of coal per hour, guaranteeing to load the contracted monthly quantity of Seventy-Five Thousand (75,000) metric tons to Eighty Thousand (80,000) metric tons of coal. The pier in Semirara shall be able to accommodate for berthing and loading one 10,000 deadweight tonner vessel at a time.

d. NAPOCOR, at its expense, shall undertake to arrange with any lighterage company of its choice the transport facilities to pick-up and deliver subject coal deliveries from port of loading at Semirara to the destination at Calaca, Batangas.

e. SCC, at its expense, shall maintain at any time an inventory in Semirara of at least One Hundred Fifty Thousand (150,000) metric tons of the specification coal for purposes of ready delivery to NAPOCOR, to assure coal supply to NAPOCOR in the event of an unscheduled break-down of SCC mining operation.

7) Quantity and Quality Determination

a. SCC shall determine at the point of loading the estimated coal quantity shipped out. The weight as determined in Section (2) hereof, shall be the basis for invoicing the Eighty Percent (80%) partial payment of NAPOCOR.

b. Actual coal quantity shipped out shall be determined at the point of loading by the use of SCC continuous weighing scale at Semirara after which SCC shall issue a final and conclusive Certificate of Weight. NAPOCOR shall assign its representative(s) to witness and observe the weighting procedures and said representative(s) shall have the right to request a third party to calibrate the continuous weighting scale as the need arises to determine the actual quantity shipped out.

c. During loading, SCC shall obtain representative samples of each shipment according to ISO standards, using the automatic sampling device installed at the conveyor.

d. SCC shall have the representative samples of each shipment analyzed for calorific value and proximate analysis in accordance with ASTM standards at its laboratory which shall issue a Certificate of Analysis. NAPOCOR shall assign a representative to observe and witness the said analysis. From the bulk smaple, four-one kilogram sample shall be taken. One sample shall be given to NAPOCOR and one sample to SCC for their respective analysis. The remaining two samples shall be deposited in a lock containment to be used in case there are significant differences in analysis by both parties. In this event, a third party laboratory acceptable to both NAPOCOR and SCC shall perform the final analysis and issue a Certificate of Analysis. The fee of said third party shall be borne equally by NAPOCOR and SCC.

8) Price Adjustment

Depending upon the calorific value of the coal delivered, moisture contents, ash and sulfur values, price of coal shall be adjusted in line with the provisions presented below:

a. Calorific Value Penalty and Premium

Should the calorific value in any one shipment exceed Nine Thousand Three Hundred (9,300) Btu/lb or be lower than Eight Thousand Three Hundred (8,300) Btu/lb, the price of Semirara coal shall be adjusted in accordance with the following formula:

$$\text{Adjusted Price} = \frac{\text{Analysed Calorific Value}}{8{,}500} \times \text{FOB, Semirara Coal Price}$$

b. Moisture Adjustment

The delivered weight shall be adjusted in case the total moisture, as received, exceeds the maximum specification of run-of-mine (ROM) coal, as received, in accordance with the formula:

$$\text{Adjusted Delivered Weight} = \text{Delivered Weight} \times (1 - D)$$

where,

D: Analyzed Moisture Content (as received basis) – 20%

c. Coal delivered to NAPOCOR shall be subject to penalty when ash, sulfur and moisture values shall exceed the ranges as specified in Section (4). For values higher than the ranges as specified in the above and lower than the maximum values acceptable to NAPOCOR, the following penalty rates shall apply:

a) For ash, Two Pesos & Forty Centavos (₱2.40) per metric ton shall be deducted from the adjusted price for every one percent (1%) deviation higher than twenty two percent (22%).

b) For sulfur, Two Pesos & Forty centavos (₱2.40) per metric ton shall be deducted from the adjusted price for every one-tenth percent (0.1%) deviation higher than one and three-tenth percent (1.3%).

c) For moisture, Two Pesos & Forty Centavos (₱2.40) per metric ton shall be deducted from the adjusted price for every one percent (1%) deviation higher than fifteen percent (15%).

The penalties imposed hereinabove shall be adjusted to the same percentage increase of the Base Price whenever the fair Philippines market price is determined and/or agreed upon, or whenever the escalation formula is applied as provided for in Section (5) hereof.

d. NAPOCOR reserves the right to reject any coal delivery greater than the following coal specification, analyzed on air-dried basis:

Ash:	25%
Sulfur:	3%
Moisture:	18%

NAPOCOR reserves the right to reject any coal deliveries less than Seven Thousand Five Hundred (7,500) Btu/lb, analyzed on an air-dried basis. However, NAPOCOR has the option to accept coal beyond the allowable specification at a price to be negotiated between NAPOCOR and SCC.

9) Performance

a. In the event NAPOCOR shall not be ready to use the coal or no facilities for unloading are available in its plant site, NAPOCOR shall inform SCC fifteen (15) days in advance that it will divert the shipment to other facilities. All incidental costs for diverting such shipment shall be borne by NAPOCOR.

b. In case either or both parties hereto are unable to perform all or part of this Agreement due to force majeure or fortuitours events, war, rebellion, invasion, civil commotion, strikes or lockouts, floods and other analogous causes which are unforeseen and beyond the control of either or both parties, this Agreement shall be suspended for the duration of such force majeure and neither party shall be liable to each other for any damages suffered or expenses incurred by reason thereof. The parties shall notify each other of the existence of such force majeure. In the event that such force majeure should last longer than on (1) year, either or both parites shall have the right to terminate this Agreement without any party being entitled to any claim against the other party.

c. Except for force majeure, in the event that SCC shall not be able to supply NAPOCOR with the quantities of coal subject to this Agreement, SCC will supply NAPOCOR with coal of equivalent quantity and specified quality from other sources.

d. SCC shall immediately notify NAPOCOR in the event SCC shall not be able to comply with its obligation to provide substitute coal from other sources. Further, if after two (2) weeks from notice, SCC has not made delivery of the minimum monthly tonnage as specified in Section (2) hereof, NAPOCOR shall have the right to purchase directly the required tonnage and shall charge and debit SCC with all cost involved in such purchases even in excess of the total cost of the coal shipment not delivered computed according to the provisions of this Agreement.

e. In te event NAPOCOR shall not be able to contract relevant purchases from other sources both local and foreign to cover SCC contracted quantity deficiencies, SCC shall pay NAPOCOR all fixed charged of the first unit of the Calaca Coal Thermal Power Plant including an amount equal to eight percent (8%) per annum of revalued plant investment cost pro-rate during the time such deficiencies occur. The amount, however, shall not be less than the SCC billing for the total cost of coal delivered.

f. Except for force majeure, in the event that NAPORCOR shall not be able to pruchase all the coal subject of this Agreement, NAPOCOR assume the obligation, if so required by SCC, to market the coal elsewhere and to pay SCC the stipulated price prescribed in this Agreement.

g. Except for force majeure, in the event that NAPOCOR shall not be able to purchase all the coal subject of this Agreement and also fails to market the coal elsewhere, NAPOCOR shall pay SCC for the quantity of coal not accepted by NAPOCOR. The amount shall not be less than the total cost of the coal that NAPOCOR should be pay for the quantity not accepted.

h. In the event, however, that either SCC or NAPOCOR cannot effect delivery or take delivery, respectively, of at least twenty percent (20%) of the aggregate specification coal at guaranteed minimum quantity in any six (6) month period, either party who is not in breach of its obligation has the right to terminate this Agreement immediately upon notice to the other party.

11-4 Coal Sales Performance

The coal production from the Unong pit was started in 1979 by only releasing coal encountered during the course of the pioneering work being conducted at a small scale by using trucks and shovels with small capacities. The aggregate tonnage of the coal released in 1979 was only 4,000 tons.

In 1980, the pit opening-up work was geared up after the commitment had been made to develop large scale open cast mine at the Unong area.

Until the pit operation became full scale, completing the installation of four bucket wheel excavators in 1984, all coal release was from the pit preparation work extensively done by using conventional truck and shovel system.

Prior to the first coal shipment to NAPOCOR in 1984, SCC started selling its coal in 1980 to various consumers, depending upon the availability of salable coal released from the mining operation.

NAPOCOR has been remaining as the largest consumer of the Semirara coal, since the commencement of the coal delivery except the year of 1984. It is expected that NAPOCOR will be the only buyer of Semirara coal in 1987 and on.

Table 11-2 shows coal production of the Unong pit and Table 11-3 shows the performance of Semirara coal deliveries. The detail coal delivery to NAPOCOR Calaca Power Plant is shown in Tables 19-1 to 19-4.

Table 11-2 Coal Production Summary (Unong Pit)

(Metric Tons)

Year	Conventional Mining System	Continuous Mining System	Total
1979	4,000		4,000
1980	30,000		30,000
1981	13,000		13,000
1982	91,000		91,000
1983	326,000		326,000
1984	33,000	534,000	567,000
1985	7,000	587,000	594,000
1986	1,000	579,000	580,000
Total	505,000	1,700,000	2,205,000

Table 11-3 Semirara Coal Delivery Performance

(Metric tons)

Year	Customers	Delivery Tonnage	
1980	Biophil & Bocnotan	33,000	
	1980 Total	33,000	
1981	Biophil	12,000	
	1981 Total	12,000	
1982	Biophil	2,000	
	Atlas	68,000	
	1982 Total	70,000	
1983	Atlas	173,000	
	PNOC-CC	1,000	
	1983 Total	174,000	
1984	Atlas	264,000	
	NAPOCOR	152,000	
	PNOC-CC	103,000	
	Philphos	5,000	
	MMIC-NONOC	16,000	
	MMIC-IC	13,000	
	Others	11,000	
	1984 Total	564,000	
1985	Atlas	227,000	
	NAPOCOR	343,000	
	Philphos	22,000	
	Pasar	2,000	
	1985 Total	594,000	
		Actual (Jan. – Sept.)	Budget (Jan. – Dec.)
1986	Atlas	62,000	134,000
	NAPOCOR	237,000	410,000
	Philphos	16,000	23,000
	Pasar	5,000	5,000
	1986 Total	(320,000)	(572,000)

11-5 Coal Price

Coal price currently delivered to the Calaca power plant is 813.54 pesos per metric ton at 8,500 Btu/lb calorific value basis including freight from the Dapdap pier to Calaca plant, port charge and unloading cost.

Table 11-4 shows the breakdown.

Table 11-4 Coal Price

Pesos/mton

FOB Dapdap	750
Freight (270 km)	33.29
Unloading Cost	20.00
Port Charge	10.25
Total	813.54

Note: FOB price is subject to adjustment as specified in the coal supply agreement.

12. Semirara Island

12-1 Location and Accessibility

12-2 Climate

12-3 Geology

12. Semirara Island

12-1 Location and Accessibility

The Semirara Coal Mine is located on the Semirara island in the Sulu Sea between Mindoro Island and Panay Island at the latitude of approximately 12°N.

The Semirara island is approximately 13 km in length and 4 km in width having an area of 55 km^2, about 300 km straight distance to south from Manila, a capital of the Republic of the Philippines, and about 16 km to south from the Mindoro island. Refer to Figs. 12-1 and 12-2.

There is at least one commercial plane of the Philippine Airline available daily from Manila to San Jose, Mindoro, which takes about 40 minutes. From San Jose, a private light airplane owned by SCC is available to the island upon requests, it takes about 15 minutes to the airstrip on the island. SCC owned boat used for material supply to the island and other powered bancas or sailboat may be available for passengers from Caminawit, the port of San Jose, Mindoro. By those ocean transportations, it takes about 4 to 5 hours in good weather. The most convenient way is to take SCC company planes flying directly from Manila to the island 5 days a week whenever necessary, however, it is exclusively for the company executives except for an emergency case. There is a coal boat operating between Calaca Thermal Power Plant, Batangas, Luzon and Dapdap pier, Semirara island for coal supply to the plant. The operating schedule is usually not firmly fixed but the coal boat could be available for material and passengers upon a permission. By the coal boat, one way takes about 15 hours.

In the Semirara island, main road runs through the island connecting the Unong open-cast mining area at the east coast and the Dapdap ship-loading area and industrial area at the west side of the island. In the industrial area, mine supporting facilities such as coal stockpile yard, captive power plant, main workshop, administration office, etc. are situated.

There are also access roads for a geological exploration running toward north and south branching off the main road, providing an access to the Panian area in the north and the Himalian area in the south of the island as well as to various water sources.

12-2 Climate

The climate at the Semirara island is tropical and dominated by monsoon winds which seasonally alter directions. The island has well-defined wet and dry seasons and its annual precipitation is about 3,000 mm.

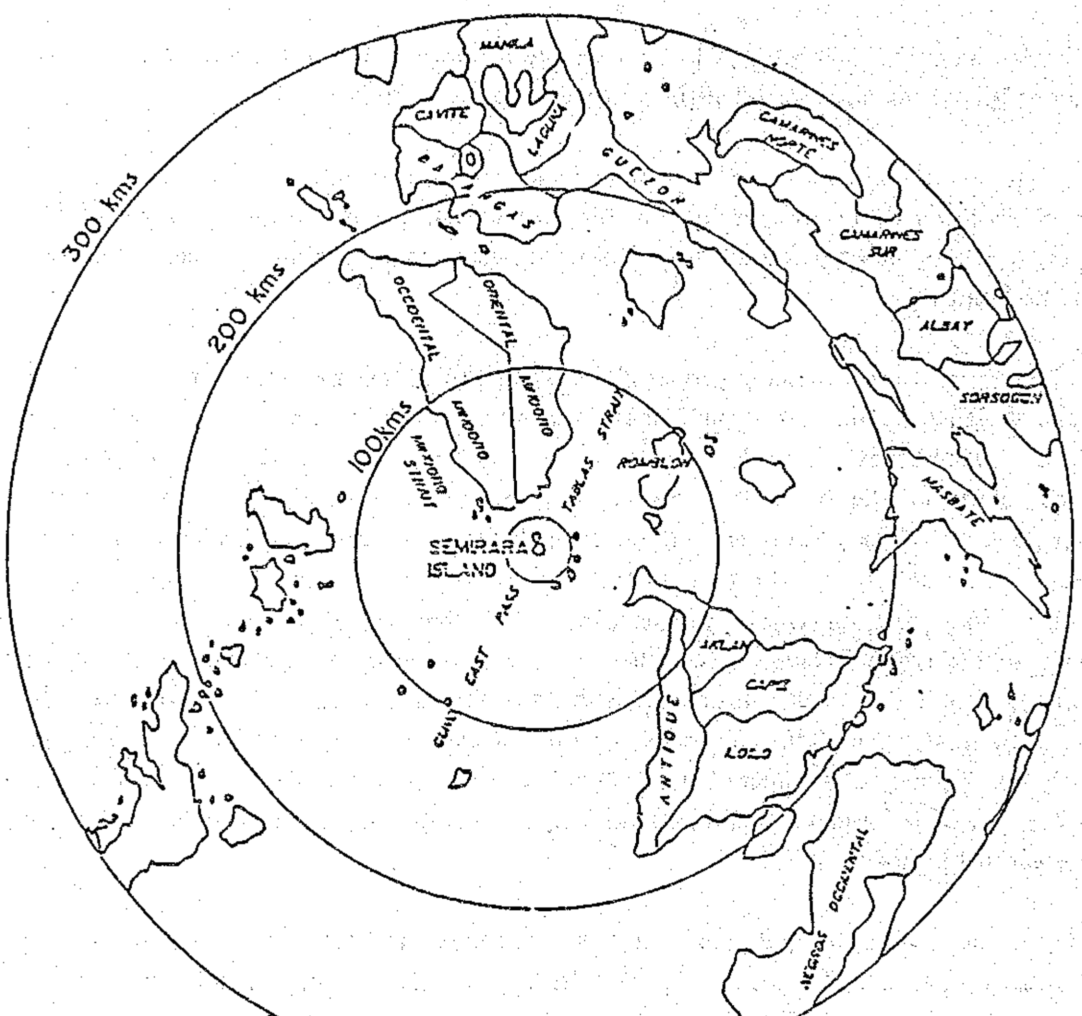


Fig. 12-1 Location of Semirara Island – 1

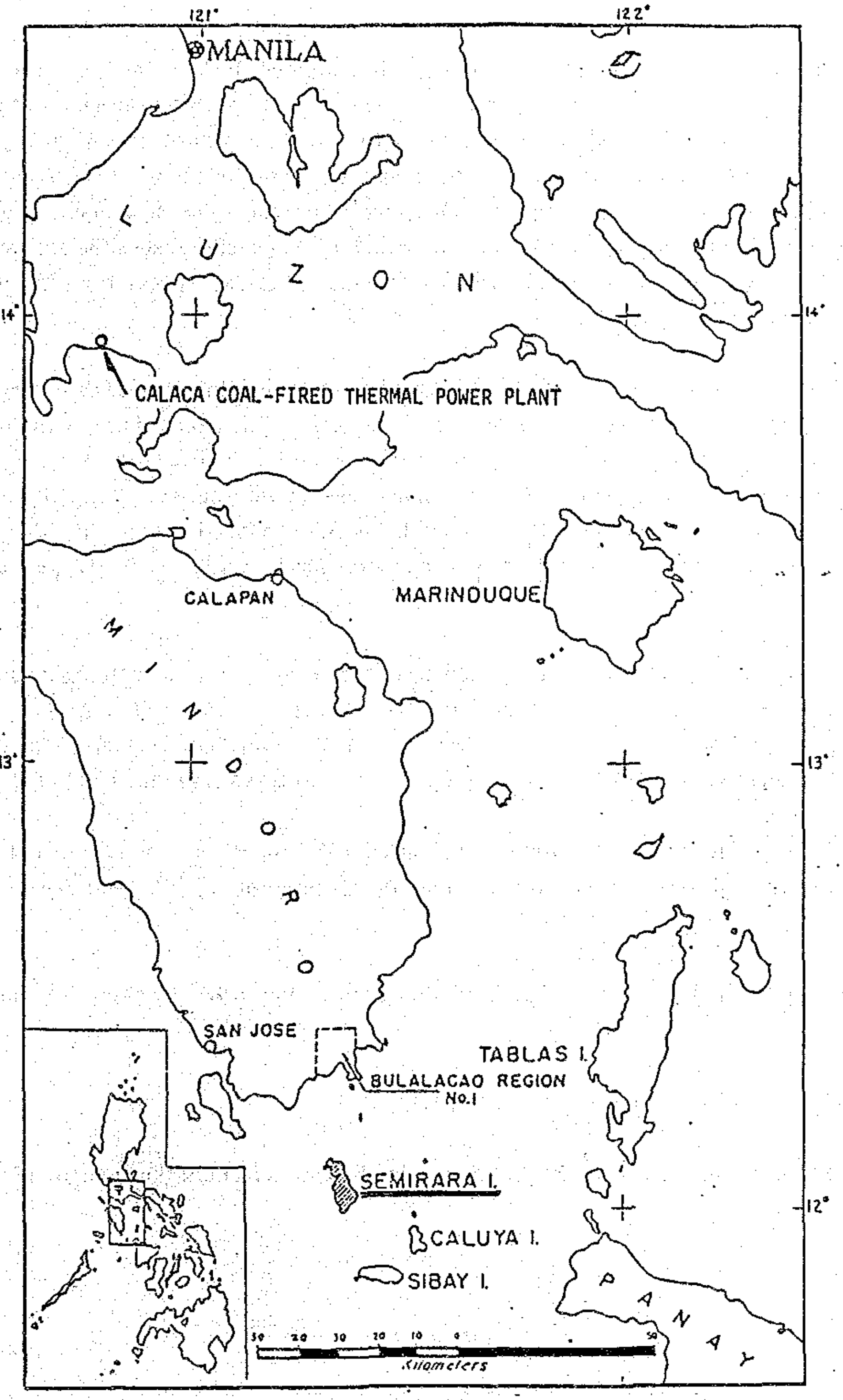


Fig. 12-2 Location of Semirara Island – 2

The dry season is from late October or early November to late March or early April with northeast monsoon. During this period, steady winds prevail from the north and northeast direction and changes to more easterly toward the end of the season. Due to the northeast monsoon, the eastern coast of the island is exposed to the wind generated high waves which sometimes reach as high as four meter, reportedly. On the conrary, water off the western side of the isalnd, where the Dapdap shiploading facilities are situated, are relatively calm. A serious water shortage has been experienced in the dry season and the whole island becomes very dry and dusty.

