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FEASIBILITY STUDY OF ASEAN COPPER PROJECT

CONTRACT NO.90/98

(FINAL REPORT)

JULY, 1991

KOBE STEEL, LTD.

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1. EXECUTIVE SUMMARY

1.1 Project Background

1.1.1 Project History

In 1984, ASEAN Copper Product Inc. (ACPI) has been formed through the participation of Philippines, Indonesia, Malaysia, Thailand and Singapore to establish a complex for manufacturing of copper and copper alloyed semi products in the Philippines as an ASEAN project.

In 1985, an international tender was called to select the contractor for construction of copper and copper alloyed manufacturing complex with annual capacity of 100,000 metric tons in Leyte using a virgin cathode as main raw material from Associated Smelting and Refining Corporation (PASAR). The objective of this project was to contribute to the national income and ASEAN economy by adding more value on downstream products, and to promote the technological and industrial development of the area. However, the project has been shelved due to uncertain economic and market conditions.

In 1987, Outokumpu Engineering of Finland has concluded a market study and feasibility study. They recommended to start the project with annual capacity of 30,000 tons of flat products including those for lead frames.

It has been pointed out that the production capacity recommended by Outokumpu needs to be reassessed on the basis of a more detailed market survey.

1.1.2 Products Lines-up

Among the 4 major copper fabricate products (flat products, tubes, rods and wires) copper and copper alloy flat products were selected to be manufactured by the project because of the following reasons:

* Flat products

Copper flat products accounts for the biggest share of importation by ASEAN and is relatively favorable to enter into this market since there is no existing local manufacturer in ASEAN region.

* Copper tubes

Entr-- into the copper tubes market is expected to be more competitive due to the establishment of production facilities in ASEAN region by many foreign firms. In contrast with the present demand of 12,000 metric tons, the total production capacity in ASEAN region is projected to reach approximately 25,000 metric tons in 1995.

* Copper wire & rods

Entry into copper and wire market in this region is very competitive since the market for wire and rods is dominated by many numbers of small lccal manufacturers recycling the scrap as the main raw materials.

1.2 Market Study

1.2.1 Market Overview

Total imports of copper and copper alloy flat products in 1989 excluding those for lead frames in ASEAN, NIES and Japan are reported approximately 68,000 metric tons as shown in Table 1.1 It can be pointed out form the statistics that the volume of importations of those products in ASEAN and Japan are relatively small compared with those in NIES. Moreover, competition with the Japanese and South Korean suppliers is expected since these countries are the major exports in this region.

1.2.2 Demand

Demand is determined by using the following projected growth rate of importations of each country and the projected demand for each country is presented in Fig. 1.1.

- Indonesia 2.3% per year
- Malaysia 3.1% per year
- Philippines 2.0% per year
- Singapore 2.5% per year

Table 1.1 Market Overview in 1989

Country	Volume of Importation (metric tons)	Share (%)	Major Industrial Usage	Share (%)	Major Supplier	Share (%)
Indonesia	2,413	3.55%	for radiators	41.44%	Japan	60%
Malaysia	1,190	1.75%	for radiators	25.71%	Japan	36%
Philippines	2,398	3.53%	for radiators	37.53%	Japan	72%
Singapore	6,146	9.05%	for electrical applications	94.04%	Japan	66%
Thailand	2,700	3.98%	for radiators	25.56%	Japan	57%
ASEAN Total	15,115	22.26%				
Hong Kong	25,014	36.84%	for electrical appilcations	-	Japan	44%
South Korea	2,743	4.04%	for electrical appilcations	-	Japan	-
Taiwan	18,318	26.98%	for electrical appilcations	19.16%	Japan	57%
NIES Total	46,075	67.87%				
Japan	6,700	9.87%	mislaneous		South Korea	75%
Grand Total	67,890	100.00%				

- Thailand 2.2% per year
- South Korea 3.0% per year
- Taiwan 2.6% per year
- Hong Kong 2.1% per year
- Japan 4.5% per year

These growth rates incorporating negative factors that demand for copper and copper alloy flat products for radiators will soon be replaced by aluminum.

1.2.3 Projected Penetration to the Market

Taking the competition with the Japanese and Korean firms into mind, following ratios of penetration were determined. The total volume to be tapped by the project in 1995 (year of start up) using these ratios were estimated 14,340 metric tons and reach approximately 19,830 metric tons in 2009.

- Indonesia 50% per year of projected demand
- Malaysia 50% per year of projected demand
- Philippines 80% per year of projected demand
- Singapore 50% per year of projected demand
- Thailand 10% per year of projected demand
- South Korea 5% per year of projected demand

Fig. 1.1 Projected importation in the region

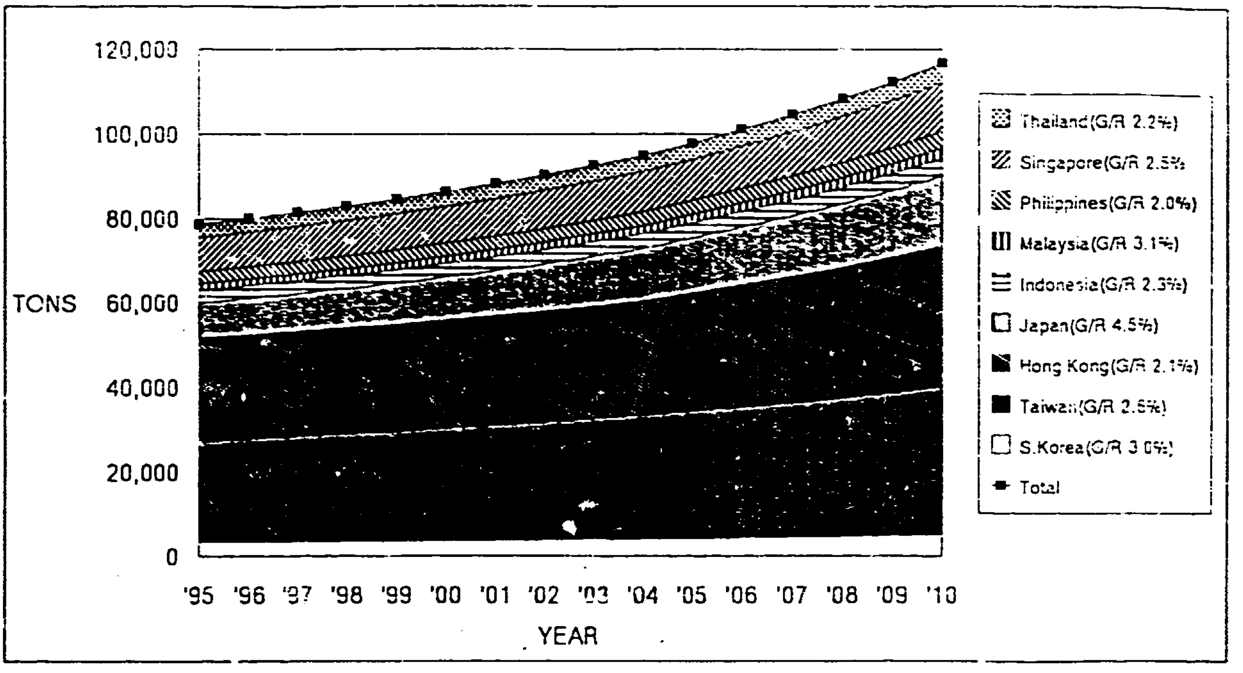
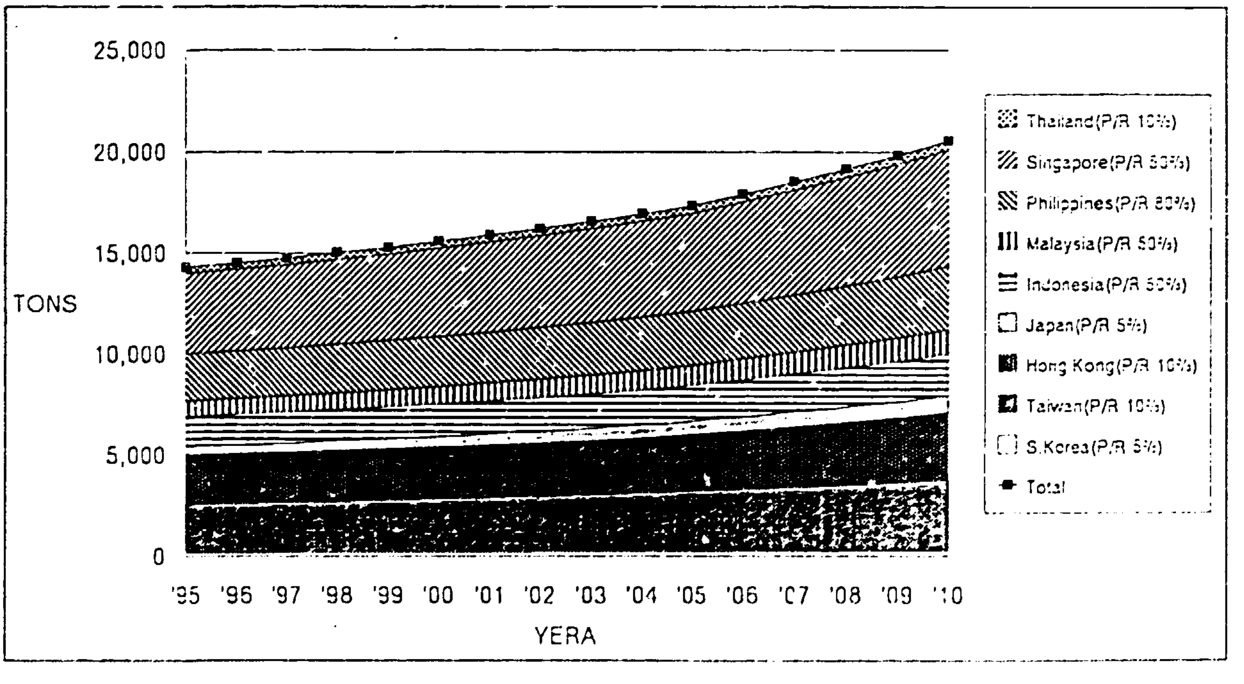


Fig. 1.2 Projected amount to he penetrated by the project



- Taiwan 10% per year of projected demand
- Hong Kong 10% per year of projected demand
- Japan 5% per year of projected demand

The volume to be tapped by each country is shown in Fig. 1.2.

1.2.4 Plant Capacity

Based on the projected volume of penetration to the market, annual capacity within the range of 15,000 to 20,000 metric tons are considered as feasible normal plant capacity. Therefore, this study was made on the basis of the plant capacity of 15,000 metric tons with the expansion of 3,000 metric tons.

1.2.5 Product Mix

In line with the market analysis and the actual applications of each country in the market, following product mix was determined for this study.

Material	Thickness (mm)	ton/year
Copper	0.1	600 - 720
	0.5	1,200 - 1,440
	1.0	1,200 - 1,440
Brass (70/30)	0.3	1,200 - 1,440
	0.75	1,800 - 2,160
Brass (65/35)	0.15	600 - 720
	0.3	1,200 - 1,440
	0.75	1,800 - 2,160
	0.8	1,800 - 2,160
	1.2	1,800 - 2,160
	1.5	1,800 - 2,160
Total		15,000 - 18,000

1.3 Materials and Input

Raw materials for the plant are copper cathode, zinc and scrap. The required amounts of the raw materials for the plant capacity of 15,000 - 180,000 tons/year are

	15,000 t/y		18,000 t/y
Copper cathode	11,762	-	14,114 (t/y)
Zinc	4,372	-	5,246 (t/y)

Other auxiliary materials, such as oil and lubricant, chemicals, consumables are summarized in Schedule 4.1 of Chapter 4.

The estimated consumption data of required utilities are listed in Table 4.4. Major utilities and their consumption for 15,000 t/y - 18,000 t/y plant are as follows:

	15,000 t/y	18,000 t/y
Electricity	45,289 MWH/year,	53,347 MWH/year
Raw-water	426,250 m^3/year,	511,500 m^3/year
LPG	6,600 m^3/year,	7,920 m^3/year

or in terms of product weight,

Electricity	3.02 MWH/ton,
Raw water	28.4 m^3/ton,
LPG	0.44 m^3/ton,

1.4 Location and Site

Site survey and study have been carried out for two places, i.e., Isabel, Leyte and Batangas, Luzon.

The site at Isabel has been selected in this study mainly due to availability of raw water and electricity at relatively low cost and the advantage of locating near PASAR, copper cathode supplier to this plant.

In Isabel the site location is planned to be between the PHILPHOS plant site and the existing staff housing site, as the area had been almost flattened and the access is easily available for plant staff as well as material transportation.

Detail comparison data between the two sites are summarized in Table 5.1 in Chapter 5, where each site condition and relevant information are listed from various aspects.

The study team suggests further that the project proponents should secure pollution free operation in the proposed site. This means the environmental condition in Isabel should not be worsen by any means.

1.5 Project Engineering

1.5.1 Plant Layout

On the basis of 15,000 t/y plant capacity site plan and general layout of production shop are shown in Fig. 6.1 and Fig. 6.2 in Chapter 6, respectively, with consideration of plant expansion in the future.

Material flow in the production shop is illustrated in Fig. 6.3A and Fig. 6.3B, where each arrow indicates the flow and amount of raw materials, in-process coils and return scraps.

Fig. 6.4 shows feedstock area to be allocated for the material storage. The storage area calculation is given in table 6.1.

1.5.2 Technology and Process

Horizontal casting process has been adopted from economical and technical viewpoints.

The initial investment cost for the horizontal casting process is remarkably lower than that for hot rolling process.

In this regard the horizontal coasting process is generally suitable for the plant where production amount is relatively small, i.e., less than 20,000 tons/year or so.

The main process for foundry shop and rolling shop is described with the summary table of standard process in Table 6.2 and process flow sheet for each kind of product.

1.5.3 Equipment

Details of equipment description and its capacity calculation are described in Chapter 6.3.
Accordingly number of required equipment, number of shift and working ratio are calculated and summarized in Table 6.3 and Table 6.4 of Chapter 6.

Main specification of production equipment as well as auxiliary facilities are given in the specification sheets attached to Chapter 6.

1.6 Overhead Costs

Following are counted as overhead costs:

- Spare parts required annually
- Property and fire insurance premium
- Distribution cost covering the transport cost from the plant site to Manila port
- Packing materials for the products
- Depreciation of plant equipment and buildings

1.7 Manpower

Manpower organization chart is proposed in Fig. 8.1 based on the plant capacity 15.000 t/y.

The required manpower is as follows:

Manager class	:	13
Engineer class	:	15
Office staff class	:	24
Technician 1 labour class	:	242
Total	:	294

In order to cope with gradual increase of production amount, manning program during the initial start-up period is presented in Table 8.1.

Year	Total Manpower
1	219
2	245
3	271
4	294

Finally qualification and job requirements are described in section 8.2 for each job category.

1.8 Project Implementation

Project implementation schedule is presented in Fig. 9.1 covering from ITB tender preparation stage to commencement of commercial operation, total 40 months.

Manpower organization and manning requirements for the plant construction phase are also proposed as shown in Fig. 9.2 and Fig. 9.3 of Chapter 9. Duties and qualification for each job are briefly described.

In Chapter 9.3 overall construction schedule is worked out detail in Fig. 9.4, based on which manning aggregation curve is calculated as shown in Fig. 9.5.

These schedule and the manpower curve are the basis for calculating construction cost of the plant.

1.9 Financial Evaluation

1.9.1 Investment Costs

Total investment costs for original case was estimated as follow:

	Original Case (18,000 tpa)
Foreign currency	151 million US$
Local currency	29 million US$
Total	180 million US$

Break down of the investment costs is presented in Schedule 10.2.

1.9.2 Production Costs

Total production costs is presented in table 1.2. The costs are broken down between direct cost, administrative overheads, depreciation and financial costs.

TABLE 1.2. Total Production Costs

(1000US$)

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Production Amount (tons)	6,000	9,000	12,000	15,000	15,341	15,620	15,910	16,250	16,610
Main Raw Materials	15,019.39	22,529.08	30,038.78	37,539.93	38,389.76	39,089.41	39,811.84	40,661.67	41,562.04
Other Raw Materials	381.07	571.78	762.37	952.75	974.18	992.07	1,010.34	1,054.82	1,054.73
Utilities	1,044.22	1,566.33	2,088.43	2,609.95	2,669.03	2,717.68	2,767.90	2,826.99	2,889.58
Direct Labour	486.00	542.00	598.00	648.00	686.00	686.00	686.00	686.00	686.00
Spares and Maintenance	3,650.00	3,650.00	1,826.00	1,826.00	1,826.00	1,826.00	1,826.00	1,826.00	1,826.00
Factory Overheads	600.37	900.56	1,200.74	1,500.58	1,534.35	1,562.52	1,591.40	1,625.37	1,661.36
Factory Costs	21,181.04	29,759.74	36,514.32	45,077.21	46,079.33	46,873.68	47,693.48	48,680.85	49,679.71
Administrative Overheads	609.60	415.60	415.60	609.60	349.60	349.60	349.60	349.60	349.60
Depreciation	11,042.95	11,074.05	11,074.05	11,074.05	11,074.05	11,074.05	11,074.05	11,074.06	1,257.55
Financial Costs	9,813.18	10,095.74	10,095.74	9,086.16	8,076.59	7,067.02	6,057.44	5,047.87	4,038.29
Total Production Costs	42,646.77	51,345.13	58,099.71	65,847.02	65,579.57	65,364.34	65,174.57	65,152.38	55,325.15
Costs per tons (average)	7.11	5.71	4.84	4.39	4.27	4.18	4.10	4.01	3.33
Of it foreign %	61.25%	52.18%	43.62%	37.74%	35.88%	34.39%	32.86%	31.26%	15.49%
Of it Variable %	36.14%	45.74%	54.68%	60.91%	62.72%	64.23%	65.77%	67.39%	83.09%

TABLE 1.2. Total Production Costs

(1000US$)

	2004	2005	2006	2007	2008	2009
Production Capacity (tons)	16,980	17,370	17,950	18,000	18,000	18,000
Main Raw Materials	42,473.79	43,447.47	44,897.31	45,031.12	45,046.78	45,090.90
Other Raw Materials	1,077.96	1,102.90	1,139.69	1,143.27	1,143.27	1,144.38
Utilities	2,952.97	3,020.67	3,121.47	3,130.77	3,131.86	3,134.93
Direct Labour	686.00	686.00	686.00	686.00	686.00	686.00
Spares and Maintenance	1,826.00	1,826.00	1,826.00	1,826.00	1,826.00	1,826.00
Factory Overheads	1,697.81	1,736.73	1,795.02	1,800.66	1,800.66	1,800.66
Factory Costs	50,714.53	51,819.76	53,465.49	53,617.82	53,634.56	53,682.87
Administrative Overheads	349.60	349.60	349.60	349.60	349.60	349.60
Depreciation	1,226.45	1,226.45	1,226.45	1,226.45	1,226.45	1,226.45
Financial Costs	3,028.72	2,019.15	1,009.57	0.00	0.00	0.00
Total Production Costs	55,319.30	55,414.95	56,051.11	55,193.87	55,210.61	55,258.92
Costs per tons (average)	3.26	3.19	3.12	3.07	3.07	3.07
Of it foreign %	13.47%	11.43%	9.31%	7.37%	7.37%	7.37%
Of it Variable %	85.21%	87.29%	89.47%	91.40%	91.40%	91.40%

1.9.3 Financing

Following assumptions was made for the financing:

a) Equity: 30% of the total investment costs

b) Investment costs in local currency shall be all covered by equity

c) Loan conditions for foregin currency:
- interest rate: 8% p.a.
- repayment: 10 years in equal installments
- grace period: 2 years from start of operation (1997)

d) Loan conditions for local currency;
- interest rate: 24% p.a.
- grace period nil

Based on the above conditions, financing schedules are shown in Schedule 10.5 of Chapter 10.

1.10 Conclusion for the Original Case

i) Overall Financial Prospects

After having executed the financial analysis, following are the summary for the original case with annual output of 18,000 metric tons.

1) Cumulative profit does not become positive for entire project life.

2) IRR shows quite low viability namely -0.11% for original case.

3) The case is more sensitive to make change in sales prices and operating costs than initial investments. However, even applying the best variable, i.e. 30% increase of sales prices, IRR is 9.25% for original case.

This low profitability is due to the following reasons.

a) Raw Material Cost

Japanese and Korean manufacturers, who are the expected competitors for the Project, are enjoying lower raw material costs since they can use a certain amount of copper scrap, which is fairly lower in cost than virgin cathode, prevailing in their local market. Adequate amounts of copper scrap are being recycled locally in these countries because of the maturity of the correlated industries.

In the case of Japanese manufacturers, they now use almost 50% scrap as raw material on average.

On the other hand, since adequate amounts of copper and copper alloy scrap are not being recycled locally in the Philippines, the Project can not enjoy the merits of using scrap from local sources.

In other words, having a stable and adequate local source of scrap rather than having a local source of copper cathode is an important factor in making the Project both viable and competitive.

b) Low Market Prices for Low Value Added Products

As for the sales prices for the flat products determined in this study, price competition is quite hard in the ASEAN and NIES market because of the strong competition between Japanese and NIES' manufacturers. In the case of Japanese manufacturers, they are suffering from low profitability in spite of using a certain amount of copper and copper alloy scrap as raw materials. Usually they strategically supply these products with low prices which only almost cover the fixed cost, in order to keep their market share in these regions. They recover the profitability by other high value added products, such as flat products for lead frames, which are the monopoly of Japanese manufacturers.

c) Plant Capacity

The market study in Chapter 3 led the conclusion that 18,000 metric tons of the flat products is the projected annual volume which can be tapped in ASEAN, NIES and Japanese markets.

This amount seems insufficient for enjoying the scale of economy for the Project with the product mix determined in this report. The large scale operation does not, however, necessarily secure commercial profitability. It depends more on how sufficiently the contribution margin can recover the financial cost. This has become clear through carrying out the sensitivity analysis for the large scale production which will be explained in the following section.

d) Low Contribution Margin

The above a) and b) are one of the critical elements which would make project profitability low. Further, since the price of the main raw material, copper cathode is controlled by LME, the production cost of the proposed plant is dominated by this component, and hardly enjoy cost advantages to reduce the production cost. Other production cost elements such as labor cost and utility cost are rather marginal and thus not substantial to reduce the total production cost. Therefore, the contribution margin (Revenue minus variable cost) turned out to be rather low.

ii) Sensitivity of IRR for the Base Case

Bearing the above in mind, the study team carried out a sensitivity analysis in order to investigate how IRR would improve by changing the parameters of each variable. the results show;

(1) reduction of production cost by lowering the raw material cost, i.e. using 50% of scrap improved IRR to approximately 1.6%.

(2) If the sales price can be lifted by 28% to 30% (one of the assumption to add lead frame, 20% of the total products, to the suggested product mix), IRR would improve to roughly 7%.

It should be noted that the study team keeps strong reservations for this assumption as mentioned in Chapter 3.

(3) A combination of the above two cases would bring IRR up to the level of approximately 8%.

The above financial evaluation indicates that the sales price is the most sensitive variable. The potential investors should look into this variable for reassessing the commercial profitability by elaborating in different product mix and different market (i.e. countries to penetrate) penetration strategies.

Furthermore, the possibility of using scrap may be pursued if the Philippines government implements, as suggested by BOI, the scrap shipyard project in the near future. This assumption may become realistic and IRR can improve, though not significantly.

1.10.2 Conclusion for the Alternative Cases

Bearing the above difficulties in mind, the study team investigated the commercial profitability of different alternative cases. the logical basis of this assumption is that the project may be able to gain higher sales volume in each targeted country. (as shown in Section 3 and Fig. A.1 of Annex)

Furthermore, the assumption extended to include lead frame products which can be considered as an attainable market segment.

The difficulties of entering into a lead frame market are clearly mentioned in Chapter 3. The study team nevertheless investigated this case, since the most effective way of improving IRR lies in this assumption. It may be noted however that it is unrealistic to expect market penetration into this segment from the beginning of the operation.

The scrap market in the Philippines may change due to the ship scrap yard project under consideration by BOI. Taking this plan into account, the study team also investigated the impact of reducing the virgin cathode portion down to 50% of the total raw material requirement. The results are shown below;

Alternative Case (30,000 T.P.A. plant using hot rolling process)

Case 1: IRR 0.9% (Base Case)

Case 2: IRR 2.04% (Using 50% scrap as raw material)

Case 3: IRR 9.31% (20% of lead frame products)

Case 4: IRR 11.02% (Combination of Case 2 and Case 3)

These alternative cases show that the project could enjoy maximum profitability of 11.02% IRR under the Case 4 assumption. The study team thus concludes that the proposed project may not be able to meet BOI's hurdle rate even under more optimistic assumptions. However, this IRR can be considered acceptable if the foreign costs will be financed by internationally available capital and all the local portion will be financed by equity. Along this line, the project may be pursued further to materialization, if potential investors consider these alternative cases to be realistic.

2. PROJECT BACKGROUND

2.1 Project History

In 1984, ASEAN Copper Product Inc. (ACPI) has been formed through the participation of ASEAN countries with the objectives to establish a complex for manufacturing of copper and copper alloyed products in the Philippines as an ASEAN project.

ACPI is outlined as follows;

- Date of registration : March, 1984
- Authorized capital : 42 million Peso
- Paid-up capital : 10.5 million Peso
- Equity participation :

Country	Stockholders	Share (%)
Philippines	ASEAN Philippine Copper Holding, Inc.	60
Indonesia	Minister of Finance	13
Malaysia	Minister of Finance	13
Thailand	Minister of Finance	13
Singapore	Temasek Holding (Pte.) Ltd.	1
Total		100

In 1985, an international tender was called to select the contractor for construction of copper and copper alloyed products manufacturing plant with annual capacity of 100,000 metric tons in Leyte, Philippines, using the virgin cathods as raw material from PASAR (Philippine Associated Smelting and Refining Corp.) smelter, having annual capacity of 138,000 tons of virgin cathods at isable in Leyte island. The main objectives of this project was to add more value on the copper downstreams products, satisfy the domestic and regional demand, further the technological and industrial development of the area, and to contribute to the national income and ASEAN economy. However, the project has been shelved since 1985, mainly due to the uncertain economic and market conditions.

Nevertheless the Philippines government kept pursuing a possibility of materialization this project within a frame work of ASEAN Industrial Project (AIP). Japanese project promoter had expressed their interests in launching the project under economic co-operation scheme in late 1980's.

In fact, co-operation with Japanese manufacturers and technology holders might be indispensable. It would enable the project owners/proponents to avoid unnecessary competition with japanese manufacturers and secure a smooth transfer of the latest technology to this project.

In 1987, Outokumpu Engineering has concluded a market study and technical feasibility study and revised its market study in 1988 for the project. They recommended to start the project with the annual capacity of 30,000-45,000 metric tons covering flat products (copper and copper alloy sheets and strips) including those for lead frames and coin blanks. However, one could argue whether or not their projected plant capacity might be realistic, since its plant capacity was decided on the basis of the full amount of projected demand in the market covering entire range of copper flat products.

This Feasbility Study Report thus first of all aimed at reviewing the product mix by Outokumpu.

2.2 Proposed Products Lines-up

Following analysis are the basis for determining the products mix.

2.2.1 General

Copper and copper alloy products can be generally classified as follows:

The list of proposed products was determined based on an assessment of the ASEAN market for various copper fabricated products including the following:

a) Flat Products - main applications are for metal manufacturing (utensils, gas stoves, others), electrical (connectors, terminals, switchboards, others), electronics, transportation (car radiators, others), and construction.

b) Copper Tubes - used mainly for air conditioning and refrigeration (ACR), and as water tubes.

Copper Alloy Tubes - used in manufacture of heat exchangers (often called condenser tubes).

c) Rod Products - include bars, sections, shapes and rods; largest application is for bus bars in power substations.

d) Wires and Cables - used for electric power transmission.

e) Coin Blanks - mainly stamped from cupro nickel sheets and used as materials for minting coins and tokens.

f) Copper Alloy Sheets for Lead Frames - thin copper alloy sheets and strips which are stamped and plated to produce lead frames, the raw material used (together with logic chips) in the manufacture of integrated circuits.

2.2.2 Reasons Considered for Selecting Copper Flat Products vis-a-vis Outokumpu's Previous Study

Among the four major copper fabricated product groups (flat products, tubes, rods and wires), flat products was selected to be manufactured because of the following reasons:

1) The market for copper flat products appears to be attractive. Among the various product groups, it accounts for the biggest share of importation by ASEAN countries. Since there is no existing local manufacturer in the Region, entry would be relatively favorable.

Statistics provided by the Copper and Copper Alloy Manufacturers Association of Japan indicate that the aggregate importation by ASEAN countries of copper fabricated products is close to 50,000 metric tons (see Table 2.1 below). Among the four major product groups, importation of flat products accounts for the biggest relative share with an average of 45 per cent of total importation during 1986 to 1988. On the other hand, importation of wires accounts for the least, with an average share of only 8 per cent.

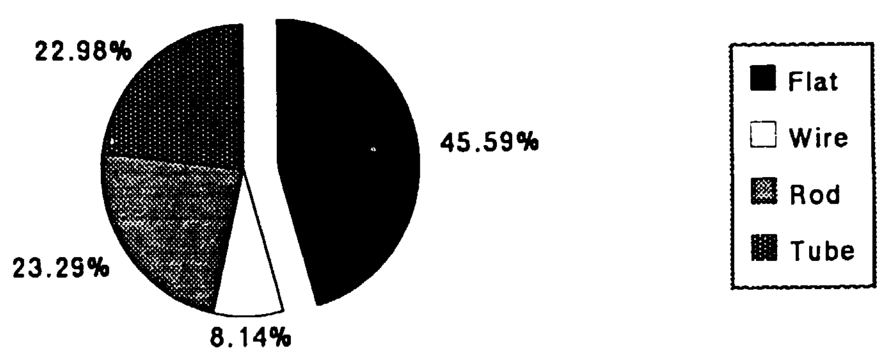
Table 2.1
Importation of Copper Fabricated Products
in the ASEAN Region
(in metric tons)

Year	Flats	Tubes	Rods	Wires	Total
1986	17,571	6,424	7,276	3,785	35,056
1987	23,065	10,263	7,515	4,444	45,287
1988	17,490	12,607	14,902	2,155	47,154
Average	19,375	9,765	9,898	3,461	42,499
% Share	45	23	23	8	100

Source: Copper and Copper Alloy Manufacturer's Association of Japan.

Figure 2.A presents the breakdown of ASEAN importation of copper fabricated products by type.

Average imports of Copper & Copper Alloy products in ASEAN (1986-1988)/Fig. 2.A



2) The ASEAN market for copper tubes is expected to become more competitive with the establishment of production facilities in the Region by major Japanese firms.

Copper tubes account for about 85 per cent of total importation of copper and copper alloy tubes by ASEAN countries.

The main application of copper tubes is for air conditioning and refrigeration (ACR). About 60 per cent of usage is for this purpose. The next largest application is for water tubes.

The ASEAN market for copper tubes is foreseen to become more competitive. Japanese ACR manufacturers in Malaysia, Singapore, and Thailand have plans to expand their production of copper tubes. These include Matsushita, Sanyo, Toshiba and Hitachi.

3) The ASEAN market for copper alloy tubes appears to be limited because of existing and planned establishments of production facilities in the Region.

There is an existing manufacturer of copper alloy tubes in Thailand, namely, Bangkok Metal Industry, with a reported capacity of 3,000 metric tons per year and planned expansion to 6,000 metric tons by 1995 (see Table 2.2).

There are proponents in Thailand and Malaysia who plan to set up facilities to manufacture copper alloy tubes in joint venture with Japanese tube manufacturers. By 1992, the total annual production capacity in the Region is projected to reach 23,200 metric tons.

Table 2.2

Name of Company	Country	Production Capacity 1990	1992	1995
Bangkok Metal Ind.	Thailand	3,000	3,000	6,000
Thai Heat Exchanger	Thailand	-	3,000	3,000
METROD	Malaysia	-	10,000	10,000
KCMA	Malaysia	-	7,200	7,200
Total		3,000	23,200	26,200

Sources: Interviews and news articles.

4) The ASEAN market for rods is very competitive and characterized by small local manufacturers, while the market for wires is limited.

The small rod manufacturers compete mainly on price. Almost all brass rods are made from scrap rather than from virgin metals.

The ASEAN market for wires is dominated by local producers in each country (see Table 2.3). Aside from this, total importation by ASEAN countries is small - less than 5,000 metric tons.

Table 2.3
Existing Production Capacities of
Copper Wire, Rod and Cable Manufacturers
in the ASEAN Region
(in metric tons per year)

Name of Company	Country	Production Capacity
Pacific Metals	Philippines	5,000
Phelps Dodge Phils, Inc.	Philippines	10,000
Bangkok Electric Wire and Cable	Thailand	7,000
Charoong Thai Wire and Cable Co., Ltd.	Thailand	2,000
PD Siam Rod	Thailand	8,500
Thai Copper Rod	Thailand	30,000
Thai Yazaki Electric Wire and Cable	Thailand	10,000
Dwi Putra Lestari	Indonesia	20,000
IKI Kabel	Indonesia	30,000
TMS (Furukawa Electric/ Supreme Cable Mfg.)	Indonesia	27,000
Tugu Tembaga Murni	Indonesia	20,000
VOKSEL	Indonesia	1,500
METROD (Malaysia) Sdn. Bhd.	Malaysia	18,000
Malayan Cable	Malaysia	8,000
Universal Cable Alpha Ind.	Malaysia	48,000
Total		245,000

Source: Interviews and news articles.

2.2.3 Reasons Considered for Excluding Coin Blanks

Although Outokumpu's study includes coin blanks, the study team proposes to drop coin blanks from the proposed product mix.

The production of coin blanks was initially proposed by Outokumpu based on a study which the company prepared in 1988. However, a further review of the ASEAN market for coin blanks based on the Opportunity Study on the Production of Cupro Nickel Coin Blanks made available by COIME indicates that the market is much smaller than initially estimated.

The Outokumpu study estimates demand at 7,500 metric tons in 1987 and 9,000 metric tons in 1990. The actual usage of cupro nickel coin blanks, which are the major copper alloy coins used in the ASEAN Region, is only 3,400 metric tons in 1987. The 1987 to 1989 coin blank usages of ASEAN countries estimated by Outokumpu are not closely correlated with actual production levels.

Outokumpu also assumed that Brunei uses directly 215 metric tons of coin blanks for minting its coins. Actually, it is the Singapore Government which purchases and mints the coins for Brunei.

The abovementioned Opportunity Study indicates that there will be approximately 4,000 metric tons of achievable market in the ASEAN Region. The breakdown is as follows:

Table 2.4
Estimated Market for Coin Blanks
in the ASEAN Region in 1989
(in metric tons)

Country	Estimated Market
Indonesia	1,200
Malaysia	800
Philippines	1,240
Singapore	760
Total	4,000

The estimated achievable market excludes the Thai market due to the recent joint venture between a Korean manufacturer (Poonsang) and a Thai company. This joint venture will most likely produce almost all kinds of coin blanks among other possible products.

The study team concluded that cupro nickel coin blanks would not be added to the proposed product mix because of the following reasons:

1) The project will face stiff competition from the Thai-Korean joint venture company which would have a lead time in establishing marketing relationship by the time the ASEAN Copper Fabrication, Inc. starts operations in 1995. The Korean firm currently dominates the ASEAN market for coin blanks.

2) As indicated in the Opportunity Study, the manufacture of coin blanks is not highly profitable because of intensive price competition. It is also difficult to forecast a stable production level.

   Procurement of coin blanks by the central banks and treasuries of ASEAN countries is done by competitive bidding where price is a major factor. For the project to win tenders, it has to bid at relatively low prices which do not provide good commercial returns even when integrated with the production of other flat products.

Purchases by ASEAN governments are not predictable as these are determined by internal decision factors and policies.

3) Production of cupro nickel coin blanks would require significant additional financial investment and technical know-how which could complicate the smooth start up of the project.

The production of cupro nickel sheets requires separate melting and casting facilities. These cannot be used for other products such as brass because of the problem of contamination. Additional stamping and blanking facilities would also be required for the manufacture of coin blanks.

The manufacture of cupro nickel sheets requires additional technical know-how and training particularly in the heating/annealing production phase. During this stage, finer dimensional tolerance and stricter temperature control are required vis-a-vis similar stage of production of other flat products.

2.2.4 Reasons Considered for Excluding Copper Alloy Sheets and Strips for Lead Frames

Copper alloy sheets and strips for the production of lead frames will also be excluded from the proposed product mix mainly because of the following reasons:

1) Penetrating the market is difficult. There are only a few lead frame manufacturers worldwide including Dyna Craft, Kobe Steel and Mitsui.

2) Quality requirements are very stringent.

Based on interviews, the quality requirements for lead frames are very strict. The coating plated on lead frames should not peel when exposed to high temperatures. There should also be no misalignment of leads and no problems in coplanarity.

Thickness tolerances are also very rigid. Whereas the tolerances for an ordinary copper sheet are indicated in hundredths of millimeters, the thickness tolerances for a lead frame are specified in thousandths of millimeters.

Based on interviews, the quality of sheets and strips supplied by a metal manufacturing company in newly industrialized economy is not yet fully satisfactory. This is despite the 10-year experience of the company in manufacturing copper alloy sheets for lead frames. Lead frame manufacturers interviewed who have reservations about the quality of the company's products include Dyna Craft International, Mitsui High Tech, and Kitako Electronics. Table 2.5 presents a profile of lead frame manufacturers and their sources and comments on supply of the copper raw materials.

Table 2.5
PROFILE OF LEAD FRAME STAMPERS/PLATERS
IN MALAYSIA AND SINGAPORE

Name of Company	Location	Ave. Monthly Consumption (in Metric Tons)	Sources/Remarks
Dyna Craft, Inc.	Penang, Malaysia	270	Multiple suppliers from Japan Ohlin Yamaha Mitsubishi Shindo Co., Ltd. Wieland KSL Poonsang Metal Manufacturing Comments: quality problems for Products of NIES
Mitsui High Tech	Kuala Lumpur, Malaysia	100	Multiple suppliers from Japan Mitsubishi Mining and Smelting Furukawa Electric Co., Ltd. Nippon Mining Co., Ltd. Hitachi Cable Ltd. - major considerations: . quality . promptness in delivery . price - not using raw materials from NIES (low quality products)

Name of Company	Location	Ave. Monthly Consumption (in Metric Tons)	Sources/Remarks
Kitako Electronics	Malacca, Malaysia	20	Multiple suppliers Siemens Mitsubishi Mining and Smelting Will consider buying from new supplier; primary consideration is quality Used to buy raw materials from NIES - not satisfied with quality
Mitsui High Tech	Singapore	100	Procurement policy dependent on customer's decision and recommendation of suppliers Multiple suppliers Mitsuibishi Mining and Smelting Furukawa Electric Co., Ltd. Nippon Mining Co., Ltd. Hitachi Cable Ltd. Poonsang Metal Manufacturing - major considerations: . quality of raw material . type of composition components . reliability Consideration of buying from new source depends on customers.

Name of Company	Location	Ave. Monthly Consumption (in Metric Tons)	Sources/Remarks
Enomoto Precision	Singapore	10	Multiple suppliers from Japan Mitsubishi Mining and Smelting Nippon Mining Co., Ltd. - major considerations: . quality . reliability Consideration of buying from new source depends on customers and if price is reasonable
Jade Technologies	Singapore	50	Multiple suppliers - major considerations: . reliability of the product . type of composition components No intention of buying from new suppliers Uses copper materials from Korea - no major problems

NIES - Newly Industrialized Economies

Source: Interviews

3.1 DEMAND AND MARKET ANALYSIS

3.1.1 Market Overview

Total imports of copper and copper alloy flat products in 1989 (excluding coin blanks and sheets for lead frames as described in Chapter 2) in the ASEAN Region and the newly industrialized economies (NIES) of Hong Kong, South Korea and Taiwan, and Japan are reported to be 67,890 metric tons (See Table 3.1). About 77% of this is accounted for by the NIES countries and Japan with a total volume of 52,775 metric tons.

Table 3.1
Importation of Copper and Copper Alloy Flat Products
by Selected ASEAN, NIES Countries and Japan, 1989
(metric tons)

COUNTRY	Volume	Share (%)
Indonesia	2,413	4
Malaysia	1,190 *	2
Philippines	2,396	4
Singapore	6,146 **	9
Thailand	2,700	4
Total ASEAN	15,115	23
Hong Kong	25,014 ***	37
South Korea	2,743	4
Taiwan	18,318 ****	27
Total NIES	46,075	68
Japan	6,700	9
TOTAL	67,890	100

* Excludes importation of copper and copper alloy flat products for fabrication of lead frames estimated at 4,680 metric tons.

** Excludes importation of copper and copper alloy flat products for fabrication of lead frames estimated at 1,920 metric tons and exports to Malaysia of 1,100 metric tons.

*** Excludes importation of copper and copper alloy flat products for fabrication of lead frames estimated at 3,000 metric tons.

**** Excludes importation of copper and copper alloy flat products for use in the manufacture of lead frames estimated at 780 metric tons.

Sources: Foreign Trade Statistics of respective countries except for Malaysia which was taken from the Copper and Copper Alloy Manufacturers Association of Japan.

3.1.2 Philippines Market

(1) Importation and Major Industry Users

The 1989 consumption of copper and copper alloy flat products in the Philippines was 2,396 metric tons, as shown in Table 3.2. This figure is derived solely from imports as there is no local production in the country.

Growth in imports during the past ten years has been erratic. Importation did not significantly increase during 1980 to 1987. In 1988, however, it rose by 40% from 1,790 metric tons to 2,500 metric tons.

Among flat products imported, an average of 87% of the total was brass.

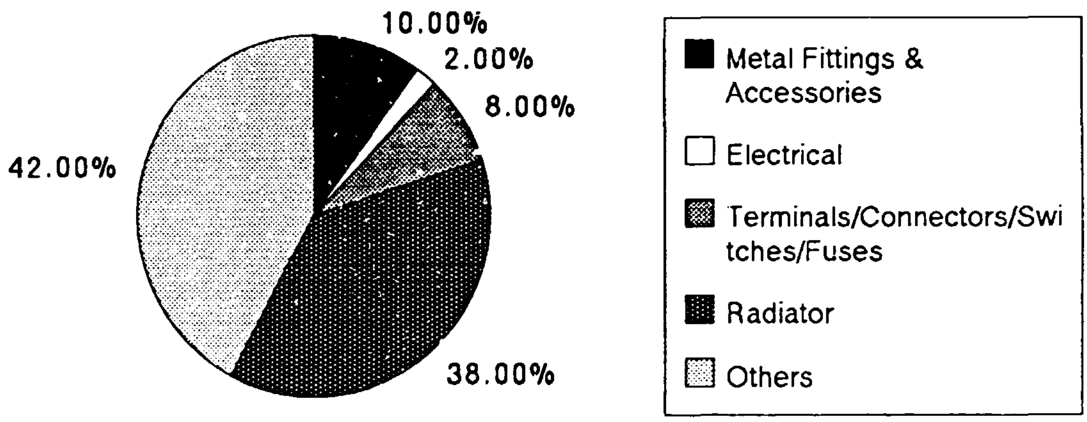
Table 3.2
PHILIPPINES
Import Volumes of Selected Copper and Copper Alloy Flat Products
(In Metric Tons)

Copper Flat Product	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Unalloyed Copper	125	182	273	236	73	77	103	306	265	294
Brass	1,333	1,259	1,457	1,388	728	838	1,358	1,465	2,196	2,017
Bronze	5	15	42	39	26	13	29	19	39	85
Total	1,463	1,456	1,772	1,663	827	928	1,490	1,790	2,500	2,396

Source: Philippine Foreign Trade Statistics.

As shown in Fig. 3.A, the major industrial user of copper and copper alloy flat products is the radiator-manufacture industry, accounting for 900 metric tons or 38% of total 1989 domestic consumption.

Domestic Consumption of Copper & Copper Alloy Flat Products by Industry Users in Philippines (1989)
Fig. 3.A



The radiator-manufacturing industry solders copper and copper alloy flat products into fins, tubes and tanks for radiators. Based on interviews, the user industry's consumption of copper and copper alloy flat products is estimated at 900 metric tons. About 80% of this is accounted for by UE-Automotive Manufacturing, Inc. which manufactures radiators under license by Toyo Corporation of Japan. The other major manufacturer is General Parts Manufacturing Corp. which uses an estimated 95 metric tons per year.

The metal fittings and accessories industry manufactures products of various shapes and sizes for bags, wallets, shoes and fashion jewelry.

Interviews with major manufacturers of terminals, connectors, switches and fuses indicate that the industry consumes about 200 metric tons of copper and copper alloy flat products annually. Major users include Eagle Electric of the Philippines (100 metric tons per year), Ever Electric Manufacturing, Inc. (40 metric tons), and Super Manufacturing Inc. (20 metric tons).

The electrical industry's consumption of brass flat products is estimated at 50 metric tons, of which General Heat Corporation has an estimated consumption of 45 metric tons per year, and Wonder Product and Development Corporation consumes two metric tons of brass flat products.

Other user industries include construction, handicraft manufactures, and trophie and plaque manufacturers.

(2) Sources of Supply

Japan has consistently been the country's biggest supplier of copper and copper alloy flat products over the past ten years, supplying an average 72% of total imports. In 1989, Japan's exports to the Philippines amounted to 907 metric tons. Major Japanese suppliers of copper and copper alloy flat products to the Philippines are Sambo, Kobe Steel, Kai-Wa, Mitsui, Okura Trading, Hitachi, Metalbunken and Mitsubishi. Other major country suppliers include Singapore, Sweden, the Republic of Korea, and Taiwan.

Table 3.3
PHILIPPINES
Import Volumes of Selected Copper and Copper Alloy Flat Products:
Plates, sheets and strip of copper and copper alloys
(In Metric Tons)

COUNTRY OF ORIGIN	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Japan	1,306	1,275	1,680	1,390	590	779	970	1,189	1,013	907
Singapore	-	-	-	-	-	-	-	91	333	320
Sweden	-	-	-	6	5	-	12	22	173	265
Korea, Republic of	2	3	37	187	110	109	338	259	493	246
Taiwan	-	34	-	13	8	1	25	16	63	210
Hong Kong	13	4	7	6	17	12	35	56	254	184
Netherlands	-	-	-	6	-	-	2	6	43	161
Australia	37	80	2	-	2	3	55	86	38	47
United Kingdom	33	24	1	6	64	18	49	19	34	28
United States	65	34	3	5	6	1	1	[illegible]	[illegible]	17
Others	7	3	42	44	23	6	3	38	40	11
Total	1,463	1,456	1,772	1,663	828	928	1,490	1,790	2,500	2,396

Source: Philippine Foreign Trade Statistics.

3.1.3 Indonesian Market

(1) Importation and Major Industry Users

Domestic consumption of copper and copper alloy flat products is satisfied solely by importing. During the last decade consumption averaged about 2,100 metric tons, with a high of 2,881 metric tons in 1985. During 1989, the volume of imports was 2,413 metric tons. (See Table 3.4)

The bulk of imports has been brass flat products which have averaged 67% of total imports during the last nine years.

Table 3.4
INDONESIA
Import Volumes of Selected Copper and Copper Alloy Flat Products
(In Metric Tons)

Copper Flat Product	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989*
Unalloyed Copper	2,622	172	355	319	372	806	876	681	938	1,092
Brass	---	1,183	2,129	1,575	1,230	1,938	1,583	1,604	1,201	1,193
Bronze	---	1	36	1	4	12	8	22	11	12
Other Copper Alloys	---	278	99	216	50	125	186	111	68	116
Total	2,622	1,634	2,619	2,111	1,656	2,881	2,653	2,418	2,218	2,413

* Based on January to November 1989 figures.

Source: Foreign Trade Statistics of Indonesia.

About 1,150 metric tons (projected: based on the 1985 estimate of the Japan Copper and Copper Alloy Manufacturers Association of 1,000 metric tons at 3.5% annual growth) of copper flat products were imported by Indonesia from Japan for use in the manufacture of radiators. Other major users are in construction, electricals and miscellaneous products.

(2) Sources of Supply

The country's biggest supplier of copper and copper alloy flat products is Japan which accounted for almost 60% of total imports in 1988. Other major country suppliers included South Korea, the People's Republic of China, Sweden and Germany.

Table 3.5
INDONESIA
Importation of Copper and Copper Alloy Flat Products
by Country of Origin, 1988
(in Metric Tons)

Country	Volume	Share
Japan	1,317	59
South Korea	184	8
People's Rep. of China	148	7
Sweden	122	6
Germany	120	5
Singapore	60	3
Chile	48	2
Taiwan	40	2
Netherlands	39	2
Australia	29	1
Others	111	5
Total	2,218	100

Source: Foreign Trade Statistics of Indonesia.

3.1.4 Malaysian Market

(1) Importation and Major Industry Users

Malaysia's domestic consumption of copper and copper alloy flat products amounts to 5,870 metric tons in 1989. This figure refers to solely imports since there is no local manufacturer of copper sheets or strips.

Imports have averaged about 3,180 metric tons during the last ten years although significantly higher volumes were registered during the last three years, possibly the result of Malaysia's economic recovery and the expansion of electronic production facilities mainly for exports. (See Table 3.6)

The major types of copper sheet imported are brass with an average share of 31% of total imports during 1980 to 1988, and unalloyed copper with 21%.

Table 3.6
MALAYSIA
Import Volumes of Selected Copper and Copper Alloy Flat Products
(In Metric Tons)

Copper Flat Product	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Unalloyed Copper	135	191	163	n.a.	228	336	504	1,734	2,082	n.a.
Brass	1,254	717	596	n.a.	753	931	705	983	1,424	
Bronze	25	27	20	n.a.	37	34	34	39	906	
Other Copper Alloys	623	1,469	1,466	n.a.	2,091	1,000	977	1,422	1,212	
Total	2,037	2,404	2,245	1,801 *	3,109	2,300	2,220	4,179	5,624	5,870 *

* Based on figures provided by the Copper and Copper Alloy Manufacturers Association of Japan

Source: Malaysian Trade Statistics.

About 4,680 metric tons of imported copper sheets and strips are estimated to be used in the manufacture of lead frames. The major manufacturers and their estimated monthly production volume is shown in the following table.

Table 3.7
MALAYSIA
Estimated Consumption of
Copper and Copper Alloy Flat Products
by Major Lead Frame Manufacturers

Name of Company	Annual Usage (Metric tons)
Dyna Craft	3,240
Mitsui High Tech	1,200
Kitako Electronics	240
Total	4,680

Source: Interviews.

Radiator manufacturers consume about 360 metric tons of imported copper flat products as shown in Table 14, with the rest used in the manufacture of miscellaneous products such as ornaments and utensils, and in construction.

Table 3.8
MALAYSIA
Breakdown of Copper and Copper Alloy Flat Products
Consumption by Major Industry

Industry	Usage (metric tons)	Per Cent
Manufacture of Lead Frames	4,680	80
Manufacture of Radiators	360*	6
Others	830	14
Total	5,870	100

* Projected (based on the 1985 estimate of the Copper and Copper Alloy Manufacturers Association of Japan of 300 metric tons at 4.4% annual growth).

Sources: Interviews.
Copper and Copper Alloy Manufacturers Association of Japan.

(2) Sources of Supply

Over the last ten years, Japan has consistently provided the greatest volume of Malaysia's requirements for copper and copper alloy flat products. In 1988, Japan accounted for 36% of total imports of flat products. The United States and Singapore supply about 25% and 18 per cent, respectively, as shown in Table 3.9.

Table 3.9
MALAYSIA
Import Volumes of Selected Copper and Copper Alloy Flat Products:
Plates, sheets and strip of copper and copper alloys
(In Metric Tons)

COUNTRY OF ORIGIN	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Japan	1,327	1,248	840	n.a.	1,334	1,311	1,034	1,150	2,051	n.a.
United States	370	595	898		1,147	384	322	723	1,408	
Singapore	57	335	273		311	163	130	244	1,035	
Taiwan	1	-	6		14	15	46	25	260	
Australia	69	89	108		62	119	65	137	204	
Hong Kong	49	19	31		84	109	90	176	197	
United Kingdom	41	15	7		33	27	50	67	101	
Poland	-	-	-		-	-	17	21	82	
China, People's Rep. of	-	-	nil		17	10	22	95	74	
Korea, Republic of	-	-	55		2	75	105	158	74	
Others	124	104	26		105	86	339	1,383	139	
Total	2,037	2,404	2,245	2,678+	3,109	2,300	2,220	4,179	5,624	5,870+

+ Based on figures provided by the Copper and Copper Alloy Manufacturers Association of Japan.

Source: Malaysian Trade Statistics.

3.1.5 Singapore Market

(1) Importation and Major Industry Users

Imports by Singapore of copper and copper alloy flat products amounts to 9,436 metric tons in 1989. Imports of flat products consist mainly of unalloyed copper flat products as shown in Table 3.10.

Singapore's imports have grown from 5,603 metric tons in 1981 to 9,436 metric tons in 1989. A large drop in consumption was noted in 1986, when it fell to 7,540 metric tons from 9,901 metric tons the previous year.

Table 3.10
SINGAPORE
Import Volumes of Selected Copper and Copper Alloy Flat Products
(In Metric Tons)

Copper Flat Product	1981	1982	1983	1984	1985	1986	1987	1988	1989
Unalloyed Copper	n.a.	1,010	5,830	7,678	9,901	7,540	8,765	8,542	9,436
Brass		2,624	---	---	---	---	---	---	---
Bronze		320	---	---	---	---	---	---	---
Other Copper Alloys		1,045	---	---	---	---	---	---	---
Total	5,603 +	4,999	5,830	7,678	9,901	7,540	8,765	8,542	9,436

\+ Based on figures provided by the Copper and Copper Alloy Manufacturers Association of Japan.

Source: Singapore Trade Statistics.

Semi-finished strips for electrical applications and computers account for over half of all imports, with an estimated annual usage of 5,780 metric tons as shown in Table 3.11. Lead frame manufacturers consume 1,920 metric tons and exports to Malaysia amounted to 1,100 metric tons.

Table 3.11
SINGAPORE
Breakdown of Copper and Copper Alloy Flat Products Consumption by Major Industry

Industry	Usage (metric tons)	Per cent (%)
Electrical Applications and Computers	5,780*	61
Manufacture of Lead Frames	1,920	20
Exports to Malaysia	1,100	12
Others	636	7
Total	9,436	100

* Projected (based on the 1985 estimate of the Copper and Copper Alloy Association of japan of 5,00 metric tons at 3.7% annual growth).

Source: Interviews
Cooper and Copper Alloy Manufacturers Association of Japan.

Major manufacturers of lead frames and their estimated consumption volumes are shown in the following table.

Table 3.12
SINGAPORE
Estimated Consumption of Copper and Copper Alloy Flat products by Major Lead Frame Manufacturers

Company	Annual Consumption (metric tons)
Mitsui High Tech	1,200
Jade Technologies	600
Enomoto Precision Engineering	120
Total	1,920

Source: Interviews.

(2) Sources of Supply

The bulk of Singapore's imports came from Japan which provided 66% of the flat products in 1989, with West Germany a distant second with 9%. A sharp rise in imports from South Korea over the last three years has made that country the third largest source of copper flat products with an eight per cent share, from zero in 1982. (See Table 3.13)

Table 3.13
SINGAPORE
Import Volumes of Copper and Copper Alloy Flat Products
(In Metric Tons)

COUNTRY OF ORIGIN	1981	1982	1983+	1984+	1985	1986	1987	1988	1989
Japan	n.a.	3,957	4,569	5,044	4,740	4,812	5,722	5,830	6,216
Germany, Fed. Rep. of		306	163	511	668	684	931	686	870
Korea, Republic of		-	3	33	32	91	453	670	757
United States		144	210	328	169	224	313	415	278
Poland		-	-	-	17	68	274	-	243
Hong Kong		154	93	89	126	155	176	191	203
Australia		128	89	1,249	1,114	132	128	130	176
Malaysia		10	16	-	-	16	-	42	143
Brazil		-	-	9	-	-	-	-	133
United Kingdom		29	8	26	37	83	101	147	95
Others		271	679	389	2,998	1,275	667	431	322
Total	5,603 *	4,999	5,830	7,678	9,901	7,540	8,765	8,542	9,436

* 1981 figure provided by the Copper and Copper Alloy Manufacturers Association of Japan.
\+ Based on January to November 1989 figures.

Source: Singapore Trade Statistics

3.1.6 Thai Market

(1) Importation and Major Industry Users

In 1989 domestic consumption of copper and copper alloy flat products amounted to 2,700 metric tons. All of this was imported.

Brass flat products accounted for 41% of total imports in 1989, while unalloyed copper flat products for 25% or 676 metric tons.

Imports of copper and copper alloy flat products in Thailand have fluctuated erratically during the past ten years. There were decreases in imports in 1983, 1986 and 1988. Imports of flat products peaked in 1987 at 3,068 metric tons as shown in Table 3.14.

Table 3.14
THAILAND
Import Volumes of Copper and Copper Alloy Flat Products
(In Metric Tons)

Copper Flat Product	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989*
Unalloyed Copper	1,438	1,850	n.a.	1,848	2,074	n.a.	n.a.	n.a.	506	676
Brass	---	---	n.a.	---	---	n.a.	n.a.	n.a.	1,619	1,108
Bronze	---	---	n.a.	---	---	n.a.	n.a.	n.a.	15	12
Other Copper Alloys	---	---	n.a.	---	---	n.a.	n.a.	n.a.	325	904
Total	1,438	1,850	2,700 +	1,848	2,074	2,450 +	2,296 +	3,063 +	2,465	2,700

* Based on January to March 1989 import statistics.
\+ Based on figures provided by the Copper and Copper Alloy Manufacturers Association of Japan.

Source: Foreign Trade Statistics of Thailand.

About 690 metric tons of copper sheeting and strips were used in the manufacture of radiators. The rest were used in the manufacture of miscellaneous products including those for construction, stoves, utensils, etc.

(2) Sources of Supply

Japan is the largest supplier of copper and copper alloy flat products to Thailand, accounting for 57% in 1988, the last year for which data by country of origin is available. South Korea and Taiwan were other major suppliers of copper flat products. (See Table 3.15)

Table 3.15
THAILAND
Import Volumes of Copper and Copper Alloy Flat Products
(In Metric Tons)

COUNTRY OF ORIGIN	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Korea, Rep. of	-	99	n.a.	88	266	n.a.	n.a.	n.a.	483	n.a.
United States	3	10		7	12				21	
Japan	1,372	1,598		1,599	1,655				1,415	
Chile	-	-		-	-				63	
Taiwan	9	52		8	24				179	
Sweden	-	-		-	-				38	
Australia	nil	27		32	-				44	
France	1	nil		nil	-				26	
Germany, Fed. Rep. of	2	nil		3	2				32	
New Zealand	-	2		-	-				nil	
Other Countries	50	62		111	115				164	
Total	1,438	1,850	2,700*	1,848	2,074	2,450*	2,296*	3,068*	2,465	2,700+

* Figures provided by the Copper and Copper Alloy Manufacturers Association of Japan.
\+ Annualized total based on imports for the period January to March 1989.

Source: Foreign Trade Statistics of Thailand.

3.1.7 Hong Kong Market

(1) Importation and Major Industry Users

Hong Kong imported 28,014 metric tons of copper and copper alloy flat products in 1989. Brass accounted for 20,870 metric tons, while unalloyed copper and bronze accounted for 4,865 and 2,342 metric tons, respectively, as shown in Table 5.16.

Imports have grown over the last five years, from 14,352 metric tons in 1985 to the current level. During 1989 Hong Kong experienced a decline of about 6,000 metric tons in imports, probably due to the start up of commercial operations of a new local plant with an annual capacity of 12,000 metric tons. The plant is owned by Chiaphua-Shinko Alloy Co., Ltd., the sole manufacturer of copper alloy flat products in Hong Kong.

Table 3.16
HONG KONG
Import Volumes of Selected Copper and Copper Alloy Flat Products
(In Metric Tons)

Description	1985	1986	1987	1988	1989
Unalloyed Copper	1,435	2,236	3,540	5,662	4,865
Bronze	854	1,300	2,033	2,216	2,342
Brass	12,063	10,273	21,564	26,138	20,807
TOTAL IMPORTS	14,352	19,809	27,137	34,016	28,014*

* Updated figures for 1989
Source: Hong Kong Trade Statistics.

Hong Kong lead frame manufacturers use an estimated 3,000 metric tons of copper and copper alloy flat products per year, as shown in the following table.

Table 3.17
HONG KONG
Consumption of Copper and Copper Alloy Flat Products
by Major Lead Frame Manufacturers

Name of Company	Annual Usage (metric tons)
Mitsui High Tech	1,200
Possell	1,200
ASM	420
QPL	180
Total	3,000

Source: Interviews

(2) Sources of Supply

About 70% of all copper flat products were imported in 1989. Japan was the largest supplier, accounting for 44% of total. Other important suppliers included South Korea, the People's Republic of China, Brazil, West Germany, and Taiwan.

Table 3.18
HONG KONG
Import Volumes of Copper and Copper Alloy Flat Products
(in Metric Tons)

Country of Origin	1985	1986	1987	1988	1989
Japan	7,714	10,034	14,537	15,388	12,304
Korea, Republic of	3,456	5,767	6,902	6,946	7,452
China, People's Republic of	1,662	2,505	2,412	5,992	3,269
Brazil	-	-	433	1,952	2,465
Germany, Federal Republic of	161	325	905	1,052	1,031
Taiwan	285	375	351	892	629
South Africa	45	78	16	29	225
United Kingdom	202	72	200	149	135
United States	35	150	301	130	170
Australia	76	143	109	11	104
others	665	327	460	465	176
H Total	14,352	19,809	27,137	34,016	26,014

Source: Hong Kong Trade Statistics.

Chiaphua-Shinko Co., Ltd., the sole local supplier, was incorporated in June 1965 as a joint venture of Chiap Hua Copper Alloy Factory, Ltd. of Hong Kong, Kobe Steel Ltd. and Nissho Iwai Co., Ltd. of Japan, shared respectively on a 60:30:10 basis.

Chiaphua-Shinko recently relocated their manufacturing plant to the Hong Kong New Territories, incorporating the latest technology. The new plant started operations on November 8, 1988 with a production capacity exceeding 1,000 metric tons per month. During 1989, production output was indicated to be about 12,000 metric tons.

The company produces sheet and strips of brass 65/35 and 70/30, alloys composed of 65% copper/35% zinc, and 70% copper/30% zinc, respectively. Its sheet and strips are used for manufacturing various products, such as electronic and electrical components, battery caps, watch and clock parts,metal buckles and buttons, costume ornaments and brassware, etc. It mainly sells its brass strip and sheets to Hong Kong manufacturers with a few per cent exported to ASEAN countries.

3.1.8 South Korean Market

(1) Importation and Major Industry Users

South Korea imported 6,256 metric tons of copper and copper alloy flat products in 1989. Statistics indicate that 3,513 metric tons were used in manufacturing semiconductors.

Over the last ten years imports of copper and copper alloy flat products, excluding those used for semi-conductors, have manifested uncertain growth as shown in the following table 3.19.

Table 3.19
SOUTH KOREA
Import Volumes of Selected Copper and Copper Alloy Flat Products
(In Metric Tons)

Description	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Plates, sheets and strip of refined (unalloyed) copper										
- For use in manufacturing semiconductors	---	---	10	---	---	---	1	---	1	---
- Others	822	501	185	170	238	134	132	211	2,288	135
Subtotal	822	501	195	170	238	134	133	211	2,289	135
Plates, sheets and strip of copper-zinc base alloys (brass)										
- For use in manufacturing semiconductors	---	---	21	13	1	4	---	---	---	85
- Others	1,158	882	531	782	766	774	855	1,292	1,475	1,642
Subtotal	1,158	882	552	795	767	778	855	1,292	1,475	1,727
Plates, sheets and strip of copper-tin base alloys (bronze)										
- For use in manufacturing semiconductors	---	---	---	---	---	---	---	---	35	---
- Others	131	66	53	80	159	88	163	410	628	716
Subtotal	131	66	53	80	159	88	163	410	663	716
Plates, sheets and strip of other copper alloys										
- For use in manufacturing semiconductors	---	---	50	397	143	444	1,497	2,290	2,889	3,428
- Others	507	1,481	787	224	594	123	237	197	274	250
Subtotal	507	1481	837	621	737	567	1734	2487	3163	3678
TOTAL IMPORTS	2,618	2,930	1,637	1,666	1,901	1,567	2,885	4,400	7,590	6,256
Less: Plates, sheets and strip of copper and copper alloys for use in manufacturing semiconductors	---	---	81	410	144	448	1,498	2,290	2,925	3,513
TOTAL	2,618	2,930	1,556	1,256	1,757	1,11[illegible]	1,387	2,110	4,665	2,743

Source: Foreign Trade Statistics of Korea.

Manufacturers of lead frames used an estimated 3,513 metric tons of imported copper alloy sheets and strips in 1989. As shown in Table 5.20, the lead frame manufacturers have capacity requirements totalling 3,600 metric tons of copper and copper alloy sheets and strips a year.

Aside from lead frame manufacturers who consumed 56% of all imports of copper and copper alloy flat products in 1989, radiator manufacturers accounted for about 37% with the rest used for electrical applications such as connectors, terminals, and control boards.

Table 3.20

SOUTH KOREA

Estimated Copper and Copper Alloy Flat Products Consumption by Major Lead Frame Manufacturers

Name of Company	Annual Usage (metric tons)
Korea Samsung Aerocraft	2,040
Lucky Gold Star Telecom	480
Tae Suk Precision Co., Ltd.	1,080
Estimated Capacity Requirement	3,600
Actual Consumption	3,513*

* Based on Foreign Trade Statistics of Korea

Source: Interviews

Table 3.21

SOUTH KOREA

Breakdown of Copper and Copper Alloy Flat Products
Consumption by User Industry

Industry User	Annual Usage (metric tons)	Per Cent
Manufacture of Lead Frames	3,513	56
Manufacture of Radiators	2,340*	37
Electrical Applications and Other Industries	403	7
Total	6,256	100

* Projected (Based on the 1985 estimate of the Copper and Copper Alloy Manufacturers Association of Japan of 2,000 metric tons per year at 4.0% annual growth).

Sources: Interviews
Copper and Copper Alloy Manufacturers
Association of Japan

(2) Source of Supply

Japan supplied 89% of the country's imports in 1989. Other suppliers included the People's Republic of China, West Germany, the United States, and Sweden. (See Table 3.22)

Korea has a local manufacturer of copper and copper alloy flat products, namely, Poongsan Metal Manufacturing Co., Ltd.

Table 3.22
SOUTH KOREA
Import Volumes of Selected Copper and Copper Alloy Flat Products:
Plates, Sheets and Strip, of Copper Alloys +
(In Metric Tons)

Country of Origin	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Japan	2,559	2,798	424	1,193	1,236	911	1,320	2,006	2,153	2,450
China, Republic of	-	-	1	-	-	-	-	-	87	110
West Germany	2	20	19	56	32	40	24	33	101	92
United States	31	53	11	5	21	10	22	23	2,086	31
Sweden	-	-	-	-	-	-	5	-	-	12
Finland	-	-	-	-	-	-	-	26	173	6
Hong Kong	-	-	-	-	-	-	-	*	54	1
France	26	1	533		105	7	-	-	1	-
United Kingdom	-	6	23	2	*	1	12	3	2	*
Switzerland	-	-	-	-	-	-	-	1	8	-
Others	-	52	545	-	363	150	4	18	-	41
Total	2,618	2,930	1,556	1,256	1,757	1,119	1,387	2,110	4,665	2,743

+ Excludes plates, sheets and strip of copper-nickel-zinc (cupro nickel) or copper-nickel (nickel silver) base alloys and other copper alloys for use in manufacturing semiconductors.
* Less than one (1) metric ton.

Source: Foreign Trade Statistics of Korea.

3.1.9 Taiwan Market

(1) Importation and Major Industry Users

Total imports of copper and copper alloy flat products amounted to 19,098 metric tons in 1989. Brass imports accounted for the largest share with 11,690 metric tons (see Table 3.23). Importation has been erratic over the last nine years.

Table 3.23
TAIWAN
Import Volumes of Selected Copper and Copper Alloy Flat Products *
(In Metric Tons)

Description	1981	1982	1983	1984	1985	1986	1987	1988	1989
Plates, sheets and strip of refined copper (unalloyed copper)	1,143	1,891	953	1,146	1,021	1,178	1,307	1,215	1,587
Plates, sheets and strip of copper-zinc base alloys (brass)	10,142	9,810	15,398	19,327	16,338	19,385	19,767	15,437	11,690
Plates, sheets and strip of copper-tin base alloys (bronze)	348	73	162	224	371	984	1,511	1,657	3,515
Plates, sheets and strip of other copper alloys	1,162	988	935	988	1,022	1,550	2,673	3,053	2,306
TOTAL IMPORTS	12,795	12,762	17,448	21,685	18,752	23,097	25,258	21,362	19,098

* Excludes plates, sheets and strip of copper-nickel-zinc (cupro nickel) or copper-nickel (nickel silver) base alloys.

Sources: Taipei Trade Statistics.

Lead frame manufacturers in Taiwan consume an estimated 780 metric tons annually as shown in Table 3.24. Around 700 metric tons of copper flat products are used in the production of radiators, while 3,510 metric tons are used for electrical and electronic products such as connectors, terminals, switchboards, and control boards.

Table 3.24
TAIWAN
Estimated Consumption of Copper and Copper Alloy Flat Products by Major Lead Frame Manufacturers

Name of Company	Annual Usage (metric tons)
Jyntoku	600
Getmore	60
Kenley Precision Industrial Co., Ltd.	120
Total	780

Source: Interviews

Table 3.25

TAIWAN

Breakdown of Consumption of Copper and Copper Alloy Flat Products by User Industry

User Industry	Annual Usage (metric tons)	Per Cent
Manufacture of Lead Frames	780	4
Electrical Applications	3,510*	18
Manufacture of Radiators	700*	4
Others	14,108	74
Total	19,098	100

* Projected (based on the 1985 estimates of the Copper and Copper Alloy Manufacturers Association of Japan of 3,000 metric tons for electrical applications and 600 metric tons for radiators at 4.0% annual growth).

Sources: - Interviews
- Copper and Copper Alloy Manufacturers Association of Japan

(2) Source of Supply

Japan is the major country supplier of copper flat products to Taiwan, providing 57% of all imports in 1989. Most of the remainder was supplied by South Korea and West Germany. (See Table 3.26)

Taiwan has three local manufacturers of copper and copper alloy flat products. These are First Copper & Iron Industrial Co., Ltd., Hsin Tai Industry Co., Ltd., and Minchali Metal Industry Co., Ltd. (additional information will be added as soon as we receive this from our office).

Table 3.26
TAIWAN
Import Volumes of Copper and Copper Alloy Flat Products
(In Metric Tons)

COUNTRY OF ORIGIN	1981	1982	1983	1984	1985	1986	1987	1988	1989
Japan	12,585	11,489	13,253	12,923	11,251	13,695	14,805	11,520	10,996
Korea	34	1,074	3,782	7,186	5,066	5,503	5,346	5,352	4,273
Germany, Federal Republic of	115	38	188	426	590	1,852	3,680	3,822	2,794
United States	36	12	58	125	89	71	117	105	318
Hongkong	6	-	21	4	1	3	7	-	150
Finland	-	-	-	12	41	27	224	121	84
Netherlands	-	-	30	-	*	6	7	22	17
Italy	-	-	-	-	-	*	-	-	5
France	1	1	1	20	831	1,189	361	79	-
United Kingdom	1	-	2	-	25	12	56	67	-
Others	17	148	113	988	858	739	655	274	461
Total	12,795	12,762	17,448	21,685	18,752	23,097	25,258	21,362	19,098

* Less than 1 metric ton

Source: Taipei Trade Statistics

3.1.10 Japanese Market

(1) Current demand

1) Production of flat products

Total production of flat products (copper and copper alloy sheets and strips), including those for lead frames for the last ten years 1980 to 1989 is presented in Table 3.27.

2) Imports of flat products

Imports of flat products including those for lead frames from each country are presented in Table 3.28. Imports in 1989 totaled 7,491 metric tons, and about 75% (i.e 5,629 metric tons) of this amount were imported from a state-owned Korean firm.

* Note: Products for lead frames acounted for approximately 10% of total imports. This ratio is based on the actual import figures of a major exporter in Korea. Import figures excluding lead frames are shown in Fig. 3.B.

3) Exports of flat products

The total amount of exports of flat products, including those for lead frames, to ASEAN and NIES countries is presented in Table 3.29.

4) Current demand of flat products

Current demand for copper and copper alloy wrought products in 1989 was approximately 1,050,000 metric tons as shown in Fig. 3.C and Table 3.30. Out of this amount, about 430,000 metric tons, which is equal to 42% of total demand for wrought products, represents the demand for copper alloy sheets and strips (flat products) as shown in Fig. 3.D and Table 3.31. (Approximately 7% of flat products for the fabrication of lead frames is included in these figures.)

Current applications for each product are listed in Table 3.32 and 3.E.

