6.13 Analysis and Inspection Facilities

Data obtained from analysis operations should be submitted as rapidly as possible for such purposes as the supervision of raw and sub materials and determination of the chemical composition of the sponge iron and the crude steel.

In other words, analytical data is closely related to production flow on the upper stream side.

On the other hand, inspection operations pertain to the down stream side as this work concerns the quality control of the final product and the quality assurance to the users.

Therefore, in consideration of each function and of data supervision system, the analysis center and inspection laboratory will be housed in individual buildings. The analysis center and the inspection laboratory will be in the same building since this Works is a simple one centering around the production of reinforcing bars.

6.13.1 Analysis

6.13.1.1 The main job of the analysis center is to analyze the samples received from the EF and CC works

through air tube and to feed back to these sections within minutes, the required analytical values which are then used for controlling production.

Besides, chemical inspections of raw and sub-materials and sponge iron regularly transported will be made.

Equipment analysis, functionally capable of carrying out simultaneous poly-elementary analysis, is essential in performing the analytical processes rapidly, while the on-line analysis system through the CPU is necessary for rapid feed-back of analytical data.

The accuracy and reliability of the analytical data are factors which determine the production procedures of the sponge iron, the crude steel, and for bars and rods in particular, quality specifications in the majority of cases can only be met through the chemical composition of the sponge iron and the steel so that this is a problem of the utmost importance.

Equipment supervision is, of course, important in maintaining accuracy, but computerized logic is a prerequisite in performing adequate steps, such as

compensation for the presence of various elements as well as for drift in the main analyzer.

6.13.1.2 Samples to be analyzed and the analyzer

Samples to be analyzed and the analyzers are shown in Fig. 6.13-1.

1) There are two principal types of main equipmental analyzers as follows:

- ° Fluorescent X-ray analyzer (FX)
- ° Photoelectric spectrochemical analyzer

Generally, elements lighter than ^{11}Na cannot be analyzed through the FX analyzer ("C" analysis cannot be effected), but samples in powder form such as slag can be analyzed.

On the other hand, although "C" and "B" analysis can be rapidly performed through the photoelectric spectro analyzer, but requires samples of fixed shape and moreover slag analysis cannot be performed.

2) As back-up for the FX analyzer or data processor, and for the analysis of unidentifiable specimens, a "C.S." determinator will be installed.

Fig. 6.13-1 Fundamental Point of View About Samples and Analyzer in Analysis Center

	Samples	Purpose of Analysis	Actions According to Analysis Results	Analysis Items	Analyzer
STEEL	Scrap	Acceptance judgement according to the requirements in contract.	Actions following the contract	C, Si, Mn, P, S, Cu, Ni, Cr, Mo, Sn	[C]: Carbon (and Sulphur) Determinator [Other elements]: Fluorescent X-ray Analyzer (FX)
	Scrap to be charged	Quality assurance	Selection of scrap and calculation of scrap combination.		
	EF Sample in furnace Ladle Sample	Analysis of elements in molten steel Representative chemical composition of the charge	Control of refining condition Acceptance judgement according to the specified steel. Decision of the application	C, Si, Mn, P, S, Cu, Ni, Cr, Mo, Sn ditto + Sol.Al, O, N, Ti, B, V, etc.	[C]: Carbon (and Sulphur) Determinator [O]: Oxygen Determinator [N]: Nitrogen Determinator [Sol.Al]: Atomic Absorption Analyzer [B]: Chemical Analysis [Others]: FX, but samples, not applicable in size or shape, are analyzed chemically.
	Products (Bar, Wire)	(1) Quality assurance (Check analysis)	Quality improvement	The same as the ladle analysis	
	Semi-finished products (billet, ingot)	(2) Examinations Quality control Claim Identification of steel	Development of process	C and other element required	
SLAG	EF Slag	Slag composition in refining process	Control of refining condition	TFe, SiO_2, CaO (MnO, MgO, Al_2O_3, P, S, TiO_2) CaO/SiO_2	[All Components]: FX
OTHER MATERIALS		Sewage, Fuel, etc.			Chemical Analysis

3) For the analysis of "Sol.Al" an atomic absorption analyzer is to be used. For the analysis of other substances, which due to size or form cannot be analyzed through the above devices, chemical analysis should be carried out.

6.13.1.3 The list of analysis facilities

The list of analysis facilities required in Fig.6.13-2. Where the main equipment required for chemical analysis are listed.

Fig: 6.13-2 SPECIFICATION PLAN OF MAIN FACILITIES

FACILITY ANALYSIS CENTER

NO.	EQUIPMENT	Q'TY	SPECIFICATION	REMARKS
1.	Fluorescent X-ray Analyzer with Analysis Data Processor	1	X-ray Quantometer Simultaneous detection of 14 elements Scanner 2 with automatic sample feeding mechanism Data Processor: Core 16KW Peripheries: Typewriter (1) CRT process operating console (1)	Fixed Channel: Si, Mn, P, S, Cu, Ni, Cr, Mo, Aℓ, Ti, Pb, Ca, Mg, Fe
2.	MG Installations for FX and Data Processor	1	220V, 10KVA	
3.	[C·S] Determinator	2	LECO CS-46 with EB-25 electronic balance and printer	
4.	[N] Determinator	1	LECO TN-15 " " " " " "	
5.	[O] Determinator	1	LECO RO-16 " " " " " "	
6.	AC Stabilizer 220V	2	30KVA	For [C-S] and [N], [O] Determinators
7.	Balance Desk	4	1,100 x 750 x 760 h for electronic balance	
8.	Atomic Absorption & Flame Emission Spectrophotometer	1		Analysis of [Soℓ.Aℓ] and other metallic elements
9.	Manometer	1		Volume compensation of reference gas in determinator
10.	Sample Preparation Devices	1 Unit		
	(1) High-speed cutter (dry		With dust collector	
	(2) Disk-vibration mill			
	(3) Briquette press		30T press	
	(4) Drilling machine			
	(5) Grinder			
	(6) Belter			
	(7) Balance cutter			For cutting 2mmø pin sample
	(8) Rod cutter		Hydraulic	For cutting 5 ∿ 6mmø pin sample
	(9) VS cutter			For shaving chip
	(10) Rough balance		Scale 200g	

FACILITY _____

SPECIFICATION PLAN OF MAIN FACILITIES

NO.	EQUIPMENT	Q'TY	SPECIFICATION	REMARKS
11.	Chemical Analysis Devices	1 Unit		Resolution with acid, vaporizing determination in wet analyzing for analytical balance
	(1) Draft chamber		Frontage: 1,800mm	
	(2) Analyzing bench		2,000 x 750 x 900 h	
	(3) Balance desk		1,100 x 750 x 760 h	
	(4) Distillatory apparatus			
	(5) Centralized gas piping installations		Piping network of gas (Ar, He, N_2, C_2H_2, N_2O, air, etc.)	Collective control of gas in Bombe
12.	Physical and Chemical Appliances for chemical analysis	1 Unit		
	(1) Digital		Wave length: 200 ∿ 850mm	Extinction analysis (ex. Mn, P, etc.)
	(2) pH meter		Range: pH 0 ∿ 14, accuracy: 0.1 pH	pH measurement of waste water, etc.
	(3) Digital balance		SAUTER, scale 200g, sensitivity: 0.9 mg	Precise weighing of samples and reaction products
	(4) Rough balance		Scale 200g	Rough weighting for compounding of chemicals
	(5) Magnetic stirrer		Max. 300°C	Compound stirring of solution in titration
	(6) Shaker of separated funnel			
	(7) Water bath			Isothermal heating of solution in reaction tube
	(8) Aspirator			
	(9) Oil concentration meter		Sensitivity 0.1 ppm	Weight analysis
	(10) Electric muffle furnace		Heating temp.: Max. 1200°C; Timer: 48 hr.	
	(11) Electric isothermal dryer		Heating temp.: Max. 300°C	Dryer for glass appliances and object to be analyzed
	(12) Refrigerator			
	(13) Waste Water Treatment Installation			
13.	Waste Water Treatment Installations	1	Neutralizing/settling treatment	Removing heavy metal
14.	Exhaust Gas Treatment Installations	1	Alkaline shower cleaning	Removing acid gas
15.	Standard Samples for chemical and equipment analysis	1 Set	National Bureau of Standards	

6.13.2 Inspection laboratory

6.13.2.1 General

As a division of the quality control organization governing the entire production plant, the inspection laboratory has a job to supply necessary quality control information.

This laboratory also undertakes the quality guarantee by carrying out specified tests and providing inspection certificates.

Analysis on the material showing abnormality in each process, investigations on complained material, and other researches and studies to enhance quality are also included.

As regards the quality control, basic concept is the independent inspection by each shop to create satisfactory quality. Therefore, dimensional, appearance, and shape inspection belong to each product shop.

6.13.2.2 Material testing items

Material testing items for each product quality in the rod and bar plant is tensile test such as yield point, tensile strength and elongation.

These test items, based on the requirements of Japanese Industrial Standards, are related to the quality guarantee. Comparison table between JIS and AISI in terms of expression of kind of steel is attached as Appendix. (Fig.6.13-3) The figure contains the test items covering the future production of high-grade quality steels.

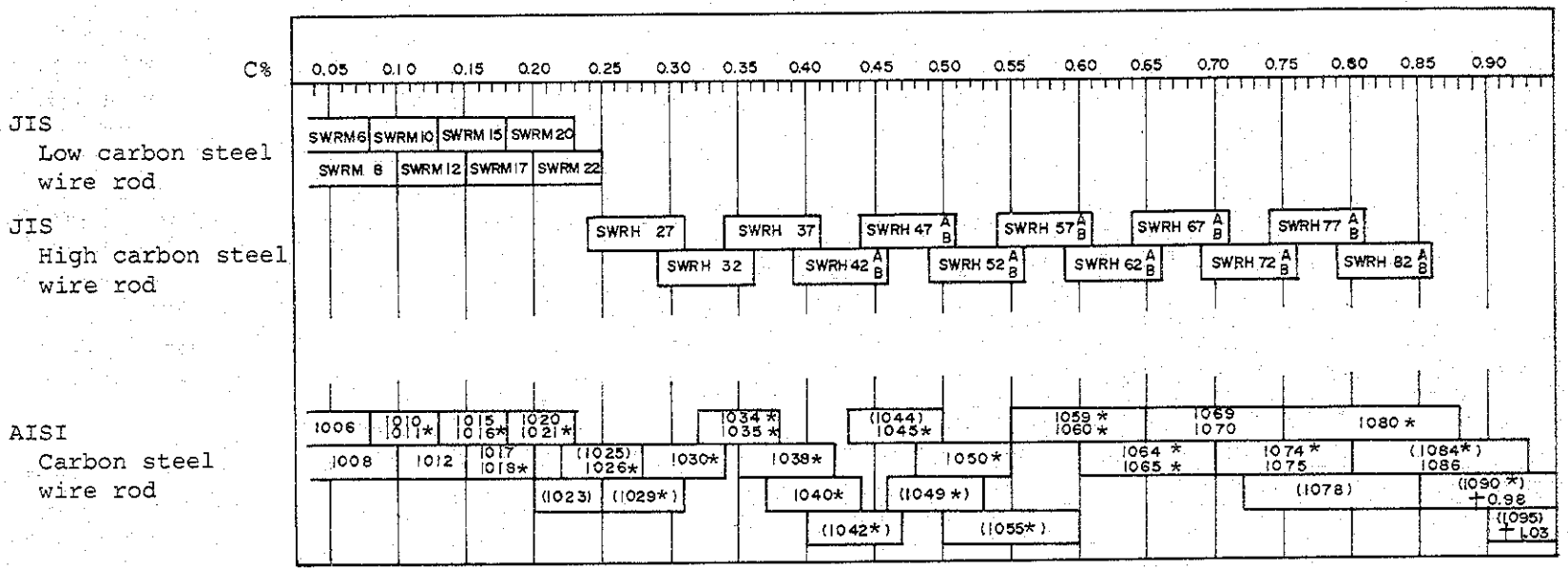
As regards the quality control and improvement, research and study items including the check analysis on sulphur print and segregation in the billet cross section, electro-microscopic testing to analyze control condition of cooling system, etc. must be determined separately.

6.13.2.3 General specification of material testing facilities

Fig.6-13-4 shows the list of required material testing facilities and the general specification.

6.13.3 Fig. 6.13-5 of General Layout shows the analysis and inspection room on the 1st floor and Fig. 6.13-6 shows the layout of staff office on the 2nd floor.

Fig. 6.13-3 COMPARISON TABLE in carbon content of wire rod



( ): SAE
* : High Mn-steel
† : Upper limit

FACILITY INSPECTION LABORATORY

Fig. 6-13-4 SPECIFICATION PLAN OF MAIN FACILITIES

NO.	EQUIPMENT	Q'TY	SPECIFICATION	REMARKS
1	Tensile Testing Machine (1) 100T universal testing machine (2) 20T universal testing machine (3) 5T tensile testing machine (4) 500kg tensile testing machine	4	Hydraulic loading, Electronic self-balancing type Capacity change-over: Min. 5 steps Accuracy: Within ±1% of indicated load Screw-driven loading with constant strain control Capacity change-over: Min. 5 steps Accuracy: Within ±1%	Max. load: Round bar, Dia. = 32φ 65kgf/mm^2(TS) → 52.2T Min. load: Wire, Dia. = 1.6φ 30kgf/mm^2(TS) → 60.3kg
2	Charpy Impact Testing Machine	1	30kgf·m	
3	End Quenching Apparatus	1		
4	Twist Test Machine (1) For large dia. of 3 ∿ 6mmφ (2) For small dia. of 1 ∿ 3mmφ	2	With digital counter Distance between chucks: 500mm, 20rpm Ibid: 200mm, 30rpm	Hardenability test
5	Repeated fatigue Testing Machine	1	Diameter applied: ∿ 5mmφ	
6	Rotary Bending fatigue Test Machine	1	Max. bending moment: 10kgf·m (0.1kgf·m step)	
7	Hardness Tester (1) Brinell hardness tester (2) Vicker's hardness tester (3) Micro-vicker's hardness tester (4) Rockwell hardness tester	4		
8	Microscope (1) Universal projector (2) Optical metallographic microscope (3) Largefield metallographic microscope (4) Scanning electron microscope	4	Magnification: Max. 100 " Max. 1000 " Max. 2000 With spatter coating apparatus Magnification: Max. 40,000 Resolution: 300Å	Austenite grain size test, non-metallic inclusions, measuring decarburized depth and other microscopic testing.

