INFRASTRUCTURE SURVEY REPORT

FOR THE HUANZALA MINE

IN THE REPUBLIC OF PERU

Vol. I

FEBRUARY 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO JAPAN

PREFACE

In response to the request of the Government of the Republic of Peru, the Japanese Government decided to conduct a survey on the development of hydro-electric power related to the Huanzala Mine Project and entrusted the survey to the Japan International Cooperation Agency (JICA). JICA sent a survey team headed by Mr. Yoshiharu Miyanaga to Peru from September 12 to October 21, 1983.

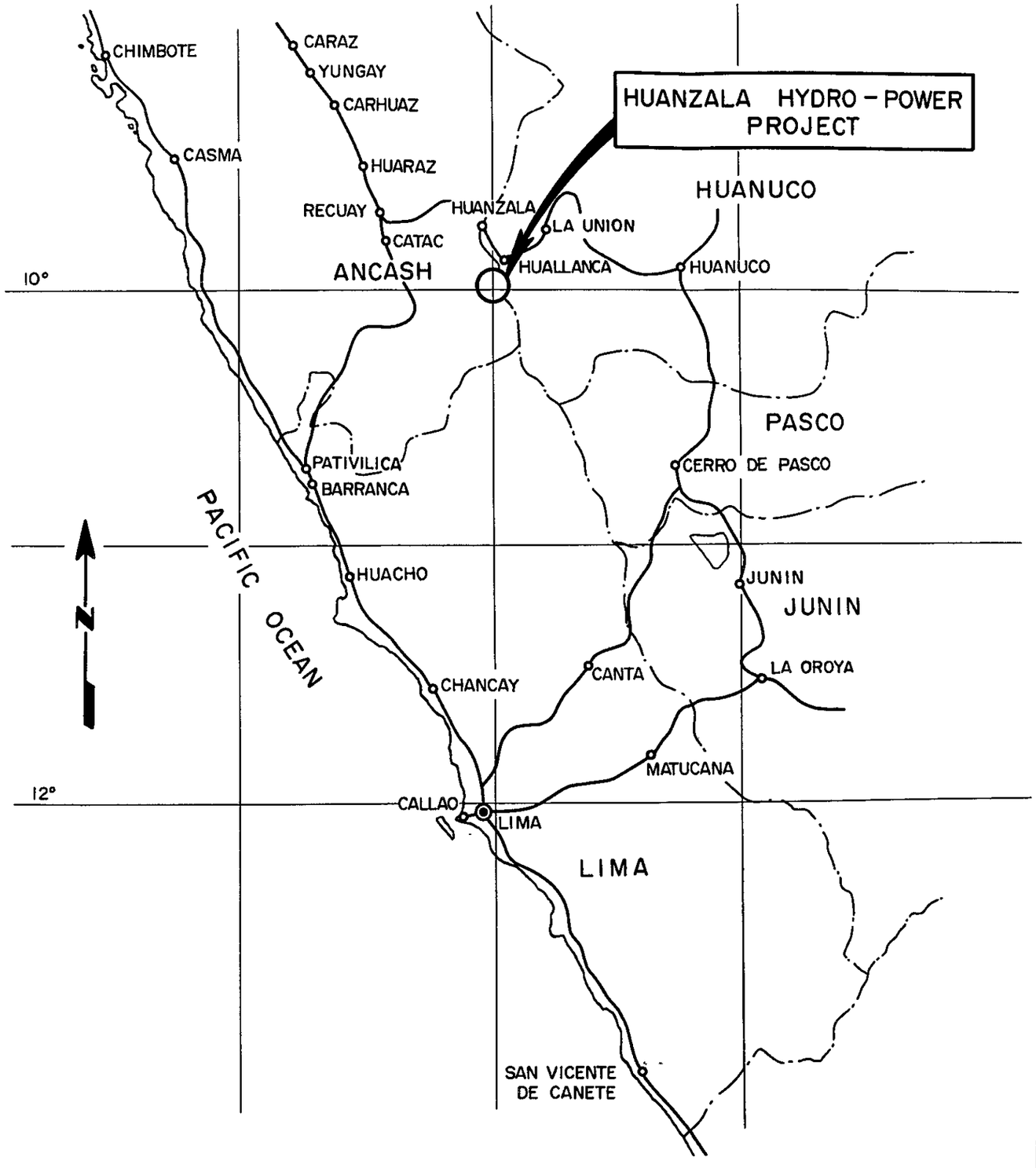
The team, with the cooperation of the officials concerned of the Gevernment of Peru, conducted a field survey in Huallanca area . After the team returned to Japan, further studies were made and the present report has been prepared.

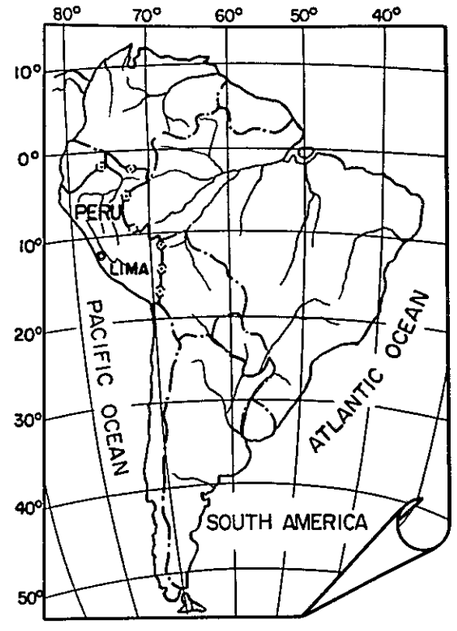
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two contries.

I wish to express my deep appreciation to the officials concerned of the Government of the Republic of Peru for their close cooperation extended to the team.

Tokyo, February 1984

Keisuke Arita
President
Japan International Cooperation Agency





0 100 km

LOCATION	DATE	DESCRIPTION	BY

REVISION

JAPAN INTERNATIONAL COOPERATION AGENCY

HUANZALA HYDRO-POWER PROJECT

KEY AND LOCATION MAP

EPDC International Ltd. TOKYO JAPAN

D.R; SUBMITTED;
T.R; RECOMMENDED;
C.K; APPROVED;

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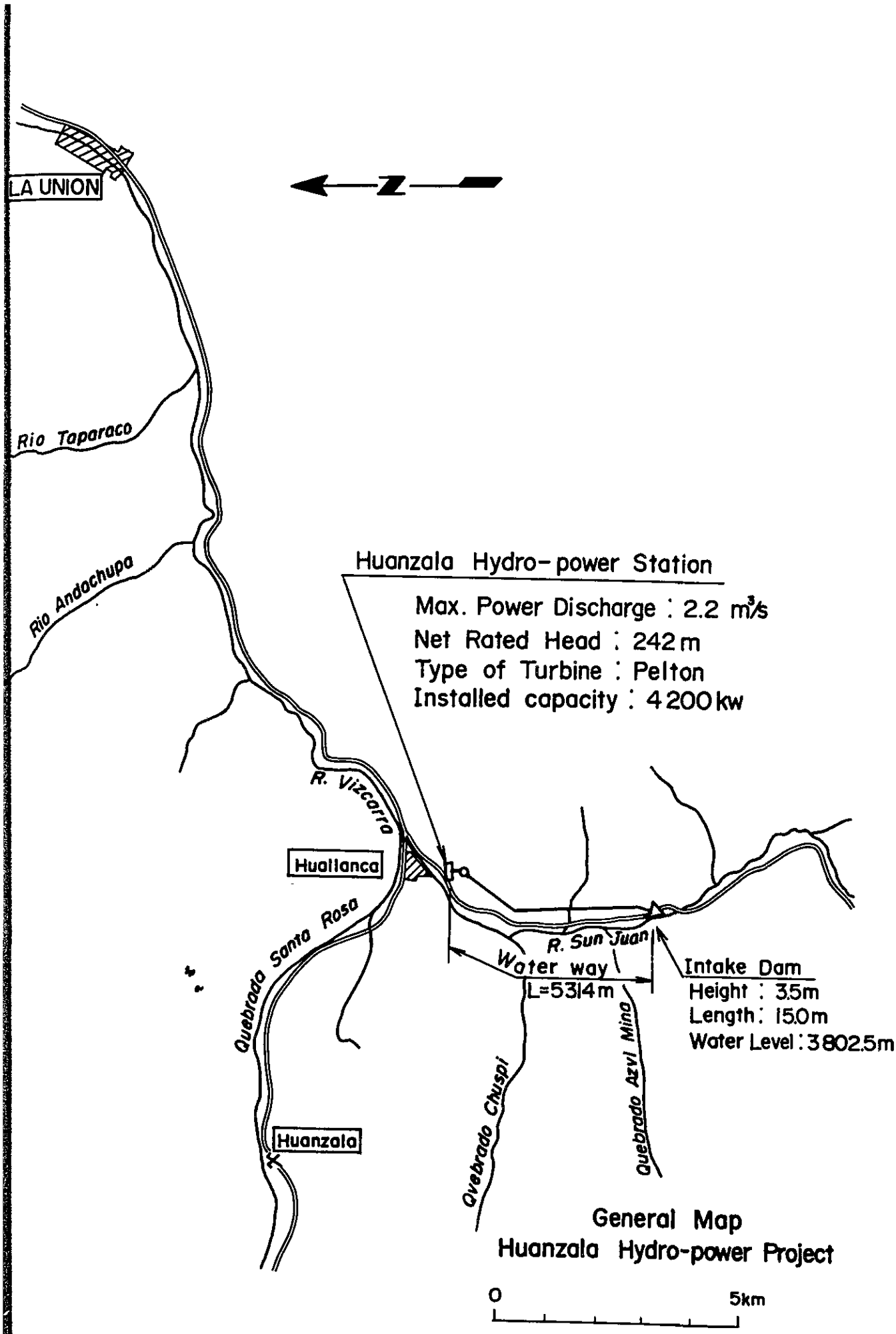

General Map
Huanzala Hydro-power Project

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CONCLUSIONS

1. Fifteen years have elapsed since the opening of Huanzala Mine in 1968, and during this period the mine has grown to one of the promising mines in Peru which produces silver, lead and zinc. Ore extraction is going on at present at a rate of 285,000 ton/yr. The Mine will be possible to continue its operation at the same production rate as now for approximately the next 20 years.

2. The fuel cost for the diesel generators which is the main motive power source of Huanzala Mine has continued to rise sharply year after year, and the ratio of electric power cost in the production cost of Huanzala Mine had risen to 16% in 1982. Therefore, for the sake of long-term stability in management of the Mine, Santa Luisa S.A has come to contemplate construction of a hydro-electric power station.

3. There is insufficient electric power supply at present in Huallanca and La Union which are located in the vicinity of the Huanzala Mine. The residents there have expressed the intention that they desire for their public use to consume part of electricity to be generated by Huanzala Hydro-electric Power Station of the Project.

   Santa Luisa S.A., taking into consideration the co-existence with them, have also intended to positively agree to their wishes. From this standpoint, it is required for Santa Luisa that the financing source with soft conditions to be provided by JICA financing system could be available to construct the said power station.

4. The Project contemplates the construction of Huanzala Hydro-electric Power Station having an installed capacity of 4,200 kW in order to cope with the power demand of the mine use and the public use in Huallanca and La Union. Since the generating capacity of the station decreases in the low-water season, the existing diesel power plants have to continue to be used for the supplementary firing after completion of the Project.

5. For the purpose of the public use, Huanzala hydro-electric power station will provide the necessary power. Since the available power discharge, accordingly the power output, decreases during the dry season, substantial power within the output of the power station will be supplied for the public use. The ratio of the public use and the output is maximum 47% in dry season and 19% in wet season resulting in 30.7% in annual average.

6. The major features of Huanzala Hydro-electric Power Station are summarized as follows:

Diversion weir	:	Length 30 m, Height 3.5 m
Intake water level	:	EL. 3,802.5 m
Conduction canal	:	4,650 m
Head tank water level	:	EL. 3,796.5 m
Center of turbine	:	EL. 3,547.3 m
Effective head	:	242.0 m
Max. power discharge	:	2.2 cu.m/sec
Installed capacity	:	4,200 kW
Energy production	:	32,187 x 10^3 kWh/yr.

The total construction cost is estimated to be US$13,568,000 in terms of the constant price in 1983 and the construction period will be 2 years.

7. The financial and economic evaluation are performed based on the following considerations since the Project is characterized by the dual purposes, the one is that the electric power supply for the mine use and the other is for the public use in the vicinity areas.

- Evaluation are made for two cases. These are; the first case of constructing a hydro power station (with Project) and the second case of not constructing the one but continuing to use the diesel power plants (without Project).
- Project benefit or profitability is evaluated in terms of the saving amount in expenditures to be brought about by the Project.

- All construction cost required will be prepared by the borrowed fund with the following financing conditions.

  70% of construction cost: Annual interest 3%
  Repayment year 20 yrs with 5 years grace period

  30% of construction cost: Annual interest 8%
  Repayment year 7 years

As a result of financial and economic evaluation, the financial internal rate of return (FIRE) is 8.91% after tax and the economic internal rate of return (EIRR) is 11.93% respectively.

8. From a standpoint of the financial internal rate of return after taxes (FIRR = 8.91%), it will be necessary for the Project implementation to use a financing resource with a soft-interest and long-term conditions.

9. In addition to the direct benefit which can provide low cost energy to the mine and the public use by the construction of Huanzala Hydro-electric Power Station, following indirect effects will be brought about into the vicinity areas.

   - Regional development by introducing various light industries such as cheese factory and lumber mill, etc.
   - Improvement of infrastructures in the Project area such as roads and rivers.
   - Improvement of living conditions by introducing water supply, drainage system and TV broadcasting station.

   Further, the Project is of great significance from a standpoint of contributing to the rural electrification program which has been executed by the Peru government. The Project will be truly appreciated too, since there is scarce cooperation by the Japan Government for this kind of program.

10. As a result of various studies, the economic international rate of return (EIRR) is satisfactory to EIRR level of IBRD financed pro-

jects in Peru and substantial development effect can be expected. As to the financial international rate of return (FIRR), it might be not necessarily satisfactory in view of the Mine management.

In addition, the percentage of the power for public use is considerably large against the output of Huanzala Hydro-electric Power Station.

In consideration of these reasons, it is judged that the Project is eligible for realising it by official financing source with a long-term and soft-interest conditions.

Financial and Economic Evaluation

Installed Capacity	4,200 kW	
Amount of Investment (at 1983 Price)	US$13,568 thousand	
Financing Conditions	70% of Fund:	Interest 3% annum Repayment period 20 years including 5-year grace period
	30% of Fund:	Interest 8% annum Repayment period 7 years with no grace period
Project Life	20 years	
FIRR		
Before tax	10.76%	
After tax	8.91%	
EIRR	11.93%	
Unit Cost of Energy		
1983	US$ 9.1 cent/kwh	(by the existing diesel power plant)
1987	US$ 9.3 cent/kwh	(by the combination of hydro and diesel)
	US$11.2 cent/kwh	(by diesel power plant)
2006	US$ 7.4 cent/kwh	(by the combination of hydro and diesel)
	US$16.0 cent/kwh	(by diesel power plant)

Sensitivity Analysis

		FIRR after taxes	EIRR
Investment:	10% up	7.77%	10.34%
	10% down	10.25%	13.79%
Fuel Cost :	10% up	9.93%	13.38%
	10% down	7.85%	10.41%

Financing Capacity

Financing Options

Project Date

Risks

Before Tax

After Tax

Debt Ratio

Sensitivity Analysis

Investment

Fuel Cost

CHAPTER 1

INTRODUCTION

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1.1 Background

Huanzala Mine is located at the village of Huallanca in Dos de Mayo Province, Departamento de Huanuco, Republic of Peru, and was opened in 1968 by Compania Minera Santa Luisa S.A. (capitalization 3.9 billion soles, hereafter called Santa Luisa) in which Mitsui Mining and Smelting Co., Ltd. (hereafter called Mitsui M&S) and Mitsui & Co., Ltd. have invested at a ratio of 7:3. The mine, which is now 15 years old, annually produces approximately 285,000 tons of crude ore of silver, lead and zinc. These are made at the end into the two varieties of products of lead concentrate and zinc concentrate with the entire quantities exported to Japan.

Seven Japanese engineers and approximately 700 Peruvian staffs and employees are working at the mine which is contributing greatly to the development of the Republic of Peru in the aspects of creating employment opportunities and opening up an undeveloped region, in addition to the said export promoting.

The power transmission network of Electricidad Peru S.A. (hereafter called ElectroPeru) does not cover this region, and therefore, Huanzala Mine has its own diesel generating facilities (11 units) of firm output of 4,050 kW as a private source of motive power. However, Mitsui M&S and Huanzala Mine have kept an intention to construct their own hydro-power station in addition to the diesel facilities as a more economical motive power source due to the following situations.

Although the Republic of Peru is an oil-producing country which presently has surpluses for export, there is a possibility that within a period of several years surpluses for export will vanish and the country will be transformed into an oil-importing country because of delays in oil-field development. Accordingly, the government is encouraging petroleum conservation with water power resources utilized as much as possible instead of petroleum.

Added to this general situation, that the price of light oil used for diesel power generation has risen sharply in recent years, that the consumption of light oil is high since efficiencies of diesel engines are poor (to approximately 70% at sea level) because of the thinness of air at the mine located at an elevation of approximately 4,000 m, that many difficulties are encountered in transportation of fuel, and further, that loans for plant and equipment investment made at the time of opening of the mine have been almost completely repaid were taken into consideration, and Santa Luisa, with the cooperation of ElectroPeru, has from several years ago been investigating the possibility of constructing a private hydro-electric power station on a stream in the area surrounding the mine.

As a result of the investigations which included runoff surveys, geological explorations, surveying, etc., it was concluded that construction of a power station of about 3,000 to 4,000 kW would be possible, and a source of funds has been sought in order to realize this hydro-electric power project.

Huanzala Mine, owned 100% by Japanese enterprises, has since its opening received loans from the Export-Import Bank of Japan and the Japan International Cooperation Agency (hereafter called JICA) for consolidation of infrastructure facilities, and loans from the Overseas Economic Cooperation Fund and subsidies from the Metal Mining Agency of Japan for investigations and prospecting. Of these, the loans from JICA were applied to development of a public road cum ore transport road of 58 km between Huanzala and Catac, and repayment is still going on at present. Accordingly, Mitsui M&S and Santa Luisa would like to take advantage of JICA's loan system for construction of the hydro-electric power station under the same principles as before.

In order to obtain the above-mentioned loan, Mitsui M&S and Santa Luisa requested the Japanese Government for a feasibility study to improve the accuracy of the hydro-electric power generating scheme from an engineering point of view, and moreover, to secure the loan from the JICA's system. Upon receiving the above said request, JICA made a contract with EPDC International Ltd. for the feasibility study on "Infra-

structure Survey for the Huanzala Mine in the Republic of Peru" and made them perform the site-survey and feasibility study.

1.2 Scope of Report and Objective

Whereas loans from the Export-Import Bank of Japan or the Overseas Economic Cooperation Fund are made considering development projects themselves undertaken overseas by Japanese enterprises, the loan system provided by JICA is for developing infrastructures related to the above-mentioned development projects, and the facilities must be not only for private purposes, but also serve public welfare in the surroundings and contribute to the cultures and economies of the regions. Consequently the main objective of this report is to study the technical feasibility, to evaluate the financial and economic justification of the Project, based on the site-survey, basic data collected by JICA Survey Team on hydrology, geology, topography and boring results made at the sites of diversion, canal and powerhouse, and finally to justify whether Huanzala Hydro-electric Project would be eligible for a project for which JICA loan system is provided in view of the lending conditions.

1.3 Site Survey

Prior to site survey, the JICA Survey Team made a preparatory study of the damsite, canal routes, and three alternative sites (A, B and C) for the powerhouse based on topographical maps and other data obtained in advance. Upon accumulating various information of the Project as well as the said study results, the site survey were carried out during the 40-day period from September 12 to October 21, 1983. In the site survey based at the camp of Santa Luisa's Huanzala Mine, various technical and economic investigations at the project site, investigations of the existing diesel generating facilities at the mine, investigations at the ElectroPeru offices in Huallanca and La Union regarding the state of electric power consumption in the region, and interview to residents of the region, etc. were carried out.

