Survey Report on Iron and Steel Development in Indonesia

Jan. 1973

Overseas Technical Cooperation Agency

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OVERSEAS TECHNICAL COOPERATION AGENCY

Preface

The Government of Japan, in response to the request of the Government of the Republic of Indonesia, undertook to conduct a feasibility survey for the iron and steel development in Indonesia and entrusted the execution of the survey to the Overseas Technical Cooperation Agency (O. T. C. A.). Being congniyant of the importance of iron and steel industries in Indonesia, the O. T. C. A. organized a survey team comprising eight members, headed by Mr. Takitsu Mitsui, Deputy director of engineering and consulting division of Nippon Steel Corporation and dispatched it to the Republic of Indonesia for a period of 32 days from October 4 to November 4, 1972.

Thanks to the kind cooperation of the Government of Indonesia, the survey was carried out satisfactorily and the report is now ready for presentation herewith. On behalf of the O. T. C. A., I would like to take this opportunity to express my deep gratitude to the authorities of various agencies of the Government of Indonesia concerned, for their wholehearted cooperation and support extended to the team in the execution of the survey.

KEIICHI TATSUKE
Director General Overseas
Technical Cooperation Agency

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List of Attached Exhibits, Tables and Maps

Chapter I Introduction

The team, consisting of eight members (Exhibit-1), sent by the Overseas Technical Cooperation Agency in accordance with the agreement made between the Government of the Republic of Indonesia and the Government of Japan carried out its investigation with the cooperation of the Directorate General of Basic Industry, the Department of Industry, between October 8, 1972 - November 3, 1972. The assigned objectives were:

a. carry out study of market demand pattern and product requirements up to 1985
b. establish a master plan for iron and steel industry development that includes types of production, capacity and favorable location
c. estimate the investment and production cost for a specific industrial establishment

Details of these objectives are attached as Exhibit-2.

The team had many interviews with prominent governmental officials and officials of national and private companies directly or indirectly connected with the development of the iron and steel industry and the steel consuming industries. Field trips were made to Bandung, Cilacap, Yogyakarta, Surabaya, Medan and to the Cilegon - Merak - Anyer - Lor regions.

The survey schedule is attached as Exhibit-3.

The information collected and the findings made during this survey period were submitted to Mr. Ir. Suhartoyo, Director General, Directorate General for Basic Industry, Department of Industry on November 3, 1972 in the form of an interim report.

The team is continuing its evaluation of the survey. And particular emphasis is being placed on the analysis of the steel market, the specification of production facilities, infrastructural works and financial appraisals of the team's proposals and their effects on the national economy.

The team hopes that this report will be favorably accepted by the Indonesian Government. It also wishes to take advantage of this report to express its sincere gratitude for the cooperation and assistance extended by the Indonesian Government.

Chapter II Current and Future Trends in Steel Demand

i) Current Trend

The Indonesian economy got rid of stagnation and assumed an upward course when it entered the first five year plan (1969/70 - 1973/74) and its Gross Domestic Product (GDP) on a real-term basis has shown an average growth rate of 7.1% during the past few years. The team acknowledges that this upward swing is due mainly to the Government's sound fiscal policy, its positive attitude to foreign aid and the increase of foreign private investment into the country. These Government policies have brought about reactivation of pending development projects, rehabilitation of economic structure and general improvement in the living standards.

In view of this economic change, the demand for steel has risen rapidly in the last few years. (Ref. to Table 1-1)
Reflecting the nature of the aforementioned economic recovery, the consumption of steel in the building and civil engineering sector, occupied a large part of the total steel consumption. The manufacturing activity also regained impetus with the first year plan. The competent authority estimates that the yearly growth rate of steel consumption in light industries has been in the neighborhood of 10% whereas the steel demand of basic industries has just started to grow.
Although it is true that the steel demand mainly for steel pipes and fabricated steel structures, for the development of petroleum exporation and production has contributed much to the growth of steel consumption, it can hardly be said that this sector has been the mainstay of steel demand. (Ref. to Table 1-2)

Regionally the Jakarta area represents the largest steel consuming region and the Surabaya area and the Medan area follow. Steel demand is estimated to have reached 668,000 MT in 1971 (CY) and 764,000 MT in 1972 (CY) on a finished steel basis. When averaged for the years 1970 - 72 (CY), the figure reaches 641,000 MT. (Ref. to Table 1-1)

A simplified pattern of steel demand averaged for the years 1970 - 72 (CY), is indicated as follows.

long products	43.8 %
flat products	34.6 %
tubular products	21.6 %
	100.0 %

When welded pipes are included among flat products, because the former are fabricated exclusively from the latter, the above pattern changes as follows.

long products	43.8 %
flat products	47.0 %
tubular products	9.2 %
	100.0 %

1) The Future Prospect of the National Economy

The future course of the growth rate of steel demand depends upon the GDP rate of growth and the pattern of this growth. The team notices that the economic pattern in the country is gradually changing from rehabilitation and stabilization into real development in various economic fields, particularly in manufacturing industries. (Ref. to Table 1-2) This change in economic pattern may bring about a short period of stagnation. However, the team is of the opinion that the economy will revive in the course of implementation of the second five year plan, and that the GDP average growth rate will exceed that of the first five year plan. But the extent to which further petroleum development will contribute, cannot be predicted at present. The team's conservative estimate in this field is due to the rather slow growth rate of petroleum export in the past few years. Taking into consideration this prospect, it is expected that steel demand will come not only from rehabilitation and restabilization, but also from new development fields, resulting in a wider coverage of consuming sectors. In other words the future prospect of steel demand will be supported by private investment as well as by public expenditure, i.e., by the enlargement of manufacturing sector as well as by governmental investment in improvement of infrastructure.

The team understands that one of the "guiding" principles of the second five year plan is the augmentation of employment. Consequently, manufacturing industries will be given higher priority than in the preceding plan. In this connection the well-balanced investment between manufacturing, especially basic industries, and infrastructure will be the cornerstone of the second five year plan.

The prominent economists responsible for formulating the second five year plan stated that the average growth rate of GDP (in a real term basis) in the 1970's ranged from 7.0% to 8.0%. Therefore the team decided to adopt 7.5% as the average growth rate of GDP during the second five year plan and 8% during the third five year plan. (Ref. to Exhibit 4-1)

iii) The Future Demand for Steel

In forecasting the future demand (or apparent consumption) for steel the team adopted the following three methods:

a) summing up of sector by sector demand forecast

b) macro-analysis using Gross Domestic Production

c) macro-analysis using Gross Domestic Capital Formation

Tables 1-3 and 1-4 show the results of a) method. It consists of summing up sectorial end use amounts of steel based upon various published information and information obtained from Government officials, bankers and traders. The outline of these tables are transcribed below.

year	apparent consumption of finished steel (1,000 MT)
1971	668
74	933
79	1,651
84	not available

The Method (b) (Ref. to Exhibit 4-2) consists of multiplying the apparent consumption of finished steel in the past by assumed GDP growth rates plus 100%. The results are shown below.

year	apparent consumption of finished steel (1,000 MT)
1971	668
74	940
79	1,717
84	2,917

The Method (c) (Ref. to Exhibit 4-2) consists of multiplying the apparent consumption of finished steel in the past by GDCF growth rates which is calculated from assumed ratio GDCF/GDP plus 100%. The results are shown below.

year	apparent consumption of finished steel (1,000 MT)
1971	668
74	940
79	1,680
84	3,000

The figures obtained by the three methods are summarized below.

	apparent finished steel consumption (1,000 MT)		
year	(a) method	(b) method	(c) method
1971 (actual)	668.0	668.0	668.0
74	932.6	940.0	940.0
79	1,650.8	1,717.0	1,680.0
84	not available	2,917.0	3,000.0

It is to be noted that there is close correlation between all figures. In other words the figures obtained by (a) method are proved reliable by (b) and (c) methods. Therefore, the team adopted the below-listed figures for its analysis of the steel market.

Forecast of Apparent Steel Consumption

year	(finished steel basis) (1,000 MT) (per Capita, Kg)	(converted to crude steel basis) (1,000 MT) (per Capita, Kg)
1971	668.0 (5.6)	853.7 (7.1)
74	933.0 (7.2)	1,190.0 (9.1)
79	1,651.0 (11.4)	2,100.0 (14.5)
84	2,920.0 (17.9)	3,730.0 (22.8)

From the above the following tabulation is made.

period	annual growth rate of steel consumption	steel consumption growth rate/growth rate of GDP
1971-74	11.8 %	1.66
75-79	12.4 %	1.33
80-84	12.1 %	1.27

Product mix is tabulated from Table 1-4.

	1970-72 average	1974	1979
long product	43.8 %	42.0 %	41.2 %
flat product	34.6	35.8	38.3
tabular product	21.6	22.2	20.5

It is to be noted that the percentage of flat products will increase with the increase in the GDP share of the manufacturing sector.

Chapter III Estimated Production of Existing Steel Mills and Mills Presently Under Construction

Existing steel mills and those presently under construction can be divided into the following five categories:

i) Scrap Rerolling Mills

These mills produce concrete reinforcing bars or flat bars from scrap principally derived from ship-breaking. At this moment 9 mills are in operation. (Ref. to Table 2-1 a and 2-16).

According to the statistics supplied by the Directorate General of Basic Industry, their licensed capacity on a two shift basis is 142,000 MT/y, but in the light of observations made by the team at several mills actual production is thought to be about one third of the capacity just mentioned. Therefore, the production of finished steel in 1972 is estimated to be about 50,000 MT. Excluding licensees who have never reported about their project, but including licensees who have started their construction (except P. T. Krakatau) the estimated production in 1974 will be around 60,000 MT. Production of these mills is severely restricted by the shortage of rerollable scrap. Consequently, any future increase of production will not be remarkable. The team recommends that the Government encourage ship-breaking works. But even if this is realized, the mills will have to depend partially on imported rerollable scrap or billets purchased in the future.

ii) Rolling Mills with Melting Furnaces

At present three rolling mills with furnaces are in operation. One of the mills operates an open hearth furnace, while the remaining two operate electric furnaces. Total production is expected to be 40,000 M/T in 1972. (Ref. to Table 2-1) One of these mills has another furnace under construction and a few other rolling mills are planning to constructing electric furnaces. However, availability of purchased scrap constitutes a grave problem since the amount of scrap which can be collected in the country is limited. Therefore, the price of scrap, currently about $20/MT, will inevitably rise to $45 - $55/MT the international price level of imported scrap. Due to the high interest rate on bank loans there exists the strong possibility that scrap imported into Indonesia will exceed the international price level. Therefore, the team estimates that the production of these mills in 1974 will be around 80,000 MT. In the future this group of mills may have to depend heavily on scrap or billets (or billet-size ingots) purchased from outside.

iii) Galvanized Sheet Mills

Seven mills (Ref. to Table 2-2) scattered widely throughout the country, are presently operating 10 lines. Raw-material cold rolled sheets are imported mainly from Japan. The total production of these mills in 1972 is estimated at about 95,000 MT. More lines are being constructed (Ref. to Table 2-2). Production for 1974 is expected to reach 109,000 MT. Competition among these mills has been very keen and the growth of demand will not be so fast as in the past few years. It is also expected that roofings and sidings made of galvanized sheets will have to compete with substitutional materials such as tiles, plastics, woods, etc., if sales price of galvanized sheets exceeds a certain level.

iv) Pipe Mills

Currently galvanized (or non-galvanized) water pipes ranging from 1/2" to 4" are produced by 8 electric straight welding lines at 6 mills. Two of the 8 are for small diameter welded pipes for conduit tubes and furniture (Ref. to Table 2-3). The total production of pipe in 1972 is estimated to be 21,000 MT. A few more pipe lines are under construction, but the competition among them is getting severe and consequently will tend to bring down the average utilization rate of capacity. Production for 1974 is estimated at 30,000 MT. Besides the above lines the Hoogovens-IPI-Krakatau group is now constructing a 4" - 62" spiral pipe mill in Cilegon. The team was told that two more lines would be added later. Since the capacity of these mills depends upon sizes to be produced, it is difficult to estimate their production for 1974.

All skelp (or slit hot and cold coils) is imported from abroad.

v) Wire Drawing Mills

Presently three mills (one of them is P.T. Krakatau) are in operation and one mill is under construction (Ref. to Table 2-4). The estimated production of drawn wire for 1972 is 10,000 MT and for 1974 30,000 MT. Since wire products are widely used in housing, farms, roads, packing, containers, etc., it is believed that the demand for wire will rapidly increase. The team considers that the Government should encourage private investment in wire product manufacturing, and since this manufacturing field is relatively labor intensive and production units are small, it will contribute to regional development.

All estimations are summed up in the table as follows:

unit: MT

category	1972	1974
a	50,000	60,000
b	40,000	80,000
c	95,000	109,000
d	21,000	30,000*
e	10,000	30,000

*) spiral pipe excluded.

Chapter IV The Infrastructure from the Standpoint of Iron and Steel Industry

i) Geographical Features of Indonesia, and Maritime Transportation

Indonesia consists of Java, Sumatra, Kalimantan, Sulawesi, Irian Barat and many other islands. The center of the country is West Java. This feature suggests that well-developed interinsular and coastal transportation are of paramount importance to nation-wide industrial and commercial activities. A large-scale steel industry requires a nation-wide sales network.

The transport system is at present in a very poor condition. From this viewpoint the team would like to remind the Indonesian Government that one of the most important factors in the successful development of industry in Japan was the cheap and well-organized interinsular and coastal transportation. In this connection the team would be happy to hear from the competent authority that a reconstruction and reorganization plan for the shipping industry has been initiated. The team compiled the following part of the report on the assumption that the interinsular and coastal transportation would be substantially improved during the 1970's. Otherwise the concept of a national steel production center would be meaningless and the integrated steel plant to be proposed would not be able to compete with imported steel products.

ii) Harbor Facilities

The four most important international harbors, namely, Jakarta, Surabaya, Medan and Cilacap were visited by the team. The results of this survey show that these ports will be able to become centers of international trade and industry if they are dredged and their loading and unloading facilities are strengthened.

However, even after these improvements, they will never be able to accommodate ships of over 30, 000 DWT. Thus they are unsuitable as sites for an integrated steel plant, as such plants must have a berth which can accommodate at least a 60, 000 DWT carrier (Ref. to Table 3).

Therefore, one of the key factors in establishing a master-plan for the iron and steel industry is to determine a suitable location for the construction of a deep water (at least 12 - 13 meters deep) harbor.

iii) Electric Power Generation and Transmission

The iron and steel industry is not only a large power consuming industry, but also its peak power demand is very high, unlike the power demand in the aluminium or fertilizer industries. In order to alleviate this high peak demand, a large steel plant, even if equipped with its own power station, should be connected with a rigid national power grid. However, none of the four industrial areas mentioned previously, especially the Jakarta area, are equipped with powerful electric distribution systems. Consequently, it is to be hoped that the power grid in the West Java region be up-graded to over 300, 000 KW and a high voltage transmission line be constructed from Jakarta to the North West end of Java by the time the integrated steel plant to be proposed is completed.

iv) Water Supply

A large scale steel plant uses a vast amount of water. Since in Indonesia, irrigation has the highest priority for water, an integrated steel plant should be located in a place where an ample supply of water is available without conflicting with irrigation systems. At least 20 - 30 m^3 of additional water/MT of crude steel is needed when 80% recirculation rate is adopted.

v) Land Transportation

For an iron and steel mill, even for one adjacent to a good harbor, transportation by rail or by road is important for distribution of products as well as for collection of auxiliary raw materials. Also, it must be pointed out here that the equipment for a large steel plant is often very heavy. In this respect Indonesia's transportation systems leave much to be desired. Particularly the railway from Jakarta to the North West end of Java should be improved and the highway between the two places should be made capable of accepting 15-ton vehicles.

vi) Land and its Sub-surface Structure

Land space necessary for an integrated steel plant is about 1 m^2/yearly MT (excl. land for a waterpipeline and a reservoir). If houses of employees, hospitals, schools and recreation facilities are built outside the plant site, additionally 0.5 m^2/yearly MT will be needed. One can estimate how large necessary area should be for this type of plant.

Since the equipment, such as blast furnaces, rolling mill stands, boilers and power alternators, etc. for a large scale steel plant is very heavy, the load bearing force of the sub-surface structure is a very important factor for locating such a plant.

In addition a large steel plant tends to attract to nearby areas various manufacturers of steel made products, suppliers of auxiliary raw materials and mill supplies and plant waste material disposal facilities. Therefore, some area should be reserved for these associated enterprises near the plant. In other words the land space where a large steel plant can be located must be large enough to constitute an industrial estate with a common infrastructure.

vii) Supporting Industry

The iron and steel industry needs machines and supplies of almost-all diciplines of technology, particularly the mechanical and electrical industry which is developing in the Jakarta area. They should be further encouraged in order to support the integrated steel plant to be proposed.

Chapter V Raw Materials and Fuels for the Iron and Steel Industry

i) Iron Ores

According to the results of geological survey so far carried out in the country there has been found no large scale deposits of magnetite or hematite suitable for metallurgical use. (Ref. to Tables 4-1 and 4-2) Lateritic iron ore beds (Table 4-3) occuring in several places in the Kalimantan and the Sulawesi areas can not be economically used for ironmaking with the presently available technology. With regard to the sand iron (Ref. to Map 1 and Table 4-2) the deposit near Cilacap will be exhausted in several years due to export of about 300,000 dry MT/y. The sand iron deposit near Yogyakarta which is estimated at 20,000,000 dry MT has not been developed yet. The exploration underway (100 x 20 m grid exporation expected to end during 1972) shows that the quality of this iron sand is likely to be inferior to Cilacap iron sand. With the present state of knowledge it is extremely difficult to treat it technically and economically.
The SL - RN process, a kind of rotary kiln direct reduction process (Ref. to Exhibit 5-1), cannot be economically applied to this kind of ore. Therefore, the only way of using this ore is by mixing it to some limited extent into sinter feed for blast furnaces. This way of use depends upon the economy of transportation method and cost to be incurred from the mines to Cilacap.

ii) Fuels

Coals produced in Ombilin and Bukit Asam and other places (Table 5) are not suitable for metallurgical use although some amount could be used for blending cokeoven feed. Accordingly, the only domestically available fuel expected to be used for ironmaking is natrual gas which may be found in the West of Java and its offshore area. The natural gas can be reformed to the mixture of H^2 and CO by steam or by partial oxidation methods and used for reducing iron bearing materials into iron-sponges or pre-reduced pellets. This process is called "natural gas direct reduction" and many processes appear in the lists of patents throughout the world. Out of them, the Midland and Ross Process (Midrex) (Ref. to Exhibit 5-2) and HYLSA Process (HyL) (Ref. to Exhibit 5-2) has been commercially applied in several steel plants. In addition U.S. Steel Corp. and Armco Steel Corp. have under construction direct reduction plants featuring the HIB Process and Armco Process, respectively. The results of operation in these two American companies have not yet been disclosed. In all these processes mentioned above the amount of natural gas (assuming 9,000 Kcal - 10,000 Kcal/Nm^3) needed for producing a ton of sponge or reduced pellet is about 400 - 600 Nm^3. Therefore, in order to apply one of these processes for 2 million ton annual production of crude steel for a minimum of 20 years 12 - 18 x 10^8 Nm^3 deposits of natural gas (50% reserve included but gas for utilities excluded) must be found. The experts of PERTAMINA informed this team of their preliminary exploration in West Java. According to their information active exploration is planned for the North side of West Java in the coming years, but the probability of finding such a large scale deposit in the extreme West of Java is entirely unknown. Apart from West Java, large deposits of natural gas may be found and exploited elsewhere in the country. However, combination of such a large deposit of natural gas and a location of a steel plant described in Chapter IV may be very difficult to be found. At any rate, this eventuality cannot be anticipated. Therefore, if by chance such a combination is found it should be studied as an entirely separate steel project. The team would further like to advise that this matter be carefully studied by inviting a feasibility study team consisting of direct reduction experts and natural gas exploration experts, being aware of the technical risks involved. If the deposit of natrual gas in the extreme West of Java is of a small scale, the gas can be very effectively used for thermal electric power generation and reheating furnaces of the conventional integrated steel plant, because natural gas is an ideal fuel from the environmental standpoint.

iii) Auxiliary Raw Materials

According to the information obtained at the Geological Survey Institute, limestone suitable for metallurgical purpose can be found in West Java (Ref. to Table 6). Dolomitic limestone or soft dolomite occurs in East Java and Manganese ore in West and Central Java. But there is no assurance that these resources can be used for metallurgical purposes qualitatively and quantitatively. The team was informed of the availability of ingot making bricks from some factory in Bandung, although high-grade refractory materials have to be imported. As for ferro-alloys, it is to be hoped that electric power generated by Asahan Project will be made available for producing necessary amount of ferro-manganese and ferro-silicon.

iv) Possibility of Import of Raw Materials

As mentioned in the previous paragraphs Indonesia is rather poor in raw material resources for the iron and steel industry, but geographically its position is favorable for importing them because of its proximity to Australia where iron ores of good quality and coking coal of medium and high volatile types are abundant and their prices are comparatively lower than the average international level. (Ref. to Tables 7-1 and 7-2) In addition this proximity to Australian raw materials sources benefits not only transportation cost, but also running capital due to short voyage time. In other words Indonesia is more advantageously located than Japan and Korea for metallurgical raw materials.

Chapter VI Opinions on the Proposed Important Steel Projects

i) Cilegon Reactivation Project

a) P. T. Krakatau is preparing to reactivate Cilegon Steel Plant which was partially constructed a decade ago on the advice of Consulting Firm Manderstam. (The wire drawing mill has commenced operation and a spiral pipe mill planned by Hoogovens-IPI-Krakatau will be completed at the end of 1972).

According to P. T. Krakatau's plan the two rolling mills mentioned below will be completed at the end of 1974 by utilizing as far as possible, the Russian machinery already delivered and stocked.

1 bar mill, annual production capacity (three shift basis) 125,000 MT

(after reheating capacity increase) 150,000 MT

Specification of this mill: billet 100 x 100 mm

7 tandem stand roughers (new) - 6 stands cross country (old) - 4 tandem finishers (old) - cooling bed (old)

Products of this mill: round bars

1 light section mill, annual production capacity (three shift basis) 120,000 MT

Specification of this mill: billet 100 x 100 mm

1 stand rougher (old) - a 3-high stand with a tilting table (old) - 1 stand finisher (new) - cooling bed (new)

Products of this mill: joists, channels, equal angles, unequal angles, light rails, small billets

Water supply: 170 litres/second from 13 wells in the vicinity of Cilegon.