The wet season is from late May or early June to late September or early October, dominated by southwest monsoon winds which are less constant than those of the northeast monsoon. During this period the western side of the island are exposed to high waves created by the winds and almost 70% of annual precipitation occurs. It usually causes various problems in the pit operation, making the pit floor tremendously muddy, the depth of the mud sometimes reaches as deep as to our waist level, thus tire vehicles are unable to operate efficiently.

The climatological data of the island has been taken at the meteorological station on the captive power plant, since December 1984. The station has a 100 meter high tower and mainly monitors environmental conditions within the immediate vicinity of the plant. The station incorporates a PDL-24 meteorological monitoring system in the Philippines.

At 100 meter level of the tower, wind speed and direction are monitored and wind speed, direction, air temperature, relative humidity are monitored at 10 meter level of the tower.

Precipitation measurement has been done, since July 1985, by using manual rain gage.

The monitoring data is summarized in Table 12-1.

Fig. 12-3 graphically indicate the actual rainfall measurement at the Semirara island.

Table 12-1 Climatological Data at Semirara Island
(December 1984 to October 1986)

	100 m elevation		10 m elevation		
	Wind Velocity (km/h)	Temperature (°C)	Wind Velocity (km/h)	Temperature (°C)	Relative Humidity (%)
1984					
December	25.95	–	15.82	–	69.82
1985					
January	24.51	–	13.05	–	69.82
February	22.23	–	12.62	–	65.55
March	25.04	27.07	13.48	27.96	60.67
April	17.52	28.05	9.31	28.13	66.16
May	18.55	28.55	10.05	29.18	63.11
June	25.42	26.44	10.06	27.99	74.63
July	14.74	–	4.75	–	77.26
August	–	–	–	–	–
September	–	–	–	–	–
October	–	–	–	–	–
November	–	–	–	–	69.26
December	–	–	–	–	65.76
1986					
January	28.55	–	3.38	23.48	63.11
February	22.65	–	11.17	23.85	67.28
March	25.93	–	12.64	24.93	62.28
April	25.77	–	13.88	26.49	62.51
May	15.70	–	7.77	26.87	70.95
June	11.55	–	6.54	25.87	69.61
July	14.79	–	7.20	25.47	72.16
August	21.10	–	10.31	25.58	86.08
September	16.11	–	6.00	25.27	–
October	17.49	–	7.03	25.08	–
November	–	–	–	–	–
December	–	–	–	–	–

Prevailing Wind Direction (January to October 1986)

	100 m elevation			10 m elevation		
	Direction	Velocity (kph) Min.	Velocity (kph) Max.	Direction	Velocity (kph) Min.	Velocity (kph) Max.
1986						
January	E-NE	3.6	68.4	N-NE	0.5	76.9
February	E-NE	0.1	45.7	–	2.5	75.8
March	E-NE	0.6	52.4	–	0.4	83.5
April	E-NE	0.8	46.1	–	5.8	78.5
May	SW	0.1	32.9	–	0.0	64.1
June	W-SW	0.1	49.6	–	0.5	54.4
July	S-SW	0.2	43.6	–	0.0	106.3
August	W-SW	0.1	38.9	–	0.0	87.7
September	W-SW	0.1	29.4	–	0.0	74.7
October	SE	0.1	95.3	–	0.1	90.1

Precipitation Data

Year	Month	Total Monthly Precipitation (mm)
1985	July	80.0
	August	101.2
	September	213.8
	October	213.8
	November	12.8
	December	0.0
1986	January	0.0
	February	0.0
	March	0.0
	April	0.0
	May	109.6
	June	108.6
	July	492.3
	August	627.8
	September	589.4

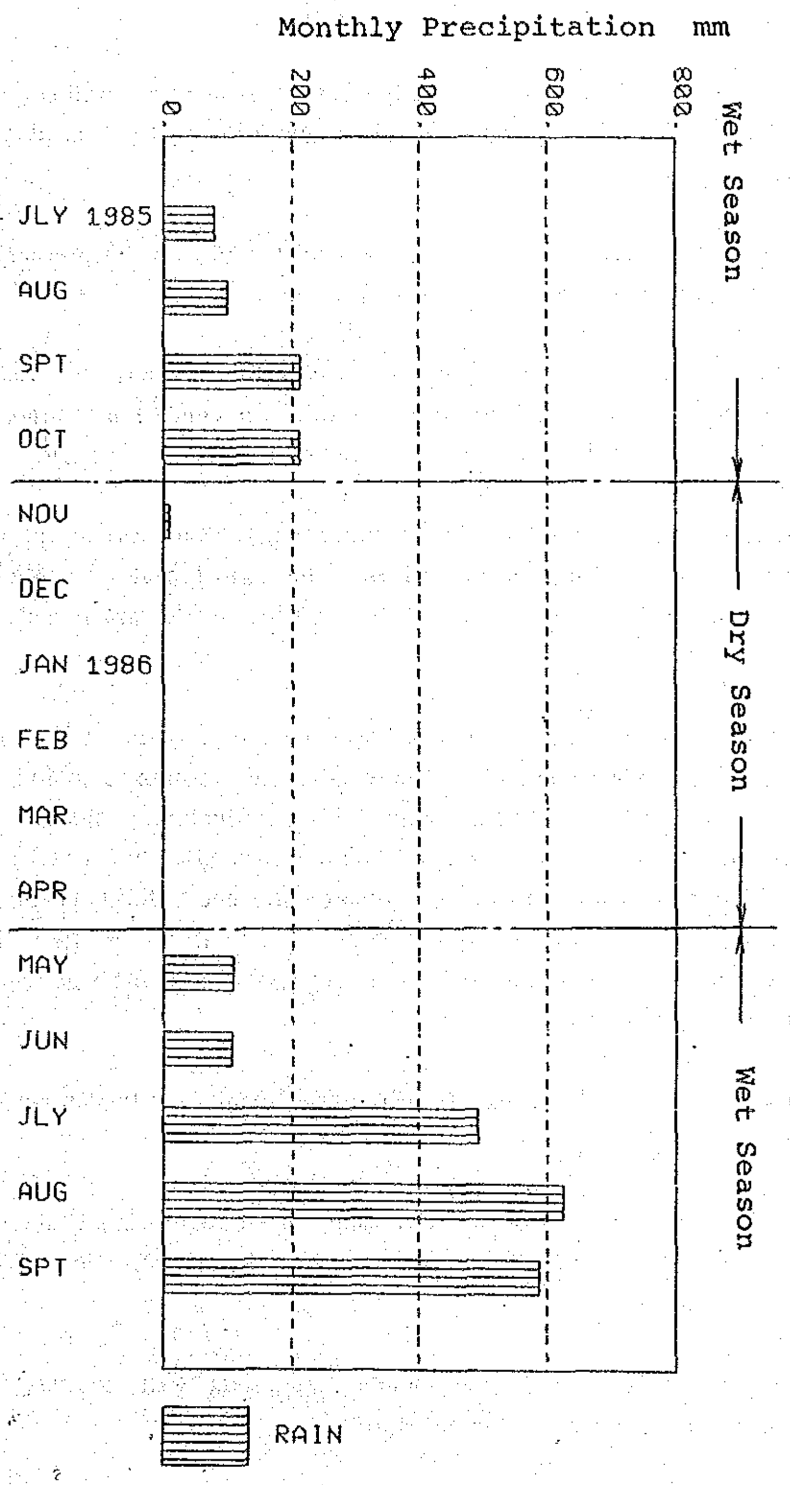


Fig. 12-3 Rainfall Data at Semirara Island

12-3 Geology

The geology and local resources of the Semirara island are well summarized in the report prepared by Jose F. Vergara for the Philippine Bureau of Mines. Refer to Fig. 12-1 Semirara Island Coal Reserves.

The Semirara island is composed entirely of Tertiary and Quaternary sedimentary origin rocks of which age ranges from Miocene to recent.

Fig. 12-4 shows typical stratigraphic sections for northern and eastern Semirara Islands, which have been divided into Alluvium formed in Quaternary to recent, Buenavista limestone in Pliocene Tertiary and Semirara formation in Miocene Tertiary.

The oldest rocks exposed on the island are the Semirara formation, which is a coal bearing measures composed mainly of sandstone, shale and limestone at Miocene age. The Semarara formation is divided into three members by Jose F. Vergara, namely lower, middle and upper.

The lower member consists of two subdivisions cropping out at the west part of the Unong area and Abalong Creek. The lower subdivision comprises mainly light gray to brownish tuffaceous shale interbedded with sandstones including siltstone, carbonaceous shale, conglomerate and more than two coal beds of reasonable thickness for mining. Judging from fossils in this member, the age is estimated Miocene. The coal bearing shale unit is overlain conformably by an upper subdivision composed with sandstone with brown shale parting. Conglomerate is predominant in some layers and its pebbles are coarser and more angular in the eastern outcrops.

Fig. 12-5 shows the sub-surface lithology of this member in the Unong area.

The middle member consists of two units, the lower one is gray to brown tuffaceous shale with subordinate interbedded layers of gray sandstone and thin coal bed. This unit is well exposed in Himalian area on Bayong Creek and on the upper portion of Abalong Creek, west side of Unong area.

The upper unit of the middle member comprises with alternating cross-bedded sandstone and thinner layers of tuffaceous shale.

The upper member of the Semirara formation consists of limestone with maximum thickness of about 100 m in the northern part of the island and thinning out in the southern part of the island.

Many fossils found in the limestone indicates that the limestone member is of Miocene age. The Semirara limestone lies conformably on the middle member as seen in the Western Panian area and on Barimbig Creek in the Barimbig area.

The Buenavista limestone belongs to the age of Pliocene, of which thickness reaches as thick as 150 meters in some area. It overlies unconformably the older Semirara formation. Limestone having white, pink and gray colors, are extensively exposed on the island. It is generally massive, porous and coralline and fossils found in this limestone is of Pliocene age.

The alluvium which is estimated to be of Quaternary overlies unconformably all of the older lithologic units on the Semirara island. They are composed mainly of materials from the lower and middle members of the Semirara formations without showing clear contacts with the other formation.

The strata of the Semirara island is generally dipping from 5 to 30 degrees at the outcrops and it is much steeper in some areas.

There are a few plunging anticlines and the most coal outcrops on the axes.

One outcrops occurs at Panian where the northwest flank of a broad structure dips at about 30 degrees towards west and the sothwest flank is cut off by a fault.

There are two minor anticlines at Unong area rising northeastward toward the coast.

At Himalian, an anticline is partially exposed at the west side of the limestone ridge.

There are many small faultings in the Semirara strata and they have two trends, one is northeast and the other is northwest. The northeast trending fault which seems to be a reverse type may bound the Panian coal area on the southeast.

It is also estimated that there is an east-west trending normal fault crossing the southern part of the Semiarara island, north of Alegria and west of Tinogboc.

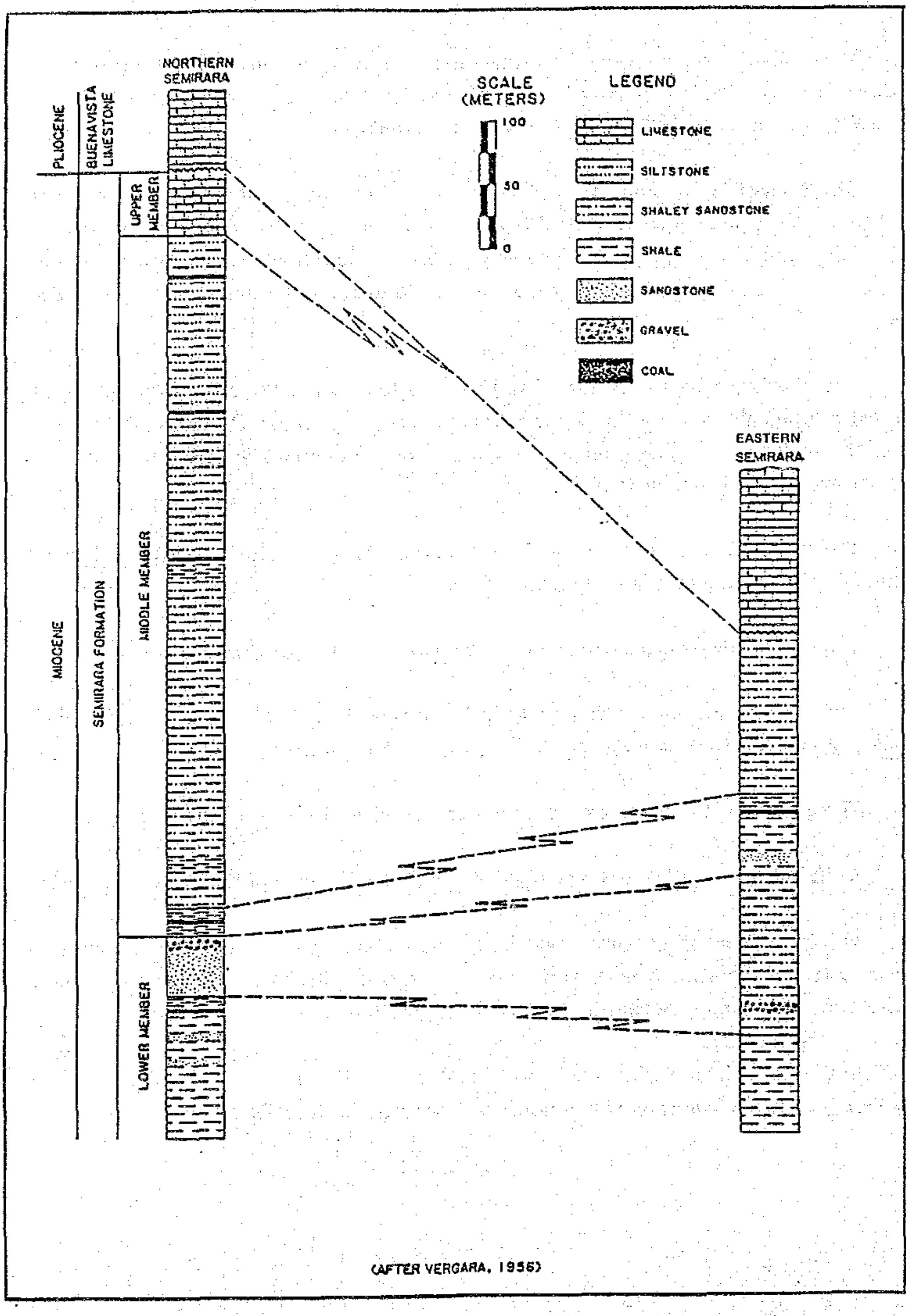


Fig. 12-4 Representative Stratigraphic Columns at Semirara Island

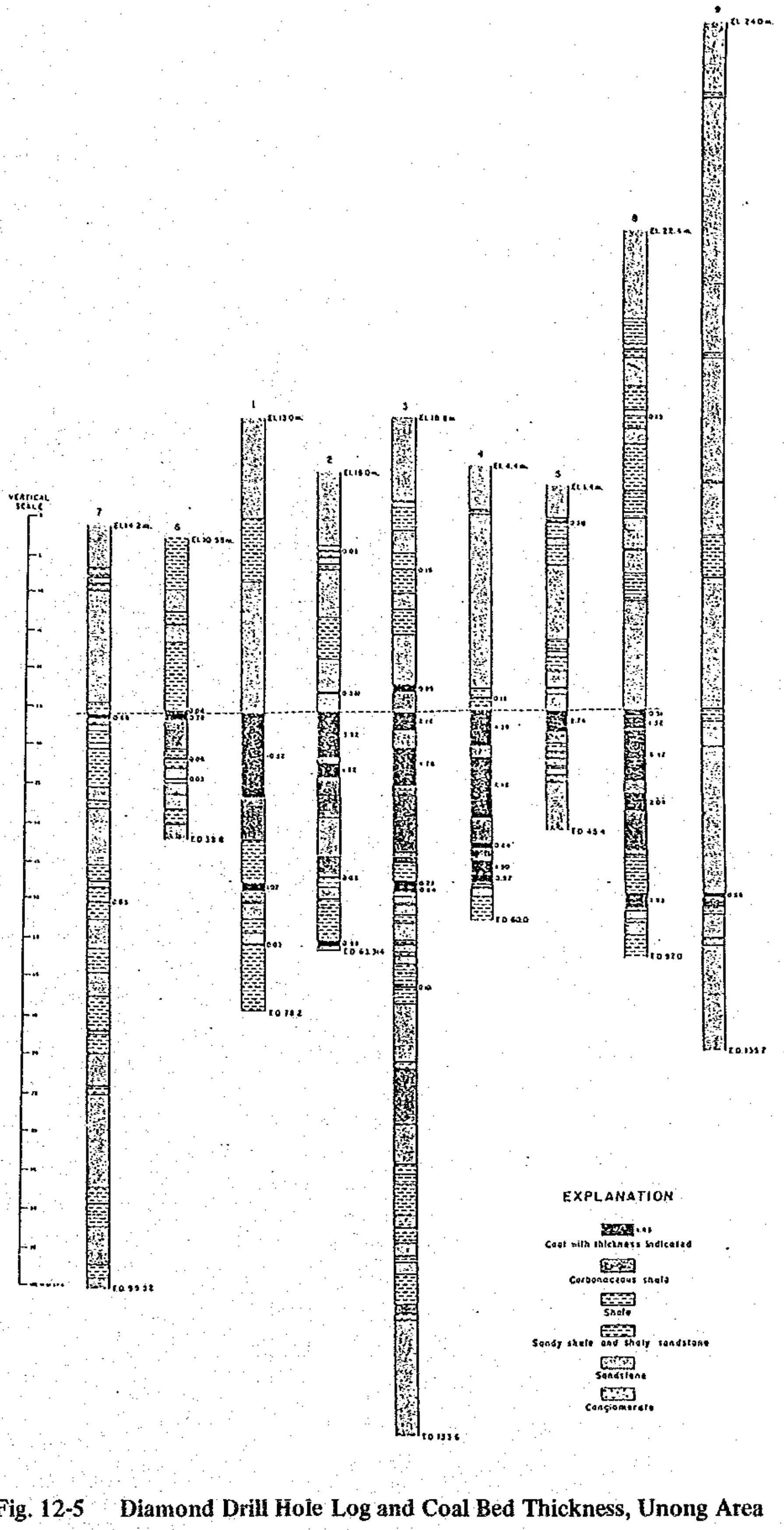


Fig. 12-5 Diamond Drill Hole Log and Coal Bed Thickness, Unong Area

13. Semirara Coal Mine

13-1 History of Mine Development

13-2 Unong Reserve Area General Geology and Coal Seam Occurrence

13-3 Coal Quality

13-4 Investment Cost

13-5 Mine Supporting Facilities

13-6 Maintenance Service Facilities

13. Semirara Coal Mine

13-1 History of Mine Development

1) Exploration

An occurrence of coal on the Semirara island has been known since early days and exploratory drilling for mining have been documented as early as 1940.

