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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

VIENNA, AUSTRIA

AND

ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

RABAT, MOROCCO

PROJECT PROFILE

ON

STEAM CONDENSER

FINAL REPORT

DEVELOPMENT CONSULTANTS INTERNATIONAL LIMITED

MANAGEMENT CONSULTANCY DIVISION

24-B PARK STREET, CALCUTTA 700 016, INDIA

PROJECT PROFILE
ON
STEAM CONDENSER

FEBRUARY 1996

DEVELOPMENT CONSULTANTS INTERNATIONAL LIMITED
MANAGEMENT CONSULTANCY DIVISION

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DCIL-105/AC-5/1109 March 15, 1996

United Nations Industrial
Development Organisation
Vienna International Centre
P.O. Box 300
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Attn : Mr V. Koloskov

Project Profile on Steam Condenser

Dear Sirs :

We take pleasure in submitting to you twenty (20) copies of our Final Report on the above subject.

We trust that you will find the present report useful and responsive to your requirement.

We look forward to further association with your organisation in future.

Thanking you,

Very truly yours :
DEVELOPMENT CONSULTANTS
INTERNATIONAL LIMITED

Siddhartha Ganguly
Project Coordinator

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LIST OF ABBREVIATIONS

AC	Alternating current
ADM	Admiralty Material
ANSI	American National Standards Institution
ARSCU	Admiralty Resistance Copper
ASME	American Society for Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BWG	British Wire Gauge
CIF	Cost Insurance & Freight
CNC	Computerised Numerically Controlled
DC	Direct Current
FOB	Free on board
HEI	Heat Exchange Institute
ID	Inner Diametre
IRR	Internal Rate of Return
LxH	Length x Height
OD	Outer Diametre
SWG	Standard Wire Gauge
SWL	Safe working load
TEMA	Tubular Exchangers Manufacturers' Association
TR	Tonnes of Refrigeration
WxDxH	Width x Depth x Height

SECTION - 1
INTRODUCTION

INTRODUCTION

The Sixth Arab Industrial Development Conference held in Damascus in October 1984, stressed on the importance of setting up facilities in the Arab region for manufacture of products used in electricity generation, transmission and distribution. Subsequently, the Arab Industrial Development and Mining Organization (AIDMO), prepared a Sectoral Report on the status of electricity generation, growth prospects in the region and requirement of equipment/facilities thereof. The study covered 21 Arab countries for the period 1986-2010 AD.

Based on the findings of the Sectoral study, the AIDMO, in consultation with the United Nations Industrial Development Organization (UNIDO), shortlisted 8 products for which it wanted to get project profiles prepared. One of the designated products is Steam Condenser. The objective of the project profile is to provide sufficient information so that prospective promoters and sponsors find themselves in a position to evaluate the project.

The Scope of Work for this Project Profile includes the following :

- Description, special characteristics, features and uses of the product
- Identification of major end-user industries
- Assessment of present production capacity
- Assessment of supply and demand for the product in the designated region

- Identification of demand-supply gap and evaluation of the possibility of entering the market
- Description of basic manufacturing process
- Process flow chart
- Brief specifications of plant and machinery, and their indicative prices
- Estimated requirements of raw materials, their sources and prices
- Estimated requirements of utilities such as power, water, compressed air, fuel oil, etc.
- Estimated requirement of manpower
- Estimated requirement of space, and plant layout
- Plant location
- Project cost estimate
- Project financial analysis and evaluation
- Project implementation schedule

This study is confined to the following 13 countries -

Algeria	Bahrain
Egypt	Iraq
Jordan	Kuwait
Libya	Morocco
Saudi Arabia	Sudan
Syria	Tunisia
U.A.E.	

A separate market survey, according to the AIDMO, was not required to be carried out prior to preparing this project

profile, since the information and projections contained in the Sectoral study conducted by them was indicated to be adequate for the purpose. Therefore, the Section on 'Market Analysis' is based entirely on the Sectoral study carried out by the AIDMO.

The contents of this Report have been organised in a manner as to present the reader with a logical sequence of analysis and findings.

Salient features of the project have been summarised in the following Section. The Section presented thereafter describes the product with a view to familiarise the reader with its features, characteristics and uses. The Section on 'Market Analysis' provides demand projections. Plant capacities and recommended locations for establishing the proposed manufacturing facilities are discussed in the next Section.

Manufacturing process is dealt with in a separate Section, titled 'Manufacturing Process'. This is followed by a Section on 'Plant and Equipment'. Estimates of raw materials and other inputs, requirement of utilities, and estimates of space and layout are presented in separate Sections. These are followed by a Section on estimated requirement of manpower and the recommended organisation structure. Financial Analysis and Implementation Plan for the project are presented in the last two Sections respectively.

SECTION - 2
SUMMARY OF FINDINGS

SUMMARY OF FINDINGS

It is recommended that one manufacturing plant with a capacity of 1,320 tonnes per annum (TPA) be set up to manufacture steam condensers within the designated region. Initially, this plant will manufacture five numbers each of 30 MW and 150 MW condensers. Gradually, the product-mix can be modified or expanded to include 300 and 600 MW condensers. This should be sufficient to cater to the demand for the product right up to 2010 AD.

Further, it is suggested that the plant be set up in Algeria. It will cater to the requirement of entire Arab region.

It is observed that with the increase in demand for power, new power generating stations would be set up, and that by itself will justify establishing the proposed plant.

Summary of basic parameters and significant features of the Project is presented in Exhibit-1.

SECTION - 3
PRODUCT ANALYSIS

PRODUCT ANALYSIS

The exhaust steam which is expelled by the steam turbine of a thermal power plant has considerable amount of heat energy which remains unused. The thermal efficiency of the complete steam power generation cycle may be improved significantly by making use of this heat energy. Steam condensers are attached to the low pressure exhaust of steam turbines; these condense the exhaust steam for reuse in the closed cycle. They also produce a vacuum or desired back pressure at the turbine exhaust for improving the efficiency of the power plant.

Steam condensers are mainly of two types :

- o mixed jet condensers
- o surface condensers

In the mixed jet type of condenser, the steam is in direct contact with the cooling water and heat is exchanged by conduction. In the surface type condenser, heat is transferred between steam and cooling water by conduction through the tube walls ; there is no direct contact between steam and cooling water.

In modern power plants, surface condensers are preferred to the mixed jet type of condensers because of the following reasons :

- o Mixing of steam and cooling water in the latter may contaminate the condensate. This may make it unsuitable for recycling condensate back to the steam generation plant.

- A high-vacuum condenser requires 60-100 Kg of water per Kg of steam condensed. Requirement of water in the mixed jet condenser is very high. This requirement can be met only if it is installed in close proximity of natural sources of water like lakes and rivers. The water from lakes and rivers cannot be used in boilers unless it is fully treated and purified. The cost of treatment and purification of the feed water can be very high, making the installation of the mixed jet condenser uneconomical.

- Mixed jet condensers need a large amount of injection water, which, in turn, release considerable amount of non-condensable gases. It is estimated that nearly 0.02 m^3 free air is released from 1 m^3 of water at 25°C. The release of the non-condensable gases reduces vacuum in the condenser and thus decreases its efficiency.

- In the mixed jet type of condenser extraction pumps require twice the amount of power required by a surface condenser of the same capacity.

Mixed jet condensers are used in conjunction with steam engines or in small capacity power plants. On the other hand, the surface steam condenser is essentially used in the steam turbine-powered utility power plants. Together with the steam generators and the turbogenerators, it forms the central part of any vapour cycle system. Surface condensers are described in greater detail in the following paragraphs.

SURFACE CONDENSERS

Exhibit-2 shows a typical horizontal downflow, double pass, rectangular shell surface condenser used in power plants. Cooling water flows horizontally through the upper half of the tubes, downward through the back water box at the left and then returns through the lower tube banks to the outlet at the right-hand bottom of the front water box. Steam from turbine exhaust enters the condenser from the top, condenses and collects in the hot well, from where it is recycled to the boiler by a condensate pump. This type of arrangement has the following advantages :

- o Volume of the incoming steam is reduced as rapidly as possible by exposing it to the coolest part of water.
- o Subcooled droplets of condensate dripping from the upper tubes tend to increase the effective surface area for absorption of steam.
- o The warmest part of cooling water is just above the hot well. This maintains the condensate temperature close to the steam temperature, thereby reducing heat loss from and oxygen absorption of the water.

Types of Surface Condensers

Surface condensers may be classified according to the following characteristics :

- o Horizontal or vertical - depending on the position of their tubes. The horizontal configuration is more commonly used.

- Number of passes - single pass or double pass
- Direction of flow of condensate - downflow, central flow or inverted flow
- Shape of the shell - cylindrical, oval, U-shape or rectangular

Condensers may be of the single pass or the double pass types depending on the number of times the condensing water passes the length of the condenser. In the double pass condenser, water enters and leaves the same water box which is divided by a partition. In the single pass condenser, the cooling water enters one box and exits from the box at the opposite end. The double pass arrangement is more efficient and is preferred when supply of cooling water is limited.

In the downflow type of condenser, spent steam from the turbine enters the condenser from the top to flow downward over the nest of tubes. In the central flow type, steam flows radially towards the centre and passes over the entire periphery of tubes to be extracted at the bottom. In the inverted flow type, steam enters near the bottom and flows upward. After flowing near the outer surface, the condensed steam flows downward to exit from the bottom.

DESIGN AND CONSTRUCTIONAL PARAMETERS

The design and construction of a surface condenser should satisfy the following functional requirements :

- The steam should be well distributed in the vessel and the pressure drop should be minimum.
- The steam should enter the condenser with the least possible resistance.

- Circulating water should pass with least friction but with a velocity consistent with high efficiency.
- The steam should lose only its latent heat, there should be no subcooling of condensate. To achieve this, quantity of cooling water circulating through the tubes should be regulated in such a manner as to ensure that the temperature of the condenser is equal to the saturation temperature of steam.
- Cooling water should pass through tubes and steam should be on the shell side, so that no sediment is deposited on the outer surface of the tubes which is difficult to clean. In case there is scale formation on the inner surface of the tubes, cleaning can be done by removing end-plates and passing motor-driven brushes.
- There should be an arrangement for extraction of non-condensables rapidly from the condenser.
- Air extraction should be at the coolest section of the tubes and air extraction point should be shielded from downflowing condensate by means of baffles. This will ensure extraction of air with a much smaller amount of water vapour, thus preventing loss of potential condensate.

Components of a Surface Condenser

Main components of a surface condenser are :

- Shell
- Back and Front Water Box
- Tube Sheet

- Tubes
- Steam Inlet
- Outlet to Air Ejector
- Condensate Outlet
- Hot well
- Cooling Water Inlet and Outlet
- Steady Plate

Materials used in construction of surface condensers are listed in Exhibit-3. This Exhibit also indicates the relevant ASTM standards.

Shell and Tube Sheet : The steam region in a surface condenser has a pressure of about 11 mm Hg absolute, while the pressure in the water region is 1.34 - 2.7 times atmospheric pressure. This differential pressure across the shell and tube sheets generates very large forces. The condenser shell is often made round or oval. It is heavily ribbed to resist the external pressure load and to prevent the shell from buckling inward. The water boxes at the ends are provided with a number of transverse webs to withstand the water pressure. The thickness of the shell and the tube sheet vary depending on the size and shape of the surface condenser.

Tube : The tubes in a condenser are arranged in a bundle with steam entry lines being created by the omission of certain groups of tubes. The tubes are fastened on to tube sheets at their ends and loosely supported by one or more intermediate plates. As the shell is of steel and the tubes of copper alloy differential thermal expansion is encountered. Different designs adopted to overcome the differential expansion are as follows :

- Rolling tubes tightly into one tubesheet, packing in the other
- Rolling tubes into both sheets, with a flexible joint between one sheet and the supporting shell
- Fixed tube ends but with bowed tubes installed
- Both ends packed

AIR REMOVAL

Heat transfer in a surface condenser is hindered by the presence of non-condensable gases which mix with the condensate film on the tube surface. The sources of leakage of air and other non-condensable gas are numerous. Leaks may occur in the boiler steam, the turbine packing glands or the exhaust nozzle connection. Cooling water leakage, through the tube packing, is another source, because raw water contains dissolved gases which are relieved under vacuum. Vents in the low pressure heaters and leaks in the condenser shell itself provide more of the undersirable gas. Unless atmospheric relief valves are water sealed, air will leak through them.

Air infiltration is a serious factor and should be kept down as much as possible. Since it is not practicable to eliminate it entirely, arrangements are made for continuously drawing it out of the condenser and compressing it up to atmospheric pressure, where it can be released. Steam-jet air ejector is used to remove non-condensable air and gases from condensers.

TESTING

All condensers undergo Hydrostatic and Performance tests.

Hydrostatic Test

Condenser shells upto 2286 mm I.D. or equivalent cross sectional area are tested at 1.405 Kg/sq cm hydrostatic pressure. Larger shells are tested by filling the water to the level of the steam inlet. Shell area which are subjected to water pressure are tested at 1.405 Kg/sq cm.

Tubes are tested before assembling to 70.27 Kg/sq cm hydrostatic pressure.

Performance Test

Performance Tests are linked to turbine operation and vice-versa. Performance tests are carried out according to ANSI/ASME Performance Test Code 12.2.1983.

AUXILIARIES IN A CONDENSING PLANT

Major auxiliaries required in a steam condensing plant are -

- A condensate pump to extract the condensed steam from the condenser and feed it to hot well
- A dry air pump to remove air and non-condensable gases
- A feed water pump to force the condensate from the hotwell to boiler
- A cooling water pump for circulating cooling water
- Cooling tower to re-cool the circulating water after it gets heated in the condenser

- An atmospheric relief valve for relieving the pressure from the condenser when the condenser does not function properly

Schematic of a condenser circuit with these auxiliaries is shown in Exhibit 1.

Capacities of the above auxiliaries are recommended by the condenser manufacturers after taking into consideration the condenser's operational parameters.

JOB NO. : DCIL-105 EXHIBIT : 2

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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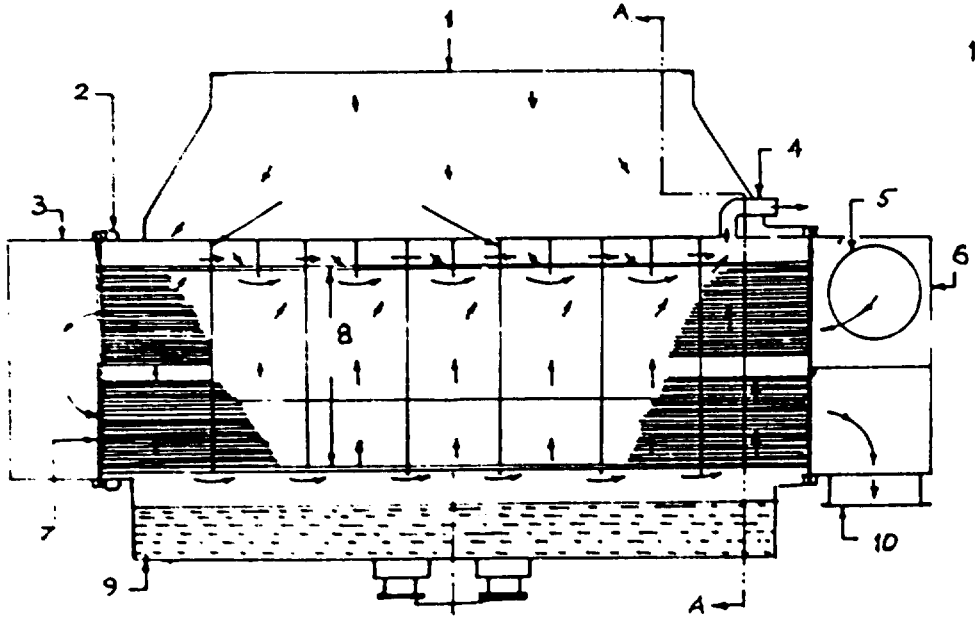
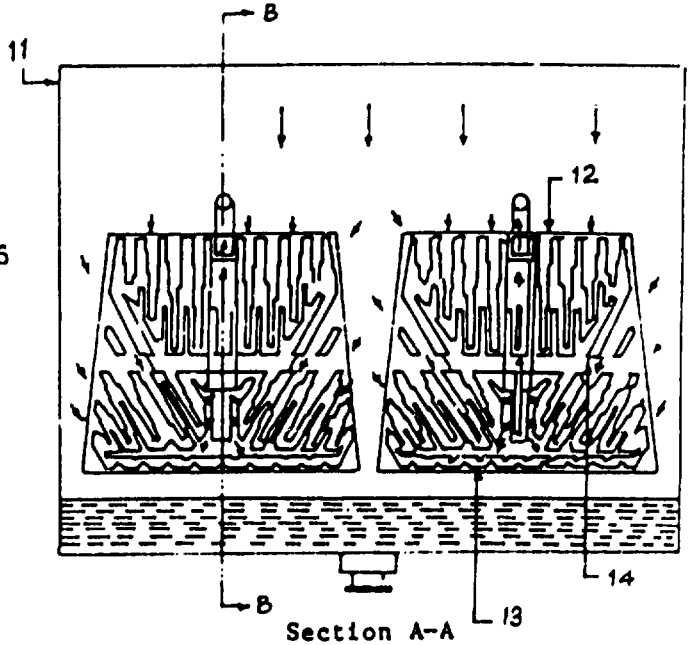
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

HORIZONTAL, DOWNFLOW, DOUBLE PASS, RECTANGULAR SHELL SURFACE CONDENSER



Section B-B



Section A-A

LEGEND

1. STEAM INLET
2. SHELL EXPANSION JOINT
3. BACK WATER BOX
4. AIR CONNECTION
5. WATER INLET CONNECTION
6. FRONT WATER BOX
7. TUBE SHEET
8. TUBE BACK
9. HOT WELL
10. WATER INLET CONNECTION
11. CONDENSER SHELL
12. STEADY PLATE
13. TUBES
14. BAFFLE

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EXHIBIT : 3

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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PROJECT PROFILE ON STEAM CONDENSERS

MATERIALS USED IN CONSTRUCTION OF SURFACE CONDENSERS

Sl. No.	Name of the Component	Material of Construction	ASTM Specification
1.	Water Box & Water Box Cover	Cast Iron Steel	ASTM Spec A-278 Class 30 ASTM A-285 Grade C - Flange Quality
2.	Shell Plate	Steel	ASTM A-285 Grade C - Flange Quality
3.	Tube Sheet	Rolled Muntz Metal	ASTM Spec B-171
4.	Tube Support Plate	Steel	ASTM A-285 Grade C - Flange Quality or Free Machining steel plate
5.	Tubes	Admiralty Metal Arsenical Copper Aluminium Brass Muntz Metal Aluminium Bronze 90-10 Copper Nickel 70-30 Copper Nickel 304 Stainless Steel	ASTM Spec C-11
		Aluminium	ASTM Spec B-234

JOB NO. : DCIL-105

EXHIBIT : 4

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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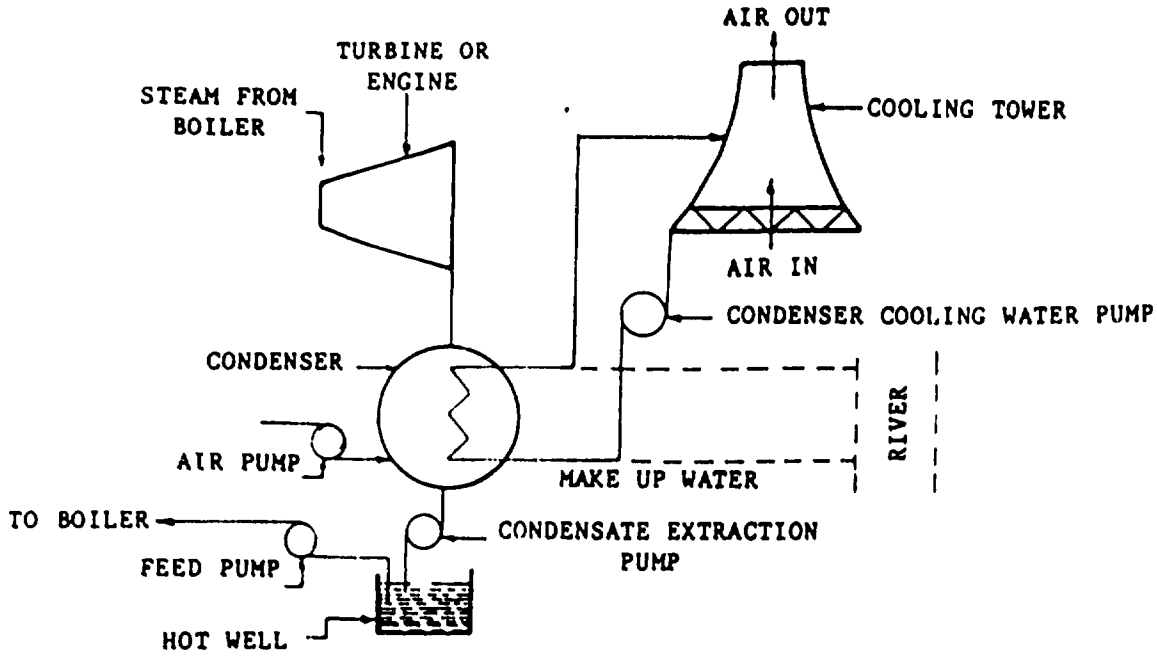
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION
PROJECT PROFILE ON STEAM CONDENSERS
SCHEMATIC OF A CONDENSER CIRCUIT



SECTION - 4
MARKET ANALYSIS

MARKET ANALYSIS

Steam condensers are used in association with steam boilers. Exhaust steam from steam turbines is condensed in condensers and the recovered condensate is recycled to the boilers. Demand for condensers, therefore, is linked to the demand for steam boilers used for power generation.