Power: existing 400 KVA x 4 (old) diesels

	under construction	1,140 KVA x 5 (new) diesels
	planned	5,000 KVA x 2 (new) diesels

The total estimated expenditure for construction is $14,000,000.

b) This plan of reactivation seems to be a good one as far as existing Russian machinery must be utilized to the maximum extent. However, the estimated cost of billet $108.44 at CIF railway sidings is too low compared with prevailing international price level. The team considers also that the scheduled increase of 80% billet-rolled product yield to 90% after 5 years is too conservative and believes that 2 years are enough for raising the yield from 80% to 90% provided that rollers are well trained in advance. (Ref. to Exhibit-7)

c) The existing maintenance shop is so well equipped as to be fit for an integrated plant. However, as long as Cilegon Plant remains an independent rolling mill this shop means a heavy overhead cost. Therefore, it is desirous that this shop be taken from the asset list of the plant and used either as a public training school or a metal commodities manufacturing establishment. The various off-site facilities such as guest houses, sports ground, etc. should also to be out of accounting of the plant in order to reduce the manufacturing overhead cost. Otherwise, it will be difficult for this plant to compete with other bar manufacturers mentioned in Chapter III a) and b).

d) The team is not informed of the book value of Russian-made assets transferred to P. T. Krakatau from the national treasury. However, it feels that evaluation of these assets should be made in such a way that the depreciation cost of fixed assets shall not be exceedingly heavy.

e) The team has been informed of a possible venture between P. T. Krakatau and a foreign company for utilizing the existing open hearth shop building for producing stamp forged goods, and thinks it a quite appropriate way of utilizing an existing asset and space. It also hopes that this will contribute to the reduction of plant overhead cost.

ii) Cold Strip Mill Project

The team is aware of a project put forward by a Japanese group of steel manufacturers and trading firms to build near Anyer-Lor a cold strip mill plant having 2 sets of reversing cold strip mills and auxiliary facilities. The project will start in 1973 and its final production target is 325,000 MT by 1985. The products will be 0.2 mm - 1.3 mm thick and 1.2 m wide primarily intended for galvanized sheet mills mentioned in Chapter III-c and also for commodities fabricated from cold sheets such as oil drums, enamel ware, etc. The total expenditure is estimated to be in the neighborhood of $65,000,000 which included the cost of infrastructural facilities such as a 400 mm dia. water supply pipeline, a 10,000 DWT ship accommodating berth, a power plant, housing, etc. This project should be approved by the competent authority since the forecast of flat product demand shown in Table 1-3 justifies this size of plant. However, if there are no Government protection measures, the cost of production will be about 40 % higher than the price of cold sheets presently imported from Japan. It appears that the Indonesian Government is considering necessary fiscal measures to alleviate this difficulty. The team fears that due to this protection measure the price of galvanized sheets and other metal products will be pushed up. However, it must be admitted that creation of a new pioneering industry makes some Government protection inevitable. In this connection it is recommendable that the investment to be made for infrastructure should be transferred to the Government assets, and the freight cost for distributing products to widely scattered G.I. sheet mills be substantially reduced by rationalization of interinsular and coastal shipping. These two measures will keep the sales prices of the proposed plant at a level lower than anticipated.

Chapter VII Proposal for the Development of Iron and Steel Industry on a Long Term Basis

i) Necessity of Constructing an Integrated Steel Plant

As mentioned in Chapter II the demand for steel in the country will reach 1,651,000 MT on a rolled steel basis or 1,800,000 MT on a crude steel basis by 1979 and 2,920,000 MT and 3,730,000 MT, respectively, in 1984. This means that crude steel consumption per capita will be 14.5 kg and 22.8 kg, respectively. Out of this amount steel products which should not be domestically produced due to the order small lots, such as heavy rails, thick and wide plates and sheets, wide-flanged beams, seamless tubes, wagon tires etc., and technically sophisticated steel products such as stainless and other alloy steels, high grade wire and rope, electrical sheets, tin plates, deep drawing sheets, high tensile steels, low temperature steels, etc. which will probably represent about 25 - 30% of the total demand, will have to be imported from abroad. Steel products for general commercial purposes should be domestically produced. Having this aspect in mind the team recognizes that <u>the time has come to seriously consider the construction of an integrated steel plant, to form the solid foundation for industrialization of Indonesia whose population is already 120,000,000.</u> Taking into account the fact that scrap resources in the country are scarce and that the raw materials for steel is poor unless a great deposit of natural gas in a convenient location is found, this integrated steel plant will have to depend upon imported raw materials. However, as pointed out already the country is better situated than Japan, Korea or Taiwan owing to its close proximity to Australia. This proposed integrated plant should be constructed in two stages; the first, for long products during

1973 - 1979, and the second, for flat products during 1980 - 84.

ii) Process to be Applied for the Integrated Steel Plant

On the assumption that natural gas is not available, there exist only three processes which can be adopted.

A) scrap import - electric furnace - crude steel

B) rotary kiln - sponge iron - electric furnace - crude steel

C) blast furnace - pig iron - oxygen converter - crude steel

A) process is not recommendable due not only to the high maintenance cost of intraplant power generators, but due to the small added value and the severe fluctuation of international scrap price and availability. B) process may be applied on a small scale, but one must be aware of the technical risks involved and the fact that there is no large scale steel plant based upon this process in the world. Therefore, the team is in the position of recommending the application of conventional C) process. In this connection it must be pointed out that most of the large-scale integrated steel plants now under construction or planned throughout the world have adopted this C) process.

With regard to coke supply; two ways are open, one is the construction of coke-oven plant, and the other, import from Australia or Japan. The former way may result in the reduction of coke cost at the blast furnace, but initial capital investment is considerable. Therefore, the team is inclined to recommend that in the first stage it is better to import coke on a long term basis and in the second stage to construct cokeoven plant together with by-product plants because it will not be easy to constantly import nearly one million MT annually of coke.

As for billet-making three processes are available as follows:

A) blooming mill - billeting mill

B) continuous casting - billeting mill

C) continuous casting

A) process is advantageous when the second stage of the plant construction for flat products is implemented because the blooming - slabbing type mill can be used for both blooms and slabs unless total tonnage to be rolled is over 2 million MT. In addition it is easy to make 50 x 50 mm billets for supply to outside rerollers.

However, disadvantages of this process are the high initial investment and the low yield rate from crude steel to billet, compared with B) or C) processes.

B) process is advantageous in respect of easiness of operation and control because the section area of continuous casting mould is large and the number of strands is few. This process can easily produce small 50 x 50 mm billets. On the other hand the construction cost of this process is naturally higher than C) process.

C) process is most advantageous from the standpoint of construction cost and the yield rate from crude steel to billet. However, the minimum section area of mould is 80 x 80 mm and the necessary number of strands is much more than B) process for the same tonnage of molten steel. Therefore, this process involves a high level of technical skill when the tonnage to be handled is very large.

After carefully comparing these three processes technically and financially the team came to the conclusion that C) process should be adopted together with a simple billeting mill for 50 x 50 mm billets for sale.

iii) Scale of the Integrated Steel Plant

Besides the two rolling mills to be set up in Cilegon Plant the team considers it necessary to have a wire rod mill of 146, 000 MT annual capacity on a billet consumption basis in order to supply rods not only to Cilegon wire drawing mill, but also to outside wire drawing mills. This mill should preferably be located inside the integrated plant because metallurgical control will be facilitated if it is set up near the steelmaking place. The team recognizes the importance of Surabaya area for the development of heavy industries such as shipbuilding and repair, heavy machinery making and steel structure fabrication and considers that a medium-size steel mill may be needed there.

Therefore, either by the Government initiative or by that of private investors a rolling mill about 110, 000 MT annual capacity for bars and sections on a billet consumption basis should be constructed in the Surabaya region.

Whether billets used for this mill should be supplied by the proposed integrated plant or supplied by combination of an electric furnace and a continuous casting setup was a matter of study in depth.

Exhibit 8, and its Tables 1, 2, 3, 4 and 5 show the results of this study. The comparison between Ex. 8 - Table 5 and Table 16-6 leads the team to recommend the former route. This mill should be located in the Sourthern part of Tandes Industrial Estate due to its proximity to the railway and the electric transmission line and the good sub-surface condition. (Ref. to Map - 2)

Summing up the needed amount of billets for the first stage of the integrated plant the following table is shown.

billets for the Cilegon mills	300,000 MT
billets for the Wire Rod mill	146,000 MT
billets for the Surabaya mill	110,000 MT
billets for rerollers	84,000 MT
total billets	640,000 MT (a)
crude steel for (a)	674,000 MT (b).

Table 8 shows that the steelmaking capacity is 815,000 MT/y, well over the 674,000 MT/y in (b). This is because steelmaking capacity must have a surplus in order to operate billet-size continuous casters with precise temperature control of molten steel in the ladle. However, when operators are highly skilled, the steelmaking shop will be able to utilize the rated capacity.

Assuming the hot metal rate for an oxygen converter as 85%:

pig iron for (b)	622,000 MT
pig iron for foundry	20,000 MT
total pig iron	642,000 MT (c).

The Table 8 shows that the capacity of the blast furnace is 773,000 MT, well over the necessary amount of pig iron. This is because of meeting the highest productivity of the steelmaking shop just mentioned. The scale of the plant represented by the figures (a), (b) and (c) will be realized by two 85-ton/charge oxygen converters (one in operation the other relining) and one blast furnace of inner volume of 1,450 m^3. The specifications and the material flow are shown in

Table 8 and Table 9-1.

Obviously this scale is not the optimum size of an integrated steel plant, but is viable when compared with other alternative processes. It is also to be taken into account that in the second stage this plant will be expanded to 2,000,000 MT by adding a larges blast furnace, an additional oxygen converter and probably a 56" semi-continuous hot strip mill. (Refer to Table 8, 9-2) It is also recommended that a cokeoven plant for the second blast furnace be constructed.

iv) Location of the Integrated Steel Plant

The conditions and prerequisites for this type of plant have been discussed in Chapter IV. Taking them into account the team recommends that the plant be located in an area along the coast between Merak and Anyer-Lor based upon the following reasons. (Ref. to Map-3)

a) Together with Cilegon Plant and the proposed cold strip mill plant the proposed plant will make the triangular area Merak-Cilegon - Anyer-Lor a great steel complex and a common infrastructure can be used for all the three plants and factories to be constructed for supporting this steel complex.

b) It appears that acquisition of land is rather easy and levelling of the plant site will be facilitated by the availability of banking material from nearby mountains. The sub-surface geological structure is permissibly good. (Ref. to Table 11).

c) Marine charts show that a deep water berth (12 - 13 m deep) will be rather easy to construct. The geographical and meteorological conditions at the site eliminate the need for an expensive breakwater. (Ref. to Map-4)

The type of berth may either be a detached pier or a quay berth, depending upon the thickness of the coral reef. (the former is adopted for the cost accounting in Chapter VIII).

d) The catchment of Lake Danau (area, 20,000 Hectares, annual rain fall 2,500 mm, coefficient of run off 50%) from which the River Cidanau flows will discharge 8 - 10 m^3/second of water by constructing a dam and either by laying about 30 km of pipeline or by boring a pressure tunnel. (Ref. to Map-3) If the estimation is made on a safe side, 6 m^3/second which is just sufficient for a two million ton steel plant will be secured. (the pipeline type is adopted for the cost accounting in Chapter VIII).

e) The plant hinterland is not only in West Java, especially the Jakarta Industrial area, but also South Sumatra.

With the former the distance is about 120 km and a 150,000 Volt transmission line, a first grade railway and a superhighway are not difficult to construct or upgrade. With the Sumatra railway wagon carrying ferry boats and a railway to Palembang are being planned by the competent office of land transportation.

f) The plant is well positioned with regard to communication with the other main islands of the country and with Australia.

v) The Contribution of the Government to the Plant

It is needless to say that the proposed integrated plant will require a great investment in its infrastructure. If the plant itself has to invest capital into this infrastructure the capital cost of products will become too high to be internationally as well as nationally competitive. If the Government trys to support this plant with a high tariff wall, the prices of products will rise and tend to hamper healthy growth of demand for steel.

Therefore, the proposed integrated steel plant can be considered only on the condition that the Government directly invests in its infrastructure, especially through acquisition and preparation of land, water supply system, harbor facilities, electric transmission line and first class railway and highway between Jakarta and the previously mentioned triangular area. In this connection the team would like to point out the precedents of Pohang Steel Co. in Korea and Malayawata Steel Co. in Malaysia. The rough specification and the estimation of the construction cost for this infrastructure are shown in Table 12 and 13.

vi) Basic Survey of Civil Engineering Information

The infrastructure mentioned above is based upon the information which the team was able to obtain during its stay in Indonesia. Thus estimation is rather approximate. In this connection the team would like to suggest that the competent authorities carry out the following surveys.

a) boring test in several spots around a dam site

b) geological survey of the place where a reservoir will be constructed.

c) boring test of the terrain of a pressure water tunnel if a tunnel-type waterway is preferred.

d) average and minimum discharge of the Cidanau River and water quality (especially, drift sand, hardness and density of suspended solids)

e) detailed topographical survey of the plant site (scale 1/500 - 1/2000)

f) boring test of the plant site and load test of bearing force of the earth

g) quality of plant site banking earth

h) strength and thickness of coral reef along the plant site coast

vii) Employment of the Plant Personnel

According to our experiences in Japan, for the plant described above the total employment will be about 2,000 persons in the first stage and about 3,000 persons in the second stage including all sub-contractor personnel. However, it may be difficult to expect the labor productivity of Japanese workers because of different degrees of skill and automatization.

Therefore, the team sets the plant's manpower plan in accordance with that in Pohan Steel Co. Korea, which corresponds to about 50% of Japanese labor productivity. (Ref. to Table 10) It is needless to point out that some unskilled jobs such as scrap yard workers, plant waste materials disposal workers, truck drivers, etc. can be filled by sub-contract workers. However, the team is not aware of the ability of sub-contractors in Indonesia, therefore, the sub-contracting arrangement should be up to the plant management. Additionally the mill in Surabaya will need about 740 persons.

viii) Construction Schedule

Table 14 shows an approximate construction schedule. The detailed schedule should be made only after the completion of the survey described in vi), and after decision of layout and consultation with machine builders and contractors.

However, it is important to note that if the Government decides to commission ironmaking and steelmaking facilities in December 1979, actual construction must start at the latest in the middle of 1974.

This means engineering work for land and water supply must start in the middle of 1973.

It is also pointed out that a berth and auxiliary unloaders should be completed before delivery of machines and equipment imported from aborad. On the other hand the construction schedule of the wire rod mill and the billet mill can be shifted to later because it is considered that in the initial stage of operation all billets produced by continuous casting will be supplied to Cilegon Plant.

Chapter VIII Financial Appraisal of the Team's Proposal

i) Construction Cost

The construction cost of the infrastructure, i.e., $61,708,000 described in Table 13 should be borne by the Government as a kind of industrial estate formation expenditure, as emphasized already. Therefore, in this chapter the cost and profit aspects of the integrated steel plant are analysed. Table 15 shows the construction cost details of production equipment and ancillary facilities. The outline is transcribed as follows.

	Construction cost	Construction cost/MT of crude steel/year
first stage	$162,540,000	$240
second stage	256,690,000	195
total	419,230,000	210

The team considers that this MT/y construction cost level compares favorably with other integrated steel plants built or under construction in the developing countries. However, it must be remembered that the estimation was made on the price level as of the end of 1972.

ii) Assumed Conditions for Cost Analysis

Due to the short period of survey the team was not able to acertain various cost factors to be taken into cost accounting. Thus it was inevitable to assume these uncertain cost factors more or less arbitrarily. Therefore, it is to be stressed that further studies on them are necessary for the implementation of this proposal. The important assumptions are described below.

a) Main raw materials will be imported from Australia by 50,000 DWT carriers.

(Ref. to Table 7-2). A small amount of iron sand in Jokyakarta will be used on the basis of CIF$10/MT on the assumption that the government will give subsidy or extra-special railway charge reduction to the transportation from the mines to Cilacap. As for coke in the first stage, the team investigated current Australian coke prices and assumed that CIF price of coke would be around $45/MT. The assumed price of limestone would be $3/MT, which is a little higher than that in Japan taking into account the high cost of truck transportation in Indonesia. The price of fuel oil is assumed at about $15.6/KL, which is lower than the international level. The team thinks that this price could be further lowered by means of a long-term contract with PERTAMINA. Ferro-Manganese and Ferro-Silicon will cost $150/MT, which is rather cheap, because the team expects Asahan Project will supply cheap power to a ferro-alloy factory to be built. Imported scrap is assumed CIF plus landing cost $55/MT and prices of rolls, moulds and refractory brick are assumed as 30% - 50% above the current Japanese prices.

b) Wages and salaries are difficult to assume because the team found a considerable difference by region. However, taking an example of a manufacturing company in Jakarta the following level is taken into cost accounting.

engineers, managers & general foremen	$1,200/year
sub-foremen and workers	$30/month

It is needless to point out that the wage and salary level will go up towards 1979 and 1984, however, the management will be able to compensate at least partially for this increase by raising productivity of labor.

c) Depreciation rates of machines, buildings and non-mechanical installations are based upon 12 years for machines and 30 years for others in accordance with the national standards, that is, on an average 15 years. The straight line method is applied for calculation. The maintenance cost is assumed 4% of book value of the fixed assets, excluding labor cost for maintenance, that is to say, representing only parts and components and various materials for repair. This 4% will be realized only with a well organized maintenance system and skilled repair workers.

d) Interest rates and equity ratio for construction capital are very difficult to assume because the team is not in the position to know from where the capital will come. However, in order to carry out cost accounting the team had to make the following bold assumption:

equity capital/debt finance	30/70
interest rate (current World Bank rate before interest tax)	7.25% (b)

However, there is the possibility that the lowest rate of the Bank of Indonesia, that is, 12% (a) may be applied, and on the other hand that some special loan may be available with 5% rate (c). Accordingly the annual payment of interest is compared as follows.

Assuming that reimbursement of loans has been made by half (hereafter this condition is called "normal financial condition") annual interest payment will be,

	first stage	second stage
Case (a) 12% x 1/2	$6,680,000	$17,170,000
Case (b) 7.25% x 1/2	4,124,000	10,637,000
Case (c) 5% x 1/2	2,830,000	7,310,000

(Obviously interest amount in the beginning years of operation doubles the figures mentioned here.)

	first stage	second stage
Case (a)	\$11.0/MT of product	\$9.4/MT of product
Case (b)	6.0 "	5.8 "
Case (c)	4.5 "	4.0 "

(Obviously the interest burden in the beginning years of operation doubles the figures mentioned here.)

With regard to running capital the current rate in the country is around 20%, which is exorbitantly high, therefore, the team assumed 7.5% which is the current Euro-dollar rate. The necessary running capital amount is calculated on the basis of: voyage time of imported raw materials - 10 days, period of stocking of raw materials - 45 days and time from production to delivery - 50 days and receipt of payment immediately after delivery. This assumption leads to the conclusion that the interest of running capital will represent approximately 2% of the total cost.

e) The interest amount during construction, the expenditure of operational preparation, the training cost of staff and foremen and the engineering and consulting fee for operation have to be taken into the cost accounting of the first five years. However, the "normal financial condition" mentioned already excludes this expenditure.

The team assumes these expenditures on an annual basis as follows:

	1st stage	2nd stage
interest during construction	$4, 124, 000 ($6. 5)	$6, 513, 000 ($3. 5)
operational preparation	800, 000 (1. 3)	1, 300, 000 (0. 7)
training and consulting	600, 000 (1. 0)	1, 200, 000 (0. 7)
total	5, 524, 000 (8. 8)	9, 013, 000 (4. 9)

Note: figures in parentheses indicate expenditure per MT of finished steel.

f) The shipping cost of finished steel is rather high in Indonesia as can be seen from the following table. Although the team expects considerable reduction in transportation cost, especially in maritime freight tariff, it adopted $6. 83/MT of finished product for the average shipping cost based upon current tariff rates.

	shipment	means	rate ($/MT)
West Java (Jakarta)	40%	railway	1. 06
Central Java (Sumarang)	10	ship	7. 43
East Java (Surabaya)	20	ship	9. 57
Sumatra (Medan)	15	ship	14. 20
Others	15	ship	10. 81
Average			6. 83

Source: Buku Tarip "Daftar Uang Tambang"

g) For examination of financial viability of the proposed integrated steel plant the sales prices of steel products in Indonesian market must be set.

However, the team wondered what price level should be assumed and came to the conclusion that it would be most appropriate to set the level on Antwerp FOB price as of Dec. 1972 plus $20 (freight, port charges and 5% sales tax), that is,

U.S.$/MT

	average Antwerp price as of Dec. 1972	average freight, changes and sales tax	total
wire rod	128(max. 136-min. 120)	20	148
hot rolled coil	127(max. 132-min. 121)	20	147
billet(100x100)*	96(max. 108-min. 84)	20	116
billet(50x 50)**	109 (max. 121-min. 197)	20	129

Since there is no published price of billet with asterisk in the Antwerp price list, the team adopted the current price level in Australia. Billet of 50 x 50 is rather unusual in the international market. Its price marked with double asterisk is set on the price of billet (100 x 100) plus the cost of breaking down.

iii) Cost Accounting

Table 16 shows the details of cost accountig in each operation of integrated steel manufacturing. The final results under the "financial normal condition" are transcribed below.

full cost of products at customers' quays or sidings before tax

	first stage	second stage
billet (50 x 50)	$118/MT	$93/MT
billet (100 x 100)	106	85
wire rod (dia. 5.5-12)	129	103
hot coil (1.6 x 12,000)		107

iv) Profit and Loss Statement

In the examination of profit and loss aspect the team preset 10% dividend and dividend propensity 2 in order to calculate necessary tariff protection in the first stage, but in the second stage the profit was calculated as the difference of the total cost and the total sales income based upon Antwerp FOB prices plus $20. Table 17 shows the results of this examination. Combining this table with the price level of products discribed in ii)-g) Table 18 is established. The line of "required compensation" for billets means that a tariff wall of 20% is necessary to enable the plant to successfully compete with imported billets whereas there is no apparent need to raise the existing tariff rates of 10% and 20% for wire rod and hot coil, respecitvely.

These tariff rates are not exorbitant when compared with those of the developing steelmaking countries shown in this table. Table 19 indicates the break even point analysis which is considered to be the best way of studying the relationship of profit with capacity utilization rate. In the first stage the annual production of 674,000 MT of crude steel will enable the plant to realize annual profit $8.4 million $/y whereas at the annual production of 518,000 MT the profit will be nul. Profit will be $16.71 million $/y when the plant reaches the maximum capacity. This analysis means that the management of the plant should try to apply every conceivable measure to acquire managerial and operational skill and know-how as quickly as possible. As pointed out already in the beginning stage of operation the management will have to bear the burden of high interest payment double that of the "normal financial condition" and also meet the expenditure mentioned in ii)-e. For illustrating this situation the following trial calculation is made.

profit at 647,000 MT production per year	8.4	million $
loss at 70% capacity utilization rate	-10.5	"
doubling of interest burden	-4.1	"
loss due to deferred depreciation	-5.5	"
	-11.7	

This will suggest the necessity of profit and loss examination year by year when the detailed information about construction cost, interest rates, wage and salary level, manpower, capital structure, etc. becomes available.

In the second stage the break even point will shift to 54% utilization rate. However, the management should be aware of the possibility of the financial situation in the beginning years of the second stage illustrated as follows.

profit at full operation	57.7	million $
80% of capacity utilization rate	-25.0	
loss due to 10% increase of construction cost	-5.6	
loss due to 30% additional maintenance cost	-5.5	
doubling interest-payment for the initial years of the second stage	-8.5	
loss due to deferred depreciation	-9.0	
	+4.1	

Note: assuming the depreciation of the first stage construction cost has been normally carried out during the first five years, but that of the second stage not at all.

i) Concluding this chapter the team would like to stress again that although the financial situation shown above look rather favorable, many ambiguous factors and elements in the cost accounting and the profit and loss statement are included and accordingly the readers of this report must not draw any hasty conclusion. On the other hand the readers may use this report as a guide in determining the prerequisites for securing viability of the proposal.

Chapter IX Effects of the Proposal on the National Well-being

The favorable effects to be brought about by the team's proposal on the well-being of the nation can be divided into two parts; one is foreign currency saving, and the other the increase of employment.

i) Foreign Currency Saving

The calculation is made on import substitution effect. That is to say, it is made by comparing the amount of foreign currency in the case where no integrated steel plant is built with the outflow of foreign currency in the case where the integrated steel plant is built. (Ref. to Table 20)

This calculation indicates that $36, 940, 000/y, namely 47.4% of the former case will be saved.