JAPAN - Table 3.27 -

Production of Flat Products (including lead frames) (x 1,000 m/t)

	Copper			Copper-Alloyed						G-Total
				Brass						
	Sheets	Strips	Total	Sheets	Strips	Sub total	Bronze Sheets/ Strips	Zn-Ni Sheets/ Strips	Total	
1980	32.8	96.6	129.4	41.9	168.2	210.1	22.9	4.9	237.9	367.3
1981	27.7	91.2	118.9	36.8	157.9	194.7	22.9	4.6	222.2	341.1
1982	27.0	92.9	119.9	37.1	148.8	185.9	21.0	3.9	210.8	330.7
1983	28.9	109.7	138.6	37.9	180.0	217.9	28.1	5.4	251.4	390.0
1984	33.0	126.3	159.3	40.4	178.5	218.9	29.9	5.9	254.7	414.0
1985	30.7	119.9	150.6	41.3	175.5	216.8	24.9	6.4	248.1	398.7
1986	33.1	132.7	165.8	34.9	180.6	215.5	29.3	7.5	252.3	418.1
1987	33.0	154.0	187.0	33.2	187.8	221.0	33.9	8.1	263.0	450.0
1988	33.2	150.9	184.1	31.9	185.8	217.7	38.9	8.6	265.2	449.3
1989	35.5	164.7	200.2	31.3	196.4	227.7	38.8	7.9	274.4	474.6
% share ('89)	7.5	34.7	42.2	6.6	41.4	48.0	8.2	1.7	57.8	100.0
% growth ('88/'89)	6.9	9.1	8.7	-1.9	5.7	4.6	-0.3	-8.1	3.5	5.6

Source: Japan Copper and Copper Alloy Manufacturers' Association

Imports of Flat Products in Japan (including L/F)

	1,980	1,981	1,982	1,983	1,984	1,985	1,986	1,987	1,988	1,989
S.Korea										
Copper	0	0	2	0	0	9	8	16	20	103
Copper Alloy	166	446	830	1,980	4,713	3,124	3,980	4,189	4,835	5,526
Sub- Total	166	446	832	1,980	4,713	3,133	3,988	4,205	4,855	5,629
Taiwan										
Copper	0	0	0	0	0	0	7	7	217	82
Copper Alloy	0	0	0	0	0	1	4	10	81	100
Sub- Total	0	0	0	0	0	1	11	17	298	182
U.S.A.										
Copper	7	32	6	4	6	5	42	67	930	533
Copper Alloy	3	9	10	6	303	125	445	875	621	535
Sub- Total	10	41	16	10	309	130	487	942	1,551	1,068
Finland										
Copper	0	0	0	0	0	0	0	0	3	187
Copper Alloy	0	0	0	0	0	0	0	0	0	0
Sub- Total	0	0	0	0	0	0	0	0	3	187
France										
Copper	0	0	0	0	0	0	0	40	133	166
Copper Alloy	0	0	0	0	1,160	0	0	7	4	8
Sub- Total	0	0	0	0	1,160	0	0	47	137	174
W.Geramany										
Copper	2	22	0	0	3	11	1	16	9	8
Copper Alloy	2	1	6	2	24	238	120	247	224	74
Sub- Total	4	23	6	2	27	249	121	263	233	82
Other Countries										
Copper	30	21	50	0	26	61	0	7	26	13
Copper Alloy	10	2	1	453	111	96	11	9	38	156
Sub- Total	40	23	51	453	137	157	11	16	64	169
Total										
Copper	39	75	58	4	35	86	58	153	1,338	1,092
Copper Alloy	181	458	847	2,441	6,311	3,584	4,560	5,337	5,803	6,399
Sub- Total	220	533	905	2,445	6,346	3,670	4,618	5,490	7,141	7,491

(× 1000MT)
Source . Japan Copper & Copper Alloy Manufacturers' Association

Imports of Flat Products in Japan (excluding L/F)

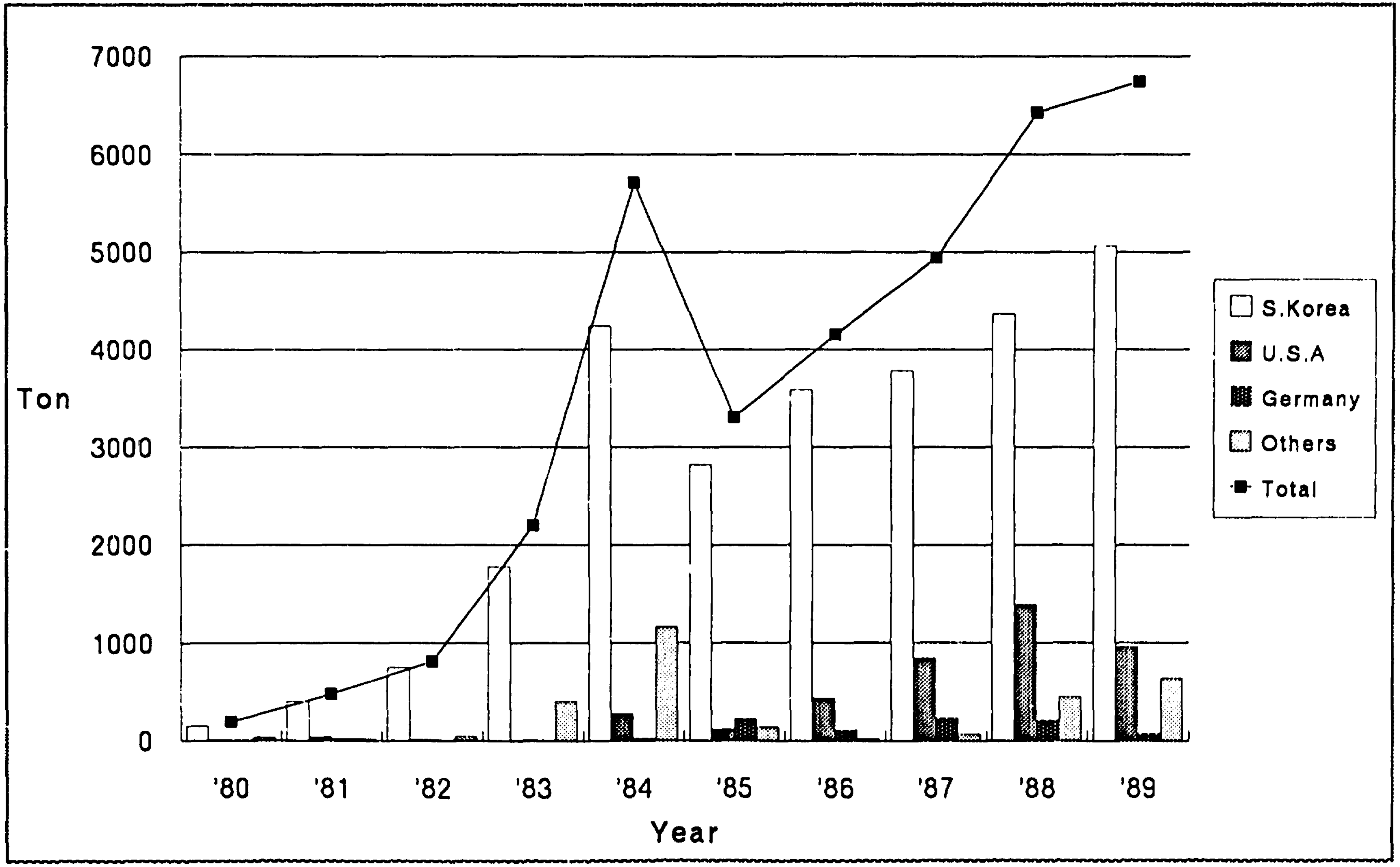


Fig. 3.B

J A P A N Export of Flat Products (including lead frames) - Table 3.29 -

(Metric ton)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
PHILIPPINES										
Copper	152	101	126	157	48	31	57	57	85	150
Copper Alloyed	1,150	1,359	1,851	2,486	928	795	1,063	1,233	970	828
Total	1,302	1,460	1,977	2,643	976	826	1,120	1,290	1,055	978
THAILAND										
Copper	148	186	205	162	143	138	186	186	107	197
Copper Alloyed	1,789	2,330	2,287	2,180	1,997	2,005	1,319	1,792	1,421	1,377
Total	1,937	2,516	2,492	2,342	2,140	2,143	1,505	1,978	1,528	1,574
SINGAPORE										
Copper	293	909	887	1,120	1,644	1,117	1,241	1,888	1,732	2,364
Copper Alloyed	3,498	3,615	3,773	4,107	5,510	5,277	6,759	9,726	3,915	4,478
Total	3,791	4,524	4,660	5,227	7,154	6,394	8,000	11,614	5,647	6,842
MALAYSIA										
Copper	60	176	200	228	233	392	231	185	149	301
Copper Alloyed	981	391	640	667	548	689	851	536	543	1,182
Total	1,041	567	840	895	781	1,081	1,082	721	692	1,483
INDONESIA										
Copper	405	290	374	167	202	297	259	156	162	148
Copper Alloyed	1,592	2,141	2,151	1,511	1,735	1,743	1,225	958	982	814
Total	1,997	2,431	2,525	1,678	1,937	2,040	1,484	1,114	1,144	962
ASEAN TOTAL										
Copper	1,058	1,662	1,792	1,834	2,270	1,975	1,974	2,472	2,235	3,160
Copper Alloyed	9,010	9,836	10,702	10,951	10,718	10,509	11,217	14,245	7,831	8,679
TOTAL	10,068	11,498	12,494	12,785	12,988	12,484	13,191	16,717	10,066	11,839
HONG KONG										
Copper	470	469	631	432	559	640	703	1,115	1,308	1,201
Copper Alloyed	12,776	9,890	10,955	9,058	9,068	9,222	11,296	15,317	15,808	11,085
Total	13,246	10,359	11,586	9,490	9,627	9,862	11,999	16,432	17,116	12,286
S.KOREA										
Copper	902	621	215	215	340	485	1,082	1,301	1,768	2,512
Copper Alloyed	4,270	3,509	2,575	2,699	2,866	2,913	5,054	6,768	5,017	4,577
Total	5,172	4,130	2,790	2,914	3,206	3,398	6,136	8,069	6,785	7,089
TAIWAN										
Copper	1,328	1,066	1,543	676	418	410	519	788	864	802
Copper Alloyed	14,006	14,511	13,673	17,985	19,227	17,049	22,675	24,647	12,164	13,644
Total	15,334	15,577	15,216	18,661	19,645	17,459	23,194	25,435	13,028	14,446
NIES TOTAL										
Copper	2,700	2,156	2,389	1,323	1,317	1,535	2,304	3,204	3,940	4,515
Copper Alloyed	31,052	27,910	27,203	29,742	31,161	29,184	39,025	46,732	32,989	29,306
Total	33,752	30,066	29,592	31,065	32,478	30,719	41,329	49,936	36,929	33,821
ASEAN/NIES TOTAL										
Copper	3,758	3,818	4,181	3,157	3,587	3,510	4,278	5,676	6,175	7,675
Copper Alloyed	40,062	37,746	37,905	40,693	41,879	39,693	50,242	60,977	40,820	37,985
TOTAL	43,820	41,564	42,086	43,850	45,466	43,203	54,520	66,653	46,995	45,660

Source: Japan Copper and Copper Alloy Manufacturers' Association

Demand of Wrought Products in Japan

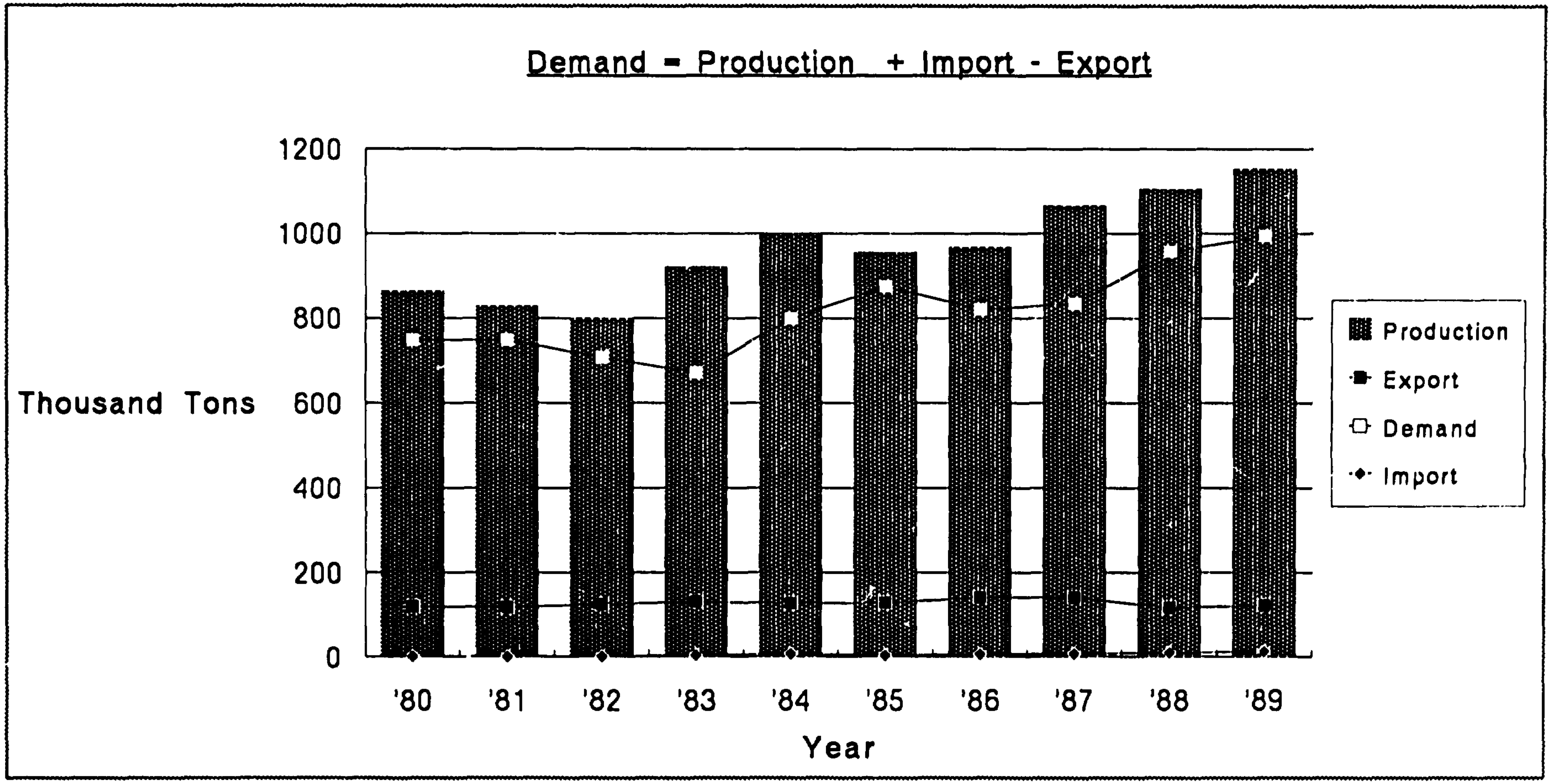


Fig. 3.C

JAPAN - Table 3.30 -

Demand figures of Copper and Copper Alloyed Wrought Products

(x 1,000 m/t)

	Production A)	%growth	Import	%growth	Export	%growth	Demand	%growth
1980	866.0		2.3		120.0		748.3	
1981	830.0	-4.2	2.2	-4.3	118.7	-1.1	713.5	-4.7
1982	801.4	-3.4	1.6	-27.3	124.1	4.5	678.9	-4.8
1983	921.2	14.9	4.9	206.3	130.4	5.1	795.7	17.2
1984	996.2	8.1	7.5	53.1	126.6	-2.9	877.1	10.2
1985	956.4	-4.0	4.5	-40.0	128.3	1.3	832.6	-5.1
1986	968.3	1.2	7.2	60.0	140.3	9.4	835.2	0.3
1987	1,066.6	10.2	8.2	13.9	140.8	0.4	934.0	11.8
1988	1,106.0	3.7	10.3	25.6	116.9	-17.0	999.4	7.0
1989	1,153.5	4.3	12.4	20.4	122.1	4.4	1,043.8	4.4

(Demand = Production + Import - Export)

Source: Japan Copper and Copper Alloy Manufactuers' Association

Demand for Flat Products in Japan (including L/F)

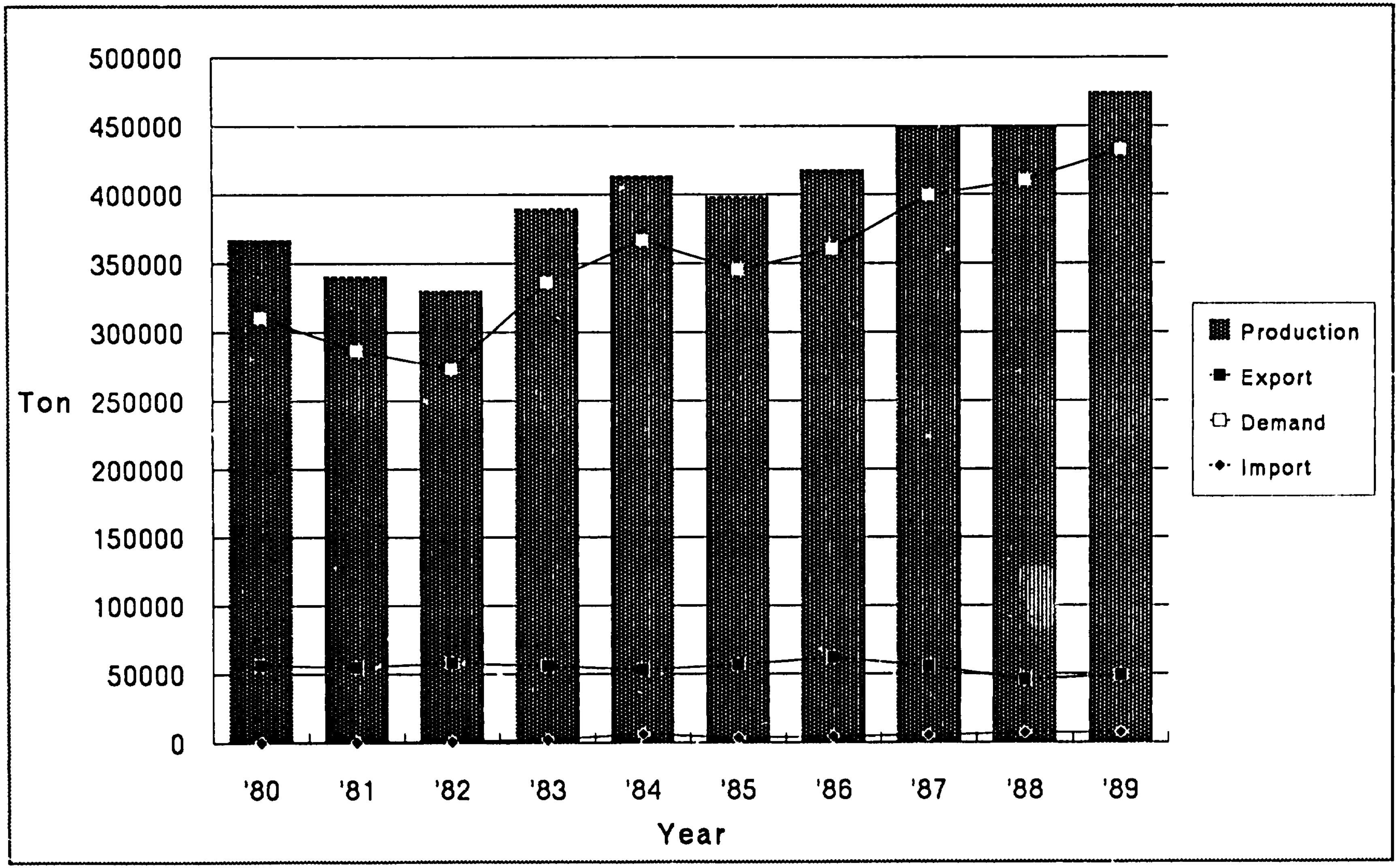


Fig. 3.D

J A P A N - Table 3.31 -

Demand figures of Flat Products

(x 1,000 m/t)

	Production	%growth	Import	%growth	Export	%growth	Demand	%growth
1980	367.3		0.2		56.4		311.1	
1981	341.1	-7.1	0.5	150.0	55.0	-2.5	286.6	-7.9
1982	330.7	-3.0	0.9	80.0	58.1	5.6	273.5	-4.6
1983	390.0	17.9	2.4	166.7	56.0	-3.6	336.4	23.0
1984	414.0	6.2	6.3	162.5	53.3	-4.8	367.0	9.1
1985	398.7	-3.7	3.7	-41.3	56.7	6.4	345.7	-5.8
1986	418.1	4.9	4.6	24.3	62.2	9.7	360.5	4.3
1987	450.0	7.6	5.5	19.6	55.8	-10.3	399.7	10.9
1988	449.3	-0.2	7.1	29.1	45.9	-17.7	410.5	2.7
1989	474.6	5.6	7.5	5.6	49.1	7.0	433.0	5.5

(Demand = Production + Import - Export)

Source: Japan Copper and Copper Alloy Manufactuers' Association

J A P A N Application & Supply of Flat Products - Table 3.32 -

(For 1989) (x 1,000 m/t)

	Copper			Copper Alloyed										G-Total	%Share
				Brass			Bronze			Others					
	Sheets	Strips	Total	Sheets	Strips	S-Total	Sheets	Strips	S-total	Sheets	Strips	S-total	Total		
* Metal manufacturing															
1. Utensils	1.5	2.4	3.9	0.8	9.2	10.0	#	#	#	0.4	0.1	0.5	10.5	14.4	2.9
2. Gas/Oil stoves	1.2	8.1	9.3	0.2	1.5	1.7	0.0	0.0	0.0	0.0	0.0	0.0	1.7	11.0	2.2
3. Others	1.2	5.1	6.3	3.9	8.9	12.8	0.4	0.2	0.6	0.0	0.0	0.0	13.4	19.7	4.0
* Electrical & electronics															
1. Semiconductors	1.0	27.5	28.5	#	1.9	1.9	#	3.1	3.1	#	0.3	0.3	5.3	33.8	6.9
2. Connectors & terminals	1.5	12.4	13.9	0.3	50.8	51.1	0.4	15.0	15.4	0.1	2.0	2.1	68.6	82.5	16.9
3. Switch/control boards	2.3	8.0	10.3	0.9	7.5	8.4	#	1.1	1.1	#	0.3	0.3	9.8	20.1	4.1
4. Others	2.0	15.0	17.0	1.8	14.1	15.9	0.4	7.1	7.5	0.9	1.6	2.5	25.9	42.9	8.8
* Transportation															
1. Car	0.5	24.7	25.2	0.9	55.5	56.4	0.2	1.6	1.8	#	0.2	0.2	58.4	83.6	17.1
2. Ships & others	#	0.2	0.2	0.3	0.6	0.9	0.0	#	#	#	0.0	0.0	0.9	1.1	0.2
* Precision machinery & instruments	0.8	0.5	1.3	1.8	2.7	4.5	#	0.4	0.4	#	0.4	0.4	5.3	6 6	1.3
* General machinery & instruments manufacturing															
1. Air-conditioners & refrigeraters	#	1.1	1.1	#	0.3	0.3	0.0	#	0.0	0.0	#	#	0.3	1.4	0.3
2. Heat exchangers	0.4	0.2	0.6	0.6	#	0.6	#	#	0.0	0.0	#	#	0.6	1.2	0.2
3. Valves & others	0.2	0.3	0.5	0.5	0.4	0.9	#	#	0.0	#	0.0	#	0.9	1.4	0.3
* Other manufacturing	2.7	11.8	14.5	3.2	9.3	12.5	0.0	1.3	1.3	0.2	0.4	0.6	14.4	28.9	5.9
* Construction	7.0	22.4	29.4	0.8	1.1	1.9	0.0	0.0	0.0	0.0	0.0	0.0	1.9	31.3	6.4
* Others	11.7	13.2	24.9	9.7	23.4	33.1	0.3	1.6	1.9	0.0	0.5	0.5	35.5	60.4	12.3
Total	34.0	152.9	186.9	25.7	187.2	212.9	1.7	31.4	33.1	1.6	5.8	7.4	253.4	440.3	90.0
* For Export	1.8	13.8	15.6	5.7	21.5	27.2	0.0	5.6	5.6	0.3	0.4	0.7	33.5	49.1	10 0
G-Total	35.8	166.7	202.5	31.4	208.7	240.1	1.7	37.0	38.7	1.9	6.2	8.1	286.9	489.4	100.0

Source: Japan Copper and Copper Alloy Manufacturers' Association

- Less than one (1) metric ton

Applicaiton of Flat products in Japan (1989)

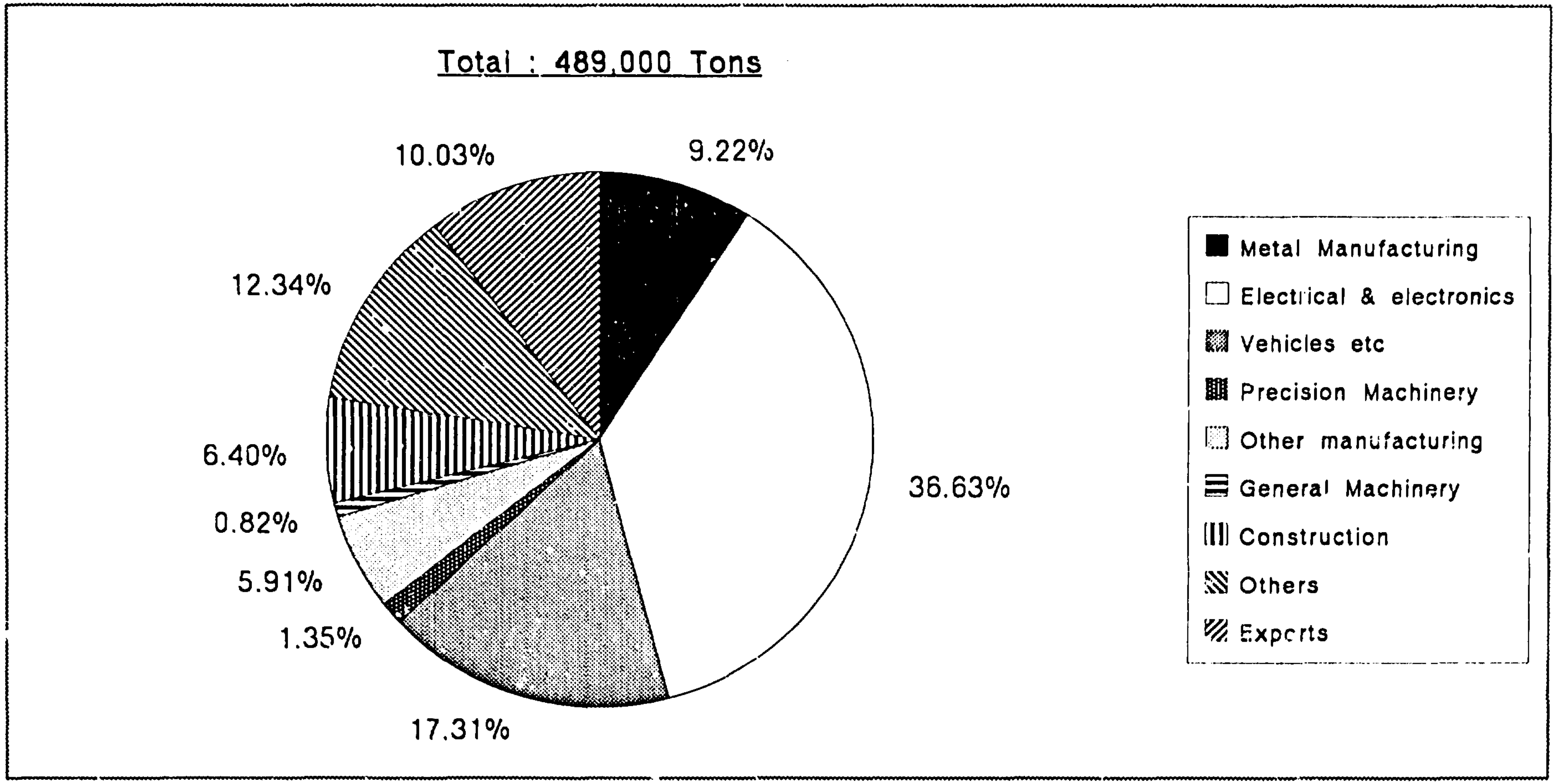


Fig. 3.E

(2) Case Study of a Major Exporter to Japan

The following case study of a major exporter to the Japanese market was made in order to examine further aspects of the Japanese market.

In 1989, imports of copper and copper alloyed sheets and strips into Japan totalled 7,491 metric tons, and 5,629 metric tons, i.e. 75% of total imports, was imported by a state-owned Korean firm. This Korean firm has been trying to tap the Japanese market since its establishment in 1968. In evaluating the possibility of penetrating the Japanese market, the experience of this Korean firm, which has an export oriented strategy and whose export sales account for about 40% of its total sales, might serve as an example, since the ASEAN Copper Fabrication Inc. has a similar target.

After a huge investment in production facilities and the introduction and accumulation of new technology since 1968, the Korean firm's annual production capacity now attains approximately 150,000 metric tons and covers almost all product lines. The quality of their products in sheet (except lead frames) is now considered good and almost the same as Japanese sheet in the international market, and their price levels are competitive when compared with those of the Japanese product.

The Korean firm entered the Japanese market for copper sheet for the first time in 1979, exporting around 150 metric tons, and they have been slowly increasing sales to Japan ever since. In 1989, after 20 years from the start up of operations, exports to Japan barely reached 5,000 metric tons. This amount, however, equals only 1% of the total production of sheet in Japan and 3% of the total production of sheet in Korea. This firm has just barely tapped the Japanese market in spite of being competitive in both quality and price.

These low penetration ratios clearly show that there are other essential factors necessary for tapping the Japanese market besides quality and price.

Interviews with several Japanese end-users have shown that the following are indispensable factors in selecting suppliers.

- Quick delivery
- After-sale service
- Joint research & development

Delivery terms in particular are the most important factors for satisfying Japanese end users. For instance, flat products should usually be delivered within 7 days after receiving an order due to the strict requirements of end-users. Therefore, all of the Japanese suppliers are now trying to install slitting bases near by their end-users to offer on time delivery services.

In view of the above, foreign suppliers wishing to penetrate the Japanese market should not only be competitive in terms of price and quality but also at least have storage and slitting centers in Japan in order to meet the needs required by end-users. Without such facilities, they would not be able to adhere to prompt delivery schedules since their products would be delivered by ship. Therefore, in order to succeed in Japanese market, investment costs for installing such service center should be also considered.

(3) Case Study of a Similar Industry in Japan

Since the aluminum fabrication industry can serve as a similar example, the following study is presented in order to understand the trends of the copper fabrication industry in Japan.

Many aspects of the aluminum fabrication industry are similar to those of the copper industry.
Firstly, low penetration ratios by foreign suppliers to the Japanese market can be pointed out. The annual import volume has remained at about 60,000 tons for the past 10 years, and this is equal to only 3% of the total production of aluminum in Japan. The reasons for this low penetration ratio are due to the same factors mentioned in 1.6 above, and, therefore, the market shares held by foreign suppliers will probably not expand rapidly in the future.

Secondly, the industrial structure that ensures profitability is almost the same as that in the copper industry. The steel and cement industries can enjoy the merits of economies of scale and profitability can be expected even if product lines are shifted only to high value-added products. However, since total sales of the copper and aluminum industries are so small compared with such industries as steel and cement (annual production is 100,000,000 tons and 80,000,000 tons respectively in contrast to the annual production of 1,200,000 tons of copper and of 2,000,000 tons of aluminum products), almost all product lines, i.e. low grade and high grade, should be produced in order to ensure profitability. Therefore, it is quite certain that the industrial structure of the copper and aluminum industries will not be drastically changed.

Finally, Japanese firms operating in both of these non-ferrous industries have been competitive in terms of prices and technologies in the international market, and they will likely remain so in the future since demand for these non-ferrous products in the international market will probably expand.

3.2 PROJECTED IMPORTATION

3.2.1 General Forecast of Demand for Flat Products

Interviews with several Japanese copper fabricators as well as end-users, such as car manufacturers, have shown that copper and brass for radiators will soon be replaced by aluminum for lightening cars and motorcycles worldwide. Therefore, the following assumption was applied in forcasting the demands in ASEAN and NIES countries and in Japan.

Japan: Current ratio of consumption for radiators, which is approximately 17% of the total consumption of flat products, will decrease by 10% within the next 10 years.

NIES countries: the current consumption ratio for radiators, which is approximately 20% of total consumptions of flat products, will decrease by 10% within the next 10 years.

ASEAN countries: the current consumption ratio for radiators, which is approximately 20% of total consumption of flat products, will decrease by 30% within the next 15 years.

3.2.2 Project Growth Rates of Importations

Projected growth rates for imports using time series regressions for each Asean country, Nies Country and Japan for the period 1995 - 2010 (proposed plant life from the start-up to the end), reflecting the negative growth rate for radiators, were determined as follows:

- Indonesia : 2.3% per year
- Malaysia : 3.1% per year
- Philippines : 2.0% per year
- Singapore : 2.5% per year
- Thailand : 2.2% per year
- South Korea : 3.0% per year
- Taiwan : 2.6% per year
- Hong Kong : 2.1% per year
- Japan : 4.5% per year

Based on the above growth rates, imports are projected to increase to 14,340 metric tons in 1995 and reach 116,750 metric tons in 2010. (See Table 3.33 and Fig. 3.F)

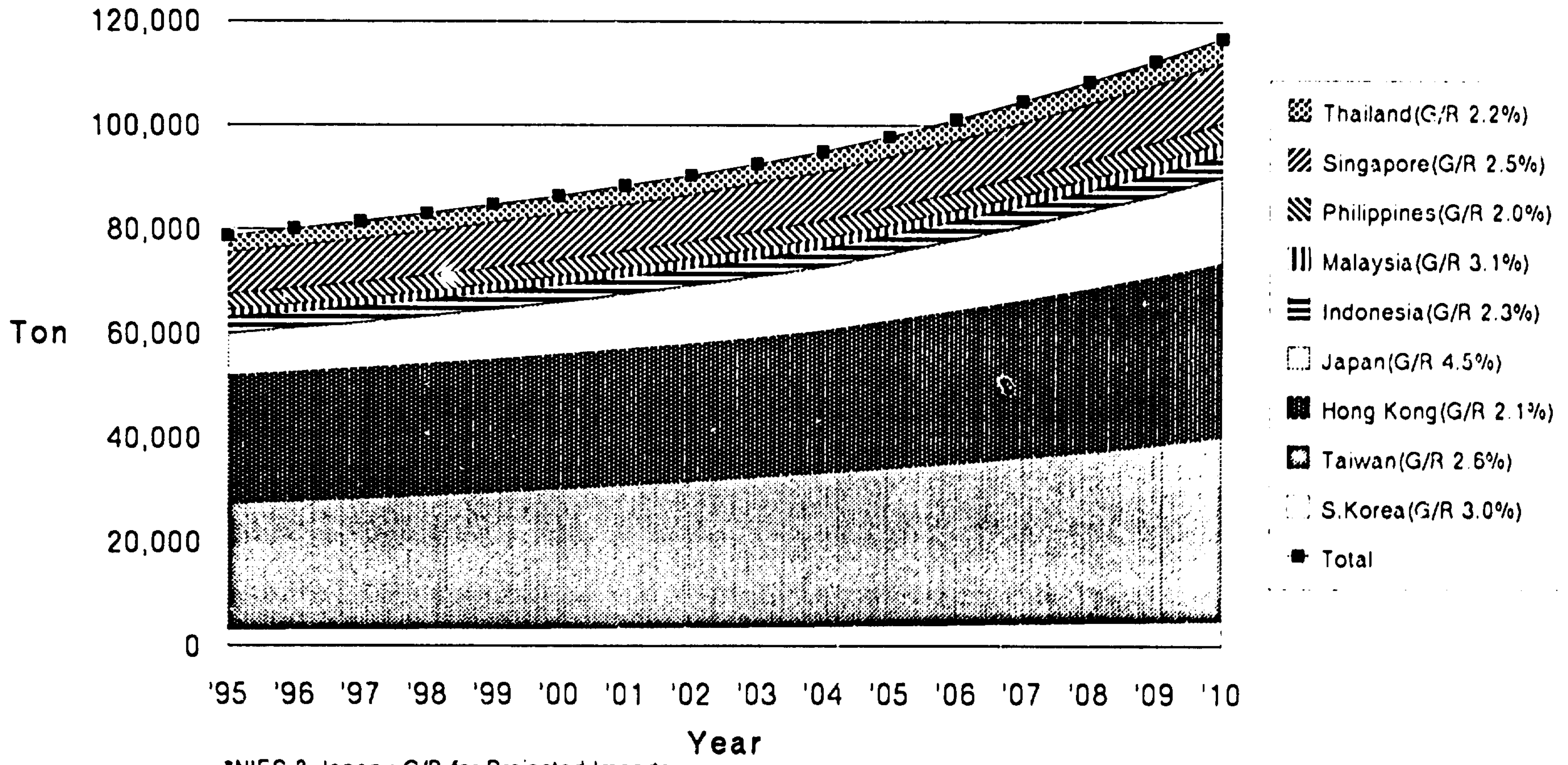
Projected Market Size of Flat Products in ASEAN/ NIES/ Japan (excluding L/F)

Metric tons

	S.Korea	Taiwan	Hong Kong	Japan	Indonesia	Malaysia	Philippines	Singapore	Thailand	Asean/NIES Japan TTL
1995	3,270	24,170	24,460	8,230	2,970	1,540	2,900	7,980	3,300	78,820
1996	3,330	24,620	24,660	8,580	3,010	1,570	2,940	8,110	3,350	80,170
1997	3,390	25,100	24,880	8,840	3,060	1,610	2,970	8,250	3,390	81,490
1998	3,450	25,620	25,120	9,210	3,110	1,650	3,010	8,400	3,450	83,020
1999	3,520	26,170	25,390	9,720	3,160	1,690	3,060	8,550	3,500	84,760
2000	3,600	26,750	25,690	10,120	3,220	1,730	3,100	8,720	3,560	86,490
2001	3,680	27,370	26,010	10,640	3,280	1,780	3,150	8,900	3,620	88,430
2002	3,770	28,020	26,360	11,160	3,340	1,830	3,200	9,080	3,690	90,450
2003	3,860	28,720	26,750	11,780	3,410	1,880	3,260	9,280	3,760	92,700
2004	4,000	29,450	27,160	12,330	3,480	1,940	3,310	9,490	3,830	94,990
2005	4,160	30,230	28,090	12,960	3,550	1,990	3,350	9,660	3,890	97,880
2006	4,300	31,060	29,060	13,600	3,650	2,070	3,450	10,000	4,010	101,200
2007	4,500	31,920	30,060	14,260	3,770	2,160	3,560	10,350	4,140	104,720
2008	4,680	32,840	31,090	15,010	3,900	2,250	3,670	10,720	4,280	108,440
2009	4,860	33,970	32,160	15,690	4,020	2,340	3,780	11,100	4,410	112,330
2010	5,060	35,300	33,270	16,570	4,160	2,440	3,900	11,490	4,560	116,750

Table 3,33

Projected Market Size of Flat products in ASEAN/NIES/Japan (excluding L/F)



*NIES & Japan : G/R for Projected Imports
*ASEAN : G/R for projected demand

Fig. 3.F

3.2.3 Project Market Penetration

In order to determine the market volume, the following average ratios of penetration from the proposed year of start up, i.e. 1995, for each NIES and ASEAN country market were chosen:

- Indonesia : 50% per year of projected demand
- Malaysia : 50% per year of projected demand
- Philippines : 80% per year of projected demand
- Singapore : 50% per year of projected demand
- Thailand : 10% per year of projected demand
- South Korea : 5% per year of projected import
- Taiwan : 10% per year of projected import
- Hong Kong : 10% per year of projected import
- Japan : 5% per year of projected import

The potential market to be tapped in the proposed market, i.e., that of the NIES and ASEAN Countries and Japan, using the above ratios of penetration, is projected to increase to 14,340 metric tons in 1995 and reach 20,570 metric tons in 2010. (See Table 3.34 and Fig. 3.G)

Projected Market Size to be penetrated by the project (excluding L/F)

Metric tons

	S.Korea	Taiwan	Hong Kong	Japan	Indonesia	Malaysia	Philippines	Singapore	Thailand	Asean/NIES Japan TTL
1995	160	2,420	2,450	410	1,490	770	2,320	3,990	330	14,340
1996	170	2,460	2,470	430	1,510	790	2,350	4,060	340	14,580
1997	170	2,510	2,490	440	1,530	810	2,380	4,130	340	14,800
1998	170	2,560	2,510	460	1,560	830	2,410	4,200	350	15,050
1999	180	2,620	2,540	490	1,580	850	2,450	4,280	350	15,340
2000	180	2,680	2,570	510	1,610	870	2,480	4,360	360	15,620
2001	180	2,740	2,600	530	1,640	890	2,520	4,450	360	15,910
2002	190	2,800	2,640	560	1,670	920	2,560	4,540	370	16,250
2003	190	2,870	2,680	590	1,710	940	2,610	4,640	380	16,610
2004	200	2,950	2,720	620	1,740	970	2,650	4,750	380	16,980
2005	210	3,020	2,810	650	1,780	1,000	2,680	4,830	390	17,370
2006	220	3,110	2,910	680	1,830	1,010	2,760	5,000	400	17,950
2007	230	3,190	3,010	710	1,890	1,080	2,850	5,180	410	18,550
2008	230	3,280	3,110	750	1,950	1,130	2,940	5,360	430	19,180
2009	240	3,400	3,220	780	2,010	1,170	3,020	5,550	440	19,830
2010	250	3,530	3,330	830	2,080	1,220	3,120	5,750	460	20,570

Table 3,34

Market Size to be penetrated by the Project

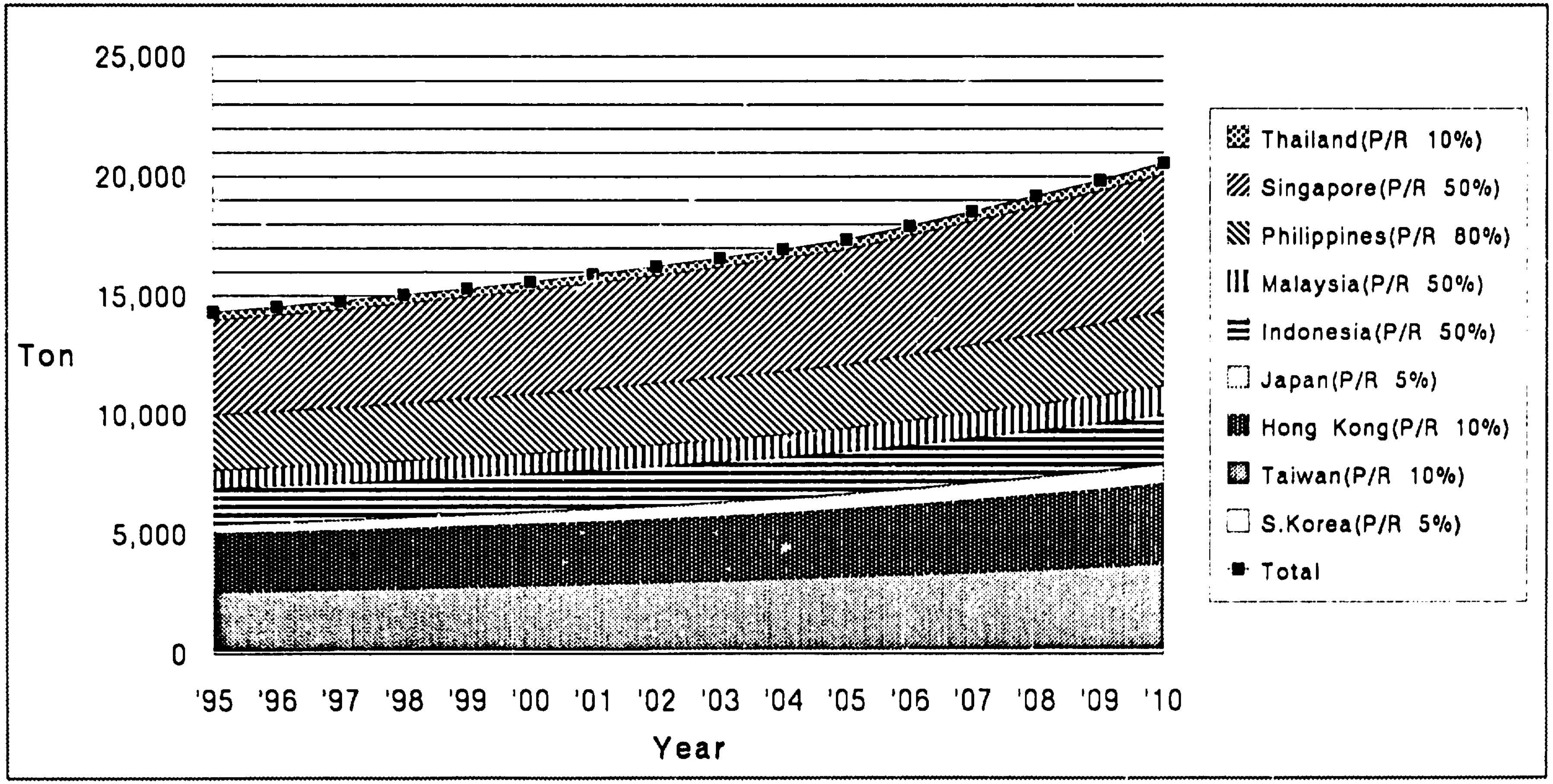


Fig. 3.G

3.3 PLANT CAPACITY AND PRODUCTION PROGRAMME

3.3.1 Plant Capacity

The projected annual market penetration derived from the previous Section 3.2 is approximately 15,000 tons of copper and copper alloy flat products at the time of the proposed start-up, i.e. 1995.

This shows that the feasible normal capacity of the plant might be 15,000 tons per year in 1995 with consideration for future expansion with 3,000 tons of plant capacity in accordance with the growth of market demand. In order to accurately assess the details of the feasible normal capacity with a suitable combination of processing equipment, it is necessary to assume that the product mix is based on market demand with basic specifications in a reasonable and appropriate way.

3.3.2 Product Mix

(1) Market demand

Flat products of the plant are classified into copper and copper alloy (mainly brass) according to the market study.

Recent market demand is used to roughly determine the products ratio between copper and copper alloy flats.

Table 3.35 shows the aggregated amount of imports for copper and copper alloy in each country throughout the past five years (1985-1989).

Table 3.35 Aggregated Import Amount (1985-1989)

* Total during 1985-1988
** Ratio calculated from the amount in 1981 and 1982
*** Total of imported amount only

Country	Copper (ton)	Copper Alloy (ton)
Indonesia	4,393 (35%)	8,190 (65%)
Malaysia *	4,657 (33%)	9,666 (67%)
Philippines	1,045 (11%)	8,059 (89%)
Singapore **	17,674 (40%)	26,510 (60%)
Thailand	2,819 (22%)	10,160 (78%)
Hong Kong ***	17,738 (14%)	105,590 (86%)
Japan ***	2,727 (10%)	25,683 (90%)
S. Korea ***	3,000 (25%)	9,124 (75%)
Taiwan ***	6,308 (6%)	101,259 (94%)

Sources: Foreign Trade Statistics of Indonesia
Malaysian Trade Statistics
Philippines Foreign Trade Statistics
Singapore Trade Statistics
Foreign Trade Statistics of Thailand
Japan Copper and Copper Alloy Manufacturer's

Using these ratios to multiply with the projected demand in each country as of 1995 (refer to Table 3.34) and totaling the amount for copper and copper alloy respectively, we can obtain the projected production amount and its ratio approximately as follows:

Cooper	3,270 ton/year (22%)
Copper Alloy	11,730 ton/year (78%)

(2) Application of products

In line with the result of market study and the actual application of products, brass (70/30) and brass (65/35) have been selected as the optimum products among the copper alloys, since these kinds of brass account for the largest portion of market demand in contrast with other alloy.

Application of copper, brass (70/30) and brass (65/35) as the final product is summarized in Table 3.36 and mainly categorized into three fields, i.e., miscellaneous, radiator and electric use. Brass (70/30) is mainly used for electric field as connectors, terminals, etc. and brass (65/35), is used for radiators or other miscellaneous uses. Market demand of the latter is usually 2-3 times larger than that of the former.

It is therefore assumed in this study that the production ratio of brass (70/30) and brass (65/35) is about 1:3.

The reference thickness and temper grade for each applied product are also decided in Table 3.36 in order to study the process flow and equipment capacity for each product.

Table 3.36 Application and Reference Thickness

Application		Material	Thickness Range (mm)	Reference Thickness (mm)	Temper Grade
Miscellaneous Utensils, Stoves, Others		Copper	0.5 - 1.5	0.5 1.0	0
		Brass (65/35)	0.3 - 3.5	0.3 0.75 1.5	H/2 H/2
Radiator	Fin	Copper	0.07 - 0.1	0.1	H/2
	Tube	Brass (65/35)	0.1 - 0.15	0.15	H/2
	Head	Brass (65/35)	0.6 - 1.2	0.8 1.2	0
Electric use Connectors, Terminals, Switches, etc.		Brass (70/30)	0.2 - 1.0	0.3 0.75	H/2 H/2

(3) Process and equipment consideration

Another important aspect for estimating the product mix is to consider the production process, major equipment capacity and investment cost.

The selected process in this feasibility study is horizontal casting as described in Chapter VI, where several melting - casting machines are to be arranged in the Foundry Shop.

The nominal capacity of existing casting machines for a strip size of 660 mm x 16.5 mm is approximately 1 ton per hour. Assuming that there is a 3-shift (24-hour) operation, 275 working days/year, 75% effective operating ratio and 66% product yield, the feasible normal capacity of one casting machine in terms of the final product weight is calculated as 1(ton/hr) x 24(hr/day) x 275(day/year) x 0.75 x 0.66 = 3,267 (ton/year).

The feasible normal capacity of about 3,000 tons/year can also be verified by machine manufacturers or from experience of operating plants using a similar process.

Finally from the viewpoint of minimizing the equipment cost and standardizing the machine parts, it is preferable to adopt five sets of the same melting-casting machines (3,000 t/y each) for 15,000 t/y production.

(4) Product mix

The product mix and basic specifications of the product can now be determined according to the above-mentioned considerations.

Copper	3,000 t/y
Brass (70/30)	3,000 t/y
Brass (65/35)	9,000 t/y

Details are shown on Table 3.37 concerning the product mix for this feasibility study. The final shape of the product is either sheet or strip. In the case that both shapes are applicable as final products, the relevant production amount is divided by two. For example, product No. 2 - 0.5 mm thick copper has production of 1,200 t/y, consisting of 600 t/y sheets and 600 t/y strips.

Table 3.37 Product Mix

Product No.	Material	Thickness (mm)	Temper	Amount ton/year	Amount ton/month	Shape sheet	Shape strip
1	Copper	0.1	H/2	600	50		o
2		0.5	0	1,200	100	o	o
3		1.0	0	1,200	100	o	o
4	Brass (70/30)	0.3	H/2	1,200	100		o
5		0.75	H/2	1,800	150		o
6	Brass (65/35)	0.15	H/2	600	50		o
7		0.3	H/2	1,200	100	o	o
8		0.75	H/2	1,800	150	o	o
9		0.8	0	1,800	150	o	o
10		1.2	0	1,800	150	o	
11		1.5	H/2	1,800	150	o	o
		Total		15,000	1,250		

3.3.3 Production Programme

As the feasible normal plant capacity and the relevant product mix have been determined, the next stage is to assess the production program for the plant start-up and the following initial production periods.

It is assumed that the plant will produce 40% of the normal capacity in the 1st year and increase production to 20% per year from the 2nd year, then reach the feasible normal capacity of 15,000 t/y in the 4th year.

Year	Production (t/y)
1	6,000 (40%)
2	9,000 (60%)
3	12,000 (80%)
4	15,000 (100%)
5-15	15,000 - 18,000

According to this production plan the expected quantity of each product is forecasted in the following Schedule 3.1.

Schedule 3.1 Production Programme

Products	Specifications	Units at 100% Capacity	Year 1		Year 2		Year 3	
			Capacity <40%>	Units	Capacity <60%>	Units	Capacity <80%>	Units
1) Copper strip	thickness : 0.1mm temper grade : H/2	ton	240	tons	360	tons	480	tons
2) Copper strip	thickness : 0.5mm temper grade : soft	ton	240	tons	360	tons	480	tons
3) Copper sheet	thickness : 0.5mm temper grade : soft	ton	240	tons	360	tons	480	tons
4) Copper strip	thickness :1.0mm temper grade : soft	ton	240	tons	360	tons	480	tons
5) Copper sheet	thickness :1.0mm temper grade : soft	ton	240	tons	360	tons	480	tons
6) Brass (70/30) strip	thickness : 0.3mm temper grade : H/2	ton	480	tons	720	tons	960	tons
7) Brass (70/30) strip	thickness : 0.75mm temper grade : H/2	ton	720	tons	1,080	tons	1,440	tons
8) Brass (65/35) strip	thickness : 0.15mm temper grade : H/2	ton	240	tons	360	tons	480	tons
9) Brass (65/35) strip	thickness : 0.3mm temper grade : H/2	ton	240	tons	360	tons	480	tons
10) Brass (65/35) sheet	thickness : 0.3mm temper grade : H/2	ton	240	tons	360	tons	480	tons
11) Brass (65/35) strip	thickness : 0.75mm temper grade : H/2	ton	360	tons	540	tons	720	tons
12) Brass (65/35) sheet	thickness : 0.75mm temper grade : H/2	ton	360	tons	540	tons	720	tons
13) Brass (65/35) strip	thickness : 0.8mm temper grade : soft	ton	360	tons	540	tons	720	tons
14) Brass (65/35) sheet	thickness : 0.8mm temper grade : soft	ton	360	tons	540	tons	720	tons
15) Brass (65/35) sheet	thickness : 1.2mm temper grade : soft	ton	720	tons	1,080	tons	1,440	tons
16) Brass (65/35) strip	thickness : 1.5mm temper grade : H/2	ton	360	tons	540	tons	720	tons
17) Brass (65/35) sheet	thickness : 1.5mm temper grade : H/2	ton	360	tons	540	tons	720	tons
TOTAL			6,000	tons	9,000	tons	12,000	tons

Schedule 3.1 Production Programme

Products	Specifications	Units at 100% Capacity	Year 4 Capacity <100%>	Units	Year 5 Capacity <100%>	Units	Year 6 Capacity <100%>	Units
1) Copper strip	thickness : 0.1mm. temper grade : H/2	ton	600	tons	614	tons	625	tons
2) Copper strip	thickness : 0.5mm temper grade : soft	ton	600	tons	614	tons	625	tons
3) Copper sheet	thickness : 0.5mm temper grade : soft	ton	600	tons	614	tons	625	tons
4) Copper strip	thickness :1.0mm temper grade : soft	ton	600	tons	614	tons	625	tons
5) Copper sheet	thickness :1.0mm temper grade : soft	ton	600	tons	614	tons	625	tons
6) Brass (70/30) strip	thickness : 0.3mm temper grade : H/2	ton	1,200	tons	1,227	tons	1,250	tons
7) Brass (70/30) strip	thickness : 0.75mm temper grade : H/2	ton	1,800	tons	1,841	tons	1,874	tons
8) Brass (65/35) strip	thickness : 0.15mm temper grade : H/2	ton	600	tons	614	tons	625	tons
9) Brass (65/35) strip	thickness : 0.3mm temper grade : H/2	ton	600	tons	614	tons	625	tons
10) Brass (65/35) sheet	thickness : 0.3mm temper grade : H/2	ton	600	tons	614	tons	625	tons
11) Brass (65/35) strip	thickness : 0.75mm temper grade : H/2	ton	900	tons	920	tons	937	tons
12) Brass (65/35) sheet	thickness : 0.75mm temper grade : H/2	ton	900	tons	920	tons	937	tons
13) Brass (65/35) strip	thickness : 0.8mm temper grade : soft	ton	900	tons	920	tons	937	tons
14) Brass (65/35) sheet	thickness : 0.8mm temper grade : soft	ton	900	tons	920	tons	937	tons
15) Brass (65/35) sheet	thickness : 1.2mm temper grade : soft	ton	1,800	tons	1,841	tons	1,874	tons
16) Brass (65/35) strip	thickness : 1.5mm temper grade : H/2	ton	900	tons	920	tons	937	tons
17) Brass (65/35) sheet	thickness : 1.5mm temper grade : H/2	ton	900	tons	920	tons	937	tons
TOTAL			15,000	tons	15,341	tons	15,620	tons

Schedule 3.1 Production Programme

Products	Specifications	Units at 100% Capacity	Year 7		Year 8		Year 9	
			Capacity <100%>	Units	Capacity <100%>	Units	Capacity <100%>	Units
1) Copper strip	thickness : 0.1mm temper grade : H/2	ton	636	tons	650	tons	664	tons
2) Copper strip	thickness : 0.5mm temper grade : soft	ton	636	tons	650	tons	664	tons
3) Copper sheet	thickness : 0.5mm temper grade : soft	ton	636	tons	650	tons	664	tons
4) Copper strip	thickness :1.0mm temper grade : soft	ton	636	tons	650	tons	664	tons
5) Copper sheet	thickness :1.0mm temper grade : soft	ton	636	tons	650	tons	664	tons
6) Brass (70/30) strip	thickness : 0.3mm temper grade : H/2	ton	1,273	tons	1,300	tons	1,329	tons
7) Brass (70/30) strip	thickness : 0.75mm temper grade : H/2	ton	1,909	tons	1,950	tons	1,993	tons
8) Brass (65/35) strip	thickness : 0.15mm temper grade : H/2	ton	636	tons	650	tons	664	tons
9) Brass (65/35) strip	thickness : 0.3mm temper grade : H/2	ton	636	tons	650	tons	664	tons
10) Brass (65/35) sheet	thickness : 0.3mm temper grade : H/2	ton	636	tons	650	tons	664	tons
11) Brass (65/35) strip	thickness : 0.75mm temper grade : H/2	ton	955	tons	975	tons	997	tons
12) Brass (65/35) sheet	thickness : 0.75mm temper grade : H/2	ton	955	tons	975	tons	997	tons
13) Brass (65/35) strip	thickness : 0.8mm temper grade : soft	ton	955	tons	975	tons	997	tons
14) Brass (65/35) sheet	thickness : 0.8mm temper grade : soft	ton	955	tons	975	tons	997	tons
15) Brass (65/35) sheet	thickness : 1.2mm temper grade : soft	ton	1,909	tons	1,950	tons	1,993	tons
16) Brass (65/35) strip	thickness : 1.5mm temper grade : H/2	ton	955	tons	975	tons	997	tons
17) Brass (65/35) sheet	thickness : 1.5mm temper grade : H/2	ton	955	tons	975	tons	997	tons
TOTAL			15,910	tons	16,250	tons	16,610	tons

Schedule 3.1 Production Programme

Products	Specifications	Units at 100% Capacity	Year 10		Year 11		Year 12	
			Capacity <100%>	Units	Capacity <100%>	Units	Capacity <100%>	Units
1) Copper strip	thickness : 0.1mm temper grade : H/2	ton	679	tons	695	tons	718	tons
2) Copper strip	thickness : 0.5mm temper grade : soft	ton	679	tons	695	tons	718	tons
3) Copper sheet	thickness : 0.5mm temper grade : soft	ton	679	tons	695	tons	718	tons
4) Copper strip	thickness :1.0mm temper grade : soft	ton	679	tons	695	tons	718	tons
5) Copper sheet	thickness :1.0mm temper grade : soft	ton	679	tons	695	tons	718	tons
6) Brass (70/30) strip	thickness : 0.3mm temper grade : H/2	ton	1,358	tons	1,390	tons	1,436	tons
7) Brass (70/30) strip	thickness : 0.75mm temper grade : H/2	ton	2,038	tons	2,084	tons	2,154	tons
8) Brass (65/35) strip	thickness : 0.15mm temper grade : H/2	ton	679	tons	695	tons	718	tons
9) Brass (65/35) strip	thickness : 0.3mm temper grade : H/2	ton	679	tons	695	tons	718	tons
10) Brass (65/35) sheet	thickness : 0.3mm temper grade : H/2	ton	679	tons	695	tons	718	tons
11) Brass (65/35) strip	thickness : 0.75mm temper grade : H/2	ton	1,019	tons	1,042	tons	1,077	tons
12) Brass (65/35) sheet	thickness : 0.75mm temper grade : H/2	ton	1,019	tons	1,042	tons	1,077	tons
13) Brass (65/35) strip	thickness : 0.8mm temper grade : soft	ton	1,019	tons	1,042	tons	1,077	tons
14) Brass (65/35) sheet	thickness : 0.8mm temper grade : soft	ton	1,019	tons	1,042	tons	1,077	tons
15) Brass (65/35) sheet	thickness : 1.2mm temper grade : soft	ton	2,038	tons	2,084	tons	2,154	tons
16) Brass (65/35) strip	thickness : 1.5mm temper grade : H/2	ton	1,019	tons	1,042	tons	1,077	tons
17) Brass (65/35) sheet	thickness : 1.5mm temper grade : H/2	ton	1,019	tons	1,042	tons	1,077	tons
TOTAL			16,980	tons	17,370	tons	17,950	tons

Schedule 3.1 Production Programme

Products	Specifications	Units at 100% Capacity	Year 13		Year 14		Year 15	
			Capacity <100%>	Units	Capacity <100%>	Units	Capacity <100%>	Units
1) Copper strip	thickness : 0.1mm temper grade : H/2	ton	720	tons	720	tons	720	tons
2) Copper strip	thickness : 0.5mm temper grade : soft	ton	720	tons	720	tons	720	tons
3) Copper sheet	thickness : 0.5mm temper grade : soft	ton	720	tons	720	tons	720	tons
4) Copper strip	thickness :1.0mm temper grade : soft	ton	720	tons	720	tons	720	tons
5) Copper sheet	thickness :1.0mm temper grade : soft	ton	720	tons	720	tons	720	tons
6) Brass (70/30) strip	thickness : 0.3mm temper grade : H/2	ton	1,440	tons	1,440	tons	1,440	tons
7) Brass (70/30) strip	thickness : 0.75mm temper grade : H/2	ton	2,160	tons	2,160	tons	2,160	tons
8) Brass (65/35) strip	thickness : 0.15mm temper grade : H/2	ton	720	tons	720	tons	720	tons
9) Brass (65/35) strip	thickness : 0.3mm temper grade : H/2	ton	720	tons	720	tons	720	tons
10) Brass (65/35) sheet	thickness : 0.3mm temper grade : H/2	ton	720	tons	720	tons	720	tons
11) Brass (65/35) strip	thickness : 0.75mm temper grade : H/2	ton	1,080	tons	1,080	tons	1,080	tons
12) Brass (65/35) sheet	thickness : 0.75mm temper grade : H/2	ton	1,080	tons	1,080	tons	1,080	tons
13) Brass (65/35) strip	thickness : 0.8mm temper grade : soft	ton	1,080	tons	1,080	tons	1,080	tons
14) Brass (65/35) sheet	thickness : 0.8mm temper grade : soft	ton	1,080	tons	1,080	tons	1,080	tons
15) Brass (65/35) sheet	thickness : 1.2mm temper grade : soft	ton	2,160	tons	2,160	tons	2,160	tons
16) Brass (65/35) strip	thickness : 1.5mm temper grade : H/2	ton	1,080	tons	1,080	tons	1,080	tons
17) Brass (65/35) sheet	thickness : 1.5mm temper grade : H/2	ton	1,080	tons	1,080	tons	1,080	tons
TOTAL			18,000	tons	18,000	tons	18,000	tons

3.4 FREIGHT RATES

The prevailing in-deck rates for copper and copper alloy flat products from Manila to the different main ports in the ASEAN Region and the NIES countries are listed in Table 3.38. Freight rates are mainly based on twenty- and forty-footer containers.

Table 3.38
Freight Costs of Copper and Copper Alloy Flat Products
From Manila to Major Asian Ports
(US Dollars)

	Jakarta	Kuala Lumpur	Singapore	Bangkok	Hong Kong	Tokyo, Kobe, Nagoya	Korea	Taiwan
(1) Fil-Japan Shipping Corp.	---	---	40 footer - $750	---	---	20 footer - $ 550	---	40 footer- $400
			20 footer - $550			40 footer - $ 750		20 footer- $250
						(To: Yokohama, Osaka)		
						20 footer- $ 750 40 footer- $1,200		
(2) Sealand Service Inc.	---	$29.75/mt	$40/mt	$29.75/mt	$22/mt	$40/mt	$32.25/mt	$23/mt
		minimum/ container $43.25	minimum/ container $43.25	minimum/ container $43.25		minimum/ container $60	minimum/ container $60	minimum/ container $60
		LCL charge $ 4	LCL charge $ 4	LCL charge $ 4		LCL charge $ 4	LCL charge $ 4	LCL charge $ 4
(3) American President Lines	20 footer - $ 850	20 footer -	20 footer - $565	20 footer -	--- $545	---	20 footer - $650	---
$510								
	40 footer -	40	footer -	40	footer -	40	footer -	---
footer -								
	$1,225	$975	$775	$925			$465	

NOTE: Twenty footer-containers can carry a 17 metric ton-load, forty footer-containers, 20 metric ton-load.

Source: Interviews.

3.5 TARIFF DUTIES

Based on the most recent publications of the Customs Codes of the different ASEAN, NIES and Japan countries covered, imports of copper and copper alloy flat products classified under HS Code 74.09: Copper plates, sheets and strip, of a thickness exceeding 0.15 mm, will be applied with specific tariff rates ad valorem.

Table 3.40 presents the tariff rates on the import of copper and copper alloy flat products. In the case of the Philippines, Executive Order No. 413 will effectively reduce the tariff rate of raw materials to 10 per cent. Although the implementation of EO No. 413 was specified on September 1, 1990, this has been indefinitely suspended pending its review by Congress.

Table 3.40
Tariff Rates of Copper and Copper Alloy Flat Products
in Selected ASEAN and NIES Countries
Percent Ad Valorem
(Per Metric Ton)

HS Code/ SITC Code	Description	ASEAN Countries: Indonesia	Malaysia	Philippines*	Singapore	Thailand	NIES Countries: Hong Kong	South Korea	Taiwan
	Copper plates, sheets and strip,								
	of a thickness exceeding 0.15 mm.								
	- Of refined copper:				none			[for use in]	
7409.11	-- In coils	5	2	10		17		[semicon:10%]	
682.5100	Strip							[ ]	
682.5200	Other							[other: 15%]	
7409.19	-- Other	5	2	10		17			
682.5100	Strip								
682.5200	Other								
	- Of copper-zinc base alloys (brass)				none			[for use in]	
7409.21	-- In coils	5	2	10		17		[semicon:10%]	
682.5100	Strip							[ ]	
682.5200	Other							[other: 15%]	
7409.29	-- Other	5	2	10		17			
682.5100	Strip								
682.5200	Other								
	- Of copper-tin base alloys (bronze)				none			[for use in]	
7409.31	-- In coils	5	2	10		17		[semicon:10%]	
682.5100	Strip							[ ]	
682.5200	Other							[other: 15%]	
7409.39	-- Other	5	2	10		17			
682.5100	Strip								
682.5200	Other								
7409.90	- Of other copper alloys			10	none	17		[for use in]	
682.5100	Strip	5	2					[semicon:10%]	
682.5200	Other	5	2					[ ]	
								[other: 15%]	

* Per Executive Order No. 413, 10 per cent tariff rate will be imposed on imported raw materials effective Sept. 1, 1990.

Sources: Customs and Tariff Code of Indonesia, 1989.
Customs and Tariff Code of Malaysia, 1988.
Customs and Tariff Code of the Philippines, 1988.
Customs and Tariff Code of Singapore.
Customs and Tariff Code of Thailand.

3.6 PRICES

Table 3.40 presents the projected market prices of copper and copper alloy flat products on FOB Manila Port basis.

In order to make a realistic assumption that the products of this project will penetrate the ASEAN, NIES and Japanese market, the sales price should be at least lower than the prevailing market price in each country. From this view point, the advantages of lower freight and marine insurance from Manila to major ports in the selected countries, compared with those from Japan, was considered in determining the sales price.

Moreover, 50% deduction of existing import tariff in all the ASEAN, which is the incentive under the AIP Scheme, was also reflected in determining the sales prices.

The sales revenue based on these projected prices are shown in the following Schedule 3.2.

Table 3.40 Projected Prices of Copper and Copper Alloy Flat Products per Metric Tons

Products Mix (thickness in mm)	S.Korea	Taiwan	Hong Kong	Japan	Indonesia	Malaysia	Philippines	Singapore	Thailand
1) Copper strip (0.1)	3,800	3,900	3,500	3,300	4,620	4,250	4,200	3,800	4,600
2) Copper strip (0.5)	3,700	3,900	3,600	3,400	4,600	4,150	3,800	3,600	4,350
3) Copper sheet (0.5)	3,700	3,900	3,600	3,400	3,900	4,150	3,700	3,700	4,350
4) Copper strip (1.0)	3,900	4,100	3,700	3,600	4,200	4,150	4,000	4,200	4,500
5) Copper sheet (1.0)	3,850	4,100	3,800	3,600	3,900	4,150	3,900	4,200	4,500
6) Brass (70/30) strip (0.3)	3,300	3,300	3,300	3,200	3,600	3,650	3,400	3,400	3,700
7) Brass (70/30) strip (0.75)	3,300	3,250	3,250	3,300	3,400	3,650	3,400	3,500	3,700
8) Brass (65/35) strip (0.15)	3,400	3,600	3,550	3,400	3,500	3,450	3,600	3,600	3,900
9) Brass (65/35) strip (0.3)	3,350	3,300	3,300	3,400	3,500	3,550	3,500	3,500	3,600
10) Brass (65/35) sheet (0.3)	3,300	3,300	3,300	3,450	3,400	3,350	3,500	3,600	3,900
11) Brass (65/35) strip (0.75)	3,200	3,200	3,200	3,300	3,400	3,350	3,400	3,500	3,700
12) Brass (65/35) sheet (0.75)	3,250	3,300	3,300	3,400	3,400	3,650	4,100	3,700	3,900
13) Brass (65/35) strip (0.8)	3,300	3,200	3,200	3,300	3,300	3,550	3,800	3,400	3,700
14) Brass (65/35) sheet (0.8)	3,250	3,300	3,300	3,400	3,400	3,550	3,600	3,600	3,800
15) Brass (65/35) sheet (1.2)	3,250	3,300	3,300	3,400	3,300	3,450	3,500	3,400	3,800
16) Brass (65/35) strip (1.5)	3,200	3,200	3,200	3,200	3,400	3,350	3,300	3,400	3,700
17) Brass (65/35) sheet (1.5)	3,200	3,300	3,200	3,300	3,400	3,350	3,400	3,400	3,900

(US Dollars)

*Except those for Philippines, above prices are all FOB major ports prices from Manila port
*As for Philippines, above prices are wholesalers' price
*Incorporating the incentive for the 50% deduction of import tariffs for all ASEAN countries

Schedule 3-1. Estimate of Sales Revenues

Thousand US$

Products			Year 1						Year 2						Year 3					
Description (thickness in mm)	Unit Price (average)		Quantities to be sold (tons)			Sales revenues			Quantities to be sold (tons)			Sales revenues			Quantities to be sold (tons)			Sales revenues		
	exp.	loc.	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total
1) Copper strip (0.1)	3.89	4.20	201	39	240	783	163	947	302	58	360	1,176	244	1,420	403	77	480	1,569	324	1,893
2) Copper strip (0.5)	3.83	3.80	201	39	240	771	148	919	302	58	360	1,158	220	1,378	403	77	480	1,545	293	1,838
3) Copper sheet (0.5)	3.78	3.70	201	39	240	761	144	904	302	58	360	1,142	215	1,356	403	77	480	1,523	286	1,809
4) Copper strip (1.0)	4.06	4.00	201	39	240	816	155	972	302	58	360	1,226	232	1,458	403	77	480	1,635	309	1,944
5) Copper sheet (1.0)	4.04	3.90	201	39	240	813	151	964	302	58	360	1,220	226	1,447	403	77	480	1,628	301	1,929
6) Brass (70/30) strip (0.3)	3.40	3.40	402	78	480	1,368	264	1,632	604	116	720	2,054	395	2,448	806	154	960	2,739	525	3,264
7) Brass (70/30) strip (0.75)	3.39	3.40	604	116	720	2,047	396	2,443	906	174	1,080	3,073	592	3,665	1,208	232	1,440	4,099	787	4,886
8) Brass (65/35) strip (0.15)	3.57	3.60	201	39	240	717	140	857	302	58	360	1,077	209	1,286	403	77	480	1,437	278	1,715
9) Brass (65/35) strip (0.3)	3.42	3.50	201	39	240	688	136	824	302	58	360	1,033	203	1,236	403	77	480	1,377	270	1,648
10) Brass (65/35) sheet (0.3)	3.44	3.50	201	39	240	691	136	827	302	58	360	1,038	203	1,241	403	77	480	1,384	270	1,655
11) Brass (65/35) strip (0.75)	3.35	3.40	302	58	360	1,011	198	1,209	453	87	540	1,518	296	1,814	604	116	720	2,025	394	2,418
12) Brass (65/35) sheet (0.75)	3.49	4.10	302	58	360	1,052	239	1,291	453	87	540	1,579	357	1,936	604	116	720	2,107	475	2,582
13) Brass (65/35) strip (0.8)	3.32	3.80	302	58	360	1,002	221	1,223	453	87	540	1,504	331	1,834	604	116	720	2,006	440	2,446
14) Brass (65/35) sheet (0.8)	3.44	3.60	302	58	360	1,039	210	1,249	453	87	540	1,560	313	1,874	604	116	720	2,081	417	2,498
15) Brass (65/35) sheet (1.2)	3.36	3.50	604	116	720	2,027	408	2,435	906	174	1,080	3,043	609	3,653	1,208	232	1,440	4,059	810	4,870
16) Brass (65/35) strip (1.5)	3.31	3.30	302	58	360	1,000	192	1,192	453	87	540	1,501	287	1,789	604	116	720	2,003	382	2,385
17) Brass (65/35) sheet (1.5)	3.36	3.40	302	58	360	1,015	198	1,213	453	87	540	1,524	296	1,820	604	116	720	2,033	394	2,426
TOTAL			5,029	971	6,000	17,604	3,498	21,103	7,549	1,451	9,000	26,425	5,228	31,653	10,070	1,930	12,000	35,249	6,955	42,204

Schedule 3.2. Estimate of Sales Revenues

Products			Year 4						Year 5						Year 6					
Description (thickness in mm)	Unit Price (average)		Quantities to be sold (tons)			Sales revenues			Quantities to be sold (tons)			Sales revenues			Quantities to be sold (tons)			Sales revenues		
	exp.	loc.	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total
1) Copper strip (0.1)	3.89	4.20	504	96	600	1,961	404	2,365	516	98	614	2,007	412	2,418	526	99	625	2,046	417	2,462
2) Copper strip (0.5)	3.83	3.80	504	96	600	1,932	365	2,297	516	98	614	1,977	372	2,350	526	99	625	2,016	377	2,392
3) Copper sheet (0.5)	3.78	3.70	504	96	600	1,905	355	2,261	516	98	614	1,950	363	2,312	526	99	625	1,987	367	2,354
4) Copper strip (1.0)	4.06	4.00	504	96	600	2,045	384	2,429	516	98	614	2,093	392	2,485	526	99	625	2,133	397	2,530
5) Copper sheet (1.0)	4.04	3.90	504	96	600	2,036	375	2,411	516	98	614	2,084	382	2,466	526	99	625	2,124	387	2,511
6) Brass (70/30) strip (0.3)	3.40	3.40	1,008	192	1,200	3,427	653	4,080	1,031	196	1,227	3,506	666	4,173	1,051	198	1,250	3,574	675	4,249
7) Brass (70/30) strip (0.75)	3.39	3.40	1,512	288	1,800	5,118	980	6,098	1,547	294	1,841	5,237	1,000	6,236	1,577	298	1,874	5,338	1,012	6,350
8) Brass (65/35) strip (0.15)	3.57	3.60	504	96	600	1,797	346	2,143	516	98	614	1,839	353	2,192	526	99	625	1,875	357	2,232
9) Brass (65/35) strip (0.3)	3.41	3.50	504	96	600	1,720	336	2,056	516	98	614	1,760	343	2,103	526	99	625	1,794	347	2,141
10) Brass (65/35) sheet (0.3)	3.44	3.50	504	96	600	1,732	336	2,068	516	98	614	1,772	343	2,115	526	99	625	1,806	347	2,154
11) Brass (65/35) strip (0.75)	3.35	3.40	756	144	900	2,533	490	3,023	773	147	920	2,592	500	3,092	788	149	937	2,642	506	3,148
12) Brass (65/35) sheet (0.75)	3.49	4.10	756	144	900	2,636	591	3,227	773	147	920	2,697	603	3,299	788	149	937	2,749	610	3,359
13) Brass (65/35) strip (0.8)	3.32	3.80	756	144	900	2,509	548	3,057	773	147	920	2,567	559	3,126	788	149	937	2,617	565	3,183
14) Brass (65/35) sheet (0.8)	3.44	3.60	756	144	900	2,604	519	3,122	773	147	920	2,664	529	3,193	788	149	937	2,716	536	3,251
15) Brass (65/35) sheet (1.2)	3.36	3.50	1,512	288	1,800	5,078	1,009	6,087	1,547	294	1,841	5,196	1,029	6,225	1,577	298	1,874	5,297	1,042	6,339
16) Brass (65/35) strip (1.5)	3.32	3.30	756	144	900	2,508	476	2,984	773	147	920	2,566	485	3,051	788	149	937	2,616	491	3,107
17) Brass (65/35) sheet (1.5)	3.36	3.40	756	144	900	2,543	490	3,033	773	147	920	2,602	500	3,101	788	149	937	2,652	506	3,158
TOTAL			12,598	2,402	15,000	44,086	8,657	52,742	12,890	2,450	15,340	45,107	8,830	53,937	13,140	2,480	15,620	45,982	8,938	54,920

Schedule 3.2. Estimate of Sales Revenues

Products			Year 7						Year 8						Year 9					
Description (thickness in mm)	Unit Price (average)		Quantities to be sold (tons)			Sales revenues			Quantities to be sold (tons)			Sales revenues			Quantities to be sold (tons)			Sales revenues		
	exp.	loc.	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total
1) Copper strip (0.1)	3.89	4.20	536	101	636	2,083	423	2,506	548	102	650	2,130	430	2,560	560	104	664	2,178	438	2,616
2) Copper strip (0.5)	3.83	3.80	536	101	636	2,054	383	2,437	548	102	650	2,100	389	2,489	560	104	664	2,147	397	2,544
3) Copper sheet (0.5)	3.78	3.70	536	101	636	2,025	373	2,398	548	102	650	2,071	379	2,449	560	104	664	2,117	386	2,504
4) Copper strip (1.0)	4.07	4.00	536	101	636	2,181	403	2,584	548	102	650	2,230	410	2,639	560	104	664	2,280	418	2,698
5) Copper sheet (1.0)	4.04	3.90	536	101	636	2,162	393	2,555	548	102	650	2,211	399	2,610	560	104	664	2,261	407	2,668
6) Brass (70/30) strip (0.3)	3.40	3.40	1,071	202	1,273	3,642	685	4,328	1,095	205	1,300	3,724	696	4,420	1,120	209	1,329	3,808	710	4,518
7) Brass (70/30) strip (0.75)	3.38	3.40	1,607	302	1,909	5,435	1,028	6,464	1,643	307	1,950	5,557	1,044	6,602	1,680	313	1,993	5,683	1,065	6,748
8) Brass (65/35) strip (0.15)	3.57	3.60	536	101	636	1,910	363	2,273	548	102	650	1,953	369	2,322	560	104	664	1,997	376	2,373
9) Brass (65/35) strip (0.3)	3.41	3.50	536	101	636	1,828	353	2,181	548	102	650	1,869	358	2,227	560	104	664	1,911	365	2,277
10) Brass (65/35) sheet (0.3)	3.44	3.50	536	101	636	1,841	353	2,194	548	102	650	1,882	358	2,240	560	104	664	1,925	365	2,290
11) Brass (65/35) strip (0.75)	3.35	3.40	803	151	955	2,692	514	3,206	821	154	975	2,753	522	3,275	840	157	997	2,815	532	3,347
12) Brass (65/35) sheet (0.75)	3.49	4.10	803	151	955	2,801	620	3,421	821	154	975	2,864	630	3,494	840	157	997	2,929	642	3,571
13) Brass (65/35) strip (0.8)	3.32	3.80	803	151	955	2,667	575	3,242	821	154	975	2,727	584	3,310	840	157	997	2,789	595	3,384
14) Brass (65/35) sheet (0.8)	3.44	3.60	803	151	955	2,767	544	3,312	821	154	975	2,829	553	3,382	840	157	997	2,893	564	3,457
15) Brass (65/35) sheet (1.2)	3.36	3.50	1,607	302	1,909	5,398	1,058	6,456	1,643	307	1,950	5,519	1,075	6,594	1,680	313	1,993	5,644	1,096	6,740
16) Brass (65/35) strip (1.5)	3.31	3.30	803	151	955	2,663	499	3,162	821	154	975	2,723	507	3,229	840	157	997	2,784	517	3,301
17) Brass (65/35) sheet (1.5)	3.36	3.40	803	151	955	2,703	514	3,217	821	154	975	2,763	522	3,285	840	157	997	2,826	532	3,358
TOTAL			13,390	2,520	15,910	46,853	9,082	55,935	13,690	2,560	16,250	47,903	9,226	57,129	14,000	2,610	16,610	48,988	9,406	58,394

Schedule 3.2. Estimate of Sales Revenues

Products			Year 10						Year 11						Year 12					
Description (thickness in mm)	Unit Price (average)		Quantities to be sold (tons)			Sales revenues			Quantities to be sold (tons)			Sales revenues			Quantities to be sold (tons)			Sales revenues		
	exp.	loc.	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total
1) Copper strip (0.1)	3.89	4.20	573	106	679	2,229	445	2,674	588	107	695	2,285	450	2,736	608	110	718	2,363	464	2,827
2) Copper strip (0.5)	3.83	3.80	573	106	679	2,198	403	2,601	588	107	695	2,253	407	2,661	608	110	718	2,330	420	2,749
3) Copper sheet (0.5)	3.78	3.70	573	106	679	2,167	392	2,560	588	107	695	2,222	397	2,618	608	110	718	2,297	408	2,706
4) Copper strip (1.0)	4.06	4.00	573	106	679	2,325	424	2,749	588	107	695	2,383	429	2,812	608	110	718	2,464	442	2,906
5) Copper sheet (1.0)	4.04	3.90	573	106	679	2,314	413	2,727	588	107	695	2,372	418	2,790	608	110	718	2,453	431	2,883
6) Brass (70/30) strip (0.3)	3.40	3.40	1,146	212	1,358	3,898	721	4,619	1,175	214	1,390	3,996	729	4,725	1,215	221	1,436	4,132	751	4,883
7) Brass (70/30) strip (0.75)	3.39	3.40	1,720	318	2,038	5,822	1,081	6,903	1,763	322	2,084	5,968	1,093	7,061	1,823	331	2,154	6,171	1,126	7,297
8) Brass (65/35) strip (0.15)	3.57	3.60	573	106	679	2,044	382	2,426	588	107	695	2,096	386	2,482	608	110	718	2,167	397	2,564
9) Brass (65/35) strip (0.3)	3.41	3.50	573	106	679	1,956	371	2,327	588	107	695	2,006	375	2,381	608	110	718	2,074	386	2,460
10) Brass (65/35) sheet (0.3)	3.44	3.50	573	106	679	1,970	371	2,341	588	107	695	2,019	375	2,395	608	110	718	2,088	386	2,475
11) Brass (65/35) strip (0.75)	3.35	3.40	860	159	1,019	2,881	541	3,422	881	161	1,042	2,954	547	3,500	911	166	1,077	3,054	563	3,617
12) Brass (65/35) sheet (0.75)	3.49	4.10	860	159	1,019	2,998	652	3,650	881	161	1,042	3,073	659	3,733	911	166	1,077	3,178	679	3,857
13) Brass (65/35) strip (0.8)	3.32	3.80	860	159	1,019	2,854	604	3,458	881	161	1,042	2,926	611	3,537	911	166	1,077	3,026	629	3,655
14) Brass (65/35) sheet (0.8)	3.44	3.60	860	159	1,019	2,962	572	3,534	881	161	1,042	3,036	579	3,615	911	166	1,077	3,139	596	3,735
15) Brass (65/35) sheet (1.2)	3.36	3.50	1,720	318	2,038	5,777	1,113	6,890	1,763	322	2,084	5,922	1,126	7,047	1,823	331	2,154	6,123	1,159	7,282
16) Brass (65/35) strip (1.5)	3.30	3.30	860	159	1,019	2,836	525	3,361	881	161	1,042	2,908	531	3,438	911	166	1,077	3,007	546	3,553
17) Brass (65/35) sheet (1.5)	3.36	3.40	860	159	1,019	2,892	541	3,433	881	161	1,042	2,965	547	3,512	911	166	1,077	3,066	563	3,629
TOTAL			14,330	2,650	16,980	50,124	9,551	59,675	14,690	2,680	17,370	51,384	9,659	61,042	15,190	2,760	17,950	53,133	9,947	63,080

Schedule 3.2. Estimate of Sales Revenues

Products			Year 13						Year 14						Year 15					
Description (thickness in mm)	Unit Price (average)		Quantities to be sold (tons)			Sales revenues			Quantities to be sold (tons)			Sales revenues			Quantities to be sold (tons)			Sales revenues		
	exp.	loc.	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total	exp.	loc.	total
1) Copper strip (0.1)	3.90	4.20	609	111	720	2,374	465	2,838	610	110	720	2,375	464	2,838	610	110	720	2,378	461	2,838
2) Copper strip (0.5)	3.83	3.80	609	111	720	2,337	420	2,757	610	110	720	2,338	419	2,757	610	110	720	2,340	417	2,757
3) Copper sheet (0.5)	3.78	3.70	609	111	720	2,304	409	2,713	610	110	720	2,305	408	2,713	610	110	720	2,308	406	2,714
4) Copper strip (1.0)	4.05	4.00	609	111	720	2,471	442	2,913	610	110	720	2,472	441	2,913	610	110	720	2,475	439	2,913
5) Copper sheet (1.0)	4.04	3.90	609	111	720	2,460	431	2,891	610	110	720	2,461	430	2,891	610	110	720	2,464	428	2,892
6) Brass (70/30) strip (0.3)	3.40	3.40	1,219	221	1,440	4,144	752	4,896	1,219	221	1,440	4,146	750	4,896	1,221	219	1,440	4,151	746	4,896
7) Brass (70/30) strip (0.75)	3.38	3.40	1,828	332	2,160	6,184	1,128	7,313	1,829	331	2,160	6,187	1,126	7,313	1,831	329	2,160	6,194	1,118	7,312
8) Brass (65/35) strip (0.15)	3.57	3.60	609	111	720	2,173	398	2,572	610	110	720	2,174	397	2,572	610	110	720	2,177	395	2,572
9) Brass (65/35) strip (0.3)	3.41	3.50	609	111	720	2,080	387	2,467	610	110	720	2,081	386	2,467	610	110	720	2,083	384	2,467
10) Brass (65/35) sheet (0.3)	3.44	3.50	609	111	720	2,094	387	2,481	610	110	720	2,095	386	2,481	610	110	720	2,098	384	2,481
11) Brass (65/35) strip (0.75)	3.35	3.40	914	166	1,080	3,063	564	3,627	914	166	1,080	3,064	563	3,627	916	164	1,080	3,068	559	3,627
12) Brass (65/35) sheet (0.75)	3.49	4.10	914	166	1,080	3,187	680	3,868	914	166	1,080	3,189	679	3,867	916	164	1,080	3,192	674	3,867
13) Brass (65/35) strip (0.8)	3.32	3.80	914	166	1,080	3,034	631	3,665	914	166	1,080	3,036	629	3,665	916	164	1,080	3,039	625	3,664
14) Brass (65/35) sheet (0.8)	3.44	3.60	914	166	1,080	3,148	597	3,746	914	166	1,080	3,150	596	3,746	916	164	1,080	3,153	592	3,746
15) Brass (65/35) sheet (1.2)	3.36	3.50	1,828	332	2,160	6,141	1,162	7,303	1,829	331	2,160	6,144	1,159	7,303	1,831	329	2,160	6,151	1,151	7,302
16) Brass (65/35) strip (1.5)	3.31	3.30	914	166	1,080	3,030	548	3,577	914	166	1,080	3,031	546	3,577	916	164	1,080	3,035	543	3,577
17) Brass (65/35) sheet (1.5)	3.36	3.40	914	166	1,080	3,075	564	3,639	914	166	1,080	3,076	563	3,639	916	164	1,080	3,080	559	3,639
<u>TOTAL</u>			15,235	2,765	18,000	53,301	9,967	63,267	15,241	2,759	18,000	53,323	9,944	63,267	15,259	2,741	18,000	53,385	9,880	63,265

Schedule 3.2. Estimate of Sales Revenues

4.1 RAW MATERIAL

The raw materials for the plant consist of copper cathode, zinc and scrap. These are usually semi-processed materials and supplied from external sources.

One of the major function of this project is to utilize the copper cathode produced by PASAR and produce copper and brass flat products for domestic use and export.

4.1.1 Copper Cathode

The major source of supplying copper cathode is PASAR, which has the sufficient production capacity of 100,000 t/y copper cathode with further expansion.

(1) Required amount for production

Based on the product mix in Chapter III the required amount of copper cathode is calculated as follows:

$$A \times R1 \times R2 \times R3 = P,$$

where A : total required amount of copper for melting (t/y)

R1: metal loss at melting

R2: yield at melting and casting

R3: total yield from casting to the final product

P : amount of the final product (t/y)

$$A = \frac{P}{R1 \times R2 \times R3}.$$

Table 4.1 below shows the yield ratio and result of the calculation for each material of the product mix.

	Copper	Brass (70/30)	Brass (65/35)	Total
P (t/y)	3,000	3,000	9,000	15,000
R1	0.98	0.97	0.97	
R2	0.95	0.95	0.95	
R3	0.674	0.660	0.657	
A (t/y)	4,781	4,933	14,866	
A copper	4,781	3,453	9,663	17,897
A zinc	0	1,480	5,203	6,683

Table 4.1 Required Amount for Production

The total required amounts for brass are divided into its composition copper and zinc in Table 4.1.

(2) Return scrap

The calculation of the required copper cathode amount should also cover return scrap that is returned from the various processing equipment in the factory.

The total amount of remeltable scrap is estimated as the difference between P and (A - metal loss) in Table 4.1 multiplied by availability factor (0.95 is assumed).

Copper (4,781 x 0.98 - 3,000) x 0.95 = 1,601 (t/y),

Brass (70/30) (4,933 x 0.97 - 3,000) x 0.95 = 1,696 (t/y),

Brass (65/35) (14,866 x 0.97 - 9,000) x 0.95 = 5,149 (t/y).

(3) Required input of copper cathode

Annual supply programme of copper cathode is determined from the above figures as follows:

Product	Virgin Metal	Required Input (t/y)
Copper	Copper	4,781 - 1,601 = 3,180
Brass (70/30)	Copper	(4,933 - 1,696) x 0.7 = 2,266
	Zinc	(4,933 - 1,696) x 0.3 = 971
Brass (65/35)	Copper	(14,866 - 5,149) x 0.65 = 6,316
	Zinc	(14,866 - 5,149) x 0.35 = 3,401

Table 4.2 Required Input of Virgin Metal

Accordingly the total required input of copper cathode is

3,180 + 2,266 + 6,316 = 11,762 (t/y).