The followings are the history of exploration work down on the Semirara island documeted by the Philippine Bureau of Mines.

Year	Activities
1940	Geological study was conducted by Melendres, Mariano M. on the coal areas of Panian and Unong for the National Development Company (Government Corporation) "The Semirara District, Antique" National Development Co., (unpublished report)
1947	Coal reserve estimation study was conducted on the coal areas of the Semirara island by Nestorio N. Lim for the Philippine Bureau of Mines. "Coal deposits of Semirara Island, Antique Province" Mr. Mariano Salazar prepared a report on the coal property on the island of Semirara for the Philippine Bureau of Mines. (unpublished report)
1952	Geological work was conducted under the direction of Jose F. Vergara. A topographical map of a 14 square kilometer area in Panian, Semirara, Himalian and Unong barrios and also geological mapping was done extensively covering all areas of the island, parts in detail, and the rest be reconnaisance.
1953	Totally eighteen diamond drills were done in the Unong area for the Philippine Bureau of Mines and the work was reviewed by J. Marvin Weller of the U.S. Geological Survey and the U.S. Mutual Security Agency, now the International Cooperation Administration.

Year	Activities
1955	The U.S. Geological Survey and the International Cooperation Administration made a field review of the island. The coal reserves were re-calculated according to the standards adopted by Philippine Bureau of Mines.

2) Mine Development

July 1977

Semirara coal Consortium, which comprises with Vulcan Industrial and Mining Corporation and Sulu Sea Oil Development Corporation, was formed and the extensive exploration was started on the Semirara island signing the exploration agreement with the Ministry of Energy of the Philippines.

Seafront Petroleum and Mineral Corporation joined the Consortium later on..

September 1978

Vulcan Industrial and Mining Corporation, Manila, Philippines, and Astromineral Ges.m.b.H., Vienna, Austria, a wholly owned subsidiary or Vesto-alpine AG, Linz, Austria, concluded a contract for an engineering study on an open cast coal mine at Unong area, Semirara, Philippines, and if the result of the engineering study proves, Astromineral Ges.m.b.H. supplies all necessary equipment for the operation on a turn-key basis.

The engineering study was scheduled to have been completed by early 1980.

Early 1980

Semirara Coal Corporation was formed in Manila, changing the name of Vulcan Industrial and Mining Corporation.

This new entity is responsible for all future mining operation on the Semirara island.

June 1980

Completion of the engineering study.

Commencement of the mine construction and development.

November 1980

A supplementary agreement was signed between Semirara Coal Corporation (SCC) and Astromineral Ges.m.b.H. to retain all relevant supervisory work and management for the project including mine development, equipment erection and installation, operation start-up, maintenance and repair, training of local experts.

Voest-Alpine AG was awarded main supplier of all required equipments including bucket wheel excavators, belt conveyors, spreaders, coal handling and shiploading system, workshops, power plant and auxiliary equipments on a turn-key basis.

December 1980

Coal Supply Agreement was signed between the National Power Corporation of the Philippines and Semirara Coal Corporation to supply approximately nine hundred thousand (900,000) metric tons of coal per year for a specified period of fifteen (15) years to the thermal power plant to be built in Calaca, Batangas, Luzon, Philippines.

July 1984

Commencement of coal shipment to NAPOCOR Calaca Thermal Power Plant. (Coal extraction was a whole seam recovery, so-called "run-of-mine" by SCC.)

October 1984

NAPOCOR refused to take coal from Semirara due to some troubles in the power plant boiler as well as in the coal handling system which were considered to have been caused by inferior quality coal than the contracted specifications.

February 1985

NAPOCOR resumed to take coal supply from Semirara, since Semirara Coal Corp. modified their mining method at the Unong pit from the whole seam extraction (run-of-mine) to selective mining which removes clay partings as waste.

August 1987

NAPOCOR and SCC are negotiating to modify the coal supply agreement.

13-2 Unong Reserve Area General Geology and Coal Seam Occurrence

As previously mentioned, there are three reserve areas identified particularly rich in coal deposits. The Unong area is one of those three reserve areas and has been known of its easier access due to the extensively exposed outcrops along the northeastern coast of the island.

It has been reported that several exploration drill data is available from the geological study conducted by the National Development Company, a government organization, in 1940 and another exploratory survey which conducted eighteen diamond drills under the supervision of the Philippines Bureau of Mines in 1953, the data was reviewed later on by the U.S. Geological Survey and the U.S. Mutual Security Agency, now the International Cooperation Administration. Some data on the coal quality is also available from the coal sample analyses done in 1960's.

In addition to those old data from the explroatory drills conducted in the old days, the majority data was obtained through the exploratory drillings extensively performed by Semirara Coal Corp. geological group in the latter half of 1970's with the purpose of the feasibility study report which evaluated a viability of the project. In the exploratory drillings, approximately 50 diamond drills had been conducted at 250 meter grids covering all Unong coal reserve area. The aggregate drilling distance reaches as long as 11,000 meters.

The geological maps, cross sections as well as coal quality data attached to the feasibility study report were jointly prepared by SCC and Austromineral based on the above-mentioned geological exploration. Those geological sections are the basis of the pit design as well as mining operation and have always been updates by SCC geological group who are responsible for an implementation of the mining face mapping and additional drilling in the pit area.

In the Unong area, the Semirara formation, which is a coal bearing measures at Miocean age, is predominantly outcropping. The Buenavista limestone at Piocene age, which overlies the old Semirara formation is exposed mainly at Unong Point and Pasal Point in the western part of the Unong area. The alluvium at Quaternary is exposed along the coast. On the sea bottom off the coast of the Unong area, there occurred coral reefs extending seaward as far as 500 meters, however, the area has been reclaimed with waste removed from the Unong pit.

Fig. 13-1 shows typical stratigraphic column of Semirara formation at the Unong area, complied from Vulcan's geological logging data.

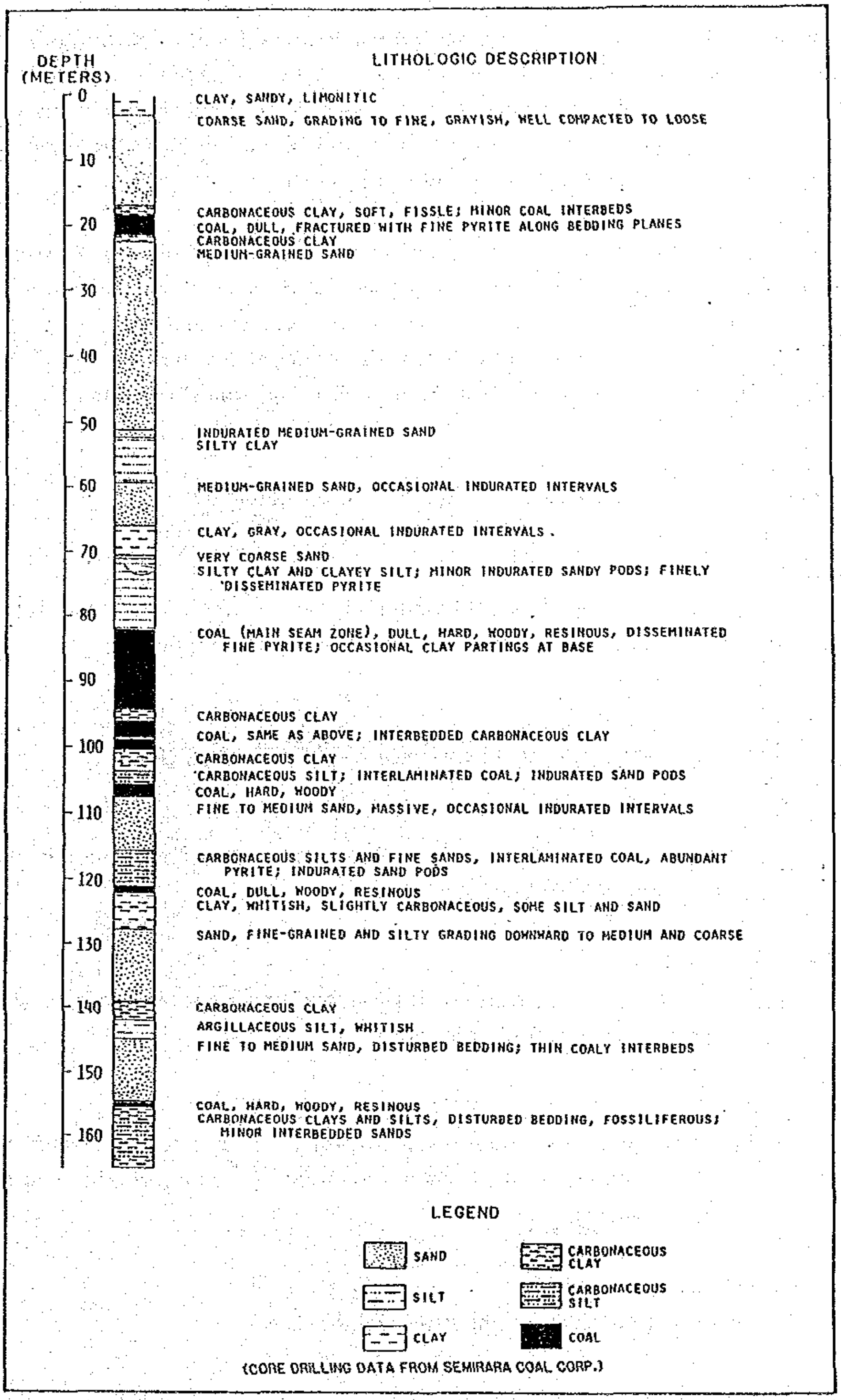


Fig. 13-1 Typical Stratigraphic Column at Unong

As indicated in Fig. 13-1, there are several rhythmic cycles of sedimentation in the assemblage of units. The overall lithology of the formation is largely unindulated fine-grained silty sands, silts, coaly or carbonaceous clays and brown coals, clays, and coals. The general strike of the Semirara Formation is between N30°W and N40°W at the Unong area, and dips range from 5 to 36 degrees toward southwest.

According to Dames & Moore geologist who has conducted brief reconnaisance to the Semirara mine site, most of the rhythmic cycles, or sequence of sedimentation begin at the bottom with coarser clastics interbedded with fine-grained silty sand, impure clay, or brown coal. Four of the cycles occur below the principal coal horizon, and four are stratigraphically above it. They are described from lower to uppermost as below:

Lower Sequence L-I

Silt grading upward to clay, and then to carbonaceous clay and coal.

Lower Sequence L-II

Coarse to medium-grained sand grading upward to fine-grained sand, silt, and coal. Sands have minor indurated zones. Coal is discontinuous.

Lower Sequence L-III

Silt or fine-grained sand grading upward to clay and coal seams.

Lower Sequence L-IV

Fine-grained sand grading upward to silty sand and carbonaceous silt; terminates at bottom of main Seam sequence.

Main Seam Sequence

Thick interval of coal, occurring either as one large or several smaller, closely spaced seams. Layer of kaolinitic clay at top.

Upper Sequence U-I

Marked distinction from Main Seam Sequence. Coarse to fine-grained sands with silty impurities, silicified wood, crossbedding, unconformities, and occasional coal fragments.

Coal-free Sedimentary Sequence

Fine-grained sands with silt impurities; minor clays.

Upper Sequence U-II

Fine-grained sands grading upwards silts, then to clays. Coal seam at top.

Sequence Poor in Coal

Fine-grained kaolinitic sands and interbedded silts.

There are many coal seems in the Unong area, however, majority occurrence of coal is in the Main seam zone. Its thickness varies from about 2 to 30 meters from hole to hole. The strike and dips are same as above stated Semirara formation. The coal seams were extensively outcropping at the northeastern side of the Unong pit along the coast, where mining operation was initiated. The coal seam occurrence is identified as deep as 260 meters on the southwestern side of the area.

Fig. 13-2 shows typical coal columnar section of the Main seam comprising 14 plies. The Main seam is divided into the Upper Main seam and the Lower Main seam. Nos. 1 to 7 plies belong to the upper main seam which contains relatively higher grade coal plies. Nos. 8 to 14 plies from the lower main seam with relatively lower grade coal plies, Nos. 2, 8 and 10 plies are mudstone layers which range from 1 to 3 meters in thickness.

The coal in the Main seam changes its appearance from hard, massive and bright which is higher grade coal section; to dull black woody coal with platy pyrite fracture fillings and to woody or powdery brown coal with remaining coalified plant. The latter two sections usually represent lower grade coal. There also exists small lumps of solidified orange-brown colored resin in the coal seam.

Besides the Main seam, there occur two mineable Minor seams lying below the Main seam. The upper one is called the first Minor seam and the lower one is the second Minor seam.

During the first site survey, geological mapping was conducted at the mining faces of #4 and #5 conveyor lines where the Main seam and the first Minor seam were well-exposed. The second Minor seam was mapped at the exposure on the northeastern side of the pit. Fig. 13-3 to 13-5 show the columnar sections. Sampling of the coal seams was also done at the above-mentioned places. Figs. 13-3, 13-4 and 13-5 show the measureded sections of the coal seams at the sampling places.

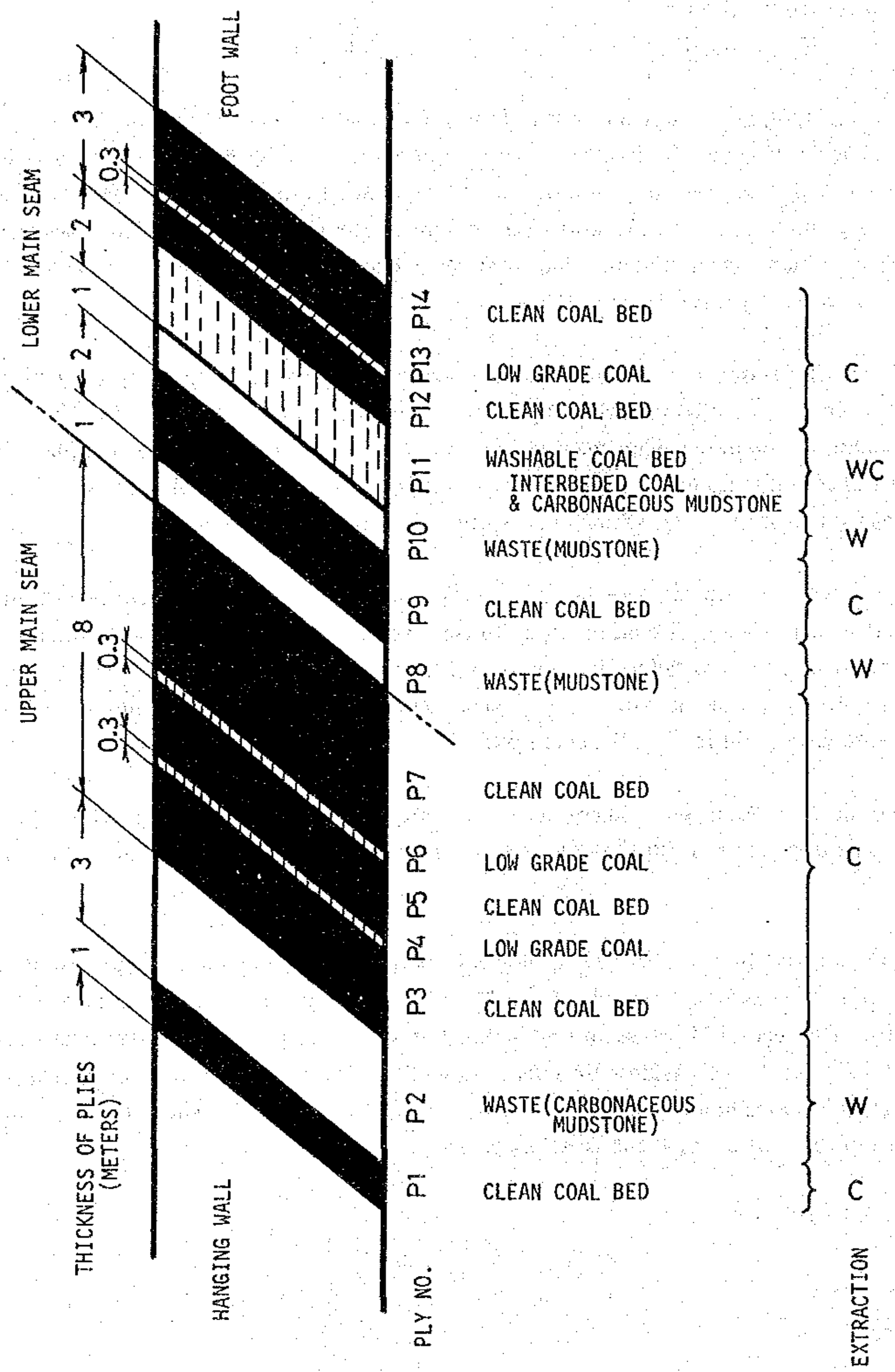


Fig. 13-2 Typical Coal Columnar Section of Main Seam Comprising 14 Plies

Ply No.	Thick. (m)	
1	0.80	Dull clean coal, bright coal part 15 %
2	1.20	Dark gray - brown gray siltstone
3	0.90	Dull clean coal, bright coal part 20 %
4	0.40	Dark brown-gray carbonaceous mudstone
5	2.25	Dull clean coal, bright coal part 20 %
6	0.30	Dark brown gray carbonaceous mudstone
7	14.10	Dull clean coal, bright coal part 20 %
8	1.95	Waste ply including dull low-grade coal & Carbonaceous siltstone

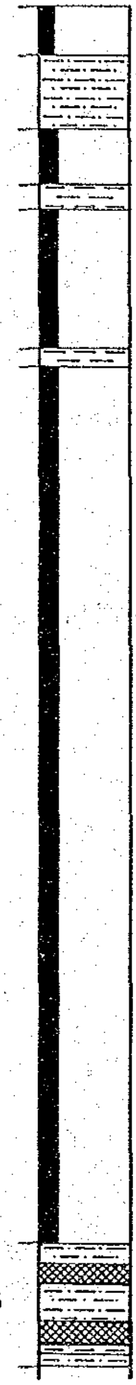
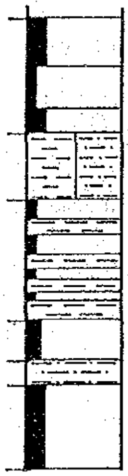


Fig. 13-3 Unong Pit Main Seam Sample Face A (Line #5) – 1



Ply No.	Thick. (m)	Description
9	1.80	Dull clean coal, bright coal part 20 % Dull low-grade coal, bright coal part 10 % Dull clean coal, bright coal part 20 %
10	1.05	Dark brown carbonaceous mudstone & siltstone
11	1.86	Waste coal, dull coal interbedded with dark carbonaceous mudstone, bright coal part 10 %
12	0.63	Dull clean coal, bright coal part 15 %
13	0.38	Dark gray siltstone
14	1.32	Dull clean coal, bright coal part 20 %

