CHAPTER 11

CONSTRUCTION SCHEDULE AND WORK PROGRAM

CHAPTER 11 CONSTRUCTION SCHEDULE AND WORK PROGRAM

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FIGURE LIST

CHAPTER 11 CONSTRUCTION SCHEDULE AND WORK PROGRAM

11.1 CONSTRUCTION SCHEDULE

11.1.1 GENERAL

Water supply to Laguna Aricota and Aricota No. 3 Hydroelectric Power Scheme is predicted on the necessity for it to be implemented as soon as possible in view of the present state of utilization of lake water.

In effect, according to the growth in power demand, it is necessary for the water supply scheme to start operation by July 1987, and Aricota No. 3 Power Station by the end of 1987. Particularly, since the water supply scheme, including dilution and drainage of Laguna Loriscota, will require a period of 3 years, there will be a necessity for it to be started by July 1984. Besides the diluting and draining, other works, are to have a construction period of 2 years, and are planned to be started in July 1985. As for Aricota No. 3 Power Station, it was assumed the main work would require two and a half years, and was planned to be started in July 1985. However, preliminary works required to be carried out in advance in order to be able to start the main work.

The principle work processes of the two plans are as shown in Fig. 11- 1 and Fig. 11-2.

11.1.2 WORK SCHEDULE FOR WATER SUPPLY SCHEME

(1) Loriscota Waterway (Laguna Loriscota - Tocco Site)

This project is planned to be done in three years including dilution and drainage of Laguna Loriscota, and the open canal at Loripongo will need to be constructed in as short time as possible.

After completion of the Loripongo open canal and the downstream-side waterway to the Tocco site, the dilution and drainage of Laguna Loriscota will follow. In this case, the connecting point between the lake bottom and the waterway left dam-like in excavation is to be dug down in accordance with lowering water level due to drainage.

The water collection canal is to be constructed toward the end of the dilution and drainage process, or after completion of drainage.

(2) Tocco Waterway (Tocco Site - Rio Mataza)

Planning was made for excavation and embankment works to be carried out first, followed by lining concreate from several places.

Other than the above, tunnelling is planned for excavation of 50 m/mo and lining for 75 m/mo, with the work to be completed in two years.

(3) Tocco Dam and Water Pump-up Facilities

Although it would be possible for Tocco Dam and the pumping station to be constructed simultaneously, it was planned for the work to be done in a series considering the overall schedule in order to save on the quantity of machinery and number of personnel to be employed.

A period of 20 months was estimated for the pipe line form ordering to intallation and testing. It is necessry for the pipe line to be ordered at an early date after start of construction on the scheme.

11.1.3 WORK SCHEDULE FOR ARICOTA NO.3 SCHEME

In order to start work on the No. 3 scheme in July 1985, access roads to the portals of the adit tunnels and about 10 km transmission line for construction (10,000 V) from Aricota No. 2 Power Station to Chulibaya are to be completed as preparatory works by the end of June 1985.

The points requiring caution from the standpoint of the work schedule are the following:

(1) Waterway Tunnel

Work adits are to be provided at three places with planning done on the basis of average advance of excavation 100 m/mo and advance of lining 150 m/mo. The 6.4 km of tunnelling work to the head tank will comprise the critical path for this scheme.

(2) Penstock and Powerhouse Excavation

Since the powerhouse site is located immediately downstream of the steeply-sloped portion of the penstock, the bottom part of the penstock is to be excavated at an early stage after start of construction, following which excavation is to be done from the tailrace side to the powerhouse.

There are no other places that would especially pose problems in construction, but since a period of 2 months will be required for trial operation, all work must be completed by the end of October 1987.

11.2 WORK PROGRAM

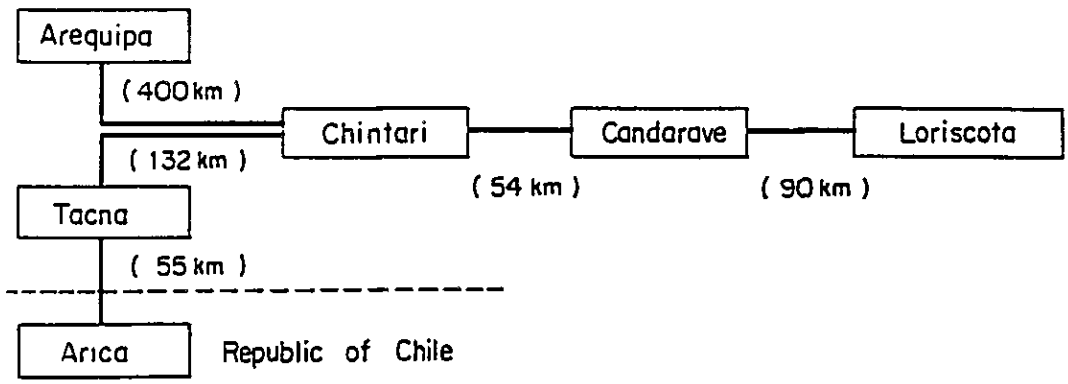
11.2.1 GENERAL

In the work program for construction, the regional conditions and the climatic conditions of the water supply scheme area at an altitude exceeding EL. 4,000 m, and the No. 3 scheme area are taken into consideration.

The traffic and transportation conditions are comparatively good for both areas and it will not be necessary for large-scale main roads to be constructed newly. Materials procured domestically would be transported chiefly from Tacna and Arequipa, while imported materials would be landed at the port of Arica in the Republic of Chile and transported by the Pan American Highway to Chintari, then to Candarave, and on to the water supply scheme area.

Of construction materials, cement and reinforcing steel are produced domestically and are commonly distributed in Departamento de Tacna, but it will be necessary for measures to be taken for stable supply during the period of construction.

Transportation Map



11.2.2 CONSTRUCTION FACILITIES FOR WATER SUPPLY SCHEME

Regarding temporary facilities for construction, the kinds of facilities to be installed and their scales would be decided depending on site condition, scales of structures, construction work schedule, topographical and geological conditions, etc., the principal facilities being the following:

(1) Worker's Camp

The camp is to be provided at a place close to the construction site, where a water supply for daily life is available, and an existing road is nearby.

(2) Electric Power for Construction

The waterway is to be of great length while there will be no work requiring a large power supply at one place. The transmission line to be provided from Suches for power supply to Tocco Pumping Station will not be constructed in time to serve as a power source for construction. Consequently, all electric power for construction is planned to be supplied using portable diesel power geneators wherever necessray.

(3) Concrete Facilities

For concrete aggregates and rock used in lining waterways, good-quality materials from excavation muck, and river-bed deposits are to be used.

A concrete plant is to be provided at the Tocco site with concrete supplied to the dam, spillway, pumping station, and for pump-up pipeline installation. Concrete for lining waterways is to be supplied by engine-driven mixers which are to be moved along the waterways.

11.2.3 CONSTRUCTION OF MAJOR STRUCTURES (Water Supply Scheme)

(1) Loriscota Waterway

The Loriscota waterway can be broadly divided into the three parts below.

a) Loripongo open canal
b) Waterway from Loripongo site to Tocco site
c) Collection canals at Loriscota lake bottom area

Of these, a) and b) can be worked simultaneously while the work of c) would be done in succession to a) and b) after diluting and draining Laguna Loriscota.

The average daily volume of excavated earth at the principal part of the Loripongo open canal will be about 1,500 m^3. The excavation can be achieved with two parties consisting of 40-ton class bulldozers, 2.0 m^3 class wheel loaders, and 10-ton class dump trucks, but in deciding on the construction equipment to be used, it would be desirable to carry out detailed studies such as topographical and geological investigations.

(2) Tocco Intake Dam and Pumping Station

A multiple-stage diversion method is to be adopted for care of river in construction of the intake dam. Firstly, the present river flow is to be diverted to the left-bank side by embankment work, and excavation and construction of concrete structures carried out at spillway portion. A temporary diversion bypass is to be provided at the overflow weir. Later, the flow is to be switched to the spillway side, and construction of the dam proper is to be carried out. Dam construction is to be performed in the order to excavation, foundation treatment, and embankment, then the works are completed by providing a asphalt-concrete facing.

The pumping station and pump-up pipeline works are to be executed in parallel to the intake dam.

(3) Tocco Waterway

The open canal is to be excavated mainly using oil-hydraulic backhoes, with muck handling and banking operaitons done by bulldozer.

The waterway tunnel is to be constructed from the downstream side, driving full face by the rail method.

11.2.4 CONSTRUCTION FACILITIES FOR ARICOTA NO.3 SCHEME

Principal Temporary Facilities in Aricota No. 3 Schem Area are as following.

(1) Temporary Buildigns

The office and camp of the owner, and the contractor's office are to be provided in the Chintari district, with workers' quarters provided at both the Chintari and Chulibaya districts.

(2) Access Roads

Access roads totalling approximately 7 km in length are to be constructed to Work Adits No. 1 and No. 2 to be provided at the waterway tunnel, and to the head tank site. However, since a steeply-sloped topography is seen in part, it will be necessary to carry out prior topographical investigations in detailed route selection.

(3) Electric Power for Construction

It is estimated that the electric power requirements for construction will amount to about 1,600 kW. This power is to be supplied from Aricota No. 2 Power Station with a transmission line for construction (10,000 V) to be installed from the power station to the Chulibaya district for delivery to the various receiving facilities.

(4) Concrete Facilities

Concrete aggregates are to be collected from the river bed of the Rio Curibaya, while also, good quality material from tunnel excavation muck is to be crushed and used.

An aggregate plant and a batching plant are to be provided at the Chulibaya site, with concrete supplied to the various work sites by truck mixers.

11.2.5 CONSTRUCTION OF MAJOR STRUCTURES (Aricota No.3 Scheme)

(1) Regulating Pond and Intake

The regulating pond and intake facilities such as the intake must be constructed while continuing operation of the No. 2 power station. Therefore, a culvert is to be constructed from the tailrace of the No. 2 power station to detour the intake facilities, and the natural flow of the Rio Curibaya and power generation discharge is diverted. Following this, excavation, concrete placement, and embankment while compacting with heavy equipment are to be carried out, upon which asphalt concrete is to be placed.

(2) Waterway Tunnel

Tunnel excavation is to be performed with the full face driven by the rail method. Drilling of holes is to be done using oil-hydraulic jumbos. The muck after blasting is to be hauled outside by battery-powered locomotive and steel carts. As a rule, the excavation muck is to be disposed at safe places near portal.

In lining work, transportation of concrete inside the tunnel is to be done using placer and sliding forms. Since the tunnel work is on the critical path, the work is to be on a 24-hour basis and attention is required so as to manage the work schedule.