4.1.2 Zinc

The required annual input of zinc is calculated in Table 4.2 to be

971 + 3,401 = 4,372 (t/y).

The virgin zinc is to be supplied from external sources usually in a ingot form.

4.1.3 Scrap

The major source of scrap is the return scrap in the factory as described in section 4.1.1.
All the return scrap is remelted in the melting furnace and recirculated through the production process.
The return scrap amount shares about 30% of the total input amount for production and the remainder is supplied from outside.

Another supply source is market scrap.
Market scrap can also be used in the melting process without any technological difficulty. Commercial aspects should be considered in respect to the market price of scrap v.s. virgin metals or copper cathode, domestic supply or imports, transportation cost, etc.

4.2 AUXILIARY MATERIAL

Various kinds of auxiliary materials are required for the process of copper and copper alloy flats production.
These materials are mainly categorized in oils, lubricants, chemicals and consumables.
Required amount of each auxiliary material is estimated under full production amount 15,000 t/y.
During the initial start-up years of the plant, the material amount should be reduced in proportion to the expected annual production.

4.2.1 Oil and Lubricants

(1) Roll coolant oil

Roll coolant oil is used for cooling rolls off of Rolling Mills (Cold Roughing Mill and Cold Finishing Mill).
Soluble oil (3-5% in water) is usually used for cold rough-rolling and mineral oil for cold finish-rolling.
Annual consumption is estimated as:

Soluble oil	14,000 lit./y
Mineral oil	12,000 lit./y

(2) Hydraulic oil

Hydraulic oil is used mainly by the hydraulic actuating system in the machine.

As compensation of oil leakage or for replacement of contaminated oil, the annual consumption is estimated to be about 25,000 lit./y.

(3) Grease and lubricating oil

Moving parts of machines, sliding faces, driving gears, etc. are lubricated by grease or relevant lubricating oils.

Annual consumption is estimated as

Grease	20,000 kg/y
Lubricating oil	6,000 lit./y

(4) Grinding oil for Roll Grinding Machines

Soluble oil	2,400 lit./y

4.2.2 Chemicals

(1) Sulfuric acid

Sulfuric acid of 10-15 vol % is used in the pickling process and periodically added or completly replaced. Estimated annual consumption is about

120 m^3/y for 15% H_2SO_4, or

26 m^3/y for 70% H_2SO_4

(2) Alkaline agents

Degreasing and continuous annealing/pickling processes require alkaline agents for degreasing coil surfaces. The alkaline agent is usually supplied in powder form (such as in 20 kg bag) and is made into a 1-2% solution in hot water. Annual consumption is estimated at about 7,200 kg of powder.

(3) Corrosion inhibitors

Corrosion inhibitors are added (0.2-0.8% solution) into hot water rinse tanks equipped for pickling and degreasing in order to prevent discoloration of the coil surface or rust after cleaning.

Annual consumption is about 2,400 kg of powder.

4.2.3 Consumables

Various kinds of consumables are required at the production stage, most of which take up a relatively small portion of the annual budget. Therefore some major consumables are listed below in Table 4.3 with their estimated annual consumption.

Item	Usage	Annual Consumption
Grinding wheel Grinding wheel Grinding wheel	for Cold Roughing Mill Roll for Cold Finishing Mill Roll - do -	5 pcs 10 pcs 20 pcs
Diamond wheel	for blade sharpening	10 pcs
Diamond tip	for thickness gauge of rolling mill	60 pcs
N_2 gas cylinder	for hydraulic accumulation	10 pcs
CO_2 gas cylinder	for fire extinguishing	40 pcs
Sticker plate	For Cold Roughing Mill	30 pcs
Steel band	for coil strapping	200 pcs
Packing material	for product packing	5,000 unit
Miscellaneous	Paper filter, chart paper, ink set, cleaning wiper, etc.	

Table 4.3 Major Consumables

4.3 UTILITY

4.3.1 Utility Consumption

Empirical data for utility consumption obtained from an existing plant with an equivalent process/ production or from equipment manufacturers are referred to in order to estimate utility consumption using the selected equipment/process for this study. The results are summarized in Table 4.4, where the consumption figures are given equipment-wise in hourly rate. These figures are used for cost estimates in the following section.

UTILITY CONSUMPTION DATA

ITEM NO.	EQUIPMENT	QTY	Electric Power (kW)	Average Power (kW)	Emergency Power (kW)	Cooling Water (m3/hr)	Fresh Water (m3/hr)	Emergency Water (m3/hr) X hr	Steam (kg/hr)	Compressed Air (Nm3/hr)	LPG (liter/hr)
100	Production Equipment									100	
101	Melting Furnace	5	4000	2750		150				100	
102	Casting Line	5	3500	1750		125	1	25 x 4		40	
103	Scalping Machine	1	800	670		20	1			220	
104	Cold Roughing Mill	1	2800	2000		170	1		1000	630	
105	Side Trimming Machine	1	150	130		4				100	
106	Annealing Furnace	2	320	260	300	440		40 x 4		240	772
107	Pickling Line	1	200	160		4	10		900	80	
108	Cold Finishing Mill	1	1900	1500		100			600	500	
109	Degreasing Line	1	220	160		4	10		900	80	
110	A/P Line	1	1000	1000	20	100	15	5 x 4		60	175
111	Heavy Gauge Slitting Machine	1	180	140		4				120	
112	Light Gauge Slitting Machine	1	120	80		4				120	
113	Cut-to-Length Machine	1	230	170		4				40	
114	Large Roll Grinder	1	60	60			1				
115	Small Roll Grinder	1	20	20			1				
116	Scalping Blade Sharpener	1	5	5			1				
150	Raw Material Handling	TOTAL	100	60		20		1 x 4		20	53
160	Packing Facility	TOTAL	20	20						20	
200	Maintenance Shop	TOTAL	50	30		4				20	
300	Transportation Facility	TOTAL	520	260							
400	Utility Supply Station	TOTAL	950	760		36			200		
500	Electrical Equipment	TOTAL	700	520		100					
600	Laboratory	TOTAL	15	10							

Table 4.4

4.3.2 Quality of Utility for Equipment

Qualitative properties or basic specifications required for each kind of utility are described below.

(1) Electricity

- Phase	:	Three (3)
- Frequency	:	60 Hz
- Voltage variation from rated voltage	:	±5%
- Frequency variation from rated frequency	:	±2%

(2) Water

1) Cooling water

- pH	:	6.8-7.5
- Suspended solid	:	Max. 10 ppm
- Total hardness	:	Max. 120 ppm
- Total dissolved solid	:	Max. 300 ppm
- Chloride as Cl	:	Max. 30 ppm
- Inlet temperature	:	Max. 32°C
- Outlet temperature	:	Max. 40°C
- Inlet pressure	:	Approx. 2-3 bar
- Outlet pressure	:	Atm.

2) Make-up water

- pH	:	6.8-7.5
- Suspended solid	:	Max. 3 ppm
- Total hardness	:	Max. 40 ppm
- Total dissolved solid	:	Max. 100 ppm
- Chloride	:	Max. 10 ppm
- Total iron	:	Max. 0.1°C
- Ammonium ion	:	Nil
- Sulphide ion	:	Nil
- Inlet temperature	:	Max. 35°C
- Inlet pressure	:	Approx. 2-3 bar

(3) Steam

- Pressure	:	6-7 bar (Max. 7 bar)
- Temperature	:	Saturated

(4) Compressed air

- Pressure (at feeding point)	:	5-7 bar (Max. 7 bar)
- Temperature	:	Max. 40°C
- Humidity	:	Saturated
- Oil content	:	Max. 0.05 g/m^3

(5) LPG

Detail specification is in accordance with the available LPG in the Philippines. For plant operation, it would be required for LPG to be vapourized and diluted with air.

(6) Effluent disposal

1) Waste pickling acid

- pH	:	1.8-2.5
- Suspended solid	:	Max. 30 ppm
- Cu	:	Approx. 35 ppm
- Zn	:	Approx. 50 ppm
- Pb	:	Approx. 1 ppm
- Fe	:	Approx. 2 ppm

2) Waste oil

- pH	:	8-9
- n-Hex extract	:	100,000-400,000 ppm
- Specific gravity	:	0.9
- Specific heat	:	0.5 kcal/kg
- Boiling point	:	170-180°C

4.3.3 Utility Supply Facilities

In order to supply the required utilities in sufficient quantity and with adequate quality, relevant facilities should be included in the plant, such as:

- Power Substation
- Raw Water Treatment
- Boiler
- Air Compressor
- LPG Station

Details of the facilities or layout are described in Chapter VI.

4.4 SUPPLY PROGRAM

As described in Chapter V, major utilities, particularly electricity and raw water, together with some auxiliary materials are easily available at the Isabel Site at a relatively lower cost compared with the Batangas Site.

It should be noted that the existing water supply line (LWSS = Leading Water Supply System) to the Isabel area can be used without expansion as the water supplied is sufficient to cover the needs of this new plant.

Other major materials, such as LPG, oils and lubricants, etc. are also available according to the site survey carried out by the study team. Details can be found in Table 5.1, Chapter V.

4.5 COST ESTIMATE OF MATERIALS AND INPUTS

Cost estimate for each itemized material has been carried out and summarized in the attached Schedule 4.1:

Materials and Inputs

US $

Year 1

No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost Local	Cost Foreign	Cost Total
1	4,705	ton	Copper cathode	+		2,670	12,561,816	0	12,561,815
2	1,749	ton	Zinc ingot	+		1,400	2,448,320	0	2,448,320
3	5,600	liter	Soluble oil		+	4	0	24,010	24,010
4	4,800	liter	Mineral oil		+	2	0	11,100	11,100
5	10,000	liter	Hydraulic oil	+		0.88	8,756	0	8,756
6	8,000	kg	Grease	+		0.84	6,713	0	6,713
7	2,400	liter	Lubricant oil	+		0.91	2,189	0	2,189
8	960	liter	Grinding oil		+	6	0	5,556	5,556
9	104	m3	Sulfuric acid (70%)	+		74	7,696	0	7,696
10	2,880	kg	Alkaline powder	+		2.9	8,352	0	8,352
11	960	kg	Corrosion inhibitor	+		6.9	6,624	0	6,624
12	12,000	kg	Caustic soda (32% solution)	+		0.44	5,253	0	5,253
13	14,400	kg	Alminum sulfate	+		0.44	6,304	0	6,304
14	160	kg	Coagulant acid	+		8.76	1,401	0	1,401
15	4,800	kg	Scale inhibitor	+		8.03	38,524	0	38,524
16	18,116	MWH	Electricity	+		38	693,928	0	693,928
17	2,640	K.liter	LPG	+		0.33	871	0	871
18	170,500	m3	Raw water	+		0.36	61,380	0	61,380
19	2	pc	Grinding wheel		+	775	0	1,550	1,550
20	4	pc	Grinding wheel		+	813	0	3,250	3,250
21	8	pc	Grinding wheel		+	813	0	6,500	6,500
22	4	pc	Diamond wheel		+	3,625	0	14,500	14,500
23	24	pc	Diamond Chip		+	2,750	0	66,000	66,000
24	4	pc	N2 Gas cylinder		+	663	0	2,650	2,650
25	16	pc	CO2 gas Cylinder		+	763	0	12,200	12,200
26	12	pc	Sticker plate		+	913	0	10,950	10,950
27	80	pc	Steel band		+	63	0	5,000	5,000
28	1	lot	Other miscellaneous		+	125,000	0	125,000	125,000
			Total				15,858,127	288,266	16,146,393

Materials and Inputs									US $
						Year		2	
No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost		
							Local	Foreign	Total
1	7,057	ton	Copper cathode	+		2,670	18,842,724	0	18,842,724
2	2,623	ton	Zinc ingot	+		1,400	3,672,480	0	3,672,480
3	8,400	liter	Soluble oil		+	4	0	36,015	36,015
4	7,200	liter	Mineral oil		+	2	0	16,650	16,650
5	15,000	liter	Hydraulic oil	+		0.88	13,133	0	13,133
6	12,000	kg	Grease	+		0.84	10,069	0	10,069
7	3,600	liter	Lubricant oil	+		0.91	3,283	0	3,283
8	1,440	liter	Grinding oil		+	5	0	8,334	8,334
9	156	m3	Sulfuric acid (70%)	+		74	11,544	0	11,544
10	4,320	kg	Alkaline powder	+		2.9	12,528	0	12,528
11	1,440	kg	Corrosion inhibitor	+		6.9	9,936	0	9,936
12	18,000	kg	Caustic soda (32% solution)	+		0.44	7,880	0	7,880
13	21,600	kg	Alminum s[illegible]e	+		0.44	9,456	0	9,456
14	240	kg	Coagulant acid	+		8.75	2,101	0	2,101
15	7,200	kg	Scale [illegible]tor	+		8.03	57,787	0	57,787
16	27,173	MWH	Electricity	+		38	1,040,892	0	1,040,892
17	3,960	K.liter	LPG	+		0.33	1,307	0	1,307
18	255,750	m3	Raw water	+		0.36	92,070	0	92,070
19	3	pc	Grinding wheel		+	775	0	2,325	2,325
20	6	pc	Grinding wheel		+	813	0	4,875	4,875
21	12	pc	Grinding wheel		+	813	0	9,750	9,750
22	6	pc	Diamond wheel		+	3,625	0	21,750	21,750
23	36	pc	Diamond Chip		+	2,750	0	99,000	99,000
24	6	pc	N2 Gas cylinder		+	663	0	3,975	3,975
25	24	pc	CO2 gas Cylinder		+	763	0	18,300	18,300
26	18	pc	Sticker plate		+	913	0	16,425	16,425
27	120	pc	Steel band		+	63	0	7,500	7,500
28	1	lot	Other miscellaneous		+	187,500	0	187,500	187,500
			Total				23,787,191	432,399	24,219,590

Materials and Inputs

US $

Year 3

No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost Local	Cost Foreign	Cost Total
1	9,410	ton	Copper cathode	+		2,670	25,123,632	0	25,123,632
2	3,498	ton	Zinc ingot	+		1,400	4,896,640	0	4,896,640
3	11,200	liter	Soluble oil		+	4	0	48,020	48,020
4	9,600	liter	Mineral oil		+	2	0	22,200	22,200
5	20,000	liter	Hydraulic oil	+		0.88	17,511	0	17,511
6	16,000	kg	Grease	+		0.84	13,425	0	13,425
7	4,800	liter	Lubricant oil	+		0.91	4,378	0	4,378
8	1,920	liter	Grinding oil		+	6	0	11,112	11,112
9	208	m3	Sulfuric acid (70%)	+		74	15,392	0	15,392
10	5,760	kg	Alkaline powder	+		2.9	16,704	0	16,704
11	1,920	kg	Corrosion inhibitor	+		6.9	13,248	0	13,248
12	24,000	kg	Caustic soda (32% solution)	+		0.44	10,507	0	10,507
13	28,800	kg	Alminum sulfate	+		0.44	12,608	0	12,608
14	320	kg	Coagulant acid	+		8.76	2,802	0	2,802
15	9,600	kg	Scale inhibitor	+		8.03	77,049	0	77,049
16	36,231	MWH	Electricity	+		38	1,387,856	0	1,387,856
17	5,280	K.liter	LPG	+		0.33	1,742	0	1,742
18	341,000	m3	Raw water	+		0.36	122,760	0	122,760
19	4	pc	Grinding wheel		+	775	0	3,100	3,100
20	8	pc	Grinding wheel		+	813	0	6,500	6,500
21	16	pc	Grinding wheel		+	813	0	13,000	13,000
22	8	pc	Diamond wheel		+	3,625	0	29,000	29,000
23	48	pc	Diamond Chip		+	2,750	0	132,000	132,000
24	8	pc	N2 Gas cylinder		+	663	0	5,300	5,300
25	32	pc	CO2 gas Cylinder		+	763	0	24,400	24,400
26	24	pc	Sticker plate		+	913	0	21,900	21,900
27	160	pc	Steel band		+	63	0	10,000	10,000
28	1	lot	Other miscellaneous		+	250,000	0	250,000	250,000
			Total				31,716,254	576,532	32,292,786

Materials and Inputs

US $

Year 4

No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost Local	Cost Foreign	Cost Total
1	11,762	ton	Copper cathode	+		2,670	31,404,540	0	31,404,540
2	4,372	ton	Zinc ingot	+		1,400	6,120,800	0	6,120,800
3	14,000	liter	Soluble oil		+	4	0	60,025	60,025
4	12,000	liter	Mineral oil		+	2	0	27,750	27,750
5	25,000	liter	Hydraulic oil	+		0.88	21,889	0	21,889
6	20,000	kg	Grease	+		0.84	16,781	0	16,781
7	6,000	liter	Lubricant oil	+		0.91	5,472	0	5,472
8	2,400	liter	Grinding oil		+	6	0	13,890	13,890
9	260	m3	Sulfuric acid (70%)	+		74	19,240	0	19,240
10	7,200	kg	Alkaline powder	+		2.9	20,880	0	20,880
11	2,400	kg	Corrosion inhibitor	+		6.9	16,560	0	16,560
12	30,000	kg	Caustic soda (32% solution)	+		0.44	13,133	0	13,133
13	36,000	kg	Alminum sulfate	+		0.44	15,760	0	15,760
14	400	kg	Coagulant acid	+		8.76	3,502	0	3,502
15	12,000	kg	Scale inhibitor	+		8.03	96,311	0	96,311
16	45,289	MWH	Electricity	+		38	1,734,820	0	1,734,820
17	6,600	K.liter	LPG	+		0.33	2,178	0	2,178
18	426,250	m3	Raw water	+		0.36	153,450	0	153,450
19	5	pc	Grinding wheel		+	775	0	3,875	3,875
20	10	pc	Grinding wheel		+	813	0	8,125	8,125
21	20	pc	Grinding wheel		+	813	0	16,250	16,250
22	10	pc	Diamond wheel		+	3,625	0	36,250	36,250
23	60	pc	Diamond Chip		+	2,750	0	165,000	165,000
24	10	pc	N2 Gas cylinder		+	663	0	6,625	6,625
25	40	pc	CO2 gas Cylinder		+	763	0	30,500	30,500
26	30	pc	Sticker plate		+	913	0	27,375	27,375
27	200	pc	Steel band		+	63	0	12,500	12,500
28	1	lot	Other miscellaneous		+	312,500	0	312,500	312,500
			Total				39,645,318	720,665	40,365,983

Materials and Inputs									US $
						Year		5	
No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost Local	Cost Foreign	Cost Total
1	12,029	ton	Copper cathode	+		2,670	32,116,376	0	32,116,376
2	4,471	ton	Zinc ingot	+		1,400	6,259,538	0	6,259,538
3	14,317	liter	Soluble oil		+	4	0	61,386	61,386
4	12,272	liter	Mineral oil		+	2	0	28,379	28,379
5	25,567	liter	Hydraulic oil	+		0.88	22,385	0	22,385
6	20,453	kg	Grease	+		0.84	17,162	0	17,162
7	6,136	liter	Lubricant oil	+		0.91	5,596	0	5,596
8	2,454	liter	Grinding oil		+	6	0	14,205	14,205
9	266	m3	Sulfuric acid (70%)	+		74	19,676	0	19,676
10	7,363	kg	Alkaline powder	+		2.9	21,353	0	21,353
11	2,454	kg	Corrosion inhibitor	+		6.9	16,935	0	16,935
12	30,680	kg	Caustic soda (32% solution)	+		0.44	13,431	0	13,431
13	36,816	kg	Alminum sulfate	+		0.44	16,117	0	16,117
14	409	kg	Coagulant acid	+		8.76	3,582	0	3,582
15	12,272	kg	Scale inhibitor	+		8.03	98,494	0	98,494
16	46,316	MWH	Electricity	+		38	1,774,143	0	1,774,143
17	6,750	K.liter	LPG	+		0.33	2,227	0	2,227
18	435,912	m3	Raw water	+		0.36	156,928	0	156,928
19	5	pc	Grinding wheel		+	775	0	3,963	3,963
20	10	pc	Grinding wheel		+	813	0	8,309	8,309
21	20	pc	Grinding wheel		+	813	0	16,618	16,618
22	10	pc	Diamond wheel		+	3,625	0	37,072	37,072
23	61	pc	Diamond Chip		+	2,750	0	168,740	168,740
24	10	pc	N2 Gas cylinder		+	663	0	6,775	6,775
25	41	pc	CO2 gas Cylinder		+	763	0	31,191	31,191
26	31	pc	Sticker plate		+	913	0	27,996	27,996
27	205	pc	Steel band		+	63	0	12,783	12,783
28	1	lot	Other miscellaneous		+	319,583	0	319,583	319,583
			Total				40,543,945	737,000	41,280,945

Materials and Inputs

US $

Year 6

No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost Local	Cost Foreign	Cost Total
1	12,248	ton	Copper cathode	+		2,670	32,702,594	0	32,702,594
2	4,553	ton	Zinc ingot	+		1,400	6,373,793	0	6,373,793
3	14,579	liter	Soluble oil		+	4	0	62,506	62,506
4	12,496	liter	Mineral oil		+	2	0	28,897	28,897
5	26,033	liter	Hydraulic oil	+		0.88	22,794	0	22,794
6	20,827	kg	Grease	+		0.84	17,475	0	17,475
7	6,248	liter	Lubricant oil	+		0.91	5,698	0	5,698
8	2,499	liter	Grinding oil		+	6	0	14,464	14,464
9	271	m3	Sulfuric acid (70%)	+		74	20,035	0	20,035
10	7,498	kg	Alkaline powder	+		2.9	21,743	0	21,743
11	2,499	kg	Corrosion inhibitor	+		6.9	17,244	0	17,244
12	31,240	kg	Caustic soda (32% solution)	+		0.44	13,676	0	13,676
13	37,488	kg	Alminum sulfate	+		0.44	16,411	0	16,411
14	417	kg	Coagulant acid	+		8.76	3,647	0	3,647
15	12,496	kg	Scale inhibitor	+		8.03	100,292	0	100,292
16	47,161	MWH	Electricity	+		38	1,806,526	0	1,806,526
17	6,873	K.liter	LPG	+		0.33	2,268	0	2,268
18	443,868	m3	Raw water	+		0.36	159,793	0	159,793
19	5	pc	Grinding wheel		+	775	0	4,035	4,035
20	10	pc	Grinding wheel		+	813	0	8,461	8,461
21	21	pc	Grinding wheel		+	813	0	16,922	16,922
22	10	pc	Diamond wheel		+	3,625	0	37,748	37,748
23	62	pc	Diamond Ch [illegible]		+	2,750	0	171,820	171,820
24	10	pc	N2 Gas cylinder		+	663	0	6,899	6,899
25	42	pc	CO2 gas Cylinder		+	763	0	31,761	31,761
26	31	pc	Sticker plate		+	913	0	28,507	28,507
27	208	pc	Steel band		+	63	0	13,017	13,017
28	1	lot	Other miscellaneous		+	325,417	0	325,417	325,417
			Total				41,283,991	750,452	42,034,443

Schedule 4.1. Materials and Inputs

Materials and Inputs

US $

Year 7

No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost		
							Local	Foreign	Total
1	12,476	ton	Copper cathode	+		2,670	33,309,749	0	33,309,749
2	4,637	ton	Zinc ingot	+		1,400	6,492,129	0	6,492,129
3	14,849	liter	Soluble oil		+	4	0	63,667	63,667
4	12,728	liter	Mineral oil		+	2	0	29,434	29,434
5	26,517	liter	Hydraulic oil	+		0.88	23,217	0	23,217
6	21,213	kg	Grease	+		0.84	17,800	0	17,800
7	6,364	liter	Lubricant oil	+		0.91	5,804	0	5,804
8	2,546	liter	Grinding oil		+	6	0	14,733	14,733
9	276	m3	Sulfuric acid (70%)	+		74	20,407	0	20,407
10	7,637	kg	Alkaline powder	+		2.9	22,147	0	22,147
11	2,546	kg	Corrosion inhibitor	+		6.9	17,565	0	17,565
12	31,820	kg	Caustic soda (32% solution)	+		0.44	13,930	0	13,930
13	38,184	kg	Alminum sulfate	+		0.44	16,716	0	16,716
14	424	kg	Coagulant acid	+		8.76	3,715	0	3,715
15	12,728	kg	Scale inhibitor	+		8.03	102,154	0	102,154
16	48,037	MWH	Electricity	+		38	1,840,066	0	1,840,066
17	7,000	K.liter	LPG	+		0.33	2,310	0	2,310
18	452,109	m3	Raw water	+		0.36	162,759	0	162,759
19	5	pc	Grinding wheel		+	775	0	4,110	4,110
20	11	pc	Grinding wheel		+	813	0	8,618	8,618
21	21	pc	Grinding wheel		+	813	0	17,236	17,236
22	11	pc	Diamond wheel		+	3,625	0	38,449	38,449
23	64	pc	Diamond Chip		+	2,750	0	175,010	175,010
24	11	pc	N2 Gas cylinder		+	663	0	7,027	7,027
25	42	pc	CO2 gas Cylinder		+	763	0	32,350	32,350
26	32	pc	Sticker plate		+	913	0	29,036	29,036
27	212	pc	Steel band		+	63	0	13,258	13,258
28	1	lot	Other miscellaneous		+	331,458	0	331,458	331,458
			Total				42,050,467	764,385	42,814,852

Schedule 4.1. Materials and Inputs

Materials and Inputs									US $
							Year	8	
No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost		
							Local	Foreign	Total
1	12,742	ton	Copper cathode	+		2,670	34,021,585	0	34,021,585
2	4,736	ton	Zinc ingot	+		1,400	6,630,867	0	6,630,867
3	15,167	liter	Soluble oil		+	4	0	65,027	65,027
4	13,000	liter	Mineral oil		+	2	0	30,063	30,063
5	27,083	liter	Hydraulic oil	+		0.88	23,713	0	23,713
6	21,667	kg	Grease	+		0.84	18,180	0	18,180
7	6,500	liter	Lubricant oil	+		0.91	5,928	0	5,928
8	2,600	liter	Grinding oil		+	6	0	15,048	15,048
9	282	m3	Sulfuric acid (70%)	+		74	20,843	0	20,843
10	7,800	kg	Alkaline powder	+		2.9	22,620	0	22,620
11	2,600	kg	Corrosion inhibitor	+		6.9	17,940	0	17,940
12	32,500	kg	Caustic soda (32% solution)	+		0.44	14,228	0	14,228
13	39,000	kg	Alminum sulfate	+		0.44	17,073	0	17,073
14	433	kg	Coagulant acid	+		8.76	3,794	0	3,794
15	13,000	kg	Scale inhibitor	+		8.03	104,337	0	104,337
16	49,063	MWH	Electricity	+		38	1,879,389	0	1,879,389
17	7,150	K.liter	LPG	+		0.33	2,360	0	2,360
18	461,771	m3	Raw water	+		0.36	166,238	0	166,238
19	5	pc	Grinding wheel		+	775	0	4,198	4,198
20	11	pc	Grinding wheel		+	813	0	8,802	8,802
21	22	pc	Grinding wheel		+	813	0	17,604	17,604
22	11	pc	Diamond wheel		+	3,625	0	39,271	39,271
23	65	pc	Diamond Chip		+	2,750	0	178,750	178,750
24	11	pc	N2 Gas cylinder		+	663	0	7,177	7,177
25	43	pc	CO2 gas Cylinder		+	763	0	33,042	33,042
26	33	pc	Sticker plate		+	913	0	29,656	29,656
27	217	pc	Steel band		+	63	0	13,542	13,542
28	1	lot	Other miscellaneous		+	338,542	0	338,542	338,542
			Total				42,949,094	780,720	43,729,814

Materials and Inputs

US $

Year 9

No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost Local	Cost Foreign	Cost Total
1	13,024	ton	Copper cathode	+		2,670	34,775,294	0	34,775,294
2	4,841	ton	Zinc ingot	+		1,403	6,777,766	0	6,777,766
3	15,503	liter	Soluble oil		+	4	0	66,468	66,468
4	13,288	liter	Mineral oil		+	2	0	30,729	30,729
5	27,683	liter	Hydraulic oil	+		0.88	24,238	0	24,238
6	22,147	kg	Grease	+		0.84	18,583	0	18,583
7	6,644	liter	Lubricant oil	+		0.91	6,060	0	6,060
8	2,658	liter	Grinding oil		+	6	0	15,381	15,381
9	288	m3	Sulfuric acid (70%)	+		74	21,305	C	21,305
10	7,973	kg	Alkaline powder	+		2.9	23,121	0	23,121
11	2,658	kg	Corrosion inhibitor	+		6.9	18,337	0	18,337
12	33,220	kg	Caustic soda (32% solution)	+		0.44	14,543	0	14,543
13	39,864	kg	Alminum sulfate	+		0.44	17,452	0	17,452
14	443	kg	Coagulant acid	+		8.76	3,878	0	3,878
15	13,288	kg	Scale inhibitor	+		8.03	106,649	0	106,649
16	50,150	MWH	Electricity	+		38	1,921,024	0	1,921,024
17	7,308	K.liter	LPG	+		0.33	2,412	0	2,412
18	472,001	m3	Raw water	+		0.36	169,920	0	169,920
19	6	pc	Grinding wheel		+	775	0	4,291	4,291
20	11	pc	Grinding wheel		+	813	0	8,997	8,997
21	22	pc	Grinding wheel		+	813	0	17,994	17,994
22	11	pc	Diamond wheel		+	3,625	0	40,141	40,141
23	66	pc	Diamond Chip		+	2,750	0	182,710	182,710
24	11	pc	N2 Gas cylinder		+	663	0	7,336	7,336
25	44	pc	CO2 gas Cylinder		+	763	0	33,774	33,774
26	33	pc	Sticker plate		+	913	0	30,313	30,313
27	221	pc	Steel band		+	63	0	13,842	13,842
28	1	lot	Other miscellaneous		+	346,042	0	346,042	346,042
			Total				43,900,582	798,016	44,698,598

Materials and Inputs

US $

Year 10

No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost Local	Cost Foreign	Cost Total
1	13,315	ton	Copper cathode	+		2,670	35,549,939	0	35,549,939
2	4,949	ton	Zinc ingot	+		1,400	6,928,746	0	6,928,746
3	15,848	liter	Soluble oil		+	4	0	67,948	67,948
4	13,584	liter	Mineral oil		+	2	0	31,413	31,413
5	28,300	liter	Hydraulic oil	+		0.88	24,778	0	24,778
6	22,640	kg	Grease	+		0.84	18,997	0	18,997
7	6,792	liter	Lubricant oil	+		0.91	6,195	0	6,195
8	2,717	liter	Grinding oil		+	6	0	15,723	15,723
9	294	m3	Sulfuric acid (70%)	+		74	21,780	0	21,780
10	8,150	kg	Alkaline powder	+		2.9	23,636	0	23,636
11	2,717	kg	Corrosion inhibitor	+		6.9	18,746	0	18,746
12	33,960	kg	Caustic soda (32% solution)	+		0.44	14,867	0	14,867
13	40,752	kg	Alminum sulfate	+		0.44	17,840	0	17,840
14	453	kg	Coagulant acid	+		8.76	3,965	0	3,965
15	13,584	kg	Scale inhibitor	+		8.03	109,024	0	109,024
16	51,267	MWH	Electricity	+		38	1,963,817	0	1,963,817
17	7,471	K.liter	LPG	+		0.33	2,465	0	2,465
18	482,515	m3	Raw water	+		0.36	173,705	0	173,705
19	6	pc	Grinding wheel		+	775	0	4,387	4,387
20	11	pc	Grinding wheel		+	813	0	9,198	9,198
21	23	pc	Grinding wheel		+	813	0	18,395	18,395
22	11	pc	Diamond wheel		+	3,625	0	41,035	41,035
23	68	pc	Diamond Chip		+	2,750	0	186,780	186,780
24	11	pc	N2 Gas cylinder		+	663	0	7,500	7,500
25	45	pc	CO2 gas Cylinder		+	763	0	34,526	34,526
26	34	pc	Sticker plate		+	913	0	30,989	30,989
27	226	pc	Steel band		+	63	0	14,150	14,150
28	1	lot	Other miscellaneous		+	353,750	0	353,750	353,750
			Total				44,878,499	815,793	45,694,292

Materials and Inputs									US $
						Year	11		
No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost		
							Local	Foreign	Total
1	13,620	ton	Copper cathode	+		2,670	36,366,457	0	36,366,457
2	5,063	ton	Zinc ingot	+		1,400	7,087,886	0	7,087,886
3	16,212	liter	Soluble oil		+	4	0	69,509	69,509
4	13,896	liter	Mineral oil		+	2	0	32,135	32,135
5	28,950	liter	Hydraulic oil	+		0.88	25,347	0	25,347
6	23,160	kg	Grease	+		0.84	19,433	0	19,433
7	6,948	liter	Lubricant oil	+		0.91	6,337	0	6,337
8	2,779	liter	Grinding oil		+	6	0	16,085	16,085
9	301	m3	Sulfuric acid (70%)	+		74	22,280	0	22,280
10	8,338	kg	Alkaline powder	+		2.9	24,179	0	24,179
11	2,779	kg	Corrosion inhibitor	+		6.9	19,176	0	19,176
12	34,740	kg	Caustic soda (32% solution)	+		0.44	15,208	0	15,208
13	41,688	kg	Alminum sulfate	+		0.44	18,250	0	18,250
14	463	kg	Coagulant acid	+		8.76	4,056	0	4,056
15	13,896	kg	Scale inhibitor	+		8.03	111,528	0	111,528
16	52,445	MWH	Electricity	+		38	2,008,922	0	2,008,922
17	7,643	K.liter	LPG	+		0.33	2,522	0	2,522
18	493,598	m3	Raw water	+		0.36	177,695	0	177,695
19	6	pc	Grinding wheel		+	775	0	4,487	4,487
20	12	pc	Grinding wheel		+	813	0	9,409	9,409
21	23	pc	Grinding wheel		+	813	0	18,818	18,818
22	12	pc	Diamond wheel		+	3,625	0	41,978	41,978
23	69	pc	Diamond Chip		+	2,750	0	191,070	191,070
24	12	pc	N2 Gas cylinder		+	663	0	7,672	7,672
25	46	pc	CO2 gas Cylinder		+	763	0	35,319	35,319
26	35	pc	Sticker plate		+	913	0	31,700	31,700
27	232	pc	Steel band		+	63	0	14,475	14,475
28	1	lot	Other miscellaneous		+	361,875	0	361,875	361,875
			Total				45,909,276	834,530	46,743,808

Materials and Inputs									US $
							Year	12	
No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost		
							Local	Foreign	Total
1	14,075	ton	Copper cathode	+		2,670	37,580,766	0	37,580,766
2	5,232	ton	Zinc ingot	+		1,400	7,324,557	0	7,324,557
3	16,753	liter	Soluble oil		+	4	0	71,830	71,830
4	14,360	liter	Mineral oil		+	2	0	33,208	33,208
5	29,917	liter	Hydraulic oil	+		0.88	26,194	0	26,194
6	23,933	kg	Grease	+		0.84	20,082	0	20,082
7	7,180	liter	Lubricant oil	+		0.91	6,548	0	6,548
8	2,872	liter	Grinding oil		+	6	0	16,622	16,622
9	311	m3	Sulfuric acid (70%)	+		74	23,024	0	23,024
10	8,616	kg	Alkaline powder	+		2.9	24,986	0	24,986
11	2,872	kg	Corrosion inhibitor	+		6.9	19,817	0	19,817
12	35,900	kg	Caustic soda (32% solution)	+		0.44	15,716	0	15,716
13	43,080	kg	Alminum sulfate	+		0.44	18,859	0	18,853
14	479	kg	Coagulant acid	+		8.76	4,191	0	4,191
15	14,360	kg	Scale inhibitor	+		8.03	115,252	0	115,252
16	54,196	MWH	Electricity	+		38	2,076,002	0	2,076,002
17	7,898	K.liter	LPG	+		0.33	2,606	0	2,606
18	510,079	m3	Raw water	+		0.36	183,629	0	183,629
19	6	pc	Grinding wheel		+	775	0	4,637	4,637
20	12	pc	Grinding wheel		+	813	0	9,723	9,723
21	24	pc	Grinding wheel		+	813	0	19,446	19,446
22	12	pc	Diamond wheel		+	3,625	0	43,379	43,379
23	72	pc	Diamond Chip		+	2,750	0	197,450	197,450
24	12	pc	N2 Gas cylinder		+	663	0	7,928	7,928
25	48	pc	CO2 gas Cylinder		+	763	0	36,498	36,498
26	36	pc	Sticker plate		+	913	0	32,753	32,759
27	239	pc	Steel band		+	63	0	14,958	14,958
28	1	lot	Other miscellaneous		+	373,958	0	373,958	373,958
			Total				47,442,230	862,396	48,304,626

Materials and Inputs

US $

Year 13

No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost Local	Cost Foreign	Cost Total
1	14,114	ton	Copper cathode	+		2,670	37,685,448	0	37,685,448
2	5,246	ton	Zinc ingot	+		1,400	7,344,960	0	7,344,960
3	16,800	liter	Soluble oil		+	4	0	72,030	72,030
4	14,400	liter	Mineral oil		+	2	0	33,300	33,300
5	30,000	liter	Hydraulic oil	+		0.88	26,267	0	26,267
6	24,000	kg	Grease	+		0.84	20,138	0	20,138
7	7,200	liter	Lubricant oil	+		0.91	6,567	0	6,567
8	2,880	liter	Grinding oil		+	6	0	16,668	16,668
9	312	m3	Sulfuric acid (70%)	+		74	23,088	0	23,088
10	8,640	kg	Alkaline powder	+		2.9	25,055	0	25,056
11	2,880	kg	Corrosion inhibitor	+		6.9	19,872	0	19,872
12	36,000	kg	Caustic soda (32% solution)	+		0.44	15,760	0	15,760
13	43,200	kg	Alminum sulfate	+		0.44	18,912	0	18,912
14	480	kg	Coagulant acid	+		8.76	4,203	0	4,203
15	14,400	kg	Scale inhibitor	+		8.03	115,573	0	115,573
16	54,347	MWH	Electricity	+		38	2,081,784	0	2,081,784
17	7,920	K.liter	LPG	+		0.33	2,614	0	2,614
18	511,500	m3	Raw water	+		0.36	184,140	0	184,140
19	6	pc	Grinding wheel		+	775	0	4,650	4,650
20	12	pc	Grinding wheel		+	813	0	9,750	9,750
21	24	pc	Grinding wheel		+	813	0	19,500	19,500
22	12	pc	Diamond wheel		+	3,625	0	43,500	43,500
23	72	pc	Diamond Chip		+	2,750	0	198,000	198,000
24	12	pc	N2 Gas cylinder		+	663	0	7,950	7,950
25	48	pc	CO2 gas Cylinder		+	763	0	36,600	36,600
26	36	pc	Sticker plate		+	913	0	32,850	32,850
27	240	pc	Steel band		+	63	0	15,000	15,000
28	1	lot	Other miscellaneous		+	375,000	0	375,000	375,000
			Total				47,574,381	864,798	48,439,179

Materials and Inputs

US $

Year 14 - 15

No.	Quantity	Unit	Item Description	L	F	Unit Cost	Cost Local	Cost Foreign	Cost Total
1	14,114	ton	Copper cathode	+		2,670	37,685,448	0	37,685,448
2	5,246	ton	Zinc ingot	+		1,400	7,344,950	0	7,344,960
3	16,800	liter	Soluble oil		+	4	0	72,030	72,030
4	14,400	liter	Mineral oil		+	2	0	33,300	33,300
5	30,000	liter	Hydraulic oil	+		0.88	26,267	0	26,267
6	24,000	kg	Grease	+		0.84	20,138	0	20,138
7	7,200	liter	Lubricant oil	+		0.91	6,567	0	6,567
8	2,880	liter	Grinding oil		+	6	0	16,668	16,668
9	312	m3	Sulfuric acid (70%)	+		74	23,088	0	23,088
10	8,640	kg	Alkaline powder	+		2.9	25,056	0	25,056
11	2,880	kg	Corrosion inhibitor	+		6.9	19,872	0	19,872
12	36,000	kg	Caustic soda (32% solution)	+		0.44	15,760	0	15,760
13	43,200	kg	Alminum sulfate	+		0.44	18,912	0	18,912
14	480	kg	Coagulant acid	+		8.76	4,203	0	4,203
15	14,400	kg	Scale inhibitor	+		8.03	115,573	0	115,573
16	54,347	MWH	Electricity	+		38	2,081,784	0	2,081,784
17	7,920	K.liter	LPG	+		0.33	2,614	0	2,614
18	511,500	m3	Raw water	+		0.36	184,140	0	184,140
19	6	pc	Grinding wheel		+	775	0	4,650	4,650
20	12	pc	Grinding wheel		+	813	0	9,750	9,750
21	24	pc	Grinding wheel		+	813	0	19,500	19,500
22	12	pc	Diamond wheel		+	3,625	0	43,500	43,500
23	72	pc	Diamond Chip		+	2,750	0	198,000	198,000
24	12	pc	N2 Gas cylinder		+	663	0	7,950	7,950
25	48	pc	CO2 gas Cylinder		+	763	0	36,600	36,600
26	36	pc	Sticker plate		+	913	0	32,850	32,850
27	240	pc	Steel band		+	63	0	15,000	15,000
28	1	lot	Other miscellaneous		+	375,000	0	375,000	375,000
			Total				47,574,381	864,798	48,439,179

5.1 DATA AND ALTERNATIVES OF LOCATION AND SITE

5.1.1 Fundamental Requirements on Location and Site

Fundamental requirements for the location and site of the plant operation of the ASEAN Copper Fabrication Project are as follows.

(1)	Land	:	Approx. 100,000 m^2
(2)	Power demand	:	Approx. 10 MW
(3)	Industrial water	:	Approx. 1,000 m^3/Day
(4)	Skilled labour for the plant operation	:	Approx. 300
(5)	Port required	:	International and domestic pier

5.1.2 Alternative Plant Location and Site

Taking into consideration public policies, the following industrializing estates can be listed as possible alternative locations and sites for the plant operation of the ASEAN Copper Fabrication Project.

(1)	Isabel, Leyte, Region 8, Philippine	:	See Fig. 5.1 and Fig. 5.2
(2)	Batangas, Luzon, Region 4, Phillipine	:	See Fig. 5.3 and Fig. 5.4

The site at Isabel is located in the Leyte Industrial and Development Estate (LIDE).
The expected site at Batangas is located in the Batangas Regional Industrial Center (BRIC).

5.1.3 Evaluation of the Alternative Location and Site

The study team visited Isabel and Batangas for to select the best location and site for the project. The results of the survey, and the evaluations are summarized below.

(1) Raw material versus market orientation

Regarding raw material supply, Isabel has an advantage because copper cathodes, can be supplied easily from the neighboring copper smelting firm PASAR.

On the other hand, Batangas has an advantage as regards delivery of the products for domestic market because it is located near the consumption center. However, distance from the domestic consumption center is not a critical factor for plant site selection in this case since most of the products would be exported from nearest port of the plant.

(2) Topographic condition

There is no obvious difference in topographic conditions or difficulty regarding site preparation between Isabel and Batangas.

(3) Infrastructure

1) Industrial water

a) Industrial water up to 1,250 m^3/day can be supplied from the existing LWSS (Leading Water Supply System) pipe line at Isabel, even after PASAR's 25 per cent expansion in production capacity.
Furthermore, the possibility of future expansion of the water supply has been considered by LWSS.

b) There is no existing industrial water supply pipe line at Batangas.
Due to the low average well discharge (approx. 50 - 70 m^3/hr) at Batangas, more than 20 deep wells would have to be dug in the site in order to supply sufficient industrial water.
In addition, to dig deep wells at the site, which is located near the seashore of Batangas bay would cause problems with salty water penetrating the well.
There is definite uncertainty concerning the supply of industrial water at Batangas.

2) Power

a) High-tension power is available at the existing NPC's substation both at Isabel and at Batangas.

b) Power costs at PASAR, Isabel and Batangas are 1.05 Pesos/kWH and 2.8 Pesos/kWH, respectively. It is clear therefore that Isabel has an advantage on the cost of the electric power consumption.

3) Transportation

a) Ports

The existing PHILPHOS's pier and a new public pier which is under construction would be available at Isabel.

At Batangas, existing public piers are available.

Customs clearance is available at both Isabel and Batangas.

b) Roads

Concrete and/or asphalt paved road near the Site is available both at Isabel and at Batangas.

c) Passenger transportation system

No public passenger transportation system exists around the site at either Isabel or Batangas.

A passenger transportation system, especially for shift workers, is required at both locations.

4) Fuel gas and petroleum products

There is no obvious difference between Isabel and Batangas for the procurement of fuel gas (LPG) and petroleum products such as kerosene and lubricants.

5) Communication systems

Telephone, telex and facsimile are available both at Isabel and at Batangas.

(4) Labour circumstances

There is no obvious difference between Isabel and Batangas regarding respect to labour or wages.

(5) Waste disposal

Concerning pollution control, the rules and regulations of the National Pollution Control Commission for air pollutants and DENR administrative orders on Effluent Regulations for effluent are applied both at Isabel and at Batangas.

(6) Living conditions

1) Housing

Construction of housing for employees should be considered both at Isabel and at Batangas.

2) Supporting facilities

In the case of Isabel, the existing clinic and schools near the site should be slightly expanded to accept new comers. However, the existing facilities at Batangas should be sufficient.

A comparison table for selection of the plant location and the Site is shown in Table 5.1.1 as follows:

Table 5.1.1 Comparison Table for Location and Site Selection

ITEM	ISABEL	BATANGAS					
1. Climate							
1.1 Air temperature		Jan.	Mar.	May	Jul.	Sep.	Nov.
- Highest temperature average (deg. C)		29.0	31.2	32.7	30.7	31.2	30.9
- Lowest temperature average (deg. C)	(No data)	21.4	22.5	24.6	24.0	23.7	23.5
1.2 Rain							
- Rain fall (mm/month)		103.7	31.6	214.3	473.3	349.8	26.0
- Rainy day (days/month)		10	5	11	18	18	17
		(Data: Luzon 1986)					
1.3 Flooding	No flooding	No flooding					
1.4 Earthquake							
Max. intensity	Approx. 4	4.7					

ITEM	ISABEL/LEYTE	BATANGAS/LUZON
2. Location and Site		
2.1 Location	See Fig. 5.1	See Fig. 5.3
- Town	Isabel	Batangas
- Region	Leyte, Region 8	Batangas, Region 4
- Distance from nearest town	Approx. 4 km south of Isabel	Approx. 4 km south of Batangas City
- Distance from center of consumption (Metro Manila)	SE 530 km	S 100 km
2.2 Site description		
- Available area (Length x width)	Approx. 120,000 m^2 Approx. (400 m x 300 m)	Approx. 120,000 m^2 Approx. (400 m x 300 m)
- Height above sea level	Approx. 10-25 m	Approx. 5-20 m
- Geographical orientation	See Fig. 5.2	See Fig. 5.4
- Topography	Grassy, sparsely wooded, gently undulating field on small peninsula by the Camote sea.	Sparsely wooded and gently undulating field located south of Batangas city near the seashore.
- Public policies concerned	Leyte Industrial and Development Estate (LIDE) established by National Development Company (NDC).	Batangas Regional Industrial Center (BRIC) designated by DTI.

ITEM	ISABEL	BATANGAS
2.3 Geology		
- Outline of soil	Geological formation consists of clayey weathered limestone, clayey silt, badly weathered limestone and a mixture of the above. The layers are as follows: ° Gravel size and clayey weathered limestone between ground level (GL) and -1.5 m below GL. ° Badly weathered coralline limestone between -3 and -9 m below GL. ° Coarse to gravel size or clayey weathered limestone between -9 and -21 m below GL. ° Hard clayey silt and weathered limestone fragment mixture between -22 and -33 m GL.	Geological formation consists mostly of waterlaid volcanic turf characterized by relatively deep soil and soft bedrock.
- Soil bearing capacity	20 tons/m^2	
2.4 Price of land	Rental fee? (Rent from NDC)	60-150 P/m^2 (Private land)

ITEM	ISABEL	BATANGAS
3. Material versus market orientation	Isabel is located far from the domestic consumption center but close to the neighboring copper smelting firm, would be material oriented. However, this is not critical because most of the products would be exported directly from the nearest port. Note: ° Copper cathodes can be supplied by neighboring copper smelting firm PASAR. ° All products should be shipped.	The Location of Batangas is domestic market oriented. However, this is not critical because most of the products would be exported from the nearest port. Note: ° Copper cathodes can be supplied from PASAR by shipping service. ° Products can be delivered by trucks for domestic customer and by ship for export.

ITEM	ISABEL	BATANGAS
4. Infrastructure		
4.1 Industrial water		
- Supply system	Industrial water pipe line (LWSS)	° No existing system ° Deep well available
- Available quantity (m^3/Day)	Maximum 1,250* m^3/Day Note: The above (*) value shows available quantity after PASAR's 25 per cent expansion in production capacity.	Average well discharge: 41 m^3/Day Note: More than 25 deep wells must be dug at the site to get the required industrial water.
- Water quality		
° Turbidity	0	No data Acceptable for drinking quality
° Conductivity (Micromho/cm)	325	
° Total hardness (as $CaCO_3$)	130-150	
° PH	7-7.5	
° Total solids (mg/l)	420	
- Charge (Pesos/m^3)	6-7	5.6
4.2 Drinking water	Available (Purified from industrial water)	Available from well

ITEM	ISABEL	BATANGAS
4.3 Power		
- Power availability	32 MVA	40 MVA
- Point of tie-in	NPC, Isabel main substation	NPC, Batangas substation
- Distance from the Site	Approximately 3 km	Approximately 7 km
- High-tension voltage	138 kV	230 kV/69 kV
- Phase	3	3
- Frequency	60 Hz	60 Hz
- Frequency of power failure	2-3 times/year (Total 92 hours in 1989)	
- Charge	1.05 Pesos/kWH (Negotiable)	2.80 Pesos/kWH
	Note: 1) The above 32 MVA is available when power barge comes back from Cebu. 2) Additional geo-thermal power station, 44 MW in capacity, is under planning in Leyte.	Note: 1) Another 100 MVA substation will be installed at Batangas in future. 2) 350 MVA additional power supply through NPC will be available by 1992.
4.4 Transportation		
- Road	A concrete paved national road is available as accessing road.	A asphalt paved provincial road is available as accessing road.
- Port		
° Nearest pier	1) Existing PASAR's and PHILPHOS's piers would be available. 2) Public pier which is constructing at Isabel is available within few years.	Existing Sta. Clava piers, Batangas city are available.

ITEM	ISABEL	BATANGAS
° Distance from the Site	1) PASAR/PHILPHOS's pier: approx. 1 km 2) Public pier, Isabel: approx. 4 km	Approx. 4 km
° Dimensions of the pier	Pier / Length (m) / Draft (m) PASAR's pier 100 11 PHILPHOS's pier 500 11 Public pier 300 9	Pier / Length (m) / Draft (m) Longest one 127 Max. 15 Medium one 105 Max. 9.5 Shortest one 84 Max. 7 Max. vessel size: 10,000 DWGT
° Custom clearance	Available at Isabel Note: PHILPHOS's and PASAR's piers are often congested.	Available at Batangas
- Passenger transportation system	° No system exists. ° Transportation system, especially for shift workers, desirable.	° No system exists around the Site. ° Transportation system, especially for shift workers, desirable.
4.5 Fuel and Gas		
- LPG Gas		
° Availability ° Charge	Available 8.32 Pesos/kg	Available 8.32 Pesos/kg
- Kerosene		
° Availability	Available	Available
- Lubricant oil and grease		
° Availability	Available	Available

ITEM	ISABEL	BATANGAS
4.6 Communication system		
- Telephone	Available	Available
- Telex	Available	Available
- Facsimile	Available	Available

ITEM	ISABEL	BATANGAS
5. Labour circumstances		
5.1 Availability of labour		
- Administrative staff	Available	Available
- Engineer	Available	Available
- Skilled labour	Available	Available
5.2 Wage rates		
- Administrative staff		
- Engineer	More than 5,000 Pesos/month	More than 5,000 Pesos/month
- Skilled labour	Approx. 100 Pesos/day	Approx. 100 Pesos/day
5.3 Normal working hours	8 hours/day	8 hours/day
5.4 Normal working days per week	6 days/week	6 days/week

ITEM	ISABEL	BATANGAS
6. Waste disposal		
- Air pollutants	° Anti air pollution facilities are required. ° To be conformed to official gazette Vol.74, No.23 Rules and Regulations of the National Pollution Commission (1978)	° Same as the left ° Same as the left
- Effluent	° Waste water treatment facilities are required. ° To be conformed to DENR Administrative Order No.35, Series of 1990 Revised Effluent Regulations of 1990, Revising and Amending the Effluent Regulations of 1982.	° Same as the left ° Same as the left

ITEM	ISABEL	BATANGAS
7. Living condition		
- Housing	Consideration of housing for new comers is desirable because the site at Isabel is remote.	Consideration of housing for new comers is desirable because most of the engineers and skilled labours would come from other districts.
- Supporting facilities	Schools and clinic for PASAR and PHILPHOS should be expanded to accept the new comers from the copper fabrication project.	No facilities are required because existing facilities in Batangas city are available for the new comers.

Data sources for location and Site selection

1. Investment and operating costs in the Philippines (Issued by Investment and Information Center and the Bondeu export Marketing Board. Jan. 1990)

2. Data for Feasibility Study Report (Given by Department of Trade and Industry (DTI) Batangas Provincial Office. Jul. 1990)

3. Tuklas Batangas for Investment Opportunities (Issued by DTI, Region IV Batangas Provincial Office)

4. Road map of the Philippines (Published by National Bookstore, Inc.)

5. Data given by DTI, Board of Investment (BOI)

6. Data given by ASEAN Commitee on Industry, Minerals and Energy (COIME)

7. Data given by Philippine Associated Smelting & Refining Corporation (PASAR)

8. Map of Batangas Bay and Vicinity (Published by PCGS)

9. Map of Merida, Leyte (Published by NAMRIA)

5.2 SUGGESTED LOCATION AND SITE

As a result of the evaluation, the study team recommends that Isabel, (Fig. 5.1 and Fig. 5.2), is the optimum Site for the project in view of following reasons.

(1) Qualified industrial water can be supplied easily from the existing LWSS's pipe line.

(2) High-tension power is available at low cost.

(3) Copper cathode, can be supplied from a neighbouring copper smelter PASAR.

(4) The question of distance from the domestic market can be solved by arranging regular shipping services as PASAR does, since domestic demand is less than 20 per cent of the total output of the plant.

5.2 SUGGESTED LOCATION AND SITE

As a result of the evaluation, the study team recommends that Isabel, where is shown as the possible area for the copper fabrication project on Fig. 5.1 and Fig. 5.2, is the optimum Site for the project in view of following reasons.

(1) Qualified industrial water can be supplied easily from the existing LWSS's pipe line.

(2) High-tension power is available at low cost.

(3) Copper cathode, one of the raw material, is supplied from neighbouring copper smelter PASAR.

(4) A question on distance from the domestic market is relieved to arrange regular shipping service as PASAR does since domestic demand is less than 20 per cent of the total output of the plant.

As mentioned above, there is no existing industrial water supply line at Batangas area. The biggest problem in this regard is that more than a dozen of deep wells are to be digged or a long pipe line is to be laid from the water source (lake or river) far from the site.

In both cases remarkable amounts of initial cost should be invested to establish water supply line.

Furthermore due to the difference of charge for electric power (1.05 Pesos/kWH for Isabel and 2.8 Pesos/kWH for Batangas), there would be big difference in production cost between the two sites.

It can be roughly estimated from the above viewpoints that the cost increase when selecting Batangas site in comparison with Isabel site would be

US$ 740,000 for initial investment cost, and
US$ 2,890,000/year for production cost.

From the viewpoint of material transportation, Isabel site has the advantage that the copper cathode can be supplied by the neighboring smelting plant PASAR. This reduces the transportation cost of raw material, which amounts to more than 10,000 tons per year.

It is also noted that the existing pier is adjacent to the plant site of Isabel, while the available port for Batangas area is a little far from the site. These make some difference for product transportations cost as more than 80% of the products would be exported abroad.

These are the major economical reasons for the plant site selection.

Another aspect to be considered is to develop industries and increase employment rate at local area like Leyte in order to avoid excessive concentration of industries and people to Luzon.

Under consideration of the above-mentioned situations, Isabel is more recommended than Batangas. Detail comparison data between the two sites are to be referred in Chapter V.

5.3 MEASURES AGAINST ENVIRONMENTAL POLLUTION

5.3.1 Self-Sustained Environmental Free Operation

Processing plant for copper and copper alloy flat products is in general pollution-free factory as the process is mainly metal forming/rolling with little chemical reaction.

The proposed plant consisting of Foundry Shop and Rolling Shop is also so designed to prevent the environmental pollution.

The following facilities are considered in this study for the purpose of treating effluents/wastes as well as ensuring clean environmental condition around the site.

(1) Dust Collector

The Melting Furnaces and the Casting Lines are equipped with the common Dust Collector of bag filter type to keep the Foundry Shop clean.

(2) Chip Collector

The Scalping Machine is equipped with the Chip Collector to collect the scalped chips with cyclone separator and return chips to Foundry Shop for remelting.

(3) Roll Coolant System

Roll Coolant System for rolling mills is designed to be a closed circuit type, that circulates the coolant oil and does not discharge the oily waste to outside. Filtering unit is also incorporated in the system.

(4) Waste Water Treatment System

Waste water containing acid or alkaline solution discharged from Pickling/Degreasing Equipment and A/P Line is sent to Waste Water Treatment System for neutralization, precipitation, filtration and dehydration.

The used acid, other wastes or sewage can be treated with this system as well.

A incinerator is also included in the system to treat used oul, oily wastes or the like.

(5) Drainage and Sewage Pit

A concrete pit for drainage and sewage is arranged at the corner of plant site to collect rain water, treated water, etc. and discharge them out of the site without harmful pollutants for environment.

5.3.2 Environmental Consideration in the Proposed Site

During the site survey, the study team learned that the Philippine Government decided to initiate the environment inspection in Isabel, mainly for sea water pollution. The mass media reported that the area might have been contaminated by the existing factories in Isabel. One of the factories operating in the area is PASAR which will most likely be the major raw material supplier to this copper fabrication project.

It should be indeed noted that any new projects in that area should not worsen the environmental conditions in the area. If increased production of virgin cathode by PASAR would simply worsen the environment, the study team would have to suggest that a sound government policy to abate the environmental pollution.

If the environment inspection recommends that the production method of PASAR be improved to the acceptable level of pollution free, the implementation of the captioned project should respect this recommendation. Specifically the actual erection of the plant may have to wait until the environmental pollution devised is fully installed at PASAR plant.

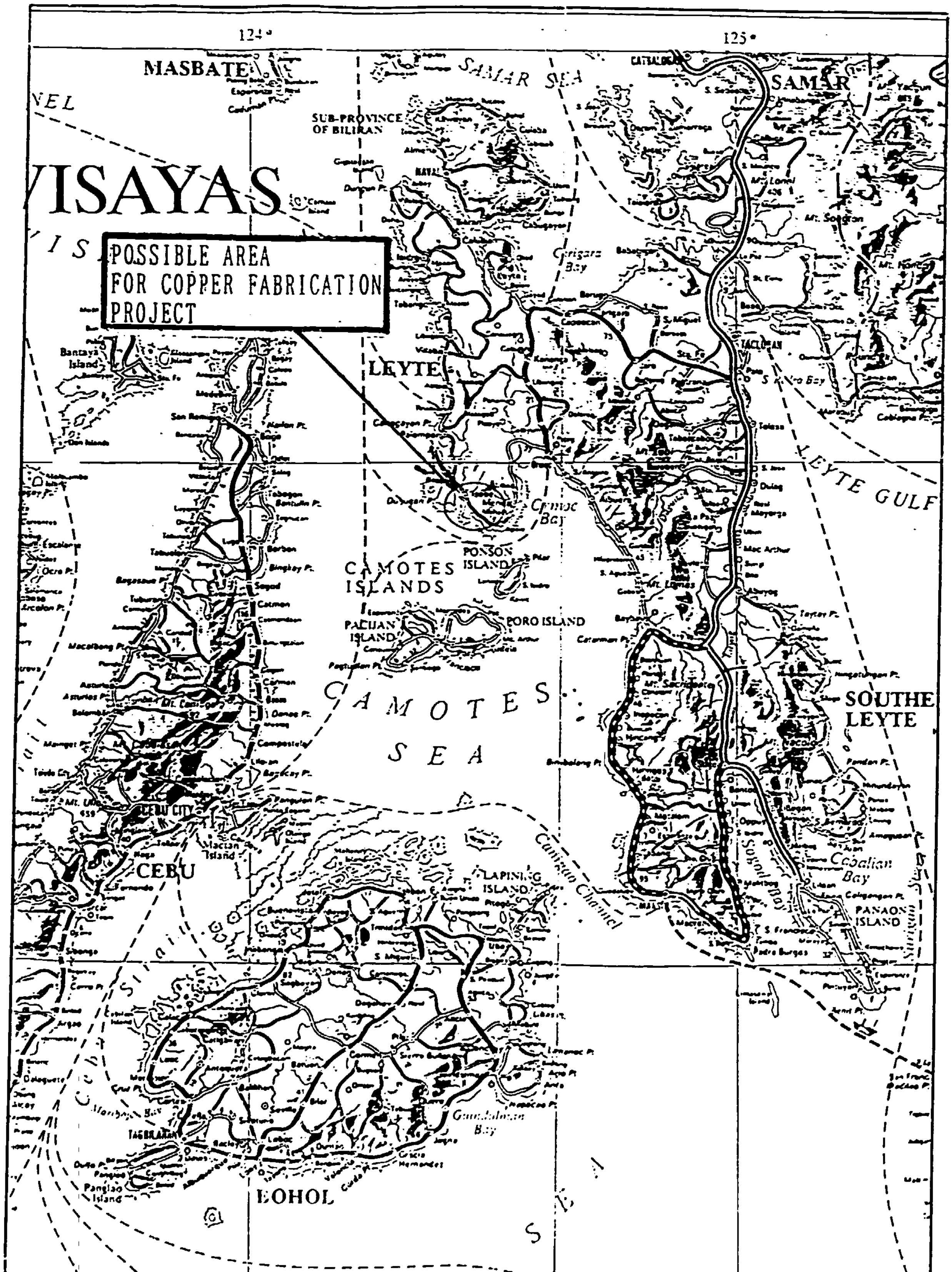


Fig.5.1 Isabel, Leyte

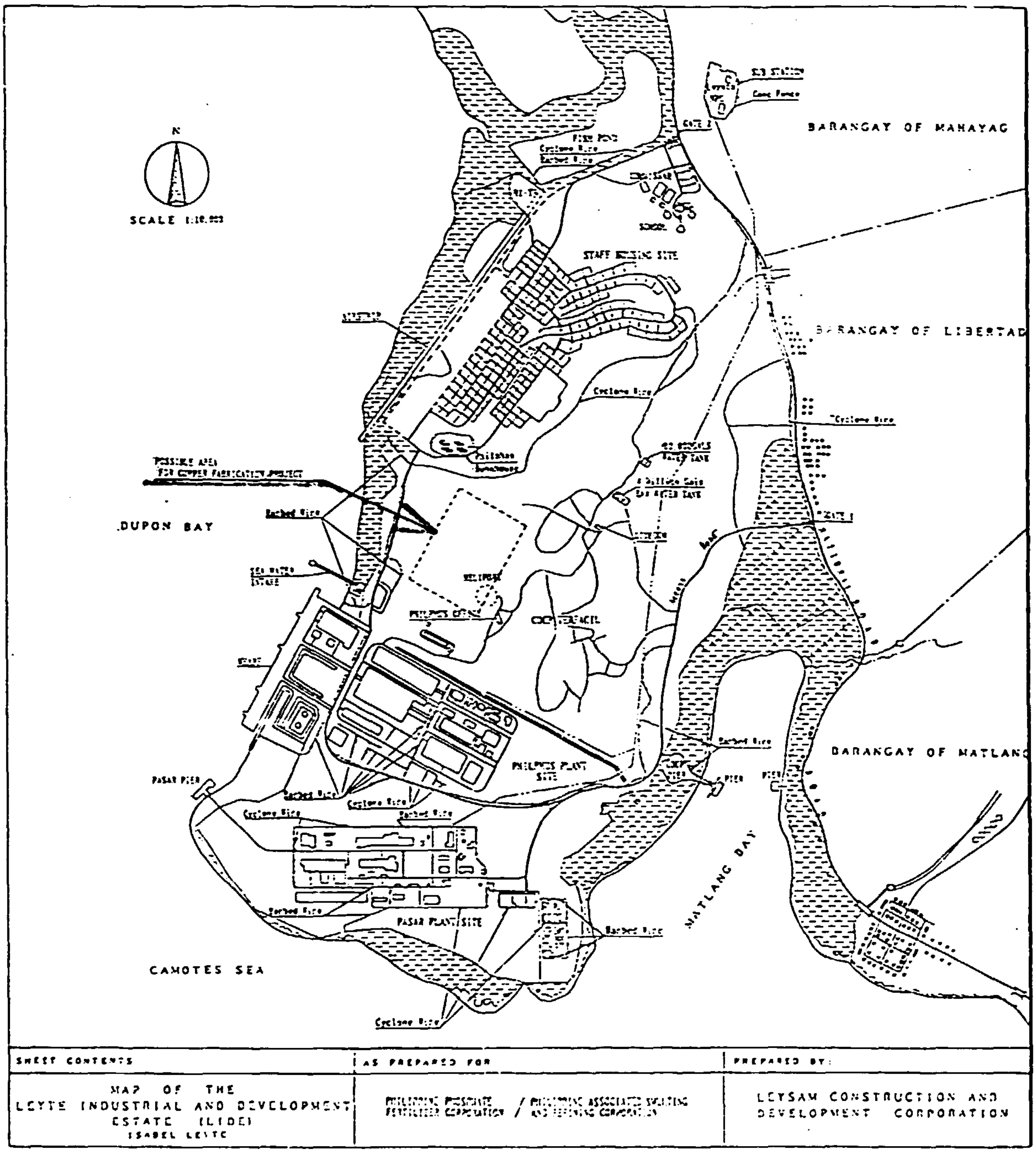


Fig.5.2 Site Location at Isabel

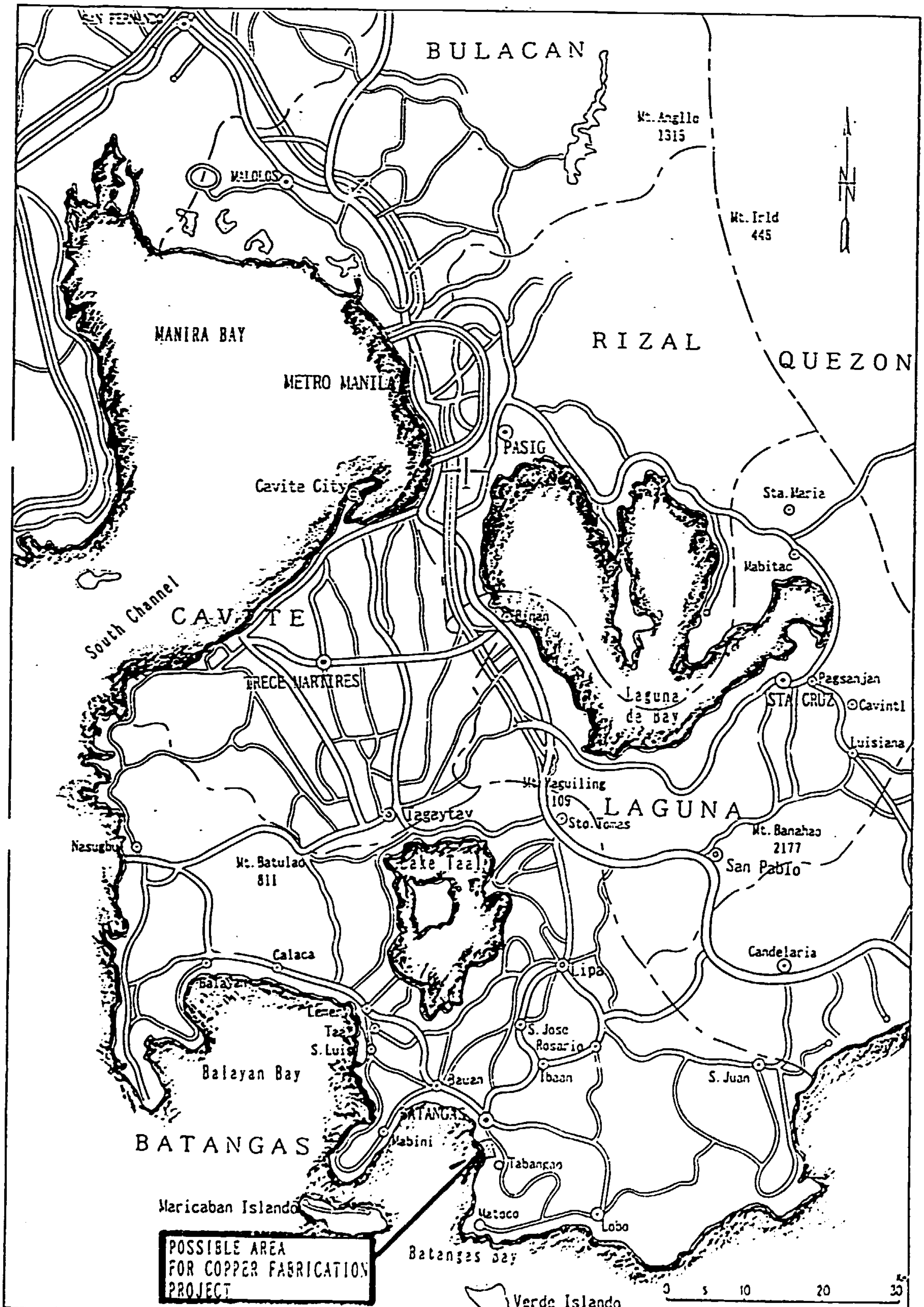


Fig.5.3 Batangas, Luzon

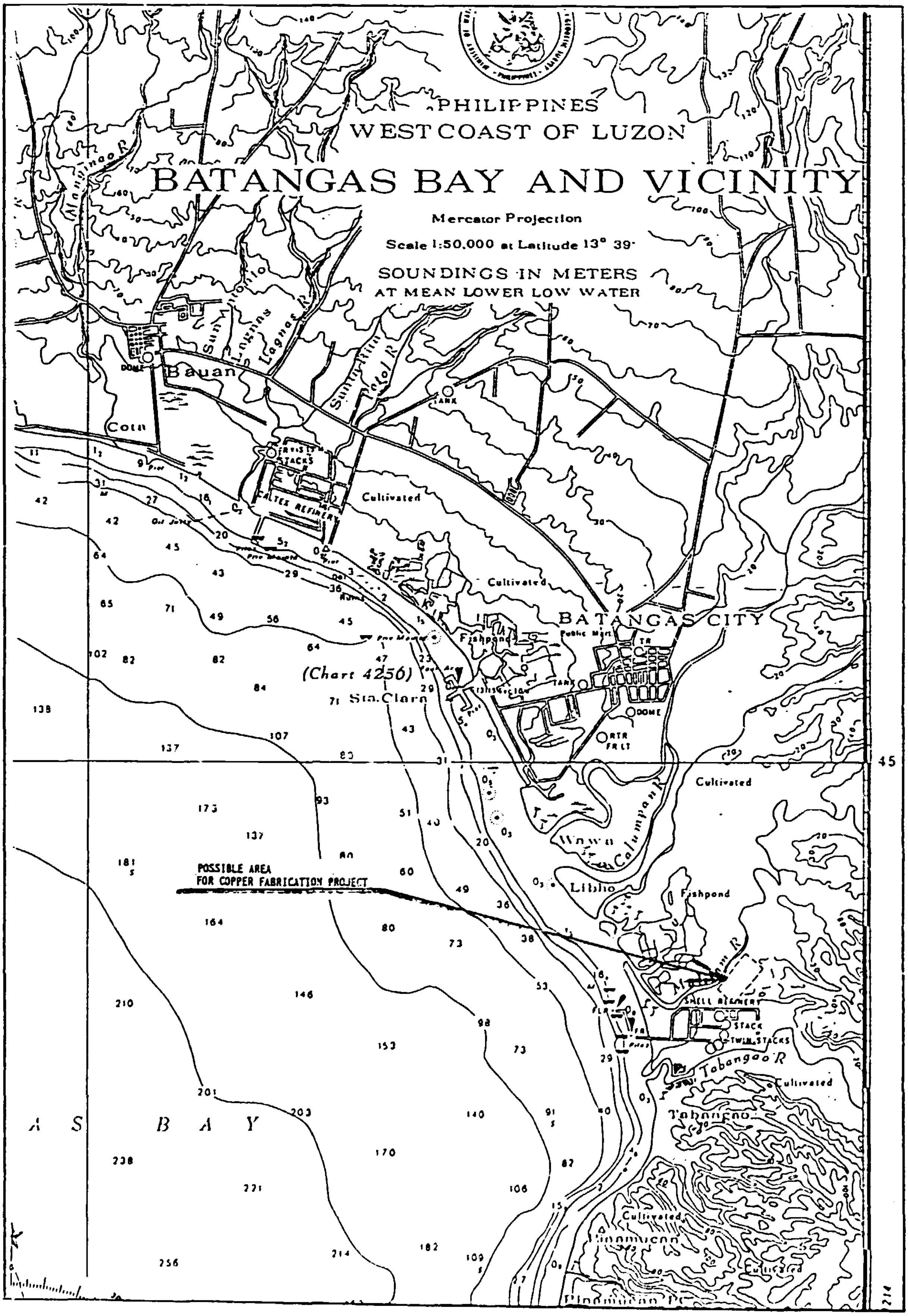


Fig.5.4 Site Location at Batangas

6.1 PLANT LAYOUT

6.1.1 Site Plan

Based on the market study and plant capacity described in Chapter III, site plan and general layout have been considered from various aspects.

The site plan is shown in Fig. 6.1 with the area of 300 m x 400 m for the entire plant according to the site survey, where production shops (Foundry Shop and Rolling Shop), various service stations, offices, etc. are to be located.

The scope of project covers the required activities, such as design, procurement, transportation, construction, commissioning and operation of all the facilities, shop or building in the entire plant.

As the major components of the project, each shop/building and its proposed area are listed below.

Item No.	Shop/Building	Area (m x m)
701	Foundry Shop	96 x 40
702	Rolling Shop	72 x 220
703	Electric Room No.1	24 x 40
704	Electric Room No.2	7 x 40
705	Electric Room No.3	7 x 30
706	Utility Supply Station	40 x 100
707	LPG Station	15 x 20
708	Substation	24 x 15
709	Laboratory	20 x 40
710	Main Office	20 x 70
711	Canteen	40 x 40
712	Gate Complex	30 x 25

SITE PLAN

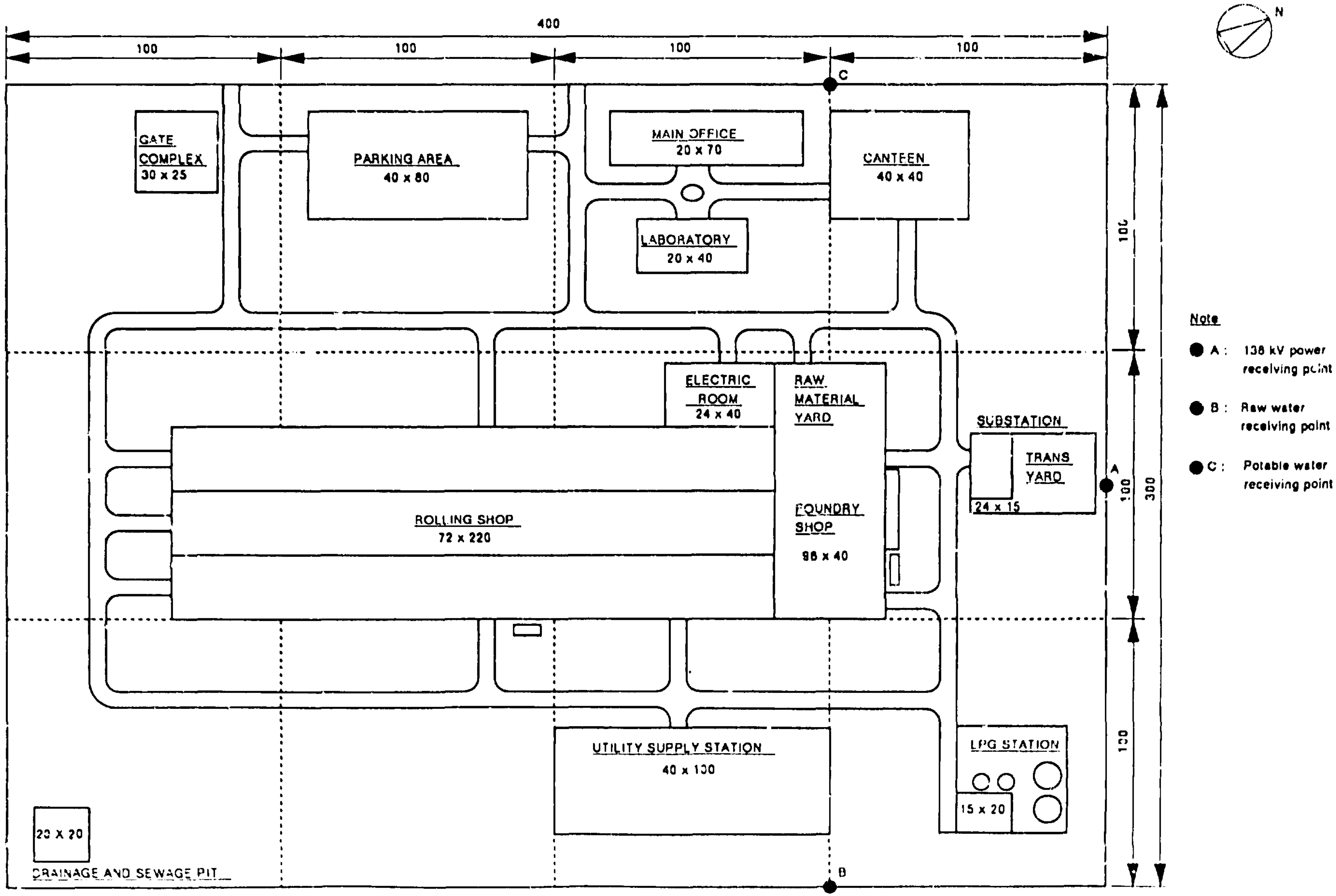


Fig.6.1

Offices and canteen are placed upper area of the plant, production shops in the middle and utility facilities in the lower and right corner.

The lower left corner is reserved mainly for future expansion of production shop, particularly for cold rolling and finishing processes.

Location of receiving electric power and water from external sources are also specified in Fig. 6.1 under consideration of existing supply lines at Isabel area.
The location of substation, utility station and production shop are partly so selected to minimize the distance from receiving point of respective utilities to consuming unit.

According to the site survey the proposed site area has already been levelled and confirmed to have soil bearing capacity of 20 tons/m^2, that results in great advantage to reduce the cost of site preparation and civil works.

6.1.2 General Layout

General layout of production equipment is shown in Fig. 6.2. When selecting the layout and equipment arrangement, attention is focused on optimum flow of materials with consideration of necessary space for feedstock.

Working ratio of each equipment should also be considered as well as No. of equipment to be placed in the specified area. Among such considerations followings are the major important factors to be taken into account when selecting the layout.

(1) Total plant capacity and product mix,

(2) Production process,

(3) Equipment capacity, working ratio and Nos.,

(4) Material flow and feedstock area,

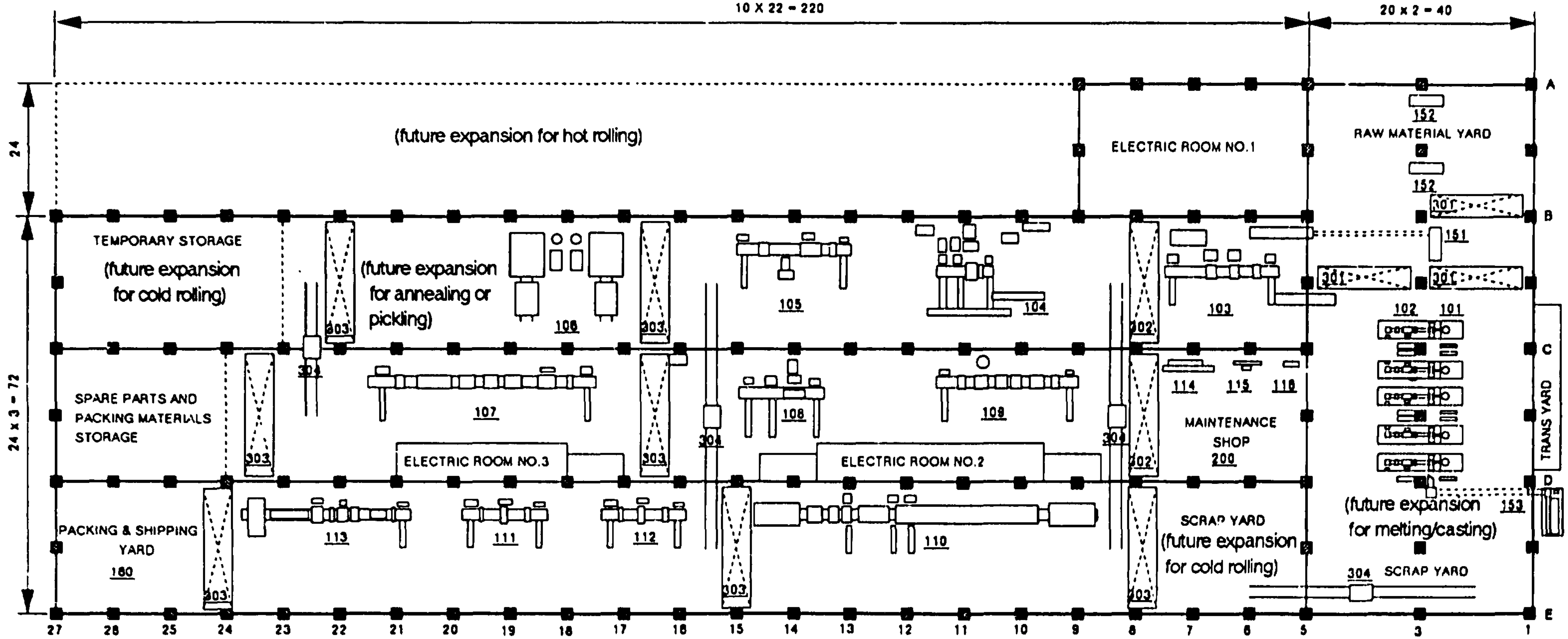
(5) Future expansion of production.