According to the Sectoral Study carried out by the AIDMO, the average annual increase in power generating capacity for the Arab region comprising 20 countries ranges from 7,000 MW in the early 1990s to nearly 9,900 MW by 2010 AD. The increase in the generating capacities in the designated region is likely to range from 6,700 MW in the early 1990s to nearly 9,300 MW by 2010 AD. Correspondingly, demand for various electrical equipment including steam condensers is estimated to increase substantially to be able to generate the additional power.

Annual requirement of steam condensers, as projected by the AIDMO for the entire Arab region is presented in Exhibit-5. It is assumed on a conservative basis that only about 70% of the additional generating capacity proposed in the AIDMO report might actually be implemented. Consequently, the demand for various electrical equipment is taken to be 70% of the projections made by the AIDMO.

Manufacturing and marketing of heavy equipment such as steam boilers and condensers require a high degree of skill and expertise in project coordination. Therefore, a new company is unlikely to manufacture the entire range of equipment

from 30 MW to 600 MW. Hence, it is recommended that only one manufacturing unit be set up for the entire Arab region to initially manufacture 5 numbers each of 30 MW and 150 MW steam condensers. Gradually, the product-mix may be expanded to include 300 MW and 600 MW condensers as well.

The tonnage for condenser shown in Exhibit-5 is based on the norms used in the AIDMO report. The actual weight is likely to be much higher. In fact, the gross weight of 5 numbers each of 30 MW and 150 MW steam condensers will be of the order of 1300 tonnes.

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JOB NO. : DCIL-105

EXHIBIT : 5

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
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PROJECT PROFILE ON STEAM CONDENSERS

PROJECTED ANNUAL REQUIREMENT OF STEAM CONDENSERS

Year	600 MW		300 MW		150 MW		30 MW		Total	
	Nos	Tons	Nos	Tons	Nos	Tons	Nos	Tons	Nos	Tons
1991-1995	5	2250	8	2400	3	450	5	225	21	5325
1996-2000	7	3150	10	3000	5	750	5	225	27	7125
2001-2005	10	4500	3	900	5	750	6	270	24	6420
2006-2010	11	4950	3	900	6	900	1	45	21	6795

SECTION - 5
PLANT LOCATION

PLANT LOCATION

It is recommended that the plant suggested in the previous section be set up in Algeria to cater to the demand for condensers in the designated region.

Generally, selection of a plant location to manufacture condensers is based on the following considerations :

- size of the domestic market in each of the 13 countries within the designated region
- local availability of major raw material
- proximity to the source of raw material, and the availability of road, rail or sea linkages
- local availability of bought-out auxiliary equipment like pumps, air ejectors, spring mountings, valves, cooling towers, etc
- availability of qualified technical personnel and skilled workmen
- availability of essential infrastructural facilities such as power, water, etc.
- relationships and affiliations among different nations within the region

Considering all the above criteria Egypt would have been the ideal choice for setting up the plant. However, the plant is suggested to be located in Algeria, primarily to reduce regional imbalances. Among the Arab countries the ones which

are close to the middle-east are already industrially developed compared to their counterparts in the north African region. Condenser manufacturing facilities in Algeria will be able to serve the needs of this region and once developed can also feed the middle-east market. Initially, some critical components and trained manpower may have to be imported from other industrially developed countries. However, with continuous technology absorption and upgradation, the plant will go a long way in bringing economic and industrial development to this region.

SECTION - 6
MANUFACTURING PROCESS

MANUFACTURING PROCESS

The condensing equipment that are employed in conjunction with steam generators and steam turbines in a power plant include a surface condenser and allied equipment such as pumps for circulating the condensate, cooling water and air removal pumps, temperature and pressure measuring devices, piping network including relief and control valves, etc.

Manufacturers of surface condensers usually adopt the following procedure. They procure the allied equipment from external agencies, fabricate the condensing unit in their own plants and finally erect the whole system at the site. The equipment are also tested for performance at the site.

After their design and manufacture, steam condensers are tested for conformance to various national and international standards. The most widely accepted standards are those instituted by TEMA, HEI, ASME (Boiler and pressure vessel codes) and ANSI. It is a statutory obligation on the part of all manufacturers of the product to conform to any one of the above mentioned standards or their equivalent, as specified by the client.

The surface condenser is an air-tight shell, enclosing a large number of tubes of smaller diameter, arranged in various configurations. The tubes may be made of either copper alloy or stainless steel. The other elements of the condenser are steam inlet casing, back and front water boxes, hot well, tube sheets, tube supporting plates, casings for water inlet, water outlet and condensate outlet, stiffeners and gusset plates, etc. The shell and other

elements are fabricated from plates of varying thickness. Thus, the manufacture of a surface condenser mainly involves metal working and metal forming operations, welding, tube bending, tube fitting and assembly work.

Some of the important manufacturing processes are discussed below :

METAL-WORKING AND METAL-FORMING

The plates used in construction of the surface condenser are cut and formed to shape in cold condition. High capacity presses, plate straightening rolls, bending rolls, shearing and oxy-cutting machines, edge-planing and bevelling machines, and dished end forming machines are required for metal-working and metal-forming operations.

WELDING

Different welding processes such as arc welding with coated electrodes, automatic submerged arc welding, 'TIG' welding, 'MIG' welding and gas welding play a significant part in the fabrication of a surface condenser and its components.

In all the above mentioned welding processes, the source of heat is an electric arc whose temperature may be as high as 5727° C. Of these methods, gas-shielded arc welding is generally preferred. The shielding gas used may be carbon dioxide or argon.

Carbon dioxide is used in welding low carbon steels. This method of welding is favoured because it provides higher output, lower cost and deeper penetration. Owing to the high temperature of the stream of shielded gas heated by the arc, the metal cools slowly and a sound weld is obtained. The

possibility of automating this process without the use of fluxes makes it more suitable to adopt.

Argon is used mainly in welding aluminium members, as well as thin sheets of high alloy stainless steel and heat resisting steels.

Selection of Electrodes

Selecting the right electrode for a type of job is one of the most important decisions the Welder must make. The American Welding Society (AWS) has developed a number code to identify and classify electrodes approved by the ASTM. Various AWS-ASTM electrode classifications, their recommended position relative to the workpiece, application and polarity are listed in the Exhibit-6.

Preheating and Post-weld Heat Treatment

Preheating of parts which are to be welded counteracts high stresses in the deposited weld-metal and prevents cracks from developing in low-alloy steels after welding. The preheating temperature varies from 150° to 400° F depending upon the chemical composition and thickness of the material to be welded. Less preheating will be required if welding is done with low hydrogen electrodes. Preheating is generally done by oxy-acetylene heating torches.

Post-weld heat treatment, which is dependent on the complexity of the structure, composition and thickness of the material, is required for the following reasons :

- to reduce hard zones in the weld area of carbon and low-alloy steels

- to relieve residual stresses caused by welding
- to reduce corrosion resistance of some materials
- to reduce distortion during subsequent machining by removing local concentration of residual stresses

The temperature for heat treatment may vary from 1100° to 1375° F.

TUBE BENDING AND FIXING

The tubes most commonly used in a surface condenser are either of copper alloy or of stainless steel. The outer diameters vary from 22 to 25 mm and the wall thickness varies from 18 to 22 SWG (Standard Wire Gauge).

Tube Bending

The condenser tubes are bent in cold condition by any one of the following methods :

- rotary draw bending
- rotary compression bending
- three roll bending
- ram type bending

Rotary draw bending is the most commonly used method. This method uses different types of mandrels for tube bending.

The plain and duckhill mandrels are for heavier walled sections which require less internal support. Ball-type mandrels are used for thin-wall sections, as balls can go around the bend to provide support and prevent the wall from collapsing.

Tube Fixing

Tubes are firmly attached to the tube sheets by tube expanding or tube rolling. The expanding or rolling process involves cold working of the ends of the tubes so that these are in intimate contact with the sheet metal containing tube holes. When the tube is expanded, its inside and outside diameters and length increases, while its wall thickness decreases.

The expanding tool contains rolls set at a slight angle to the body of the expander. This causes the tapered mandrel to feed inward when it is rotated clockwise. As the mandrel feeds inwards, the rolls develop the internal force which expands the tube.

MACHINING

Construction of surface condensers requires several hundred holes to be drilled, reamed, tapped and spot-faced or counter sunk. Holes of different diameters and depth may be drilled by portable drilling machines with universally adjustable drilling head. A number of mountings and attachments are fitted to the condenser's shell. Seating for the mountings are machined with the help of specially devised machine tools. In addition, some general purpose machine tools are also required.

QUALITY CONTROL

As mentioned earlier, each of the surface condenser manufacturing processes must conform to the norms set by various associations like the TEMA, HEI, ASME, ANSI, etc.

These norms can be best maintained by controlling the quality of base materials and weldments thru' non-destructive testing. The four basic tests used for maintaining welding quality are :

- o radiography
- o ultrasonics
- o magnetic particle testing, and
- o liquid penetrant testing

The first two are used for volumetric examination and the rest for surface examination.

JOB NO. : DCIL-105 EXHIBIT : 6

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

AWS-ASTM ELECTRODE CLASSIFICATIONS AND RECOMMENDED APPLICATIONS

Electrode (AWS-ASTM) Numbers	Position	Use	Type of Current Used
E 4520	All	-	DCSP
E 6010	All	Penetration	DCRP
6011	All	Penetration	DCRP or AC
6012	All	Production	DCSP or AC
6013	All	Sheet Metal and Fillets	DCSP, DCRP or AC
6020	H (Fillets)	-	DCSP or AC
	F	-	DCSP, DCRO or AC
6027 (Iron Powder)	H (Fillets)	-	DCSP or AC
	F	-	DCSP, DCRP or AC
E 7010-X	All	-	DCRP
7011-X	All	-	DCRP or AC
7014-X	All	-	DCSP, DCRP or AC
7015-X	All	-	DCRP
7016-X (Low Hydrogen)	All	-	DCRP or AC
7018-X (Low HYdrogen)	All	-	DCRP or AC
7020-X	H (Fillets)	Chrome-Moly Steel	DCSP or AC
	F	-	DCSP, DCRP or AC
7024-X (Iron Powder)	H (Fillets)	-	-
	F	-	DCSP, DCRP or AC
7027-X (Iron Powder)	H (Fillets)	-	DCSP or AC
	F	-	DCSP, DCRP or AC

JOB NO. : DCIL-105 EXHIBIT : 6

Electrode (AWS-ASTM) Numbers	Position	Use	Type of Current Used
7028-X	{ H (Fillets)	-	-
	{ F	-	DCRP or AC
E 8010-X	All	Chrome-Moly Steel	DCRP
8011-X	All	Chrome-Moly Steel	DCRP or AC
8013-X	All	-	DCSP, DCRP or AC
8015-X	All	-	DCRP
8016-X (Low Hydrogen)	All	Nickel Alloy	DCRP or AC
8018-X (Iron Powder)	All	-	DCRP or AC
E 9010-X	All	Chrome-Moly Steel	DCRP
9011-X	All	Chrome-Moly Steel	DCRP or AC
9013-X	All	-	DCSP, DCRP or AC
9015-X	All	-	DCRP
9016-X (Low Hydrogen)	All	-	DCRP or AC
9018-X (Iron Powder)	All	-	DCRP or AC
E 10010-X	All	Chrome-Moly Steel	DCRP
10011-X	All	-	DCRP or AC
10013-X	All	-	DCSP, DCRP or AC
10015-X	All	-	DCRP
10016-X (Low Hydrogen)	All	Nickel Alloy	DCRP or AC
10018-X (Iron Powder)	All	-	DCRP or AC
E 11015-X (Low Hydrogen)	All		DCRP
11016-X	All		DCRP or AC

JOB NO. : DCIL-105 EXHIBIT : 6

Electrode (AWS-ASTM) Numbers	Position	Use	Type of Current Used
11018-X (Iron Powder)	All	-	DCRP or AC
E 12015-X	All	-	DCRP
12016-X (Low Hydrogen)	All	Nickel Alloy	DCRP or AC
12018-X (Iron Powder)	All	-	DCRP or AC

Note - The Suffix X stands for A_1, B_1, B_2, etc., and designates chemical composition of the weld metal.

SECTION - 7
PLANT AND EQUIPMENT

PLANT AND EQUIPMENT

In order to make the estimated number of steam condensers of 150 MW and 30 MW rating, the plant will need nearly 1,300 tonnes of steel plates and tubes. Manufacturing the above items in a single plant will offer considerable economies of scale. The plant will have the following facilities :

- Production and Tool Room
- Material Testing and Welding Development Centre
- Maintenance
- Material Handling
- Utilities

Exhibit-7 presents dimensions, weights and other operating characteristics of surface condensers of the 600 MW, 300 MW, 150 MW and 30 MW ratings. These parameters have been arrived at by applying basic thermodynamic principles to data published by various manufacturers of surface condensers. In terms of tonnage, the 600 MW, 300 MW, 150 MW and 30 MW types of condensers are equivalent to 450, 375, 190 and 74 tonnes, respectively.

Dimensional parameters of condenser shells are given below :

	Rating (MW)			
Dimension (m)	600	300	150	30
Length	12.65	10.40	9.00	6.70
Breadth	18.00	11.00	6.00	2.24
Height	5.00	6.00	6.00	6.00

These dimensions represent a condenser shell which is shaped like a rectangular parallelopiped. But, in practice, the shape may also be cylindrical, oval or U-shaped, depending on the design parameters.

It is obvious from the above that condensers are unwieldy. This makes it difficult to transport them from the manufacturing plant to the site. Therefore, condensers are hardly ever assembled wholly in the shop. A good part of the work has to be done at the site. However, rising costs of construction and skilled labour have rendered the field construction costlier. Condenser manufacturers, therefore are adopting prefabrication techniques which reduce field work on the one hand, and on the other, pose less problems in transportation of prefabricted materials from the plant to the site. Some of these techniques are discussed below :

Shop-tubed Modules

Condensers are designed in modular form, i.e., a condenser may typically consist of a number of modules. The condenser shell module is completely shop-assembled with all shell plates, tube supports, tubes, baffles, gussets, struts, braces, spray pipes and connections instalied. Other sub-assemblies such as water boxes are shipped and assembled at site after testing.

Sectionalised Components

Sub-assemblies are fabricated at the factory with temporary braces, lifting lugs and field assembly clips, to permit easy erection at the site.

Panelised Construction

Individual panels and components are fabricated at shop and shipped to site. Parts are inspected and match marked prior to shipment.

In practice, the apportionment of work between shop fabrication and field assembly that is economically advantageous, varies with the type and size of condenser, shipping weight and clearance restrictions, job-site limitations and availability of skilled labour. Manufacturing facilities should be so designed that most of the parts are fabricated at the plant itself. Suitable adjustments will have to be made depending upon the quantum of fabrication work that will be required to be done at the site.

The proposed facilities can manufacture condensers up to 150 MW as a single unit. Higher capacity condenser shells, however, will have to be made in modules. It is assumed here that the maximum weight of the component to be transported by road will not exceed 125 tonnes. In most cases, tube fitting and expanding will be done at the site.

The main production processes involved in manufacturing surface condensers are :

- Preparation of Condenser Components
- Fabrication
- Welding
- Machining
- Tubing
- Erection
- Testing and Commissioning

Based on the design parameters and the demand for the product, the manufacturing workload is estimated in Exhibit-8. This exhibit separately explains the operations involved in manufacturing a 150 MW and a 30 MW condenser.

Production and Tool Room

The production shop will have equipment for the following sections :

- Cutting
- Metal Forming
- Welding
- Drilling
- General Machinery Section for production, tool repair and maintenance
- Assembly, Testing and Despatch

List of equipment for production and tool room is presented in Exhibit-9.

Material Handling

List of equipment for material handling is included in Exhibit-9. Material handling facilities have been designed in such a way that the production area, raw material stores, general stores and finished goods despatch area are all within the reach of overhead EOT cranes. Capacity of the cranes have been determined by considering the maximum weight of a single piece which is to be handled at each stage of production. A completely assembled, 150 MW condenser will weigh 190 tonnes for which 200/10 tonne EOT cranes have been provided.

For inter-bay material movement, 2 battery-operated trolleys are provided. Besides, 2 fork lift trucks and 1 mobile crane is also provided. Material movement outside the plant will be done by hired vehicles. However, 2 trucks have been provided for general purpose use and for emergency.

Material Testing and Welding Development Centre

To ensure that the condensers function as specified by the designer of the equipment, these must be manufactured from quality raw material. Suitable facilities have been suggested in the material testing section to check the physical and chemical properties of incoming materials. Equipment have also been recommended for destructive and non-destructive testing of the finished components. Welding plays an important role in manufacturing of condensers. It requires welders who are highly skilled. Thus, equipment required for welding development and welders' training have also been included in the above section.

List of equipment for material testing and welding development are listed in Exhibit-10.

Auxiliary Equipment

List of auxiliary equipment is presented in Exhibit-11. This includes a 25 tonne weighbridge. In case railway siding facilities are available, then capacity of the weighbridge may go up to 150 tonnes.

