domestic Currency Portion

Interest	:	10.0%/yr
Repayment term	:	10 years with 3 years deferment
Repayment method	:	Equal installments of principal

In the case of the loan conditions of Case A, borrowings from an international financing institution will be the necessary total investment of US$91,603,000 and interest during construction of US$14,514,000, a total of US$106,117,000 (see Table 12-7). The temporary works costs required from 1979 to 1981 and the commitment charge accompanying the loan was considered as being met by ICEL with its own funds.

In the case of the loan conditions of Case B, the government-to-government aid amount is to be the foreign currency equivalent of US$54,013,000 from 1981, with borrowings from foreign city banks to be US$37,767,000 for the domestic currency portion from 1982 and the interest of US$11,368,000 on the foreign and domestic currency portions, a total of US$49,135,000. Consequently, the temporary works cost and the amount corresponding to the interest on foreign currency in 1981 were considered to be covered with ICEL's own funds (see Table 12-8 and Table 12-10).

	ICEL's found	External found	Total
Case A	3,676	106,117	109,793
Case B	2,655	103,149	105,804

12.3 Tariff Rates

In the financial analysis of the Julumito Hydro-electric Power Project, the future elec tricity tariff rates were estimated based on the current tariff rate system, further estimating the appropriate ratio of power generating costs in the electricity charges (cost of existing power gene ation facilities, cost of purchasing electricity from power systems, cost of new electric power supply sources, etc.), upon which the electricity charge at the generating end is calculated.

12.3.1 Tariff Rate at Consumer End

Electricity charges should not be such that the electric power company will gain excessive profits, but must not be such that proper management of the electric power company will not be possible. In effect, the electricity charge must be something that compensates the necessary cost in order for an electric power company, based on efficient management, to supply good service to consumers. It is judged from the present tariff rates of CEDELCA and CEDENAR that the soundnesses of the enterprises will be impaired, but improvements can be looked forward to if the revisions in charges being contemplated by CEDELCA and CEDENAR as indicated in Table 12-1 were to be carried out.

Table 12-1 Average Tariff Rate estimated by CEDELCA and CEDENAR

Unit: Col. $/kWh

	1978	1979	1980	1981	1982	Annual increase (%)
CEDELCA	0.76	0.96	1.19	1.49	1.87	25.2
CEDENAR	0.80	1.08	1.35	1.69	2.11	27.4

The above tariff rates are the averages for the various consumers and take into consideration future electricity charge raises monthly of 2% based on the current tariff rates.

The Survey Team will consider that the future electricity charges, with the above-mentioned estimated CEDELCA and CEDENAR rates as bases, will be raised annually at a rate of 18% from 1982 to 1985 when Julumito Hydro-electric Power Station will start operation, 13% from 1986 to 1990, and be constant from 1991. The tariff rates estimated based on the above are shown in Table 12-2.

Table 12-2 Estimated Average Tariff Rate

Unit: Col. $/kWh

	1985	1986	1987	1988	1989	1990	1991 to
CEDELCA	3.07	3.47	3.92	4.43	5.01	5.65	6.38
CEDENAR	3.47	3.92	4.43	5.01	5.65	6.38	7.21
Average	3.27	3.70	4.18	4.72	5.33	6.02	6.80

Note: It is assumed that the electricity of the Julumity Hydro-electric Power Project will be sold 50% each to CEDELCA and CEDENAR.

12.3.2 Tariff Rate at Generating End

The percentages by items of expenditures from the electric enterprise revenues of CEDELCA and CEDENAR in 1977 were the following:

Unit: %

Expenditure Item	CEDELCA	CEDENAR	
Power generation	31.4	28.6	
Power purchase	15.6	31.5	Purchased from ISA
Transmission	4.3	0.9	
Distribution	16.8	10.7	
Bill collection	8.6	12.7	
General administrative expenses	23.3	15.6	
Total	100.0	100.0	

The costs required for power generation by CEDELCA and CEDENAR including expenditures for purchasing electric power from ISA are 47.0% and 60.1%, respectively. The unit price of power purchased from ISA is 0.6 Colombian peso/kWh, roughly equal to the electricity charge at customer end, and consequently, the ratio of generating cost will become higher in accordance with increase in the ratio of power purchases. In comparison, the ratios of the generating end costs in the total generating costs in the U.S.A. and Japan are 40 - 45%.