SPECIFICATION PLAN OF MAIN FACILITIES

FACILITY INSPECTION LABORATORY

NO.	EQUIPMENT	Q'TY	SPECIFICATION	REMARKS
9	Non-Destructive Testing Apparatus	2		
	(1) Magnetic particle testing apparatus		Half-wave rectification, magnetizing current: Max. 3500A	
	(2) Ultrasonic flaw detector		Portable type with battery, frequency: 1 ∿ 10MHz with high frequency cables, probes, charger and reference standard blocks	
10	Photographic Appliances	1		
	(1) Camera			
	(2) Printer			
	(3) Expander			
	(4) Washer			
	(5) Dryer of film			
	(6) Dryer of printed paper			
	(7) Rough balance (200gr scale)			
11	Electric Furnace	4	(1) ∿ (3), with programmed control	
	(1) Tubular electric furnace		Heating temp.: Max. 1100°C (1000°C usually)	
	(2) Nitrogen atmospheric furnace		" "	
	(3) Carburizing furance		" Max. 1350°C (1000°C usually)	
	(4) Oil-temper bath		Bath capacity: 250 x 200 x 400h, 20ℓ temp.: ≦300°C usually	
12	Preparation Devices of Specimens for Microscopic Inspection	1		
	(1) Fine cutting machine (wet)			
	(2) Grinder (dry)		2-head type, with dust collector	
	(3) Belt sander (wet)		2-head type	
	(4) Polishing machine			
	(5) Ultrasonic cleaner		Twin type	
	(6) Handy dryer			
	(7) Press for resin molding			

SPECIFICATION PLAN OF MAIN FACILITIES

FACILITY INSPECTION LABORATORY

NO.	EQUIPMENT	Q'TY	SPECIFICATION	REMARKS
13	Machining Facilities of Test Piece	1		
	(1) Band saw machine		Cutting capacity: 250ϕ or 175H x 300W, 2.2KW	Power shows only that of main motor
	(2) High-speed cutter (dry)		Grindstone: 405ϕ x 3.6t x 25.4ϕ, 2.2KW	
	(3) Surface grinder		Working table: 605 x 175W	
			Grindstone: 205ϕ x 196T x 50.8ϕ, 1.1KW	
	(4) Lathe		Stroke 260mm, center distance max. 1,000mm 16 ~ 1,000rpm, 5.5KW	
	(5) Vertical milling machine		Working table: 920 x 240, 1.5KW	
	(6) Horizontal milling machine		" " " "	
	(7) Combination grinder			
	(8) Cutter grinding machine			
14	Draft Chamber	1	Frontage: 1,800mm	Macro-etching test and sulphur print test
15	Heavy Pickling Bath	1	1,000 x 1,200 x 500H, rubber coated	Macro-etching test of billet and ingot
16	1.5T Monorail	1	Travelling distance: 18m	For handling of test material or scrap, and maintenance of machines
17	Waste Water Treatment Installations	1	Neutralizing/settling treatment	For water from heavy pickling, etching, chemicals, polishing rooms and darkrooms
18	Exhaust Gas Treatment Installation	1	Alkaline shower cleaning treatment	For exhaust gas from etching, heavy pickling rooms and darkrooms

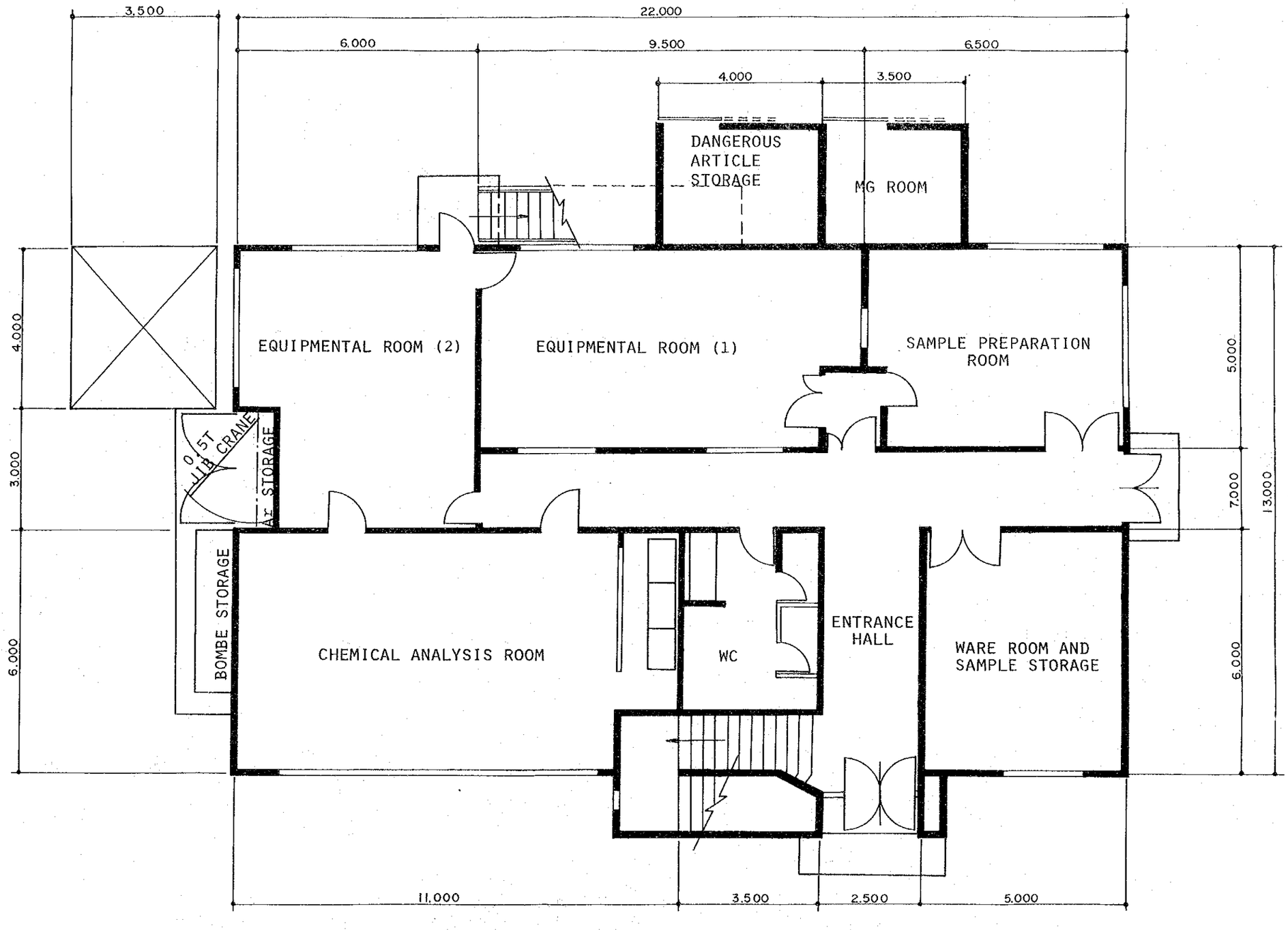


FIG. 6,13-5 ANALYSIS CENTER
1ST FLOOR 1:100

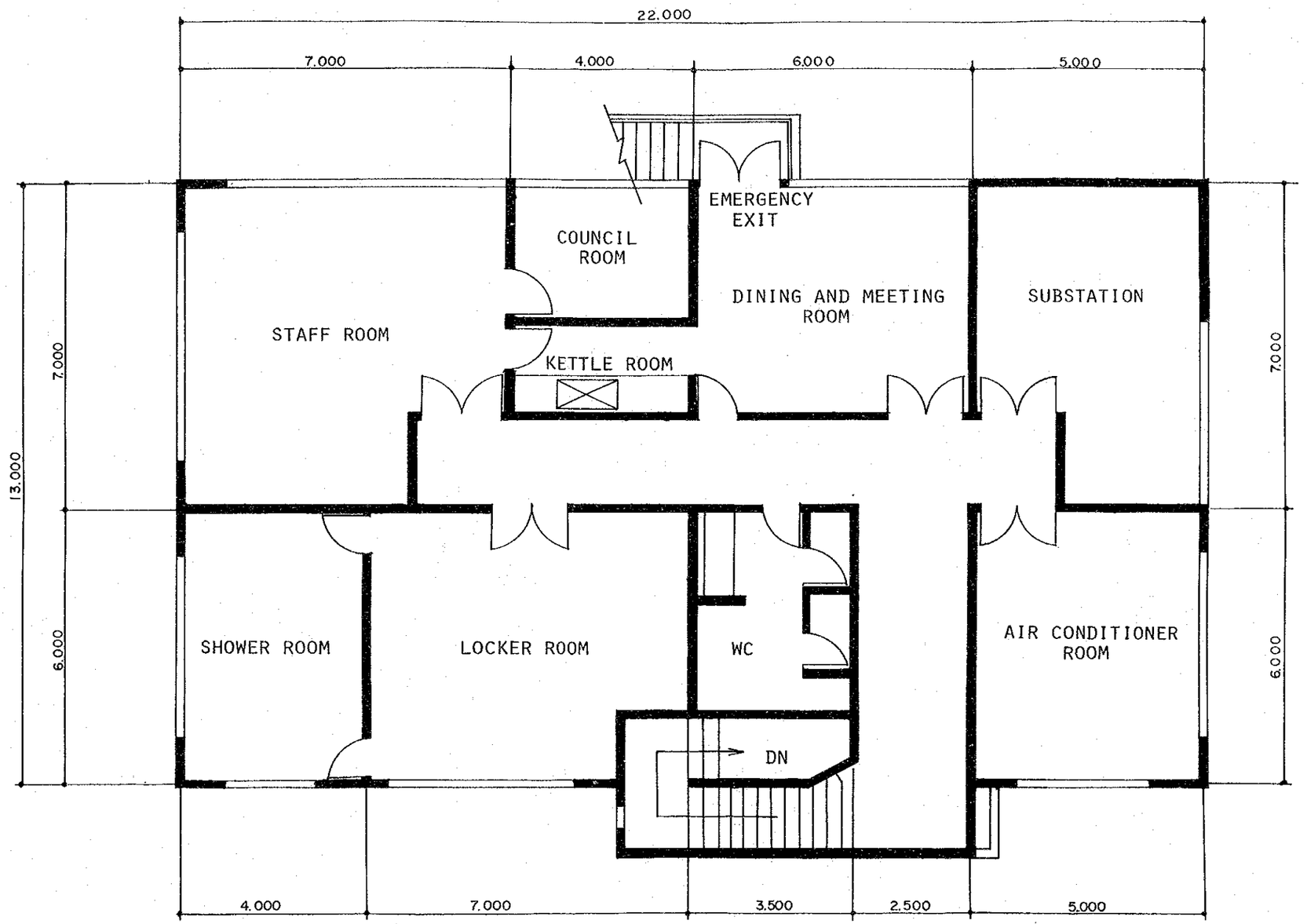


FIG. 6.13-6 ANALYSIS CENTER
2ND FLOOR 1:100

6.14 Warehouse and Shipping Facilities

6.14.1 Presupposition

6.14.1.1 Delivery conditions

To be delivered on the purchaser's car at the warehouse of this plant.

6.14.1.2 Period of stockage

Period of stockage is assumed at max. 21 days for the calculation of yard in compliance with the Memorandum of March 16, 1979. Although in-depth investigation is necessary on the product sales and distribution system by the time this plant is brought into operation.

6.14.1.3 Means of shipment

Judging from the current situation in Egypt, trucks or trailers are presumed to take charge of most of shipment. In any case, necessary arrangement is taken to enable shipment by rail.

6.14.1.4 Loading system for shipment

Times and days for shipment is 7 hours/day during daytime of 25 days/month.

6.14.2 Location of warehouse

For the location of warehouse, following two plans may be considered:

(A) Warehouse located in direct connection to mill-end yard

(B) Warehouse as independent building separated from the mill.

Roll plan for this mill being made by size, reclassification is naturally needed for shipment. In the case of Plan (A), where the warehouse is to be directly connected to mill-end yard, there is possibility that interference is expected between the longitudinal crane operation for transportation of received material and the crane operation for classification or despatching.

Accordingly, sure and effective product control becomes as follows: Namely, only the control by size and product kind is made in the mill-end yard, and the classification by order (for each user) is made together with the primary classification while the product is transported to the warehouse for each destination on the trailer. Secondary classification for each lot is made in the warehouse.

In view of above reason, it is recommended to plan the product shipping warehouse as a separate building.

6.14.3 Warehouse area

Five day's amount of product is stored in the mill-end yard, then required warehouse area is estimated at 27,500 m^2. Refer to Table 6.14-1.

Table 6.14-1 Warehouse area calculation table

Product	Amount of product	Stock-age period	Amount to be stored	Capa-city	Net area	Effec-tive ratio	Required area
	MT/Y	D	MT	$/m^2$	m^2		m^2
Rod	578,400	16	30,848	2	15,424	0.7	22,000
Bar	144,600	16	7,712	2	3,856	0.7	5,500
Total	723,000	16	35,560	2	19,280	0.7	27,500

6.14.4 Warehouse crane

6.14.4.1 Work condition

(A) Product receiving time - 21 H/D

(B) Product dispatching time - 7 H/D

(C) Work peak ratio - 130%

(D) Crane operation ratio - 70%

6.14.4.2 Hook and crane capacity

(A) Rod: Two C-type hooks are provided - parallel to one crane. 3 coils are applied to one hook. Lifting capacity becomes as follows:

2T/coil x 3 coil/hook x 2 hook = 12T/each

To ensure effective operation, the turning-post type with fixed hook is adopted.

(B) Bar: Double-hook crane is equipped with a hook for long product to lift three lots of combined bars.

2T/lot x 3 lot = 6T/each

As the hook weighs 4 ton, crane capacity becomes as follows:

Bar 6T + Crane 4T = 10T (5t + 5t)

6.14.4.3 Crane efficiency

(A) Rod: Lifting capacity - 12T/each

Lot composition ratio - 70%

Cycle time - 6 min/each (10 each/hr)

12T/each x 0.7 x 10each/hr = <u>84T/H</u>

(B) Bar: Lifting capacity - 6T/each

6T/each 0.7 x 10each/H = <u>42T/H</u>

6.14.4.4 Required crane numbers

(A) Rod

a) Crane for receiving

Amount of reception - 1928 T/D

(578400 T/y ÷ 300 D/y)

Peak ratio - 130%

Efficiency - 84 T/H

Crane operation factor - 70%

Receiving time - 21 H/D

$$\frac{1928\ T/D \times 1.3}{84T \times 0.7 \times 21H} = 2.02 \longrightarrow 2$$

b) Crane for despatching

Despatching time - 7 H/D

$$\frac{1928\ T/D \times 1.3}{84T \times 0.7 \times 21H} = 6.09 \longrightarrow 6$$

c) Crane for classification

Cranes for dispatching, when not used, are accommodated.

d) Total

According to above calculations, eight cranes. However, for the sake of layout, nine cranes are to be arranged.