Maintenance

List of equipment for maintenance shop is shown in Exhibit-12.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 7

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

DIMENSIONS AND WEIGHTS OF SURFACE CONDENSERS

Sl. No.	Description	Unit	Rating (MW) 600	300	150	30
1.	Steam load	Kg/hr/m²	42.30	34.60	39.00	39.00
2.	Tube surface area for condensing	m²	32141	20228	9000	2500
3.	Tube surface area for cooling @ 5% of (2)	m²	1607	1011	450	125
4.	Total tube surface area	m²	33748	21239	9450	2625
5.	Tube Dimension					
	(i) Outer diameter	mm	22	25	25	25
	(ii) Gauge	BWG	22	18	18	18
	(iii) Length	m	12.65	10.4	9	6.7
6.	Tube material	-	SS	ARSCU	ARSCU	ADM
7.	Tubes	Nos.	38619	25605	13340	4991
8.	Steam flow	Kg/sec	396	194	98	27
9.	Steam density	Kg/m³	0.035	0.035	0.035	0.035
10.	Steam flow volume	m³/sec	11322	5555	2786	774
11.	Steam flow rate	m/sec	76	76	76	76
12.	Steam inlet area	m²	149	73	37	10
13.	Tube matrix width	m	18	11	6	2.24
14.	Header shut area	m²	94	47	24.5	9.22

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Sl. No.	Description	Unit	Rating (MW) 600	300	150	30
15.	Header shut thickness	mm	38	38	38	32
16.	Header shut height	m	3	4	4	4
17.	Shell height	m	5	6	6	6
18.	Shell plate thickness	mm	22	22	22	20
19.	Tubing weight	Tonne	222	226	99	27
20.	Header plate (2 nos.) weight	Tonne	34	29	15	5
21.	Shell plate weight	Tonne	95	60	38	21
22.	Weight of sitting, support structure, inlet and outlet flanges, access ports, water boxes, etc.	Tonne	100	60	38	21
23.	Total condenser weight (19 + 20 + 21 + 22)	Tonne	451	375	190	74

OD - Outer Diameter BWG - British Wire Gauge

Tube matrix width * - $\frac{1.5 \times \text{steam inlet area}}{\text{Tube length}}$

Header shut area ** - 1.5 (Tube OD x 1.4)^2 x No. of tubes

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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PROJECT PROFILE ON STEAM CONDENSERS

MANUFACTURING LOAD

Sl. No.	Operation	Unit	Condenser Rating (MW) 150	30	Total
1.	Preparation including dressing, marking, cutting and forming of plate work	MT	546	282	828
2.	Edge preparation length for welding	M	480	165	645
3.	Tube cutting	Nos	70035	26203	96238
4.	Tube fitting and expanding	Nos	66700	24955	91655
5.	Drilling holes	Nos	524500	189330	713830
6.	Fabrication excluding tubing	MT	455	235	690
7.	Welding length	M	6300	3488	9788
8.	Stress relieving	MT	455	235	690
9.	Marking for machining of seatings, mahole covers, etc., and other joints	Nos	50	50	100
10.	Machining	Nos	50	50	100
11.	Shop assembly and dismantling	MT	950	370	1320
12.	Surface cleaning (shot blasting)	M^2	5688	2938	8626
13.	Primer and painting	M^2	5688	2938	8626
14.	Packing for despatch	MT	950	370	1320
15.	Site erection and commissioning	MT	950	370	1320

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EXHIBIT : 9

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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PROJECT PROFILE ON STEAM CONDENSERS

LIST OF PRODUCTION AND TOOL ROOM EQUIPMENT

Sl. No.	Equipment	Brief Specifications			Nos. Required	Power Consumption (KW)	Total Price ($)
	Cutting Machines						
1.	Plate Shearing Machine	Type	:	Hydraulic	1	25	49,590
		Shearing Length	:	1600 mm			
		Max Plate Thickness	:	10 mm			
2.	Cropping, Punching and Section Shearing Machine	Max Section of Angles	:	130 x 130 x 12 mm	1	8	51,330
		Max Section of Plates	:	120 x 16 mm			
		Max Dia of Holes to be punched	:	30 x 20 mm thick			
3.	Circular Cold Saw	Type	:	Semi-automatic Hydraulically operated	1	10	48,600
		Cutting Capacity					
		Round	:	25 - 350 mm			
		Square	:	300 mm			
		Saw Blade Size	:	1010 mm			
4.	Abrasive Wheel Cut off Machine	Type	:	Dry Cutting with Pneumatic Chucking	2	40	70,000
		Cutting Capacity					
		Solid Section	:	63 mm Dia			
		Hollow Section	:	80 mm Dia			
		Bevel Cut	:	45°			

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JOB NO. : DCIL-105 EXHIBIT : 9

Sl. No.	Equipment	Brief Specifications			Nos. Required	Power Consumption (KW)	Total Price ($)
5.	Profile Cutting Machine	Type	:	Oxyacetylene Profile Cutting Machine incorporating coordinate drive and photoelectric scanning system	1	1	21,000
		Cutting Length	:	9000 mm			
		Cutting Width	:	3200 mm			
		Max Thickness	:	60 mm			
6.	Plasma Cutting Machine including suitable power source, main control unit, reservoir unit, travel carriage, water cooled plasma torch with accessories and pressure regulation for Argon, Nitrogen and Hydrogen	Current Range for Plasma Cutting	:	40 - 300 Amps	1	29	20,350
		Max Thickness of Plate to be cut	:	Up to 70 mm			
7.	Line and Circle Cutting Machine	Plate Thickness for Square Cut	:	3 - 100 mm	3	0.4	3,600
		Plate Thickness for Bevel Cut	:	66 mm			
		Circle Cutting Dia	:	150 - 1500 mm			
8.	Universal Nibbling Machine	Throat Depth	:	1500 mm	1	4	2,950
		Max Circle Dia cut from a square blank	:	1235 mm			
		Length of Stroke	:	2 - 10 mm			
9.	Plate Edge Planner	Max Planning Length	:	9000 mm	1	22	1,63,300
		Max Plate Thickness	:	80 mm			

JOB NO. : DCIL-105 EXHIBIT : 9

Sl. No.	Equipment	Brief Specifications			Nos. Required	Power Consumption (KW)	Total Price ($)
	Metal Forming Machines						
10.	3 Roll Plate Bending Machine	Working Width	:	3000 mm	1	90	1,22,800
		Max Plate Thickness	:	30 mm			
11.	7 Roll Plate Straightening Machine with 3 Rollers at the bottom and 4 Rollers at the top	Straightening Capacity			1	75	1,50,000
		Plate Width	:	3200 mm			
		Plate Thickness	:	25 mm			
		Rolling Speed	:	3.5 - 6 mtrs/min.			
12.	Beam Straightening Machine	Type	:	Ram type	1	15	56,680
		Capacity	:	250 tonne			
		Ram Stroke	:	630 mm			
		Table Width	:	2500 mm			
13.	Tube Bending Machine	Type	:	Rotary Draw	1	3	40,000
		Max External Dia of Tube	:	25 mm			
14.	Pneumatic Hammer	Weight of Falling Parts	:	170 kg	1	20	44,200
		Max Stroke	:	430 mm			
		Single Blow Energy	:	452 kgm			
		Anvil Block Weight	:	1700 kg (approx)			
15.	Oil Fired Furnace	Size of Heating Chamber	:	600 x 600x 1500 mm	1		50,000

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Sl. No.	Equipment	Brief Specifications		Nos. Required	Power Consumption (KW)	Total Price ($)
16.	Dished End Forming Machine	Max Cold Spinning Dia : 4.4 m		1	20	1,25,000
		Max Cold Spinning Thickness : 22 mm				
17.	Hydraulic Press	Capacity : 200 tonnes		1	30	59,250
		Standard Stroke Length : 630 mm				
		Shut Height (Bolster to Platen) : 710 mm				
18.	Heavy Duty Pedestal Grinder	Type : Double Ended		7	18	8,400
		Wheel Size : 400 x 50 x 40 mm				
19.	Hydraulic Press Brake	Capacity : 250 tonnes		1	50	70,850
		Max Width of Plate : 3200 mm				
		Max Thickness of Plate : 20 mm				
20.	Stress Relieving Furnace	Type : Bogie-type Oil Fired		1	45	82,000
		Chamber Size : 10 x 8 x 8 mtrs				
		Max Operating Temperature : 850° C				
		Max Weight of a Single Piece : 60 tonnes				
21.	Shot Blasting Booth	Type :	Pneumatically operated, equipped with shot recovery unit and complete dust collection unit	1	10	17,790
		Chamber Size : 10 x 8 x 8 mtrs				

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Sl. No.	Equipment	Brief Specifications			Nos. Required	Power Consumption (KW)	Total Price ($)
22.	Painting Booth	Type	:	Painting Booth equipped with environmental control units including exhaust fans and water scrubbing facilities	1	-	10,000
		Chamber Size	:	10 x 8 x 8 mtrs			
Welding Machine							
23.	Welding A.C. Transformer Set	Type	:	Forced Air Cooled	5	150	4,600
		Range of Welding Current	:	60 - 600 Amps			
		Rated Current	:	500 Amps			
24.	Welding A.C. Transformer Set	Type	:	Forced Air Cooled	3	55	1,870
		Range of Welding Current	:	40 - 300 Amps			
		Rated Current	:	250 Amps			
25.	Welding A.C. Transformer Set	Type	:	Forced Air Cooled	3	70	1,960
		Range of Welding Current	:	60 - 450 Amps			
		Rated Current	:	350 Amps			
26.	Rectifier D.C. Welding Set	Type	:	Forced Air Cooled	4	157	10,300
		Range of Welding Current	:	70 - 600 Amps			
		Rated Current	:	600 Amps			

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Sl. No.	Equipment	Brief Specifications			Nos. Required	Power Consumption (KW)	Total Price ($)
27.	Submerged Arc Welding Set	Type	:	Constant Potential with D.C. rectifier power source	2	110	13,130
		Rated Current	:	1200 Amps			
		Wire feed rate	:	0.9 - 7.5 metres/min.			
28.	TIG Welding Set complete with Argon arc torch and accessories, D.C. suppresor unit, high frequency unit, water circulation unit and D.C. rectifier power source	Type	:	Semi-automatic	2	40	8,645
		Range of Welding Current	:	40 - 350 Amps			
		Rated Current	:	300 Amps			
		Open Circuit Voltage Range	:	52 - 62 V			
29.	MIG Welding Set complete with D.C. rectifier power source, servo wire feeder unit, CO_2 regulator cum flowmeter, and heater with core assembly	Type	:	Semi-automatic	2	34	6,370
		Rated Current	:	400 Amps			
		Open Circuit Voltage	:	55 V D.C.			
30.	Welding Positioners, Booms, Manipulators, etc.	Capacity	:	10 tonnes	2	2	500
		Capacity	:	40 tonnes	4	16	
31.	Electrode Drying Oven	Type of Control	:	Thermostat	2	4	500
		Temperature Range	:	50 - 300° C			
	Drilling Section						
32.	Drilling Machine	Type	:	CNC, 3 Spindle with movable bed suitable for drilling tube plates	1	20	70,000
		Max Size of Tube Plate	:	12.5 x 5 mtrs			
		Max Hole Size	:	30 mm			

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Sl. No.	Equipment	Brief Specifications		Nos. Required	Power Consumption (KW)	Total Price ($)
33.	Radial Drilling Machine	Max Drilling Capacity in Steel (50 kg/mm²)	: 50 mm	2	15	55,670
		Arm Length	: 2.3 mtrs			
34.	Portable Drilling Machine	Type	: Heavy Duty Radial type with Universal Drilling Head	1	10	2,500
		Max Hole Size	: 40 mm			
		Arm Length	: 2 mtrs			
35.	Column Drilling Machine	Drilling Capacity in Steel	: 50 mm	2	8	4,000
		Table Size	: 1000 x 650 mm			
36.	Pillar Drilling Machine	Drilling Capacity in Steel	: 40 mm	2	4	2,800
		Table Diameter	: 335 mm			
37.	Floor type Horizontal Drilling, Boring, Milling and Facing Machine	Max Spingle Diameter	: 160 mm	1	70	1,18,100
		Length of Floor	: 10 mtrs			
		Width of Floor	: 8 mtrs			
38.	Vertical Boring Machine	Type	: Single Column Movable	1	63	1,40,510
	Material Handling Equipment					
39.	E.O.T. Crane	Capacity	: 10 tonnes	6	180	3,40,080
		Span	: 20 mtrs			
		Class	: III			

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Sl. No.	Equipment	Brief Specifications		Nos. Required	Power Consumption (KW)	Total Price ($)
40.	E.O.T. Crane	Capacity	: 25 tonnes	1	50	1,18,872
		Span	: 20 mtrs			
		Class	: III			
41.	E.O.T. Crane	Capacity	: 200/10 tonnes	2	250	4,44,000
		Span	: 20 mtrs			
		Class	: III			
42.	Forklift Truck	Type	: Diesel Engine Operated	1	-	71,740
		Capacity	: 5 tonnes			
		Load Centre	: 600 mm			
		Max Fork Height	: 4.5 mtrs			
43.	Forklift Truck	Type	: Diesel engine operated	2	-	82,280
		Capacity	: 3 tonnes			
		Load Centre	: 500 mm			
		Max Fork Height	: 4 mtrs			
44.	Mobile Crane	Type	: Tyre mounted, diesel engine operated	1	-	65,220
		Overall Jib Length	: 11.5 mtrs			
		Max Lifting Capacity at 3 M radius	: 10 tonnes			
45.	Inter-bay Material Transfer Trolleys	Type	Battery Operated	2	-	100
		Capacity	100 kg			

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Sl. No.	Equipment	Brief Specifications		Nos. Required	Power Consumption (KW)	Total Price ($)
46.	Hand Push Trolleys	Capacity	: 1000 kg	8	-	800
		Capacity	: 500 kg	8		600
47.	Double Wheel Barrow	Type	: Heavy Duty	8	-	800
		Capacity	: 0.2 m^3			
48.	Truck	Loading Capacity	: 8000 kg	1	-	7,500
		Loading Capacity	: 5000 kg	1	-	7,500
	TOTAL					28,67,637

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JOB NO. : DCIL-105 EXHIBIT : 10

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PROJECT PROFILE ON STEAM CONDENSERS

LIST OF EQUIPMENT FOR MATERIAL TESTING AND WELDING DEVELOPMENT CENTRE

Sl. No.	Equipment	Brief Specifications	Nos. Required	Power Consumption (KW)	Total Price ($)
1.	Brinell Hardness Testing Machine	Type : Power operated Applied Load : 250 - 3000 kgs	1	1.0	11,170
2.	Rockwell Hardness Testing Machine	The machine shall use both steel ball and diamond cone Minor Load : 10 kg Major Load : 100 kg, 150 kg	1	1.0	9,080
3.	Universal Testing Machine	Type : Hydraulically loaded Capacity : 100 Tonnes	1	6.0	17,000
4.	Crack Depth Detection and Die Penetrant Test Equipment	Standard	1	-	600
5.	Compressor Testing Machine	Capacity : 100 Tonnes	1	1.0	800
6.	Impact Testing Machine	Type : Pendulam type impact tester charpy system Capacity With Complemtary Weights : 30 kgm Without Complementary Weights : 15 kgm	1	1.0	1,000

JOB NO. : DCIL-105 EXHIBIT : 10

Sl. No.	Equipment	Brief Specifications			Nos. Required	Power Consumption (KW)	Total Price ($)
7.	Metallographic Specimen Mounting Bakelite Press	Capacity	:	8 tonnes	1	1.0	800
8.	Surface Grinder	Type	:	Swing type, floor model with cup wheel	1	2.0	50
		Sample Size					
		Diameter	:	30 - 50 mm			
		Thickness	:	3 - 35 mm			
9.	Specimen Grinding and Polishing Machine for Metallography	Disc Size	:	200 mm	1	1.0	500
10.	Electrolytic Polishing Apparatus	Type	:	Laboratory type electrolytic polishing apparatus	1	1.0	200
		Max Sample Diameter	:	250 mm			
		Max Sample Height	:	40 mm			
11.	Metallographic Microscope	Type	:	Projection-cum-Photo-micrograph laboratory type microscope	1	-	100
		Magnification	:	58 - 1800 dia			
12.	Material Testing Spectro-scope	Used for qualitative and quantitative analysis of samples using microphotometer and photographic plate or film for recording			1	-	580
13.	Apparatus for Deter-mination of Carbon and Sulphur	Max Carbon Content	:	4.5%	1	-	100
		Max Sulphur Content	:	0.15%			

JOB NO. : DCIL-105 EXHIBIT : 10

Sl. No.	Equipment	Brief Specifications			Nos. Required	Power Consumption (KW)	Total Price ($)
14.	Bench Drilling Machine	Dia of Hole	:	13 mm	1	0.6	3,000
		Table Size	:	350 x 50 mm			
15.	Electric Muffle Furnace	Type	:	Laboratory	1	5.0	2,000
		Dimension	:	475 x 175 x 175 mm			
16.	Ultrasonic Testing Equipment	Type	:	Ultrasonic, pulse reflection, portable type	F	-	26,000
		Measuring Range in Steel	:	1 - 1000 cm			
		Frequency Range	:	0.5 - 10 Mc/s			
17.	Magnetic Crack Detector	The detector shall produce both longitudinal and circular magnetic fields			1	-	21,390
		Current Range	:	250 - 1200 amps			
		Voltage Range	:	4 - 8 volts			
18.	Abrasive Cutting Machine	Type	:	Submerged type, wet oscillating cutting machine for laboratory use	1	12.0	8,000
		Max Cutting Capacity	:	100 mm			
		Dia of Cutting Wheel	:	450 mm			
19.	Weighing Machine	Type	:	Micro analytical balance	1	-	100
		Capacity		20 gms			
		Sensitivity per Scale Division	:	0.01 mg			

JOB NO. : DCIL-105 EXHIBIT : 10

Sl. No.	Equipment	Brief Specifications			Nos. Required	Power Consumption (KW)	Total Price ($)
20.	Weighing Machine	Type	:	Analytical balance	1	-	150
		Capacity	:	200 gms			
		Sensitivity	:	0.1 mg			
21.	Hydraulic Test Pump complete with pressure gauge, check valve, outlet valve and water tank	Test Pump	:	100 kg/cm^2			200
		Tank Capacity	:	8 litres			
Portable Testing Tools							
1.	Portable Hardness Tester	Type	:	Rockwell	1	-	500
2.	Portable Hardness Tester	Type	:	Poldi type hardness tester (ferrous and non-ferrous) consisting of tester, standard test bar and measuring magnifiscope	1	-	500
		Indentor	:	10 mm dia Prinell Ball			
3.	Portable X-Ray Equipment	Type	:	Industrial	1	-	600
		Max Thickness	:	100 mm			
		Sensitivity	:	1 - 2 %			
Welding Development Section							
1.	CO_2 Semi-automatic Welding Equipment	Rated Current	:	400 Amps	2	34	6,370
		Open Circuit Voltage	:	55 V DC			

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EXHIBIT : 10

Sl. No.	Equipment	Brief Specifications			Nos. Required	Power Consumption (KW)	Total Price ($)
2.	Semi-automatic MIG Welding Equipment	Type	:	Semi-automatic	2	34	6,370
		Rated Current	:	400 Amps			
		Open Circuit Voltage	:	55 V D.C.			
3.	Manual TIG Welding Equipment	Type	:	Manual	2	40	3,190
		Range of Welding Current	:	40 - 350 Amps			
		Rated Current	:	300 Amps			
		Open Circuit Voltage Range	:	52 - 62 V			
4.	Automatic Submerged Arc Welding Facilities	Type	:	Constant Potential with D.C. rectifier power source	2	100	13,130
		Rated Current	:	1200 Amps			
		Wire feed rate	:	0.9 - 7.5 metres/min.			
5.	Metal Spraying Machine	Size of Spraying Wires	:	0.8 - 4.0 mm	2	-	100
		Spraying Metals	:	Steel, Stainless Steel, Copper, Brass, Bronze, Aluminium, Tin, Nickel, Molybdenum, Lead, etc.			
		Drive	:	Air turbine			

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 10

Sl. No.	Equipment	Brief Specifications		Nos. Required	Power Consumption (KW)	Total Price ($)
6.	Manual Metal Arc Welding Facilities	Type : Forced Air Cooled Range of Welding Current : 60 - 600 Amps Rated Current : 500 Amps		2	60	7,500
7.	Oxyacetylene Gas Welding Facilities	Standard		2	-	5,000
8.	High Pressure Welder Training Booths	Standard		8	-	5,000
	TOTAL					1,51,000

JOB NO. : DCIL-105

EXHIBIT : 1

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

LIST OF AUXILIARY EQUIPMENT AND HAND TOOLS

Sl. No.	Equipment	Brief Specifications	Nos. Required	Power Consumption (KW)	Total Price ($)
	Auxiliary Equipment				
1.	Surface Plate	Surface plate made of close grained C.I. of 200 BHN sturdy angle iron frame and adjusting jacks Top Surface Size : 2000 x 1000 mm Overall Height of Table : 286 mm	6	-	
2.	Work Bench	50 mm laminated wood top in a angle iron frame with four angle iron legs Area of Top Surface : 2000 x 850 mm Floor to Top Height : 900 mm	40	-	
3.	Work Table	All steel, welded construction work tables Top surface : 1000 x 3000 mm Min. Plate Thickness : 40 mm Height of Table : 950 mm	10	-	
4.	Workers' Tool Cabinet	Steel cabinets consisting of two shelves Size (W x D x H) : 600 x 450 x 750 mm	150	-	
5.	Bar, Pipe and Rod Storage Rack	Heavy duty double-arm six high storage rack of steel Capacity : 3 Tonnes	100	-	

JOB NO. : DCIL-105 EXHIBIT : II

Sl. No.	Equipment	Brief Specifications			No. Required	Power Consumption (KW)	Total Price ($)
6.	All Steel Open Storage Rack	The rack shall have six shelves			30	-	
		Overall Size (W x D x H)	:	1200 x 450 x 1950 mm			
		Capacity	:	1500 kg/cm²			
7.	Heavy Duty Wooden Skid	Made of hard wood with metal frame			30	-	
		Top Surface	:	900 x 1000 mm			
		Load Capacity	:	1500 kgs			
8.	Steel Tote Box	Welded steel construction covered with heavy duty wire mesh			30	-	
		Size (L x W x D)	:	1000 x 1000 x 450 mm			
9.	Closed Storage Shelf	Welded steel sheet shelf with lockable doors			30	-	
		Overall Height	:	2000 mm			
		Tray Dimensions (W x D):		1000 x 450 mm			
		Load Capacity	:	500 kg/cm²			
10.	Stillages	Stillages shall be used for construction of platform for assembly work as well as for storing sheets, plates and long rolled section. The stillage shall be made of welded construction.			150	-	
		Size (L x H)	:	3000 x 750 mm			
		Width of a Frame	:	300 mm			
11.	Craddles	Type	:	Made out of steel angles or wire frames	30		
		Carrying Capacity		1 tonne			