According to the Feasibility Study Report of the Julumito Hydro-electric Power Project submitted in 1972 to the Colombian Government by the Japanese Government, the ratio of the generating-end cost obtained from the costs of the transmission lines, substations and distribution lines to customers in the CEDELCA Power System was 40% of the total cost.

Based on the above, the Survey Team will fix the electricity charge of Julumito Power Station at the receiving end of New Popayan Substation to be the electricity charge at the customer end in 1985 multiplied by 0.45. The tariff rates to be applied in the financial analysis of Julumito Hydro-electric Power Station are shown in Table 12-3.

In Table 12-3, since the estimated electricity charge at the customer end in 1977 is the average charge in Japan of 2.77 Colombian peso/kWh, the estimated tariff rate of 3.27 Colombian peso/kWh in 1985 is only 18% higher than the rate in Japan in 1977. In effect, the tariff rates of CEDELCA and CEDENAR in 1985 will not be extremely high even when compared with the current electricity charges of Japan.

Table 12-3 Estimated Tariff Rate at Customer and Generating End

		1985	1986	1987	1988	1989	1990	1991 to
Customers end	Col. $/kWh	3.27	3.70	4.18	4.72	5.33	6.02	6.80
Generating end	Col. $/kWh	1.47	1.67	1.88	2.12	2.40	2.71	3.06
Generating end	US mill/kWh	35.9	40.7	45.9	51.7	58.5	66.1	75.4

For the secondary energy generated at Julumito Hydro-electric Power Station, the above generating end tariff rates are to be multiplied by 0.7.

12.4 Annual Cost of Julumito Hydro-electric Power Station

12.4.1 Operation and Maintenance Cost

The operation and maintenance cost of Julumito Hydro-electric Power Station consists of wages of operation and maintenance personnel, maintenance and repair cost of facilities, miscellaneous costs such as insurance, and general administrative costs.

These costs have been discussed in Item 11.2.2, and are estimated to be the following in 1985 when Julumito Hydro-electric Power Station starts operation.

	1985 (US$$10^3$)	Annual Growth Rate (%)
Operation and maintenance personnel wages	102	10
Facilities maintenance & repair costs	852	5
Insurance, others	85	3
General administrative costs	175	10
Total	1,214	-

12.4.2 Depreciation Cost

The depreciation cost is to be calculated by the straight line method with residual balance as zero, while the service lives of facilities are to be the following according to Decreto de Ley 2286 (July 7, 1948):

Civil structure	50 yr
Electrical equipment	25 yr
Transmission line	50 yr
Gate, penstock	30 yr

Based on the above conditions, the annual depreciation costs are calculated as shown below.

	1979 Value	Escalation	Total	Depreciation
Civil structure	42,111	17,125	59,236	1,184
Electrical equipment	10,597	4,309	14,906	596
Transmission line	553	225		16
Gate, penstock	3,756	1,527	5,283	176
Other	5,180	2,111	7,299	101
Sub-total	*62,205	25,297	87,502	2,073

Note; * Contingency is not included

12.5 Repayment Plan

The funds allotted to repayment of loans are the net income from current accounts and the depreciation reserves. The net incomes for Case A and Case B of loan conditions are shown in Table 12-5 and Table 12-6. According to the two tables, it is clear that the net income will be larger for the loan conditions of Case B, and this is due to the difference in the interest borne.

Meanwhile, looking at cash flow, it will be the seventh year after start of operation of Julumito Hydro-electric Power Station for both loan conditions of A and B that the cumulative deficits will turn to surpluses. The cumulative surplus in 1994 will be 80% larger for Case B compared with Case A.

The amount to be borne by ICEL with its own funds will be US$3,676,000 for Case A and US$2,655,000 for Case B, larger for Case A, due to the difference in loan conditions.

