The testing center is mainly for rolled products and positioned in the center of rolling area, and samples taken at each rolling mill are collected using trucks.

(4) Stand-by equipment

Instrumental analysis apparatus and tensile tester are used very frequently and indispensable equipment for daily production activity, therefore, if any trouble occurs to those equipment, it sometimes leads to a considerable term of production suspension. So, it seems desirable to have stand-by equipment, but in this plan, any stand-by equipment are not provided by preventing troubles throughout regular maintenance and inspection of those equipment.

6-12-3. Technical explanation

(1) Sampling points for testing and analysis

Points where samples are taken for testing and analysis are shown in Fig. 7-6-56.

(2) Selection of apparatus and equipment.

1) Analysis apparatus

There are two categories to analyze alloying elements and compounds in irons and steels. One is the instrumental analysis represented by fluorescent X-ray analysis and optical emission spectrometry. And, the other is the wet chemical analysis such as atomic absorptiometry, spectrophotometry, gravimetry and titrimetry.

Instrumental analysis method has high efficiency in measurement and besides gives stable measured results with less variations in the examination due to indi-

vidual difference. Therefore, even though the frequency of analysis concerned is more or less low, the instrumental analysis apparatus is employed for the normal method as much as possible.

For rapid analysis of molten steel at steelmaking stage, a vacuum type optical emission spectrometer is adopted and used almost exclusively as the analysis is much frequent.

The frequency of analysis is low for raw materials as compared to that for steel, but as samples are often in powder form which causes much difficulties in the analysis by optical emission spectrometer, a fluorescent X-ray analyzer is installed mainly for analysis of raw materials. since plain carbon steels account for the major part of total production, the fluorescent X-ray analyzer and optical emission spectrometer both of which can analyze the maximum of twenty elements are good enough.

However, when the requirement of accuracy in analysis of C and S, which are important elements contained in steel, is very strict, both of the analysis apparatus above cannot meet such specification. Also considering future diversification up to high grade steels, a simultaneous carbon and sulphur determinator of infrared ray absorption type is installed. Though gas analysis in steel is rarely requested for quality assurance, it is sometimes necessary to examine gas content for the study of quality rejects and for the confirmation of cleanliness of molten steels, and a simultaneous nitrogen and oxygen determinator of infrared ray absorption type is employed.

Though analysis jobs are performed mainly by instrumental analysis, the chemical analysis method is fundamentally indispensable and a set of wet chemical

analysis apparatus including an atomic absorption spectrometer and a spectrometer is installed. Such apparatus can be applied when particular elements or compounds which cannot be determined by the instrumental analysis are examined, or shape and size of analysis samples are not suited to the instrumental analysis, or accuracy of apparatus used in instrumental analysis is calibrated.

As tensile test and bend test are performed frequently and size range of test pieces is wide (cross-sectional area of test pieces being about 24 to 1,300 $mm^2$), 2 units of universal testing machine, namely one each of high load (100-t) and low load (30-t) machine, are installed. The 30-t unit is mainly for wire rods and bars of 25 mm dia. and under. Each of them is equipped with an extensometer and a X-Y recorder so as to measure proof stress of medium and high carbon steels.

One each of impact testing machine, three types of hardness tester and optical microscope are adopted and they are adequate as those tests are not so frequent. Test piece preparation for mechanical testing is self-performed within the testing center, and not contracted out, in order to save the required time from sampling to the finish of the shipping test and to ensure the prompt delivery of products.

Both wire rods and most of bars in as-rolled condition can be applicable to test pieces for tensile and bend tests as they are. However, test pieces of sections for tensile and bend testings as well as those of bars and sections for impact testings are formed from products as-rolled by means of machining. For the purpose above, a lathe equipped with copying attachment, a milling machine and a surface grinding machine are installed.

(3) Production of high grade steel in future

As already mentioned, the testing and analysis equipment contemplated in this plan can cover most of the requirement for the future production of high grade steels and the buildings of both analysis center and material testing center are provided with some space to accommodate additional equipment.

6-12-4. Specifications of major equipment

Major equipment and their specifications for analysis and material testing are as shown in Tables 7-6-39 and 7-6-40 respectively.

Table 7-6-37 Materials to be Analyzed and Analysis Items

| Classification | Material | Purpose of Analysis | Analysis Items (Components) | Analysis Apparatus/Method |
|---|---|---|---|---|
| Raw Material | Pellet | Quality confirmation | T.Fe, P, CaO, $SiO_2$, $P_2O_5$ | Fluorescent X-ray analyzer |
| | | | | Atomic absorption spectrophotometer |
| | | | | Spectrophotometer |
| | | | Met.Fe, FeO | Chemical analysis (volumetry) |
| | | | C.S | Carbon and sulphur determinator |
| | DRI (Sponge iron) | Quality confirmation | T.Fe, P | Fluorescent X-ray analyzer |
| | | | C.S | Carbon and sulphur determinator |
| | | | Met.Fe | Chemical analysis (volumetry) |
| | Ferro alloy Fe-Si | Acceptance inspection | $Al_2O_3$, CaO, $TiO_2$ | Atomic absorption spectrophotometer |
| | | | Si | Chemical analysis (gravimetry) |
| | | | P | Spectrophotometer |
| | | | S | Carbon and sulphur determinator |
| | Fe-Mn | | Mn | Chemical analysis (volumetry) |
| | | | $SiO_2$ | Spectrophotometer |
| | Lime stone | Acceptance inspection | MgO, CaO | Chemical analysis (volumetric method) |
| | | | S | Chemical analysis (neutralization titrimetry) |
| | | | Ignition Loss | Chemical analysis (gravimetry) |

| Classi-fication | Material | Purpose of Analysis | Analysis Items (Components) | Analysis Apparatus/Method |
|---|---|---|---|---|
| Raw Material (cont'd) | Burnt lime | Quality confirmation | MgO, CaO | Chemical analysis (volumetry) |
| | | | S | Carbon and sulphur determinator |
| | Scrap from outside | Acceptance inspection | Mn | Atomic absorption spectrophotometer |
| | | | C | Spectrophotometer |
| | | | | Carbon and sulphur determinator |
| Steel | Cast sample from molten State in steelmaking process | Quality assurance (Reprensentative chemical composition of heat) | C, Si, Mn, P, S, Cu, Ni, Cr, V, Nb, Al | (C),(S): Carbon and sulphur determinator (N),(O): Nitrogen and oxygen determinator (Others): Optical emission spectrometer |
| | | Quality confirmation | C, Si, Mn, P, S, Cu, Ni, Cr, V, Nb, Mo, Ti, Sn, Al, N, O | Samples not applicable to instrumental analysis are analyzed chemically. |
| | Semi-product (Cast billet) | Quality confirmation | C, Si, Mn, P, S, Cu, Ni, Cr, V, Nb, Mo, Ti, Sn, Al, N, O | |
| | Finished product (Wire rod) (Bar) (Section) | Quality assurance (Check analysis) | C, Si, Mn, P, S, Cu, Ni, Cr, V, Nb, Al | |
| | | Quality assurance (Investigation of product rejected/ complained) | C, Si, Mn, P.S, Cu, Ni, Cr, V, Nb, Mo, Ti, Sn, Al N, O, | |

| Classi-fication | Material | Purpose of Analysis | Analysis Items (Components) | Analysis Apparatus/Method |
|---|---|---|---|---|
| Others | Slag from EAF | Quality confirmation | T.Fe, CaO, $SiO_2$, $K_2O$, $Na_2O$, $P_2O_5$, MgO, $Al_2O_3$, MnO, $TiO_2$ C.S | Fluorescent X-ray analyzer |
| | Mould power in continuous casting process | Acceptance inspection | CaO, $SiO_2$, $Na_2O$, $K_2O$, C | Fluorescent X-ray analyzer |

Table 7-6-38 Type of Material Testings and Testing Items

| Classification | Name of Testing | Testing items | Purpose of Testing/Remarks |
|---|---|---|---|
| Metallurgical Testing | Microscopic testing | Microstructure<br>Grain size (Austenite, Ferrite)<br>Chemical segregation<br>Non-metallic inclusion (Cleanliness) | . Mainly for quality confirmation<br>. Quality assurance being required for high quality steels |
| | Macrostructure testing | Cast structure<br>Internal crack, Scam<br>Porosity, Chemical segregation | . Mainly for quality confirmation of continuously cast billet |
| | Sulphur print testing | Sulphide distribution<br>Chemical segregation | |
| Mechanical Testing | Tensile testing | Yield stress (Proof stress)<br>Tensile stress,<br>Elongation<br>Reduction of area | . Quality assurance<br>. Commonly applied to bars, sections and wire rods subject to direct patenting |
| | Bend testing | Crack on bended portion<br>Bending angle,<br>Bending radius | . Quality assurance<br>. Commonly applied to bars and sections for general structural use |
| | Impact testing (Charpy test) | Impact value,<br>Crystallinity<br>Transition temperature | . Quality assurance<br>. Applied only to bars and sections for hull and machine structural use |
| | Hardness testing | Vickers hardness<br>Brinell hardness<br>Rockwell hardness | . Mainly for quality confirmation |
| | | Rockwell superficial hardness (Hardenability) | . Quality assurance<br>. Applied only to structural steels with specified hardenability bands by Jominy's end quenching method |