Fig. 11-1 Construction Schedule for Water Supply Scheme

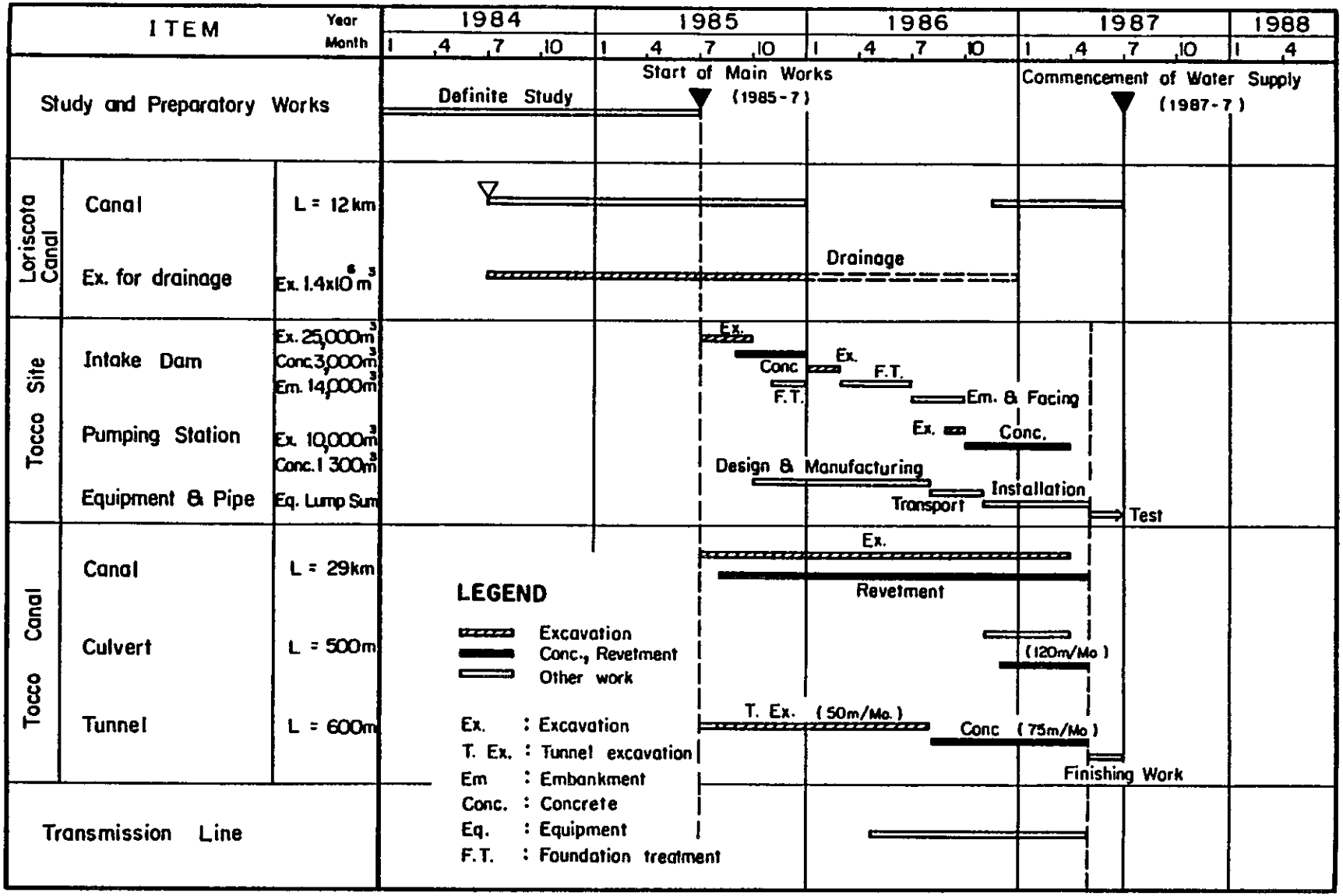
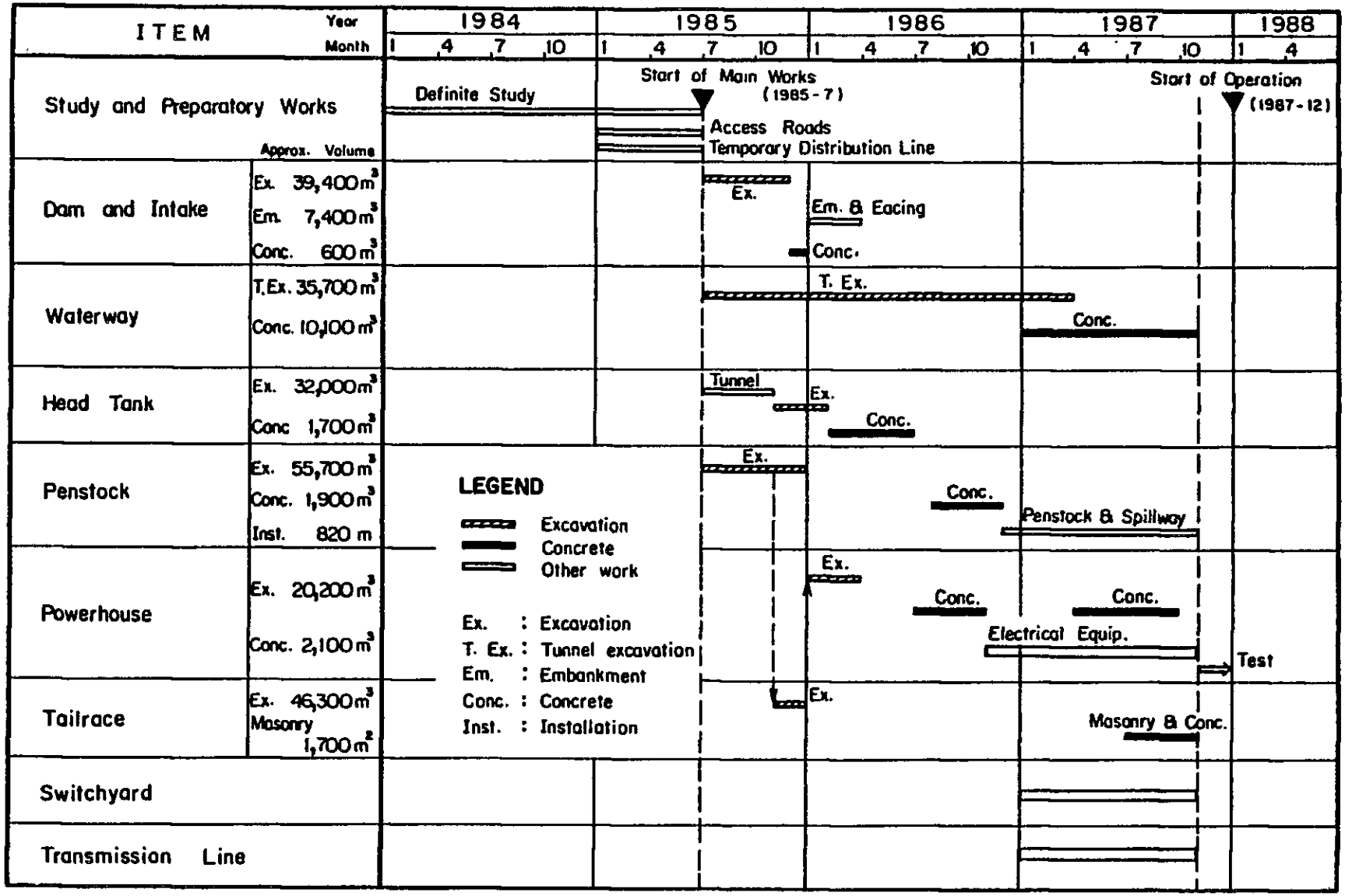


Fig. 11-2 Construction Schedule for Aricota No.3 Power Station



CHAPTER 12

CONSTRUCTION COST

CHAPTER 12 CONSTRUCTION COST

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TABLE LIST

CHAPTER 12 CONSTRUCTION COST

12.1 BASIC CONDITIONS

12.1.1 GENERAL

In estimation of the construction cost of the Project, the natural conditions of the sites, regional conditions, the scale of the works, and the technological level which can be expected at the present time were taken into consideration, and estimations were made based on prices in December 1982.

The construction cost was estimated with items procurable in Peru as requiring local currency and all other items as requiring foreign currency.

12.1.2 SCOPE OF CONSTRUCTION COST ESTIMATION

The scope of construction cost estimation was that indicated below.

(1) Laguna Aricota Water Supply Scheme

a) Laguna Loriscota drainage works

b) Intake facilities

Loriscota waterway

Tocco Dam, pumping station, switchyard, pump-up pipeline and head tank

Tocco waterway

Access road and temporary facilities for construction

c) 69 kV transmission line

Suches - Tocco 35 km

d) Suches substation

69 kV transmission line outgoing facilities	for 1 cct

e) Telecommunication facilities

Aricota No. 2 terminal station	HF

(2) Aricota No. 3 Scheme

a) Aricota No. 3 Power Facilities

Dam and intake

Headrace tunnel, head tank, and penstock

Powerhouse and switchyard

Access road and temporary facilities for construction

b) 138 kV Transmission Line

Aricota No. 3 - Aricota No. 2	8 km

c) Aricota No. 2 Power Station

138 kV transmission line outgoing facilities	for 1 cct

d) Telecommunication Facilites

Aricota No. 2 terminal station	PLC
Aricota No. 3 terminal station	PLC

12.2 COMPONENTS OF CONSTRUCTION COST

12.2.1 CIVIL WORKS COST

(1) Work quantities were calculated based on the drawings attached to Chapters 7 and 8. The principal work quantities by type of work are shown in Fig. 11-1 and Fig. 11-2.

(2) Of reference unit prices, for those of local currency such as materials and labor procurable in Peru, the prevailing prices in Departamento de Tacna were used.

As for imported materials and imported machinery, CIF prices were calculated by adding ocean freight and insurance to internationally competitive FOB prices in Japan, and these were all listed as requiring foreign currency.

The principal ones among the reference unit prices adopted are given in Table 12-1.

(3) For unit prices of works, the unit prices in civil works in the neighborhood of the project area were referred to, and based on the reference unit prices, the figures were determined taking into consideration empirical prices under similar construction conditions in Japan.

(4) Construction Equipment, Hydraulic Equipment

Construction equipment and hydraulic equipment were predicated on imports, but the conditions were that they would be exempted from import duties and sales taxes. It was assumed that hydraulic equipment would be manufactured overseas and supplied, and transportation to the job site and all expenses incidental to the transportation, and the costs of assembly, installation and adjustment at the job site would be included in the construction cost.

Table 12-1 Basic Unit Prices for Civil Works

Unit: US$

Item	Unit	Price	Currency
(labor)			
Foreign Foreman	day	105	in foreign currency
Foreman	"	13	in local currency
Operator	"	11	"
Labor	"	9	"
(Material)			
Cement	t	85	in local currency
Reinforcing bar	t	850	"
Dynamite	kg	2.1	"
Diesel oil	lit.	0.3	"

Note : 1. day = 8 hours

2. Materials prices are for Chintari site. 5%. Additional price is applied for Andes site.

12.2.2 ELECTRICAL WORKS COST

It was considered that the main equipment and materials (turbine, generator, main transformer, outdoor switchgear, steel tower, conductor, insulator, and telecommunications equipment) would all be manufactured abroad and supplied, and the costs of these imported items requiring foreign currency were calculated on the basis of CIF prices adding ocean freight and insurance to internationally competitive FOB prices in Japan.

All equipment and materials imported from Japan would be landed at the port of Africa in Chile, from where they would be transported by truck and trailer to the project site, the cost of such transportation being calculated in the local currency requirements.

The costs of installation works were calculated referring to work performances in the past, assuming that all of the transmission line construction cost would be covered by local currency, while generating and transforming equipment were calculated separated into foreign and local currency requirements.

12.2.3 ADDITIONAL INVESTIGATION WORKS COST

Expenses required for additional investigations to be carried out prior to the definite design study were included.

12.2.4 ADMINISTRATIVE COST AND ENGINEERING FEE

The expenses required for management of the construction project by CORDETACNA, and the costs for definite designs and supervision to be made hereafter by a foreign consultant were calculated.

12.2.5 CONTINGENCY COST

As a reserve to cope with changes in work quantities which are unforeseeable at present, 15% of the direct construction costs, additional investigation costs, administrative costs and engineering fee for the water supply scheme, and 10% of the same items for the Aricota No. 3 scheme were included as contingency costs.

12.2.6 INTEREST DURING CONSTRUCTION

The rates of 4.5% for the foreign currency and, 10.5% for the local currency are taken as the interest during construction period respectively.