Unit: 10^3 US$

	Case A	Case B	A-B
(1) Found required	109,793	105,804	3,989
ICEL's found	3,676	2,655	1,021
External found	106,117	103,149	2,968
(2) Not income in 1985	-1,508	177	-1,685
" 1990	8,755	12,118	-3,363
" 1995	13,828	16,120	-2,292
(3) Cash flow			
Accumlated cash balance in 1987	-7,349	- 8,440	1,091
" " 1994	27,234	48,893	-21,659

Seen from the above conclusions, the loan conditions of Case B will be desirable. However, even with Case A it may be said that this Project will be quite reasonable from the standpoint of funds.

Seen from the figures given in Table 12-4 through Table 12-10, when the repayment period is shorter and the interest rate higher than the loan conditions of Case A and Case B, it will be necessary for the start of operation of the Project not to be in 1985, but set back further.

Table 12-4 Investment for Construction (without interest during construction)

Unit: 10^3US$

		1 1979			2 1980			3 1981			4 1982		
		Total	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total	Foreign currency	Local currency
A	Generating facility	0	0	0	0	0	0	0	0	0	17,954	9,562	8,392
B	Transmission line	0	0	0	0	0	0	0	0	0	55	40	15
C	Preparatory works	139	0	139	0	0	0	684	0	684	6	4	2
	Sub-total	139	0	139	0	0	0	684	0	684	18,015	9,606	8,409
E	Engineering and adm. costs	0	0	0	571	571	0	149	149	0	711	459	252
F	Compensation	0	0	0	0	0	0	870	0	870	0	0	0
G	Contingency	0	0	0	0	0	0	0	0	0	1,053	522	531
	Sub-total	0	0	0	571	571	0	1,019	149	870	1,764	981	783
	Total (1979 prices)	139	0	139	571	571	0	1,703	149	1,554	19,779	10,587	9,192
K	Escalation	0	0	0	43	43	0	371	29	342	5,245	2,281	2,964
	Total investment required	139	0	139	614	614	0	2,074	178	1,896	25,024	12,868	12,156

		5 1983			6 1984			7 1985			Total		
		Total	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total	Foreign currency	Local currency
A	Generating facility	24,257	15,996	8,261	14,253	9,144	5,109	0	0	0	56,464	34,702	21,762
B	Transmission line	415	304	111	83	61	22	0	0	0	553	405	148
C	Preparatory works	48	33	15	10	7	3	0	0	0	887	44	843
	Sub-total	24,720	16,333	8,387	14,346	9,212	5,134	0	0	0	57,904	35,151	22,753
E	Engineering and adm. costs	1,223	896	327	777	525	252	0	0	0	3,431	2,600	831
F	Compensation	0	0	0	0	0	0	0	0	0	870	0	870
G	Contingency	2,461	1,465	996	1,411	823	588	0	0	0	4,925	2,810	2,115
	Sub-total	3,684	2,361	1,323	2,188	1,348	840	0	0	0	9,226	5,410	3,816
	Total (1979 prices)	28,404	18,694	9,710	16,534	10,560	5,974	0	0	0	67,130	40,561	26,569
K	Escalation	11,414	6,324	5,090	10,227	5,390	4,837	0	0	0	27,300	14,066	13,234
	Total investment required	39,818	25,018	14,800	26,761	15,950	10,811	0	0	0	94,430	54,627	39,803

Table 12-5 Statement of Income (Case A)