JOB NO. : DCIL-105

EXHIBIT : 11

Sl. No.	Equipment	Brief Specifications			Nos. Required	Power Consumption (KW)	Total Price ($)
12.	Weighbridge	Type	:	Lever Type, Road Transport	1	-	
		Capacity	:	25 Tonnes			
		Platform Size (L x W)	:	8 x 3 m			
13.	Portable Platform Weighing Scale	Type	:	Arm type	6	-	
		Capacity	:	500 kgs			
14.	Roller Stand	Length	:	10 m	12	-	
		Width of Track	:	1 m			
		Length	:	10 m	12		
		Width of Track	:	0.5 m			
	Hand Tools						
15.	Hand Drill	Type	:	Pistol grip type drill	2	1.0	
		Max Capacity to Drill in Mild Steel	:	8 mm			
16.	Hand Grinder	Type	:	Hand held horizontal grinder	2	0.5	
		Wheel Dia	:	150 mm			
		Speed	:	4500 rpm			
17.	Tachometer	Speed Range	:	0 - 5000 rpm	2	-	
18.	Tennon Saw	Size	:	300 mm	2	-	

JOB NO. : DCIL-185 EXHIBIT : 11

Sl. No.	Equipment	Brief Specifications		Nos. Required	Power Consumption (KW)	Total Price ($)
19.	Compass Saw	Size	: 200 mm	2	-	
20.	Pattern Maker's Scale	Stainless steel contraction for steel, iron castings			-	
		Length	: 300 mm	4 (sets)		
			: 600 mm	4 (sets)		
	TOTAL				Lump sum	6,500

JOB NO. : DCIL-105

EXHIBIT : 12

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANISATION

PROJECT PROFILE ON STEAM CONDENSERS

LIST OF EQUIPMENT FOR MAINTENANCE SHOP

Sl. No.	Equipment	Brief Specifications		Nos. Required	Power Consumption (KW)	Total Price ($)
1.	Hydraulic Jack	Type	: Remote Control pumping unit with screwed ram and safety lock, operating handle and high pressure metallic tube connection to feed oil	4	-	800
		Capacity	: 10 Tonnes			
		Closed Height	: 298 mm			
		Hydraulic Lift	: 150 mm			
		Max. Height	: 448 mm			
2.	Screw Jack	Type	: Ratchet type, lifting and traversing screw jacks	4	-	1,200
		Capacity	: 5 Tonnes			
		Closed Height	: 500 mm			
		Lift	: 200 mm			
		Dia of Head	: 88 mm			
3.	Chain Pulley Block	Type	: Balanced Spur Gear Fixed Mounting	2	-	300
		Load Capacity	: 2 Tonnes SWL			
		Lift	: 3 m			

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 12

Sl. No.	Equipment	Brief Specifications		Nos. Required	Power Consumption (KW)	Total Price ($)
4.	Collapsible Ladder	Type	: Self-supporting extendable all Aluminium Ladder	2	-	300
		Closed Height	: 5 m			
		Extended Height	: 9 m			
5.	Pressure Gauge	Pressure Range	: 0-100 kg/cm²	1	-	100
6.	Puller	3 legged forged pullers for bearings, gears, pulleys, etc.				
		Size	: 500 mm	2	-	50
			: 400 mm	2	-	50
			: 300 mm	2	-	50
7.	Plumb Ball	Brass with Steel Point		2	-	40
		Weight	: 4 Oz			
8.	Vibration Meter	Portable, battery operated		1	-	100
9.	Pitting Press	Capacity	: 10 tonnes	1	5	5,000
10.	Pillar Drilling Machine	Drilling Capacity in Steel	: 13 mm	1	10	800
		Table Diameter	: 300 mm			
11.	Pedestal Grinder	Wheel Size	: 178 x 25 x 20 mm	1	0.5	1,200
		Distance between Wheels	: 410 mm			
12.	Flexible Grinder	Type	: Motor swivel suspension and flexible shaft type	2	0.4	100
			Two speed grinder			

JOB NO. : DCIL-105 EXHIBIT : 12

Sl. No.	Equipment	Brief Specifications			Nos. Required	Power Consumption (KW)	Total Price ($)
		Max Size of Grinding Wheel	:	100 x 10 mm			
13.	Hydraulic Pipe Bending Machine	Type	:	Motorised pipe blending machine	1	-	10,000
		Pipe Size	:	12 mm - 50 mm			
		Puller Capacity	:	20 tonnes			
14.	Arc Welding Sets	Welding Current	:	70 - 450 Amp	2	24	9,000
15.	Hand Push Trolleys	Max Capacity	:	200 kg	3	-	225
16.	E.O.T. Crane	Type	:	Single Girder	1	10	25,000
		Class	:	III			
		Capacity	:	3 tonnes			
		Span	:	10.5 M			
17.	Water Tank for Cleaning	Type	:	To clean parts with both kerosene and water with a grating in the chamber separating them	2	-	4,800
		Overall Chamber Size	:	2000 x 1200 x 800 mm			
18.	Cable Tester	Type	:	Standard	1	-	100
19.	Electrical Testing Board for Testing Welding Machines	Type	:	Standard		-	200
	TOTAL						59,415

SECTION - 8
RAW MATERIALS AND OTHER INPUTS

RAW MATERIALS AND OTHER INPUTS

The basic materials, consumables and bought out items required for manufacturing are classified under the following main groups :

- Steel plates for condenser shell
- ARSCU or ADM tubes
- Packing bushes for tube ends
- Fasteners like nuts and bolts, gaskets, expansion joints and neck joints
- Steel grits for shot blasting
- Mountings for manhole covers, water inlet and outlet, air outlet, steam chest inlet, door and manhole opening and closing mechanism, piping, etc.
- Primer and paints
- Welding electrodes
- Oxyacetylene gas
- Furnace oil
- Auxiliary equipment like condensate and cooling water pumps, air ejector, spring mountings, piping network, etc.
- Instruments like thermometers, pressure gauges, etc.

- Hardware including slings, chains, wire ropes and other miscellaneous items including cutting oil, lubricants, soaps, cotton waste and electrical consumables.

Technical specifications of these materials and their annual requirement are presented in Exhibit-13.

While estimating the requirement of shell plates, a wastage factor of 20% has been assumed. In case of tubes, however, wastage has been assumed as 5%.

All auxiliary equipment shall be bought-out and supplied directly to the erection site. The cost of these has not been taken into consideration while estimating the production cost of the steam condenser. Roughly, these represent about 10 to 20% of the total price of a condenser.

All locally purchased materials may be stocked for two months' use. The materials to be imported may be stocked for four months' use.

JOB NO. : DCIL-105 EXHIBIT : 13

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

REQUIREMENT OF RAW MATERIALS AND CONSUMABLES

Sl. No.	Component	Material Specifications	Annual Requirement (Tonnes)	Price ($)
1.	Plates	Mild steel boiler quality as per BS 1501 Thickness - 22 mm	496	674.40
2.	Header Plate	Mild steel boiler quality as per BS 1501 Thickness - 38 mm	120	174.00
3.	Angles and Channels	Mild steel as per BS 4848 Part IV	215	70.95
4.	Tube	As per BS 3274 Material of Construction		
		ARSCU	520	12,480.00
		ADM	150	3,600.00
5.	Packing Bushes	As per BS 4480	40	38.80
6.	Fasteners like Nuts and Bolts, Gaskets, Expansion Joints and Neck Joints	As per BS 6104	11	10.70
7.	Steel Grits	Chilled Steel Angular Shots Grade 8 - 14 mesh As per BS 2451	1.3	0.52

JOB NO. : DCIL-105 EXHIBIT : 13

Sl. No.	Component	Material Specifications	Annual Requirement (Tonnes)	Price ($)
8.	Mountings for manhole covers, water inlet & outlet, air outlet, steam chest inlet, door and manhole opening & closing, mechanism piping, etc.	Material of Construction - Cast Iron and Steel	10	16.00
9.	Primer and Paints	As per BS 2523	750	11.62
10.	Welding Electrodes	As per BS 2493	14	1.00
11.	Oxy acetylene Gas	As per BS 1821	8000 m^3	0.20
12.	Furnace Oil	As per BS 2869	70	67.90
13.	Auxiliary equipment like condensate and cooling water pumps, air ejector, spring mountings, piping network, etc.	Standard	lump sum	500.00
14.	Instruments like Thermometres, Pressure Gauges	Standard	lump sum	3.00
15.	Hardwares including sling, chains, wire ropes and other miscellaneous items including cutting oil, lubricants, soaps, cotton wastes and electrical consumables	Standard	lump sum	2.00
	TOTAL			17,671.09

SECTION - 9
UTILITIES

UTILITIES

Utilities in the plant will include power, water, compressed air and fuel oil for furnaces. Apart from the above, facilities have been suggested for air-conditioning of the administrative building and for fire-fighting.

Power

A summary of power requirement is presented in Exhibit-14. While calculating the total load, power required for general lighting, air-conditioning, dust collection and fume control units and for other utilities have also been considered. The lighting load for the office building has been computed based on the assumption that it will merely supplement the natural light which will otherwise be sufficient. As all the equipment will not be operated simultaneously, different load factors have been considered for various types of equipment. Welding sets, in general, have a very low power factor. Based on the different load and power factors, total requirement of power is estimated as 1,709 KVA. Since the power rating required for production equipment and services is 415/220 volts, 2 transformers, each of 1,000 KVA rating are recommended. It is assumed that the power will be tapped from a 11 KV overhead transmission line. Thus the transformer will have a step down ratio from 11 KV to 415/220 volts. Further, to reduce the fault level and fluctuations in the lighting line, 1 lighting transformer of 300 KVA capacity is also recommended.

Water

Water in the plant will be needed for the following purposes:

- o production
- o heat treatment
- o as coolant for metal cutting tools
- o for cooling the central air-conditioning system
- o for cooling air compressors

Average rate of requirement of water for the above functions is about 5 m^3 per hour.

The plant will also need water for :

- o drinking and cooking
- o sanitation, gardening and shop floor washing

Requirement of water for the above mentioned needs is shown in Exhibit-15. The total average requirement is estimated at 10 m^3 per hour. For human and sanitary needs, the water consumption has been estimated at 60 litres per person per 8 hour shift.

It is proposed that the plant be equipped with a 4" dia deep tubewell, 2 pumps - each of 20 m^3 per hour capacity, and 2 overhead tanks (including one standby) of 40 m^3 capacity each.

Compressed Air

Compressed air is needed in the plant for the following purposes :

- o operating hand tools like chipping hammers, hand grinders, etc.

- operating spray guns in the painting booth
- operating shot blasting guns in shot blasting booth
- Combustion and atomisation of fuel oil in heat treatment furnace

Connected load of compressed air as shown in Exhibit-16 for the first three purposes is estimated as 14.1 m^3 per minute. Considering a demand factor of 0.4, maximum rate of consumption is estimated as 5.4 m^3 per minute. Considering delivery losses and compressor efficiency, the compressor capacity required is about 12 m^3 per minute. Therefore it is recommended that 4 compressors of 3 m^3 per minute capacity delivering air at 7 Kg per cm^2 pressure be provided.

To meet the compressed air requirement for combustion and atomisation of fuel oil, air blowers which will be required to be supplied together with the furnaces, will have the following capacities -

- combustion air blowers 2 x 9300 m^3 per hour
- atomising air blowers 2 x 1700 m^3 per hour

Fuel Oil

The heat treatment furnace will require a constant supply of oil. It is estimated that the annual oil requirement will be approximately 385 m^3.

An overhead oil tank of 20 m^3 capacity has been provided from which the oil will be pumped to the furnace. This tank should be capable of storing 15 days' oil requirement. Valves, piping and instruments will also need to be provided for distributing oil from the main tank to individual tanks.

Air-conditioning

It is proposed that the administrative building be centrally air-conditioned to create a conducive atmosphere for efficient working of the personnel housed in the building. For this purpose, a centralised air-conditioning system of 110 tonnes of refrigeration (TR) capacity with individual air handling units for each floor is recommended. The system shall have a separate cooling tower of the induced draft type for water cooling. The workshop shall be provided with room coolers for circulation of air.

Major equipment and accessories for all utilities are listed in Exhibit-17.

Fire Protection System

Sufficient number of fire extinguishers of different types will be required for fighting fire within the workshop premises. The entire fire fighting system/appliances is classified into three major categories, viz., portable extinguishers, wheeled extinguishers and fixed systems. Apart from these, other appliances like fire detector, alarms, sand/water buckets, etc., will also be needed.

Transport

The company may provide cars only to the top personnel belonging to levels 1 and 2. Therefore, in all, 2 cars and 2 buses should be sufficient.

JOB NO. : DCIL-105

EXHIBIT : 14

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

SUMMARY OF POWER REQUIREMENT

Sl. No.	Description	Connected Load (KW)	Demand Factor	Max Demand (KW)	Power Factor	KVA Demand
	Voltage - 415/220 Volts					
1.	Production Equipment inclusive of Material Handling Equipment	1218	0.4	487	0.8	609
2.	Welding and Welding Development	906	0.4	363	0.6	605
3.	Material Testing Laboratory	33	0.4	13	0.8	16
4.	Tool Room	132	0.3	40	0.8	50
5.	General Lighting	460	0.4	184	0.8	230
6.	Air-conditioning, Air Circulation, Environment Dust and Fume Control Unit	170	0.7	119	0.8	149
7.	Miscellaneous (Water Pumps and Compressors)	100	0.4	40	0.8	50
	TOTAL			1246		1709

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 15

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

SUMMARY OF WATER REQUIREMENT

Sl. No.	Description	Water Consumption (M^3/Hour)
1.	Water for Technical Purposes (average)	1
2.	Average Requirement of Cooling Water for Central Air-conditioning Plant	4
3.	Average Requirement for human consumption and Sanitary Purposes for 378 Persons	5
4.	Peak Consumption for (3)	25
5.	Total Average Consumption	10
6.	Total Peak Consumption	30

JOB NO. : DCIL-105 EXHIBIT : 16

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

SUMMARY OF COMPRESSED AIR REQUIREMENT

Sl. No.	Description	Air Consumption (m^3/Minute)
1.	Production Equipment, Tool Room and Painting Booth	8.5
2.	Shot Blasting Booth	5.6
	Total	14.1

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 17

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

MAJOR EQUIPMENT AND ACCESSORIES FOR UTILITIES

Sl. No.	Description	Price ($)
1.	**Electrical System**	
	o 2 x 1000 KVA step down Oil Cooled Transformer (Step down ratio 11 KV : 415/220 volts 3 phase, 50 Hz)	43,800
	o 1 x 300 KVA (415/220 volts) Oil Cooled Lighting Transformer	6,400
	o 11 KV Switchgears, Isolator, Accessories, MCC, Distribution Boards, Cables and Grounding Materials	4,000
	o Lighting, Fans and Room Coolers	4,000
	o Intercommunication System	20,000
2.	**Water Supply System**	
	o Two Water Pumps (20 m^3/hour capacity each), 2 Overhead Tanks (40 m^3 capacity each), Valves and Other Fittings for water distribution and cost of digging 4" dia Tubewell	23,000 3,230
3.	**Compressed Air System**	
	o Four Compressors of 3 m^3 per minute capacity delivering air at 7 kg per cm^2 pressure	23,300

JOB NO. : DCIL-105 EXHIBIT : 17

Sl. No.	Description	Price ($)
4.	**Fuel Oil System**	
	o Overhead Fuel Oil Storage Tank (20m³ capacity) with individual Storage Tanks for Furnaces, Pumps, Valves, Piping and Instruments for transfer of Fuel Oil	7,250
5.	Air-conditioning System for two storied Administrative Building - 110 TR Central Air-conditioning Unit with individual Air Handling Unit for each floor	1,25,000
6.	Fire-fighting Equipment	10,000
7.	Furniture, Fittings, Drawing Equipment, File Cabinets, Phones, Office Equipment, etc.	2,000
8.	Transport (2 Cars and 2 Buses)	60,000
	TOTAL	3,31,980

SECTION - 10
SPACE AND LAYOUT

SPACE AND LAYOUT

Space required for various sections in the plant is shown in Exhibit-18. Each section of the plant comprises a number of work centres. The space for each work centre has been worked out based on the following requirements :

- o area occupied by equipment
- o working area
- o area for movement of men and materials
- o area for temporary storage of incoming and outgoing materials

The total built up area is estimated as 19,355 m^2, while the total land area is estimated as 47,000 m^2. This includes about 7,900 m^2 of land area for possible future expansion.

Buildings in the plant are divided into the following three categories, depending on their functions and constructional features :

- o Workshop building
- o Administrative building
- o Auxiliary buildings

Workshop Building

Layout of machine tools and equipment in different production shops are presented in Exhibit-19, enclosed in a pouch at the end of this Report.

While preparing the layout of machines in different shops, care has been taken to ensure unidirectional flow of material to the extent possible. The machines are also placed in a way that will facilitate easy movement of men and material handling equipment. Gangways of 3.5 metres width have been provided between different production shops.

It is envisaged that the workshop buildings will be of reinforced concrete construction. The columns, roofing, floor, etc., shall also be of RCC structure. Height of the workshop building from the floor to the top of the gantry level has been considered as 13.5 metres. The building should be so designed as to make maximum use of natural lighting and ventilation. Sound proof glass panes are recommended for shop offices to aid supervision and control.

Administrative Building

The administrative building shall be made of two storeyed RCC brick construction. Space for workshop office, administrative office and auxiliary buildings have been worked out based on the manpower requirement.

Auxiliary Buildings

Auxiliary buildings include toilets and wash rooms, security office, transformer house, pump house, material testing and welding development centre, training centre, etc. All these have been located at appropriate places. These shall be built with masonry bricks and cement.

For effective operation the workshops, utility centres and other buildings are so located that they are not far from each other. The administrative building has been located a

little far away so that it is least affected by the noise, and the hustle and bustle of the workshops.

Exhibit-20, enclosed in a pouch at the end of this Report, shows the relative location of different shops and buildings. Estimated cost for civil work including land development, fencing, drainage, roads and building construction are shown in Exhibit-21.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 18

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

ESTIMATE OF SPACE REQUIRED

Sl. No.	Desription	Area (sq m)
1.	**Workshop**	
	o Raw Material Stockyard	810
	o Despatch Area	540
	o Cutting and Forming Shop	3420
	o General Machine Shop	1710
	o Fabrication and Welding Shop	1710
	o Final Assembly and Testing Shop	2070
	o General Store	888
	o Workshop Offices	468
	o Aisles and Gangways	4059
	Sub-total	15675
2.	**Administrative Building - Double Storeyed**	800
3.	**Auxiliary Buildings**	
	o Transformer House and Distribution Centre	216
	o Pump House	36
	o Maintenance Shop	720

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 18

Sl. No.	Desription	Area (sq m)
	o Canteen and Wash Room	216
	o Welding Development and Material Testing Laboratory	1152
	o Training Centre	540
	Sub-total	2880
4.	Total Built up Area	19355
5.	Open Area Required	19355
6.	Total Land Area provided inclusive of Area for future expansion	47000

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 21

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

ESTIMATED COST OF CIVIL WORK

Sl. No.	Description	Area (sq m)	Cost ($)
1.	Land and Land Development including fencing, drainage and road construction	47,000	4,877.46
2.	Workshop Building having a height of 8 metres from floor to top of crane rail	15,675	19,781.85
3.	Administrative Building - double storeyed	800	1,211.20
4.	Auxiliary Buildings comprising workshop offices, toilets and washrooms in workshop, refreshment centres, transformer house, pump house, first-aid centre, security, garage and control room	2,880	4,360.32
	TOTAL		30,230.83

SECTION - 11
MANPOWER AND ORGANIZATION

MANPOWER AND ORGANISATION

The organisation has been designed to meet the functional needs of a plant in which 1,300 tonnes of steel plates and tubes will be processed annually to manufacture condensers of varying capacity. The organisation will carry out all the activities performed by a typical manufacturing unit. In order that the plant can plan, execute, co-ordinate and control all the necessary activities, the deployment of manpower has been categorised under the following heads :

- Production
- Maintenance
- Quality Control and Welding Development
- Engineering
- Materials
- Marketing
- Finance and Accounts
- Personnel and Administration

Based on the above eight activities/functions, the organisation has been divided into seven departments. Production and maintenance have been put together. Each department will be under the charge of a departmental head. Five departmental heads shall report to the Director, while the remaining two shall report to the Works Manager. Organisation chart for the senior level management is presented in Exhibit-22.

Production

Drilling Machines in the general machinery shop and the welding Section will work in two shifts. All other Sections

within the Production Department will work in single shift.

Production and Maintenance have been placed under overall supervision of a Manufacturing Manager, who will report to the Works Manager. Manufacturing Manager will be assisted by the General Superintendant who will be in charge of production, and the Plant Engineer who will be responsible for the maintenance function.

Direct manpower requirement in the production shop is estimated in Exhibit-23.