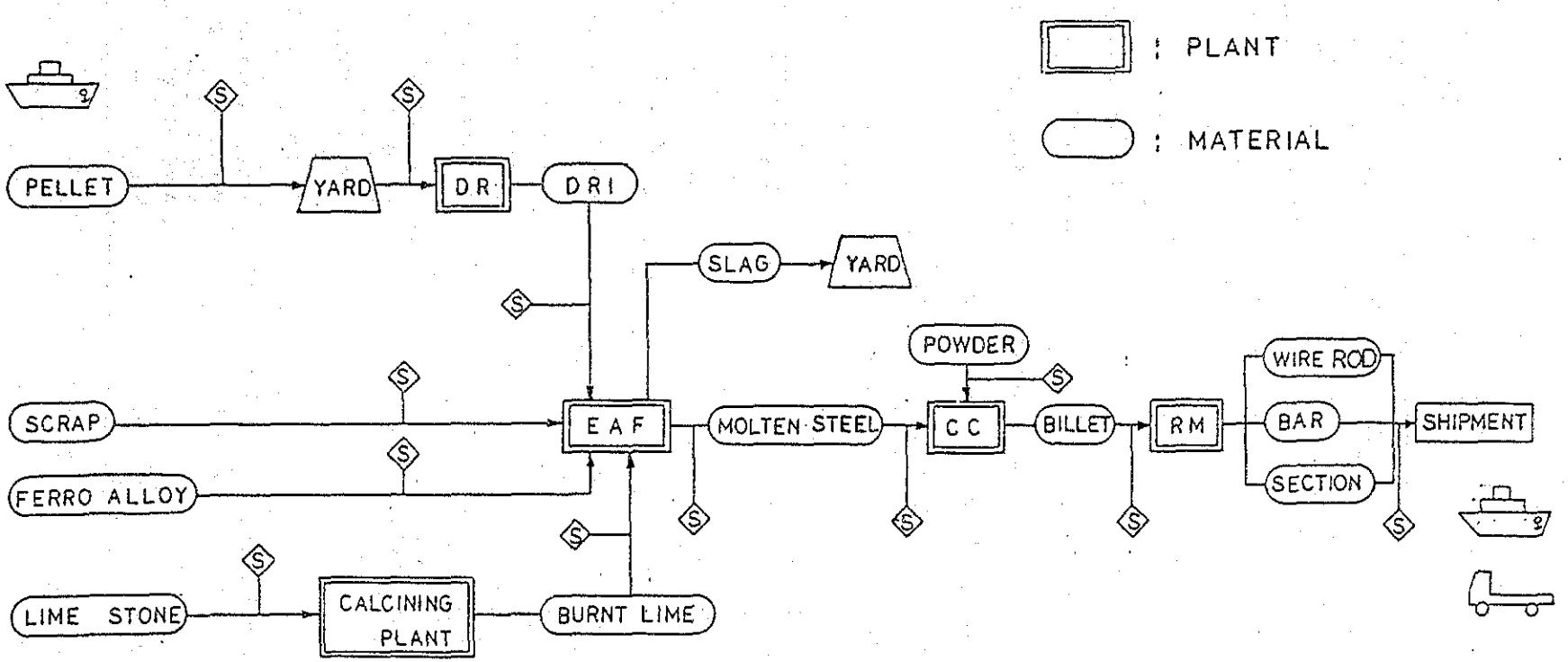



Fig. 7-6-56 Sampling Stages for Material Testing/Analysis

Table 7-6-39 Major Equipment List of Analysis Center

| Classification | Name of Equipment | Q'ty | Specification |
|---|---|---|---|
| 1. Building | ° Main building | 1 | Floor area: 20m x 35 m = 700 $m^2$<br>Structure : R.C., 1 story |
| 2. Sample Preparating Equipment | ° Jaw Crusher | 1 | |
| | ° Disc vibration mill | 1 | Batch type |
| | ° Briquette press | 1 | 30-ton hydraulic press |
| | ° Abrasive cut-off machine | 1 | Wet cutting type |
| | ° Vertical drilling machine | 1 | Drilling size : Max. 19 mm dia. |
| | ° Bench drilling machine | 1 | |
| | ° Abrasive belt grinder | 2 | |
| | ° Double head pedestal grinder | 2 | |
| | ° Rough balance | 1 | |
| | ° Band saw | 1 | |
| | ° Muffle furnace | 1 | . Electric resistance type<br>. Heating temp.: Max. 1100°C |
| 3. Analysis Equipment | ° Fluorescent X-ray analyzer | 1 | . Multichannel type<br>. Analytical : Twenty (20) elements<br>. Analysis time: 60 sec.<br>Including microcomputer system |
| | ° Optical emission spectrometer | 1 | . Vacuum type<br>. Analytical : Eighteen (18) elements<br>. Analysis time: 20 sec.<br>Including microcomputer system |
| | ° Simultaneous carbon and sulphur determinator | 1 | . Infrared ray absorption type<br>. Measuring range for 1g specimen : Up to 3.5%<br>. Analysis time: 20 sec. |

| Classification | Name of Equipment | Q'ty | Specification |
|---|---|---|---|
| 3. Analysis Equipment (Cont'd) | ° Simultaneous nitrogen and oxygen determinator | 1 | . Infrared ray absorption type for oxygen<br>. Thermal conductivity detection type for nitrogen<br>. Measuring range for 1g specimen<br>: Up to 2,000 ppm for oxygen<br>: Up to 5,000 ppm for nitrogen<br>. Analysis time: 40 sec. |
| | ° Atomic absorption spectrometer | 1 | . Flame emission type<br>. Wave length : 1,900 to 9,000A<br><br>Including<br>: Hollow cathode lamps and a hot cathode deuterium lamp |
| | ° Spectrometer | 1 | . Wave length : 2,000 to 10,000A<br>. Reading : Digital display<br><br>Including quartz cells |
| | ° Orsat gas analysis apparatus | 1 | . Orsat-Lunge type<br>. Analytical gas<br>: CO, $CO_2$, $O_2$, $H_2$, $CH_4$ |
| | ° Electronic balance | 1 | . Dual range, top loading type<br>. Capacity : 2,800/280g |
| | ° Dring oven | 2 | . Heating temperature: Max. 200°C |
| | ° Wet chemical analysis device | 1 set | Including<br>Balance desk<br>Draft chamber<br>Analyzing bench<br>Distilled water making apparatus<br>Pure water making apparatus<br><br>. Chemical glass utensils (Beaker, flask, etc.)<br>Reagent<br>Refrigerator |

| Classification | Name of Equipment | Q'ty | Specification |
|---|---|---|---|
| 4. Auxiliary Equipment | ° Electrical equipment | 1 set | |
| | ° Water supply equipment | 1 set | Including Waste water treatment |
| | ° Gas supply equipment | 1 set | . For Ar, $N_2$, $C_2H_2$, $N_2O$, He |
| | ° Air conditioner | | |
| | ° Truck | 1 | For sample transportation |

Table 7-6-40 Major Equipment List of Testing Center

| Classification | Name of Equipment | Q'ty | Specification |
|---|---|---|---|
| 1. Building | ° Main building | 1 | Floor area: 20m x 30 m = 600m$^2$<br>Structure : R.C., 1 story |
| 2. Test Piece Preparing Equipment | ° Band saw | 1 | Cutting capacity: Approx. 400 mm dia. |
| | ° Engine lathe | 1 | . Swing : 300 mm<br>. Distance between centers: 800 mm<br>. Including copying attachment |
| | ° Vertical milling machine | 1 | Table dimension: 1300 mm x 290 mm |
| | ° Drilling machine | 1 | Drilling size: Max. 40 mm dia. |
| | ° Surface grinding machine | 1 | Table : 650 mm x 500 mm |
| | ° Abrasive belt grinder | 1 | Wet type |
| | ° Double head pedestal grinder | 1 | |
| | ° Polishing machine | 1 | . Wheel dia. : 300 mm |
| | ° Heat treatment furnace | 1 | . Electric resistance type<br>. Heating temperature: Max. 1200°C |
| | ° Heat treatment furnace | 1 | . Electric resistance type<br>. Heating temperature: Max. 600°C |
| | ° Pickling bath | 1 | . For macrostructure and surface defects examination |
| | ° Jominy end quenching apparatus | 1 | . For hardenability examination |
| 3. Material Testing Equipment | ° Universal testing machine | 1 | . Application : Tensile and bend<br>. Capacity : 100 ton<br>. Equipped with extensometer and X-Y recorder<br>. Including punches for bend test |
| | ° Universal testing machine | 1 | . Application : Tensile and bend<br>. Capacity : 30 ton<br>. Equipped with extensometer and X-Y recorder<br>. Including punches for bend test |

| Classification | Name of Equipment | Q'ty | Specification |
|---|---|---|---|
| 3. Material Testing Equipment (Cont'd) | ° Impact testing machine | 1 | . Charpy type<br>. Capacity : 30 kg.m |
| | ° Brinell hardness tester | 1 | |
| | ° Rockwell hardness tester | 1 | |
| | ° Vickers hardness tester | 1 | |
| | ° Optical microscope | 1 | Magnification : x50 to x1,000 |
| | ° Projector | 1 | Magnification : x5 to x50<br>Mainly for non-metallic inclusion examination and observation of rebar deformations |
| | ° Weighing apparatus | 1 | . Digital indication type<br>. Capacity : 10 kg |
| | ° Ultrasonic flaw detector | 1 | Portable type |
| | . Measuring device | 1 set | Micrometer, vernier calipers, etc. |
| 4. Auxiliary Equipment | ° Dark room equipment | 1 set | Including processing unit |
| | ° Electrical equipment | 1 set | |
| | ° Water supply and drainage equipment | 1 set | |
| | ° Air conditioner | 1 set | |
| | ° Hoist | 1 | Capacity : 2 ton |
| | ° Sample transportation equipment | 1 | Truck |

## 6-13. Maintenance facilities

### 6-13-1. Basic idea

Maintenance facilities are to be installed for maintenance of production facilities and their accessory facilities of the new steel works. The maintenace facilities consist of the central maintenance shop and area maintenance shops.

The central maintenance shop engages in manufacture of parts such as machined parts, fabricated parts and forgings as well as major part of repair work occurring in the production plant and others. However, the facilities are to be of such scale as required for general maintenance work, and manufacture and repair of special goods (high quality, large size, etc.) are to be contracted out and excluded.

Area maintenance shops engage in minor repair which does not require high grade equipment and skill in repair work when sudden troubles occur at production plants and others as well as disassembly and maintenance of small equipment. The area maintenance shop is to be of small scale and located adjacent to the plants assigned.

### 6-13-2. Premises for facilities plan

(1) Organization of maintenance shops

Maintenance shops of the new steel works consist of the following and the area maintenance shops are to be set up adjacent to respective plants assigned.

a. Central maintenance shop
b. Iron making area maintenance shop
   (Assigned: port, raw material yard, scrap yard, DR)
c. Steelmaking area maintenance shop
   (Assigned: EAF, CC, lime calcining)

d. Rolling area maintenance shop
(Assigned: section mill, bar mill, rod mill)

e. Utility area maintenance shop
(Assigned: power plant, sub-station, gas, water supply and drainage)

(2) Scope of manufacture

Goods to be manufactured by the central maintenance shop and those not manufactured are to be as follows:
(Those not manufactured are to be contracted out.)

1) Items manufactured

a) General manufactured spare parts less than 10 tons
b) Fabricated goods less than 10 tons

2) Items not manufactured

a) All castings and heat-treated parts
b) Large forgings
c) Spare parts requiring high technic and skill in the manufacturing
d) Spare parts whose manufacturing in the works are not economical.
e) Electric and instrumental parts
f) Machined parts and fabricated parts 10 tons or more
g) Spare parts of rubber or high polymer material

(Note: Area maintenance shop is not to engage in manufacturing usually.)

(3) Scope of repair work

Area maintenance shops are to engage in minor repair work which does not require high grade equipment and skill in the work when troubles occur at production plants and others as well as disassembly-maintenance of small equipment in principle, and the major part of full-scale repair work is to be done at the central maintenance shop, except the following which are to be contracted out.

Repair work not performed in the steel works:

1) Repair of special items and high quality items which require most special repairing skill

2) Repair work on vehicles and those of civil engineering, building and water

(4) Maintenance organization

1) Maintenance department is an independent central organization integrating the central maintenance shop, area maintenance shops and maintenance technical staff.

2) Personnel assigned to the inspection job to grasp the condition of facilities and plan necessary maintenance are to be positioned at area maintenance shops.

3) Cleaning, adjustment, retightening, oiling and small repair work are assigned to personnel of each production and accessory plant.

4) Personnel for periodical repair work belong to the central maintenance shop.

5) Working condition of personnel of the central maintenance shop and area maintenance shops is daytime shift. But in area maintenance shops, personnel for small and sudden troubles are positioned by the system of 4-group 3-shift.

6-13-3. Specifications of major equipment

The central maintenance shop consists of the following:

a) Machining shop
b) Fabricating shop
c) Forging shop
d) Machine repair shop
e) Electric repair shop
f) Measuring instrument repair shop
g) Maintenance sub-center

As already mentioned, area maintenance shops are set up at 4 different areas (iron making, steelmaking, rolling and utility).

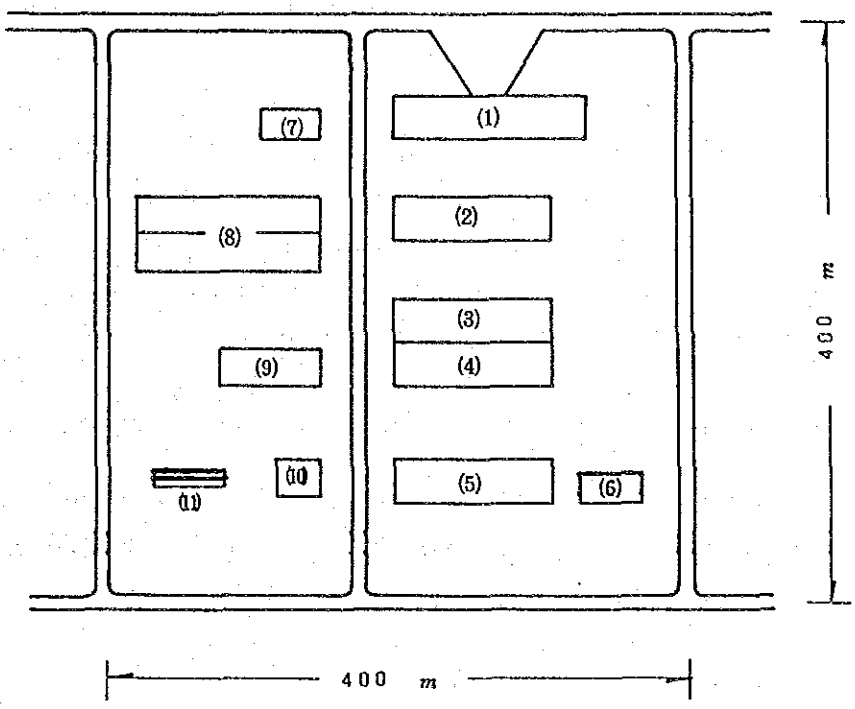
Specifications of major equipment of the above shops and sub-center are shown in Table 7-6-41.