On the other hand the main production facilities and part of the infrastructural facilities will have to be paid for by foreign currency. By dividing the amount of foreign currency for investment by the annual amount of saving, the first stage investment in foreign currency will be paid out in 4.1 years and, if the infrastructural investment is excluded, in 3.1 years. The same method is applied to the second stage and Table 20 shows that the payout period will be 1.3 years for all foreign currency investment. However, it must be pointed out that this calculation is made under the "normal financial condition". Until reaching this condition various payments to be made in foreign currency described in XIII ii) (e) are to be taken into account. Therefore, 4.1 years of payout period are only indicative of the magnitude of foreign currency saving. Nevertheless the team concludes that the balance of payment situation, which will deteriorate during the construction period, will recover after several years. When the steel market in Indonesia is not tight steel products may be exported to nearby countries although this possibility is excluded from Table 20. If this situation occurs, it will greatly contribute to the balance of payments. It is also expected that parts and components, refractory bricks, sulphuric acid, rolls and moulds etc. will be supplied by domestic manufacturers in the course of the development of Indonesian heavy and chemical industries and that this will contribute to further improve the balance of payments. If the saying "demand is the mother of supply" is true, the visible existence of an integrated steel plant will psychologically encourage business circles to create industries to support the plant operation. Integration will not be limited to within the plant, but will be extended to surrounding industrial fields.

ii) Employment

Basic industries such as the iron and steel industry have the large output utilization effects or "forward linkage effects" which mean the activity induced by processing products supplied in the market whereas they have "backward linkage effects" which indicate the demand of an industry in question for products of other industries and services. For this point of view the iron and steel industry ranks top among industries and services shown in Table 21-1. In other words the iron and steel industry is one of the best industries for creating new industries and employment. For example, investment in international air lines needs enormous amounts of foreign currency, but such airlines belong to the lowest linkage effect group of industries and services. The team was unable to calculate the employment created by these forward and backward linkage effects because of lack of an input-output table precise enough to undertake calculation. For reference, Table 21-2 shows the relations between investment and labor in the country.

Thus the team failed to calculate quantitative employment figures to be created by the proposed integrated plant. However, if the rule of thumb that steel employment creates the same amount of employment outside steel is true, the first stage of the plant construction will create 4,000 jobs inside the plant and 4,000 jobs outside the plant and in the second stage 6,000 jobs inside and 6,000 jobs outside. The employment figures mentioned above concern only the integrated steel plant, and exclude employment of Cilegon Plant, the Cold Rolling Plant and Surabaya Plant. The workers for construction of the plant and the infrastructure are also excluded. All in all, the team considers that its proposal will eventually create approximately 20,000 jobs and the triangular area Merak-Anjer-Lor-Cilegon will become one of the most prosperous and industrialized areas in Indonesia.

Chapter X Labor, Education and Training

The hearing made at the factories visited by this team indicate that Indonesian workers have good aptitude for metallurgical work if they are well-trained and correctly instructed. However, existing vocational training schools are not adequate for the workers who will be employed in the proposed integrated plant. Special training facilities, particularly for maintenance jobs will have to be set up if the Government decides to go ahead with this project. It appears that professional education of the staff in universities is good (Ref. to Exhibit-9).
However, generally speaking university graduates lack practical training for running a large plant and need to be retrained at foreign steel plants. How to constitute a solid and able middle management class consisting of engineers and managers is considered to be the most important key to open up a new age of industrialization. The team considers that this middle management class for a two million MT integrated steel plant should consist of at least 20 persons. Their functions and training are shown in Exhibit 10. Research of iron and steel technology is being carried out in Bandung Institute of Technology and Geological Survey Institute, but the team hopes that the newly built MIDC in Bandung will become a center for practical research.

Chapter XI Standardization and Quality Control

Standardization

i) Standardization of steel products is a highly specialized field and only qualified people can execute the task. Therefore, the team would like to put forward in this report some suggestions which might be useful for initiation of Indonesian National Industrial Standards. (hereafter INIS)

ii) The first step in this task may be the establishment of an office in the Department of Industry, which is the centre of coordination of all standardization activities and responsible for publication of standards and assembling and disseminating the information connected with international standards.
The responsibility for establishing INIS may rest either with a commission consisting of high Government officials, college professors and leaders of industry or with some Government setup or the board of directors of a chartered private association. This body will be charged with decision-making and promulgation. The recommendations to be submitted to this highest body are to be formulated by many committees, each of which will be responsible for a certain product or a certain group of products. This committee must consist of representatives of producers, users and neutral members (very often college professors or researchers of public research insitutes). Consensus between producers' side and users' side is essential for any national standards.

iii) The standardization activities should start from the products for general commercial transactions, such as concrete reinforcing bars and other steel products generally used for building and civil engineering at present. However, at the same time, testing methods must be also standardized. For the time being the steel products which are subject to some internationally used standards, such as those for ocean-going vessels, petroleum exploration and production, and pressure vessels and tubes, need not be standardized.

iv) The Government should oblige steel producers to install testing equipment as a prerequisite for granting license and the government inspectors should visit the producers from time to time to inspect their testing records and the calibrations of their testing equipment. None of the several steel factories visited by the team had a tensile testing machine or a simple chemical analysis laboratory. The team feels it urgent that the government take necessary action to enforce the installation of at least tensile and hardness testing machines and chemical analysis laboratories for the five important elements of steel, that is, C, Si, Mn, P and S. More sophisticated testing equipment such as X-ray analysers, weldability measuring instruments, gas analysers, etc. may be set up on a cooperative basis in each steel producing region. The team expects that the newly built MIDC will be able to help steel producers set up and operate them.

v) Once standards are established, the Government should not be hasty to rigorously enforce them, because this may disturb traditional transaction methods. The team thinks that the best way of enforcing established standards is to apply them to the purchase of Government sponsored building and civil engineering projects. The official building code should prescribe the use of standardized products because of safety factors involved.

Quality Control

Quality control to be discussed here is mainly concerned with quality control of steel producers in their producing plants. This is also a very specialized field of technology, and consequently, only an outline of quality control measures is given.

i) The first step of quality control is the compliance by the producers with the established standards. For this step not only steel refining and rolling operations, but raw material purchasing must be taken into account.

ii) The second step may be to comply with the requests of customers who may order products complying with specifications other than INIS and who may order particular packing methods. For this, it is necessary that salesmen must be technically trained and ready to give advice to their customers. For sophisticated products, sales engineers or mill representatives will have to participate in important transactions and claims.

iii) Advanced stages of quality control in a plant will involve statistical quality control techniques, research activities and establishment of technical and operational standards applicable to all manufacturing processes in order to minimize the rate of rejection in the final testing before shipping. It is also necessary to keep records of manufacturing such as charge number, copy of mill sheets and files of claims. And the appraisals of the quality of products by customers will have to be systematically traced to enable mill operators and researchers to improve their technical and operational standards.

Chapter XII Conclusions and Recommendations

i) The current Indonesian iron and steel industry is on the first step of a backward integration, but the shortage of scrap will seriously restrict the growth of production of steel in a few years.

ii) The market analysis carried out by the team is tabulated below:

unit: 1,000 MT

	finished steel basis	crude steel basis
1971	668	851
1974	933	1,190
1979	1,651	2,100
1984	2,920	3,730

This means that the apparent crude steel consumption of 7.1 kg per capita in 1971 will increase to 14.5 kg in 1979 and 22.8 kg in 1984. Compared with other South-East Asian countries these figures are still low. However, in order to achieve this growth the capital formation in manufacturing industries must be accelerated, resulting in the increase of their share of apparent steel consumption from 24.6% in 1971 to 31.7% in 1979.

iii) The Cilegon Project by P. T. Krakatau and the Cold Strip Mill Project by a Japanese group are considered to be appropriate ones. However, the both should try to reduce their production and distribution costs with all efforts. In addition to these the team recommends the construction of a medium-size independent bar mill in Surabaya.

iv) In order to meet the major part of demand for steel and to supply semi-finished products to the existing and planned steel mills, an integrated steel plant should be established with the capacity and the construction schedule as follows.

	first stage	second stage	total
period of construction	1974 - 79	1980 - 84	1984
crude steel capacity	674,000 MT	1,326,000 MT	2,000,000 MT
products	billet, wire rod	hot coil	billet, wire rod, hot coil
construction cost	\$162,540,000	\$256,690,000	\$419,230,000

The location of this plant should be on the coast between Merak and Anjer-Lor chiefly due to the easiness of deep water harbor construction because the poorness of the main raw materials for the steel industry in Indonesia necessitates the massive importation of them mainly from Australia.

v) Since Indonesia is an insular nation, the sales network of a large steel plant must depend upon a well-organized interinsular and coastal transportation system. The Government should endeavor to establish such a system. The power generation and transmission network in West Java must be improved and expanded during the 1970's and the railway and the highway between Jakarta and the West end of Java must be upgraded.

vi) The Government should be financially and directly responsible for the construction of infrastructure necessary for a large steel complex to be established around the proposed integrated steel plant. A comprehensive geological, topographical and hydrographical survey should be undertaken immediately for this infrastructure.

vii) The viability of the proposed plant depends upon many unknown factors and elements such as interest rates, equity ratio, market prices of steel products, etc. However, on the basis of assumption of these unknown factors and elements the team considers that the plant is financially viable and will be internationally competitive provided that in addition to the existing protection tariff rates on wire rod and hot coil, a 20% tariff rate is set on billet.

viii) The effect on the balance of payment of foreign currency by the construction of the proposed plant will be favorable in the long run, and the magnitude of the backward and forward linkage effects by this investment in the steel industry ranks top among the various industries and services, although these effects can not be quantitatively computed due to the lack of necessary data.

ix) The Government should establish an official system of standardization starting from standardization of steel products for general usage, and should also take up necessary measures to encourage mill operators to apply quality control system.

x) The Government should start to give practical education abroad to a selected group of engineers and managers who will become the management nucleus of the proposed integrated steel plant. These engineers and managers should carry out preliminary planning of the plant and afterwards seek the assistance of some foreign consulting and engineering firm. However this elite group should continue to put forward their initiatives and creative imaginations. An Indonesian steel plant must be really an Indonesian one.

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MARKET ANALYSIS
JAPAN IRON AND STEEL FEDERATION

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National Study on Iron & Steel Industry Content of The Report

1. Market Study and Analyse

Past trend of steel consumption, future projected trend of consumptions by type of products, by year.
Type of products ; iron, primary (rolled) steel products, secondary steel products.
Projection should be made at least up to 1980.

2. Establishment of a National Steel Industry.

Study and analised domestic raw materials availability, the present production facilities, and projects in planning stage.
Based on the projected consumption pattern, the present production facilities and projects in planning stage, to establish a development program for iron & steel production.
The development program should be detailed in ;
type and capacity of production, location, schedule of construction and production, manpower requirement and training program, infrastructional support (physically and legally), etc.
Benefit of the development program to the overhall national economy.

3. Feasibilities

A detail technical, economical and financial feasibilities should be attached to each establishment within the development programm as described in point (2).

4. Standardization, Quality Control

To recommend and assist in establishment of a mechanism for standardization and quality control problems.

Directorate General for Basic Industry.

Itinerary of the Team

Exhibit-3

date	description	date	description		date	description
Oct. 4	Lv. Tokyo - Ar. Singapore (4 members)	Oct. 20	discussion at the Bandung Institute of Technology and MIDC, Lv. Bandung - Ar. Jakarta	(3 members) Lv. Bandung - Ar. Cilacap inspection of iron sand deposits and harbor facility.	Nov. 1	discussion at the BAPPENAS. drafting of the interim-report.
5	collection of data for market analysis.	21	plant visit	Lv. Cilacap - Ar. Yogyakarta inspection of iron sand deposits exploration	2	visit to the Embassy of Japan. completion of the interim-report.
6	visit to the Embassy of Japan and Proto-Type Training Center, observation of the Juron Industrial Estate.	22	Lv. Jakarta - Ar. Surabaya	Lv. Yogyakarta - Ar. Surabaya	3	submission of the interim-report to the Directorate General of Basic Industry.
7	collection of data for market analysis.	23	plant visits		4	Lv. Jakarta
8	Lv. Tokyo and Singapore - Ar. Jakarta (all other members)	24	discussion at the Municipal Master-plan office and the Port Authority visit to the industrial estates. Lv. Surabaya - Ar. Jakarta	Lv. Surabaya - Ar. Medan	5	Ar. Tokyo
9	courtesy call to and discussion with the Embassy of Japan.	25	discussion at the Bank of Indonesia.	discussion at the Regional Office of Department of Industry. plant visits		
10	courtesy call to and discussion with the Directorate General of Basic Industry, Department of Industry.	26	collection of data. drafting of the interim-report	plant visits Lv. Medan - Ar. Jakarta		
11	discussion at the Central Statistics Bureau and the Directorate General of Light Industry and Handicraft.	27	study at the P.N. PERTAMINA			
12	discussion at the Department of Public Works and Power. visit to the Jakarta Industrial Estate.	28	collection of data, drafting of the interim-report.			
13	discussion at the Directorate General of Basic Industry. plant visit.	29	drafting of the interim-report.			
14	plant visit.	30	plant visits.			
15	consolidation of data and materials.	31	discussion at the Directorate General of Sea Communications, Department of Communications, discussion with the Embassy of Japan and the Directorate General of Basic Industry on the interim-report.			
16	visit to P. T. Krakatau Lv. Jakarta - Ar. Cilegon					
17	inspection at Cilegon Steel Plant of P. T. Krakatau, observation of Cidanau River and Merak Lv. Cilegon - Ar. Jakarta					
18	discussion at the Department of Mines and the Directorate General of Land Communications, Department of Communications Lv. Jakarta - Ar. Bandung					
19	discussion at the Geological Survey and the Bandung Vocational and Managorial Training Center. plant visits.					

Exhibit 4-1. Annual Growth Rate of GDP in the Developing Countries

The source of this statistics is of U. N. National Income Statistics and the countries on the way of development are shown here.

	country	period	annual growth rate of GDP(%)		country	period	annual growth rate of GDP(%)
Asia	India	1960 - 68	3.1	Africa	Morocco	1960 - 69	3.8
	Indonesia	"	2.1		Nigeria	60 - 66	4.5
	S. Korea	60 - 69	9.1		Egypt	64 - 68	1.8
	Malaysia	60 - 66	5.8		Sudan	66 - 68	6.9
	Pakistan	60 - 69	5.4	Latin America	Argentine	60 - 69	4.0
	Philippines	"	4.9		Brazil	60 - 68	4.4
	Formosa	"	10.3		Chile	60 - 69	4.6
	Thailand	"	8.2		Mexico	60 - 67	6.7
Near East	Iran	"	9.0		Peru	60 - 69	4.9
	Turkey	"	6.4		Venezuela	"	5.9
	Israel	60 - 66	9.0		Columbia	"	4.9

Comparing these growth rate in the 1960's it is noticed that the growth rate of Indonesia in the 1970's is more or less comparable to those of Thailand, S. Korea, Iran and Mexico in the 1960's.
For reference the rates of growth of manufacturing industries and those of building and civil engineering in Thailand and S. Korea in the 1960's are shown below.

	manufacturing	building & civil engineering
Thailand	11.0	13.4
S. Korea	16.9	19.1

Exhibit 4-2. Macro-analysis by Using Gross Domestic Products

The assumptions were made on GDP as follows.

GDP (in real terms) growth rate		1973	7.1%
		1974	7.2%
	average	1974 - 1979	7.5%
	"	1979 - 1984	8.0%

The actual results of the past several years of GDP and apparent consumption of finished steel are shown below.

year	x *GDP (billion Rps)	yearly growth rate (%)	y *apparent steel consumption (1,000MT)
1967	448.0	1.4	158.9
68	478.8	6.9	233.5
69	513.0	7.1	392.4
70	548.4	6.9	490.3
71	586.8	7.0	668.0
72	628.5	7.1	764.3

* source: Central Bureau of statistics, 1972 figures are estimated by the team.

From the above table the following equation is established.

$y = 2,469\ x - 841.7$ corelation coefficient = 0.912

Using this equation and assumed GDP growth rate

year	apparent finished steel consumption (1,000 MT)
1974	940.
1979	1,717.
1984	2,917.

Exhibit 4-3. Macro-analysis by Using Gross Domestic Capital Formation

The gross domestic capital formation (GDCP) which is a constituent of GDP is known to have a close relationship with the apparent steel consumption. Exhibit 4-3-Table 1 indicates the past trend of GDCP and rates GDCP/GDP. Extrapolating the trend curve of the rate GDCP/GDP the following figures are forecast.

	GDCP/GDP
1972	13.5%
74	14.0
79	16.0
84	18.5

Multiplying these rates by GDP figures already mentioned for these years the following figures are obtained.

	GDCP (billion Rps.)
1972	84.8
74	101.0
79	165.8
84	281.6

The equation connecting GDCP with the apparent steel consumption is obtained by a regression method as follows.

$y = 11.41x - 213.0$ y = apparent steel consumption

$r = 0.966$ x = GDCP

From this equation and the GDCP figures obtained above the following steel consumption figures are reached.

	1,000 MT
1974	940
79	1,680
84	3,000

In order to examine the probability of the rates GDCP/GDP forecast above an international historical cross examination was carried out with the thought that the steel consumption situation of Formosa, S. Korea, Brazil and Mexico in the 1960's is likely to be similar to that of Indonesia in the 1970's. For this comparison Exhibit 4-3-Table 2 is attached. This table shows that the forecast figures for GDCP/GDP in Indonesia seem to be quite reasonable.

Expenditure on Gross Domestic Product at Constant 1960 Price in Indonesia (unit: billions Rps.)

calender year	gross domestic product (A)	growth rate (%)	gross domestic capital formation (B)			B/A (%)
			construction and works	machinery and equipment	total	
1960	390.2		19.4	11.3	30.7	7.9
1961	412.6	+5.7	25.0	19.1	44.1	10.7
1962	420.2	+1.8	21.3	18.8	40.1	9.5
1963	410.8	-2.2	16.3	14.3	30.6	7.4
1964	425.3	+3.5	16.4	18.4	34.8	8.1
1965	429.9	+1.1	18.6	17.6	36.2	8.4
1966	441.9	+2.8	21.0	19.7	40.7	9.2
1967	448.0	+1.4	18.4	14.8	33.2	7.4
1968	478.8	+6.9	21.8	24.5	46.3	9.7
1969	513.0	+7.1	....	....	53.1	10.4
1970	548.4	+6.9	....	....	63.2	11.5
1971	586.8	+7.0	....	....	73.8	12.6
1972 (estimate)	628.5	+7.1	....	....	84.8	13.5
average 1960 - 72		+4.0				
average 1967 - 72		+7.0				
1974 (forecast)	721.6				101.0	14.0
1979 (forecast)	1,036.2				165.8	16.0
1984 (forecast)	1,522.2				281.6	18.5

source: Central Bureau of Statistics up to 1971

		unit	1960	1963	1964	1965	1966	1967	1968	1969	1970	source
Formosa	G D P (A)	million N.T. $	62,561	87,134	102,209	112,867	125,554	143,045	167,975	190,806	218,428	industry of free china November, 1972
	gross capital formation (B)	" "	10,361	13,335	14,872	19,090	23,974	30,185	37,130	43,107	49,381	
	B/A	%	16.6	15.3	14.6	16.9	19.1	21.1	22.1	22.6	22.6	
	steel consumption	1,000 M.T	370	436	489	638	799	913	1,165	1,177	1,446	
South Korea	G D P (A)	thousand million won	244.9	484.6	691.5	798.2	1,018.7	1,220.4	1,552.5	2,022.1	....	year of National Accounts Statistics 1970. U.N.
	gross capital formation (B)	" "	26.8	89.7	101.2	118.5	223.1	272.2	421.3	614.6	....	
	B/A	%	10.9	18.5	14.6	14.8	21.9	22.3	27.1	30.4	....	
	steel consumption	1,000 M.T	100	445	300	440	573	843	1,125	1,536	1,744	
Brazil	G D P (A)	thousand million new crujeiros	2.76	11.93	23.06	36.82	53.73	71.49	99.88			" "
	gross capital formation (B)	" "	0.51	2.24	4.30	6.77	8.18	10.85	17.23			
	B/A	%	18.5	18.8	18.6	18.4	15.2	15.2	17.3			
	steel consumption	1,000 M.T	2,812	3,320	3,428	3,143	4,103	4,016	4,879	5,532	6,088	
Mexico	G D P (A)	thousand million rupees	155.9	194.8	228.0	246.2	276.3	306.4				" "
	gross capital formation (B)	" "	23.2	28.0	36.6	39.0	45.5	52.9				
	B/A	%	14.9	14.4	16.0	15.8	16.5	17.3				
	steel consumption	1,000 M.T	1,728	2,167	2,597	2,746	2,970	3,303	3,525	3,706	4,168	
Iran	G D P (A)	thousand million rials	330.6	399.8	440.4	499.7	540.3	602.9	675.1	772.5	838.9	
	gross capital formation (B)	" "	55.4	50.3	62.4	81.1	90.0	116.8	134.7	154.2	176.1	
	B/A	%	16.8	12.6	14.2	16.2	16.7	19.4	20.0	20.0	21.0	
	steel consumption	1,000 M.T	375	491	693	907	1,008	1,403	1,594	1,798	2,085	

The Outline of SL-RN Process

This process is a combination of what have been announced separately as S-L (STELCO-Lurgi) process and as R-N (Republic-National Lead) process. It uses either green pellet, fired pellet or lump ore as the raw materials and either anthracite, coke or bituminous coal as the reducing agent. Iron ore and reducing agent together with limestone are charged into a rotary kiln and heated to about 1,100°C. The materials reduced in the kiln is cooled below 100°C. after passing through a cooling drum and separated by screening and magnetic seperation into the reduced iron, char, coal ash and others. In the use of low-volatile coal heating is applied by the main burner located at the discharge end of the kiln and by the shell burners. When high-volatile coal is used, heating is effected by the main burner located at the discharge end of the kiln and by airports, the bulk of the rotary kiln being kept at 1,000 - 1,100°C. In use of green pallet it is dried and hardened continuously before being charged into the kiln.

The SL-RN process plants now under commercial operation are as follows.

Company	Highveld[1] Steel	New Zealand Steel	Falconbridge[2] Nickel Mines
Place	Witbank South Africa	Auckland New Zealand	Falconbridge Canada
Plant-size	4 kilns 4 x 60m	1 kiln 4 x 60m	1 kiln 5 x 50m

Ore through put	1,000,000 MT.	190,000 MT.	425,000 MT.
Raw materials Ore	lamp ore	iron sand 60.5% Fe 8% TiO_2	pyrrhotite calcined 66.5% Fe, 1% Ni sub-bituminous
Product	40% pre-reduced Ore	highly reduced pellet	highly reduced pellet

Remarks: (1) The product in this plant has to be charged into electric furnaces to be converted to pig iron. Therefore, strictly speaking this is not a direct reduction process.

(2) The product is nickel including pellet and should be considered as a kind of ferro-nickel.

It seems that New Zealand plant and Falconbridge plant are not in smooth operation due to various mechanical and metallurgical troubles. It is reported by Dr. H. Serbent and Dr. W. Janke at the Seminar on Direct Reduction of Iron Ore: Technical and Economic Aspect held in Bucharest in Sept. 1972 that both of these plants are being operated at 75% of their rated capacity.

The construction cost for the SL-RN rotary kiln and its ancillary facilities is claimed to be about $10,400,000 on a basis of 1,000 MT/day. The team neither knows the details of the estimate of this construction cost, nor the effect of scaling up on its economy.

The unit input for this process is as follows, assuming that reduced pellets with a metallization degree of 95% are obtained from 66% Fe pellet.

iron ore	1,480 kg
linestone	50
reducing coal (L.V. 6,500 Kcal/kg)	600 (3200×10^3 Kcal)
bentonite	15
power	85 KWH
water	2 m^3
maintenance cost	$1,948

In connection with application of this process to TiO_2-rich iron sand the following comment may be useful. From metallurgical standpoint TiO_2 tends to slow down reduction reaction inside a kiln and remains unreduced in sponge iron. In the succeeding stage, that is, in melting in an electric furnace TiO_2 in sponge iron causes various difficulties such as low yield of Fe in steelmaking, large volume of slag, damage to refractory lining. Therefore, when the economic viability of this process is examined, the economy from the iron sands to the steel ingot must be integrally taken into account.