Manpower requirement and organisation chart for different Departments are shown in their respective exhibits as indicated below.

Sl. No.	Shop	Exhibit for Manpower	Exhibit for Organisation Chart
1.	Production	24	26
2.	Maintenance	25	26
3.	Quality Control and Welding Development	27	28
4.	Engineering	29	30
5.	Materials	31	32
6.	Marketing	33	34
7.	Finance and Accounts	35	36
8.	Personnel and Administration	37	38

Because of the large size, manpower required to carry out the production and maintenance functions are shown separately in Exhibits 24 and 25 respectively. The organisation chart for production and maintenance is shown in Exhibit-26.

It was explained earlier that a good part of the work will be done in the workshop and the rest will be done at the site. As the actual allocation can not be estimated at this stage, for the sake of conveniene only the manpower required in the shop is being considered here. The manpower required at the site will be additional. It is suggested that a Site Superintendent be posted at the site to oversee construction and erection. It is also proposed that very few skilled people be drawn from the shop during this phase. Unskilled workmen may be hired locally.

Quality Control and Welding Development

This department will be headed by a Quality Control Manager, with one Senior Engineer (Mechanical Testing Laboratory) reporting to him.

The Welding Engineer in the Production Departmen. who reports to the Manufacturing Manager will be responsible for the Welding Development Section. His functions will include providing in-house training to welders and trouble-shooting during welding operations in the Shop.

Manpower requirement and organisation chart for this department are shown in Exhibit-27 and Exhibit-28, respectively.

Engineering

Manpower requirement and organisation chart for Engineering Department are shown in Exhibit-29 and Exhibit-30 respectively.

Materials

The Materials department will be headed by a Materials

Manager who will be assisted by a Materials Engineer and a Stores Officer.

Manpower requirement and organisation chart for this department are shown in Exhibit-31 and Exhibit-32 respectively.

Marketing

The marketing department will be under the charge of a Marketing Manager, who will be assisted by two Area Managers. Four Sales Engineers will report to these two Area Managers. Manpower requirement and organisation chart for Marketing Department are shown in Exhibit-33 and Exhibit-34 respectively.

Finance and Accounts

Accounts Manager will head this department. He will be supported by a Senior Accountant and a Senior Cost Accountant.

Manpower requirement and organisation chart for this department are presented in Exhibit-35 and Exhibit-36 respectively.

Personnel and Administration

Exhibit-37 presents the requirement of manpower for this department. Organisation chart is presented in Exhibit-38.

Exhibit-39 presents a summary of manpower requirement for the entire plant.

Manpower has been grouped into nine salary levels.The designations, salary levels and number of personnel in the

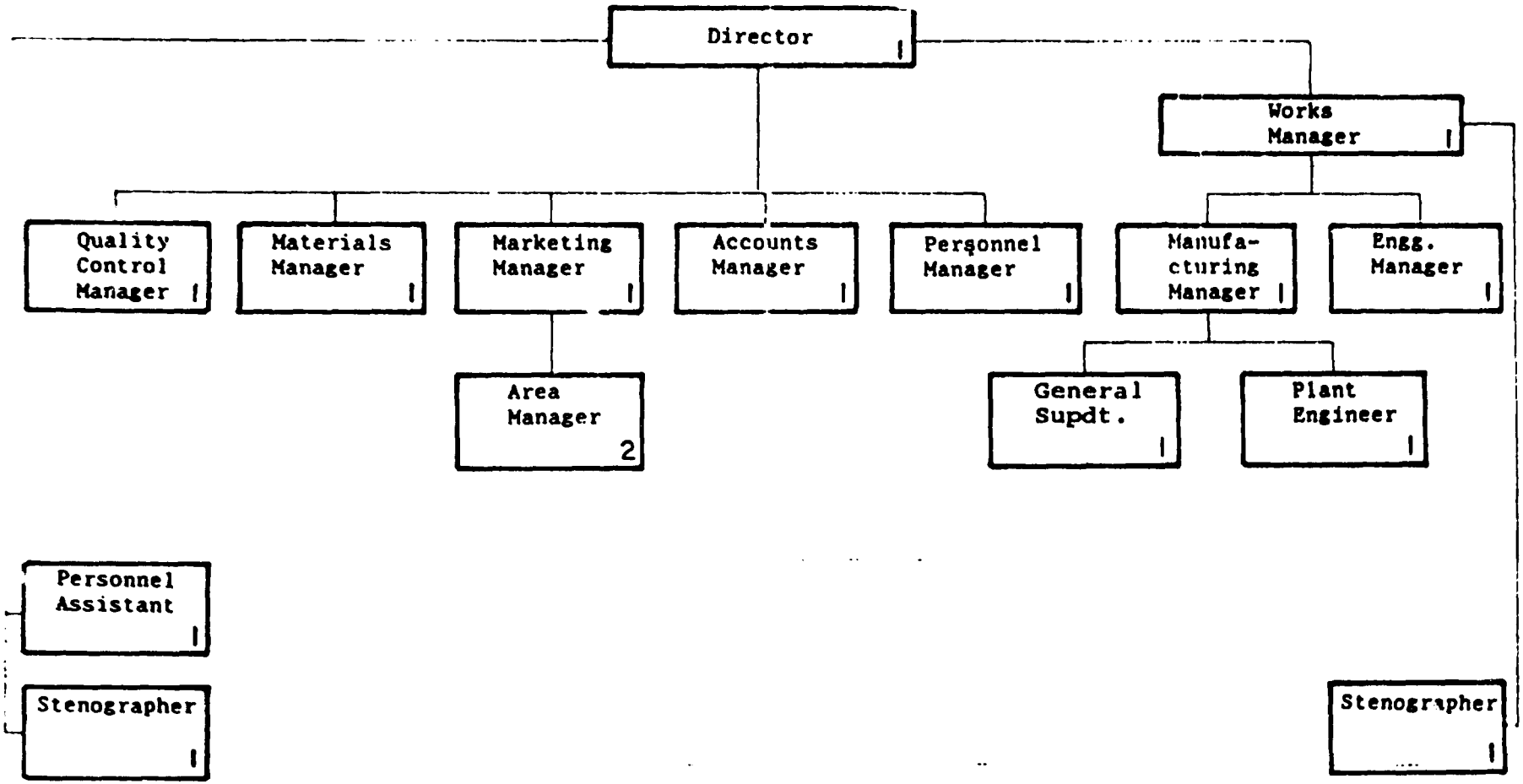
organisation structure of each department may be observed from relevant serial numbers given in the exhibits relating to manpower requirement for the respective departments.

The statement of monthly salaries and wages is presented in Exhibit-40.

JOB NO. : DCIL-105

EXHIBIT : 22

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION
PROJECT PROFILE ON STEAM CONDENSERS
ORGANIZATION CHART : SENIOR LEVEL MANAGEMENT



JOB NO. : DCIL-105

EXHIBIT : 23

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

DIRECT WORKFORCE REQUIREMENT

Sl. No.	Division	Machine Operator				Marker			Fitter			Tac Welder			Gas Cutter			Chipper			Welder				Grand Total			
		HS	S	US	T	S	US	T	S	US	T	S	US	T	S	US	T	S	US	T	HS	S	US	T	HS	S	US	T
1.	Metal Cutting Section	1	11	9	21	1	1	2	2	-	2														1	14	10	25
2.	Metal Forming Section	1	6	5	12																				1	6	5	12
3.	General Machine Shop	3	15	2	20	1	1	2	1	1	2														3	17	4	24
4.	Tool Room	1	11	1	13	2	1	3	7	1	8										-	1	-	1	1	21	3	25
5.	Fabrication & Welding, and Assembly Section					1	1	2	3	1	4	1	1	2	2	1	3	1	-	1	2	6	-	8	2	14	4	20
6.	Sub-assembly and Complete Assembly								1	2	3										-	1	-	1	-	2	2	4
7.	Hydraulic Pressure Testing								1	-	1														-	1	-	1
8.	Dismantling and Despatch								1	1	2														-	1	1	2
9.	Shot Blasting Booth	-	1	1	2																				-	1	1	2

JOB NO. : DCIL-105

EXHIBIT : 23

Sl. No.	Division	Machine Operator				Marker			Fitter			Tac Welder			Gas Cutter			Chipper			Welder				Grand Total			
		HS	S	US	T	S	US	T	S	US	T	S	US	T	S	US	T	S	US	T	HS	S	US	T	HS	S	US	T
10.	Painting Booth	-	1	2	3																				-	1	2	3
11.	Heat Treatment Furnace	-	3	3	6																				-	3	3	6
12.	Material Handling																											
	- Crane/Truck Driver	-	10	-	10																				-	10	-	10
	- Material Handler	-	-	17	17																				-	-	17	17
	Total	6	58	40	104	5	4	9	16	6	22	1	1	2	2	1	3	1	-	1	2	8	-	10	8	91	52	151

Note : HS - Highly Skilled S - Skilled US - Unskilled T - Total

JOB NO. : DCIL-105 EXHIBIT : 24

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

MANPOWER REQUIREMENT : PRODUCTION

Sl. No.	Designation	Salary Level	Number
A.	Superintendent	5	5
B.	Site Superintendent	5	1
C.	Welding Engineer	5	1
D.	Foreman	6	16
E.	Welding Instructor	6	1
F.	Progress Clerk	7	2
G.	Highly Skilled Machine Operator	7	6
H.	Highly Skiled Welder	7	2
I.	Skilled Machine Operator	8	45
J.	Skilled Furnace Operator	8	3
K.	Crane/Truck Driver	8	10
L.	Marker	8	5
M.	Fitter	8	16
N.	Skilled Welder	8	9
O.	Gas Cutter	8	2
P.	Chipper	8	1
Q.	Helper	9	35
R.	Material Handler	9	17
	Total		177

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 25

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

MANPOWER REQUIREMENT : MAINTENANCE

Sl. No.	Designation	Salary Level	Number
A1.	Maintenance Engineer	5	2
B1.	Foreman - Shop Maintenance	6	1
C1.	Foreman - Mechanical Utilities and Building	6	2
D1.	Foreman - Transformer House and Central Distribution	6	1
E1.	Highly Skilled Mechanical Fitter	7	3
F1.	Highly Skilled Electrician	7	2
G1.	Skilled Welder	8	2
H1.	Skilled Mechanical Fitter	8	10
I1.	Skilled Machine Operator	8	2
J1.	PLumber	8	1
K1.	Skilled Electrician	8	7
L1.	Helper	9	15
	Total		48

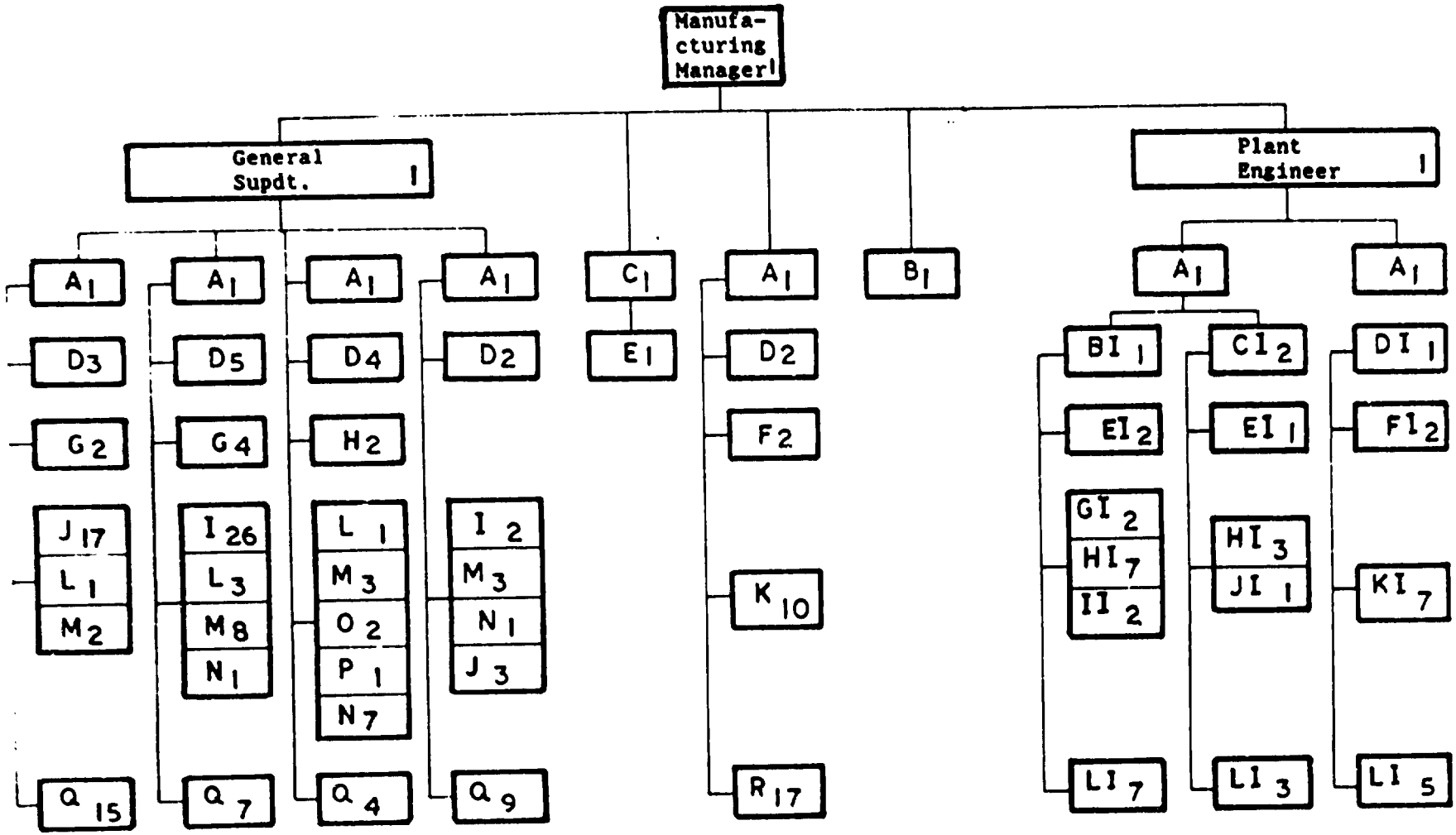
JOB NO. : DCIL-105

EXHIBIT : 26

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

ORGANIZATION CHART : PRODUCTION AND MAINTENANCE



DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 27

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

MANPOWER REQUIREMENT : QUALITY CONTROL AND WELDING DEVELOPMENT

Sl. No.	Designation	Salary Level	Number
A.	Engineer (Mech Testing Laboratory)	5	1
B.	Inspection Engineer	5	2
C.	Inspector	6	12
D.	Non-destructive Testing Machine Operator	6	2
E.	Supervisor	6	1
F.	Chemist	6	1
G.	Photo Film Developer	8	1
H.	Store Keeper	8	1
I.	Clerk-cum-Typist	8	3
J.	Laboratory Assistant	9	2
K.	Machine Operator	9	2
	Total		28

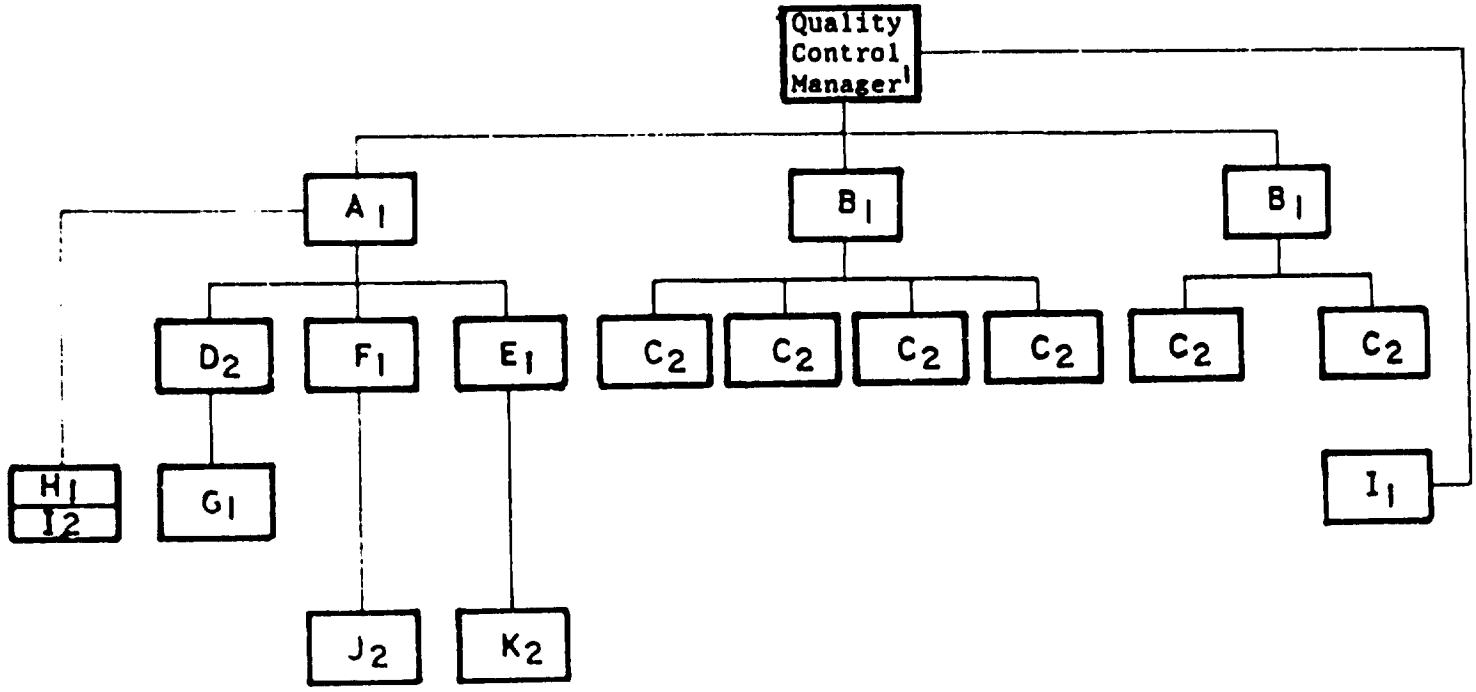
JOB NO. : DCIL-105

EXHIBIT : 28

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

ORGANIZATION CHART : QUALITY CONTROL AND WELDING DEVELOPMENT



DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 29

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

MANPOWER REQUIREMENT : ENGINEERING

Sl. No.	Designation	Salary Level	Number
A.	Sr Design Engineer	5	1
B.	Sr Planning Engineer	5	1
C.	Design Engineer	6	1
D.	Process Planning Engineer	6	1
E.	Work Order Engineer	6	1
F.	Technical Assistant	7	1
G.	Draftsman	7	3
H.	Printing Machine Operator	8	1
I.	Steno Typist	8	2
	Total		12

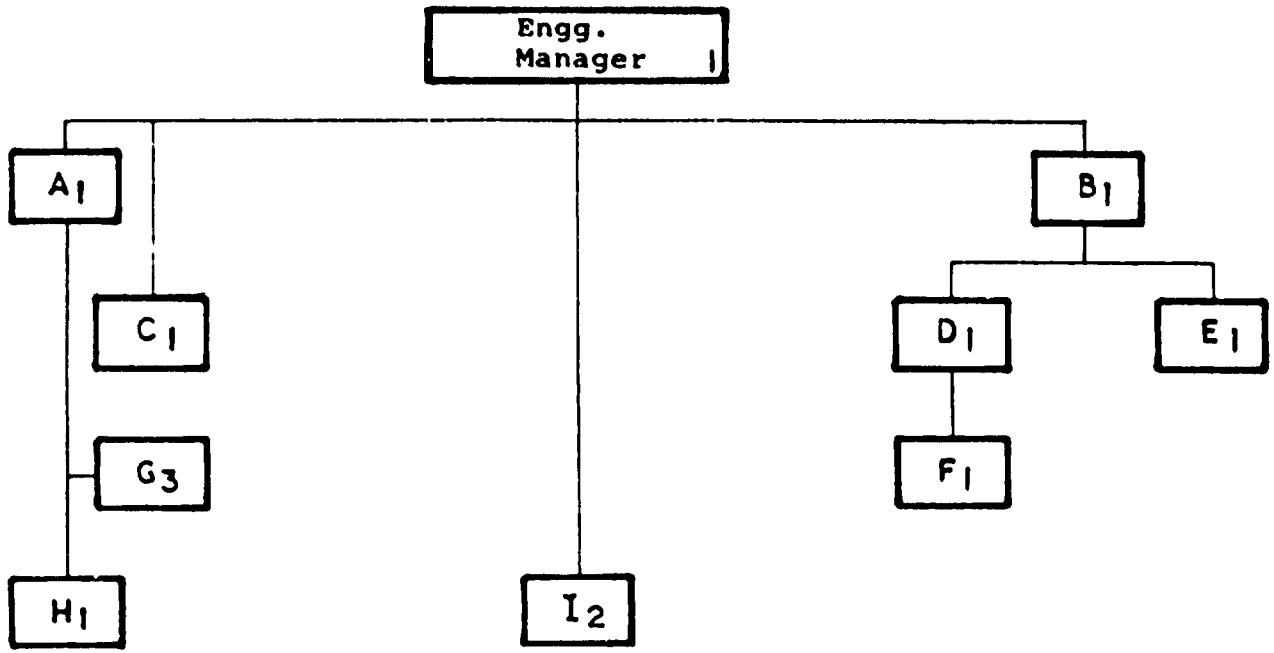
JOB NO. : DCIL-105

EXHIBIT : 30

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

ORGANIZATION CHART : ENGINEERING



DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 31

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

MANPOWER REQUIREMENT : MATERIALS

Sl. No.	Designation	Salary Level	Number
A.	Materials Engineer	5	1
B.	Stores Officer	5	1
C.	Store Keeper	6	2
D.	Purchase Assistant	7	4
E.	Stores Assistant	7	3
F.	Tool Issue Clerk	8	4
G.	Material Issue Clerk	8	3
H.	Goods Despatch Clerk	8	2
I.	Steno Typist	8	1
J.	Handler	9	10
	Total		31