(c.f., Fig. 6.14 - 1)

(B) Bar

a) Crane for receiving

Amount of reception - 482 T/D

(144600 T/y ÷ 300 D/y)

Efficiency - 42 T/H

$$\frac{482\ T/D \times 1.3}{42T \times 0.7 \times 21H} = 1.01 \longrightarrow 1$$

b) Crane for dispatching

$$\frac{482\ T/D \times 1.3}{42T \times 0.7 \times 7H} = 3.04 \longrightarrow 3$$

c) Crane for classification

Same as for the case of rod

d) Total

According to above calculation, total of four cranes.

6.14.5 Layout of product warehouse

6.14.5.1 Size of warehouse for rod

Generally, yard efficiency increases with increasing warehouse width. Considering the construction cost of the crane and building, 40m width is chosen. Less the crane dead space width of 2m (one side) and the forklift passage width of 8m, net warehouse width becomes 30m.

Accordingly, required warehouse length is

$22{,}000\ m^2 \div 30\ m = \underline{730\ m}$

(c.f., Table 6.14 - 1)

6.14.5.2 Size of warehouse for bar

12m long products are stored in two rows in the width direction of warehouse. Products are distance 2m from each other, and crane dead space of 2m width is taken on each side. Therefore, the net warehouse width becomes 30m.

Required warehouse length is

$5{,}500\ m^2 \div 24\ m = \underline{230\ m}$

6.14.5.3 Car passage

To allow two 20t trailers (width: about 3m each) to run side by side, passage width is determined at 10m. For receiving product, one passage is provided. For despatching two passages are provided to enable as may cars as possible to enter in short time.

6.14.5.4 Specific layout

As shown in Fig. 6.14 - 1, specific layout of warehouse is determined as:

40 m x 260 m x 3 warehouses +

30 m x 260 m x 1 warehouse

according to overall considerations on the number of cranes, required width, and length.

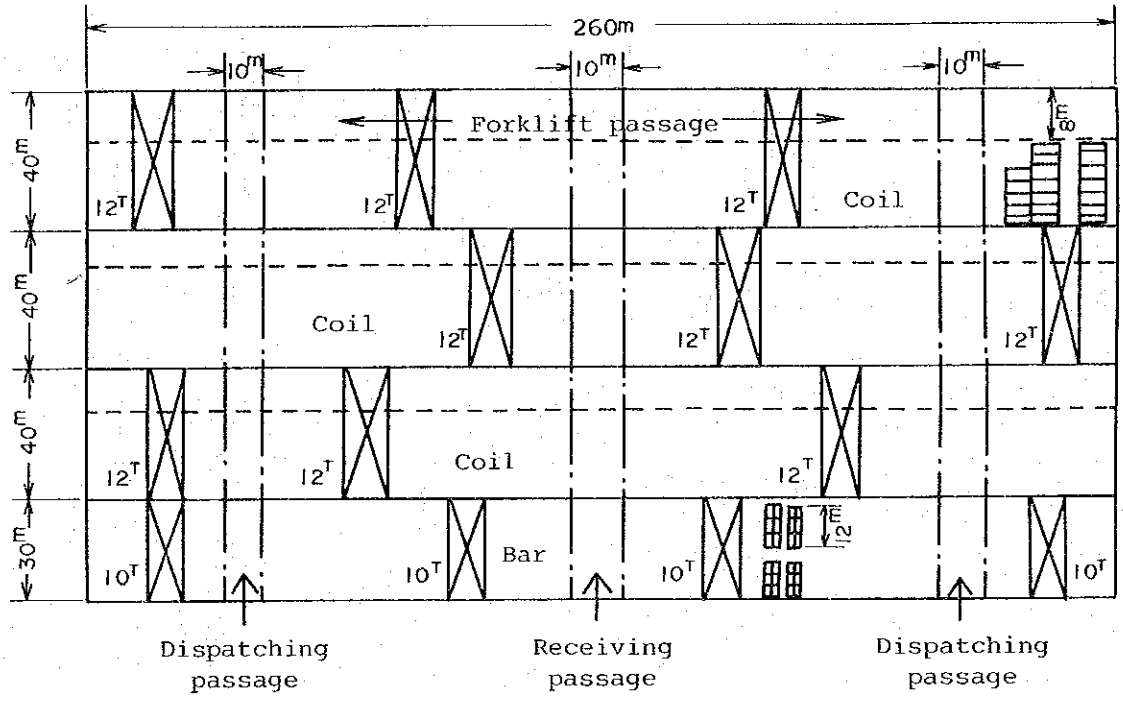


Fig.6.14-1 Warehouse and Shipping Facilities

6.14.6 Forklift

For the case where small vehicles will have to enter the warehouse or to rearrange product which has been transferred to near the passage by crane prior to loading, and handle various materials, forklift are to be prepared.

Specification: With a ram for coils

Capacity - 10T (3 ∿ 4 coil/each)

Number - Four units

6.14.7 Personnel arrangement and work organization

6.14.7.1 Personnel arrangement

According to the layout and capacity of equipment as above discussed, the personnel arrangement becomes as listed on Table 6.14 - 2.

Table 6.14 - 2

Item		1st shift	2nd shift	3rd shift	Total	Remarks
Rod	Number of cranes operated	9	5	5		
	Yard control	3	3	3	9	
	Check	9	5	5	19	
	Crane operation	9	5	5	19	
	Hitching & signalling	9	5	5	19	
	Forklift operation	4	0	0	4	
Bar	Number of cranes operated	4	2	2		
	Yard control	1	1	1	3	
	Check	4	2	2	8	
	Crane operation	4	2	2	8	
	Hitching & signalling	8	4	4	16	
Supervising		1	1	1	3	
Total		52	28	28	108	

6.14.7.2 Work organization

Table 6.14 - 3 shows the work organization for personnel on Table 6.14 - 2.

Table 6.14 - 3 Work organization for warehouse

Foreman	Work class	Group leader		Total
			persons shift	
1 x 3	Yard control	(1 x 3) --	4 x 3	12
	Check	(1 x 3) --	7 x 3	
			6 x 1	29
	Crane	(1 x 3) --	7 x 3	
			6 x 1	27
	Hitching & signalling	(1 x 3) --	9 x 3	
			8 x 1	35
	Forklift	(1 x 3) --	4 x 1	4
1 x 3	Total	(5 x 3)	27 x 3	3
			24 x 1	105

6.14.8 Product shipment by rail

6.14.8.1 Presupposition

Though, under the current situation in Egypt, trucks or trailers are mostly used for the product shipment, necessary arrangement is also taken for the shipment by rail.

6.14.8.2 Railroad within the plant

Railroads of 1400m x 2 lines are laid along the southern boundary of the plant site. Of these, one is for the incoming wagon and its loading while the other for shunting locomotives.

6.14.8.3 Loading method

Products are transferred by the trailer (20 t) from the product warehouse and loaded by the fork-lift (10 t) assigned to the product warehouse.

6.14.8.4 Locomotive

In compliance with the agreement of March 16, 1979, the locomotive of Egypt Railway Authority leads the wagon into the plant site. After returning via the shunting line, the locomotive comes to the site to pull out the loaded wagons.

6.14.9 Table of equipment item

Table 6.14 - 4

No.	Equipment item	Q'ty	Specification
1	Warehouse		
	1) Building	1 set	40m x 260m x 3 warehouses 30m x 260m x 1 warehouse = 39,000 m^2
	2) Overhead travelling crane	13 sets	12T x 12 sets 6T + 6T Double post, Turning post type 10T x 4 sets 5T + 5T Double hook, Operator's cabin fixed on the crane
2	Railway truck	1 set	2800 m
3	Cargo equipment		
	1) Forklift	4 sets	10T type, with ram

Chapter 7 Implementation Plan

7.1 Construction Schedule

Construction schedule referred to here covers the period from the start of this project (i.e., start of basic engineering) up to the operation start, and is estimated to run up to fifty (50) months.

In the construction of an integrated steel plant, the commissioning of direct reduction plant is placed at the center of production plan of the steel plant as a whole.

In this proejct, however, the steelmaking plant is given the leading position in the plan due to following reasons:

a. Different from other principal equipment, the steelmaking operation greatly depends upon the skillfulness of operators, and thus their training must be given the prime concern.

b. Due to tight supply-demand balance for billets in Egypt, there are shortages of 100,000 t/y for National Metal and 10,000 t/y for Delta Steel.

Namely, the start-up of steelmaking plant is planned to be advanced by three months to that of DR plant and the bar and rod mill. During this three-month period, only the scrap is to be used.

Implementation plan is decided on the basis of the following conditions.

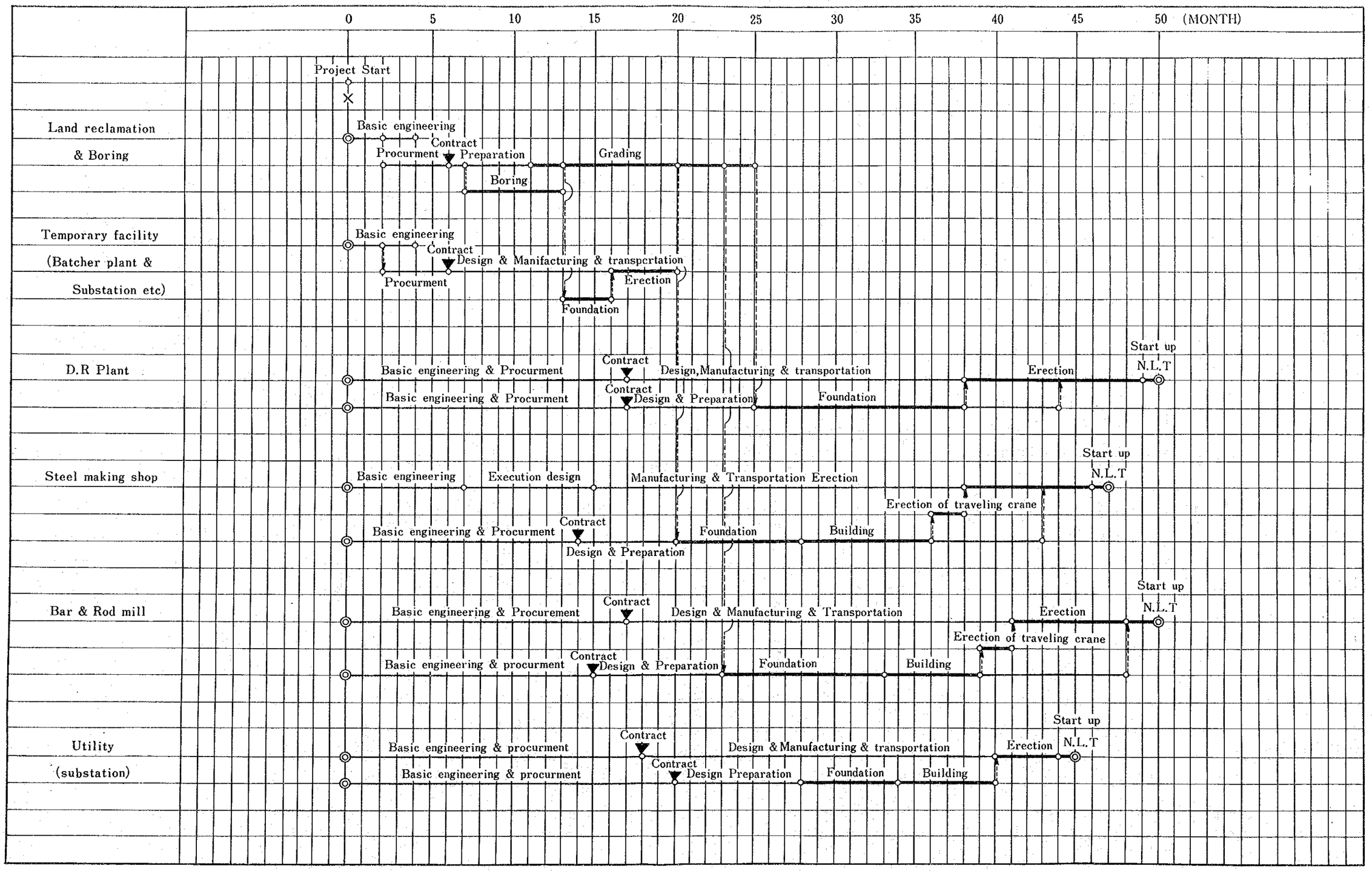
1) Procurement shall be on the basis of international tender or bilateral contract and in packages of plant units. Increase of number of packages has the tendency to increase the time of implementation, although this is not always the rule.

2) Construction should be carried out by the smallest number of contractors, preferably one but not more than three.

3) "Bill of Quantities Contract" method shall be considered for the implementation phase.

Table 7.1-1 shows the construction schedule. The table is applied only to the land preparation, temporary construction equipment, DR plant, steelmaking plant, bar and rod mill, and utility. Schedule for auxiliary equipment is shorter than that for primary equipment, and thus does not affect the construction schedule as a whole.

Table 7.1-1 EL-Dikheila Project Construction schedule



7.2 Request addressed to Special Committee in performing the Project

7.2.1 Construction schedule as shown on Table 7.1-1 applies only to the work within the plant, following infrastructural conditions must be adjusted so that this schedule can be kept correctly.

1) Within 11 months after the project start, disposal area for surplus soil (which is caused by site grading) and the access way for transportation dump truck must be secured. Soil to be discharged by grading amounts to 4.5 million m^3 (total).

   240 11-ton dump truck will go and return per hour in average.

2) Within 11 months after the project start, re-routing of a part of road running along the north side of site must be completed to remove the interference with the site location.

3) Within 17 months after the project start, and yet within three months before starting the foundation work for steelmaking plant, temporary drinking water facility and temporary power cable up to the site for the construction work should be completed.

4) Within 20 months after the project start, the foundation work for the steelmaking plant will be started which causes increase in the amount of construction material transferred into the site. By this time, the reconstruction of Alexandria - Matrouh Road to the north of site must be completed.

5) Within 41 months after the project start, and yet within 6 months before start-up of steelmaking plant, stock of scrap must be started. Accordingly, scrap berth of mineral jetty and scrap transportation road up to site must be completed.

6) Within 44 months after the project start, and yet within 6 months before the start-up of DR plant, stock of oxide pellet or iron ore will be started. By this time, the mineral jetty, unloader, stacker, ore yard, reclaimer, and belt conveyor must be completed.

7) Within 45 months after the project start, and yet within 2 months before the start-up of steelmaking plant, permanent electrical, drinking water, natural gas facilities must be completed to ensure stable supply of these utilities for the trial operation and operation.

8) Within 48 months after the project start, and yet within 2 months before the start-up of bar and rod mill, the railroad for product shipment must be completed to enable to ship the product from hot run test.

9) Import and unloading work for construction machinery, steel structures, and equipments will be started in about 8 months after the project start and reaches a peak during the period from 17 to 47 months. Delay in the transportation work causes directly the delay in the progress of the project. In particular, due attention should be paid to prevent the transportation work of this project from being hampered by the reconstruction of Alexandria Port and the new port construction.