The plant capacity and product mix are already examined in Chapter III.

Production process and equipment capacity are also described in the following sections with the reasons for selection and some alternatives.

Therefore in this section the material flow, feedstock area and future expansion plan are stated with respect to the selected layout or alternatives.

GENERAL LAYOUT



PRODUCTION EQUIPMENT

101 Melting Furnace
102 Casting Line
103 Scalping Machine
104 Cold Roughing Mill
105 Side Trimming Machine
106 Annealing Furnace
107 Pickling Line
108 Cold Finishing Mill
109 Degreasing Line
110 A/P Line
111 Heavy Gauge Slitting Machine
112 Light Gauge Slitting Machine
113 Cut-to-Length Machine
114 Large Grinder
115 Small Grinder
116 Scalping Blade Sharpener
151 Briquette Press
152 Plate Shear
153 Dust Collector
160 Packing Facility

AUXILIRY EQUIPMENT

200 Maintenence Facilities

301 Overhead Crane 10/5 Ton
302 Overhead Crane 10/5 Ton
303 Overhead Crane 5 Ton
304 Traverser

Fig.6.2

Scale : 1 / 1000

6.1.3 Material Flow and Feedstock

Raw materials, in-process coils and return scraps are transferred through the production equipment. Material flow and feedstock area in the production shop are illustrated in Fig. 6.3 and Fig. 6.4, respectively. Estimated annual amounts of each material is presented on the arrow of the material flow in terms of No. of coils.

(1) Raw Materials and Melting/Casting

Copper cathode plates (1,025 tons/month) are placed in the raw material yard (between line A - B and columns 3 - 5, approx. 350 m^2 available).

As the required stock area for copper cathode plates is approx. 3.2 tons/m^2, total area for 1 month stock of the cathode is approximately

$$1,025 - 3.2 = 320\ m^2.$$

Therefore the raw material yard has enough space for 1 month stock.

The cathode plate is sheared by Plate Shear (Item 152) into smaller pieces and collected into a scrap bag.

Then the bags of sheared cathode are stored between lines A - B and columns 1 - 3 together with zinc ingots from market.

Both materials are transported when required to the entry side of Melting Furnace (Item 101) with Overhead Crane (Item 301).

One-third of return scrap comes out from the Scalping Machine (Item 103) in chipped form and collected by the chip collector, then briquetted by Briquette Press (Item 151) into a cylindrical form of approx. 120 mm dia. x 50 - 60 mm thick.

The briquetted pieces are then dried by kiln-type dryer in order to remove oil and water contained in the briquettes.

The dried briquettes are contained in scrap bags and stored at the entry side of the Melting Furnace.

It is normally assumed for each production equipment to hold at least 1 - 3 shift feedstock materials in order to prevent waiting time or stoppage of equipment.

For melting-casting equipment which has production capacity of approx. 1 ton/hour each, required feedstock amounts for 5 melting-casting machines are about 5.38 tons/hour of raw materials under assumption of 93% yield at this process.

Therefore it requires 5.38 x 8 hours = 43 tons raw materials as entry feedstock during 1-shift.

On the other hand as the raw material weight contained in a scrap bag (1.2 m x 0.8 m x 0.7 m = 0.67 m^3) is estimated at least 1.3 ton (W/V = 2), the required Nos. of scrap bags are 43 - 1.3 = 33 pieces.

One scrap bag requires approx. 1.5 m x 1.6 m = 2.4 m^2 area, then the total area is 33 x 2.4 = 80 m^2, that is shown at the entry side of Melting Furnaces as 20 m x 4 m area for 1-shift, and 240 m^2 (30 m x 8 m) for 3-shift operation.

Exit side of melting-casting machines has the feedstock area of 120 m^2 capable of storing approx. 60 coils of 4.5 tons weight (1 coil needs 2 m^2 area), which is sufficient to store all coils produced by 5 casting machines during 3-shift (27 coils) plus 1-shift feedstock for Scalping Machine (16 - 24 coils).

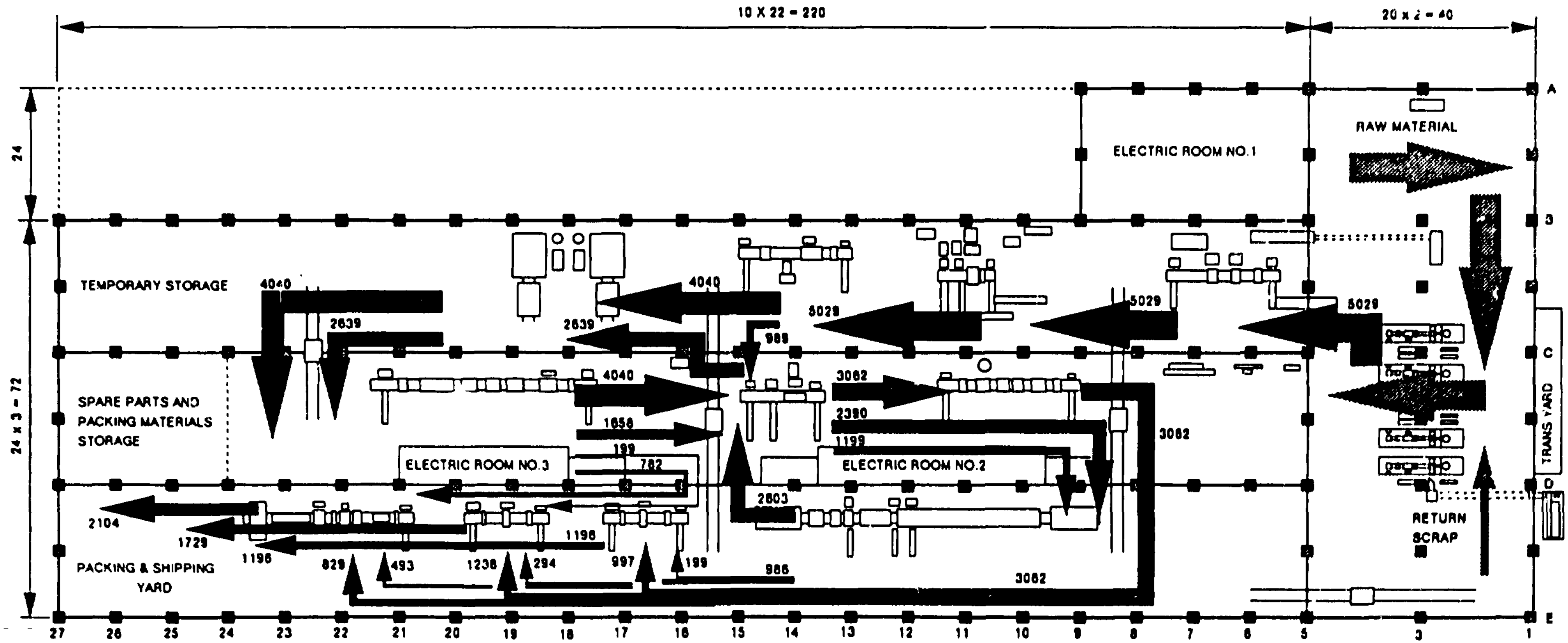
Equipment layout in Foundry Shop is so arranged that the above-mentioned material flow is smoothly performed and the required feedstock area is properly allocated. As is often seen in this type of process, configuration and material flow of Foundry Shop is parpendicular to the succeeding process shop (Rolling Shop in this case) mainly due to the consideration of material flow and future expansion.

(2) In-process Materials (Coils) and Rolling

In the same manner as described for Foundry Shop, the material flow and the relevant feedstock area are studied as illustrated in Fig. 6.3 and Fig. 6.4.

In estimating the feedstock area for each equipment, not only the required shift-base stocks (as described for Foundry Shop) but also the production capacity balance with the preceeding equipment are also studied. The result of the area study is summarized in Table 6.1, that is to be referred with Fig. 6.4.

MATERIAL FLOW DIAGRAM FOR RAW MATERIAL AND PRODUCT



NOTE

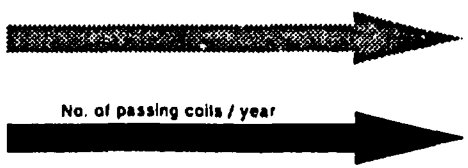


Fig.6.3A

MATERIAL FLOW DIAGRAM FOR RETURN SCRAP

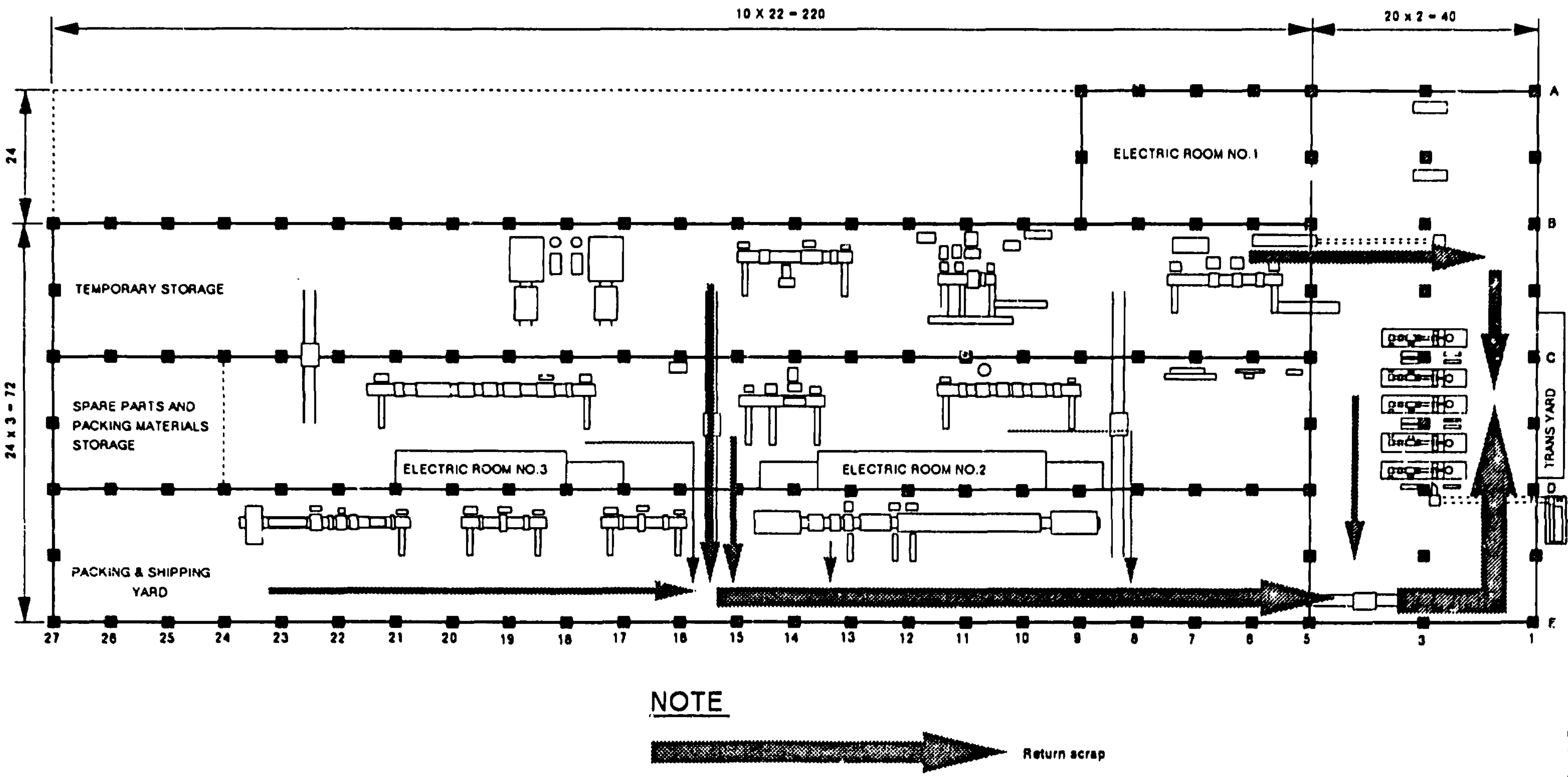
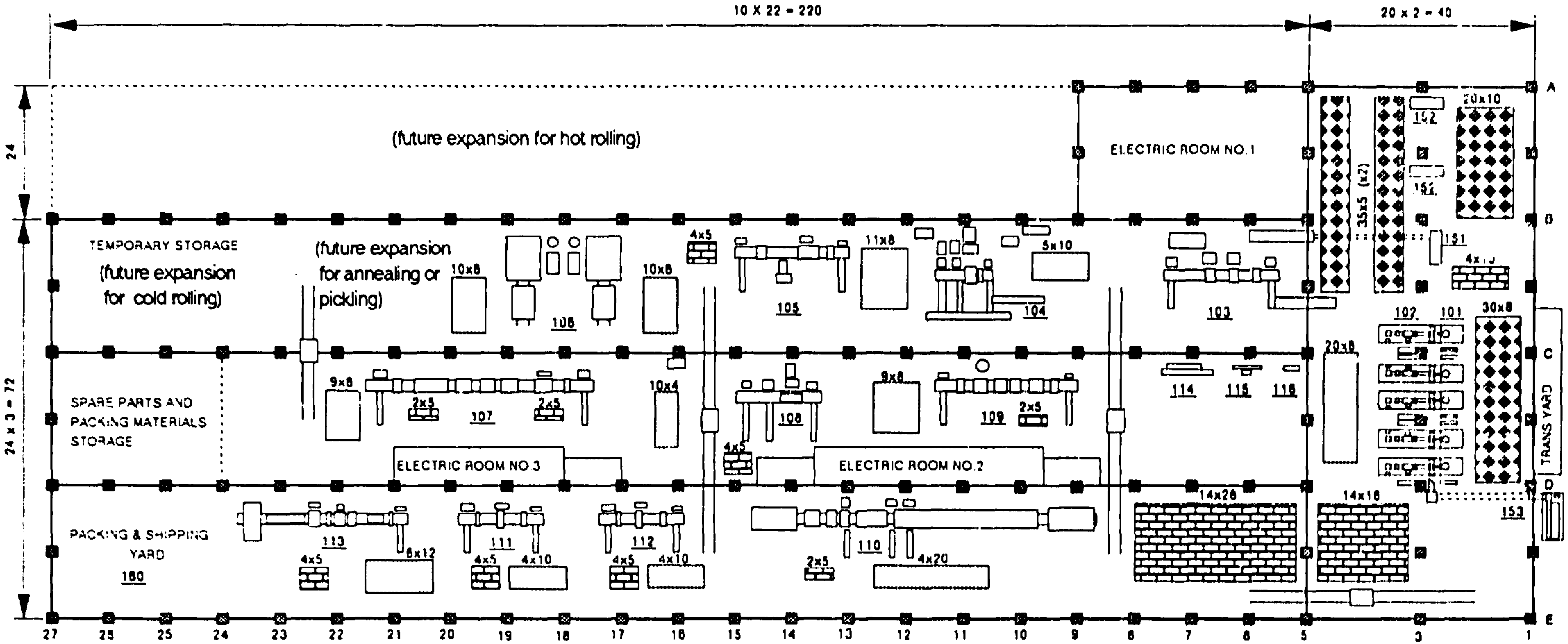


Fig.6.3B

FEEDSTOCK AREA



PRODUCTION EQUIPMENT

101 Melting Furnace
102 Casting Line
103 Scalping Machine
104 Cold Roughing Mill
105 Side Trimming Machine
106 Annealing Furnace
107 Pickling Line
108 Cold Finishing Mill
109 Degreasing Line
110 A/P Line
111 Heavy Gauge Slitting Machine
112 Light Gauge Slitting Machine
113 Cut-to-Length Machine
114 Large Grinder
115 Small Grinder
116 Scalping Blade Sharpener
151 Briquette Press
152 Plate Shear
153 Dust Collector
160 Packing Facility

NOTE

Raw material stock area

In-process coil stock area

Return scrap storage area

Fig.6.4

FEEDSROCK AREA STUDY

	TOTAL HOUR	TOTAL NO. OF COIL	CAPACITY HOUR/COIL	NO. OF SHIFT	NO. OF COIL/SHIFT (A)	NO.OF COIL/DAY	CAPACITY DIFFERENCE (B)	TOTAL NO. OF COIL (A)+(B)	REQUIRED AREA(M**2)	AREA SIZE M x M	REMARK
Melting Furnace				3					240	30 x 8	As described in 6.1.3
Casting Line				3					-	-	As described in 6.1.3
Scalping Machine	1885	5029	0.37	2	21	42		21	42	7 x 6	At exit side of casting
Cold Roughing Mill	2345	5029	0.47	2	17	34	8	25	50	5 x 10	B = 42 - 34
Side Trimming Machine	979	5029	0.19	1	42	42		42	84	11 x 8	
Annealing Furnace	6988	6281	1.11	3	7	21	21	28	56	10 x 6 (x 2)	B = 42 - 21
Pickling Line	1971	6679	0.30	2	27	54		27	54	9 x 6	
Cold Finishing Mill	3890	9290	0.42	3	19	57		19	38	10 x 4	
Degreasing Line	2000	3062	0.65	2	12	24	23	35	70	9 x 8	B = 57 - 24
A/P Line	2963	3589	0.83	3	10	30	27	37	74	4 x 20	B = 57 - 30
Heavy Gauge Slitting M/C	4064	1729	2.35	3	3	10	14	17	34	4 x 10	B = 24 - 10
Light Gauge Slitting M/C	3642	1196	3.05	3	2	8	16	18	36	4 x 10	B = 24 - 8
Cut-to-Length Machine	1306	2104	0.62	1	13	13	23	36	72	6 x 12	B = (54+24+30) / 3 - 23

Note : The required area for one coil is calculated as follows :

Dimension of coil Max. 1300 mm dia. x 660 mm wide

Space between coils is approx. 700 mm and 340 mm.

Area = (1.3 + 0.7) m x (0.66 + 0.34) m = 2 m x 1 m = 2 m

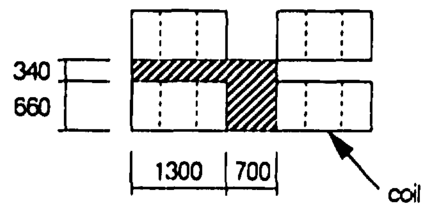


Table 6.1

6.1.4 Future Expansion

As mentioned in the market study it is considered in this study to incorporate the future expansion plan with the presented layout toward the plant capacity of 18,000 ton/year or even more.

Not only the plant area but the No. of processing equipment with its production capacity should be considered for the expansion plan.

Following is the proposed expansion plan of some major equipment and/or alternative process.

(1) Expansion of Foundry Shop

In order to meet the additional 3,000 ton/year production, the space between lines D - E and columns 1 - 5 is reserved for installing additional one set of melting-casting machine of the similar capacity 1 ton/hour.

The alloy grade can be arbitrarily selected, such as Cu-Ni alloy or phosphor bronze, depending on market demand.

In case that more expansion is desired, the above area and the raw material yard can be allocated for larger melting furnace and vertical type continuous slab casting machine incorporated with slab heating furnace and hot rolling mill.

(2) Expansion of Rolling Shop

Future expansion for 18,000 ton/year base can be attained by introducing the following additional equipment:

1) Annealing furnace (1 set)
2) Cold finishing mill (1 set)
3) Slitting machine (1 set)

The relevant expansion area is also suggested in Fig. 6.2 General Layout.

The other equipment has sufficient production capacity to cover the 20% extention of plant capacity.

Furthermore if the new product mix is desired to include higher quality of products, it is recommended to adopt multi-high (12-high, 20-high) cold finishing mill as an additional mill, that ensures higher gauge tolerance and thinner products.

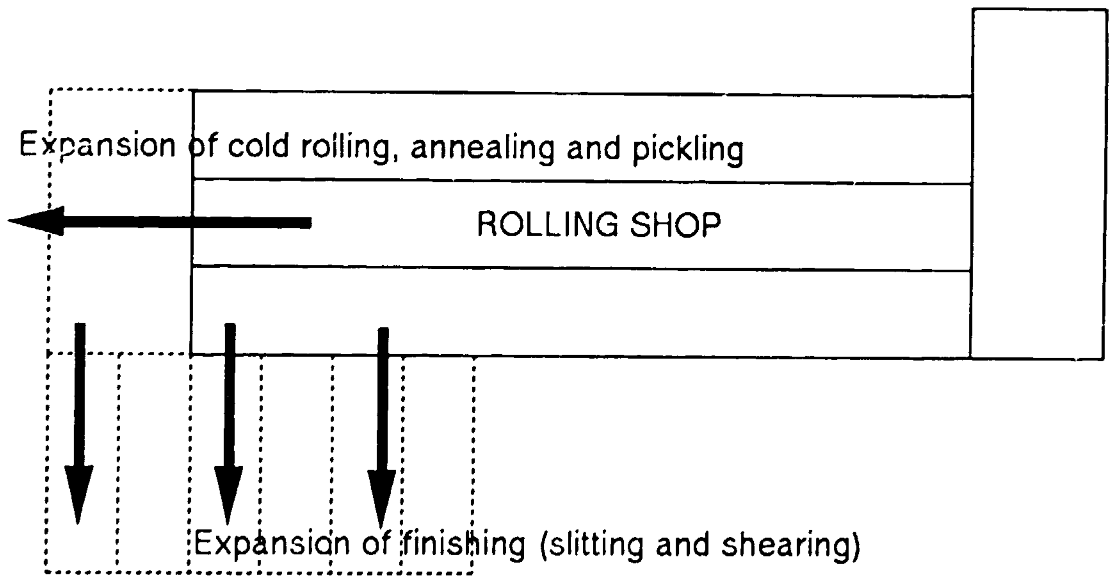
(3) Larger Expansion

The bay area between lines A - B and columns 9 - 27 is reserved for future expansion to introduce hot rolling process, consisting of slab heating furnace and hot rolling mill.

Conventional hot rolling mill for copper and copper alloy is in general capable of processing approx. 20 - 40 ton/hour amounts, depending on slab size and slab heating capacity. Consequently the annual production of hot rolling reaches more than 30,000 ton/year even in 1 shift operation.

In this case annealing/pickling facilities as well as finishing lines (slitting and cut-to-length) should also be additionally installed. The Rolling Shop Building is to be extended, leftward or downward.

It is also recommended as an alternative expansion plan to extend the Rolling Shop Building parpendicularly downward to the existing shop. This arrangement will provide greater capability and variation for further expansion of cold rolling and finishing process as shown below.



6.2 TECHNOLOGY AND PROCESS

6.2.1 Selection of Process

(1) Melting/Casting Process

Major concern in selecting the melting/casting process is whether to adopt hot rolling process or not.

Generally speaking, hot rolling process is applied to the plant of minimum 30,000 ton/year or more of copper and copper alloy flat products. This is because of the larger production capacity of hot rolling mill as described in section 6.1.4.

On the other hand hot rolling process has the following disadvantages compared with horizontal casting process.

1) Initial investment cost and operating cost are remarkably higher particularly if the plant capacity is less than 20,000 ton/year. For the plant size of this study, the initial cost for hot rolling is almost twice as much as that for horizontal casting process.

Rough estimate of cost for each process is

- $23 million for hot rolling process
- $11 million for horizontal casting process

as the initial investment for the relevant equipment. Therefore for medium or small size rolling shop hot rolling is not feasible.

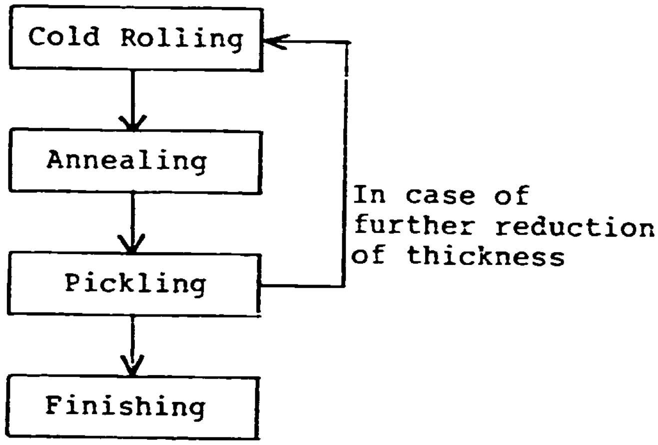
2) From the technological viewpoint some of the copper alloy, such as phosphor bronze or Cu-Ni alloy, are not quite suitable for hot rolling process due to its hot ductility characteristics.

The main reason for selecting horizontal casting process is the above point 1) in this study. However expansion space for introducing hot rolling process is also considered in the presented plan to cope with future expansion of plant capacity, when scale merit of larger production amount would compensate for the initial investment cost.

(2) Rolling/Finishing Process

The purpose of cold rolling process is to reduce the coil thickness with satisfying the product quality such as gauge tolerance, temper grade, mechanical property, etc.

There exists the normal and conventional cold rolling process as shown below.



Due to the work-hardening characteristics of copper/copper alloy (or metal in general) cold rolling is normally limited to 70 - 80% thickness reduction followed by annealing process.

The annealing process performs softening work through heating and keeping the rolled coil at approx. 500°C temperature in the furnace and also controls temper and mechanical property of products.

After completion of annealing, pickling process follows to remove thin oxidized layer on the coil surface.

The pickled coil is then sent to finishing process (slitting or shearing) or returned to cold rolling mill if further thickness reduction or tempering is required.

Continuous annealing and pickling process is adopted in A/P Line for thinner coils (less than 1.0 mm thick), that has some advantages in material handling, production efficiency and quality control.

Finishing process consists of slitting and shearing to produce strips in coil and sheared sheet, respectively.

In general for rolling and finishing, conventional method is applied as there exists few alternative process.

Attention is rather paid to the study of equipment capacity and suitable combination of equipment in order to follow the selected process and attain the production capacity of the plant.

6.2.2 Process Description

(1) Foundry Shop

The Foundry Shop is designed to produce coils of copper and brass to be further processed in the Rolling Shop. Raw materials, such as copper cathode, zinc and return scrap, are melted in Melting Furnace and casted into a coil form by Casting Line. Cast strip size is 660 mm wide and approx. 17 mm thick with weight of max. 4,500 kg.

The Foundry Shop includes the following production equipment:

1) Melting Furnace : 5 sets

2) Casting Line : 5 sets

Raw materials for copper casting consists of

- electrolytic copper (copper cathode)
- copper scrap from the Casting Line and/or the Rolling Shop
- copper scrap from market (if available).

Raw materials for brass casting consists of

- electrolytic copper (copper cathode)
- zinc billets
- copper and brass scrap from the Casting Line and/or the Rolling Shop
- copper and brass scrap from market (if available).

These raw materials or scraps are handled by Raw Material Handling Facilities to be suitably shaped for charging into Melting Furnace.

1) Melting

The Melting Furnaces are of coreless type induction furnaces. In principle, it would be possible to use various heating sources such as oil or gas as well as electric power. However for the purpose of accurate temperature monitoring and its controllability required for the furnace, the electrical low frequency coreless induction furnace has proved to be specially suitable.

During melting the furnace is in a horizontal position, which is tilted to feed the molten metal into the Holding Furnace in the Horizontal Casting Machine.

Melting temperature of copper and brass is as follows:

a) Copper : Approx. 1,180°C

b) 70/30 Brass : Approx. 1,100°C

c) 65/35 Brass : Approx. 1,100°C

Before casting, molten metal is manually slagged into slag buckets and analyzed for quality control.

2) Casting

The lines for completely continuous casting of heavy gauge plates are exclusively built in horizontal arrangement. The horizontal continuous casting line consists of

a) Holding furnace

b) Cooling system

c) Withdrawal device

d) Flying shear

e) Up-coiler.

Molten metal in the holding furnace is cooled in the cooling system through the mould. During casting, molten metal is poured into the holding furnace at the specified interval.

The solidified plate having left the mould is pulled with the withdrawal device at the specified pitch and speed.

Flying shear is equipped to cut the top and tail crop of the plate or to divide the cast plate at suitable length for coils.

Scalping device is in many cases incorporated in-line with the casting machine. However, in this study one Scalping Machine is arranged off-line for common use of all the five casting line.

This alternative plan reduces the initial investment cost for casting lines by approx. 15%.

(2) Rolling Shop

The Rolling Shop is designed to produce copper and brass semi-products consisting of sheets and coiled strips. The thickness range of products is 0.1 mm to 3.5 mm.

The Rolling Shop includes the following major equipment:

1)	Scalping Machine	:	1 set
2)	Cold Roughing Mill	:	1 set
3)	Side Trimming Machine	:	1 set
4)	Annealing Furnace	:	2 sets
5)	Pickling Line	:	1 set
6)	Cold Finishing Mill	:	1 set
7)	Degreasing Line	:	1 set
8)	A/P Line	:	1 set
9)	Heavy Gauge Slitting Machine	:	1 set
10)	Light Gauge Slitting Machine	:	1 set
11)	Cut-to-Length Machine	:	1 set

The general processes to produce copper and brass semi-finished products are described hereunder, although different processes are applied depending on the type of products.

1) Scalping Machine

Cast plate undergoes surface treatment process through the Scalping Machine. In the scalping machine both surfaces of cast plate are scalped to remove the surface oxidized layer to the depth approx. 0.9 mm and the edge approx. 2.5 mm, then the scalped plate is wound into a coil by the up-coiler.

2) Cold Rough Rolling and Side Trimming

Plate in coil having been scalped and up-coiled is conveyed to the 4-high non-reversing Cold Roughing Mill, where 6 coils are grouped to compose one rolling lot and undergo cold roughing reduction according to the rolling pass schedule specified for each type or kind of materials.

The Cold Roughing Mill is of non-reversing type, and is to be equipped with both up-coiler for thick gauge strip and tension reel for thin gauge.

In view of reducing the stock amount of in-process materials and achieving simplification of production control, gauge application should be unified for each kind of material. Coils are rolled principally down to approx. 3.0 mm thickness for copper and 3.5 mm thickness for brass.

After cold rough rolling, both sides of coil are trimmed by approx. 15 mm each in order to prevent cracks in cold rolling process.

After rough rolling, brass coils are annealed by the Annealing Furnace and pickled by the Pickling Line. The pickled copper coils are transferred directly to the Cold Finishing Mill without annealing and pickling.

3) Annealing and Pickling
Two Annealing Furnaces are arranged for intermediate and/or final annealing of heavy gauge coils. In the cold rolling process, coil is rolled down to a specified thickness and undergoes work-hardening. When total reduction rate exceeds a certain figure, intermediate annealing should be applied.

The Annealing Furnace is of indirect combustion type with protective gas atmosphere. Copper coils are annealed under protective gas atmosphere to prevent oxidation, while brass coils are annealed without protective gas.

Coils, after being annealed, are pickled by the Pickling Line. One pickling line is installed in order to obtain clean surfaces and can treat coils of 1.0 - 3.5 mm thickness.

Waste acid water discharged from these pickling lines as well as the A/P Line shall be transferred to and treated by the waste water treatment system.

4) Finish Rolling

Coils transferred from the Cold Rough Rolling Mill and the Pickling Line are further rolled by the Cold Finishing Mill.

This rolling mill is of 4-high, reversing type and designed to roll coiled strips down to min. 0.1 mm.

After the rolling coils are annealed by the Annealing Furnace and pickled by the Pickling Line, or annealed and pickled by the A/P Line in case of intermediate rolling or soft temper products, while coils are transferred to the temper rolling processes in case of semi-hard or hard temper products.

5) A/P Line

The A/P Line (continuous annealing and pickling line) is arranged for intermediate and/or final annealing for light gauge coils.

This A/P Line has a floating type furnace, and is applied to 0.1 - 1.0 mm thickness strips.

6) Degreasing

In case of semi-hard and hard temper products, coolant oil on the coil surface is removed by the Degreasing Line before being transferred to finishing processes.

7) Finishing

Finishing process includes slitting, cutting, inspection and packing. In the Slitting Machine, coil is longitudinally and simultaneously sheared into a number of strips. In the Cut-to-Length Machine, coil is cut to the specified length. After being slitted or cut, strips or sheets are inspected for dimension, surface defects and mechanical properties and then packed according to the relevant specification.

8) Packing/Shipping

The strips and sheets are packed with packing materials (paper, wood, tape, etc.) on the packing work table one by one.

The product weight is measured before and after the packing and recorded for shipping control.

(3) Auxiliary Shop

1) Laboratory

Laboratory is designed to do the following check and tests and inspection:

a) Analysis of chemical composition

Before casting slabs, molten metal is analyzed for controlling its quality.

b) Test for mechanical properties

After slitting or cutting, mechanical properties of strip or sheet, such as tensile strength, elongation, grain size, are checked if they satisfy the required specification.

c) Checking of coolant oil or chemicals

In order to obtain products of satisfactory quality, it is unavoidable to check periodically the quality of coolant oil and chemicals used in the Rolling Shop.

2) Maintenance Shop

The maintenance shop is designed

a) to repair damaged equipment and parts
b) to produce some spare parts, and
c) to carry out periodical equipment check.

The major facilities in the maintenance shop are as follows:

- Lathe
- Drilling machine
- Shaping machine
- Metal cutter
- Welding machine and gas cutting torch
- Auxiliary tools (mechanical)
- Auxiliary tools (electrical)

3) Utility Supply Station

The facilities related to utility are as follows:

a) Raw water treatment

b) Cooling tower and pump

c) Boiler

d) Air compressor

e) LPG station

f) Waste water treatment system

g) Power substation

6.2.3 Process Flow Sheet

(1) Standard Process

Standard process to produce each kind of product is summarized in Table 6.2. Upper columns of the table contains basic data according to the proposed product mix with the product coil weight and the required Nos. of coils per year.

Lower columns shows the standard process for each kind of product that is to be processed through the designated equipment.

(2) Process Flow Sheet

More detail information is given on the Process Flow Sheet for each product along the production process, where changes in product dimensions, weight and yield ratio are calculated based on some empirical operational data.

Coil length data is used for estimating the working time and working ratio of each equipment in order to check the production capacity v.s. the required capacity from the product mix.

Weight and yield data are the bases of calculating the required amounts of raw material and estimating return scrap amounts as demonstrated in Chapter IV.

STANDARD PROCESS

PRODUCT NO.	1	2A	2B	3A	3B	4	5	6	7A	7B	8A	8B	9A	9B	10	11A	11B
MATERIAL	Copper	Copper	Copper	Copper	Copper	Brass(70/30)	Brass(70/30)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(35/35)
PRODUCT SHAPE	Strip	Strip	Sheet	Strip	Sheet	Strip	Strip	Strip	Strip	Sheet	Strip	Sheet	Strip	Sheet	Sheet	Strip	Sheet
THICKNESS (MM)	0.1	0.5	0.5	1.0	1.0	0.3	0.75	0.15	0.3	0.3	0.75	0.75	0.8	0.8	1.2	1.5	1.5
TEMPER GRADE	H/2	SOFT	SOFT	SOFT	SOFT	H/2	H/2	H/2	H/2	H/2	H/2	H/2	SOFT	SOFT	SOFT	H/2	H/2
PRODUCTION (TON/Y)	600	600	600	600	600	1200	1800	600	600	600	900	900	900	900	1800	900	900
PER COIL WT (TON)	3.11	3 02	3.02	3.02	3.02	2.97	2.98	3.04	2.98	2.98	2.99	2.99	3.07	3.07	3.09	2.76	2.76
NO. OF COIL /YEAR	193	199	199	199	199	404	609	198	202	202	301	301	294	294	583	326	326
Melting Furnce	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Casting Line	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Scalping Machine	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Cold Roughing Mill	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Side Trimming Machine	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Annealing Furnace				O	O	O O	O	O O	O O	O O	O	O	O	O	O O	O O	O O
Pickling Line				O	O	O O	O	O O	O O	O O	O	O	O	O	O O	O O	O O
Cold Finishing Mill	O O O	O	O	O	O	O O O	O O	O O O	O O O	O O O	O O	O O	O	O	O	O O	O O
Degreasing Line	O					O	O	O	O	O	O	O				O	O
A/P Line	O O	O	O			O	O	O	O	O	O	O	O	O			
Heavy Gauge Slitting M/C				O			O				O		O			O	
Light Gauge Slitting M/C	O	O				O		O	O								
Cut-to-Length Machine			O		O					O		O		O	O		O
Inspection & Packing Line	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

Note :

a) Product No. is the same No. as listed in the Product Mix Table in Chapter III. "A" and "B" in the No. denotes strip and sheet, respectively.

b) The train of circle in the table shows the order of equipment by which each product is to be processed.

Table 6.2

Process Flow Sheet

Specification of Materail
Product Item No. : 1
Alloy Grade : Phosphorus-deoxidized Copper
Quantity : 600 Ton/Y (50Ton/M)
Temper Grade : 1/2 Hard
Product Size : 0.1T x 600W x Coil

No.	Equipment Name	Dimension Thickness (mm)	Width (mm)	Length (m)	Slab/Coil Weight (kg)	Yield Ratio Equip. (%)	Total (%)	Note
1	Casting Line	16.8	665	45.3	4,500			
2	Scalping Machine	15.0	660	45.3	4,018	89.3	89.3	
3	Cold Roughing Mill	3.0	660	228	4,018			
4	Side Trimming Machine	3.0	630	228	3,835	95.4	85.2	
5	Cold Finishing Mill	0.5	630	1,272	3,566	93.0	79.2	
6	AP Line	0.5	630	1,271	3,563	99.9	79.1	
7	Cold Finishing Mill	0.12	630	5,211	3,507	98.4	77.8	
8	AP Line	0.12	630	5,210	3,506	100.0	77.8	
9	Cold Finishing Mill	0.10	630	6,227	3,493	99.6	77.5	
10	Degreasing Line	0.10	630	6,226	3,492	100.0	77.5	
11	Light Gauge Slitting Machine	0.10	20～300	6,126	3,271	93.6	72.6	Total Width 600mm
12	Inspection/Packing	0.10	20～300	coil	3,107	95.0	69.0	
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Process Flow Sheet

Specification of Materail
Product Item No. : 2-A
Alloy Grade : Phosphorus-deoxidezed Copper
Quantity : 600Ton/Y (50Ton/M)
Temper Grade : Soft
Product Size : 0.5T x 600W x Coil

No	Equipment Name	Dimension			Slab/Coil Weight (kg)	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)		Equip. (%)	Total (%)	
1	Casting Line	16.8	665	45.3	4,500			
2	Scalping Machine	15.0	660	45.3	4,018	89.3	89.3	
3	Cold Roughing Mill	3.0	660	228	4,018			
4	Side Trimming Machine	3.0	630	228	3,835	95.4	85.2	
5	Cold Finishing Mill	0.5	630	1,272	3,566	93.0	79.2	
6	AP Line	0.5	630	1,271	3,563	99.9	79.1	
7	Light Gauge Slitting Machine	0.5	20~300	1,191	3,182	89.2	69.4	Total Width 600mm
8	Inspection/Packing	0.5	20~300	coil	3,023	95.0	67.2	
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Process Flow Sheet

Specification of Materail
Product Item No. : 2-B
Alloy Grade : Phosphorus-deoxidezed Copper
Quantity : 600Ton/Y (50Ton/M)
Temper Grade : Soft
Product Size : 0.5T x 600W x 1800L

No.	Equipment Name	Dimension			Slab/Coil Weight	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)	(kg)	Equip. (%)	Total (%)	
1	Casting Line	Same as 2-A						
2	Scalping Machine							
3	Cold Roughing Mill							
4	Side Trimming Machine							
5	Cold Finishing Mill							
6	AP Line							
7	Cut-to-Length Machine	0.5	600	1.8	3,182	89.2	69.4	
8	Inspection/Packing	0.5	600	1.8	3,023	95.0	67.2	
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Process Flow Sheet

Specification of Materail
Product Item No. : 3-A
Alloy Grade : Phosphorus-deoxidized Copper
Quantity : 600Ton/Y (50Ton/M)
Temper Grade : Soft
Product Size : 1.0T x 600W x Coil

No.	Equipment Name	Dimension			Slab/Coil Weight	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)	(kg)	Equip. (%)	Total (%)	
1	Casting Line	16.8	665	45.3	4,500			
2	Scalping Machine	15.0	660	45.3	4,018	89.3	89.3	
3	Cold Roughing Mill	3.0	660	228	4,018			
4	Side Trimming Machine	3.0	630	228	3,835	95.4	85.2	
5	Cold Finishing Mill	1.0	630	636	3,566	93.0	79.2	
6	Annealing Furnace	1.0	630	636	3,566			
7	Pickling Line	1.0	630	635	3,560	99.8	79.1	
8	Heavy Guage Slitting	1.0	20~300	595	3,177	89.2	70.6	Total Width 600mm
9	Inspection/Packing	1.0	20~300	coil	3,018	95.0	67.1	
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Process Flow Sheet

Specification of Materail
Product Item No. : 3-B
Alloy Grade : Phosphorus-deoxidezed Copper
Quantity : 600 Ton/Y (50Ton/M)
Temper Grade : Soft
Product Size : 1.0T x 600W x 1800L

No.	Equipment Name	Dimension			Slab/Coil Weight (kg)	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)		Equip. (%)	Total (%)	
1	Casting Line							
2	Scalping Machine							
3	Cold Roughing Mill							
4	Side Trimming Machine	Same as 3-A						
5	Cold Finishing Mill							
6	Annealing Furnace							
7	Pickling Line							
8	Cut-to-Length Machine	1.0	600	595	3,177	89.2	70.6	
9	Inspection/Packing	1.0	600	1.8	3,018	95.0	67.1	
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Process Flow Sheet

Specification of Materail
Product Item No : 4
Alloy Grade : 70/30 Brass
Quantity : 1200Ton/Y (100Ton/M)
Temper Grade : 1/2 Hard
Product Size : 0.3T x 600W x coil

No	Equipment Name	Dimension			Slab/Coil Weight	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)	(kg)	Equip. (%)	Total (%)	
1	Casting Line	16.8	665	46.8	4,500			
2	Scalping Machine	15.0	660	46.8	4,018	89.3	89.3	
3	Cold Roughing Mill	3.5	660	202	4,018			
4	Side Trimming Machine	3.5	630	202	3,836	95.5	85.3	
5	Annealing Furnace	3.5	630	202	3,836			
6	Pickling Line	3.5	630	201	3,816	99.5	84.8	
7	Cold Finishing Mill	1.0	630	658	3,567	93.5	79.3	
8	Annealing Furnace	1.0	630	658	3,567			
9	Pickling Line	1.0	630	657	3,562	99.8	79.2	
10	Cold Finishing Mill	0.35	630	1,821	3,454	97.0	76.8	
11	AP Line	0.35	630	1,820	3,452	99.9	76.9	
12	Cold Finishing Mill	0.3	630	2,100	3,414	98.9	75.8	
13	Degreasing Line	0.3	630	2,099	3,412	99.9	75.7	
14	Light Gauge Slitting Machine	0.3	20~600	2,019	3,126	91.6	69.3	Total Width 600mm
15	Inspection/Packing	0.3	20~600	coil	2,970	95.0	66.0	
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Process Flow Sheet

Specification of Materail
Product Item No. : 5
Alloy Grade : 70/30 Brass
Quantity : 1800 Ton/Y (150Ton/M)
Temper Grade : 1/2 Hard
Product Size : 0.75T x 600W x Coil

No.	Equipment Name	Dimension Thickness (mm)	Width (mm)	Length (m)	Slab/Coil Weight (kg)	Yield Ratio Equip. (%)	Total (%)	Note
1	Casting Line	16.8	665	46.8	4,500			
2	Scalping Machine	15.0	660	46.8	4,018	89.3	89.3	
3	Cold Roughing Mill	3.5	660	202	4,018			
4	Side Trimming Machine	3.5	630	202	3,836	95.5	85.3	
5	Annealing Furnace	3.5	630	202	3,836			
6	Pickling Line	3.5	630	201	3,816	99.5	84.8	
7	Cold Finishing Mill	0.88	630	747	3,567	93.5	79.3	
8	A/P Line	0.88	630	746	3,562	99.8	79.1	
9	Cold Finishing Mill	0.75	630	852	3,467	97.3	77.0	
10	Degreasing Line	0.75	630	851	3,463	99.9	76.9	
11	Heavy Gauge Slitting Machine	0.75	20~300	811	3,117	90.0	69.2	Total Width 600 mm
12	Inspection/Packing	0.75	20~600	coil	2,961	95.0	65.8	
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Process Flow Sheet

Specification of Materail
Product Item No. : 6
Alloy Grade : 65/35 Brass
Quantity : 600 Ton/Y (50Ton/M)
Temper Grade : 1/2 Hard
Product Size : 0.15T x 600W x Coil

No.	Equipment Name	Dimension			Slab/Coil Weight	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)	(kg)	Equip. (%)	Total (%)	
1	Casting Line	16.8	665	47.4	4,500			
2	Scalping Machine	15.0	660	47.4	4,018	89.3	89.3	
3	Cold Roughing Mill	3.5	660	204	4,018			
4	Side Trimming Machine	3.5	630	204	3,836	95.5	85.3	
5	Annealing Furnace	3.5	630	204	3,836			
6	Pickling Line	3.5	630	203	3,817	99.5	84.9	
7	Cold Finishing Mill	1.0	630	664	3,571	93.5	79.4	
8	Annealing Furnace	1.0	630	664	3,571			
9	Pickling Line	1.0	630	663	3,566	99.8	79.2	
10	Cold Finishing Mill	0.18	630	3,573	3,459	97.0	76.8	
11	AP Line	0.18	630	3,572	3,458	100.0	76.8	
12	Cold Finishing Mill	0.15	630	4,265	3,439	99.5	76.4	
13	Degreasing Line	0.15	630	4,264	3,438	100.0	76.4	
14	Light Gauge Slitting Machine	0.15	20~300	4,164	3,199	93.0	71.1	Total Width 600 mm
15	Inspection/Packing	0.15	20~300	coil	3,039	95.0	67.5	
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Process Flow Sheet

Specification of Materail
- Product Item No : 7-A
- Alloy Grade : 65/35 Brass
- Quantity : 600 Ton/Y (50Ton/M)
- Temper Grade : 1/2 Hard
- Product Size : 0.3T x 600W x Coil

No	Equipment Name	Dimension			Slab/Coil Weight	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)	(kg)	Equip. (%)	Total (%)	
1	Casting Line	16.8	665	47.4	4,500			
2	Scalping Machine	15.0	660	47.4	4,018	89.3	89.3	
3	Cold Roughing Mill	3.5	660	204	4,018			
4	Side Trimming Machine	3.5	630	204	3,836	95.5	85.3	
5	Annealing Furnace	3.5	630	204	3,836			
6	Pickling Line	3.5	630	203	3,817	99.5	84.9	
7	Cold Finishing Mill	1.0	630	664	3,571	93.5	79.4	
8	Annealing Furnace	1.0	630	664	3,571			
9	Pickling Line	1.0	630	663	3,566	99.8	79.2	
10	Cold Finishing Mill	0.35	630	1,837	3,459	97.0	76.8	
11	AP Line	0.35	630	1,836	3,457	99.9	76.7	
12	Cold Finishing Mill	0.3	630	2,118	3,420	98.9	75.9	
13	Degreasing Line	0.3	630	2,117	3,418	99.9	75.8	
14	Light Gauge Slitting Machine	0.3	20~300	2,037	3,133	91.7	69.5	Total Width 600 mm
15	Inspection/Packing	0.3	20~300	coil	2,976	95.0	66.1	
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Process Flow Sheet

Specification of Materail
Product Item No. : 7-B
Alloy Grade : 65/35 Brass
Quantity : 600 Ton/Y (50Ton/M)
Temper Grade : 1/2 Hard
Product Size : 0.3T x 600W x 1800L

No	Equipment Name	Dimension			Slab/Coil Weight	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)	(kg)	Equip. (%)	Total (%)	
1	Casting Line							
2	Scalping Machine							
3	Cold Roughing Mill							
4	Side Trimming Machine							
5	Annealing Furnace							
6	Pickling Line							
7	Cold Finishing Mill	Same as 7-A						
8	Annealing Furnace							
9	Pickling Line							
10	Cold Finishing Mill							
11	AP Line							
12	Cold Finishing Mill							
13	Degreasing Line							
14	Cut-to Length Machine	0.3	600	1.8	3,133	91.7	69.5	
15	Inspection/Packing	0.3	600	1.8	2,976	95.0	66.1	
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Process Flow Sheet

Specification of Materail
Product Item No. : 8-A
Alloy Grade : 65/35 Brass
Quantity : 900 Ton/Y (75Ton/M)
Temper Grade : 1/2 Hard
Product Size : 0.75T x 600W x Coil

No.	Equipment Name	Dimension			Slab/Coil Weight	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)	(kg)	Equip. (%)	Total (%)	
1	Casting Line	16.8	665	47.4	4,500			
2	Scalping Machine	15.0	660	47.4	4,018	89.3	89.3	
3	Cold Roughing Mill	3.5	660	204	4,018			
4	Side Trimming Machine	3.5	630	204	3,836	95.5	85.3	
5	Annealing Furnace	3.5	630	204	3,836			
6	Pickling Line	3.5	630	203	3,817	99.5	84.9	
7	Cold Finishing Mill	0.88	630	755	3,571	93.5	79.4	
8	A/P Line	0.88	630	754	3,566	99.8	79.3	
9	Cold Finishing Mill	0.75	630	862	3,472	97.4	77.2	
10	Degreasing Line	0.75	630	861	3,468	99.9	77.1	
[illegible]	Heavy Gauge Slitting Machine	0.75	20~300	821	3,150	90.8	70.0	Total Width 600 mm
[illegible]	Inspection/Packing	0.75	20~300	coil	2,992	75.0	66.5	
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Process Flow Sheet

Specification of Materail
Product Item No : 8-B
Alloy Grade : 65/35 Brass
Quantity : 900 Ton/Y (75Ton/M)
Temper Grade : 1/2 Hard
Product Size : 0.75T x 600W x 1800L

No	Equipment Name	Dimension Thickness (mm)	Width (mm)	Length (m)	Slab/Coil Weight (kg)	Yield Ratio Equip. (%)	Total (%)	Note
1	Casting Line							
2	Scalping Machine							
3	Cold Roughing Mill							
4	Side Trimming Machine							
5	Annealing Furnace							
6	Pickling Line	Same as 8-A						
7	Cold Finishing Mill							
8	Annealing Furnace							
9	A/P Line							
10	Cold Finishing Mill							
11	Degreasing Line							
12	Cut-to-Length Machine	0.75	600	1.8	3,150	90.8	70.0	
13	Inspection/Packing	0.75	600	1.8	2,992	95.0	66.5	
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Process Flow Sheet

Specification of Materail
Product Item No. : 9-A
Alloy Grade : 65/35 Brass
Quantity : 900 Ton/Y (75Ton/M)
Temper Grade : Soft
Product Size : 0.8T x 600W x Coil

No.	Equipment Name	Dimension			Slab/Coil Weight	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)	(kg)	Equip. (%)	Total (%)	
1	Casting Line	16.8	665	47.4	4,500			
2	Scalping Machine	15.0	660	47.4	4,018	89.3		
3	Cold Roughing Mill	3.5	660	204	4,018			
4	Side Trimming Machine	3.5	630	204	3,836	95.5	85.3	
5	Annealing Furnace	3.5	630	204	3,836			
6	Pickling Line	3.5	630	203	3,817	99.5	84.9	
7	Cold Finishing Mill	0.8	630	830	3,571	93.5	79.4	
8	A/P Line	0.8	630	829	3,567	99.9	79.3	
9	Heavy Gauge Slitting Machine	0.8	20~300	789	3,235	90.7	71.9	Total Width 600 mm
10	Inspection/Packing	0.8	20~300	coil	3,073	95.0	68.3	
11								
12								
13								
14								
15								
16								
17								
18								

KOBE STEEL, LTD.

Process Flow Sheet

Specification of Materail
Product Item No. : 9-B
Alloy Grade : 65/35 Brass
Quantity : 900 Ton/Y (75Ton/M)
Temper Grade : Soft
Product Size : 0.8T x 600W x 1800L

No.	Equipment Name	Dimension			Slab/Coil Weight	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)	(kg)	Equip. (%)	Total (%)	
1	Casting Line	Same as 9-A						
2	Scalping Machine							
3	Cold Roughing Mill							
4	Side Trimming Machine							
5	Annealing Furnace							
6	Pickling Line							
7	Cold Finishing Mill							
8	A/P Line							
9	Cut-to-Length Machine	0.8	600	1.8	3,235	90.7	71.9	
10	Inspection/Packing	0.8	600	1.8	3,073	95.0	68.3	
11								
12								
13								
14								
15								
16								
17								
18								

Process Flow Sheet

Specification of Materail
Product Item No. : 10
Alloy Grade : 65/35 Brass
Quantity : 1800 Ton/Y (150Ton/M)
Temper Grade : Soft
Product Size : 1.2T x 600W x 1800L

No.	Equipment Name	Dimension			Slab/Coil Weight	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)	(kg)	Equip. (%)	Total (%)	
1	Casting Line	16.8	665	47.4	4,500			
2	Scalping Machine	15.0	660	47.4	4,018	89.3	89.3	
3	Cold Roughing Mill	3.5	660	204	4,018			
4	Side Trimming Machine	3.5	630	204	3,836	95.5	85.3	
5	Annealing Furnace	3.5	630	204	3,836			
6	Pickling Line	3.5	630	204	3,817	99.5	84.9	
7	Cold Finishing Mill	1.2	630	553	3,571	93.5	79.4	
8	Annealing Furnace	1.2	630	553	3,571			
9	Pickling Line	1.2	630	552	3,565	99.8	79.3	
10	Cut-to-Length Machine	1.2	600	1.8	3,251	91.2	72.3	
11	Inspection/Packing	1.2	600	1.8	3,088	95.0	68.6	
12								
13								
14								
15								
16								
17								
18								

Process Flow Sheet

Specification of Materail
Product Item No : 11-A
Alloy Grade : 65/35 Brass
Quantity : 900 Ton/Y (75Ton/M)
Temper Grade : 1/2 Hard
Product Size : 1.5T x 600W x Coil

No	Equipment Name	Dimension Thickness (mm)	Dimension Width (mm)	Dimension Length (m)	Slab/Coil Weight (kg)	Yield Ratio Equip. (%)	Yield Ratio Total (%)	Note
1	Casting Line	16.8	665	47.4	4,500			
2	Scalping Machine	15.0	660	47.4	4,018	89.3	89.3	
3	Cold Roughing Mill	3.5	660	204	4,018			
4	Side Trimming Machine	3.5	630	204	3,836	95.5	85.3	
5	Annealing Furnace	3.5	630	204	3,836			
6	Pickling Line	3.5	630	204	3,817	99.5	84.9	
7	Cold Finishing Mill	1.75	630	380	3,571	93.5	79.4	
8	Annealing Furnace	1.75	630	380	3,571			
9	Pickling Line	1.75	630	379	3,562	99.7	79.2	
10	Cold Finishing Mill	1.5	630	419	3,375	94.7	75.0	
11	Degreasing Line	1.5	630	418	3,367	99.8	74.8	
12	Heavy Gauge Slitting Machine	1.5	20~300	378	2,901	86.1	64.4	Total Width 600 mm
13	Inspection/Packing	1.5	20~300	coil	2,756	95.0	61.2	
14								
15								
16								
17								
18								

Process Flow Sheet

Specification of Materail
Product Item No. : 11-B
Alloy Grade : 65/35 Brass
Quantity : 900 Ton/Y (75Ton/M)
Temper Grade : 1/2 Hard
Product Size : 1.5T x 600W x 1800L

No.	Equipment Name	Dimension			Slab/Coil Weight	Yield Ratio		Note
		Thickness (mm)	Width (mm)	Length (m)	(kg)	Equip. (%)	Total (%)	
1	Casting Line							
2	Scalping Machine							
3	Cold Roughing Mill							
4	Side Trimming Machine							
5	Annealing Furnace							
6	Pickling Line	Same as 11-A						
7	Cold Finishing Mill							
8	Annealing Furnace							
9	Pickling Line							
10	Cold Finishing Mill							
11	Degreasing Line							
12	Cut-to-Length Machine	1.5	600	1.8	2,901	86.1	64.4	
13	Inspection/Packing	1.2	600	1.8	2,756	95.0	61.2	
14								
15								
16								
17								
18								

6.3 EQUIPMENT

6.3.1 Selection of Equipment

In accordance with the plant capacity and the selected process, production and auxiliary equipment should be selected under consideration of technical advantages, equipment capacity, working hours, No. of shift, etc.

Technical assessment from these viewpoints and justification for selection are described below for major production equipment.

The results of calculation for total working hours/year, No. of shift and working ratio are summarized in Table 6.3 and Table 6.4.

(1) Melting and Casting

3-ton Melting Furnace of 2 ton/hour melting rate and 5-ton Holding Furnace of Casting Line of 1 ton/hour feeding rate are combined.

Among various aspects for selecting equipment, the feeding rate of Horizontal Casting Machine should be firstly considered. According to the technical survey of machine manufacturer and experience of operating factory, the max. feeding rate of horizontal casting is empirically predetermined.

For strips of 660 mm wide and 16.8 mm thick, the max. feeding rate is approx. 9 - 11 m/hour, or approx. 0.9 - 1.1 ton/hour (in average 1.0 ton/hour) for copper and brass strip.

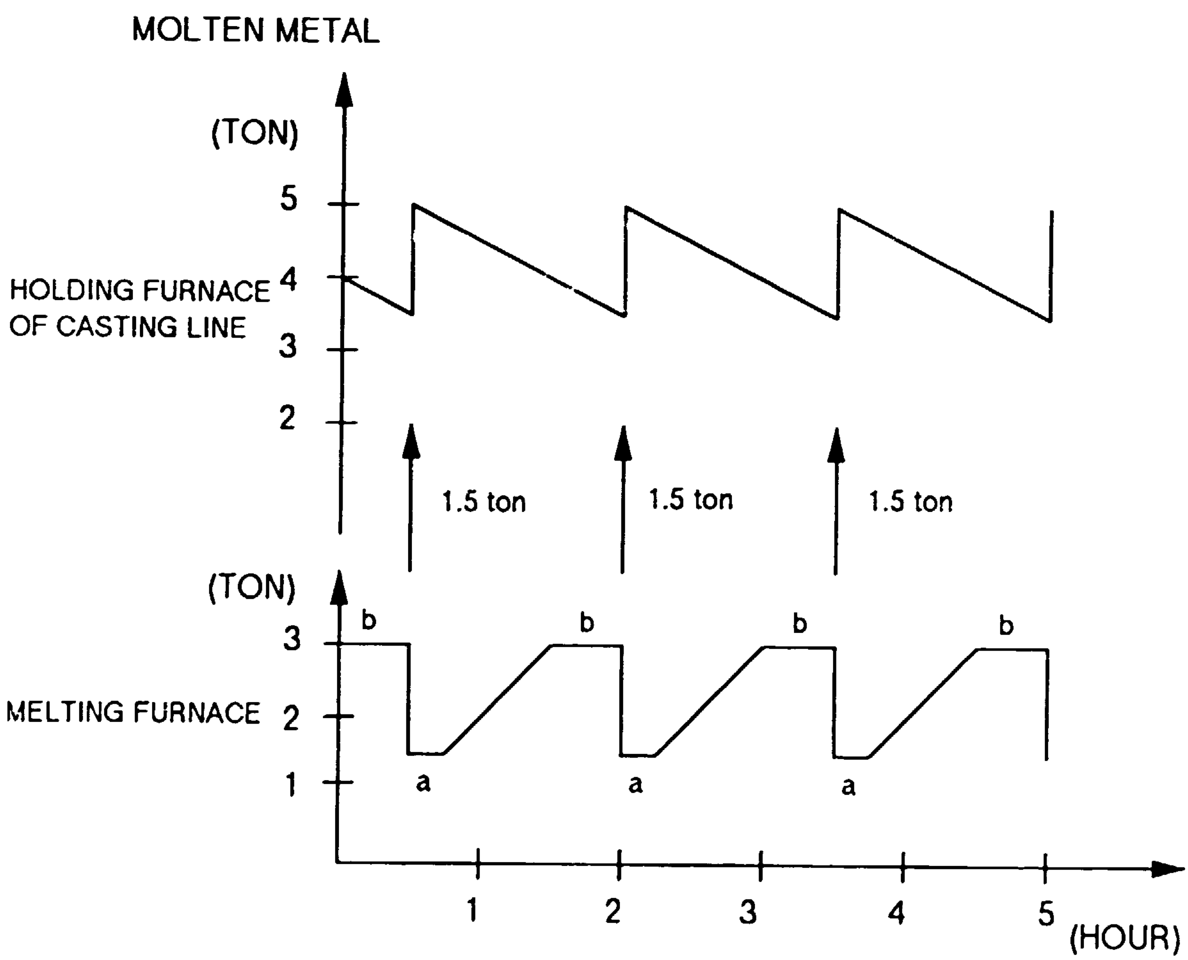
In consideration of required head pressure (empirically more than 3 ton in Holding Furnace) to smoothly feed the molten metal through the mould located lower part of the furnace, the volume capacity of the Holding Furnace is to be 3 ton + topped amount (to be more than 1 ton/hour) from Melting Furnace. For this study topping amount is estimated to be 1.5 tons at the time interval of 1.5 hours.

Therefore the holding capacity of 3 + 1.5 ⟶ 5 ton/hour is selected under the fixed feeding rate of 1 ton/hour.

As for Melting Furnace, it should supply 1.5 tons molten metal at 1.5 hours, then minimum 1 ton/hour melting rate is required. Additionally spare time for raw material charging and chemical composition checking of molten metal should also be taken into accounts, e.g. total 1 hour margin. Therefore 2 ton/hour melting rate would be reasonable.

3-ton volume is selected so that half of the molten metal remains after discharging 1.5 tons molten mental in order to enable smooth and continuous meiting ot added cold raw materials.

Under the selected capacity cycle time study at the operation stage can be carried out and illustrated as shown below.



a : charging raw materials into the Melting Furnace
b : checking chemical composition of molten metal ,etc.

(2) Scalping

It is required to remove the surface brittle layer of as-cast coil before cold rolling process. For this purpose double surface scalping machine with edge milling capability is adopted with pay-off reel and up-coiler, which arrangement is suitable for continuous coil scalping. The scalping line speed 3 - 5 m/min mainly depending on scalping depth and the motor power is selected to process the required Nos. of coils in 2-shift operation under consideration of empirical operational data.

Scalped chips are automatically collected by chip collector and returned by conveyor to Foundry Shop for drying and/or briquetting.

(3) Cold Rolling (Roughing and Finishing)

Non-reversing type roughing mill is selected to roll six coils as one group.

Each coil is rolled only one pass each time and circulated from the exit side to the entry side of the mill by coil car and coil conveyor. This arrangement has advantages in presetting the same roll gap and rolling the several coils with the same reduction or thickness as is applied to this case.

On the other hand reversing type finishing mill is chosen in order to cope with the rolling operation of various thickness and different pass schedule for each coil. Two tension reels are arranged for this purpose at both entry and exit sides of the mill.

Four-high roll configuration is adopted for both of the mills as it is suitable for cold rolling where large rolling force is required with rather smaller dia. work rolls.

In order to control required gauge tolerance push-up mechanism is incorporated with automatic gauge control system for both mills. For the finishing mill the camber control system is also included to ensure higher gauge tolerance and tempering capability.

The rolling pass schedule is theoretically calculated with assumption of relevant idle time, which results in 2-shift and 3-shift operation for Cold Roughing Mill and Cold Finishing Mill, respectively.

(4) Annealing and Pickling

Batch type annealing furnace and pickling line are adopted for handling thick coils of 1 mm or more in according with the widely used conventional method.

The Annealing Furnace is equipped with radiant tube burners and recirculation fan to anneal max. 16 coils, DX gas generator is arranged to provide protective gas into the furnace in order to prevent oxidation of copper coils or other kind of copper alloy for future.

The spray type Pickling Line performs the process of pickling - water rinsing - scrubbing - hot water rinsing - drying in order to remove oxidized layer from annealed coil surface. Entry and exit shears and stitching machine are arranged to cut and join the successive coil ends for semi-continuous operation.

A/P Line has the similar arrangements with floating type furnace and accumulators, that enables completely continuous operation of annealing and pickling. This equipment is also widely adopted to treat thin coils (usually less than 1.0 mm) for annealing and tempering to the required extent.

The circulation fans and major process rollers are driven by DC motors in order to control the optimum line speed, annealing time and strip tension in line.

The Annealing Furnace and the A/P Line are operated under 3-shift as is calculated in Table 6.3, while the Pickling Line under 2-shift.

(5) Finishing

Loop slitting method is adopted for the Slitting Machines to minimize the effect of tension during slitting and reduce residual strain, which is more difficult for tension slitting method.

As there are a large number of combination of blade width and spacer width, wide variety of slit strip width can be achieved, depending on the market's demand. Both of the Slitting Machine should be operated 3-shift due to long threading time for each coil.

For the Cut-to-Length Machine die-set type flying shear is adopted to follow the designed line speed of max. 80 m/min.

Numerical control system for cut length adjustment is also incorporated by which a few mm length tolerance is attained.

1-shift operation is sufficient to produce the required amounts of sheets as calculated in Table 6.3 and 6.4.

TOTAL WORKING HOURS

	PRODUCT NO.	1	2A	2B	3A	3B	4	5	6	7A	7B	8A	8B	9A	9B	10	11A	11B	TOTAL WORKING HOURS	
	MATERIAL	Copper	Copper	Copper	Copper	Copper	Brass(70/30)	Brass(70/30)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)	Brass(65/35)		
	PRODUCT SHAPE	Strip	Strip	Sheet	Strip	Sheet	Strip	Strip	Strip	Strip	Sheet	Strip	Sheet	Strip	Sheet	Sheet	Strip	Sheet		
	THICKNESS (MM)	0.1	0.5	0.5	1.0	1.0	0.3	0.75	0.15	0.3	0.3	0.75	0.75	0.8	0.8	1.2	1.5	1.5		
	TEMPER GRADE	H/2	SOFT	SOFT	SOFT	SOFT	H/2	H/2	H/2	H/2	H/2	H/2	H/2	SOFT	SOFT	SOFT	H/2	H/2		
	PRODUCTION (TON/Y)	600	600	600	600	600	1200	1800	600	600	600	900	900	900	900	1800	900	900		
	PER COIL WT (TON)	3.11	3.02	3.02	3.02	3.02	2.97	2.96	3.04	2.98	2.98	2.99	2.99	3.07	3.07	3.09	2.76	2.76		
	NO. OF COIL /YEAR	193	199	199	199	199	404	609	198	202	202	301	301	294	294	583	326	326		
ITEM NO																				
101	Melting Furnce																		4526 *1	Melting Furnce
102	Casting Line																		4526 *1	Casting Line
103	Scalping Machine	80.7	83.2	83.2	83.2	83.2	146.1	220.3	72.3	73.7	73.7	109.9	109.9	107.3	107.3	212.8	119.0	119.0	1885	Scalping Machine
104	Cold Roughing Mill	93.3	96.2	95.2	96.2	96.2	187.9	283.2	92.1	93.9	93.9	134.0	134.0	136.7	136.7	271.1	151.6	151.6	2345	Cold Roughing Mill
105	Side Trimming Machine	39.9	41.1	41.1	41.1	41.1	77.4	116.7	38.0	38.7	38.7	57.7	57.7	56.4	56.4	111.7	62.5	62.5	979	Side Trimming Machine
106	Annealing Furnace																		3494 *2	Annealing Furnace
107	Pickling Line				63.0	63.0	236.3	159.4	116.5	118.8	118.8	79.3	79.3	77.4	77.4	394.5	193.4	193.4	1971	Pickling Line
108	Cold Finishing Mill	599.3	122.4	122.4	78.9	78.9	429.6	397.9	439.9	214.8	214.8	197.2	197.2	149.9	149.9	242.9	127.1	127.1	3890	Cold Finishing Mill
109	Degreasing Line	421.1					292.2	227.4	309.2	147.1	147.1	114.4	114.4				113.6	113.6	2000	Degreasing Line
110	A/P Line	695.1	140.6	140.6			408.7	252.7	393.0	206.0	206.0	124.9	124.9	135.2	135.2				2903	A/P Line
111	Heavy Gauge Slitting M/C				451.1			1494.1				691.3		674.2			753.1		4064	Heavy Gauge Slitting M/C
112	Light Gauge Slitting M/C	815.4	467.3				1154.1		707.2	498.3									3642	Light Gauge Slitting M/C
113	Cut-to-Length Machine			132.3		122.7					215.5		169.1		162.7	336.2		167.3	1306	Cut-to-Length Machine

Note :

*1) 5029 coils / year x 4.5 tons / coil x 1 ton / hour = 22631 hours / year.
5 sets of machines --- 22631 / 5 = 4526 hours / year per machine

*2) Copper 28 hours / charge x 25 charges / year = 700 hours / year
Brass 16 hours / charge x 393 charges / year = 6288 hours / year
Total 6988 hours /year
2 sets of furnaces --- 6988 / 2 = 3494 hours / year per furnace

Table 6.3

Example of working hour calculation

(a) Product No. 1

(b) Production amount = 600 tons / year.

(c) Product coil weight = 3.11 tons.
(refer to Process Flow Sheet)

(d) Required Nos. of coils / year = (b) / (c) = 193.

(e) In case of Scalping Machine, coil length at this process is 45.3 m.
(refer to Process Flow Sheet)

(f) Average line speed of Scalping Machine for copper is 3 m / min.

(g) Contact time / coil = (e) / (f) = 15.1 min.

(h) Idle time / coil (threading, handling, etc.) = 10 min.

(i) Working time / coil = (g) + (h) = 25.1 min.

(j) Total working time / year = (i) x (d) = 4844 min. = 80.7 hour.

All the figures in Table 6.3 are calculated in the similar manner for each process and each equipment.

NO. OF SHIFT AND WORKING RATIO

	TOTAL WORKING HOURS	NO. OF EQUIPMENT	WORKING HOUR / EQUIPMENT (A)	NO. OF SHIFT	TOTAL OPERATING HOURS (B)	WORKING RATIO (%) (A) /(B) x 100
Melting Furnace	22631	5	4526	3	4950	91.4
Casting Line	22631	5	4526	3	4950	91.4
Scalping Machine	1885	1	1885	2	3300	57.1
Cold Roughing Mill	2345	1	2345	2	3300	71.1
Side Trimming Machine	979	1	979	1	1650	59.3
Annealing Furnace	6988	2	3494	3	4950	70.6
Pickling Line	1971	1	1971	2	3300	59.7
Cold Finishing Mill	3890	1	3890	3	4950	78.6
Degreasing Line	2000	1	2000	2	3300	60.6
A/P Line	2963	1	2963	3	4950	59.9
Heavy Gauge Slitting M/C	4064	1	4064	3	4950	82.1
Light Gauge Slitting M/C	3642	1	3642	3	4950	73.6
Cut-to-Length Machine	1306	1	1306	1	1650	79.1

Note :
Operating hours for 3-shift = 24 hours / day x 275 days / year x 0.75 = 4950 hours / year, where 0.75 is power factor for operating hours.

In the same manner, 3300 hours / year for 2-shift and 1650 hours / year for 1-shift.

Table 6.4

6.3.2 Equipment List and Specification

List and major specification of the selected equipment are described in this section.

Each equipment is categorized into the following groups from the functional and/or area wise viewpoint.

Item No.	Equipment
100s	Production Equipment
200s	Maintenance Facility
300s	Transportation Facility
400s	Utility Supply Station
500s	Electrical Equipment
600s	Laboratory
700s	Other Auxiliary

The equipment specification sheets are attached to this chapter are prepared based on the experience of supplying and/or operating the similar equipment in Kobe Steel and other plants.

The specification is to be read for reference and for the purpose of investment cost estimation, therefore figures or description in the specification sheet is not binding for any other purpose.

The indicative investment cost for the equipment for the plant with production capacity of 15,000 ton/year and for the expansion of 3,000 ton/year are shown in the following Schedule 6.1 and 6.2 respectively.

EQUIPMENT LIST

ITEM NO.	EQUIPMENT	QTY
100	Production Equipment	
101	Melting Furnace	5
102	Casting Line	5
103	Scalping Machine	1
104	Cold Roughing Mill	1
105	Side Trimming Machine	1
106	Annealing Furnace	2
107	Pickling Line	1
108	Cold Finishing Mill	1
109	Degreasing Line	1
110	A/P Line	1
111	Heavy Gauge Slitting Machine	1
112	Light Gauge Slitting Machine	1
113	Cut-to-Length Machine	1
114	Large Roll Grinder	1
115	Small Roll Grinder	1
116	Scalping Blade Sharpener	1
150	Raw Material Handling	
151	Briquette Press	1
152	Plate Shear	2
153	Dust Collector	1
154	Platform Scale	2
160	Packing Facility	
161	Platform Scale	6
162	Coil Tilter	5
163	Packing Table with Jib Crane	5
164	Packing Tool	10
200	Maintenance Shop	
201	Lathe	2
202	Drilling Machine	2
203	Shaping Machine	1
204	Double Head Grinder	2
205	Metal Cutter	1
206	Arc Welding Machine	3
207	Gas Cutting Torch	6
208	Surface Plate	2

EQUIPMENT LIST

ITEM NO.	EQUIPMENT	QTY
300	Transportation Facility	
301	Overhead Crane 10/5 Ton	3
302	Overhead Crane 10/5 Ton	2
303	Overhead Crane 5 Ton	7
304	Traverser	4
305	Fork Lift	3
400	Utility Supply Station	
401	Raw Water Treatment	1
402	Cooling Tower and Pump	1
403	Boiler	1
404	Air Compressor	3
405	LPG Station	1
406	Diesel Oil Tank	1
410	Fire Fighting System	1
420	Waste Water Treatment System	1
500	Electrical Equipment	
501	Substation	1
502	Transformer	1
503	Electric Room No.1	1
504	Electric Room No.2	1
505	Electric Room No.3	1
506	Lighting System	1
507	Paging System	1
600	Laboratory	
601	X-ray Analyzer	1
602	Tensile Tester	1
603	Vikers Hardness Tester	2
604	Ericksen Cupping Tester	1
605	Microscope	1
606	Sample Polisher	1
607	Lapping Machine	1
608	Rolling Oil Tester	1
700	Other Auxiliary	
701	Truck Scale	1
702	Fire Car	1
703	Ambulance	1
704	Vehicles	8
705	Simple Parts	1

Major Specification of

Selected Equipment

ITEM NO.	:	101
EQUIPMENT	:	Melting Furnace
SECTION	:	Foundry Shop
QUANTITY	:	5

MAIN SPECIFICATION

Type	:	Low frequency coreless type furnace
Volume	:	Max. 3,300 kg (Usually 3,000 kg)
Melting rate	:	Max. 2 ton/h
Frequency	:	60 Hz
Required power	:	Approx. 550 kWh/ton

MAJOR COMPONENTS

a) Furnace proper

b) Working deck

c) Fume corrector

d) Hydraulic system

e) Electrical equipment

ITEM NO. : 102

EQUIPMENT : Casting Line

SECTION : Foundry Shop

QUANTITY : 5 (one for copper, four for brass)

MAIN SPECIFICATION

Type	:	Horizontal type continuous casting line
Volume	:	Max. 5,500 kg (Usually 5,000 kg)
Dimension and weight of cast coil		
Thickness	:	16 - 20 mm
Width	:	650 - 700 mm
Inside diameter	:	Min. 600 mm
Outside diameter	:	Max. 1,500 mm
Weight	:	Max. 4,500 kg
Capacity	:	0.9 - 1.1 ton/hour

MAJOR COMPONENTS

a) Holding furnace with die

b) Cooling system

c) Withdrawal device

d) Flying shear

e) Up-coiler

f) Electrical equipment

ITEM NO. : 103

EQUIPMENT : Scalping Machine

SECTION : Foundry Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Horizontal double face scalping
Form of scrap	:	Scalped scrap from scalping machine
Dimension and weight of coil to be scalped		
Thickness	:	Max. 20 mm
Width	:	Max. 700 mm (Nor. 660 mm)
Length	:	Max. 50 m
Line speed	:	0 - 5 m/min
Scalping depth	:	Max. 1.0 mm each surface (Nor. 0.9 mm)
		Max. 3.0 mm each side (Nor. 2.5 mm)

ITEM NO. : 103

EQUIPMENT : Scalping Machine

SECTION : Foundry Shop

QUANTITY : 1

MAJOR COMPONENTS

a) Coil conveyor

b) Pay-off reel

c) Roller leveller

d) Edge milling machine

e) Up-coiler

f) Outlet table

g) Coil transfer

h) Chip collector

i) Coolant unit

j) Hydraulic system

k) Lubricating system

l) Electrical equipment

ITEM NO.	:	104
EQUIPMENT	:	Cold Roughing Mill
SECTION	:	Rolling Shop
QUANTITY	:	1 set

MAIN SPECIFICATION

Type : 4-high non-reversing mill with hydraulic push-up system

Dimension and weight of coil to be rolled

Thickness	:	Nor. 15.0 mm Max. 17.0 mm
Width	:	350 - 660 mm
Inside diameter	:	Approx. 600 mm
Outside diameter	:	Max. 1,300 mm
Weight	:	Max. 4,500 kg

Dimension of finished coil

Thickness	:	Min. 2.5 mm
Inside diameter	:	508 mm
Outside diameter	:	Max. 1,300 mm

Rolling speed : 0 - 250 m/min

Coolant oil : Soluble oil

ITEM NO. : 104

EQUIPMENT : Cold Roughing Mill

SECTION : Rolling Shop

QUANTITY : 1 set

MAJOR COMPONENTS

a) Coil car

b) Pay-off reel

c) Pinch roll & Leveller

d) Mill proper

e) Up-coiler

f) Tension reel with belt wrapper

g) Coil transfer

h) Coil conveyor

i) Entry walking beam

j) Roll coolant system

k) Hydraulic system

l) Lubricating system

m) Electrical equipment

ITEM NO. : 105

EQUIPMENT : Side Trimming Machine

SECTION : Rolling Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Slitting type with scrap chopper
Dimension and weight of coil to be trimmed		
Thickness	:	2.0 - 4.0 mm
Width	:	350 - 660 mm
Inside diameter	:	508 mm
Outside diameter	:	Max. 1,300 mm
Weight	:	Max. 4,500 kg
Trimmed width	:	10 - 20 mm usually 660 mm ---> 630 mm
Line speed	:	0 - 50 m/min

MAJOR COMPONENTS

a) Coil car

b) Pay-off reel

c) Milling machine

d) Scrap chopper

e) Tension reel

f) Hydraulic system

g) Lubricating system

h) Electrical system

ITEM NO. : 106

EQUIPMENT : Annealing Furnace

SECTION : Rolling Shop

QUANTITY : 2

MAIN SPECIFICATION

Type	: Indirect heating with protective gas atmosphere
Dimension and weight of coil to be annealed	
Thickness	: 0.8 - 4.0 mm
Inside diameter	: 500 - 600 mm
Outside diameter	: Max. 1,300 mm
Weight	: Max. 4,500 kg Nor. 4,000 kg
Load capacity	: Max. 4,000 kg x 16 coils/charge
Nos. of coil to be charged	: Max. 16
Furnace temperature	: Max. 600°C
Coil heating temperature	: 350 - 550°C

ITEM NO. : 106

EQUIPMENT : Annealing Furnace

SECTION : Rolling Shop

QUANTITY : 2

MAIN SPECIFICATION (Cont'd)

Annealing time

Copper	:	Heating time: 12 hours Cooling time: 12 hours
Brass	:	Heating: 12 hours (at 4,000 kg x 16 coils)

* These times depend on material and load.
* Heating and cooling of copper are carried out under protective gas atmosphere to prevent oxidation.

Protective gas	:	DX gas
Type of burner	:	Radiant tube burner
Heating source	:	L.P.G.

ITEM NO. : 106

EQUIPMENT : Annealing Furnace

SECTION : Rolling Shop

QUANTITY : 2

MAJOR COMPONENTS

a) Coil car

b) Coil rotating machine

c) Combustion equipment

d) Furnace proper

e) Exhaust system including stack

f) DX gas generator

g) Cooling unit

h) Coil stand

i) Pneumatic system

j) Lubricating system

k) Electrical equipment

ITEM NO. : 107

EQUIPMENT : Pickling Line

SECTION : Rolling Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Spray type continuous pickling/degreasing line
Dimension and weight of coil to be pickled		
Thickness	:	1.0 - 3.5 mm
Width	:	350 - 660 mm
Inside diameter	:	508 mm
Outside diameter	:	Max. 1,300 mm
Weight	:	4,000 kg
Line speed	:	0 - 60 m/min
Chemicals to be used	:	Diluted sulphuric acid for pickling

ITEM NO. : 107

EQUIPMENT : Pickling Line

SECTION : Rolling Shop

QUANTITY : 1

MAJOR COMPONENTS

a) Coil car

b) Pay-off reel

c) Roller leveller

d) Entry side shear

e) Stitcher

f) Acid pickling tank

g) Water rinse tank

h) Scrubber

i) Hot-water rinse tank

j) Wringer roll

k) Dryer

l) Bridle roll

m) Exit side shear

n) Deflector roller

o) Tension reel

p) Hydraulic system

q) Lubricating system

r) Electrical equipment

ITEM NO. : 108

EQUIPMENT : Cold Finishing Mill

SECTION : Rolling Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	4-high reversing mill with hydraulic push-up system
Dimension and weight of coil to be rolled		
Thickness	:	Max. 4.0 mm
Width	:	350 - 660 mm
Inside diameter	:	508 mm
Outside diameter	:	Max. 1,300 mm
Weight	:	Max. 4,500 kg
Dimension of finished coil		
Thickness	:	Min. 0.1 mm
Inside diameter	:	508 mm
Outside diameter	:	Max. 1,300 mm
Rolling speed	:	0 - 180/500 m/min
Coolant oil	:	Mineral oil

ITEM NO. : 108

EQUIPMENT : Cold Finishing Mill

SECTION : Rolling Shop

QUANTITY : 1

MAJOR COMPONENTS

a. Coil car

b) Pay-off reel

c) Bridle roller unit

d) Mill proper

e) Tension reel with belt wrapper

f) Roll coolant system including filtration

g) Fume exhaust system

h) Automatic gauge control system

i) Fume exhaust system

j) Fire extinguishing equipment for mill proper and oil cellar

k) Roll coolant system

l) Hydraulic system

m) Lubricating system

n) Electrical equipment

ITEM NO. : 109

EQUIPMENT : Degreasing Line

SECTION : Rolling Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Spray type continuous degreasing type
Dimension and weight of coil to be pickled		
Thickness	:	0.1 - 1.5 mm
Width	:	350 - 660 mm
Inside diameter	:	508 mm
Outside diameter	:	Max. 1,300 mm
Weight	:	Max. 4,000 kg
Line speed	:	0 - 80 m/min
Chemicals to be used	:	Diluted alkali for degreasing

ITEM NO. : 109

EQUIPMENT : Degreasing Line

SECTION : Rolling Shop

QUANTITY : 1

MAJOR COMPONENTS

a) Coil car
b) Pay-off reel
c) Roller leveller
d) Entry side shear
e) Stitcher
f) Degreasing tank
g) Water rinse tank
h) Scrubber
i) Hot-water rinse tank
j) Wringer roll
k) Dryer
l) Bridle roll
m) Exit side shear
n) Deflector roll
o) Tension reel
p) Hydraulic system
q) Lubricating system
r) Electrical equipment

ITEM NO. : 110

EQUIPMENT : A/P Line

SECTION : Rolling Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Continuous annealing and pickling line
Dimension and weight of coil to be treated		
Thickness	:	0.1 - 1.0 mm
Width	:	350 - 660 mm
Inside diameter	:	508 mm
Outside diameter	:	Max. 1,300 mm
Weight	:	4,000 kg
Temperature	:	400 - 750°C
Line speed	:	Max. 50 m/min
Capacity	:	3 ton/h for 0.35 t x 630w Brass
Protective gas	:	DX gas
Type of burner	:	Radiant tube burner
Heating source	:	L.P.G.