12.2.7 COMPENSATION COST

Expenses assuming effects on the Rio Tambo Basin due to dilution and drainage of Laguna Loriscota water and the necessary land compensation costs in the project area were included as compensation costs.

12.3 TOTAL CONSTRUCTION COST AND CONSTRUCTION COST BY YEAR

The December 1982 prices obtained from the construction schedule, work program, and estimating conditions for the construction cost will be US$38.40 million for the water supply scheme of which US$18.505 million would be a foreign currency portion and US$19.895 million a local currency portion. Similarly, for the same time, the cost of the Aricota No. 3 scheme would be US$29.00 million, of which US$15.628 million would be a foreign currency portion, and US$13.372 million a local currency portion.

Therefore, a total construction cost for the project including two schemes will be US$67.40 million, of which US$34.133 million would be a foreign portion and US$33.267 million would be a local portion.

The water supply scheme would require a construction period of 3 years including dilution and drainage of Laguna Loriscota, while the Aricota No. 3 scheme would require 3 years including preparatory works. Regarding the direct construction costs

during these periods, the terms for payment of the foreign and local currency portions were assumed to be the following based on which the abovementioned total construction cost was allocated by year.

	On Contracting	On Loading Ship	On Completing Installation	At Completion
Foregin Currency Portion				
Transmission line equipment, materials	30%	30%	30%	10%
Generating & transforming equipment, pumping station equipment, telecommunication equipment	10%	50%		40%
Hydraulic equipment (gate, penstock)	10%	50%	30%	10%
Local Currency Portion				
Civil & building construction	Work accomplished basis			
Personnel costs, materials procured in Peru	Work accomplished basis			

It was presumed that all construction equipment would be brought into Peru at the responsibility of the contractor.

The total construction cost and funds required by year are shown in Tables 12-2 and 12-3.

Table 12-2 Summary of Estimated Construction Cost

Item	Total Cost	Foreign Currency	Local Currency
I. WATER SUPPLY SCHEME			
A. Water Supply Facility	24,456,000	12,632,000	11,824,000
A.1 Civil Work	21,320,000	10,051,000	11,269,000
(1) Diversion Works	7,440,000	4,123,000	3,317,000
(2) Drainage Canal	2,100,000	1,050,000	1,050,000
(3) Collecting Canal	180,000	114,000	66,000
(4) Tocco Intakedam	1,000,000	400,000	600,000
(5) Pumping Station	540,000	174,500	365,500
(6) Pipe Line	330,000	113,000	217,000
(7) Head Tank	200,000	89,500	110,500
(8) Water Way	8,030,000	3,987,000	4,043,000
(9)	1,500,000	0	1,500,000
A.2 Hydraulic Equipment	1,440,000	1,152,000	288,000
A.3 Electrical Equipment	1,696,000	1,429,000	267,000
B. Transmission Line	1,294,000	791,000	503,000
C. Additional Investigation	400,000	160,000	240,000
D. Administration Cost	2,705,000	1,358,000	1,347,000
E. Compensation	900,000	0	900,000
F. Contingency	4,437,000	2,230,000	2,207,000
G. Sub-Total	34,192,000	17,171,000	17,021,000
H. Interest during Construction	4,208,000	1,334,000	2,874,000
Total	38,400,000	18,505,000	19,895,000
II. ARICOTA NO. 3 POWER STATION			
A. Generating Facility	21,247,000	11,990,000	9,257,000
A.1 Civil Work	12,823,000	5,192,000	7,631,000
(1) Care of River	413,000	187,000	226,000
(2) Dam and Intake	631,000	287,000	344,000
(3) Water Way	9,369,000	3,707,000	5,662,000
(4) Head Tank	434,000	179,000	255,000
(5) Penstock and Spillway	706,000	316,000	390,000
(6) Powerhouse	804,000	299,000	505,000
(7) Tailrace	330,000	146,000	184,000
(8) Switchyard	136,000	71,000	65,000
A.2 Hydraulic Equipment	2,065,000	1,652,000	413,000
A.3 Electrical Equipment	6,359,000	5,146,000	1,213,000
B. Transmission Line	383,000	254,000	129,000
C. Additional Investigation	256,000	102,000	154,000
D. Administration Cost	2,200,000	1,241,000	959,000
E. Compensation	100,000	0	100,000
F. Contingency	2,379,000	1,291,000	1,088,000
G. Sub-Total	26,565,000	14,848,000	11,717,000
H. Interest during Construction	2,435,000	780,000	1,655,000
Total	29,000,000	15,628,000	13,372,000
GRAND TOTAL	67,400,000	34,133,000	33,267,000

Table 12-3 Fund Requirement in Each Year

Unit: 10^3 US$

Item	Total			1984			1985			1986			1987			1988		
	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
I. WATER SUPPLY SCHEME																		
A. Water Supply Facility	24,456	12,632	11,824	3,265	1,656	1,609	5,795	3,049	2,743	8,042	4,522	3,520	7,357	3,405	3,952			
A.1 Civil Works	21,320	10,051	11,269	3,265	1,656	1,609	5,506	2,792	2,714	6,653	3,374	3,279	5,896	2,229	3,667			
A.2 Hydraulic Equipment	1,440	1,152	288	0	0	0	144	115	29	864	691	173	432	346	86			
A.3 Electrical Equipment	1,696	1,429	267	0	0	0	142	142	0	525	457	68	1,029	830	199			
B. Transmission Line	1,294	791	503	0	0	0	0	0	0	904	557	347	390	234	156			
C. Additional Investigation	400	160	240	400	160	240	0	0	0	0	0	0	0	0	0			
D. Administration Cost	2,705	1,358	1,347	367	182	185	579	305	274	894	508	326	865	363	502			
E. Compensation	900	0	900	0	0	0	0	0	0	0	0	0	900	0	900			
F. Contingency	4,437	2,230	2,207	605	300	305	955	503	452	1,476	839	637	1,401	588	813			
G. Sub-total	34,192	17,171	17,021	4,637	2,298	2,339	7,326	3,857	3,469	11,316	6,426	4,890	10,913	4,590	6,323			
H. Interest during Construction	4,208	1,334	2,874	175	52	123	618	190	428	1,289	422	867	2,126	670	1,456			
I. Total	38,400	18,505	19,895	4,812	2,350	2,462	7,944	4,047	3,897	12,605	6,848	5,757	13,039	5,260	7,779			
II. ARICOTA NO. 3 POWER STATION																		
A. Generating Facility	21,247	11,990	9,257	0	0	0	4,244	2,023	2,221	6,637	3,786	2,851	7,459	4,078	3,381	2,907	2,103	804
A.1 Civil Work	12,823	5,192	7,631	0	0	0	3,705	1,525	2,180	4,194	1,680	2,514	3,642	1,468	2,174	1,282	519	763
A.2 Hydraulic Equipment	2,065	1,652	413	0	0	0	205	164	41	1,035	828	207	620	496	124	205	164	41
A.3 Electrical Equipment	6,359	5,146	1,213	0	0	0	334	334	0	1,408	1,278	130	3,197	2,114	1,083	1,420	1,420	0
B. Transmission Line	383	254	129	0	0	0	0	0	0	0	0	0	358	229	129	25	25	0
C. Additional Investigation	256	102	154	256	102	154	0	0	0	0	0	0	0	0	0	0	0	0
D. Administration Cost	2,200	1,211	989	36	0	36	433	206	227	741	423	318	784	432	352	206	150	56
E. Compensation	100	-	100	100	0	100	0	0	0	0	0	0	0	0	0	0	0	0
F. Contingency	2,379	1,291	1,088	40	0	40	47	227	250	815	465	350	821	434	387	226	165	61
G. Sub-total	26,565	14,848	11,717	432	102	330	5,154	2,456	2,698	8,193	4,674	3,519	9,422	5,173	4,249	3,364	2,443	921
H. Interest during Construction	2,435	780	1,655	19	2	17	236	60	176	723	220	503	1,457	498	959	0	0	0
I. Total	29,000	15,628	13,372	451	104	347	5,390	2,516	2,874	8,916	4,894	4,022	10,879	5,671	5,208	3,364	2,443	921
GRAND TOTAL	67,400	34,133	33,267	5,263	2,454	2,809	13,334	6,563	6,771	21,521	11,742	9,779	23,918	10,931	12,987	3,364	2,443	921

CHAPTER 13

ECONOMIC ANALYSIS

CHAPTER 13 ECONOMIC ANALYSIS

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CHAPTER 13 ECONOMIC ANALYSIS

13.1 BASIC CONSIDERATIONS

In economic analysis of the Project, the financial cost and benefit are analyzed first, and the effect of implementing the project is evaluated financially. This amounts to analyzing the cost and benefit from the standpoint of a single project, or the side of the enterprise carrying out the project, with cost based on market prices.

Meanwhile, an economic cost-benefit analysis of the effect of implementation of the project through comparison and analysis in the economic policy of the state as a whole is also made here. The aim of this analysis is the long-range economic growth of the state, with cost analyzed replacing market price by efficiency price. The concrete techniques and detailed preconditions in the two analyses and evaluations will be described in their respective sections.

The evaluations will be economic analyses comparing the total expense and benefit during whole service life of the project whether to do financial evaluation or economic evaluation from the viewpoint of the state economy.

The total expense consists of the construction cost of all facilities involved in the Project, the equipment replacement cost of electrical equipment, and operation and maintenance costs. The total benefit, in case of considering a hydroelectric development project, may be the electricity charge revenue from power production through operation of facilities in financial evaluation, or the cost due to an alternative facility, for example, in economic evaluation. Further, in case there is agriculture in the downstream area utilizing the power generation

discharge, the net benefit obtained from that agriculture is calculated. The net benefit in this case is the gross income from agricultural production less the expense required for production.

In the case of the present Project, the incremental electric energy at the exsiting power station group realized through the water supply scheme, the electric energy produced at a new power station (Aricota No. 3), and the benefit from irrigated agriculture in the Locumba Valley and at Ite Norte using power generation discharge may be calculated, and the economic analysis is made considering cost and benefit as described below.

a) The construction cost covers the facilities of the water supply scheme, the power generating facilities in the Aricota No. 3 scheme, the power transmission facilities to the No. 2 power station, and expansion of the switchyard at the No. 2 power station.

b) The intake facilities and water pump-up facilities at Laguna Aricota are not included in the construction cost. This is because the cost of intake facilities at Laguna Aricota in the case of without the Project is included in the Aricota No. 1 and No. 2 power generation projects, and reservoir operation with the Project does not require new intake facilities, besides the case of without the project.

c) The equipment replacement costs of intake facilities, power generating facilities, and power transmission facilities for Aricota No. 1 and No. 2 Power Stations were included in calculations only from the second term. This was because the period of evaluation of Aricota No. 1 and No. 2 Power Stations must be extended 15 years so as to coincide with that of Aricota No. 3 Power Station.

d) For a similar reason, after original service lives of Aricota No. 1 and No. 2 Power Stations expire (A.D.2018 and after), the ratio of the operation and maintenance cost will be doubled.

e) The operation and maintenance cost for the existing power station group is to be evaluated at the same level as for the No. 3 power station. In effect, the operation and maintenance cost of the existing power station group is calculated from that of the No. 3 power station on the basis of installed capacity ratio. The operation and maintenance cost sought, or that corresponding to increased energy production is allocated according to the ratio of energy production.

f) What may be included as benefits are those from the net increased energy production at the existing No. 1 and No. 2 power stations through the water supply scheme, the energy production at Aricota No. 3 Power Station, and irrigated agriculture in the Locumba Valley and at Ite Norte utilizing the power generation discharge.

g) Of these, the benefit from energy production is calculated in the financial analysis based on the actual average electricity rate at the end of December 1982. On the other hand, in the economic analysis, calculations by the two methods of considering the cost of a capable facility of which is able to furnish service equal to that obtained by the Project as benefit, and of considering the electricity charge as the amount payable by recipients of service are used. The respective electricity rates are described in the following sections.

h) The method of calculating agricultural benefit is described in detail in the Appendix-VII. Only existing

cultivated land in the Locumba Valley and at Ite Norte are included as areas benefiting from implementation of the Project, and new cultivated land is not considered. In effect, the difference between the minimum irrigated area with the water supply scheme and that without the Project will be the area receiving benefit. By minimum irrigated area is meant here the irrigated area which is secured by the minimum monthly average discharge based on 90% dependable one.

i) The agricultural benefits thus obtained would be on the basis of market prices in Peru, whereas in an economic analysis the basis should be efficiency prices, or border prices, the same as benefit from electric power, but here it is hypothesized that market prices and efficiency prices are equal.

j) Implementation of the Project is an urgent matter, and the lead time from planning to start of operation of facilities is comparatively short. Therefore, escalation will not be considered in the economic analysis, in view also of the fact that it will be difficult to predict the future from the present economic situation.