7.3 Additive Study on Delay of Construction by One Year

JICA intended to study two following case on delay of construction by one year in accordance with memorandum of June 25, 1979.

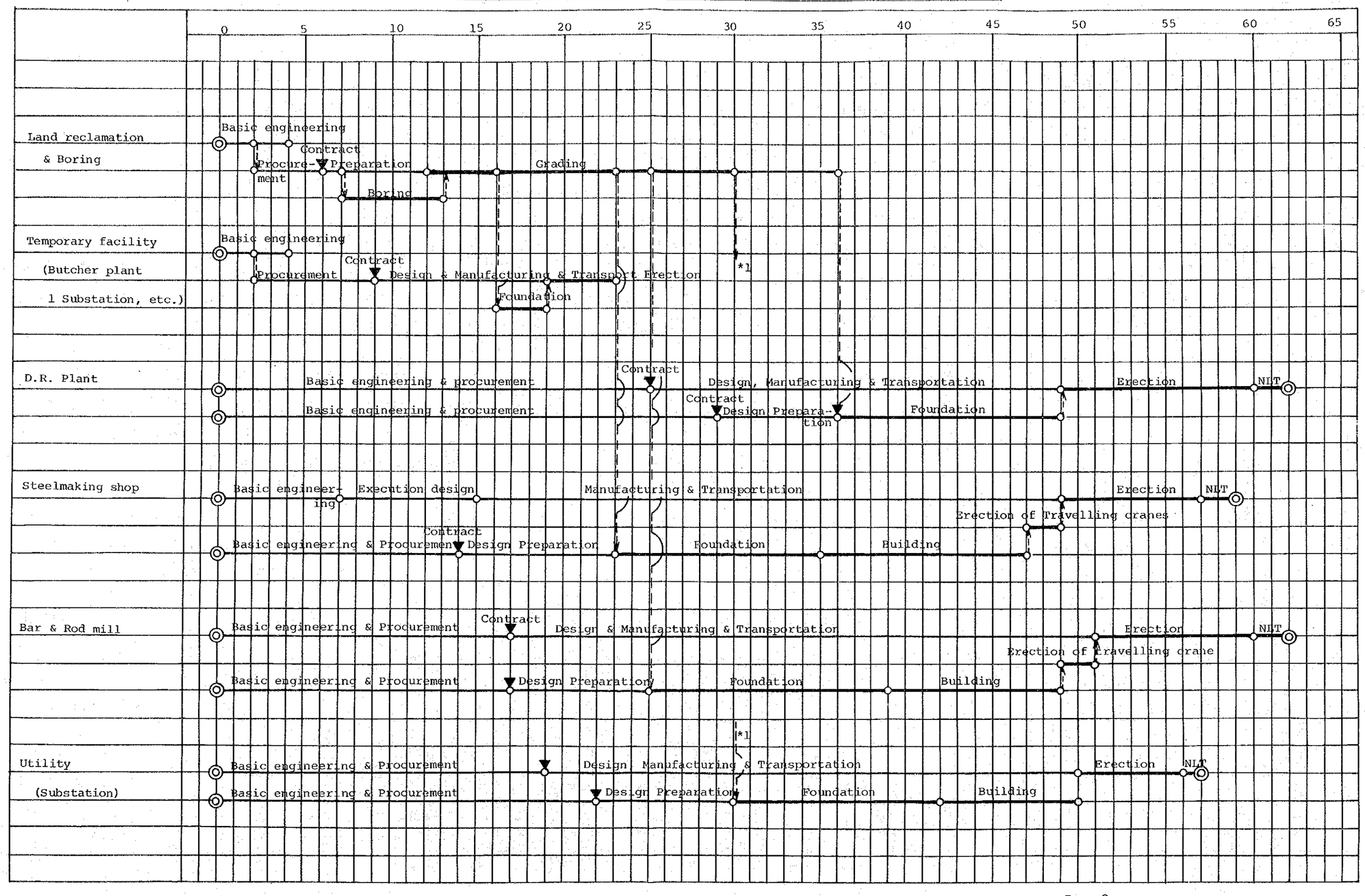
1) Dealy of only land preparation by one year.

2) Delay of total construction by one year.

After the study of the above two cases, there is

little defference between two cases. So Financial study on 2) is only carried out. Implementation schedule in case of delay is shown in Table 7.3-1. As for financial analysis, please refer to Chapter 11.

Table 7.3-1 Alternative Construction Schedule - One year delay



Chapter 8 Estimation of Personnel Requirement Organization, Training and Technical Assistance Plan

8.1 Company Organization

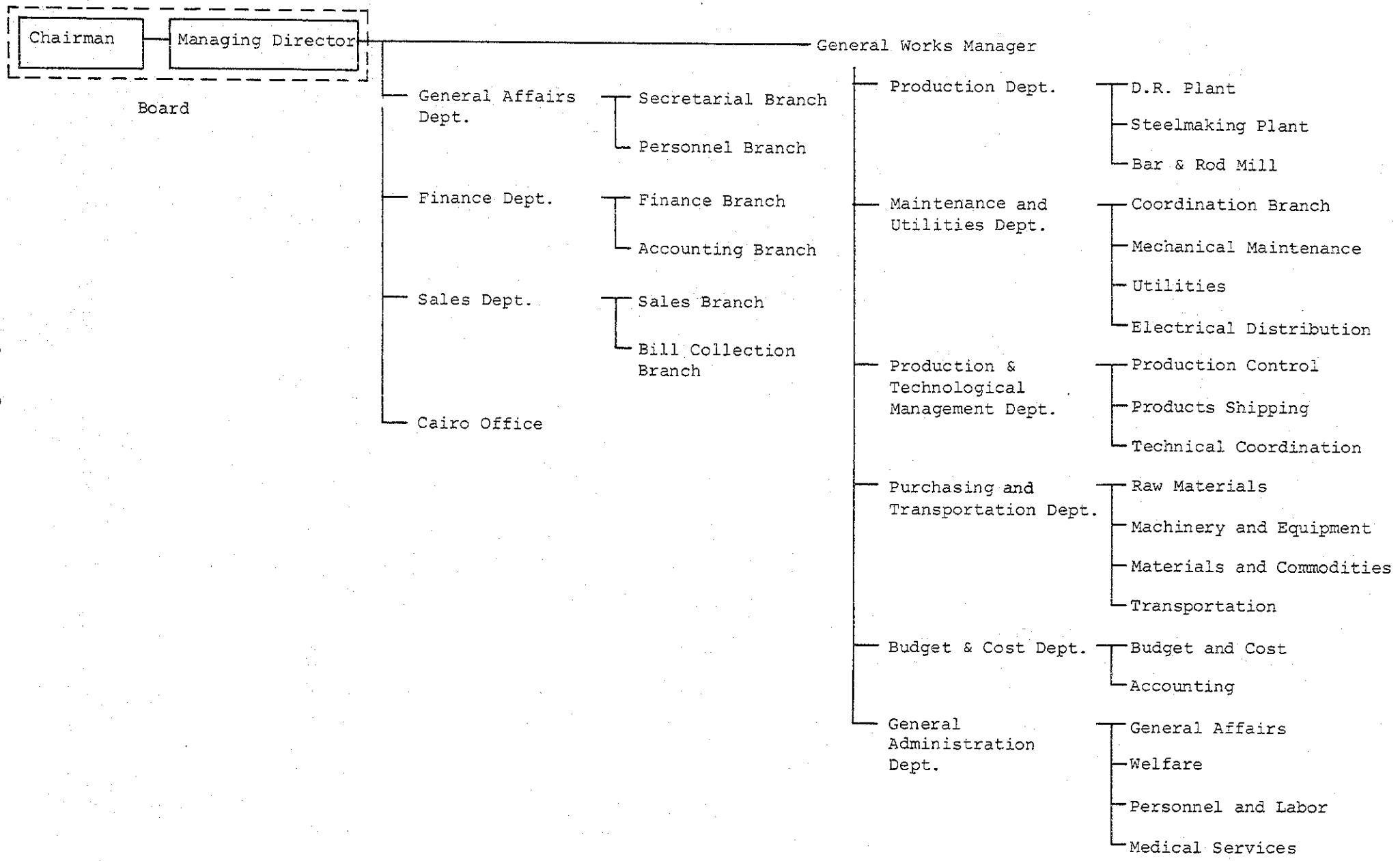
For this project, whose target is set at 800,000 t/y on the crude steel base to produce principally round bar for reinforcing bar, simple and small-scale company organization is enough. Since the product sales activity is made under the control of distribution bureau subject to the Ministry of Housing, only the minimum required business and bill collection organization is required of the company.

Head office and main organization are located in the works while the liaison office in charge of coordination with the Government Agencies is established in Cairo.

The works organization includes a direct procuction department, supporting maintenance and utility department, and administrative department.

Table 8 - 1 shows the company organization.

Table 8-1 Organization



8.2 Personnel Requirement Plan

Table 8-2 shows the personnel requirement in the head office and Table 8-3 the personnel requirement in the works.

Total personnel requirement amounts to 1801.

Where the branch employing
4-crew system is adopted.

Table 8-2 Head Office Personnel

Department	Section	Manager	Super-intendent	Assistant super-intendent	Office staff
Administration	Secretary	1	1	1	3
	Personnel		1	1	2
Finance	Accounting	1	1	1	3
	Finance		1	1	1
Sales	Sales	1	1	1	3
Cairo office	-	1	2	2	6
Total		4	7	7	18/36

Board Member: 10 excluded in the above personnel.

Table 8-3 Manpower for Steelmaking Plant

Department	Section or Plant	Manager	Super-intendent	Assistant Super-intendent	Engineer	Office Staff	Worker	Subtotal
General Administration	General Affairs	1	1	2	-	8 (3)	-	11
	Welfare		1	2	-	8 (2)	-	11
	Medical Service		1	1	-	4 (3)	-	6
	Personnel and Labor		1	3	-	13 (3)	-	18/46
Budget and Cost	Budget and Cost	1	1	2	-	8 (2)	-	11
	Accounting		1	1	-	7 (2)	-	10/21
Purchasing & Transportation	Raw Material	1	1	2	-	3 (1)	-	6
	Machinery and Equipment		1	2	-	6 (2)	15	24
	Materials and Commodities		1	2	-	6 (2)		9
	Transportation		1	2	-	7 (2)	112	123/162
Production & Technological Management	Production Control	1	1	4	6	11 (5)	8	30
	Shipping		1	2	1	5 (2)	108	117
	Technical Control		1	4	9	6 (4)	41	62/209
Production	D R Plant	1	1	2	10	2 (1)	37	52
	Steelmaking Plant		1	3	7	8 (2)	483	502
	Bar and Roll Mill		1	2	8	6 (2)	263	281/835
Maintenance and Utilities	Coordination	1		1	2	3 (1)	-	6
	Mechanical Maintenance		1	6	24	14 (3)	322	367
	Utility		1	2	4	5 (2)	61	73
	Electric Power		1	2	2	5 (1)	35	46/492
Total		6	19	47	73	135	1,485	1,765

8.3 Training Plan

8.3.1 General training plan is aimed at technical skill training. However, in this project that is one of the first private steel manufacturing business, in Egypt, training relating to company management such as raw material supply, accounting, production cost calculation and sales structure is required along with technical skill training.

A training method includes

1) Training by means of the handling and operation manuals which will be submitted at the construction phase by the manufacturers concerned,
2) Abroad training,
3) Training through technical assistance after start-up operation.

Among these, 2) Abroad training is useful in terms of production flow, equipment features, etc. and establishment of good human relation if the company which gives technical assistance after start-up do training overseas. But the company that receives trainees generally does not allow them on the job training to operate handles, depress buttons, etc. since they execute commercial operation. Since there are problems in language and custom

and it is not effective for its expenditures, it should be limited to key persons. It is recommended that training for workers in El Dikheila Works is made by themselves placing emphasis on trainings in paras 1) and 3) with assistance by foreign steel manufacturers.

8.3.2 Abroad training

As described above, this training is conducted for managers and superintendents. It is most effective to dispatch key persons to the country of the company which will execute engineering services in the project, and adopt class room system in which explanation and discussion are made for each facility and equipment at the time when basic plan and purchasing specifications are prepared.

In addition 1 - 2 years before the start-up, the Works that operate DR-EAF Route i.e. QASCO, SIDOR, etc. are to be visited by the trainees.

Then witnessing the equipment installation and trainings by handling and operation manuals submitted by manufacturers are made on the job site basis.

The JICA proposals on abroad training are shown in Table 8-4.

Table 8-4 Abroad training plan

	Construction Phase			
	1 ∿ 12 months	13 ∿ 24 months	25 ∿ 36 months	37 ∿ 48 months
Production Dept.	4 Mos. DR EF B & R		2 Mos.	
Maintenance and Utilities	Elect. 2 Mos. Maint. Utility		2 Mos.	
Production and Technical Affairs Dept.	Production Shipping		2 Mos.	
Purchasing and Transportation Dept.	4 Mos. 3 Mos. Purchasing		1 Mo.	On the job training
Budget and Cost Dept.	4 Mos. Budget			
Financial Dept.		1 Mo.		
Sales Dept.				
Civil & Building	2 Mos. Civil 2 Mos. Building			

Remarks: —— Class

--- Visit to works

\\\\\ On the job training

8.3.3 On the job training

Training for workers shall be on the job basis as a rule. Key workers who lead operation such as foremen, assistant foremen, group leaders, etc. are to be employed 1 - 1.5 years prior to the start-up so as to receive training. Workers are employed no later than 6 months before the start-up.

Guidance for on the job training is described in the next paragraph "Technical Assistance."

8.4 Proposals Relating to Technical Assistance Plan

8.4.1 Facility and equipment planned to be used in this project rank among the highest in the world at present. In addition the rating up plan to reach the full nominal capacity in one year and to achieve target production (117% of nominal capacity for DR Plant) in 2 years is exceptionally ambitious. The above rating up plan is found only in a Korean POSCO project. Also, this project of DR-EAF Route is first in Egypt and to achieve this plan it is suggested that not only technical assistance but also management assistance with experienced able staff be executed by the foreign steelworks.

8.4.2 Proposal for technical assistance plan

Technical assistance is to be done beginning 1 - 2 years before the start-up and contents of technical assistance are as follows:

1) Detailed examination relating to company's organization and management
2) Preparation of provisions and standards
3) Witness of no-load and on-load test of various units and examination of problems related thereto
4) Preparation of operational matters
5) Operational assistance before and after start-up (3 shifts and/or day time)
6) Operation (3 shifts and/or day time) etc.

Technical assistance is to be done on man-to-man basis or on one-trainer to plural trainee basis.

For 2 - 3 years after start-up the trainers are to attend and give guidance on the line.
However, the company that gives training will transfer the posts to the employees trained gradually, based upon the skillfulness of the workers.