At Lima, the capital, the basic understanding of Santa Luisa concerning the hydro-electric project was confirmed, and while examining the states of accounting and finances of the company, contacts were also made with the "Ministerio de Energia y Minas" (MEM) and ElectroPeru to request cooperation with the current investigations, and at the same time the concepts of the two regarding the hydro-electric project of Santa Luisa were confirmed.

At MEM, the Survey Team was advised that in case Santa Luisa builds the hydro-electric power station, since it would be a desirable thing for the sake of petroleum conservation, MEM would provide full backing with regard to procedures to be taken and other aspects.

Meanwhile, in a conference with ElectroPeru, it was said that ElectroPeru would cooperate fully in case Santa Luisa constructs a hydro-electric power station at Huallanca, but they would also like power to be supplied to the two districts of Huallanca and La Union for use of the public. If the hydro-electric power station (156 kW) of ElectroPeru presently at Huallanca would have an adverse influence on the Project, there would be no objection to abolishing the existing station so long as the optimum plan could be established.

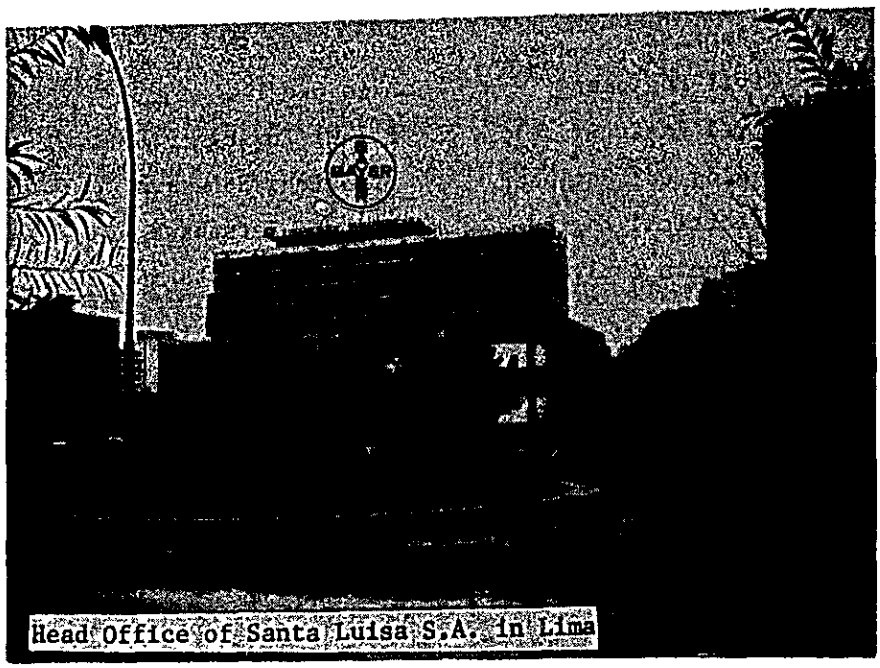
Furthermore, the points below were confirmed at the conference. That is, subclause b) in Article 42 of the General Law Concerning Electric Power stipulates that not less than 20% of electric power capacity must be furnished to serve the public use, while c) states that the rights are to expire 30 years after start of operation with the facilities at 30 years to be transferred gratuitously to ElectroPeru. These two conditions apply to private generating facilities of capacities 30,000 kW and higher. Therefore, the present Project which is only around 3,000 to 4,000 kW would not be directly affected, but it is possible that as an adaptation of the conditions, administrative guidance would be provided requiring that about 20% be furnished as for the public use.

The composition of the Survey Team was that given below.

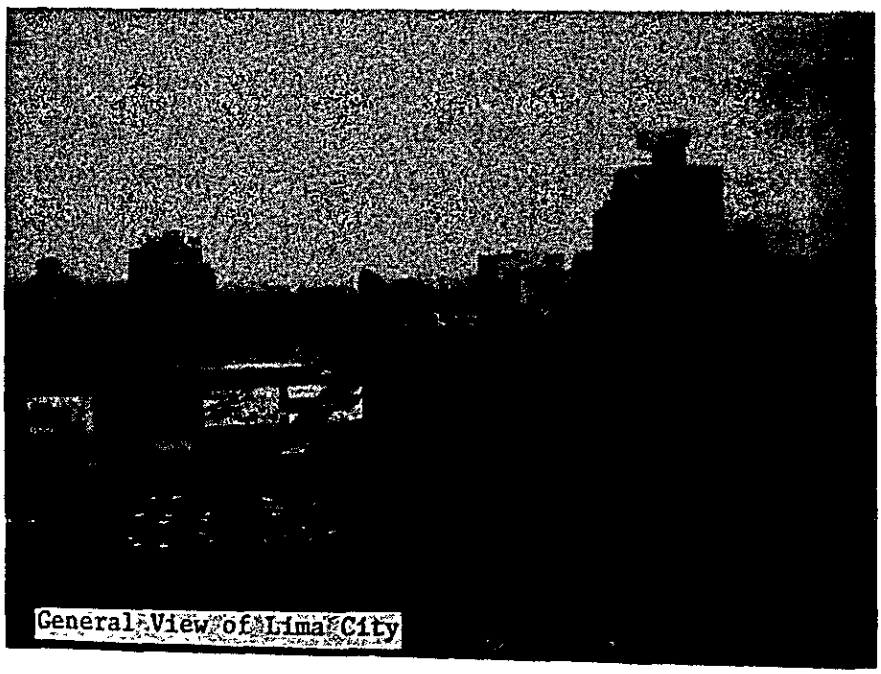
Team Leader	Yoshiharu Miyanaga
Economist	Kenzou Hagio
Civil Engineer	Akio Okajima
Civil Engineer	Eiichi Fujiki 1/
Geological Engineer	Hiromichi Sobukawa
Electrical Engineer	Hiroshi Katsukawa
Economic Analyst	Teruhisa Hirota 2/
Economist	Kouichi Aida
Coordinator	Yoshihiko Sumi

1/ Mitsui Kinzoku Engineering
MESCO Inc.

2/ Sumitomo Trust & Banking Co.



Head Office of Santa Luisa S.A. in Lima



General View of Lima City

General View of Huallanca

CHAPTER 2

GENERAL SITUATION IN THE REPUBLIC OF PERU

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2.1 Geography

The Republic of Peru faces the Pacific Ocean at the northwest part of the South American continent and is situated at 0° to 14° south latitude, and 68° to 82° west longitude. The total area of the national territory is 1.29 million sq.km, approximately 3.3 times that of Japan, and the size is third among South American countries after Brazil and Argentina.

The topography of the Republic of Peru is extremely varied. The land can be broadly divided into three regions called Costa, Sierra and Selva, each region having its own characteristics regarding climate.

The Costa runs north-south as a belt 50 to 100 km wide along the Pacific Ocean coast. There is practically no rainfall throughout the year with the land being barren desert except at plains along rivers which can be irrigated.

The Sierra is situated on the eastern side of the Costa and comprises the Andes Mountain Range of elevations 3,000 to 5,000 m above sea level. Contrasted to the Costa being a desert, the region becomes greener with higher elevation. At heights between 3,000 and 3,500 m above sea level where the Project site is located, there is an increased amount of trees, while the climate is temperate throughout the year.

The Selva is the region from the eastern foothills of the Andes Mountain Range to the eastern border which makes up 50% of the national territory and is entirely covered by a great forest. Particularly, the northeast portion centered at Iquitos comprises the upstream area of the Amazon, and a vast flatland is spread out.

2.2 Climate

The Republic of Peru is located in the tropics according to latitude, but because of the cold Humboldt Current flowing offshore from south to

north, the climate is temperate. For example, the minimum temperature at Lima, the capital, is 12°C while the maximum does not exceed 30°C. The annual precipitation there is about 30 mm and what can really be called rain is not seen throughout the year. July to September in the winter corresponds to the rainy season and Lima is enveloped in fog produced by collision of cold and warm currents, and the sun is hardly ever visible.

In recent years, the abnormal ocean current phenomenon called El Nino has become famous in Japan for having affected even its climate (especially, with a warm winter in 1983). This is the phenomenon of the surface of the ocean offshore of Peru being prominently raised above normal (by 2 to 6°C), and because of this, there were heavy rains in the north and drought in the south in 1983. At the same time the agricultural crops were damaged, the fishing industry was severely hit.

The Andes highlands above 3,000 m are low in temperature and have a comparatively large amount of precipitation, with snow and hail seen in the rainy season, while glaciers are developed on mountains higher than 5,000 m in the elevation.

The temperature is high from the eastern slopes of the Andes to the lowlands in the upstream area of the Amazon. There is much rainfall, the climate is tropical, and jungles are formed.

2.3 Population

The total population of the Republic of Peru is approximately 19 million (1983 estimate) with 6 million, close to 30% of the whole, living in the city of Lima and its environs. The trend of urban concentration has become increasingly stronger in recent years. The reasons for the above are that the electrification rate in the provinces is low, there are no notable industries other than agriculture and stock raising, in addition to which the birth rate is very high. People unable to find employment opportunities in the provinces have poured into Lima. Suppressing the population of the capital is one of the objectives for which rural electrification is being planned and implemented as a major policy of the government.

2.4 Economy

Although Peru, in a Belaunde Administration, compared with other Central and South American countries, has a relatively diversified industrial structure, it is basically an agricultural and mining country. The ups and downs of exports of primary industrial products acutely affect the economy of the country.

The main exports of Peru are firstly mining products such as copper, silver, lead, zinc, and iron ore which make up approximately one half of the total export amount, while from 1978, export of petroleum was started. Secondly, there are agricultural products such as cotton, sugar, coffee, and wool, but recently, the growth in exports of non-traditional products such as textiles, cement, chemicals and processed marine products has become notable. On the other hand, the main imports are capital goods and foodstuffs.

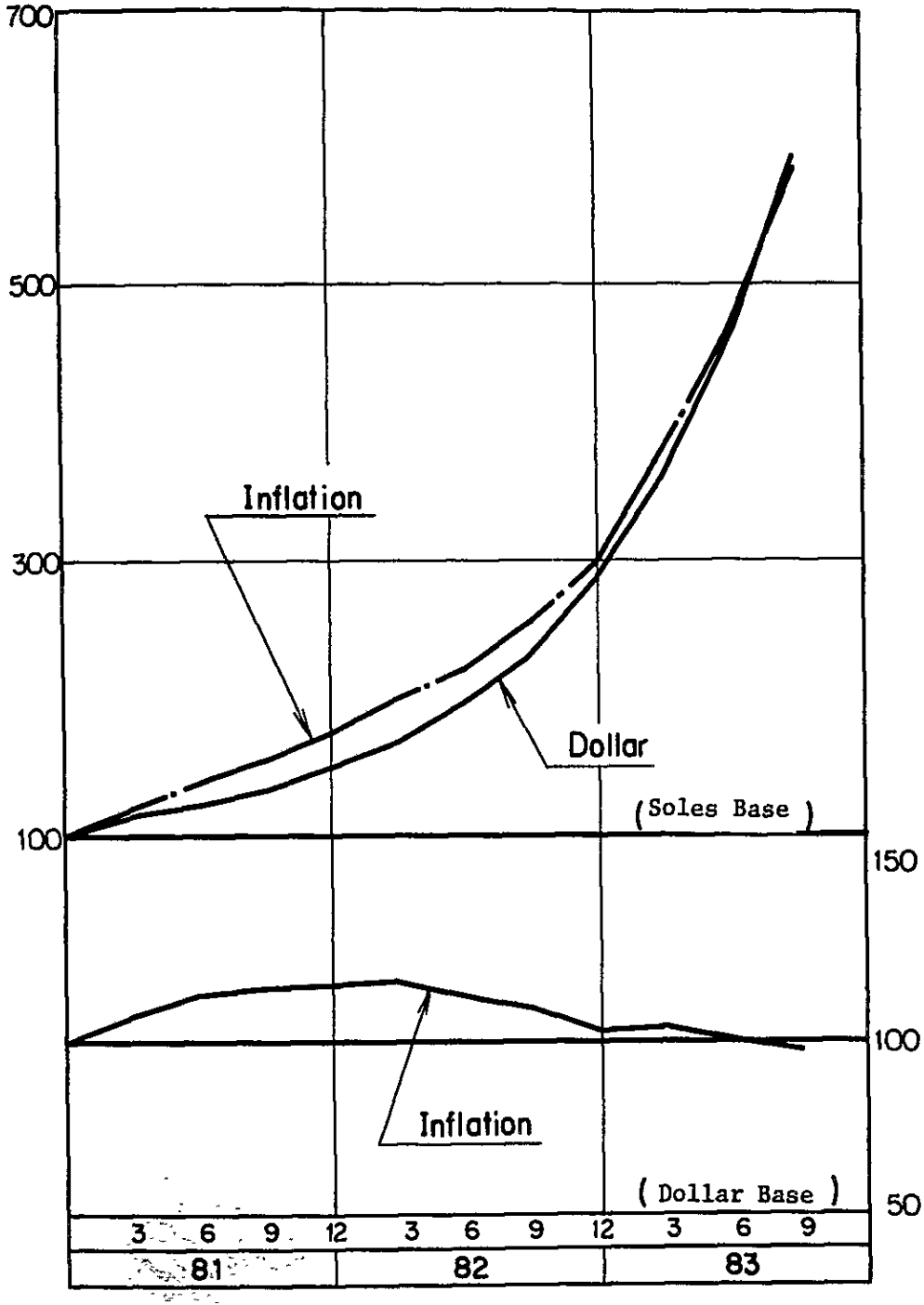
After the oil shock, from 1974 to 1977, Peru was troubled with large deficits, and in 1978 a loan was obtained from the IMF, while the balance of foreign exchange was maintained by postponing repayments of foreign debts. At the same time a new economic policy was announced with a series of austerity measures taken such as abolishing of subsidies for daily necessities, making administrative reforms, raising interest rates, etc., and favorable results were gradually achieved. In addition, it happened that from the latter half of 1978 through 1979, the international market for mining products such as copper and silver improved greatly so that foreign exchange revenues increased sharply and the trade balance at the end of 1979 showed an unprecedented surplus of approximately 1.4 billion dollars.

With return of civilian rule in 1980, imports were deregulated and there was a rapid influx of automobiles, electrical appliances and consumer goods in general and there was prosperity in 1981 and the first half of 1982 so that the livelihood of the populace benefited. Subsequently, the international market situation in minerals showed a sudden deterioration, while with the decline in production in agriculture, fishing and petroleum extraction due to natural setbacks caused

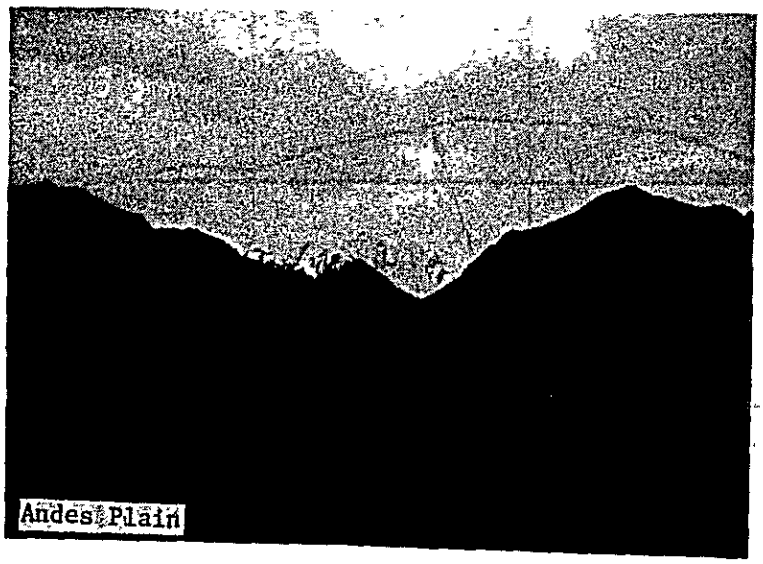
by El Nino, there was an abrupt turnaround to an extremely bad economic condition. The situation was such that financial relief measures such as in the form of deferment of repayments was asked of foreign bank syndicates in March 1983, and of creditor nations in May.

At present, unemployment has increased and inflation has worsened with the downturn in the economy.

Fig. 2-4-1 Escalation Index of
Infration and Dollar




Andes Glacier


Andes Plain

2.5 Mining and Petroleum

The Andes Mountain Range, with a string of tall peaks higher than 5,000 m and headed by Mt. Huazcalan of EL. 6,768 m, runs longitudinally through the national territory of Peru to form a natural barrier to development of the country. But on the other hand, this mountain range holds abundant underground resources, and Peru has long been known as one of the leading mining countries of the world. Particularly, Peru is favored with base metals and is seventh in the world in copper production, fifth in lead, and fourth in zinc, while it is said that with regard to reserves the country is sixth in lead and fourth in zinc.

The ratio of the contribution by mining to the gross domestic product (GDP) is about 6% and not very high, but approximately half of exports is made up of mining products so that the industry is aiding the Peruvian economy substantially. Accordingly, regarding mine development which had been maintained by a 1950 law, the Government since 1969 has established various laws and ordinances in succession to promote new mining policies to this day.

Meanwhile, with regard to exploration for petroleum resources, it was begun from the latter half of 1972 with participation by the majors of the world, but discoveries of deposits were not as hoped for, and by 1975 many exploration companies had retreated to leave only several concerns. However, in 1978, a pipeline crossing over the Andes was completed with loans from foreign countries headed by Japan, and exports were started, including to Japan.

The population at present is roughly 210,000 bbl daily of which 140,000 bbl are being consumed domestically with 60,000 bbl allotted to export. But not much can be expected of reserves, and there is a possibility that surplus for exports will disappear within 10 years. Therefore, in order to hold down domestic consumption, the Government has raised petroleum product prices. It is thought the prices of petroleum products will rise in the future on a dollar basis.

2.6 Electric Power

2.6.1 General

In view of the special nature of the power generation project being considered in the Project, a study will be made dividing into power generation and transmission projects of relatively large scale and power generation projects of small-scale aiming to raise the electrification rate of local areas in the provinces based on a Rural Electrification Program.

The power generating facilities and the electric energy production of Peru in 1981 are as shown in Table 2-6-1. The daily load curve is a night-time peak type with the influence of power for lighting stronger than that of power for manufacturing, the per capita electric energy consumption being about 550 kWh/yr, one of the lowest rates among Latin American countries.

Due to the sharp deterioration in economic conditions from 1982 to 1983, industrial activities have stalled and all large-scale hydro-electric projects which were to have been started were postponed. It is foreseen that the power generating facilities expansion program will be greatly slowed down hereafter.

2.6.2 Rural Electrification Program

At present, electricity is not being supplied to 12 million persons, approximately 65% of Peruvian nation. In more than 2,000 towns and villages with populations of 500 and over, either electric power is not being supplied, or if supplied, it is at a rate so inadequate that industrial development is hindered.

Because of this, the Government has given priority to promotion of the Rural Electrification Program to develop industry in the provinces and suppress the flow of population into the cities. Construction of small-scale power stations based on this program was started at the time of the previous military administration, and even now, mini hydro-

electric power stations of several hundred to several thousand kilowatts as listed in Table 2-6-2 are under construction or being planned with the cooperation of Great Britain, West Germany and China. After this program is implemented as scheduled, the electrification rate will reach 56% in 1990.

However, what was clarified from the investigations made JICA Survey Team in the two districts of Huallanca and La Union is that accomplishing this program will be difficult unless there is considerable aid from overseas or investment by the Government. The reason is that even if these power stations were to start operation and electricity were to be supplied to people, it will be difficult for these people to sufficiently prepare the electricity charges and also difficult for example for ElectroPeru to recover depreciation costs and operation and maintenance costs.