Fig. 13-3 Unong Pit Main Seam Sample Face A (Line #5) – 2

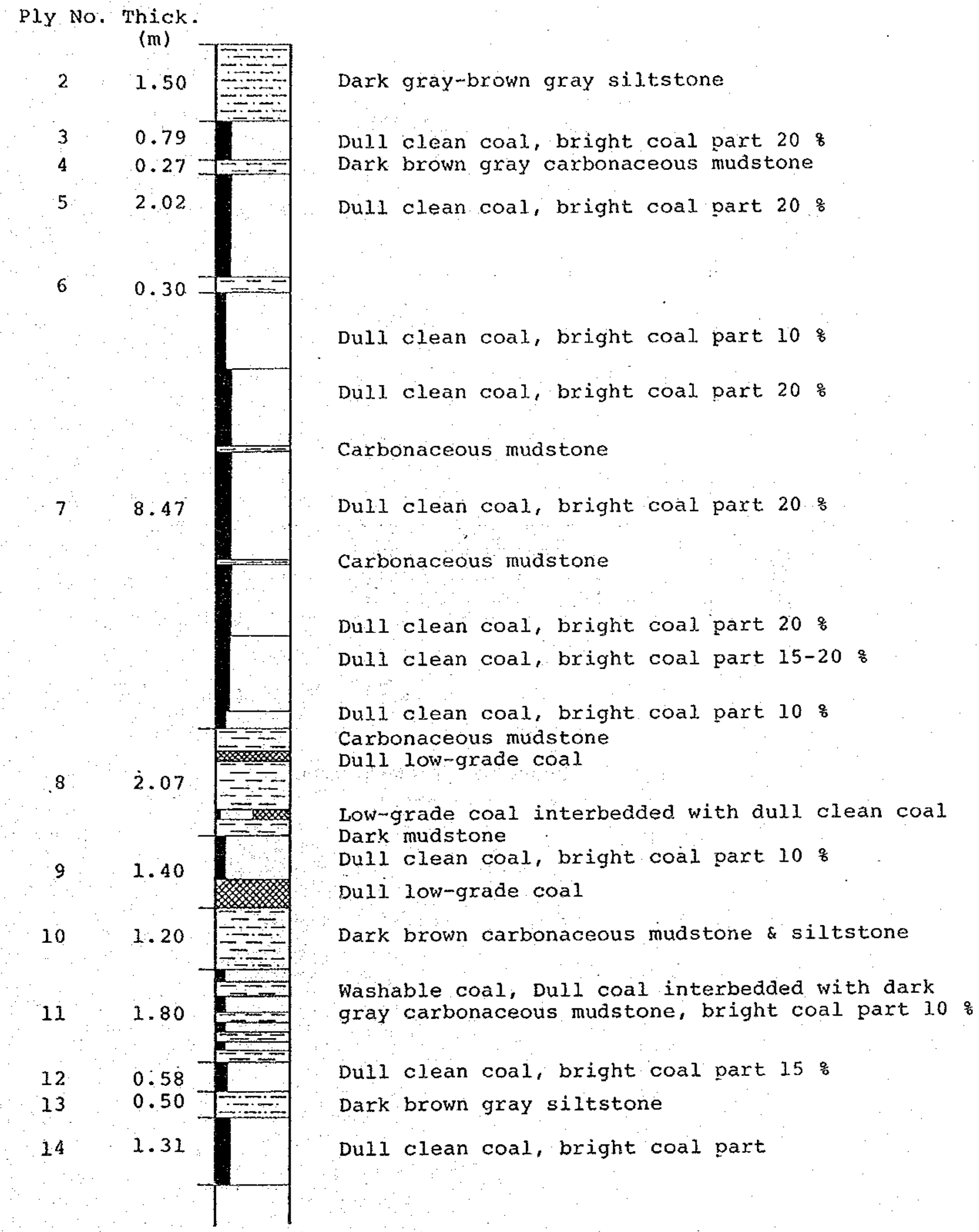
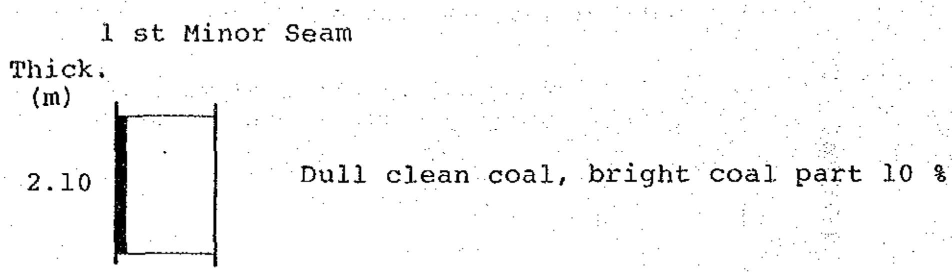


Fig. 13-4 Unong Pit Main Seam Sample Face B (Line #4)



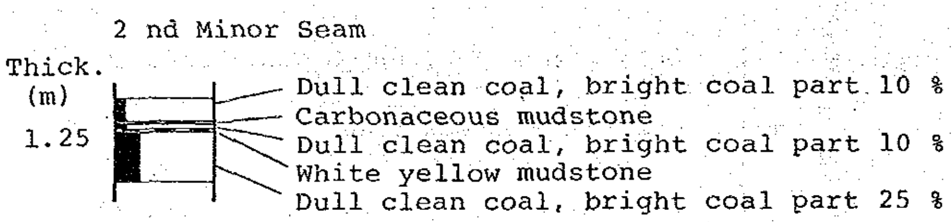


Fig. 13-5 Unong Pit Upper Main Seams

13-3 Coal Quality

It is estimated that 17,220,000 tons of proven and probable in-site reserves are sitting in the Unong pit excluding 3,400,000 tons of dirty coal which is expected to degrade the quality of saleable coal.

The average coal to be produced from the said reserves in the Unong pit is originally expected to have the quality listed in Table 13-1, when recovered by a whole seam extraction, so-called "run-of-mine".

Table 13-1 Expected "Run-of-Mine" Quality

Ash	16–19%
Fixed carbon	26–29%
Volatile matters	35–41%
Sulfur	1% max.
Total moisture	16–19%
Calorific value	8,000–9,000 Btu/lb
Hardgrove index	40–50

Note: (1) Figures are on an as-received basis.
(2) After Austromineral study

From July to October 1984, "run-of-mine" extraction was exclusively performed in the Unong pit. Quality of the "run-of-mine" coal delivered to NAPOCOR Calaca power plant is listed in Table 13-2.

Table 13-2 Actual "Run-of-Mine" Quality Delivered to Calaca

		Min.	Max.	Weighted Ave.
Ash	%	7.76	26.80	17.74
Fixed carbon	%	23.13	31.22	26.82
Volatile matter	%	26.29	32.57	29.50
Sulfur	%	0.44	0.70	0.58
Total moisture	%	21.70	30.87	25.96
Calorific value	Btu/lb	6,115	7,919	6,906
Hardgrove index		N/A	N/A	N/A

Note: (1) Figures are on an as-received basis.
(2) After NAPOCOR analysis data
(3) Shipment Nos. 001 to 029 (July–October 1987)

Fig. 13-6 indicates ash content, total moisture and calorific value variations by shipment graphically.

It is observed that the average ash content stays within the expected range but the total moisture content and calorific value are far out of the range. In addition, those figures show very high variations by shipment.

Details of the coal quality will be mentioned in the section of coal quality up-grading.

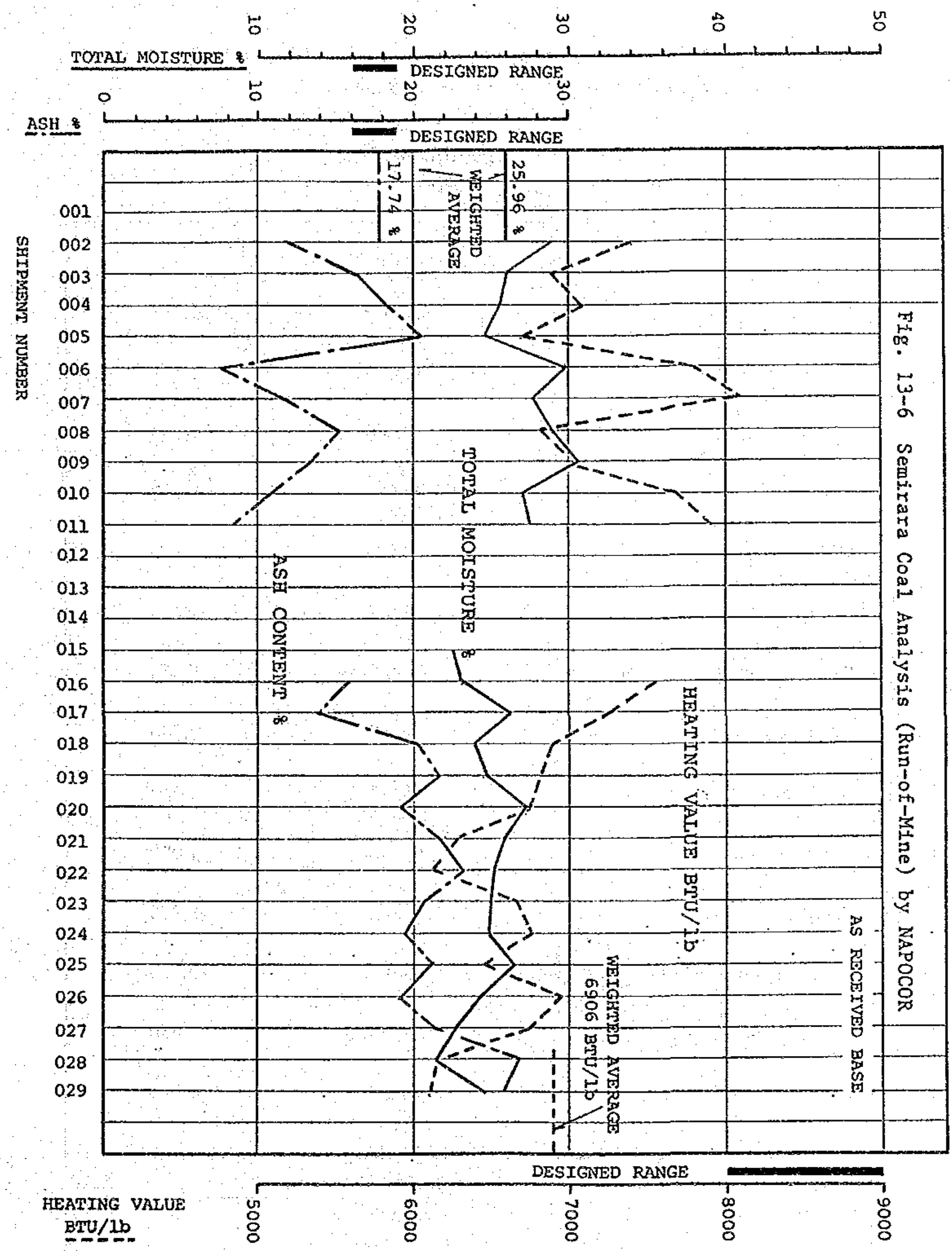


Fig. 13-6 Actual "Run-of-Mine" Quality Delivered to Calaca

13-4 Investment Cost

The total investment cost for the Semirara coal mine construction is summarized in Table 13-3, including the cost for the Unong pit development.

Table 13-3 Investment Cost (as of 1980)

Items	Pesos x 1,000	US$ x 1,000
1. Bucket wheel excavator	167,000	21,710
2. Belt conveyors	258,000	33,540
3. Auxiliary equipment	70,000	9,100
4. Stockpile	29,000	3,770
5. Shiploader	7,000	910
6. Workshop	55,000	7,150
7. Spares, assembling, training	71,000	9,230
8. Drainage	21,000	2,730
9. Buildings, civil eng., earthwork	65,000	8,450
10. Infrastructure	54,000	7,020
11. Captive power plant	141,000	18,330
12. Studies and management	83,000	10,790
13. Inter-island transport	5,000	650
14. Assembling (SCC's share)	18,000	2,340
Sub-Total	1,044,000	135,720
Contingency	59,000	7,670
Grand Total	1,103,000	143,390

Note: ₱1.0 = US$0.13

In addition to the 1,103 million pesos of toal investment cost, approximately 122 million pesos were required to obtain the Unong pit mining rights.

13-5 Mine Supporting Facilities

All facilities had to be constructed for this particular mining operations on the isolated island where exist only a few native communities.

The facilities extend from the pit operation system on the eastern side of the island to the coal stockpiling and shiploading facilities on the west coast including all indirect service facilities such as town site, commissary, clinic, airstrip and the like.

They are all laid out paying special attention not to sterilize the valuable coal resources, maintaining easier access to the future development of Himalian and Panian areas.

All design and construction have been done in consideration of future expansion for the probable mine production scale up.

Fig. 13-7 shows the infrastructure layout of the whole operation, which is divided into three areas, industrial area, town site and mine site.

In the industrial area, major supporting facilities such as shiploader, stacker and reclaimer, pilot coal preparation, captive power plant, service shop, laboratory, administration, office are situated. Filling station, storage building are also in this area.

The town site is located at the center of the island, approximately 3 km northeast of the industrial area and 6 km northwest of the Unong pit.

The location was carefully selected considering personnel transportation, water and power supply, and easier access to the operations.

At the town site, housings for the mine employee, hospital, church, commissary are situated as well as guest house and mess.

At the Unong pit, emergency diesel power station, maintenance shop, mine office are located besides the mining equipment such as bucket wheel excavators and conveyor system.

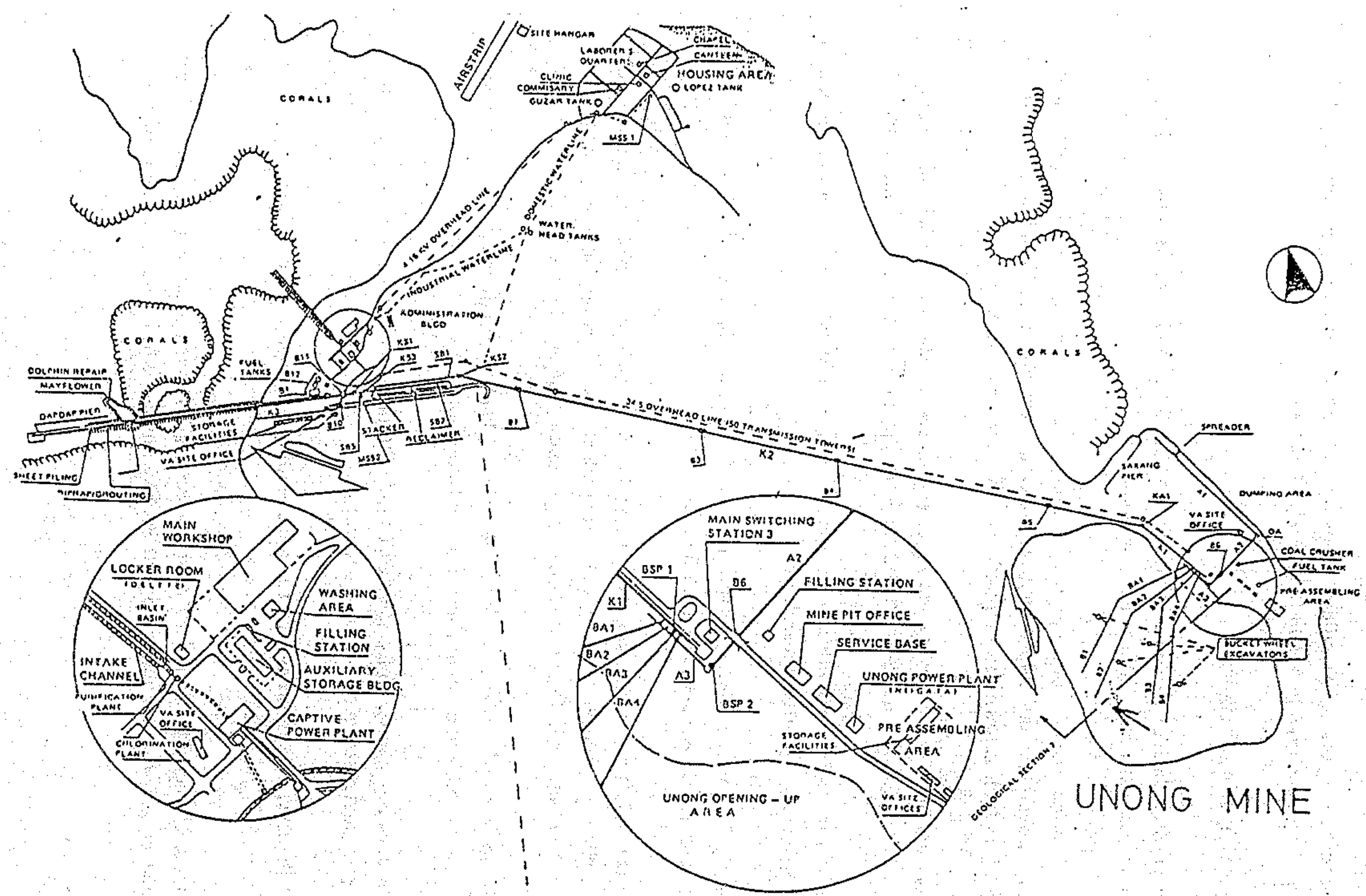


Fig. 13-7 General Layout of Unong Project

1) Shiploading Facilities

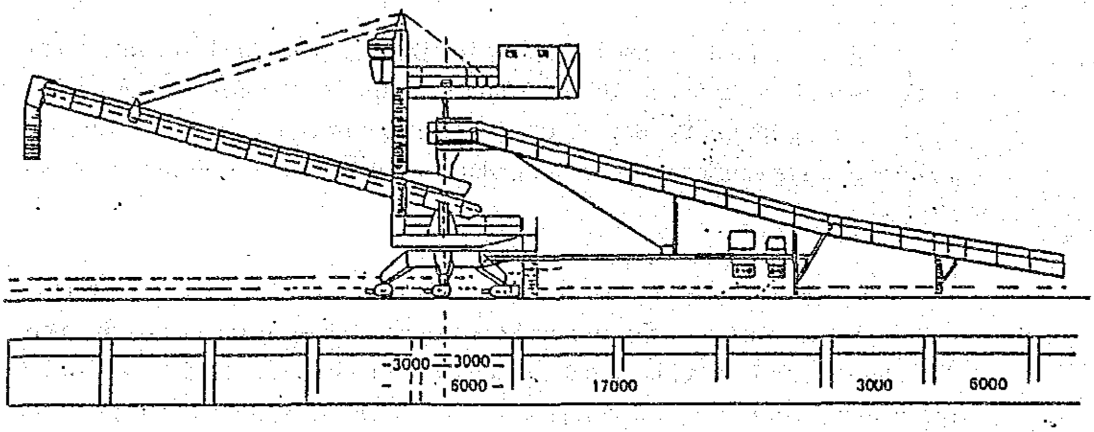
The shiploading facilities are located at the Dapdap pier which is constructed in the central western part of the island to minimize the effect of prevailing northeast monsoon in the dry season. The pier is constructed with 1.1 km long and 10 m wide causeway to accommodate vessels up to 20,000 tons of capacity.

The coal reclaimed at the stockpiling area is transported via the 2.5 km long belt conveyor system to the shiploader on the causeway at the end of the pier. The shiploading is done by the Trimmer with a belt speed of 15 m/sec. or by the loading chute with the integrated dust collection system which exhausts 1,800 m^3/hr of air quantity.