13.2 FINANCIAL ANALYSIS

13.2.1 CONDITIONS

The effects of implementation of the Project will be analyzed from a financial standpoint. The fund requirements by year for construction of facilities are shown in Table 13-1. The cash flow for the entire service lives for valuations are as shown in Table 13-2 based on the fund requirements by year and the basic conditions on costs described in the preceding section.

Of the benefits, that of electric power is calculated by the average electricity rate in the South West Region as of the end

of December, 1982. On looking at the state of electricity rates in the most recent past, it may be noted that revisions have been made several times a year in accordance with escalation in commodity prices. Therefore, Table 13-3 was prepared making corrections based on the newest data obtained, "Resumen de Venta de Energia Electrica a Nacional, Año 1982, ELECTROPERU S.A.," and the rate of price escalation in 1982. According to this, the average electricity rate in the South West Region as of the end of December 1982 is estimated to have been 33 mills/kWh.

13.2.2 FINANCIAL INTERNAL RATE OF RETURN

The total cost of the Project according to market prices (cash flow) and the results of calculating internal rate of return based on the cash flow are shown in Table 13-4 and Table 13-5.

The calculation results indicate that the financial internal rate of return with the Project will be 7.5%.

Table 13-1 Financial and Economic Costs in Initial Stage

Unit: 10^3 US$

Item	1984	1985	1986	1987	1988	Total
[I] Financial Cost						
Foreign Currency						
Water Supply Scheme	2,298	3,857	6,426	4,590	0	17,171
Aricota No. 3 Power Station	102	2,456	4,674	5,173	2,443	14,848
Total of F.C.	2,400	6,313	11,100	9,763	2,443	32,019
Local Currency						
Water Supply Scheme	2,339	3,469	4,890	6,323	0	17,021
Aricota No. 3 Power Station	330	2,698	3,519	4,249	921	11,717
Total of L.C.	2,669	6,167	8,409	10,572	921	28,738
[II] Economic Cost						
Foreign Currency						
Water Supply Scheme	2,298	3,857	6,426	4,590	0	17,171
Aricota No. 3 Power Station	102	2,456	4,674	5,173	2,443	14,848
Total of F.C.	2,400	6,313	11,100	9,763	2,443	32,019
Local Currency						
Water Supply Scheme	1,842	2,733	3,793	4,229	0	12,597
Aricota No. 3 Power Station	178	2,142	2,766	3,222	705	9,013
Total of L.C.	2,020	4,875	6,559	7,451	705	21,610

Table 13-2 Financial Cost Flow

Unit: 10^3 US$

Year	INVESTMENT COST													O & M				GRAND TOTAL
	Water Supply Scheme			Aricota No. 3 P/S			Total	Aricota No. 1 P/S	Aricota No. 2 P/S	Pumping Station	Transmission Line	Total	Total	Water Supply	Aricota No. 3 P/S	Aricota No.1, 2 & Pumping Station	Total	
	Dam and Equipment	Transmission Line	Total	Dam and Equipment	Transmission Line	Total												
1984	4,637	0	4,637	432	0	432	5,069	0	0	0	0	0	5,069	0	0	0	0	5,069
85	7,326	6	7,326	5,154	0	5,154	12,480	0	0	0	0	0	12,480	0	0	0	0	12,480
86	10,172	1,144	11,316	8,193	0	8,193	19,509	0	0	0	0	0	19,509	0	0	0	0	19,509
87	10,420	493	10,913	8,989	433	9,422	20,335	0	0	0	0	0	20,335	0	0	0	0	20,335
88	0	0	0	3,334	30	3,364	3,364	0	0	0	0	0	3,364	162	276	360	798	4,162
89	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	360	798	798
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	360	798	798
91	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	360	798	798
92	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	360	798	798
93	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	360	798	798
94	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	360	798	798
95	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	360	798	798
96	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	360	798	798
2008	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	360	798	798
9	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	360	798	798
10	362	0	362	652	0	652	1,014	0	0	0	0	0	1,014	162	276	360	798	1,812
11	1,755	1,144	2,901	2,956	0	2,956	5,857	0	0	0	0	0	5,857	162	276	360	798	6,655
12	1,849	493	2,342	4,619	433	5,052	7,394	0	0	0	0	0	7,394	162	276	360	798	8,192
13	0	0	0	1,967	30	1,997	1,997	0	131	0	0	131	2,128	162	276	360	798	2,926
14	0	0	0	0	0	0	0	207	2,872	0	0	3,079	3,079	162	276	360	798	3,877
15	0	0	0	0	0	0	0	2,584	4,498	0	0	7,082	7,082	162	276	360	798	7,880
16	0	0	0	0	0	0	0	3,490	2,019	*2,000	3,380	10,889	10,889	162	276	360	798	11,687
17	0	0	0	0	0	0	0	1,527	0	*1,000	704	3,231	3,231	162	276	360	798	4,029
18	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	720	1,158	1,158
19	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	720	1,158	1,158
2020	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	720	1,158	1,158
2035	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	720	1,158	1,158
36	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	720	1,158	1,158
37	0	0	0	0	0	0	0	0	0	0	0	0	0	162	276	720	1,158	1,158
TOTAL	36,523	3,274	39,797	36,296	926	37,222	77,019	7,808	9,520	*3,000	4,084	24,412	101,431	8,100	13,800	25,200	47,100	148,531

Table 13-3 Calculated Tariff Rate

Unit: mills/kWh

	Northern	Central	Southwestern	Haucho
Public Use				
Street Lamp	11.62	3.97	12.53	15.77
Residencial	32.51	31.32	30.31	38.35
Minor Industry	58.62	67.99	52.64	73.41
Commercial	95.25	92.78	78.38	115.32
General	51.30	56.53	46.65	77.16
Pump	15.87	21.25	7.38	18.01
Average	37.00	43.87	30.16	45.24
Major Industry	57.48	71.93	35.57	96.84
Others	27.90	10.14	-	-
Enter Prise	-	15.38	-	-
Average in total	38.77	33.83	33.10	59.78

Table 13-4 Estimated Financial Net Present Value

PROJECT EVALUATION BY THE NET PRESENT VALUE (N.P.V) METHOD
--- WITHOUT SHADOW PRICE FACTOR ---

*** EVALUATION CRITERIA ***

CALAULATION PERIOD --- 54 YEARS DISCOUNT RATE --- 10.0 %

Unit:10^3US$

	HYDROPOWER					ALTERNATIVE				
YEAR	INVESTMENT (MIL.TL)	ANNUAL COST (MIL.TL)	COST FLOW (MIL.TL)	NET PRESENT VALUE (I= 10.0 %) P.V.F (P.U)	NET PRESENT VALUE (I= 10.0 %) N.P.V (MIL.TL)	INVESTMENT (MIL.TL)	ANNUAL COST (MIL.TL)	BENEFIT FLOW (MIL.TL)	NET PRESENT VALUE (I= 10.0 %) P.V.F (P.U)	NET PRESENT VALUE (I= 10.0 %) N.P.V (MIL.TL)
1984	5069.00	0.0	5069.00	0.9091	4608.18	0.0	0.0	0.0	0.9091	0.0
1985	12480.00	0.0	12480.00	0.8264	10314.06	0.0	0.0	0.0	0.8264	0.0
1986	19549.00	0.0	19549.00	0.7513	14687.49	0.0	0.0	0.0	0.7513	0.0
1987	20439.00	0.0	20439.00	0.6830	13960.16	0.0	0.0	0.0	0.6830	0.0
1988	3364.00	798.00	4162.00	0.6209	2584.29	0.0	6337.00	6337.00	0.6209	3934.79
1989	0.0	798.00	798.00	0.5645	450.45	0.0	6337.00	6337.00	0.5645	3577.09
1990	0.0	798.00	798.00	0.5132	409.50	0.0	6337.00	6337.00	0.5132	3251.90
1991	0.0	798.00	798.00	0.4665	372.26	0.0	6337.00	6337.00	0.4665	2956.28
1992	0.0	798.00	798.00	0.4241	338.43	0.0	6337.00	6337.00	0.4241	2687.53
1993	0.0	798.00	798.00	0.3855	307.67	0.0	6337.00	6337.00	0.3855	2443.21
1994	0.0	798.00	798.00	0.3505	279.70	0.0	6337.00	6337.00	0.3505	2221.10
1995	0.0	798.00	798.00	0.3186	254.27	0.0	6337.00	6337.00	0.3186	2019.18
1996	0.0	798.00	798.00	0.2897	231.15	0.0	6337.00	6337.00	0.2897	1835.62
1997	0.0	798.00	798.00	0.2633	210.14	0.0	6337.00	6337.00	0.2633	1668.75
1998	0.0	798.00	798.00	0.2394	191.04	0.0	6337.00	6337.00	0.2394	1517.05
1999	0.0	798.00	798.00	0.2176	173.67	0.0	6337.00	6337.00	0.2176	1379.14
2000	0.0	798.00	798.00	0.1978	157.88	0.0	6337.00	6337.00	0.1978	1253.76
2001	0.0	798.00	798.00	0.1799	143.53	0.0	6337.00	6337.00	0.1799	1139.78
2002	0.0	798.00	798.00	0.1635	130.48	0.0	6337.00	6337.00	0.1635	1036.17
2003	0.0	798.00	798.00	0.1486	118.62	0.0	6337.00	6337.00	0.1486	941.97
2004	0.0	798.00	798.00	0.1351	107.84	0.0	6337.00	6337.00	0.1351	856.34
2005	0.0	798.00	798.00	0.1228	98.03	0.0	6337.00	6337.00	0.1228	778.49
2006	0.0	798.00	798.00	0.1117	89.12	0.0	6337.00	6337.00	0.1117	707.72
2007	0.0	798.00	798.00	0.1015	81.02	0.0	6337.00	6337.00	0.1015	643.38
2008	0.0	798.00	798.00	0.0923	73.65	0.0	6337.00	6337.00	0.0923	584.89
2009	0.0	798.00	798.00	0.0839	66.96	0.0	6337.00	6337.00	0.0839	531.72
2010	1014.00	798.00	1812.00	0.0763	138.22	0.0	6337.00	6337.00	0.0763	483.38
2011	5857.00	798.00	6655.00	0.0693	461.49	0.0	6337.00	6337.00	0.0693	439.44
2012	7394.00	798.00	8192.00	0.0630	516.43	0.0	6337.00	6337.00	0.0630	399.49
2013	2128.00	798.00	2926.00	0.0573	167.69	0.0	6337.00	6337.00	0.0573	363.17
2014	3079.00	798.00	3877.00	0.0521	201.99	0.0	6337.00	6337.00	0.0521	330.16
2015	7082.00	798.00	7880.00	0.0474	373.23	0.0	6337.00	6337.00	0.0474	300.14
2016	10889.00	798.00	11687.00	0.0431	503.22	0.0	6337.00	6337.00	0.0431	272.86
2017	3231.00	798.00	4029.00	0.0391	157.71	0.0	6337.00	6337.00	0.0391	248.05
2018	0.0	1158.00	1158.00	0.0356	41.21	0.0	6337.00	6337.00	0.0356	225.50
2019	0.0	1158.00	1158.00	0.0324	37.46	0.0	6337.00	6337.00	0.0324	205.00
2020	0.0	1158.00	1158.00	0.0294	34.06	0.0	6337.00	6337.00	0.0294	186.37
2021	0.0	1158.00	1158.00	0.0267	30.96	0.0	6337.00	6337.00	0.0267	169.42
2022	0.0	1158.00	1158.00	0.0243	28.15	0.0	6337.00	6337.00	0.0243	154.02
2023	0.0	1158.00	1158.00	0.0221	25.59	0.0	6337.00	6337.00	0.0221	140.02
2024	0.0	1158.00	1158.00	0.0201	23.26	0.0	6337.00	6337.00	0.0201	127.29
2025	0.0	1158.00	1158.00	0.0183	21.15	0.0	6337.00	6337.00	0.0183	115.72
2026	0.0	1158.00	1158.00	0.0166	19.22	0.0	6337.00	6337.00	0.0166	105.20
2027	0.0	1158.00	1158.00	0.0151	17.48	0.0	6337.00	6337.00	0.0151	95.64
2028	0.0	1158.00	1158.00	0.0137	15.89	0.0	6337.00	6337.00	0.0137	86.94
2029	0.0	1158.00	1158.00	0.0125	14.44	0.0	6337.00	6337.00	0.0125	79.04
2030	0.0	1158.00	1158.00	0.0113	13.13	0.0	6337.00	6337.00	0.0113	71.85
2031	0.0	1158.00	1158.00	0.0103	11.94	0.0	6337.00	6337.00	0.0103	65.32
2032	0.0	1158.00	1158.00	0.0094	10.85	0.0	6337.00	6337.00	0.0094	59.38
2033	0.0	1158.00	1158.00	0.0085	9.86	0.0	6337.00	6337.00	0.0085	53.98
2034	0.0	1158.00	1158.00	0.0077	8.97	0.0	6337.00	6337.00	0.0077	49.08
2035	0.0	1158.00	1158.00	0.0070	8.15	0.0	6337.00	6337.00	0.0070	44.62
2036	0.0	1158.00	1158.00	0.0064	7.41	0.0	6337.00	6337.00	0.0064	40.56
2037	0.0	1158.00	1158.00	0.0058	6.74	0.0	6337.00	6337.00	0.0058	36.87
TOTAL	101575.00				53345.40	0.0				42914.32