JICA proposals related to technical assistance are as shown in Table 8-5.

Table 8-5 Personnel Requirement for Technical Assistance

Dept. \ Year	-2		-1		1	2	3	4	5	6
1. Head office		1	1	3	6	6	4	4	3	3
2. Works										
General works manager		1	1	1	1	1	1	1	1	1
General administration		1	1	2	4	4	4	3	2	2
Budget and cost		-	-	2	4	4	3	2	1	1
Purchasing and transportation		1	1	6	9	8	7	5	4	3
Production and technological control		1	1	8	17	9	6	6	4	4
Production: DR-plant		2	2	7	13	13	7	7	4	4
Production: Steelmaking plant		2	2	15	31	31	25	25	8	8
Production: Bar and rod mill		2	2	10	25	25	16	16	8	8
Maintenance and utilities		4	4	15	30	30	20	20	18	8
Total	-	15	15	70	140	131	93	89	53	42

Chapter 9 Estimation of Capital Cost

This chapter estimates the direct capital cost and accompanying indirect cost required for the construction of the new works. In addition, these capital costs have been classified into equipment CIF price, installation cost, civil work cost and erection cost.

9.1 Basic concept for direct capital cost

Capital cost calculation is based on the following basic concepts; first calculated without considering price escalation then considering it.

9.1.1 Classification of import and domestic procurement is as follows:

1) Equipment to be purchased: Import

2) Site work: Domestic

3) Construction material: Import, except for ballast, sand, red brick which can be procured domestically. Of steel structures to be procured, about 3,000 tons will be supplied in Egypt.

9.1.2 Base for estimation

1) Equipment to be purchased

Estimation for equipment to be purchased (including spare parts for one year) is based on the international price level as of March, 1979, and calculated on the CIF Egypt basis. It is also assumed that tariffs, etc. are exempted according to Law 43.

2) Erection and installation cost

This cost at site is estimated on the basis of cost prevailing in the first half of 1979 and data in Egypt.

3) Construction material cost

Construction material is classifed according to 9.1.1. For those to be imported, estimation is made on the basis of international price level as of March, 1979 same as 1) above and calculated on the CIF Egypt basis.

4) Currency and exchange rate

Estimation is made basically on Yen-basis and partially on Egyptian-Pound basis, and converted into US dollars. Exchange rate is US$1 = £E0.70 = ¥200. Due attention should be paid to the fluctuation of exchange rate.

5) Price escalation rate

For price escalation rate the following values are adopted.

	1979	1980	After 1981 and onward
International price standard	7%	7%	7%
Domestic price standard in Egypt	15%	12%	9%

(Per memorandum signed between SC and JICA on June 25, 1979)

6) Capital cost classified into foreign and domestic currency without considering price escalation is shown in Table 9.1 and one classified into equipment CIF price, erection and installation cost, civil work cost and erection cost in Table 9.3. Also capital cost with price escalation considered is shown in Tables 9.2 and 9.4.

Table 9-1 Estimate of capital cost - without escalation

Unit: $1,000

Facility	Foreign currency	Local currency	Total
Land reclamation	5,250	10,500	15,750
DR plant	65,435	7,230	72,665
Steelmaking plant	103,230	19,759	122,989
Bar and rod mill	111,265	24,965	136,230
Calcining plant	5,409	629	6,038
Power distribution (Incld. communication)	22,749	6,522	29,271
Transportation (Incld. products shipping)	18,334	10,270	28,604
Utilities	22,149	5,851	28,000
Oxygen	2,925	360	3,285
Maintenance shop	8,336	2,813	11,149
Analysis and inspection	2,441	475	2,916
Administration office	1,166	1,084	2,250
Engineering fee	34,000	-	34,000
Contingency	36,000	9,000	45,000
Total	438,689	99,458	538,147

Table 9-2 Estimate of capital cost - with escalation

Unit: $1,000

Facility	Foreign currency	Local currency	Total
Land reclamation	6,580	11,825	18,405
DR plant	80,030	10,605	90,635
Steelmaking plant	125,250	27,715	152,965
Bar and rod mill	134,945	36,735	171,680
Calcining plant	6,595	870	7,465
Power distribution (Incld. communication)	27,690	9,135	36,825
Transportation (Incld. products shipping)	23,165	14,775	37,940
Utilities	27,210	8,175	35,385
Oxygen	3,565	505	4,070
Maintenance shop	10,150	3,915	14,065
Analysis and inspection	2,985	665	3,650
Administration office	1,400	1,485	2,885
Engineering fee	40,550	-	40,550
Contingency	44,400	11,100	55,500
Total	534,515	137,505	672,020

Table 9-3 BREAKDOWN OF CAPITAL COST — WITHOUT ESCALATION

(Unit: US$ 1,000)

	Foundation			Building			Facility of Equipment					Total Cost	
	Quantity		Cost	Quantity		Cost	Quantity		Cost C.I.F.	Cost Installation	Cost Sub-Total		
Land Reclamation	Excavation 5,250,000m³		Foreign 5,250			-		Foreign	-	-	-	Foreign	5,250
	Fill 750,000m³		Local 10,500			-		Local	-	-	-	Local	10,500
	Surplus Soil 4,500,000m³		Sub-Total 15,750			-		Sub-Total	-	-	-	Total	15,750
	(G.L=M.S.L+7.0M)												
DR Plant	Concrete	9,500m³	Foreign 2,630	Steel Structure	95t	Foreign 420		Foreign	57,225	5,160	62,385	Foreign	65,435
	Re-Bar	855t	Local 2,290	Roofing & Siding	3,800m²	Local 365	8,118t	Local	-	4,575	4,575	Local	7,230
			Sub-Total 4,920	Concrete	560m³	Sub-Total 785		Sub-Total	57,225	9,735	66,960	Total	72,665
Steel Making Plant	Concrete	27,000m³	Foreign 8,065	Steel Structure	5,320t	Foreign 13,030		Foreign	74,955	7,180	82,135	Foreign	103,230
	Re-Bar	1,740t	Local 8,130	Roofing & Siding	52,070m²	Local 4,730	17,218t	Local	-	6,899	6,899	Local	19,759
			Sub-Total 16,195	Concrete	3,560m³	Sub-Total 17,760		Sub-Total	74,955	14,079	89,034	Total	122,989
Bar and Rod Mill	Concrete	55,000m³	Foreign 15,230	Steel Structure	5,700t	Foreign 14,825		Foreign	75,870	5,340	81,210	Foreign	111,265
	Re-Bar	3,850t	Local 12,845	Roofing & Siding	93,800m²	Local 5,600	11,090t	Local	-	6,520	6,520	Local	24,965
			Sub-Total 28,075	Concrete	70m³	Sub-Total 20,425		Sub-Total	75,870	11,860	87,730	Total	136,230
Calcining Plant	Concrete	1,500m³	Foreign 440	Steel Structure	190t	Foreign 385		Foreign	4,445	139	4,584	Foreign	5,409
	Re-Bar	135t	Local 265	Roofing & Siding	2,530m²	Local 235	1,198t	Local	-	129	129	Local	629
			Sub-Total 705	Concrete	170m³	Sub-Total 620		Sub-Total	4,445	268	4,713	Total	6,038
Power Distribution	Concrete	8,000m³	Foreign 2,055	Steel Structure	- t	Foreign 890		Foreign	16,920	2,884	19,764	Foreign	22,749
(Incld. Communication)	Re-Bar	560t	Local 2,280	Roofing & Siding	8,430m²	Local 980	825t	Local	-	3,262	3,262	Local	6,522
			Sub-Total 4,335	Concrete	3,000m³	Sub-Total 1,870		Sub-Total	16,920	6,146	23,026	Total	29,271
Transportation	Concrete	8,500m³	Foreign 3,610	Steel Structure	4,200t	Foreign 7,525		Foreign	6,700	499	7,199	Foreign	18,334
(Incld. Products Shipping)	Re-Bar	510t	Local 3,350	Roofing & Siding	80,000m²	Local 6,645	-	Local	-	275	275	Local	10,270
			Sub-Total 6,960	Concrete	- m³	Sub-Total 14,170		Sub-Total	6,700	774	7,474	Total	28,604
Utilities	Concrete	15,500m³	Foreign 4,480	Steel Structure	95t	Foreign 325		Foreign	14,090	3,225	17,315	Foreign	22,149
	Re-Bar	1,365t	Local 3,895	Roofing & Siding	3,440m²	Local 280	4,269t	Local	-	1,676	1,676	Local	5,851
			Sub-Total 8,375	Concrete	355m³	Sub-Total 605		Sub-Total	14,090	4,931	18,991	Total	28,000
Oxygen	Concrete	400m³	Foreign 135	Steel Structure	75t	Foreign 205		Foreign	2,285	300	2,585	Foreign	2,925
	Re-Bar	5t	Local 75	Roofing & Siding	1,830m²	Local 110	194t	Local	-	175	175	Local	360
			Sub-Total 210	Concrete	- m³	Sub-Total 315		Sub-Total	2,285	475	2,760	Total	3,285
Maintenance Shop	Concrete	6,000m³	Foreign 1,755	Steel Structure	1,080t	Foreign 3,205		Foreign	3,090	286	3,376	Foreign	8,336
	Re-Bar	540t	Local 945	Roofing & Siding	20,110m²	Local 1,715	417t	Local	-	153	153	Local	2,813
			Sub-Total 2,700	Concrete	1,315m³	Sub-Total 4,920		Sub-Total	3,090	439	3,529	Total	11,149
Analysis and Inspection	Concrete	500m³	Foreign 125	Steel Structure	- t	Foreign 295		Foreign	1,930	91	2,021	Foreign	2,441
	Re-Bar	45t	Local 130	Roofing & Siding	1,420m²	Local 305	36t	Local	-	40	40	Local	475
			Sub-Total 255	Concrete	585m³	Sub-Total 600		Sub-Total	1,930	131	2,061	Total	2,916
Administration Office	Concrete	1,000m³	Foreign 291	Steel Structure	- t	Foreign 875		Foreign	-	-	-	Foreign	1,166
	Re-Bar	90t	Local 269	Roofing & Siding	2,000m²	Local 815	-	Local	-	-	-	Local	1,084
			Sub-Total 560	Concrete	1,200m³	Sub-Total 1,690		Sub-Total	-	-	-	Total	2,250
Total	Concrete	132,900m³	Foreign 44,066	Steel Structure	16,755t	Foreign 41,980		Foreign	257,509	25,134	282,643	Foreign	368,689
	Re-Bar	9,695t	Local 44,974	Roofing & Siding	269,430m²	Local 21,780	-	Local	-	23,704	23,704	Local	90,458
			Total 89,040	Concrete	10,815m³	Total 63,760		Total	257,509	48,838	306,347	Total	459,147
Engineering Fees												Foreign	34,000
												Local	-
												Total	34,000
Contingency												Foreign	36,000
												Local	9,000
												Total	45,000
Grand Total												Foreign	438,689
												Local	99,458
												Total	538,147

Table 9-4 BREAKDOWN OF CAPITAL COST—WITH ESCALATION (Unit: US$ 1,000)

	Foundation			Building			Facility of Equipment					Total Cost	
	Quantity		Cost	Quantity		Cost	Quantity		Cost C.I.F.	Cost Installation	Cost Sub-Total		
Land Reclamation	Excavation 5,250,000m³		Foreign 6,580			–		Foreign	–	–	–	Foreign	6,580
	Fill 750,000m³		Local 11,825			–		Local	–	–	–	Local	11,825
	Surplus Soil 4,500,000m³		Sub-totll 18,405			–		Sub-Total	–	–	–	Total	18,405
	(G.L=M.S.L+7.0M)												
DR Plant	Concrete	9,500m³	Foreign 3,275	Steel Structure	95t	Foreign 535		Foreign	69,460	6,760	76,220	Foreign	80,030
	Re-Bar	855t	Local 3,080	Roofing & Siding	3,800m²	Local 550	8,118t	Local	–	6,975	6,975	Local	10,605
			Sub-Total 6,355	Concrete	560m³	Sub-Total 1,085		Sub-Total	69,460	13,735	83,195	Total	90,635
Steel Making Plant	Concrete	27,000m³	Foreign 9,720	Steel Structure	5,320t	Foreign 15,625		Foreign	90,715	9,190	99,905	Foreign	125,250
	Re-Bar	1,740t	Local 11,145	Roofing & Siding	52,070m²	Local 6,385	17,218t	Local	–	10,185	10,185	Local	27,715
			Sub-Total 20,865	Concrete	3,560m³	Sub-Total 22,010		Sub-Total	90,715	19,375	110,090	Total	152,965
Bar and Rod Mill	Concrete	55,000m³	Foreign 18,395	Steel Structure	5,700t	Foreign 17,790		Foreign	93,015	5,745	98,760	Foreign	134,945
	Re-Bar	3,850t	Local 17,695	Roofing & Siding	93,800m²	Local 7,635	11,090t	Local	–	11,405	11,405	Local	36,735
			Sub-Total 36,090	Concrete	70m³	Sub-Total 25,425		Sub-Total	93,015	17,150	110,165	Total	171,680
Calcining Plant	Concrete	1,500m³	Foreign 535	Steel Structure	190t	Foreign 465		Foreign	5,425	170	5,595	Foreign	6,595
	Re-Bar	135t	Local 365	Roofing & Siding	2,530m²	Local 325	1,198t	Local	–	180	180	Local	870
			Sub-Total 900	Concrete	170m³	Sub-Total 790		Sub-Total	5,425	350	5,775	Total	7,465
Power Distribution	Concrete	8,000m³	Foreign 2,545	Steel Structure	–	Foreign 1,040		Foreign	20,545	3,560	24,105	Foreign	27,690
(Incld. Communication)	Re-Bar	560t	Local 3,230	Roofing & Siding	8,430m²	Local 1,300	825t	Local	–	4,605	4,605	Local	9,135
			Sub-Total 5,775	Concrete	3,000m³	Sub-Total 2,340		Sub-Total	20,545	8,165	28,710	Total	36,825
Transportation	Concrete	8,500m³	Foreign 4,550	Steel Structure	4,200t	Foreign 9,360		Foreign	8,615	640	9,255	Foreign	23,165
(Incld. Products	Re-Bar	510t	Local 4,855	Roofing & Siding	80,000m²	Local 9,480	–	Local	–	440	440	Local	14,775
Shipping)			Sub-Total 9,405	Concrete	– m³	Sub-Total 18,840		Sub-Total	8,615	1,080	9,695	Total	37,940
Utilities	Concrete	15,500m³	Foreign 5,455	Steel Structure	95t	Foreign 395		Foreign	17,095	4,265	21,360	Foreign	27,210
	Re-Bar	1,365t	Local 5,415	Roofing & Siding	3,440m²	Local 395	4,269t	Local	–	2,365	2,365	Local	8,175
			Sub-Total 10,870	Concrete	355m³	Sub-Total 790		Sub-Total	17,095	6,630	23,725	Total	35,385
Oxygen	Concrete	400m³	Foreign 165	Steel Structure	75t	Foreign 250		Foreign	2,775	375	3,150	Foreign	3,565
	Re-Bar	5t	Local 110	Roofing & Siding	1,830m²	Local 145	194t	Local	–	250	250	Local	505
			Sub-Total 275	Concrete	– m³	Sub-Total 395		Sub-Total	2,775	625	3,400	Total	4,070
Maintenance Shop	Concrete	6,000m³	Foreign 2,200	Steel Structure	1,080t	Foreign 3,840		Foreign	3,750	360	4,110	Foreign	10,150
	Re-Bar	540t	Local 1,350	Roofing & Siding	20,110m²	Local 2,350	417t	Local	–	215	215	Local	3,915
			Sub-Total 3,550	Concrete	1,315m³	Sub-Total 6,190		Sub-Total	3,750	575	4,325	Total	14,065
Analysis and Inspection	Concrete	500m³	Foreign 150	Steel Structure	– t	Foreign 355		Foreign	2,365	115	2,480	Foreign	2,985
	Re-Bar	45t	Local 190	Roofing & Siding	1,420m²	Local 415	36t	Local	–	60	60	Local	665
			Sub-Total 340	Concrete	585m³	Sub-Total 770		Sub-Total	2,365	175	2,540	Total	3,650
Administration Office	Concrete	1,000m³	Foreign 335	Steel Structure	– t	Foreign 1,065		Foreign	–	–	–	Foreign	1,400
	Re-Bar	90t	Local 345	Roofing & Siding	2,000m²	Local 1,140	–	Local	–	–	–	Local	1,485
			Sub-Total 680	Concrete	1,200m³	Sub-Total 2,205		Sub-Total	–	–	–	Total	2,885
Total	Concrete	132,900m³	Foreign 53,905	Steel Structure	16,755t	Foreign 50,720		Foreign	313,760	31,180	344,940	Foreign	449,565
	Re-Bar	9,695t	Local 59,605	Roofing & Siding	269,430m²	Local 30,120	–	Local	–	36,680	36,680	Local	126,405
			Total 113,510	Concrete	10,815m³	Total 80,840		Total	313,760	67,860	381,620	Total	575,970
Engineering Fees												Foreign	40,550
												Local	–
												Total	40,550
Contingency												Foreign	44,400
												Local	11,100
												Total	55,500
Grand Total												Foreign	534,515
												Local	137,505
												Total	672,020