		Unit	1 1985	2 1986	3 1987	4 1988	5 1989	6 1990	7 1991	8 1992	9 1993	10 1994	11 1995	12 1996
(A)	Gross revenue from sales	10^3 US$	10,268	11,642	13.129	14,789	16,737	18.909	21.569	21.569	21.569	21.569	21.569	21.569
	Annual sales of energy													
	Firm energy	GWh	253.5	253.5	253.5	253.5	253.5	253.5	253.5	253.5	253.5	253.5	253.5	253.5
	Unit sales prices	US mills/kWh	35.9	40.7	45.9	51.7	58.5	66.1	75.4	75.4	75.4	75.4	75.4	75.4
	Revenue	10^3 US$	9,101	10,317	11,636	13,106	14,830	16,756	19,114	19,114	19,114	19,114	19,114	19,114
	Secondary energy	GWh	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5
	Unit sales prices	US mills/kWh	25.1	28.5	32.1	36.2	41.0	46.3	52.8	52.8	52.8	52.8	52.8	52.8
	Revenue	10^3 US$	1,167	1,325	1,493	1,683	1.907	2,153	2,455	2,455	2,455	2,455	2,455	2,455
(B)	Total operating cost	10^3 US$	3,287	3,361	3,439	3,522	3,611	3,707	3,808	3,917	4,034	4,160	4,294	4,437
	Operation and maintenance	10^3 US$	1,214	1,288	1,366	1,449	1,538	1,634	1,735	1,844	1,961	2,087	2,221	2,364
	Salaries and wages	10^3 US$	102	112	123	135	149	164	180	198	218	240	264	290
	Maintenance expense	10^3 US$	852	895	940	987	1,036	1,088	1,142	1,199	1,259	1,322	1,388	1,457
	Miscellareous expense	10^3 US$	85	88	91	94	97	100	103	106	109	112	115	118
	Administration expense	10^3 US$	175	193	212	233	256	282	310	341	375	413	454	499
	Depreciation	10^3 US$	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073
(C)	Operating income: (A)-(B)	10^3 US$	6,981	8,281	9,690	11,267	13,126	15,202	17,761	17,652	17,535	17,409	17,275	17,132
(D)	Financial expenses	10^3 US$	8,489	8,141	7,765	7,359	6,921	6,447	5,936	5,384	4,787	4,143	3,447	2,695
	Interest for loan	10^3 US$	8,489	8,141	7,765	7,359	6,921	6,447	5,936	5,384	4,787	4,143	3,447	2,695
(E)	Net income: (C)-(D)	10^3 US$	-1,508	140	1,925	3,908	6,205	8,755	11,825	12,268	12,748	13,266	13,828	14,437

Salable energy of Julumito power plant

Firm energy 259.4 (1-0.01) (1-0.003) (1-0.01) = 253.5 GWh

Secondary energy 47.6 (1-0.01) (1-0.003) (1-0.01) = 46.5 GWh

where: Outage factor : 1.0 %

Station service : 0.3 %

Transmission line loss : 1.0 %

Table 12-6 Statement of Income (Case B)

	Unit	1 1985	2 1986	3 1987	4 1988	5 1989	6 1990	7 1991	8 1992	9 1993	10 1994	11 1995	12 1996
(A) Gross revenue from sales	10^3 US$	10,268	11,642	13,129	14,789	16,737	18,909	21,569	21,569	21,569	21,569	21,569	21,569
Annual sales of energy													
Firm energy	GWh	253.5	253.5	253.5	253.5	253.5	253.5	253.5	253.5	253.5	253.5	253.5	253.5
Unit sales prices	US mills/kWh	35.9	40.7	45.9	51.7	58.5	66.1	75.4	75.4	75.4	75.4	75.4	75.4
Revenue	10^3 US$	9.101	10,317	11,636	13,106	14,830	16,756	19,114	19,114	19,114	19,114	19,114	19,114
Secondary energy	GWh	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5
Unit sales prices	US mills/kWh	25.1	28.5	32.1	36.2	41.0	46.3	52.8	52.8	52.8	52.8	52.8	52.8
Revenue	10^3 US$	1,167	1,325	1,493	1,683	1,907	2,153	2,455	2,455	2,455	2,455	2,455	2,455
(B) Total operating cost	10^3 US$	3,287	3,361	3,439	3,522	3,611	3,707	3,808	3,917	4,034	4,160	4,294	4,437
Operation and maintenance	10^3 US$	1,214	1,288	1,366	1,449	1,538	1,634	1,735	1,844	1,961	2,087	2,221	2,364
Salaries and wages	10^3 US$	102	112	123	135	149	164	180	198	218	240	264	290
Maintenance expenses	10^3 US$	852	895	940	987	1,036	1,088	1,142	1,199	1,259	1,322	1,388	1,457
Miscellareous expenses	10^3 US$	85	88	91	94	97	100	103	106	109	112	115	118
Administration expenses	10^3 US$	175	193	212	233	256	282	310	341	375	413	454	499
Depreciation	10^3 US$	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073
(C) Operating income: (A)-(B)	10^3 US$	6,981	8,281	9,690	11,267	13,126	15,202	17,761	17,652	17,535	17,409	17,275	17,132
(D) Financial expenses	10^3 US$	6,804	6,102	5,400	4,698	3,891	3,084	2,277	1,470	1,365	1,260	1,155	1,050
Interest for F.C	10^3 US$	1,890	1,890	1,890	1,890	1,785	1,680	1,575	1,470	1,365	1,260	1,155	1,050
Interest for L.C	10^3 US$	4,914	4,212	3,510	2,808	2,106	1,404	702	-	-	-	-	-
(E) Net income: (C)-(D)	10^3 US$	177	2,179	4,290	6,569	9,235	12,118	15,484	16,182	16,170	16,149	16,120	16,082