The Outline of Midrex Process

This process developed by the Midrex Division of Midland-Ross Corp. It uses mainly fired pellet as the raw materials and natural gas as the reductant. The natural gas is reformed into mixture of $H_2 + CO$ by an independent reformer and sent by a high pressure blower into the middle zone of a shaft furnace. The furnace top gas is cleaned of dust in a dust catcher before delivery to the gas reformer. In the bottom of the shaft inert gas is injected for cooling the product to some 65°C for being carefully prevented from re-oxidation. The inert gas for cooling is cooled by a water-cooled gas-cooler as it is used for recirculation.

The plants which commercially operate this process are as follows.

Oregon Steel Co.	Portland, U.S.A.	400,000 MT/y
Georgetown Steel Co.	South Carolina, U.S.A.	400,000 MT/y
Hamburger Stahlwerke, G.m.b.H.	Hamburg, Germany	400,000 MT/y

Neither the construction cost nor unit inputs have not been disclosed. It is only reported that the total heat consumption is 3225×10^3 Kcal/MT of reduced pellet, that is, 432 Nm^3 of natural gas (1 Nm^3 of natural gas = 7,500 Kcal). The paper titled "Use of the Midland-Ross Direct Reduction Process in a steel Works of Small to Medium Capacity" presented at the Seminar on Direct Reduction of Iron Ore: Technical and Economic Aspects held in Bucharest in Sept. 1972 may be of some use for those interested in this process.

In this paper the authors, W. Maschlanka, H. Knapp and P. Kohl describe the rough specification of the shaft furnace and the performance of operation. The authors emphasize that the SiO_2 and $A\ell_2O_3$ in charged pellets must not be in excess of 3% in order to keep the slag quantity below 100 Kgs. in the electric furnace into which reduced pellets are charged. They also stress that careful measures must be taken for preventing reduced pellets from being reoxidized by moisture.

In the World Bank's report "Planning for Industrial Development in Indonesia" Chapter VIII the authors give the construction cost of Midrex 400,000 MT of metallized pellet. However, in the light of the fact that Midland-Ross Corp. is strictly keeping technical and financial details of this process in secret, the team wonders from where the World Bank has obtained the construction cost data. Therefore, the team is not in the position of criticizing whether or not the World Bank's data is fair or biased.

The Outline of HyL Process

This process was developed by the Hojalata Lamina S.A., Mexico and the Kellog Co. has got the licensing right of this process. It uses the lump ore or the pellet as the raw material and the natural gas after being reformed to the mixture of $CO + H_2$ as reductant. The high-temperature gas leaving the reformer which generates steam in passage through a boiler, is cooled in a cooler for removal of excess moisture and is sent to the vertical retort reduction furnaces. The reduction furnace comprises one set of 4 retorts, each equipped with an equal number of gas coolers and gas heaters. In each of the retort reduction takes place by the following cycle to turn out the product:

Retort	I	unloading & loading stage	discharge reduced iron and charge new raw materials
	II	cooling stage	cool high-temperature reduced iron by fresh reducing gas and preheat reducing gas
	III	final reduction stage	reduce finally partially reduced iron by high-temperature reducing gas preheated in Retort II.
	IV	partial reduction stage	heat and partially reduce charged ore by off-gas from Retort III

This process has been smoothly operated since the commissioning of a 200 MT/d plant at Monterry, Mexico in 1957 and there is no doubt about the economic viability of this process.

The HyL plants in operation and under construction are as follows:

HYLSA	Monterry	200 MT/d	1957 start up
"	"	600 "	1960 "
TAMSA	Veracruz	500 "	1967 "
HYSA	Puebla	667 "	1969 "
USIBA	Bohia (Brazil)	600 "	under construction
HYLSA	Monterrey	1,000 "	"

The standard operational and constructional costs disclosed by the Kellog Co. are as follows.

plant size	660 MT(Fe)/d.	1,400MT(Fe)/d.	2,800 MT(Fe)/d.
plant	$8.4 million	$15.9 million	$30.9 million
operation/MT(Fe)			
natural gas	17.3 MMBtu	16.8 MMBtu(1)	>16.8 MMBtu
electricity	9 KwH	9 KwH	9 KwH
water	1,000 gal.	900 gal.	900 gal.
maintenance labor and supplies	$1.31	$1.28	$1.28
catalyst and chemicals	$0.14	$0.14	$0.14
operational labor	7 men/shift	10 men/shift	15 men/shift
supervision fremen	1 man/shift	1 man/shift	1 man/shift
superintendent	1 man/day	1 man/day	1 man/day

Remarks:

i) 16.8 MMBtu ≑ 4,230 x 10^3 Kcal

ii) assuming that the mean metallization degree of the product is 92% from 66% Fe iron ore, 4,500 x 10^3 Kcal/MT of metallized pellet.

iii) assuming that thermal value of 1 Nm^3 of natural gas is 9,000 Kcal, 520 Nm^3 of natural gas/MT of metallized pellet.

The product of this process is a form of sponge iron and consequently it is easily re-oxided. This fact suggests that sponge iron should be carefully handled and stocked with necessary measures for moisture prevention.

Manganese

There are only a few manganese ore mines now being mined at these deposits as Karangunggal in West Jawa and Kliripan is Central Jawa, but the ore deposits are in general of small scale and are not economical.

The Kliripan deposit used to produce the largest quantity of manganese ore in Indonesia. The biggest ore body of the Kliripan is now mined out, and the present production takes place for only about 900 tons per month at the Karangunggal ore body. Product ore contains about 80% of MgO2, and about 2,000 tons of ore is consumed by domestic battery manufacturers.

Also, about 10,000 tons of ore is being exported for metallurgical purpose. The manganese ore deposit is located at Doy Island north of the Halmahera Island, but the size of this deposit is considered not too large. Manganese ore is very useful mineral for iron-making, steel making or ferro-alloy producing. In Indonesia, however, any huge resource of this ore is not likely to be found.

Dolomite

Dolomite or dolomitic limestones deposits are mostly found in the Tuban area in North Jawa and at Madura Island. It is considered that very close co-relation can be found between these type of rock and normal limestones of the miocene Rembang formation, but the origin of these dolomites or dolomitie limestones is yet to be proved.

Dolomites are as useful flux as limestones and fluorspar, and it is also useful as basic refractories. In this respect, further details of ore deposits and ore specification are of great interest to be investigated.

source: Department of Mines

The Statement of Profit by Accelerating Rolling Mill Yield Improvement
(Light section and Bar)

Exhibit-7

Mandelstam consultants recommend that 80% yield of billet rolling should be brought to 90% after 4,5 years and assume that the price of billet at the sidings of works is 45,000 Rps; that is, U.S.$108 per MT. The team considers that the improvement of yield of billet rolling should be realized after 2 years. On the other hand the price of billet is very much underestimated because the latest price of billet in Australia is U.S.$ 84 ~ 108 at Sydney FOB. If the freight and the transportation cost from the unloading place to the mill is added, the price will be around US$ 116. However, here the team indicates the favorable effect on the cost accounting by accelerating improvement of rolling yield provided that the price of billet is 45,000 Rps/MT.

unit: 1,000 Rps.

	after 2 years				after 2.5 years				after 3 years				total			
	quantity	price	total	cost/finish ton	quantity	price	total	cost/finish ton	quantity	price	total	cost/finish ton	quantity	price	total	cost/finish ton
yield 90% billets	T 44,600	45	2,007,000	50	T 52,300	45	2,353,500	50	T 51,200	45	2,304,000	50	T 148,100	45	6,664,500	50
credits - scale	3% 1,338				3% 1,569				3% 1,536				3% 4,443			
- scrap	7% 3,122	7	▽ 21,854		7% 3,661	7	▽ 25,627	▽ 0.5	7% 3,584	7	▽ 25,088	▽ 0.5	7% 10,367		▽ 72,569	▽ 0.5
billet cost net	40,140		1,985,146	49.5	47,070		2,327,873	49.5	46,080		2,278,912	49.5	T 133,290		6,591,931	49.5
total operating cost			446,000	11.1			444,550	9.4			435,200	9.4			1,325,750	
total product cost			2,431,146	60.6			2,772,423	58.9			2,714,112	58.9			7,917,681	
income from sales	T 40,140	75	3,010,500		T 47,070	75	3,530,250		T 46,080	75	3,456,000		T 133,290	75	9,996,750	
profit			579,354				757,827				741,888				2,079,069	

The Medium Size of a Steel Mill in Surabaya

i) For the supply of billets to this mill four alternate routes were studied, namely.

A) Scrap-electric furnaces only with captive power generators - continuously cast billets

B) Scrap-electric furnaces with captive generators connected with a public grid - continuously cast billets

C) Scrap-electric furnaces without captive generators, but connected with a public grid - continuously cast billets

D) Purchasing billets from the integrated steel plant

ii) The team has been informed of the bright prospect of the East Java electric grid owing to the development of Karangkates hydro-project. However, it is doubtful that C) process can be applied because of a limited supply capacity of the public grid and possible disturbance in power users in general. Therefore, this should be removed from the range of choice.

iii) With regard to A) process the team visited two steel mills whose furnaces are operated only with their captive power generators and has heard that a few more mills are contemplating to adopt this process.
However, it is needless to point out that in this process generators are exposed to the drastic change of power demand of furnaces, particularly during the melting period and the

maintenance cost of generators is very expensive. It is still unknown that how much the maintenance cost will be if the furnace capacity is large, say, 25 MT. Thus the team is of the opinion that it should be avoided to choose this process.

iv) The consideration mentioned in ii) and iii) leads to choose between B) or D). The materials flow chart and the outlined specifications of equipment is shown in Exhibit 8-1- Table 1. The electric circuit, the construction cost and the manning are indicated in Exhibit 8-1- Table 2, Table 3 and Table 4, respectively.

v) Exhibit 8-2 is the results of financial comparison between B) and D) although various unknown factors are involved in this cost analysis. Consequently the team is in preference of D) process not only because of the cost aspect, but also because of economic risk involved in dependence upon purchased scrap.

Exhibit 8 - Table 1. Material Flow and Main Specification of the Mill in Surabaya

(full line - B) process and dotted line - D) process

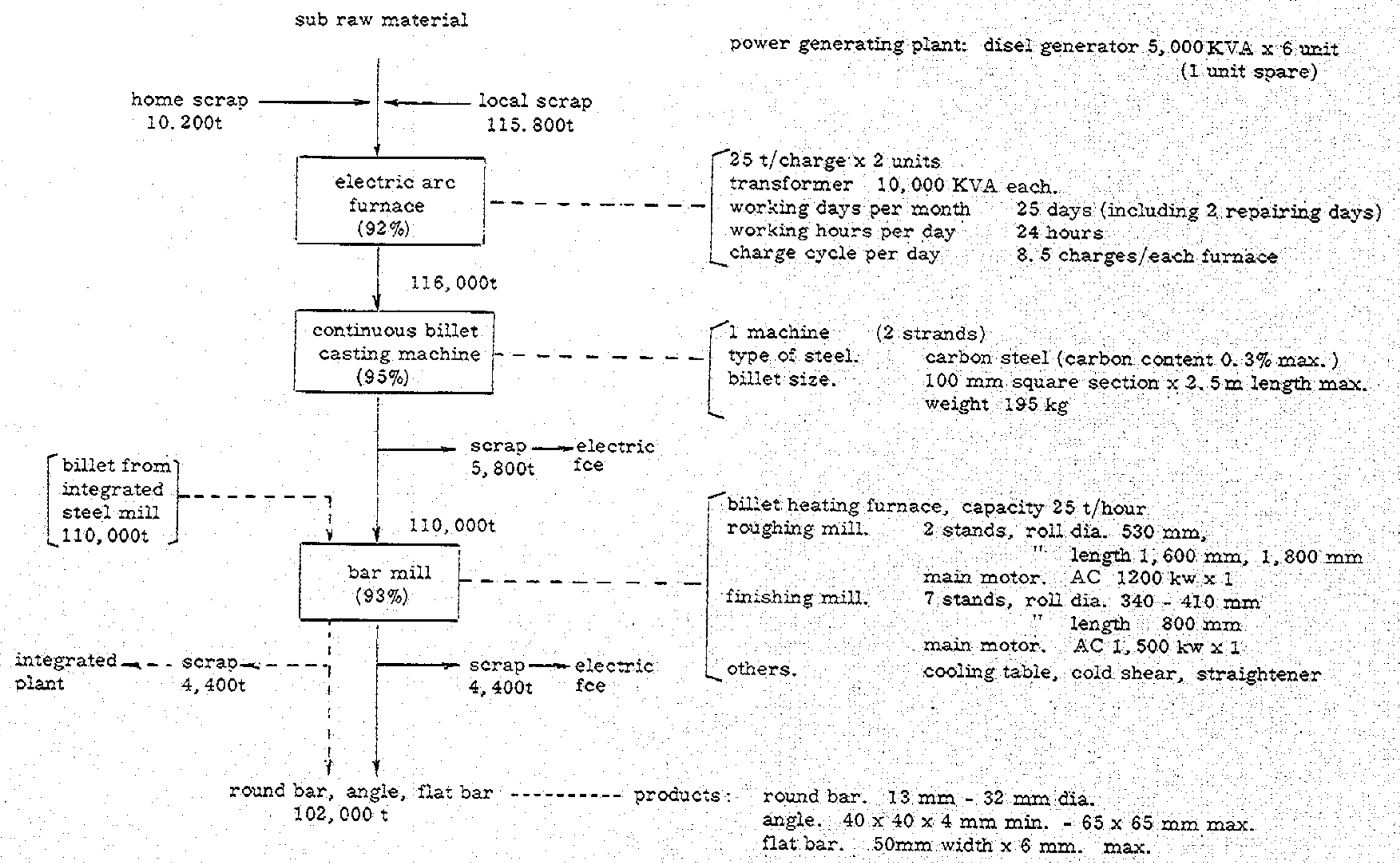


Exhibit 8 - Table 2. Electric Circuit of the Mill

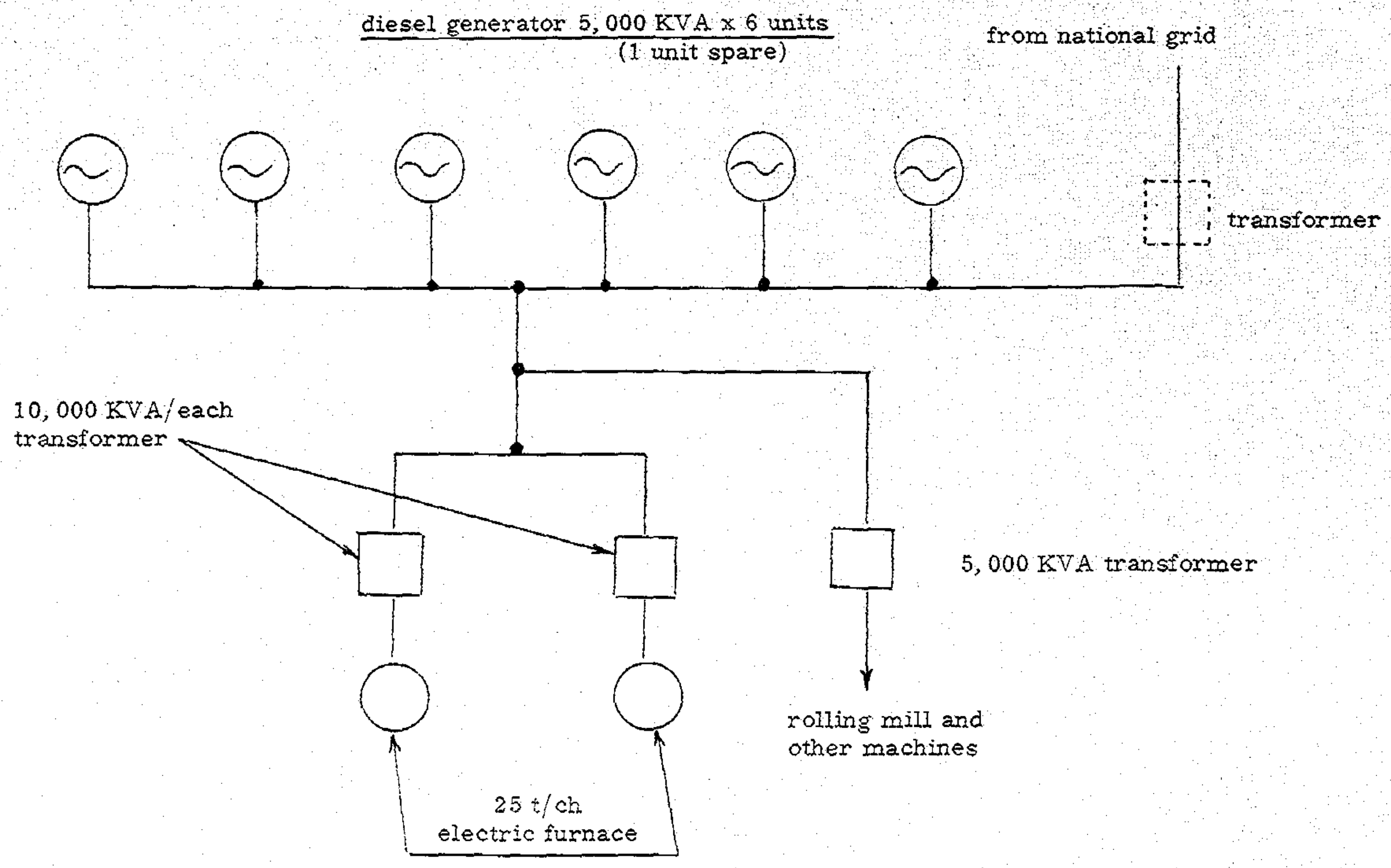


Exhibit 8 - Table 3. Rough Estimated Construction Cost of the Mill (excl. land, land preparation but incl. water way)
(unit; 1, 000 US$)

	(FOB) equipment	installation	foundation	building	total
steelmaking	4, 300	250	300	900	5, 750
rolling mill	2, 800	350	450	550	4, 150
generating plant and others	3, 800	350	490	220	4, 860
total	10, 900	950	1, 240	1, 670	14, 760

Exhibit 8 - Table 4. Manning of the Mill

	staff class	foremen class	sub-foremen class	worker class	total
steelmaking	3	6	23	196	228
rolling mill	3	3	18	240	264
generating plant and others	3	3	22	174	202
office	4		15	20	39
total	13	12	78	630	733

Exhibit 8 - Table 5. Cost Accounting of the Mill in Surabaya

(all cost and price factors are same as those of the integrated steel plant)

production	billet 110,000 T/Y (yield 95.0%)					bar 102,000 T/Y (yield 93.0%)				
item	annual requirements ($x10^3$MT)	unit price/cost (US $)	amount ($x10^3$ US$)	consumption per unit (kg)	unit cost (US$)	annual requirements ($x10^3$MT)	unit price/cost (US $)	amount ($x10^3$ US$)	consumption per unit (kg)	unit cost (US$)
imported scrap	115.8	58.00		1,053	61.06	billet 110	124.53	13,698.3		134.3
home scrap	10.2	58.00		93	5.38					
m. materials	116.0			1,146	66.44					
ferro-alloys		149.35		10	1.49					
burnt lime		22.73		30	0.68					
limestone		3.00		2	0.01					
fluorspar		42.86		2	0.08					
coke breeze		118.18		1	0.12					
silica sand		21.1		1	0.02					
alminium		844.16		0.2	0.17					
s. materials				46.2	2.57					
raw material cost					69.01	110	124.53	13,698.3		134.3
home scrap	5.8	58.00		53	△3.06	4.4	58.00			▲2.50
credit	5.8	58.00		53	△3.06	4.4	58.00			▲2.50
fuel							17.81/T		.50ℓ/T	0.78
brick and others					5.52					
roll and mould					4.00		1.1 kg		2kg/T	2.21
power		28.29/MWH		635 KWH/T	17.96		28.29/MWH		100KWH/T	2.83
compressed air										
water		32.47/ 1,000m^3		40m^3/T	1.30		32.47/ 1,000m^3		20m^3/T	0.65
miscellaneous		850.00		5.5	4.68					0.9
variable cost					33.46					7.37
var. ma. cost					99.41					139.17
labor			70.56		0.64			86.4		0.85
depreciation			490.57		4.46			351.7		3.45
maintenance			540.4		4.92			196.2		1.92
miscellaneous			91.3		0.83			232.6		2.28
overhead			345.0		3.14			250.5		2.44
fixed cost					13.99					10.94
ma. cost					113.40					150.11
interest (equipment)					2.87					1.22
interest (operation)					2.33					3.03
selling and administration										11.02
general cost					5.93					
full cost (of billet)					124.53			(of bar)		165.38

Information of Superior Technological Education

university or college	
Bandung Institute of Technology	civil engineering civil engineering geodesy & surveying sanitary engineering mechanical & electrical engineering electrical engineering mechanical engineering industrial engineering mineral technology geology mining petroleum engineering engineering physics & chemical technology engineering physics chemical technology chemistry & biology chemistry biology pharmacy mathematics & physics mathematics physics astronomy meteorology & geophysics fine arts & design fine arts architecture regional & city planning
Srabaya Institute of Technology	civil engineering chemical engineering mechanical engineering ship building electrical engineering
University of Gadja Mada (Yogyakarta)	civil engineering chemical engineering

university or college	
University of Indonesia (Jakarta)	civil engineering mechanical engineering metallurgical engineering
University of North Sumatra (Medan)	civil engineering mechanical & industrial engineering
University of Trisakti (Jakarta)	civil engineering mechanical engineering electrical engineering
* Perguruan Teknik Tmgji Nasional (Jakarta)	civil engineering mechanical engineering architecture

note: * technical academy
some other private universities have technical faculties.

Bandung Institute of Technology

total number of students		5,500 (five years)
number of graduates of technological faculties		350
out of which		
mineral eng.	15 - 20	
metallurgical eng.	5 - 8	
mechanical eng.	40	
electrical eng.	40	
civil eng.	60	
architecture	30	

this figure represents 60% of the total number of graduates of technological faculties relating to metal industries in Indonesia.

Exhibit-10

Training Schedule of Engineers and Managers

field		number of trainees	training period	subject of training
1.	general plant management	2	3 to 6 months	on-the job training
2.	ironmaking	2	"	"
3.	steelmaking	2	"	"
4.	rolling	2	"	"
5.	technical control	2	"	"
6.	planning & management	2	"	"
7.	maintenance	2	"	"
8.	production planning	2	"	"
9.	utilities	2	"	"
10.	industrial engineering	2	"	"
11.	metallurgy - test and research	2	"	"
12.	personnel affairs and labor relations	2	"	"
13.	raw materials purchasing	2	"	"
14.	sales	2	"	"
15.	finance	2	"	"
16.	management and construction	10	about 1 month	inspection tour

Remarks:

1) All persons participating in this training must be engineers or college graduates.

2) All persons must be English speaking. If they are trained in non-English speaking countries, additionally 2 to 3 months will be needed mainly for language education.