Note: Benefit of Irrigation is included in the Alternative Cost.

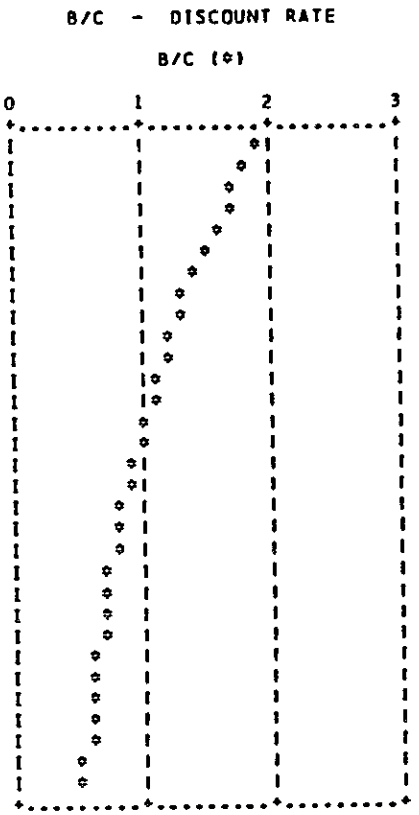
Table 13-5 Estimation of Financial Internal Rate of Return

DISCOUNT RATE VARIABLE SHEET
--- WITHOUT SHADOW PRICE FACTOR ---

*** EVALUATION CRITERIA ***

CALAULATION PERIOD --- 54 YEARS

	DISCOUNT RATE (%)	HYDRO TOTAL INVEST (MIL.TL)	ALT TOTAL INVEST (MIL.TL)	BENEFIT - COST ANALYSYS COST (MIL.TL)	BENEFIT (MIL.TL)	B-C (MIL.TL)	B/C RATIO
	1.0	101575.00	0.0	123645.12	238701.12	115056.00	1.9305
	1.5	101575.00	0.0	113874.50	208975.94	95101.44	1.8351
	2.0	101575.00	0.0	105518.31	183969.31	78451.00	1.7435
	2.5	101575.00	0.0	98338.87	162829.37	64490.50	1.6558
	3.0	101575.00	0.0	92140.44	144869.25	52728.81	1.5723
	3.5	101575.00	0.0	86761.25	129530.12	42768.87	1.4929
	4.0	101575.00	0.0	82070.87	116369.19	34298.31	1.4179
	4.5	101575.00	0.0	77958.44	105016.00	27057.56	1.3471
	5.0	101575.00	0.0	74335.19	95177.81	20842.62	1.2804
	5.5	101575.00	0.0	71126.75	86611.31	15484.56	1.2177
	6.0	101575.00	0.0	68270.31	79117.19	10846.87	1.1589
	6.5	101575.00	0.0	65714.62	72531.44	6816.81	1.1037
	7.0	101575.00	0.0	63416.32	66719.94	3303.62	1.0521
*	7.5	101575.00	0.0	61338.73	61568.64	229.91	1.0037
	8.0	101575.00	0.0	59451.34	56983.38	-2467.95	0.9585
	8.5	101575.00	0.0	57728.39	52886.00	-4842.39	0.9161
	9.0	101575.00	0.0	56148.23	49210.82	-6937.41	0.8764
	9.5	101575.00	0.0	54692.45	45902.59	-8789.86	0.8393
	10.0	101575.00	0.0	53345.40	42914.32	-10431.09	0.8045
	10.5	101575.00	0.0	52093.80	40206.34	-11887.46	0.7718
	11.0	101575.00	0.0	50925.90	37743.93	-13181.97	0.7412
	11.5	101575.00	0.0	49832.11	35498.40	-14333.71	0.7124
	12.0	101575.00	0.0	48804.06	33444.95	-15359.11	0.6853
	12.5	101575.00	0.0	47834.56	31562.00	-16272.56	0.6598
	13.0	101575.00	0.0	46917.44	29831.17	-17086.27	0.6358
	13.5	101575.00	0.0	46047.10	28235.89	-17811.20	0.6132
	14.0	101575.00	0.0	45218.95	26762.28	-18456.67	0.5918
	14.5	101575.00	0.0	44428.96	25398.16	-19030.79	0.5717
	15.0	101575.00	0.0	43673.54	24132.67	-19540.87	0.5526
	15.5	101575.00	0.0	42949.79	22956.73	-19993.05	0.5345
	16.0	101575.00	0.0	42254.68	21861.51	-20393.17	0.5174



* --- I.R.R (HYDROPOWER)

13.3 COMPARISON WITH ALTERNATIVE THERMAL PLANT

13.3.1 ALTERNATIVE THERMAL FACILITIES

As the technique employed most commonly in the past, the method of assuming an alternative thermal power facility capable of furnishing equal service and comparing with the cost of that facility will be taken up.

In this case, the purpose is to select one of either, construction of a hydroelectric power plant or an alternative facility.

The increased energy production at the existing Aricota No. 1 and No. 2 Power Stations and the energy production at the new Aricota No. 3 Power Station will be 84 GWh and 71 GWh, respectively. In case of evaluating the increased energy production at the existing power stations by the alternative thermal facilities, the method generally adopted is to use the fuel cost and various operating expenses incurred by additional firing, and not to calculate the cost involved in construction of the thermal power station.

If the construction cost of the alternative facility is calculated versus the increased electric energy, the evaluation on benefit will be overestimated from the standpoint of the balance of electric power, while if not calculated, the result will be underestimated.

As previously stated in the chapter on the power demand forecast, there is no thermal power generating facility in the power system of the Project for additional firing to produce the equivalent of the increased electric energy. Here, to be on the conservative side, the figures in case of estimating based on Aricota No. 3 Power Station alone is adopted for the construction

cost of the alternative thermal facility, and for the increased energy production, only the operating cost per kWh is to be calculated.

The scale of the alternative thermal power plant is indicated in Table 13-6. The cost for the entire service (cash flow) based on this is shown in Table 13-7. This corresponds to the benefit in economic analysis, and the benefit from irrigated agriculture and the total benefit are also given.

Table 13-6 Alternative Thermal Power Plant

Item	Unit	
Installed Capacity	kW	16,600
Thermal Efficiency	(%)	35
Annual Plant Factor	(%)	50.2
Annual Energy Production	10^6 kWh	72.9
Station Service Ratio	%	6.0
Annual Available Energy	10^6 kWh	68.5
Fuel Consumption Rate	ℓ/kWh	0.253
Unit Fuel Price	US$/kℓ	195
Construction Cost	10^3US$	10,790
Unit energy Cost	US$/kWh	0.049

Note:

1/ Installed Capacity of Thermal Power Plant

$$P_t = 13,400 \times 1.24^{*2} = 16,600 \text{ kW}$$

2/ Annual Energy Production

$$E_t = 155.01^{*1} \times 10^6 \times 1.03^{*2} = 159.60 \times 10^6 \text{ kwh}$$

*1. Including Increased Energy Production

*2. Adjustment Factor for kW and kWh

Item	Hydro	Thermal
Station Service loss (%)	0.3	6
Failure loss (%)	0.3	5
Repair loss (%)	2	12

*2 kW Adjustment Factor

$$= \frac{(1-0.003) \times (1-0.003) \times (1-0.02)}{(1-0.06) \times (1-0.05) \times (1-0.12)} = 1.24$$

$$\text{kWH} = \frac{(1-0.03)}{(1-0.06)} = 1.03$$

3/ Investment Cost = Unit Construction Cost^{*3} x Installed Capacity

= 650 US$/kW x 16,600 kW

= 10,790 x 10^3US$

*3 Insterest during construction is not included.

4/ Investment Schedule

	1st (0.10)	2nd (0.50)	3rd (0.40)	x 10^3US$ Total (1.00)
Total	1,080	5,400	4,310	10,790
F.C.	920	4,600	3,660	9,180
L.C.	160	800	650	1,610

5/ Fuel Consumption Rate

$$= \frac{860.216 \text{ Kcal/kWh}}{9,700 \text{ Kcal} \times 0.35} = 0.253 \text{ /kWh}$$

Table 13-7 Cost Flow of Alternative Thermal Power Plant and Benefit of Irrigation

Unit: 10^3US$

Year	Alternative Thermal Power Plant			Benefit of Irrigation	Total
	Investment Cost	O & M	Energy Cost		
1984	-	-	-	-	-
1985	1,080	-	-	-	1,080
1986	5,400	-	-	-	5,400
1987	4,310	-	-	-	4,310
1988	-	270	7,823	1,375	9,468
1989	-	270	7,823	1,375	9,468
1990	-	270	7,823	1,375	9,468
⋮					
2008	-	270	7,823	1,375	9,468
2009	-	270	7,823	1,375	9,468
2010	1,080	270	7,823	1,375	10,548
2011	5,400	270	7,823	1,375	14,868
2012	4,310	270	7,823	1,375	13,778
2013	-	270	7,823	1,375	9,468
2014	-	270	7,823	1,375	9,468
⋮					
2034	-	270	7,823	1,375	9,468
2035	-	270	7,823	1,375	9,468
2036	-	270	7,823	1,375	9,468
2037	-	270	7,823	1,375	9,468
Total	21,580	13,500	391,150	68,750	494,980

Note: 1/ Investment Cost (10,790 x 10^3US$) is based on the price level on Dec. 1982 without interest during construction, import duties and escalation etc.