ITEM NO. : 110

EQUIPMENT : A/P Line

SECTION : Rolling Shop

QUANTITY : 1

MAJOR COMPONENTS

a) Coil car

b) Pay-off reel

c) Pinch roll

d) Entry side shear

e) Stitcher

f) Degreasing unit

g) Bridle roll unit

h) Entry side accumulator

i) Annealing furnace

j) Pickling tank

k) Water rinse tank

l) Scrubber

m) Hot-water rinse tank

n) Dryer

o) Exit side accumulator

p) Exit side shear

q) Tension reel with belt wrapper

r) Hydraulic system

s) Combustion system

t) Exhaust fan and duct

u) Electrical equipment

ITEM NO. : 111

EQUIFMENT : Heavy Gauge Slitting Machine

SECTION : Rolling Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Drive cut type with looper
Dimension and weight of coil to be slitted		
Thickness	:	0.6 - 2.0 mm
Width	:	350 - 660 mm
Inside diameter	:	508 mm
Outside diameter	:	Max. 1,300 mm
Weight	:	Max. 4,000 kg
Width of finished product	:	20 - 330 mm
Line speed	:	Max. 200 m/min
No. of slit	:	Max. 20

ITEM NO. : 111

EQUIPMENT : Heavy Gauge Slitting Machine

SECTION : Rolling Shop

QUANTITY : 1

MAJOR COMPONENTS

a) Coil car

b) Pay-off reel

c) Off-gauge winder

d) Pinch roll and flattener roll

e) Entry side looper

f) Cutter stand

g) Exit side looper

h) Tension pad

i) Tension reel

j) Scrap winder

k) Hydraulic system

l) Lubricating system

m) Electrical equipment

ITEM NO. : 112

EQUIPMENT : Light Gauge Slitting Machine

SECTION : Rolling Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Drive type with looper
Dimension and weight of coil to be slitted		
Thickness	:	0.1 - 1.0 mm
Width	:	350 - 660 mm
Inside diameter	:	508 mm
Outside diameter	:	Max. 1,300 mm
Weight	:	Max. 4,000 kg
Width of finished product	:	20 - 330 mm
Line speed	:	Max. 200 m/min
No. of slit line	:	Max. 20

ITEM NO. : 112

EQUIPMENT : Light Gauge Slitting Machine

SECTION : Rolling Shop

QUANTITY : 1

MAJOR COMPONENTS

a) Coil car

b) Pay-off reel

c) Off-gauge winder

d) Pinch roll and flattener roll

e) Entry side looper

f) Cutter stand

g) Exit side looper

h) Tension pad

i) Tension reel

j) Scrap baller

k) Hydraulic system

l) Lubricating system

m) Electrical equipment

ITEM NO. : 113

EQUIPMENT : Cut-to-Length Machine

SECTION : Rolling Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Flying shear
Dimension and weight of coil to be cut		
Thickness	:	0.3 - 3.5 mm
Width	:	350 - 660 mm
Inside diameter	:	508 mm
Outside diameter	:	Max. 1,300 mm
Weight	:	Max. 4,000 kg
Cutting length	:	600 - 1,800 mm
Line speed	:	0 - 80 m/min

ITEM NO. : 113

EQUIPMENT : Cut-to-Length Machine

SECTION : Rolling Shop

QUANTITY : 1

MAJOR COMPONENTS

a) Coil car

b) Pay-off reel

c) Pinch roll and flattener roll

d) Side trimmer

e) Scrap chopper

f) Leveller

g) Looper

h) Guide roll and measuring roll

i) Cutter stand

j) Runout conveyor

k) Scrap piler

l) Prime piler

m) Hydraulic system

n) Lubricating system

o) Electrical equipment

ITEM NO. : 114

EQUIPMENT : Large Roll Grinding Machine

SECTION : Rolling Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Wheel traverse with cambering device
Diameter to be ground	:	400 - 1,000 mm
Weight between centers	:	Max. 8 ton
Distance between centers	:	Max. 4,000 mm
Dimension of wheel	:	610 mm dia. x 75 mm width

MAJOR COMPONENTS

a) Grinding machine proper including

- Headstock
- Footstock
- Wheel head with cambering device
- Carriage

b) Diamond tool for wheel truing

c) Coolant system

d) Electrical equipment

ITEM NO. : 115

EQUIPMENT : Small Roll Grinding Machine

SECTION : Rolling Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Roll traverse with cambering device
Diameter to be ground	:	50 - 500 mm
Weight between centers	:	Max. 3 ton
Distance between centers	:	Max. 3,000 mm
Dimension of wheel	:	610 mm dia. x 75 mm width

MAJOR COMPONENTS

a) Grinding machine proper including
   - . Headstock
   - . Footstock
   - . Table and longitudinal feed device
   - . Wheel head with cambering device

b) Diamond tool for wheel truing

c) Coolant system

d) Electrical equipment

ITEM NO. : 116

EQUIPMENT : Scalping Blade Sharpener

SECTION : Rolling Shop

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Wet cut
Cutter to be sharpened		
Diameter	:	Max. 205 mm
Overall length	:	Max. 1,230 mm
Helical angle	:	0 - 30°
Blade material	:	Tungsten carbide
Table		
Swing on table	:	Max. 240 mm
Stroke	:	1,000 mm
Drive	:	Hydraulic
Grinding wheel carriage		
Vertical movement	:	Max. 100 mm
Wheel size	:	250 mm dia. x 13 mm wide

MAJOR COMPONENTS

a) Coolant system

b) Hydraulic system

c) Electrical equipment

ITEM NO. : 151

EQUIPMENT : Briquette Press with Dryer

SECTION : Raw Material Handling

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Hydraulic press
Form of scrap	:	Scalped chip from Scalping Machine
Dimension of briquette	:	120 mm dia. x 30 - 100 mm
Capacity	:	1,000 kg/hour
Heating source	:	L.P.G.

MAJOR COMPONENTS

a) Scrap hopper

b) Belt conveyor

c) Vibration feeder

d) Kiln type drying unit

e) Hydraulic press

f) Chain conveyor

g) Hydraulic system

ITEM NO. : 152

EQUIPMENT : Plate Shear

SECTION : Raw Material Handling

QUANTITY : 2

MAIN SPECIFICATION

Type	:	Standard gap shear
Dimension of plate to be sheared		
Thickness	:	Max. 25 mm
Length	:	Max. 1,850 mm
Shearing cycle	:	26 cycle/min
Plate clamp	:	Hydraulic clamp
Back gauge length	:	5 - 750 mm

MAJOR COMPONENTS

a) Air compressor

b) Feeding table

c) Receiving table

ITEM NO. : 153

EQUIPMENT : Dust Collector

SECTION : Raw Material Handling

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Bag filter
Fan	:	Turbo fan
Capacity	:	1,800 m^3/hour at 130°C
Static pressure	:	450 mmH_2O
Bag	:	Polyester

MAJOR COMPONENTS

a) Hood and duct

b) Dust discharger

c) Electrical equipment

ITEM NO. : 154

EQUIPMENT : Platform Scale

SECTION : Raw Material Handling

QUANTITY : 2

MAIN SPECIFICATION

(1)	Capacity	:	Max. 5,000 kg
	Scale	:	5 kg
	Qty	:	1 set
(2)	Capacity	:	Max. 2,000 kg
	Scale	:	2 kg
	Qty	:	1 set

MAJOR COMPONENTS

a) Recorder

b) Printer

ITEM NO. : 163

EQUIPMENT : Packing Table with Jib Crane

SECTION : Packing Facility

QUANTITY : 5

MAIN SPECIFICATION

Type	:	Roller table type
Dimension of table	:	1,000 mm wide x 5,000 mm long
Roller	:	Rubber lining
Roller drive	:	By AC motor

MAJOR COMPONENTS

a) Receiving table

b) Working table

c) Discharging table

d) Jib crane (max. 1 ton)

e) Vacuum lifter

ITEM NO. : 164

EQUIPMENT : Packing Tool

SECTION : Packing Facility

QUANTITY : 10

MAIN SPECIFICATION

(1)	Straping tool:	Signode model
(2)	Strap :	Approx. 20 mm wide band (steel, brass, polypropylene, etc.)
(3)	Paper feeder :	Manual roller type
(4)	Strap dispenser :	Signode model

ITEM NO. : 201

EQUIPMENT : Lathe

SECTION : Maintenance Shop

QUANTITY :

MAIN SPECIFICATION

(1) Swing over bed : Max. 750 mm

Swing over carriage : Max. 500 mm

Distance between centers : Max. 2,500 mm

Width of bed : 500 - 600 mm

Main motor : AC 15 kW

(2) Swing over bed : Max. 500 mm

Swing over carriage : Max. 300 mm

Distance between centers : Max. 1,000 mm

Width of bed : 300 mm

Main motor : AC 7.5 kW

MAJOR COMPONENTS

a) Coolant system

b) Lighting facilities

c) Center

d) Driving dog

e) Chuck

f) Service tools and tool box

g) Other standard accessories

ITEM NO. : 202

EQUIPMENT : Drilling Machine

SECTION : Maintenance Shop

QUANTITY : 1

MAIN SPECIFICATION

Swing	:	Max. 750 mm
Drilling capacity for steel	:	Max. 50 mm dia.
Screwing capacity for steel	:	Max. 30 mm dia.
Distance between table top and spindle end	:	Max. 750 mm Min. 75 mm
Distance between base top and spindle end	:	Max. 1,000 mm Min. 800 mm
Spindle taper hole type	:	M.T. No.4
Main motor	:	Approx. AC 2.2 kW

MAJOR COMPONENTS

a) Ordinary drill

b) Service tools and tool box

c) Other standard accessories

ITEM NO. : 203

EQUIPMENT : Shaping Machine

SECTION : Maintenance Shop

QUANTITY : 1

MAIN SPECIFICATION

Ram stroke	:	Max. 650 mm
Shaping width	:	Max. 650 mm
Distance between table top and underface of ram	:	Max. 450 mm
Table dimension	:	Approx. 600 mm x 400 mm
Vertical travel of table	:	Approx. 650 mm
Main motor	:	Approx. AC 2.2 kW

MAJOR COMPONENTS

a) Machine vice

b) Service tools and tool box

c) Other standard accessories

ITEM NO. : 204

EQUIPMENT : Double Head Grinder

SECTION : Maintenance Shop

QUANTITY : 2

MAIN SPECIFICATION

Grinding wheel dimension	:	Approx. 300 mm x 50 mm x 25 mm (dia. x bore x width)
Distance between wheels	:	Approx. 500 mm
Main motor	:	Approx. 0.75 kW

MAJOR COMPONENTS

a) Grinding wheel

b) Service tools and tool box

c) Other standard accessories

ITEM NO. : 205

EQUIPMENT : Metal Cutter

SECTION : Maintenance Shop

QUANTITY : 1

MAIN SPECIFICATION

Dimension of cutter blade	:	Approx. 350 mm x 50 mm x 2.5 mm (dia. x bore x thickness)
Stopper stroke	:	0 - 1,000 mm
Main motor	:	1.1 kW

MAJOR COMPONENTS

a) Coolant system

b) Cutter blade

c) Service tools and tool box

d) Other standard accessories

ITEM NO. : 206

EQUIPMENT : Arc Welding Machine

SECTION : Maintenance Shop

QUANTITY : 3

MAIN SPECIFICATION

Type	:	Electric arc type with electric shock absorber
Electric current	:	(1) 180 - 220A (2) 300 - 360A (3) 400 - 480A each 1 piece

MAJOR COMPONENTS

a) Cable and electric holder

b) Service tools and tool box

c) Other standard accessories

ITEM NO. : 207

EQUIPMENT : Gas Cutting Torch

SECTION : Maintenance Shop

QUANTITY : 6

MAIN SPECIFICATION

Type	:	Propane/oxygen mix nozzle type
Nozzle diameter	:	1.6, 2.3, 3.4 (mm) each 2 pieces

MAJOR COMPONENTS

a) Propane and oxygen cylinder set with pressure regulator

b) Carriage cart for cylinders

c) Rubber hose

ITEM NO. : 208

EQUIPMENT : Surface Plate

SECTION : Maintenance Shop

QUANTITY : 2

MAIN SPECIFICATION

Dimension of plate	:	(1) 900 mm x 900 mm x 150 mmt (2) 1,800 mm x 2,700 mm x 150 mmt each 1 piece
Material	:	Steel
Machined surface finish	:	Max. roughness Rmax. = 6.3 micron meter Rave. = 1.6 micron meter

ITEM NO. : 301

EQUIPMENT : Overhead Crane 10/5 Ton

SECTION : Transportation Facility (Foundry Shop)

QUANTITY : 3

MAIN SPECIFICATION

Rated load	:	Main hoist = 10 ton Sub hoist = 5 ton
Span	:	18.6 m
Lift	:	10 m
Speed	:	Lift = 8 m/min Traverse = 40 m/min Travel = 120 m/min
Motor	:	Lift = 22 kW/ 15 kW Traverse = 2.2 kW Travel = 15 kW
Rail	:	Min. 30 kg/m

MAJOR COMPONENTS

a) Crane hook

b) C-hook for coil lifting

c) Sling wire rope

ITEM NO. : 302

EQUIPMENT : Overhead Crane 10/5 Ton

SECTION : Transportation Facility (Rolling Shop)

QUANTITY : 2

MAIN SPECIFICATION

Rated load	:	Main hoist = 10 ton Sub hoist = 5 ton
Span	:	22.6 m
Lift	:	10 m
Speed	:	Lift = 8 m/min Traverse = 40 m/min Travel = 120 m/min
Motor	:	Lift = 22 kW/ 15 kW Traverse = 2.2 kW Travel = 15 kW
Rail	:	Min. 30 kg/m

MAJOR COMPONENTS

a) Crane hook

b) C-hook for coil lifting

c) Sling wire rope

ITEM NO. : 303

EQUIPMENT : Overhead Crane 5 Ton

SECTION : Transportation Facility (Rolling Shop)

QUANTITY : 7

MAIN SPECIFICATION

Rated load	:	5 ton
Span	:	22.6 m
Lift	:	10 m
Speed	:	Lift = 12 m/min Traverse = 40 m/min Travel = 120 m/min
Motor	:	Lift = 15 kW Traverse = 2.2 kW Travel = 5.5 kW
Rail	:	Min. 22 kg/m

MAJOR COMPONENTS

a) Crane hook

b) C-hook for coil lifting

c) Sling wire rope

ITEM NO. : 304

EQUIPMENT : Traverser

SECTION : Transportation Facility

QUANTITY : 4

MAIN SPECIFICATION

Type	:	Electric motor driven on rails
Load capacity	:	20 ton
Travelling speed	:	Approx. 15 m/min
Travelling distance	:	Two (2) sets 41.2 m Two (2) sets 13.7 m
Travelling wheel		
Quantity	:	Four (4)
Outer diameter	:	600 mm
Chassis size		
Width	:	1,800 mm
Length	:	4,000 mm
Motor	:	One (1) - 5.5 kW
Control	:	Pendant switch control and remote radio control
Brake	:	Magnet brake

ITEM NO. : 304

EQUIPMENT : Traverser

SECTION : Transportation Facility

QUANTITY : 4

MAJOR COMPONENTS

a) Rails and fittings

b) Pendant switch and remote control switch

c) Electrical equipment

ITEM NO. : 305

EQUIPMENT : Fork Lift

SECTION : Transportation Facility

QUANTITY : 3

MAIN SPECIFICATION

Type	:	Electric battery driven
Capacity	:	Max. 5,000 kg
Lift height	:	Max. 3,000 mm
Lift speed	:	200 mm/sec
Travel speed	:	Max. 12 km/hour with stepless control
Own weight	:	9,000 kg

ITEM NO.	: 401
EQUIPMENT	: Raw Water Treatment
SECTION	: Utility Supply Station
QUANTITY	: 1

MAJOR COMPONENTS AND SPECIFICATION

a)	Raw water basin	: 1 x 1,000 m^3
b)	Raw water pump	: 2 x 100 m^3/h x 10 mAq
c)	Chemical dosing unit	: 3
d)	Clarifier	: 1 x 100 m^3/h
e)	Sludge discharge pump	: 2 x 0.5 m^3/h x 20 mAq
f)	Clarified water basin	: 1 x 100 m^3
g)	Filter feed pump	: 2 x 100 m^3/h x 12 mAq
h)	Gravity filter	: 2 x 50 m^3/h
i)	Backwash water basin	: 1 x 50 m^3
j)	Backwash water pump	: 2 x 4 m^3/h x 12 mAq
k)	Filtered water basin	: 1 x 300 m^3
l)	Softener feed pump	: 2 x 60 m^3/h x 25 mAq

ITEM NO. : 401

EQUIPMENT : Raw Water Treatment

SECTION : Utility Supply Station

QUANTITY : 1

MAJOR COMPONENTS AND SPECIFICATION

m)	Softener	: $1 \times 60\ m^3/h$
n)	Salt dissolving tank	: $1 \times 20\ m^3$
o)	Salt solution pump	: $2 \times 1\ m^3/h \times$ 15 mAq
p)	Fresh water basin	: $1 \times 250\ m^3$
q)	Fresh water pump	: $2 \times 50\ m^3/h \times$ 45 mAq
r)	Make-up water pump	: $2 \times 70\ m^3/h \times$ 10 mAq
s)	Miscellaneous use water pump	: $2 \times 10\ m^3/h \times$ 30 mAq
t)	Piping materials	: 1 lot

Refer to the attached drawings:

- Fig. UT.1 : Utility Station Flow Diagram
- Fig. UT.2 : Utility Station Layout

ITEM NO. : 402

EQUIPMENT : Cooling Tower and Pump

SECTION : Utility Supply Station

QUANTITY : 1

MAJOR COMPONENTS AND SPECIFICATION

a) Cooling tower : 1 x 1,300 m^3/h x 3 cells

b) Chemical dosing unit : 1 for scale inhibitor

c) Cold water basin : 1 x 350 m^3

d) Cooling water pump : 3 x 650 m^3/h x 50 mAq

e) Emergency water pump : 1 x 80 m^3/h x 50 mAq driven by diesel engine

f) Hot water basin : 1 x 300 m^3

g) Hot water pump : 3 x 650 m^3/h x 15 mAq

h) Piping materials : 1 lot

Refer to the attached drawings:

- Fig. UT.1 : Utility Station Flow Diagram
- Fig. UT.2 : Utility Station Layout

ITEM NO. : 403

EQUIPMENT : Boiler

SECTION : Utility Supply Station

QUANTITY : 1

MAJOR COMPONENTS AND SPECIFICATION

a) Boiler : 1 x 4 ton/hr x 7 kg/cm^2

b) Water tank

c) Steam pressure reducing valve

d) Steam trap

e) Exhaust duct with damper

f) Expansion joint

g) Piping materials : 1 lot

ITEM NO. : 404

EQUIPMENT : Air Compressor

SECTION : Utility Supply Station

QUANTITY : 3

MAJOR COMPONENTS AND SPECIFICATION

a) Air compressor: 3 x 1,300 Nm^3/h x 7 kg/cm^2

b) Compressor motor : 1 x 200 kW x 4P

c) Air receiver : 1 x 5 m^3

d) Piping materials : 1 lot

ITEM NO. : 405

EQUIPMENT : LPG Station

SECTION : Utility Supply Station

QUANTITY : 1

MAJOR COMPONENTS AND SPECIFICATION

a)	LPG storage tank	:	2 x 300 m^3
b)	Feed pump	:	3 x 0.3 ton/h
c)	Vaporizer	:	3 x 0.3 ton/h
d)	Mixer	:	3 x 0.3 ton/h
e)	Surge tank	:	2 x 20 m^3
f)	Piping materials	:	1 lot

ITEM NO. : 406

EQUIPMENT : Diesel Oil Tank

SECTION : Utility Supply Station

QUANTITY : 1

MAJOR COMPONENTS AND SPECIFICATION

a) Diesel oil tank : 1 x 20 m^3

b) Oil feed pump : 2 x 54 lit./min x 3 kgf/cm^2

c) Piping materials : 1 lot

ITEM NO. : 410

EQUIPMENT : Fire Fighting Equipment

SECTION : Utility Supply Station

QUANTITY : 1

MAJOR COMPONENTS AND SPECIFICATION

a)	Fire water pump	: 1 x 230 m^3/h x 70 mAq driven by electric motor
b)	Fire water pump	: 1 x 230 m^3/h x 70 mAq driven by diesel engine
c)	Jocky pump	: 1 x 4.5 m^3/h x 70 mAq
d)	Hydrant	: 12
e)	Hosereel	: 30
f)	Portable extinguisher	: 100
g)	Piping materials	: 1 lot

ITEM NO. : 420

EQUIPMENT : Waste Water Treatment System

SECTION : Utility Supply Station

QUANTITY : 1

MAJOR COMPONENTS AND SPECIFICATION

a) Clarifier rake: 1 x center shaft type

b) Sludge thickener : 1 x 2.4 m dia. x 3 mh

c) Cake hopper : 1 x 4 m^3

d) Fume scrubber : 1 x 250 mm dia. x 620 mmh

e) Filter : 1 x pressure filter type

f) Dehydrator : 1 x automatic press type

g) Reaction tank : 1 x 8.8 m^3 with mixer

h) Coagulation tank : 1 x 2.75 m^3 with mixer

i) Neutralization tank : 1 x 8.8 m^3 with mixer

j) Coagulant acid dissolving tank : 1 x 27.5 m^3 with mixer

k) Hydrochloric acid storage tank : 1 x 2 m^3

ITEM NO. : 420

EQUIPMENT : Waste Water Treatment System

SECTION : Utility Supply Station

QUANTITY : 1

MAJOR COMPONENTS AND SPECIFICATION

l)	Hydrochloric acid dilution tank	:	1 x 0.85 m^3 with mixer
m)	Filter cloth washing water tank	:	1 x 0.2 m^3
n)	Ferric chloride storage tank	:	1 x 2 m^3
o)	Lime dissolving tank	:	1 x 18 m^3 with mixer
p)	Pumps and piping materials	:	1 lot

UTILITY STATION FLOW DIAGRAM

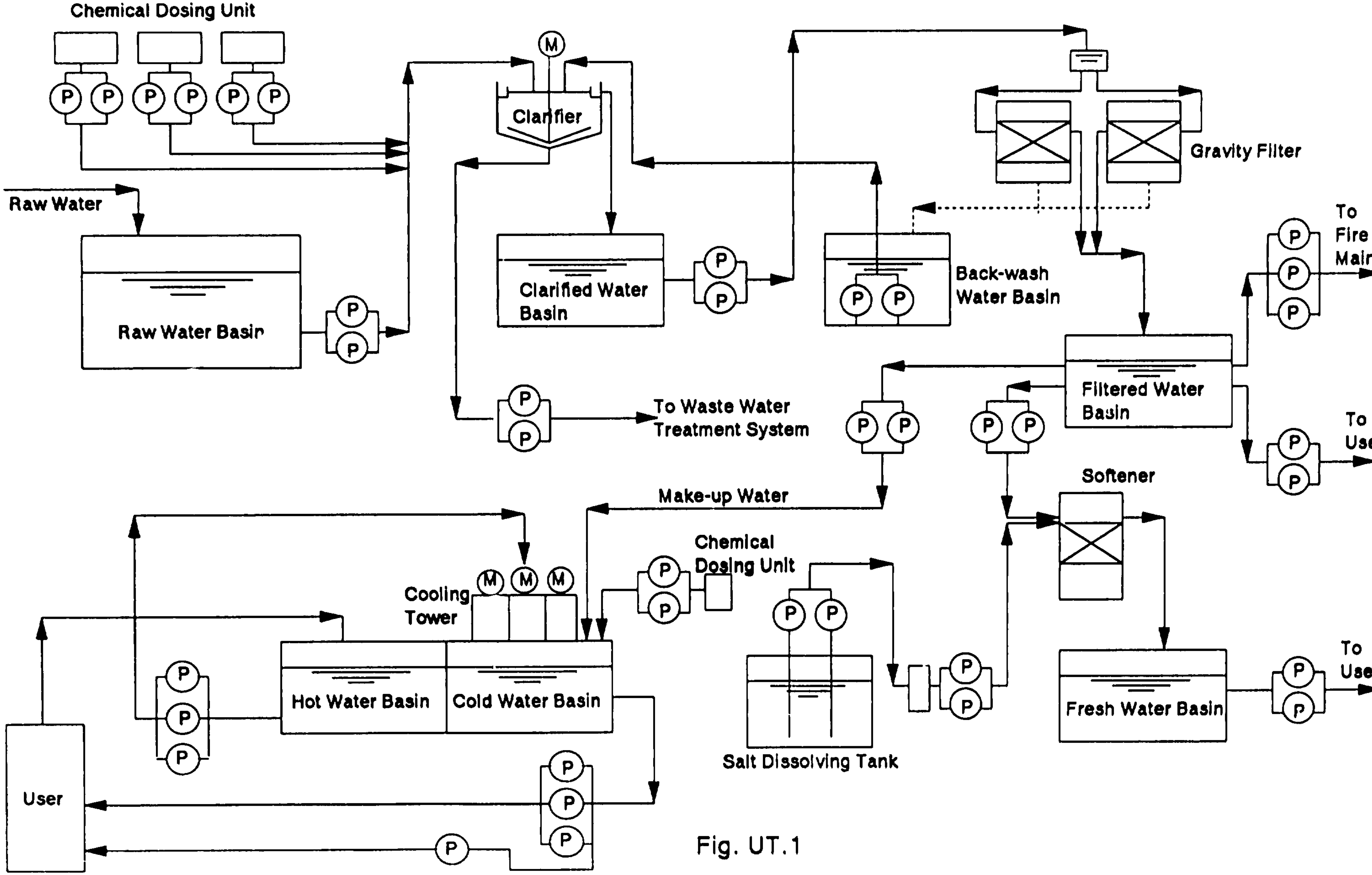


Fig. UT.1

UTILITY STATION LAYOUT

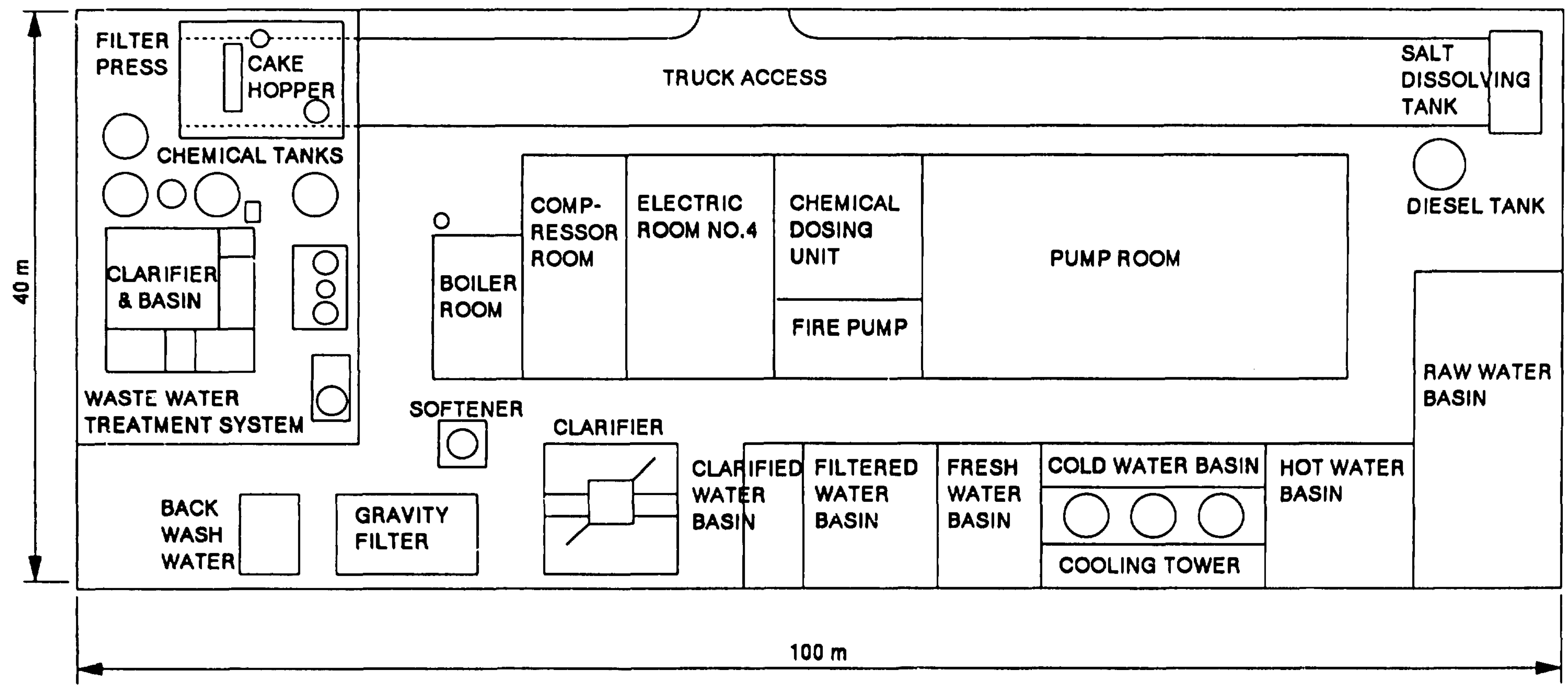


Fig. UT.2

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

1. General Concept

1) Incoming power

Two (2) incoming lines at 138 kV, 60 Hz, 3-phase electric power shall be received and terminated by the local Electric Power Co. to the take-over points on the steel structure in the outdoor substation.

If both the lines are fed from same source of supply by Electric Power Co., then both the lines will be energized in parallel operation at 138 kV for added reliability. Otherwise both the lines will be energized to feed plant load independently with all bus-section breakers open circuited.

The 138 kV source of supply from Electric Power Co. will have solidly grounded neutral system. Also all the equipments will be designed based on the maximum fault level at 138 kV (with both lines in parallel operation) be 5,000 MVA and maximum voltage and frequency variation within $\pm 5\%$ and $\pm 1\%$ respectively, at 138 kV.

ITEM NO.	: 500
EQUIPMENT	: Electrical Equipment (all included)
SECTION	: Electrical Equipment
QUANTITY	: 1

2) Utilization voltages

Following voltage levels will be adopted for various applications:

	System voltage	Application
a)	138 kV, 3-phase, 3-wire, AC (Neutral grounded directly)	Incoming supply to the substation
b)	11 kV, 3-phase, 3-wire, AC (Neutral grounded through 200A resistor)	Primary power distribution, supply to furnace transformers
c)	3.3 kV, 3-phase, 3-wire, AC (Neutral grounded through 150A resistor)	Supply to thyristor transformer rated above 400 kVA, AC motors above 200 kW
d)	460V, 3-phase, 3-wire, AC (Neutral grounded directly)	Thyristor transformers of 400 kVA and below, AC motors of 200 kW or smaller
e)	230/460V, 3-phase, 4-wire, AC (Neutral grounded directly)	Local power distribution, miscellaneous power supply, lighting and socket outlet system
f)	750V, 2-wire, DC (Ungrounded)	DC motors rated 400 kW and above
g)	440V, 2-wire, DC (Ungrounded)	DC motors rated less than 400 kW
h)	220V, 2-wire, DC (Ungrounded)	Smaller capacity DC motors
i)	220V, 1-phase, 2-wire, AC	Logic control system, solenoid valves

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

	System voltage	Application
j)	110V, 2-wire, AC (Ungrounded)	Power supply to control system and annunciators
k)	110V, 2-wire, DC (Ungrounded)	Switchgear control circuits, hardwired logic and interlocking circuits
l)	Others	As per manufacturers practice for standard products

3) Standards

In general, relevant International Electrotechnical Commission (IEC) recommendations and Japanese Standards will be adopted for system and equipment design. However for certain special equipment (e.g. thyristor panels, PLCs) respective manufacturer's standard will be applied.

4) Reference drawing

For detail of distribution system, refer single line diagram, drawing nos.

a) 500 - DE51-00001

b) 500 - DE51-00002

c) 500 - DE51-00003

d) 500 - DE51-00004

ITEM NO. :	500
EQUIPMENT :	Electrical Equipment (all included)
SECTION :	Electrical Equipment
QUANTITY :	1

2. Power Receiving and Step-down

1) 138 kV Power receiving and step-down

A set of SF6 Gas Insulated Switchgear (GIS) and transformers will be provided outdoor to receive the 138 kV, 3-phase, 60 Hz power and step it down to 11 kV.

The GIS for incoming line, bus-tie and transformer feeders will consist of disconnection switches, circuit breakers, metering outfits, etc.

These switches and circuit breakers will be operable from the 11 kV Switchboard room.

a) SF6 gas circuit breakers

Quantity	:	Five (5) nos.
Rated voltage	:	145 kV
Lightning impulse withstand voltage	:	650 kV
Power frequency withstand voltage (1 min)	:	275 kV
Rated normal current	:	Not less than 630A
Rated short time current	:	25 kA

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

b) Metering outfit

i) Instrument transformers (voltage and current)

Quantity	:	Two (2) nos.
Type	:	Outdoor use, oil immersed
Rated primary voltage	:	138 kV
Lightning impulse withstand voltage	:	650 kV
Power frequency withstand voltage (1 min)	:	275 kV
Accuracy	:	Class 0.5
Phase	:	3

ii) Meters

Quantity : Two (2) nos.

A watt-hour meter, var-hour meter and maximum demand meter will be mounted in outdoor type panel in the substation area.

c) 138 kV/11 kV Power transformers

Quantity	:	Two (2) nos.
Type	:	Outdoor, oil immersed type
Standards	:	IEC-76
Rated capacity	:	16/20 MVA

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

Cooling	:	Air natural (for 16 MVA) ONAN, Forced air (for 20 MVA) ONAF
Percent impedance	:	7.5 to 10.0%
Insulation	:	Class A
Temperature rise limits over 40 deg C	:	65 deg C for winding (Measured by resistance method) 60 deg C for top oil (Measured by thermometer method)
Wiring connection	:	Star-delta-star
Tap changer	:	On load 13 steps, plus or minus 15% at maximum
Accessories	:	Buchholz relay, thermostat, Oil level gauge, dryer for air breather, etc.

d) Supervisory and protection relay panel

Quantity : One (1) no.

The supervisory and protection relay panel will be located in the switchboard room. The supervisory panel will have meters and lamps and switches for remote supervision and operation.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

e) Storage battery and charger

Quantity : One (1) set

This system will consist of storage battery bank, battery charger and DC 110V distribution board.

The batteries will be of alkaline type. The charger will be of automatic floating and high rate charging type.

The DC power system for the substation and the electrical rooms will have a capacity of 200 ampere hours for 5 hours and the output voltage will be 110V.

2) 11 kV and 3.3 kV power receiving and distribution

The 11 kV power received from the substation will be distributed to the furnace transformers, as well as 11 kV/3.3 kV power transformers, and 11 kV/460V distribution transformer, located in various Electric Rooms (ER), as shown in the single line diagrams. The utility system load will be fed through 11 kV duplicate feeder.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

The static condensers will be provided in order to improve the power factor.
The target values of the power factor at 11 kV busbar will be 0.9 lag.

The 11 kV switchboard, battery and charger unit will be located in switchboard room, besides substation area, whereas static condensers will be installed adjacent to this room.

The 11 kV distribution to furnace transformers, located in transformer yard besides the furnaces, will be looped for 2 No. furnace section loads. Looping will be through individual switch and fuse unit, installed nearby to transformers.

Similarly 11 kV distribution for 11 kV/3.3 kV transformers and 11 kV/460V distribution transformers will also be looped through individual switch and fuse unit, installed indoor in respective electric rooms.

The 3.3 kV power will be distributed to thyristor transformers through 3.3 kV switchboards in electric room.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

a) 11 kV switchgear

Quantity of circuit breaker	:	Seventeen (17) nos.
Type	:	Indoor, metal-enclosed compartmentalized type
Standard	:	JEM-1153, (equivalent to IEC-298)
Rated voltage	:	12 kV
Lightning impulse withstand voltage	:	75 kV
Power frequency withstand voltage (1 min)	:	28 kV
Rated short time current	:	25 kA for 1 second
Enclosure	:	IP-20
Type of circuit breaker	:	Vacuum break type
Rated current of circuit breaker	:	630A, 2,000A

Construction features:

- The switchgear will be factory-built assemblies having a power bus compartment, a circuit-breaker compartment, a power cable compartment and a low-voltage compartment. Each compartment will be segregated from others by suitable barriers.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

- Each circuit breaker will be arranged in withdrawable configuration having a SERVICE (CONNECTED) position and a TEST/DISCONNECTED (ISOLATED) position.
- Automatic shutters will be provided to cover bus side and line side in the switchgear compartment, when the circuit-breaker is withdrawn from the SERVICE position.
- Power busbars, connections and supports will be designed to withstand mechanical and thermal stresses generated during short-circuits.
- Current transformers will be of moulded construction with appropriate accuracy class and rated output as necessary for each specific application.

b) 11 kV switch and fuse unit

Quantity	:	Twenty (20) nos.
Type of unit	:	Indoor, self stand, metal enclosed containing load break switch and fuse
Switch operation	:	Manual, gang operated, quick make quick break type
Switch rating	:	Not less than 600 Amp.
Type of fuses	:	Current limiting type

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

c) 11 kV/3.3 kV power transformers

Quantity	:	Two (2) nos.
Type	:	Outdoor, oil-immersed type
Standard	:	IEC-76
Rated capacity	:	5/7.5 MVA
Cooling	:	Air natural (for 5 MVA) ONAN, Forced air (for 7.5 MVA) ONAF
Percent impedance	:	5.0 to 7.5%
Insulation	:	Class A
Temperature rise limits over 40 deg C	:	65 deg C for winding (Measured by resistance method) 60 deg C for top oil (Measured by thermometer method)
Wiring connection	:	Delta-star
Tap changer	:	Off load, 5 steps plus and minus 5.0% at maximum
Accessories	:	Buchholz relay, thermostat, oil level gauge, dryer for air breather, etc.

d) 3.3 kV switchgear

The technical requirements are principally same as those of the 11 kV switchgear, except for the following items:

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

Quantity of circuit breakers	:	Eight (8) nos.
Rated voltage	:	3.6 kV
Lightning impulse withstand voltage	:	40 kV
Power frequency withstand voltage (1 min)	:	10 kV
Rated current of circuit breaker	:	630A, 1,600A

e) 11 kV/460V distribution transformer

i) For electric room-1

Quantity	:	Two (2) nos.
Type	:	Outdoor, oil-immersed type
Standard	:	IEC-76
Rated capacity	:	2.0 MVA
Cooling	:	Air natural ONAN
Percent impedance	:	5.0 to 6.0%
Insulation	:	Class A
Temperature rise limits over 40 deg C	:	65 deg C for winding (Measured by resistance method) 60 deg C for top oil (Measured by thermometer method)
Wiring connection	:	Delta-star

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

Tap changer	:	Off load, 5 steps plus and minus 5.0% at maximum
Accessories	:	Buchholz relay, thermostat, oil level gauge, dryer for air breather, etc.

ii) For electric room-2 and 3

Quantity	:	Four (4) nos.
Type	:	Indoor, dry type
Standard	:	IEC-76
Rated capacity	:	1.0 MVA
Cooling	:	Air natural (AN)
Percent impedance	:	4.5 to 6.0%
Insulation	:	Class F
Temperature rise limits, over 40 deg C	:	100 deg C (Measured by resistance method)
Wiring connection	:	Delta-star
Tap changer	:	Off load, 5 steps plus and minus 5.0% at maximum
Accessories	:	Flat base, lifting eyelets, hand hole, thermometer with contact

iii) For electric room-4 (in Utility Supply Station)

Quantity	:	Two (2) nos.
Type	:	Outdoor, oil-immersed type
Standard	:	IEC-76

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

Rated capacity	:	1.6 MVA
Cooling	:	Air natural ONAN
Percent impedance	:	5.0 to 6.0%
Insulation	:	Class A
Temperature rise limits over 40 deg C	:	65 deg C for winding (Measured by resistance method) 60 deg C for top oil (Measured by thermometer method)
Wiring connection	:	Delta-star
Tap changer	:	Off load, 5 steps plus and minus 5.0% at maximum
Accessories	:	Buchholz relay, thermostat, oil level gauge, dryer for air breather, etc.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

3. Low Voltage Switchgear (Load Center) and Power Distribution Boards

Quantity : One (1) lot

The 460V Low voltage switchgear (load center) will be used on the secondary side of distribution transformers for distributing AC power to various loads and thyristor transformers.

Power distribution boards will be used for subdistribution of AC or DC power such as local distribution, small power, lighting power, control power, emergency power, etc.

The incoming units of load center will have Air Circuit Breaker (ACB) or Moulded Case Circuit Breaker (MCCB), as indicated in the single line diagram. The load center will have sectionalized bus with ACB or MCCB, where indicated in single line diagram. Incomer and bus tie of load center will be of withdrawable configuration, whereas outgoing MCCB feeder will be of fixed type construction.

The power distribution boards will have incoming and outgoing MCCBs or switch fuse unit of fixed type construction.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

Standard:

The load center and power distribution boards will conform to the Japanese Standard JEM-1265 and generally conform to IEC-439.

Construction features:

- The load centers and power distribution boards are cubicle type Factory Built Assemblies (FBA) of metal enclosed construction.
- The enclosure of load center and power distribution boards will provide IP-40 degree of protection, when used for indoor applications.
- The load center will be of floor mounted, free standing type, vertical of multi-tier construction and compartmental design having busbar compartment and circuit breaker unit compartment.
- The power distribution boards will be of floor mounted self standing type or of wall mounted type.

Protective devices:

- The incoming unit of the load center incorporates overload/short circuit protection by relays or overcurrent trip devices or overcurrent release.
- The load center and power distribution boards outgoing units are protected by overcurrent release of respective MCCB.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

4. Emergency Power Supply

Quantity : One (1) set

A 460V AC diesel engine generator and power distribution board will be provided in the electric room-1.

The diesel engine generator will have a control panel, and a storage battery set for starting the engine.

The engine generator will start automatically after the 138 kV power fails.

The diesel engine generator will be rated 375 kVA, 0.8 lag.

The emergency supply will be provided to following sections.

- Annealing furnace
- A/P line
- Emergency lighting

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

5. Communication System

1) Paging system

Quantity : One (1) set

This system will be used for ordinary paging (group or whole) function and for simultaneous calls among the main operating stations and electrical rooms by using a key-switch on the handsets.

An amplifier may be built in the handsets or be installed separately according to the manufacturer's standard and a corn speaker will be provided to the handsets located in noisy areas.

2) Telephone system

Quantity : One (1) set

Telephone system will be of private automatic branch exchange with interconnection to public telephone system, to be installed in main office area.

This system will be composed of private automatic branch exchange, power source with batteries, operation desk and handsets. A facsimile unit will also be interconnected to telephone system.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

Telephone handsets will generally be located in or around office areas, laboratory, canteen, gate complex, 11 kV switchboard room, electrical rooms and major operating stations.

3) Telex system

Quantity : One (1) no.

The telex unit including a typewriter and a tape reader will be provided and will be installed in the main office.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

6. Lighting and Outlet Sockets

Quantity : One (1) 1 lot

1) Lighting fixtures

a) For incandescent lamps, selection will be made among 60, 100 and 200W. The type of screw base will comply with IEC-64, (E27).

b) For mercury-arc lamps, selection will be made among 250, 400, 700 and 1,000W. The type of screw base will comply with IEC-188 (E27, E40).

c) For high-pressure sodium lamps, selection will be made among 125, 250, 400 and 1,000W. The type of screw base will comply with E-27, E-40.

d) For fluorescent lamps, selection will be made among 20, 40 and 65W and will comply with IEC-81.

e) Pole for road illumination
The 5 - 7 m steel pole with 250W sodium lamp for road.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

f) Emergency lighting fixtures

Emergency lighting fixtures will be provided to the office rooms, electrical rooms and in plant where changeover operations required.

These fixtures will be fluorescent lamps with rechargeable Ni-Cd battery or some of the ordinary lamps will be powered by the emergency generator. These fluorescent lamps will have 3 hour emergency duration.

Emergency exit sign lights will also be provided as per local regulations and in addition to normal supply will be backed up by rechargeable Ni-Cd battery.

2) Lighting intensity

No.	Location	Average illumination level (lux)	Lighting fixtures	
			Type	Wattage
1	Main office building	450	fluorescent	40W
2	Laboratory	500	fluorescent	40W
3	Canteen	200	fluorescent	40W
4	Gate complex	350	fluorescent	40W
5	Parking area	25	sodium	125W
6	Substation (outdoor)	100	mercury	400W

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

No.	Location	Average illumination level (lux)	Lighting fixtures	
			Type	Wattage
7	Electrical room			
	- Switchgear, switchboard area	250	fluorescent	40W
	- Control panel, thyristor panel, supervisory panel area	350	fluorescent	40W
8	Transformer yard	50	sodium	125W
9	Roll shop	250	mercury	700W
10	Melting and casting shop	250	mercury	700W
11	Scrap yard	150	mercury	700W
12	Packing and shipping yard	250	mercury	700W
13	Utility supply station	50	mercury	400W
14	Road lighting	5	sodium	125W or 250W

The fluorescent lamp for emergency use will be smaller than 40W rated wattage.

3) Air craft warning lights

Air craft warning lights backed up by emergency supply will be provided to fume stack or other tall structure as per the local regulations.

4) Outlet sockets

The outlet sockets will be provided to various areas for welding machines and maintenance tools/lamps.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

a) AC 460V switch outlet sockets

32A, 3P+E according to IEC-309-2 standard sheet 2-II or

125A, 3P+E according to IEC-309-2 standard sheet 2-IV/2-IVa

An isolating switch will be provided along with mechanical interlocking system.

b) AC 230V outlet sockets

16A, 2P+E according to IEC-309-2 standard sheet 2-I and sheet 2-II

5) Power distribution boards for lighting and outlet sockets

a) The power distribution boards will be designed for feeding 460V or 460/230V, 3-phase, 60 Hz power to various consumers and will be equipped with requisite number of incoming isolator and outgoing moulded case circuit-breakers (MCCBs) or earth leakage breakers. These isolator and breakers will be mounted on the plate in these distribution boards.

b) The power distribution boards will be of non-compartmental steel enclosed self-supporting floor-mounted type or wall-mounted type.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

7. Cables and Erection

Quantity	:	One (1) lot

1) Standards

Power and control cables	:	IEC
Other material	:	Local standards of country of origin

2) Selection of cables

a) Kinds of cables

11 kV, 3.3 kV, 750V, 460V system power cable	:	XLPE insulated PVC sheathed
Control cable	:	PVC insulated PVC sheathed

b) The conductors will be copper.

c) Power cables will have cross-sectional area of 4 sqmm or larger and control cables will be of 1.5 sqmm, in general.

d) Multicore power cables will be of 300 sqmm and single core power cables 625 mm at maximum respectively.

e) Cables buried directly underground will be steel-armoured and the other cables will be unarmoured.

f) Control cables laid in very hot area will be of heat resistant type.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

3) Cable shelves and support

a) The following cable shelves will be used.

- Cable duct
- Cable tray
- Cable rack (ladder type)

b) Cable shelves will be hot dip galvanized or painted, 900 mm wide maximum, in principle.

c) Cable duct will be made of the galvanized steel with 2.5 mm thick or more. Duct covers will be 1.5 mm thick or more.

d) Cable trays will be 300, 400 or 600 mm wide, made of galvanized steel plate of 2.0 mm thick or more and will be 50 mm deep or more.

e) Ladder type cable racks will be made of angle or channel steel of 4.0 mm thick or more for longitudinal members, and round bar of 9 mm or 13 mm diameter for cross members at interval of 150 mm. Cable racks will be 300, 400, 600 or 900 wide.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

4) Cabling method

a) The 11 kV and 3.3 kV power cables will be generally laid on cable racks in one layer with spacings of not less than one cable diameter, in principle. However, these cables will be laid touching each other on the rack, if appropriate derating factor is considered for sizing these cables.

b) The power cables for 460V AC or DC circuit will be also laid on ladder type cable racks in one layer with no space between any two cables in principle.

c) Special control cables such as those for telephone, communication, interfacing to a computer, etc., will be laid in the cable trays or cable ducts.

d) Power cables of each voltage class will normally be laid on separate cable racks. If cables of two voltage classes or more share one tray or rack, steel separators will be provided on the rack.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

8. Earthing and Lightning Protection System

Quantity : One (1) lot

i) All earthing systems will be designed to ensure effective operation of protective gears in case of earth faults. The total earth resistance at any point of the earthing system for substation and electric rooms will be one ohm or smaller. However, for other areas, the resistance will not exceed 5 ohms.

2) For plant buildings and electrical rooms, one main earthing ring will be provided along the plant building periphery and be connected to required number of earthing electrodes. The main earthing ring will be placed on cable trays or be buried directly in the ground. The main earthing ring will be connected to the electrical equipment, transformer neutral, and the structure. This ring will be made of copper wire of 116 mm^2, 70 mm^2 or 35 mm^2.

3) For electronic circuits, an independent earthing system will be provided with separate electrode of 10 ohms, or smaller.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

QUANTITY : 1

4) All buildings/structures storing explosives, inflammable gases, fuel oil, etc., substation area, electrical equipment rooms will be provided with lightning protection.

5) Structures having roof made of metal sheets, metal chimneys, and towers not exceeding 40 meters in height will not be provided with lightning protection. However, suc' ·tructures and installations will be adequately ·arthed to ensure a free conducting path for lightning stroke.

ITEM NO. : 500

EQUIPMENT : Electrical Equipment (all included)

SECTION : Electrical Equipment

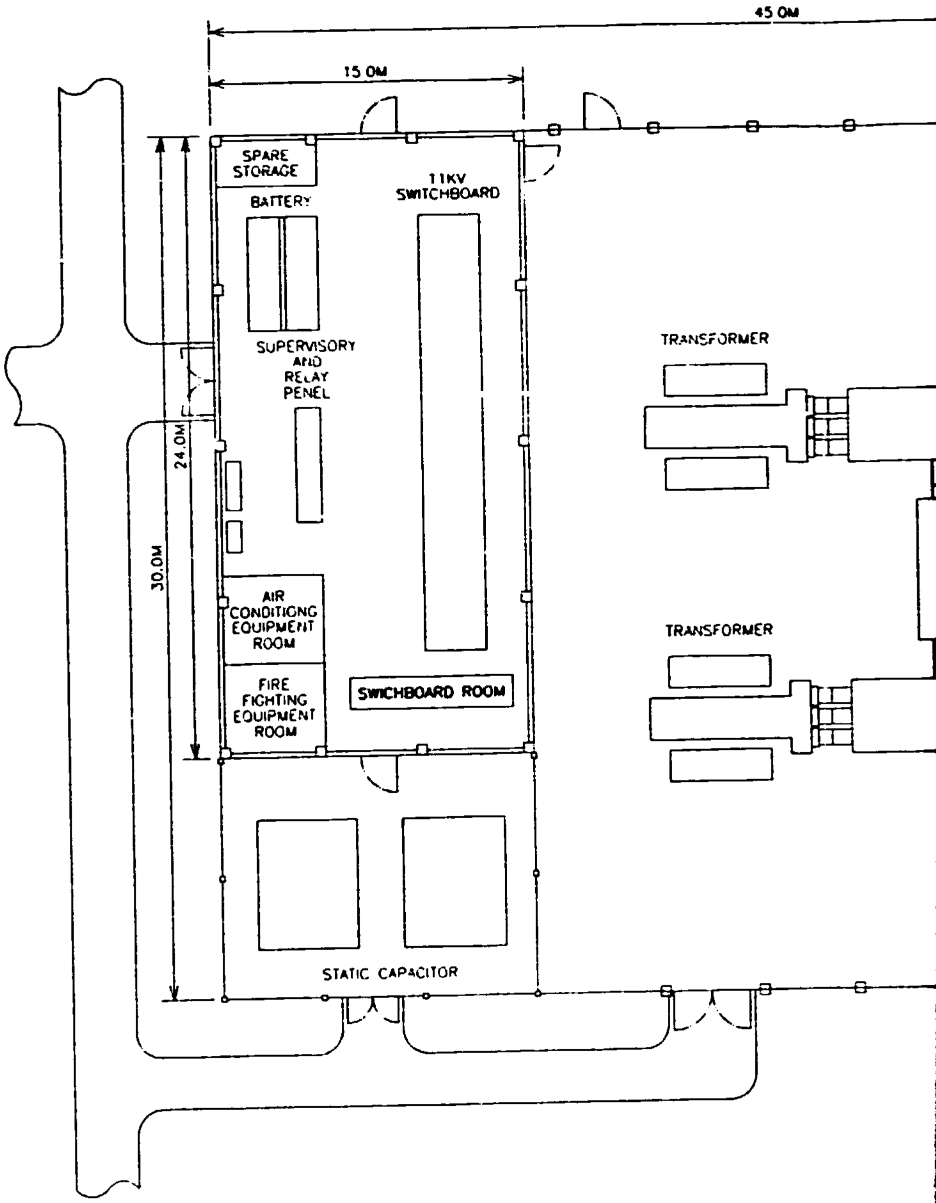
QUANTITY : 1

9. Air Conditioning System

Quantity : One (1) lot

Air conditioning system will be provided for 11 kV switchboard room, part of electric room-1 wherein electronics control equipments are located, electric room-2 and 3, and area for instrumentacion control equipments for electric room-4.

3RD ANGLE PROJECTION



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SECTION 1

REV. NO.	REVISION NOTE			
D		19		
C		19		
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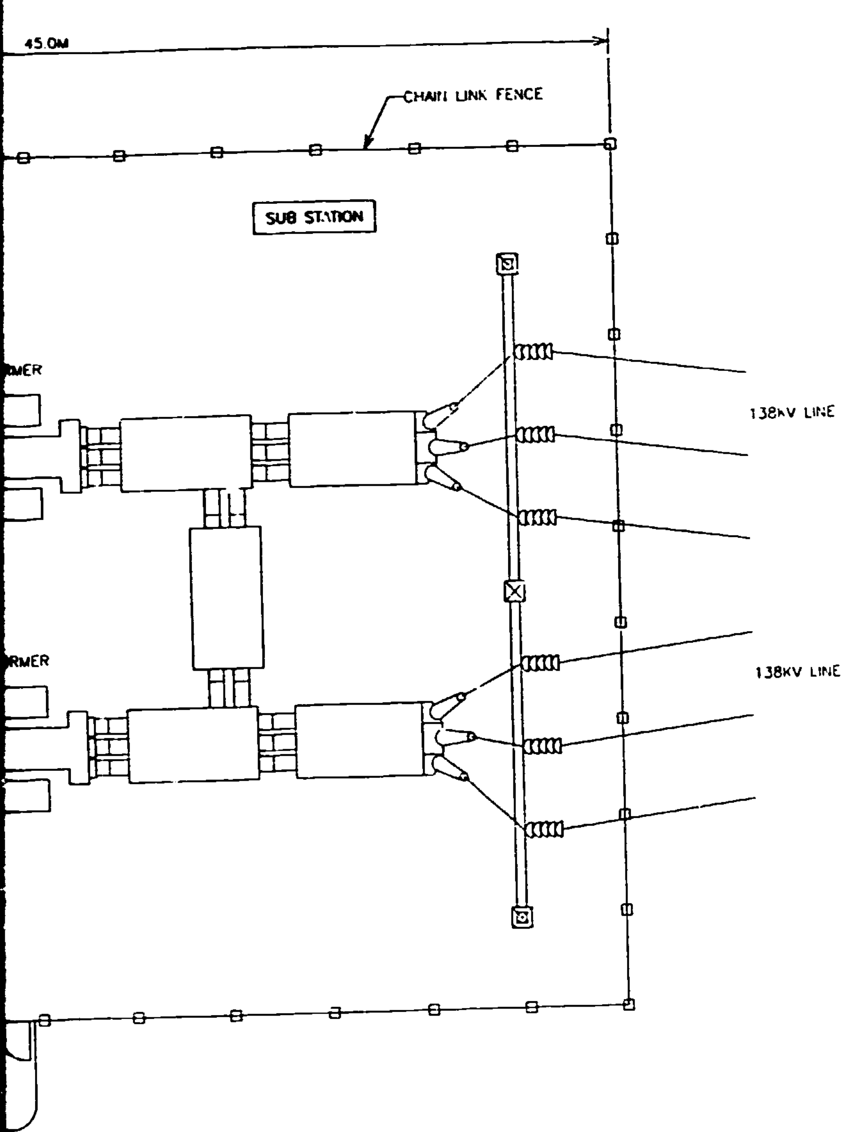

SECTION 2

KOBELCO

KOBE STEEL, LTD.

ENGINEERING & MACHINERY DIVISION

TITLE

138KV SUB · STATION
AND
SWITCHBOARD ROOM
LAYOUT

SCALE: N.T.S

ISSUED BY

NAME 0004-10-lay001

O. NO. 190 600 090

T. NO. 2-

19				
19				
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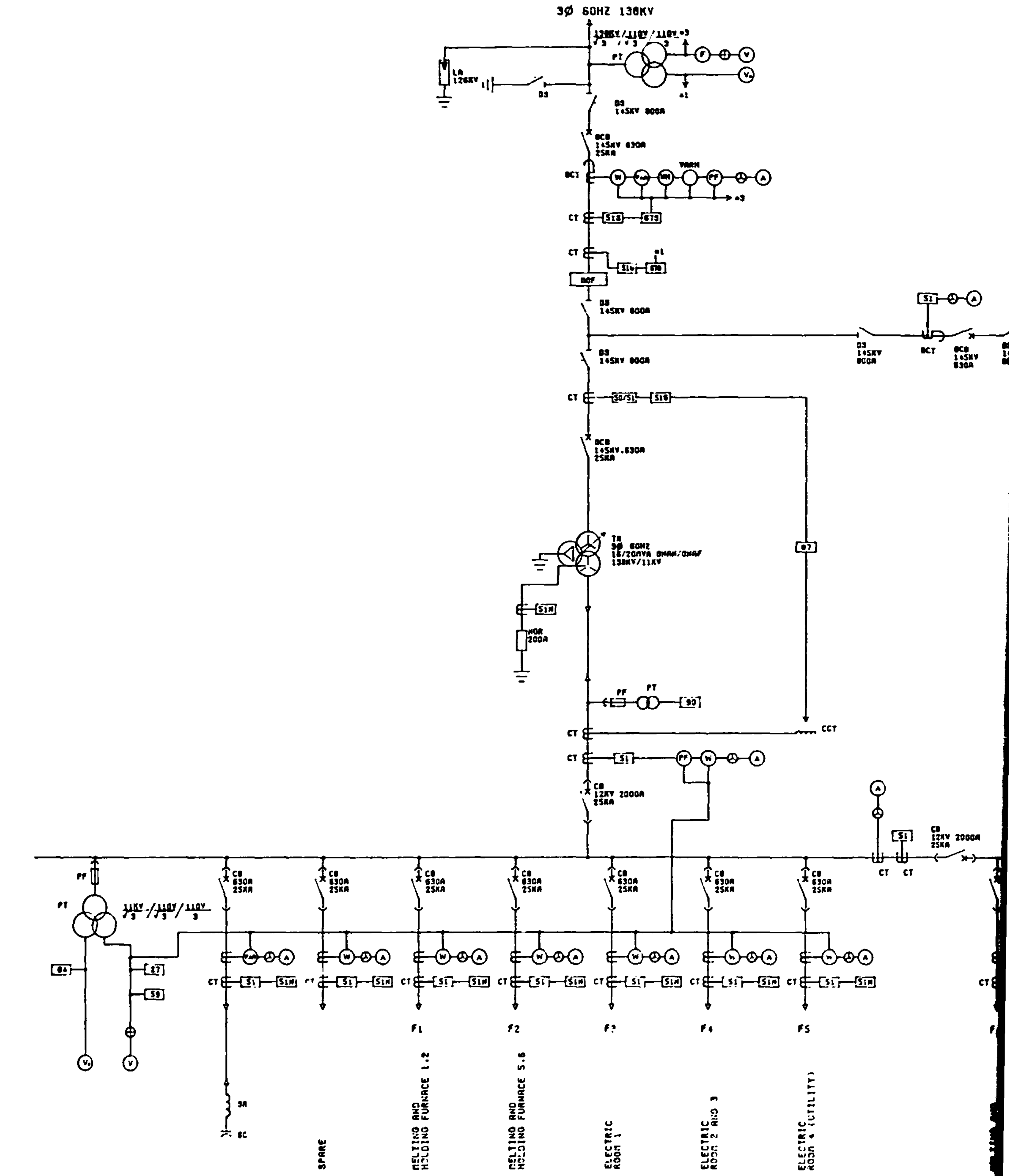
DEC 20 1990				
DESIGNED	CHECKED	APPROVED		REVIEWED
ENGINEERING DEPARTMENT				

JOB NO.	AREA	DRAWING NO.	REV.
X89BRZ	500	DE62-0001	0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LA 126KV
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DS 145KV 800A
BCB 145KV 630A 25KA
BCT
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BOF
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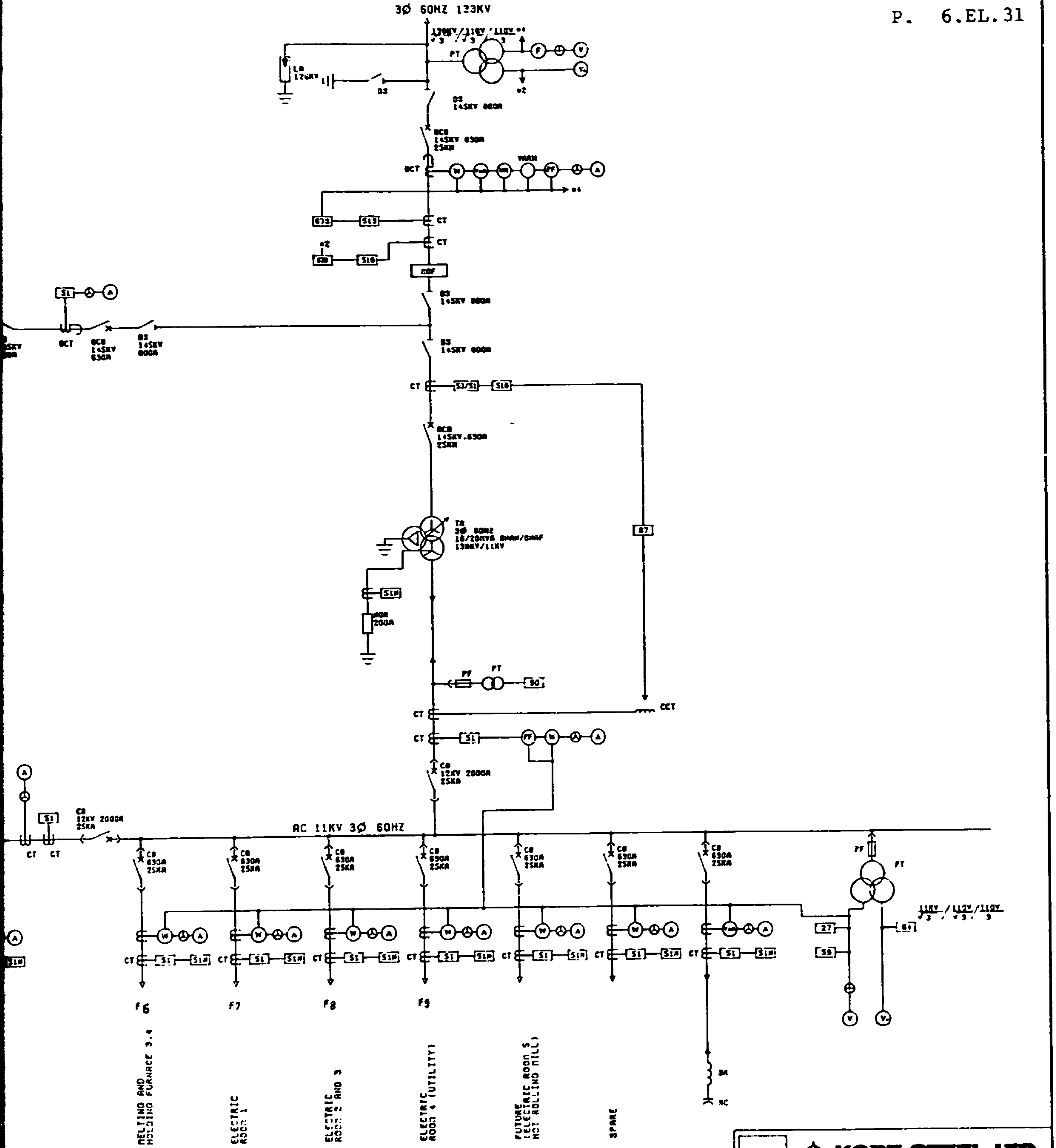
NGR 200A
PF
PT
CCT
CB 12KV 2000A 25KA
CB 630A 25KA
F1
F2
F4
F5
SR
SC
SPARE
MELTING AND HOLDING FURNACE 1.2
MELTING AND HOLDING FURNACE 5.6
ELECTRIC ROOM 1
ELECTRIC ROOM 2 AND 3
ELECTRIC ROOM 4 (UTILITY)

SECTION 1



SECTION 2

KOBE STEEL, LTD.

ENGINEERING & MACHINERY DIVISION

TITLE

SINGLE LINE DIAGRAM (1/3)

REV. NO.	REVISION NOTE	DESIGNED	CHECKED	APPROVED	REVIEWED
		ENGINEERING DEPARTMENT			

SCALE

ISSUED BY

NO. 190600090

JOB NO.	AREA	DRAWING NO.	REV.
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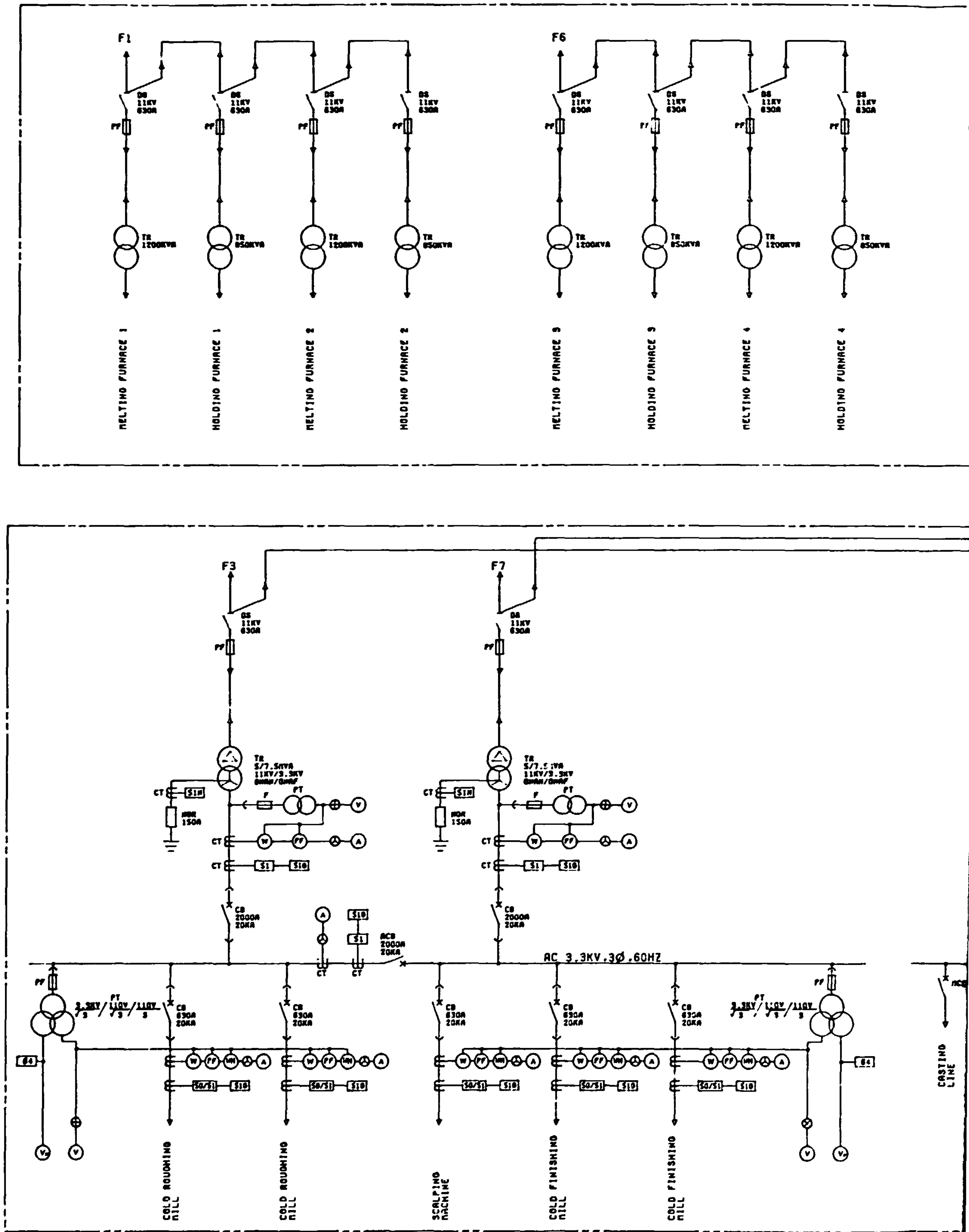
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F6
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PF
TR 1200KVA
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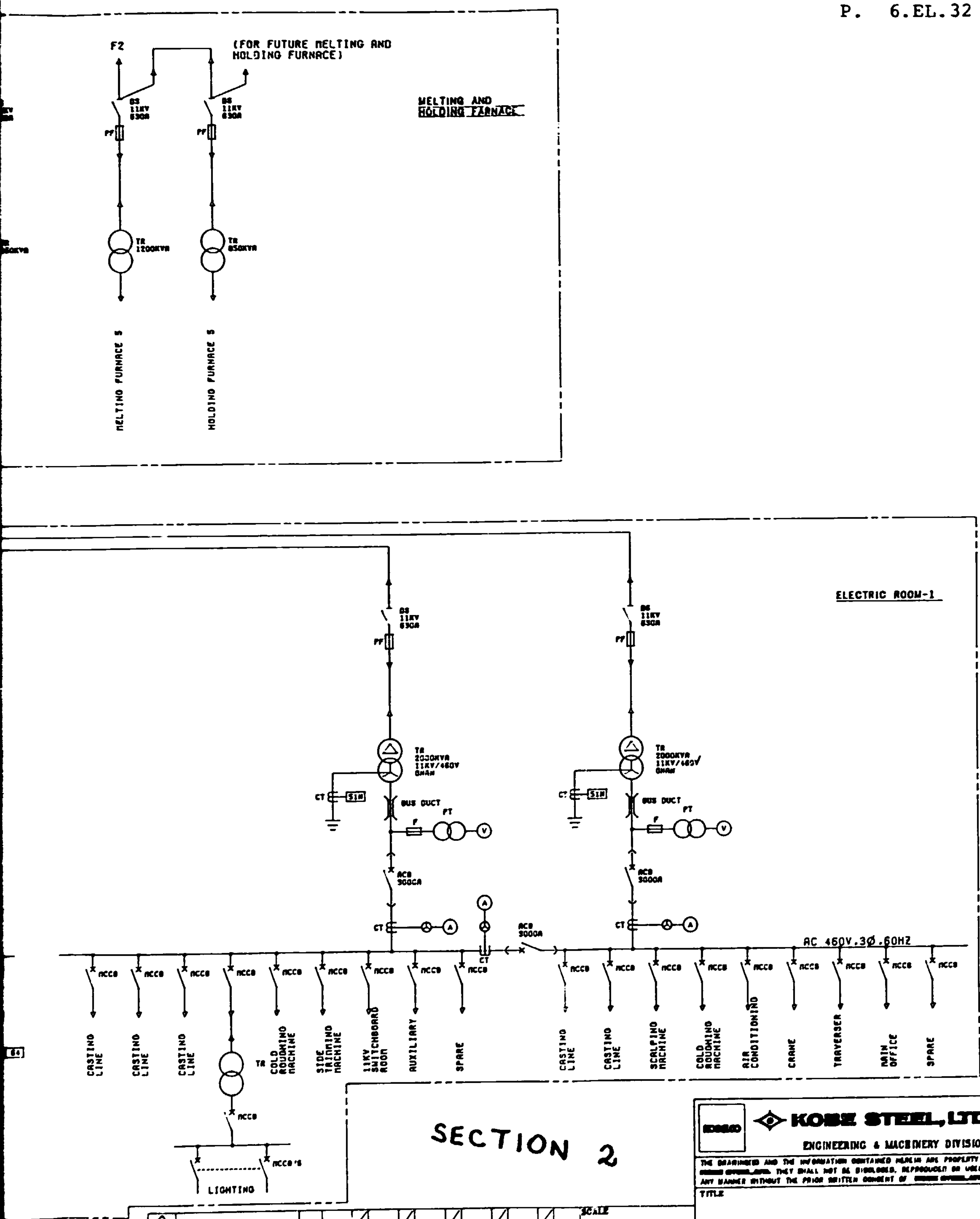
MELTING FURNACE 3
HOLDING FURNACE 3
MELTING FURNACE 4
HOLDING FURNACE 4
F3
F7
CT
NGR 150A
PT
CB 2000A 20KA
ACB 2000A 20KA
AC 3.3KV,3Ø,60HZ
CB 630A 20KA
COLD ROUGHING MILL
SCALPING MACHINE
COLD FINISHING MILL
CASTING LINE

SECTION 1



KOBE STEEL, LTD.
ENGINEERING & MACHINERY DIVISION

◇D		19						
◇C		19						
◇B		19						
◇A		19						
◇0		19						
REV. NO.	REVISION NOTE	DESIGNED	CHECKED	APPROVED			REVIEWED	
		ENGINEERING DEPARTMENT						

SCALE

ISSUED BY

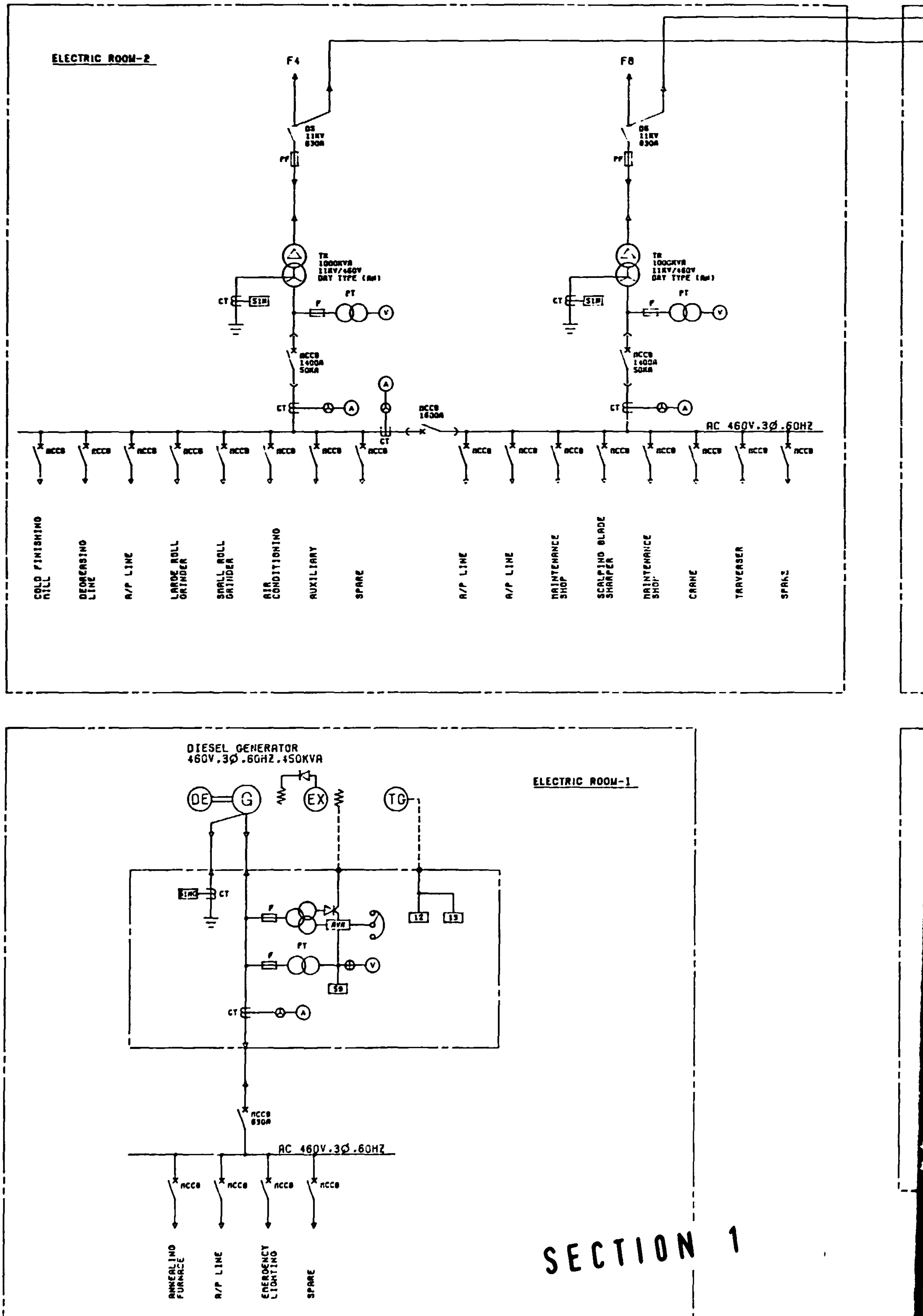
O. NO. 190600090

T. NO. 1-

TITLE

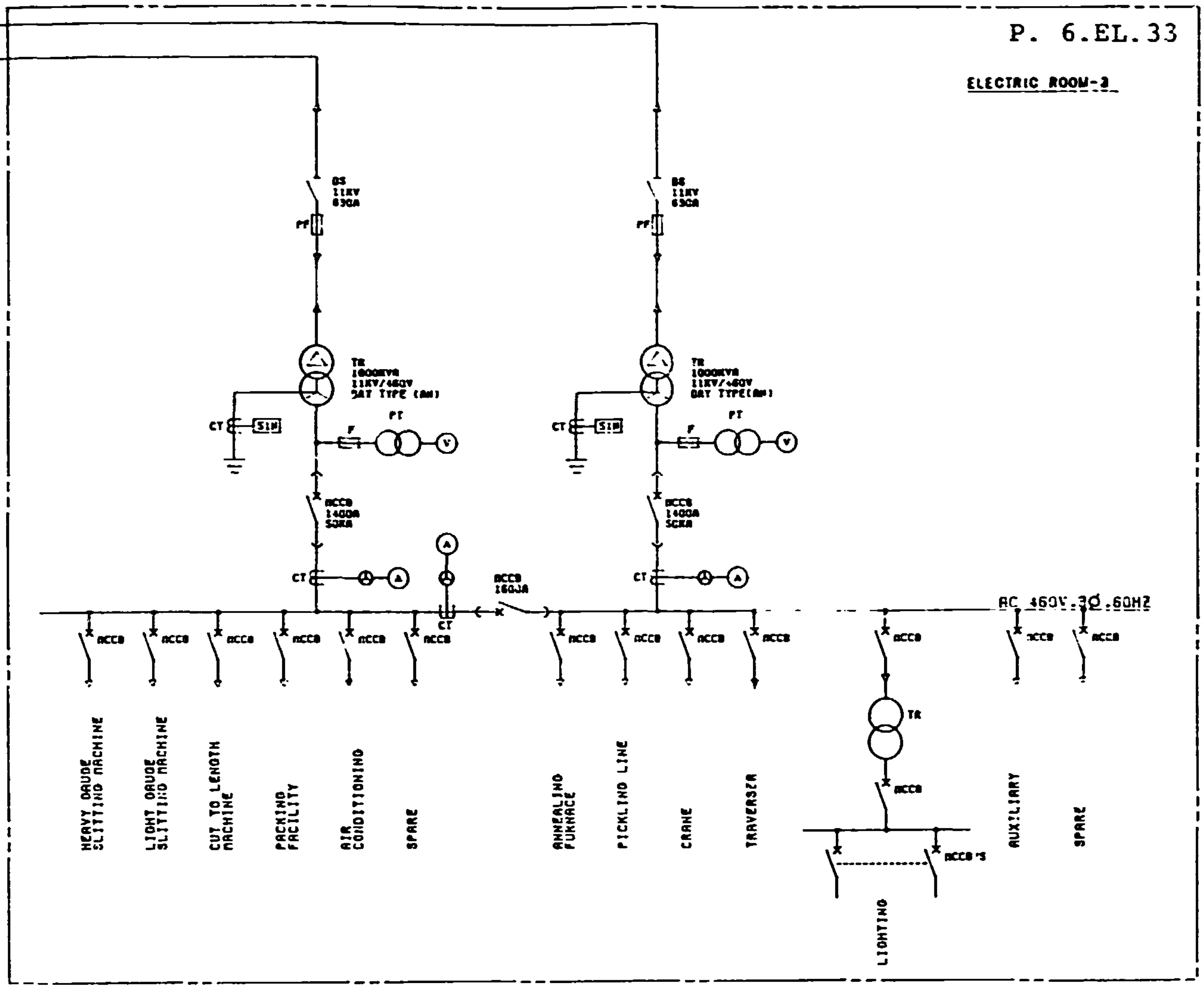
SINGLE LINE DIAGRAM (2/3)

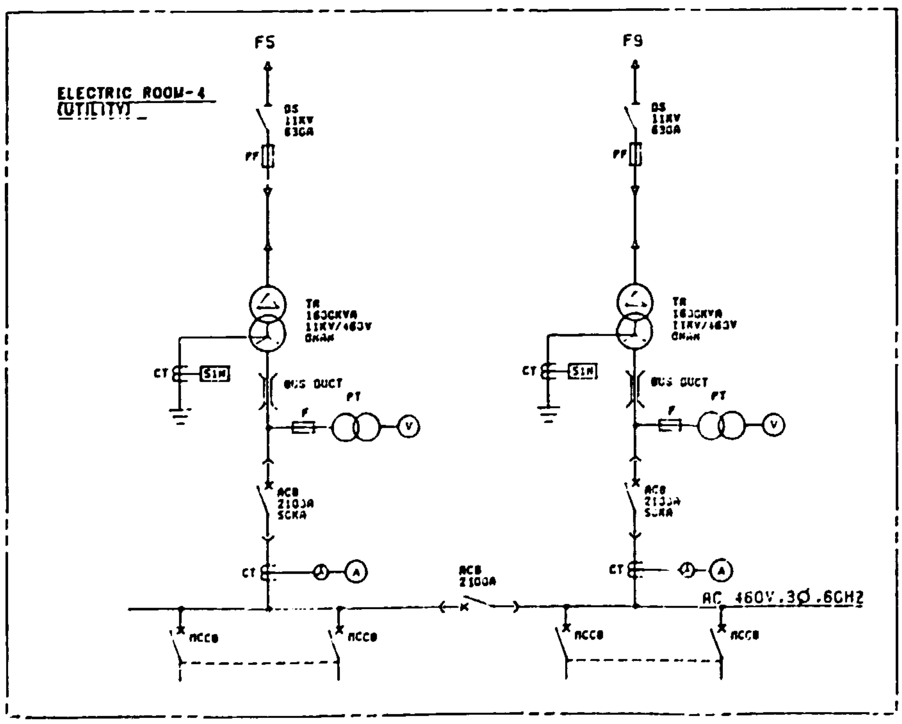
JOB NO.	AREA	DRAWING NO.	REV
X89BRZ	5 0 0	D E 6 1 - 0 0 0 0 2	0



ELECTRIC ROOM-2
F4
F8
DS
11KV
630A
PF
TR
1000KVA
11KV/460V
DRY TYPE (AN)
CT
51N
PT
F
V
ACCB
1400A
50KA
A
ACCB
1600A
AC 460V.3Ø.60HZ
ACCB
COLD FINISHING MILL
DEGREASING LINE
A/P LINE
LARGE ROLL GRINDER
SMALL ROLL GRINDER
AIR CONDITIONING
AUXILIARY
SPARE
A/P LINE
A/P LINE
MAINTENANCE SHOP
SCALPING BLADE SHARPER
MAINTENANCE SHOP
CRANE
TRAVERSER
SPARE
DIESEL GENERATOR
460V.3Ø.60HZ.450KVA
ELECTRIC ROOM-1
DE
G
EX
TG
51G
CT
F
AVR
PT
12
13
59
A
V
ACCB
630A
AC 460V.3Ø.60HZ
ACCB
ANNEALING FURNACE
A/P LINE
EMERGENCY LIGHTING
SPARE

SECTION 1





SECTION 2

KOBE STEEL, LTD.