Table 12-7 Amortization Schedule (Case A)

Unit: 10^3US$

n	Year	Borrowing: Foreign currency	Borrowing: Local currency	Borrowing: Interest for loan	Borrowing: Total	Redemption: Commitment charge for loan	Redemption: Principal	Redemption: Interest	Redemption: Sub-total	Redemption: Total	Outstanding balance
1	1979										
2	1980										
3	1981										
4	1982	12,868	12,156	2,002	27,026	593				593	
5	1983	25,018	14,800	5,187	45,005	256				256	
6	1984	15,950	10,811	7,325	34,086	0				0	106,117
7	1985						4,351	8,489	12,840	12,840	101,766
8	1986						4,699	8,141	12,840	12,840	97,067
9	1987						5,075	7,765	12,840	12,840	91,992
10	1988						5,481	7,359	12,840	12,840	86,511
11	1989						5,919	6,921	12,840	12,840	80,592
12	1990						6,393	6,447	12,840	12,840	74,199
13	1991						6,904	5,936	12,840	12,840	67,295
14	1992						7,456	5,384	12,840	12,840	59,836
15	1993						8,053	4,787	12,840	12,840	51,783
16	1994						8,697	4,143	12,840	12,840	43,086
17	1995						9,393	3,447	12,840	12,840	33,693
18	1996						10,145	2,695	12,840	12,840	23,548
19	1997						10,956	1,884	12,840	12,840	12,592
20	1998						12,592	1,007	13,599	13,599	0
Total		53,836	37,767	14,514	106,117	849	106,114	74,405	180,519	181,368	-

Note: Commitment charge for loan: 0.75 % per annum

Table 12-8 Amortization Schedule (Case B)

Unit: 10^3US$

n	Year	Borrowing						Redemption							
								Principal			Interest			Total	Outstanding balance
		Foreign currency	Local currency	Interest F.C	Interest L.C	Interest Total	Total	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total		
1	1979														
2	1980														
3	1981	178					178								
4	1982	12,868	12,156	457	1,216	1,673	26,697								
5	1983	25,018	14,800	1,332	2,696	4,028	43,846								
6	1984	15,950	10,811	1,890	3,777	5,667	32,428								103,149
7	1985								7,019	7,019	1,890	4,914	6,804	13,823	96,130
8	1986								7,019	7,019	1,890	4,212	6,102	13,121	89,111
9	1987								7,019	7,019	1,890	3,510	5,400	12,419	82,092
10	1988							3,001	7,019	10,020	1,890	2,808	4,698	14,718	72,072
11	1989							3,001	7,019	10,020	1,785	2,106	3,891	13,911	62,052
12	1990							3,001	7,019	10,020	1,680	1,406	3,084	13,104	52,032
13	1991							3,001	7,021	10,020	1,575	702	2,277	12,299	42,010
14	1992							3,001		3,001	1,470		1,470	4,471	39,009
15	1993							3,001		3,001	1,365		1,365	4,366	36,008
16	1994							3,001		3,001	1,260		1,260	4,261	33,007
17	1995							3,001		3,001	1,155		1,155	4,156	30,006
18	1996							3,001		3,001	1,050		1,050	4,051	27,005
19	1997							3,001		3,001	945		945	3,946	24,004
20	1998							3,001		3,001	840		840	3,841	21,003
21	1999							3,001		3,001	735		735	3,736	18,002
22	2000							3,001		3,001	630		630	3,631	15,001
23	2001							3,001		3,001	525		525	3,526	12,000
24	2002							3,001		3,001	420		420	3,421	8,999
25	2003							3,001		3,001	315		315	3,316	5,998
26	2004							3,001		3,001	210		210	3,211	2,297
27	2005							2,997		2,997	80		80	3,077	0
Total		54,014	37,767	3,679	7,689	11,368	103,149	54,014	49,135	103,149	23,600	19,656	43,256	146,405	-