2/ Operation and Maintenance Cost are as following.

Power Facilities: 10,790 x 10^3US$ x@2.5% = 270 x 10^3US$

Energy: *1 159.66 x 10^6 kWh x @0.049US$/kWh = 7,823 x 10^3US$

* including increased energy production

Table 13-9 Economic Cost Flow

Unit: 10^3 US$

Year	INVESTMENT COST												O & M				GRAND TOTAL
	Water Supply Scheme			Aricota No. 3 P/S			Total	Aricota No. 1 P/S	Aricota No. 2 P/S	Pumping Station	Transmission Line	Total	Total	Water Supply	Aricota No. 3 P/S	Aricota No.1, 2 & Pumping Station	Total	
	Dam and Equipment	Transmission Line	Total	Dam and Equipment	Transmission Line	Total												
1984	4,140	0	4,140	280	0	280	4,420	0	0	0	0	0	4,420	0	0	0	0	4,420
85	6,590	0	6,590	4,598	0	4,598	11,188	0	0	0	0	0	11,188	0	0	0	0	11,188
86	9,195	1,034	10,229	7,450	0	7,450	17,679	0	0	0	0	0	17,679	0	0	0	0	17,679
87	8,437	398	8,835	8,057	386	8,443	17,278	0	0	0	0	0	17,278	0	0	0	0	17,278
88	0	0	0	3,120	28	3,148	3,148	0	0	0	0	0	3,148	139	258	337	734	3,882
89	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	337	734	734
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	337	734	734
91	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	337	734	734
92	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	337	734	734
93	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	337	734	734
94	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	337	734	734
95	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	337	734	734
96	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	337	734	734
2008	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	337	734	734
9	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	337	734	734
10	341	0	341	612	0	612	953	0	0	0	0	0	953	139	258	337	734	1,687
11	1,655	1,034	2,689	2,773		2,773	5,462	0	0	0	0	0	5,462	139	239	337	734	6,196
12	1,742	398	2,140	4,333	386	4,719	6,859	0	0	0	0	0	6,859	139	258	337	734	7,593
13	0	0	0	1,845	28	1,873	1,873	0	125	0	0	125	1,998	139	258	337	734	2,732
14	0	0	0	0	0	0	0	197	2,728	0	0	2,925	2,925	139	258	337	734	3,659
15	0	0	0	0	0	0	0	2,455	4,273	0	0	6,728	6,728	139	258	337	734	7,462
16	0	0	0	0	0	0	0	3,316	1,918	1,900	3,200	10,334	10,334	139	258	337	734	11,068
17	0	0	0	0	0	0	0	1,451	0	950	669	3,070	3,070	139	258	337	734	3,804
18	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	674	1,071	1,071
19	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	674	1,071	1,071
2020	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	674	1,071	1,071
2035	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	674	1,071	1,071
36	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	674	1,071	1,071
37	0	0	0	0	0	0	0	0	0	0	0	0	0	139	258	674	1,071	1,071
TOTAL	32,100	2,864	34,964	33,068	828	33,896	68,860	7,419	9,044	2,850	3,869	23,182	92,042	6,950	12,900	22,916	42,766	134,808

13.3.2 ECONOMIC COST

The cost of the Project versus the cost of the alternative thermal power plant (the benefit from the hydro power facility), must be based on the efficiency prices previously mentioned.

This is obtain . by eliminating the following from the financial cost based on market prices:

a) Customs duties on importation of materials and equipment,
b) Sales taxes, etc., included in domestic materials prices,
c) Price differentials concerning domestic materials and equipment in comparison with international prices,
d) Price differential between labor costs and shadow wages of labor,
e) Items (b), (c) and (d) contained in transportation cost.

In calculation of financial costs, imported materials and equipment are based on CIF prices, so that conversion to efficiency prices is mainly done by corrections of the local currency portion. The results, which are the ratios of efficiency prices to market prices are as shown in Table 13-8.

The cash flow of economic costs is given in Table 13-9.

Table 13-8 Ratio of Market Price and Efficiency Price

Scheme	Water Supply	Aricota No. 3
Civil Work	0.90	0.88
Hydraulic Equipment	0.94	0.94
Electric Equipment	0.95	0.94
Transmission	0.88	0.89
Weighted Average	0.87	0.90

13.3.3 EVALUATION BY ALTERNATIVE THERMAL PLANT

The total cost for the entire service life (cash flow) based on efficiency prices is given in Table 13-9. As shown in Table 13-10, in case the discount rate is taken to be 10%, the benefit-cost ratio (B/C) of the Project is 1.53 indicating that implementing the Project is more advantageous than the case of the alternative thermal. Further, as shown in Table 13-11, the equalizing discount rate of the Project in comparison with the alternative thermal power plant is 17.1%.

Table 13-10 Estimated Net Present Value of the Alternative Plan

PROJECT EVALUATION BY THE NET PRESENT VALUE (N.P.V) METHOD
--- WITH SHADOW PRICE FACTOR ---

*** EVALUATION CRITERIA ***

CALAULATION PERIOD --- 54 YEARS DISCOUNT RATE --- 10.0 %

Unit:10^3US$

	HYDROPOWER					ALTERNATIVE				
YEAR	INVEST-MENT (MIL.TL)	ANNUAL COST (MIL.TL)	COST FLOW (MIL.TL)	NET PRESENT VALUE (I= 10.0 %) P.V.F (P.U)	N.P.V (MIL.TL)	INVEST-MENT (MIL.TL)	ANNUAL COST (MIL.TL)	BENEFIT FLOW (MIL.TL)	NET PRESENT VALUE (I= 10.0 %) P.V.F (P.U)	N.P.V (MIL.TL)
1984	4420.00	0.0	4420.00	0.9091	4018.18	0.0	0.0	0.0	0.9091	0.0
1985	11188.00	0.0	11188.00	0.8264	9246.29	1080.00	0.0	1080.00	0.8264	892.56
1986	17679.00	0.0	17679.00	0.7513	13282.53	5400.00	0.0	5400.00	0.7513	4057.11
1987	17278.00	0.0	17278.00	0.6830	11801.14	4310.00	0.0	4310.00	0.6830	2943.80
1988	3148.00	734.00	3882.00	0.6209	2410.43	0.0	9468.00	9468.00	0.6209	*873.91
1989	0.0	734.00	734.00	0.5645	414.33	0.0	9468.00	9468.00	0.5645	.34-.46
1990	0.0	734.00	734.00	0.5132	376.66	0.0	9468.00	9468.00	0.5132	4858.61
1991	0.0	734.00	734.00	0.4665	342.42	0.0	9468.00	9468.00	0.4665	4416.92
1992	0.0	734.00	734.00	0.4241	311.29	0.0	9468.00	9468.00	0.4241	4015.39
1993	0.0	734.00	734.00	0.3855	282.99	0.0	9468.00	9468.00	0.3855	3650.36
1994	0.0	734.00	734.00	0.3505	257.26	0.0	9468.00	9468.00	0.3505	3318.51
1995	0.0	734.00	734.00	0.3186	233.88	0.0	9468.00	9468.00	0.3186	3016.83
1996	0.0	734.00	734.00	0.2897	212.62	0.0	9468.00	9468.00	0.2897	2742.57
1997	0.0	734.00	734.00	0.2633	193.29	0.0	9468.00	9468.00	0.2633	2493.25
1998	0.0	734.00	734.00	0.2394	175.72	0.0	9468.00	9468.00	0.2394	2266.59
1999	0.0	734.00	734.00	0.2176	159.74	0.0	9468.00	9468.00	0.2176	2060.54
2000	0.0	734.00	734.00	0.1978	145.22	0.0	9468.00	9468.00	0.1978	1873.22
2001	0.0	734.00	734.00	0.1799	132.02	0.0	9468.00	9468.00	0.1799	1702.93
2002	0.0	734.00	734.00	0.1635	120.02	0.0	9468.00	9468.00	0.1635	1548.12
2003	0.0	734.00	734.00	0.1486	109.11	0.0	9468.00	9468.00	0.1486	1407.38
2004	0.0	734.00	734.00	0.1351	99.19	0.0	9468.00	9468.00	0.1351	1279.44
2005	0.0	734.00	734.00	0.1228	90.17	0.0	9468.00	9468.00	0.1228	1163.13
2006	0.0	734.00	734.00	0.1117	81.97	0.0	9468.00	9468.00	0.1117	1057.39
2007	0.0	734.00	734.00	0.1015	74.52	0.0	9468.00	9468.00	0.1015	961.26
2008	0.0	734.00	734.00	0.0923	67.75	0.0	9468.00	9468.00	0.0923	873.88
2009	0.0	734.00	734.00	0.0839	61.59	0.0	9468.00	9468.00	0.0839	794.43
2010	953.00	734.00	1687.00	0.0763	128.68	1080.00	9468.00	10548.00	0.0763	804.60
2011	5462.00	734.00	6196.00	0.0693	429.66	5400.00	9468.00	14868.00	0.0693	1031.02
2012	6859.00	734.00	7593.00	0.0630	478.67	4310.00	9468.00	13778.00	0.0630	868.58
2013	1998.00	734.00	2732.00	0.0573	156.57	0.0	9468.00	9468.00	0.0573	542.61
2014	2925.00	734.00	3659.00	0.0521	190.63	0.0	9468.00	9468.00	0.0521	493.28
2015	6728.00	734.00	7462.00	0.0474	353.43	0.0	9468.00	9468.00	0.0474	448.44
2016	10334.00	734.00	11068.00	0.0431	476.57	0.0	9468.00	9468.00	0.0431	407.67
2017	3070.00	734.00	3804.00	0.0391	148.90	0.0	9468.00	9468.00	0.0391	370.61
2018	0.0	1071.00	1071.00	0.0356	38.11	0.0	9468.00	9468.00	0.0356	336.92
2019	0.0	1071.00	1071.00	0.0324	34.65	0.0	9468.00	9468.00	0.0324	306.29
2020	0.0	1071.00	1071.00	0.0294	31.50	0.0	9468.00	9468.00	0.0294	278.45
2021	0.0	1071.00	1071.00	0.0267	28.63	0.0	9468.00	9468.00	0.0267	253.13
2022	0.0	1071.00	1071.00	0.0243	26.03	0.0	9468.00	9468.00	0.0243	230.12
2023	0.0	1071.00	1071.00	0.0221	23.66	0.0	9468.00	9468.00	0.0221	209.20
2024	0.0	1071.00	1071.00	0.0201	21.51	0.0	9468.00	9468.00	0.0201	190.18
2025	0.0	1071.00	1071.00	0.0183	19.56	0.0	9468.00	9468.00	0.0183	172.89
2026	0.0	1071.00	1071.00	0.0166	17.78	0.0	9468.00	9468.00	0.0166	157.18
2027	0.0	1071.00	1071.00	0.0151	16.16	0.0	9468.00	9468.00	0.0151	142.89
2028	0.0	1071.00	1071.00	0.0137	14.69	0.0	9468.00	9468.00	0.0137	129.90
2029	0.0	1071.00	1071.00	0.0125	13.36	0.0	9468.00	9468.00	0.0125	118.09
2030	0.0	1071.00	1071.00	0.0113	12.14	0.0	9468.00	9468.00	0.0113	107.35
2031	0.0	1071.00	1071.00	0.0103	11.04	0.0	9468.00	9468.00	0.0103	97.60
2032	0.0	1071.00	1071.00	0.0094	10.04	0.0	9468.00	9468.00	0.0094	88.72
2033	0.0	1071.00	1071.00	0.0085	9.12	0.0	9468.00	9468.00	0.0085	80.66
2034	0.0	1071.00	1071.00	0.0077	8.29	0.0	9468.00	9468.00	0.0077	73.32
2035	0.0	1071.00	1071.00	0.0070	7.54	0.0	9468.00	9468.00	0.0070	66.66
2036	0.0	1071.00	1071.00	0.0064	6.85	0.0	9468.00	9468.00	0.0064	60.60
2037	0.0	1071.00	1071.00	0.0058	6.23	0.0	9468.00	9468.00	0.0058	55.09
TOTAL	92042.00				47420.25	21580.00				72738.75

Note: Benefit of Irrigation is included in the Alternative Cost.