Table 7-6-41 Specification of Major Equipment

| Shop | Specification | | |
|---|---|---|---|
| 1. Machining shop | Building area: 30 m x 110 m = 3,300 $m^2$ | | |
| | 10-ton crane | 3 | (units) |
| | Lathe | 17 | |
| | Grinder | 2 | |
| | Milling machine | 3 | |
| | Boring machine | 2 | |
| | Planing machine | 2 | |
| | Other equipment & tools | | |
| 2. Fabricating shop | Building area: 30 m x 110 m = 3,300 $m^2$ | | |
| | 10-t crane | 3 | (units) |
| | Plate shear | 1 | |
| | Hydraulic press | 3 | |
| | Bending roller | 2 | |
| | Annealing furnace | 1 | |
| | Welders, various types | 27 | |
| | Other equipment & tools | | |
| 3. Forging shop | Building area: 20 m x 40 m = 800 $m^2$ | | |
| | 5-t crane | 1 | (unit) |
| | Air hammer | 2 | |
| | Heating furnace | 2 | |
| | Other equipment & tools | | |
| 4. Machine repair shop | Building area: 30 m x 110 m = 3,300 $m^2$ | | |
| | 15-t crane | 1 | (unit) |
| | 10-t crane | 1 | |
| | Hydraulic press | 2 | |
| | Balancing machine | 1 | |
| | Metal spraying device | 1 | |
| | Other equipment & tools | | |
| 5. Electric repair shop | Building area: 30 m x 80 m = 2,400 $m^2$ | | |
| | 20-t crane | 1 | (unit) |
| | Lathe | 3 | |
| | Planing machine | 1 | |
| | Balancing machine | 2 | |
| | Drying furnace | 1 | |
| | Other equipment & tools | | |
| 6. Instrument repair shop | Building area: 15 m x 30 m x 2 = 900 $m^2$ | | |
| | 5-t crane | 1 | (unit) |
| | Various instrumental equipment | | |
| 7. Maintenance | Building area: 16 m x 50 m x 2 = 1,600 $m^2$ | | |
| 8. Other facilities (Cent. maint. shop & warehouse) | Trucks for maintenance, etc. | 25 | (unit) |
| | Substation | 1 | |

Table 7-6-41 Specification of Major Equipment (Cont'd)

| Shop | Specification |
|---|---|
| 9. Area maintenance shop (Same at 4 areas) | Building area: 20 m x 60 m = 1,200 $m^2$<br>5-t crane 1 (unit)<br>Boring machine 2<br>Other equipment & tools |




(1) Central maintenance sub-center
(2) Electric & instrument repair shop
(3) Machine repair shop
(4) Machining shop
(5) Fabricating shop
(6) Forging shop
(7) Office of central material warehouse
(8) Spare parts warehouse
(9) Warehouse for general material & refractories
(10) Rolled steel warehouse
(11) Oil & fat warehouse

Fig. 7-6-57 Layout of Central Maintenance Shop and Central Material Warehouse (1/5000)

## 6-14. Central material warehouse

### 6-14-1. Basic idea

Central material warehouse is constructed to store and control en bloc materials used in production plants and accessory plants. However, as it is considered advantageous in mobility and economy that of materials used in operation, EAF electrodes, refractories and sub-materials are kept at steelmaking plants and rolling rolls and roll guides at rolling mill plants, those materials are excluded from those under the control of the central material warehouse.

The central material warehouse is closely related with the central maintenance warehouse and the both are arranged adjacent each other.

### 6-14-2. Premises for facilities plan

(1) Kind and quantity of materials kept in the warehouse

Quantity of material stocked is based on the following condition.

| | | |
|---|---|---|
| a) Spares | Equivalent to 2-year's consumption | |
| b) General material | -"- | 3-month's consumption |
| c) Refractories | -"- | -"- |
| d) Oil & fat | -"- | -"- |
| e) Rolled steel | -"- | -"- |

Provided, however, that EAF electrodes, refractories and sub-materials are stocked at steel making plants and rolling rolls and roll guides at rolling mill plants and those materials are excluded from the above.

(2) Material warehouse is divided as follows:

a) Spare part warehouse
b) General material & refractory warehouse
c) Oil & fat warehouse
d) Rolled steel warehouse

(3) Management system

1) All materials kept in the central material warehouse are managed en bloc.
(Note: Materials stocked other than in the central material warehouse are managed by plants where they are used.)

2) Personnel of the central material warehouse belong to maintenance dept. and their working condition is day-time shift, but some 3-shift personnel are assigned as emergency personnel.

6-14-3. Specification of major equipment

Table 7-6-42 Specification of Major Equipment

| Warehouse | Specification |
|---|---|
| 1. Spare part warehouse | Building area: 25 m x 130 m x 2 = 6,500 $m^2$ |
| | 10-t crane 2 (units) |
| | Forklift 2 |
| | Rack & others |
| 2. General material & refractory warehouse | Building area: 25 m x 70 m = 1,750 $m^2$ |
| | Forklift 2 (units) |
| | Rack & others |
| 3. Oil & fat warehouse | Building area: 50 m x 6 m x 2 = 600 $m^2$ |
| | 0.5-t crane 2 (units) |
| | Forklift 2 |
| | Others |
| 4. Rolled steel warehouse | Building area: 25 m x 30 m = 750 $m^2$ |
| | 10-t crane 1 (unit) |
| | Others |

6-14-4. Layout

See Sec. 6-13 Maintenance facilities.

## 6-15. Administration facilities

### 6-15-1. Basic idea

The following can be listed as facilities which are generally considered as administration facilities of modern steel works.

a) Production office
b) Subcenter
c) Canteen
d) Guard office
e) First-aid station
f) Fire station
g) Hospital
h) Employees' housing
i) Guesthouse
j) Education & training center, etc.
k) Welfare facilities (athletic ground, tennis court, swimming pool, gymnasium, etc.)
l) Secondary facilities such as road fence drainage etc.

In this pre-F/S, of those facilities, only those built in the steel works are considered as described later.

### 6-15-2. Premises for facilities plan

(1) Facilities to be installed

Such administration facilities as production office, subcenter, canteen and guard office are planned to be installed in the works.

First-aid station, hospital, company house and others are built in the township outside of the works.

(2) Outline of major facilities

1) Offices, canteens, etc.

a) Production office

Assuming the number of administration personnel to be about 300 (about 8% of the total employees of the works), the size of the building is planned to have space of about 10 $m^2$ per person, including space for keeping documents and common space.

b) Subcenter

Subcenters are to be built at four places close to raw material facilities & DR plant, EAF & CC plants, rolling mills, and power plant, respectively.

The buildings are of reinforced concrete construction.

c) Canteen

Canteen is planned assuming that 80% of production office personnel and 10% of plant workers will use canteen. Cooking and feeding facilities also are included.

d) Guard office

Three gates are planned for the works and a guard office is installed at each gate.

2) Transport and communication

a) Road

Main roads are to be of 2 lanes a way totalling 4 lanes. Road in each plant site is of one lane a way totalling 2 lanes, in principle.

b) Communication

As a modern steel works, proper telephone facilities, paging system and others are planned.

## 6-16. Civil and building work

### 6-16-1. Basic idea

Civil and building work in the project of construction of the steel works for the second generation in Indonesia includes that of site preparation, port construction each plant and shop construction, administration facilities, and boundary fences, roads, gates and sewers.

Not to mention the large-scaled civil work as site preparation, civil and building work for the facilities of the steel works is very difficult one because of big dimensions and complexity of the work due to foundations of very heavy equipment, complex foundations, complex interface between various facilities and large buildings. Therefore, contractors of civil and building work must be those who have sufficient experiences in such work in the construction of steel works and are capable of performing the work satisfactorily.

Though detailed information is not available on the past performance and ability of construction companies in Indonesia, this report envisages in compliance with the instruction of the Ministry of Industry of Indonesia that all the civil and building work including supply of required construction equipment and materials are to be carried out by Indonesian construction companies.

### 6-16-2. Site preparation

(1) Cilegon area

1) Present condition of proposed site

The proposed site for the new steel works is located to the north of P.T. Krakatau Steel and between the shoreline and the existing highway and railway. It is very flat with ground level being M.S.L.+2.0 m ∿ +3.0 m.

Main existing structures at the site are the highway and railway above mentioned and power transmission line on the east of the railway.

2) Site preparation plan

In planning site preparation, the following points are taken into consideration; namely, earth work should be as small as possible; work of removing or relocating the existing road, railway, power transmission line, etc. to other places should be minimized; and the shore-line is effectively utilized in the port plan.

Therefore, the site preparation work is so planned that part of the sea in front of the site is reclaimed to avoid large-scaled removal or relocation of the existing structures and enable ensuring shoreline necessary for the port construction. Ground level of the prepared site is to be M.S.L.+4.0 m in view of the highest tide level in the past (+1.421 m) and ground level of the site of P.T. Krakatau Steel.

The quantity of fill material required for the reclamation is expected to be about 6 million $m^3$, but as dredged material from port construction cannot be expected in this area, the entire fill material is carried in from proper overland site.

However, no information is available on such overland sites, and it is assumed that the site locates about 10 km distant from the proposed site. The township for the employees of the works is not considered in this pre- F/S, but the site where fill material is to be taken may be utilized as the township area.

(2) Arun area

1) Present condition of the proposed site

The proposed site of the new steel works is adjacent to the boundary of P.T. Asean Aceh Fertilizer (A.A.F.) and extends broadly to the west. It is enclosed by line about 4 km from the boundary of A.A.F. and line about 1.5 km from the shoreline to the existing highway in the south.

The site is almost free of difference of elevation and very flat and the ground level is M.S.L.+2.0 m∿+2.5 m or so.

Existing structures which may interfere the proposed site are fish farms, private houses, railway, etc., but the railway is already out of use and its removal should pose no problems. Removal and relocation of fish farms and private houses, however, will pose a problem of compensation.

2) Site preparation plan

As the case of Cilegon area, the quantity of earth work, existing structures, port construction plan and others are taken into consideration in planning preparation of the site.

The ground level of the site is made M.S.L.+4.5 m in view of the highest tide level (+2.200 m) in the past.

The quantity of fill material required in the site preparation is expected to be about 9 million $m^3$, about 60% of which is to be covered by dredged soil. The remaining 40% is to be covered by fill material brought in from other places, assuming as the case of Cilegon area that places where fill material is obtained are located about 10 km distant from the proposed site. Also, of the 9 million $m^3$, about 10% is to replace soft soil at the fish farms.

## 6-16-3. Civil and building work for the facilities of the steel works

### (1) Conditions for plan

#### 1) Design ground level

As mentioned in the site preparation plan, the ground levels of the sites for new steel works are to be

| | |
|---|---|
| Cilegon area | M.S.L.+4.0 m |
| Arun area | M.S.L.+4.5 m. |

#### 2) Foundation type

As described in Chap. VI 1. natural condition, the surface soils at both Cilegon and Arun areas are soft to the depth of 15 m or more so pile foundation is planned to be used. But as for the foundation of railway track at the raw material yard, considering uneven subsidence and lateral movement of the foundation as well as ease and economy of maintenance and repair of rail tracks, soil improvement is applied to the foundation to ensure necessary bearing capacity and prevent subsidence and lateral movement of the foundation.

Specification of piles, structures for which piles are used, their bearing capacity, bearing capacity of the improved ground and others are given below.

a) Specification of piles and structures to which they are applied

| | Size | Structures |
|---|---|---|
| PC pile | 400 ø | Foundations for conveyor, light weight machinery and general buildings |
| | 500 ø | Foundations for general machinery and plant buildings |
| Steel pipe pile | 600 ø<br>700 ø | Foundations for heavy machinery and vibrating machinery, top heavy structures such as stacks, elevated water tanks, etc. |

b) Permissible bearing capacity and lateral resistant force

| | PC Pile | | Steel Pipe Pile | |
|---|---|---|---|---|
| | 400 ø | 500 ø | 600 ø | 700 ø |
| Vertical bearing capacity (t) | 75 | 100 | 150 | 200 |
| Lateral resistant force (t) | 4 | 7 | 12 | 15 |

c) Bearing capacity of improved ground

Long-term permissible bearing capacity 15 $t/m^2$

3) Specification of buildings

Buildings are classified into two types; steel frame construction and reinforced concrete construction.