Chapter 10 Estimation of Production Cost

10.1 Cost Accounting Precondition

10.1.1 Cost accounting method

The intent of cost accounting is to judge the synthetic profitability of a project. As the types of end products to be manufactured under this project are limited to bars and rods, the method of cost accounting best suited for this project is the "process cost system."

Fig.10.1 shows the classification of section consisting of five manufacturing processes - lime calcination, direct reduction furnace, electric arc furnace, continuous casting, and rolling - and of seven auxiliary sections of natural gas, electric power, water, oxygen, nitrogen, compressed air, and intra-works transportation in addition to one plant management section.

Cost distribution from the auxiliary sections to the manufacturing sections and the plant management section is proportional to the amounts of services rendered by the auxiliary sections. Cost distribution from the plant management

section to the manufacturing sections is proportional to the number of personnel belonging to the respective plants.

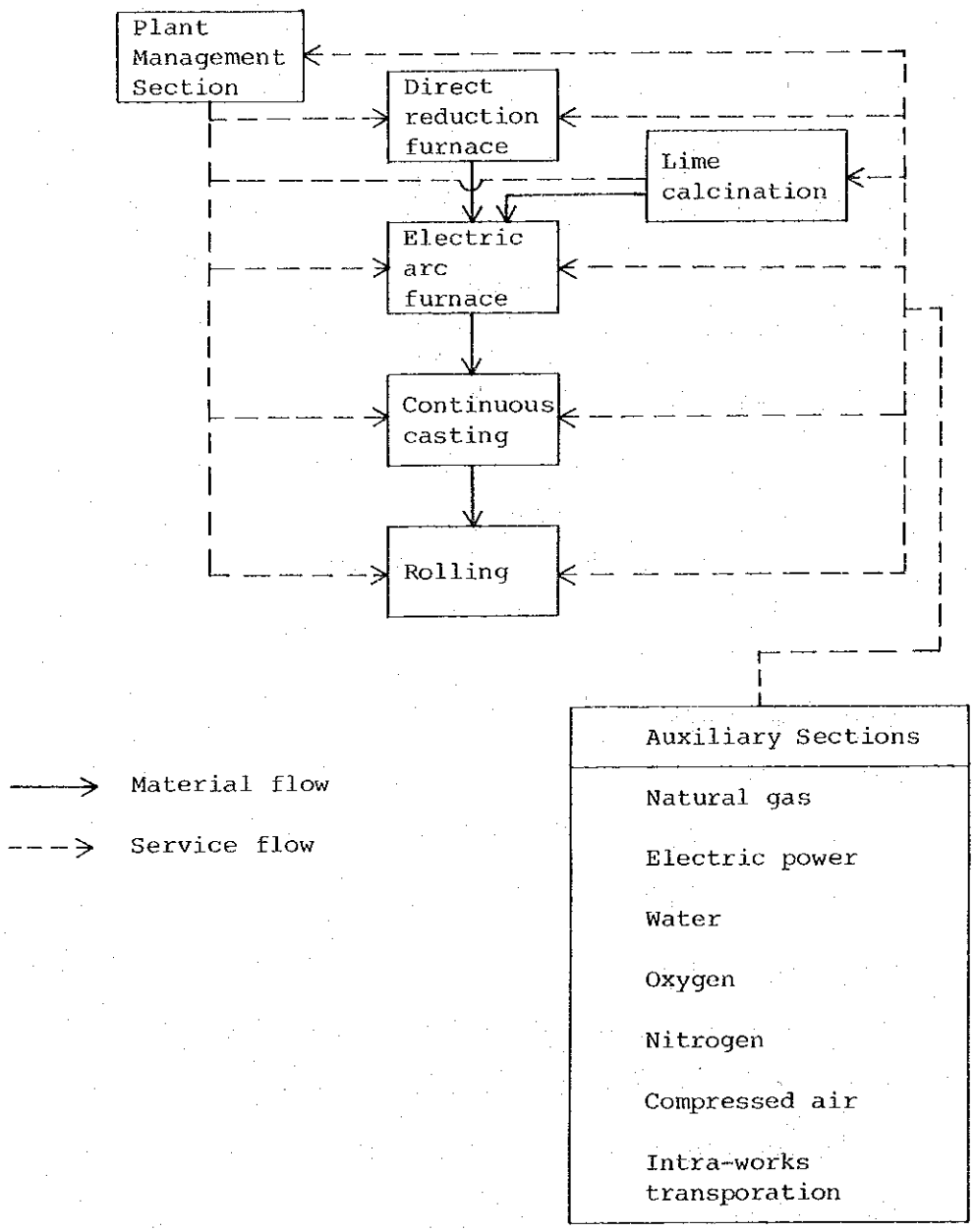


Fig. 10.1

10.1.2 Classification of variable cost and fixed cost

Variable cost covers raw materials, operational materials and all auxiliary sections costs, and fixed cost covers the manufacturing sections' labor, welfare, maintenance, plant management and amortization costs incurred from the manufacturing sections.

10.1.3 Price levels

Based on the results of site investigation conducted in Egypt and the results of discussions with the counterpart and taking into account the knowledge and experience owned by the study mission, the price and cost levels which will form a basis for cost accounting are proposed as follows:

(1) The proposed price levels are based on those prevailing as of March, 1979 when the site investigation was conducted.

(2) The term "Basic Case" used hereinafter means a case for which cost accounting and financial analysis are made using the March, 1979 price level and without consideration given to any inflation factor.

(3) The term "Escalation Case" used hereinafter

means a case for which cost accounting and financial analysis are made on the basis of the March, 1979 price level and with consideration given to inflation prevailing up until the start-up of commercial operation of the Works.

The annual rates of inflation (based on compound interest) are shown on Table 10.1, the rates being applied with cost factor divided into three categories.

Table 10.1

Year / Factor	-4	-3	-2	-1	1
In Egypt	15%	12%	9%	9%	9%
Outside Egypt	7	7	7	7	7
Natural gas & energy	10	9	7.5	7.5	7.5
Bar and rod selling prices	6	6	6	6	6

(4) The currency to be used is the US dollar, with exchange rates established as follows:

$1 = E£0.7 and $1 = ¥200

(5) The metric system is used for all physical measurements.

10.1.4 Import taxes

(1) For the materials, equipment and supplies to be imported from overseas for constructing the proposed steelworks, the assumption is made that all import taxes are exempted as provided for by Article 16 of the Investment Law of Egypt (Law 43/1974, 1977).

(2) For the imported raw materials required for operating the steelworks, calculations are made for two cases where import taxes are exempted and imposed. For the Basic Case, however, calculation is made only for the case where import taxes are exempted.

10.1.5 Amount of capital cost

The amount of capital cost is as shown in Chapter 9 hereof.

10.1.6 Prices of raw materials

The prices of raw materials are as listed on Tables 10.2 and 10.3. For the conceptual pricing of raw materials see Chapter 5.

Table 10.2 Prices of raw and main materials
(Basic Case)

(US$/Ton)

Material	Imported and domestically available	CIF price	Works yard delivery price
Pellet	Imported	36.30	39.38
Lump ore	"	25.70	28.78
Scrap	"	150.53	153.20
Fe-Mn	"	426.00	444.20
Fe-Si	Domestically available		491.43
Limestone	"		2.90
Coke breeze	"		120.80
Fluorite	Imported	228.00	246.20
Aluminum	Domestically available		1308.60
Electrode	Imported	2361.00	2379.20

Note 1: No import taxes are included for the Basic Case.

Note 2: As it is assumed that the Fe content in imported scrap is 95% and the Fe content in the return scrap in the steelworks is 100%, the unit consumption of scrap for the electric arc furnace is expressed in Fe fineness so that the box contents may be dealt with on a unified basis. Table 10.1 shows the CIF price (US$143/ton) and the works yard delivery price (US$145.54/ton) of imported scrap in terms of price per ton of pure Fe.

Table 10.3 Prices of raw and main materials
(Escalation Case)

(US$/ton)

Material	Imported or domestically available	CIF price	Works yard delivery price (Import taxes exempted)	Works yard delivery price	
				Rate of tax vs CIF	(Import taxes imposed)
Pellet	Imported	50.93	56.07	11.8%	62.08
Lump ore	"	36.06	41.20	"	45.46
Scrap	"	211.19	215.65	8.71	234.04
Fe-Mn	"	597.68	628.04	"	680.10
Fe-Si	Domestically available		819.71	-	819.71
Limestone	"		4.84	-	4.84
Coke breeze	"		201.49	-	201.49
Fluorite	Imported	319.88	350.24	11.8	387.99
Aluminum	Domestically available		2182.74	-	2182.74
Electrode	Imported	3312.48	3342.84	16.95	3904.31

Note 1: Similar to the Basic Case, the scrap prices given above are shown in terms of 100% Fe.

10.1.7 Prices of other materials

For the prices of other materials, the corresponding prices prevailing in Egypt are assumed with reference to the applicable factors established in Japan.

10.1.8 Prices of by-products

For the prices of by-products which will crop up from the respective plants, the following concepts are applied:

(1) The price of return scrap should be evaluated at the same price level as with the works yard delivery price of imported scrap.

(2) Although pellets, screened lump ore fines and the scale generated at the plants after the steelmaking are considered marketable, it is judged that their selling prices almost correspond to their processing and transport cost, these materials are not taken as by-products.

(3) As it is difficult to anticipate the marketable price of the surplus oxygen at the oxygen plant, it is not taken as a by-product.

10.1.9 Labor cost

Wages, salaries and welfare cost are estimated with reference to the past records of those at the major Egyptian steelworks attached to the public sector. The feasibility study of this project is being carried out on the basis that it belongs to the private sector. As compared with the public sector which is subject to the various government restrictions in numerous aspects, the private sector would have much room for relatively free decision-making as to employees' incentives, etc. Also, it is conceivable that in order to make the steelworks operate to gain the rate of operation according to the scheduled commissioning curve and consequently to achieve the intent of the project, employment of personnel who can speak English and have the highest possible capability and providing them with prior, sufficient education are absolutely necessary. Based on this concept, it is judged that the wage and salary levels of the private sector must be higher than those of the public sector.

Tables 10.4 and 10.5 show the projects' assumed wages and salaries by occupation based on this

concept. Wages or salaries given on the tables stands for the annual income before tax per capita. Welfare cost accounts for 26% of the wage or salary.

Table 10.4 Unit labor cost
(Basic Case)

(US$/capita/year)

Occupation	Wage or salary	Welfare cost
Managing Director	26,790	26% of wage or salary
General Manager or General Works Manager	16,080	
Assistant General Works Manager	12,500	
Manager	8,930	
Superintendent	7,140	
Assistant Superintendent	5,360	
Engineer	4,110	
Office worker	2,680	
Worker	2,680	
Average	2,959	769
	3728	

For personnel of each plans, see Chapter 8. For the start-up operation period of each plant, labor cost is estimated for the number of staff corresponding to the respective working organizations before full-working organization will have been established.

Table 10.5 Unit labor cost
(Escalation Case)

Occupation	Wage or salary	Welfare cost
Managing Director	44,690	26% of wage or salary
General Manager or General Works Manager	26,820	
Assistant General Works Manager	20,850	
Manager	14,900	
Superintendent	11,910	
Assistant Superintendent	8,940	
Engineer	6,860	
Office worker	4,470	
Worker	4,470	
Average	4,936	1,283
	6,219	

10.1.10 Maintenance cost

Maintenance cost for each plant consists of the

material cost and labor cost involved in the maintenance work. The required annual maintenance cost for each plant is determined on the assumption that, based on the past records available in Japan, it shares 3% of the capital cost invested in each plant.

10.1.11 Depreciation cost

Depreciation cost is not included separately in the plant's manufacturing cost, but collectively included in the depreciation cost item appearing on the profit and loss statement.

The fixed installment method is adopted for depreciation, with the categories of assets depreciated and service life being in conformity to the Egyptian tax law and as shown on Table 10.6. It is assumed that the land on which the steelworks is to be built is on a lease basis, so the reclamation cost of the land is considered to be depreciated for the same number of years as with the case for the plant buildings. The residual value of the asset is considered to be zero.

The legal service lives of trucks and automobiles are 5 years, and they are to be renewed every 5 years. Although the service lives of the equipment

belonging to the auxiliary sections are 10 years, they can be repaired every year for prolonged life, so it is assumed that they not be renewed for a period of 17 years which is identical to that of the manufacturing equipment.