Table 13-4 shows specifications of the shiploader. Fig. 13-8 shows the dimensions and photo of the shiploader.

Table 13-4 Shiploader

Material Handled	Coal
Capacity	1,000 tons/hr.
Boom Length	20 m
Belt Width	1.2 m
Belt Speed	5.2 m/sec.
Belt Speed of Trimmer	15 m/sec.
Travelling Speed	8/32 m/min.
Service Weight	196 tons
Dust Collector Air Volume	1,800 m^3/hr.



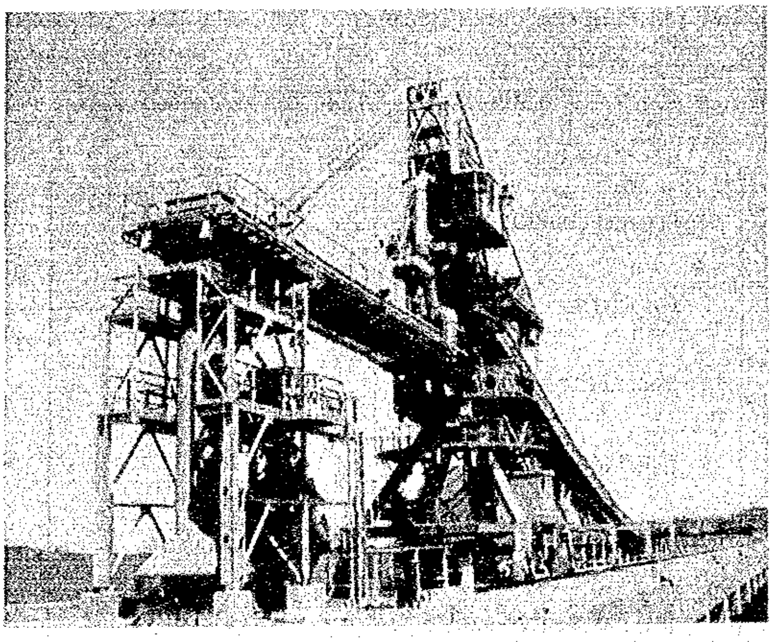


Fig. 13-8 Shiploader

2) Stockpile Area

The coal produced at the Unong pit is transported to the stockpile area where stacker and reclaimer are installed. The stockpiling area consists of two wings, one on each side of the belt conveyors for the system. The northern wing is exclusively used for so called washable coal and the southern wing is for saleable coal. Each wing has a capacity to accommodate about 130,000 tons of coal.

During the course of stacking and reclaiming product coal, considerable efforts are made in blending to attain as uniform coal quality as possible with the existing system.

The stacker and reclaimer are rail mounted type and the reclaimer can reach only to the southern wing of the stockpiling area. The specifications are listed in Table 13-5. The reclaimer can cover only southern wing of the stockpiling area. Fig. 13-8 shows the configuration of the system.

Table 13-5 Stacker and Reclaimer System

Coal Stacker:	
Material Handled	Coal
Stacking Capacity	3,060 tons/hr.
Boom Length	29.6 m
Belt Width	1.4 m
Belt Speed	5.2 m/sec.
Maximum Stacking Height	16 m
Working Speed/Travelling Speed	12 m/min.
Total Weight including Tripper carriage	250 tons
Recalimer:	
Material Handled	Coal
Reclaiming Capacity	1,000 tons/hr.
Bucket Wheel Diameter	6.3 m
Number of Buckets	8 ea.
Reclaimer Boom Length	22.8 m
Belt Width	1.2 m
Belt Speed	4.2 m/sec.
Working Speed	6.0 m/min.
Travelling Speed	12.0 m/min.
Total Installed Power	250 kW
Total Weight	177 tons

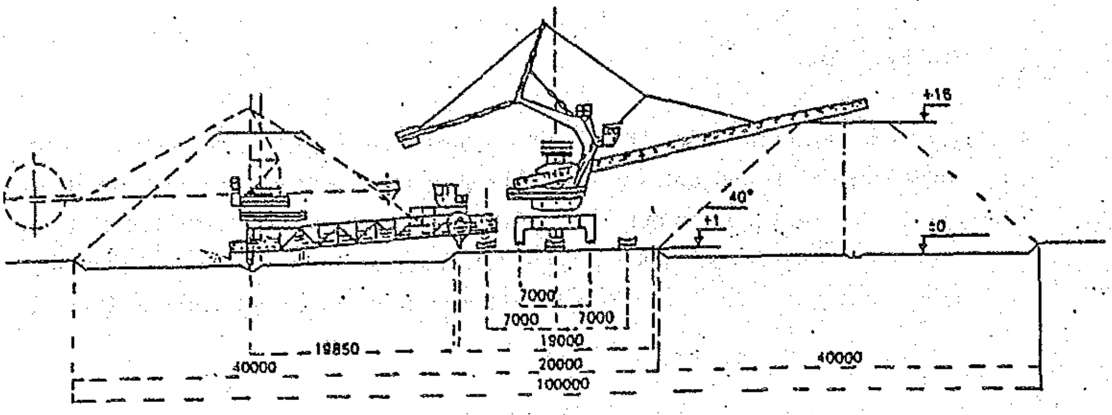


Fig. 13-9 Stacker and Reclaimer System

3) Coal Transportation System

The coal produced at the Unong pit is transported to the stockpile area by the overland coal belt conveyor system running across the center part of the island.

The system consists of two conveyor units, K1 and K2. K1 conveyor, which is about 510 m long, receives coal from either one of the four belt conveyor lines coming out the pit and reports to K2 conveyor.

K2 conveyor is about 4,100 m long and runs to the stockpiling area.

There is a single roll crusher installed at the transfer tower between K1 and K2 conveyors. It is by-passed in the regular operation but is ready to operate anytime upon the requirement.

Table 13-6 shows specifications of the conveyor system.

Table 13-6 Overland Coal Conveyor

		K1	K2
Belt Width	(mm)	1,000	1,000
Length, Center to Center	(m)	508	4,069
Capacity	(tons/hr.)	1,020	1,020
Belt Speed	(m/s)	4.2	4.2
Drive Capacity	(kW)	1 x 225	3 x 280
Belting Type	(N/mm)	St 630	St 1,250

4) Captive Power Plant

All required electric power for the mining opeations is being supplied by the captive power plant at the industrial area near the stockpiling area.

The mining operations comprise the whole activity on the island relating to the coal operation such as pit mining operation, coal transportation system, stockpiling and reclaiming, pilot coal washing plant, shiploading, service shops, laboratory, administration office as well as clinic, commissary, mess, residential quarter and the like.

The power plant, consisting of two units with a capacity of 7.5 MW per unit, is designed to minimize the effect of system failure. The aggregate capacity of 15 MW (7.5 MW x 2 units) is aimed at supporting the whole Unong pit related operations as well as the initial mining operations at Panian area.

The plant is laid out considering the future installation of two additional units depending upon the expansion of the mining operation. Fig. 13-10 shows the layout of the plant.

Moreover, the plant is designed with stocker-type boilers in order to use locally-produced coal form Unong pit. In practice, low grade coal, such as washed coal and rejected coal by NAPOCOR is being used for fuel after blending at appropriate ratio for the purpose of saving valuable salable coal.

The yearly coal consumption vaires depending upon the heating value but it ranges approximately from 25,000 to 38,000 tons. For example, the heating value of washed coal ranges from 5,400 to 7,700 Btu/lb and approximately 8,200 Btu/lb for the coal rejected by NAPOCOR. The average heating value of the coal fed into the boilers is in the range of 6,200 to 7,000 Btu/lb.

In the case that the plant is unable to generate sufficient output due to abnormally low grade fuel coal with low heating value or due to higher moisture content in the fuel coal which is more likely to occur particularly in rainy season, waste engine oil and hydraulic oil of heavy mining equipment are used as emergency booster fuel after being clarified by centrifuges.

At present, the average output of the plant is estimated at about 40% and the maximum output is 70% indicating an extra capacity of 30%. However, 100% output can be obtained if the heating value of fuel coal reaches at 8,500 Btu/lb, otherwise, additional units must be installed.

Maintenance of the plant is being conducted on weekends. Generating units are being stopped one at a time when the bucket wheel excavators do not operate.

Besides the captive power plant, there is an emergency power supply system at the Unong pit area. The emergency power station is equipped with two units of diesel-powered generator each of 1.5 MW capacity to secure the mining operations by running the minimum required vital system such as pit dewatering facilities, belt conveyors and the like.

Fig. 13-11 shows the power distribution diagram from the captive power plant and the emergency power station.

The electricity generated at the captive power plant is transmitted at 4,160 V and the voltage is reduced to 440 and/or 220 V depending upon the requirements being sent to the town site, administration building, main workshops, etc.

The original 4,160 V electricity is boosted up to 34,500 V at the substation where the two units of transformers are installed and transmitted to the main switch station at the Unong pit area, through the high voltage power line transversing the center part of the island, from west to east. Before distributing to the bucket wheel excavators, the voltage is reduced to 4,160 V at the main switching station. To the other facilities, it is reduced further to 440/220 depending upon the requirement.

Considering the very scarce fresh water on the island, the captive power plant is designed to use sea water in its main cooling system which requires 3,000 m^3 of water per hour. In such case, fresh water consumption is curbed at 100 m^3 per hour.

A water-softening system is employed to treat the fresh water thereby meeting the acceptable standard of the boiler before feeding.

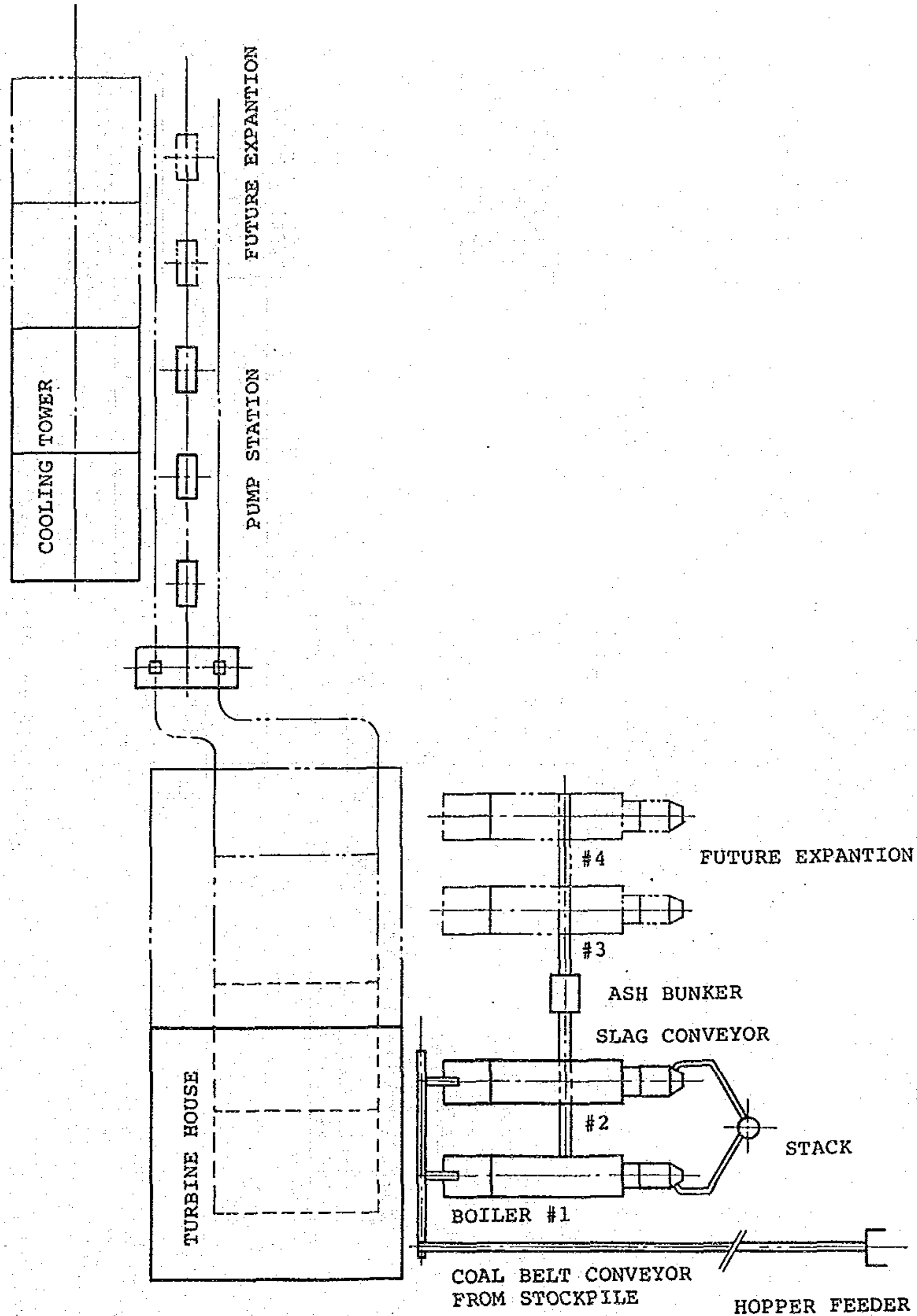


Fig. 13-10 Captive Power Plant Floor Plan

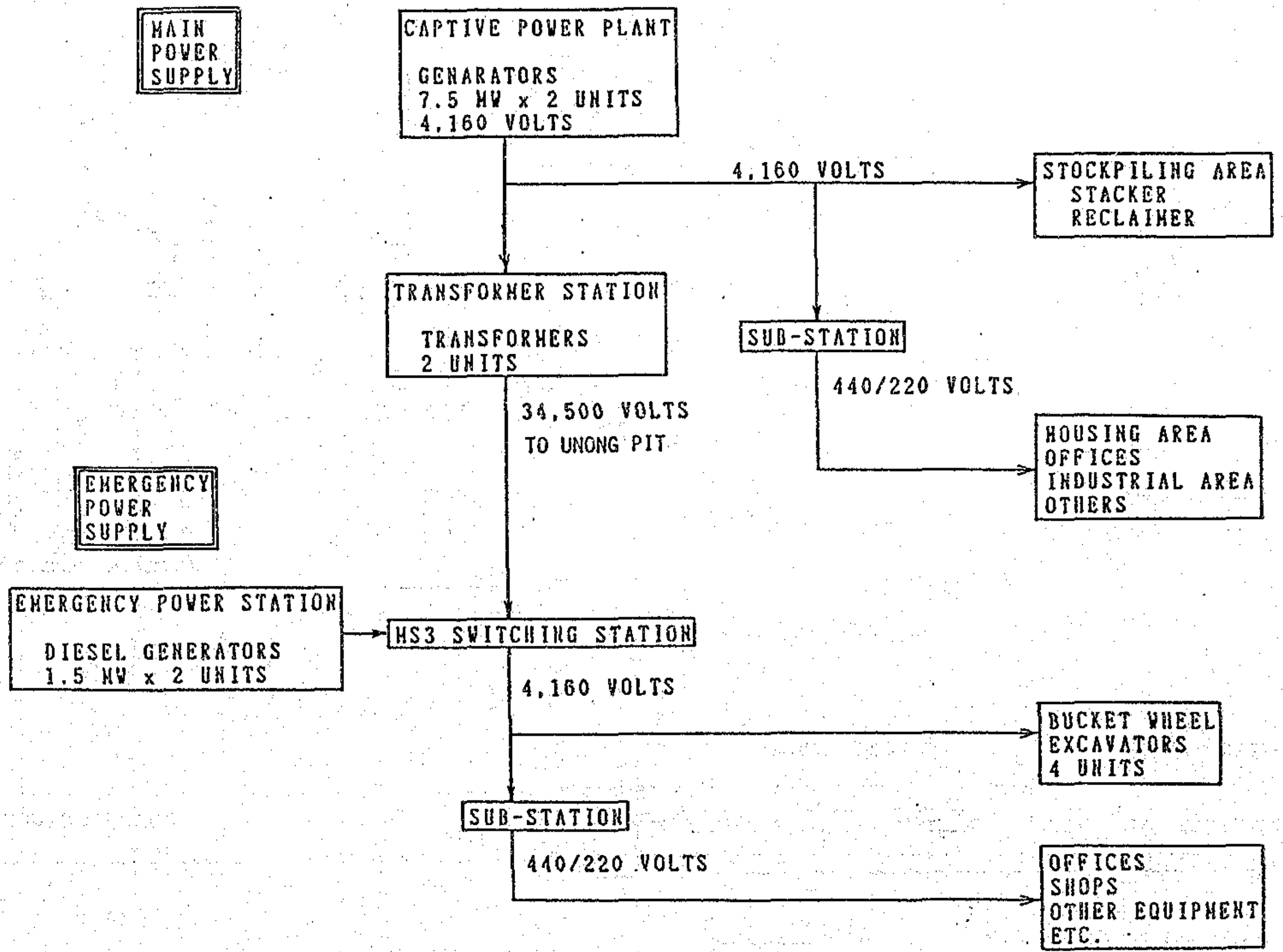


Fig. 13-11 Unong Mine Power Supply System Diagram

5) Water Supply System

The water resource on the Semirara island is extremely limited, especially during dry season, form the end of October to the end of March. In this critical period, the water supply is stopped at night time, from 9:00 p.m. to 4:00 a.m., in order to increase the water level in the water supply tanks.

As shown in Fig. 13-12 and Table 13-7, there are two water sources available at present, which are natural springs and deep wells.

The water supplied to the town site where most of employees reside and to the industrial area is obtained from Bunlao and the Binaroto natural springs and the HI-35B deep well with very small quantity. Among those, the Bunlao natural spring is the main water source, providing about 70% of 2,333 m^3 per day which is an aggregate water volume from those water sources. The Binaroto natural spring provides 18% and the rest is from the HI-35B deep well.

Water from those sources are pumped to the two water tanks with a capacity of 300 cubic meter each located on the hill between the town site and the industrial area through the Bunlao pumping facilities and the pipeline which distance is about 4.6 km.

From the water tanks, water is supplied by a gravity directly to the industrial area, the Quzar tank and the Lopez tank which are the water supply sources for the town site. The Quzar tank is the main tank while the Lopez tank is a supplement.

At the Unong pit area, water is obtained from J-23B, DW-91, DW-78 deep wells drilled at the perimeter of the mining pit. The aggregate water volume of the deep wells is approximately 961 m^3 per day which is considerably smaller than that of the town and industrial area.

The water from the Bunlao, the Binaroto natural springs and the HI-35B is all hard water with very high mineral content and is not suitable for drinking. The water at the Unong pit area is so-called "break water" containing some sea water and is therefore absolutely not drinkable. It is only used for miscellaneous purposes such as house cleaning, washing and the like.