To take Huallanca as an example, the revenue of ElectroPeru in one month obtained by supplying 262 households with a 156-kW power station is about 50,000 to 60,000 yen in Japanese currency, the electricity charge per household being around 200 yen. In contrast, the salaries of the power station staff of three (manager, clerk and operator) total about 80,000 yen so the situation is that even personnel costs cannot be covered with electricity charge revenues. ElectroPeru, therefore, is making earnest efforts to reduce deficits by suspending operation during the daytime (10 hours from 8:00 a.m. to 6:00 p.m.), to save on the salary of one operator and repair costs. Because of such a situation the demands of local residents for a 3-phase industrial power supply to build cheese factories and lumber mills, have been neglected.

Even though there are electricity generating facilities, those can not provide adequate energy for developing industries, and the livelihood of the residents is accordingly very hard to be improved.

In the discussions with JICA Survey Team, ElectroPeru indicated that the present power plant would be abolished if Santa Luisa would supply electric power for use by the public.

Although the small-scale power stations hereafter are constructed by aid from foreign countries, construction costs are showing a trend of rise even on a dollar basis. If high inflation rates as at present should continue, the electricity would be of very high cost on the basis of domestic currency (soles, hereafter SL.), and for rural people who have scarce chance to obtain cash income, it would not be possible to use electricity even if the power stations were to be built.

In view of such circumstances, if the proposed Huanzala hydro-electric power station were to be realized by JICA loan system, it would not only be cooperating with rural electrification and improvement of the financial position of ElectroPeru, but it would also contribute to development of local industries and construction of roads, and provide opportunities for employment for the people in these areas. thus the various effects by the Project for developing industries adequate to the regions and for enhancing the living standard of the residents.

Table 2-6-2 Provincial and Rural Electrification Program in 1982 and 1983

	Location	Financial Resource	No. of Unit	Hydro-potential (kw)	Population in 1981	Commission-ing Year	Remarks	
ANCASH	Huari	Cofide (Bank of Peru)	1	1,400	11,000	1983	En construcción	(1)
	San Marcos	Republica Popular China	1	100	1,200	1982	En construcción	(2)
AMAZONAS	Bagua	Reino Unido (English)	1	2,000		1985	En evaluación	
APURIMAC	Chuquibambilla	República Popular China	2	200	2,000	1983	En construcción	(3)
	Antabamba	Cofide	1	70	2,000	1982	En construcción	(4)
	Abancay	Reino Unido	1	1,000		1985	En evaluación	
	Andahuaylas	Reino Unido	1	1,000		1985	En evaluación	
	Villar Chiora	Por Concertar	1	50	1,200	1983	En construcción	(5)
	Sabalno	Por Concertar	1	28	600	1983	En construcción	(6)
	Pomacocha	Por Concertar	2	125	900	1983	En construcción	(7)
	Acobamba	Por Concertar	1	95	400	1983	En construcción	(8)
AREQUIPA	Viraco-Machahuay	Cofide	1	180	1,000	1982	En construcción	9
	Huanca	República Popular China	1	75	1,000	1982	En construcción	10
	Camaná	Cofide	1	600	14,000	1984	Por iniciar construcción	11
	Santa Rita de Sibvas	Republica Federal de Alemana (W. Germany)	1	160	500	1984	Donación	12
	Caraveli	Por Concertar	1	1,100	1,800	1983	Por iniciar construcción	13
	Cotahuasi	Por Concertar	1	50	1,700	1983	Por iniciar construcción	14
	Camaná	Reino Unido	1	2,000	2,000	1985	En evaluación	15
	Madrigal	Reino Unido	1	800		1984	En evaluación	
	Colca	Reino Unido	1	500		1984	En evaluación	
AYACUCHO	Pausa	Cofide	1	200	500	1982	En construcción	10
	Chavina	Cofide	1	280	1,500	1982	En construcción	17
		Republica Popular China	2	125	3,600	1983	En construcción	18

	Location	Financial Resource	No. of Unit	Hydro-potential (kw)	Population in 1981	Commissioning Year	Remarks	
	Huancasancos	República Popular China	2	55	3,400	1983	En construcción	19
	Incuyo	República Federal Alemana	1	160	800	1984	En construcción	20
	Laramate	República Federal Alemana	1	200	1,100	1984	En estudio	21
	Ayacucho	Reino Unido	1	5,000		1985	En evaluación	
	Puquio	Reino Unido	1	1,000		1984	En evaluación	
CAJAMARCA	Pomahuaca	Cofide	1	65	600	1982	En construcción	22
	Namora	República Popular China	1	75	900	1982	En construcción	23
	Cutervo	A.I.D.	2	500	6,800	1984	En estudio	24
	Cajamarca	A.I.D.	2	400	6,900	1984	En estudio	25
	St. Cruz de Suán	A.I.D.	2	400	4,100	1984	En estudio	26
	Celendín	A.I.D.	2	800	8,500	1985	En estudio	27
	Cajamrca	Reino Unido	1	5,000		1985	En evaluación	
	Chota	Reino Unido	1	1,000		1984	En evaluación	
	Jaén	Reino Unido	1	2,000		1985	En evaluación	
	Pucará	A.I.D.	1	420	3,300	1985	En estudio	28
	San Marcos-Ichucan	A.I.D.	2	125	4,100	1985	En estudio	29
CUSCO	Quincemil	República Popular China	2	55	1,000	1983	En estudio	20
	Paucartambo	Por Concertar	1	312	2,200	1983	En construcción	31
	Pomacanchis	Reino Unido	1	2,000		1984	En evaluación	
HUANUCO	Huánuco	Reino Unido	1	4,000		1985	En evaluación	
	Tantamayo	República Popular China	1	160	300	1983	En construcción	32
JUNIN	Pichanaqui	Cofide	2	625	9,400	1983	En construcción	33
	Chongos-Alto	A.I.D.	1	850	6,000	1984	En estudio	34
	Tarma	Reino Unido	1	2,000		1985	En evaluación	
	La Merced	Reino Unido	1	2,000		1985	En evaluación	
	Satipo	Reino Unido	1	3,000		1984	En evaluación	
LAMBAYEQUE	Oyotan	Reino Unido	1	500		1984	En evaluación	
	Motupe	Reino Unido	1	800		1984	En evaluación	

	Location	Financial Resource	No. of Unit	Hydro-potential (kw)	Population in 1981	Commission-ing Year	Remarks	
LA LIBERTAD	Otuzco	Reino Unido	1	800		1984	En evaluación	
LIMA	Canta	República Popular China	1	250	2,700	1982	En construcción	35
	Santa Leonor	República Popular China	2	100	700	1983	En construcción	36
	Hongos	República Popular china	2	125	600	1982	En construcción	37
	Ravira-Pacaraos	República Popular China	2	75	400	1983	En construcción	38
	Yangas	D.L. 163	1	75	300	1982	En construcción	39
	Oyón	Reino Unido	1	1,000		1984	En evaluación	
	Cajatambo	Por Concertar	2	220	2,500	1984	En construcción	40
	Quinches	Por Concertar	2	175	1,400	1983	En construcción	41
	Santo Domingo de Naya	Por Concertar	2	120	700	1983	En construcción	42
	Cotahuasi	Donación	1	15		1982	En estudio	
PASCO	Pozuzo	Cofide	2	485	300	1984	En estudio	43
	Huachón	República Federal Alemana	1	120	2,000	1984	En estudio	44
PIURA	Morropón	Reino Unido	1	800		1984	En evaluación	
SAN MARTIN	San José de Sisa	Cofide	1	130	4,500	1982	En construcción	45
	Tabalosos	Cofide	1	376	6,000	1982	En construcción	
SAN MARTIN	Moyobamba	Reino Unido	1	5,000		1985	En evaluación	
	Tarapoto	Reino Unido	1	3,000		1985	En evaluación	
	Juanjul	Reino Unido	1	2,000		1985	En evaluación	
TUMBES	Tumbes	Reino Unido	1	10,000		1985	En evaluación	

NOTA: (1) El Programa de Cooperación Técnica de la República Federal Alemana comprende adicionalmente la ejecución de 5 Proyectos Piloto de alcance microregional.
(2) Dentro del programa de la AID se encuentran en la fase de Estudio y delinición 20 proyectos adicionales.
(3) Los proyectos con financiación "Reino Unido" tiene carácter referencial y serán ajustados con los estudios respectivos.
(4) La Fuente de financiamiento se refiere a la adquisición de grupo hidráulico. Las obras civiles y montaje serán financiados con todos del D.L. 163.

Table 2-6-1 Generating Capacity and Energy Demand in Peru

		1979	1980	1981
Population (10^3 persons)		17,290	17,780	18,260
Generating Capacity	Hydro (MW)	1,633	1,861	1,918
	Thermal (MW)	1,280	1,331	1,364
	Total (MW)	2,913	3,192	3,282
Energy Demand	Hydro (10^6 KWh)	6,543	7,622	7,800
	Thermal (10^6 KWh)	2,709	2,183	2,300
	Total (10^6 KWh)	9,252	9,805	10,100
	Growth Rate (%)	5.6	6.0	3.0
Consumed Energy per Man-year (KWh)		535	551	553

Source: World Energy Statics

CHAPTER 3

RELATION BETWEEN THE REPUBLIC OF PERU AND JAPAN

CHAPTER 3 RELATION BETWEEN THE REPUBLIC OF PERU AND JAPAN

In 1899 the first group of immigrants from Japan arrived in Peru, and since then immigration continued with 203 sailings until immediately before World War II. Today, including second and third generation descendents, there is a Japanese-ancestry society of approximately 70,000 in Peru. This number is the second largest in South America after Brazil.

The economic relationship between Japan and Peru is one where Japan imports from Peru mineral resources such as copper, lead, and zinc, and agricultural products such as cotton, sugar, and coffee, and exports to Peru capital goods such as industrial equipment. Recently, exports amounted to US$350 million and imports US$600 million in 1981, and US$320 million and US$540 million in 1982, and imports by Japan from Peru exceed the exports to Peru.

Peru has numerous enterprises which have come from Japan. In addition to Mitsui Mining and Smelting Co. connected with the Project, enterprises such as Ajinomoto, Toyota Motor, Nissan Motor, Asahi Chemical Industry, Matsushita Electric Industrial and Nippon Whaling have built factories centered at Lima. Besides the governmental agencies such as JICA and OECF, there are approximately 50 trading companies and the resident staffs amount to more than 200 persons.

In the aspect of technical cooperation, Japan is aiding Peru in a wide variety of fields such as fishing, agriculture, telecommunications, vocational training, mine security, electric power, medicine, etc., through acceptance of trainees, dispatching of engineers and investigations or studies of development projects, etc.

In the aspect of economic cooperation, Japan has provided long-term loans at low interest through the Overseas Economic Cooperation Fund (OECF) and the Export-Import Bank of Japan (EXIM) since 1971 for projects in electric power, telecommunications, agriculture, etc. (Table 3-1)

In this way, although the two countries are separated by a great distance, they have a relationship of long and close cooperation culture-

wise and economy-wise. It is thought necessary for this relationship of cooperation to be further expanded in the future.

Table 3-1-1 Japan Governmental Loan to the Republic of Peru

Date of L/A	Name of Project	Amount (Billion Yen)	Condition of Loan: Interest % Year	Condition of Loan: Repayment Period (Grace Yr.)	Financing Institute
Dec. 1971	Lima-Chimbote Transmission Line Project (I)	54	3.5	25 (7)	OECF
Feb. 1972	Talara Fertilizer Plant Project	136	5.5	20 (5)	EXIM Bank
Mar. 1972	Microwave Telecommunication System Project	40	5.5	20 (5)	EXIM Bank
Sept.1976	Lima-Chimbote Transmission Line Project (II)	15	3.5	25 (7)	OECF
Mar. 1978	Expansion Work for Microwave Telecommunication Project	36	5	20 (7)	OECF
Mar. 1980	Five Projects of Governmental Developments for Transportation, etc.	75.91	4.25	25 (7)	OECF
Apr. 1983	Expansion Work of Telecommunication Network for Lima Metropolitan	98.7	4.25	25 (7)	OECF

CHAPTER 4

HUANZALA MINE

CHAPTER 4 HUANZALA MINE

CHAPTER 4 HUANZALA MINE

4.1 History and Future

The discovery of Huanzala Mine is said to have been made a long time ago during Spanish colonial days. At the beginning of this century, Mr. Piagio, who was influential in economic circles of Peru, obtained a mining concession and started exploration together with the Cerro de Pasco firm but was unsuccessful in developing the mine.

An investigation was made in 1961 by a geologist of Mitsui M&S, and since it was found to be promising, Mitsui M&S obtained the mining rights and concluded a contract for an option to purchase the entire stock of Santa Luisa Mining S.A. owned by Mr. Piagio and his three partners.

As a result of explorations through the boring and adit excavation in two phases between February 1965 and March 1966, ore reserves of 2 million tons and grade of 20% lead and zinc combined was confirmed. The option was exercised from October 1966; all shares of the said Santa Luisa were obtained by Mitsui M&S and Mitsui & Co., and the mining activities was immediately started by Santa Luisa S.A. which is completely invested by Japan firms.

Subsequently, during a short period of one and a half years, production facilities such as mining tunnels, concentrator, power plant, and appurtenant facilities such as living quarters, school, hospital and road for transporting concentrates were completed, and in April 1968 operation was started on a scale of 500 ton/day of crude ore production.

After this stage, investigations were carried out on adjoining areas, and while a new mining area was discovered. The scale of crude ore production was successively enlarged and 1,050 ton/day was attained in 1976. However production has been continued at a level of 950 ton/day since 1982.

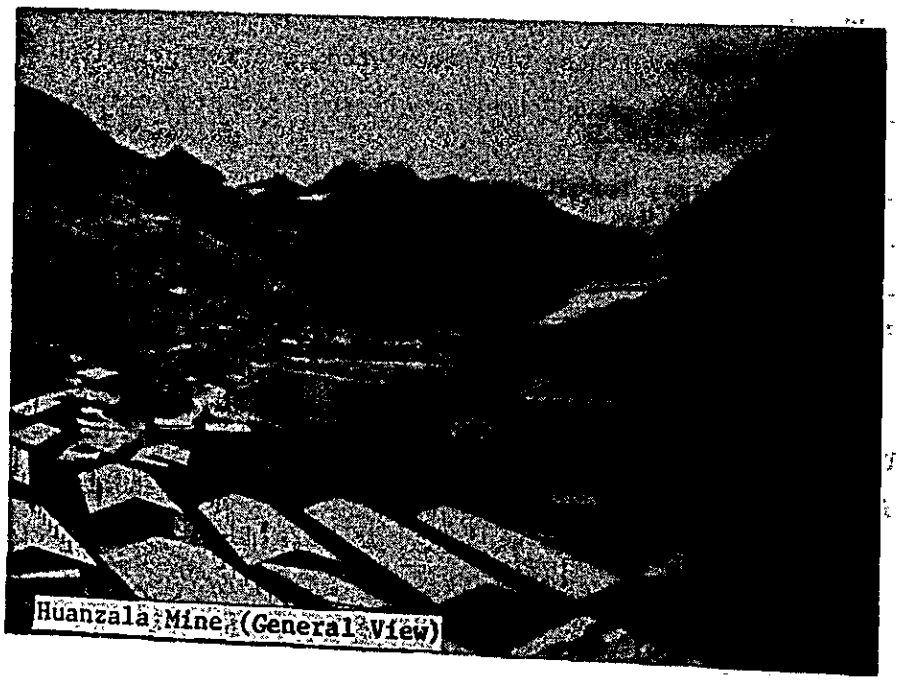
The reserves of ore confirmed at present are approximately 4.5 million tons. With daily production of 950 tons of the same scale as at

present, 285,000 ton/year, there will be at least a 15-year supply, and when discovery of new veins is taken into account, the remaining life of this mine may be considered to be a minimum of 20 years.

At the initial stage of operation the three kinds of concentrates of copper, lead, and zinc were being produced. As development of the Recuerdo shaft progressed and the ratio of ore from it increased, the grade of copper decreased. From 1979 separation and classification of copper concentrate was discontinued so that at present the two varieties of concentrates of lead and zinc are being produced. Although the concentrates are of the two varieties of lead and zinc, a feature is that the content of silver is high. It can be said that the concentrate sales amount of Santa Luisa is governed by the price of silver.

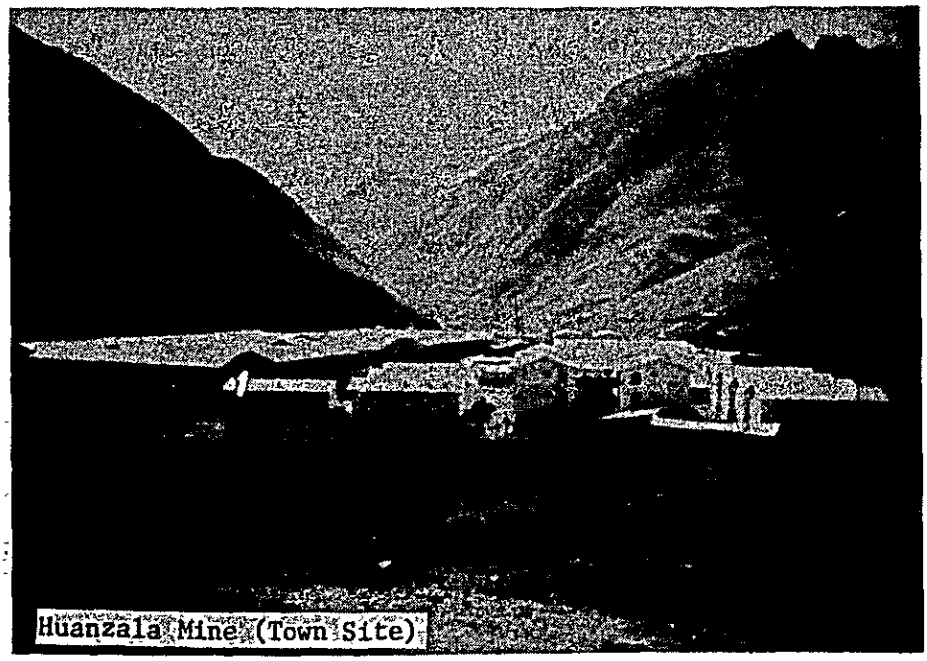
Huanzala Mine is one of a small number of top-class mines of Peru and is sixth in lead production and fourth in zinc. The concentrates produced there are exported 100% to Japan, where they are refined into silver, lead, zinc, etc. at Hachinohe Refinery.

Since a life of about 20 years can still be expected of Huanzala Mine, expansion and remodelling of living quarters and improvement of the school, church, hospital, etc. required by law or regulation are being done sustained by the favorable income from rising silver prices, while if a loan can be obtained from JICA, it is planned by Santa Luisa to start construction of the hydro-electric power station without delay.