ENGINEERING & MACHINERY DIVISION

TITLE

SINGLE LINE DIAGRAM (3/3)

REV. NO.	REVISION NOTE	DATE	DESIGNED	CHECKED	APPROVED	REVIEWED
D		19				
C		19				
B		19				
A		19				
0		19				

ENGINEERING DEPARTMENT

SCALE

ISSUED BY

O. NO. 190600090

T. NO. 1-

JOB NO.	AREA	DRAWING NO.	REV.
X89BRZ	6 0 0	D E 5 1 - 0 0 0 0 3	0

SYMBOL	LETTER	DESCRIPTION	SYMBOL	LETTER	DESCRIPTION
	DS ES	DISCONNECTING SWITCH EARTHING SWITCH		PT	POTENTIAL TRANSFORMER WITH GROUND DETECTION SECONDARY
	MC VCS	CONTACTOR, NORMALLY OPEN VACUUM SWITCH		PD	COUPLING CAPACITOR POTENTIAL DEVICE
	CB	CIRCUIT BREAKER (DRAW OUT TYPE)		IM	INDUCTION MOTOR
	GCB CB ACB MCCB HSCB	SF6 GAS CIRCUIT BREAKER CIRCUIT BREAKER AIR CIRCUIT BREAKER MOLDED CASE CIRCUIT BREAKER HIGH-SPEED CIRCUIT BREAKER	 G	DM G	DIRECT CURRENT MOTOR GENERATOR
	PF F	POWER FUSE ENCLOSED FUSE		ACL L	AC REACTOR REACTOR
	PF FS	POWER FUSE ISOLATING FUSE-SWITCH	VD	VD	VOLTAGE DETECTOR
	CH	CABLE HEAD		VR	VARIABLE RESISTOR (DIAL TYPE)
	E	EARTH GROUND	AVR	AVR	AUTOMATIC VOLTAGE REGULATOR
	BD	BUS DUCT	TG	TG	TACHOMETER GENERATOR
	T	POWER TRANSFORMER		RF	RECTIFIER
	PT	POTENTIAL TRANSFORMER	EX	EX	EXCITER
	LA	LIGHTNING ARRESTER	DE	DE	DIESEL ENGINE
	SC	STATIC CAPACITOR (AC)	[12]		OVER-SPEED RELAY
	THY	THYRISTOR	[illegible]		SYNCHRONISM CHECK RELAY
	NGR	NEUTRAL GROUND RESISTOR	[14]		UNDER-SPEED RELAY
	CT	CURRENT TRANSFORMER	[27]		UNDER-VOLTAGE RELAY
	BCT	BUSHING CURRENT TRANSFORMER	[50]		INSTANTANEOUS OVER-CURRENT RELAY
	CCT	COMPENSATIONAL CURRENT TRANSFORMER	[illegible]		INSTANTANEOUS OVER-CURRENT GROUNDING RELAY
	SR	SERIES REACTOR			

SECTION 1

	SYMBOL	LETTER	DESCRIPTION	SYMBOL	LETTER	DESCRIPTION
CONDARY	50G		INSTANTANEOUS OVER-CURRENT GROUNDING RELAY	A	A	AMMETER
TIAL	50S		INSTANTANEOUS OVER-CURRENT SELECTIVE RELAY	V	V	VOLTMETER
	50S		INSTANTANEOUS OVER-CURRENT SELECTIVE RELAY	W	W	WATTMETER
	51		OVER-CURRENT RELAY		VAR	VARMETER
	51G		OVER-CURRENT GROUNDING RELAY	PF	PF	POWER-FACTOR METER
	51N		OVER-CURRENT NEUTRAL RELAY	F	F	FREQUENCY METER
	51NG		OVER-CURRENT NEUTRAL GROUNDING RELAY	V0	V0	ZERO-PHASE VOLTMETER
TYPE I	51S		OVER-CURRENT SELECTIVE RELAY	WH	WH	WATT-HOUR METER
TOR	59		OVER-VOLTAGE RELAY		VARH	VAR-HOUR METER
	64		OVER-VOLTAGE GROUND RELAY		VS	VOLTMETER CHANGE-OVER SWITCH
	67G		DIRECTIONAL OVER-CURRENT GROUND FAULT RELAY		AS	AMMETER CHANGE-OVER SWITCH
	67S		DIRECTIONAL OVER-CURRENT SELECTIVE RELAY	S/A	SA	SURGE ABSORBER
	64		VOLTAGE RELAY	MOF	MOF	METERING OUTFIT
	87		DIFFERENTIAL RELAY			
	90		VOLTAGE REGULTING RELAY			

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ENT

SECTION 2

KOBELCO

KOBE STEEL, LTD.

ENGINEERING & MACHINERY DIVISION

TITLE

GRAPHICAL SYMBOLS FOR SINGLE LINE DIAGRAM

REV. NO.	REVISION NOTE	DESIGNED	CHECKED	APPROVED	REVIEWED
		ENGINEERING	DEPARTMENT		

SCALE

ISSUED BY 7D5

O. NO. 1305000090

P. NO. 1-

JOB NO.	AREA	DRAWING NO.	REV.
X80BRZ	500	DE51-00001	0

ITEM NO. : 601

EQUIPMENT : X-ray Analyzer

SECTION : Laboratory

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Scanning type X-ray fluorescence spectrometer
X-ray power	:	Max. 3 kW
Scanning speed	:	Max. 4°/min
Range of element to be analyzed	:	5B, 6C, 7N, 80 - 92U
Model No.	:	SHIMAZU VF-320A or equivalent

MAJOR COMPONENTS

a) Accessories as per manufacturer's standard

ITEM NO. : 602

EQUIPMENT : Tensile Tester

SECTION : Laboratory

QUANTITY : 1

MAIN SPECIFICATION

Capacity	:	Max. 25,000 kgf
Model No.	:	SHIMAZU AG-25TB or equivalent

MAJOR COMPONENTS

a) Accessories as per manufacturer's standard

ITEM NO. : 603

EQUIPMENT : Vikers Hardness Tester

SECTION : Laboratory

QUANTITY : 2

MAIN SPECIFICATION

Capacity	:	1 - 50 kgf
Test load accuracy	:	$\pm 1\%$
Magnification of microscope	:	100
Model No.	:	AKASHI AVK-AII or equivalent

MAJOR COMPONENTS

a) Accessories as per manufacturer's standard

ITEM NO. : 604

EQUIPMENT : Erichsen Cupping Tester

SECTION : Laboratory

QUANTITY : 1

MAIN SPECIFICATION

Puncking diameter : 20 mm

Material to be tested

Alloy	:	Copper or brass strip
Thickness	:	0.1 - 2.0 mm
Width	:	70 - 90 mm

MAJOR COMPONENTS

a) Accessories as per manufacturer's standard

ITEM NO. : 605

EQUIPMENT : Microscope

SECTION : Laboratory

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Metallurgical invested Binocular type
Magnification	:	5 - 1,000
Illumination	:	Koehler illumination with a halogen lamp
Model No.	:	Olympus PMG-3 or equivalent

MAJOR COMPONENTS

a) Camera

b) Accessories as per manufacturer's standard

ITEM NO. : 606

EQUIPMENT : Sample Polisher

SECTION : Laboratory

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Disk type with polishing paper
Spindle speed	:	240 rpm
Wheel diameter	:	203 mm
Motor	:	1 x AC 0.2 kW

MAJOR COMPONENTS

a) Dryer

b) Accessories as per manufacturer's standard

ITEM NO. : 607

EQUIPMENT : Lapping Machine

SECTION : Laboratory

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Vibration type
Lap diameter	:	230 mm

MAJOR COMPONENTS

a) Accessories as per manufacturer's standard

ITEM NO. : 608

EQUIPMENT : Rolling Oil Tester

SECTION : Laboratory

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Burret titrator with magnet stirrer
Application	:	Titration by karl Fisher's method
Titration water range	:	0 - 30 mg

MAJOR COMPONENTS

a) Water bath

b) Pot furnace

c) Accessories as per manufacturer's standard

ITEM NO. : 701

EQUIPMENT : Truck Scale

SECTION : Other Auxiliary

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Load-cell type
Capacity	:	Max. 30 ton
Accuracy	:	1/3,000
Platform dimension	:	8,000 mm x 3,000 mm

MAJOR COMPONENTS

a) Digital display

b) Printer

ITEM NO. : 702

EQUIPMENT : Fire Car

SECTION : Other Auxiliary

QUANTITY : 1

MAIN SPECIFICATION

Type	:	Diesel engine driven
Water tank	:	3,000 - 4,000 liter
Water pump	:	2,000 lit./min x 50 mAq

MAJOR COMPONENTS

a) Water hose and nozzle

b) Connector to hydrant

c) Foam making facilities

d) Standard accessories

ITEM NO. : 703

EQUIPMENT : Ambulance

SECTION : Other Auxiliary

QUANTITY : 1

MAIN SPECIFICATIO.

Type	:	Diesel engine driven
Engine	:	4,000 cc diesel oil
Seating capacity	:	1 driven and 5 crews

MAJOR COMPONENTS

a) First aid facilities

b) Bed and chairs

c) Water tank (18 lit.)

ITEM NO. : 704

EQUIPMENT : Vehicles

SECTION : Other Auxiliary

QUANTITY : 8

MAJOR COMPONENTS AND SPECIFICATION

(1) 5 ton truck : 2 (diesel engine)

(2) 10 ton truck : 1 (diesel engine)

(3) President car: 1 (3,000 cc)

(4) Staff car : 2 (3,000 cc)

(5) Shuttle bus : 2 (40 passengers)

ITEM NO. : 705

EQUIPMENT : Simple Parts

SECTION : Other Auxiliary

QUANTITY : 1

MAJOR COMPONENTS AND SPECIFICATION

a) Spool : 300 pieces

b) Scrap bag : 300 pieces

c) Tool box : 20 pieces

d) Spare parts rack : 40 sets

e) Coil rack : 350 sets

f) Roll rack : 5 sets

g) Service tools : 1 lot

Schedule 6.1 Estimate of Equipment

Equipment								
						Thousand US$		
No.	Quantity	Item Description	L	F	Unit Cost	Cost		
100		PRODUCTION EQUIPMENT				Foreign	Local	Total
101	5	Melting Furnace		+	1,060	5,300	0	5,300
102	5	Casting Line		+	1,300	6,700	0	6,700
103	1	Scalping Machine		+	3,200	3,200	0	3,200
104	1	Cold Roughing Mill		+	10,300	10,300	0	10,300
105	1	Side Trimming Machine		+	1,800	1,800	0	1,800
106	2	Annealing Furnace		+	1,950	3,900	0	3,900
107	1	Pickling Line		+	2,300	2,300	0	2,300
108	1	Cold Finishing Mill		+	8,100	8,100	0	8,100
109	1	Degreasing Line		+	2,200	2,200	0	2,200
110	1	A/P Line		+	9,300	9,300	0	9,300
111	1	Heavy Gauge Slitting Machine		+	1,800	1,800	0	1,800
112	1	Light Gauge Slitting Machine		+	1,700	1,700	0	1,700
113	1	Cut-to-Length Machine		+	2,000	2,000	0	2,000
114	1	Large Roll Grinder		+	1,200	1,200	0	1,200
115	1	Small Roll Grinder		+	700	700	0	700
116	1	Scalping Blade Sharpener		+	200	200	0	200

Schedule 6.1 Estimate of Equipment

No.	Quantity	Item Description	L	F	Unit Cost	Cost		
150		**(Raw Material Handling)**				Foreign	Local	Total
151	1	Briquette Press		+	1,000	1,000	0	1,000
152	2	Plate Shear		+	200	400	0	400
153	1	Dust Collector		+	300	300	0	300
154	2	Platform Scale		+	50	100	0	100
160		**(Packing Facility)**						
161	2	Platform Scale		+	50	100	0	100
162	5	Coil Tilter		+	24	120	0	120
163	5	Packing Table with Jib Crane		+	20	100	0	100
164	10	Packing Tool		+	4	40	0	40
		Sub-Total (100 - 199)				62,860	0	62,860

Schedule 6.1 Estimate of Equipment

No.	Quantity	Item Description	L	F	Unit Cost	Cost		
200		MAINTENANCE SHOP				Foreign	Local	Total
201	2	Lathe		+	150	300	0	300
202	2	Drilling Machine		+	20	40	0	40
203	1	Shaping Machine		+	0	0	0	0
204	2	Double Head Grinder		+	15	30	0	30
205	1	Metal Cutter		+	20	20	0	20
206	3	Arc Welding Machine		+	3	9	0	9
207	6	Gas Cutting Torch		+	2	12	0	12
207	2	Surface Plate		+	15	30	0	30
		Sub-Total (200 - 299)				441	0	441

Schedule 6.1 Estimate of Equipment

No.	Quantity	Item Description	L	F	Unit Cost	Cost		
						Foreign	Local	Total
300		TRANSPORTATION FACILITY						
301	3	Overhead Crane 10/5 Ton		+	170	500	0	500
302	2	Overhead Crane 10/5 Ton		+	250	500	0	500
303	7	Overhead Crane 5 Ton		+	170	1,200	0	1,200
304	4	Traverser		+	50	200	0	200
305	3	Fork Lift		+	140	410	0	410
Sub-Total (300 - 399)						2,810	0	2,810

Schedule 6.1 Estimate of Equipment

No.	Quantity	Item Description	L	F	Unit Cost	Cost		
						Foreign	Local	Total
400		UTILITY SUPPLY STATION						
401	1	Raw Water Treatment		+	900	900	0	900
402	1	Cooling Tower and Pump		+	700	700	0	700
403	1	Boiler		+	200	200	0	200
404	3	Air Compressor		+	133	400	0	400
405	1	LPG Station		+	600	600	0	600
406	1	Diesel Oil Tank		+	40	36	0	36
410	1	Fire Fighting System		+	600	600	0	600
420	1	Waste Water Treatment System		+	1,300	1,300	0	1,300
Sub-Total (400 - 499)						4,736	0	4,736

Schedule 6.1 Estimate of Equipment

No.	Quantity	Item Description	L	F	Unit Cost	Cost		
500		ELECTRICAL EQUIPMENT				Foreign	Local	Total
501	1	Substation		+	4,600	4,600	0	4,600
502	1	Transformer		+	1,700	1,700	0	1,700
503	1	Electric Room No.1		+	700	700	0	700
504	1	Electric Room No.2		+	700	700	0	700
505	1	Electric Room No.3		+	1,000	1,000	0	1,000
506	1	Lighting System		+	1,000	1,000	0	1,000
507	1	Paging System		+	400	400	0	400
Sub-Total (500 - 599)						10,100	0	10,100

Schedule 6.1 Estimatc of Equipment

No.	Quantity	Item Description	L	F	Unit Cost	Cost		
600		LABORATORY				Foreign	Local	Total
601	1	X-ray Analyzer		+	400	400	0	400
602	1	Tensile Tester		+	200	200	0	200
603	2	Vikers Hardness Tester		+	12	23	0	23
604	1	Ericksen Cupping Tester		+	23	23	0	23
605	1	Microscope		+	23	23	0	23
606	1	Sample Polisher		+	7	7	0	7
607	1	Lapping Machine		+	20	20	0	20
608	1	Rolling Oil Tester		+	18	18	0	18
Sub-Total (600 - 699)						715	0	715

Schedule 6.1 Estimate of Equipment

No.	Quantity	Item Description	L	F	Unit Cost	Cost		
						Foreign	Local	Total
700		**OTHER AUXILIARY**						
701	1	Truck Scale		+	100	100	0	100
702	1	Fire Car		+	100	100	0	100
703	1	Ambulance		+	40	36	0	36
704	8	Vehicles		+	40	300	0	300
705	1	Simple Parts		+	1,800	1,800	0	1,800
		SPARE PARTS						
-	-	Spare Parts for 2 years for items 100 - 799		+	-	7,300	0	7,300
		SHIPPING CHARGES						
-	-	Shipping Charge for items 100 - 799)		+	-	400	0	400
		OCEAN FREIGHT		+	-	1,367	0	1,367
-	-	Ocean freight including marine insurance						
Sub-Total (700 -799)						11,403	0	11,403
Grand-Total (100 - 799)						93,065	0	93,065

Schedule 6.2 Estimate of Equipment required for the expansion

Equipment required for the expansion								
								Thousand US$
No.	Quantity	Item Description	L	F	Unit Cost	Cost		
100		PRODUCTION EQUIPMENT				Foreign	Local	Total
101	1	Melting Furnace		+	1,060	1,060	0	1,060
102	1	Casting Line		+	1,300	1,300	0	1,300
108	1	Cold Finishing Mill		+	8,100	8,100	0	8,100
111	1	Slitting Machine		+	1,800	1,800	0	1,800
-	-	Shipping Charges		+	61	61	0	61
-	-	Ocean Freight including marine insurance		+	232	232	0	232
Total						12,554	0	12,554

6.4 CIVIL ENGINEERING WORKS

According to the site survey and the technical data obtained from PASAR, the proposed area in Isabel are almost levelled and there requires only a little preparation work before starting the civil work for shops and building.

Furthermore the soil bearing capacity of 20 tons/m^2 is quite sufficient to bear the equipment load without any piling work.

Therefore these works are eliminated from the study. Even if some preparation work is required, the work is negligible small in comparison with the main civil and building work under the above circumstances.

Major works and data are summarized in Table 6.5 and the production shop drawing is shown on Fig. 6.5.

The investment cost for the civil and engineering work for the plant with the capacity of 15,000 ton/year and the investment cost required for the expansion programme are shown in the following Schedule 6.3 and 6.4 respectively.

Summary of Civil and Building Works

	Foundation Work Concrete Volume (m3)	Building Structure	Floor Area (m2)	Remark
Production Shops (Foundry, Rolling and Electric Rooms)	For Building : 1900 For Machines : 10500 For Floors : 14700 x 0.2	Steel Structure : 2550 ton Roofing and Cladding : 37000 m2	20640	Crane Rail Height = 9 m
Utility Station	For Machines : 1600 For Floors : 1950 x 0.2	1-story building of RC Structure Area : 988 m2	988	
LPG Station	For Machines : 200 For Floors : 1140 x 0.2	1-story building of RC Structure Area : 300 m2	300	
Substation	For Machines : 500	1-story building of RC Structure Area : 360 m2	360	
Office Buildings (Laboratory, Main Office, Canteen and Gate Complex)	Included in Building	1-story building of RC Structure Area : 4550 m2 (total)	800 + 1400 + 1600 + 750	
Outdoor Works				
1) Road and parking lot	Total area to be paved =	13400 m2		
2) Utility channel /culvert	Total length to be digged =	685 m (2100 m3concrete)		
3) Others	Drainage and sewage pit	(400m2), thrust block for fire main, etc.		

Table 6.5

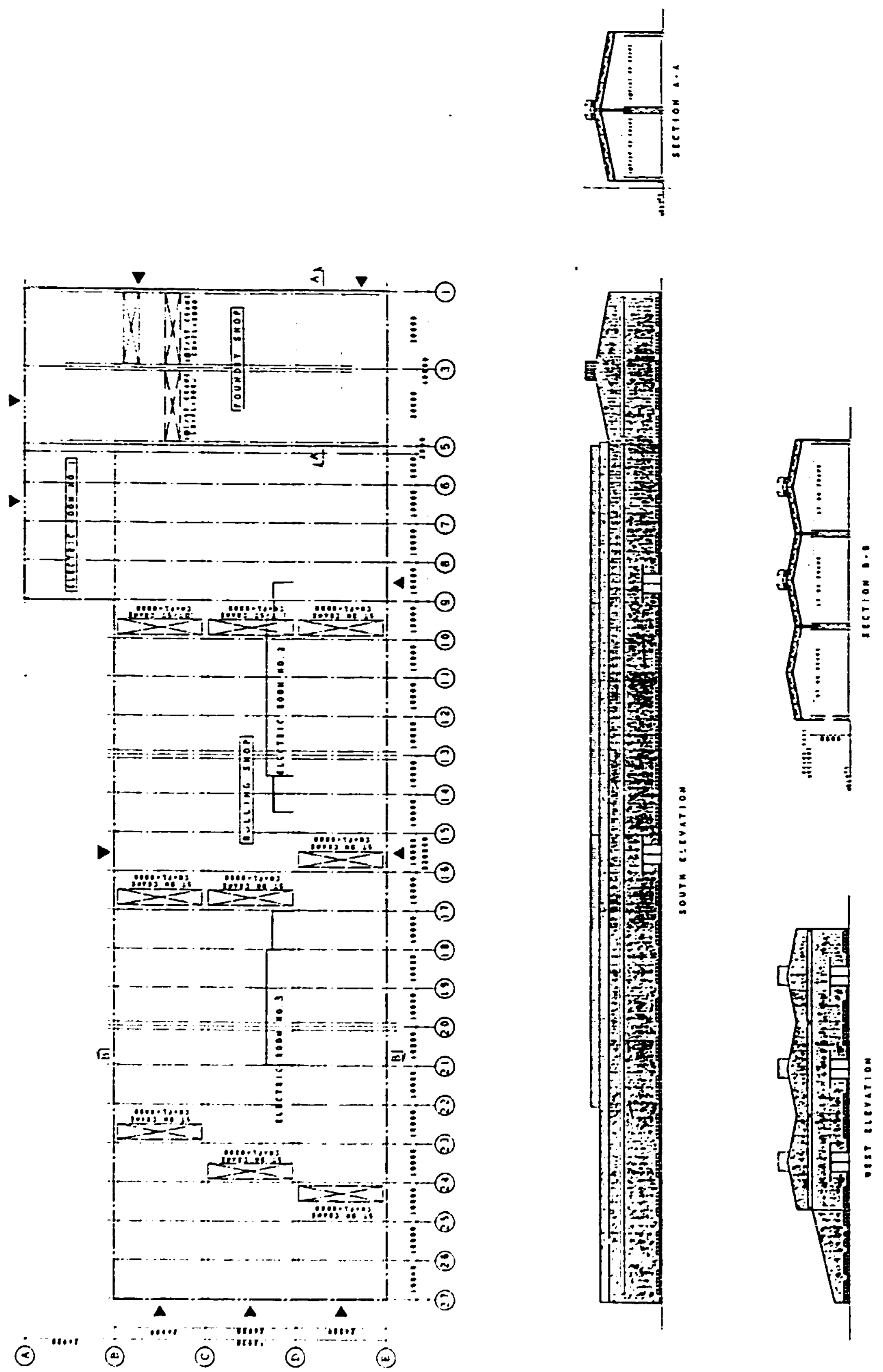

FOUNDRY SHOP
ROLLING SHOP
SOUTH ELEVATION
WEST ELEVATION
SECTION A-A
SECTION B-B

Fig. 6.5

Schedule 6.3. Civil Engineering Works

Civil Engineering Works — Thousand US$

No.	Quantity	Unit	Item Description	L	F	Unit Cost (average)	Cost Foreign	Cost Local	Total
1	2,600	ton	Steel structure	+	+	3.20	6,034	2,275	8,309
2	37,000	m2	Roofing and Cladding	+	+	0.03	859	324	1,182
3	22,000	m3	Concrete	+	+	0.30	4,814	1,815	6,629
4	5,000	m2	RC building	+	+	0.30	1,094	413	1,507
5	13,400	m2	Road pavement	+	+	0.04	400	151	551
6	-	-	Sub-Contractors' fee	+		-	0	14,389	14,389
7	81	M/M	Supervisors for Civil Works	+	+	18.72	1,381	135	1,516
8	-	-	Civil and building drawings		+	-	1,042	0	1,042
9	-	-	Civil survey and preparation		+	-	947	0	947
10	-	-	Miscellaneous for design work		+	-	1,184	0	1,184
			Total				17,756	19,501	37,257

Schedule 6.4. Civil Engineering Works required for the expansion

Civil Engineering Works required for the expansion

Thousand US$

No.	Quantity	Unit	Item Description	L	F	Unit Cost (average)	Cost Foreign	Cost Local	Total
1	442	ton	Steel structure	+	+	3.20	1,026	387	1,413
2	6,290	m2	Roofing and Cladding	+	+	0.03	146	55	201
3	3,740	m3	Concrete	+	+	0.30	818	309	1,127
4	850	m2	RC building	+	+	0.30	186	70	256
5	2,278	m2	Road pavement	+	+	0.04	68	26	94
6	-	-	Sub-Contractors' fee	+		-	0	2,446	2,446
7	14	M/M	Supervisors for Civil Works	+	+	18.72	235	23	258
8	-	-	Civil and building drawings		+	-	177	0	177
9	-	-	Civil survey and preparation		+	-	161	0	161
10	-	-	Miscellaneous for design work		+	-	201	0	201
			Total				3,018	3,315	6,334

7. OVERHEAD COSTS

In this study, following items are counted as overhead costs at the time of full capacity operation (i.e. 18,000 tons per year):

a) Spare Parts

Spare parts required annually including those for periodical shut down for the plant was estimated as 925,000 US dollars.

Almost all of the spare parts are to be imported.

b) Property and Fire Insurance

Insurance premium for building was estimated as 0.3% of the value of the building including its contents and for Warehouse was estimated as 0.2%.

*source: Philippine Insurance Ratings Association

c) Distribution Costs

Distribution costs covering the transport cost of the products from the factory in Isable to Manila port was estimated as 500,000 US dollars equivalent to Peso.

d) Packing Materials for the products

Packing materials such as bundles, special strings etc. for the delivery of the products was estimated 800,000 US dollars.

These materials are planned to be procured locally.

e) Depreciation of Equipment and Machinery

Depreciation for the equipment and machinery was calculated for 10 years on straight line basis, and 25% of salvage value thereafter.

f) Depreciation of Buildings

Depreciation for the building was calculated for 20 years on straight line basis, and 25% of salvage value thereafter.

Office supplies and utilities for the office are not counted since its proportion is negligible small.

8.1 MANPOWER ORGANIZATION

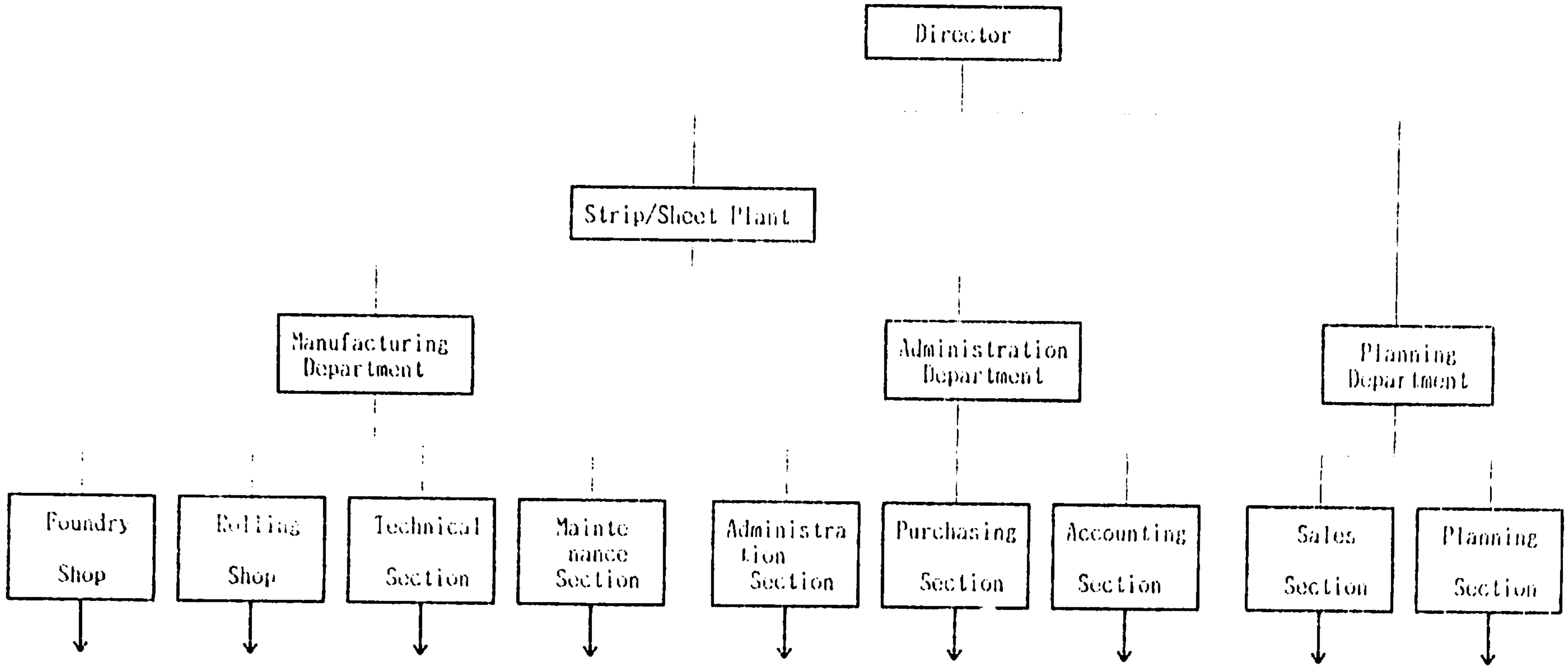
8.1.1 Organization Chart

An Overall manpower organization chart is shown in Fig. 8.1 with details of each shop and section. Total No. of manpower is as follows:

- Managing Director	:	1
- General Manager	:	3
- Section Manager	:	9
- Engineer/Superintendent	:	15
- Office Staff	:	24
- Technician/Labour	:	242
Total	:	294

The required No. of manpower is specified in each organization chart as,

No. of manpower x No. of shift.

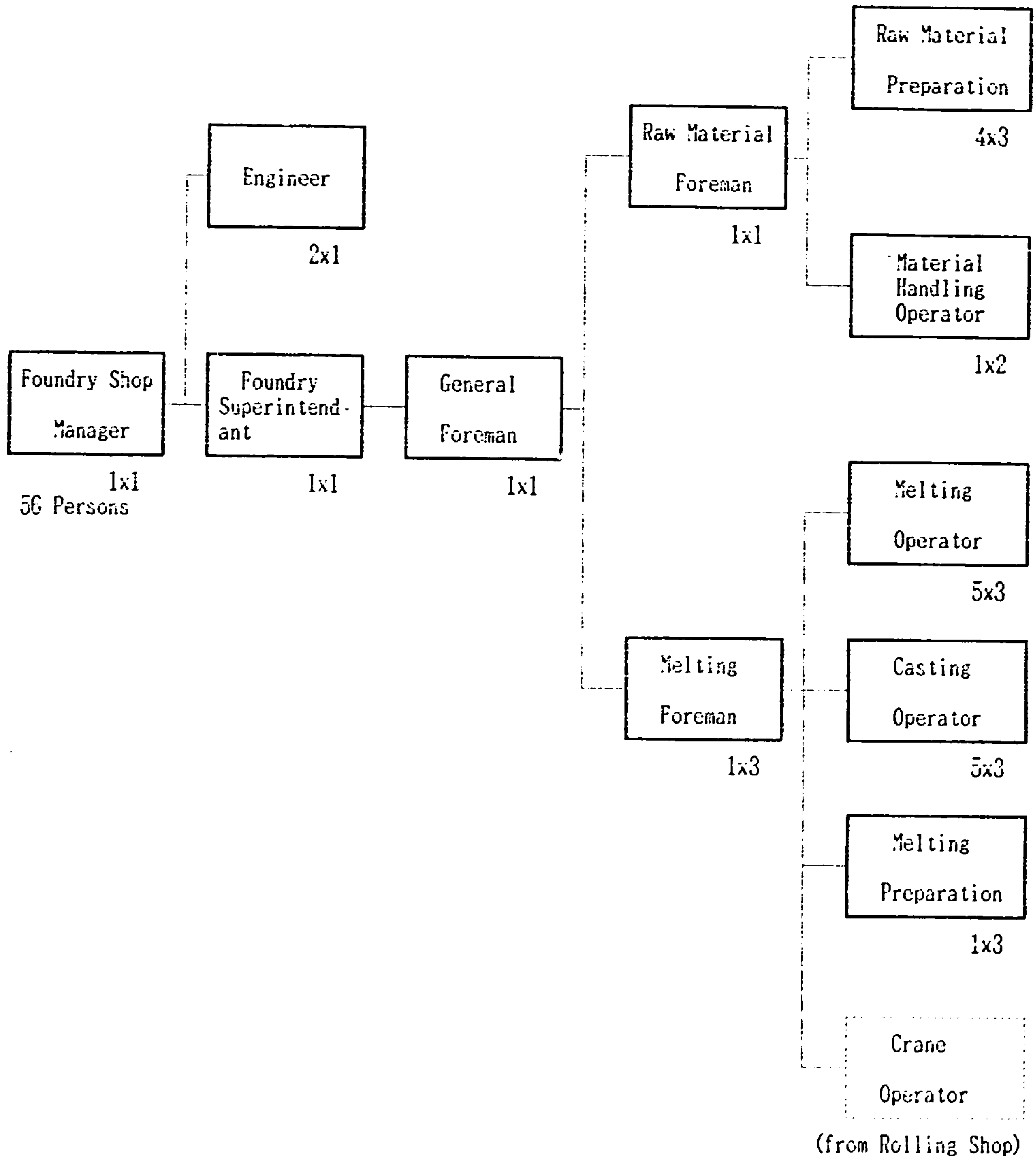


- Organization of each section is shown in the following pages.
- Number of shifts and workers is based on a production ratio of 15,000 Ton/Y.
- Number of Worker

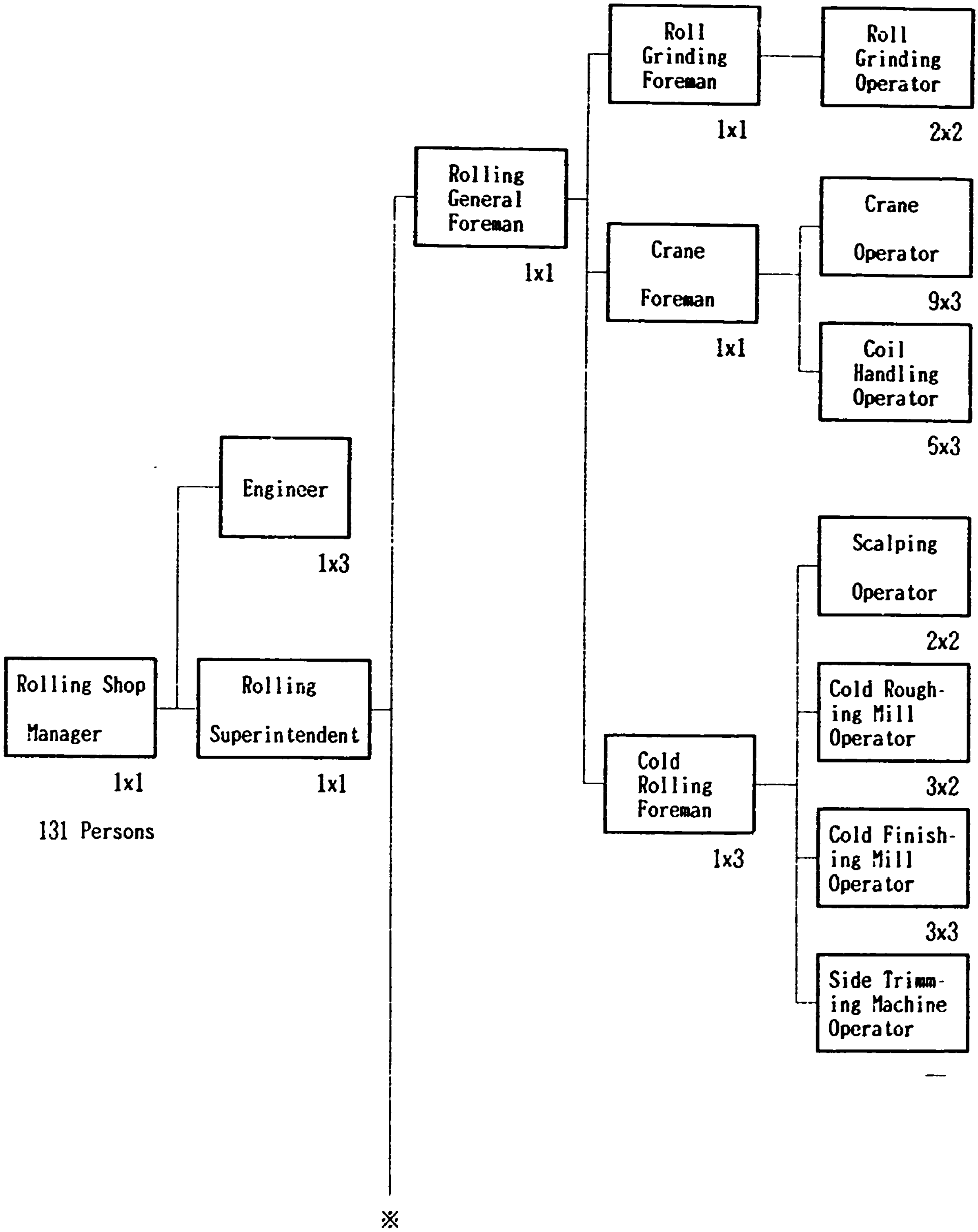
Manager	: 13 Persons	
Engineer	: 15 Persons	(including Superintendents)
Office Staff	: 24 Persons	
Technician	: 242 Persons	

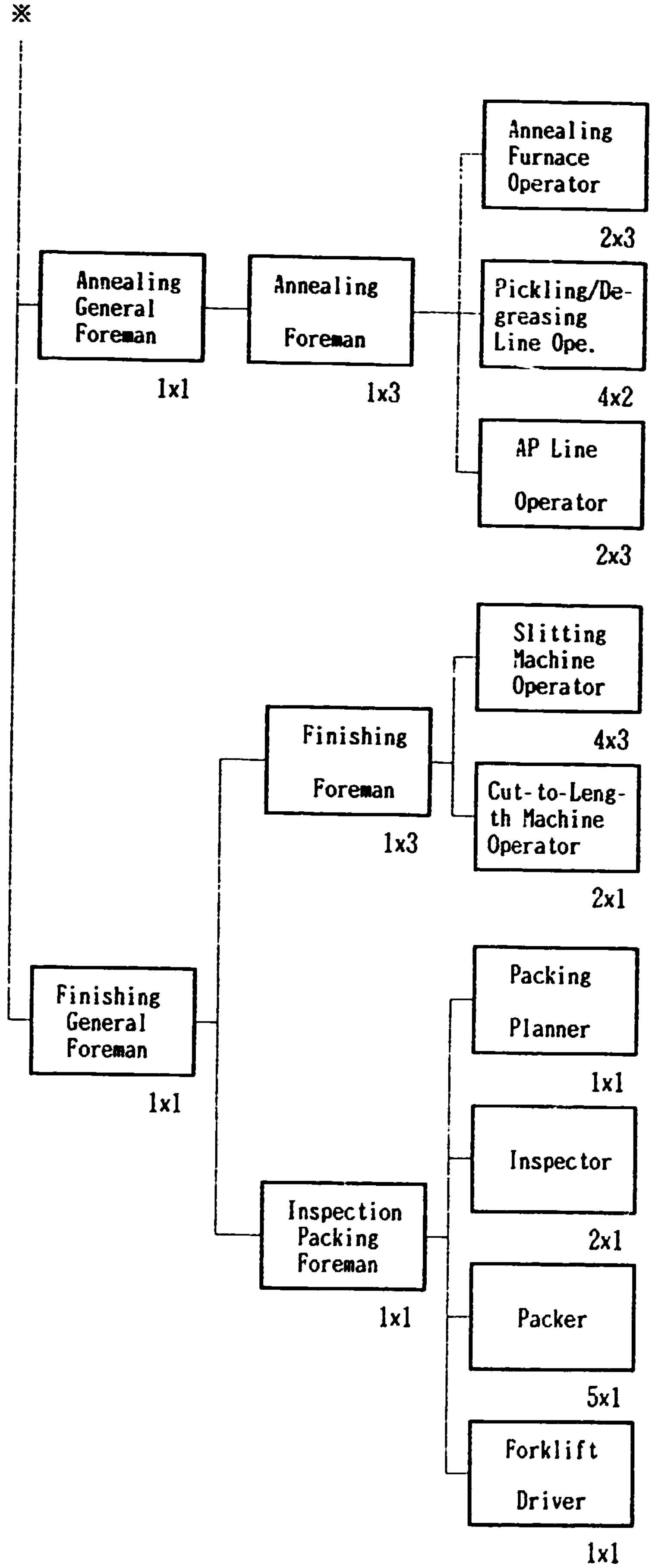
Fig. 8.1 Manpower Organization

(1) Foundry Shop

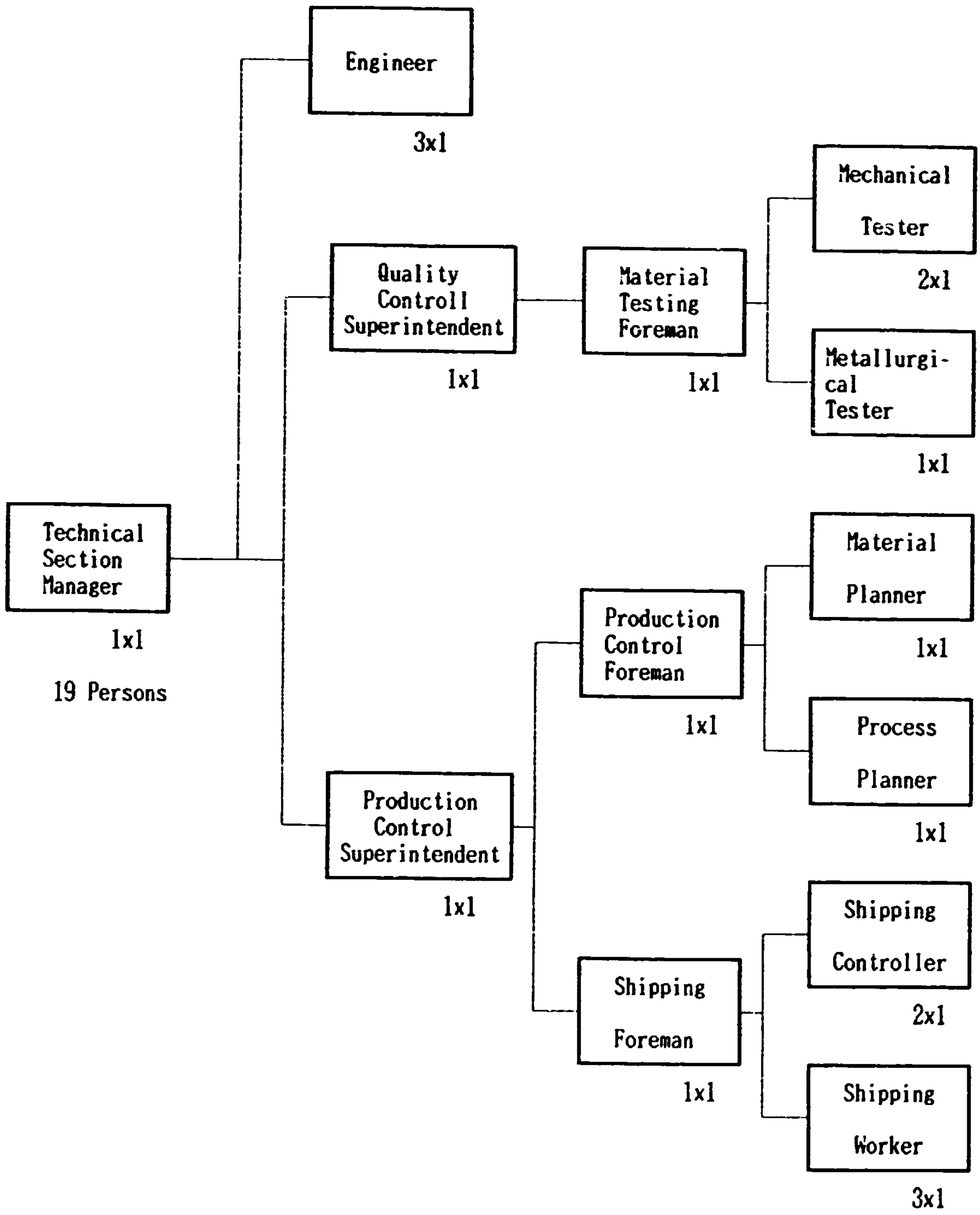


(2) Rolling Shop

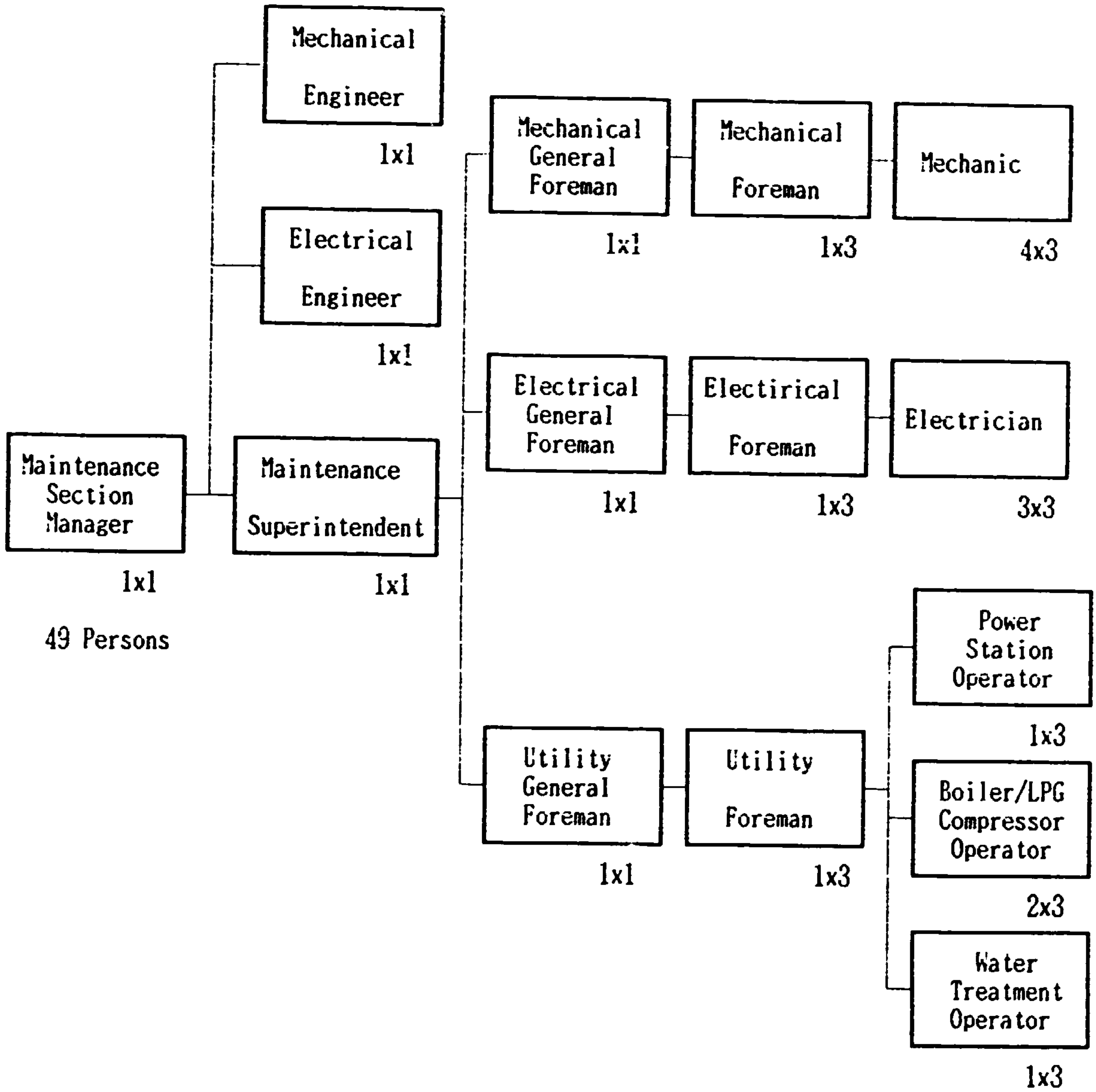



※
Annealing General Foreman
1x1
Annealing Foreman
1x3
Annealing Furnace Operator
2x3
Pickling/De-greasing Line Ope.
4x2
AP Line Operator
2x3
Finishing Foreman
1x3
Slitting Machine Operator
4x3
Cut-to-Length Machine Operator
2x1
Finishing General Foreman
1x1
Inspection Packing Foreman
1x1
Packing Planner
1x1
Inspector
2x1
Packer
5x1
Forklift Driver
1x1

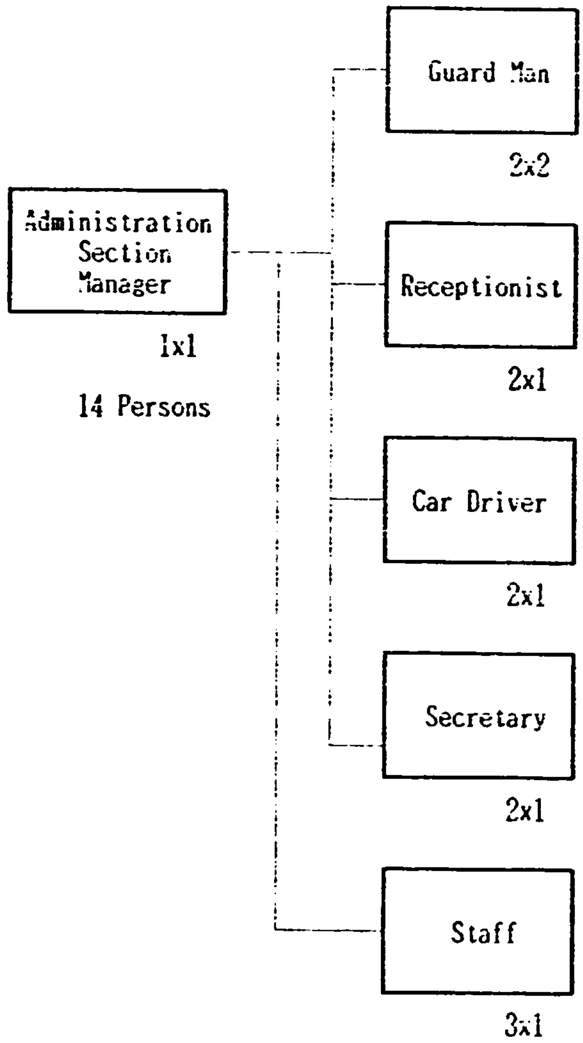
(3) Technical Section



(4) Maintenance Section



⑤ Administration Section



(6) Purchasing Section

Purchasing Section Manager — Staff

1x1 3x1

4 Persons

(7) Accounting Section

Accounting Section Manager — Staff

1x1 3x1

4 Persons

(8) Sales Section

Sales Section Manager — Staff

1x1 8x1

9 Persons

(9) Planning Section

Planning Section Manager — Staff

1x1 3x1

4 Persons

8.1.2 Manning Programme

It is not necessary in general to hire all the required manpower from the start-up year. According to the production programme the plant would be up to 40% capacity in the 1st year and increase by 20% each year until reaching full capacity.

No. of staff and labour can also be gradually increased to meet production amount requirements. Table 8.1 shows the relevant manning programme from the 1st year to the 4th year, when the plant will reach normal production.

The resulting manning programme is used to estimate the annual manpower cost and its variation.

Year	1	2	3	4
Manager Class				
- Managing Director	1	1	1	1
- General Manager	3	3	3	3
- Section Manager	9	9	9	9
Sub-total	13	13	13	13
Engineer/Staff Class				
- Metallurgical Engineer	5	5	5	5
- Mechanical Engineer	3	3	3	3
- Electrical Engineer	1	1	1	1
- Production Engineer	1	1	1	1
- Superintendent	5	5	5	5
- Office Staff	12	16	20	24
Sub-total	27	31	35	39
Labour Class				
- Melting/Casting	36	42	48	52
- Rolling	91	103	115	126
- Technical Section	13	13	13	13
- Maintenance Section	33	37	41	45
- Administration Section	6	6	6	6
Sub-total	179	201	223	242
Total	219	245	271	294

Table 8.1 Manning Programme

8.2 MANPOWER REQUIREMENTS

In the manpower organization chart, basic functions and the related object of each specified section/position are described.

Qualifications or personal requirements for each position can be roughly stated as follows:

(1) Manager Class

- More than 5 years experience as a manager of production plant or equivalent.
- Graduate of college/university or equivalent

(2) Engineer/Staff Class

- Engineer:
  Graduate of technical college/university in the respective field or equivalent
- Staff:
  Graduate of college/university or equivalent
- Superintendent:
  Graduate of technical institute and more than 10 years experience at a production plant or equivalent

(3) Labour

- Foreman:
  Graduate of technical institute and more than 5 years experience at a production plant or equivalent
- Operator:
  More than 3 years experience at a production plant or equivalent

8.2.1 Manpower Requirements for the Foundry Shop

(1) Basic Function

Operation of melting and casting equipment in the Foundry Shop to satisfy production goals and quality guidelines within the budget and the required delivery schedule.

(2) Duty and Responsibility of Each Position

1) Manager

Responsible for the operational management of the Foundry Shop to satisfy production goals and quality guidelines within budget objectives and delivery time.

2) Engineer

Under the direction of the Foundry Shop Manager, plans and adjusts, to improve maintenance and efficiency of all production equipment and processing technology in the Foundry Shop to fulfil production goals, quality, cost and delivery requirements for casted plates within the given guidelines.

3) Superintendent

Under the direction of the Melting Shop Manager, directs his crew to achieve the production goals to the specified quality and cost and within the required delivery time. Plans programs to repair and improve the equipment in the Foundry Shop to prevent unforeseen failures and accidents.

4) General Foreman

Under the direction of the Foundry Shop Superintendent, directs and supervises the Raw Material Foreman and the Melting Foreman. Responsible for raw material control, quality and production goals of melting and casting within the directed delivery time. Secures the safety of his crew, develops on- and off-the-job training and exercises personnel management.

5) Raw material group

a) Raw Material Foreman

Under the direction of the Foundry Shop General Foreman, directs and supervises his crew to receive raw materials and provides materials required for melting furnaces. Directly involved in the above jobs.

b) Raw Material Preparation

Under the direction of Raw Material Foreman, operates briquet press, dryer and plate shear to press and/or dry chips from Scalping Machine, shear copper cathode, etc.

c) Material Handling Operator

Under the direction of the Raw Material Foreman, receives raw materials including scrap. Provides raw materials required for each melting furnace with a crane or forklift.

6) Melting group

a) Melting Foreman

Under the direction of the Foundry Shop General Foreman, directs and supervises his crew to melt copper and copper alloy according to technical standards. Directly involved in the above jobs.

b) Melting Operator

Under the direction of the Melting Foreman, operates the melting furnace to melt copper and copper alloy and charges them into the holding furnace of the casting line. Takes samples and brings them to the laboratory to analyze composition.

c) Casting Operator

Under the direction of the Melting Foreman, operates the casting machine and auxiliary equipment to cast copper and copper alloy plates, inspects and stores them temporarily in the coil stock area at the exit side of Casting Line.

d) Melting Preparation

Under the direction of the Melting Foreman, arranges raw materials for the melting furnace and transfers cast coils to the Scalping Machine.

e) Crane Operator

Refer to the crane operator of the Rolling Shop.

8.2.2 Manpower Requirements for the Rolling Shop

(1) Basic Function

Operation of rolling and finishing equipment in the Rolling Shop to satisfy production goals and quality guidelines within the budget and required delivery schedule.

(2) Duty and Responsibility of Each Position

1) Manager

Responsible for the operational management of the Rolling Shop to meet production goals and quality guidelines within budget objectives and delivery time.

2) Engineer

Under the direction of the Rolling Shop Manager, plans and adjusts, to improve maintenance and efficiency of all production equipment and processing technology in the Rolling Shop to fulfil production goals, quality, cost and delivery requirements for coil and sheet products within the given guidelines.

3) Superintendent

Under the direction of the Rolling Shop Manager, directs his crew to achieve production goals to the specified quality and cost and within the required delivery time. Plans programs to repair and improve the equipment in the Rolling Shop to prevent unforeseen failures and accidents.

4) Rolling group

a) Rolling General Foreman

Under the direction of the Rolling Shop Superintendent, directs and supervises the Cold Rolling Foreman, the Roll Grinding Foreman and the Crane Foreman. Responsible for cold rolling to meet cold coil production goals at the specified quality and consumption rate and within the directed delivery time. Responsible for roll grinding and roll preparation targets and for control of cranes. Secures the safety of his crew, develops on- and off-the-job training programs and exercises personnel management.

b) Rolling Foreman

Under the direction of the Rolling General Foreman, directs and supervises his crew to operate and inspect Cold Roughing Mill, Side Trimming Machine, Cold Finishing Mill and auxiliary equipment. Directly involved in the above job.

c) Scalping Operator

Under the direction of the Rolling Foreman, operates the Scalping Machine. Receives cast coils from the Melting/Casting Shop and scalps coil surfaces and both edges to the specified thickness/width to feed coils into the Cold Roughing Mill. Inspects and maintains the machines, scalping cutters, chip collector, etc.

d) Cold Roughing Mill Operator

Under the direction of the Rolling Foreman, operates the Cold Roughing Mill. Prepares coils in the rolling sequence and rolls them into the size and quality specified in the work order sheet. Inspects and maintains the Cold Roughing Mill equipment allotted to him.

e) Cold Finishing Mill Operator

Under the direction of the Rolling Foreman, operates the Cold Finishing Mill. Prepare coils in the rolling sequence and rolls them into the size and quality specified in the work order sheet. Inspects and maintains the Cold Finishing Mill equipment allotted to him.

f) Side Trimming Machine Operator

Under the direction of the Rolling Foreman, operates the Side Trimming Machine. Trims both sides of the coil into the specified width. Inspects and maintains the Side Trimming Machine allotted to him.

g) Roll Grinding Foreman

Under the direction of the Rolling General Foreman, directs and supervises his crew to operate and inspect the roll grinding machine and roll preparation equipment. Directly involved in the above jobs.

h) <u>Roll Grinding Operator</u>

Under the direction of the Roll Grinding Foreman, grinds various rolls to a specified roll crown and surface finish according to the degree of wear and application. Operates a scalping cutter sharpening device. Records the amount ground, applies rust preventives to rolls, wraps them with rust prevention paper and stores them on the roll rack. Checks cutting oil.

i) <u>Crane Foreman</u>

Under the direction of the Rolling General Foreman, directs and supervises his crew to operate and inspect cranes and auxiliary equipment; handles and moves the coils, specifying the number of coils to be handled, and the existing place and location to be moved to based on the material handling work order sheet.

j) <u>Crane Operator</u>

Under the direction of the Crane Foreman, operates the crane to assist in carrying raw materials, scrap, in-process and finished products, rolls for roll changing in the mills and roll setting on the roll grinder or removing from it and machinery parts to maintain mill shop equipment. Inspects and maintains the crane, slings and auxiliary equipment.

k) Coil Handling Operator

Under the direction of the Crane Foreman, checks the product tag for identification and does necessary hooking in the product yard and stock yard for handling the coils and sheet products. Directs and signals the Crane Operator and delivers the stock to the specified area.

5) Annealing group

a) Annealing General Foreman

Under the direction of the Rolling Superintendent, directs and supervises the Annealing Foreman. Responsible for annealing and pickling line operations to meet specified production goals and quality at the specified consumption rate and within the directed delivery time. Secures the safety of his crew, develops on- and off-the-job training programs and exercises personnel management.

b) Annealing Foreman

Under the direction of the Annealing General Foreman, directs and supervises his crew to operate and inspect the annealing furnace and pickling equipment providing them with production goals, yield, specified quality, etc. Directly involved in the above jobs.

c) Annealing Furnace Operator

Under the direction of the Annealing Foreman, places coils on trays, charges them in the Annealing Furnace and anneals at the stated temperature and duration to obtain the specified mechanical properties of cold rolled coils. Maintains and inspects the Annealing Furnace and auxiliary equipment. Takes charge of the L.P.G. storage facility. Monitors instruments during operation.

d) Pickling/Degreasing Line Operator

Under the direction of the Annealing Foreman, conducts the pickling process of annealed coils, treats them in acid to clean the metal surface of scales and impurities.

Carries out the degreasing process of coils with 1/2 hard or hard temper, treats them in alkali liquid to remove coolant oil on the coil surface. Maintains and inspects pickling/degreasing equipment and acid/alkali solution. Sets the spool on the tension reel, winds the leading end of the coil on the tension reel and monitors the strip surface.

e) AP Line Operator

Under the direction of the Annealing Foreman, carries out the annealing and packing process for cold rolled coils to impart the specified mechanical properties and to clean the coils of scales and impurities. Maintains and inspects the annealing and pickling equipment and acid liquid. Sets the annealing conditions. Records the fuel consumption rate.

6) Finishing group

a) Finishing General Foreman

Under the direction of the Rolling Superintendent, directs and supervises the Finishing Foreman and the Inspection and Packing Foreman.

Responsible for processing coil and sheet products, inspection and packing, to meet production goals and the quality specified, at the specified consumption rate and within the directed delivery time. Secures the safety of his crew, develops on- and off-the-job training programs and exercises personnel management.

b) Finishing Foreman

Under the direction of the Finishing General Foreman, directs and supervises his crew to operate and inspect the Cut-to-Length Machine, the Slitting Machine and auxiliary equipment providing them with the goals, yield, specified quality, delivery date, etc. Directly involved in the above jobs.

c) Slitting Machine Operator

Under the direction of the Finishing Foreman, stationed, one person, at the entry and at the exit of the Slitting Machine. Slits the coils ensuring the specified width and quality. Inspects and maintains the equipment.

Takes samples and brings them to the specified place and registers the material testing number. Prepares coils, spools and the product rack and attaches the tension reel. Disposes of the rejected coil.

d) Cut-to-Length Machine Operator

Under the direction of the Finishing Foreman, operates the Cut-to-Length Machine, one person positioned at the entry and at the exit sides. Cuts the sheets to the specified length in accordance with the finishing work order sheet while checking sheet quality. Inspects and maintains the Cut-to-Length Machine as instructed by the Finishing Foreman.

e) Inspection/Packing Foreman

Under the direction of the Finishing General Foreman, directs and supervises his crew to operate and inspect packing devices and forklift trucks. Determines the packing schedule of coils and sheets in accordance with the packing line work order sheet. Directly involved in the above jobs.

f) Packing Planner

Under the direction of the Inspection/ Packing Foreman, specifies packing style and determines the packing order of coils and sheets and ensures the stated delivery date with the Shipping Foreman. Orders and receives packing materials. Prepares packing specification tables.

g) Inspector

Under the direction of the Inspection/ Packing Foreman, inspects the packing and marking of sheet and coil products ready for shipment, in accordance with the inspection and packing work order sheet. Inspects the packing equipment and slings and samples required for re-inspection. Files material test results.

h) Packer

Under the direction of the Inspection/ Packing Foreman, prepares packing materials, inspects, packs, marks and labels sheet or coil products for shipment in accordance with the inspection and packing work order sheet. Inspects packing equipment and slings.

Transfers packed products to specified areas. Allocates sheet products according to allocation instructions. Records inspection results.

i) Forklift Driver

Under the direction of the Inspection/ Packing Foreman, operates forklift trucks to assist packing work, carrying coils, sheets, packing materials, packed products and scrap. Inspects and maintains forklift trucks.

8.2.3 Manpower Requirements for the Technical Section

(1) Basic Function

1) Production planning (monthly, semi-annually and annually)
2) Designing technical standards, standard processes, etc.
3) Quality assurance
4) Technical services, etc.

(2) Responsibility of Each Position

1) Manager

Responsible for the technical management of the plant for product and process standards, and quality control measures plus outlines the overall planning of the production schedule.

2) Engineer

Under the direction of the Technical Manager and in collaboration with other Engineers in the Manufacturing Department, assists in designing and modifying the plans for rolling procedures and quality control programs and in achieving their objectives through their thorough execution and coordination with all related departments and sections.

3) Production Control Superintendent

Under the direction of the Technical Manager, and in conjunction with his crew, and based on the sales programs of copper, brass and special copper alloy products, determines and supervises the overall production schedule of melting/casting, rolling and finishing to produce and deliver products in the specified form, size and quality and within the stated delivery time.

4) Quality Control Superintendent

Under the direction of the Technical Manager, directs his crew to attain the required quality of finished and intermediate products. Develops quality control programs to guarantee the specified quality of products to customers. Develops new technical standards.

5) Production control group

a) Production Control Foreman

Under the direction of the Production Control Superintendent, and based on sales programs, determines and supervises the overall production schedule of melting/casting, rolling and finishing to produce and deliver products according to specifications within the stated delivery time.

b) <u>Material Planner</u>

Under the direction of the Production Control Foreman, supervises the progress of overall production processes to avoid any delay. Responsible for stocking and allotment of slab and in-process materials.

c) <u>Process Planner</u>

Under the direction of the Production Control Foreman, based on the overall production plan, determines the work schedule of casting, rolling, annealing and finishing. Supervises the progress to ensure the stated delivery date.

d) <u>Shipping Foreman</u>

Under the direction of the Production Control Foreman, directs and supervises his crew to load the packed coils and sheets into the trucks according to the shipping schedule, for transportation to the delivery point. Sorts out the packed products according to their mode of transportation viz. by sea or by road. Directly involved in the above jobs.

e) Shipping Controller

Under the direction of the Shipping Foreman, and based on the sales program determines shipping schedules for coil and sheet products. Issues invoices, checks and follows up shipping deliveries of coil and sheet products to ensure the stated delivery date to customers. Decides and specifies the mode of transportation of products to customers, viz. by sea or by road, based on the customer's order.

f) Shipping Workers

Under the direction and supervision of the Shipping Foreman, checks shipping invoices and loads the packed coils and sheets into the trucks, for proper transportation without damage. Inspects slings and other equipment allotted to him.

6) Quality control group

a) Material Testing Foreman

Under the direction of the Quality Control Superintendent, directs and supervises his crew to hold high accuracy and correctness of material tests and to secure the quality of finished and in-process products.

Secures the safety of his crew and develops on- and off-the-job training programs and exercises personnel management.

b) Mechanical Tester

Under the direction of the Material Testing Foreman, tests mechanical properties and the metal structure of finished and in-process products using testing equipment. Performs daily and monthly inspection of testing equipment.

c) Metallurgical Tester

Under the direction of the Material Testing Foreman, machines samples into test pieces and performs material tests to investigate the cause of defects in faulty products and for developing new products. Analyzes the composition of molten metal before casting into slab. Tests the quality of the oil and chemicals used in the Rolling Shop. Inspects testing equipment daily and monthly.

8.2.4 Manpower Requirements for Maintenance Section

(1) Basic Function

1) General and special maintenance work

2) Planning and execution of equipment modification, erection, etc.

3) Operating utility facilities

(2) Responsibility of Each Position

1) Manager

Responsible for the technical management of the plant including the installation, maintenance, and replacement of plant facilities. Responsible for stable operation of utilities.

2) Mechanical Engineer

Under the direction of the Maintenance Manager and in collaboration with other Engineers of the Technical Department, assists in designing and modifying plans for utilizing mechanical production, equipment, utility and auxiliary equipment including cranes, and in achieving their objectives through their thorough execution, and coordination with all related departments and sections.

3) Electrical Engineer

Under the direction of the Maintenance Manager and in collaboration with other Engineers of the Technical Department, assists in designing and modifying plans for utilizing electrical production, equipment, utility and auxiliary equipment including cranes, and in achieving their objectives through thorough execution, and coordination with all related departments and sections.

4) Maintenance Superintendent

Under the direction of the Technical Manager, directs the installation and maintenance of all equipment and utilities to achieve production goals of specified quality and price and within the required delivery time. Approves preventive maintenance programs.

5) Mechanical group

a) Mechanical General Foreman

Under the direction of the Maintenance Superintendent, directs and supervises the Maintenance Foreman. Responsible for the achievement of satisfactory inspection and maintenance of machinery to secure stable operation of production equipment and auxiliary equipment. Secures safety of his crew, reduces cost, develops on- and off-the-job training program and exercises personnel management.

b) Mechanical Foreman

Under the direction of the Mechanical General Foreman, directs and supervises his crew to inspect and repair all the plant mechanical equipment, including cranes and forklift trucks. Directly involved in the above task to secure stable operation.

c) Mechanic

Under the direction of the Mechanical Foreman, repairs and inspects all machinery in the plant including cranes and forklift trucks to achieve stable operation of production equipment.

6) Electrical group

a) Electrical General Foreman

Under the direction of the Maintenance Superintendent, directs and supervises the Electrical Foreman. Responsible for achieving satisfactory inspection and maintenance of electrical equipment, instruments of production, utility equipment including computer systems, auxiliary equipment, and cranes. Secures the safety of his crew, develops on- and off-the-job training programs and exercises personnel management.

b) Electrical Foreman

Under the direction of the Electrical General Foreman, directs and supervises his crew to inspect and repair electrical equipment and instruments including computer system, power sub-station and cranes. Directly involved in the above jobs.

c) Electrician

Under the direction of the Electrical Foreman, inspects and maintains electrical equipment and melting furnace instruments, casting lines, hot and cold rolling mills, finishing and annealing lines, the roll grinding shop, utilities, the computer system, the power sub-station, and cranes as specified by the Electrical Foreman.

7) Utility group

a) Utility General Foreman

Under the direction of the Maintenance Superintendent, directs and supervises the Utility Foreman. Responsible for the smooth operation of the power station, boiler, air-compressor, gas station, waste-water treatment and raw-water treatment. Secures the safety of his crew, develops on- and off-the-job training programs and exercises personnel management.

b) Utility Foreman

Under the direction of the Utility General Foreman, directs and supervises his crew to operate utility facilities. Records the consumption of electricity, steam, gas and water and reports this to the Maintenance Superintendent. Directly involved in the above jobs.

c) Power Station Operator

Under the direction of the Utility Foreman, controls and adjusts the power station in order to supply stable electrical power to the whole plant.

d) LPG/Boiler/Air-Compressor Operator

Under the direction of the Utility Foreman, operates the LPG station boiler and air-compressor in order to supply LPG, steam and compressed air to the plant. In charge of the gas station.

e) Water Treatment Operator

Under the direction of the Utility Foreman, operates raw-water treatment to supply industrial water and potable water, and waste-water treatment to prevent the discharge of harmful matter into the river or sea.

8.2.5 Manpower Requirements for Other Sections

(1) Administration Section

- Labour management in the plant
- Welfare for plant workers
- Receptionist and secretary
- Security guard
- Car driver
- Other general affairs

(2) Purchasing Section

- Purchasing of raw materials
- Purchasing of consumables
- Purchasing of spare parts

(3) Accounting Section

- Budget control
- Cost control
- Paying and receiving cash

(4) Sales Section

- Domestic sales activities
- Sales activities for exports
- Planning of monthly fiscal term and long term production figures
- Coordination between the factory and customers

(5) Planning Section

- Personnel management including employment
- Drafting the fiscal term and long term management policy

8.3 TRAINING PROGRAMME

Before starting the hot-run or commissioning the equipment, the Owner's personnel should be well-trained and be familiarized with the manufacturing process and equipment/machines to be operated.
For this purpose relevant training of the Owner's personnel should be planned and carried out through off-site and/or on-the-job training courses.

The basic training course/schedule is described in this chapter, this is recommended for some key personnel among the manpower organization shown in the section 8.1.

It should be noted that training for the manager/ engineer class is also important as well as for foreman/operator, because well-established management in production planning, quality control, etc. is indispensable for meeting the various requirements of production. Each manager and engineer should be experienced and become familiar with the process and equipment of the plant through training courses and O.J.T.

8.3.1 The Basic Training Course

(1) Manager Class (1 month)

a) Introduction and orientation

b) Introduction to production processes and equipment

c) Management system

- Organization
- Reporting and decision-making
- Personnel management

d) Lectures and observations on plant operation

- Melting and casting/scalping
- Cold rolling
- Annealing and pickling
- Finishing (cutting and slitting)
- Packing and shipping

e) The production control system

- Introduction and familiarization

f) The quality control system

- Introduction and familiarization

g) Executive program on corporate management

- Management philosoply
- Production policy
- Labour relations
- Case studies in decision making/trouble shooting
- Total quality control
- Study tours, etc.

(2) Engineer Class (3 months)

a) Introduction and orientation

b) Production processes and equipment

- Melting/casting process
- Rolling process
- Annealing/pickling process
- Finishing process
- Packing/shipping process

c) Outline of the production control system

d) Outline of the quality control system

e) Storage and spare parts control

f) Detailed study on the construction and function of each piece of equipment

g) Operation and maintenance procedures

h) Observation of operating plant including some training

(3) Foreman/Operator Class (3 months)

a) Introduction and orientation

b) Basis of process and equipment

c) Construction and function of all equipment

d) Operation and maintenance procedures with important check points

e) Safety measures

f) Observation of machines in operation

g) Actual working/operating training at the operating plant

8.3.2 Training Schedule

The proposed training schedule in Fig. 8.2 is for off-site training to be carried out at an operating plant using similar processes and equipment.

Off-site training service is normally provided by a know-how supplier and separately contracted between the owner and the supplier on a man-month basis. That has been adopted for cost estimation in this study.

In addition to off-site training, on-the-job training is carried out during cold-run, hot-run and commissioning periods on site.

