

CHAPTER 4

COST ESTIMATION AND CONSTRUCTION PROGRAM



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CHAPTER 4 COST ESTIMATION AND CONSTRUCTION PROGRAM

4.1 Cost Estimation

4.1.1 Basic Conditions

In estimation of the construction cost of Huanzala Hydro-electric Power Station, natural and regional conditions of the project site, scale of construction, and technological level were considered. The calculations were made based on commodity prices as of June 1983.

The basic conditions for estimation of construction cost were as follows:

(1) Scope of Cost Estimation

In estimation of the construction cost, Huanzala Power Station including intake dam, headrace, etc., the transmission line of approximately 10 km from the power station to the Huanzala Mine-side interconnection, and the addition of one 5,200 kVA transformer are to be considered in the cost estimate. Further, the costs required before starting with work such as detail design and preparatory works are included.

(2) Cost of Civil Works

- (a) The work quantities were estimated in accordance with the preliminary design drawings attached to Chapter 3, "Preliminary Design," and further detailed design drawings when necessary.
- (b) Regarding unit prices, the costs of materials and laborers obtained in Peru were estimated based on commodity prices as of June 1983. As for the prices of imported materials and imported construction equipment, these were estimated based on CIF prices in 1983.
- (c) Unit construction costs were calculated taking into account recent estimation results (Yuncan Project, Aricota

Project) in Peru, construction experiences in Japan in recent years, and the regional conditions of the Huanzala site.

- (d) A contingency cost corresponding to 5% of the total cost of civil works was calculated.

(3) Cost of Equipment

It was considered that the various kinds of equipment such as penstock, gates, electrical equipment, power transforming facilities excepting the main transformer, and transmission line insulators would be manufactured abroad and supplied. It was assumed that the principal transmission line materials and the main transformer to be used would be manufactured in Peru. Ocean freight, insurance, landing costs, import duties, inland transportation costs in Peru, and installation costs were added as necessary.

(4) Engineering Fee

Costs required for detail design and supervision were included in the engineering fee.

(5) Administrative Cost

Engineer personnel costs, equipment costs and administration costs of the Lima and Huanzala construction offices were included in the administrative cost.

(6) Land Acquisition Cost

The acquisition costs of land to be submerged as a result of construction of the intake dam, land of structures, and other necessary land were included.

(7) Interest during Construction

Interest during construction was estimated based on the construction schedule and the annual fund requirements. The interest rates used were 3% per annum for 70% of the construction cost and 8% per annum for the remaining 30%.

4.2 Total Construction Cost

The total construction cost required for Huanzala Hydro-electric Power Station is calculated to be US\$13,590,000. The breakdown is as shown in Table 4-2-1.

Table 4-2-1 Summary of Estimated Construction Cost

<u>Item</u>	<u>Cost (10³\$)</u>
1. Civil works	
(1) Intake (Dam, Intake, Sedimentation Basin)	578
(2) Open Channel	1,057
(3) Headrace Tunnel	1,765
(4) Head Tank	517
(5) Penstock (Penstock, Foundation)	1,040
(6) Powerhouse (Access Road, Building, Turbine-Generator Foundation)	504
(7) Miscellaneous (Temporary Road, Protection Wall)	557
2. Electric Work	
(1) Electrical Equipment (Turbine, Generator, Transformer)	4,000
(2) Huanzala Substation	287
(3) Transmission Line	417
3. Compensation	304
4. Engineering Fee	1,218
5. Administration Cost	435
6. Contingency	304
7. Interest during Construction	<u>585</u>
Grand Total	<u>13,568</u>

4.3 Construction Method

Matters on which special attention should be paid in connection with the construction method for the Huánzala Hydro-electric Project are described below.

4.3.1 Care of River

In construction of the intake dam, it is necessary for the river water to be diverted. Concrete of the bottom part of the dam can be placed providing a diversion works excavated in the river bed. After this, it will be advantageous to handle the river water providing a bypass waterway inside the dam body making it possible for upper concrete to be placed. Based on the above, it was planned for construction of the intake dam to be started in the low-water season of the first year with construction completed on plugging of the bypass waterway in the low-water season of the following year.

4.3.2 Access Road

There is a departmental road running along the Rio San Juan from Huallanca to Pte. Arequipa and the intake site. During construction, this departmental road would be used as the main route for transportation of materials. However, since maintenance of this road is not complete, it will be necessary to increase the width, correct the profile, and provide drainage works before the main construction work is commenced.

For construction of the headrace, it will be further necessary to provide access roads from this departmental road. For the headrace construction, access roads leading to the upper portals of the No. 1 and No. 2 tunnels were planned, while for the head tank and penstock, an access road running along the penstock to reach the head tank was scheduled.

Accordingly, special temporary facilities such as ropeways will not be used for the construction purpose of head tank and penstock.

4.3.3 Headrace Tunnel

The No. 1 tunnel will have a length of 1,000 m. Comprehensively judging matters such as ventilation, muck disposal, construction efficiency, and construction time, the work is to be executed dividing it into two sections starting from the upstream and the downstream portals.

4.3.4 Quality of Cement and Securing of Concrete Aggregate

Approximately 10,000 cu.m of concrete will be used in construction of the Project. Regarding fine aggregate to be used for the concrete, it will be necessary for further investigations and studies to be carried out including utilization of mine tailings.

With respect to the quality of cement produced in Peru and the relations between types of aggregate used and strength of concrete, it will be necessary to be confirmed and tested before start of construction.

4.4 Construction Program

According to the previous studies, the construction program of the Project is estimated to be 10 months for the detailed design and preparatory works and 24 months for the construction works respectively totaling to 34 months. The construction program is as shown on Fig. 4-4-1.

Fig. 4-4-1 Construction Schedule for Huanzala Hydro-power Project

I T E M	Year Month	1984			1985			1986			1987					
		1	4	7	10	1	4	7	10	1	4	7	10	1	4	
Study and Preparatory Works		Definite Study Start of Main Works (1985-1) Access Roads														
	Approx. Volume															
Dam and Intake	Ex. 13,000 m ³															
	Conc. 1,800 m ³															
Headrace Canai	Ex. 34,000 m ³															
	Conc. 800 m ³ Masonry 14,000 m ²															
NO.1 Headrace Tunnel	Ex. 5,000 m ³															
	Conc. 700 m ³															
No.2 Headrace Tunnel	Ex. 3,300 m ³															
	Conc. 400 m ³															
Head Tank and Spillway	Ex. 3,600 m ³															
	T-Ex. 300 m ³															
	Conc. 900 m ³															
	Masonry 700 m ²															
Penstock	Ex. 1,000 m ³															
	Conc. 1,300 m ³															
	Inst. 660 m															
Powerhouse	Ex. 8,000 m ³															
	Conc. 300 m ³															
	House 300 m ²															
Electrical Equip																
Transmission Line																

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