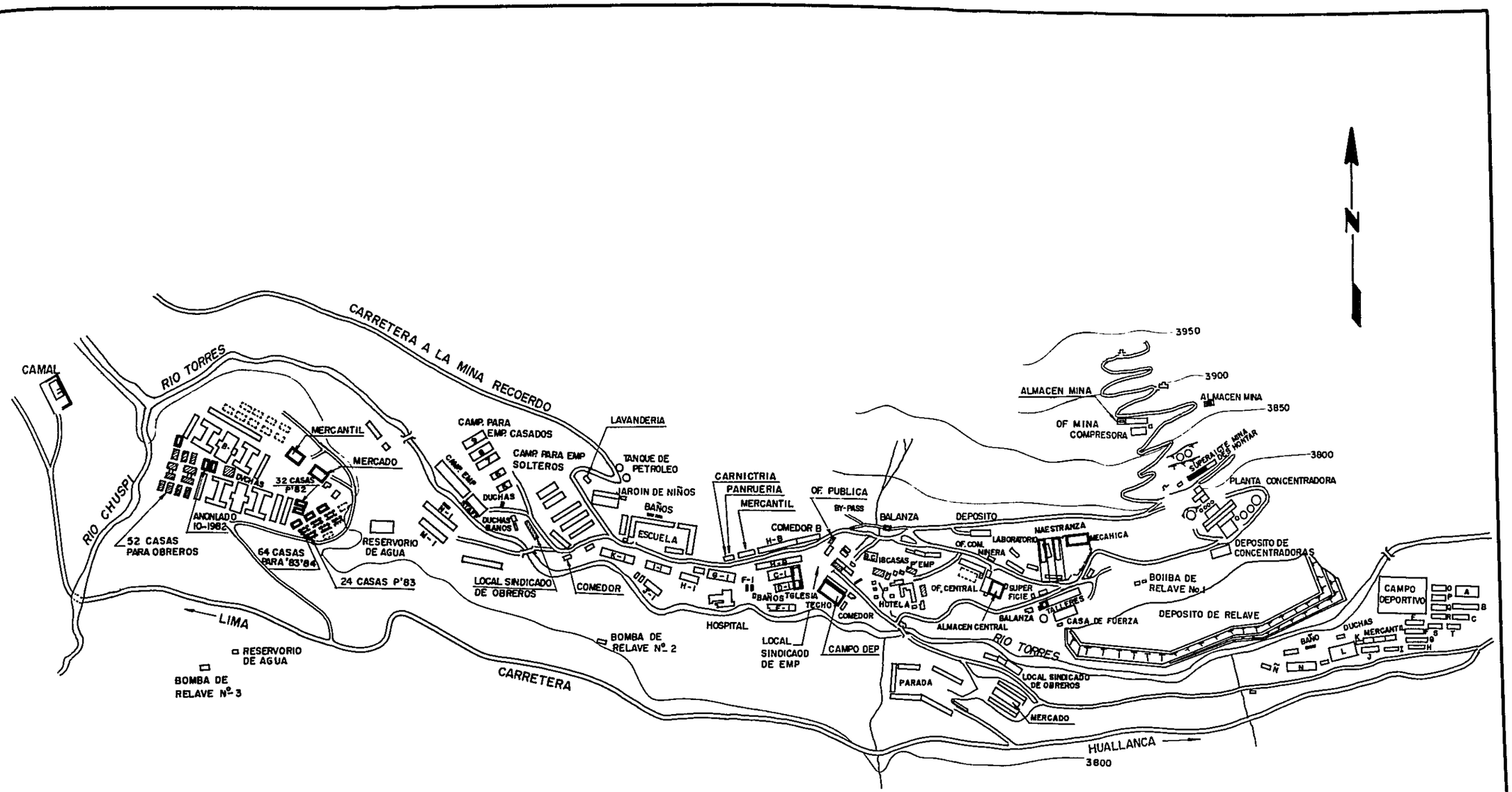


Huanzala Mine (General View)

Huanzala Mine (Concentrate Plant)



Huanzala Mine (Town Site)



NOTA 1982-OCT-20
- CAMPAMENTO
- TALLERES
- ALMACEN
- BALANZA
- GRIFO

NOTAS 1981-DIC-14
- : CONSTRUCCIONES EFECTUADAS
- : CONSTRUCCIONES PARA '82
- : CONSTRUCCIONES PARA '83 r'84

Fig. 4-1-1

JAPAN INTERNATIONAL COOPERATION AGENCY

HUANZALA MINING
GENERAL PLAN

EPDC International Ltd
TOKYO JAPAN

D.R.; SUBMITTED,
T.R ; RECOMMENDED,
C.K.; APPROVED,

LOCATION	DATE	DESCRIPTION	BY
		REVISION	

4 — 5 SHEET NO. OF

4.2 Official Financing from Japan

With regard to development of Huanzala Mine, loans were made from the beginning stage by governmental agencies from the viewpoint of the importance of securing overseas mineral resources. In other words, the main pieces of equipment consisting of concentrator facilities, diesel generators, etc., related to putting this mine on a commercial basis were almost all imported from Japan, and loans from the Export-Import Bank of Japan totalling 3.2 billion yen were made on two occasions, at the time of development and at the time of expansion, for these imported items (2.4 billion yen for development, 800 million yen for expansion. See Table 4-2-1). For exploration at this mine a loan of 300 million yen was received from OECF in 1971. Further, in accordance with the system of the Metal Mining Agency of Japan for overseas geological structure investigations, a subsidy totalling approximately 700 million yen for the mine and its surrounding area has so far been granted to Santa Luisa starting from 1973.

Regarding this subsidy from the Metal Mining Agency, even if as a result of investigations it is deemed promising and mining is operated, in case there is no profit it need not be repaid. Since profit has come to be produced at Huanzala Mine as a result of mining operations, Mitsui M&S is presently studying about the method of repayment for the said subsidy. Accordingly, it is thought this subsidy can be interpreted as "a kind of loan."

Further, as the transport route for the concentrates from this mine, there was at the early stage of development a route of 420 km along the Cordillera Central passing through Aquia and Chiquian to reach the port of Callao. Since the condition of the road was poor and required considerable time to travel, a new road of 58 km was later constructed from Huanzala Mine to Catac to develop a route of 440 km passing through Catac and Pativilica to reach Callao Port. A loan of approximately 400 million yen was made by JICA for development of this road and Santa Luisa is now repaying this loan.

Table 4-2-1 Japan Governmental Finance to Santa Luisa S.A.

Year of L/A	Object of Finance	Financier	Amount (Million Yen)	Completion of Repayment
1963	Mining Development	EXIM and commercial banks	2,466	1973
1971	Exploitation of Mines	OECF	353	1980
1973	Installation of Equipment	EXIM and commercial banks	782	1979
1975	Road Development	JICA and commercial banks	445*	1986
1973	Exploitation of Mines	MMAJ	673	-

* Note; SICA331

4.3 Diesel Generating Facilities

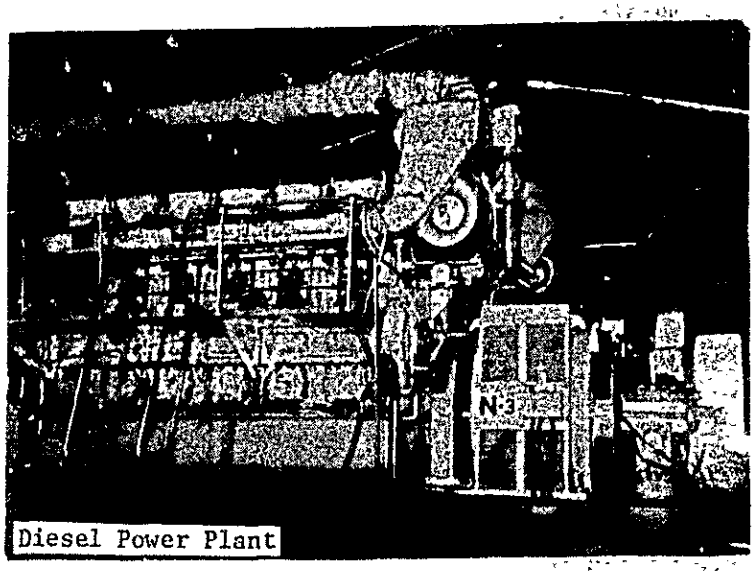
Huanzala Mine is located at a highland of elevation 4,000 m and the efficiency of a diesel generator is greatly lowered (to approximately 70% at sea level) due to thinness of air. At the time of opening of the mine, a hydro-electric power station was given thought. However when the shortage of available water during the dry season was taken into consideration, it was judged that 100% of the electric power requirement could not be met with only hydro so that the combined use of diesel generation could not be avoided. However the idea of a hydro-electric power station was dropped since this would result in dual investment.

At the time of opening of the mine, operation was started with diesel generating facilities of 1,800 kW (450 kW x 4 with 1 unit as reserve). In step with the subsequent expansion for production facilities, the power generating facilities were also expanded, and at present the installed capacity is for firm output of 4,050 kW.

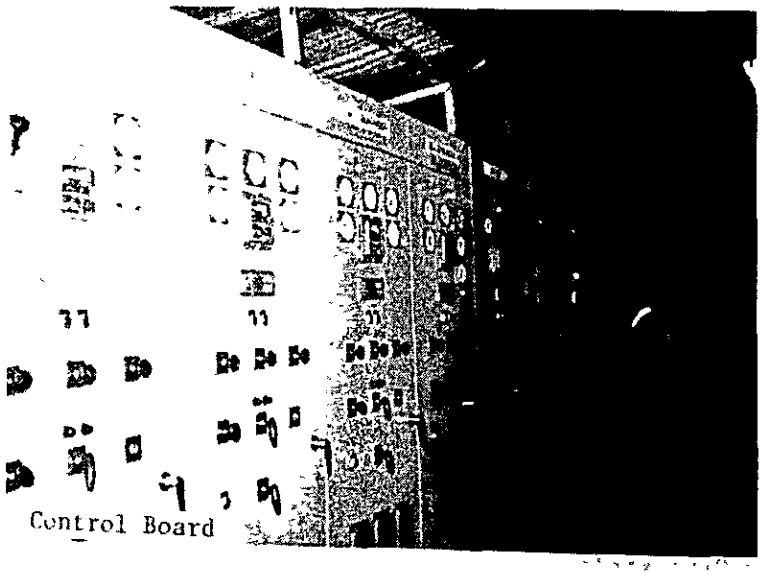
With the successive rises in fuel oil prices since 1980 added to the increase in electric energy consumption, the proportion of the electric

power cost in the concentrate production cost has gradually risen. On the occasion of repayment of the borrowings made at the time of opening of the mine having been completed except for the JICA loan, it was decided to contemplate that the main motive power, i.e. the diesel power plants, should be replaced by the hydro-electric power station.

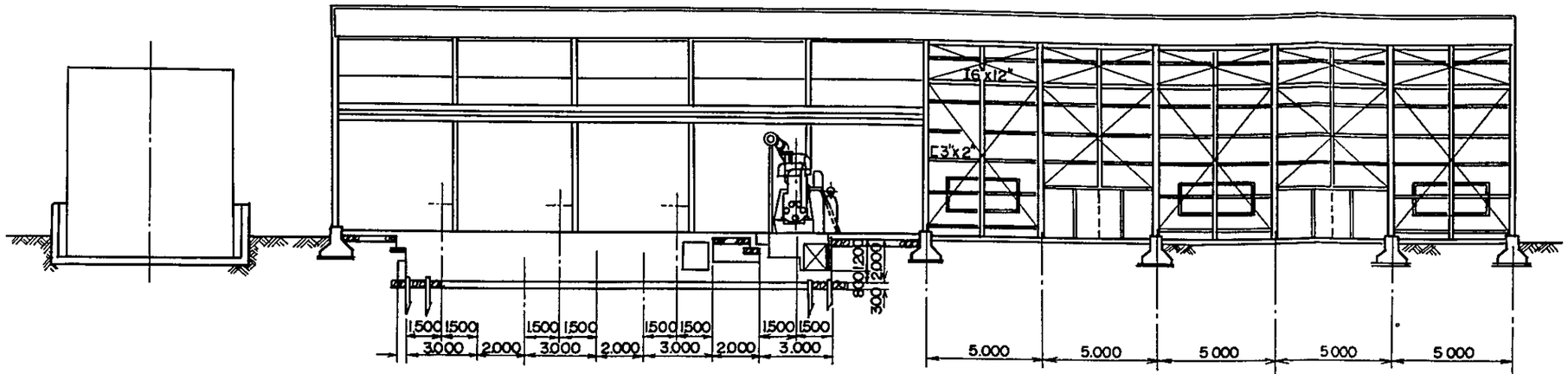
Diesel Power Station at Huanzala Mine



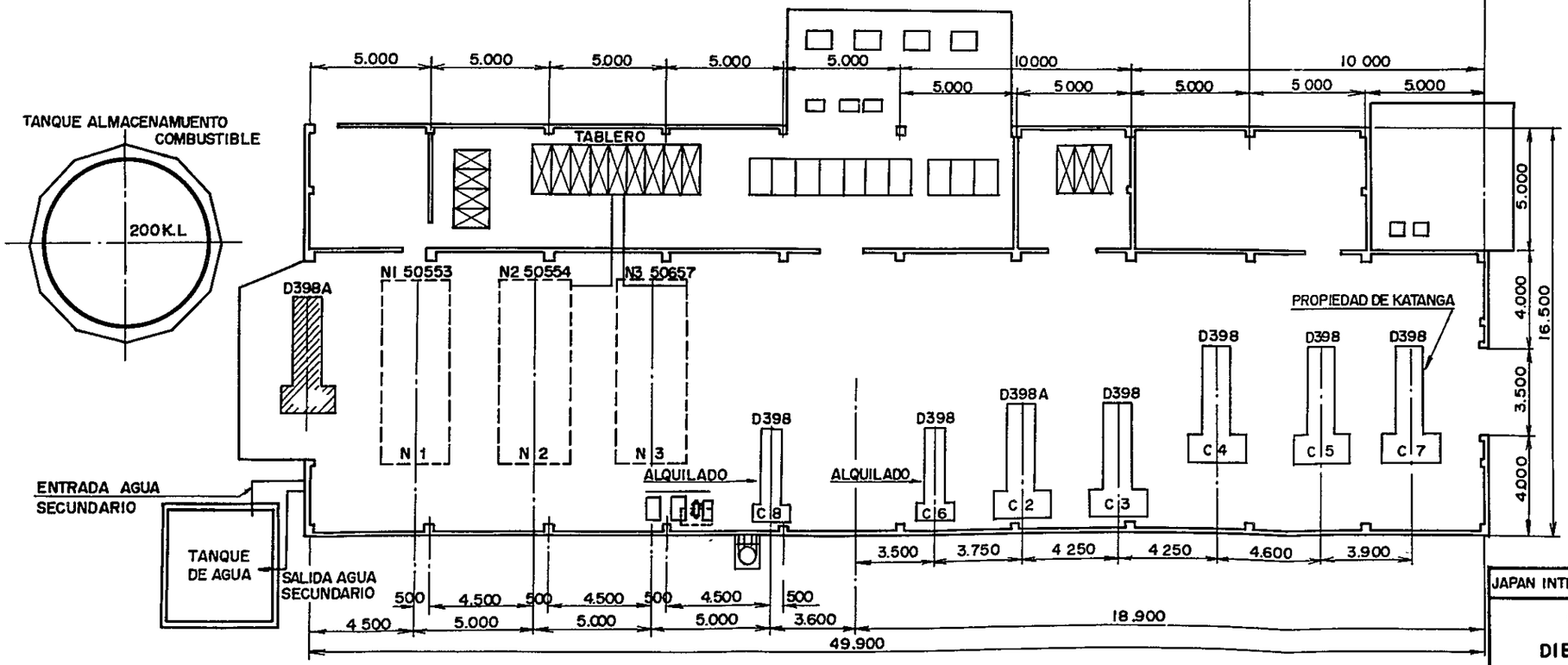
Diesel Power Plant



Control Board



ELEVACION



PLANTA

Fig. 4-3-1

LOCATION	DATE	DESCRIPTION	BY
		REVISION	

JAPAN INTERNATIONAL COOPERATION AGENCY

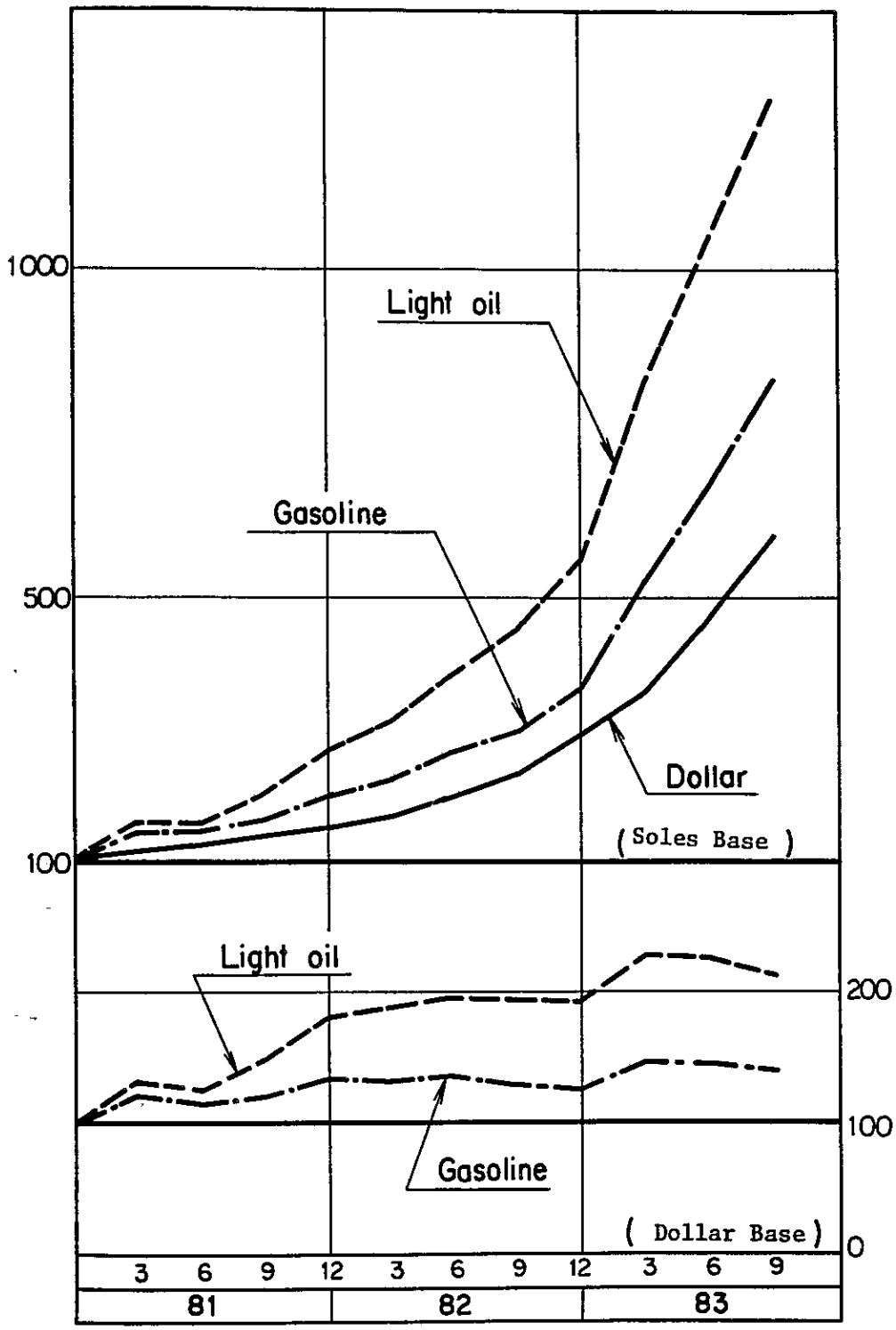
HUANZALA MINING
DIESEL POWER STATION

EPDC International Ltd. TOKYO JAPAN

D.R.; SUBMITTED.
T.R.; RECOMMENDED,
C.K., APPROVED;

— — —

Fig. 4-3-2 Escalation Index of
Light Oil, Gasoline and Dollar



4.4 Basic Conception on Equipment Investment in Mine Management

It is said to be an extreme rarity for a mine to be explored and developed, and to succeed with ample returns obtained. In case of an overseas undertaking it will be even more difficult. However, for resources-poor Japan, it should become an increasingly important matter to seek resources overseas.

Huanzala Mine developed by Mitsui M&S is one of the few examples of success overseas, and it is expected to prosper still further in the future. For this, however, it is an important and urgent matter for sound management of the mine to construct a hydro-electric power station to bring down the electric power cost which makes up 16% of the concentrate production cost. Even if the quantity of crude ore processed should remain constant hereafter, it may be expected that electric power consumption and the fuel oil price will rise annually. If diesel power generation were to be relied on as at present, the weight of the above-mentioned electric power cost will become increasingly great, and this would become a factor to make operation difficult.

A hydro-electric power station requires a large initial investment. However the service life is long at 40 years or more and the generating cost will become even cheaper when depreciation is finished. Hydro-electric power station is necessary by all means for long-term, stable management of the mine, and now that repayment of the loan received at the time of opening of the mine has been completed it is thought best to start construction.

It is said that for a mine to have a private hydro-electric power station is equal to that it is a superior mine. Not only will the electric power cost be lowered, but since it will be possible for employees to work at the mine on a long-term basis and in a stable manner, it is said this encourages the will to work and improves the rate of permanency of employment. Therefore, there are very many cases of good mines possessing private hydro-electric power stations.

However, since a large investment is required for construction of a hydro-electric power station, the proprietor of a mine must decide

whether new investment is to be made or not upon thorough study of the items below.