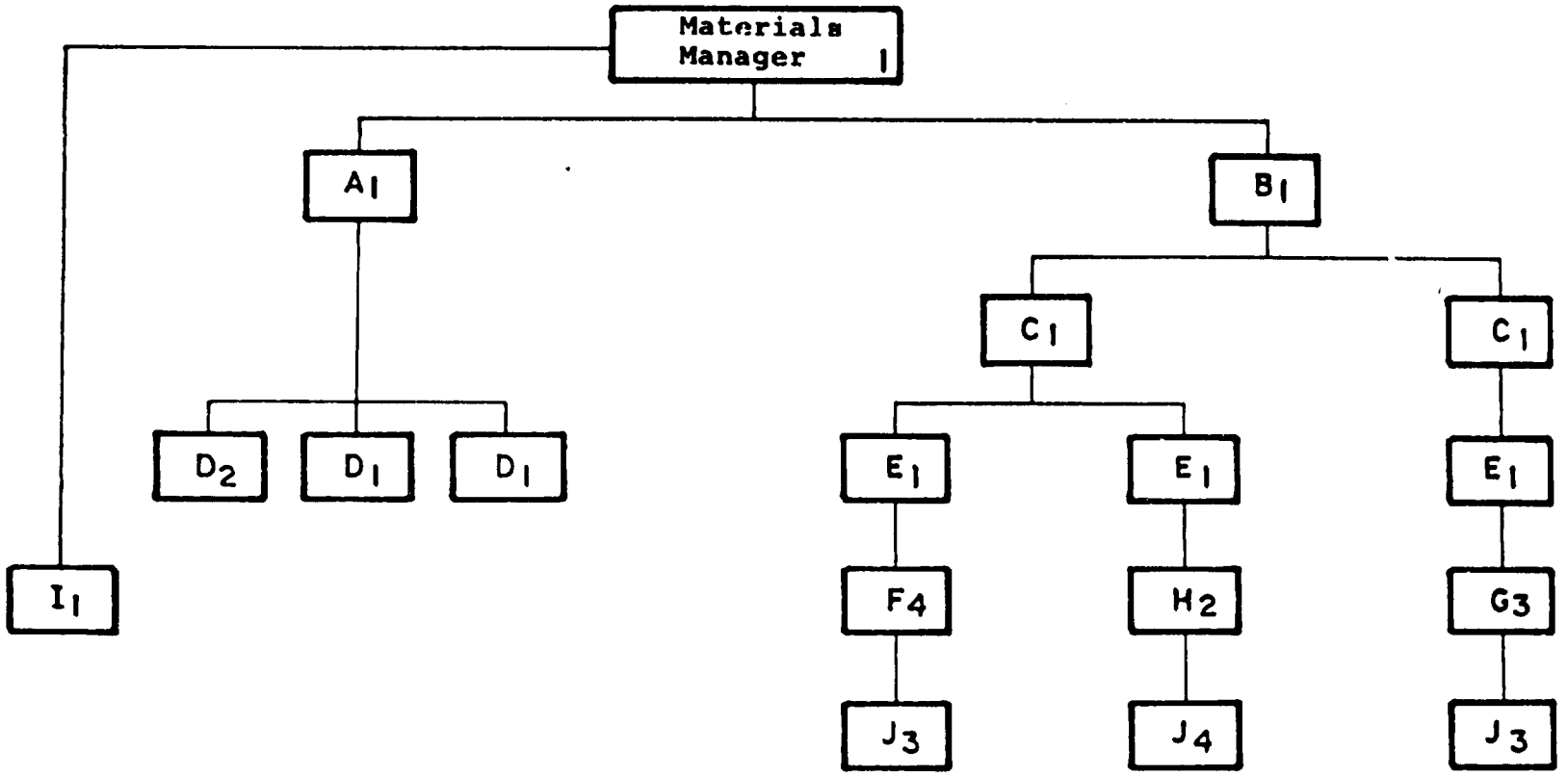
JOB NO. : DCIL-105

EXHIBIT : 32

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

ORGANIZATION CHART : MATERIALS



DEVELOPMENT CONSULTANTS

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 33

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

MANPOWER REQUIREMENT : MARKETING

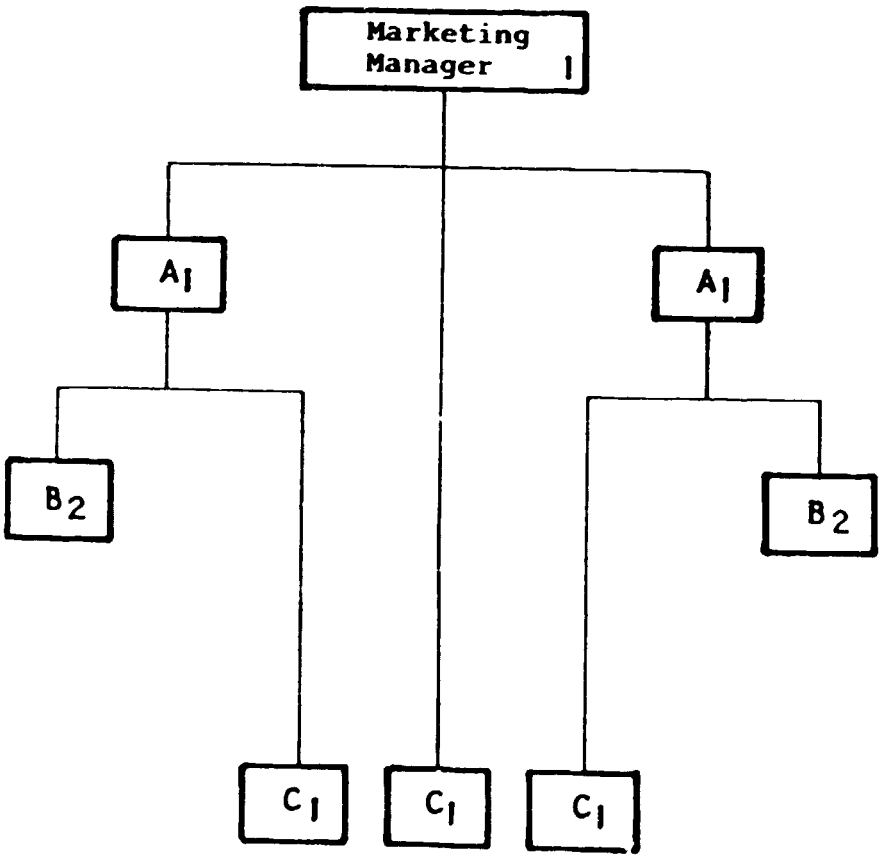
Sl. No.	Designation	Salary Level	Number
A.	Area Manager	4	2
B.	Sales Engineer	5	4
C.	Steno Typist	8	3
	Total		9

JOB NO. : DCIL-105 EXHIBIT : 34

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

ORGANIZATION CHART : MARKETING



JOB NO. : DCIL-105 EXHIBIT : 35

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

MANPOWER REQUIREMENT : FINANCE AND ACCOUNTS

Sl. No.	Designation	Salary Level	Number
A.	Senior Accountant	5	1
B.	Senior Cost Accountant	5	1
C.	Accountants	6	2
D.	Accounts Assistant	7	4
E.	Cashier	7	1
F.	Accounts Clerk	8	5
G.	Steno Typist	8	2
	Total		16

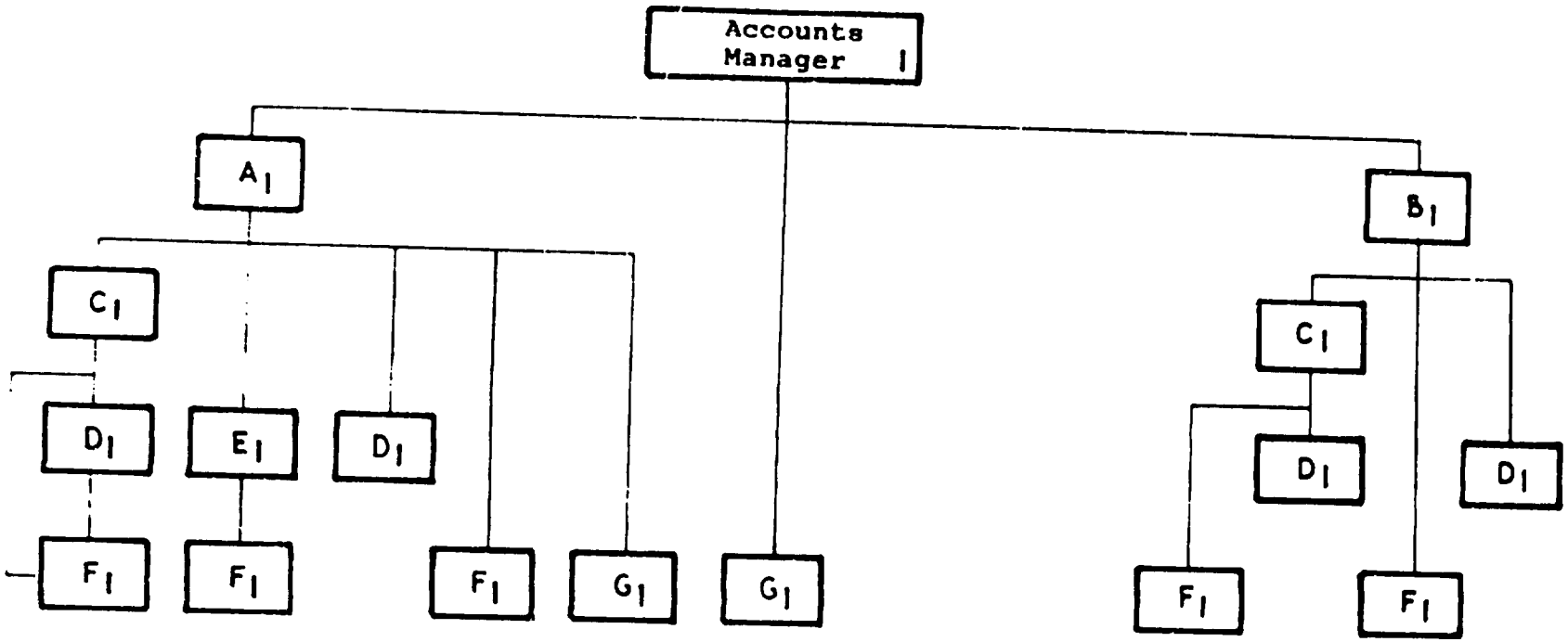
JOB NO. : DCIL-105

EXHIBIT : 36

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

ORGANIZATION CHART : FINANCE AND ACCOUNTS



JOB NO. : DCIL-105 EXHIBIT : 37

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

MANPOWER REQUIREMENT : PERSONNEL AND ADMINISTRATION

Sl. No.	Designation	Salary Level	Number
A.	Personnel Officer	5	1
B.	Administrative Officer	5	1
C.	Workers' Training Officer	6	1
D.	Chief Security Guard	6	1
E.	Canteen Incharge	7	1
F.	Security Guard	7	3
G.	Welfare Assistant	7	1
H.	Incharge-Environment and First Aid	7	1
I.	Stenographer	8	1
J.	Driver	8	4
K.	Cook	8	2
L.	Clerk-cum-Typist	8	2
M.	Telephone Operator cum Receptionist	8	1
N.	Despatch Clerk	8	1
O.	Watchman	9	10
P.	Waiter and Helper	9	4
Q.	Sweeper and Gardener	9	8
	Total		43

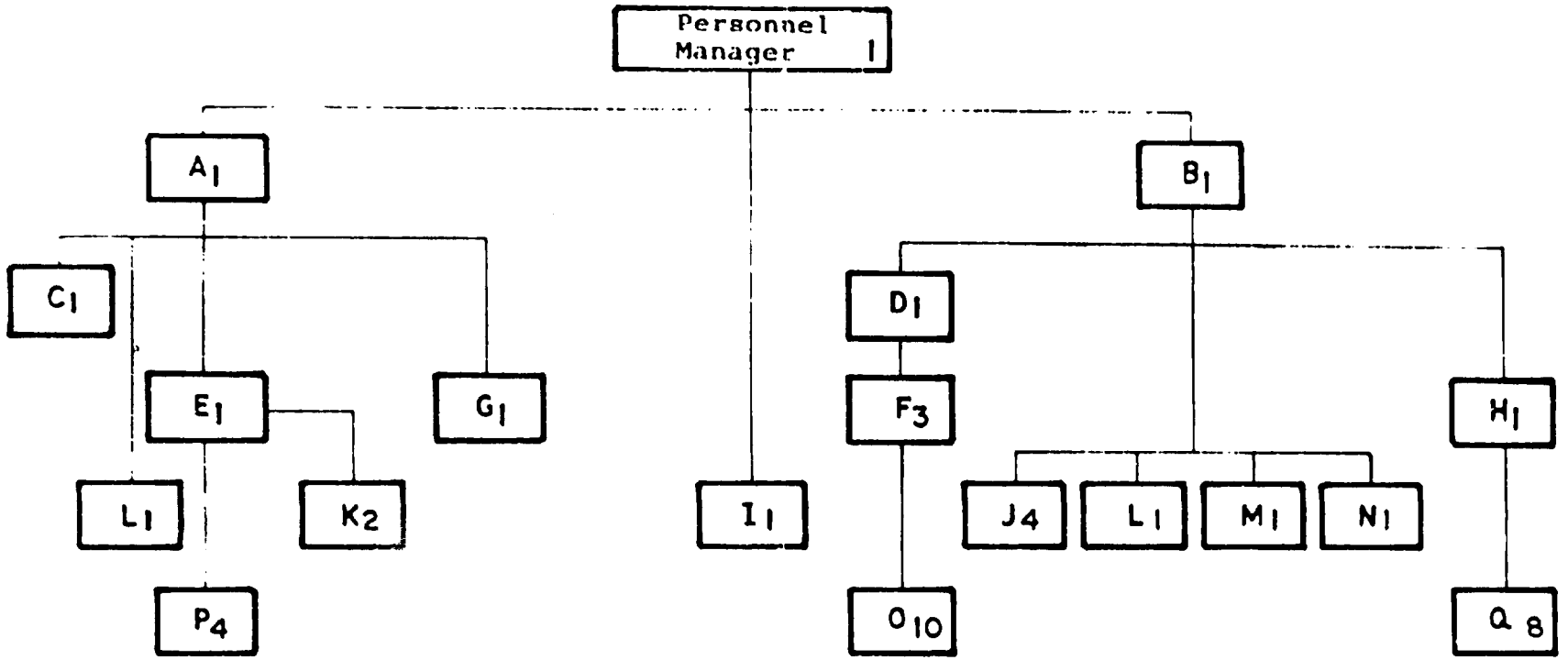
JOB NO. : DCIL-105

EXHIBIT : 38

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

ORGANIZATION CHART : PERSONNEL AND ADMINISTRATION



DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 39

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

SUMMARY OF MANPOWER REQUIREMENT

Sl. No.	Designation/Department	Number
1.	Director	1
2.	Works Manager	1
3.	Engineering Manager	1
4.	Marketing Manager	1
5.	Accounts Manager	1
6.	Personnel Manager	1
7.	Manufacturing Manager	1
8.	Materials Manager	1
9.	Quality Control Manager	1
10.	Plant Engineer	1
11.	General Superintendent	1
12.	Production	177
13.	Maintenance	48
14.	Quality Control and Material Testing Laboratory	28
15.	Engineering	12
16.	Materials	31
17.	Marketing	9

JOB NO. : DCIL-105 **EXHIBIT : 39**

Sl. No.	Designation	Number
18.	Finance and Accounts	16
19.	Personnel and Administration	43
20.	Personal Assistant to Director	1
21.	Steno for Director	1
22.	Steno for Works Manager	1
	Total	378

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 40

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSERS

STATEMENT OF MONTHLY SALARIES AND WAGES

Salary Level	Numbers	Monthly Salary ($) Basic	Other Benefits	Total per Month ($)
1	1	9,000		9,000
2	1	8,000		8,000
3	7	6,000		42,000
4	4	5,000		20,000
5	24	3,739		89,736
6	47	2,711		1,27,417
7	37	1,636		60,532
8	154	1,500		2,31,000
9	103	981		1,01,043
TOTAL	378			6,88,728

SECTION - 12
FINANCIAL ANALYSIS AND EVALUATION

FINANCIAL ANALYSIS AND EVALUATION

COUNTRY : ALGERIA

The financial analysis and evaluation of the proposed project for setting up of Steam Condenser plant in this country are based on the capacity utilisation, price and costs.

Project Cost

The estimated cost of the project of setting up a Steam Condenser plant manufacturing 5 numbers each of 30 MW and 150 MW Condensers is around US $ 43 million as can be seen from Exhibit-41. The project cost includes the expenditure towards

- Land and land development
- Building and civil work
- Plant and machinery
- Miscellaneous fixed assets
- Preliminary expenses
- Pre-operative expenses
- Technical know-how fees

Preliminary expenses have been assumed on a lumpsum basis on the project cost. Pre-operative expenses have three components, viz., establishment, travelling expenses and miscellaneous expenses. Establishment costs have been computed on the basis of salaries payable and overheads to various personnel who have to be recruited at various levels, during the construction period. Travelling expense have been taken as approximately 10% of establishment costs

from second to the last quarter of the construction period. Miscellaneous expenses have also been taken on a lumpsum basis. Technical know-how fees have been taken as 3.5% of the project cost excluding interest during construction and margin money for working capital.

5% cushion has been provided towards contingency. This cost also includes interest during construction and margin money for working capital.

Phasing of capital expenditure is based on implementation plan, and interest during construction has been computed based on the phasing. These two are presented in Exhibits 42 and 43 respectively.

Margin money for working capital is presented in Exhibit-44. In computing margin money it is assumed that adequate provisions have to be kept towards storage of raw materials and consumables required to be imported.

The project is assumed to be financed by Debt-Equity Ratio of 1:1.

Production, Sales and Revenue

Statement of production and sales of various product range and the revenue that will be generated from the sales of the products over the 10-year period are presented in Exhibits 45 and 46 respectively. Capacity utilisation is assumed at the rate of 80% in the first year and 100% from the second year onwards.

Costs

The annual costs of production and sales computed over 10 years are presented in Exhibit-47. In estimating these costs it is assumed that the salaries and wages will increase at the flat rate of 5% every year.

Profitability

Projected profitability statement is presented in Exhibit-48. The average profit before tax works out to 7.5% of average revenue.

Statement of fixed assets and depreciation under straight line method is presented in Exhibit-49. Tax computation and depreciation for tax are presented in Exhibits 50 and 51 repspectively.

Working capital requirements are shown in Exhibit-52.

Projected cash flow statement and balance sheet over 10-year period are shown in Exhibits 53 and 54 respectively.