Plant buildings are of steel frame construction and their roofs and walls are built with corrugated colored galvanized steel sheet.

Of buildings other than plant buildings, the production office building is planned to be reinforced concrete construction.

Operating rooms, electric rooms, subcenters and others are planned to have columns, beams and floors of reinforced concrete and walls built with bricks.

(2) Conditions and scope of cost estimation

1) Conditions of estimation

The following are made premises for cost estimation of civil and building work.

a) In compliance with the instruction of the Ministry of Industry of Indonesia, it is assumed that all of materials, labor, equipment, etc., can be procured in Indonesia.

b) Civil and building work is to be performed by Indonesian contractors and completed within the construction period given already.

c) In principle, unit prices of civil and building work are set based on the information described in the answer dated April 21, 1987, from Indonesian Ministry of Industry to the questionnaire of JICA.

d) However, for items, of which information on unit price was not available, their unit prices are assumed based on the experience in Japan.

e) Unit prices given in the above answer are assumed to include overhead and profits.

f) It is assumed that fill material required for site preparation, except that of dredged material, is obtained at places about 10 km distant from the proposed site and carried to the site. Assuming material cost of fill material is free, only expenses incurred from excavation to transportation to the site are estimated.

g) Disposal area for surplus of excavated material in the civil and building work is assumed to be ensured adjacent to the proposed site and used free of charge.

h) Contingencies occurring in the work (e.g. cost of removal of unexpected obstacles) are not to be included in the civil and building work.

2) Scope of estimation

a) The estimation is confined to the civil and building work in the compound of the steel works.

b) Therefore, the estimation of civil and building work for facilities outside of the steel works, for example access roads and railways to the steel works and township, is not to be included.

c) Furnitures such as desks, chairs, lockers, etc. and cooking utensils are to be outside of the scope of the estimation.

d) Temporary facilities necessary only for the civil and building work are within the scope of the estimation.

e) Engineering fee necessary from planning to execution and completion of the civil and building work is to be outside of the scope of the estimation.

6-16-4. Construction work quantities

Construction work quantities of major works are roughly estimated as shown in Table 7-6-43.

The quantities shown in the table show those for major equipment and steel frame structures. It is considered that roughly 10% of the above quantities (excluding those of steel frame) should be added to the above as the quantities for reinforced concrete structures, boundary fences, various underground piping works.

However, the above quantities are estimated figures only based on soil data, topographic map, hydrographic survey result etc. of the adjacent areas of Cilegon and Arun because soil data, topographic map of the two proposed

sites and also the result of hydrographic survey and information of sea bed soil in respective sea areas are not available. Therefore, at the stage of next study, it is necessary to conduct, in detail, soil investigation, topographic survey and hydrographic survey at the proposed sites and collect accurate information about those matters. By so doing, the quantities and the construction costs will be revised to more practical and more accurate figures.

Table 7-6-43 Quantities of Major Works

| | Cilegon Area | | | | | | Arun Area | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pile S.P.*/P.C.* | Excavation ($m^3$) | Concrete ($m^3$) | Rebar (t) | Steel frame (t) | | Pile S.P.*/P.C.* | Excavation ($m^3$) | Concrete ($m^3$) | Rebar (t) | Steel frame (t) | |
| Port facilities | 7,500 / - | - | 38,000 | 4,500 | - | | 36,000 / - | - | 68,000 | 7,600 | - | |
| Raw material facilities | - / 35 | 5,500 | 1,300 | 100 | - | | - / 35 | 5,500 | 1,300 | 100 | - | |
| DR furnace facilities | 2,850 / 1,260 | 60,000 | 45,000 | 4,050 | 600 | | 3,550 / 1,260 | 60,000 | 45,000 | 4,050 | 600 | |
| EAF facilities | - / 2,120 | 82,500 | 19,000 | 3,900 | 6,900 | | - / 2,120 | 82,500 | 19,000 | 3,900 | 6,900 | |
| CC facilities | - / 1,010 | 97,000 | 16,700 | 1,350 | 5,100 | | - / 1,010 | 97,000 | 16,700 | 1,350 | 5,100 | |
| Rolling facilities | 3,300 / 4,870 | 266,000 | 73,500 | 5,500 | 9,250 | | 4,100 / 4,960 | 270,000 | 74,100 | 5,540 | 9,760 | |
| Utility facilities | - / 2,550 | 365,500 | 69,400 | 5,680 | 4,180 | | - / 2,550 | 363,500 | 68,700 | 5,620 | 4,180 | |
| Central maintenance & warehouse facilities | - / 2,030 | 28,500 | 17,500 | 1,220 | 5,770 | | - / 2,030 | 28,500 | 17,500 | 1,220 | 5,770 | |
| Transport facilities | - / 25 | 1,500 | 800 | 80 | - | | - / 20 | 1,400 | 800 | 80 | - | |
| Administraion facilities | - / 150 | 5,000 | 4,000 | 400 | - | | - / 150 | 5,000 | 4,000 | 400 | - | |
| Total S.P. / P.C. | 13,650 / 14,050 | 911,500 | 285,200 | 26,780 | 31,800 | | 43,650 / 14,135 | 913,400 | 315,100 | 29,860 | 32,310 | |
| Site preparation (fill material) | 6 million $m^3$ | | | | | | 9 million $m^3$ | | | | | |

* Note: Unit of steel pipe (S.P.) pile is ton and that of P.C. pile is piece.

# Chapter VIII. ROUGH ESTIMATE OF INVESTMENT

# Chapter VIII. ROUGH ESTIMATE OF INVESTMENT

## 1. Basic Idea in Estimation of Investment

### 1-1. Division of domestic and imported purchasing

Though it is not proper for this pre-F/S to set division of purchasing in detail, the following condition was assumed for making rough estimate of the investment amount.

| | |
|---|---|
| (1) Site preparation, civil engineering & building works: | 100% domestic purchasing |
| (2) Materials for the above: | -"- |
| (3) Machinery & equipment: | 100% imported purchasing |
| (4) Spare parts: | -"- |
| (5) Erection works: | Percentage not specifically assumed |
| (6) Others: | See Item 2-3. |

### 1-2. Bases of estimation

(1) Point of time of estimation

| | |
|---|---|
| Domestic purchasing: | March 1987 |
| Imported purchasing: | June 1987 |

(2) Currency

| | |
|---|---|
| Domestic purchasing: | Indonesian rupiiah (Rp.) |
| Imported purchasing: | Japanese yen (Converted to Rp.) |

(3) Exchange rate ¥100 = Rp.1,074.63

### 1-3. Effect of price fluctuation

The investment amount in this pre-F/S is at prices as of the above time of estimation and effect of possible price fluctuation by the time of construction is not counted.

1-4. Customs duties and other taxes

In view of the division of purchasing, possibility of policy change of taxation and the nature of this pre-F/S, the estimation was made on the tax-free basis.

1-5. Interest during construction

Matters of financing, or raising funds, are outside of the scope of this pre-F/S and interest during construction is not counted. However, reference figures are given in the memo separately.

2. Rough Estimate of Investment Amount

2-1. Total investment (Unit: Rp.Million)

Cilegon: 2,497,285 (Rp.1,557x$10^3$ per ton of crude steel)
Arun : 2,627,696 (Rp.1,638x$10^3$ per ton of crude steel)

Breakdown of the total investment by site, cost item and facilities is shown in Table 8-2-1.

2-2. Direct construction costs (Unit: Rp.Million)

Cilegon: 2,259,006
Arun : 2,381,909

The top 7 facilities whose direct construction costs are largest are shown below.

Cilegon: (Unit: Rp.Million)

| | | |
|---|---|---|
| 1) | Power plant | 683,289 (30.2%) |
| 2) | DR plant | 291,201 (12.9%) |
| 3) | Wire rod mill plant | 202,842 ( 9.0%) |
| 4) | Power receiving and distributing plants | 151,790 ( 6.7%) |
| 5) | EAF plant | 147,084 ( 6.5%) |
| 6) | Bar mill plant | 144,086 ( 6.4%) |
| 7) | Port & cargo handling facilities | 135,054 ( 6.0%) |

| Arun: | (Unit: Rp.Million) |
|---|---|
| 1) Power plant | 684,879 (28.7%) |
| 2) DR plant | 290,626 (12.2%) |
| 3) Port & cargo handling facilities | 274,488 (11.5%) |
| 4) Wire rod mill plant | 203,666 ( 8.6%) |
| 5) Power receiving and distributing plants | 150,843 ( 6.3%) |
| 6) EAF plant | 147,084 ( 6.2%) |
| 7) Bar mill plant | 144,911 ( 6.1%) |

Breakdown of direct construction costs by site and by facilities is shown in Table 8-2-2. And breakdown of the investment by site, cost item and facilities is given in Tables 8-2-3 and 8-2-4.

2-3. Other investment amount

(1) Engineering fee

Engineering fee is fluid depending on relation between the new steel works and engineering companies, but in this pre-F/S the fee is estimated empirically (4% of the total investment).

(2) Pre-operating costs

This includes expenses for establishment of the company, construction management, and other preparations for the start of operation. Empirically estimated amount was included. (0.3% of the total investment)

(3) Spares and stores

These are spares and replacement parts of machinery and equipment which become necessary after the start of operation and must be prepared in advance. The costs of those spares and stores equivalent to about 2-year's requirements are included.

(4) Contingency

5% of the investment for "machinery and equipment" is included as contingency expenses.

(5) Others

Expenses of education and training by suppliers and vehicles are included in "machinery and equipment", but operation guidance fee is not included. In addition, as "transportation and insurance premium" included in the direct construction costs, 15% of the sum of "machinery and equipment" and "spares and stores" is added.

Table 8-2-1 Total Investment

(Unit: Rp.Million)

| | Cilegon | | Arun | |
|---|---|---|---|---|
| | Amount | % | Amount | % |
| 1. Site preparation | 58,395 | 2.3 | 46,530 | 1.8 |
| 2. Civil engineering & building works | 343,872 | 13.8 | 456,253 | 17.4 |
| 3. Machinery & equipment | 1,443,981 | 57.8 | 1,461,540 | 55.6 |
| 4. Erection works | 187,338 | 7.5 | 189,395 | 7.2 |
| 5. Transportation & insurance | 225,420 | 9.0 | 228,191 | 8.6 |
| (Total of direct construction costs) | (2,259,006) | (90.4) | (2,381,909) | (90.6) |
| 6. Engineering fee | 99,866 | 4.0 | 105,082 | 4.0 |
| 7. Pre-operating costs | 7,517 | 0.3 | 7,909 | 0.3 |
| 8. Spares & stores | 58,694 | 2.4 | 59,717 | 2.3 |
| 9. Contingency | 72,202 | 2.9 | 73,079 | 2.8 |
| (Total of other investment) | (238,279) | (9.6) | (245,787) | (9.4) |
| Total investment | 2,497,285 | 100.0 | 2,627,696 | 100.0 |
| (Per ton of crude steel) | ($Rp.1,557 \times 10^3$) | | ($Rp.1,638 \times 10^3$) | |

Table 8-2-2 Direct Construction Costs

(Unit: Rp.Million)

| | Cilegon | | Arun | |
|---|---|---|---|---|
| | Amount | % | Amount | % |
| (1) Port & cargo handling facilities | 135,054 | 6.0 | 274,488 | 11.5 |
| (2) Raw material handling facilities | 14,267 | 0.6 | 14,207 | 0.6 |
| (3) Intraworks transport & scrap yard | 23,174 | 1.0 | 22,527 | 0.9 |
| (4) Lime calcining plant | 19,527 | 0.9 | 19,527 | 0.8 |
| (5) DR plant | 291,201 | 12.9 | 290,626 | 12.2 |
| (6) EAF plant | 147,084 | 6.5 | 147,084 | 6.2 |
| (7) CC plant | 114,807 | 5.1 | 113,423 | 4.8 |
| (8) Section mill plant | 129,945 | 5.8 | 130,570 | 5.5 |
| (9) Bar mill plant | 144,086 | 6.4 | 144,911 | 6.1 |
| (10) Wire rod mill plant | 202,842 | 9.0 | 203,666 | 8.6 |
| (11) Oxygen, argon, nitrogen & compressed air supply facilities | 29,686 | 1.3 | 29,366 | 1.2 |
| (12) Water supply, drainage & natural gas supply facilities | 10,638 | 0.5 | 8,369 | 0.4 |
| (13) Power plant | 683,289 | 30.2 | 684,879 | 28.7 |
| (14) Power receiving & distributing plants | 151,790 | 6.7 | 150,843 | 6.3 |
| (15) Testing & analysis facilities | 6,600 | 0.3 | 6,630 | 0.3 |
| (16) Maintenance facilities | 55,901 | 2.5 | 55,488 | 2.3 |
| (17) Central material warehouse | 7,020 | 0.3 | 6,815 | 0.3 |
| (18) Administration facilities | 33,700 | 1.5 | 31,960 | 1.3 |
| (19) Common facilities | 58,395 | 2.5 | 46,530 | 2.0 |
| Total | 2,259,006 | 100.0 | 2,381,909 | 100.0 |

Remarks: 1) Direct construction costs here are the sum of site preparation, civil eng. & building, machinery & equipment, erection, transport & insurance.