(a) Life of Mine and Depreciation of Facilities

The development of a mine is started if it can be confirmed that there are reserves at least for roughly 10 years. At the same time that mining is done, exploration is carried out for the next vein to continue with or expand production. But if a new vein is not discovered, the mine would end up being sold, or having its operations curtailed and then being closed. Therefore, it is said that the common practice in capital investment for small- to medium-sized mines is for amortization to be done within about 10 years.

In this way, there is a considerable difference between the amortization periods taken for mine facilities and a hydro-electric plant. The amortization period was taken to be 20 years in the present study since it is said the present ore reserves will last for at least 15 years and promising veins will be expected.

(b) Fluctuations in International Prices of Products

The prices of non-ferric metals such as gold, silver, copper, lead, and zinc are determined not in relation to the individual production costs, but from international market prices at exchanges in London and New York. Accordingly, the proprietor must consider at all times when it will no longer be possible to continue with operation as the price of the principal mineral produced from the mine declines.

The main products of Huanzala Mine are zinc, lead, and silver according to the order of quantity, but going by monetary amounts, silver makes up approximately 50% at present. On looking at the price fluctuations of silver, whereas there was a rise to US$40 for one troy ounce (Toz = 31.1 g) in 1979, it dropped to the $5 level in 1982, and at present it is around $8 (an average of $11/Toz in 1983, the time of the survey). Consequently, it would be necessary for a proprietor to give consideration to the state of the operation in case the price of silver drops to around $5/Toz.

(c) Incidence of Exchange Loss or Profit

A severe inflation is going on in the Republic of Peru at present and the currency has been drastically devalued. What was $1 = SL.992 at the beginning of 1983 had been devalued to $1 = SL.2265 by the end of the year, and it cannot yet be hoped for the currency to be stabilized very soon. Meanwhile, with regard to the finances of Santa Luisa, both foreign claimable assets and foreign currency debts are produced. Sales are determined in terms of dollars on the basis of international prices of goods (foreign claimable assets), while loans in dollars and in yen are obtained as funds for operation and equipment (foreign currency debts), so that the influence of exchange fluctuations on company management is great. In effect, when the exchange rate has fallen a profit will be produced with respect to sales, but losses will be incurred regarding loans received in dollars and yen. As a reference, exchange losses exceeded exchange profits in 1982, with a net loss of US$2 million incurred.

It is not necessarily realistic to consider that large-scale exchange losses as in recent times will occur for 10 years and 20 years hereafter. But from the standpoint of mine management it should be noted that such serious exchange losses might be taken place in future.

(d) Limit to Investment

The present annual revenue of Santa Luisa is estimated to be approximately US$20 million. It seems reasonable to hold total borrowings to one third of annual income, about US$7 million. This means that when the amount for working capital is deducted, the limit to investment for new facilities will be around US$5 million. The construction cost of the hydro-electric power station will be around US$13 million, greatly exceeding the said limitation. However it will become possible to save more than US$1 million annually after completion of the hydro-electric power station. This saving amount will be regarded to be a kind of income. If a long-term, low-

interest loan can be available from JICA, it is thought that Santa Luisa will not necessarily be particular about the above-mentioned limit to borrowings.

Fig. 4-4-1 Trend of Unit Price of Light Oil, Cost of Generation and Percentage of Electric Power Energy Production

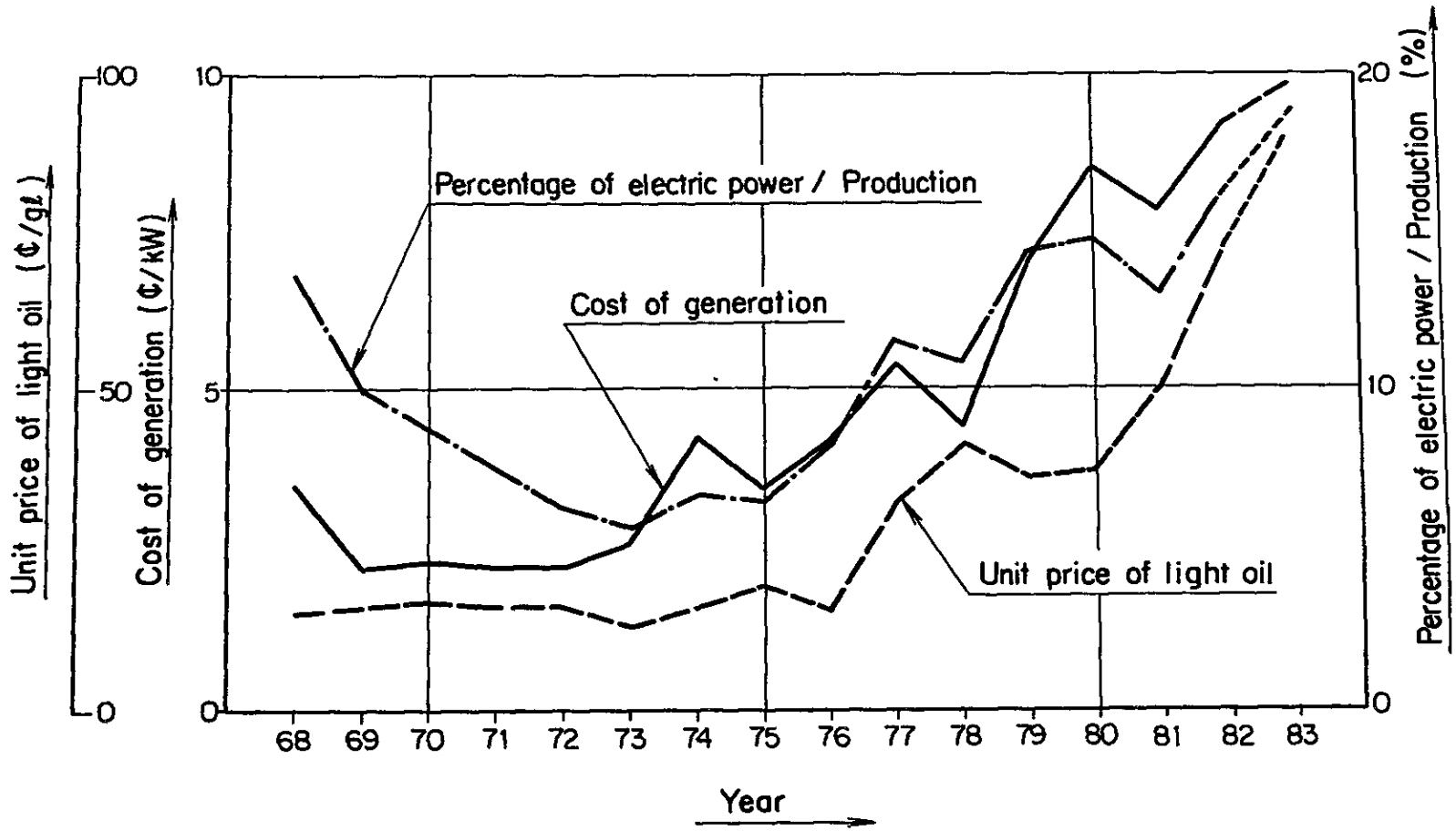
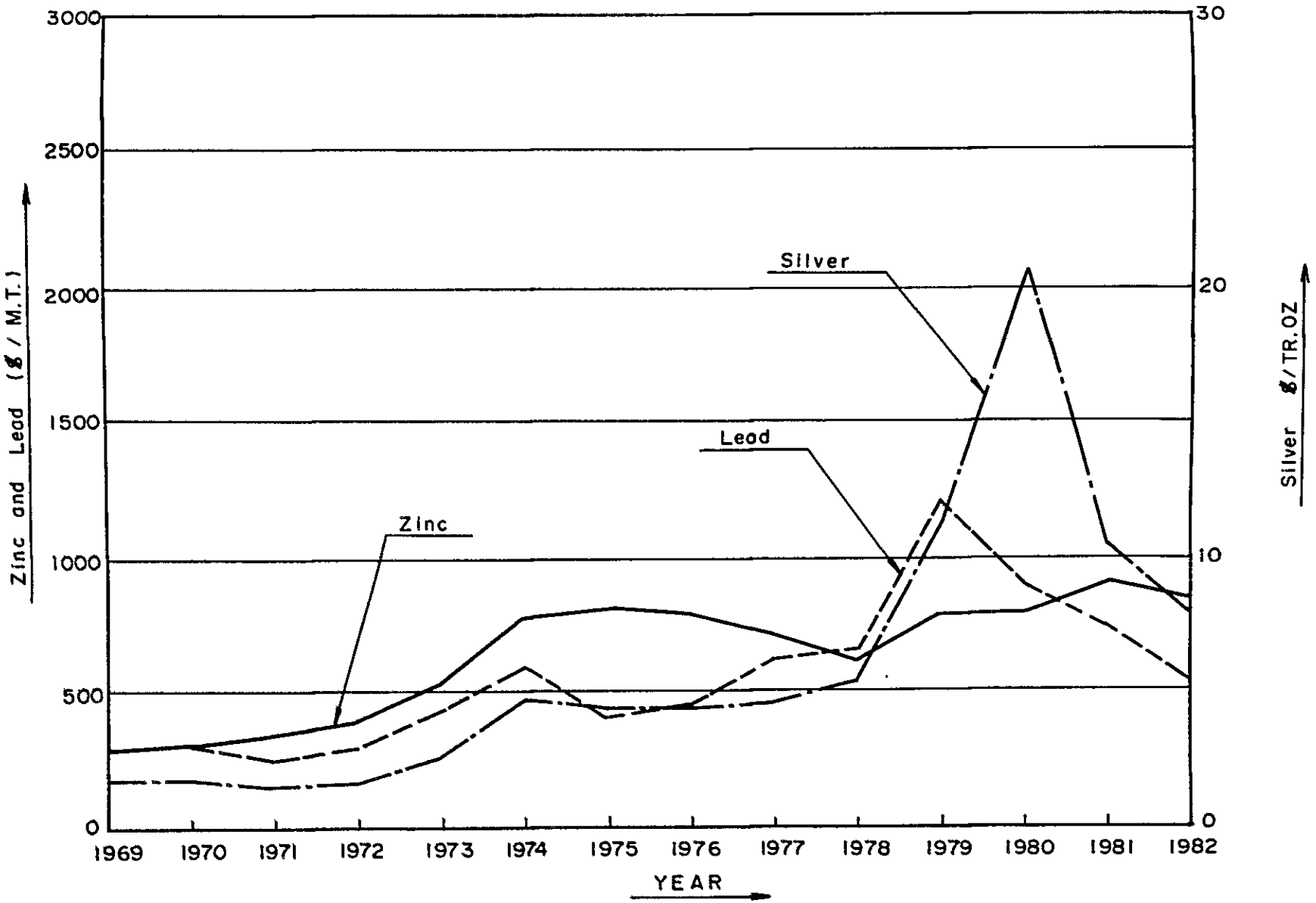
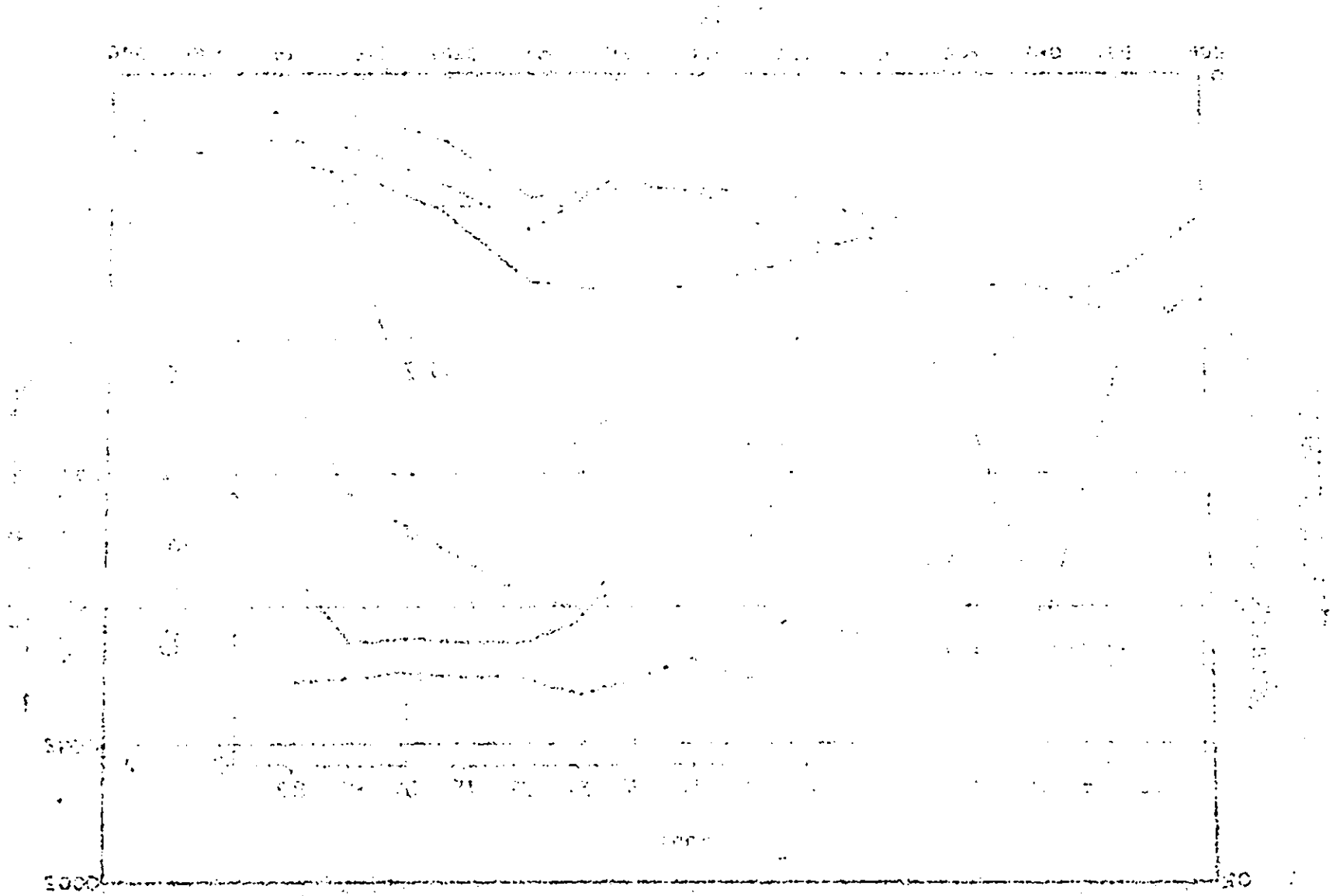


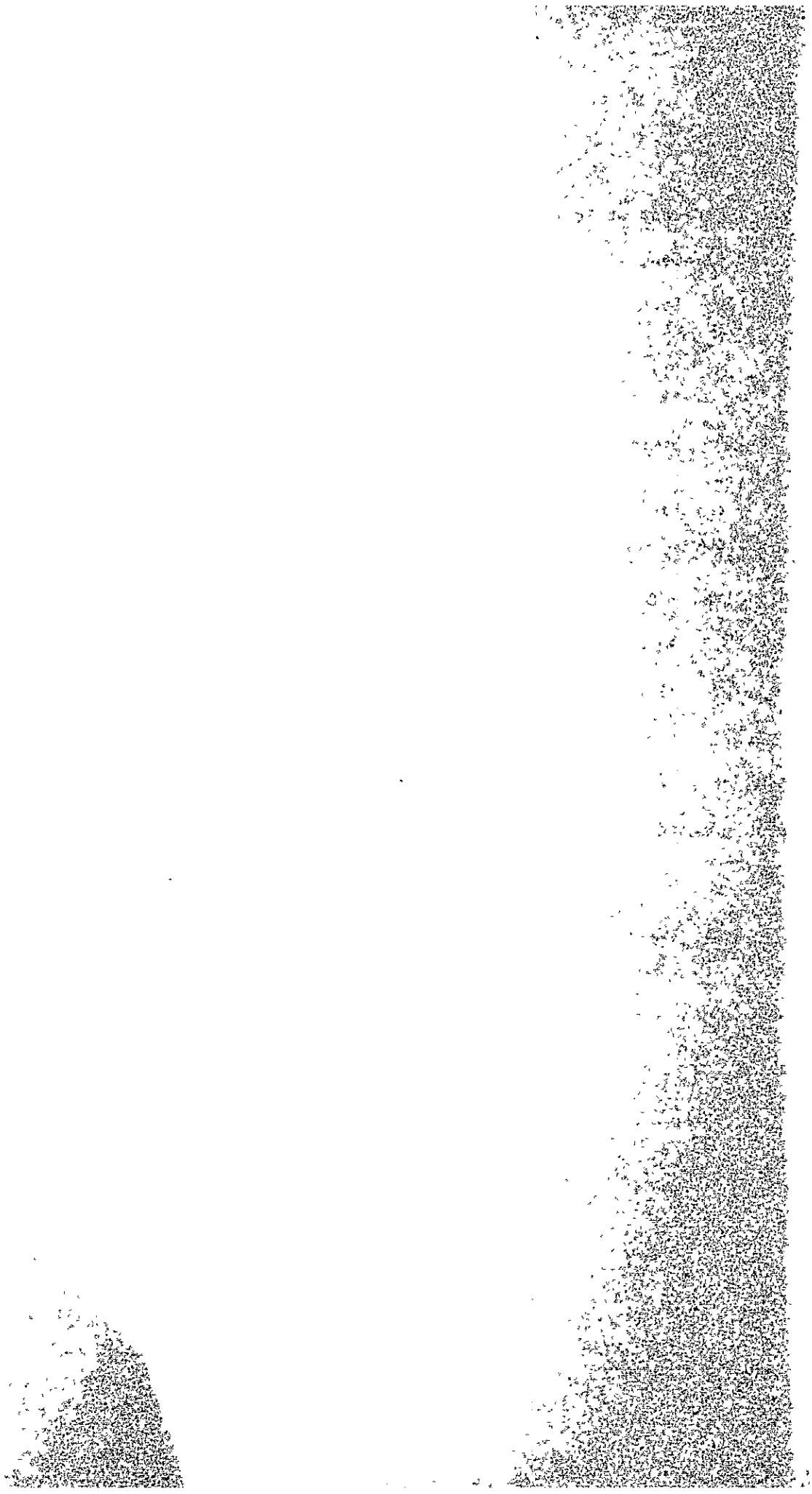
Fig. 4-4-2 Price of Silver, Zinc and Lead





CHAPTER 5

LOAD FORECAST



CHAPTER 5 LOAD FORECAST

CHAPTER 5 LOAD FORECAST

5.1 Forecast of Power Demand for Public Use

5.1.1 General

It was assumed that the service area of the Project for supply of electric power for public use would be the two districts of Huallanca and La Union taking into consideration the wishes of ElectroPeru. Although barely, these two districts have diesel generating facilities of 156 kW at Huallanca and 125 kVA at La Union. Huallanca and La Union are not included in the Rural Electrification Program (Table 2-6-2) presently being carried out by ElectroPeru, and neither are they scheduled to be incorporated in the transmission line network.

Accordingly, forecasts of the demand for the public use from the proposed hydro-electric power station will be made taking into consideration the present situations at the two districts.

5.1.2 Situation of electric Power Supply and Demand at Huallanca

Huallanca is located at the confluence of the Rio San Juan and the Rio Santa Rosa 10 km away from Huanzala Mine, and the hydro-electric power station planned by the Project would be provided at this village. The population was 3800 and the households were 650. Among which electricity consumers were 262 in July 1983.

This was a community which prospered with silver refine before. There were two silver refineries with each having private hydro-electric power generating facilities which were abandoned. Several years ago, because of strong desire of local residents, the presently-existing hydro-electric power station of 156 kW was provided by ElectroPeru. At the initial stage upon start-up, power was supplied continuously on a 24-hour basis. But as previously stated that revenues of ElectroPeru were not enough even to cover personnel costs. ElectroPeru presently is supplying electric power only for lighting between 6:00 p.m. to 8:00

a.m. with operation of the power station stopped during the daytime in order to save on the personnel cost of one operator and reduce maintenance costs.