Table 12-9 Statement of Cash Flow (Case A)

Unit: 10^3US$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
(A) Cash receipt	139	614	2,074	27,619	45,261	34,086	565	2,213	3,998	5,981	8,278	10,828	13,898	14,341	14,821	15,339
1) Net income							-1,508	140	1,925	3,908	6,205	8,755	11,825	12,268	12,748	13,266
2) Depreciation							2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073
3) Borrowing	-	-	-	27,026	45,005	34,086										
4) ICEL's fund	139	614	2,074	593	256	0										
(B) Cash disbursment	139	614	2,074	27,619	45,261	34,086	4,351	4,699	5,075	5,481	5,919	6,393	6,904	7,456	8,053	8,697
1) Construction expenditure	139	614	2,074	27,619	45,261	34,086										
Investment	139	614	2,074	25,024	39,818	26,761										
Interest				2,002	5,187	7,325										
Commitment charge				593	256	0										
2) Repayment																
Principal of IFI loan							4,351	4,699	5,075	5,481	5,919	6,393	6,904	7,456	8,053	8,697
(C) Cash balance: (A)-(B)	0	0	0	0	0	0	-3,786	-2,486	-1,077	500	2,359	4,435	6,994	6,885	6,768	6,642
(D) Accumulated total							-3,786	-6,272	-7,349	-6,849	-4,490	-55	6,939	13,824	20,592	27,234

Table 12-10 Statement of Cash Flow (Case B)

Unit: 10^3US$

	1 1979	2 1980	3 1981	4 1982	5 1983	6 1984	7 1985	8 1986	9 1987	10 1988	11 1989	12 1990	13 1991	14 1992	15 1993	16 1994
(A) Cash receipt	139	614	2,080	26,697	43,846	32,428	2,250	4,252	6,363	8,642	11,308	14,191	17,557	18,255	18,243	18,222
1) Net income							177	2,179	4,290	6,569	9,235	12,118	15,484	16,182	16,170	16,149
2) Depreciation							2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073	2,073
3) Borrowing			178	26,697	43,846	32,428										
4) ICEL's fund	139	614	1,902	0	0	0										
(B) Cash disbursment	139	614	2,080	26,697	43,846	32,428	7,019	7,019	7,019	10,020	10,020	10,020	10,022	3,001	3,001	3,001
1) Construction expenditure	139	614	2,080	26,697	43,846	32,428										
Investment	139	614	2,074	25,024	39,818	26,761										
Interest			6	1,673	4,028	5,667										
2) Repayment of debit							7,019	7,019	7,019	10,020	10,020	10,020	10,022	3,001	3,001	3,001
Principal of governmental credit										3,001	3,001	3,001	3,001	3,001	3,001	3,001
Principal of banker's credit							7,019	7,019	7,019	7,019	7,019	7,019	7,021	-	-	-
(C) Cash balance: (A)-(B)	0	0	0	0	0	0	-5,017	-2,767	-656	-1,378	1,288	4,171	7,535	15,254	15,242	15,221
(D) Accumlated total							-5,017	-7,784	-8,440	-9,818	-8,530	-4,359	3,176	18,430	33,672	48,893

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