2) Common facilities include site preparation cost of Rp.58,395 million (Cilegon) and Rp.46,530 million (Arun).

Table 8-2-3 Detailed Table of Investment

Site: Cilegon (Unit: Rp.Million)

| | Total | (1) Port & cargo handling | (2) Raw material handling | (3) Transport & scrap yard | (4) Lime calcining plant | (5) DR plant | (6) EAF plant | (7) CC plant |
|---|---|---|---|---|---|---|---|---|
| 1. Site preparation | 58,395 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Civil eng. & building | 343,872 | 85,915 | 4,380 | 3,393 | 699 | 28,146 | 30,090 | 22,247 |
| 3. Machinery & equipment | 1,443,981 | 37,537 | 8,060 | 17,033 | 15,045 | 200,376 | 93,492 | 73,612 |
| 4. Erection | 187,338 | 5,631 | 505 | 61 | 1,505 | 30,056 | 9,349 | 7,361 |
| 5. Transport & insurance | 225,420 | 5,971 | 1,322 | 2,687 | 2,278 | 32,623 | 14,153 | 11,587 |
| (Total of direct construction costs) | (2,259,006) | (135,054) | (14,267) | (23,174) | (19,527) | (291,201) | (147,084) | (114,807) |
| 6. Engineering fee | 99,866 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7. Pre-operating costs | 7,517 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8. Spares & stores | 58,694 | 2,267 | 752 | 880 | 140 | 17,108 | 860 | 3,632 |
| 9. Contingency | 72,202 | 1,877 | 403 | 852 | 752 | 10,019 | 4,675 | 3,681 |
| (Total of other investment) | (238,279) | (4,144) | (1,155) | (1,732) | ( 892) | (27,127) | (5,535) | (7,313) |
| Total investment | 2,497,285 | 139,198 | 15,422 | 24,906 | 20,419 | 318,328 | 152,619 | 122,120 |

Table 8-2-3 Detailed Table of Investment (Cont'd)

Site: Cilegon

(Unit: Rp.Million)

| | (8) Section mill | (9) Bar mill | (10) Wire rod mill | (11) $O_2$, Ar, $N_2$, com-pressed air | (12) Water supply, drainage & natural gas | (13) Power plant | (14) Power rec. & distri. | (15) Testing & analysis |
|---|---|---|---|---|---|---|---|---|
| 1. Site preparation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Civil eng. & building | 24,642 | 25,522 | 25,582 | 5,074 | 3,235 | 37,083 | 7,731 | 619 |
| 3. Machinery & equipment | 83,391 | 93,923 | 140,454 | 19,666 | 3,815 | 496,511 | 110,687 | 4,750 |
| 4. Erection | 8,339 | 9,392 | 14,045 | 1,967 | 3,009 | 74,477 | 16,603 | 475 |
| 5. Transport & insurance | 13,573 | 15,249 | 22,761 | 2,979 | 579 | 75,218 | 16,769 | 756 |
| (Total of direct construction costs) | (129,945) | (144,086) | (202,842) | (29,686) | (10,638) | (683,289) | (151,790) | (6,600) |
| 6. Engineering fee | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7. Pre-operating costs | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8. Spares & stores | 7,093 | 7,737 | 11,284 | 193 | 43 | 4,943 | 1,107 | 290 |
| 9. Contingency | 4,170 | 4,696 | 7,023 | 983 | 191 | 24,826 | 5,534 | 238 |
| (Total of other investment) | (11,263) | (12,433) | (18,307) | (1,176) | ( 234) | (29,769) | (6,641) | ( 528) |
| Total investment | 141,208 | 156,519 | 221,149 | 30,862 | 10,872 | 713,058 | 158,431 | 7,128 |

Table 8-2-3 Detailed Table of Investment (Cont'd)

Site: Cilegon

(Unit: Rp.Million)

| | (16) Maintenance facilities | (17) Central material warehouse | (18) Administration facilities | (19) Common facilities |
|---|---|---|---|---|
| 1. Site preparation | 0 | 0 | 0 | 58,395 |
| 2. Civil eng. & building | 9,811 | 4,466 | 25,237 | 0 |
| 3. Machinery & equipment | 36,828 | 2,031 | 6,770 | 0 |
| 4. Erection | 3,683 | 203 | 677 | 0 |
| 5. Transport & insurance | 5,579 | 320 | 1,016 | 0 |
| (Total of direct construction costs) | (55,901) | (7,020) | (33,700) | (58,395) |
| 6. Engineering fee | 0 | 0 | 0 | 99,866 |
| 7. Pre-operating costs | 0 | 0 | 0 | 7,517 |
| 8. Spares & stores | 365 | 0 | 0 | 0 |
| 9. Contingency | 1,841 | 102 | 339 | 0 |
| (Total of other investment) | (2,206) | ( 102) | ( 339) | (107,383) |
| Total investment | 58,107 | 7,122 | 34,039 | 165,778 |

Table 8-2-4 Detailed Table of Investment

Site: Arun

(Unit: Rp.Million)

| | Total | (1) Port & cargo handling | (2) Raw material handling | (3) Transport & scrap yard | (4) Lime calcining plant | (5) DR plant | (6) EAF plant | (7) CC plant |
|---|---|---|---|---|---|---|---|---|
| 1. Site preparation | 46,530 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Civil eng. & building | 456,253 | 209,893 | 4,320 | 402 | 699 | 27,571 | 30,090 | 20,863 |
| 3. Machinery & equipment | 1,461,540 | 49,315 | 8,060 | 19,075 | 15,045 | 200,376 | 93,492 | 73,612 |
| 4. Erection | 189,395 | 7,397 | 505 | 47 | 1,505 | 30,056 | 9,349 | 7,361 |
| 5. Transport & insurance | 228,191 | 7,883 | 1,322 | 3,003 | 2,278 | 32,623 | 14,153 | 11,587 |
| (Total of direct construction costs) | (2,381,909) | (274,488) | (14,207) | (22,527) | (19,527) | (290,626) | (147,084) | (113,423) |
| 6. Engineering fee | 105,082 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7. Pre-operating costs | 7,909 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8. Spares & stores | 59,717 | 3,235 | 752 | 946 | 140 | 17,108 | 860 | 3,632 |
| 9. Contingency | 73,079 | 2,466 | 403 | 954 | 752 | 10,019 | 4,675 | 3,681 |
| (Total of other investment) | (245,787) | (5,701) | (1,155) | (1,900) | ( 892) | (27,127) | (5,535) | (7,313) |
| Total investment | 2,627,696 | 280,189 | 15,362 | 24,427 | 20,419 | 317,753 | 152,619 | 120,736 |

Table 8-2-4 Detailed Table of Investment (Cont'd)

Site: Arun

(Unit: Rp.Million)

| | (8) Section mill | (9) Bar mill | (10) Wire rod mill | (11) $O_2$, Ar, $N_2$, compressed air | (12) Water supply, drainage & natural gas | (13) Power plant | (14) Power rec. & distri. | (15) Testing & analysis |
|---|---|---|---|---|---|---|---|---|
| 1. Site preparation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2. Civil eng. & building | 24,461 | 25,541 | 25,600 | 4,754 | 2,526 | 34,929 | 6,784 | 649 |
| 3. Machinery & equipment | 84,036 | 94,567 | 141,099 | 19,666 | 2,740 | 499,391 | 110,687 | 4,750 |
| 4. Erection | 8,404 | 9,457 | 14,110 | 1,967 | 2,687 | 74,909 | 16,603 | 475 |
| 5. Transport & insurance | 13,669 | 15,346 | 22,857 | 2,979 | 416 | 75,650 | 16,769 | 756 |
| (Total of direct construction costs) | (130,570) | (144,911) | (203,666) | (29,366) | (8,369) | (684,879) | (150,843) | (6,630) |
| 6. Engineering fee | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7. Pre-operating costs | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8. Spares & stores | 7,093 | 7,737 | 11,284 | 193 | 32 | 4,943 | 1,107 | 290 |
| 9. Contingency | 4,202 | 4,728 | 7,055 | 983 | 137 | 24,970 | 5,534 | 238 |
| (Total of other investment) | (11,295) | (12,465) | (18,339) | (1,176) | ( 169) | (29,913) | (6,641) | ( 528) |
| Total investment | 141,865 | 157,376 | 222,005 | 30,542 | 8,538 | 714,792 | 157,484 | 7,158 |

Table 8-2-4 Detailed Table of Investment (Cont'd)

Site: Arun

(Unit: Rp.Million)

| | (16) Maintenance facilities | (17) Central material warehouse | (18) Administration facilities | (19) Common facilities |
|---|---|---|---|---|
| 1. Site preparation | 0 | 0 | 0 | 46,530 |
| 2. Civil eng. & building | 9,398 | 4,276 | 23,497 | 0 |
| 3. Machinery & equipment | 36,828 | 2,031 | 6,770 | 0 |
| 4. Erection | 3,683 | 203 | 677 | 0 |
| 5. Transport & insurance | 5,579 | 305 | 1,016 | 0 |
| (Total of direct construction costs) | (55,488) | (6,815) | (31,960) | (46,530) |
| 6. Engineering fee | 0 | 0 | 0 | 105,082 |
| 7. Pre-operating costs | 0 | 0 | 0 | 7,909 |
| 8. Spares & stores | 365 | 0 | 0 | 0 |
| 9. Contingency | 1,841 | 102 | 339 | 0 |
| (Total of other investment) | (2,206) | ( 102) | ( 339) | (112,991) |
| Total investment | 57,694 | 6,917 | 32,299 | 159,521 |

# Chapter IX. CONCLUSION AND RECOMMENDATIONS

# Chapter IX. CONCLUSION AND RECOMMENDATIONS

## 1. Outline

(1) In accordance with the agreement reached between the Governments of Indonesia and Japan, Step III study, the pre-F/S, was made following Step I study (steel demand study) and Step II study (site survey).

(2) This report covers and integrates all the studies made under Step I through Step III.

(3) Data used in this report are based on those provided through official organizations as well as the Ministry of Industry of Indonesia and, in addition, include the information which the members of the study team gathered during field survey in respective Steps.

However, it should be added that as regards fields, of which data were hard to obtain or not available, the members made assumption based on their years of experience and knowledge in their respective fields.

(4) The object of this pre-F/S was defined as below between the Indonesian side during the course of study work under each Step.

1) The site is to be limited to Lhokseumawe (Arun) area and Cilegon Industrial Estate, and the pre-F/S to be made on the condition that the new steel works for the second generation is to be constructed on either site.

2) The new steel works is to be an integrated steel works producing non-flat products of medium sections, small bars and wire rods.

3) Based on the result of Step I study, the production scale of the steel works is not to exceed 2 million tons a year in terms of crude steel.

However, in view of the change of economic condition in Indonesia since the Step I study, the demand and supply gap of this magnitude is to be assumed to appear sometime after 1990.

4) Production process adopted is to be direct reduction (DR) process using natural gas produced locally in Indonesia and other processes are out of the scope of study.