The local residents have asked ElectroPeru for supply of 3-phase power for motive purposes, but there is no outlook for this to be realized, and development of industry has consequently been hindered.

The enthusiasm of the residents for expansion of electric power facilities is great. A large number of residents including the mayor participated in the interview made by JICA Survey Team, and it was strongly requested for electric power to be supplied when the power station of Santa Luisa is completed.

Huanzala Mine, from the standpoint of jurisdiction, comes under the administration of Huallanca, and has had a close relationship with this village from the time of opening of the mine. Not only has it employed laborers, but also, it has continued to provide a fair amount of assistance with respect to improvements of roads, rivers and streams, and additions to the elementary and secondary school buildings. The concern of Santa Luisa on completion of the power station would be the supply of electricity for the public use of this village.

5.1.3 Situation of Electric Power Supply and Demand at La Union

La Union is located approximately 30 km downstream from Huallanca and is a town which was founded prior to Inca empire days. It is also known for the ruins of Viejo Huanuco in its vicinity. The town is the center of government and culture of this area, and is also a collecting and distributing point for agricultural and stock raising products, and commerce is then developed. The population was 9,500 and the households were 1,500. Among which the electricity consumers are 296 in July 1983.

There previously was a hydro-electric power station of 50 kW owned by ElectroPeru, but this was damaged in a flood in 1981 and was abandoned. At present, electric power is being supplied by a temporary diesel generating facility of 125 kVA. The turbine and generator of the

abandoned power station has already been diverted elsewhere, while it appears there are no plans at present for restoration of the hydroelectric plant.

The present state of electric power demand at La Union is as shown in Table 5-1-2. In order to save fuel costs, power supply is being limited to 6 hours from 6 o'clock in the evening to 12 midnight.

5.1.4 Requests of Local Residents

The electric energy annually consumed by the residents of Huallanca and La Union totalling 13,300 persons is approximately 220,000 kWh, and this in terms of per capita consumption is 17 kWh, which is extremely low compared with the average of 550 kWh for entire Peru.

The main reasons for this situation are the three points that electrification rate is low at 26%, that there is no electric power for industrial uses, and that the duration of power supply is short.

Therefore, in interviews held with residents by JICA Survey Team, it was emphatically stated in particular by the residents of both districts that they wanted a continuous 24-hour supply and 3-phase motive power supply to be used for cheese factories, lumber mills, repair shops, etc., for the purpose of industrial promotion.

5.1.5 Requests of ElectroPeru and General Law Concerning Electric Power in Peru

As stated in Section 1.3, ElectroPeru has expressed full cooperation with construction of the hydroelectric power station in the Project, while at the same time has asked that electricity supply to the public use in the two districts of Huallanca and La Union upon its completion. Santa Luisa, in response, within limits that the economics will not be impaired, has the intention of supplying electricity for the public use.

The request by ElectroPeru was made on the basis of subclause b) of Article 42 of the General Law Concerning Electric Power. But actually,

since there is no obligation on the part of Santa Luisa according to this subclause, it would not be impossible to refuse to comply with the request. Taking into consideration the fact that Huanzala Mine has cooperated with the local community in various ways ever since it was opened and the proposed power station would be constructed in Huallanca, it would be reasonable to comply with the request made by ElectroPeru.

The relevant articles of the General Law Concerning electric Power are given in Table 5-1-4.

5.1.6 Load Forecast of Public Use

The electricity supplied from the power station to be constructed will mainly be for motive power at the mine and 24-hour continuous supply and 3-phase motive power will be possible so that the wishes of the residents in Huallanca and La Union can be amply met.

The load forecast of Public Use was based on the following conditions:

(1) The service areas are to be the two districts of Huallanca and La Union.

(2) The start of operation of the power station is to be in January 1987, and the load forecast is to be made for the subsequent 20-year period to match the depreciation period for the power station.

(3) The hydro-electric power station at Huallanca (156 kW) and the diesel power generating facility at La Union (125 kW) are to be discarded simultaneously with start of operation of the proposed power station.

(4) The demand (maximum load) at the time of start of operation in 1987 is to consist of 200 kW for lighting and 100 kW for industry, a total of 300 kW. The present maximum demand is 150 kW for lighting only. Assuming that there will be annual growth of about 10% hereafter, the demand will become 200 kW in

1987. Further, it is assumed that supply of 3-phase power for motive purposes will be commenced simultaneously with start of operation and the factory load at that time is estimated as being 100 kW.

(5) Although it is extremely difficult to estimate the growth in demand of public use after start of operation. Assuming that the present economic conditions and the living standard in Peru would continue for a while but the latent demand of industry would be developed by electric power supply, it is considered that the growth in demand will be an annual rate of 5% for both lighting and industry (both maximum power demand and electric energy demand).

(6) In estimating the electric energy demand, that for lighting is based on a load factor of 70% and daily duration of consumption of 7 hours, and that for industry a load factor of 70% and daily duration of consumption of 10 hours.

The maximum power and energy demands for the individual years during the 20-year period from 1987 calculated in accordance with the above conditions are as shown in Table 5-3-1 and Table 5-3-2, respectively. The maximum power demand 20 years later will be 800 kW, and approximately 20% of the installed capacity of 4,200 kW.

Table 5-1-1 Service Condition of Electricity in Huallanca and La Union

Item	Huallanca	La Union	Remarks
Population	3,800	9,500	
Household	650	1,500	
Consumer	262	296	June, 1983
Electrification (%)	40	20	Ave. 26%
Installed Power Plant (kw)	Hydro 156	Diesel 125	
Service Hours	6.00PM - 8.00AM 14 hrs.	6.00PM - 12.00PM 6 hrs.	
Revenue of Electricity (yen/month)	57,000	164,000	June, 1983
Monthly Energy Consumption (kWh)	7,148	10,840	June, 1983
Electricity Tariff	Residential 50 yen (below 30 kwH/month) 8 yen (above 30 kwH inclusive) Commercial 680 yen (below 30 kwH/month) 23 yen (above 30 kwH inclusive)		
Electricity Payment per Household	Abt. 200 yen	550 yen	
Major Industry	Agriculture and cattle-breeding	Agriculture, cattle-breeding and commerce	

Table 5-1-2 Actual Public Power and Energy Demand in Huallanca and La Union

	Max. Power Demand (kW)			Max. Energy Demand (kWh)		
	Huallanca	La Union	Total	Huallanca	La Union	Total
Jan	50	76	126	11,404	9,349	20,753
Feb	46	67	113	7,758	7,973	15,731
Mar	54	74	128	6,506	10,062	16,568
Apr	54	82	136	7,860	10,387	18,247
May	57	88	145	6,820	10,697	17,517
Jun	54	82	136	7,148	10,840	17,988
Jul	64	85	149	8,932	11,387	20,319
Aug	54	96	150	8,428	11,889	20,317
Total	-	-	-	64,856	82,584	147,440
Average	54	81	135	8,107	10,323	18,430
Installed Capacity	156	125	281	-	-	-

Source: Electro Peru, 1983

Table 5-1-3 LA LEY GENERAL DE ELECTRICIDAD

TITULO VI

DE LOS AUTOPRODUCTORES Y/O CONCESIONARIOS

Articulo 39º--Cuando una empresa de servicio publico de electricidad no se encuentra en condiciones de atender oportunamente los requerimientos de energia, electrica, solicitados por personas naturales o juridicas, el Ministerio de Energia y Minas, previo informa de ELECTROPERU, podra autorizar a los solicitantes a realizar como autoproductores las actividades de generacion, transmision y/o distribucion de energia electrica que requieran para su uso. La Resolucion autoritativa fijara el pago que el Autoproductor deba hacer mensualmente al Fondo de Desarrollo Electrico.

En los casos en que la potencia a instalarse sea igual o inferior a 500 Kw, la autorizacion sera concedida por la empresa regional correspondiente.

El reglamento establecera las diferencias entre los Autoproductores que generan para su utilizacion permanente y los que lo hacen para suplir deficiencias de la Empresa de Servicio Publico de Electricidad.

La Direccion General de Electricidad normara la instalacion y uso de plantas electricas de emergencia que no constituyan autoproduccion de electricidad. Las condiciones de operacion de tales plantas seran especificadas en la respectiva autorimacion.

Articulo 40º--Cuando una Empresa de Servicio Publico de Electricidad requiera de los excedentes de potencia y energia electrica que pudiera disponer permanentemente un Autoproductor, es obligacion de este celebrar con dicha empresa contrato de suministro de tales excedentes. Estos seran determinados por las partes, teniendo en cuenta las reservas necesarias para atender los requerimientos de expansion del Autoproductor. En caso de discrepancia, seran determinados por la Direccion General de Electricidad.

Articulo 41º--Los Autoproductores no podran utilizar recursos hidraulicos o geotermicos superiores a los 30 MW sin celebrar un contrato de concesion segun las normas de los articulos 42º, 43º y 44º de esta ley.

To do aumento de capacidad de generacion de los Autoproductores, requiere autorizacion previa de la Direccion General de Electricidad.

Articulo 42º--Cuando el Ministerio de Energia y Minas considere conveniente complementar los planes de desarrollo electrico nacional a cargo de ELECTROPERU, podra otorgar concesiones a terceros para el uso energetico de fuentes hidraulicas o geotermicas bajo las condiciones siguientes.

a) La capacidad a instalarse debera ser suporior a los 500 Kw;

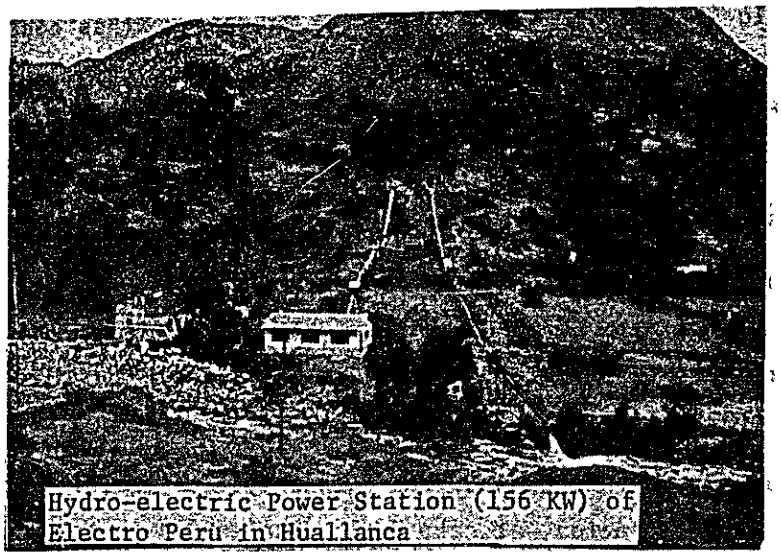
b) Por lo menos el 20% de la capacidad de generacion debera ser destinada al servicio publico de electricidad, salvo en los casos debidamente comprobados por la Direccion General de Electricidad, donde no existe demanda suficiente para absorber dicho porcentaje.

c) Las concesiones tendran una duracion no mayor de 30 anos, a partir de la puesta en operacion, al cabo de los cuales las instalaciones pasaran en buen estado y sin costo alguno a propiedad de ELECTROPERU o sus filiares.

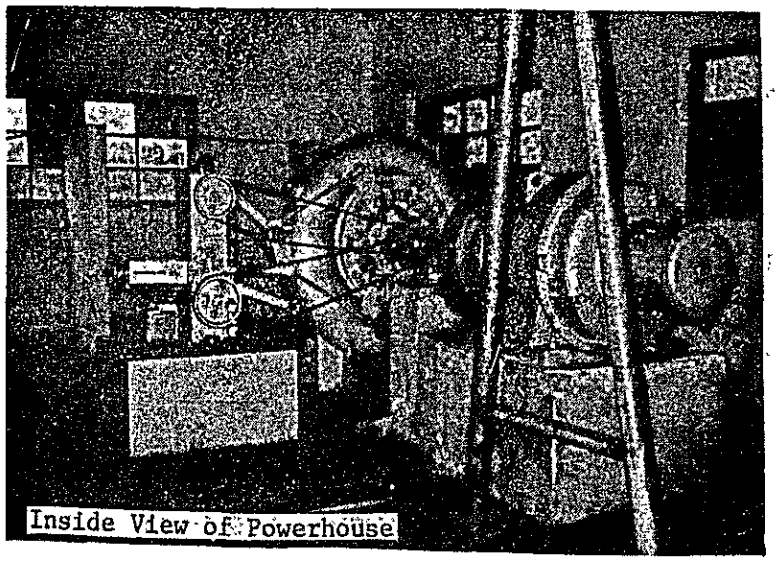
Articulo 43º--Los Autoproductores y los concesionarios, con autorizacion, de la Direccion General de Electricidad y previo acuerdo con la Empresa de Servicio Publico de Electricidad que corresponda, podran suministrar energia electrica a uno o mas usuarios individuales, cuando sus instalaciones estuvieran en capacidad de efectuar el suministro.

Las instalaciones de transmision y distribucion necesarias para dicho suministro seran costeadas por los beneficiarios y seran de su propiedad. La venta de energia se efectuara a precios proporcionales a los costos respectivos y segun tarifas aprobadas por la Comision de Tarifas-Electricas.

Articulo 44º--Hagase extensivo a todo Autoproductor y a todo Concesionario, al tributario senalado en el parrafo terce o del articulo 143º del Decreto Legislativo Nº109. Ley General de Mineria.

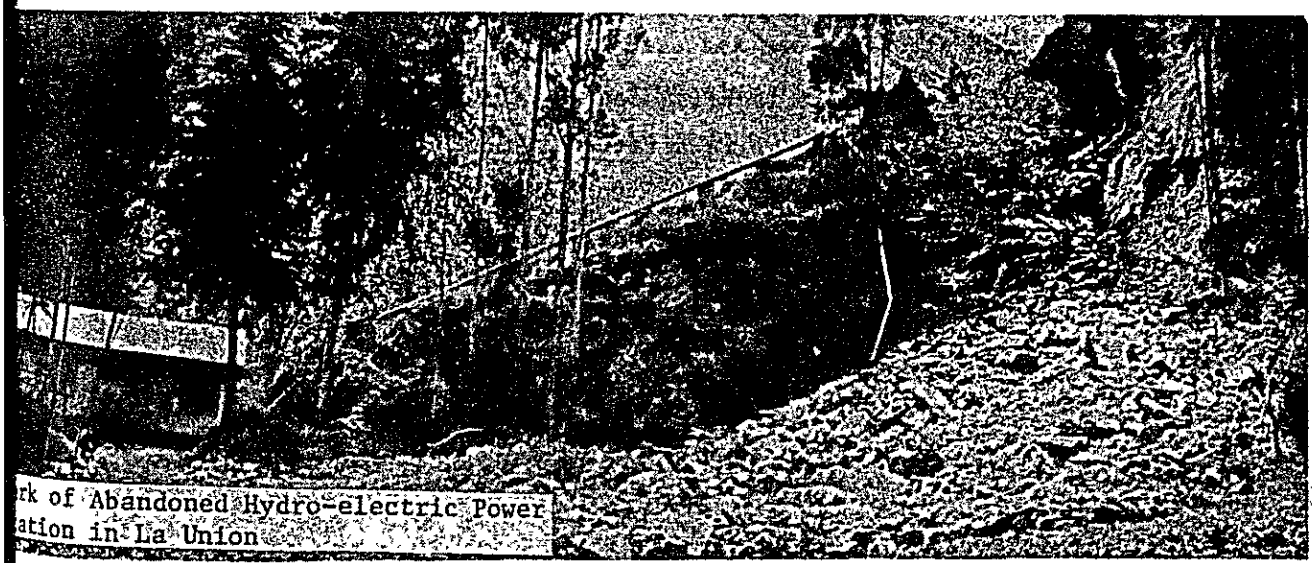


Hydro-electric Power Station (156 KW) of Electro Peru in Huallanca



Inside View of Powerhouse

Diesel Power Plant (125 KVA)
of Electro Peru in La Union



rk of Abandoned Hydro-electric Power
ation in La Union

5.2 Power Demand Forecast for Huanzala Mine

5.2.1 General

Huanzala Mine is favored with high-grade ore deposits having contents of 20% or more mainly of lead and zinc. It is certain that 15 to 20 years of operation will still be possible hereafter. The present rate of extraction of crude ore is 950 ton/day, or 285,000 ton annually, and it is scheduled for operation to continue at roughly the present scale while improving the production plant and consolidating welfare facilities such as company housing and camp.

The present states of the principal facilities are as described below.

(a) Ore Mining Facilities

Mining of ore is presently being done by the cut-and-build method at the two shafts of Huanzala Main and Recuerdo Main. Many of the pieces of equipment used in the shafts are of relatively small size, while transport inside the shafts is done not only by battery-powered locomotives, but also by dump trucks in combination. Therefore the electric power required for ore mining is not very great.

(b) Ore Concentrate

Ore concentrate is being done by the leaching flotation methods, and the layout is a rational one considering gravity flow and consists in order from the top of crusher, ball mill, flotation cells (3 steps), filter, and concentrate storage.

The present rate of yield is 15% and the unit consumption of electric power for concentration in 1981 was 35.3 kWh/ton (crude ore).

(c) Tailing Disposal

The tailing materials remaining after flotation is all pumped up in three stages by volute pump to the Chuspi spoil area on a tributary of the Rio Torres, where it is concentrated, classified and deposited.

(d) Water

Water for the mine is drawn from the Tanash Ravine upstream on the Rio Torres from where it is dropped through a pipe by gravity flow and used in the mine. In the dry season, since the quantity of water becomes insufficient, pump-up is done from the mainstream Rio Torres.

(e) Company Housing and Welfare Facilities

The employees of the mine numbered approximately 700 persons as of September 1983, besides which there were several subcontractors with their employees living in the vicinity. It is required by the Mine Law that company housing meeting a given standard must be provided to their employees and their families. At present in the Huanzala area there are 730 units of company housing and 70 units of subcontractor housing, a total of 800 units in which there are approximately 5,000 persons living. As health and welfare facilities for these people, Santa Luiza has constructed a hospital, elementary school, kindergarten, gymnasium, store, etc., and a large mining town is comprised. It is made obligatory under the Mine Law for electric power for these company houses and health and welfare facilities to be supplied free of charge. In recent years the use of large-scale electrical appliances such as electric cookers, electric stoves, etc. have increased, and power consumption for living is growing at a higher rate than the power consumption for production.

5.2.2 Electric Power Demand Performance

At the time of opening of the mine in 1968, operation was carried out with four 450-kW diesel generators for a total firm output of 1,800 kW. Later, in step with expansion of the production setup, the power generating facilities were also increased, and at present there are eleven generators (including one unit as reserve), and the firm output is 4,050 kW.

The distribution lines from the power station to the various loads in the mine comprise the following five systems, the largest load being for the Concentrate Plant Line which takes up approximately 46% of the whole.

(a) Concentrate Plant Line
(b) Mining Line
(c) Recuerdo Mining Line
(d) Tailing Line
(e) Camp Line

The variation in maximum load in recent years has been as shown in Fig. 5-2-2, and in the most recent 5-year period the 2,700 kW in 1977 became 3,200 kW in 1983, for a growth at a rate of about 4% annually. Especially, the demand which has increased most prominently is that for livelihood such as for the office, company housing and camp, etc. (Camp Line), the increase having been at an annual rate of 8% from the 400 kW in 1977 to 600 kW in 1983. The maximum load recently in 1983 (April - August 1983) was constantly 3,100 kW to 3,200 kW.

In order to find the trend of daily variation in load on a normal workday of the mine, the hourly load records of the third Wednesday (standard day) of each month for the most recent 1-year period was investigated. The result was that shown in Fig. 5-2-3, and it may be seen that variations in load during the day are very small.

The demand on a holiday is that of the Camp Line only, and is a maximum of about 600 kW.

Meanwhile, with regard to energy consumption, the electric energy per ton of crude ore has been increasing at an annual rate of 3.5% (Fig. 5-2-4), and in the future, even if operation is continued at a constant rate of crude ore processing, it is thought that the energy consumption will continue to increase. The following are conceivable as the reasons for the increase.