Subjects to be Trained on

i) general plant management

a) organization of plant personnel

b) conveyance inside the plant

c) safety and health control

d) relations with sub-contractors

e) various regulations applicable to the plant personnel

ii) ironmaking

a) raw materials receiving, stocking and supplying

b) technical control of raw materials preparation

c) blast furnace operation

d) technical standards of blast furnace operation

e) safety and health control of the ironmaking shop

iii) steelmaking

a) hot metal receiving and supplying

b) steelmaking operation and control of steelmaking auxiliary raw materials, scrap, ladle repair, skull disposal, etc.

c) continuous casting operation and ingot making

d) technical standards of steelmaking operation

e) safety and health control of the steelmaking shop

iv) rolling

a) control of billets and their conditioning

b) reheating furnace operation

c) rolling mill operation

d) cutting operation

e) control of auxiliary equipment such as cranes and cooling beds

f) technical standards of rolling operation

g) safety and health control of the rolling shop

v) metallurgical control

a) system and organization of control

b) systemization of technical standards

c) technical information and patent control

vi) planning and management

a) planning of management policy

b) organization of the steel company as a whole

c) budget control

d) analysis of managerial results

e) future prospect and solution of particular problems for the steel company

vii) maintenance

a) organization

b) control system

c) inspection, testing and standards of repair works

d) inspection, testing and control of repair works

e) control of parts and components

f) control of lubrication

g) repair statistics, etc.

viii) production planning

a) organization

b) control of production planning system

c) procedure of production planning

d) system of plant control as a whole

e) control of material flow and routing

ix) utilities

a) organization of supply of power, water, BF gas, oxygen, compressed air, steam, etc.

b) power generation, distribution and maintenance control

c) heat control

d) control of measuring instruments and automatic control devices

x) industrial engineering

a) diagonosis of shops and improvement

b) job evaluation and analysis of functions

c) design of systems

d) studies of application of I.E. techniques

e) " of documents for management

f) control of sub-contracting

xi) test and research

a) inspection and testing organization

b) standards of inspection and testing

c) control of inspection and testing operation

d) planning and control of research projects

e) quality control system

xii) personnel affairs and labor relations

a) personnel control

b) salary and wage control

c) welfare system control

d) industrial relations with trade unions

xiii) purchasing

a) organization

b) investigation of raw materials sources (source, kind, grade, quality, price, etc.)

c) planning of supply and demand adjustment

d) contract system of purchasing

xiv) sales

a) general market survey

b) market analysis of each type of product

c) relations with customers and wholesalers

d) price system

e) export business

f) distribution system

xv) finance

a) general accounting

b) fund control

c) cost control

d) control of fixed assets

e) financial analysis of the company

f) control of investment outside the company

xvi) inspection tour

a) integrated production system as a whole

b) organization of top management

c) managerial control measures of each plant

d) management policies

e) industries associated with the steel industry

f) problems and prospects of the steel industry

g) control of construction of an integrated steel plant

Table 1-1. The apparent Steel Consumption during 1960 - 1972 by Types of Products

(unit: 1,000 MT)

		1960		1961		1962		1963		1964		1965		1966	
long products	rail and materials for railway	10.7		23.5		43.4		4.5		8.2		4.4		7.5	
	sheet-pile / angle, channel, beam and other profile	12.9		23.9		21.9		11.7		14.5		18.2		8.0	
	bar (incl. concrete steel	51.9		131.5		40.7									
	of which import							37.1		55.1		90.7		52.3	
	of which domestic production	(-)		(-)		(-)		(-)		(-)		(-)		(-)	
	wire rod	1.3		2.6		3.1									
	steel wire	20.0		32.7		22.9		27.2		19.0		39.9		20.3	
	of which import														
	of which domestic production	(-)		(-)		(-)		(-)		(-)		(-)		(-)	
	sub-total	96.8	44.5	214.2	61.2	132.0	62.1	76.0	45.5	96.8	58.8	153.2	64.8	88.1	59.5
flat products	plate	10.5		22.4		12.9									
	sheet (incl. skelp, hoop and strip excl. galvanized sheet)	22.5		27.3		17.9		28.4		18.7		25.6		18.2	
	hot rolled sheet	14.2		19.8		13.6									
	cold rolled sheet	8.3		7.5		4.3									
	tinplate	18.8		32.3		14.6		24.1		2.1		6.3		5.9	
	of which prime														
	of which waste, waste														
	galvanized sheet	26.5		29.8		7.3		16.9		23.6		22.8		17.0	
	of which														
	of which domestic production														
	steel structure	3.3		2.5		3.8		3.5		7.2		6.1		2.5	
	sub-total	81.6	37.5	114.3	32.6	56.5	26.6	72.9	43.7	51.6	31.3	60.8	25.7	43.6	29.4
tubular products	steel pipe and tube (incl. fitting)	39.1	18.0	21.7	6.2	23.9	11.3	18.0	10.8	16.3	9.9	22.3	10.5	16.2	11.1
	of which seamless														
	of which welded														
	of which import														
	of which domestic production	(-)		(-)		(-)		(-)		(-)		(2.3)		(3.1)	
total		217.5	100.0	350.2	100.0	212.4	100.0	166.9	100.0	164.7	100.0	236.3	100.0	148.1	100.0

		1967		1968		1969		1970		1971		1972 estimate	
long products	rail and materials for railway	4.4		3.9		6.9		10.2		7.7		10.0	
	sheet-pile / angle, channel, beam and other profile	6.7		14.6		21.4		34.8		57.7		70.0	
	bar (incl. concrete steel					100.2		123.8		158.1		195.0	
	of which import	17.5		40.4		(95.7)		(119.0)		(150.6		(105.0)	
	of which domestic production	(-)		(-)		(4.5)		(4.8)		(7.5		(90.0)	
	wire rod												
	steel wire	24.1		30.9		47.4		45.0		57.1		72.0	
	of which import	(24.1)		(30.9)		(47.4)		(45.0)		(57.1)		(62.0)	
	of which domestic production	(-)		(-)		(-)		(-)		(-)		10.0	
	sub-total	52.7	33.2	89.8	38.4	175.9	44.8	213.8	43.6	280.6	42.0	347.0	45.4
flat products	plate									52.3			
	sheet (incl. skelp, hoop and strip excl. galvanized sheet)	40.2		43.7		68.7		93.8		31.8		102.0	
	hot rolled sheet									(1.8			
	cold rolled sheet									(30.0)			
	tinplate	9.5		18.1		29.6		27.4		30.2		33.5	
	of which prime									(9.4			
	of which waste, waste									(20.8)			
	galvanized sheet	26.3		39.1		35.9		49.0		78.3		95.7	
	of which	(26.3)		(31.0)		(27.4)		(15.0)		(1.9)		(1.2)	
	of which domestic production	(-)		(8.1)		(8.5)		(34.0)		(76.4)		(94.5)	
	steel structure	1.3		2.8		3.9		13.4		23.7		34.0	
	sub-total	77.3	48.6	103.7	44.4	138.1	35.2	183.6	37.4	216.3	32.4	265.2	34.7
tubular products	steel pipe and tube (incl. fitting)	28.9	18.2	40.0	17.2	78.4	20.0	92.9	19.0	171.1	25.6	152.1	19.9
	of which seamless	(11.7)		(24.1)		(30.3)		(37.7)		(63.1)		(54.8)	
	of which welded	(16.5)		(14.7)		(45.4)		(52.2)		(96.6)		(91.3)	
	of which import	(15.2)		(13.5)		(43.4)		(49.2)		(88.6)		(70.1)	
	of which domestic production	(1.3)		(1.2)		(2.0)		(3.0)		(8.0)		(21.2)	
total		158.9	100.0	233.5	100.0	392.4	100.0	490.3	100.0	668.0	100.0	764.3	100.0

source: import statistics and domestic production figures.

Table 1-2. The apparent Steel Consumption by Type of Product and by Sector in 1971.

(unit: M.T)

	sector consuming / products	apparent finished steel consumption	building and civil engineering	ship building and repair	bicycle	automobile and motorcycle repair	can and container	home and business appliances and utensils	industrial agricultural and transportation equipment and their repair	wire secondary products	others (incl. items unclassified)
long products	rail and materials for railway	7,700	7,700								
	sheetpile	} 57,700	} 36,683								} 1,835
	angle, channel, beam, and other profile			759				2,500	15,923		
	bar (incl. concrete steel)	} 158,100	} 148,720	317	86	5		75	1,140		
	wire rods			7				2,750		5,000	
	steel wire (excl. secondary products of wire)	57,100	13,840		1,270		30	5,960		36,000	
	sub-total	280,600 42.0	206,943 41.2	1,083 12.1	1,356 16.2	5 2.2	30 0.1	11,285 67.5	17,063 38.7	41,000 100.0	1,835 53.1
flat products	plate	52,303	26,467	7,575		22			16,619		1,620
	sheet (incl. skelp, hoop and strip, excl. galvanized sheet)	31,797	2,210	85	3,250	176	15,310	3,830	6,936		
	hot rolled sheet	(1,831)	(1,010)	(85)	(-)	(-)	(-)	(-)	(736)		
	cold rolled sheet	(29,966)	(1,200)	(-)	(3,250)	(176)	(15,310)	(3,830)	(6,200)		
	tin plate	30,200	3,038				27,000		162		
	of which prime	(9,392)	(840)				(8,500)		(52)		
	of which waste-waste	(20,808)	(2,198)				(18,500)		(110)		
	galvanized sheets	78,300	75,549			15	300	200	2,236		
	steel structure*	23,700	23,700								
	sub-total	216,300 32.4	130,964 26.1	766 85.8	3,250 38.9	213 95.1	42,610 99.9	4,030 24.1	25,953 58.9		1,620 46.9
tubular products	steel pipe and tube (incl. fittings)	171,100 25.6	164,676 32.7	187 2.1	3,750 44.9	6 2.7		1,400 8.4	1,081 2.4		
	of which seamless	(63,100)	(62,909)	(35)	(-)	(-)		(-)	(156)		
	of which welded	(96,600)	(90,367)	(152)	(3,750)	(6)		(1,400)	(925)		
	total	668,000 100.0	502,583 100.0	8,937 100.0	8,356 100.0	224	42,640 100.0	16,715 100.0	44,097 100.0	41,000 100.0	3,455 100.0
		100.0	75.3	1.3	1.2	....	6.4	2.5	6.6	6.2	0.5

* built up frame work (corresponding Indonesian import statistical code No. 8450, 8460, 8470)

source: based on various types of information and verbal description by Indonesian Government Officials

Table 1-3. The Future Demand for Steel up to 1979 by Sector

(unit: 1,000 MT)

calender year / consuming sector	1971		1974		1979		1984	average growth	annual rate (%)
	amount	%	amount	%	amount	%		1974/1971	1979/1974
building and civil engineering	502.6	75.4	690.8	74.1	1,128.3	68.3		11.2	10.3
ship-building	8.9	1.3	13.4	1.4	47.9	2.9		14.6	29.0
bycycle	8.4	1.2	13.0	1.4	27.3	1.7		15.6	16.0
automobile and motorcycle (for repair only)	0.2	...	1.0	0.1	3.2	0.2		...	...
can and container	42.6	6.4	60.6	6.5	123.8	7.5	not available	13.0	15.4
home and business appliances and utensils	16.7	2.5	26.1	2.8	57.8	3.5		16.0	17.2
industrial, agricultural, and transportation equipment and their repair	44.1	6.6	64.3	6.9	127.1	7.7		13.4	14.6
wire secondary products	41.0	6.2	63.4	6.8	135.4	8.2		15.6	16.4
others (incl. items unclassified)	3.5	0.5	0	0	0	0		...	...
total	668.0	100.0	932.6	100.0	1,650.8	100.0	2,920.0	11.8	12.4
* crude steel basis	1971: 851.1	1972: 972.1	1,190.0		2,100.0		3,730.0	11.8	12.0
** per capita crude steel consumption	7 kg		9.2 kg		14.5 kg		22.8 kg		

* crude steel conversion rates are as follows: rail and materials for railway 1.20 various types of long products 1.20 plate & sheet 1.35 tinplate 1.35 steel wire 1.30 steel pipe and tube 1.30 (ref. to Table 1-4)

** population 1971 120,149 x 10^3
74 128,814 "
79 145,093 "
84 163,298 "
} based upon the data of Central Bureau of Statistics

source: Team's Survey

Table 1-4. Future Demand for Steel up to 1984 by Types of Products (finished steel basis)

(unit: 1,000 MT)

		1971	1974	1979	1984
long products	rail and materials for railway	7.7	8.2	26.0	not avail.
	sheet pile	57.7	92.5	162.6	"
	angle, channel, beam, and other profiles				
	bar (incl. concrete steel)	158.1	208.2	335.4	"
	wire rod				
	steel wire	57.1	81.8	15.8	"
sub-total		280.6	390.5	682.0	"
flat products	medium and heavy plate	52.3	80.8	162.4	"
	sheet (incl. skelp, hoop and strip, excl. galvanized sheet)	31.8	53.6	149.3	"
	hot rolled sheet	1.8	not avail.	"	
	cold rolled sheet	30.0	not avail.	"	
	tinplate	30.2	44.2	90.0	"
	of which prime	(9.4)	not avail.	"	"
	of which waste-waste	(20.8)	not avail.	"	"
	galvanized sheet	78.3	108.2	129.0	"
	steel structure (*)	23.7	45.0	102.7	"
sub-total		216.3	332.0	633.4	"
tubular products	steel pipe and tube (incl. fitting)	171.1	210.1	335.4	"
	of which seamless	(63.1)	(73.0)	(100.9)	"
	of which welded	(96.6)	(137.1)	(226.4)	"
total		668.0	932.6	1,650.8	2,920.0

* built-up frame work (corresponding to Indonesian Import Statistics code No. 8450, 8460, 8470)

source: Team's Survey

Table 2-1a. Existing Bar Mills as of Nov. 1972

unit: MT

name of company	location	number of line	licensed capacity	estimated production capacity(rolled steel basis)			steelmaking furnace	production capacity (3 shifts)
				1 shift	2 shifts	3 shifts		
P. T. Air Trading	Jakarta	2	18,000	5,000	10,000	15,000	1 open hearth	15,000
P. T. Raka-ta Baja	"	1	42,000	10,000	20,000	30,000	oil fired rotary fce. planned	-
P. T. Jakarta	"	1	12,000	6,000	12,000	18,000	5T electric fce.	15,000
P. T. P. B. Wuhan	"	1	14,000	10,000	20,000	30,000	-	-
P. T. Industri Ancol	"	2	7,500	6,000	-	9,000	-	-
P. T. Iro Steel Works	"	2	139,000	8,000	16,000	24,000	8T electric fce.	18,000
P. T. Interu	"	2	30,000	6,000	12,000	18,000	-	-
P. T. San Iron	"	1	10,000	5,000	10,000	15,000	-	-
P. T. Waru Jaya	Surabaya	1	12,000	5,000	10,000	15,000	-	-
P. T. Pyoamid	Medan	1	6,000	5,000	10,000	15,000		
P. T. Besi Baja Sum.	"	3	24,000	5,000	10,000	15,000		
P. T. Gunung Gahapi	"	1	5,500	6,000	12,000	18,000		
total		18	320,000	71,000	142,000	222,000		48,000

Table 2-1b. Bar Mills under Construction as of Nov. 1972

P. T. Garsino Jaya	Jakarta	-	36,800					
P. T. Krakatau Steel	Cilegon		200,000					
P. T. Car Steel	Semarang		9,600					
			246,400					

Table 2-1c. Bar Mills and Steelmaking Furnaces under Construction as of Nov. 1972

unit: MT

name of capacity	location	number of line	licensed capacity	estimated production capacity(rolled steel basis)			steelmaking furnace	production capacity (3 shifts)
				1 shift	2 shifts	3 shifts		
P. T. P. Garung Steel	Jakarta		60,000				? electric fce.	24,000
P. T. Mexifero Indust.	"		7,500					
P. T. Ini Baja	"		25,000					
P. T. Aneka Gam	Surabaya							
P. T. Gunung Bahapi	Medan		4,800				7t electric fce.	14,400
P. T. Jatim Utama	Surabaya		20,000				? electric fce.	12,000
total			117,300					50,400

source: Department of Industry

Table 2-2. Galvanized Sheet Mills as of Oct., 1972

unit: MT

name of company	location	start up year	no. of line	annual capacity
P. T. Tumbak Mas	Jakarta	1965	2	24,000
P. T. Fumira	Semerang	1969	1	12,000
		1972	1	12,000
P. T. Iron Nasional Industri	Medan	-	1	12,000
P. T. Industri Baja Garuda	"	1969	2	24,000
P. T. Sermani Steel Co.	Makassar	1970	1	12,000
P. T. Tumbak Mas Jaja	Surabaya	1970	1	12,000
P. T. Polygung Nusartara	Padang	1972	1	12,000
P. T. F. I. I.	Pontianak	und. const.	1	12,000
P. T. Rodamas	Palembang	planned	1	12,000
Existing capacity			10	120,000
under-construction and planned capacity			2	24,000

source: Department of Industry and
Nippon Steel Corporation

Table 2-3. Pipe Mills as of Nov. 1972

unit: MT

name of company	location	start up year	no. of line	annual capacity	size range
P. T. Bakried Brothers	Jakarta	1966	2	21,000	1/2" - 4"
P. T. Aneka Jakarta	"	1971	1	5,000	1/2" - 4"
P. T. Inasu	Bandung	1971	1	12,000	1/2" - 4"
P. T. Respati Jaja	Semarang	1972	1	12,000	1/2" - 4"
P. T. Pipa Mas	Surabaya	1972	2	21,000	5/8" - 4"
P. T. Spindo	"	1972	1	12,000	1/2" - 4"
P. T. Anarin	Medan	planned	1	12,400	1/2" - 4"
P. T. Krakatau	Cilegon	und. const. 1973 start	1	?	4" - 62" spiral
Existing and planned capacity				95,400	

source: Department of Industry and the team's survey.

Table 2-4. Wire Drawing Mills as of Nov. 1972

unit: MT

name of company	location	start up year	annual capacity
Universal Metal	Jakarta	1972	30,000 (ind. planned cap.)
Iron Wire Works	"	1972	12,000
P. T. Krakatau	Cilegon	1972	30,000 (ind. planned cap.)
Universal Metal	Surabaya	und. const.	12,000
unknown	"	planned	24,000
unknown	"	planned	30,000
Existing, und. construction, planned capacity			108,000

source: The team's survey

Table 3. Freight-and Ship Tonnage Relation for Iron Ore and Coal from Australia to Java.

(on a basis of ships launched in 1974-75)

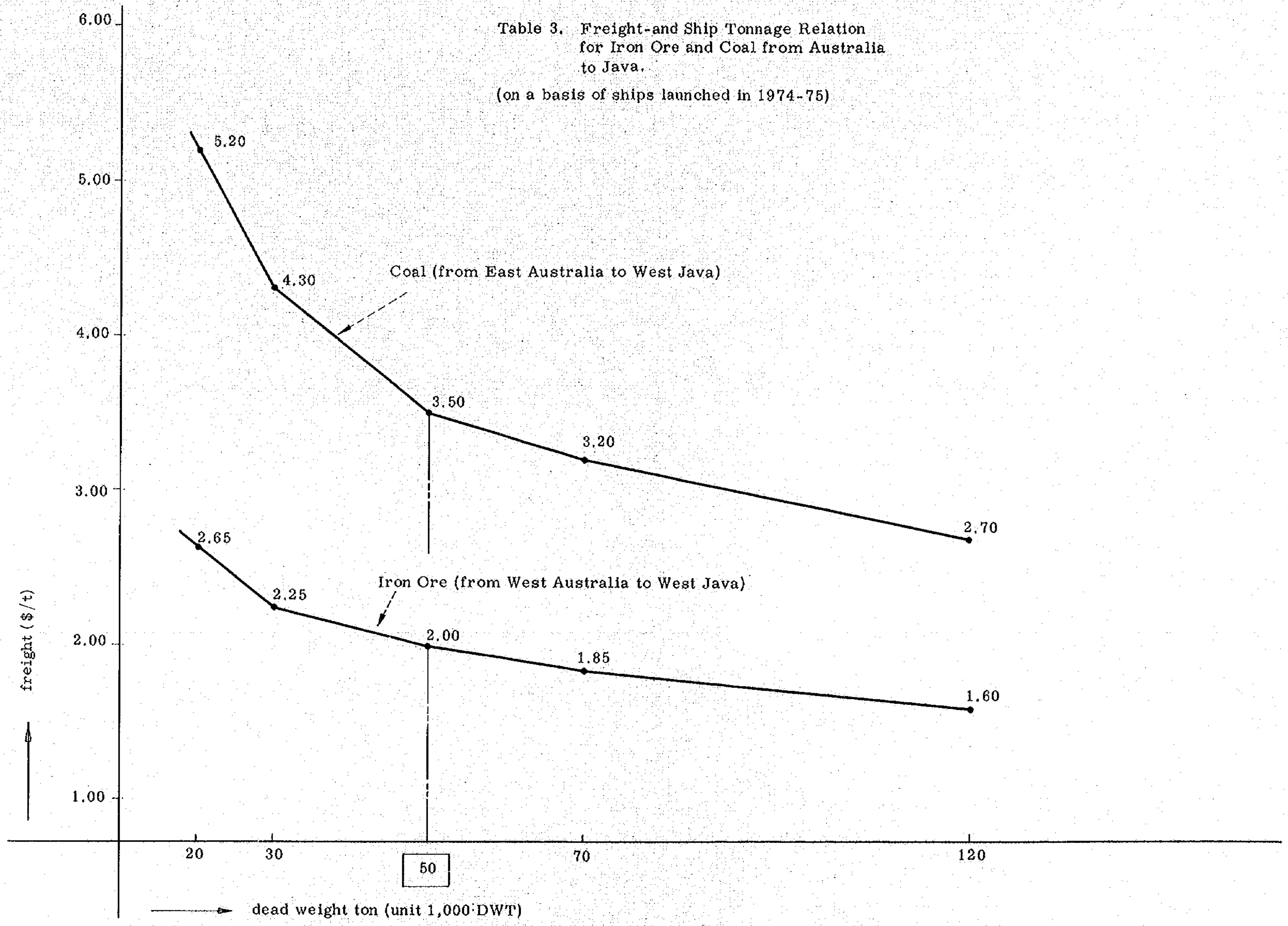


Table 4-1. Hematite - Magnetite Ores of Kalimantan

No.	deposits	primary ore				deluvial ore				remarks
		reserve, metric ton	Fe	S	P	reserve, metric ton	Fe	S	P	
1.	Ulin	30,000 *	-	-	-	419,000 **	51.86	0.12	0.07	reference: Kochergin I.A. & Sastrosoegito S. (1965) "report on results of prospecting and exploration surveys on hematite magnetite ores in South Easten part of Kalimantan."
						70,300 *	43.30	0.13	0.07	
2.	Melati	-	-	-	-	67,900 **	58.52	0.10	0.06	
						40,800 **	51.85	0.07	0.12	
3.	Tembaga	439,800 **	64.43	0.26	0.08	408,200 **	57.64	0.14	0.03	
4.		25,000 *	-	-	-					
4.	Batukora	35,000 *	-	-	-	105,800 ***	50.99	0.03	0.09	
5.	Jajakan	1,000,000 *	57.36	0.04	0.04	128,700 **	56.51	-	-	
6.	Tanjung	27,000 *	-	-	-	109,700 ***	52.65	0.11	0.10	
						40,400 *	45.06	0.07	0.12	
7.	Riampinang	500,000 *	-	-	-	520,500 **	60.98	0.07	0.06	
						128,700 **	55.77	0.07	0.04	
8.	Tanalang	2,617,700 **	59.40	0.62	0.03	2,044,600 **	58.43	0.07	0.05	
		335,800 *	53.72	0.52	-	64,300 *	51.38	0.02	0.05	
9.	Batuberani	-	-	-	-	64,800 **	-	-	-	
	total reserves:	- *** (proved) 3,057,500 ** (probable) 1,952,800 * (possible)				215,500 *** (proved) 3,653,700 ** (probable) 344,500 * (possible)				
	total	5,010,300				4,213,700				

source: Department of Mines

Table 4-2. Hematite - Magnetite of Sumatra

deposits	reserve, metric ton			
	proved	probable	possible	total
Lampong region				
1. Pematang Burhan	260,000	280,000	150,000	690,000
2. Tanjung Senang-Penyandingan	25,000	450,000	700,000	1,175,000
3. Riau-Kirangan	15,000	-	170,000	185,000
total	300,000	730,000	1,020,000	2,050,000

Source: Department of Mines

Table 4-3. Ni - Cr Bearing Iron Laterites of Sulawesi and Kalimantan

deposits	reserve, metric ton			
	proved	probable	possible	total
Sulawesi				
1. Larona	-	-	370, 000, 000	370, 000, 000
2. Lingkona	-	-	1, 500, 000	1, 500, 000
3. Lingkobale	-	-	1, 500, 000	1, 500, 000
4. Karipinan	-	-	1, 000, 000	1, 000, 000
5. Boneputih	-	-	2, 000, 000	2, 000, 000
total			376, 000, 000	376, 000, 000
Kalimantan				
1. Gunung Kukusan	-	-	176, 000, 000	176, 000, 000
2. Sebuku Island	6, 303, 000	19, 817, 000	-	26, 120, 000
3. Suwangi Island	-	-	25, 000	25, 000
4. Danawan Island	-	-	7, 500, 000	7, 500, 000
total	6, 303, 000	19, 817, 000	183, 525, 000	209, 645, 000
total	6, 303, 000	19, 817, 000	559, 525, 000	585, 645, 000

Notes : 1. Sulawesi : average Fe content = 49 percent.