The project breaks even at around 84.8% and shows internal rate of return of 12.8% as can be seen from Exhibits 55 and 56 respectively. In computing internal rate of return, outflow is taken as the project cost and inflow is taken as the profit before interest, depreciation and tax.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 41

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSER

ESTIMATED PROJECT COST

('000 US $)

Sl. No.	Items	Value	Total
1.	Land and Land Development (@ US$ 252 per m² for 19,355 m²)	4877.46	4877.46
2.	Building and Civil Work		
i)	Workshop Building (@ US$ 1262 per m² for 15,675 m²)	19781.85	
ii)	Administrative Building (@ US$ 1514 per m² for 800 m²)	1211.20	
iii)	Auxiliary Buildings (@ US$ 1514 per m² for 2,880 m²)	4360.32	
	Sub-total (2)		25353.37
3.	Plant and Machinery		
i)	Imported		
	- Production & tool room equipment	2867.64	
	- Material testing & welding development equipment	151.08	
	- Maintenance equipment	59.42	
	- Auxiliary equipment and handtools	6.50	
	Total F.O.B. Value	3084.64	
ii)	Insurance & Freight (@ 10% of FOB Value)	308.46	
iii)	C.I.F. Value	3393.10	
iv)	Import duty @ 6% on CIF value	203.59	
v)	Transportation @ 1% of CIF Value	33.93	
	Landed Cost at Site [Sub-total (3)]		3630.62

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 41

('000 US $)

Sl. No.	Items	Value	Total
4.	Miscellaneous Fixed Assets		
i)	Transformers	50.20	
ii)	Switchgears	4.00	
iii)	Central Airconditioning system	125.00	
iv)	Illumination,Fans and Room Coolers	4.00	
v)	Water Pumps and Tank	26.23	
vi)	Overhead Fuel Storage Tank	7.25	
vii)	Compressors	23.30	
viii)	Fire fighting system	10.00	
ix)	Telecommunication system	20.00	
x)	Office Furniture and Equipment	2.00	
xi)	Vehicles	60.00	
	Sub-total (4)		331.98
5.	Preliminary Expenses	25.00	25.00
6.	Pre-operative Expenses		
i)	Establishment	1583.72	
ii)	Travelling Expenses	157.00	
iii)	Miscellaneous	45.00	
			1785.72
7.	Technical Know-how Fees	1374.00	1374.00
8.	Sub-total (1 thru 7)	-	37378.15
9.	Contingency @ 5% on above	-	1868.91
10.	Sub-total (8 & 9)	-	39247.06
11.	Interest during Construction	-	2953.85
12.	Margin Money for Working Capital	-	803.99
	TOTAL COST		43004.89

JOB NO. : DCIL-105

EXHIBIT : 42

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANISATION

PROJECT PROFILE ON STEAM CONDENSER

PHASING OF CAPITAL EXPENDITURE

('000 US $)

	Total	Construction Period in Quarters								
		1	2	3	4	5	6	7	8	9
1. Land and Land Development	4877.46	0.00	975.50	1950.98	1950.98	0.00	0.00	0.00	0.00	0.00
2. Building and Civil Work	25353.37									
i) Workshop Building	19781.85	0.00	0.00	0.00	4945.46	4945.46	4945.46	4945.47	0.00	0.00
ii) Administrative Building	1211.20	0.00	0.00	0.00	0.00	484.48	484.48	242.24	0.00	0.00
iii) Auxiliary Buildings	4360.32	0.00	0.00	0.00	0.00	1453.44	1453.44	1453.44	0.00	0.00
3. Plant and Machinery	3630.62									
i) Ordering	1089.19	0.00	0.00	0.00	1089.19	0.00	0.00	0.00	0.00	0.00
ii) Supply, delivery and installation at site	2541.43	0.00	0.00	0.00	0.00	0.00	0.00	2477.90	63.53	0.00

JOB NO. : DCIL-105 EXHIBIT : 42

('000 DS $)

	Total	Construction Period in Quarters								
		1	2	3	4	5	6	7	8	9
4. Miscellaneous Fixed Assets	331.98									
i) Transformers	50.20	0.00	0.00	0.00	10.04	0.00	0.00	40.16	0.00	0.00
ii) Switchgears	4.00	0.00	0.00	0.00	0.80	0.00	3.20	0.00	0.00	0.00
iii) Central Airconditioning system	125.00	0.00	0.00	0.00	25.00	0.00	0.00	60.00	40.00	0.00
iv) Illumination,Fans and Room Coolers	4.00	0.40	0.00	0.72	0.72	0.72	0.72	0.72	0.00	0.00
v) Water Pumps and Tank	26.23	0.00	0.00	0.00	13.12	13.11	0.00	0.00	0.00	0.00
vi) Overhead Fuel Storage Tank	7.25	0.00	0.00	0.00	3.60	3.65	0.00	0.00	0.00	0.00
vii) Compressors	23.30	0.00	0.00	0.00	4.66	0.00	0.00	0.00	18.64	0.00
viii) Fire fighting system	10.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	5.00	0.00
ix) Telecommunication system	20.00	0.00	2.00	0.00	0.00	2.00	4.00	4.00	4.00	4.00
x) Office Furniture and Equipment	2.00	0.00	0.10	0.10	0.20	0.20	0.20	0.20	0.20	0.80
xi) Vehicles	60.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	0.00	40.00
5. Preliminary Expenses	25.00	12.50	12.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Pre-operative Expenses	1785.72									
i) Establishment	1583.72	0.00	30.21	65.13	100.35	100.35	163.35	163.35	163.35	797.63
ii) Travelling Expenses	157.00	0.00	3.00	6.00	10.00	10.00	16.00	16.00	16.00	80.00
iii) Miscellaneous	45.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
7. Technical Know-how Fees	1374.00	68.70	274.80	274.80	137.40	137.40	137.40	137.40	137.40	68.70
8. Sub-total (1 thru' 7)	37378.15	86.60	1313.11	2312.73	8296.52	7155.81	7218.25	9545.88	453.12	996.13
9. Contingency @ 5% on above	1868.91	4.33	65.66	115.63	414.83	357.79	360.91	477.29	22.66	49.81
10. Total (8 & 9)	39247.06	90.93	1378.77	2428.36	8711.35	7513.60	7579.16	10023.17	475.78	1045.94

JOB NO. : DCIL-105 EXHIBIT : 43

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANISATION

PROJECT PROFILE ON STEAM CONDENSER

ESTIMATION OF INTEREST DURING CONSTRUCTION

('000 US $)

	Construction Period in Quarters									Total
	1	2	3	4	5	6	7	8	9	
Capital Expenditure	90.93	1378.77	2428.36	8711.35	7513.60	7579.16	10023.17	475.78	1045.94	39247.06
Margin Money	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	803.99	803.99
Total	90.93	1378.77	2428.36	8711.35	7513.60	7579.16	10023.17	475.78	1849.93	40051.05
Equity	45.87	696.27	1238.00	4429.08	3903.11	4005.09	5308.59	586.47	1289.97	21502.45
Loan	45.86	696.28	1237.99	4429.08	3903.11	4005.09	5308.59	586.48	1289.97	21502.45
Total	91.73	1392.55	2475.99	8858.16	7806.22	8010.18	10617.19	1172.95	2579.94	43004.90

JOB NO. : DCIL-105 EXHIBIT : 43

('000 US $)

	Construction Period in Quarters									Total
	1	2	3	4	5	6	7	8	9	
Interest on loan										
- @ 14% p.a.	0.80	12.18	21.66	77.51	68.30	70.09	92.90	10.26	22.57	376.27
		1.60	24.37	43.33	155.02	136.61	140.18	185.80	20.53	707.44
			1.60	24.37	43.33	155.02	136.61	140.18	185.80	686.91
				1.60	24.37	43.33	155.02	136.61	140.18	501.11
					1.60	24.37	43.33	155.02	136.61	360.93
						1.60	24.37	43.33	155.02	224.32
							1.60	24.37	43.33	69.30
								1.60	24.37	25.97
									1.60	1.60
Total	0.80	13.78	47.63	146.81	292.62	431.02	594.01	697.17	730.01	2953.85
Debt/Equity	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

MEANS OF FINANCING : EQUITY 21502.45
LOAN 21502.45
TOTAL 43004.90

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 44

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSER

MARGIN MONEY FOR WORKING CAPITAL

('000 US $)

Sl. No.	Item	Period (Days)	Cost	Bank Finance Available (%)	(Amount)	Margin Money
1.	Raw materials & Consumables	90	3513.02	100%	3513.02	0.00
2.	Finished Stock	30	1709.52	100%	1709.52	0.00
3.	Sundry Debtors	30	2400.00	100%	2400.00	0.00
Sub-total			7622.54		7622.54	0.00
4.	Expenses	30	803.99	0%	0.00	803.99
	Total		8426.53		7622.54	803.99

JOB NO. : DCIL-105 EXHIBIT : 45

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSER

STATEMENT OF PRODUCTION AND SALES

(in Nos)

		OPERATING YEARS									
		1	2	3	4	5	6	7	8	9	10
Working Days/Year		300	300	300	300	300	300	300	300	300	300
Utilisation		80%	100%	100%	100%	100%	100%	100%	100%	100%	100%
30 MW Condenser											
Capacity	(No.)	5	5	5	5	5	5	5	5	5	5
Annual Output	(No.)	4	5	5	5	5	5	5	5	5	5
Sales	(No.)	4	5	5	5	5	5	5	5	5	5
150 MW Condenser											
Capacity	(No.)	5	5	5	5	5	5	5	5	5	5
Annual Output	(No.)	4	5	5	5	5	5	5	5	5	5
Sales	(No.)	4	5	5	5	5	5	5	5	5	5

JOB NO. : DCIL-105

EXHIBIT : 46

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANISATION

PROJECT PROFILE ON STEAM CONDENSER

STATEMENT OF REVENUE

('000 US $)

	Average Selling Price ('000 US $ per Unit)	OPERATING YEARS									
		1	2	3	4	5	6	7	8	9	10
30 MW Condenser	1300.00	5200.00	6500.00	6500.00	6500.00	6500.00	6500.00	6500.00	6500.00	6500.00	6500.00
150 MW Condenser	6000.00	24000.00	30000.00	30000.00	30000.00	30000.00	30000.00	30000.00	30000.00	30000.00	30000.00
Total		29200.00	36500.00	36500.00	36500.00	36500.00	36500.00	36500.00	36500.00	36500.00	36500.00

JOB NO. : DCIL-105

EXHIBIT : 47

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANISATION

PROJECT PROFILE ON STEAM CONDENSER

COST OF PRODUCTION AND SALES

('000 US $)

	OPERATING YEARS									
	1	2	3	4	5	6	7	8	9	10
A. Variable Cost										
Raw Materials and Consumables	13568.80	16961.00	16961.00	16961.00	16961.00	16961.00	16961.00	16961.00	16961.00	16961.00
Power	79.34	99.08	99.08	99.08	99.08	99.08	99.08	99.08	99.08	99.08
Water	4.42	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52
Sub-total	13652.56	17065.60	17065.60	17065.60	17065.60	17065.60	17065.60	17065.60	17065.60	17065.60
Contingency (@ 5% on above)	682.63	853.28	853.28	853.28	853.28	853.28	853.28	853.28	853.28	853.28
Total 'A'	14335.18	17918.88	17918.88	17918.88	17918.88	17918.88	17918.88	17918.88	17918.88	17918.88
B. Fixed Cost										
i) Labour & Plant Overhead *										
a) Direct labour	3498.38	3673.30	3848.22	4023.14	4198.06	4372.98	4547.89	4722.81	4897.73	5072.65
b) Indirect labour	1212.52	1273.15	1333.77	1394.40	1455.02	1515.65	1576.28	1636.90	1697.53	1758.15
c) Supervision	1529.00	1605.45	1681.90	1758.35	1834.80	1911.26	1987.71	2064.16	2140.61	2217.06
Sub-total	6239.90	6551.90	6863.89	7175.89	7487.88	7799.88	8111.88	8423.87	8735.87	9047.86

JOB NO. : DCIL-105

EXHIBIT : 47

('000 US $)

	OPERATING YEARS									
	1	2	3	4	5	6	7	8	9	10
ii) Other Factory Expenses										
a) Maintenance @ 3% on Plant & Equipment	108.92	108.92	108.92	108.92	108.92	108.92	108.92	108.92	108.92	108.92
b) Maintenance @ 1% on Building & Civil Work	253.53	253.53	253.53	253.53	253.53	253.53	253.53	253.53	253.53	253.53
c) Miscellaneous	72.49	72.49	72.49	72.49	72.49	72.49	72.49	72.49	72.49	72.49
Sub-total	434.94	434.94	434.94	434.94	434.94	434.94	434.94	434.94	434.94	434.94
iii) Administrative & Sales Expenses										
a) Salaries *	2024.83	2126.07	2227.32	2328.56	2429.80	2531.04	2632.28	2733.52	2834.76	2936.01
b) Overheads	404.97	425.21	445.46	465.71	485.96	506.21	526.46	546.70	566.95	587.20
Sub-total	2429.80	2551.29	2672.78	2794.27	2915.76	3037.25	3158.74	3280.23	3401.72	3523.21
Total (i+ii+iii)	9104.65	9538.13	9971.62	10405.10	10838.59	11272.07	11705.56	12139.04	12572.53	13006.01
Contingency (@ 5% on above)	455.23	476.91	498.58	520.26	541.93	563.60	585.28	606.95	628.63	650.30
Total 'B'	9559.88	10015.04	10470.20	10925.36	11380.51	11835.67	12290.84	12745.98	13201.15	13656.31
Total Cost of Production and Sales (A+B)	23895.06	27933.91	28389.07	28844.23	29299.39	29754.55	30209.72	30664.86	31120.03	31575.19

* Assumed to increase at the flat rate of 5% straight line every year

JOB NO. : DCIL-105

EXHIBIT : 48

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSER

PROJECTED PROFITABILITY STATEMENT

('000 US $)

Elements	OPERATING YEARS									
	1	2	3	4	5	6	7	8	9	10
Raw Materials and Consumables	13568.80	16961.00	16961.00	16961.00	16961.00	16961.00	16961.00	16961.00	16961.00	16961.00
Power	79.34	99.08	99.08	99.08	99.08	99.08	99.08	99.08	99.08	99.08
Water	4.42	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52	5.52
Labour & Plant Overhead	6239.90	6551.90	6863.89	7175.89	7487.88	7799.88	8111.88	8423.87	8735.87	9047.86
Other Factory Expenses	434.94	434.94	434.94	434.94	434.94	434.94	434.94	434.94	434.94	434.94
Administrative & Sales Expenses	2429.80	2551.29	2672.78	2794.27	2915.76	3037.25	3158.74	3280.23	3401.72	3523.21
Sub-total	22757.20	26603.73	27037.21	27470.70	27904.18	28337.67	28771.16	29204.64	29638.13	30071.61
Contingency	1137.85	1330.19	1351.86	1373.53	1395.21	1416.88	1438.56	1460.23	1481.91	1503.58
Total	23895.05	27933.92	28389.07	28844.23	29299.39	29754.55	30209.72	30664.87	31120.04	31575.19
Stock Variation	-1709.52	-319.68	-26.92	-26.93	-26.92	-26.93	-26.92	-26.93	-26.92	-26.93
Cost of Production and Sales	22185.53	27614.24	28362.15	28817.31	29272.47	29727.62	30182.80	30637.94	31093.12	31548.26
PROJECTED REVENUE	29200.00	36500.00	36500.00	36500.00	36500.00	36500.00	36500.00	36500.00	36500.00	36500.00
Profit before Interest and Depreciation	7014.47	8885.76	8137.85	7682.69	7227.53	6772.38	6317.20	5862.06	5406.88	4951.74

JOB NO. : DCIL-105

EXHIBIT : 48

('000 US $)

Elements	OPERATING YEARS 1	2	3	4	5	6	7	8	9	10
Interest										
On Term Loan										
- @ 12% p.a.	2580.29	2580.29	2580.29	2381.81	2183.33	1984.84	1786.36	1587.88	1389.39	1190.91
On Working Capital Loan										
- @ 14% p.a.	1067.16	1067.16	800.37	533.58	266.79	0.00	0.00	0.00	0.00	0.00
Sub-total	3647.45	3647.45	3380.66	2915.39	2450.12	1984.84	1786.36	1587.88	1389.39	1190.91
Profit before Depreciation	3367.02	5238.31	4757.19	4767.30	4777.41	4787.54	4530.84	4274.18	4017.49	3760.83
Depreciation and Amortisation	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10
Profit before Tax	1613.92	3485.21	3004.09	3014.20	3024.31	3034.44	2777.74	2521.08	2264.39	2007.73
Tax	403.48	892.14	791.52	835.54	855.58	874.65	826.11	776.72	726.53	675.60
Distributable Profit	1210.44	2593.07	2212.57	2178.66	2168.73	2159.79	1951.63	1744.36	1537.86	1332.13
Dividend	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Retained Earnings	1210.44	2593.07	2212.57	2178.66	2168.73	2159.79	1951.63	1744.36	1537.86	1332.13
Add Back : Depreciation and Amortisation	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10
NET CASH ACCRUAL	2963.54	4346.17	3965.67	3931.77	3921.83	3912.89	3704.73	3497.46	3290.96	3085.23

JOB NO. : DCIL-105

EXHIBIT : 49

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANISATION

PROJECT PROFILE ON STEAM CONDENSER

STATEMENT OF FIXED ASSETS AND DEPRECIATION UNDER STRAIGHT LINE METHOD

('000 US $)

Description	Value	Technical Know-how Fees	Sub-Total	Contin-gency	Sub-Total	Interest during Construction	Sub-Total	50% of Pre-op Expenses	Total	Rate (%)	Amount
1. Land & Land Development	4877.46	0.00	4877.46	0.00	4877.46	0.00	4877.46	0.00	4877.46	0%	0.00
2. Building & Civil Work	25353.37	1188.29	26541.66	1616.29	28157.95	2554.58	30712.53	772.06	31484.59	4%	1259.38
3. Plant & Mahinery	3630.62	170.16	3800.78	231.45	4032.23	365.82	4398.05	110.56	4508.61	8%	360.69
4. Miscellaneous Fixed Assets	331.98	15.55	347.53	21.17	368.70	33.45	402.15	10.10	412.25	10%	41.23
5. Preliminary Expenses	25.00	0.00	25.00	0.00	25.00	0.00	25.00	0.00	25.00	10%	2.50
6. Pre-operative Expenses	1785.72	0.00	1785.72	0.00	1785.72	0.00	1785.72	-892.72	893.00	10%	89.30
7. Technical Know-how Fees	1374.00	-1374.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0%	0.00
Sub-total	37378.15		37378.15		39247.06		42200.91		42200.91		1753.10
8. Contingency	1868.91	0.00	1868.91	-1868.91	0.00	0.00	0.00	0.00	0.00		-------
Sub-total	39247.06		39247.06		39247.06		42200.91		42200.91		
9. Interest during Construction	2953.85	0.00	2953.85	0.00	2953.85	-2953.85	0.00	0.00	0.00		
Total	42200.91		42200.91		42200.91		42200.91		42200.91		

JOB NO. : DCIL-105

EXHIBIT : 50

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANISATION

PROJECT PROFILE ON STEAM CONDENSER

TAX COMPUTATION

('000 US $)

	OPERATING YEARS									
	1	2	3	4	5	6	7	8	9	10
Profit before Depreciation	3367.02	5238.31	4757.19	4767.30	4777.41	4787.54	4530.84	4274.18	4017.49	3760.83
Less : Current Depreciation	1753.10	1669.75	1591.13	1425.14	1355.10	1288.93	1226.41	1167.29	1111.36	1058.44
Balance	1613.92	3568.56	3166.07	3342.16	3422.31	3498.61	3304.43	3106.89	2906.13	2702.39
Less : Unabsorbed Depreciation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taxable Income	1613.92	3568.56	3166.07	3342.16	3422.31	3498.61	3304.43	3106.89	2906.13	2702.39
Tax @ 25%	403.48	892.14	791.52	835.54	855.58	874.65	826.11	776.72	726.53	675.60

JOB NO. : DCIL-105

EXHIBIT : 51

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSER

DEPRECIATION FOR TAX

('000 US $)

	WDV Rate	Building & Civil Work 4%	Plant and Machinery 8%	Misc. Fixed Assets 10%	Amortisation 10%	Total
Value		31484.59	4508.61	412.25	918.00	
Depreciation Year 1		1259.38	360.69	41.23	91.80	1753.10
Balance		30225.21	4147.92	371.03	826.20	
Depreciation Year 2		1209.01	331.83	37.10	91.80	1669.75
Balance		29016.20	3816.09	333.92	734.40	
Depreciation Year 3		1160.65	305.29	33.39	91.80	1591.13
Balance		27855.55	3510.80	300.53	642.60	
Depreciation Year 4		1114.22	280.86	30.05	91.80	1516.94
Balance		26741.33	3229.94	270.48	550.80	
Depreciation Year 5		1069.65	258.40	27.05	91.80	1446.90
Balance		25671.67	2971.54	243.43	459.00	
Depreciation Year 6		1026.87	237.72	24.34	91.80	1380.73
Balance		24644.81	2733.82	219.09	367.20	
Depreciation Year 7		985.79	218.71	21.91	91.80	1318.21
Balance		23659.02	2515.11	197.18	275.40	
Depreciation Year 8		946.36	201.21	19.72	91.80	1259.09
Balance		22712.65	2313.91	177.46	183.60	
Depreciation Year 9		908.51	185.11	17.75	91.80	1203.16
Balance		21804.15	2128.79	159.72	91.80	
Depreciation Year 10		872.17	170.30	15.97	91.80	1150.24
Balance		20931.98	1958.49	143.74	0.00	