5) The pre-F/S is not to study the new steel works in the style closer to the reality in the light of the condition of proposed sites, but to make so-called conceptional design of the steel works and estimate funds required for its construction based on various given and assumed conditions.

Therefore, the pre-F/S does not include financial analysis nor economic analysis of the project.

2. Conclusion of the Pre-F/S

(1) Simplified line-up of facilities

Very simplified line-up of production facilities with DR furnace x 2 -- EAF x 4 -- LF x 2 -- CC x 2 -- Rolling mills (section mill, bar mill and wire rod mill) was planned.

(2) Compact layout and consideration for future expansion

Layout of the facilities is so planned that material flow can be smooth and that operation of hot charge connecting CC and RM and others can be made for energy saving. If expansion of facilities becomes necessary in future, the layout can easily accommodate it.

(3) Facilities plan of the latest technological level

Facilities are planned to include the latest technology appropriate to the new steel works for the second generation. Namely,

1) High efficiency

Full consideration is given to have most economical productive facilities from DR furnace through rolling mill.

2) Production of quality products

High grade steels such as special steel are out of the scope of this pre-F/S, but it is planned that production of those products, if required in future, is possible by installing a few additional facilities such as degassing facilities and billet conditioning facilities.

3) Low production cost

Factors which have effect on production cost such as basic consumption units of various materials and services required for operation, material/product yield, etc. are planned on the basis of actual performance of operation of similar facilities in Japan.

4) Automated & computerized facilities

In planning the facilities, consideration is given to automation and computerization from the viewpoint of ensuring personnel economy and stable quality.

5) Environmental preservation

In the facilities plan, pollution control facilities (air pollution, noise, effluent, etc.) are planned with reference to the present level of pollution control facilities in Japan, which are the highest level in the world.

(4) High labor productivity

Labor productivity of the new steel works calculated on the number of personnel directly engaged in production activity only is about 400 t/man-year.

The number does not include the personnel of so-called indirect departments such as head office and others, but even if those personnel are included, the productivity is high as compared with that of similar steel mills in Japan.

(5) Effective capital investment

As one of criteria of effectiveness of capital investment in constructing a new steel works at a new site, there is the amount of investment per ton of crude steel produced annually. In this project, it is about $1,100.

Though no suitable comparative example is available in recent years, it can safely be said it is an effective investment in the light of the instances of steel works constructed in the past.

3. Recommendations

The object and preconditions of this pre-F/S are as mentioned already.

If the Government of Indonesia contemplates promotion of this project in future, the matters enumerated below would require further study and consideration.

(1) Selection and detailed field survey of the site

Two sites at Arun area and Cilegon Industrial Estate are proposed in this instance and either site must be selected finally as the site for the new steel works and detailed field survey conducted. Such survey should be made with reference to the items mentioned in Chapter VI.

(2) Detailed study of natural gas, industrial water & power

(3) Review of required construction funds by field survey

Such review should be necessary especially for civil engineering (incl. port) and equipment erection works.

(4) Curtailment of construction period

Any delay in the general construction schedule has a big effect on profitability of this project.

(5) Financial analysis and economic analysis

In implementing this project, study should be made on its profitability on the basis of required construction funds as reviewed above.

(6) Study of alternate plans

In view of natural gas production and power condition as well as infrastructure in the vicinity of the sites proposed, the idea to construct DR plant at Arun site and EAF and subsequent facilities at Cilegon Industrial Estate is very realistic and worth full study.

In that case, stepwise construction of facilities also should be studied in order to decrease initial investment.

(Reference)

# Progress Report for the Pre-Feasibility Study on the National Iron and Steel Development for the Second Generation in the Republic of Indonesia

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

P.O. BOX 216 MITSUI BLDG.
2-1, NISHI-SHINJUKU, SHINJUKU-KU, TOKYO
160 JAPAN

Jakarta, March 11, 1987

Ministry of Industry
Republic of Indonesia

Attn : Ir. H.M. Toyib
Director of Basic Metal Industry

Subject : Progress Report for the Pre-Feasibility Study on the National Iron and Steel Development for the Second Generation in the Republic of Indonesia

Dear Sir :

Attached 15 copies are the Progress Report prepared by the Step III mission of JICA for the captioned study.
In this report, the premises for the study are described under item 3.b. The Step III mission will develop the captioned study in Japan based upon these premises.
The premises are based upon technical information and data obtained officially through governmental agencies.
The answers to the questionnaire which was mailed in mid February 1987 to MOI are anticipated to be given to JICA within two weeks after JICA mission's arrival to Japan, and the information to be contained in these answers will also be the basis of the pre-feasibility study, if they arrive Japan timely for the study.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

P.O. BOX 216 MITSUI BLDG.
2-1, NISHI-SHINJUKU, SHINJUKU-KU, TOKYO
160 JAPAN

If you agree to the above, please return one copy of this letter to us by signifying your concurrences.

Truly yours,

Kenji KOBAYASHI
Mission Leader
The Feasibility Study Mission (JICA)

Agreed and confirmed :

Ir. H.M. Toyib
Director of Basic Metal Industry
M O I.

# PROGRESS REPORT

FOR

# THE PRE-FEASIBILITY STUDY

ON

# THE NATIONAL IRON AND STEEL DEVELOPMENT FOR THE SECOND GENERATION IN THE REPUBLIC OF INDONESIA

MARCH 11, 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO, JAPAN

CONTENTS

# The Pre-Feasibility Study
# on
# the National Iron and Steel Development for
# the Second Generation in the Republic of Indonesia

## 1. Objective of the Study Team

### a. Background

In the Republic of Indonesia, with a fast growth of steel demand, steel production was predicted to be short.

The Government of Indonesia therefore was anxious for construction of a new steel mill and requested Japan, in February 1983, to cooperate in a study for such steel mill. The request was carefully considered by the Japanese government and it was decided that a study mission consisting of staffs from member companies of the Japan Iron and Steel Federation with the Federation acting as liaison office was to be dispatched to Indonesia. The mission for preliminary studies for the study was sent three times; in July 1983, February and August 1984, and all the three study teams were conducted by Japan International Cooperation Agency and the Japan Iron and Steel Federation as missions under direct control of the Japanese government. The current mission is the mission for Step Three of the study (herein-after

called Step III mission) and its objective was to carry out in the form of a pre-feasibility study without conducting a soil investigation, covering two sites, Cilegon and Arun, for future location of the non-flat steel plant. The members of Step III mission are shown later.

b. Objective of the Study

Objective of the study is to conduct a study on technological and economic feasibility of the National Iron and Steel Development for the Second Generation in the Republic of Indonesia.

Overall procedures of the study were agreed between DGMBI MOI in charge of the study on the Indonesian side and the preliminary study team dispatched in July, 1984 and the scope of works including such agreement was signed on July 31, 1984. According to the scope of works and the minutes of meeting signed on December 20, 1986, the Step III mission conducted field studies on the conceptional design of the plant, environmental control measures and construction costs (rough estimation) etc. from March 1st to 11th, 1987, with cooperation of DGMBI, the counterpart in this study on the Indonesian side.

In order to achieve the above objectives, the Step III mission covered the following items.

1) Preparation of the conceptional design of the plant
   a. Study on the type of products and their optimum production scale
   b. Determination of the process
   c. The design standards and process flow sheet including material balance of the proposed plant
   d. Layout of the proposed plant
   e. Drawings of the plant
   f. Plant construction plan
   g. Operation program including organization and man power plan
2) Environmental control measure
3) Financial analysis
   a. Overall investment costs (rough estimation on construction cost)

2. Members List of the Mission and their Jobs

a. Kenji KOBAYASHI, Mission Leader
   Overall management of the mission and preparation of a master plan for this project

b. Masahiro OISHI, Technical Coordination
   In carrying out the survey, coordination of assignments of the following 11 members as well as

matters not assigned to them, e.g. studies for such subjects as central maintenance and repair shops and central material warehouses.

c. Itsuo NOZAWA and Ichiro OKUMURA, Civil Engineering

Success of construction of the steel plant depends firstly on availability of effective land of 300 ha and secondly on possibility of construction of port which can accomodate flow of various materials corresponding to the production of maximum 2 million tons of steel a year.

Assigned to the study of overland portion and marine transportation part of civil engineering work. They studied, in addition to the above, the main office, refectory, other office buildings, roads and water intake and drainage facilities within the proposed sites of the steel works.

d. Shigeki SATO, Raw Materials

Assigned to the study of the raw materials yard facilities and raw materials test/analysis facilities, and if required pellet firing and ore crushing facilities.

e. Hiroshi NAGUMO, Gas Based Direct Reduction Plant

Assigned to the study of gas based direct reduction plant (including the process ranging from raw materials acceptance to DRI temporary storage) and sub-center office of iron making area.

f. Jutaro SHIMOGO, Electric Arc Furnace Plant

Assigned to the study of the EAF plant (including the

furnace-side scrap yard, materials yard and furnace lining), lime calcining plant and steelmaking test/analysis facilities.

g. Shinya UEDA, Continuous Casting Plant

Assigned to the study of the CC plant (including the ladle/tundish shops, and cranes for EAF/CC), temporary billet yard (in CC plant), outgoing billet yard (if billets are to be sold) and sub-center offices within the steelmaking area.

h. Masaru SHIMIZU, Rolling Plants

Assigned to the study of the rolling plants (wire-rod mill, bar mill and section mill), test center, products warehouse, billet yards (in rolling plants), and sub-center offices within the rolling area.

i. Yoshiki NAKAHARA, Energy-Utility

Assigned to the following studies:

Power supplies and communications (power plant, power receiving/distributing facilities, and local communications facilities);

water supply/discharge (local reservoirs, raw water treating facilities, sea-water intake facilities, and waste water treating facilities);

Oxygen (oxygen plant, holder, compressed air facilities (air center), etc.);

Local utility piping (utility piping for oxygen, natural gases, nitrogen and water to all plants and mills).

j. Yoshishige UEMURA, Transportation

Assigned to the following studies:

Wharf handling facilities (raw materials wharf handling facilities, products wharf handling facilities and wharf-raw materials yards conveyance facilities);

Local transportation (rail-road transportation (including shunting yard), trackless transportation (including fire engine and ambulance-car), and weighers (for trucks and rail-road vehicles);

Treatment of scrap and wastes (scrap yard facilities, slag disposal facilities, heavy scrap treating facilities and slag/waste dump).

k. Hideyuki YOSHII, Coordination on Investment

Relevant studies for estimation of investment cost.

Studies for laws and regulation regarding equipment investment.

l. Yoshiki TAJIRI, Demand and Supply of Steel

Reviews for demand and supply of steel in the Republic of Indonesia.

Complementary study to STEP I and II.

3. Methods for Executing the Study

a. Method of Study

The study to be conducted by the Step III mission comprises a pre-feasibility study on the two sites in Cilegon and Arun areas presented by the Indonesian side

for the purpose of working out a rough estimation of the total amount of investment required for the construction of new integrated non-flat steel plant. An outline of the study method is shown in the flowchart on the following page.