The highest water demand is 680 m^3 per day for the town site, followed by 478 m^3 per day for the industrial area, 442 m^3 per day for the captive power

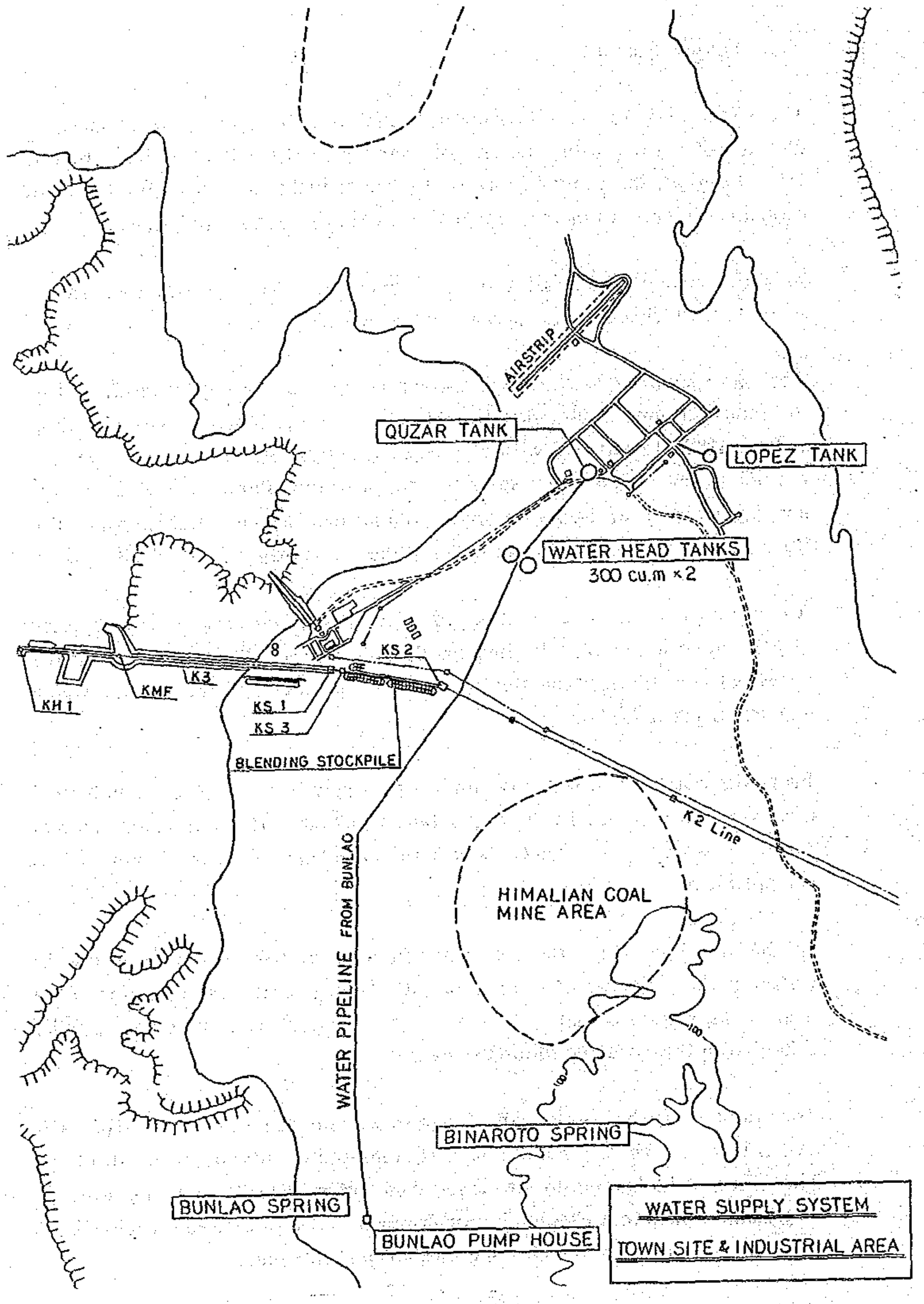


Fig. 13-12 Water Sources

Table 13-7 Semirara Island Unong Mine Fresh Water Supply and Deamnd

1. Water Distribution

Sources		Supply cu.m/day (%)	Demand cu.m/day
Town and Office Area			
Bunlao	(Natural Spring)	1,728 (74)	2,110
Brinaroto	(Natural Spring)	423 (18)	–
HI-35B	(Well)	173 (8)	–
Sub-Total		2,333 (100)	2,110
Mine Site			
J-23B		346	511
DW-91		504	
DW-78		110	
Sub-Total		961	511
Grand-Total		3,293	2,621

2. Water Demand

Endorser	cu.m/day	%
Industrial Area	478	26
Power Plant	442	24
Town	680	37
Washing Plant	212	12
Fire Hydrant	20	1

Note: DM 15 is under drilling at Himalian Area.
Approx. 43 USGPM is expected.

plant and 212 m^3 per day for the pilot coal washing plant.

In addition, 20 m^3 per day is estimated for fire hydrants. It must always be kept in the tanks as it is only used for emergency purposes.

The scarcity of the water supply is well-apprehended by all concerned people and water conservation has been strictly observed.

Especially at the captive power plant which uses large amount of cooling water, use of sea water for the main cooling system and use of fresh water only for the part "sweet cooling", which can not accept sea water are required. At present, a pumping system is being studied to recover used water for "sweet cooling". It is expected that approximately 100 m^3 of water will be recovered per day through the pumping system. The recovered water will be supplied to the pilot coal washing plant for make-up water.

In spite of those efforts for water conservation, the water supply from the current water sources is very marginal to fulfill the yearly demands consequently, the water consumption must be cut back considerably during the dry season.

Exploratory drillings have been extensively conducted in search of other water sources. The currently proceeding DM-15 drilling at Himalian area is expected to provide approximately 235 m^3 (43 USGPM) of fresh water per day.

6) Main Workshop

The main workshop is located in the industrial area to provide all required maintenance and repair work for the whole mining operations on the island including pit operation, coal handling system, captive power plant, housing and all others.

The capacity of the shop is currently almost marginal to support the Unong pit operation, but it is designed to be capable to handle two open pit operations at the same time with provision of additional manpower and equipment.

The main workshop comes under the control of the technical service department which consists of six divisions, Mobile Mechanical Division, Mine Mechanical Division, Mechanical Shop, Electrical Division, Civil Work Division and Captive Power Plant. The floor space is allocated to each division depending on its function, except the captive power plant. Each division has self-sufficient equipment to achieve assigned function.

In the mechanical shop, various machining tools are installed.

13-6 Maintenance Service System and Facilities

The Technical Service Department is responsible for all aspects of maintenance services on the island including pit equipment, coal handling system, shiploading, housing area and so on.

The department consists of Mobile Mechanical Division, Mine Mechanical Division, Mechanical Shop, Electrical Division and Civil Work Division. The captive power plant also comes under the control of this department.

The functions of each division are as follows:

Division	Function
Mobile Mechanical	Maintenance of conventional mining equipment such as shovels, dozers, dump trucks and service vehicles.
Mine Mechanical	Maintenance of continuous mining equipment such as bucket wheel excavators (BWE), belt conveyors, stockpiling facilities, shiploading facilities and all other mechanical systems.
Mechanical Shop	Machining, welding, belting repair, etc.
Electrical	Maintenance of all electrical facilities.
Civil Work	Maintenance of housing, building, water supply system, sewage system, etc.
Captive Power Plant	Whole power plant operation and management.

1) Mine Mechanical Division

The mine mechanical division has an office for the manager and the engineering staff in the main work shop and is responsible for maintenance and management of the bucket wheel excavators which are the main production equipment at the Unong pit, belt conveyor systems as well as the stacker and reclaimer system at the stockpiling area, shiploading facilities and the other mechanical facilities.

The division covers such a wide area extending from the mining pit to the shiploading facilities for 24 hours per day on 3 shift with an aggregate number of 104 workers. Particularly, the maintenance of the bucket wheel excavator occupies the majority part of this division's work.

The bucket wheel excavators are operated for 24 hours per day on 3 shifts. The actual time that the bucket wheel excavators are cutting coal or waste material averages about 15 hours per day and the remaining 9 hours, so-called operational delay, is broken down into the following categories:

Delay	Content	1986 Actual (hours/day)
(1) Maintenance		
Mechanical	Maintenance and repair of mechanical system	3.3
Electrical	Maintenance and repair of electrical system	1.0
(2) Operation	BWE move, belt conveyor switching, face inspection, weather delay, shift change, etc.	2.6
(3) Planned	Belt conveyor transfer, extension, shortening, planned operation shutdown, equipment transfer, etc.	2.2
(4) Power failure and control system	Power failure, control system failure	0.1
Total		9.2

A key to improve the productivity of the bucket wheel excavators is reducing those delay time in order to maximize the actual cutting time. The mine mechanical division has been striving to minimize the maintenance delay.

The major failures of the bucket wheel excavators are in hydraulic hoses and fittings, oil pumps, and other general mechanical systems, rollers of the crawler system and the like. The oil pumps are replaced every 5,000 operating hours based on the past experiences. Teeth of the buckets are consuming parts with only 80 hours average life, costing ₱500 each. The engineering staff and the mechanical service shop has been doing combined efforts to save the operating costs, for example, by reclaiming one tooth out of two worn out teeth.

Maintenance cost spent by the mine mechanical division in 1986 amount to approximately ₱22,000,000 including all equipments from the mining pit to the shiploading area.

2) Mobile Mechanical Division

As shown in Fig. 13-13, the Mobile Mechanical Division comprises five sections managing the heavy equipment being used for conventional mining, such as shovels, dozers, trucks as well as service vehicles and general equipment, such as forklifts, mobile cranes.

Table 13-8 shows major equipments for the conventional mining. Besides those major equipments, there are 58 units of heavy equipments for general purposes and 50 units of light service vehicles being maintained by this Division.

The office and the main work shop are situated at the industrial area and the pit service shop is at the Unong pit area.

In the main work shop, component repair and rebuilding, daily repair and service of the light vehicles are being performed according to the maintenance schedule designed by the maintenance planning section.

The maintenance planning section is situated in the office at the main work shop and is responsible for all maintenance planning, service schedule, parts procurement and control, cost management and the like.

The pit service shop comprises two sections, namely preventive maintenance section and general repair section, both of which are operated on three shifts

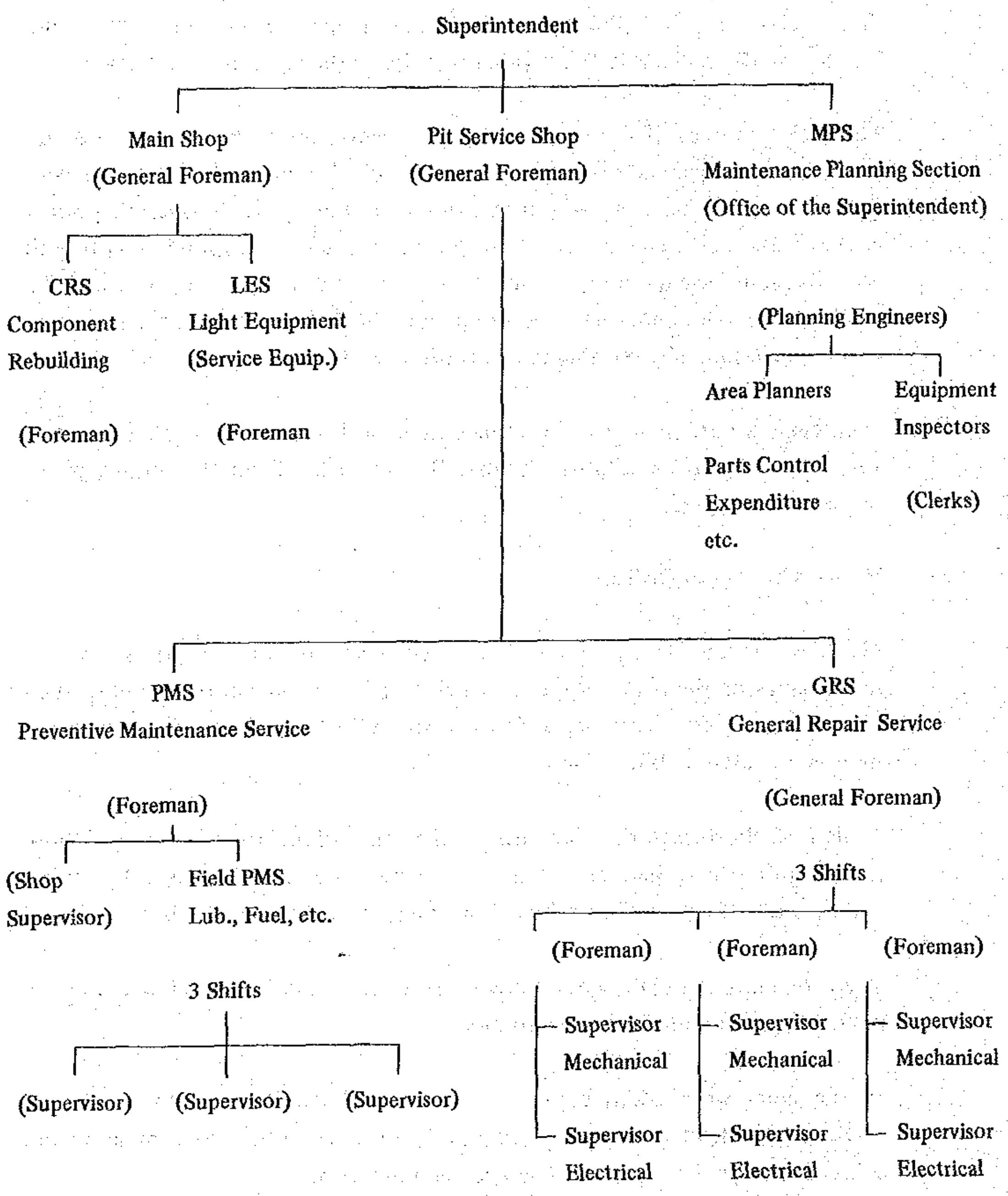


Fig. 13-13 Mobile Mechanical Division

Table 13-8 1986 Major Equipment Performance (Mobile Equipment)

87–03–16

Equipment		Type	Capacity	No. of Unit	1986 Availability %	
					Actual	Target
PS	Power Shovel	CAT 245 CAT 235 (Backhoe)	3.75 cu. yd. 2.75 cu. yd.	2 1 3	70	72
TL	Track Loader	CAT 277L (Track Loader)	4.0 cu. yd.	2	64	68
WL	Wheel Loader	CAT 950 CAT 980 C	3.5 cu. yd. 5.75 cu. yd.	2 1 3	78	75
DT	Dump Truck	CAT 769 B D5B, D350B	35 tons 35 tons	2 6 8	79	74
PDT	Dump Truck	Peter Bilt Mucks	25 tons	3	76	75
WD	Wheel Dozer	CAT 524 C	6.11 cu. yd.	1	66	75
CT	Crawer Tractor	CAT D76 CAT D8K CAT D8L	250 HP 335 HP	3 3 2 8	67	75
PL	Pipe Layer	CAT 583 K	140,000 lbs Lift at 4' overhang	2	91	75
	Trailer		60 tons	1	94	75

providing necessary services to all equipments. The preventive maintenance section provides every equipment with necessary check and services specified depending on the operating hours.

The aggregate number of workers of the mobile mechanical division is 98 and 30% of which belongs to the main work shop.

As shown in Table 13-8, physical availability of the dump trucks is 75–80% and 60–70% for the hydraulic shovels.

3) Mechanical Service Shop

The mechanical service shop occupies a portion of the main service shop being equipped with various machining tools. The main functions of this shop are machining, welding and belting repairs by receiving orders from the other areas of the whole mining operations.

There are 68 personnel in this shop including staff, machinists, office clerk, etc., being assisted by 20 to 30 additional contractual workers to cope with increasing volume of repair work, especially in welding.

Table 13-9 shows a list of machining tools in the shop.

Table 13-9 Mechanical Machining Services Division

List of Machine Tools

Machine Tools	No. of Unit
Lathe	4
Hi-Speed Shaper	1
Bench Boring Machine	1
Horizontal Boring Mill	1
Vertical Slotting Machine	1
Power Hex Saw	1
Radial Boring Machine	1
Metal Band Saw	1
Threading Machine	1
Gliding Machine	1
Pedestal Grinder	4
Dist Grinder	4
Straightening Press	1
Column Boring	1
Bench Boring	1
Chamber Furnace	1
Shearing Machine	1
Hydraulic Press	1
Universal Steel Marker & Punch	1
Horizontal Grinder	1
Three Roll Grader	1
Universal Milling Machine	1
Welder	12
Center Lathe	1
Shaper	1
Sydney Lathe	1
Column Boring Machine	1
Total	47

14. Mining System

14-1 Outline

14-2 Bucket Wheel Excavator System

14-3 Transportation System

14-4 Selective Mining

14-5 Pit Operation in Wet Season

14-6 Equipment Fleet

14-7 Operating Days

14-8 Manpower

14. Mining System

14-1 Outline

In the feasibility study prepared by Austromineral G.m.b.H., June 1980, several mining methods have been studied to decide the optimum method to achieve 1 million tons of production target with a whole seam recovery, so-called "run-of-mine". The mine is obliged to supply fuel coal to the Calaca power plant in accordance with the contracted specifications.

The pit design had to be done considering many negative factors and peculiarity of the reserve conditions, which are:

1) 3,000 mm of annual precipitation and more than 2,000 mm converges in the 4 to 5 month wet season from June to October.

2) Water soluble soft clayey sandstones and siltstones with less than 1 KN/cm^2 compressive strength.

3) 95% of the pit reserve occurs below sea level down to -150 m which is the ultimate pit bottom.

4) Relatively small pit area of 1.6 sq.km.

5) Immediate proximity of the pit to the ocean, especially on the southeastern side of the pit, with potential sea water communication and aggressive groundwater incursion.

Surface mining system is classified into continuous and conventional or discontinuous systems. The conventional systems are represented mainly by a truck and shovel system which commonly applied to virtually any type of ground conditions except where ground bearing pressure is prohibitive to the operation of the vehicles. On the other hand, continuous systems represented by bucket wheel excavators and belt conveyor transportation system are generally limited in the area where ground is soft and easy for digging with no blasting, since the belt conveyor system is vulnerable for handling blasted materials unless it is adequately crushed before loading.

Considering the characteristics of the overburden materials which hinders an efficient operations of tire vehicles especially during the wet season, continuous bucket wheel excavator system is extensively employed.

Its relatively lower peak power demand is also considered to be advantageous where power is supplied by a captive power plant.

During the phase of pit development, the opening-up cut was proceeded in parallel to the outcrop of the main seam to secure coal production. In the opening-up, conventional truck and shovel system was extensively employed. After the completion of mining benches, four bucket wheel excavators were introduced and regular mining operation was commenced.

The pit has been developed by advancing the bucket wheel excavators and the shiftable conveyor systems parallel and/or rotating depending upon the mining conditions.

As of March 1987, there were four main haulage levels, -4 m, -21 m, -36 m, -62 m, on which shiftable conveyors were installed, conveyor line #2, #3, #4, #5 respectively in descending order. The conveyor line #3 was in the process of shifting down and BWE was engaged in the excavation work to lower the fixed conveyor #3. No operational crew were allocated to the BWE on #2 conveyor line.

A water sump with adequate pumping system is prepared at the end of each conveyor line as well as at the bottom of the pit to maintain decent dewatering in the pit. The sumps and pumping systems are designed to cope with maximum rainfall of 110 mm per hour including 50% safety factor over the maximum record of 76 mm per hour in the past, at the same time 315 mm precipitation is considered in 24 hours duration. Besides the surface water dewatering system, large number of deep wells are provided along the perimeter of the pit to alleviate the incursion of sea water as well as ground water. Sea water influx is expected to be reduced by filling-in the coast line toward the off-shore with waste material from the pit operation.

Conventional mining equipments which were extensively used at the stage of pit opening-up are currently used for sump constructions, pit slope finishing and mining excavation of the small area where efficient bucket wheel excavator operations are not expected.