Table 13-11 Estimation of Equalizing Discount Rate

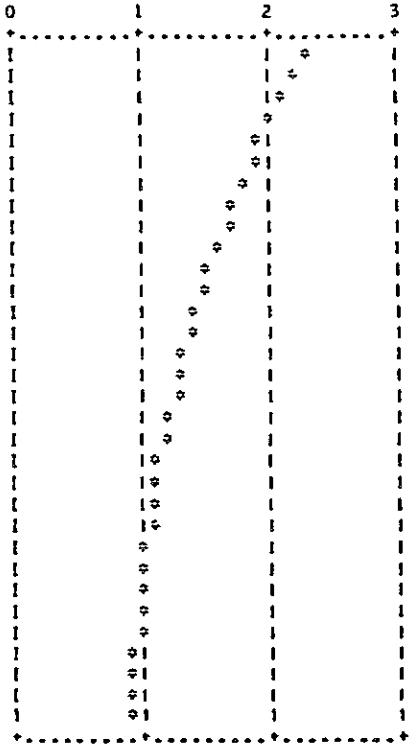
DISCOUNT RATE VARIABLE SHEET
--- WITH SHADOW PRICE FACTOR ---

*** EVALUATION CRITERIA ***

CALAULATION PERIOD --- 54 YEARS

DISCOUNT RATE (%)	HYDRO TOTAL INVEST (MIL.TL)	ALT TOTAL INVEST (MIL.TL)	BENEFIT - COST ANALYSYS COST (MIL.TL)	BENEFIT (MIL.TL)	B-C (MIL.TL)	B/C RATIO
5.0	92042.00	21580.00	66617.75	154107.37	87489.62	2.3133
5.5	92042.00	21580.00	63666.83	140825.56	77158.69	2.2119
6.0	92042.00	21580.00	61043.21	129192.50	68149.25	2.1164
6.5	92042.00	21580.00	58699.05	118957.81	60258.77	2.0266
7.0	92042.00	21580.00	56594.32	109915.62	53321.30	1.9422
7.5	92042.00	21580.00	54694.59	101890.12	47195.53	1.8629
8.0	92042.00	21580.00	52972.15	94741.25	41769.10	1.7885
8.5	92042.00	21580.00	51402.05	88344.25	36942.20	1.7187
9.0	92042.00	21580.00	49964.37	82599.37	32635.00	1.6532
9.5	92042.00	21580.00	48641.95	77421.62	28779.67	1.5917
10.0	92042.00	21580.00	47420.25	72738.75	25318.50	1.5339
10.5	92042.00	21580.00	46286.87	68489.50	22202.63	1.4797
11.0	92042.00	21580.00	45230.86	64620.92	19390.05	1.4287
11.5	92042.00	21580.00	44243.29	61087.30	16844.01	1.3807
12.0	92042.00	21580.00	43316.35	57851.11	14534.76	1.3355
12.5	92042.00	21580.00	42443.39	54879.04	12435.64	1.2930
13.0	92042.00	21580.00	41618.65	52142.66	10524.01	1.2529
13.5	92042.00	21580.00	40836.89	49616.25	8779.36	1.2150
14.0	92042.00	21580.00	40093.87	47278.45	7184.58	1.1792
14.5	92042.00	21580.00	39385.87	45110.40	5724.52	1.1453
15.0	92042.00	21580.00	38709.50	43095.27	4385.77	1.1133
15.5	92042.00	21580.00	38061.97	41218.71	3156.74	1.0829
16.0	92042.00	21580.00	37440.85	39468.04	2027.20	1.0541
16.5	92042.00	21580.00	36843.68	37831.15	987.47	1.0268
* 17.0	92042.00	21580.00	36268.63	36298.19	29.56	1.0008
* 17.1	92042.00	21580.00	36156.08	36003.26	-152.82	0.9958
17.5	92042.00	21580.00	35713.96	34860.34	-853.62	0.9761
18.0	92042.00	21580.00	35178.19	33509.54	-1668.65	0.9526
18.5	92042.00	21580.00	34660.03	32238.82	-2421.21	0.9301
19.0	92042.00	21580.00	34158.07	31041.21	-3116.85	0.9088
19.5	92042.00	21580.00	33671.30	29911.20	-3760.11	0.8883
20.0	92042.00	21580.00	33198.81	28843.64	-4355.17	0.8688

B/C - DISCOUNT RATE



* --- I.R.R (HYDROPOWER)

13.4 ECONOMIC INTERNAL RATE OF RETURN

13.4.1 CONDITIONS

As previously described, a financial analysis was made based on the averaged electricity rate in the South West Region of 33 mills/kWh as of the end of December 1982. In obtaining the economic internal rate of return, similarly to having replaced cost by efficiency price, the benefit also must be based on efficiency price determined under full competition in a free economy. From the mode of the electric power industry, it is a difficult matter to estimate benefit from efficiency price in such an economic society, and it may be that a considerable amount of subjective elements will be contained.

Here, the following were done:

a) Several regions similar economically and socially with the South West Region are selected. R.O. Norte, R.O. Sur Oeste R.O. Centro, and Zone Huacho were selected as satisfying this condition.

b) The average electricity rates of the four regions, including the South West Region, are obtained from energy sales and the electricity charge revenues, and the average vale of these are obtained. This value may be a border price not distorted by pricing policies or other artificial conditions, and is a rate possible for service recipients to pay.

Accordingly, 50 mills/kWh is adopted as the effective price (Fig. 13-1). The benefit when obtaining the economic internal rate of return is evaluated combining the electric power benefit based on this electricity rate and the agricultural benefit.

13.4.2 ECONOMIC INTERNAL RATE OF RETURN

The results of calculations are given in Tables 13-12 and 13-13. The economic internal rate of return according to electric power benefit based on effective price and electricity rate payable by service recipients and agricultural benefit is indicated to be 13.1%.

The value is an advantageous one even when compared with the internal rate of return used as a reference by the International Financing Institutions such as World Bank. Consequently, it is judged that the Project is amply feasible from an economic standpoint also.