(a) The electric power demand for livelihood such as for company housing increases annually as living standards are raised.

(b) The size of concentrate was made smaller from 100 mesh to 200 mesh.

(c) The tailing disposal area becomes more distant and the energy demand for pumping is increased.

(d) The extraction site gradually becomes farther away.

It may be noted that the electric energy consumption for the most recent 1 year from September 1982 to August 1983 was approximately 20,000 MWh (Table 5-2-1). As a result of the above study, the maximum power and energy demand is estimated to be 3,200 kW and 20,000 MWh/year, both of which are considered as a basis of load forecast.

5.2.3 Load Forecast

The basic consideration of Santa Luisa concerning power generating facilities consists of the following:

(a) The quantity of crude ore to be processed hereafter is to be maintained at 950 ton/day (285,000 ton/yr), and increase in maximum power demand is to be suppressed as much as possible.

(b) In case the maximum power demand should exceed the installed capacity, this would be coped with by temporarily cutting off the Camp Line which is not directly concerned with production.

(c) The facilities are to be improved as a whole to suppress increase in electric energy demand.

(d) To cope with a long-lasting rise in maximum power demand, cutting down of the peak including cutback of production is to be considered.

(e) In order to hold the investment amount to a minimum, it is thought to keep the installed capacity of the hydro-electric power station as small as possible.

Respecting the said consideration of Santa Luisa and upon making a study referring to past performances, assumptions for estimating a load forecast of the Huanzala mine are established as follows:

(a) The maximum power demand and annual energy consumption in 1983 to serve as the starting point for forecasting future loads are to be the following based on the performance in the most recent year.

Maximum Power Demand,	3,200 kW
Mining demand:	2,600 kW
Camp demand :	600 kW
Annual Energy Demand,	20,000 MWh
Mining demand:	16,250 MWh
Camp demand :	3,750 MWh

(b) The study on load forecast is made for a period of 24 years from 1983 to 2006.

(c) The quantity of crude ore to be processed hereafter is to be held constant at 950 ton/day (285,000 ton/yr). The depreciation period for the hydro-electric power station is to be 20 years. That is, with start of operation in 1987, depreciation is to be completed in the year 2006.

(d) The annual growth rate in maximum power demand and energy demand in relation to mining is to be 2% for 10 years from start of operation until 1996, after which it is to be 0% for 10 years. (The rate in past performance was approximately 4%.)

(e) The annual growth rate in connection with the camp is to be 4% from start to finish. (The rate in past performance was 8%.)

(f) It was assumed that for the 24-year period until 2006 the Huanzala power station would not be incorporated in the power system of ElectroPeru.

Based on the above assumptions, the forecast of maximum power demands (kW) and electric energy demands (MWh) until 2006 are estimated as shown in Table 5-3-1 and Table 5-3-2.

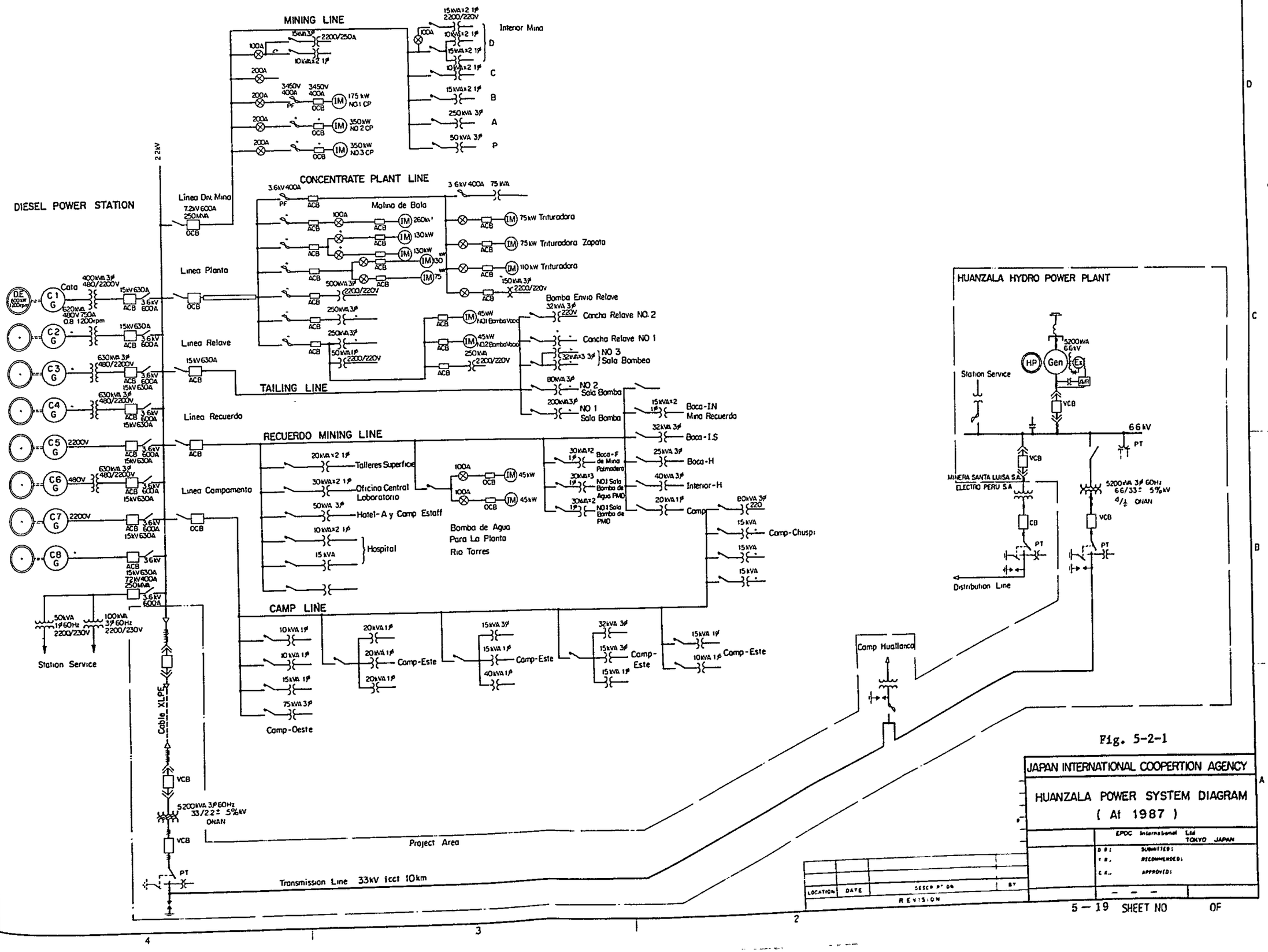


Fig. 5-2-1

JAPAN INTERNATIONAL COOPERTION AGENCY

HUANZALA POWER SYSTEM DIAGRAM
(At 1987)

EPDC International Ltd TOKYO JAPAN

D.D.: SUBMITTED:
T.D.: RECOMMENDED:
C.M.: APPROVED:

LOCATION | DATE | DESCRIPTION | BY
REVISION

Fig. 5-2-2 MAXIMUM LOAD TREND OF HUANZALA MINING

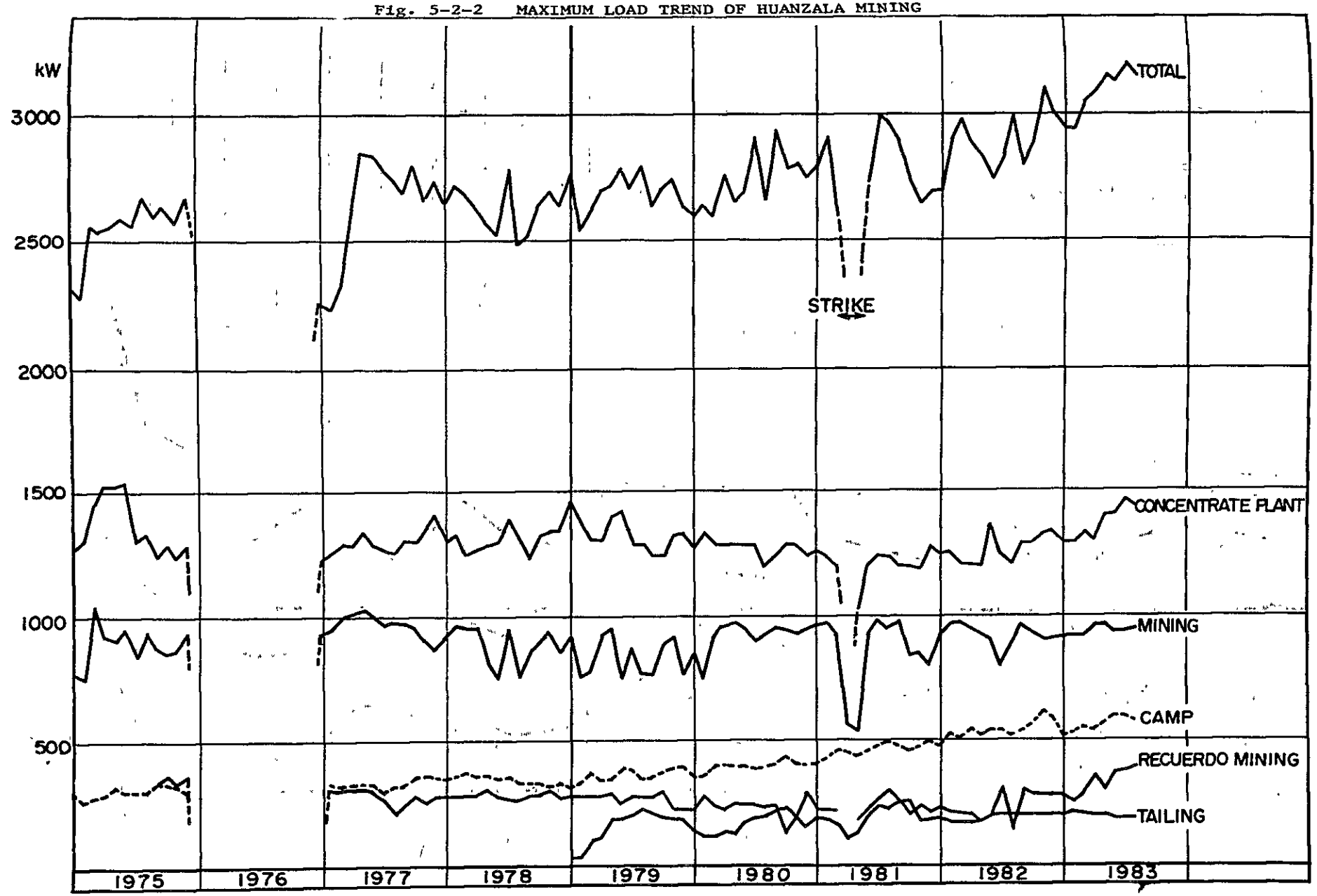


Fig. 5-2-3 Power Demand of Third Wednesday

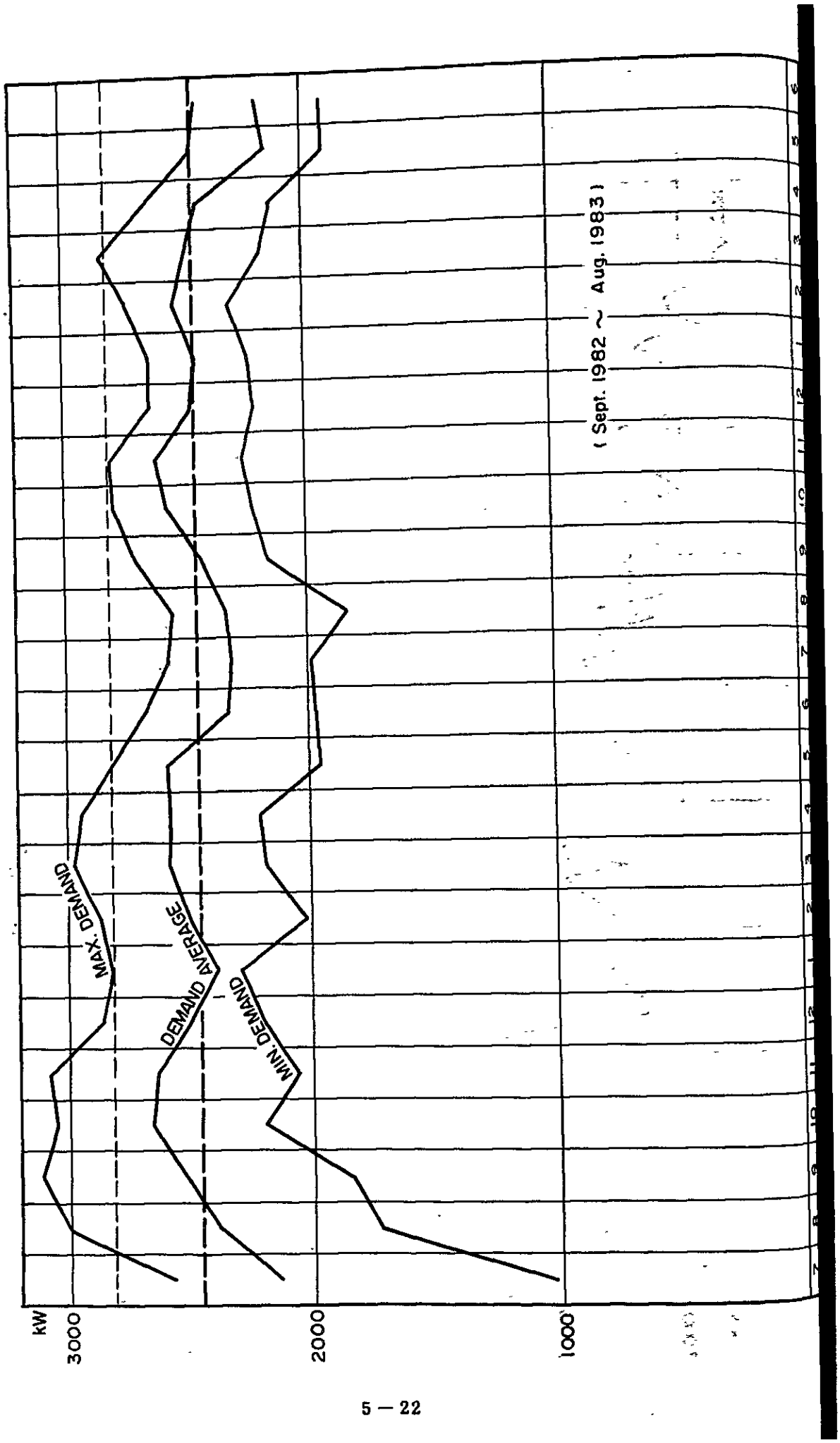


Fig. 5-2-4 Annual Product of Crude Ore and Power Energy required for Ores

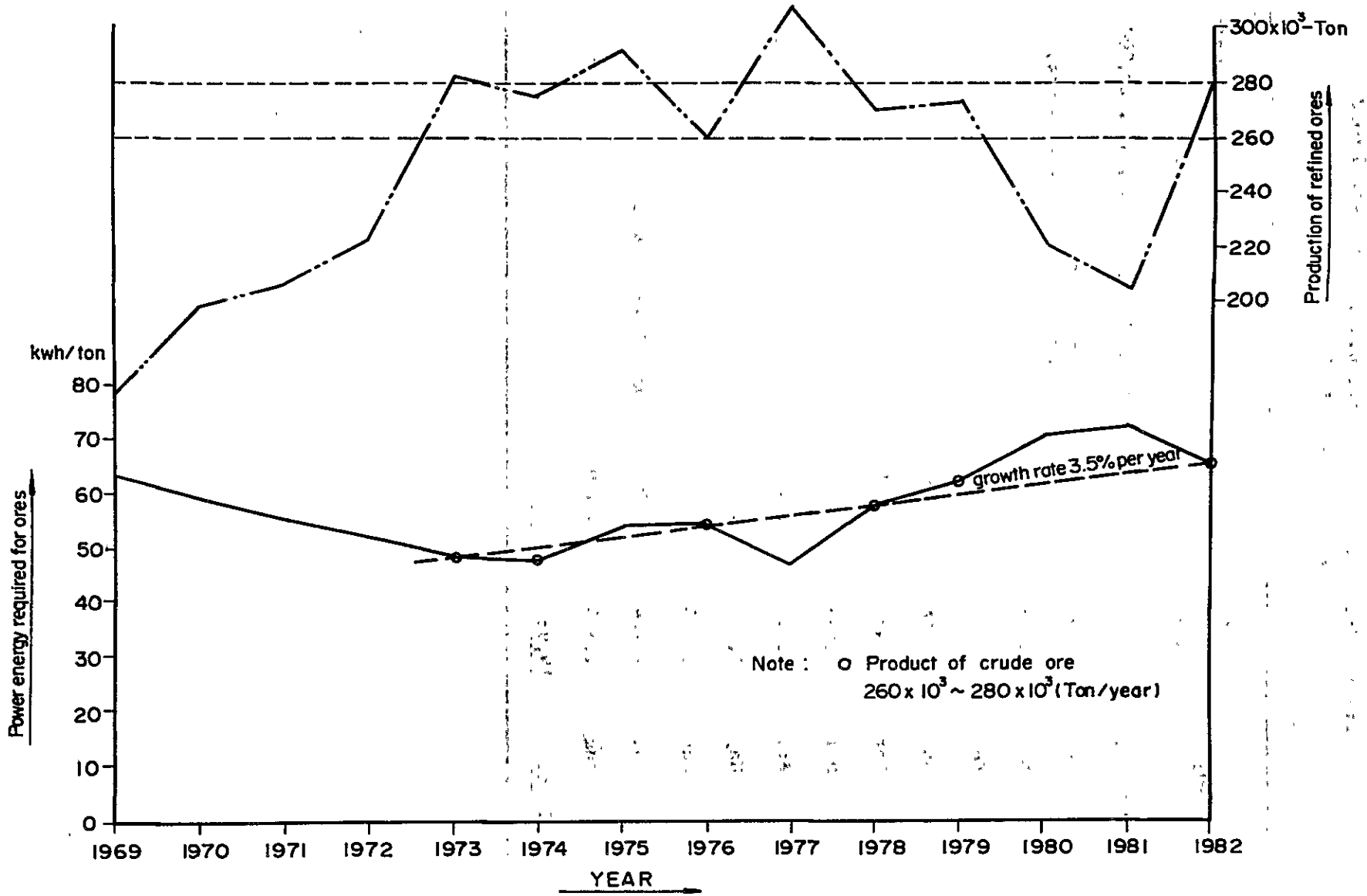


Table 5-2-1 Electrical Energy Demand and Power Demand of Huanzala Mine in a Year

Year		Energy Demand (MWh)	Max. Power Demand (KW)	Notes
1982	Sep	1,592	2,800	Total Energy Demand; Abt. 20,000 MWh
	Oct	1,744	2,900	Average Power Demand 20,000 MWH/(365 days x 24 hrs) = 2,283 KW
	Nov	1,731	3,100	
	Dec	1,653	2,990	
1983	Jan	1,668	2,950	
	Feb	1,477	2,930	
	Mar	1,644	3,060	
	Apr	1,554	3,090	
	May	1,663	3,150	
	Jun	1,706	3,140	
	Jul	1,704	3,200	Max. Power Demand
	Aug	1,844	3,150	
Total		19,980	-	

5.3 Load Forecast Combining Mining and Public Use

The load forecast combining mining and public use up to the year 2006 is estimated based on the conditions and assumptions and the results thereon are as shown in the following tables and figures.