14-2 Bucket Wheel Excavator System

In order to meet the requirements of the Unong pit operation, newly designed and developed bucket wheel excavators were introduced.

The units are Vesto-Alpine, SR400 type with following features:

1. 15 m of maximum excavation height above subgrade.

2. Long discharge boom.
3. Good buckling ability of the discharge boom.
4. Small folding angle, an angle between bucket wheel boom and discharger is approximately 30°.

The units are able to excavate 32 m high bench in three levels, 8 m trail cut, 9 m normal cut and 15 m berm cut, from one position of the shiftable face conveyor without using belt wagons which are usually required with standard design bucket wheel excavators.

Having dispensed with the belt wagon, investment cost can be reduced, as well as operating cost.

Fig. 14-1 and 14-2 show typical arrangement of SR-400 type bucket wheel excavator at mining face and overall dimensions of the unit. Specifications are summarized in Table 14-1.

There are four bucket wheel excavators allocated in the Unong pit, one on each mining bench where shiftable face conveyor is installed. In general, the ultimate bench height is 31 m which is excavated in three levels, 7 m trail cut, 9 m normal cut and 15 m berm cut. In the trail cut, BWE is capable to cut maximum 8 m, however, only 7 m is cut in normal operation keeping 1 m of allowance to accommodate undulation of the bench floor. Some benches have not been developed to 31 m yet but will reach to the ultimate height as mining face advancement. It has been discussed among operational people that the berm cut height should be reduced by 1 to 2 m for safety of the bench as well as protection of the bucket wheel boom.

The standard block width of the bucket wheel excavator is 26 m. The excavated material is discharged into a hopper car which travels over the shiftable belt conveyor following the movement of the bucket wheel excavator. The material loaded on to the shiftable face conveyor reports to the fixed conveyor which runs out of the pit.

Each bucket wheel excavator has their own independent shiftable and fixed conveyors which go up to the transfer station located at the northeast of the pit brim. At the transfer station, coal is discharged onto the overland conveyor and waste is onto the conveyor going to the spreader at the dump site.

After the completion of the bench extraction from one position of the shiftable face conveyor, it will be shifted ahead pivoting clockwise on the discharge end of the unit, then bucket wheel excavator intiates another round of excavation. When the mining bench has advanced adequately, the extension of the fixed conveyor is done. In some occasions, the

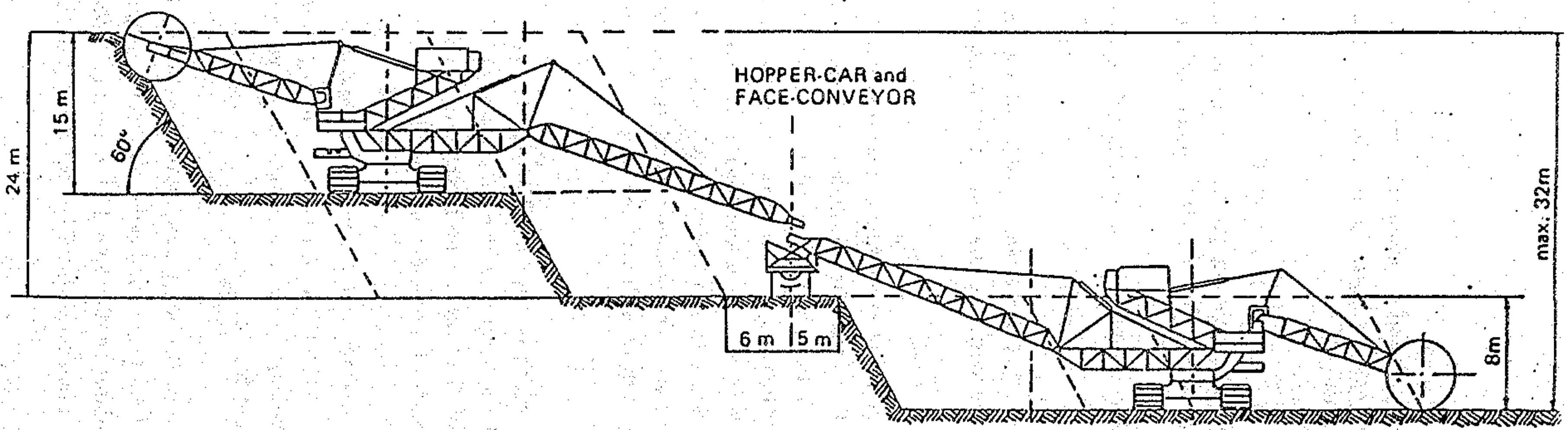


Fig. 14-1 Working Position of Bucket Wheel Excavator SR400

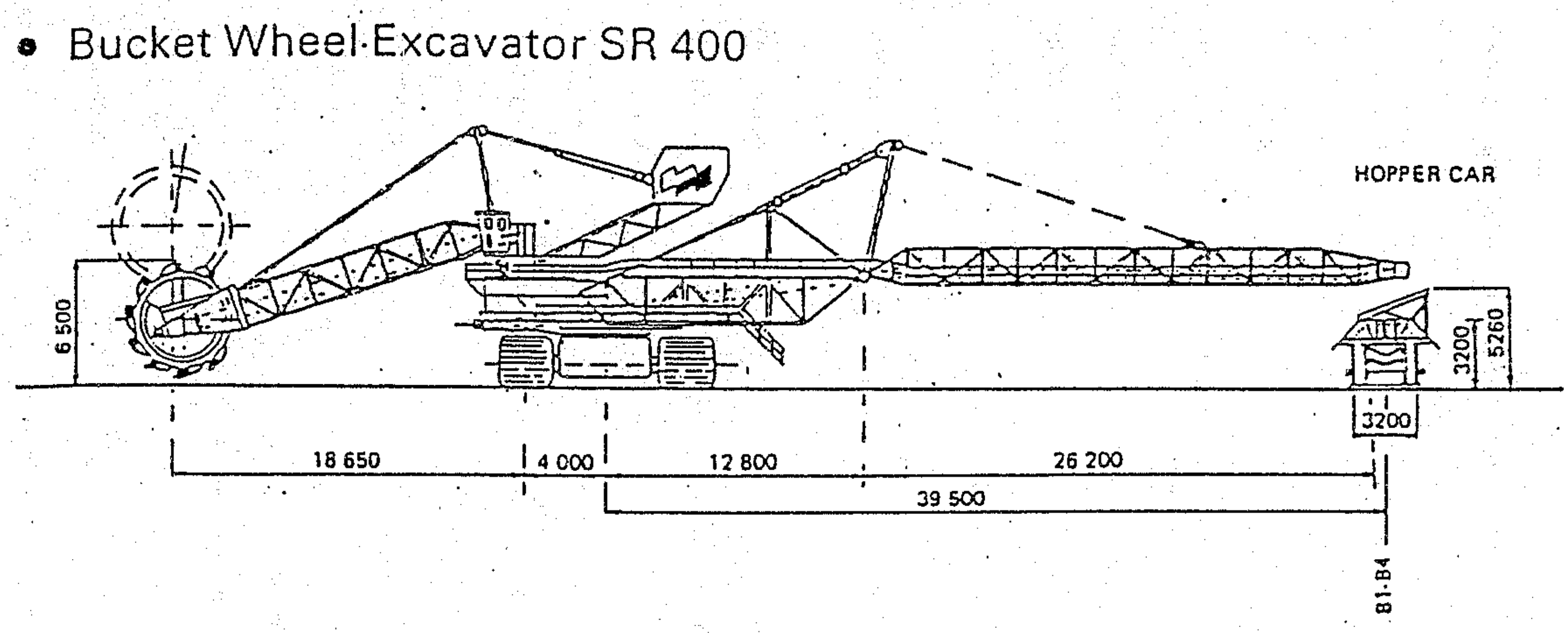


Fig. 14-2 Bucket Wheel Excavator SR400

Table 14-1 Specifications of SR400 Type BWE

Diameter of bucket wheel	6.5 m
Number of buckets	10
Bucket capacity	400 l
Theoretical output at 75 discharges/min. and 100% bucket filling	1,800 m^3 (LCM)/h
Effective output	17,000–20,000 m^3 (solid)/d
Guaranteed output	1,040 BCM/h
Circumferential force	120–180 kN
Slewability of bucket wheel boom	150°
Bucket discharges	75 bucket/min.
Length of bucket wheel boom	18.3 m
Length of discharge boom	39.0 m
Digging height	15 m/–0.5 m
High cut	9 m
Trial cut	8 m
Total installed power	1,020 kW
Power of bucket wheel	360 kW
Belt width	1.2 m
Belt speed	4.2 m/sec.
Travelling speed	6 m/min.
Max. gradient of working level	1 : 20
Service weight	450 t
Ground pressure	8.2 N/cm^2

fixed conveyor is totally lowered after excavating the base ground on which the unit is installed. The shifting of the face conveyor takes about 5 to 6 days depending on the seasons. The pit excavation is proceeded with cycling the above mentioned activities until the end of the fixed conveyor reaches at the final position and elevation in the pit, then the shiftable face conveyor will be pivoted clockwise as mining proceeds possibly 180° until it reaches the pit limit.

Amongst four bucket wheel excavators, three units are in operation and one is a stand-by or under maintenance, however, all four could be operated upon the requirement. Since early 1987, SCC has been concentrating to enhance the mine production by operating all four units, however the coal extraction is strictly controlled to operate only one unit at one time due to the limited overland coal conveyor capacity.

The spreader, located at the end of the waste conveyors, is mounted on the crawler track assembly and discharges waste material directly into the ocean.

Table 14-2 shows specifications of the spreader. The overall dimensions are indicated in Fig. 14-3.

Table 14-2 Specifications of Spreader

Material conveyed	Overburden
Theoretical conveying capacity	5,400 m^3/hr.
Bulk weight	1.8 tons/m^3
Conveying capacity	9,700 tons/hr.
Belt width	1,600 mm
Belt speed	5.5 m/sec.
Service weight incl. tripper car	125 tons
Travelling speed	7 m/min.
Total installed power	520 kW

- Spreader

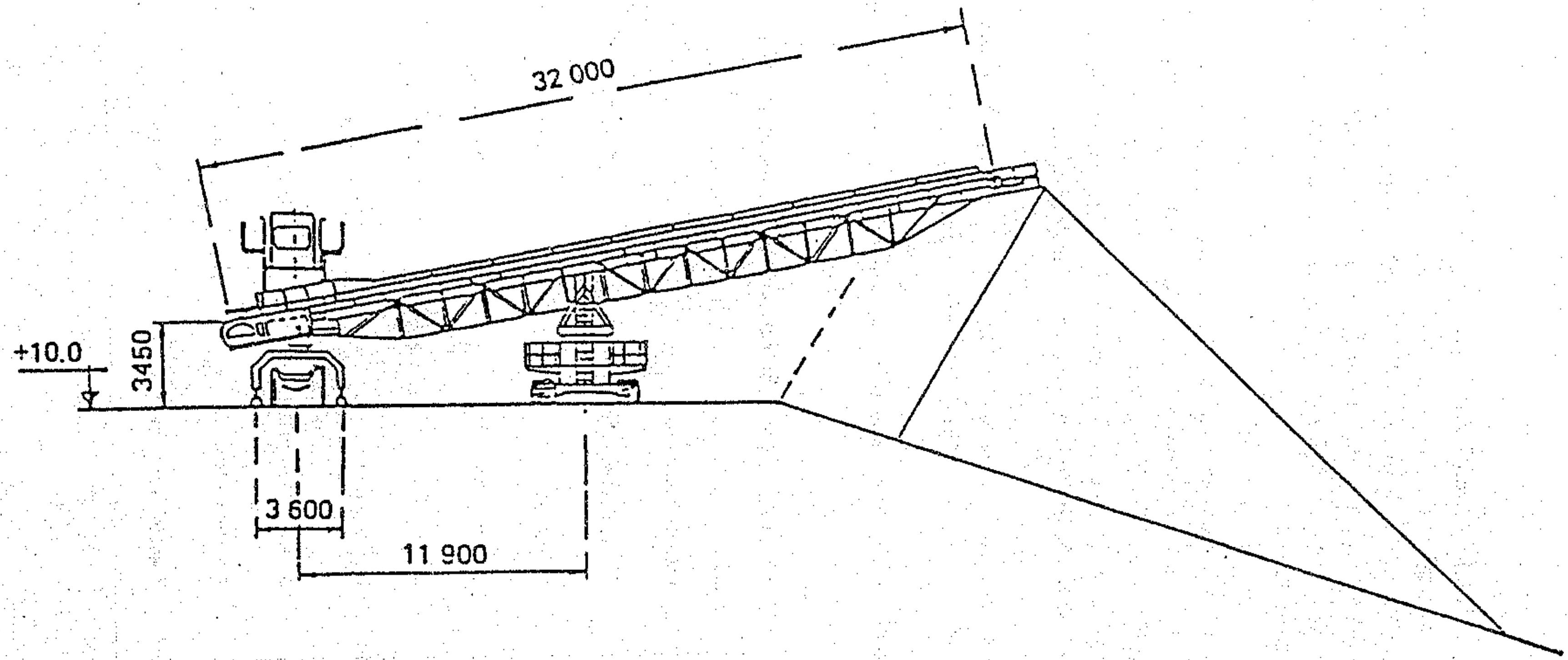


Fig. 14-3 Spreader

14-3 Transportation System

Belt conveyor systems are exclusively employed in this mining operation from the pit to coal stockpile area and waste dump site.

The aggregate length of the installed belt conveyor systems reaches as long as 15 km including the 4,069 m long K2 overland coal conveyor which is the longest single unit reporting to the coal stockpile area across the island.

The installation of those conveyor systems are inspected regularly to maintain the capacity as close as to the maximum.

Table 14-3 shows specifications of the belt conveyor systems on the island.

Table 14-3 Belt Conveyor System

Conveyor Unit	Belt Width (mm)	Length, Center to Center, Max. (m)	Capacity (theor) (tons/hr.)	Over-burden =W Coal=C	Belt Speed (m/s)	Drive Capacity Installed (kW)	Blet Type (N/mm)	Remarks
In pit								
B1	1,200	623	3,600	C+W	4.2	2 x 250	St. 1,000	Shiftable
B2	1,200	1,072	3,600	C+W	4.2	2 x 250	St. 1,000	Shiftable
B3	1,200	979	3,600	C+W	4.2	2 x 250	St. 1,000	Shiftable
B4	1,200	672	3,600	C+W	4.2	2 x 250	St. 1,000	Shiftable
BA1	1,200	530	3,600	C+W	4.2	1 x 225	St. 1,000	
BA2	1,200	426	3,600	C+W	4.2	2 x 225	St. 1,000	
BA3	1,200	278	3,600	C+W	4.2	3 x 250	St. 1,000	
BA4	1,200	400	3,600	C+W	4.2	3 x 280	St. 2,000	
Waste*								
A1	1,600	731	9,720	W	5.5	4 x 250	St. 1,000	Shiftable
A2	1,600	411	9,720	W	5.5	3 x 280	St. 1,000	
A3	1,600	103	9,720	W	5.5	2 x 250	St. 1,000	
Overland Coal								
K1	1,000	508	1,020	C	4.2	1 x 225	St. 630	
K2	1,000	4,069	1,020	C	4.2	3 x 280	St. 1,250	
Stacker and Reclaimer								
SB1	1,400	633	1,020	C	5.5	1 x 250	EP500/2	
SB2	1,200	591	1,000	C	4.2	1 x 127	EP500/2	
Weightmeter and Sampler								
SB5	1,200	46	1,000	C	4.2	1 x 45	EP500/2	
Shiploading								
K3	1,200	2,000	1,020	C	4.2	2 x 250	St. 1,000	

Notes: (1) Length of the in-pit conveyors vary as pit configuration change.
(2) Waste conveyor length and arrangement vary as mining progress.
(3) Bulk weight of waste is estimated 1.8 tons/m^3.

14-4 Selective Mining

During the period of pit opening up, from 1979 to early 1984, truck and shovel system was exclusively employed to prepare mining benches for the introduction of bucket wheel excavators which would be a major mining equipment at the Unong pit. Following the completion of the mining bench set up, totally four BWE units were introduced in the early 1984. They went into the regular mining operation at the end of June after passing through several months of trial operations.

The coal extraction having done before the end of 1984 was a whole seam recovery, as originally designed, so-called "run-of-mine" by SCC. In this coal extraction, the whole coal seam between hanging wall and footwall was recovered as salable coal including all partings. However, the so-called run-of-mine coal caused serious troubles in the coal handling system as well as in the boiler system of the Calaca power plant. The trouble was considered to have been caused by mudstone partings in the Main seam extracted together with coal plies. The mudstone became very sticky and muddy after leaching with moisture. It was experienced that the troubles were intensified during the rainy season, since the coal was exposed to open air at the stockpiling area on the Semirara island as well as at the Calaca power plant where the coal was stockpiled for the longest period before being fed into the plant. In order to cope with those problems, the whole seam extraction (run-of-mine) was changed to a selective mining which removes mudstone plies as waste and mainly extracts only coal plies as product coal.

In the Unong pit, there are three coal seams amenable for an extraction namely the Main seam and two Minor seams. The Main seam thickness averages approximately 20 meters and forms almost 80% of the total reserves. It comprises 14 piles including clean coal, carbonaceous mudstone, low grade coal and so on. The selective mining is exclusively performed on the Main seam by removing partings of more than 30 cm in thickness with 10 cm of coal at each contract of partings to be removed to minimize the contamination with the mudstone partings.

In the actual operation, operators of the bucket wheel excavators are unable to segregate the plies visually due to the distantly located operator's cabin from the mining face, as well as dust generated at the mining face and smoke from spontaneous combustion of coal, so that the bucket wheel operator follows the instruction given through a wireless radio by a foreman who is monitoring the mining face staying close to the wheel of the bucket wheel excavator. Refer to the Pictures. The foreman is responsible for the whole aspect of the selective mining and he gives accurate and exact instructions to the operator with an assistance of the updated face geological map prepared by mine geologists.

Referring to the Fig. 13-2, ply 1 (coal) is extracted after the completion of overburden removal, then ply 2 (carbonaceous mudstone) is removed as waste. From ply 3 to ply 7 are extracted all together including low grade coal, plies 4 and 6, which are difficult to segregate due to their less then 0.3 m thickness, and also those low grade coal plies are less harmful for the coal hardling system than mudstone plies. Then, removal of ply 8 and extraction of ply 9 are proceeded followed by ply 10 (mudstone) removal from the top ply to bottom ply. The ply 11, so-called washable coal, consists of interbedded coal washing plant at the stockpiling area for upgrading the calorific value of the coal. The contaminated coal spilt from mining equipment is also fed into the plant to maximize the coal recovery. The washed coal is blended with the product coal from the mining pit at a maximum ratio of 10%.

The ply 12, 13 and 14 are extracted together since the ply 13 (low grade coal) thickness is less than 0.3 m.

From ply 1 to ply 8 are called the Upper Main seam and ply 9 to ply 14 are called the Lower Main Seam.

The selective mining has been successful to reduce mudstone content in the product coal alleviating the troubles in the coal handling system as well as in the boiler at the Calaca power plant. In the selective mining, however, the belt conveyors must be switched eight times depending on the materials, consequently operating delay time increases. Each conveyor switching takes approximately 15 minutes including the time to empty the belt conveyors.