The field survey consisted :

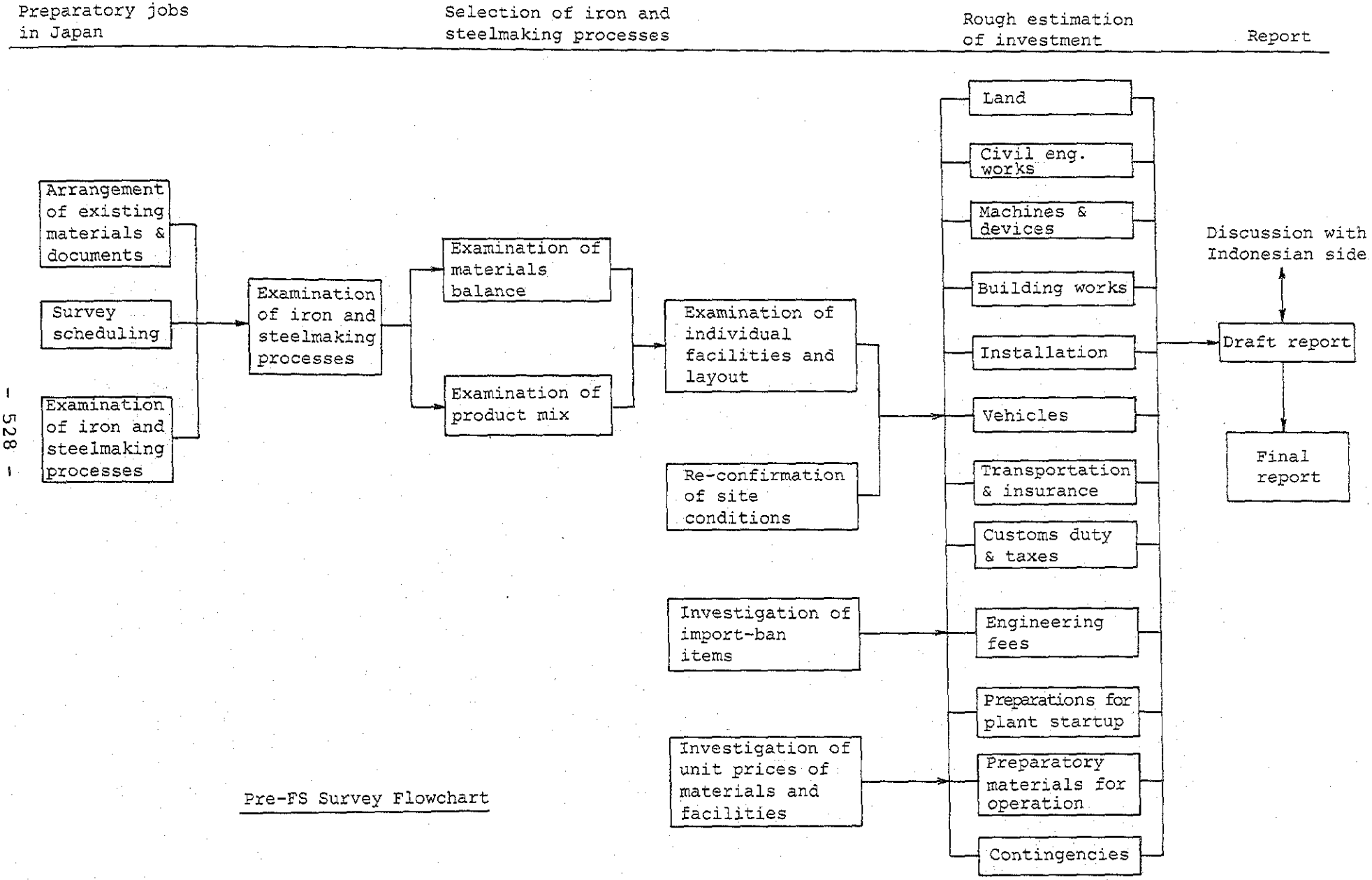
*Re-confirmation of conditions at the two sites; and

*Re-confirmation of principal production processes to be adopted

in order to set necessary premises for construction.

The product mix will be established with reference to the results of step I study and/or the demand and supply balance sheet as provided by the Ministry of Industry. Materials balances will be worked out from the yield and various amounts of consumption to decide the capacity of the individual facilities and quantity of required raw materials, slag, gases and others. The plant layout will be prepared on the basis of these facilities to be installed.

Necessary machines, installation cost and civil engineering and construction costs will be calculated for each of the facilities ranging from raw materials acceptance to ironmaking, steelmaking, rolling and products shipment. Also common costs such as those for local tranportation including necessary vehicles for conveyance, utility cost and engineering fees as well as




Pre-FS Survey Flowchart

materials for operational preparation will be calculated, and the total amount of investment will be roughly estimated.

b. Premises for the Study

During the period of the Step III mission's field survey, the followings were confirmed by and between DGMBI MOI and the Step III mission as the premises for the Study :

1) Demand and supply

DGMBI MOI stated that there was no significant demand increase of non-flat products for the coming years 1990 and 1995 according to the studies conducted by the consultants of the third country.

However, DGMBI MOI and the Step III mission agreed that the Study should be proceeded with on the assumption that the demand for non-flat products would increase as per the study results of Step I in some years after 1990.

2) Product mix

It was confirmed by and between both parties that the non-flat products should include wire rod, bar and medium section products.

3) Plant capacity

The production capacity of individual plants to produce the above products should be planned by the Step III mission paying due attention to the above

circumstances for the steel demand.

Accordingly, an optimum production capacity will be planned from technical and economical points of view for each of productive installation units within the total annual production capacity of 2.0 million tons of crude steel.

4) Production processes

It was confirmed by and between both parties that the production processes to realize the above production should be :

- Gas - based direct reduction process,
- Electric arc furnace steelmaking process,
- Continuous casting process, and
- Rolling mill process.

5) Proposed plant sites

As requested by DGMBI MOI, the study will be conducted on the conditions that Cilegon and Arun are the possible two plant sites, that one complete process from direct reduction process to rolling process will be planned for each of the proposed two plant sites, and that the comparative study of the two sites will not be conducted because of lack of data for local conditions such as soil and topographical data, etc.

However, since the equipment planning will be developed through such a manner that the utilities demand for each of the productive units, e.g.

required volume and specifications for electricity, natural gas, water, etc. are to be separately indicated, and that the capital cost investment will also be separately estimated, it will be possible for DGMBI MOI to develop the further study to install selected productive units of the integrated installations to one of the possible plant sites and to install the remaining installations to the other plant site, in case necessary.

The Step III mission will comment on this matter in the draft report from a technical point of view, in case deemed technically favorable.

6) Utilities

(6-1) Arun area

(i) Industrial water

The sources of industrial water are abundant around Arun area.

(ii) Electric power

The installed capacity of power plant and the power network around Arun area have to be increased in advance with the demand growth caused by the proposed steel works.

(6-2) Cilegon Area

(i) Industrial water

The possible shortage of water supply, mainly caused by the future expansion plan of P.T.

Krakatau Steel, is to be solved by feeding water from Karian reservoir which is now being considered by the Forest Ministry (refer to JICA Report 1985). The proposed steelworks has to depend upon the Karian reservoir as well as P.T. K.S.

(ii) Electric power

The installed capacity of power plant and the power network in West Jawa can support the operation of electric arc furnaces in the same way as at P.T. Krakatau Steel.

7) Civil and building engineering

(7-1) Purpose of site survey

Generally, the purpose of site survey regarding civil and building engineering in this type of study must be to investigate topography, subsoil conditions, prices of main construction materials, sources of basic materials, etc. necessary to develop the plan of civil and building work of an integrated steel plant to be recommended.

(7-2) Status of site survey at present

(i) Data and information obtained

Data and information obtained through the site survey are listed below :

| | Cilegon (PTKS) | Arun |
|---|---|---|
| (a) Topographic map | Not obtained | Not obtained |
| (b) Subsoil data of the site | Outline description of PTKS obtained | Brief description of assumed subsoil data of AAF obtained |
| (c) Hydrography off-shore of the site | Not obtained | Chart around AAF and Iskandar Muda harbor obtained |
| (d) Construction record | Construction duration of civil/building work for HSM, BT-CC obtained | Source place of rock and aggregates for concrete obtained. |
| (e) DWGS, specs, B/Q, etc. | General layout drawings, typical foundation dwgs, outline specs of bldg & foundation work of each plant obtained | A few preliminary dwgs and specs obtained |
| (f) Unit prices | Unit prices of materials, equipment, labor and civil/building works obtained. They will be reference data for rough estimation | Not obtained |
| (g) Design basis and standard | Not obtained | Not obtained |

(ii) MOI's answers to questionnaire

Answers to the questionnaire have not been obtained yet from MOI. However, MOI arranged and coordinated the appointments with PTKS and AAF for the Step III mission to discuss and obtain data and information regarding civil and building works of integrated steelworks.

Answers from MOI to the questionnaire are anticipated to be given within two weeks after the Step III mission's arrival to Japan.

(iii) Consideration to the obtained data and information during development of the pre-feasibility study in Japan.

(a) As a result of site survey, the Step III mission observed some obstructions to the site preparations work, such as villages, fish ponds, roads, etc. It will be assumed that any expenses and duties for removal, relocation and destruction of these obstructions will not be included in the civil and building engineering work for this pre-feasibility study.

(b) The obtained data and information will be studied and the pre-feasibility study will be undertaken based upon them.

(c) Due to the time limitation, in-house pre-feasibility study of civil and building works

will be initiated soon after this site survey. Therefore, some assumptions will be made because of lack of some data and information.

8) Method of estimation

Regarding the method of estimation of investment costs, the following items were confirmed by and between MOI and the step III mission:

(i) The costs of civil and building works will be estimated with making use of Indonesian domestic prices as much as possible. However, in case of difficulty in getting appropriate data, Japanese prices may be applied.

(ii) The costs of equipment, machinery, vehicles and spare parts will be estimated on the basis of FOB prices in Japan.

(iii) Ocean freight and insurance cost will be estimated to be 10% of the FOB prices of imported goods.

(iv) Inland transportation costs in Indonesia will be estimated to be 5% of the FOB prices of imported goods.

(v) Contingency costs will be estimated to be 5% of the FOB prices of equipment and machinery.

(vi) Interest during construction will not be included in the investment costs.

(vii) Investment costs will be estimated on the basis without taxes and duties.

(viii) All items of investment costs will be shown in Indonesian Rupiah.

(ix) Exchange rate ; ¥100= Rp. 1074.63
(Official rate of the Central Bank, on March 6th, 1987)

(x) Financing matters will not be considered in the pre-F/S report.

C. Commonsensial conditions to satisfy the above premises

The site should satisfy the following conditions, further details being to be studied by the mission:

1) Land

An open space area of less than 300 ha as steel plant site (The land to be one single lot. For effective utilization of land and efficient steel plant operation, land of rectangular shape, e.g. 1,000m x 3,000m desirable. From the viewpoint of construction costs, land to be flat as much as possible). 300ha as site for housing (for this land, the above conditions for steel plant site are not necessarily applied).

2) Port facilities

For ensuring efficient and effective steel plant operation, the following facilities are necessary and besides it is highly desirable that they form part of the steel plant, namely, they are not far from the steel plant.

Raw material unloading berth

Scrap, sub-material and general cargo berth

Products shipping berth

3) Industrial water and sea water

200,000$m^3$ fresh water/day as cooling for various purpposes -for replenishment- in the steel plant. If electric power is to be supplied from a power plant installed in the steel plant and not from outside sources, the power plant will require cooling water of

3,300,000$m^3$ sea water/day for 1,000 MW back power

(1,300,000$m^3$ sea water/day for 400 MW maximum power)

In addition, potable water is required as follows :

1,000$m^3$/day for steel plant

10,000$m^3$/day for housing area

2,500$m^3$/day for boiler feed water

(This assumes that conventional steam turbine is employed for 1,000 MW back power)

4) Manpower

The productivity target shall be 200 tons/man- year. As manpower, 10,000 persons are required as employees including management down to workers at the lowest echelon.
The workers should satisfy at least the following conditions:

They can read and understand instructions and orders.

They can write, read and understand report.

5) Others

d. Investigation at Sites

1) In Jakarta, members visited MOI and related Ministries and Agencies, conducted interviews, collected data and information concerning their respective assignments.

2) Each of the proposed sites was visited and conditions of each site were studied extensively as time permits.

3) At the proposed site of Cilegon, all the members visited P.T. Krakatau Steel and its surrounding area, conducted interviews, col-

lected data and information. At the proposed site of Arun, five members, Messrs. K. Kobayashi. I. Nozawa, I. Okumura, Y. Nakahara and Y. Uemura visited AAF (ASEAN-Aceh-Fertilizer), conducted interviews and collected data and information.

4. Study Schedule

Study schedule of step III mission is illustrated in Figure 1 which shows the study activities carried out in the Republic of Indonesia and also in Japan. Time interval and sequence of individual study components are shown also in the Figure.

The study and survey results in the Republic of Indonesia will be evaluated and formulated into the conceptional design of the proposed project during the study in Japan.