2. Kalimantan : Fe - content = 40 - 50 percent;

Ni - content = 0. 66 percent;

Cr_2O_3 = 0. 94 percent.

3. Reference : - Sigit S. (1969). "Minerals and Mining in Indonesia".

- Bemmelen, R. W. van (1949). "The Geology of Indonesia" vol. II.

source : Department of Mines

Table 4-4. Titaniferrous Magnetite Sand Deposits of Java and Bali

looation	area (sq. km)	crude ore (metric ton)	M.D (%)	concentrate (metric ton)	Fe-total (%)	TiO2 (%)
West Java						
1. Jampangkulon (recent)	7.57	57,952,727 **	16.00	9,352,636	54.21-58.60	12.50-13.75
2. Jampangkulon (old beach)	0.67	6,676,925 **	-	-	38.00 (crude ore)	10.00 (crude ore)
3. Sindangbarang	1.53	11,624,622 **	18.89	2,196,418	56.76	8.25
4. Cidaun	1.34	11,684,576 **	26.74	2,884,012	57.53	16.00
5. Cipatujah	1.97	9,443,390 **	21.52	2,032,217	57.89	12.04
6. Parigi-Pangandaran	2.19	7,100,626 **	2.67	190.024	-	-
Central Java						
7. Cilacap	8.47	44,646,672 ***	14.6	6,516,930	55.00	10.10
8. Purworajo	11.12	77,300,000 *	12.10	9,353,300	55.00	8.00
9. Wates	20.20	166,196,984 ***	12.30	20,442,229	55.00	8.00
10. Bantul	5.30	29,308,400 *	12.60	3,692,858	54.00	9.00
East Java						
11. Lumajang	-	29,571,900 **	11.50	3,400,768	55.00	8.00
		24,000,000 *	28.00	6,720,000	55.00	8.00
12. Bali	-	2,200,000 *	27.00	594,000	57.00	11.00
total reserves		217,520,581 ***	(proved)	26,959,159		
		117,934,463 **	(probable)	18,023,858		
		142,251,790 *	(possible)	22,392,375		
total		477,706,834		67,375,392		

source: Department of Mines

Table 5. Proximate Analysis of Indonesian Coals

The following table summarizes the proximate analysis of coal from the major Indonesian deposits.

mine	coal field and coal seam	free H_2O (%)	moisture (%)	ash (%)	gas (%)	fixed carbon (%)	sulfur (%)	calorific value (cal)
1	2	3	4	5	6	7	8	9
a. Ombilin	1. Tanah Hitam A. Langkok	5.2	4.3	1.2	43.5	50.9	0.6	7739
	2. "Brandveld" C	4.4	4.0	4.0	43.2	48.7	0.4	7576
b. Bukit Asam	1. Batu Besi transitional coal seams	1	15.7	0.4	40.4	43.5	0.4	6380
	2. Air Manggus A, "Glanz-kohle"		5.8	0.3	38.5	55.4	0.5	7540
	3. Ulu Berangan B		1.0	1.6	27.0	70.4	1.6	8400
	4. Bukit Tapuan B, "anthra-citic"		1.0	0.8	3.8	94.4	0.5	8460
c. Mahakam	1. Loa Kulu	9.0		3.0	40.0	48.0		6400
	2. Perdjiwa	10.0		6.0	40.0	44.0		6200
	3. Sigihan	5.0		11.0	41.0	43.0	3.35	6600
	4. Loa Pari	9.06		4.29	42.06	44.59	0.37	6550
	5. Loa Bukit	10.0		6.0	40.0	44.0		6500
d. Pulau Laut	1. Sebelimbingan		5.8	16.7	28.2	49.3	0.8	5500
	2. Selaro	6.6	3.7	4.4	49.8	42.1	0.3	7689

source: Department of Mines

Table 6-1. Most Important Limestone Deposits in Java and Madura

Tables 6-1 and 6-2 give a summary of the most important occurrences and their characteristics.

location	geological age	reserves (10^6 tons)	composition (%)		reference and remarks
			CaO	MgO	
1	2	3	4	5	6
Western Java					
1. Tjibinong	L. Pliocene	128	51	0.9	cement project, 1968.
2. Tjibodas	?	20	48.26 to 54.58	0.35 to 2.81	general survey
3. Tjibadak	L. Tertiary	24	51.45	0.94	cement project, 1964; hard compact.
4. Tagogapu	L. Tertiary	large	56	n.a	general survey.
5. Bongas	M. Pliocene	27	53.37	1.00	general survey; bedded, separated by a layer of shale, locally metamorphosed into marble.
Central Java					
6. Klaten	M. Miocene	-	50.80 to 53.90	0.55	general survey; bedded.
7. Pamotan	Pliocene and or Miocene	25	59.13	6.60	soda-ash project, 1961.
Eastern Java					
8. Gresik	Pliocene	37	53.76	0.28	P.N. semen gresik.
Madura Island					
9. Bluto	Pliocene	28	50 to 55	less than 1.00	soda-ash project, 1964; soft coral limestone, 6 6 million tons; hard shell limestone, 22 million tons.

Table 6-2. Most Important Limestone Deposits Outside Java

location	geological age	reserves (10^6 tons)	composition (%)		reference and remarks
			CaO	MgO	
1	2	3	4	5	6
Northern Sumatra					
1. Lam Teungoh Atjeh	Pre-Tertiary	200	48.31	1.27	Cement project; massive, compact limestone, and hard crystalline limestone.
2. Bohorok	Pre-Tertiary	58	53	less than 1.00	Cement project, 1961; compact, massive, crystalline limestone.
Western Sumatra					
3. Indarung	Pre-Tertiary	87	53.94 to 55.96	0.11 to 1.44	P.N. Semen Padang; a. hard, massive limestone, 43 million tons; b. white, crystalline marble, 34 million tons; c. white, fine-to medium grained crystalline calcite, 10 million tons.
Southern Sumatra					
4. Pematang Emas	Pre-Tertiary	2	53.51 to 55.32	0.29 to 2.19	Iron and steel project, 1961, as limestone flux; crystalline limestone and marble.
Kalimantan					
5. Sungai Tjantung, southeastern Kalimantan	Tertiary	con-sid-erable	55.36 to 55.74	n.a	Iron and steel project, 1962.
Sulawesi					
6. Bolaang Monggondow, northern Sulawesi	Tertiary	very large	more than 50.00	less than 1.00	General survey, 1965
7. Tonassa, southern Sulawesi	Tertiary	very large	more than 53.00	less than 1.00	P.N. Semen Tonassa, bedded limestone.
Western Irian					
8. Djajapura	Pleistocene	con-sid-erable	n.a	n.a	Coral reefs.

source: Department of Mines

Table 7-1. Quality of Australian Iron Ores and Coals

Ores

	Fe	SiO2	Al2O3	CaO	MgO	Mn	P	S	Cu	TiO2	FeO	moisture	size
(lump ore)													
Goldsworthy	65.02	4.60	1.05	0.43	0.13	0.41	0.038	0.006	0.001	0.008	0.15	4	6x30mm
Hamersley	65.90	2.31	1.15	0.14	0.06	0.04	0.032	0.009	0.001	0.080	0.27	1	"
Mt. Newman	64.78	3.99	1.42	0.12	0.11	0.54	0.038	0.010	0.002	0.080	0.20	1	"
(pellet)													
Hamersley	63.58	5.01	3.01	0.50	0.10	0.07	0.020	0.004	0.002	0.140	0.17	1	9-16mm 85% -5mm 2-3%
Robe River	63.30	5.40	3.00	0.60	0.20	0.06	0.035	0.001	0.001	0.350	0.50	1	9-16mm 90%
(fine ore)													
Goldsworthy	63.17	5.50	2.02	0.12	0.07	0.50	0.060	0.010	0.002	0.010	0.11	5	-150 mesh 12%
Hamersley	61.20	5.63	3.40	0.08	0.06	0.05	0.051	0.011	0.001	0.150	0.21	3	+6mm 15%
Mt. Newman	62.00	6.54	2.50	0.06	0.06	0.05	0.038	0.013	0.001	0.110	0.14	2	+6mm 6%

Coals

	total moisture	ash	V.M.	S	CBI	size	time of measuring
Coal Cliff	9.0	10.7	21.4	0.37	4 1/2	25mm under 100%	as of Oct. 1972
"	9.0	11.0	21.9	0.28	3 1/2	25mm under 83%	25-50 16% 50-100 1% as of Sept. 1972
Goonyella	9.7	7.5	24.9	0.50	7	25mm under 94%,25-50mm 6%	as of Aug. 1972
Liddell	6.2	7.97	38.34	0.53	3	50mm over 2.9%,25-50mm 10.4% 25mm under 96.7%	as of Sept. 1972

Table 7-2. Estimated Prices of Australian Ores and Coals as of 1971

a) ores	FOB price	freight			others	CIF price in Java		
		dead weight 20,000t	dead weight 50,000t	dead weight 120,000t		dead weight 20,000t	dead weight 50,000t	dead weight 100,000t
imp. ore(A)	lump 9.60	2.65	$ 2.00	$ 1.60	$ 0.60	12.85	$ 12.20	$ 11.80
	fine 7.60	2.65	2.00	1.60	0.60	10.85	10.20	9.80
	pellet 11.655	2.65	2.00	1.60	0.60	14.905	14.255	13.855
imp. ore (B)	lump 9.20	2.65	2.00	1.60	0.60	12.45	11.80	11.40
	fine 7.20	2.65	2.00	1.60	0.60	10.45	9.80	9.40
imp. ore (C)	lump 9.20	2.65	2.00	1.60	0.60	12.45	11.80	11.40
	fine 7.60	2.65	2.00	1.60	0.60	10.85	10.20	9.80
b) coals								
imp. coal(A)	L.V 15.70	5.20	3.90	2.70	0.80	21.70	20.40	19.20
imp. coal(B)	L.V 13.00	5.20	3.50	2.70	0.80	19.00	17.30	16.50
imp. coal(C)	H.V 11.90	5.20	3.90	2.70	0.80	16.60	16.40	15.40

Note: FOB prices are those of contracts made by the Japanese steel industry.

Freights are those of ships launched in 1974 - 75.

Table 8. Specifications of Main Facilities of the Integrated Steel Plant

	first stage (1979)	second stage (additional - 1984)
material handling	unloader 750 t/h x 2 " 20 t/h x 4 derrick 50 t/h x 1	unloader 750 t x 1
iron ore yard (including aux. materials)	area 40m x 300m x 3 stacker 2,000 t/h x 2 loader 400 t/h x 1	area 40m x 300m x 2 stacker 2,000 t/h x 1 loader 400 t/h x 1
coal and coke yard	area 40m x 500m x 3 stacker 1,400 t/h x 1 loader 100 t/h x 1	area 40m x 500m x 2 stacker 1,400 t/h x 1 loader 100 t/h x 1
coke oven	-----	capacity of charging coal 975.000 t/y x 1
sintering plant	Dwight - Lloyd type effective hearth area $100m^2$ x 1 production capacity 1,030,000 t/y	Dwight - Lloyd type effective hearth area $120m^2$ x 1 production capacity 1,170,000 t/y
blast furnace	inner volume $1,450m^3$ x 1 hot metal production 2,180 t/d (1.5 t/m^3) 773,000 t/y	hot metal production 3,140 t/d
LD converter	capacity 85 t/charge x 2 (32 ch/d) molten steel production 815,000 t/y (300 days) 1,000 t mixer x 1	85 t/charge x 1 (total molten steel 2,000,000 t/y - 70 ch/dx336 days) 1,000 t mixer x 1
ingot making	for emergency only	for emergency only
continuous casting machine	billet (100mm square section only) 6 strands/machine x 2	slab (200mm x 1,270mm section) 2 strands/machine x 3
small billet mill	billet products (50mm square - 80mm square section) 3 high mill x 1 capacity (billet base) 150,000 t/y	-----
wire rod mill	wire rod (5.5mm - 12mm diameter) semi-continuous mill (2 strands) roughing/intermediate/finishing 2 high x 10/6/8 stands capacity (billet base) 150,000 t/y	-----
hot strip mill	-----	hot coil (1.2mm x 12.7mm thickness x 1,270mm width, max. with mill edge 56" semi-continuous mill capacity (slab base) 1,200,000 t/y
oxygen plant	3,000 m^3/h x 3 (1 spare)	3,000 m^3/h x 3
power generating station	steam turbine generater 20,000 kva x 3 (1 spare)	steam turbine generater 20,000 kva x 4
products. cold pig	20,000 t/y	50,000 t/y
billet	80,000 t/y (50mm square section) 410,000 t/y (100mm square section)	142,000 t/y (50mm square section) 410,000 t/y (100mm ")
wire rod	136,000 t/y	140,000 t/y
hot coil	----	1,140,000 t/y
total	646,000 t/y	1,882,000 t/y

Table 9-1. Material Flow and Material Balance
(first stage-1979)

(unit: MT/Y)

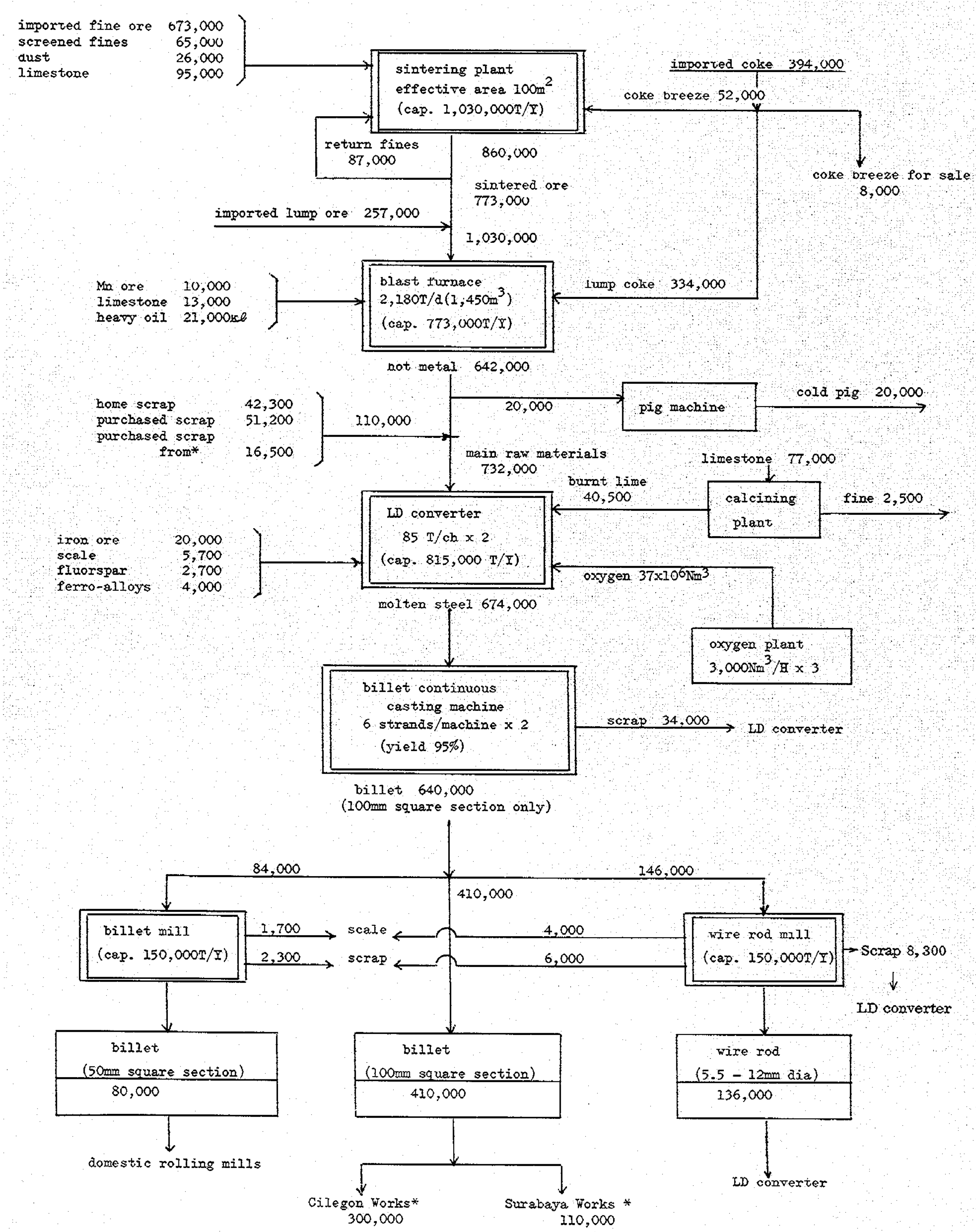


Table 9-2.Material Flow and Material Balance
(second stage-1984)

(unit: MT/Y)

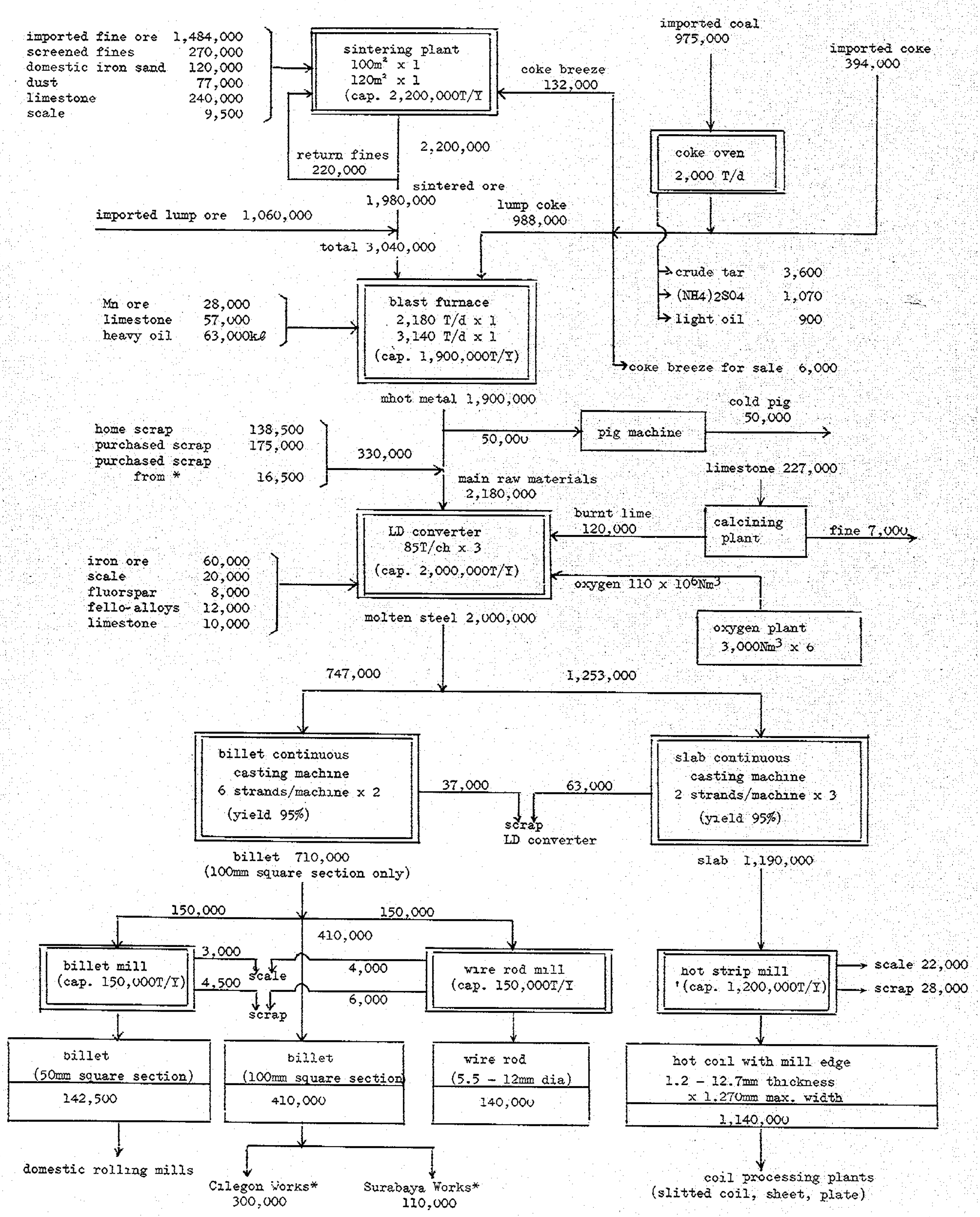


Table 10. Manning Plan for the Integrated Steel Plant

	first stage (1979)			second stage (additional - 1984)			1984		
	staff including general foremen	worker including foremen	total	staff including general foremen	worker including foremen	total	staff including general foremen	worker including foremen	total
production control and technology	65	90	155	15	40	55	80	130	210
ironmaking	45	450	495	15	370	385	60	720	880
steelmaking	48	340	388	15	180	195	63	520	583
rolling	30	480	510	20	440	460	50	920	970
electric and power plants	52	350	402	15	130	145	67	480	547
transportation, maintenance, instrumentation, communication, building repair	80	1,000	1,080	20	260	280	100	1,260	1,360
others	40	590	630	10	270	280	50	860	910
sub-total	360	3,300	3,660	110	1,690	1,800	470	4,990	5,460
clerical businesses	340	--	340	200	--	200	540	--	540
total	700	3,300	4,000	310	1,690	2,000	1,010	4,990	6,000

Note: 1. This manning plan is made in accordance with the actual situation in Pohan Steel Co., Korea.

2. For this plan 4 teams - 3 shifts work is applied for main production lines.

3. It is assumed that all jobs necessary for operation of this plant are occupied by the plant's employees without any sub-contracting.