Fig. 13-1 Calculated Tariff Rate

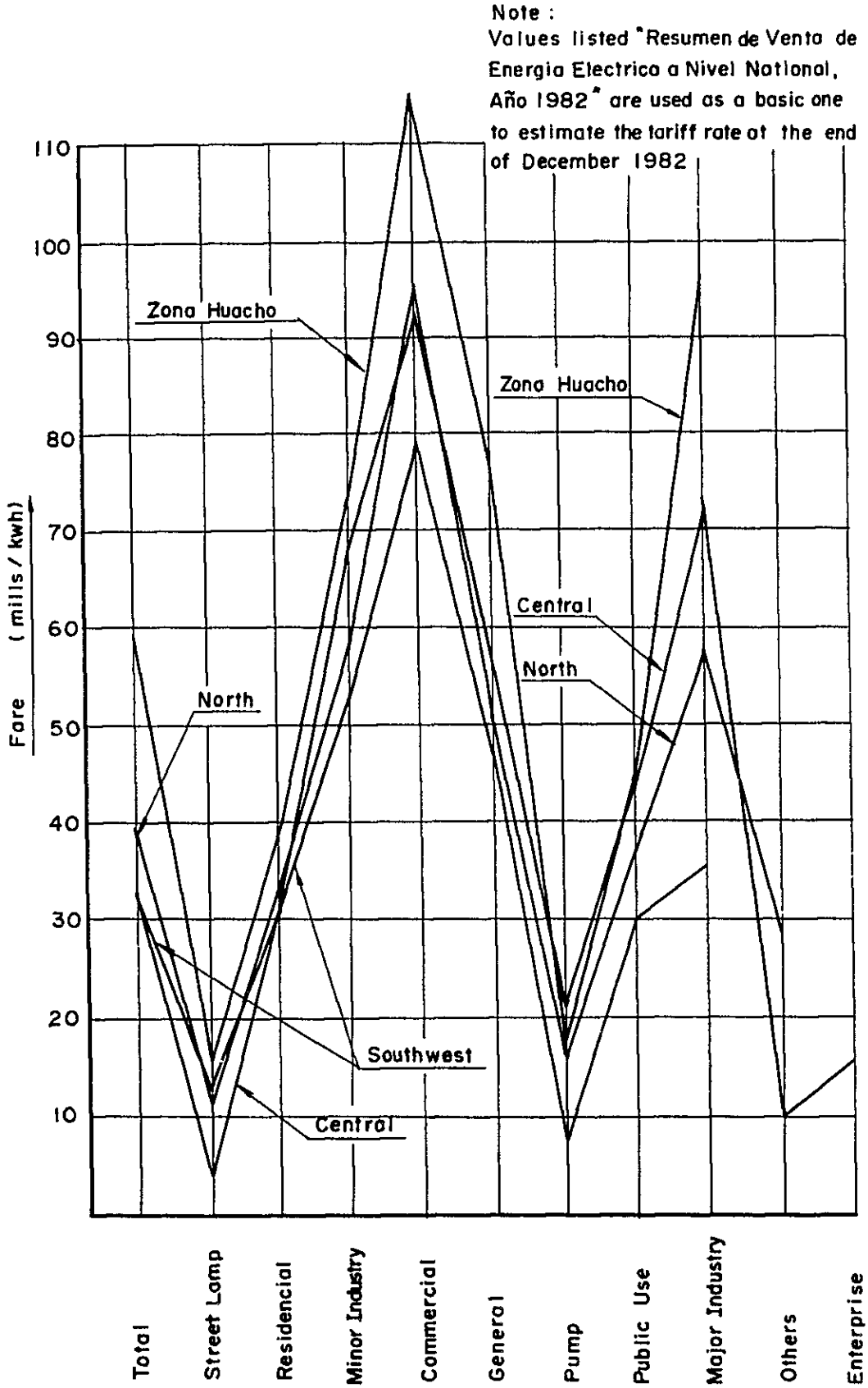


Table 13-12 Estimated Economic Net Present Value

PROJECT EVALUATION BY THE NET PRESENT VALUE (N.P.V) METHOD
--- WITH SHADOW PRICE FACTOR ---

*** EVALUATION CRITERIA ***

CALAULATION PERIOD --- 54 YEARS DISCOUNT RATE --- 10.0 % Unit:10^3US$

	HYDROPOWER					ALTERNATIVE				
YEAR	INVEST-MENT (MIL.TL)	ANNUAL COST (MIL.TL)	COST FLOW (MIL.TL)	NET PRESENT VALUE (I= 10.0 %) P.V.F (P.U)	N.P.V (MIL.TL)	INVEST-MENT (MIL.TL)	ANNUAL COST (MIL.TL)	BENEFIT FLOW (MIL.TL)	NET PRESENT VALUE (I= 10.0 %) P.V.F (P.U)	N.P.V (MIL.TL)
1984	4420.00	0.0	4420.00	0.9091	4018.18	0.0	0.0	0.0	0.9091	0.0
1985	11186.00	0.0	11188.00	0.8264	9246.29	0.0	0.0	0.0	0.8264	0.0
1986	17679.00	0.0	17679.00	0.7513	13282.53	0.0	0.0	0.0	0.7513	0.0
1987	17278.00	0.0	17278.00	0.6830	11801.14	0.0	0.0	0.0	0.6830	0.0
1988	3148.00	734.00	3882.00	0.6209	2410.43	0.0	8893.00	8893.00	0.6209	5521.87
1989	0.0	734.00	734.00	0.5645	414.33	0.0	8893.00	8893.00	0.5645	5019.89
1990	0.0	734.00	734.00	0.5132	376.66	0.0	8893.00	8893.00	0.5132	4563.54
1991	0.0	734.00	734.00	0.4665	342.42	0.0	8893.00	8893.00	0.4665	4148.68
1992	0.0	734.00	734.00	0.4241	311.29	0.0	8893.00	8893.00	0.4241	3771.53
1993	0.0	734.00	734.00	0.3855	282.99	0.0	8893.00	8893.00	0.3855	3428.67
1994	0.0	734.00	734.00	0.3505	257.26	0.0	8893.00	8893.00	0.3505	3116.97
1995	0.0	734.00	734.00	0.3186	233.88	0.0	8893.00	8893.00	0.3186	2833.61
1996	0.0	734.00	734.00	0.2897	212.62	0.0	8893.00	8893.00	0.2897	2576.01
1997	0.0	734.00	734.00	0.2633	193.29	0.0	8893.00	8893.00	0.2633	2341.83
1998	0.0	734.00	734.00	0.2394	175.72	0.0	8893.00	8893.00	0.2394	2128.94
1999	0.0	734.00	734.00	0.2176	159.74	0.0	8893.00	8893.00	0.2176	1935.40
2000	0.0	734.00	734.00	0.1978	145.22	0.0	8893.00	8893.00	0.1978	1759.46
2001	0.0	734.00	734.00	0.1799	132.02	0.0	8893.00	8893.00	0.1799	1599.51
2002	0.0	734.00	734.00	0.1635	120.02	0.0	8893.00	8893.00	0.1635	1454.10
2003	0.0	734.00	734.00	0.1486	109.11	0.0	8893.00	8893.00	0.1486	1321.91
2004	0.0	734.00	734.00	0.1351	99.19	0.0	8893.00	8893.00	0.1351	1201.74
2005	0.0	734.00	734.00	0.1228	90.17	0.0	8893.00	8893.00	0.1228	1092.49
2006	0.0	734.00	734.00	0.1117	81.97	0.0	8893.00	8893.00	0.1117	993.17
2007	0.0	734.00	734.00	0.1015	74.52	0.0	8893.00	8893.00	0.1015	902.89
2008	0.0	734.00	734.00	0.0923	67.75	0.0	8893.00	8893.00	0.0923	820.81
2009	0.0	734.00	734.00	0.0839	61.59	0.0	8893.00	8893.00	0.0839	746.19
2010	953.00	734.00	1687.00	0.0763	128.68	0.0	8893.00	8893.00	0.0763	678.35
2011	5462.00	734.00	6196.00	0.0693	429.66	0.0	8893.00	8893.00	0.0693	616.69
2012	6859.00	734.00	7593.00	0.0630	478.67	0.0	8893.00	8893.00	0.0630	560.62
2013	1998.00	734.00	2732.00	0.0573	156.57	0.0	8893.00	8893.00	0.0573	509.66
2014	2925.00	734.00	3659.00	0.0521	190.63	0.0	8893.00	8893.00	0.0521	463.33
2015	6728.00	734.00	7462.00	0.0474	353.43	0.0	8893.00	8893.00	0.0474	421.21
2016	10334.00	734.00	11068.00	0.0431	476.57	0.0	8893.00	8893.00	0.0431	382.91
2017	3070.00	734.00	3804.00	0.0391	148.90	0.0	8893.00	8893.00	0.0391	348.10
2018	0.0	1071.00	1071.00	0.0356	38.11	0.0	8893.00	8893.00	0.0356	316.46
2019	0.0	1071.00	1071.00	0.0324	34.65	0.0	8893.00	8893.00	0.0324	287.69
2020	0.0	1071.00	1071.00	0.0294	31.50	0.0	8893.00	8893.00	0.0294	261.54
2021	0.0	1071.00	1071.00	0.0267	28.63	0.0	8893.00	8893.00	0.0267	237.76
2022	0.0	1071.00	1071.00	0.0243	26.03	0.0	8893.00	8893.00	0.0243	216.15
2023	0.0	1071.00	1071.00	0.0221	23.66	0.0	8893.00	8893.00	0.0221	196.50
2024	0.0	1071.00	1071.00	0.0201	21.51	0.0	8893.00	8893.00	0.0201	178.63
2025	0.0	1071.00	1071.00	0.0183	19.56	0.0	8893.00	8893.00	0.0183	162.39
2026	0.0	1071.00	1071.00	0.0166	17.78	0.0	8893.00	8893.00	0.0166	147.63
2027	0.0	1071.00	1071.00	0.0151	16.16	0.0	8893.00	8893.00	0.0151	134.21
2028	0.0	1071.00	1071.00	0.0137	14.69	0.0	8893.00	8893.00	0.0137	122.01
2029	0.0	1071.00	1071.00	0.0125	13.36	0.0	8893.00	8893.00	0.0125	110.92
2030	0.0	1071.00	1071.00	0.0113	12.14	0.0	8893.00	8893.00	0.0113	100.83
2031	0.0	1071.00	1071.00	0.0103	11.04	0.0	8893.00	8893.00	0.0103	91.67
2032	0.0	1071.00	1071.00	0.0094	10.04	0.0	8893.00	8893.00	0.0094	83.33
2033	0.0	1071.00	1071.00	0.0085	9.12	0.0	8893.00	8893.00	0.0085	75.76
2034	0.0	1071.00	1071.00	0.0077	8.29	0.0	8893.00	8893.00	0.0077	68.87
2035	0.0	1071.00	1071.00	0.0070	7.54	0.0	8893.00	8893.00	0.0070	62.61
2036	0.0	1071.00	1071.00	0.0064	6.85	0.0	8893.00	8893.00	0.0064	56.92
2037	0.0	1071.00	1071.00	0.0058	6.23	0.0	8893.00	8893.00	0.0058	51.74
TOTAL	92042.00				47420.25	0.0				60223.64

Note: Benefit of Irrigation is included in the Alternative Cost.

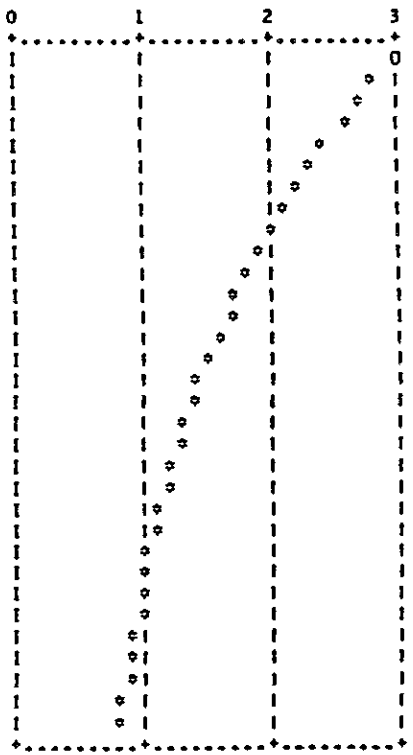
Table 13-13 Estimation of Economic Internal Rate of Return

DISCOUNT RATE VARIABLE SHEET
--- WITH SHADOW PRICE FACTOR ---

*** EVALUATION CRITERIA ***

CALAULATION PERIOD --- 54 YEARS

DISCOUNT RATE (%)	HYORD TOTAL INVEST (MIL.TL)	ALT TOTAL INVEST (MIL.TL)	BENEFIT - COST ANALYSYS COST (MIL.TL)	BENEFIT (MIL.TL)	B-C (MIL.TL)	B/C RATIO
1.0	92042.00	0.0	112243.50	334980.81	222737.31	2.9844
1.5	92042.00	0.0	103180.12	293265.56	190085.44	2.8423
2.0	92042.00	0.0	95434.81	258172.94	162738.12	2.7052
2.5	92042.00	0.0	88785.69	228506.44	139720.75	2.5737
3.0	92042.00	0.0	83050.37	203301.44	120251.06	2.4479
3.5	92042.00	0.0	78077.75	181775.44	103697.69	2.3281
4.0	92042.00	0.0	73747.12	163306.31	89559.19	2.2144
4.5	92042.00	0.0	69954.56	147374.12	77419.56	2.1067
5.0	92042.00	0.0	66617.75	133567.31	66949.56	2.0050
5.5	92042.00	0.0	63666.83	121545.94	57879.11	1.9091
6.0	92042.00	0.0	61043.21	111028.81	49985.61	1.8189
6.5	92042.00	0.0	58699.05	101786.62	43087.58	1.7340
7.0	92042.00	0.0	56594.32	93630.25	37035.93	1.6544
7.5	92042.00	0.0	54694.94	86401.06	31706.12	1.5797
8.0	92042.00	0.0	52972.15	79966.56	26994.41	1.5096
8.5	92042.00	0.0	51402.05	74216.69	22814.64	1.4438
9.0	92042.00	0.0	49964.37	69059.31	19094.94	1.3822
9.5	92042.00	0.0	48641.95	64417.21	15775.25	1.3243
10.0	92042.00	0.0	47420.25	60223.64	12803.39	1.2700
10.5	92042.00	0.0	46286.87	56423.42	10136.55	1.2190
11.0	92042.00	0.0	45230.86	52967.82	7736.95	1.1711
11.5	92042.00	0.0	44243.29	49816.56	5573.27	1.1260
12.0	92042.00	0.0	43316.35	46934.84	3618.49	1.0835
12.5	92042.00	0.0	42443.39	44292.43	1849.04	1.0436
13.0	92042.00	0.0	41618.65	41863.50	244.85	1.0059
* 13.1	92042.00	0.0	41458.93	41400.95	-57.98	0.9986
13.5	92042.00	0.0	40836.89	39624.74	-1212.15	0.9703
14.0	92042.00	0.0	40093.87	37556.76	-2537.11	0.9367
14.5	92042.00	0.0	39385.87	35642.43	-3743.45	0.9050
15.0	92042.00	0.0	38709.50	33866.50	-4843.00	0.8749
15.5	92042.00	0.0	38062.07	32216.25	-5845.82	0.8464
16.0	92042.00	0.0	37440.85	30679.27	-6761.57	0.8194



* --- I.R.R (HYDROPOWER)

13.5 SENSITIVITY ANALYSIS

The benefit and cost of the Project have been estimated based on the conditions previously described, and an economic analyses has been made based on indices such as the internal rate of return. Here, a sensitivity analysis will be made for the case of evaluating benefit by the amount payable for service recipients and agricultural benefit, and evaluating cost by efficiency price. Although data of sufficient accuracy were not available for some sectors, the various values adopted as the bases of calculations are quite capable of occurring (most probable figure).

The results of calculations are shown in Fig. 13-2. According to this figure, in case cost and benefit respectively vary 10%, the economic internal rate of return respectively vary 1.4 - 1.3%. Even under the most severe conditions of cost increased 10% and benefit decreased 10%, the general reference value (10%) of international financing institutions is satisfied.

Fig. 13-2 Sensitivity Analysis