The report submission schedule is as follows:

* Inception Report March, 1987
* Progress Report (Step III) March, 1987
* Final Report (Step III) End of December, 1987

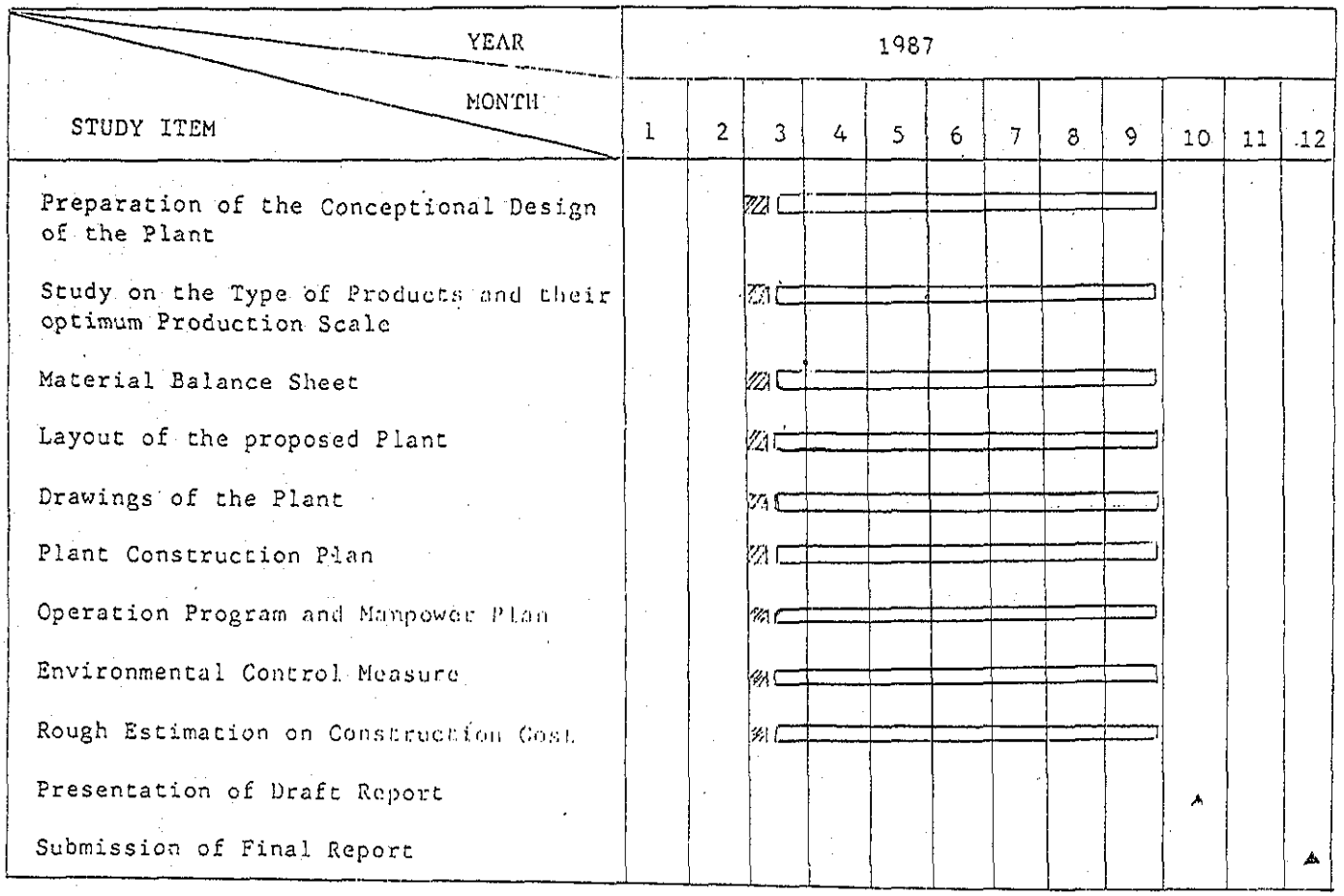
5. Organization List for Study Visit

The list of organizations in the Republic of Indonesia visited for step III study and survey is shown in Table 1.

Table 1 Organization List for Study Visit

| | |
|---|---|
| M O I | Departemen Perindustrian (Ministry of Industry) |
| D P E | Departemen Pertambangan dan Energi (Department of Mining and Energy) |
| P L N | Perusahaan Listrik Negara (National Electricity) |
| KRAKATAU | P.T. Krakatau Steel |
| B A R A T A | P.T. Barata Indonesia |
| Tosan Prima | P.T. Tosan Prima Murni |
| Pulogadung | P.T. Pulogadung Steel |
| A A F | Acean Aceh Fertilizer |
| I W W I | P.T. IWWI |
| Intan Pertiwi | P.T. Intan Pertiwi Industri |
| Indoporlen | P.T. Indoporlen |
| Unindo | P.T. Unindo |
| Jakarta Kyoei | P.T. Jakarta Kyoei |
| Tobu | P.T. Tobu Indonesia Steel |
| Universal Metal | P.T. Universal Metal |
| Kajima Corp. | Kajima Corporation |
| JETRO | Japan External Trade Organization |

Figure 1. OVERALL STUDY SCHEDULE



Reference data: Memo on "Interest during Construction"

1. Object of preparing this reference data

The rough estimate of investment in this pre-F/S does not include the amount paid as interest during construction. This is because the matters of financing is out of the scope of the study. However, it is natural that those concerned wish to know possible amount of interest during construction which is one of the components of the investment amount.

On the condition that such interest during construction has to be calculated roughly and macroscopically in view of the nature of this pre-F/S, this data are prepared and given for reference.

2. Estimation of annual expenditures of the investment

Based on the general construction schedule of the pre-F/S report, annual expenditures of the investment are estimated as follows:

(Unit: Rp. Million)

| Construction Period | Cilegon | Arun |
|---|---|---|
| 1 | 50,674 ( 2.0%) | 90,987 ( 3.5%) |
| 2 | 204,307 ( 8.2%) | 245,961 ( 9.4%) |
| 3 | 903,101 (36.2%) | 953,859 (36.3%) |
| 4 | 1,188,468 (47.6%) | 1,174,929 (44.7%) |
| 5 | 150,735 ( 6.0%) | 161,960 ( 6.1%) |
| Total | 2,497,285 (100%) | 2,627,696 (100%) |

3. Percentage of domestic and imported purchasing and that of sources of funds

In view of the nature of this pre-F/S, it is difficult to estimate accurately percentage of domestic and imported purchasing and so the percentage is assumed as given below and the sources of funds and their percentage are also assumed as in the table below.

| | | Cilegon | | | Arun | | |
|---|---|---|---|---|---|---|---|
| | | Case 1 | Case 2 | Case 3 | Case 1 | Case 2 | Case 3 |
| Division of purchasing | Domestic | 40% | 35% | 30% | 40% | 35% | 30% |
| | Imported | 60% | 65% | 70% | 60% | 65% | 70% |
| Sources of funds | Capital | 30% | 30% | 30% | 30% | 30% | 30% |
| | Domestic loan | 10% | 5% | 0% | 10% | 5% | 0% |
| | EXIM loan | 60% | 65% | 70% | 60% | 65% | 70% |

4. Interest condition

(1) Domestic loan: 13.5% p.a.

(2) EXIM loan: 4.9% p.a.

5. Total interest during construction

(Unit: Rp.Million)

| Cilegon | | | Arun | | |
|---|---|---|---|---|---|
| Case 1 | Case 2 | Case 3 | Case 1 | Case 2 | Case 3 |
| 217,027 | 195,275 | 173,521 | 235,879 | 212,235 | 188,593 |

An Example of Rough Estimate of Interest during Construction

Site: Cilegon (Unit: Rp.Million)

| Year | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Expenditures | 50,674 | 204,307 | 903,101 | 1,188,468 | 150,735 | 2,497,285 |
| Fund raised: | | | | | | |
| (Case 1) | | | | | | |
| Capital | 15,202 | 61,292 | 270,930 | 356,540 | 45,222 | 749,186 |
| Domestic loan | 5,068 | 20,431 | 90,310 | 118,847 | 15,072 | 249,728 |
| EXIM loan | 30,404 | 122,584 | 541,861 | 713,081 | 90,441 | 1,498,371 |
| (Case 2) | | | | | | |
| Capital | 15,202 | 61,292 | 270,930 | 356,541 | 45,221 | 749,186 |
| Domestic loan | 2,534 | 10,215 | 45,155 | 59,423 | 7,537 | 124,864 |
| EXIM loan | 32,938 | 132,800 | 587,016 | 772,504 | 97,977 | 1,623,235 |
| (Case 3) | | | | | | |
| Capital | 15,202 | 61,292 | 270,930 | 356,541 | 45,221 | 749,186 |
| Domestic loan | 0 | 0 | 0 | 0 | 0 | 0 |
| EXIM loan | 35,472 | 143,015 | 632,171 | 831,927 | 105,514 | 1,748,099 |
| Interest during construction: | | | | | | |
| (Case 1) | | | | | | |
| Domestic loan | 342 | 2,063 | 9,538 | 23,656 | 32,696 | 68,295 |
| EXIM loan | 744 | 4,493 | 20,772 | 51,518 | 71,205 | 148,732 |
| Total | 1,086 | 6,556 | 30,310 | 75,174 | 103,901 | 217,027 |
| (Case 2) | | | | | | |
| Domestic loan | 171 | 1,032 | 4,769 | 11,828 | 16,348 | 34,148 |
| EXIM loan | 807 | 4,868 | 22,503 | 55,811 | 77,138 | 161,127 |
| Total | 978 | 5,900 | 27,272 | 67,639 | 93,486 | 195,275 |
| (Case 3) | | | | | | |
| Domestic loan | 0 | 0 | 0 | 0 | 0 | 0 |
| EXIM loan | 869 | 5,242 | 24,234 | 60,104 | 83,072 | 173,521 |
| Total | 869 | 5,242 | 24,234 | 60,104 | 83,072 | 173,521 |

An Example of Rough Estimate of Interest during Construction (Cont'd)

Site: Arun

(Unit: Rp.Million)

| Year | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| Expenditures | 90,987 | 245,961 | 953,859 | 1,174,929 | 161,960 | 2,627,696 |
| Fund raised: | | | | | | |
| (Case 1) | | | | | | |
| Capital | 27,296 | 73,788 | 286,158 | 352,478 | 48,589 | 788,309 |
| Domestic loan | 9,099 | 24,596 | 95,386 | 117,493 | 16,195 | 262,769 |
| EXIM loan | 54,592 | 147,577 | 572,315 | 704,958 | 97,176 | 1,576,618 |
| (Case 2) | | | | | | |
| Capital | 27,296 | 73,788 | 286,158 | 352,478 | 48,589 | 788,309 |
| Domestic loan | 4,550 | 12,298 | 47,693 | 58,747 | 8,097 | 131,385 |
| EXIM loan | 59,141 | 159,875 | 620,008 | 763,704 | 105,274 | 1,708,002 |
| (Case 3) | | | | | | |
| Capital | 27,296 | 73,788 | 286,158 | 352,478 | 48,589 | 788,309 |
| Domestic loan | 0 | 0 | 0 | 0 | 0 | 0 |
| EXIM loan | 63,691 | 172,173 | 667,701 | 822,451 | 113,371 | 1,839,387 |
| Interest during construction: | | | | | | |
| (Case 1) | | | | | | |
| Domestic loan | 614 | 2,888 | 10,988 | 25,357 | 34,380 | 74,227 |
| EXIM loan | 1,338 | 6,291 | 23,928 | 55,221 | 74,874 | 161,652 |
| Total | 1,952 | 9,179 | 34,916 | 80,578 | 109,254 | 235,879 |
| (Case 2) | | | | | | |
| Domestic loan | 307 | 1,444 | 5,493 | 12,678 | 17,191 | 37,113 |
| EXIM loan | 1,449 | 6,815 | 25,922 | 59,823 | 81,113 | 175,122 |
| Total | 1,756 | 8,259 | 31,415 | 72,501 | 98,304 | 212,235 |
| (Case 3) | | | | | | |
| Domestic loan | 0 | 0 | 0 | 0 | 0 | 0 |
| EXIM loan | 1,560 | 7,339 | 27,916 | 64,425 | 87,353 | 188,593 |
| Total | 1,560 | 7,339 | 27,916 | 64,425 | 87,353 | 188,593 |