Furthermore, bucket wheel foreman, operators and belt conveyor attendances are compelled to follow more complicated and cumbersome work procedures, especially the bucket wheel foreman is imposed to high responsibility for the product coal quality control in the very adverse working environment.

14-5 Pit Operation in West Season

As previously mentioned, the island has well-defined dry and wet seasons. The dry season is approximately from November to April and the rest of the months are the wet season.

During the dry season, mining operation becomes very dusty due to a lack of moisture and strong monsoon, spontaneous combustions of coal are observed at various places, not only in the coal stockpiling area but also in the mining pit.

During the wet season, more than 70% of 3,000 mm annual precipitation occurs. A maximum rainfall experienced at the island is 350 mm per 24 hours and 76 mm per hour.

As the coal-bearing formation is mainly water soluble soft clayey sandstone and siltstone, the pit floor becomes extremely muddy with a presence of moisture, as a result, tire vehicles are almost unable to operate. Especially light service vehicles lose their function completely.

In the belt conveyor operation, waste material becomes extremely sticky in rain and sticks to the belting and belt conveyor components such as pulleys and rollers, as well as clogs-up transfer chutes, consequently conveyor systems are stalled.

In order to overcome the problem, loading rate onto the conveyor is reduced depending on the severity of the rain. In the extremely heavy rain, the loading is stopped maintaining the belt system running to let the rain wash and clean the system. Loading is resumed after the rain water is completely discharged from the system.

There seldom is problem with coal transportation even though in rain, since the coal on the conveyor is immediately after the extraction with less water soluble clayey material. Besides, all fixed coal conveyors are covered to avoid rain.

No handling problem has been experienced with coal disregarding "run-of-mine" or selective mining.

Another operational concern in the wet season is meteoric water control and drainnage. The immediate excavation block is protected from rain water inflow by grading and building small banks as well as ditches around the area. Each mining bench is provided with sumps with a pumping system as well as a ditch along the toe line of the bench. The floor of the bench is sloped with sufficient angle toward the ditch and sump for better drainage. Considerable attentions are paid to maintain those drainage system and bench shape in favorable conditions especially when it is exposed to heavy rain.

14-6 Equipment Fleet

1) Continuous Mining Equipment (BWE System)

Item	Capacity	No. of Unit
Bucket Wheel Excavator SR400	1,040 BCM/hr.	4
Shiftable Face Conveyor, 48 inch (B1, B2, B3, B4), approx. length 3,500 m	3,600 tons/hr. (2,000 cu.m/hr.)	4
Fixed In-Pit Conveyor, 48 inch (BA1, BA2, BA3, BA4), approx. length 2,000 m	3,600 tons/hr (2,000 cu.m/hr.)	4
Waste Conveyor, 63 inch approx. length 1,300 m	9,720 tons/hr. (5,400 cu.m/hr.)	3
Spreader	9,720 tons/hr. (5,400 cu.m/hr.)	1

2) Conventional Mining Equipment (Truck and Shovel System)

Item	Model	Capacity	No. of Unit
Hydraulic Excavator (Backhoe)	CAT235	1.0 cu.m	1
Hydraulic Excavator (Front Shovel)	CAT245	2.3 cu.m	2
Track Loader	CAT9771	2.48 cu.m	2
Wheel Loader	CAT950	2.29 cu.m	2
Wheel Loader	CAT980	4.0 cu.m	1
Dump Truck (35 tons)	CAT769B	16.6 BCM	2
Dump Truck (35 tons)	DJB350B	12.45 BCM	6
Dump Truck (25 tons)	Peter Bilt Mucks		3
Crawler Dozer	CATD8L	335 HP	2
Crawler Dozer	CATD8K	335 HP	3
Crawler Dozer	CATD7G	250 HP	3
Pipe Layer	CAT583K	140,000 lb lift at 4' overhand	2
Wheel Dozer	CAT824	5 cu.m	1
Motor Grader	CAT140G		1
Vibrating Road Roller (Dynapack)	CAT25D	10 tons	1
Trailer		60 tons	1
Total Unit			30

14-7 Operating Days

The mine is scheduled to oeprate 233 days yearly, 5 days per week, 3 shifts per day. One shift is 8 hours.

The yearly work days are estimated as follows:

Total Days	365
Statutory Holidays	12
Available Days	353
Weekends (Saturday and Sunday)	104
Miners' Holiday*	16
Working Days	233

* Note: Actual working days may be 249 days (353 – 104 = 249), however, SCC reported 233 days of annual working days. The difference (249 – 233 = 16) is assumed to be the miners' holiday or annual leave days.

The statutory holidays are specified in Table 14-4.

Table 14-4 Statutory Holidays

Date	Holiday
January 1	New Year's day
February 25	Anniversary of the EDSA Revolution
April 16	Holy Thursday
17	Good Friday
May 1	Labor Day
6	Araw ng Kagitingan
June 12	Independence Day
July 4	Fil-American Friendship Day
November 1	All Saint's Day
30	Bonifacio Day
December 25	Christmas Day
30	Rizal Day
Total 12 days	

14-8 Manpower

Originally the manpower requirement was estimated as listed in Table 14-5.

Table 14-5 Manpower Requirement (Planned)

	Salary	Hourly	Total
General Management	13	4	17
Mining Department	89	377	466
Personnel Department	24	27	51
Financial Department	20	3	23
Total	146	411	557

The actual manpower amount to 1,045 at the mine site excluding Manila Head Office, as of February 1987. Table 14-6 shows the details of the manpower by department.

Considering the particularity of the mining operation on the isolated island which necessitates the provision of all affiliated public service facilities such as hospital, commissary, captive power plant and the like, fairly large number of manpower may be required. Moreover, sea and air transportations for both supplies and personnel, mail service, mess hall must be operated by SCC personnel.

The number of employee engaged in the pit operation is only 233 and SCC is hoping to introduce more miners to improve the utilization of all available equipment for production improvement.

Table 14-7 and 14-8 show the detail of mine operation related personnel.

Table 14-6 Manpower and Organization (as of February 28, 1987)

1.	Residential Manager's Office (RMO)	
1.1	Office of the Resident Manager	3
1.2	Safety	6
1.3	Assay Lab.	10
1.4	Quality Control & Product Planning	38
1.5	Material's Control	40
1.6	Long Term Planning	2
	Total	105
2.	Administration and Controller-Ship	
2.1	Office of the Controller	5
2.2	Accounting Department	19
2.3	Administrative Services (Hospitals, Store, Mess., Janitorial Services, Flight, Boats, Mail, etc.)	65
2.4	Human Resources Department (HRD) (Compensation, Recruiting, Benefits, Training, etc.)	14
2.5	Electronic Data Processing (EDP) (Computer Inventory Management, Stock, Supply, Payroll, etc.)	2
2.6	Security and Communications	4
	Total	109
3.	Technical Services Division (TSD)	
3.1	Office of the TSD Manager	1
3.2	Mobile Mechanical Department	98
3.3	Mine Mechanical Department	104
3.4	Mechanical Shop Services	68
3.5	Electrical	99
3.6	Power Plant	53
3.7	Civil Works	52
	Total	475
4.	Mine Division	
4.1	Office of Mine Division Manager	1
4.2	Mine Operation	233
4.3	Mine Geology	47
4.4	Engineering Geology	47
	Total	356
Grand Total (excluding Manila Office)		1,045

Table 14-7 Mine Operation Personnel Allocation

Pit Operation

Position	No. of Man			
	D	A	N	Total
Mine General Foreman	1	1	1	3
Mine Foreman	1	1	1	3
BWE Asst. Foreman	4	4	4	12
Spreader Asst. Foreman	1	1	1	3
BWE Operator	4	4	4	12
Hopper Car Operator	4	4	4	12
Spreader Operator	1	1	1	3
MS3 Operator	1	1	1	3
Crusher Operator	1	1	1	3
Conveyor Tender	18	18	18	54
Conveyor Helper	10	10	10	30
Mine Shift Boss	1	1	1	3
Backhoe Operator	4	4	4	12
Dozer Operator	6	6	6	18
Track Loader Operator	4	4	4	12
Truck Driver	4	4	4	12
Devatering Foreman	1	1	1	3
Devatering Asst. Foreman	1	1	1	3
Pump Tender	7	7	7	21
Total	74	74	74	222

Mine Geology

Position	No. of Man			
	D	A	N	Total
Foreman	1	1	1	3
Supervisor	1	1	1	3
MS2 Operator	1	1	1	3
Stacker Operator	1	1	1	3
Reclaimer Operator	1	1	1	3
Shiploader Operator	1	1	1	3
Conveyor Tender	4	4	4	12
Conveyor Helper	2	2	2	6
Wharf Hands	2	2	2	6
Total	14	14	14	42

Grand Total	88	88	88	264

Table 14-8 Mine Operation Maintenance Manpower

87.05.20.

Area	Mechanical Man	Day	Aft.	Night	Total	Electrical Man	Day	Aft.	Night	Total	Grand Total
		Number of Men/Shift					Number of Men/Shift				
Mining Operation	Foreman	5	0	0	5	Foreman	1	1	1	3	
	Asst. Foreman					Relief	1	0	0	1	
	Lubrication	1	0	0	1	Supervisor	2	2	2	6	
	Hydraulic Group	1	0	0	1	Relief	1	0	0	1	
	Splicing	1	0	0	4	Electrician	7	7	7	21	
	BWE & Others	4	0	0	4	Relief	3	0	0	3	
	Mechanic (Hydraulic)	8	0	0	8	Sub-Total	15	10	10	35	
	Mechanic	11	11	11	33	PMS & Devatering					
	Welder	4	4	4	12	Foreman	1	0	0	1	
	Lub. Man	6	6	6	18	Asst. Foreman	1	0	0	1	
	Splicer	2	2	2	6	Supervisor	1	0	0	14	
						Electrician I	14	0	0	14	
						Electrician II	1	1	1	3	
						Sub-Total	18	1	1	20	
	Area Total	43	23	23	89	Area Total	33	11	11	55	144
Waste Conveyor System	Asst. Mech. Foreman	1	1	1	3	Electrician	1	1	1	3	
	BSP-2 Mechanic	1	1	1	3						
	A1, Spreader Mechanic	1	1	1	3						
	BSP-2 Welder	1	1	1	3						
	Area Total	4	4	4	12	Area Total	1	1	1	3	15
Stockpile & Ship-Loading	Mechanical Foreman	1	0	0	1	Electrical					
	Mechanical Foreman	1	0	0	1	Supervisor	1	0	0	1	
	(Stockpile/Blending)					Electrician	2	0	0	2	
	KS2 Mechanic	1	0	0	1						
	Reclaimer Mechanic	1	0	0	1						
	KS1/KS3 Mechanic	1	0	0	1						
	Shiploader Mechanic	1	0	0	1						
	K3 Drive Mechanic	1	0	0	1						
	Area Total	7	0	0	7	Area Total	3	0	0	3	10
	Total	54	27	27	108	Total	37	12	12	61	169

15. Mine Production Performance

15. Mine Production Performance

15-1 Conventional Mining

Conventional mining had been extensively performed by using trucks and shovels at the opening-up stage of the pit development until the bucket wheel excavator system, so-called continuous mining equipment was introduced.

After the bucket wheel excavator system took over the role of main production, the conventional mining equipment has been used for miscellaneous pit work such as sump construction, bench shaping, pit slope finishing, and the like. Mining operation is another important role for the conventional mining equipment in the small area where efficient operation cannot be expected with the bucket wheel excavator system.

Table 15-1 shows production statistics of the conventional mining.

Table 13-8 shows equipment availability in 1986.

Table 15-1 Conventional Mining System Production

	1979	1980	1981	1982	1983	1984	1985	1986
Product Coal (MT)	4	30	13	91	326	32	7	1
Waste (BCM)	41	644	1,175	1,139	1,109	718	775	328
Total BCM	44	667	1,185	1,209	1,359	743	781	329
Stripping Ratio	9.2	21.3	88.8	12.5	3.4	22.1	104.9	242.4

Notes: (1) Figures are x 1,000 except stripping ratio.
(2) Coal BCM is obtained based on S.G. 1.3.

15-2 Continuous Mining

Bucket wheel excavator system has been a major production system since it was introduced in 1984.

Three units commenced operation in February 1984 and the fourth unit was in March. After five month trial operation, all unit went into a regular full scale production in July 1984.

Since the commencement of the mining production, the extraction had been a whole seam recovery including all mudstone and low-grade coal plies, the produced coal is called "run-of-mine". It had been continued until the end of October 1984 when NAPOCOR refused the acceptance of the coal due to its inferior quality. And the coal seam cutting rate of the bucket wheel excavators during the period is considered to be the best attainable rate without being interfered by mudstone ply removal.

After that, the coal extraction method was modified to a selective mining in which major mudstone plies were removed segregating from coal plies to improve the quality of the product coal.

In this mining method, the extraction rate of the bucket wheel excavators is reduced due to the complication of the cutting system. Refer to section 14-4 selective mining.

Table 15-2 shows continuous mining system production.

Table 15-2 Continuous Mining System Production

Year	1984			1985	1986
	Trial	Regular	Total		
Production Coal (MT)	75	458	533	587	579
Waste (BCM)	1,603	3,626	5,229	8,228	6,230
Total BCM	1,661	3,987	5,639	8,680	6,658
Stripping Ratio	21.2	7.9	9.8	14.0	10.8

15-3 Continuous Mining Operational Delay Analysis

All delays in the continuous mining operation are classified into four categories, which are:

1) Maintenance Delay

This is a delay time relating to all equipment repair and maintenance, subdivided into mechanical and electrical maintenances.

2) Operational Delay

All delays related to mining operations such as belt switching, BWE move, face inspection, weather related delay and the like.

3) Planned Delay

All delays afore scheduled such as BWE transfer, belt conveyor shifting, extension and shortening, equipment transfer and political operation shut down.

4) Power Failure and Control

Power failure and other delays related to system control.

Table 15-3 shows delays and cutting time of the BWE system in percentage against total hours.

They are graphically indicated in Fig. 15-1.

The maintenance delay in 1986 is 24% which is higher than 15.6% and 14.5% in 1984 and 1985 respectively. Reasons for that is not clearly reported but assumably unexpected break down or major overhaul might have been experienced. In ordinary years, it is hoped to maintain around the level of 15% achieved in 1984 and 1985.

The average for those three years is 17.9%.

The power failure and control delay is fairly high 17.3% in 1984 comparing with 10.6 and 0.4% for 1985 and 1986 respectively. It could be interpreted that initial troubles have been solved as the accumulation of operational experience.

It is expected to maintain almost same low level as in 1986 thereafter.

The average for those three years is 9.0%.

The planned delays are 14.7, 15.0, 12.1% in 1984, 1985 and 1986 respectively, maintaining almost constant level.

The average for those three years is 14.0%.

Table 15-3 BWE Delays (July 1984 to December 1986)

Year	MT		CCP		PLDLY		OPDLY		CUT		Total	
	Hour	%	Hour	%	Hour	%	Hour	%	Hour	%	Hour	%
1984	2,559.9	15.5	2,862.2	17.3	2,440.6	14.7	2,558.8	15.5	6,138.2	37.1	16,559.7	100.0
1985	3,693.2	14.5	2,700.6	10.6	3,808.4	15.0	2,510.1	9.9	12.755.0	50.1	25,467.3	100.0
1986	4,885.7	24.0	76.0	0.4	2,466.3	12.1	2,947.8	14.5	9,965.3	49.0	20,341.1	100.0
Average		17.9		9.0		14.0		12.9		46.3		100.0

Notes:
MT: Maintenance Delay
CCP: Power Failure and Control
PLDY: Planned Delay
OPDLY: Operational Delay
CUT: Cutting Time

Data is for the period from July 1984 to December 1986 excluding the trial operation period.

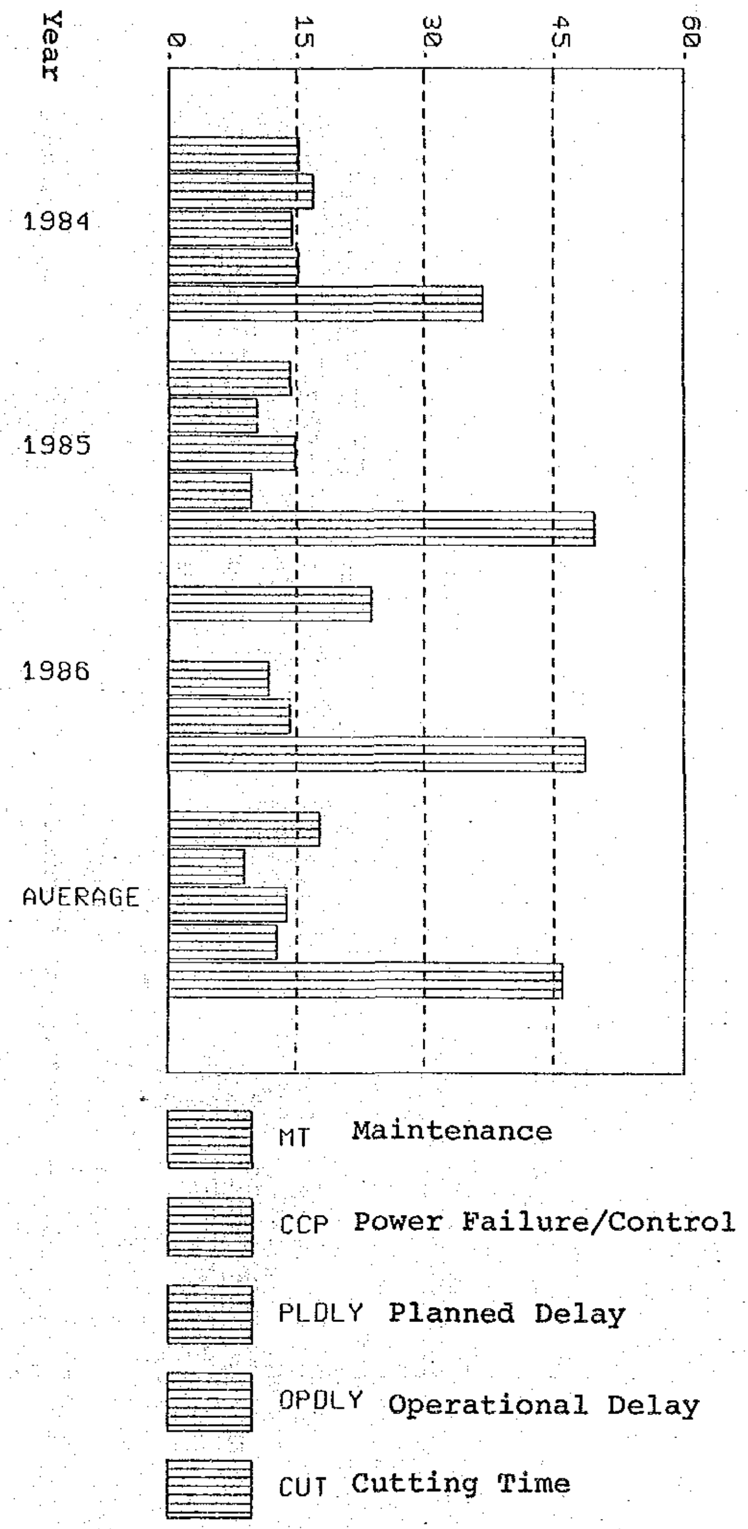


Fig. 15-1 BWE Delays in Percentage (July 1984 to December 1986) (1)