Engineering fee is taken as the asset to be depreciated, and is included in the mechanical equipment.

Table 10.6 Capital cost and legal service lives for different assets

(In US$1000)

Classification of assets	Legal Service life	Capital cost (Basic Case)	Capital cost (Escalation Case)
Mechanical equipment (engineering fee included)	17 years	343,706	424,189
Mechanical equipment attached to auxiliary sections	10	85,602	108,172
Plant buildings	33	82,118	106,800
Office building	50	2,402	3,085
Trucks and automobiles	5	3,860	4,916
Office equipment	10	55	60
Land reclamation	33	17,197	20,062
Total		534,940	667,284
Depreciation cost	Annual	32,613	40,664

10.1.12 Auxiliary section costs (See Table 10.7 Unit Cost)

(1) Natural gas

The price per cubic meter of natural gas is derived on the basis of the international crude oil price (1 barrel of Arabian Light - US$14.55), by which the price per calorie of crude oil is determined and the product multiplied by the calorie per cubic meter of Abu Qir natural gas, and then, by adding the labor and maintenance costs involved in the natural gas receiving facility of the steel-works, US$0.087 per cubic meter of natural gas is established for the Basic Case. For the Escalation Case, US$0.130 is the unit price per cubic meter of natural gas.

The basic price (US$0.087/$m^3$) of natural gas is approximately US$2.4/million BTU in terms of BTU. The price of liquefied gas upon arrival at Japan as of March, 1979 stands at US$2.2 to 2.8/million BTU, but the net import price of natural gas prevailing in the liquefied gas exporting countries excludes the costs spent for construction of the liquefaction facilities, for liquefaction

processing, and freight and interests, and will presumably be US$0.9 to 1.0/million BTU. Thus, although it appears reasonable that the price of natural gas to be applied for this project would be less than US$1.0/million BTU, in the present feasibility study the price is calculated on the basis of crude oil calorie equivalent in accordance with the SC telex dated March 28, 1979. In addition, just for information purpose, the production cost for the Escalation Case is prepared using the escalated incentive price (US$0.031/$m^3$ or US$0.857/million BTU) originally presented in the Memorandum dated March 16, 1979.

(2) Electric power

Assuming the purchase price per KWH of electricity is US$0.024 and adding to it the labor and maintenance costs involved in the substation facility, the unit electricity price is set at US$0.025/KWH for the Basic Case, and US$0.038/KWH for the Escalation Case.

(3) Water

The water used within the steelworks compound

will be circulated. Expressing the unit consumption of water for each plant in the unit consumption of make-up water and adding to the purchase price of US$0.0857 per cubic meter of make-up water the labor and maintenance costs of the water treatment facility and sewage disposal facility, the unit price per cubic meter of water is set at US$0.327 for the Basic Case, and US$0.474/$m^3$ for the Escalation Case.

(4) Oxygen and nitrogen

In the oxygen plant, oxygen will be generated together with nitrogen as a by-product, so it is difficult to derive the separate costs of oxygen and nitrogen. Here, the total cost comprising the prices of electricity, water and other utilities necessary for generating the required amounts of oxygen and nitrogen and the labor and maintenance costs is divided by the sum of the amounts of oxygen and nitrogen required, and then the average unit price of the two is obtained, that is US$0.055/$m^3$ for the Basic Case and US$0.078/$m^3$ for the Escalation Case.

In addition, however, the profit on the sale of surplus oxygen is not included in either of the obtained prices above.

(5) Compressed air

The unit price of compressed air established by the compressor plant is set at US$0.004/$m^3$ including labor and maintenance costs, for the Basic Case, and US$0.006/$m^3$ for the Escalation Case.

(6) Intra-works transportation cost

The costs (gasoline cost, labor cost and truck and vehicle repair costs) incurred from all intra-works transportation required within the steelworks are calculated in terms of one ton of material and/or product transported and then distributed to the respective plants to which the haulage service is rendered.

The unit prices of intra-works transportation for different years are as follows:

Case / Year	Basic Case	Escalation Case
1st year	$1.421/ton	$2.371/ton
2nd year	$0.824/ton	$1.374/ton
3rd year	$0.732/ton	$1.222/ton

10.1.13 Plant management cost (Factory overhead cost) (See Table 10.7 Unit Costs)

Estimating communication cost and other miscellaneous cost in addition to the cost of staff attached to the plant management section, the total annual plant management cost is set at US$1,000,200 for the Basic Case. Distributing this figure among the plants belonging to the manufacturing section, the following unit costs are obtained:

1st year: US$1,072.00/capita

2nd year on: US$1,047.30/capita

Likewise, US$1,600,400 is set for the Escalation Case, and the distributed unit costs are:

1st year: US$1,715.28/capita

2nd year on: US$1,675.77/capita

10.1.14 Other costs

The costs of consumable materials and other miscellaneous costs are estimated taking into consideration the past records available in Japan.

10.1.15 For the selling expenses, general administrative expenses, interests and deferred asset amortization costs which are not included in the manufacturing cost of the plant, see Chapter 11.

Table 10.7 Auxiliary section and plant management unit prices

Item			Unit	Unit Price (Basic Case)	Unit Price (Escalation Case)
Auxiliary section	Natural gas		$/m^3	0.087	0.130
	Electric Power		$/kwH	0.025	0.038
	Water		$/m^3	0.327	0.474
	Oxygen		"	0.055	0.078
	Nitrogen		"	0.055	0.078
	Compressed air		"	0.004	0.006
	Intra-works transportation	1st year	$/ton	1.421	2.371
		2nd year		0.824	1.374
		3rd year on		0.732	1.222
Plant management (Factory overhead) cost		1st year	$/ person	1072.00	1715.28
		2nd year on		1047.30	1675.77

Note: The incentive price of natural gas will be US$0.031/m^3 for the Escalation Case. (The inflation rate of the natural gas and energy given in Table 10.1 is applied to the prevailing (March, 1979) incentive gas price which is US$0.575/million BTU.)

10.2 Annual Plantwise Production Costs

10.2.1 Starting up of plants and establishment of project year

As the operation of the electric arc furnace and the continuous casting machines will be started three months prior to the start-up of the direct reduction furnace and the rolling mill, the time when the said two facilities are to be started up is envisaged to be the beginning of the first operating year.

The annual plantwise availability is as shown in Table 10.8. The direct reduction furnace will achieve full (100%) operation on the third month of the second year (after start-up of steelmaking plant), the electric arc furnace on the tenth month of the second year, and the rolling mill on the twelveth month of the second year.

As the start-up of the steelmaking plant will precede the start-up of the rolling mill by three months, the marketing of the billets will be possible for the first two years. Table 10.8 shows the output of billet for sale.

10.2.2 Outline of production costs (1) (Basic Case)

(1) Sponge iron

The cost of sponge iron which is estimated as US$96.60 in the first year, will be reduced to US$94.10/ton, down US$2.50, resulting from increased availability in the second year; US$89.80/ton in the third year; and finally US$88.90/ton in the fourth year. The fourth year cost is lower by US$7.70 than the first year's because increased availability will reduce the cost by US$2.70/ton and additional US$3.30/ton can be reduced from the third month of the third year by blending 30% of lump ore which is cheaper in price than pellet. On the contrary, however, by blending lump ore the total Fe content in sponge iron will be lowered from 92.7% to 91.0%, the virtual cost reduction as compared with the first year will stand at US$6/ton, not US$7.70/ton.

Viewing the cost composition of sponge iron on the fourth year when cost will become stabilized, the main raw materials (pellet and lump ore) share 58% and natural gas 30%,

obviously indicating that the percentages of the main raw materials and natural gas account for a considerably large ratio in the sponge iron production cost.

(2) Molten steel

The first year cost per ton of molten steel will be US$191.30. The cost will be reduced to US$181/ton in the second year, US$179.10/ton in the third yerar, and finally US$178.60/ton in the fourth year. This will result from a decreased sponge iron cost and a decreased fixed operating cost per ton of molten steel due to increased availability of the electric arc furnace.

Viewing the fourth year cost composition, sponge iron shares 44%, scrap 22% and electric power cost 10%, clearly indicating that electric power cost accounts for a relatively large ratio.

(3) Billet

It is anticipated that the first year cost (US$211.80/ton) of billet will drop to as low as US$194.60/ton in the fourth year due

to a decreased molten steel cost, and a decreased fixed operating cost per ton of billet resulting from increased availability.

(4) Bar and rod products

It is anticipated that the bar and rod product cost of US$254.40/ton in the first year will finally drop to US$221/ton in the fourth year due to decreased billet cost, and decreased fixed operating cost per ton resulting from increased availability.

Table 10.8 Summary of annual production costs by processes (Basic Case)

	Year	1	2	3	4
Rate of Operation (%)	Direct reduction	48%	97%	100%	100%
	Steelmaking	48	95	100	100
	Rolling	32	83	100	100
Bar and rod output		231,200 T	600,850 T	723,330 T	723,330 T
Billet output for sale		110,000	76,490	0	0
DR (Sponge iron)	Raw materials	$56.90/T	$56.90/T	$52.80/T	$51.90/T
	Variable operating cost	31.20	31.20	31.20	31.20
	Fixed operating cost	8.50	6.00	5.80	5.80
	Variable cost	88.10	88.10	84.00	83.10
	Total cost	96.60	94.10	89.80	88.90
EAF (Molten steel)	Raw materials	129.40	125.60	124.10	123.60
	Auxiliary raw materials	4.50	3.80	3.80	3.80
	Variable operating cost	46.60	46.20	46.20	46.20
	Fixed operating cost	10.80	5.40	5.00	5.00
	Variable cost	180.50	175.70	174.10	173.60
	Total cost	191.30	181.00	179.10	178.60
CC (Billet)	Raw materials	194.90	184.20	182.20	181.60
	Variable operating cost	9.70	9.70	9.70	9.70
	Fixed operating cost	7.20	3.50	3.30	3.30
	Variable cost	204.60	193.90	191.90	191.30
	Total cost	211.80	197.40	195.20	194.60
Rebar mill (Bar and rod)	Raw materials	217.20	201.90	199.50	198.90
	Variable operating cost	13.40	12.80	12.70	12.70
	Fixed operating cost	23.80	11.30	9.40	9.40
	Variable cost	230.60	214.70	212.20	211.60
	Total cost	254.40	226.00	221.60	221.00

10.2.3 Outline of Production Cost Analysis (2) - Escalation Case

Comparing the cost of the Escalation Case where the import taxes are exempted with the cost for the Base Case where without cost escalation, the former cost is higher by slightly less than 44% throughout all processes involving sponge iron, and bar & rod products. Based on the fourth year cost, the cost of the end products of bar and rod is US$221.00/ton for the Base Case while it is US$317.60/ton for the Escalation Case (Table 10.10).

Comparing the case where import taxes for the raw materials are exempted with the case where they are imposed on, the cost of bar and rod products is US$15/ton higher with the latter case (Tables 10.9 and 10.10).

The tendency of annual production cost in each plant for the Escalation Case is almost exactly the same as with the Base Case.

The detailed production cost breakdown is shown at the end of this Chapter, in Table 10.12 showing the "Base Case.", and in Table 10.13 the "Escalation Case with import duty imposed," and in

Table 10.14 the "Escalation Case with import duty exempted." The column of year bearing the number "05" denotes the first year when operation is started.

Table 10.9 Summary of Annual Production Costs in Each Plant (Escalation Case)

- Import duty imposed -

Year			1	2	3	4
Rate of operation (%)		Direct reduction	48%	97%	100%	100%
		Steelmaking	48	95	100	100
		Rolling	32	83	100	100
Bar and rod output			231,200 T	600,850 T	723,330 T	723,330 T
Output of billet to be sold			110,000	76,490	0	0
DR (Sponge iron)	Main raw materials		$89.60/T	89.60/T	83.30/T	82.00/T
	Variable operation cost		$46.70/T	$46.70/T	$46.60/T	$46.60/T
	Fixed operation cost		$11.00/T	$7.50/T	$7.10/T	$7.10/T
	Variable cost		$136.30/T	$136.30/T	$129.90/T	$128.60/T
	Total cost		$147.30/T	$143.80/T	$137.00/T	$135.70/T
EF (Molten steel)	Main raw materials		$197.70/T	$192.30/T	$190.00/T	$189.20/T
	Auxiliary raw materials		$7.00/T	$6.00/T	$5.90/T	$5.90/T
	Variable operation cost		$70.60/T	$70.00/T	$69.90/T	$69.90/T
	Fixed operation cost		$14.60/T	$7.20/T	$6.70/T	$6.70/T
	Variable cost		$275.30/T	$268.30/T	$265.80/T	$265.00/T
	Total cost		$289.90/T	$275.50/T	$272.50/T	$271.70/T
CC (Billet)	Main raw materials		$295.40/T	$280.30/T	$277.10/T	$276.30/T
	Variable operation cost		$13.70/T	$13.70/T	$13.70/T	$13.70/T
	Fixed operation cost		$10.20/T	$5.00/T	$4.70/T	$4.70/T
	Variable cost		$309.10/T	$294.00/T	$290.80/T	$290.00/T
	Total cost		$319.30/T	$299.00/T	$295.50/T	$294.70/T
Rebar mill (Bar and rod)	Main raw materials		$327.20/T	$305.70/T	$302.00/T	$301.10/T
	Variable operation cost		$19.90/T	$18.90/T	$18.70/T	$18.70/T
	Fixed operation cost		$32.80/T	$15.40/T	$12.80/T	$12.80/T
	Variable cost		$347.10/T	$324.60/T	$320.70/T	$319.80/T
	Total cost		$379.90/T	$340.00/T	$333.50/T	$332.60/T

Table 10.10 Summary of Annual Production Cost in Each Plant (Escalation Case)

- Import duty exempted -

	Year	1	2	3	4
Rate of operation (%)	Direct reduction	48%	97%	100%	100%
	Steelmaking	48	95	100	100
	Rolling	32	83	100	100
Bar and rod output		231,200 T	600,850 T	723,330 T	723,330 T
Billet output to be sold		110,000	76,490	0	0
DR (Sponge iron)	Main raw materials	$80.90/T	$80.90/T	$75.30/T	$74.20/T
	Variable operation cost	46.70	46.70	46.60	46.60
	Fixed operation cost	11.00	7.50	7.10	7.10
	Variable cost	127.60	127.60	121.90	120.80
	Total cost	138.60	135.10	129.00	127.90
EF (Molten steel)	Main raw materials	185.00	179.80	177.90	177.20
	Auxiliary raw materials	6,90	5.90	5.80	5.80
	Variable operation cost	67.80	67.20	67.10	67.10
	Fixed operation cost	14.60	7.20	6.70	6.70
	Variable cost	259.70	252.90	250.80	250.10
	Total cost	274.30	260.20	257.50	256.80
CC (Billet)	Main raw materials	279.70	264.90	262.00	261.30
	Variable operation cost	13.70	13.70	13.70	13.70
	Fixed operation cost	10.20	5.00	4.70	4.70
	Variable cost	293.40	278.60	275.70	275.00
	Total cost	303.60	283.60	280.40	279.70
Rebar mill (Bar and rod)	Main raw materials	311.50	290.30	286.90	286.10
	Variable operation cost	19.90	18.90	18.70	18.70
	Fixed operation cost	32.90	15.40	12.80	12.80
	Variable cost	331.40	309.20	305.60	304.80
	Total cost	364.30	324.60	318.40	317.60

10.2.4 Production Cost with Incentive Natural Gas Price

Table 10.11 shows the comparison between the production cost with natural gas price equivalent to crude oil price level and cost with incentive natural gas price prevailing in Egypt in March 1979, both with price escalation.