Table 11. Sub-surface Geological Structure around Anjer-Lor

1. This data was obtained in the Geological Survey Institute from the file of a Dutch geologist's boring in 1906.

2. This sub-structure is Miocene sedimentary and belongs to undifferentiated volcanic products

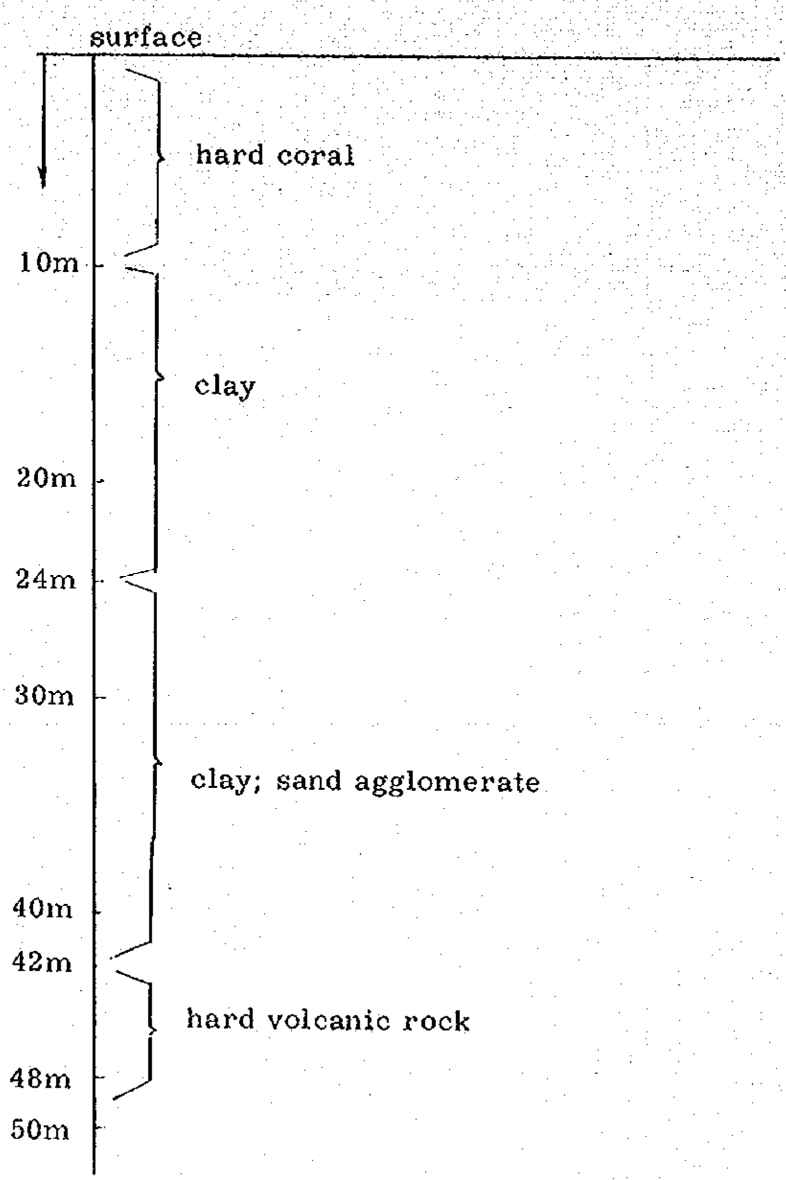


Table 12. Rough Specifications of Infrastructure for the Integrated Steel Plant

items	specifications
land preparation for the plant site	space 1,500,000 M^2 for the 1st. stage, 2,200,000 M^2 for 2nd. stage, ground level height - basic level +3M, average banking thickness +1.1M amount of banking earth 1,700,000 M^3 for the 1st, 800,000 for the 2nd, distance between the plant site and the quaries - 7 Km.
welfare facilities	manning plan, 4,000 persons for the 1st., 6,000 persons for the 2nd. land preparation, 885,000 M^2 " " " , 115,000 " " " offsite road 200,000 M^2 " " " , 30,000 " " " a hospital, two schools, a sport ground, a park, land and space for shopping and other community facilities.
offsite water supply systems	water source. total fresh water requirement 70M^3/min., potable 10M^3/min. concrete dam, height 10M, length 400M water treatment facilities 20M^3/min. x 6 sets raw water supply piping 1200ø x 30 KM water receiving pond 30,000 M^3 water purification facilities 15M^3/min. potable water supply and sewerage potable water piping from the plant 350ø x 10 KM offsite piping network 80ø - 350ø 30 KM sewerage HP 1500ø - 400ø 11 KM
harbor facilities	(see below)
road and railway	road from the national highway to the plant site 2.5 KM railway from the national line to the plant sidings 1.0 KM
electric transmission, etc.	a transmission line, 100 KM, 150 KV, two circuits 2 sets of breakers wiring for welfare facilities, cables 10 KM, 20 KV transformer 1,000 KVA x 2 sets incl. road lights, signals, etc. the communication, micro-wave, plant - Jakarta 150 KM

harbor facilities:

	depth	length	type	tonnage
main raw materials berth	-13M	300M	detached pier	50,000DWT
aux. raw materials berth	-7.5	150	sheetpiling	5,000 "
product shipment berth A	-6.5	130	"	3,000 "
" " " B	-6.5	110	"	3,000 "
fuel oil dolphin	-5.5		dolphin	2,000 "

Table 13. Rough Estimation of the Construction Cost of the Infrastructure

The cost of acquisition of the land is excluded.

unit; U. S. $ 1,000

	first stage			second stage			Total
	domestic	import	sub-total	domestic	import	sub-total	
1. land preparation	1,528	2,031	3,559	1,528	2,031	3,559	7,118
2. welfare facilities	2,943	3,901	6,844	-	-		6,844
3. offsite water supply systems	14,666	19,461	34,127	-	-		34,127
4. harbor facilities	1,201	4,249	5,450	-	-		5,450
5. road and railway	333	441	774	-	-		774
6. electric trans-mission,etc.	1,636	5,759	7,395				7,395
Total	22,307	35,842	58,149	1,528	2,031	3,559	61,708

Notes: 1. ○ starting up of work
2. △ earth breaking
3. → completion

Table 14. Construction Schedule of the Integrated Steel Plant

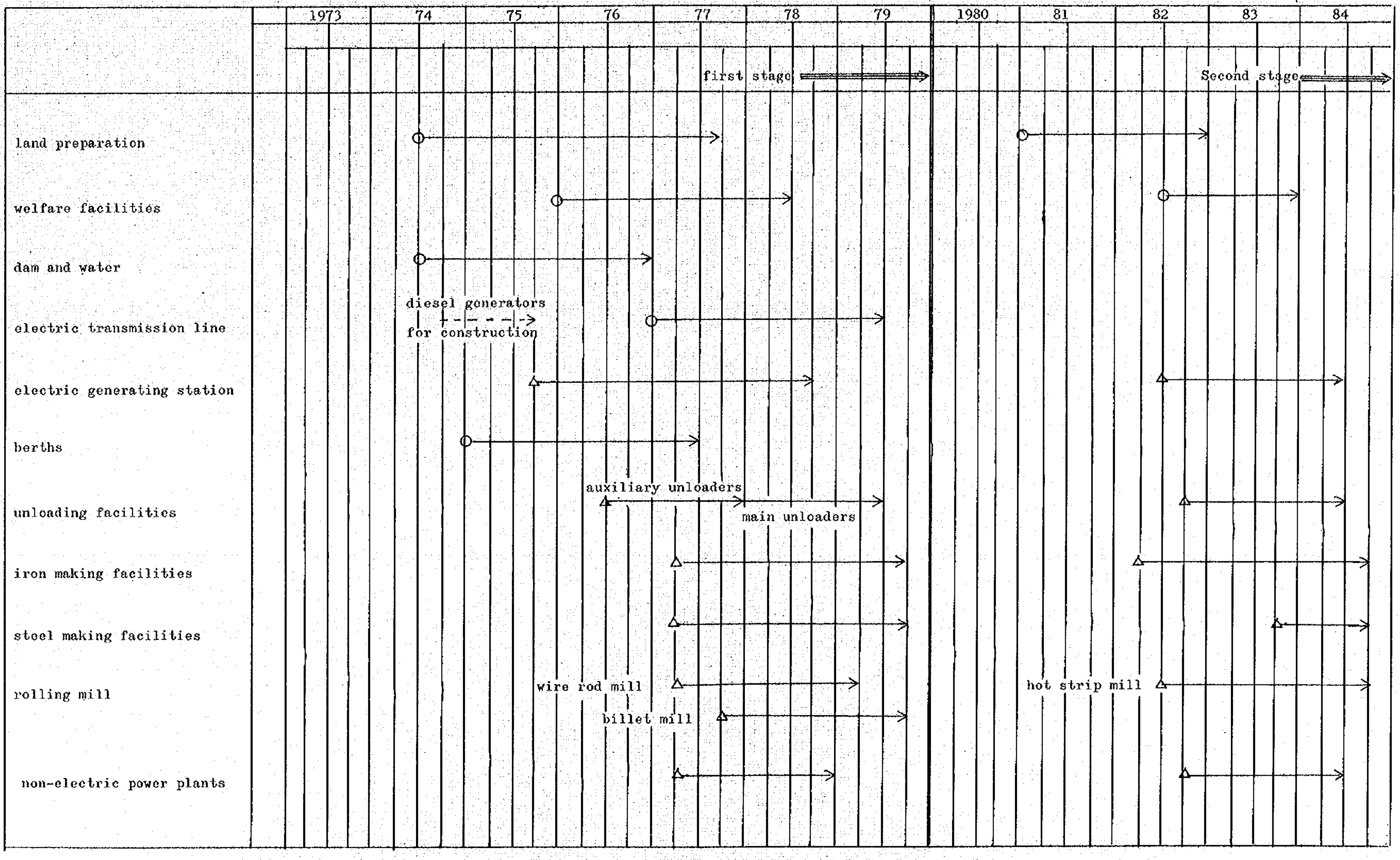


Table 15. Rough Estimation of the Construction Cost of the Integrated Steel Plant

unit: U.S.$1,000

		first stage			second stage			
		import	domestic	sub-total	import	domestic	sub-total	total
ironmaking	raw-material yard	15,810	1,880	17,690	7,910	940	8,850	26,540
	sintering plant	4,980	1,970	6,950	6,000	2,340	8,340	15,290
	blast furnace	9,740	4,180	13,920	14,130	6,060	20,190	34,110
	cokeoven & by-product plant				14,620	6,270	20,890	20,890
	sub-total	30,530	8,030	38,560	42,660	15,610	58,270	96,830
steelmaking	L.D. converter	17,720	9,600	27,320	8,630	4,680	13,310	40,630
	C.C. billetting mill	12,710	4,630	17,340				17,340
	C.C. slabbing mill				34,060	12,770	46,830	46,830
	limestone calcining fce.	2,370	1,120	3,490	2,370	1,120	3,490	6,980
	sub-total	32,800	15,350	48,150	45,060	18,570	63,630	111,780
rolling	billetting mill	1,450	650	2,100				2,100
	hot strip mill				52,760	16,330	69,090	69,090
	wire rod mill	4,450	1,420	5,870				5,870
	sub-total	5,900	2,070	7,970	52,760	16,330	69,090	77,060
energy & power	electric generating station	8,970	3,540	12,510	12,100	4,930	17,030	29,540
	power receiving and distributing system	2,520	950	3,470	2,520	950	3,470	6,940
	water treatment	4,870	2,090	6,960	4,870	2,090	6,960	13,920
	compressor	270	70	340	270	70	340	680
	oxygen plant	5,380	1,520	6,900	5,380	1,520	6,900	13,800
	piping work	6,300	2,370	8,670	8,820	3,320	12,140	20,810
	sub-total	28,310	10,540	38,850	33,960	12,880	46,840	85,690

		first stage			second stage			
		import	domestic	sub-total	import	domestic	sub-total	total
other facilities	conveyance	1,170	1,330	2,500	1,170	1,330	2,500	5,000
	road & sewerage	750	1,040	1,790	750	1,040	1,790	3,580
	office & warehouse	1,060	1,460	2,520	1,060	1,460	2,520	5,040
	raw material unloader	3,020	380	3,400	2,100	280	2,380	5,780
	shipping loader	620	70	690	540	70	610	1,300
	house for employees	9,110	6,080	15,190	4,560	3,040	7,600	22,790
	dormitory for employees	1,750	1,170	2,920	880	580	1,460	4,380
	sub-total	17,480	11,530	29,010	11,060	7,800	18,860	47,870
	total	115,020	47,520	162,540	185,500	71,190	256,690	419,230

Table 16-1. Production Cost-Cokes Oven Plant

stage	first stage					second stage				
production	T/Y (yield %)					(lump 654,000 breeze 78,000) 732,000 T/Y (yield 75.1 %)				
	annual requirements ($\times 10^3$MT)	unit price/cost (US$)	amount ($\times 10^3$US$)	consumption per unit(kg)	unit cost (US$)	annual requirements ($\times 10^3$MT) m^3	unit price/cost (US$)	amount ($\times 10^3$US$)	consumption per unit(kg)	unit cost (US$)
imp.coal(A)(L.V.)						325	20.40	6,630	444.0	9.06
imp.coal(B)(L.V.)						325	17.30	5,623	444.0	7.68
imp.coal(C)(H.V.)						325	16.40	5,330	444.0	7.28
raw material cost						975	18.03	17,583	1,332.0	24.02
COG						292,500	7.83	△ 2,290	m^3 400.0	△3.13
crude tar						3.6	13.98	△ 50	5.0	△0.07
$(NH_4)_2SO_4$						1.1	50.00	△ 55	1.5	△0.08
credit								△ 2,395		△3.28
fuel (COG)						150,000	7.83	1,175	m^3 205.0	1.61
materials								–		–
cast/roll								–		–
power						7,800	5.79	45	KwH 10.7	0.06
compressed air						2,928	0.58	2	m^3 4.0	–
water						952	9.10	9	m^3 1.3	0.01
miscellaneous								88		0.12
variable cost								1,319		1.80
var. ma. cost								16,507	**	22.54 (23.42)
labor								*		
depreciation								1,580		
maintenance								837		
miscellaneous								*		
overhead								80		
fixed cost										
ma. cost										
interest(EQ.)								546		
interest(OP.)								*		
selling & adm.								*		
full cost										

* included in "accumulated fixed cost in table 16-4.
** variable manufacturing unit cost of lump cokes

Table 16-2. Production Cost—Ore Sizing Plant

stage	first stage					second stage				
production	257,000 T/Y (yield 79.8 %)					1,060,000 T/Y (yield 79.8 %)				
	annual requirements (x 10^3MT)	unit price/cost (US$)	amount (x10^3US$)	consump-tion per unit(kg)	unit cost (US$)	annual requirements (x 10^3MT)	unit price/cost (US$)	amount (x 10^3US$)	consump-tion per unit(kg)	unit cost (US$)
imp. ore (a)	161	11.80	1,900	626.5	7.40	665	11.80	7,847	626.5	7.40
imp. ore (b)	161	11.80	1,900	626.5	7.40	665	11.80	7,847	626.5	7.40
raw material cost	322	11.80	3,800	1,253.0	14.80	1,330	11.80	15,694	1,253.0	14.80
screened fines										
credit	65	10.00	△ 650	253.0	△2.53	270	10.00	△ 2,700	253.0	△2.53
fuel										
materials										
cast/roll										
power	1,799	6.48	12	kwh 7.0	0.04	7,420	5.79	43	kwh 7.0	0.04
compressed air										
water										
miscellaneous										
variable cost			12		0.04			43		0.04
var. ma. cost			3,162		12.31			13,037		12.31
labor										
depreciation										
maintenance										
miscellaneous										
overhead										
fixed cost										
ma. cost										
interest(eq.)										
interest(op.)										
selling & adm.										
full cost										

Table 16-3. Production Cost–Sintering Plant

stage	first stage					second stage				
production	773,000		T/Y (yield 81.7 %)			1,980,000		T/Y (yield 81.8 %)		
	annual requirements (x10³MT)	unit price/cost (US$)	amount (x10³US$)	consump-tion per unit(kg)	unit cost (US$)	annual requirements (x10³MT)	unit price/cost (US$)	amount (x10³US$)	consump-tion per unit(kg)	unit cost (US$)
imp. fine ore	673	10.00	6,730	870.6	8.70	1,484	10.00	14,840	749.5	7.50
screened fines	65	10.00	650	84.1	0.84	270	10.00	2,700	136.4	1.36
return fines	87	10.00	870	112.6	1.13	220	10.00	2,200	111.1	1.11
dom. iron sand					-	120	10.00	1,200	60.6	0.60
dust	26	5.00	130	33.6	0.17	77	5.00	385	38.9	0.20
limestone fines	95	3.00	285	122.9	0.37	240	3.00	720	121.2	0.37
scale					-	9.5	15.00	143	4.8	0.07
raw material cost	946	9.16	8,665	1,223.8	11.21	2,420	5 9.17	22,188	1,222.5	11.21
return fines										
credit	87	10.00	△ 870	112.6	△1.13	220	10.00	△ 2,200	111.1	△1.11
fuel	cokes B 52	15.65	814	67.3	1.05	132	15.65	2,066	66.7	1.04
	cog -	-	-	-	-	7,242	7.83	57	(#2 6.0m³)	
	h.oil 3,092	15.65	48	4.0ℓ	0.06	3,092	15.65	48	(#1 4.0ℓ)	0.04
materials					-					-
cast/roll					-					-
power	23,190	6.48	150	kwh 30.0	0.20	59,400	5.79	343	kwh 30.0	0.17
compressed air	3,865	0.65	3	5.0m³	-	9,900	0.58	6	5.0m³	-
water	773	9.41	6	1.0m³	0.01	1,980	9.10	20	1.0m³	0.01
miscellaneous			108		0.14			277		0.14
variable cost			1,129		1.46			2,817		1.40
var. ma. cost			8,924		11.54			22,805		11.50
labor			*					*		
depreciation			470					1,040		
maintenance			278					612		
miscellaneous			*					*		
overhead			817					1,318		
fixed cost										
ma. cost										
interest (eq.)			351					677		
interest (op.)			*					*		
selling & adm.			*					*		
full cost										

Table 16-4. Production Cost-Blast Furnace

stage	first stage					2nd stage				
production	642,000 T/Y (yield %)					1,900,000 T/Y (yield %)				
	annual requirements ($x10^3$MT) (kℓ/m^3)	unit price/cost (US$)	amount ($x10^3$US$)	consumption per unit(kg)	unit cost (US$)	annual requirements ($x10^3$MT) (kℓ/m^3)	unit price/cost (US$)	amount ($x10^3$US$)	consumption per unit(kg)	unit cost (US$)
sintered ore	(75%) 773	11.54	8,920	1,204.4	13.90	(65%) 1,980	11.50	22,770	1,040.0	11.96
sized ore	257	12.31	3,164	400.0	4.92	1,060	12.31	13,049	560.0	6.89
m. material	1,030	11.73	12,084	1,604.4	18.82	3,040	11.78	35,819	1,600.0	18.85
Mn ore	10	20.00	200	15.5	0.31	28	20.00	560	15.5	0.31
lime stone	13	3.00	39	20.0	0.06	57	3.00	171	20.0	0.06
cokes	(imp.) 334	45.00	15,030	520.0	23.40	654	23.42	15,317	344.0	8.07
						(imp.) 334	45.00	15,030	176.0	7.93
h. oil	21 kℓ	15.65	329	30.0 ℓ	0.51	63 kℓ	15.65	986	30.0 ℓ	0.51
s. material			15,598		24.28			32,064		16.88
raw material cost			27,682		43.10			67,883		35.73
B.F. slag	93	0.96	△ 90	145.0	△0.14	276	0.96	△ 266	145.0	△0.14
B.F. dust	16	5.00	△ 83	25.0	△0.13	48	5.00	△ 246	25.0	△0.13
BFG	995,000	1.30	△ 1,297	1,550.0 m^3	△2.02	2,945,000	1.30	△ 3,838	1,550.0 m^3	△2.02
credit			△ 1,470		△2.29			△ 4,350		△2.29
fuel (BFG)	401,000	1.30	520	625m^3	0.81	1,190,000	1.30	1,539	625m^3	0.81
materials			64		0.10			190		0.10
cast/roll					-					-
power	60,350	6.48	392	94 kwh	0.61	179,000	5.79	1,026	94 kwh	0.54
compressed air	19,300	0.65	13	30m^3	0.02	57,000	0.58	38	30m^3	0.02
water	22,500	9.41	211	35m^3	0.33	66,500	9.10	627	35m^3	0.33
miscellaneous			135		0.21			399		0.21
variable cost			1,335		2.08			3,819		2.01
var. ma. cost			27,547		42.89			67,352		35.45
labor			216					367		
depreciation			2,370					4,480		
maintenance			1,264					2,426		
miscellaneous			198					352		
overhead			1,444					2,911		
acc. fixed cost			1,565					5,187		
fixed cost										
ma. cost										
interest (eq.)			1,452					3,389		
interest (op.)										
selling & adm.										
full cost										

Table 16-5. Production Cost-LD Converter

stage	first stage					2nd stage				
production	674,000		T/Y (yield 92.1 %)			2,000,000		T/Y (yield 91.7 %)		
	annual requirements (x10³MT)m³	unit price/cost (US$)	amount (x10³US$)	consumption per unit(kg)	unit cost (US$)	annual requirements (x10³MT)	unit price/cost (US$)	amount (x10³US$)	consumption per unit(kg)	unit cost (US$)
hot metal	(85%) 622	42.89	26,678	922.9	39.58	(85%)1,850	35.45	65,583	925.0	32.79
plant scrap	42 16.5	55.00	3,218	62.3 24.5	4.77	138.5 16.5	55.00	8,525	69.3 8.2	4.26
imp. scrap	51.5	55.00	2,833	76.4	4.20	175	55.00	9,625	87.5	4.81
m. material	732	44.71	32,729	1,086.1	48.55	2,180	38.41	83,733	1,090.0	41.86
iron ore	20	11.80	236	30.0	0.35	60	11.80	708	30.0	0.35
scale	5.7	15.00	86	8.5	0.13	20	15.00	300	8.5	0.13
fluorspar	2.7	42.86	116	4.0	0.17	8	42.86	343	4.0	0.17
ferro alloys	4.0	149.35	597	6.0	0.90	12	149.35	1,792	6.0	0.90
burnt lime	40.5	8.51	345	60.0	0.51	120	8.44	1,013	60.0	0.51
lime stone	3.4	3.00	10	5.0	0.02	10	3.00	30	5.0	0.02
s. material	76.3	18.22	1,390	113.5	2.08	230	15.43	4,186	113.5	2.08
raw material cost	808.3	42.21	34,119	1,199.6	50.63	2,410	36.48	87,919	1,203.5	43.94
LD dust	6.7	5.00	△ 34	10.0	△0.05	20	5.00	△ 100	10.0	△0.05
scrap	3.4	55.00	△ 187	5.0	△0.28	10	55.00	△ 550	5.0	△0.28
credit	10.1		△ 221		△0.33	30		△ 650		△0.33
fuel O_2	37,070	5.48	202	55.0m³	0.30	110,000	4.96	540	55m³	0.27
fuel oil	3,370kℓ	15.65	54	5.0ℓ	0.08	10,000kℓ	15.65	160	5ℓ	0.08
materials(brick)		295.46	1,995	10.0	2.96		295.46	5,920	10	2.96
cast/roll					-					-
power	6,740	6.48	44	10kwh	0.07	20,000	5.79	116	10kwh	0.07
compressed air	20,220	0.65	13	30m³	0.02	60,000	0.58	35	30m³	0.02
water	30,330	9.41	287	45m³	0.42	90,000	9.10	819	45m³	0.41
miscellaneous			2,002		2.97			5,940		2.97
variable cost			4,597		6.82			13,530		6.78
var. ma. cost			38,495		57.12			100,799		50.39
labor			150					196		
depreciation			1,730					2,590		
maintenance			1,093					1,625		
miscellaneous			128					171		
overhead			1,369					7,074		
acc. fixed cost			6,846					15,314		
fixed cost										
ma. cost										
interest (eq.)			2,421					5,753		
interest (oq.)										
selling & adm.										
full cost										