TRAINING SCHEDULE

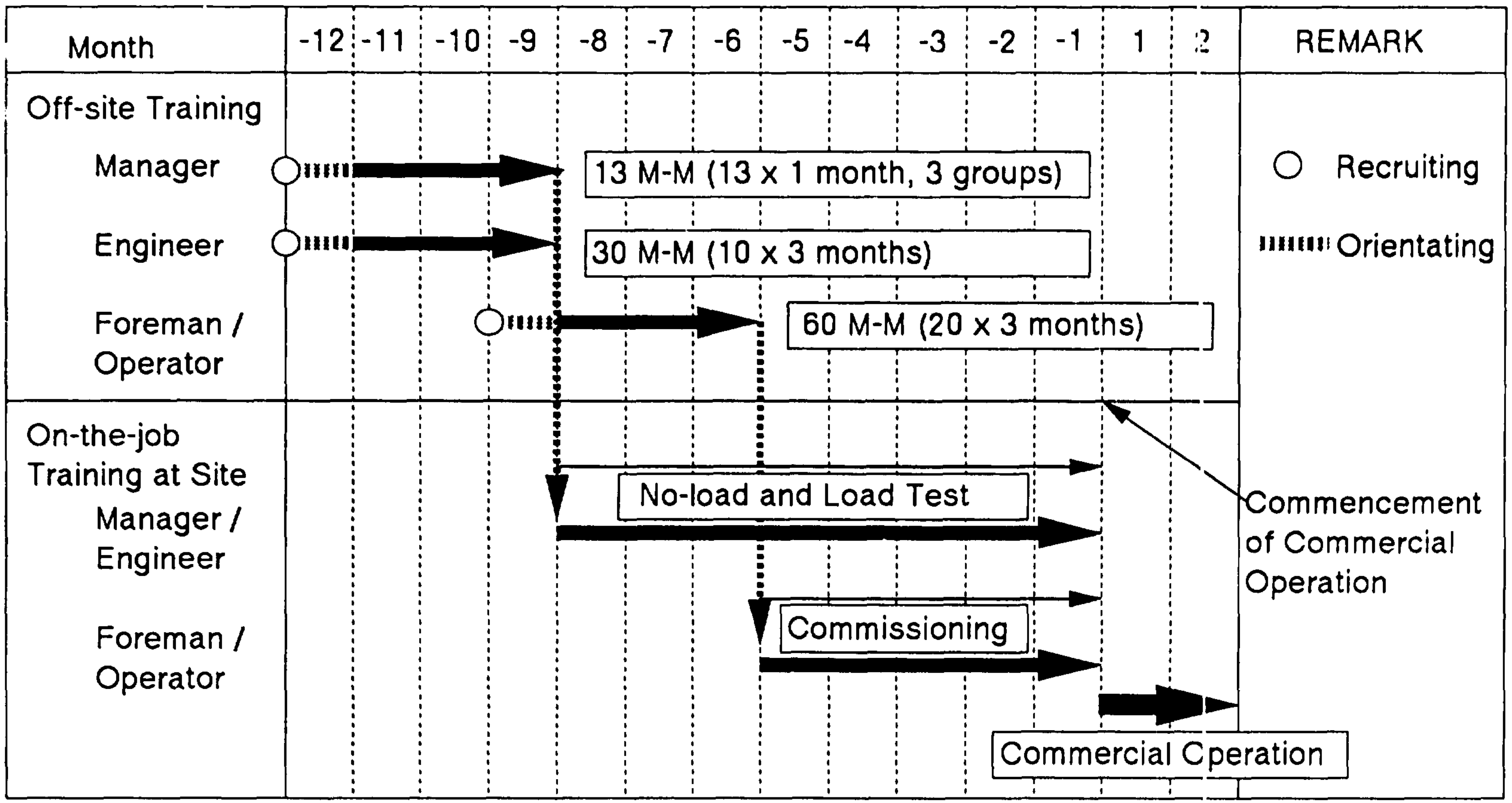


Fig. 8.2

8.4 COST ESTIMATE

Schedule 8.1. Wages

Schedule 8.1 Wages												US $
Year 1												
		Variable Costs - Wages categories					Fixed Costs - Wages categories					
		(No. of workers)					(No. of workers)					
No.	Category	Foreign	Local	Foreign	Local	Sub-total	Foreign	Local	Foreign	Local	Sub-total	Total
1	Melting & Casting Shop	0	36	0	74,250	74,250	0	0	0	0	0	74,250
2	Rolling Shop	0	91	0	187,688	187,688	0	0	0	0	0	187,688
3	Technical Section	0	13	0	26,813	26,813	0	0	0	0	0	26,813
4	Maintenance Section	0	33	0	68,063	68,063	0	0	0	0	0	68,063
5	Administration Section	0	0	0	0	0	0	6	0	12,375	12,375	12,375
	TOTAL	0	173	0	356,813	356,813	0	6	0	12,375	12,375	369,188
	Working hours per day	-	8				-	8				
	Working days per year	-	275				-	275				
	Hours per year	-	2,200				-	2,200				
	Wages per hour	-	0.75				-	0.75				
	Surcharge (%)	-	*25%				-	*25%				
	Wages per year	-	2,063				-	2,063				

* including overtime charges, social security insurance and medicare

Schedule 8.1. Wages

Schedule 8.1 Wages												US $
Year 2												
		Variable Costs - Wages categories					Fixed Costs - Wages categories					
		(No. of workers)					(No. of workers)					
No.	Category	Foreign	Local	Foreign	Local	Sub-total	Foreign	Local	Foreign	Local	Sub-total	Total
1	Melting & Casting Shop	0	42	0	86,625	86,625	0	0	0	0	0	86,625
2	Rolling Shop	0	103	0	212,438	212,438	0	0	0	0	0	212,438
3	Technical Section	0	13	0	26,813	26,813	0	0	0	0	0	26,813
4	Maintenance Section	0	37	0	76,313	76,313	0	0	0	0	0	76,313
5	Administration Section	0	0	0	0	0	0	6	0	12,375	12,375	12,375
	TOTAL	0	195	0	402,188	402,188	0	6	0	12,375	12,375	414,563

	Variable: Foreign	Variable: Local	Fixed: Foreign	Fixed: Local
Working hours per day	-	8	-	8
Working days per year	-	275	-	275
Hours per year	-	2,200	-	2,200
Wages per hour	-	0.75	-	0.75
Surcharge (%)	-	*25%	-	*25%
Wages per year	-	2,063	-	2,063

*including overtime charge, social security insurance and medicare fees

Schedule 8.1. Wages

Schedule 8.1 Wages												US $
Year 3												
		Variable Costs - Wages categories					Fixed Costs - Wages categories					
		(No. of workers)					(No. of workers)					
No.	Category	Foreign	Local	Foreign	Local	Sub-total	Foreign	Local	Foreign	Local	Sub-total	Total
1	Melting & Casting Shop	0	48	0	99,000	99,000	0	0	0	0	0	99,000
2	Rolling Shop	0	115	0	237,188	237,188	0	0	0	0	0	237,188
3	Technical Section	0	13	0	26,813	26,813	0	0	0	0	0	26,813
4	Maintenance Section	0	41	0	84,563	84,563	0	0	0	0	0	84,563
5	Administration Section	0	0	0	0	0	0	6	0	12,375	12,375	12,375
	TOTAL	0	217	0	447,563	447,563	0	6	0	12,375	12,375	459,938
	Working hours per day	-	8				-	8				
	Working days per year	-	275				-	275				
	Hours per year	-	2,200				-	2,200				
	Wages per hour	-	0.75				-	0.75				
	Surcharge (%)	-	*25%				-	*25%				
	Wages per year	-	2,063				-	2,063				

*including overtime charges, social security insurance and medicare fees

Schedule 8.1. Wages

Schedule 8.1 Wages													US $
Year 4													
		Variable Costs - Wages categories (No. of workers)					Fixed Costs - Wages categories (No. of workers)						
No.	Category	Foreign	Local	Foreign	Local	Sub-total	Foreign	Local	Foreign	Local	Sub-total		Total
1	Melting & Casting Shop	0	52	0	107,250	107,250	0	0	0	0	0		107,250
2	Rolling Shop	0	126	0	259,875	259,875	0	0	0	0	0		259,875
3	Technical Section	0	13	0	26,813	26,813	0	0	0	0	0		26,813
4	Maintenance Section	0	45	0	92,813	92,813	0	0	0	0	0		92,813
5	Administration Section	0	0	0	0	0	0	6	0	12,375	12,375		12,375
	TOTAL	0	236	0	486,750	486,750	0	6	0	12,375	12,375		499,125
	Working hours per day	-	8				-	8					
	Working days per year	-	275				-	275					
	Hours per year	-	2,200				-	2,200					
	Wages per hour	-	0.75				-	0.75					
	Surcharge (%)	-	*25%				-	*25%					
	Wages per year	-	2,063				-	2,063					

*including overtime charges, social security insurance and medicare fee

Schedule 8.1. Wages

Schedule 8.1 Wages												US $
	Year 5 - 15											
		Variable Costs - Wages categories (No. of workers)					Fixed Costs - Wages categories (No. of workers)					
No.	Category	Foreign	Local	Foreign	Local	Sub-total	Foreign	Local	Foreign	Local	Sub-total	Total
1	Melting & Casting Shop	0	58	0	119,625	119,625	0	0	0	0	0	119,625
2	Rolling Shop	0	138	0	284,625	284,625	0	0	0	0	0	284,625
3	Technical Section	0	13	0	26,813	26,813	0	0	0	0	0	26,813
4	Maintenance Section	0	45	0	92,813	92,813	0	0	0	0	0	92,813
5	Administration Section	0	0	0	0	0	0	6	0	12,375	12,375	12,375
	TOTAL	0	254	0	523,875	523,875	0	6	0	12,375	12,375	536,250
	Working hours per day	-	8				-	8				
	Working days per year	-	275				-	275				
	Hours per year	-	2,200				-	2,200				
	Wages per hour	-	0.75				-	0.75				
	Surcharge (%)	-	*25%				-	*25%				
	Wages per year	-	2,063				-	2,063				

*including overtime charges, social security insurance and medicare fee

Schedule 8.2 Salary

Year 1

No.	Category	No. of staffs		Salary per hour		Salary per year		US $
		Foreign	Local	Foreign	Local	Foreign	Local	Total
1	Managing Director	0	1		2.75	0	6,050	6,050
2	General Manager	0	3		1.75	0	11,550	11,550
3	Section Manager	0	9		1.25	0	24,750	24,750
4	Metallurgical Engineer	0	5		1.25	0	13,750	13,750
5	Mechanical Engineer	0	3		1.25	0	8,250	8,250
6	Electrical Engineer	0	1		1.25	0	2,750	2,750
7	Production Engineer	0	1		1.25	0	2,750	2,750
8	Superintendent	0	5		1.25	0	13,750	13,750
9	Senior Production Supervisor	3	0		16.00	105,600	0	105,600
10	Production Supervisor	5	0		14.00	154,000	0	154,000
9	Purchasing Officer	0	2		1.25	0	5,500	5,500
10	Accounting Officer	0	2		1.25	0	5,500	5,500
11	Sales Officer	0	4		1.25	0	11,000	11,000
12	Planning Staff	0	2		1.25	0	5,500	5,500
13	Administration Staff	0	2		1.25	0	5,500	5,500
	TOTAL	8	40			259,600	116,600	376,200

	Foreign	Local
Working hours per day	8	8
Working days per year	275	275
Hours per year	2,200	2,200
Surcharge (%)	0%	10%

Schedule 8.2 Salary

Year 2

No.	Category	No. of staffs		Salary per hour		Salary per year		US $
		Foreign	Local	Foreign	Local	Foreign	Local	Total
1	Managing Director	0	1		2.75	0	6,050	6,050
2	General Manager	0	3		1.75	0	11,550	11,550
3	Section Manager	0	9		1.25	0	24,750	24,750
4	Metallurgical Engineer	0	5		1.25	0	13,750	13,750
5	Mechanical Engineer	0	3		1.25	0	8,250	8,250
6	Electrical Engineer	0	1		1.25	0	2,750	2,750
7	Production Engineer	0	1		1.25	0	2,750	2,750
8	Superintendent	0	5		1.25	0	13,750	13,750
9	Senior Production Supervisor	1	0		16.00	35,200	0	35,200
10	Production Supervisor	1	0		14.00	30,800	0	30,800
9	Purchasing Officer	0	2		1.25	0	5,500	5,500
10	Accounting Officer	0	2		1.25	0	5,500	5,500
11	Sales Officer	0	6		1.25	0	16,500	16,500
12	Planning Staff	0	2		1.25	0	5,500	5,500
13	Administration Staff	0	4		1.25	0	11,000	11,000
	TOTAL	2	44			66,000	127,600	193,600

	Foreign	Local
Working hours per day	8	8
Working days per year	275	275
Hours per year	2,200	2,200
Surcharge (%)	0%	10%

Schedule 8.2 Salaries

Schedule 8.2 Salary

Year 3								
No.	Category	No. of staffs		Salary per hour		Salary per year		US $
		Foreign	Local	Foreign	Local	Foreign	Local	Total
1	Managing Director	0	1		2.75	0	6 050	6,050
2	General Manager	0	3		1.75	0	11,550	11,550
3	Section Manager	0	9		1.25	0	24,750	24,750
4	Metallurgical Engineer	0	5		1.25	0	13,750	13,750
5	Mechanical Engineer	0	3		1.25	0	8,250	8,250
6	Electrical Engineer	0	1		1.25	0	2,750	2,750
7	Production Engineer	0	1		1.25	0	2,750	2,750
8	Superintendent	0	5		1.25	0	13,750	13,750
9	Senior Production Supervisor	1	0		16.00	35,200	0	35,200
10	Production Supervisor	1	0		14.00	30,800	0	30,800
9	Purchasing Officer	0	3		1.25	0	8,250	8,250
10	Accounting Officer	0	2		1.25	0	5,500	5,500
11	Sales Officer	0	8		1.25	0	22,000	22,000
12	Planning Staff	0	2		1.25	0	5,500	5,500
13	Administration Staff	0	5		1.25	0	13,750	13,750
	TOTAL	2	48			66,000	138,600	204,600

	Foreign	Local
Working hours per day	8	8
Working days per year	275	275
Hours per year	2,200	2,200
Surcharge (%)	0%	10%

Schedule 8.2 Salaries

Schedule 8.2 Salary

Year 4

No.	Category	No. of staffs		Salary per hour		Salary per year		US $
		Foreign	Local	Foreign	Local	Foreign	Local	Total
1	Managing Director	0	1		2.75	0	6,050	6,050
2	General Manager	0	3		1.75	0	11,550	11,550
3	Section Manager	0	9		1.25	0	24,750	24,750
4	Metallurgical Engineer	0	5		1.25	0	13,750	13,750
5	Mechanical Engineer	0	3		1.25	0	8,250	8,250
6	Electrical Engineer	0	1		1.25	0	2,750	2,750
7	Production Engineer	0	1		1.25	0	2,750	2,750
8	Superintendent	0	5		1.25	0	13,750	13,750
9	Senior Production Supervisor	3	0		16.00	105,600	0	105,600
10	Production Supervisor	5	0		14.00	154,000	0	154,000
9	Purchasing Officer	0	3		1.25	0	8,250	8,250
10	Accounting Officer	0	3		1.25	0	8,250	8,250
11	Sales Officer	0	8		1.25	0	22,000	22,000
12	Planning Staff	0	3		1.25	0	8,250	8,250
13	Administration Staff	0	7		1.25	0	19,250	19,250
	TOTAL	8	52			259,600	149,600	409,200

	Foreign	Local
Working hours per day	8	8
Working days per year	275	275
Hours per year	2,200	2,200
Surcharge (%)	0%	10%

Schedule 8.2 Estimate of Production Cost: Salary

Year 5 - 15

No.	Category	No. of staffs		Salary per hour		Salary per year		US $
		Foreign	Local	Foreign	Local	Foreign	Local	Total
1	Managing Director	0	1		2.75	0	6,050	6,050
2	General Manager	0	3		1.75	0	11,550	11,550
3	Section Manager	0	9		1.25	0	24,750	24,750
4	Metallurgical Engineer	0	5		1.25	0	13,750	13,750
5	Mechanical Engineer	0	3		1.25	0	8,250	8,250
6	Electrical Engineer	0	1		1.25	0	2,750	2,750
7	Production Engineer	0	1		1.25	0	2,750	2,750
8	Superintendent	0	5		1.25	0	13,750	13,750
9	Senior Production Supervisor	0	0		16.00	0	0	0
10	Production Supervisor	0	0		14.00	0	0	0
9	Purchasing Officer	0	3		1.25	0	8,250	8,250
10	Accounting Officer	0	3		1.25	0	8,250	8,250
11	Sales Officer	0	8		1.25	0	22,000	22,000
12	Planning Staff	0	3		1.25	0	8,250	8,250
13	Administration Staff	0	7		1.25	0	19,250	19,250
	TOTAL	0	52			0	149,600	149,600
	Working hours per day	8	8					
	Working days per year	275	275					
	Hours per year	2,200	2,200					
	Surcharge (%)	0%	10%					

9.1 IMPLEMENTATION SCHEDULE

The project implementation schedule which refers to the all major activities from the dicision to invest and preparation for bit to the start of commercial production is shown in Fig.- 9.1.

In order to implement the project most effectively, actual progress of these activities should be always monitored according to this project implementation schedule. If any delays are going to occur, it is necessary to invest the problems, make the dicision timely, and co-ordinate the several activities to recover the delay as soon as possible, or it may be to review the project schedule.

Such monitoring and up-dating is an essential function for the implementation the project successfully.

KOBELCO

TIME

PROJECT O

SHEET NO. 1/1

	Year	1st																
	Month (th)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
*	MILESTONE																	
				①					②		③	④	⑤				⑥	
1	BIDDING	Preparation of ITB			Preparation of Bid Proposal (Bidder)				Cralification and Evaluation of Proposal									
2	CIVIL & BUILDING																	DESIGN
	WORK													TEMPORALY FACILITY				
	a)MELTING & CASTING SHOP																	
	b)ROLLING SHOP																	
	c)UTILITY SUPPLY STATION																	
	d)OTHER BUILDINGS & OUTDOOR																	
3	MANUFACTURING &															DESIGN		
	TRANSPORTATION																	MANUFACT
4	ERECTION																	
	a)MELTING & CASTING SHOP																	
	b)ROLLING SHOP																	
	c)UTILITY SUPPLY STATION																	
	d)OTHER STATIONS & BUILDINGS																	
5	COMMISSIONING																	
	a)MELTING & CASTING SHOP																	
	b)ROLLING SHOP																	
	c)UTILITY SUPPLY STATION																	

DESCRIPTION OF MILESTON

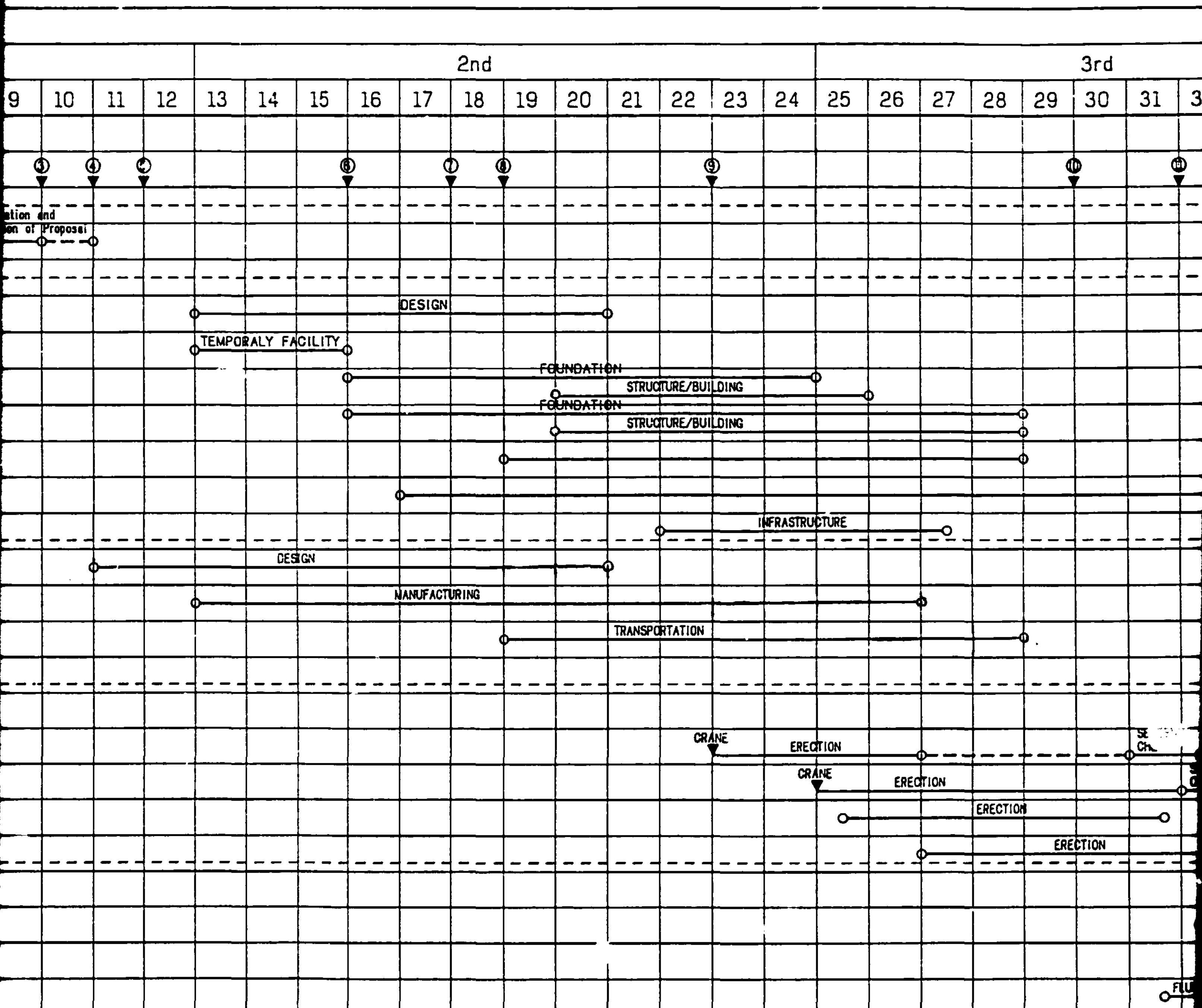
① ISSUE OF I.T.B
② BID CLOSE
③ LETTER OF INTENT
④ CONTRACT EFFECTIVE
⑤ SITE HAND OVER AND TEMPORALY UTILITY SUPPLY
⑥ EXCAVATION START
⑦ CONCRETE WORK START
⑧ FINALIZING OF MECHANICAL DESIGN
⑨ START OF ERECTION
⑩ ALL UTILITY SUPPLY
⑪ MECHANICAL CO
⑫ OPERATION PERS
⑬ COMMENCEMENT

NOTES

SECTION 1

TIME SCHEDULE

PROJECT OVERALL SCHEDULE



CAVATION START

NCRETE WORK START

NALIZING OF MECHANICAL DESIGN

ART OF ERECTION

L UTILITY SUPPLY

⑪ MECHANICAL COMPLEATION

⑫ OPERATION PERSONNEL SUPPLY

⑬ COMMENCEMENT OF COMMERCIAL OPERATION

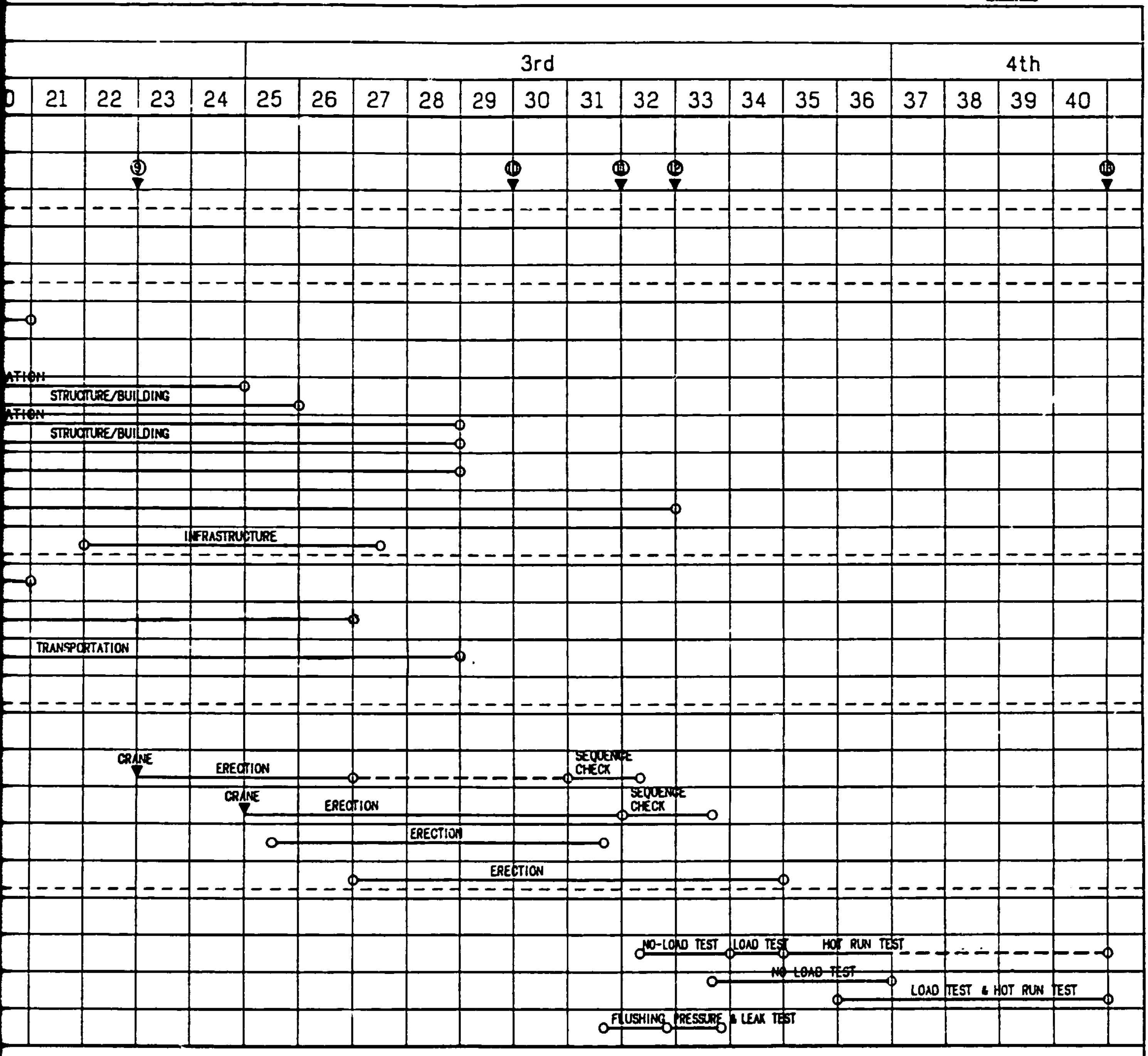
Fig. 9.1

SECTION 2

LE

CHEDULE

KOBE STEEL, LTD.
4-CHOME, IWAYANAKA-MACHI, NADA-KU, KOBE, JAPAN
CONSTRUCTION DEPARTMENT
ENGINEERING DIVISION
(SIGNATURE)



OPERATION

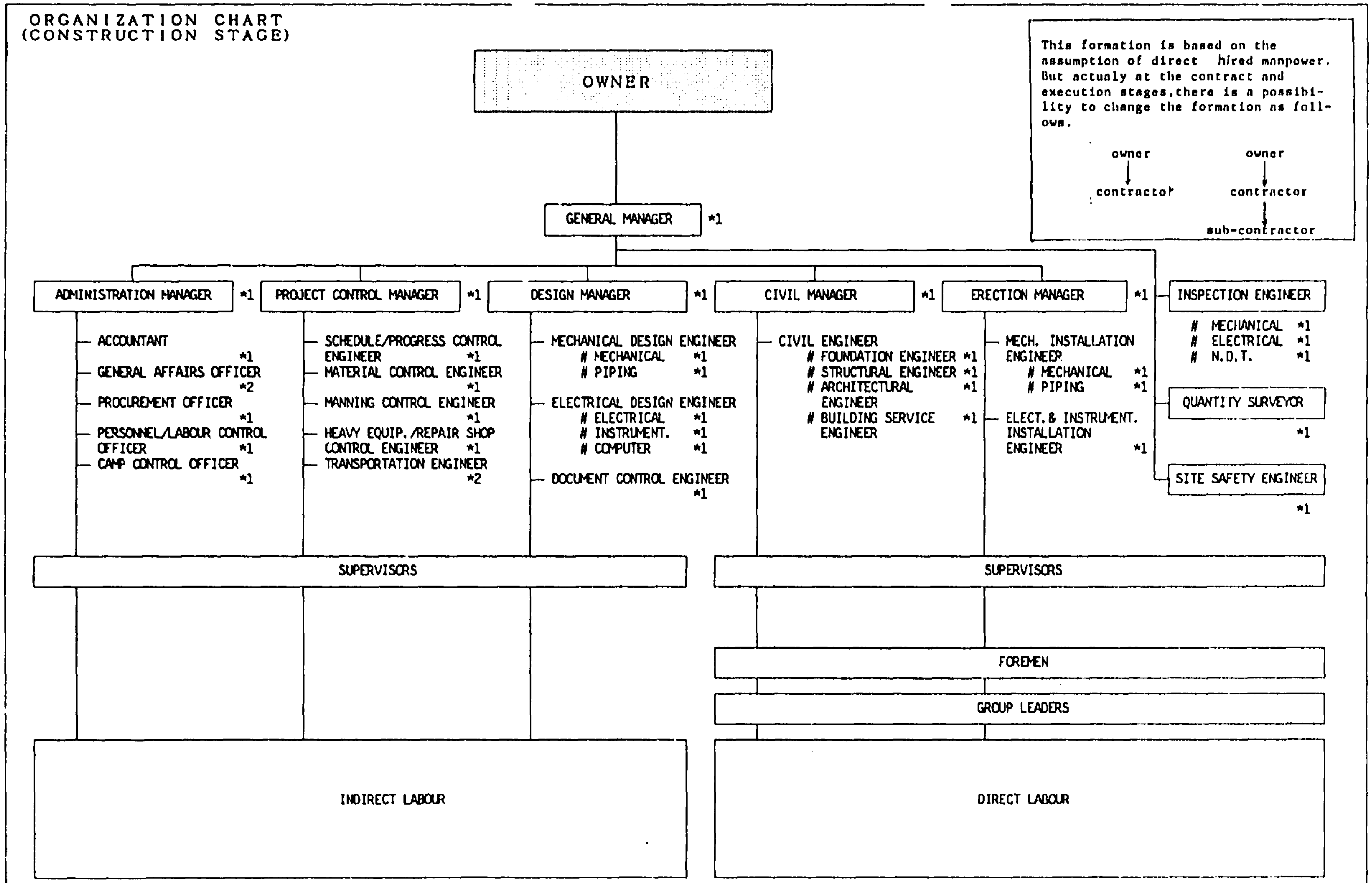
SECTION 3

Fig. 9.1

9.2 IMPLEMENTATION ORGANIZATION AND MANNING REQUIREMENTS

It should be noted that the construction phase, which embraces site preparation, civil work, building work, and mechanical and electrical equipment installation, and commissioning phase is often the most influential part of the project to project scheduling and costing.

The recommendable organization to manage these important phases are shown in Fig.- 9.2 and Fig.-9.3 and relevant manning requirements of the major posts of the organization are also described in this section.



ORGANIZATION CHART
(CONSTRUCTION STAGE)
OWNER
GENERAL MANAGER *1
ADMINISTRATION MANAGER *1
PROJECT CONTROL MANAGER *1
DESIGN MANAGER *1
CIVIL MANAGER *1
ERECTION MANAGER *1
INSPECTION ENGINEER
MECHANICAL *1
ELECTRICAL *1
N.D.T. *1
QUANTITY SURVEYOR *1
SITE SAFETY ENGINEER *1
ACCOUNTANT *1
GENERAL AFFAIRS OFFICER *2
PROCUREMENT OFFICER *1
PERSONNEL/LABOUR CONTROL OFFICER *1
CAMP CONTROL OFFICER *1
SCHEDULE/PROGRESS CONTROL ENGINEER *1
MATERIAL CONTROL ENGINEER *1
MANNING CONTROL ENGINEER *1
HEAVY EQUIP./REPAIR SHOP CONTROL ENGINEER *1
TRANSPORTATION ENGINEER *2
MECHANICAL DESIGN ENGINEER
MECHANICAL *1
PIPING *1
ELECTRICAL DESIGN ENGINEER
ELECTRICAL *1
INSTRUMENT. *1
COMPUTER *1
DOCUMENT CONTROL ENGINEER *1
CIVIL ENGINEER
FOUNDATION ENGINEER *1
STRUCTURAL ENGINEER *1
ARCHITECTURAL ENGINEER *1
BUILDING SERVICE ENGINEER *1
MECH. INSTALLATION ENGINEER
MECHANICAL *1
PIPING *1
ELECT.& INSTRUMENT. INSTALLATION ENGINEER *1
SUPERVISORS
SUPERVISORS
FOREMEN
GROUP LEADERS
INDIRECT LABOUR
DIRECT LABOUR
This formation is based on the assumption of direct hired manpower. But actualy at the contract and execution stages, there is a possibility to change the formation as follows.
owner
contractor
owner
contractor
sub-contractor

Fig. 9.2

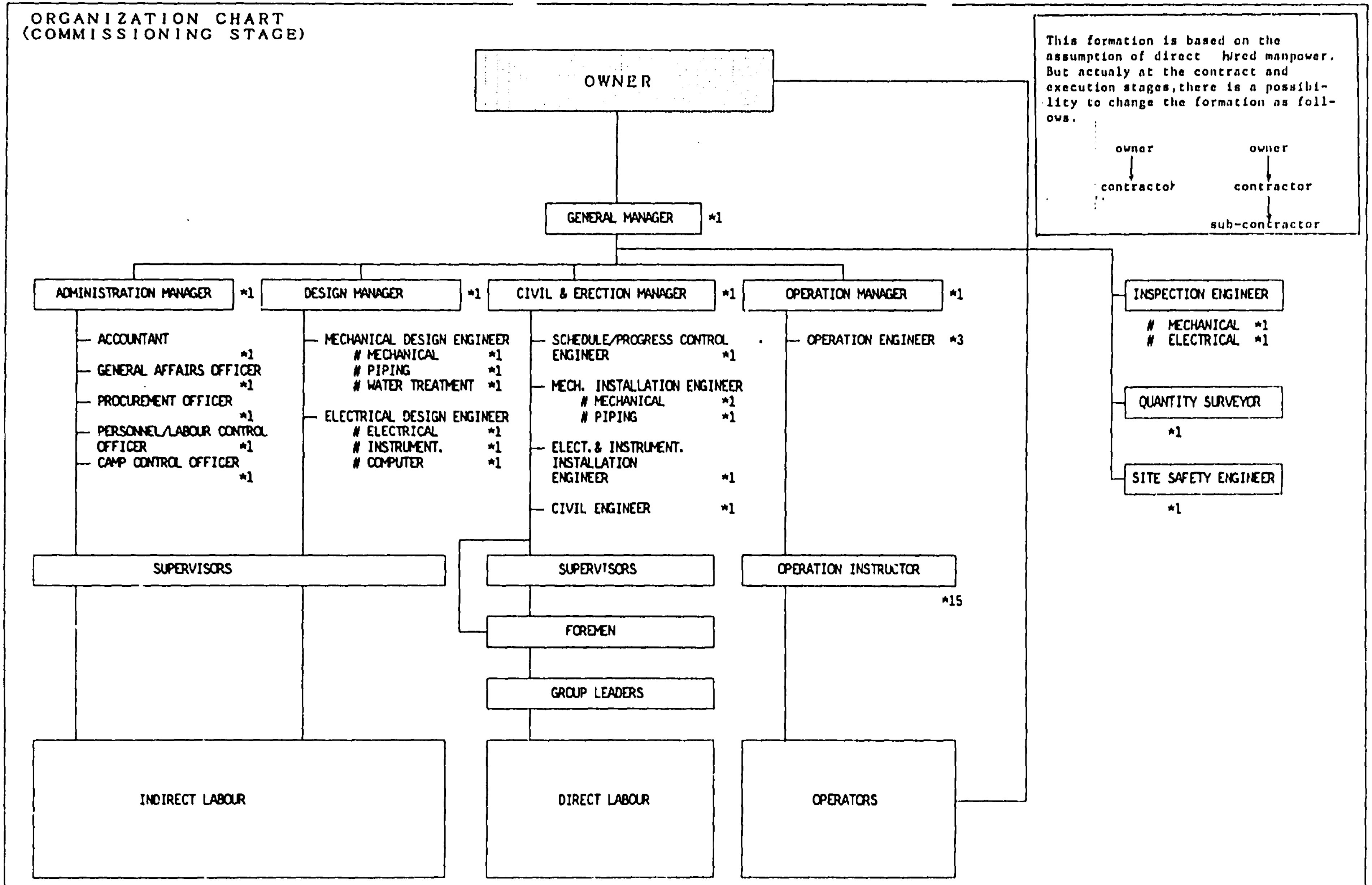

ORGANIZATION CHART
(COMMISSIONING STAGE)
This formation is based on the assumption of direct hired manpower. But actualy at the contract and execution stages, there is a possibility to change the formation as follows.
owner
contractor
owner
contractor
sub-contractor
OWNER
GENERAL MANAGER *1
ADMINISTRATION MANAGER *1
DESIGN MANAGER *1
CIVIL & ERECTION MANAGER *1
OPERATION MANAGER *1
INSPECTION ENGINEER
MECHANICAL *1
ELECTRICAL *1
QUANTITY SURVEYOR
*1
SITE SAFETY ENGINEER
*1
ACCOUNTANT *1
GENERAL AFFAIRS OFFICER *1
PROCUREMENT OFFICER *1
PERSONNEL/LABOUR CONTROL OFFICER *1
CAMP CONTROL OFFICER *1
MECHANICAL DESIGN ENGINEER
MECHANICAL *1
PIPING *1
WATER TREATMENT *1
ELECTRICAL DESIGN ENGINEER
ELECTRICAL *1
INSTRUMENT. *1
COMPUTER *1
SCHEDULE/PROGRESS CONTROL ENGINEER *1
MECH. INSTALLATION ENGINEER
MECHANICAL *1
PIPING *1
ELECT. & INSTRUMENT. INSTALLATION ENGINEER *1
CIVIL ENGINEER *1
OPERATION ENGINEER *3
SUPERVISORS
SUPERVISORS
OPERATION INSTRUCTOR
*15
FOREMEN
GROUP LEADERS
INDIRECT LABOUR
DIRECT LABOUR
OPERATORS

Fig. 9.3

MANNING REQUIREMENTS

(1) General Manager

Duties:

To be a general responsible in relation to the erection work on the site, who mainly performs the following duties.

1) General control of execution of duties by managers, engineers and foremen.

2) Necessary negotiation, as a representative, with other parties related with the erection work.

3) Planning and determination of duties to be executed by each manager.

4) Decision of manning schedule for managers and engineers.

5) Check and control of duties of managers and engineers.

6) Manager's disposal of problems and decision of means to be taken.

7) Preparation of necessary reports on the erection work to higher office.

8) Coordination with the contractor's manager.

Qualification:

To have the following qualifications, experiences and character.

1) Capability as a graduate of engineering department of university or equivalent.

2) Relevant experiences of 10 years or more.

3) Sufficient knowledge necessary for erection management.

4) Good health for the work certified by an authorized hospital and well balanced character.

(2) Administration Manager

Duties:

To perform the following duties as a staff of general manager.

1) Accounting for all related with the office.

2) Personnel management including payment of salary to all personnel, and first aid activity.

3) Procurement contracting necessary for The all work of the office.

4) General affairs including public relation.

5) Camp operation.

6) Necessary negotiation with related department/other parties in connection with above duties.

Qualification:

To have the following qualifications, experiences and character.

1) Capability as a graduate of humanities department such as politics, economics, law, etc. of university or equivalent.

2) Profound operational knowledge necessary for negotiation with foreigners, and execution of duties.

3) Relevant experience of 5 years or more.

4) Good health for the work certified by an authorized hospital and sensible/patient character.

(3) Accountant

Duties:

To perform the following duties under the direction of administration manager.

1) All accounting work for the office including cash flow.

2) Maintenance of necessary amount of cash and bank account/back account for the office.

3) Monthly arrangement of accounting report.

4) Necessary negotiation/discussion with other parties such as tax office etc.

5) Timely reporting to administration manager with respect to accounting work.

Qualification:

To have the following qualifications and experiences.

1) A graduate of economics or law department of university or equivalent

2) Relevant experience of 3 years or more.

3) Sufficient knowledge required for accounting for election office.

(4) General Affairs Officer

Duties:

To perform the following duties under the direction of administration manager.

1) Necessary negotiation preparation of papers required for the construction work, from the view point of public relation, with the parties concerned such as municipality governmental authority, press, police, etc.

2) Administrative negotiations which are not covered by other administrative staff.

3) Timely reporting to administrative manager with respect to general affairs.

Qualification:

To have the following qualifications and experiences.

1) A graduate of humanities department of university or equivalent.

2) Relevant experience of 3 years or more.

3) Sufficient knowledge required for public relations in particular.

(5) Procurement Officer

Duties:

To perform the following duties under the direction of administration manager.

1) Arrangement of concluding necessary procurement contract/agreement for the construction work with other parties, including manpower resource.

2) Checking and approval of payment for the contracted work.

3) Usual contractual maintenance of concluded contract/agreement.

4) Timely reporting to administration manager with respect to procurement.

Qualification:

To have the following qualifications and experiences.

1) A graduate of humanities department of university or equivalent.

2) Relevant experience of 3 years or more.

3) Sufficient knowledge required for contracting for procurement in particular.

(6) Personnel/Labour Control Officer

Duties:

To perform the following duties under the direction of administration manager.

1) Attendance and absence control of all personnel/labour of the office to motivate them.

2) Calculating and paying salary to all personnel/labour with proper interval based on the record and contract/agreement.

3) Check the behaviour of personnel/labour of the office to reflect it to employment contract/agreement.

4) Promoting the welfare services to all personnel/labour including personnel transportation.

5) Necessary negotiation, with respect to personnel affairs, with related parties such as labour office, immigration office, etc.

6) Timely reporting to administration manager on personnel/labour affairs.

Qualification:

To have the following qualifications and experiences.

1) A graduate of humanities department of university or equivalent.

2) Relevant experience of 3 years or more.

3) Sufficient knowledge required for personnel/labour control in particular.

(7) Camp Control Officer

Duties:

To perform the following duties under the direction of administration manager.

1) Operation of camp activities such as canteen including procurement of food stuff, camp maintenance including cleaning, assurance of utility supply, camp security, etc.

2) Necessary negotiation of the parties related to camp management.

3) Promoting of stock control of camp material and camp furniture, blanket, mattress, pillow, toilet papers, etc.

4) Arranging the treatment of waste such as garbage, effluent, etc.

5) Timely reporting to administration manager on camp control.

Qualification:

To have the following qualifications and experiences.

1) A graduate of humanities department of university or equivalent.

2) Relevant experience of 3 years or more.

3) Sufficient knowledge required for the above duties.

(8) Project Control Manager

Duties:

To promote following duties as a staff of general manager and execute actual work.

1) Schedule control of erection.
2) Material control and safe custody of equipment.
3) Progress control.
4) Custom clearance.
5) Control of inland transportation.
6) Heavy equipment and work shop control.
7) Maintenance of temporary facilities such as office, camp, etc.
8) Manning control of labours for the office.
9) Personnel management of the department.
10) Other necessary management as a representative of the department.

Qualification:

To have the following qualifications, experiences and character.

1) A graduate of engineering department of university or equivalent.
2) Relevant experience of 5 years or more.
3) Proficiency in project control in particular.
4) Sufficient knowledge necessary for execution of his duties.
5) Good health for the work certified by an authorized hospital and co-operative reasonable character.

(9) Schedule/Progress Control Engineer

Duties:

To perform the following duties under direction of project control manager.

1) Integration of the erection activities to develop overall schedule that will lead the erection activities to successful completion.

2) Checking the actual project status continuously against the planned schedule/ progress, through the period of the project.

3) Detection of any activities getting delayed to make the countermeasures through discussing with manager concerned.

4) Analysis of impact on schedule resulted from civil/building construction, drawing, documents, resources, external matters such as utilities supply, etc.

5) Timely reporting to the project control manager, on the status of the progress and any activities getting behind planned schedule together with causes and recommendable countermeasures.

6) Revision of schedule when necessary incorporating any changes in the project.

Qualification:

To have the following qualifications and experiences.

1) A graduate of technical department of university or equivalent.

2) Relevant experience of 3 years or more.

3) Sufficient knowledge required for schedule control in particular.

(10) Material Control Engineer

Duties:

To perform the following duties under direction of project control manager.

1) Promoting the execution of the safe custody and the receiving/forwarding of the equipment, based on the schedule.

2) Acutal control of erection material, tools, parts etc. which are stored in warehouse.

3) Timely reporting to the project control manager on the status of such material as mentioned above.

Qualification:

To have the following qualifications and experiences.

1) A graduate of technical department of university or equivalent.

2) Relevant experience of 3 years or more.

3) Sufficient knowledge about the erection material.

(11) Manning Control Engineer

Duties:

To perform the following duties under the direction of project control manager.

1) Coordination of labour mobilization and demobilization for each erection area based on the schedule.

2) Grasping difference between planned and actual man-hour for erection work.

3) Cause analysis of the difference between planned and actual man-hour.

4) Coordination of mobilization of labours predicted from change of engineering, external impact to work schedule such as utilities supply etc.

5) Revision of planned man-hour when necessary to re-schedule.

6) Timely reporting to the project control manager on the status of actual man-hour, especially on the details of additional man-hour and the causes of difference between plan and actual status of man-hour.

Qualification:

To have the following qualifications and experiences.

1) A graduate of technical department of university or equivalent.

2) Relevant experience of 3 years or more.

3) Sufficient knowledge required for estimation of man-hour and manning control in particular.

4) Legal experience and knowledge from the view point of employment agreement/contract.

(12) Heavy Equipment & Repair Shop Control Engineer

Duties:

To perform the following duties under the direction of project control manager.

1) Mobilization control of heavy equipment used for each construction area.

2) Adjustment and decision in regard to equipment type and period required each construction area.

3) Planning and directing the work schedule of repair shop including the repair work of damage in office/camp and other temporary building and facilities.

4) Spare parts control for heavy equipment and repair shop facility such as lathe, boring machine, welding machine, etc.

5) Promoting the operation of repair shop for the matters including fuel storage/supply to vehicles etc.

Qualification:

To have the following qualifications and experiences.

1) A graduate of mechanical engineering or automobile department of university of equivalent.

2) Relevant experience of 3 years or more.

3) Sufficient knowledge required for heavy equipment and repair shop control in particular.

(13) Transportation Engineer

Duties:

To perform the following duties under the direction of project control manager.

1) Present/witness of the receiving inspection of u 'oading at the port.

2) Coordinating and executing the custom clearance and stevedoring.

3) Scheduling and arrangement of transportation from port to storage yard in the site.

Qualification:

To have the following qualifications and experiences.

1) Relevant experience of 5 years at the customs house broker.

2) Sufficient knowledge and has a good record of similar work in a project.

(14) Design Manager

Duties:

To perform the following duties as a good supporter to erection managers under general manager's direction.

1) Review and approval on drawing and document for local manufacturing.

2) Control of drawings and documents for mechanical installation.

3) Control of drawing and document for electrical installation.

4) Review and approval on originated drawings and/or documents necessary for site modifications by fellow engineers.

5) Planning of duties of fellow engineers.

6) Arrangement of office facilities including furniture to assure the smooth execution of office work.

7) Necessary negotiation with related department/ other parties in connection with above duties.

Qualification:

To have the following qualifications, experience and character.

1) A graduate of engineering department of university or equivalent.

2) Relevant experience of 5 years or more.

3) Sufficient knowledge necessary for designing and drawing/documentation in particular.

4) Good health for the work, certified by an authorized hospital and polite character.

(15) Mechanical Design Engineer

Duties:

To perform the following duties under the direction of design manager.

1) Preparation of technical drawings and documents required for mechanical installation work.

2) Necessary modification and correction with respect to design of mechanical equipment coordinating with civil construction team and other parties concerned.

3) Examination and judgement for decision on countermeasure against the trouble in mechanical installation work.

4) Timely reporting design manager on the situation of mechanical design work.

Qualification:

To have the following qualifications and experiences.

1) A graduate of mechanical engineering department of university or equivalent.

2) Relevant experience of 3 years or more.

3) Sufficient knowledge required for mechanical design in particular.

(16) Electrical Design Engineer

Duties:

To perform the following duties under the direction of design manager.

1) Preparation of technical drawings and documents required for electrical and instrumentation installation work.

2) Necessary modification and correction with respect to design of electrical equipment and instrumentation, coordinating with civil construction team and other parties concerned.

3) Examination and judgement for decision on countermeasure against the trouble in electrical and instrumentation installation work.

4) Timely reporting to design manager on the situation of electrical and instrumentation design work.

Qualification:

To have the following qualifications and experiences.

1) A graduate of electrical engineering department of university or equivalent.

2) Relevant experience of 3 years or more.

3) Sufficient knowledge required for electrical and instrumentation design in particular.

(17) Document Control Engineer

Duties:

To perform the following duties under the direction of design manager.

1) Document control such as registration per issue and receipt, storing, filing, etc. for all kinds of technical documents such as drawings, documents transmittals, letters, etc.

2) Preparation of technical drawings and documents required for execution of cold run of each facility and equipment.

3) Disposal of any problem with respect to document control.

Qualification:

To have the following qualifications and experiences.

1) A graduate of mechanical or metallurgical engineering department of university or equivalent.

2) Relevant experience of 3 years or more.

3) Sufficient knowledge required for document control.

(18) Civil Manager

Duties:

To perform the following duties as a direct promotor of field installation work under general manager's direction.

1) Clear directions to fellow engineers and foremen for smooth execution of the civil work.

2) Planning of duties of engineers and foremen of the civil department.

3) Adjusting the duties and job allotment of engineers and foremen of the civil department.

4) Instruction as to disposal of problems relating to civil work.

5) Necessary negotiation with related departments mainly erection department/other parties in connection with civil work.

6) General control on promotion of safety control, cost saving, schedule/progress maintaining.

Qualification:

To have the following qualifications, experience and character.

1) A graduate of engineering department of university of equivalent.

2) Relevant experience of 5 years or more.

3) Satisfactory professional knowledge necessary for execution of civil work in particular.

4) Good health for the work certified by an authorized hospital and positive and frank character.

(19) Civil Engineer

Duties:

To perform the following duties under the direction of civil manager.

1) Planning, scheduling and executing of work procedures for foundation, structural, building, and architectural work.

2) Planning, scheduling and executing the smooth taking over of the structure and material to erection site from the storage both inside and outside of site.

3) Clarification/checking/approval of design drawings and calculation sheets for foundation, structural, building, and architectural works.

4) Quality control of foundation, structural, building, and architectural work including test and inspection with inspection engineer.

5) Advice and assistance to civil manager, and planning and adjusting the duties of supervisors and foremen.

Qualification:

To have the following qualifications and experiences.

1) Graduate of civil engineering department of university of equivalent.

2) Relevant experience of 5 years or more.

3) Sufficient knowledge required for performing foundation, structural, building and architectural work.

(20) Erection Manager

Duties:

To perform the following duties as a direct promotor of field installation work under general manager's direction.

1) Clear directions to fellow engineers and foremen for smooth execution of the erection work.

2) Planning of duties of engineers and foremen of the erection department.

3) Adjusting the duties and job allotment of engineers and foremen of the erection department.

4) Instruction as to disposal of problems relating to erection work.

5) Necessary negotiation with related departments/ other parties in connection with erection work.

6) General control on promotion of erection inspection and test run including, safety control, cost saving, schedule/progress maintaining.

Qualification:

To have the following qualifications, experience and character.

1) Capability as a graduate of engineering department of university of equivalent.

2) Relevant experience of 5 years or more.

3) Satisfactory professional knowledge necessary for execution of erection work in particular.

4) Good health for the work certified by an authorized hospital and positive and frank character.

(21) Mechanical Installation Engineer

Duties:

To perform the following duties under the direction of erection manager.

1) Planning, scheduling and executing of work procedures for mechanical installation.

2) Planning, scheduling and executing the smooth taking over the equipment and material to erection site from the cargo storage.

3) Planning, scheduling and executing the accomplishing mechanical installation work as per specifications.

4) Planning and adjusting the duties of supervisors and foremen for mechanical installation work.

5) Timely reporting to erection manager of the situation of mechanical installation work.

Note: Mechanical installation means any installation work such as machineries refractory work, heat insulation work, pipe fitting work, welding work, etc. except electrical and instrumentation installation work.

Qualification:

To have the following qualifications and experiences.

1) A graduate of mechanical engineering department of university or equivalent.

2) Relevant experience of 5 years or more.

3) Sufficient knowledge required for performing mechanical installation.

(22) Electrical and Instrumentation Installation Engineer

Duties:

To perform the following duties under the direction of erection manager.

1) Planning, scheduling and executing the work procedures for electrical and instrumentation work.

2) Planning, scheduling and executing the accomplishing electrical and instrumentation installation work as per specification.

3) Planning, scheduling and executing the smooth taking over the equipment and material to erection site from the cargo storage.

4) Planning and adjusting the duties of supervisors and foremen for electrical and instrumentation work.

5) Timely reporting to erection manager of the situation of electrical and instrumentation installation work.

Qualification:

To have the following qualifications and experiences.

1) A graduate of electrical engineering department of university or equivalent.

2) Relevant experience of 5 years or more.

3) Sufficient knowledge required for performing electrical and instrumentation installation.

(23) Operation Manager

Duties:

To perform the following duties as a direct promotor of commissioning work under general manager's direction.

1) Clear directions to fellow engineers, instructors and operators for smooth execution of the commissioning work.

2) Planning of commissioning programme and start-up schedule of each equipment and component and formulate the duties of engineers, instructors and operators of operation department.

3) Adjusting the duties and job allotment of engineers, instructors and operators of operation department.

4) Instruction as to disposal of problems and relating and coordination of improvement, countermeasures to construction department.

5) Taking an active part in mechanical completion stage and general control of cold run and hot run tests including cost saving, especially safety control.

Qualification:

To have the following qualifications.
Graduate in Engineering,

1) 5 years or more experience as manager in operation department of similar works with a positive attitude.

2) Satisfactory professional knowledge necessary for execution of operation in particular.

3) Good health for the work certified by an authorized hospital.

(24) Operation Engineer

Duties:

To perform the following duties under the direction of operation manager.

1) Planning and scheduling of start-up procedure after mechanical completion up to hot run test.

2) Planning and scheduling of allocation and duties of instructors and operators.

3) Planning, scheduling of the materials and utilities for test runs.

4) Judgement of satisfactory performance required of each machines with vendor's supervisor.

5) Planning of detail countermeasures with erection department in case of unsatisfactory results.

Qualification:

To have the following qualifications and experiences.

1) 5 years or more experience as staff in operation department of similar works with a positive attitude.

2) Satisfactory professional knowledge necessary for execution of operation in particular.

3) Good health for the work certified by an authorized hospital.

(25) Inspection Engineer

Duties:

To perform the following duties as a direct staff of general manager.

1) Planning and determination of inspection procedure based on proposal from others, for erection work including mechanical erection and electrical erection, etc.

2) Attendance to the site inspection.

3) Check and approve the inspection report issued from erection department.

4) Compiling the approved inspection report to hand them over to maintenance group of the shop via general manager.

5) Necessary negotiation with related department/parties for the above duties.

Qualification:

To have the following qualifications and experiences.

1) Capability on understanding equipment for the shop, technical standards applied to the equipment and inspection methods.

2) Relevant experience for the duties of 3 years or more.

(26) Quantity Surveyor

Duties:

To perform the following duties of the financial and economic aspect of construction as a direct staff of general manager.

1) Follow up of finance and contract matter at the site office.
2) Assessing of construction bill of quantity.
3) Checking of final construction cost and making of legal document.
4) Evaluation of invoice from the sub-contractor.
5) Negotiation with the sub-contractor regarding their invoice/claims.
6) Making of cost reports.
7) Preparing of the countermeasure for claim of extension, modification and etc.

Qualification:

To have the following qualifications and experiences.

Charted quantity surveyors recognized by authorities such as RICS & IQS.

(27) Site Safety Engineer

Duties:

To perform the following duties to keep site safety as a direct staff of general manager.

1) Daily safety patrol on site to report.

2) Coordination of monthly safety patrol and meeting on site headed by general manager.

3) Coordination of occasional safety meeting for countermeasure of accident happened.

4) Advice on keeping safety conditions to general manager and other managers.

5) Necessary negotiation for the above duties with related parties/authorities. Reporting of accidents to concerned authorities.

Qualification:

To have the following qualifications and experiences.

1) Capability on understanding safety control activities with technical knowledge equivalent to graduate of engineering department of university.

2) Experience of 5 years or more, on site construction safety activities.

9.3 CONSTRUCTION IMPLEMENTATION SCHEDULE AND MANPOWER REQUIREMENT

The break-down schedule of construction phase and estimated manpower requirement schedule are studied in this section. Construction labours are in general assumed as local labours that are to be directly employed as required or to be mobilized through construction contractor.

It is necessary to examine the number of staff and the period of the same to be mobilized prior to execution, which means that the manning plan is liable to be changed with the erection organization and various local conditions, etc.

Overall construction schedule is mentioned in Fig. 9.4 and estimated manpower requirement curve is mentioned in Fig. 9.5.

All the cost being required for the project implementation mentioned in this Chapter are summarized in Schedule 10.1 of the following Chapter 10.

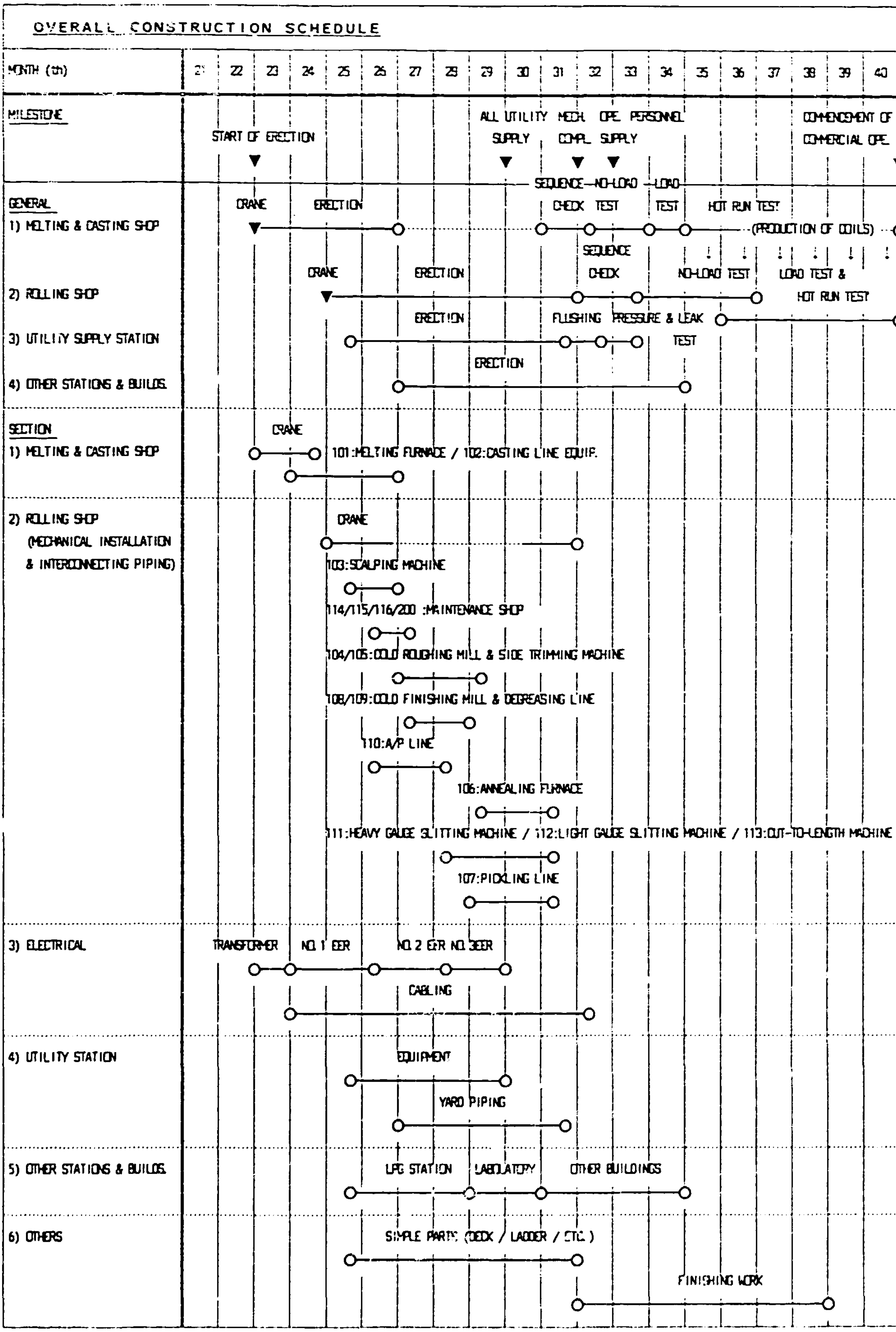
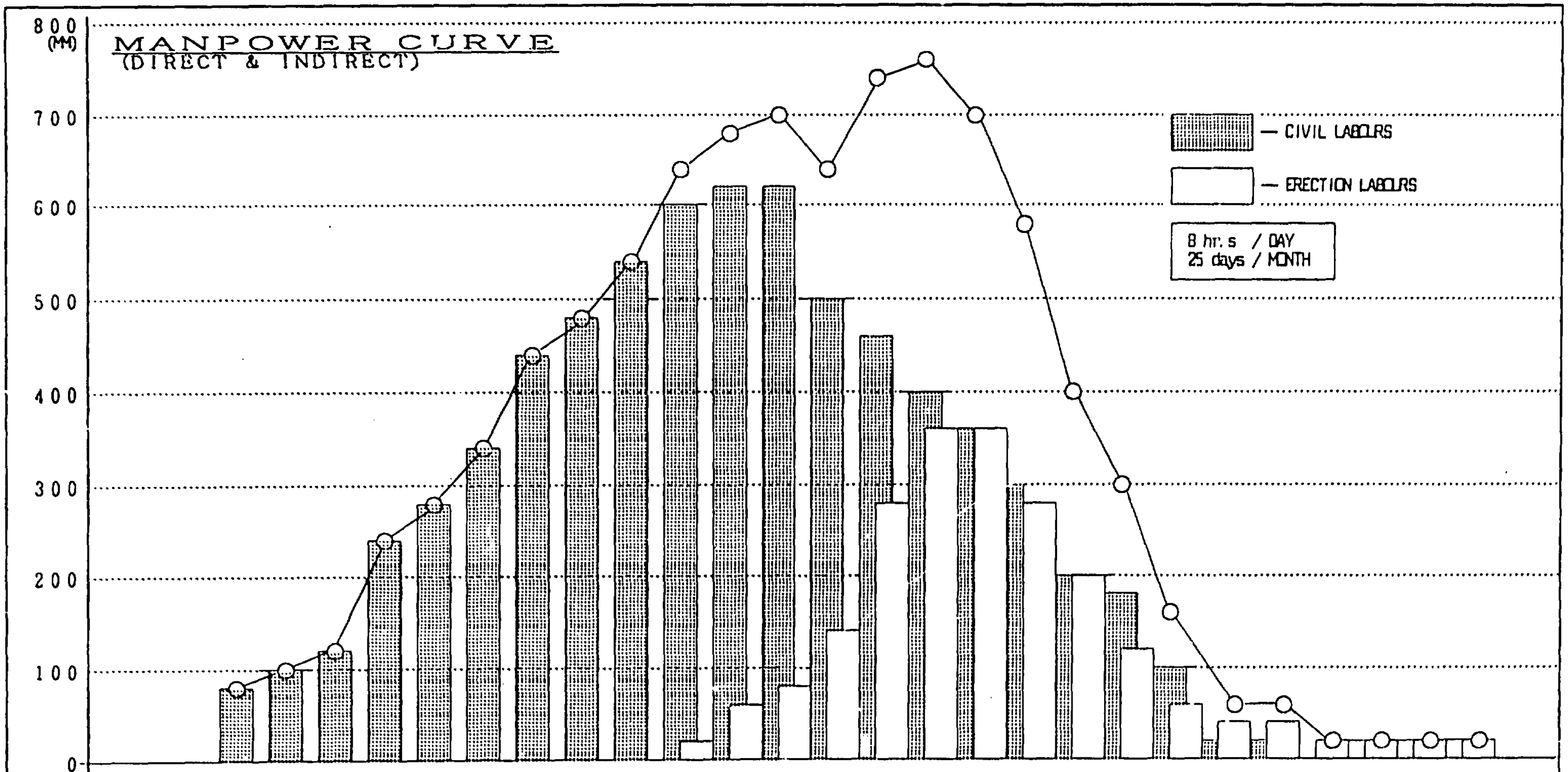

OVERALL CONSTRUCTION SCHEDULE
MONTH (th)
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
MILESTONE
START OF ERECTION
ALL UTILITY SUPPLY
MECH. COMPL.
OPE. PERSONNEL SUPPLY
COMMENCEMENT OF COMMERCIAL OPE.
GENERAL
1) MELTING & CASTING SHOP
CRANE
ERECTION
SEQUENCE CHECK
NO-LOAD TEST
LOAD TEST
HOT RUN TEST
(PRODUCTION OF COILS)
2) ROLLING SHOP
CRANE
ERECTION
SEQUENCE CHECK
NO-LOAD TEST
LOAD TEST & HOT RUN TEST
3) UTILITY SUPPLY STATION
ERECTION
FLUSHING
PRESSURE & LEAK TEST
4) OTHER STATIONS & BUILDS.
ERECTION
SECTION
1) MELTING & CASTING SHOP
CRANE
101:MELTING FURNACE / 102:CASTING LINE EQUIP.
2) ROLLING SHOP (MECHANICAL INSTALLATION & INTERCONNECTING PIPING)
CRANE
103:SCALPING MACHINE
114/115/116/200 :MAINTENANCE SHOP
104/105:COLD ROUGHING MILL & SIDE TRIMMING MACHINE
108/109:COLD FINISHING MILL & DEGREASING LINE
110:A/P LINE
106:ANNEALING FURNACE
111:HEAVY GAUGE SLITTING MACHINE / 112:LIGHT GAUGE SLITTING MACHINE / 113:CUT-TO-LENGTH MACHINE
107:PICKLING LINE
3) ELECTRICAL
TRANSFORMER
NO. 1 EER
NO. 2 EER
NO. 3 EER
CABLING
4) UTILITY STATION
EQUIPMENT
YARD PIPING
5) OTHER STATIONS & BUILDS.
LPG STATION
LABOLATORY
OTHER BUILDINGS
6) OTHERS
SIMPLE PARTS (DECK / LADDER / ETC.)
FINISHING WORK

Fig. 9.4



▼CONTRACT EFFECTIVE

MONTH (th)	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	TOTAL
CIVIL	0	0	80	100	120	250	280	330	450	480	540	600	620	620	500	460	400	350	300	200	180	100	20	20	0	0	0	0	7,000
ERECTION	0	0	0	0	0	0	0	0	0	0	0	30	50	80	140	280	350	350	280	200	120	60	40	40	20	10	10	10	2,070
TOTAL	0	0	80	100	120	250	280	330	450	480	540	630	670	700	640	740	750	700	580	400	300	160	60	60	20	10	10	10	9,070

Fig. 9.5

10. FINANCIAL EVALUATION

10.1 GENERAL

Financial evaluation was made for the Plant with the annual production capacity of 18,000 metric tons based on the horizontal casting process described in Chapter 6. (hereinafter referred to as original case)

Sales programme is based on the demand projection presented in Table 3.34 in Chapter 3.

Projected market prices listed in Table 3.40 in Chapter 3 were applied for financial evaluation.

The following general premises and assumptions were used for each case.

a) Currency: US Dollars (Exchange Rate US$1.0 = Philippines Peso 24.93 = JY135)
b) Start of Preparing Basic Engineering for Tender: September, 1992
c) Start of Construction: August, 1993
d) Start of Commercial Operation: January, 1995
e) Project Life: 15 years from the start of commercial operation

f) Depreciation for Equipment and Machinery

- Method: Straight-line method
- Year : 10 years
- Start : from the start of commercial operation
- Salvage Value: 20%

g) Depreciation for Building and Auxiliary Facilities

- Method: Straight-line method
- Year : 20 years
- Start : from the start of commercial operation
- Salvage Value: 20%

h) Taxes and Duties

- Custom Clearance and Import Tax : to be exempted
- Corporate Income Tax: 35% (tax holiday for 7 years from the start of Commercial Operation)
- Tax on Fixed Assets : to be exempted
- Other Tax and Duty : to be exempted

10.2 PRE-PRODUCTION COSTS

Pre-production costs of original case are estimated in the following Schedule 10.1.

The major items of the pre-production costs are the personnel expenditures which total 1,130 man-months of local labour, 1,360 man-months of skilled expatriates and 188 man-months of supervisors.

Consultation and tendering services cover preparation of tender documents, evaluation of bids in commercial and in technical aspects, for the selection of the optimum supplier.

Training costs for the period of 103 man-months for off-site training is included as shown in Chapter 8.3.2. The costs for on the job training during no-load test, load test and commissioning are included in commissioning costs

Schedule 10.1 Pre-Production Costs

Thousand US$

No.	Quantity	Unit	Item Description	L	F	Unit Cost (average)	Cost Foreign	Cost Local	Total
1	700	M/M	Direct labour	+		0.37	0	256	256
2	700	M/M	Skilled labour		+	2.16	1,509	0	1,509
3	500	M/M	Foreman		+	2.16	1,078	0	1,078
4	430	M/M	Indirect labour	+		0.52	0	224	224
5	45	M/M	Implementation Manager		+	18.36	826	0	826
6	45	M/M	Implementation Engineer		+	18.36	826	0	826
7	98	M/M	Vendor Supervisor		+	18.36	1,799	0	1,799
8	160	M/M	Foreman		+	13.77	2,203	0	2,203
9	-	-	Heavy machinery	+	+	-	964	1,152	2,116
10	-	-	Sub-contract fee	+	+	-	1,651	3,448	5,098
11	-	-	Consultation and Tendering (upto selection of the contractor)		+	-	1,333	0	1,333
12	-	-	Basic and Detail Engineering (including Know-How Fee)		+	-	15,833	0	15,833
13	-	-	Commissioning	+	+	-	1,601	349	1,950
14	-	-	Training of staff and labour		+	-	1,250	0	1,250
15	-	-	Inland transportation of Equipment	+		-	0	900	900
16	-	-	Erection All Risk Insurance		+	-	1,083	0	1,083
			Total				31,957	6,329	38,286

10.3 INVESTMENT COSTS

Total investment costs of the original case required up to start of commercial operation are derived from its break down set out in Schedules 6.1, 6.2, 6.3, 6.4 and 10.1, and are presented in Schedule 10.2.

Schedule of expenditure is estimated in accordance with the following terms of payment:

- Equipment and Machinery: 10% of the costs is payable as a down payment in 1992, and remaining 90% is payable by each shipment.

- Civil & Building Works, Pre-production Costs: 10% of the costs is payable as down payment in 1992, and remaining 90% is payable in progress.

Schedule 10.2 Total Investment Costs

1,000 US$

	1992 Foreign	1992 Local	1992 Total	1993 Foreign	1993 Local	1993 Total	1994 Foreign	1994 Local	1994 Total	1995 Foreign	1995 Local	1995 Total
Fixed Investment Costs												
Land Cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Civil and Building Works	1,320.00	498.00	1,818.00	5,940.00	2,240.00	8,180.00	8,958.00	5,573.00	14,531.00	0.00	0.00	0.00
Machinery and Equipment	8,565.00	115.00	8,680.00	68,125.00	104.00	68,229.00	20,634.00	622.00	21,256.00	260.00	311.00	571.00
Total Fixed Investment Costs	9,885.00	613.00	10,498.00	74,085.00	2,344.00	76,409.00	29,592.00	6,195.00	35,787.00	260.00	311.00	571.00
Pre-Production Costs												
Basic and Detailed Engineering	1,583.00	0.00	1,583.00	5,700.00	0.00	5,700.00	5,700.00	0.00	5,700.00	2,850.00	0.00	2,850.00
Erection Works	1,444.00	1,846.00	3,290.00	2,939.00	6,890.00	9,829.00	7,391.00	8,658.00	16,049.00	2,671.00	1,061.00	3,732.00
Training	125.00	0.00	125.00	0.00	0.00	0.00	563.00	0.00	563.00	563.00	0.00	563.00
Consultation and Tendering	1,333.00	0.00	1,333.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commissioning	160.00	35.00	195.00	0.00	0.00	0.00	720.00	157.00	877.00	720.00	157.00	877.00
Others	285.00	90.00	375.00	2,565.00	405.00	2,970.00	0.00	405.00	405.00	0.00	0.00	0.00
Total Pre-production Costs	4,930.00	1,971.00	6,901.00	11,204.00	7,295.00	18,499.00	14,374.00	9,220.00	23,594.00	6,804.00	1,218.00	8,022.00
Total Investment Costs	14,815.00	2,584.00	17,399.00	85,289.00	9,639.00	94,908.00	43,966.00	15,415.00	59,381.00	7,064.00	1,529.00	8,593.00
(%)	85.15%	14.85%	100.00%	89.84%	10.16%	100.00%	74.04%	25.96%	100.00%	82.21%	17.79%	100.00%

Cumulated Investment Cost 1992 - 1995 (Foreign)	151,114.00
Cumulated Investment Cost 1992 - 1995 (Local)	29,167.00
Total	180,281.00

Schedule 10.3 Total Production Costs

(1000US$)

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Production Amount (tons)	6,000	9,000	12,000	15,000	15,341	15,620	15,910	16,250	16,610
Main Raw Materials	15,019.39	22,529.08	30,038.78	37,539.93	38,389.76	39,089.41	39,811.84	40,661.67	41,562.04
Other Raw Materials	381.07	571.78	762.37	952.75	974.18	992.07	1,010.34	1,054.82	1,054.73
Utilities	1,044.22	1,566.33	2,088.43	2,609.95	2,669.03	2,717.68	2,767.90	2,826.99	2,889.58
Direct Labour	486.00	542.00	598.00	648.00	686.00	686.00	686.00	686.00	686.00
Spares and Maintenance	3,650.00	3,650.00	1,826.00	1,826.00	1,826.00	1,826.00	1,826.00	1,826.00	1,826.00
Factory Overheads	600.37	900.56	1,200.74	1,500.58	1,534.35	1,562.52	1,591.40	1,625.37	1,661.36
Factory Costs	21,181.04	29,759.74	36,514.32	45,077.21	46,079.33	46,873.68	47,693.48	48,680.85	49,679.71
Administrative Overheads	609.60	415.60	415.60	609.60	349.60	349.60	349.60	349.60	349.60
Depreciation	11,042.95	11,074.05	11,074.05	11,074.05	11,074.05	11,074.05	11,074.05	11,074.06	1,257.55
Financial Costs	9,813.18	10,095.74	10,095.74	9,086.16	8,076.59	7,067.02	6,057.44	5,047.87	4,038.29
Total Production Costs	42,646.77	51,345.13	58,099.71	65,847.02	65,579.57	65,364.34	65,174.57	65,152.38	55,325.15
Costs per tons (average)	7.11	5.71	4.84	4.39	4.27	4.18	4.10	4.01	3.33
Of it foreign %	61.25%	52.18%	43.62%	37.74%	35.88%	34.39%	32.86%	31.26%	15.49%
Of it Variable %	36.14%	45.74%	54.68%	60.91%	62.72%	64.23%	65.77%	67.39%	83.09%

Schedule 10.3 Total Production Costs

(1000US$)

	2004	2005	2006	2007	2008	2009
Production Capacity (tons)	16,980	17,370	17,950	18,000	18,000	18,000
Main Raw Materials	42,473.79	43,447.47	44,897.31	45,031.12	45,046.78	45,090.90
Other Raw Materials	1,077.96	1,102.90	1,139.69	1,143.27	1,143.27	1,144.38
Utilities	2,952.97	3,020.67	3,121.47	3,130.77	3,131.86	3,134.93
Direct Labour	686.00	686.00	686.00	686.00	686.00	686.00
Spares and Maintenance	1,826.00	1,826.00	1,826.00	1,826.00	1,826.00	1,826.00
Factory Overheads	1,697.81	1,736.73	1,795.02	1,800.66	1,800.66	1,800.66
Factory Costs	50,714.53	51,819.76	53,465.49	53,617.82	53,634.56	53,682.87
Administrative Overheads	349.60	349.60	349.60	349.60	349.60	349.60
Depreciation	1,226.45	1,226.45	1,226.45	1,226.45	1,226.45	1,226.45
Financial Costs	3,028.72	2,019.15	1,009.57	0.00	0.00	0.00
Total Production Costs	55,319.30	55,414.95	56,051.11	55,193.87	55,210.61	55,258.92
Costs per tons (average)	3.26	3.19	3.12	3.07	3.07	3.07
Of it foreign %	13.47%	11.43%	9.31%	7.37%	7.37%	7.37%
Of it Variable %	85.21%	87.29%	89.47%	91.40%	91.40%	91.40%

10.4 PRODUCTION COST

Schedule 10.3 shows the estimated production costs from 1995 to 2009 for the original case. The summary of the costs for material balance (from Chapter 4), overhead costs (from Chapter 7), and man-power (from Chapter 8) is also shown in this Schedule.

10.5 WORKING CAPITAL

Net working capital is presented in Schedule 10.4 and assumption regarding the raw materials are shown in Schedule 4.1 of Chapter 4.

Based on interviews from several manufacturers in Japan, the account receivable in foreign currency was assumed for the period of 15 days since the payment for these products are usually made by Letter of Credit without usance period.
As for the account receivable in local currency, there are a lot of variations for settlement, however it was assumed for 10 days which is considered a sufficient allowance period.

Inventory for copper cathode, which is the main raw material for the production, was assumed to be nil since the supply source, PASAR is located just near by the proposed plan site. The inventory for other raw materials was assumed for 30 days because those materials are to be imported.

Since copper cathode to be supplied by PASAR accounts for almost 80% of the total costs for raw materials, the terms of settlement with PASAR has a powerful effect on the viability of the project. Therefore, assuming to have a long term supply contract with PASAR, we set out the period for account payable as 30 days expecting such an incentive from PASAR.

Coverage of work in progress and finished products were assumed for the period of 14 days and 7 days respectively in accordance with the interviews from several manufacturers operating a similar scale of plants.

Schedule 10.4 Net Working Capital

(1000US$)

	1995	1996	1997	1998	1999	2000	2001	2002
Current Assets								
Account Receivable	663.61	895.82	1,060.12	1,308.06	1,325.30	1,347.55	1,370.51	1,397.53
Inventory & Materials	316.34	474.51	632.68	790.67	808.57	823.30	838.52	856.42
Spare Parts	3,700.70	3,700.70	1,851.36	1,851.36	1,851.36	1,851.36	1,851.36	1,851.36
Work in Progress	823.71	1,157.32	1,420.00	1,753.00	1,791.99	1,822.87	1,854.75	1,892.26
Finished Products	423.71	586.74	718.08	888.36	902.79	918.23	934.17	952.93
Cash in Hand	445.50	459.01	336.66	382.00	366.33	368.66	371.08	373.91
Total Current Assets	6,373.56	7,274.11	6,018.90	6,973.45	7,046.34	7,131.96	7,220.39	7,324.40
Cuurent Liabilities & Account Payable	1,765.10	2,479.98	3,042.86	3,756.47	3,839.97	3,906.14	3,974.46	4,054.83
Net Working Capital	4,608.47	4,794.13	2,976.04	3,216.98	3,206.36	3,225.82	3,245.93	3,269.57
Increase in Working Capital	4,608.47	185.66	-1,818.08	240.93	-10.61	19.46	20.09	23.64
Net Working Capital (Local)	476.37	675.63	874.90	1,073.42	1,098.69	1,116.81	1,135.51	1,157.52
Net Working Capita (Foreign)	4,132.09	4,118.48	2,101.16	2,143.60	2,107.68	2,109.02	2,110.42	2,112.05

Schedule 10.4 Net Working Capital

(1000US$)

	2003	2004	2005	2006	2007	2008	2009
Current Assets							
Account Receivable	1,426.15	1,455.14	1,486.09	1,532.19	1,536.44	1,536.94	1,538.34
Inventory & Materials	875.38	894.58	915.00	945.63	948.45	948.78	949.70
Spare Parts	1,851.36	1,851.36	1,851.36	1,851.36	1,851.36	1,851.36	1,851.36
Work in Progress	1,931.99	1,972.23	2,015.20	2,079.19	2,085.10	2,085.79	2,087.74
Finished Products	972.79	992.91	1,014.40	1,046.39	1,049.35	1,049.69	1,050.67
Cash in Hand	376.90	379.98	383.19	388.02	388.52	388.52	388.52
Total Current Assets	7,434.58	7,546.21	7,665.25	7,842.78	7,859.21	7,861.07	7,866.33
Cuurent Liabilities & Account Payable	4,139.98	4,226.21	4,318.30	4,455.41	4,468.07	4,469.55	4,473.72
Net Working Capital	3,294.60	3,320.00	3,346.96	3,387.37	3,391.15	3,391.53	3,392.61
Increase in Working Capital	25.04	25.40	27.08	40.32	3.77	0.38	1.08
Net Working Capital (Local)	1,180.83	1,204.44	1,229.65	1,267.19	1,270.65	1,271.06	1,272.20
Net Working Capita (Foreign)	2,113.78	2,115.55	2,117.40	2,120.19	2,120.47	2,120.47	2,120.47

10.6 FINANCING

It has been assumed that thirty percent (30%) of the total investment cost shall be covered by equity by the relevant sectors of each ASEAN country, and all the local currency portion shall be covered by this equity.

As for the foreign currency loan, an export credit loan by the Japanese government was assumed to be the source for the project.

The conditions of foreign and local currency loans are assumed as follows:

a) Foreign Currency Loan

- Interest rate: 8% pa
- Repayment period: 10 years of equal installments
- Grace period: 2 years from start of commercial operation (i.e. 1997)

b) Local Currency Loan (short term)

In case of shortage of cash, a short term loan on the following conditions are adopted.

- Interest rate: 24% p.a.
- Grace period: Nil

Based on the above conditions, a financing schedule for the original case is shown in Schedule 10.5.

Schedule 10.5 Source of Finance

(1000US$)

	1992 Jan - Jun	1992 Jul - Dec	1993 Jan - Jun	1993 Jul - Dec	1994 Jan - Jun	1994 Jul - Dec	1995	1996	1997	1998	1999
Equity	0.00	17,399.00	11,859.30	7,883.00	10,454.50	4,959.50	1,529.00	0.00	0.00	0.00	0.00
Foreign Loan	0.00	0.00	29,157.70	46,008.00	27,519.00	16,448.00	7,064.00	0.00	-12,619.67	-12,619.67	-12,619.67
Total Loan	0.00	17,399.00	29,157.70	46,008.00	27,519.00	16,448.00	7,064.00	0.00	-12,619.67	-12,619.67	-12,619.67
Current Liabilities	0.00	0.00	0.00	0.00	0.00	0.00	1,551.78	608.20	456.19	607.64	71.49
Bank Overdraft	0.00	0.00	583.15	2,086.47	3,556.00	4,436.34	12,627.31	5,132.03	10,736.31	8,786.62	6,958.79
Total Funds	0.00	17,399.00	41,600.15	55,977.47	41,529.50	25,843.84	22,772.09	5,740.23	-1,427.17	-3,225.42	-5,589.40

(1000US$)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Equity (Local Currency)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Foreign Loan	-12,619.67	-12,619.67	-12,619.67	-12,619.67	-12,619.67	-12,619.67	-12,619.67	0.00	0.00	0.00
Total Loan	-12,619.67	-12,619.67	-12,619.67	-12,619.67	-12,619.67	-12,619.67	-12,619.67	0.00	0.00	0.00
Current Liabilities	56.23	58.30	68.26	72.35	74.36	78.22	116.55	11.34	0.00	0.00
Bank Overdraft	5,677.62	4,355.33	2,981.90	1,584.72	176.11	-1,252.67	-2,877.05	-16,599.13	-16,602.58	-16,602.57
Total Funds	-6,885.82	-8,206.04	-9,569.51	-10,962.61	-12,369.20	-13,794.12	-15,380.17	-16,587.79	-16,602.58	-16,602.57

10.7 FINANCIAL EVALUATION

Cashflow statement, balance sheet and net income statement for both cases are set out in the following Schedules 10.6 to 10.8.

10.7.1 The major conclusions derived from the financial evaluation are as follows:

a) Net profit will show negative figures for the first 8 years of operation, and then become positive in 2003.

b) Cumulative profit does not become positive for the entire project life.

c) IRR shows -0.11%, and this could not be considered as viable.