Table 5-3-1	Estimated Maximum Power Demand
Table 5-3-2	Estimated Energy Demand
Fig. 5-3-1	Estimated Maximum Power Demand
Fig. 5-3-2	Estimated Energy Demand

Table 5-3-1 Estimated Maximum Power Demand of Huanzala Power System

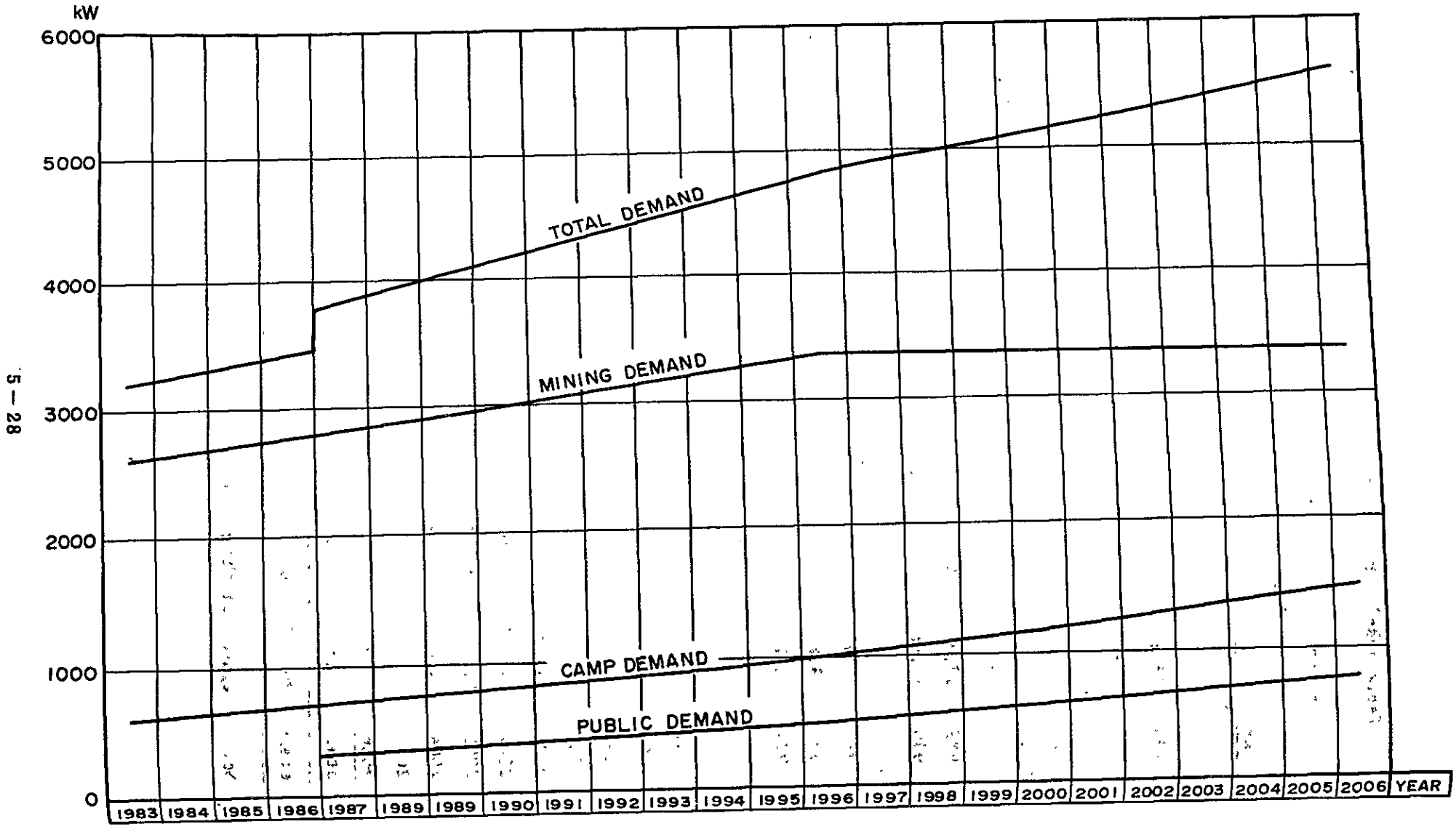
Year	Demand of Mine			Demand of Public	Total	Notes
	Mining (kW)	Camp (kW)	Total (kW)	(kW)	(kW)	
1983	2,600	600	3,200	-	3,200	
1984	2,652	624	3,276	-	3,276	
1985	2,705	649	3,354	-	3,354	
1986	2,759	675	3,434	-	3,434	
1987	2,814	702	3,516	300	3,816	Commissioning of Hydro. P.P.
1988	2,871	730	3,601	315	3,916	
1989	2,928	759	3,687	331	4,018	
1990	2,987	790	3,777	348	4,125	
1991	3,046	822	3,868	365	4,233	
1992	3,107	854	3,961	383	4,344	
1993	3,169	888	4,057	402	4,459	
1994	3,233	924	4,157	422	4,579	
1995	3,297	961	4,258	443	4,701	
1996	3,363	999	4,362	465	4,827	10th year
1997	3,363	1,039	4,402	489	4,891	
1998	3,363	1,080	4,443	513	4,956	
1999	3,363	1,124	4,487	539	5,026	
2000	3,363	1,169	4,532	566	5,098	
2001	3,363	1,215	4,578	594	5,172	
2002	3,363	1,264	4,627	624	5,251	
2003	3,363	1,315	4,678	655	5,333	
2004	3,363	1,367	4,730	688	5,418	
2005	3,363	1,422	4,785	722	5,507	
2006	3,363	1,479	4,842	758	5,600	20th year

Table 5-3-2 Estimated Energy Demand of Huanzala Power System

Year	Demand of Mine			Demand of Public	Total	Notes
	Mining (MWh)	Camp (MWh)	Total (MWh)	(MWh)	(MWh)	
1983	(16,250)	(3,750)	(20,000)	-	(20,000)	
1984	(16,575)	(3,900)	(20,475)	-	(20,475)	
1985	(16,906)	(4,056)	(20,962)	-	(20,962)	
1986	(17,245)	(4,218)	(21,463)	-	(21,463)	
1987	17,590	4,387	21,977	652	22,629	Commissioning of Hydro. P.P.
1988	17,941	4,562	22,503	684	23,187	
1989	18,300	4,745	23,045	718	23,763	
1990	18,666	4,935	23,601	754	24,355	
1991	19,039	5,132	24,171	792	24,963	
1992	19,420	5,337	24,757	832	25,589	
1993	19,808	5,551	25,359	874	26,233	
1994	20,205	5,773	25,978	917	26,895	
1995	20,609	6,004	26,613	963	27,576	
1996	21,021	6,244	27,265	1,011	28,276	10th year
1997	21,021	6,494	27,515	1,062	28,577	
1998	21,021	6,754	27,775	1,115	28,890	
1999	21,021	7,024	28,045	1,171	29,216	
2000	21,021	7,305	28,326	1,229	29,555	
2001	21,021	7,597	28,618	1,291	29,909	
2002	21,021	7,901	28,922	1,355	30,277	
2003	21,021	8,217	29,238	1,423	30,661	
2004	21,021	8,545	29,566	1,494	31,060	
2005	21,021	8,887	29,908	1,569	31,477	
2006	21,021	9,243	30,264	1,648	31,912	20th year
Total	402,809	130,637	533,446	21,554	555,000	
Average	20,140	6,532	26,672	1,078	27,500	

Note: Figures in the parentheses not included in "Total" and "Average".

Fig. 5-3-1 Estimated Maximum Power Demand of Huanzala Power System



5.4 Demand and Supply Balance

The demand and supply balance of the Huanzala Mine Electric Power System was studied considering the following basic conditions:

(a) The Huanzala Electric Power System is an independent system which will not be supplied with power from other power systems for a 20-year period after start of operation of the hydro-electric power station.

(b) The power sources of the Huanzala Electric Power System are only Huanzala Hydro-electric Power Station (4,200 kW) and the existing diesel power station including renewed diesel facilities.

(c) Huanzala Hydro-electric Power Station is a run-off-river type with no regulating capacity at all.

(d) Huanzala Hydro-electric Power Station, due to its hydrological characteristics, is capable of full-load operation during 7.5 months out of the year. During the remaining 4.5 months, the output gradually declines and the output at extreme low water is 1,600 kW.

(e) The start of operation of Huanzala Hydro-electric Power Station is to be in 1987.

(f) Since the diesel power plants are the auxiliary thermal for the above-mentioned independent system, it will supply power during peak hours (supplemental firing) and during the dry season (supplemental firing).

(g) As a result of analyzing and studying the existing diesel plant operation records of monthly third Wednesdays that are representative of ordinary workdays during the past 1-year period, supply during peak hours (supplemental firing) was taken as 15%. The time for such case will be seen in the year (1991) when the maximum load reaches the power station output (4,200

kW) as shown in Fig. 5-7-1. After that year, supplemental firing hour will gradually increase. (Fig. 5-4-1-a, Fig. 5-4-1-b and Table 5-4-1)

(h) The dry-season supply (supplemental firing) by the diesel plant will occur for approximately 4.5 months during the low-water season to augment the shortage of power and electric energy generated by the hydro-electric power station. For this purpose, the periodic inspections (at 8,000 hr and 24,000 hr, etc.) required by diesel generating facilities are to be made during the high-water season.

(i) The hydro-electric power station (156 kW) and diesel generator (125 kVA) of ElectroPeru are not calculated as supply capability in the demand and supply balance study.

The demand and supply balance forecast under the above conditions is shown in Table 5-4-1 and Fig. 5-4-2.

At the commencement year in 1987, the weight of the power of public use is estimated to be approximately 18% of the dry season output. In 1996, it will be about 30%, and in 2006 it will become approximately 47% which seems to be considerably large.

Since the power for public use will be supplied by Huanzala Power Station, the Mine has to operate the diesel power plant to meet their own power demand necessary for the mine.

Fig. 5-4-1 Two types of Diesel Supply in Wet Season

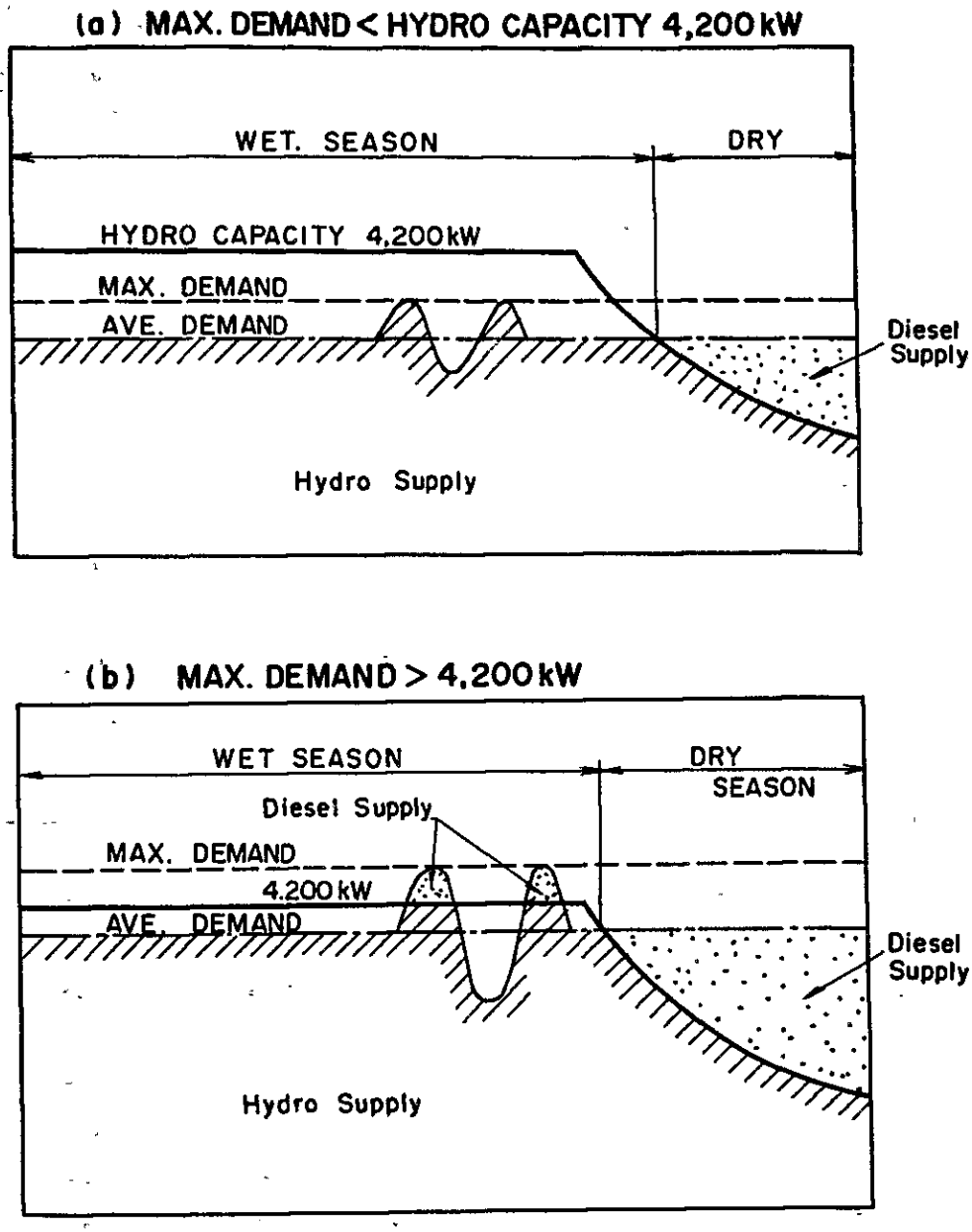
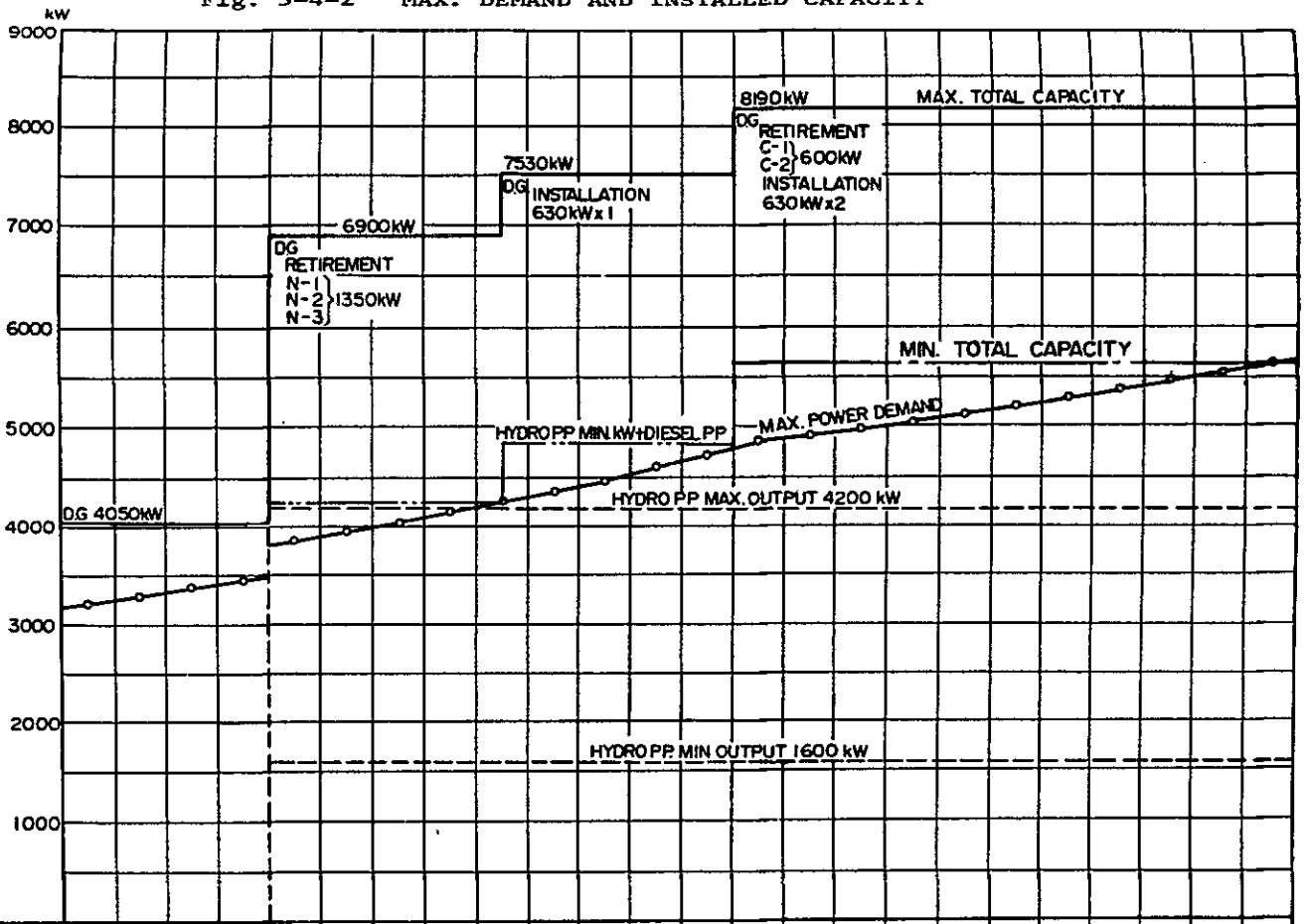


Table 5-4-1 Energy Balance in the Huanzala Power System

Year	Max Power Demand (KW)	Ave. Power Demand (KW)	Energy Demand (MWh)	Supplementary Energy by Diesel P. Plant			Energy Supplied by Hydro P. Plant (MWh)
				At Peak Time (MWh)	In Dry Season (MWh)	Total (MWh)	
1983	3,200	2,281	20,000	-	-	-	-
1984	3,276	2,337	20,475	-	-	-	-
1985	3,354	2,393	20,962	-	-	-	-
1986	3,434	2,450	21,463	-	-	-	-
1987	3,816	2,583	22,629	-	912	912	21,717
1988	3,916	2,647	23,187	-	1,015	1,015	22,172
1989	4,018	2,713	23,763	-	1,105	1,105	22,658
1990	4,125	2,780	24,355	-	1,218	1,218	23,137
1991	4,233	2,850	24,963	1	1,329	1,330	23,633
1992	4,344	2,921	25,589	13	1,464	1,477	24,112
1993	4,459	2,995	26,233	39	1,602	1,641	24,592
1994	4,579	3,070	26,845	80	1,754	1,834	25,061
1995	4,701	3,145	27,576	136	1,919	2,055	25,521
1996	4,827	3,228	28,276	210	2,095	2,305	25,951
1997	4,891	3,262	28,577	254	2,174	2,428	26,149
1998	4,956	3,298	28,890	303	2,258	2,561	26,329
1999	5,026	3,335	29,216	361	2,346	2,707	26,509
2000	5,048	3,374	29,555	425	2,440	2,865	26,690
2001	5,172	3,414	29,909	498	2,590	3,088	26,821
2002	5,251	3,456	30,277	581	2,644	3,225	27,052
2003	5,333	3,500	30,661	675	2,755	3,430	27,231
2004	5,418	3,546	31,060	778	2,871	3,649	27,411
2005	5,507	3,593	31,477	894	2,995	3,889	27,588
2006	5,600	3,643	31,912	1,026	3,126	4,152	27,760
Total	-	-	555,000	6,274	40,612	46,886	508,114

Fig. 5-4-2 MAX. DEMAND AND INSTALLED CAPACITY



YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
MAXIMUM DEMAND kW	3,200	3,276	3,354	3,434	3,816	3,916	4,018	4,125	4,233	4,344	4,459	4,579	4,701	4,827	4,891	4,956	5,026	5,098	5,172	5,251	5,333	5,418	5,507	5,600
INSTALLED CAPACITY kW	4,050	4,050	4,050	4,050	6,900	6,900	6,900	6,900	7,530	7,530	7,530	7,530	7,530	8,190	8,190	8,190	8,190	8,190	8,190	8,190	8,190	8,190	8,190	8,190
HYDRO PP MINIMUM OUTPUT +DIESEL PP kW	—	—	—	—	4,300	4,300	4,300	4,300	4,930	4,930	4,930	4,930	4,930	5,590	5,590	5,590	5,590	5,590	5,590	5,590	5,590	5,590	5,590	5,590
DIESEL PP REPLACE PLAN																								
RETIREMENT					1,350									600										
INSTALLATION									630					1,260										
TOTAL CAPACITY kW	4,050	4,050	4,050	4,050	2,700	2,700	2,700	2,700	3,330	3,330	3,330	3,330	3,330	3,990	3,990	3,990	3,990	3,990	3,990	3,990	3,990	3,990	3,990	3,990