Table 16-6. Production Cost-Continuous Casting (Billet)

stage	first stage					second stage				
production	(100∅)	640,000	T/Y (yield 95.0 %)			(100∅)	710,000	T/Y (yield 95.0 %)		
	annual requirements (x10³MT)	unit price/cost (US$)	amount (x10³US$)	consump-tion per unit(kg)	unit cost (US$)	annual requirements (x10³MT)	unit price/cost (US$)	amount (x10³US$)	consump-tion per unit(kg)	unit cost (US$)
molten steel										
raw material cost	674	57.12	38,499	1,053.0	60.15	747	50.39	37,641	1,053.0	53.06
scrap										
credit	34	55.00	△ 1,870	53.0	△2.92	37	55.00	△ 2,025	53.0	△2.92
fuel			102		0.16			114		0.16
materials brick			1,350		2.11			1,498		2.11
materials others			787		1.23			873		1.23
cast/roll		714.30	230	0.05	0.36		714.30	256	0.05	0.36
power		6.48	45	10kwh	0.07		5.79	50	10kwh	0.07
compressed air		0.65	13	$30m^3$	0.02		0.65	14	$30m^3$	0.02
water					-					-
miscellaneous			64		0.10			54		0.10
variable cost			2,591		4.05			2,859		4.05
var. ma. cost			39,220		61.28			38,475		54.19
labor			30		0.05			30		0.04
depreciation			1,220		1.91			1,220		1.74
maintenance			693		1.08			693		0.98
miscellaneous			27		0.05			27		0.04
overhead			5,026		7.84			578		0.83
acc. fixed cost			11,316		17.66			10,073		14.23
fixed cost			18,312		28.59			12,621		17.86
ma. cost			57,532		89.87			51,096		72.05
interest (eq.)			3,732		5.83			2,696		3.81
interest (op.)					1.87					1.74
selling & adm.					8.15					7.86
full cost					105.72					85.46

Table 16-7. Production Cost-Continuous Casting (Slab)

stage	first stage					second stage				
production	T/Y (yield %)					1,190,000 T/Y (yield 95.0 %)				
	annual requirements ($x10^3$MT)	unit price/cost (US$)	amount ($x10^3$US$)	consumption per unit (kg)	unit cost (US$)	annual requirements ($x10^3$MT)	unit price/cost (US$)	amount ($x10^3$US$)	consumption per unit (kg)	unit cost (US$)
molten steel										
raw material cost						1,253	50.39	63,139	1,053.0	53.06
scrap										
credit						63	55.00	△ 3,465	53.0	△2.92
fuel								190		0.16
materials brick								2,511		2.11
materials others								1,464		1.23
cast/roll							714.30	428	0.05	0.36
power							5.79	83	10kwh	0.07
compressed air							0.65	24	$30m^3$	0.02
water										-
miscellaneous								92		0.10
variable cost								4,792		4.05
var. ma. cost								64,466		54.19
labor								37		
depreciation								3,270		
maintenance								1,873		
miscellaneous								35		
overhead								1,568		
acc. fixed cost								16,897		
fixed cost										
ma. cost										
interest (eq.)								5,085		
interest (op.)										
selling & adm.										
full cost										

Table 16-8. Production Cost-Billet Breaking Down Mill

stage	first stage					second stage				
production	(50Ø)	80,000t	T/Y (yield 95.0 %)			(50Ø)	142,500	T/Y (yield 95.0 %)		
	annual requirements (x10³MT)	unit price/cost (US$)	amount (x10³US$)	consumption per unit(kg)	unit cost (US$)	annual requirements (x10³MT)	unit price/cost (US$)	amount (x10³US)	consumption per unit(kg)	unit cost (US$)
billet (100Ø)										
raw material cost	84	61.28	5,148	1,050.0	64.34	150	54.19	8,108	1,050.0	56.90
scale	1.7	15.00	△ 26	21.0	△0.32	3.0	15.00	△ 45	21.0	△ 0.32
scrap	2.3	55.00	△ 127	29.0	△1.60	4.1	55.00	△ 226	29.0	△ 1.60
credit	4.0		△ 153		△1.92	7.1		△ 271		△ 1.92
fuel (h.oil)		15.65	53	42ℓ	0.66		15.65	94	42ℓ	0.66
materials					-					
cast/roll		824.70	35	0.53	0.44		824.70	63	0.53	0.44
power		6.48	12	21kwh	0.14		5.79	17	21kwh	0.12
compressed air		0.65	-	21m³	0.01		0.58	1	21m³	0.01
water		9.41	4	5.3m³	0.05		9.10	7	5.3m³	0.05
miscellaneous			24		0.30			43		0.30
variable cost			128		1.60			225		1.58
var. ma. cost			5,123		64.02			8,062		56.56
labor			89		1.11			89		0.62
depreciation			140		1.75			140		0.98
maintenance			84		1.05			84		0.59
miscellaneous			86		1.08			86		0.60
overhead			163		2.04			113		0.79
acc. fixed cost			2,380		29.75			2,650		18.61
fixed cost			2,942		36.78			3,162		22.19
ma. cost			8,065		100.80			11,224		78.75
interest (eq.)			569		7.11			643		4.51
interest (op.)					2.09					1.94
selling & adm.					8.29					7.96
full cost					118.29					93.16

Table 16-9. Production Cost-Wire Rod Mill

stage	first stage					second stage				
production	(5.5 - 12 m/m) 136,000 T/Y (yield 93.0 %)					140,000 T/Y (yield 93.0 %)				
	annual requirements (x103MT)	unit price/cost (US$)	amount (x103US$)	consump-tion per unit(kg)	unit cost (US$)	annual requirements (x103MT)	unit price/cost (US$)	amount (x103US$)	consump-tion per unit(kg)	unit cost (US$)
billet (50 - 80)										
raw material cost	146	61.28	8,947	1,075.0	65.88	150	54.19	8,155	1,075.0	58.25
scale	4	15.00	△ 60	29.0	△0.44	4.4	15.00	△ 66	29.0	△0.44
scrap	6	55.00	△ 330	46.0	△2.53	6.4	55.00	△ 352	46.0	△2.53
credit	10		△ 390	75.0	△2.98	10.8		△ 418	75.0	△2.97
fuel (h.oil)		15.65	106	50ℓ	0.78		15.65	109	50ℓ	0.78
materials			54		0.40			56		0.40
cast/roll		1,103.90	301	2.0	2.21		1,103.90	309	2.0	2.21
power		6.48	106	kwh 120	0.78		5.79	99	kwh 120	0.70
compressed air		0.65	4	$50m^3$	0.03		0.58	4	$50m^3$	0.03
water		9.41	7	$5m^3$	0.05		9.10	7	$5m^3$	0.05
miscellaneous					–					–
variable cost			578		4.25			584		4.17
var. ma. cost			9,135		67.15			8,321		59.45
labor			120		0.88			120		0.86
depreciation			410		3.02			410		2.93
maintenance			235		1.73			235		1.68
miscellaneous			118		0.87			118		0.84
overhead			682		5.02			391		2.79
acc. fixed cost			4,212		30.97			2,650		18.93
fixed cost			5,777		42.49			3,924		28.03
ma. cost			14,912		109.64			12,245		87.48
interest (eq.)			1,134		8.34			792		5.66
interest (op.)					2.27					2.22
selling & adm.					8.42					8.07
full cost					128.67					103.43

Table 16-10. Production Cost-Hot Strip Mill

stage	first stage					second stage				
production	T/Y (yield %)					(1.2-12.7 x 1,270) 1,140,000 T/Y (yield 95.8 %)				
	annual requirements ($x10^3$MT)	unit price/cost (US$)	amount ($x10^3$US$)	consumption per unit (kg)	unit cost (US$)	annual requirements ($x10^3$MT)	unit price/cost (US$)	amount ($x10^3$US$)	consumption per unit (kg)	unit cost (US$)
slab										
raw material cost						1,190	54.19	64,456	1,044.0	56.57
scale						22	15.00	Δ 330	19.0	Δ 0.29
scrap						28	55.00	Δ 1,540	25.0	Δ 1.38
credit						50		Δ 1,870	44.0	Δ 1.67
fuel h. oil							15.65	923	52ℓ	0.81
fuel COG							7.83	1,117	$125m^3$	0.98
materials								296		0.26
cast/roll							746.75	855	1.0	0.75
power							5.79	479	73kwh	0.42
vapor							1.95	114	52	0.10
water							9.10	218	$21m^3$	0.19
miscellaneous								182		0.16
variable cost								4,184		3.67
var. ma. cost								66,770		58.57
labor								182		0.16
depreciation								4,930		4.33
maintenance								2,764		2.43
miscellaneous								184		0.16
overhead								3,584		3.14
acc. fixed cost								23,680		20.77
fixed cost								35,324		30.99
ma. cost								102,094		89.56
interest (eq.)								7,550		6.62
interest (op.)										2.21
selling & adm.										8.11
full cost										106.50

Table 16-11. Production Cost-Power Generating Plant

stage	first stage					second stage				
production	201,800 x 10^3kwh					707,700 x 10^3kwh				
	annual requirements ($\times10^3$MT)	unit price/cost (US$)	amount ($\times10^3$US$)	consump-tion per unit(kg)	unit cost (US$)	annual requirements ($\times10^3$MT)	unit price/cost (US$)	amount ($\times10^3$US$)	consump-tion per unit(kg)	unit cost (US$)
raw material cost										
vapor										
credit					-	59.3t	1.95		83.8k	Δ0.17
fuel BFG		1.30	769	2,930m^3	3.81		1.30	2,293	2,490m^3	3.24
fuel h. oil		15.65	442	140ℓ	2.19		15.65	1,663	150ℓ	2.35
materials										
cast/roll										
power		6.48		kwh 74.3	0.48		5.79		kwh 63.6	0.37
compressed air										
water										
miscellaneous										
variable cost					6.48					5.96
var. ma. cost					6.48					5.79
labor			(188)					(253)		
depreciation			(1,090)					(2,520)		
maintenance			(639)					(1,459)		
miscellaneous			(161)					(219)		
overhead										
fixed cost										
ma. cost										
interest (eq.)			(406)					(926)		
interest (op.)										
selling & adm.										
full cost										

Table 17. Profit and Loss Statement

This statement is made under the "normal financial condition"

stage		first stage			second stage			remarks
crude steel	(x10³ MT/Y)	674			2,000			
investment	(x10³ US$)	162,540			419,230			
man-power	(persons/m)	4,000			6,000			
		vol. (MT/Y)	price	amount (x10³ US$)	vol. (MT/Y)	price	amount (x10³ US$)	
sales (A)	BT (50ϕ)	80,000	139.17	11,134	142,500	129.00	18,383	sales price
	BT (100ϕ)	410,000	124.38	50,996	410,000	116.00	47,560	1st stage: fullcost x 1.15
	WR (5.5-12)	136,000	151.38	20,588	140,000	148.00	20,720	2nd stage: imp. price (CIF)
	H. Coil	-	-	-	1,140,000	147.00	167,580	
	others*			1,630			4,142	
	sub. total			(100) 84,348			(100) 258,385	
materials	imp. coal			-	975,000	18.03	17,583	
	imp. ore	1,015,000	10.61	10,766	2,874,000	10.87	31,242	
	imp. coke	334,000	45.00	15,030	334,000	45.00	15,030	
	imp. scrap	68,000	55.00	(43.4) 3,741	191,500	55.00	(38.1) 10,533	
	fuel oil			1,096			4,171	
	materials			4,816			14,736	for repair
	aux. raw mater.			1,193			4,778	
labor		4,000		(2.4) 2,028	6,000		(1.2) 3,008	
depreciation				(12.5) 10,520			(10.9) 28,240	straight-line md. service life time: (ave.) 1st 15.5yrs 2nd 14.5yrs
maintenance				(7.7) 6,502			(6.4) 16,770	
miscellaneous				(6.2) 5,217			(4.7) 12,224	
cost of goods sold (B)	sub. total			(72.2) 60,909			(61.3) 158,315	
interest (EQ.)				(4.9) 4,124			(4.2) 10,637	i. rate: 7.25%
interest (OP.)				(1.5) 1,265			(1.5) 3,875	sales x 1.5%
selling & adm.				(6.4) 5,397			(5.7) 14,893	s. 6.83$/MT
full cost (C)				(85.0) 71,695			(72.7) 187,720	
ope. profit (A)-(C)				(15.0) 12,653			(27.3) 70,665	
sales tax (D)				(5.0) 4,218			(5.0) 12,919	sales x 5%
net-profit (A)-(C)-(D)				(10.0) 8,435			(27.3) 57,746	(income before tax)
(distribution)	1) reserves			3,504			45,114	include income tax.
	2) bonus			55			55	
	3) dividend			4,876			12,577	

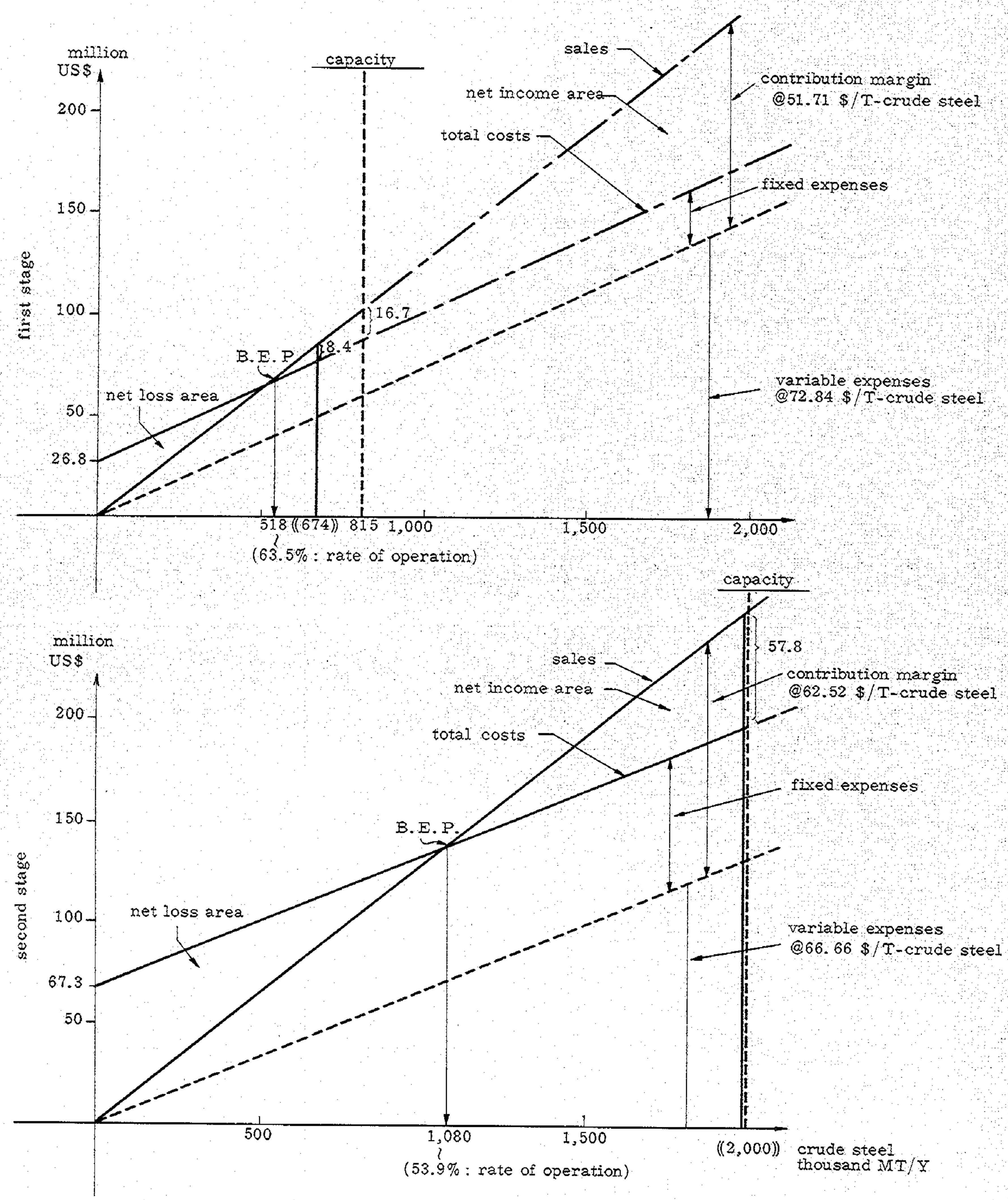
* include coke breeze, cold pig iron, BF slag, $(NH_4)_2SO_4$, and crude tar.

Table 18 Profitability and Competitivity

stage		first stage				second stage					
	products	total	billet (50x50 m/m)	billet (100x100 m/m)	wire rod (5.5-12 m/m)	total	billet (50x50 m/m)	billet (100x100 m/m)	wire rod (5.5 - 12 m/m)	hot coil	
production (MT/Y)			80,000	410,000	136,000		142,500	410,000	140,000	1,140.000	
profit table: (US$/MT) Ⓐ	sales:		US$/T 139.17	US$/T 124.38	US$/T 151.38		US$/T 129.00	US$/T 116.00	US$/T 148.00	US$/T 147.00	
	var. cost		64.02	61.28	67.15		56.56	54.19	59.45	58.57	
	fix. cost		36.78	28.59	42.49		22.19	17.86	28.03	30.99	
Ⓑ	manu. cost		100.80	89.87	109.64		78.75	72.05	87.48	89.56	
	interest(e)		7.11	5.83	8.34		4.51	3.81	5.66	6.62	
	interest(o)		2.09	1.87	2.27		1.94	1.74	2.22	2.21	sales x1.5%
	selling and adm	a. s.	1.46 6.83	1.32 6.83	1.59 6.83		1.13 6.83	1.03 6.83	1.24 6.83	1.28 6.83	
Ⓒ	full cost:		118.29	105.72	128.67		93.16	85.46	103.43	106.50	
Ⓐ-Ⓒ= Ⓓ	ope. profit:		20.88	18.66	22.71		35.84	30.54	44.57	40.50	
Ⓔ	sales tax		6.96	6.22	7.57		6.45	5.80	7.40	7.35	sales x5%
Ⓓ - Ⓔ	net profit		13.92	12.44	15.14		29.39	24.74	37.17	33.15	
competitivity (US$/MT)	imp. price:		US$/T	US$/T	US$/T		US$/T	US$/T	US$/T	US$/T	
	ⓐ max.		141	128	156		141	128	156	152	
	ⓑ min.		117	104	140		117	104	140	141	
	ⓒ mean		129	116	148		129	116	148	147	
required compensation		ⓐ	-	-	-						
		ⓑ	15.8%	19.6%	8.1%						
		ⓒ	7.2%	7.2%	2.3%						
current tariff table											
(1969-70)	India		27.5%	27.5%	27.5%		27.5%	27.5%	27.5%	27.5%	
	Thailand		20.0%	20.0%	20.0%		20.0%	20.0%	20.0%	10.0%	
	Brazil		37.0%	37.0%	37.0%		37.0%	37.0%	37.0%	20.0%	
	Peru		34.0%	34.0%	185.0%		34.0%	34.0%	185.0%	33.2%	
	Mexico		40.0%	40.0%	32.0%		40.0%	40.0%	32.0%	120.0%	
	Spain		27.0%	27.0%	29.0%		27.0%	27.0%	29.0%	50.0%	
	Indonesia		-	-	10.0%		-	-	10.0%	20.0%	

Table 19 Break-even point anaysis

$$\text{* break-even in units} = \frac{\text{fixed expenses}}{\text{contribution margin per unit}}$$



* (( )): planned production of crude steel in each stage

Table 20. Foreign Currency Saving Effect

Calculation was made under the "normal financial condition"

	item	first stage			second stage			remarks
		volume (MT/Y)	price (US$/MT)	amount ($x10^3$ US$)	volume (MT/Y)	price (US$/MT)	amount ($x10^3$ US$)	
saving of foreign currency	BT (50x50)	80,000	129.00	10,320	142,500	129.00	18,383	billet
	BT (100x100)	410,000	116.00	47,560	410,000	116.00	47,560	billet
	WR (5.5-12)	136,000	148.00	20,128	140,000	148.00	20,720	wire rod
	H. Coil	-	-	-	1,140,000	147.00	167,580	hot coil
	Ⓐ	626,000	124.61	(100%) 78,008	1,832,500	138.74	(100%) 254,243	
outflow of foreign currency ⓧ	imp. coal	-	-	-	975,000	18.03	17,583	
	imp. ore	1,015,000	10.61	10,766	2,874,000	10.87	31,242	
	imp. coke	334,000	45.00	15,030	334,000	45.00	15,030	
	imp. scrap	68,000	55.00	3,741	191,500	55.00	10,533	
	roll and mould			566			1,928	
	material(1)			3,251			8,385	for maintenance
	" (2)			2,125			6,404	brick etc.
	" (3)			200			577	raw H_2SO_4 etc.
	interest *			5,389			14,512	
	Ⓑ		(65.60)	(52.6%) 41,068		(57.95)	(41.8%) 106,194	
foreign currency saving effect	Ⓒ = Ⓐ - Ⓑ			(47.4%) 36,940			(58.2%) 148,049	
in investment foreign currency	1) main			115,020			185,500	main production facilities infrastructure
	2) infra-			35,842			2,031	
	Ⓓ			150,862			187,531	
payout period	Ⓓ/Ⓒ	4.1 yrs. (3.1 yrs.)			1.3 yrs. (1.3 yrs.)			( )shows the figures excluding infrastructure

* It is assumed that all construction capital and running capital are borrowed from abroad.

ⓧ The engineering and consulting cost and the overseas training cost may be paid with foreign currency, but they are excluded from this table.

Table 21-1 Degree of Interdependence of Economic Sectors
(in case of Italy, Japan, and the United States)

sector \ degree	interdependence through purchases from other (a) sectors (backward linkage)	interdependence through sales to other sectors (b) (foreward linkage)
intermediate manufacture (backward and forward linkage both high)		
iron and steel	66	78
non-ferrous metal	61	81
paper and products	57	78
petroleum products	65	68
coal products	63	67
chemicals	60	69
textiles	67	57
rubber products	51	48
printing & publishing	49	46
Final manufacture (backward linkage high, forward linkage low)		
grain mill products	89	42
leather and products	66	37
lumbre and wood products	61	38
apparel	69	12
transport equipment	60	20
machinery	51	28
non-metallic mineral products	47	30
processed foods	61	15
shipbuilding	58	14
miscellaneous industries	43	20
Intermediate primary production (forward linkage high, backward linkage low)		
metal mining	21	93
petroleum and natural gas	15	97
coal mining	23	87
agriculture and forestry	31	72
electric power	27	59
non-metallic minerals	17	52
Final primary production (backward and forward linkage both low)		
transport	31	26
trade	16	17
fishing	24	36
services	19	34

Note : (a) Ratio of interindustry purchases to total production (%)
(b) Ratio of interindustry sales to total demand (%)

Source : A. O. Hirschman "Strategy of Economic Development" P. 106 - 107

Original source : Chenery and Watanabe "International Comparisons" PN

Table 21-2 Number of Workers Necessary for 1 Million U. S. $. Investment in Indonesia

	1967 - 1971 number of projects	1967 - 1971 foreign investment		
		average investment per project	average number of workers per project	average number of workers per 1 million U. S. $.
		(million U. S. $)	(person)	
agriculture & fishery	113	42. 6	612	14. 4
agric estate	(47)	14. 2	183	12. 9
forestry	(57)	69. 7	1035	148. 5
fishery	(59)	18. 0	161	8. 9
mining	16	338. 4	160	0. 5
manufacturing	254	27. 7	180	6. 5
tight industry	(85)	8. 5	260	30. 6
textile industry	(17)	84. 8	328	38. 7
chemical industry	(84)	15. 9	95	6. 0
heavy industry	(68)	13. 5	114	8. 4
tele-communication	22	13. 8	170	12. 3
transportation	13	9. 4	118	12. 6
commerce	3	12. 7	191	15. 0
hotel, fourism, etc.	7	78. 4	735	9. 4
others	20	11. 9	1843	154. 8
total	448	36. 4	295	8. 1

source : bases upon foreign investment board study

note : the iron and steel industry belonging to the category of heavy industry shows 28 persons per million U. S. $. as for as figures are available.