Schedule 10.6 Cashflow

(1000US$)

	1992 Jan - Jun	1992 Jul - Dec	1993 Jan - Jun	1993 Jul - Dec	1994 Jan - Jun	1994 Jul - Dec
Total Cash Inflow	0.00	17,399.00	41,017.00	53,891.00	37,973.50	21,407.50
Financial Resources	0.00	17,399.00	41,017.00	53,891.00	37,973.50	21,407.50
Sales	0.00	0.00	0.00	0.00	0.00	0.00
Total Cash Outflow	0.00	17,399.00	41,600.15	55,977.47	41,529.51	25,843.85
Total Assets	0.00	17,399.00	41,017.00	53,891.00	37,972.50	21,407.50
Operating Costs	0.00	0.00	0.00	0.00	0.00	0.00
Cost of Finance	0.00	0.00	583.15	2,086.47	3,557.01	4,436.35
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate Tax	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (Deficit)	0.00	0.00	-583.15	-2,086.47	-3,556.01	-4,436.35
Cumulated Cash balance	0.00	0.00	-583.15	-2,669.62	-6,225.63	-10,661.98
Inflow/Local	0.00	2,583.00	1,755.00	7,883.00	10,454.50	4,959.50
Outflow/Local	0.00	2,583.00	1,755.00	7,883.00	10,454.50	4,959.50
Surplus (Deficit)	0.00	0.00	0.00	0.00	0.00	0.00
Inflow/Foreign	0.00	14,816.00	39,262.00	46,008.00	27,519.00	16,448.00
Outflow/Foreign	0.00	14,816.00	39,845.15	48,094.47	31,075.01	20,884.35
Surplus (Deficit)	0.00	0.00	-583.15	-2,086.47	-3,556.01	-4,436.35
Net Cashflow	0.00	-17,399.00	-41,017.00	-53,891.00	-37,972.50	-21,407.50
Cumulated Net Cashflow	0.00	-17,399.00	-58,416.00	-112,307.00	-150,279.50	-171,687.00

Schedule 10.6 Cashflow (production stage)

(1000US$)

	1995	1996	1997	1998	1999	2000	2001	2002
Total Cash Inflow	31,460.10	32,367.80	42,906.86	53,456.57	54,020.54	54,986.17	56,003.32	57,209.37
Financial Resources	10,358.10	714.88	702.86	713.57	83.54	66.17	68.32	80.37
Sales	21,102.00	31,653.00	42,204.00	52,743.00	53,937.00	54,920.00	55,935.00	57,129.00
Total Cash Outflow	46,569.50	41,171.62	58,530.14	68,347.16	67,198.41	66,995.59	66,808.67	66,779.15
Total Assets	14,965.56	900.54	-1,255.17	954.53	72.89	85.63	88.42	104.01
Operating Costs	21,790.76	30,175.34	36,929.91	45,686.80	46,429.27	47,223.28	48,043.15	49,007.60
Cost of Finance	9,813.18	10,095.74	10,095.74	9,086.16	8,076.59	7,067.02	6,057.44	5,047.87
Repayment	0.00	0.00	12,759.66	12,619.67	12,619.67	12,619.67	12,619.67	12,619.67
Corporate Tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (Deficit)	-15,109.40	-8,803.73	-15,623.28	-14,890.59	-13,177.88	-12,009.42	-10,805.35	-9,659.78
Cumulated Cash balance	-25,771.38	-34,575.11	-50,198.39	-65,088.98	-78,266.86	-90,276.28	-101,081.63	-110,651.40
Inflow/Local	6,463.89	5,930.86	7,657.86	9,358.57	8,912.18	9,003.05	9,149.17	9,305.01
Outflow/Local	21,034.58	26,928.79	35,363.15	43,779.95	43,973.45	44,729.74	45,538.44	46,501.72
Surplus (Deficit)	-14,570.69	-20,997.93	-27,705.29	-34,421.38	-35,061.27	-35,726.69	-36,389.27	-37,196.71
Inflow/Foreign	24,996.20	26,437.02	35,249.00	44,098.00	45,108.36	45,983.12	46,854.16	47,904.36
Outflow/Foreign	25,534.81	14,242.67	23,166.79	24,567.21	23,224.87	22,265.75	21,270.20	20,277.36
Surplus (Deficit)	-538.72	12,194.35	12,082.21	19,530.79	21,883.49	23,717.37	25,583.96	27,627.00
Net Cashflow	-13,889.22	1,292.00	7,092.14	6,815.24	7,518.38	7,677.27	7,871.76	8,097.76
Cumulated Net Cashflow	-185,576.20	-184,284.20	-177,192.10	-170,376.80	-162,858.50	-155,181.20	-147,309.40	-139,211.64

Schedule 10.6 Cashflow (production stage) (1000US$)

	2003	2004	2005	2006	2007	2008	2009
Total Cash Inflow	58,479.15	59,761.23	61,135.08	63,217.12	63,280.66	63,291.48	63,356.17
Financial Resources	85.15	86.23	92.08	137.12	12.66	1.48	4.17
Sales	58,394.00	59,675.00	61,043.00	63,080.00	63,268.00	63,290.00	63,352.00
Total Cash Outflow	66,797.56	66,824.11	66,927.12	67,621.20	54,008.88	56,813.86	56,871.59
Total Assets	110.19	111.59	119.16	177.44	16.38	1.92	5.40
Operating Costs	50,029.41	51,064.13	52,169.14	53,814.53	53,966.39	53,984.16	54,034.23
Cost of Finance	4,038.29	3,028.72	2,019.15	1,009.57	0.00	0.00	0.00
Repayment	12,619.67	12,619.67	12,619.67	12,619.66	0.00	0.00	0.00
Corporate Tax	0.00	0.00	0.00	0.00	26.12	2,827.79	2,831.96
Surplus (Deficit)	-8,318.41	-7,062.88	-5,792.04	-4,404.08	9,271.78	6,477.62	6,484.58
Cumulated Cash balance	-118,969.80	-126,032.70	-131,824.74	-136,228.82	-126,957.00	-120,479.38	-113,994.80
Inflow/Local	9,489.71	9,635.77	9,749.03	10,081.79	9,978.11	9,967.00	9,971.10
Outflow/Local	47,512.24	48,530.81	49,624.47	51,298.62	51,317.60	54,122.69	54,179.48
Surplus (Deficit)	-38,022.53	-38,895.04	-39,875.45	-41,216.83	-41,339.49	-44,155.69	-44,208.38
Inflow/Foreign	48,989.44	50,125.00	51,385.56	53,135.32	53,301.20	53,323.02	53,385.07
Outflow/Foreign	19,285.25	18,293.30	17,302.81	16,322.75	2,691.61	2,691.12	2,691.12
Surplus (Deficit)	29,704.19	31,831.70	34,082.75	36,812.57	50,609.93	50,631.90	50,693.95
Net Cashflow	8,339.55	8,585.51	8,846.78	9,225.15	9,271.77	6,477.62	6,484.58
Cumulated Net Cashflow	-130,872.10	-122,286.59	-113,439.81	-104,214.70	-94,942.93	-88,465.31	-81,980.71

Schedule 10.7 Balance Sheets (construction stage)

(1000US$)

	1992 Jan - Jun	1992 Jul - Dec	1993 Jan - Jun	1993 Jul - Dec	1994 Jan - Jun	1994 Jul - Dec
Total Assets	0.00	17,399.00	58,999.15	114,976.62	156,506.13	182,349.98
Fixed Assets, Net Depreciation	0.00	0.00	17,399.00	58,999.15	114,976.62	156,506.13
Construction in Progress	0.00	17,399.00	41,600.15	55,977.47	41,529.51	25,843.85
Current Assets	0.00	0.00	0.00	0.00	0.00	0.00
Cash, Bank	0.00	0.00	0.00	0.00	0.00	0.00
Cash Surplus, Finance Available	0.00	0.00	0.00	0.00	0.00	0.00
Loss Carried Forward	0.00	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total Liabilities	0.00	17,399.00	58,999.15	114,976.62	156,506.13	182,349.97
Equity Capital	0.00	17,399.00	29,258.30	37,141.30	47,595.80	52,555.30
Reserves, Retained Profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and Medium Terms Debt	0.00	0.00	29,157.70	75,165.70	102,684.70	119,132.70
Current Liabilities	0.00	0.00	0.00	0.00	0.00	0.00
Bank Overdraft, Finance Required	0.00	0.00	583.15	2,669.62	6,225.83	10,661.97
Total Debt	0.00	0.00	29,740.85	77,853.33	108,910.30	129,794.70
Equity, % of Liabilities	0.00%	100.00%	49.59%	32.30%	30.41%	28.82%

Schedule 10.7 Balance Sheets (production stage)

(1000US$)

	1995	1996	1997	1998	1999	2000	2001	2002
Total Assets	207,817.43	217,336.12	220,902.58	223,887.15	224,528.80	223,984.80	222,238.81	219,269.22
Fixed Assets, Net Depreciation	171,307.00	168,825.00	157,750.90	146,676.90	135,602.80	124,528.80	113,454.80	102,380.70
Construction in Progress	8,592.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Current Assets	5,928.06	6,815.09	5,682.24	6,591.45	6,680.01	6,763.30	6,849.31	6,950.49
Cash, Bank	445.48	459.01	336.66	382.00	366.33	368.66	371.08	373.90
Cash Surplus, Finance Available	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loss Carried Forward	0.00	21,544.88	41,237.01	57,132.78	70,236.73	81,879.63	92,323.98	101,563.60
Loss	21,544.88	19.692.13	15,895.77	13,104.02	11,642.91	10,444.34	9,239.64	8,000.53
Total Liabilities	207,817.43	217,336.12	220,902.58	223,887.15	224,528.78	223,984.73	222,238.81	219,269.22
Equity Capital	54,084.30	54,084.30	54,084.30	54,084.30	54,084.30	54,084.30	54,084.30	54,084.30
Reserves, Retained Profit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Long and Medium Terms Debt	126,196.66	126,196.73	113,577.00	100,957.38	88,337.66	75,718.02	63,098.34	50,478.67
Current Liabilities	1,765.10	2,479.98	3,042.86	3,756.43	3,839.97	3,906.14	3,974.46	4,054.83
Bank Overdraft, Finance Required	25,771.38	34,575.11	50,198.39	65,088.98	78,266.86	90,276.30	101,081.70	110,651.40
Total Debt	153,733.20	163,251.80	166,818.30	169,802.80	170,444.50	169,900.50	168,154.50	165,184.90
Equity, % of Liabilities	26.02%	24.89%	24.48%	24.16%	24.09%	24.15%	24.34%	24.67%

Schedule 10.7 Balance Sheets (production stage)

(1000US$)

	2003	2004	2005	2006	2007	2008	2009
Total Assets	218,121.78	213,938.30	208,475.30	201,798.03	193,558.53	184,284.90	177,812.11
Fixed Assets, Net Depreciation	101,123.10	99,896.69	98,670.23	97,443.78	96,217.33	94,990.88	93,764.43
Construction in Progress	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Current Assets	7,057.68	7,166.23	7,282.15	7,454.76	7,470.69	7,472.55	7,477.81
Cash, Bank	376.90	379.98	383.22	388.05	388.52	388.52	388.52
Cash Surplus, Finance Available	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loss Carried Forward	109,564.10	106,495.40	102,139.70	96,511.44	89,481.99	81,432.95	76,181.35
Loss	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Liabilities	218,121.78	213,938.30	208,475.30	201,798.03	193,558.53	184,284.90	177,812.11
Equity Capital	54,084.30	54,084.30	54,084.30	54,084.30	54,084.30	54,084.30	54,084.29
Reserves, Retained Profit	0.00	0.00	0.00	0.00	0.00	0.00	11,797.36
Profit	3,068.75	4,355.70	5,628.27	7,029.45	8,049.04	5,251.60	5,259.36
Long and Medium Terms Debt	37,859.00	25,239.33	12,619.66	0.00	0.00	0.00	0.00
Current Liabilities	4,139.98	4,226.21	4,318.30	4,455.41	4,468.07	4,469.55	4,473.72
Bank Overdraft, Finance Required	118,969.80	126,032.70	131,824.80	136,228.80	126,957.10	120,479.50	113,994.90
Total Debt	160,968.80	155,498.30	148,762.70	140,684.30	131,425.10	124,949.00	118,468.60
Equity, % of Liabilities	24.80%	25.28%	25.94%	26.80%	27.94%	29.35%	30.42%

Schedule 10.8 Net Income Statement

(1000US$)

	1995	1996	1997	1998	1999	2000	2001	2002
Total sales	21,102.00	31,653.00	42,204.00	52,743.00	53,937.00	54,920.00	55,935.00	57,129
Variable Costs	17,045.16	25,567.74	34,090.32	42,603.20	43,567.66	44,361.68	45,181.55	46,146
Variable margin	4,056.84	6,085.26	8,113.68	10,139.80	10,369.34	10,558.32	10,753.45	10,983.00
As % of Total Sales	19.22%	19.22%	19.22%	19.22%	19.22%	19.22%	19.22%	19.22%
Non-Variable Costs including Depreciation	15,788.55	15,681.65	13,913.65	14,157.65	13,935.65	13,935.65	13,935.65	13,935.66
Operational Margin	-11,731.71	-9,596.39	-5,799.97	-4,017.85	-3,566.31	-3,377.33	-3,182.20	-2,952.66
As % of Total Sales	-55.60%	-30.32%	-13.74%	-7.62%	6.61%	-6.15%	-5.69%	-5.17%
Cost of Finance	9,813.18	10,095.74	10,095.74	9,086.16	8,076.59	7,067.02	6,057.44	5047.868
Gross Profit	-21,544.89	-19,692.13	-15,895.71	-13,104.01	-11,642.90	-10,444.34	-9,239.64	-8,000.53
Taxable Profit	-21,544.89	-19,692.13	-15,895.71	-13,104.01	-11,642.90	-10,444.34	-9,239.64	0.00
Tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net Profit	-21,544.89	-19,692.13	-15,895.71	-13,104.01	-11,642.90	-10,444.34	-9,239.64	-8,000.53
Dividends Paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Undistributed Profit	-21,544.89	-19,692.13	-15,895.71	-13,104.01	-11,642.90	-10,444.34	-9,239.64	
Accumulated Undistributed Profit	-21,544.89	-41,237.02	-57,132.73	-70,236.74	-81,879.64	-92,323.98	-101,563.62	-109,564.10
Gross Profit (% of Total Sales)	-102.10%	-62.21%	-37.66%	-24.85%	-21.59%	-19.02%	-16.52%	-14.00%
Net Profit (% of Total Sales)	-102.10%	-62.21%	-37.66%	-24.85%	-21.59%	-19.02%	-16.52%	-14.00%
ROE (Net Profit, % of Equity)	-39.84%	-36.41%	-29.39%	-24.23%	-21.57%	-19.31%	-17.08%	-14.79%
ROI (Net Profit + Interest, % of Investment)	-6.35%	-5.19%	-3.17%	-2.19%	-1.94%	-1.84%	-1.73%	-1.61%

Schedule 10.8 Net Income Statement (1000US$)

	2003	2004	2005	2006	2007	2008	2009
Total sales	58,394.00	59,675.00	61,043.00	63,080.00	63,268.00	63,290.00	63,352.00
Variable Costs	47,167.81	48,202.53	49,307.54	50,952.93	51,104.79	51,122.55	51,172.63
Variable margin	11,226.19	11,472.47	11,735.46	12,127.07	12,163.21	12,167.45	12,179.37
As % of Total Sales	19.22%	19.22%	19.22%	19.22%	19.22%	19.22%	19.22%
Non-Variable Costs including Depreciation	4,119.15	4,088.05	4,088.05	4,088.05	4,088.05	4,088.05	4,088.05
Operational Margin	7,107.04	7,384.42	7,647.41	8,039.02	8,075.16	8,079.40	8,091.32
As % of Total Sales	12.17%	12.37%	12.53%	12.74%	12.76%	12.77%	12.77%
Cost of Finance	4,038.29	3,028.72	2,019.15	1,009.57	0.00	0.00	0.00
Gross Profit	3,068.75	4,355.70	5,628.26	7,029.45	8,075.16	8,079.40	8,091.32
Taxable Profit	3,068.75	4,355.70	5,628.26	7,029.45	74.63	8,079.40	8,091.32
Tax	0.00	0.00	0.00	0.00	26.12	2,827.79	2,831.96
Net Profit	3,068.75	4,355.70	5,628.26	7,029.45	8,049.04	5,251.60	5,259.36
Dividends Paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Undistributed Profit	3,068.75	4,355.70	5,628.26	7,029.45	8,049.04	5,251.60	5,259.36
Accumulated Undistributed Profit	-106,495.40	-102,139.70	-96,511.44	-89,482.00	-81,432.96	-76,181.36	-70,922.00
Gross Profit (% of Total Sales)	5.26%	7.30%	9.22%	11.14%	12.76%	12.77%	12.77%
Net Profit (% of Total Sales)	5.26%	7.30%	9.22%	11.14%	12.72%	8.30%	8.30%
ROE (Net Profit, % of Equity)	5.87%	8.05%	10.41%	13.00%	14.88%	9.71%	9.72%
ROI (Net Profit + Interest, % of Investment)	3.87%	4.02%	4.17%	4.38%	4.38%	2.86%	2.86%

10.8 SENSITIVE ANALYSIS

10.8.1 Sensitivity of the Variables

As mentioned in the previous Section, IRR of the project cannot be considered as viable. However, in order to seek the possibility of making the project more attractive to the investors, the following variables and assumptions have been selected for the sensitivity analysis:

a) Sales prices

20% of the plant outputs were changed to those for lead frame as the products mix. Based on this assumption, the roll margin can be expected to be 5 times higher than the normal product , and the total sales revenue will be roughly 1.28 times higher than the original revenue. This assumption is contradictory to the products mix proposed in Chapter 2, however analysis was made for reference only.

b) Cperating costs

As Japanese manufacturers use approximately 50% of copper scrap as raw materials, the same ratio was applied. Base on this assumption, approximately 8 to 10% of raw material might be reduced. However, this is just a referential indication since the market price of copper scrap are not stable and the supply sources is quite varied.

c) Initial investment

The accuracy in estimating the investment costs is varied according to factors such as procurement sources, procedure in selecting the suppliers, etc. Therefore, variation within the range of ±10% of the investment costs are usually taken into account in evaluating the project costs.

The project becomes more viable in changing sales prices and operating costs rather than initial investment. However, expecting drastic changes of the sales prices for export, which account for almost 85% of the total project outputs, is probably an unrealistic assumption. Sales prices of copper semi products consists of roll margin and copper cathode, the latter being the major component fixed by LME, and therefore only the price of roll margin can be changed for determining the sales prices. Thus, to change the price of copper cathode which accounts for about 80% of the operating costs, is much more realistic to make the project more viable provided that PASAR will give a special incentive for the price of copper cathode.

The result of the sensitivity analysis is shown in Fig. 10.1.

10.8.2 Break Even Analysis

In order to determine the impact of each variable mentioned in previous Section, the break even analysis for following cases were made, and the chart for each case are shown in Fig. 10.2 to 10.5. The fixed costs applied in the analysis are extracted from those in 5th year of production (1999).

a) Original Case

Plant with the annual capacity of 18,000 metric tons using the variables shown in Schedule 3.1, 4.1, 8.2 10.3.

The break even even point is barely reached at a capacity utilization of 210%.

b) Case 1:

This case, using 50% of copper scrap as raw material, breaks even at a capacity utilization of 133%.

c) Case 2: Producing 20% of high value added procuts

The rate of capacity utilization at the break even point of this case is 76% (4th year from start of commercial operation). The production margin at the full capacity utilization would be 7.8 million US$.

c) Case 3: Combination of above Case 1 & 2

The rate of capacity utilization at the break even point of this case is 51% (3rd year from start of commercial operation). The production margin at the full capacity utilization would be 13.2 million US$.

In view of the above, only the Case 2 and Case 3 may become realistic provided that the potential investors look into the variables for reassessing the commercial profitability by elaborating in different product mix, different market penetration strategies and in different raw materials.

Sensitivity of IRR

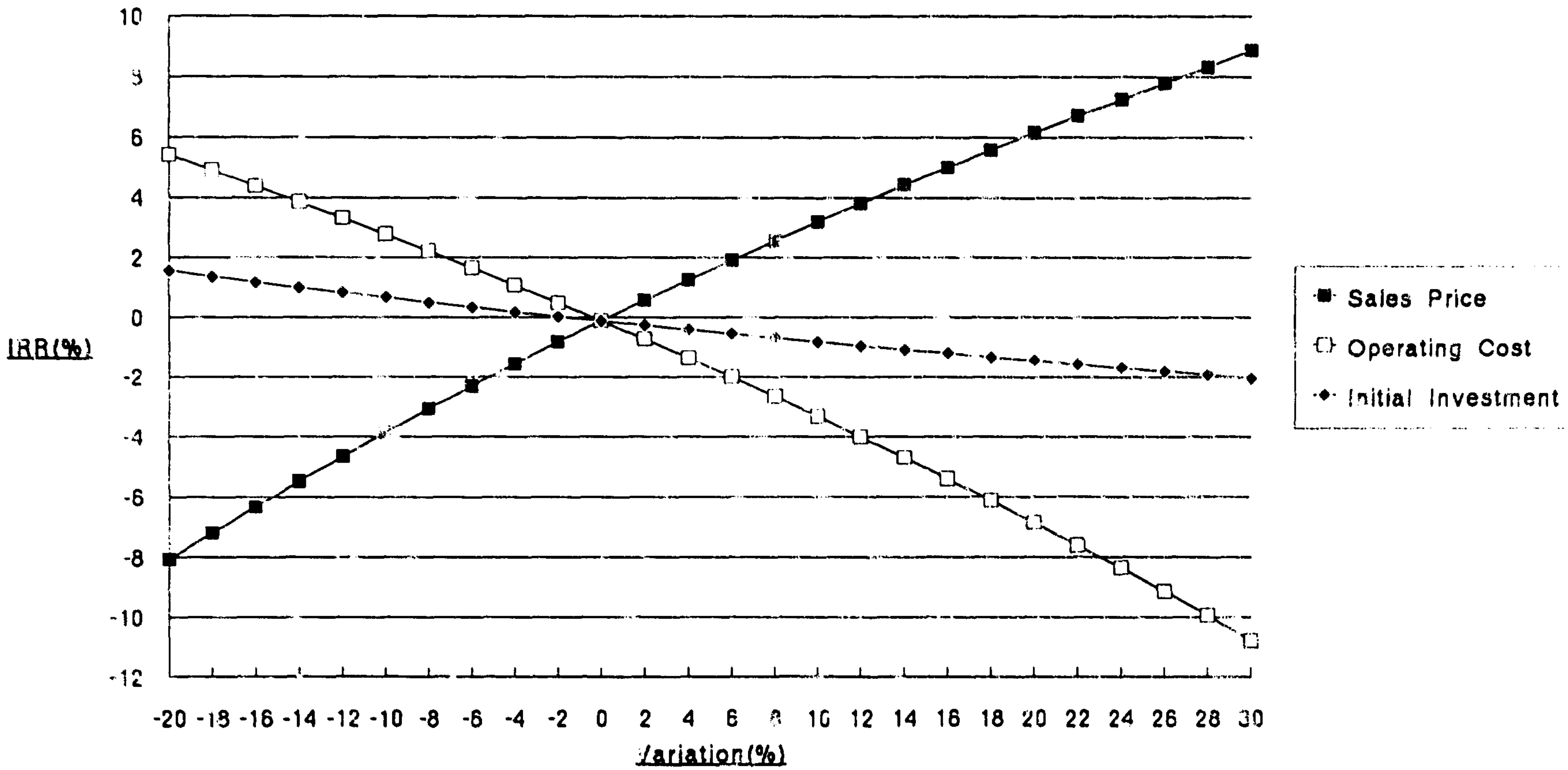


Fig.10.1

Break Even Chart / 5th Year of Production (Original Case)

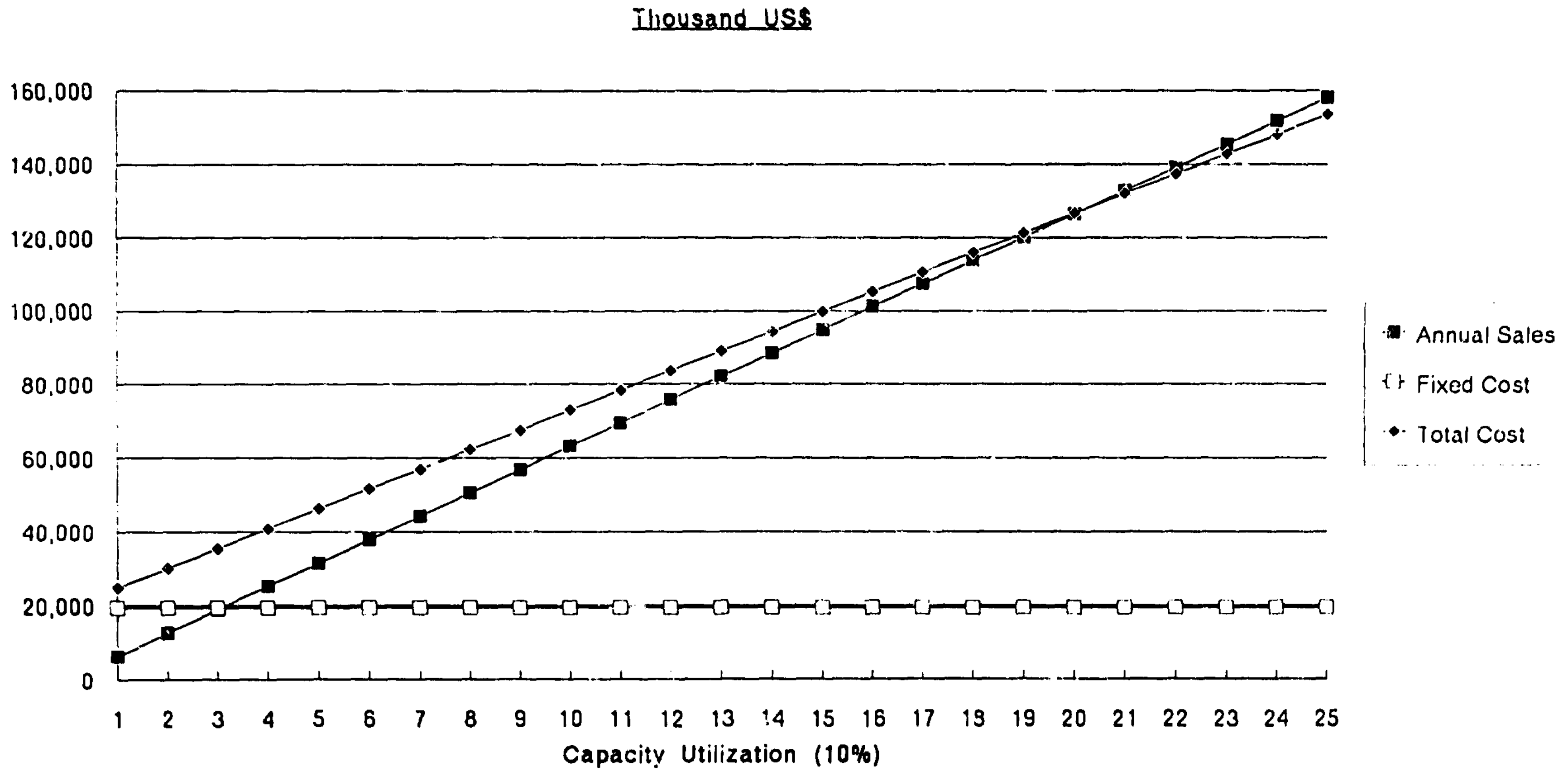


Fig. 10.2

Break Even Chart (Case 1/ Using 50% scrap)

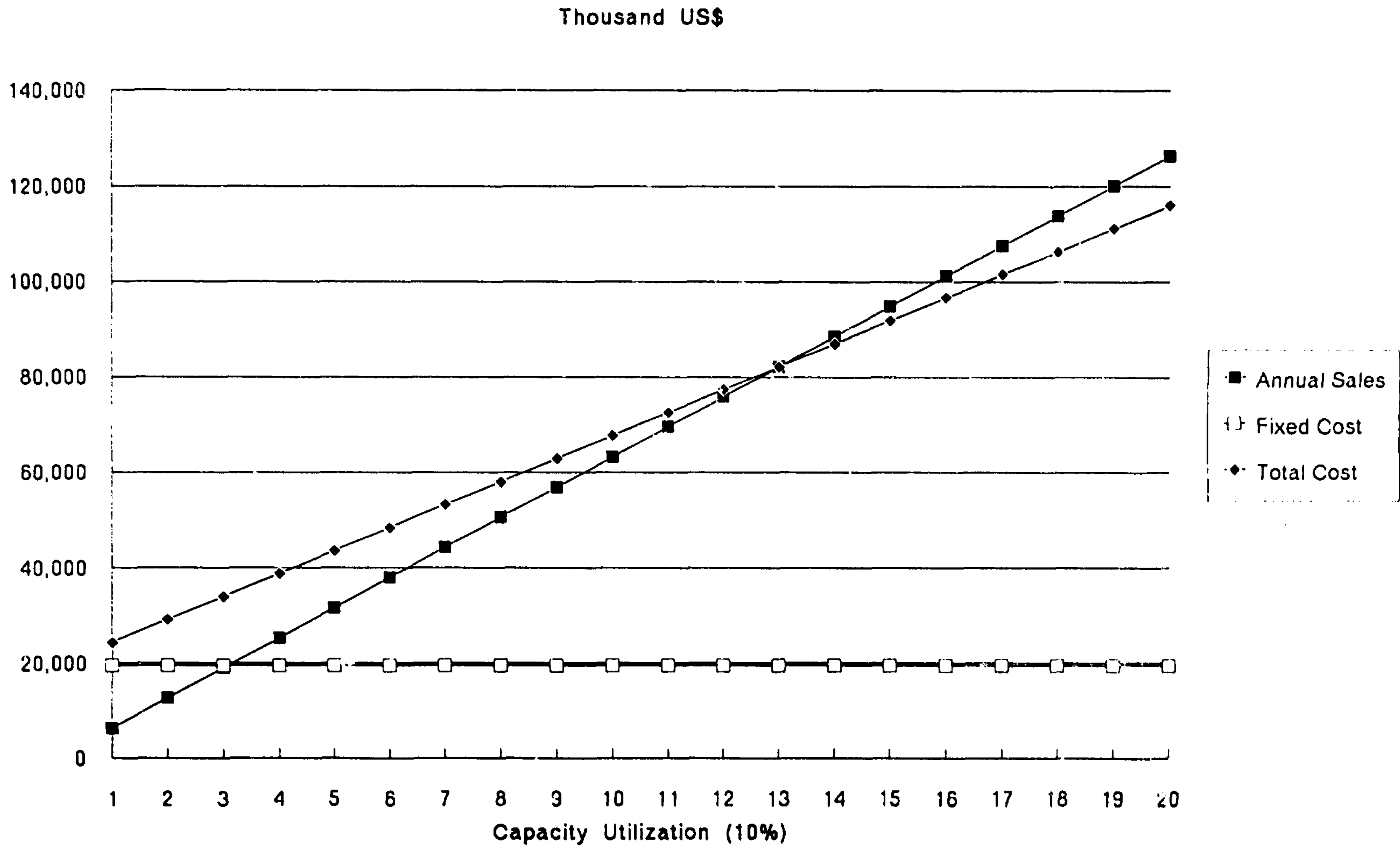


Fig. 10.3

Break Even Chart (Case 2 / Producing 20% Lead Frame)

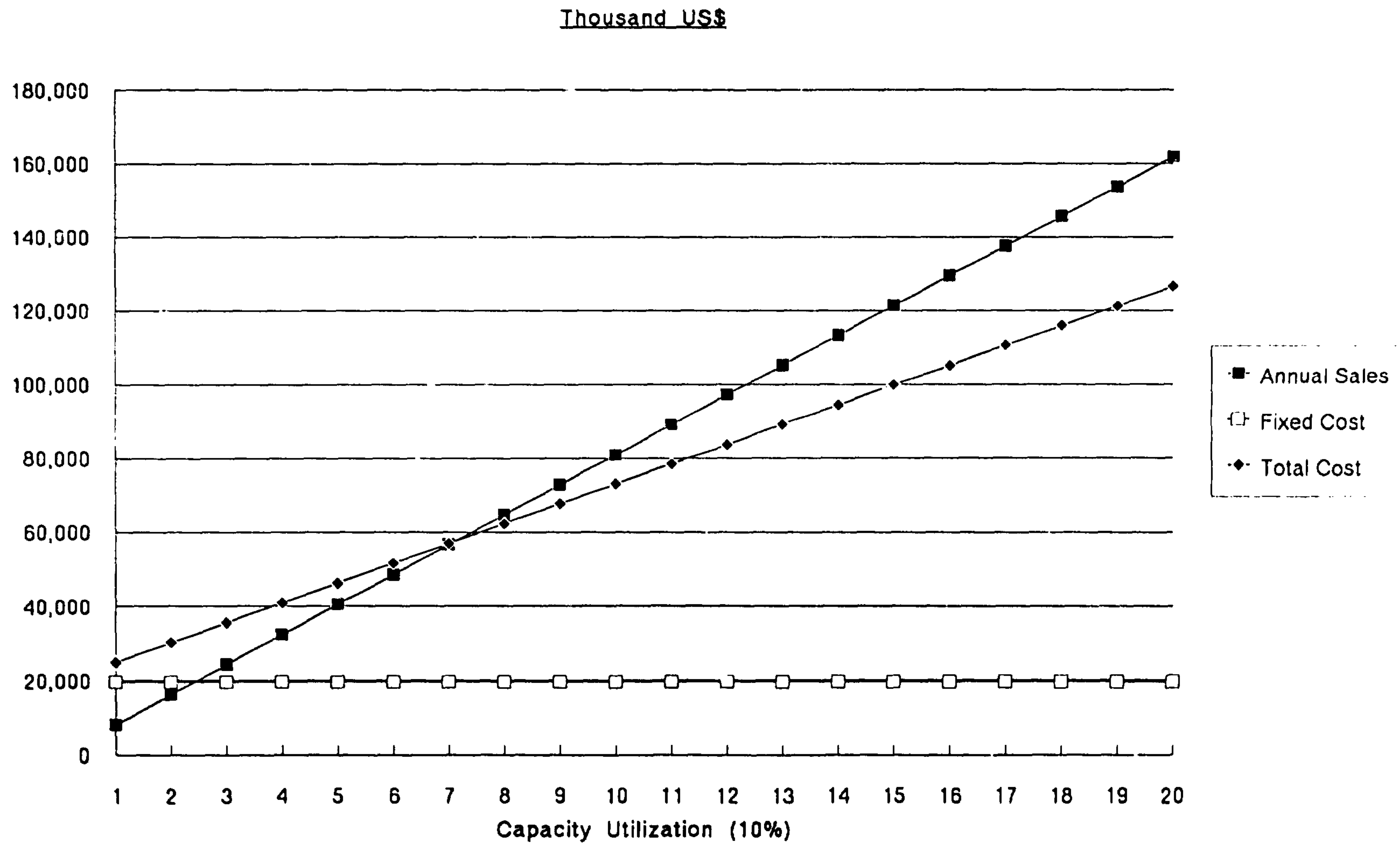


Fig. 10.4

Break Even Chart (Case 3 / Combination of Case 1 2)

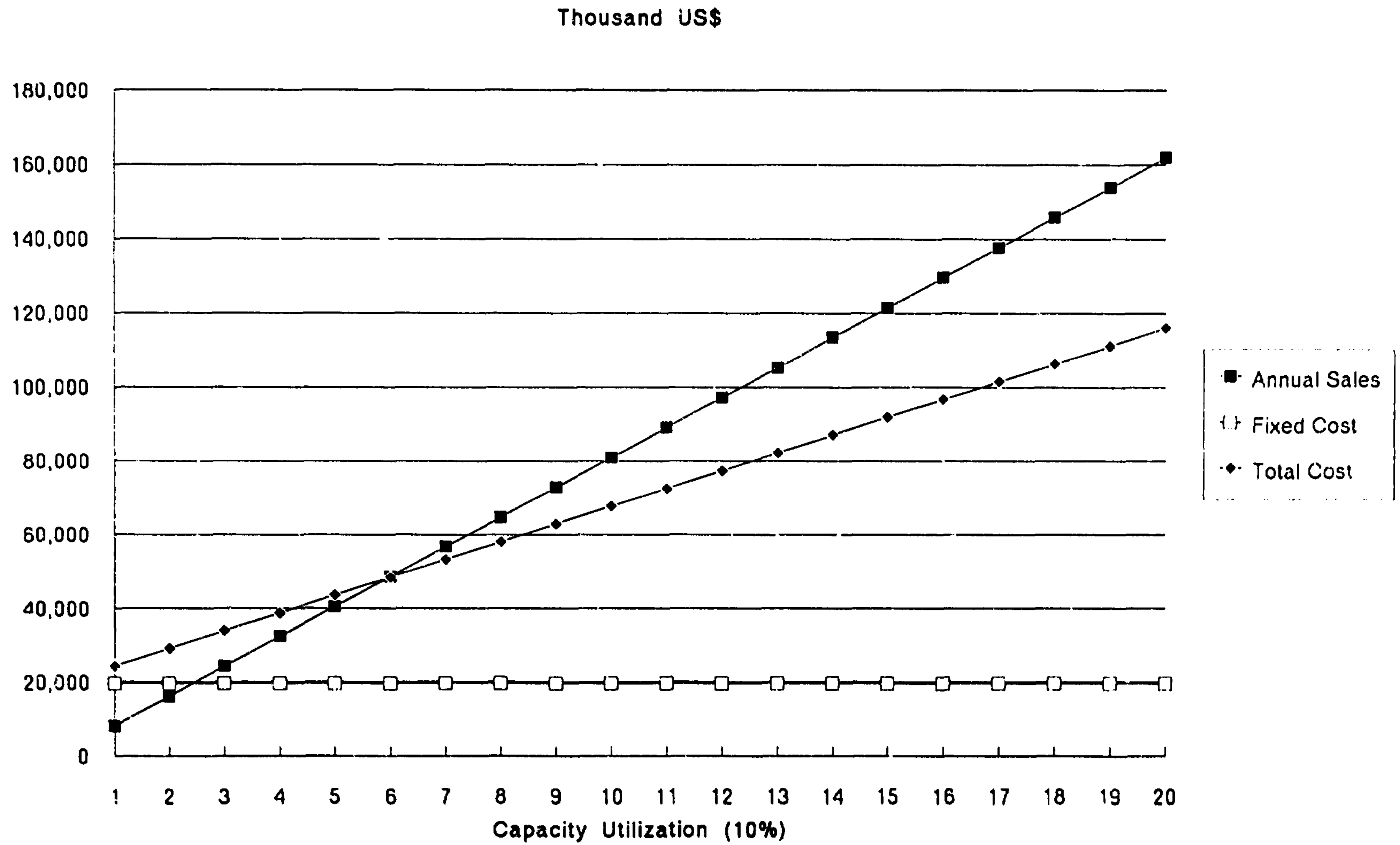


Fig. 10.5

10.8.3 Financial Analysis for Alternative Cases

The study team investigated the following alternative cases based on the plant annual capacity of 30,000 metric tons using hot rolling process. An attempt is made in order to show how commercial profitability can improve under different assumptions. One can argue that this assumption of 30,000 metric tons may not be realistic at present because of the projected market volume and expected hard competion with existing manufacturers in ASEAN, NIES and Japan. However, the results of the study could be used by potential investors for positive follow-up if judged as realistic by them as a referential indication.

a) Case 1: Keeping variable unchanged as original case
b) Case 2: Using 50% of copper scrap as raw material
c) Case 3: Incorporating 20% of flat products for lead frame
d) Case 4: Combination of above Case 2 and 3

Sensitivity of IRR for the above alternative cases are given in Fig. 10.6, 10.7, 10.8 and 10.9. Comparison of production costs between original and alternative case is also shown in Fig. 10.10.

Following Fig., Table and Schedule related to these alternative cases are provided in Annex.

Schedule A.1	Total Investment Cost
Schedule A.2	Financial Source
Schedule A.3	Production Cost of Case 4
Schedule A.4	Cash Flow of Case 4
Table A.1	Equipment List
Table A.2	Product Mix to be applied in Case 4
Fig. A.1	Product Volume to be Penetrated by the Project
Fig. A.2	Comparison of Production Costs per ton

Sensitivity of IRR (Alternative Case 1)

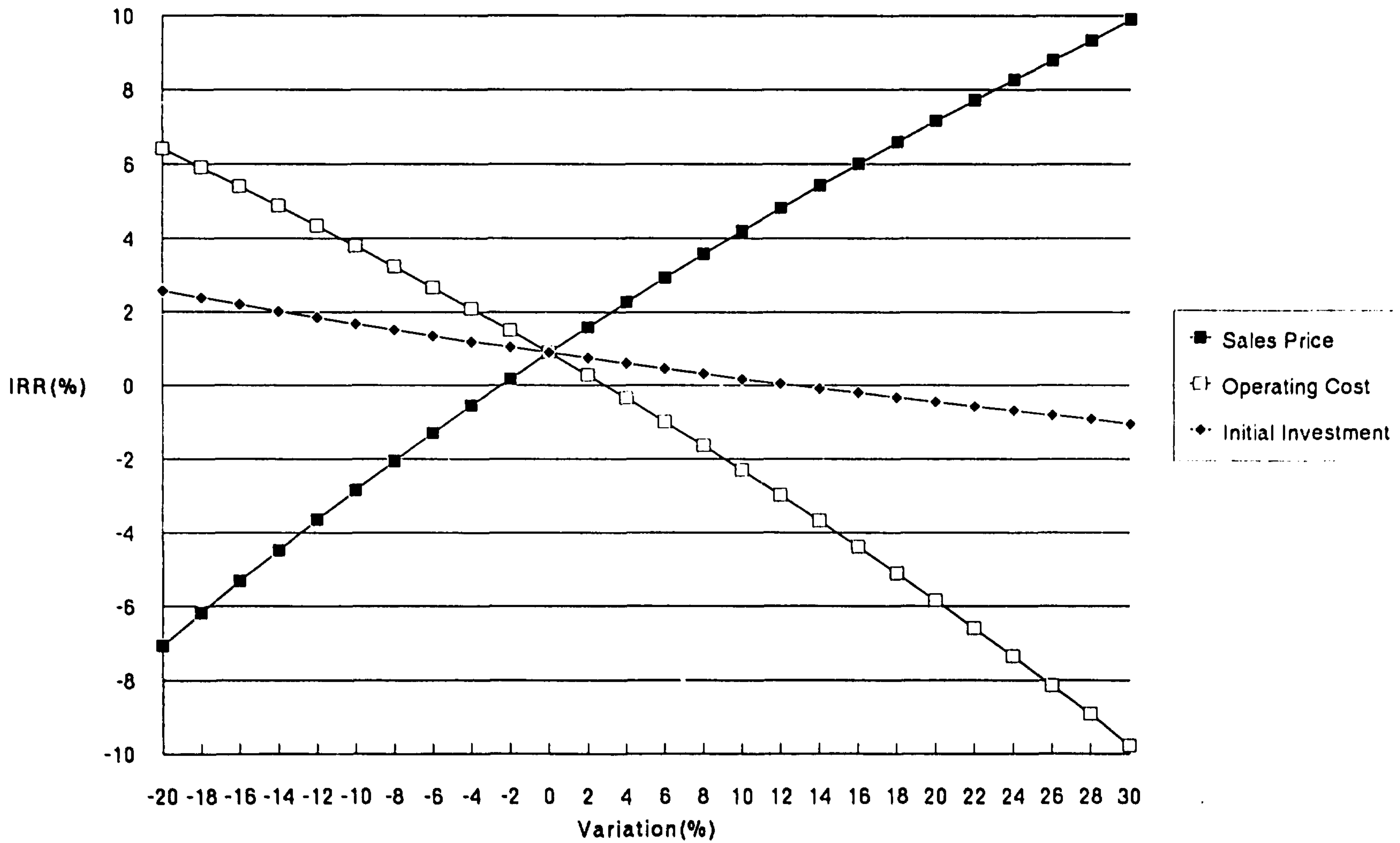


Fig.10.6

Sensitivity of IRR (Alternative Case 2)

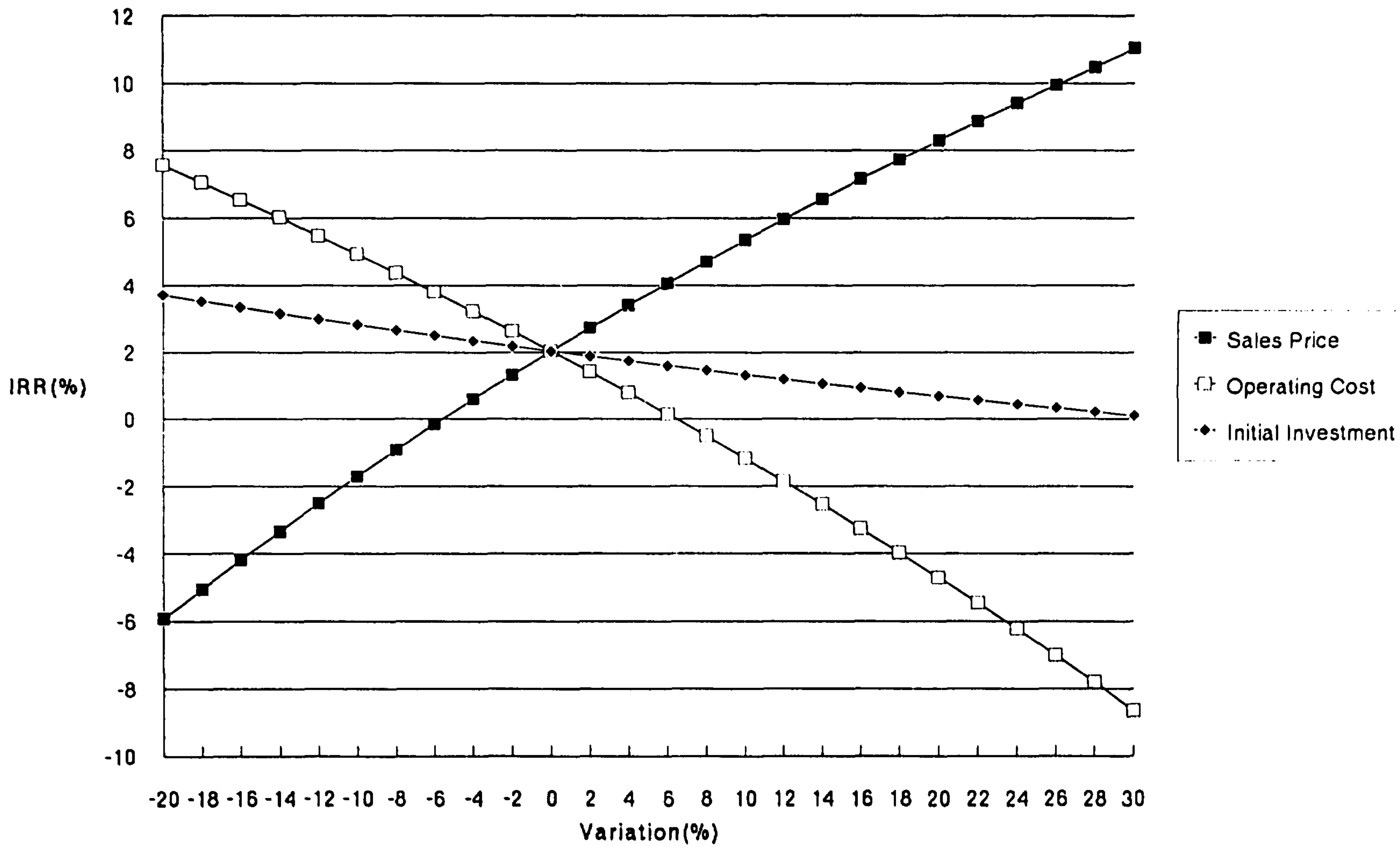


Fig. 10.7

Sensitivity of IRR (Alternative Case 3)

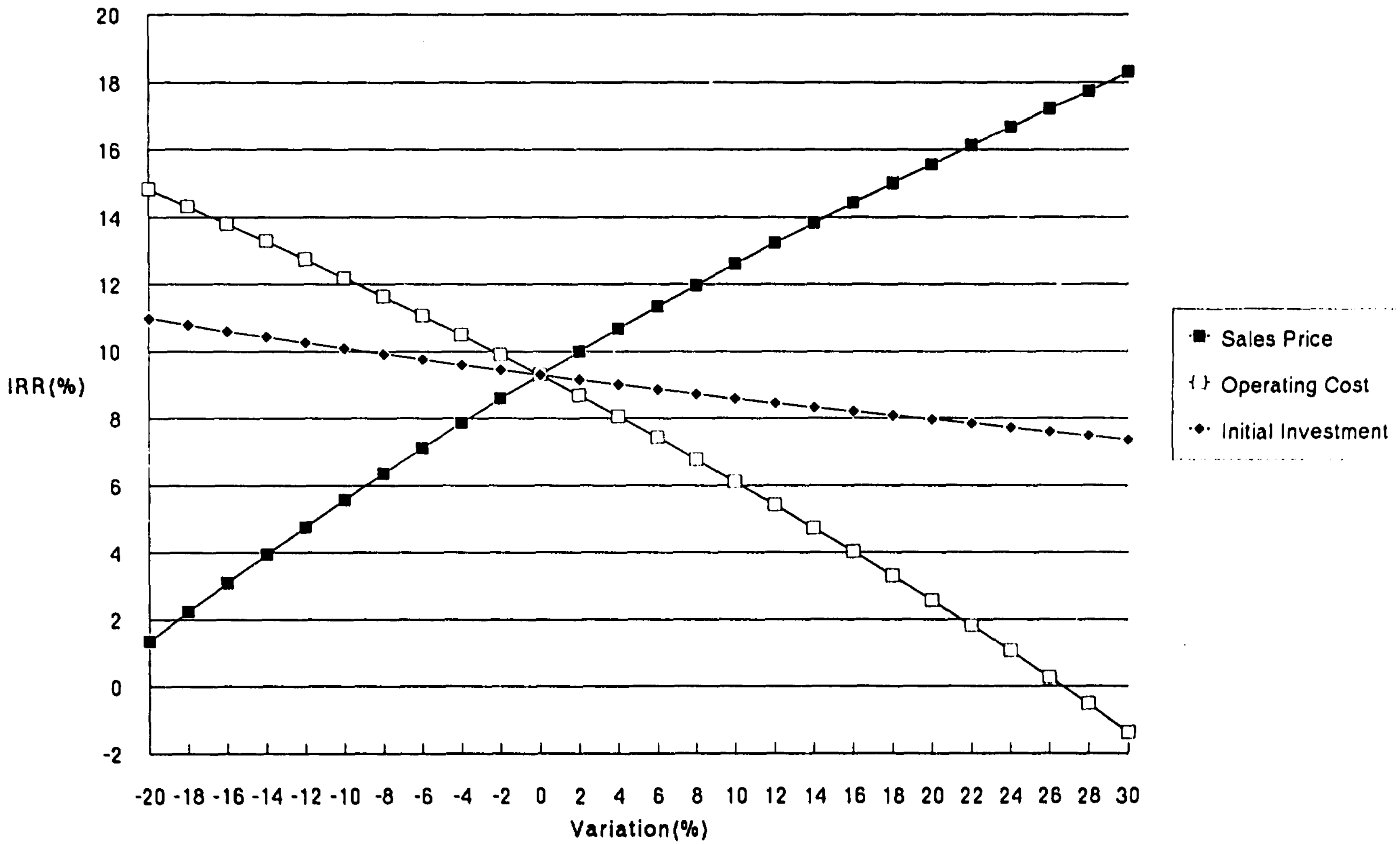


Fig.10.8

Sensitivity of IRR (Alternative Case 4)

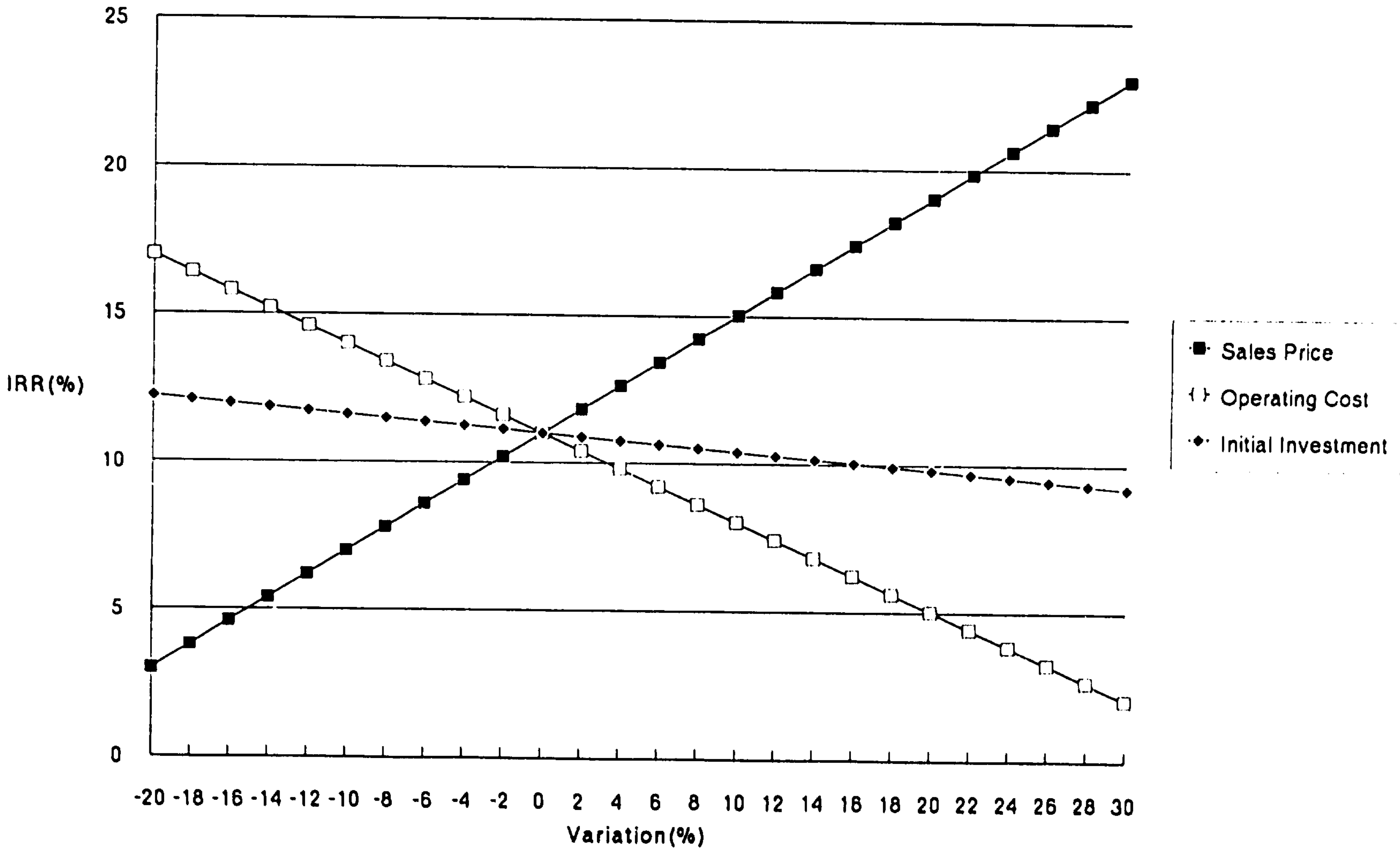


Fig. 10.9

Comparison of Production Costs per Ton

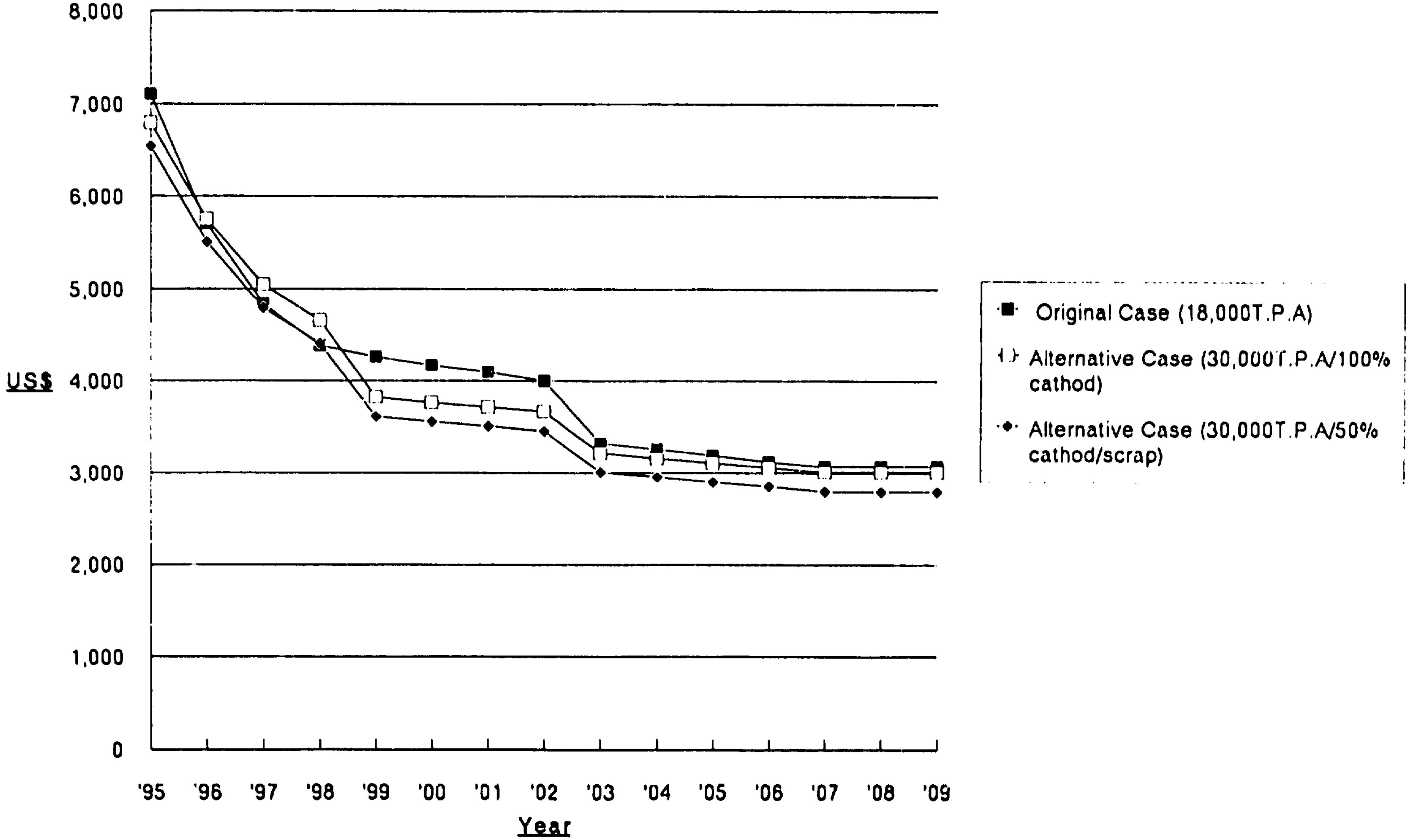


Fig.10.10

10.9 Economic Evaluation

There was insufficient information available for estimation of conversion factor. However, original case was evaluated using the followings:

Management and supervisors	0.9
Unskilled labor	0.8
Building	0.9
Local Machinery and equipment	0.9
Power	0.9
Utilities	0.9

The major raw materials such as copper cathode and zinc assumed to be supplied locally were valued based on the LME prices less ocean freight, inland transportation and insurance charges.

As for the sales revenue, domestic sales were estimated as foregin exchange on the basis of CIF prices of imported products since they are import substitution. Sales for export were based on the LME prices adjusted with ocean freight and inland transportation charges.

The cash flow in economic prices is shown in Schedule 10.9.

As the result of the evaluation, internal rate of return for the original case is 0.14%, which is also considered to be not viable project in economic terms.

Schedule 10.9 Cashflow (Economic evaluation)

(1000US$)

	1995	1996	1997	1998	1999	2000	2001	2002
Total Cash Inflow	31,445.04	32,363.52	42,902.50	53,452.22	54,020.04	54,985.76	56,602.90	57,208.88
Financial Resources	10,343.04	710.52	698.50	709.22	83.05	65.76	67.90	79.88
Sales	21,102.00	31,652.00	42,204.00	52,743.00	53,937.00	54,920.00	55,935.00	57,129.00
Total Cash Outflow	46,265.72	40,898.55	58,204.75	67,969.53	66,818.85	66,611.23	66,419.27	66,383.75
Total Assets	14,878.03	896.04	-1,259.67	950.03	72.38	85.21	87.98	103.50
Operating Costs	21,574.52	29,906.78	36,809.04	45,313.67	46,050.21	46,839.34	47,654.18	48,612.71
Cost of Finance	9,813.18	10,095.74	10,095.74	9,086.16	8,076.59	7,067.02	6,057.44	5,047.87
Repayment	0.00	0.00	12,759.65	12,619.67	12,619.67	12,619.67	12,619.67	12,619.67
Corporate Tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (Deficit)	-14,820.68	-8,535.03	-15,302.25	-14,517.31	-12,798.81	-11,625.47	-10,416.37	-9,174.87
Cumulated Cash balance	-24,561.66	-33,096.69	-48,398.94	-62,916.25	-75,715.06	-87,340.53	-97,756.91	-106,931.78
Inflow/Local	6,448.84	5,926.50	7,653.50	9,354.22	8,911.69	9,002.64	9,148.75	9,304.52
Outflow/Local	20,730.80	26,655.73	35,037.77	43,402.31	43,593.89	44,345.38	45,149.04	46,106.32
Surplus (Deficit)	-14,281.96	-20,729.23	-27,384.27	-34,048.10	-34,682.21	-35,342.74	-36,000.29	-36,801.80
Inflow/Foreign	24,996.20	26,437.02	35,249.00	44,098.00	45,108.36	45,983.12	46,854.16	47,904.36
Outflow/Foreign	25,534.92	14,242.82	23,166.98	24,567.21	23,224.96	22,265.85	21,270.23	20,277.43
Surplus (Deficit)	-538.72	12,194.20	12,082.02	19,530.79	21,883.40	23,717.27	25,583.93	27,626.93
Net Cashflow	-13,600.50	1,560.70	7,413.15	7,188.52	7,897.45	8,061.21	8,260.74	8,492.67
Cumulated Net Cashflow	-184,366.50	-182,805.80	-175,392.64	-168,204.12	-160,306.67	-152,245.46	-143,984.72	-135,492.05

Schedule 10.9 Cashflow (Economic evaluation) (1000US$)

	2003	2004	2005	2006	2007	2008	2009
Total Cash Inflow	58,478.63	59,760.70	61,134.52	63,216.27	63,280.58	63,291.47	63,356.15
Financial Resources	84.63	85.70	91.52	136.27	12.58	1.47	4.15
Sales	58,394.00	59,675.00	61,043.00	63,080.00	63,268.00	63,290.00	63,352.00
Total Cash Outflow	66,395.87	66,416.05	66,512.23	67,195.94	53,904.92	56,551.89	56,609.41
Total Assets	109.65	111.04	118.58	176.57	16.30	1.91	5.37
Operating Costs	49,628.25	50,656.62	51,754.84	53,390.13	53,541.06	53,558.72	53,608.49
Cost of Finance	4,038.29	3,028.72	2,019.15	1,009.57	0.00	0.00	0.00
Repayment	12,619.67	12,619.67	12,619.67	12,619.66	0.00	0.00	0 00
Corporate Tax	0.00	0.00	0.00	0.00	347.57	2,991.27	2,995.55
Surplus (Deficit)	-7,917.24	-6,655.35	-5,377.71	-3,979.67	9,375.66	6,739.58	6,746.74
Cumulated Cash balance	-114,849.00	-121,504.35	-126,882.06	-130,861.73	-121,486.07	-114,746.49	-107,999.75
Inflow/Local	9,489.19	9,635.24	9,748.96	10,080.95	9,979.36	9,967.00	9,971.08
Outflow/Local	47,110.54	48,122.75	49,209.60	50,873.35	51,213.64	53,860.73	53,917.30
Surplus (Deficit)	-37,621.35	-38,487.51	-39,460.64	-40,792.40	-41,234.28	-43,893.73	-43,946.22
Inflow/Foreign	48,989.44	50,125.46	51,385.56	53,135.32	53,301.21	53,323.02	53,385.07
Outflow/Foreign	19,285.32	18,293.30	17,302.64	16,322.58	2,691.61	2,691.12	2,692.12
Surplus (Deficit)	29,704.12	31,832.16	34,082.92	36,812.74	50,609.93	50,631.90	50,692.95
Net Cashflow	8,740.73	8,993.04	9,261.10	9,649.57	9,375.66	6,739.58	6,746.74
Cumulated Net Cashflow	-126,751.30	-117,758.25	-108,497.17	-98,847.59	-89,471.94	-82,732.36	-75,985.62

ANNEX

1. Total Investment Cost

Total investment costs of the alternative case is presented in Schedule A.1 based on the following estimation.

1) Equipment Cost

Item No.	Quantity	Item Description	Thousand US$ Cost
100		Production Equipment	
10A	5	Melting Furnace	6,500
10B	3	Holding Furnace	2,400
10C	3	Casting Machine	3,300
101	1	Slab Heating Furnace	3,800
102	1	Hot Rolling Mill	15,300
103	1	Scalping Machine	3,200
104	1	Cold Roughing Mill	10,300
106	3	Annealing Furnace	4,100
107	2	Pickling Line	4,800
108	2	Cold Finishing Mill	19,600
109	1	Degreasing Line	2,200
110	1	A/P Line	9,300
111	1	Heavy Gauge Slitting Machine	2,000
112	2	Light Gauge Slitting Machine	3,600
113	2	Cut-to-Length Machine	4,200
114	1	Large Roll Grinder	1,200
115	2	Small Roll Grinder	1,300
116	1	Scalping Blade Sharpener	200
150	1 lot	Raw Material Handling	2,000
160	1 lot	Packing Facility	500
200	-	Maintenance Shop	1,100
300	-	Transportation Facility	4,500
400	-	Utility Supply station	9,800
500	-	Electrical Equipment	13,000
600	-	Laboratory	2,000
700	-	Other Auxiliary	4,000
-	-	Spare Parts	10,300
-	-	Shipping Charge	1,000
-	-	Ocean Freight	3,000
Total			148,500

2) Construction Costs

The total net weight of production equipment for 30,000 t/y plant is approx. 5,000 tons, while that for 18,000 t/y is estimated about 3,000 tons.
As the construction cost (civil work and machine erection) is nearly proportional to the net weight of major equipment, the estimated cost for civil works and erection was estimated approximately 5,000/3,000 = 1.66 times higher than the original plan.

3) Materials Inputs

Proportionally increased compared with the original case, i.e. plant with the annual capacity of 18,000 metric tons.

2. Financial Source

Financing schedule based on the same conditions as original case mentioned in Chapter 10.6 is shown in Schedule A.2 hereto.

3. Market Penetration

In order to make an assumption to gain a higher sales in each targeted country, following penetration ratios were applied in alternative case.

Country	Original Case (18,000 T.P.A.)	Alternative Case (30,000 T.P.A.)
Indonesia	50%	70%
Malaysia	50%	70%
Philippines	80%	90%
Singapore	50%	70%
Thailand	10%	30%
Hong Kong	10%	35%
Japan	5%	20%
S. Korea	5%	20%
Taiwan	10%	30%

The product mix in the case of Case 4 (add lead frame to the suggested product mix) is also shown in Table A.2.

Schedule A.1 Total Investment Costs(Alternative Case)

1,000 US$

	1992 Foreign	1992 Local	1992 Total	1993 Foreign	1993 Local	1993 Total	1994 Foreign	1994 Local	1994 Total	1995 Foreign	1995 Local	1995 Total
Fixed Investment Costs												
Land Cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Civil and Building Works	2,191.20	826.68	3,017.88	9,898.04	3,718.40	13,614.44	14,870.28	9,284.62	24,154.90	0.00	0	0
Machinery and Equipment	29,702.80	115.00	29,817.80	59,405.60	104.00	59,509.60	29,702.80	622.00	30,324.80	29,702.80	311	30,014
Total Fixed Investment Costs	31,894.00	941.68	32,835.68	69,301.64	3,822.40	73,124.04	44,573.08	9,906.62	54,479.70	29,702.80	311	30,014
Pre-Production Costs												
Basic and Detailed Engineering	2,374.50	0.00	2,374.50	8,550.00	0.00	8,550.00	8,550.00	0.00	8,550.00	4,275.00	0	4,275
Erection Works	2,397.04	3,064.36	5,461.40	4,878.74	11,437.40	16,316.14	12,269.06	14,372.28	26,641.34	4,433.86	1,761	6,195
Training	187.50	0.00	187.50	0.00	0.00	0.00	844.50	0.00	844.50	844.50	0	845
Consultation and Tendering	1,999.50	0.00	1,999.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
Commissioning	266.56	58.31	324.87	0.00	0.00	0.00	1,199.52	261.56	1,461.08	1,199.52	262	1,461
Others	474.81	149.94	624.75	4,273.29	674.73	4,948.02	0.00	674.73	674.73	0.00	0	0
Total Pre-production Costs	7,699.91	3,272.61	10,972.52	17,702.03	12,112.13	29,814.16	22,863.08	15,308.57	38,171.65	10,752.88	2,023	12,776
Total Investment Costs	39,593.91	4,214.29	43,808.20	87,003.67	15,934.53	102,938.20	67,436.16	25,215.19	92,[illegible]51.35	40,455.68	2,334	42,790
(%)	90.38%	9.62%	100.00%	84.52%	15.48%	100.00%	72.78%	27.22%	100.00%	94.55%	5.45%	100.00%

Cumulated Investment Cost 1992 - 1995 (Foreign)	234,489.42
Cumulated Investment Cost 1992 - 1995 (Local)	47,697.83
Total	282,187.25

Schedule A.2 Source of Finance (Alternative Case)

(1000US$)

	1992 Jan - Jun	1992 Jul - Dec	1993 Jan - Jun	1993 Jul - Dec	1994 Jan - Jun	1994 Jul - Dec	1995	1996	1997	1998	1999
Equity	0.00	43,809.00	10,576.00	7,968.00	12,607.00	12,608.00	2,334.00	0.00	0.00	0.00	0.00
Foreign Loan	0.00	0.00	40,893.00	46,111.00	33,718.00	33,718.00	40,456.00	0.00	-19,489.60	-19,489.60	-19,489.60
Total Loan	0.00	43,809.00	40,893.00	46,111.00	33,718.00	33,718.00	40,456.00	0.00	-19,489.60	-19,489.60	-19,489.60
Current Liabilities	0.00	0.00	0.00	0.00	0.00	0.00	1,551.78	608.20	456.19	607.64	71.49
Bank Overdraft	0.00	0.00	765.86	-0.06	4,154.52	5,504.25	17,099.53	10,628.02	23,102.17	20,602.89	18,225.48
Total Funds	0.00	43,809.00	52,234.86	54,078.94	50,479.52	51,830.25	61,441.31	11,236.22	4,068.76	1,720.93	-1,192.63

(1000US$)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Equity (Local Currency)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Foreign Loan	-19,489.60	-19,489.60	-19,489.60	-19,489.60	-19,489.60	-19,489.60	-19,489.60	0.00	0.00	0.00
Total Loan	-19,489.60	-19,489.60	-19,489.60	-19,489.60	-19,489.60	-19,489.60	-19,489.60	0.00	0.00	0.00
Current Liabilities	56.23	58.30	68.26	72.35	74.36	78.22	116.55	11.34	0.00	0.00
Bank Overdraft	16,394.72	14,522.81	12,539 81	10,653.03	8,694.83	5,716.44	4,542.52	-16,599.13	-16,602.58	-16,602.57
Total Funds	-3,038.65	-4,908.49	-6,821.53	-8,764.22	-10,720.41	-12,694.94	-14,830.53	-16,587.79	-16,602.58	-16,602.57

Table A.2 Product Mix of Alternative Case

Product No.	Material	Thickness (mm)	Temper	Amount		Shape	
				ton/year	ton/month	sheet	strip
1	Copper (100% Copper)	0.1	H/2	960	80		o
2		0.5	0	1,920	160	o	o
3		1.0	0	1,920	160	o	o
4	Brass (70/30)	0.3	H/2	1,920	160		o
5		0.75	H/2	2,880	240		o
6	Brass (65/35)	0.15	H/2	960	80		o
7		0.3	H/2	1,920	160	o	o
8		0.75	H/2	1,920	240	o	o
9		0.8	0	1,920	240	o	o
10		1.2	0	1,920	240	o	
11		1.5	H/2	1,920	240	o	o
12	Copper Alloy for Lead Frame	0.2	H/2	3,000	250		o
		0.4	H/2	3,000	250		o

Schedule A.3 Total Production Costs (Case 4)

(1000US$)

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Production Amount (tons)	12,000	18,000	24,000	30,000	30,000	30,000	30,000	30,000	30,000
Main Raw Materials	27,516.47	41,273.68	55,031.40	68 769.77	68,769.77	68,769.77	68,769.77	68,769.77	68,769.77
Other Raw Materials	950.64	1,425.92	1,901.22	2,375.85	2,375.85	2,375.85	2,375.85	2,375.85	2,375.85
Utilities	1,838.82	2,758.17	3,677.54	4,595.63	4,595.63	4,595.63	4,595.63	4,595.63	4,595.63
Direct Labour	600.00	656.00	712.00	762.00	800.00	800.00	800.00	800.00	800.00
Spares and Maintenance	5,000.00	5,000.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00
Factory Overheads	1,000.31	1,500.43	2,000.57	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00
Factory Costs	36,906.24	52,614.20	65,822.73	81,503.25	81,541.25	81,541.25	81,541.25	81,541.25	81,541.25
Administrative Overheads	610.00	426.00	446.00	660.00	400.00	400.00	400.00	400.00	400.00
Depreciation	14,004.65	14,066.85	14,066.85	14,066.85	14,066.85	14,066.85	14,066.85	14,066.84	2,101.55
Financial Costs	13,973.44	15,591.68	15,591.68	14,032.51	12,473.34	10,914.18	9,355.01	7,795.84	6,236.67
Total Production Costs	65,494.33	82,698.73	95,927.26	110,262.61	108,481.44	106,922.28	105,363.11	103,803.93	90,279.47
Costs per tons (average)	5.46	4.59	4.00	3.68	3.62	3.56	3.51	3.46	3.01
Of it foreign %	50.75%	42.39%	34.34%	28.99%	27.79%	26.73%	25.65%	24.53%	13.32%
Of it Variable %	47.80%	56.78%	65.27%	70.96%	72.12%	73.18%	74.26%	75.37%	86.67%

Schedule A.3 Total Production Costs (Case 4)

(1000US$)

	2004	2005	2006	2007	2008	2009
Production Capacity (tons)	30,000	30,000	30,000	30,000	30,000	30,000
Main Raw Materials	68,769.77	68,769.77	68,769.77	68,769.77	68,769.77	68,769.77
Other Raw Materials	2,375.85	2,375.85	2,375.85	2,375.85	2,375.85	2,375.85
Utilities	4,595.63	4,595.63	4,595.63	4,595.63	4,595.63	4,595.63
Direct Labour	800.00	800.00	800.00	800.00	800.00	800.00
Spares and Maintenance	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00
Factory Overheads	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00
Factory Costs	81,541.25	81,541.25	81,541.25	81,541.25	81,541.25	81,541.25
Administrative Overheads	400.00	400.00	400.00	400.00	400.00	400.00
Depreciation	2,039.35	2,039.35	2,039.35	2,039.35	2,039.35	2,039.35
Financial Costs	4,677.51	3,118.34	1,559.17	0.00	0.00	0.00
Total Production Costs	88,658.11	87,098.94	85,539.77	83,980.60	83,980.60	83,980.60
Costs per tons (average)	2.96	2.90	2.85	2.80	2.80	2.80
Of it foreign %	11.81%	10.23%	8.59%	6.89%	6.89%	6.89%
Of it Variable %	88.25%	89.83%	91.47%	93.17%	93.17%	93.17%

Schedule A.4 Cashflow of Case 4 (production stage)

(1000US$)

	1995	1996	1997	1998	1999	2000	2001	2002
Total Cash Inflow	99,889.52	82,343.00	109,321.70	136,324.70	135,021.20	135,018.00	135,018.00	135,018.00
Financial Resources	45,865.52	1,309.00	1,276.68	1,306.71	3.17	0.00	0.00	0.00
Sales	54,024.00	81,034.00	108,045.00	135,018.00	135,018.00	135,018.00	135,018.00	135,018.00
								120,151.60
Total Cash Outflow	104,151.90	70,309.64	100,240.10	117,417.00	113,873.10	112,345.00	110,785.00	66,779.15
Total Assets	52,662.25	1,677.76	-1,285.91	1,731.77	-31.12	0.00	0.00	0.00
Operating Costs	37,516.23	53,040.20	66,268.73	82,163.25	81,941.25	81,941.25	81,941.25	81,941.25
Cost of Finance	13,973.44	15,591.68	15,591.68	14,032.51	12,473.34	10,914.18	9,355.01	7,795.84
Repayment	0.00	0.00	19,665.57	19,489.60	19,489.60	19,489.60	19,489.60	19,489.60
Corporate Tax	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10,924.92
Surplus (Deficit)	-4,262.38	12,033.36	9,081.60	18,907.70	21,148.09	22,673.00	24,233.00	14,866.38
Cumulated Cash balance	-14,686.97	-2,653.61	6,427.99	25,335.69	46,483.78	69,156.78	93,389.78	108,255.20
Inflow/Local	13,572.12	14,241.63	18,563.68	22,877.39	21,606.17	21,603.00	21,603.00	21,603.00
Outflow/Local	37,519.63	48,443.65	63,785.18	79,094.56	77,506.36	77,499.92	77,499.92	88,424.84
Surplus (Deficit)	-23,947.51	-34,202.02	-45,221.50	-56,217.17	-55,900.19	-55,896.92	-55,896.92	-66,821.84
Inflow/Foreign	86,317.40	68,101.36	90,758.00	113,447.30	113,415.00	113,415.00	113,415.00	113,415.00
Outflow/Foreign	66,632.29	21,865.99	36,454.89	38,322.56	36,366.72	34,845.11	33,285.94	31,726.00
Surplus (Deficit)	19,685.11	46,235.37	54,303.11	75,124.74	77,048.28	78,569.89	80,129.06	81,689.00
Net Cashflow	-33,078.96	27,625.04	44,162.88	52,429.70	53,111.03	53,076.75	53,076.75	42,151.82
Cumulated Net Cashflow	-272,478.00	-244,852.96	-200,690.08	-148,260.38	-95,149.35	-42,072.60	11,004.15	53,155.97

Schedule A.4 Cashflow of Case 4 (production stage) (1000US$)

	2003	2004	2005	2006	2007	2008	2009
Total Cash Inflow	135,018.00	135,018.00	135,018.00	135,018.00	135,018.00	135,018.00	135,018.00
Financial Resources	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sales	135,018.00	135,018.00	135,018.00	135,018.00	135,018.00	135,018.00	135,018.00
Total Cash Outflow	123,326.00	122,334.30	121,320.90	120,307.40	99,804.34	99,804.34	99,804.34
Total Assets	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Operating Costs	81,941.25	81,941.25	81,941.25	81,941.25	81,941.25	81,941.25	81,941.25
Cost of Finance	6,236.67	4,677.51	3,118.34	1,559.17	0.00	0.00	0.00
Repayment	19,489.60	19,489.60	19,489.60	19,489.60	0.00	0.00	0.00
Corporate Tax	15,658.48	16,225.96	16,771.67	17,317.38	17,863.09	17,863.09	17,863.09
Surplus (Deficit)	11,692.00	12,683.68	13,697.10	14,710.60	35,213.66	35,213.66	35,213.66
Cumulated Cash balance	119,947.10	132,630.80	146,327.90	161,038.50	196,252.20	231,465.86	266,679.52
Inflow/Local	21,603.00	21,603.00	21,603.00	21,603.00	21,603.00	21,603.00	21,603.00
Outflow/Local	93,158.41	93,725.88	94,271.59	94,817.30	95,363.02	95,363.02	95,363.02
Surplus (Deficit)	-71,555.41	-72,122.88	-72,668.59	-73,214.30	-73,760.02	-73,760.02	-73,760.02
Inflow/Foreign	113,415.00	113,415.00	113,415.00	113,415.00	113,415.00	113,415.00	113,415.00
Outflow/Foreign	30,167.00	28,608.43	27,049.27	25,490.11	4,441.33	4,441.33	4,441.33
Surplus (Deficit)	83,248.00	84,806.57	86,365.73	87,924.89	108,973.70	108,973.70	108,973.67
Net Cashflow	37,418.27	36,850.79	36,305.80	35,759.37	35,213.66	35,213.66	35,213.66
Cumulated Net Cashflow	90,574.25	127,425.04	163,730.84	199,489.50	234,703.16	269,916.82	305,130.48

Projected Volume to be Penetrated by the Project

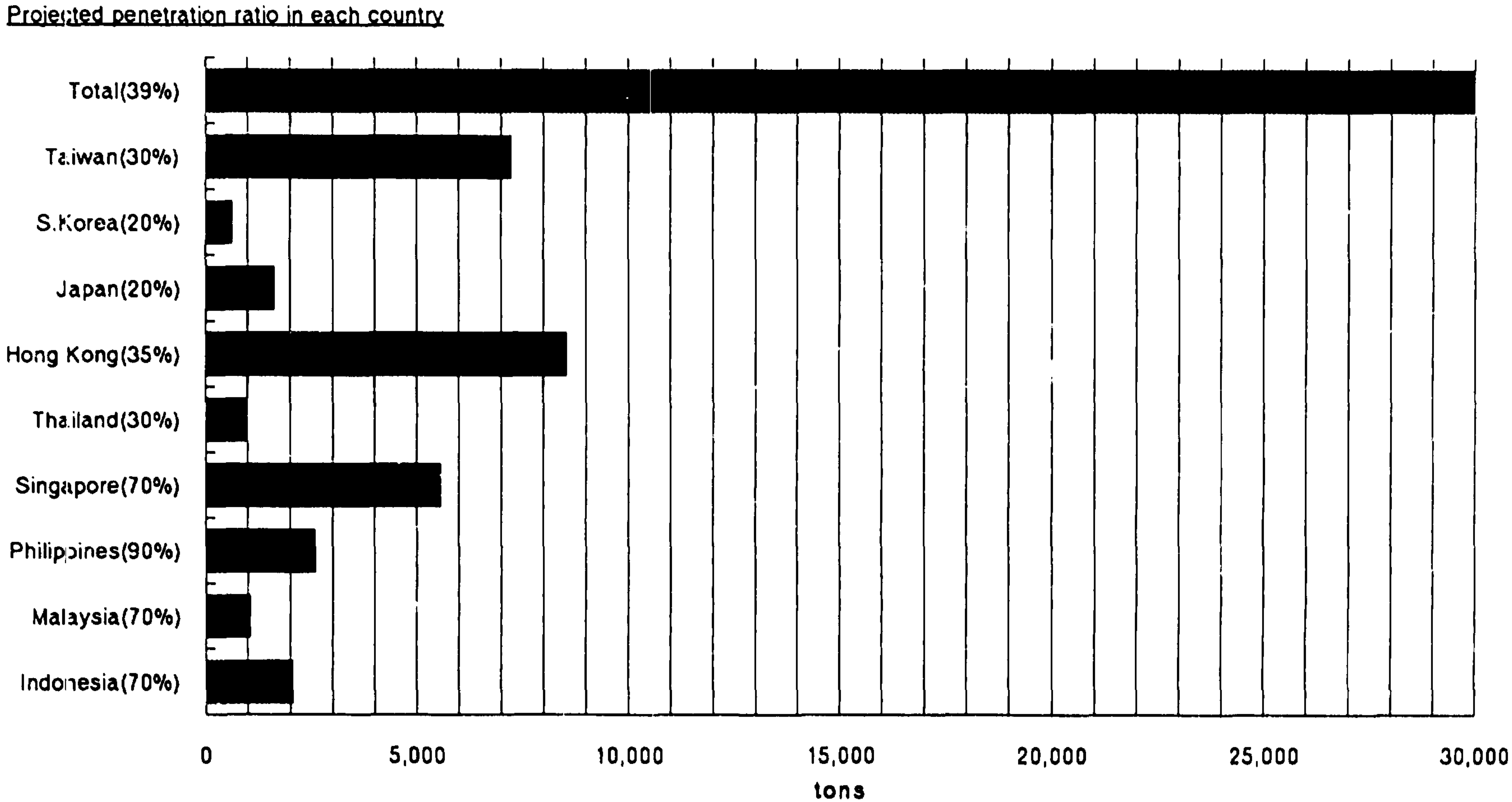


Fig. A.1