Table 10.11 Production Cost Comparison

(US$/ton)

		Where crude oil equivalent is used (A)			Where prevailing incentive price is ued (B)			Difference (B-A)
		Unit price	Unit consumption	Production cost	Unit price	Unit consumption	Production cost	
Main raw materials				$162.30/T			$162.30/T	--
Auxiliary raw materials				3.00			3.00	--
By-product				-25.40			-25.40	
Variable operation cost	Natural gas	$0.130/T	$355.80/T	46.20	$0.031/T	$355.80/T	11.10	-35.10/T
	Electric power	0.038	1,068.20	40.60	0.038	1,068.20	40.60	--
	Operational material			59.10			59.10	--
	Other variable cost			13.60			13.50	-0.10
	Subtotal			159.50			124.30	-35.20
Fixed operation cost				33.20			33.20	--
Total cost				332.60			297.40	-35.20

Note: The above comparison is based on the 4th year total production cost table. The comparison shows that the production cost using natural gas price equivalent to crude oil price level is US$35.20/ton higher than the production cost using incentive matural gas price.

Table 10-12

NO.1

PROJECT: EL-DIKHEILA PROJECT (CASE-BASE) (08:YEAR)

COST ACCOUNTING FOR LIME CALCINING PLANT

MATERIALS 134401.120 OUT PUT 60760.000 YIELD 45.21

COST ELEMENT		TOTAL AMOUNT REQUIREMENT (UNIT)		UNIT COST (DL)	TOTAL AMOUNT (1000DL)	PER TON CONSUMPTION	COST PER TON OF PRODUCT (DL)
MATERIALS	MAJOR RAW MATERIALS	134401.120	TON	2.900	389.762	2.2120	6.415
	AUXILIARY RAW MATERIALS	0.000		0.000	0.000	0.0000	0.000
	*** TOTAL	134401.120	TON		389.762	2.2120	6.415
BY-PRODUCTS		0.000		0.000	0.000	0.0000	0.000
	OTHERS	0.000		0.000	0.000	0.0000	0.000
	SCRAP	0.000		0.000	0.000	0.0000	0.000
	*** TOTAL	0.000			0.000	0.0000	0.000
VARIABLE OPE. COST	FUELS NATURAL GAS	6379800.000	M3	0.087	555.043	105.0000	9.135
	OTHERS	0.000		0.000	0.000	0.0000	0.000
	*** SUB TOTAL	6379800.000	M3		555.043	105.0000	9.135
	INGOT MOLDS & ROLLS	0.000		0.000	0.000	0.0000	0.000
	POWER	3341800.000	KWH	0.025	83.545	55.0000	1.375
	WATER	60760.000	M3	0.327	19.869	1.0000	0.327
	OXYGEN	0.000		0.000	0.000	0.0000	0.000
	NITROGEN	0.000		0.000	0.000	0.0000	0.000
	OPERATING EXPENDABLES	0.000	US.DL	0.000	133.672	0.0000	2.200
	COMPRESSED AIR	4982320.000	M3	0.004	19.929	82.0000	0.328
	INTRA-MILL TRANSPORTATION	149000.000	TON	0.732	109.068	2.4523	1.795
	OTHERS	0.000		0.000	0.000	0.0000	0.000
	*** TOTAL				921.125		15.160
*** VARIABLE COST					1310.887		21.575
FIXED OPE. COST	EMPLOYEES WAGES	44.000	M/Y	2959.000	130.196	0.0007	2.143
	BENEFITS	44.000	#####	769.340	33.851	0.0007	0.557
	*** SUB TOTAL				164.047		2.700
	MAINTENANCE	0.000	US.DL	0.000	198.000	0.0000	3.259
	SPECIAL RESERVE FOR REPAIR	0.000		0.000	0.000	0.0000	0.000
	DEPRECIATION CHARGES	0.000		0.000	0.000	0.0000	0.000
	TAXES AND LEVIES	0.000		0.000	0.000	0.0000	0.000
	FACTORY OVERHEAD COST	44.000	#####	1047.300	46.081	0.0007	0.758
	OTHERS	0.000		0.000	0.000	0.0000	0.000
		0.000		0.000	0.000	0.0000	0.000
		0.000		0.000	0.000	0.0000	0.000
	*** TOTAL				408.128		6.717
FULL PRODUCTION COST					1719.015		28.292

NO.1
PROJECT: EL-DIKHEILA PROJECT (CASE-BASE) (08:YEAR)

C O S T A C C O U N T I N G F O R DIRECT REDUCTION P L A N T

MATERIALS 1026740.000 OUT PUT 715000.000 YIELD 69.64

COST ELEMENT		TOTAL AMOUNT REQUIREMENT (UNIT)	UNIT COST (DL)	TOTAL AMOUNT (1000DL)	PER TON CONSUMPTION	PER TON COST PER TON OF PRODUCT (DL)
MATERIALS	MAJOR RAW MATERIALS	1026740.000 TON	36.200	37167.971	1.4360	51.983
	AUXILIARY RAW MATERIALS	0.000	0.000	0.000	0.0000	0.000
	*** TOTAL	1026740.000 TON		37167.971	1.4360	51.983
BY-PRODUCTS		0.000	0.000	0.000	0.0000	0.000
	OTHERS	0.000	0.000	0.000	0.0000	0.000
	SCRAP	0.000	0.000	0.000	0.0000	0.000
	*** TOTAL	0.000		0.000	0.0000	0.000
VARIABLE OPE. COST	FUELS NATURAL GAS	220935000.000 M3	0.087	19221.345	309.0000	26.883
	OTHERS	0.000	0.000	0.000	0.0000	0.000
	*** SUB TOTAL	220935000.000 M3		19221.345	309.0000	26.883
	INGOT MOLDS & ROLLS	0.000	0.000	0.000	0.0000	0.000
	POWER	96525000.000 KWH	0.025	2413.125	135.0000	3.375
	WATER	1072500.000 M3	0.327	350.707	1.5000	0.490
	OXYGEN	0.000	0.000	0.000	0.0000	0.000
	NITROGEN	2216500.000 NM3	0.055	121.907	3.1000	0.170
	OPERATING EXPENDABLES	0.000 US.DL	0.000	150.150	0.0000	0.210
	COMPRESSED AIR	0.000	0.000	0.000	0.0000	0.000
	INTRA-MILL TRANSPORTATION	55800.000 TON	0.732	40.846	0.0780	0.057
	OTHERS	0.000	0.000	0.000	0.0000	0.000
	*** TOTAL			22298.081		31.186
*** VARIABLE COST				59466.051		83.169
FIXED OPE. COST	EMPLOYEES WAGES	56.000 M/Y	2959.000	165.704	0.0001	0.232
	BENEFITS	56.000 #####	769.340	43.083	0.0001	0.060
	*** SUB TOTAL			208.787		0.292
	MAINTENANCE	0.000 US.DL	0.000	2424.000	0.0000	3.390
	SPECIAL RESERVE FOR REPAIR	0.000	0.000	0.000	0.0000	0.000
	DEPRECIATION CHARGES	0.000	0.000	0.000	0.0000	0.000
	TAXES AND LEVIES	0.000	0.000	0.000	0.0000	0.000
	FACTORY OVERHEAD COST	56.000 #####	1047.300	58.649	0.0001	0.082
	OTHERS	0.000 US.DL	0.000	1430.000	0.0000	2.000
		0.000	0.000	0.000	0.0000	0.000
		0.000	0.000	0.000	0.0000	0.000
	*** TOTAL			4121.436		5.764
FULL PRODUCTION COST				63587.487		88.934

**** NO.1
PROJECT: EL-DIKHEILA PROJECT (CASE-BASE) (08:YEAR)

C O S T A C C O U N T I N G F O R ELECTRIC ARC FURNACE P L A N T

MATERIALS 943906.000 OUT PUT 810000.000 YIELD 85.81

COST ELEMENT		TOTAL AMOUNT REQUIREMENT (UNIT)	UNIT COST (DL)	TOTAL AMOUNT (1000DL)	PER TON CONSUMPTION	PER TON COST PER TON OF PRODUCT (DL)
MATERIALS	MAJOR RAW MATERIALS	943906.000 TON	107.468	101439.973	1.1653	125.235
	AUXILIARY RAW MATERIALS	66025.000 TON	46.032	3039.234	0.0815	3.752
	*** TOTAL	1009931.000 TON		104479.208	1.2468	128.987
BY-PRODUCTS		0.000	0.000	0.000	0.0000	0.000
	OTHERS	0.000	0.000	0.000	0.0000	0.000
	SCRAP	8100.000 TON	-153.200	-1240.920	0.0100	-1.532
	*** TOTAL	8100.000 TON		-1240.920	0.0100	-1.532
VARIABLE OPE. COST	FUELS NATURAL GAS	1620000.000 M3	0.087	140.940	2.0000	0.174
	OTHERS	0.000	0.000	0.000	0.0000	0.000
	*** SUB TOTAL	1620000.000 M3		140.940	2.0000	0.174
	INGOT MOLDS & ROLLS	0.000	0.000	0.000	0.0000	0.000
	POWER	567000000.000 KWH	0.025	14175.000	700.0000	17.500
	WATER	2754000.000 M3	0.327	900.558	3.4000	1.112
	OXYGEN	1620000.000 NM3	0.055	89.100	2.0000	0.110
	NITROGEN	0.000	0.000	0.000	0.0000	0.000
	OPERATING EXPENDABLES			21704.760		26.796
	COMPRESSED AIR	12150000.000 M3	0.004	48.600	15.0000	0.060
	INTRA-MILL TRANSPORTATION	478480.000 TON	0.732	350.247	0.5907	0.432
	OTHERS	0.000	0.000	0.000	0.0000	0.000
	*** TOTAL			37409.205		46.184
*** VARIABLE COST				140647.493		173.639
FIXED OPE. COST	EMPLOYEES WAGES	231.000 M/Y	2959.000	683.529	0.0003	0.844
	BENEFITS	231.000 #####	769.340	177.718	0.0003	0.219
	*** SUB TOTAL			861.247		1.063
	MAINTENANCE	0.000 US.DL	0.000	2936.000	0.0000	3.625
	SPECIAL RESERVE FOR REPAIR	0.000	0.000	0.000	0.0000	0.000
	DEPRECIATION CHARGES	0.000	0.000	0.000	0.0000	0.000
	TAXES AND LEVIES	0.000	0.000	0.000	0.0000	0.000
	FACTORY OVERHEAD COST	231.000 #####	1047.300	241.926	0.0003	0.299
	OTHERS	0.000	0.000	0.000	0.0000	0.000
		0.000	0.000	0.000	0.0000	0.000
		0.000	0.000	0.000	0.0000	0.000
	*** TOTAL			4039.173		4.987
FULL PRODUCTION COST				144686.666		178.626

NO.1

PROJECT: EL-DIKHEILA PROJECT (CASE-BASE) (08:YEAR)

C O S T A C C O U N T I N G F O R CONTINUOUS CASTING P L A N T

MATERIALS 810000.000 OUT PUT 769500.000 YIELD 95.00

COST ELEMENT		TOTAL AMOUNT REQUIREMENT (UNIT)		UNIT COST (DL)	TOTAL AMOUNT (1000DL)	PER TON CONSUMPTION	PER TON COST PER TON OF PRODUCT (DL)
MATERIALS	MAJOR RAW MATERIALS	810000.000	TON	178.626	144686.666	1.0526	188.027
	AUXILIARY RAW MATERIALS	0.000		0.000	0.000	0.0000	0.000
	*** TOTAL	810000.000	TON		144686.666	1.0526	188.027
BY-PRODUCTS		0.000		0.000	0.000	0.0000	0.000
	OTHERS	0.000		0.000	0.000	0.0000	0.000
	SCRAP	32011.200	TON	-153.200	-4904.116	0.0416	-6.373
	*** TOTAL	32011.200	TON		-4904.116	0.0416	-6.373
VARIABLE OPE. COST	FUELS NATURAL GAS	3078000.000	M3	0.087	267.786	4.0000	0.348
	OTHERS	0.000		0.000	0.000	0.0000	0.000
	*** SUB TOTAL	3078000.000	M3		267.786	4.0000	0.348
	INGOT MOLDS & ROLLS	0.000		0.000	0.000	0.0000	0.000
	POWER	15390000.000	KWH	0.025	384.750	20.0000	0.500
	WATER	1000350.000	M3	0.327	327.114	1.3000	0.425
	OXYGEN	1231200.000	NM3	0.055	67.716	1.6000	0.088
	NITROGEN	169290.000	NM3	0.055	9.311	0.2200	0.012
	OPERATING EXPENDABLES	0.000	US.DL	0.000	4770.900	0.0000	6.200
	COMPRESSED AIR	19237500.000	M3	0.004	76.950	25.0000	0.100
	INTRA-MILL TRANSPORTATION	8000.000	TON	0.732	5.856	0.0104	0.008
	OTHERS	0.000	US.DL	0.000	1539.000	0.0000	2.000
	*** TOTAL				7449.383		9.681
*** VARIABLE COST					147231.933		191.335
FIXED OPE. COST	EMPLOYEES WAGES	227.000	M/Y	2959.000	671.693	0.0003	0.873
	BENEFITS	227.000	#####	769.340	174.640	0.0003	0.227
	*** SUB TOTAL				846.333		1.100
	MAINTENANCE	0.000	US.DL	0.000	1466.000	0.0000	1.905
	SPECIAL RESERVE FOR REPAIR	0.000		0.000	0.000	0.0000	0.000
	DEPRECIATION CHARGES	0.000		0.000	0.000	0.0000	0.000
	TAXES AND LEVIES	0.000		0.000	0.000	0.0000	0.000
	FACTORY OVERHEAD COST	227.000	#####	1047.300	237.737	0.0003	0.309
	OTHERS	0.000		0.000	0.000	0.0000	0.000
		0.000		0.000	0.000	0.0000	0.000
		0.000		0.000	0.000	0.0000	0.000
	*** TOTAL				2550.070		3.314
FULL PRODUCTION COST					149782.004		194.648