WDV : Written Down Value

JOB NO. : DCIL-105

EXHIBIT : 52

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSER

WORKING CAPITAL REQUIREMENTS
(Excluding Cash and Bank Balances)

('000 US $)

Items	OPERATING YEAR									
	1	2	3	4	5	6	7	8	9	10
1. Raw materials & Consumables	3513.02	4391.27	4391.27	4391.27	4391.27	4391.27	4391.27	4391.27	4391.27	4391.27
2. Finished Stock	1709.52	2029.20	2056.12	2083.05	2109.97	2136.90	2163.82	2190.75	2217.67	2244.60
3. Sundry Debtors	2400.00	3000.00	3000.00	3000.00	3000.00	3000.00	3000.00	3000.00	3000.00	3000.00
TOTAL	**7622.54**	**9420.47**	**9447.39**	**9474.32**	**9501.24**	**9528.17**	**9555.09**	**9582.02**	**9608.94**	**9635.87**
Increase /(decrease)	7622.54	1797.93	26.92	26.93	26.92	26.93	26.92	26.93	26.92	26.93
Stock Variation	1709.52	319.68	26.92	26.93	26.92	26.93	26.92	26.93	26.92	26.93

JOB NO. : DCIL-105 EXHIBIT : 53

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSER

PROJECTED CASH FLOW STATEMENT

('000 US $)

	Construction Period	1	2	3	4	5	6	7	8	9	10
		Y			E		A		R		
A. SOURCES											
Increase in Share Capital	21502.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Increase in Term Loan	21502.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Increase in Bank Loan	0.00	7622.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Profit be fore Tax with Interest added back	0.00	5261.37	7132.66	6384.75	5929.59	5474.43	5019.28	4564.10	4108.96	3653.78	3198.64
Depreciation	0.00	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10	1753.10
TOTAL 'A'	43004.90	14637.01	8885.76	8137.85	7682.69	7227.53	6772.38	6317.20	5862.06	5406.88	4951.74
B. APPLICATIONS											
Increase in Capital Expenditure	39247.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Increase/(Decrease) in Working Capital	0.00	7622.54	1797.93	26.92	26.93	26.92	26.93	26.92	26.93	26.92	26.93

JOB NO. : DCIL-105

EXHIBIT : 53

('000 US $)

	Construction Period	Y 1	2	E 3	4	A 5	6	R 7	8	9	10
Interest											
On Term Loan - @ 12% p.a.	2953.85	2580.29	2580.29	2580.29	2381.81	2183.33	1984.84	1786.36	1587.88	1389.39	1190.91
On Working Capital Loan - @ 14% p.a.	0.00	1067.16	1067.16	800.37	533.58	266.79	0.00	0.00	0.00	0.00	0.00
Total Interest	2953.85	3647.45	3647.45	3380.66	2915.39	2450.12	1984.84	1786.36	1587.88	1389.39	1190.91
Tax	0.00	403.48	892.14	791.52	835.54	855.58	874.65	826.11	776.72	726.53	675.60
Dividend	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Repayment of Term Loan	0.00	0.00	0.00	1654.03	1654.03	1654.03	1654.03	1654.03	1654.03	1654.03	1654.03
Repayment of Working Capital Loan	0.00	0.00	1905.63	1905.63	1905.63	1905.65	0.00	0.00	0.00	0.00	0.00
TOTAL 'B'	42200.91	11673.47	8243.15	7758.76	7337.52	6892.30	4540.45	4293.42	4045.56	3796.87	3547.47
Opening Balance	0.00	803.99	3767.53	4410.14	4789.23	5134.40	5469.63	7701.56	9725.34	11541.84	13151.85
Surplus/(Deficit) during the Year (A - B)	803.99	2963.54	642.61	379.09	345.17	335.23	2231.93	2023.78	1816.50	1610.01	1404.27
Closing Balance	803.99	3767.53	4410.14	4789.23	5134.40	5469.63	7701.56	9725.34	11541.84	13151.85	14556.12

JOB NO. : DCIL-105 EXHIBIT : 54

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANISATION

PROJECT PROFILE ON STEAM CONDENSER

PROJECTED BALANCE SHEET

('000 US $)

		Y 1	Y 2	Y 3	Y 4	Y 5	Y 6	Y 7	Y 8	Y 9	Y 10
	Share Capital	21502.45	21502.45	21502.45	21502.45	21502.45	21502.45	21502.45	21502.45	21502.45	21502.45
Add:	Reserves & Surplus	1210.44	3803.51	6016.08	8194.74	10363.47	12523.26	14474.89	16219.25	17757.11	19089.24
	SHAREHOLDERS' FUND	22712.89	25305.96	27518.53	29697.19	31865.92	34025.71	35977.34	37721.70	39259.56	40591.69
Less:	Intangible Assets	826.20	734.40	642.60	550.80	459.00	367.20	275.40	183.60	91.80	0.00
	TANGIBLE NET WORTH	21886.69	24571.56	26875.93	29146.39	31406.92	33658.51	35701.94	37538.10	39167.76	40591.69
Add:	Term Loan	21502.45	21502.45	19848.42	18194.39	16540.36	14886.33	13232.30	11578.27	9924.24	8270.21
	CAPITAL FUND	43389.14	46074.01	46724.35	47340.78	47947.28	48544.84	48934.24	49116.37	49092.00	48861.90
Less	Net Fixed Assets	39621.61	37960.31	36299.01	34637.71	32976.41	31315.11	29653.81	27992.51	26331.21	24669.91
	NET CURRENT ASSETS	3767.53	8113.70	10425.34	12703.07	14970.87	17229.73	19280.43	21123.86	22760.79	24191.99
A.	CURRENT ASSETS										
	Working Capital	7622.54	9420.47	9447.39	9474.32	9501.24	9528.17	9555.09	9582.02	9608.94	9635.87
	Cash & Bank Balance as per Cash Flow Statatement	3767.53	4410.14	4789.23	5134.40	5469.63	7701.56	9725.34	11541.84	13151.85	14556.12
	TOTAL 'A'	11390.07	13830.61	14236.62	14608.72	14970.87	17229.73	19280.43	21123.86	22760.79	24191.99
B.	CURRENT LIABILITIES										
	Bank Loan	7622.54	5716.91	3811.28	1905.65	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL 'B'	7622.54	5716.91	3811.28	1905.65	0.00	0.00	0.00	0.00	0.00	0.00
	NET CURRENT ASSETS (A-B)	3767.53	8113.70	10425.34	12703.07	14970.87	17229.73	19280.43	21123.86	22760.79	24191.99

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 55

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSER

BREAK-EVEN ANALYSIS

('000 US $)

Sl. No.	Particulars		Amount
1.	Raw Materials and Consumables		16961.00
2.	Power		99.08
3.	Water		5.52
4.	Sub-total (1 thru 3)		17065.60
5.	Contigency		853.28
6.	VARIABLE COSTS		17918.88
7.	REVENUE		36500.00
8.	CONTRIBUTION (7 - 6)		18581.12
9.	Labour & Plant Overhead*		7643.88
10.	Other Factory Expenses		434.94
11.	Administrative & Sales Expenses*		2976.50
12.	Sub-Total (9 thru 11)		11055.33
13.	Contingency		552.77
14.	Sub-Total (12+13)		11608.09
15.	Interest*		2398.04
16.	Depreciation		1753.11
17.	FIXED COSTS		15759.24
	BREAK-EVEN SALES	17*7/8	30956.80
	BREAK-EVEN POINT		84.8%
	CASH BREAK-EVEN SALES		27513.09
	CASH BREAK-EVEN POINT		75.4%

* Average over 10 years

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 56

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM CONDENSER

INTERNAL RATE OF RETURN

('000 US $)

Year	Outflow	Inflow	Net Inflow
0	-43004.89	0.00	-43004.89
1	0.00	7014.47	7014.47
2	0.00	8885.76	8885.76
3	0.00	8137.85	8137.85
4	0.00	7682.69	7682.69
5	0.00	7227.53	7227.53
6	0.00	6772.38	6772.38
7	0.00	6317.20	6317.20
8	0.00	5862.06	5862.06
9	0.00	5406.88	5406.88
10	0.00	4951.74	4951.74
11	0.00	4496.58	4496.58
12	0.00	4041.42	4041.42
13	0.00	3586.26	3586.26
14	0.00	3131.10	3131.10
15	0.00	2675.94	2675.94
	IRR	12.8%	

Outflow - Project Cost
Inflow - Profit before Interest, Depreciation & Tax

SECTION - 13
PROJECT IMPLEMENTATION PLAN

PROJECT IMPLEMENTATION PLAN

The Steam Condenser manufacturing plant will be set up in Algeria. The implementation schedule of the key activities involved in setting up the plant is presented in Exhibit-57.

The programme covers a time span of 27 months starting from the preparation and finalisation of Detailed Project Report (DPR) and ending on the commencement of commercial production. It allows adequate time for procurement and erection of the equipment. Erection of heavier equipment will become easier if procurement and installation of EOT crane is speeded up. The total time span of 9 to 12 months for delivery of equipment at site have to be strictly adhered to, as this will involve international competitive bidding. Any delay in this stage will adversely affect the commissioning of the plant in time.

Recruitment of personnel has been shown in various key points during the implementation stage. Experienced personnel will be recruited within the first seven quarters for senior levels.

Though not included in the key activities, it is important that the client applies for and obtains the necessary funds from the concerned financial institution well in time.

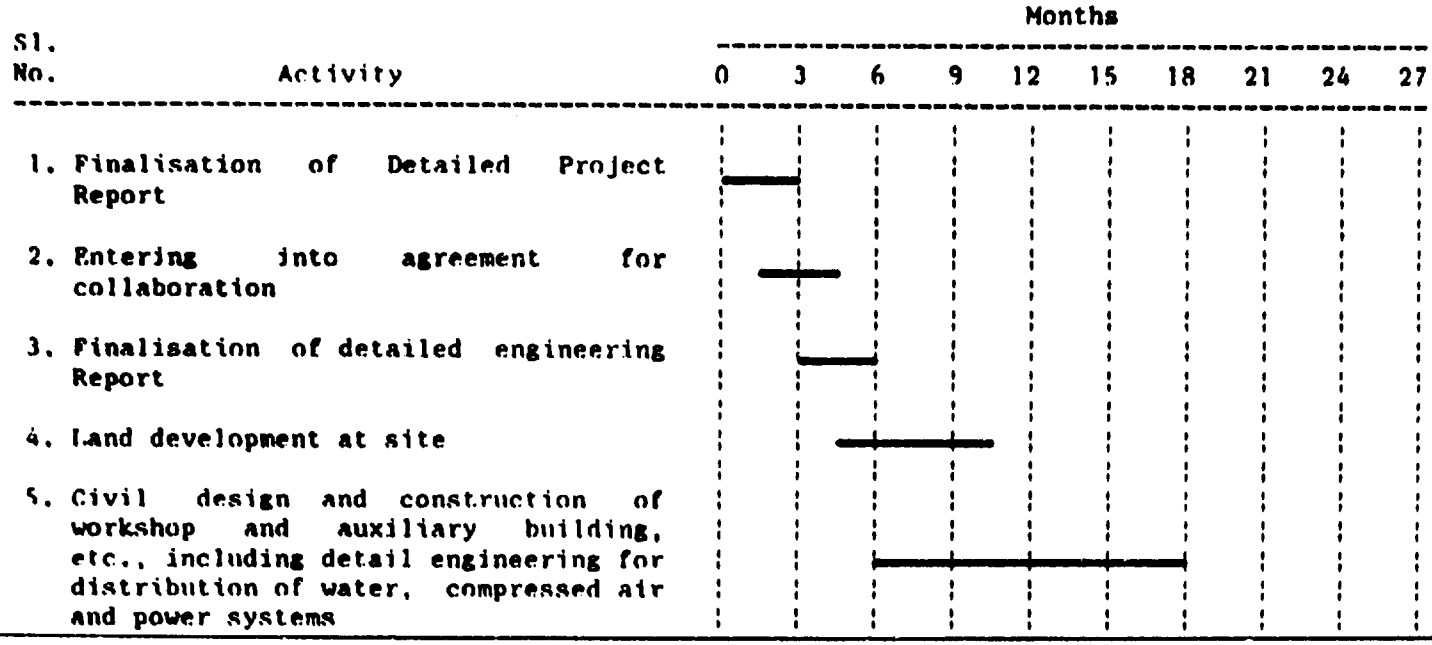
JOB NO. : DCIL-105

EXHIBIT : 57

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

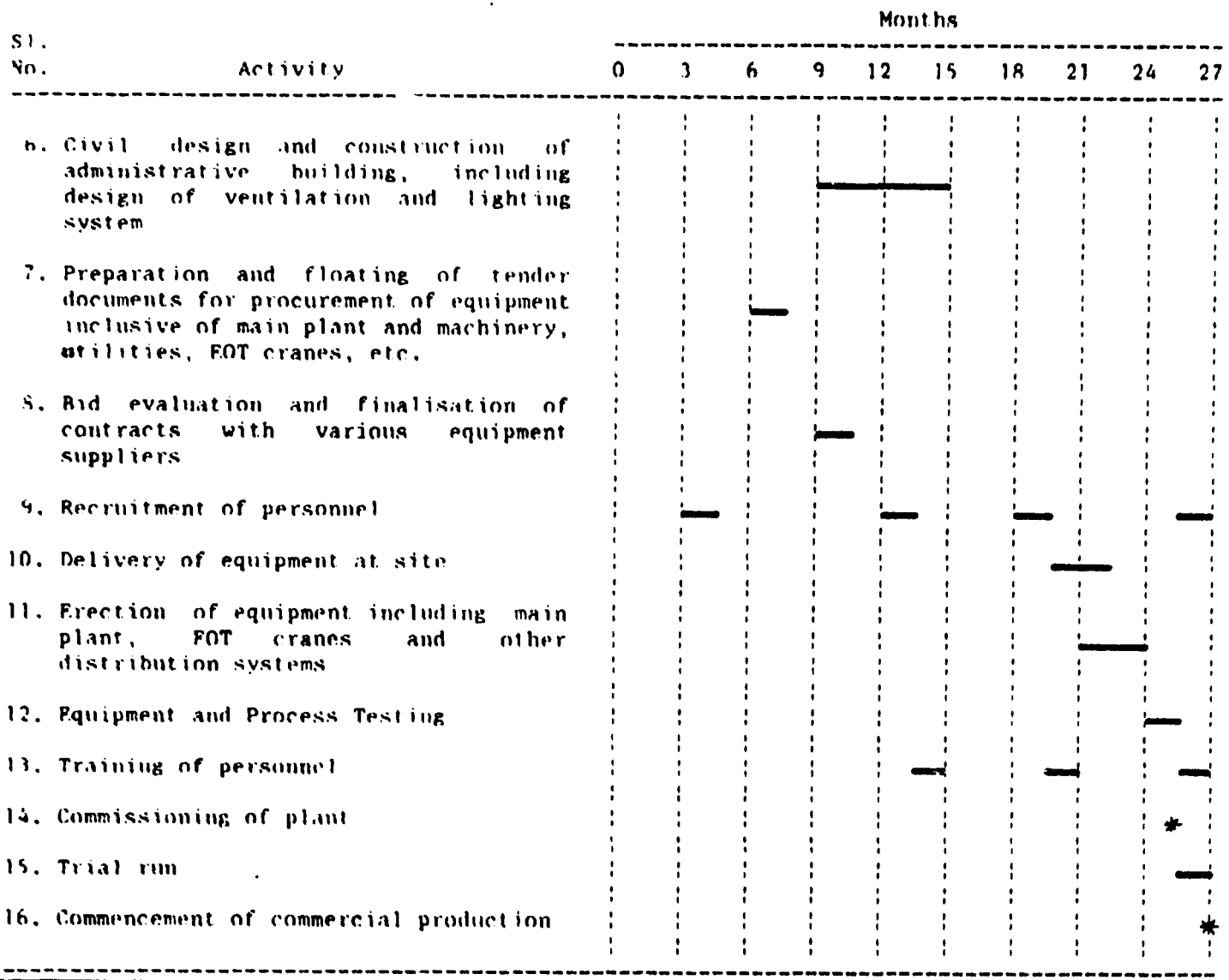
PROJECT PROFILE ON STEAM CONDENSER

PROJECT IMPLEMENTATION SCHEDULE : STEAM CONDENSER

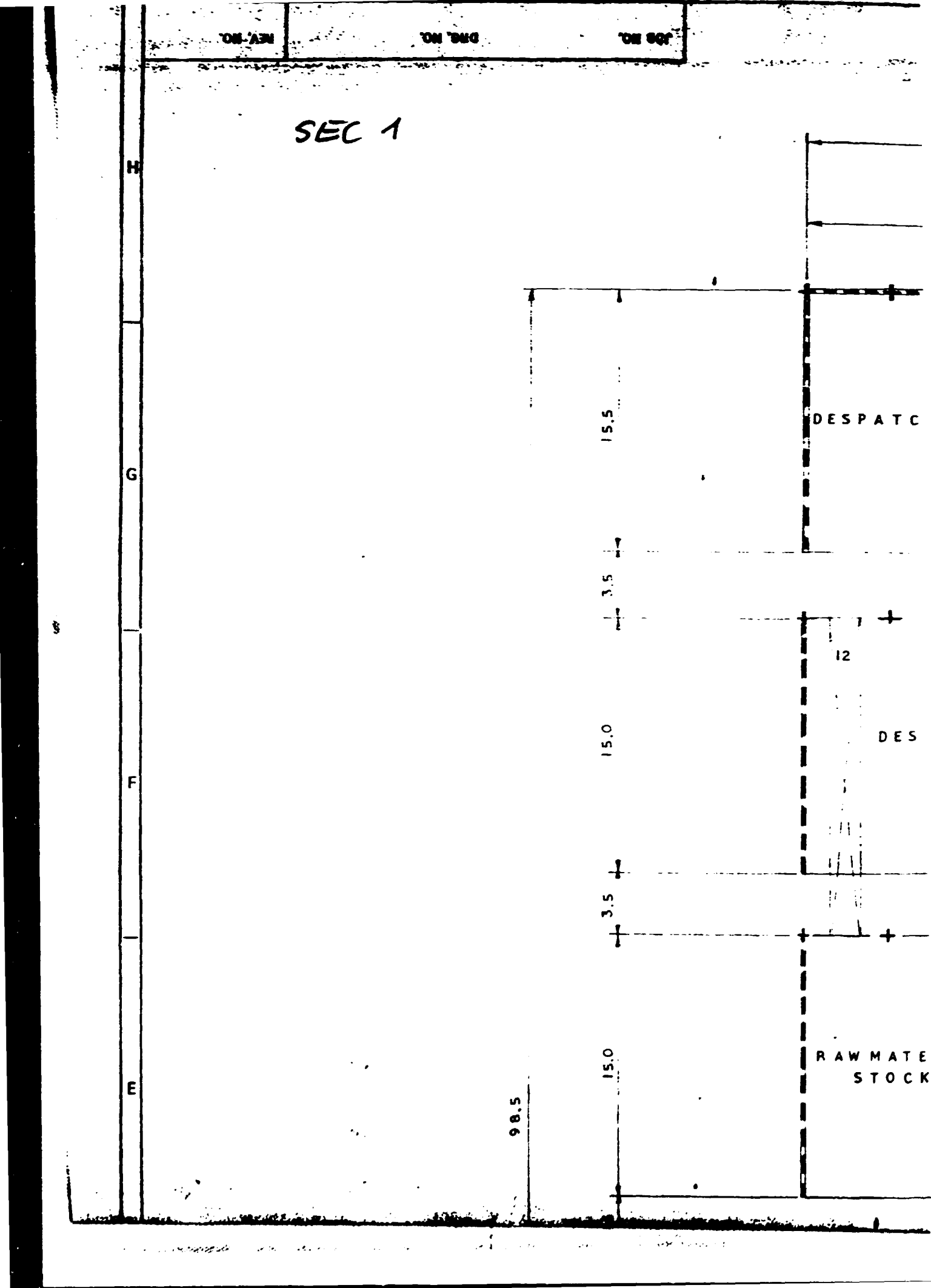


JOB NO. : DCIL-105

EXHIBIT : 57



DEVELOPMENT CONSULTANTS


SEC 1
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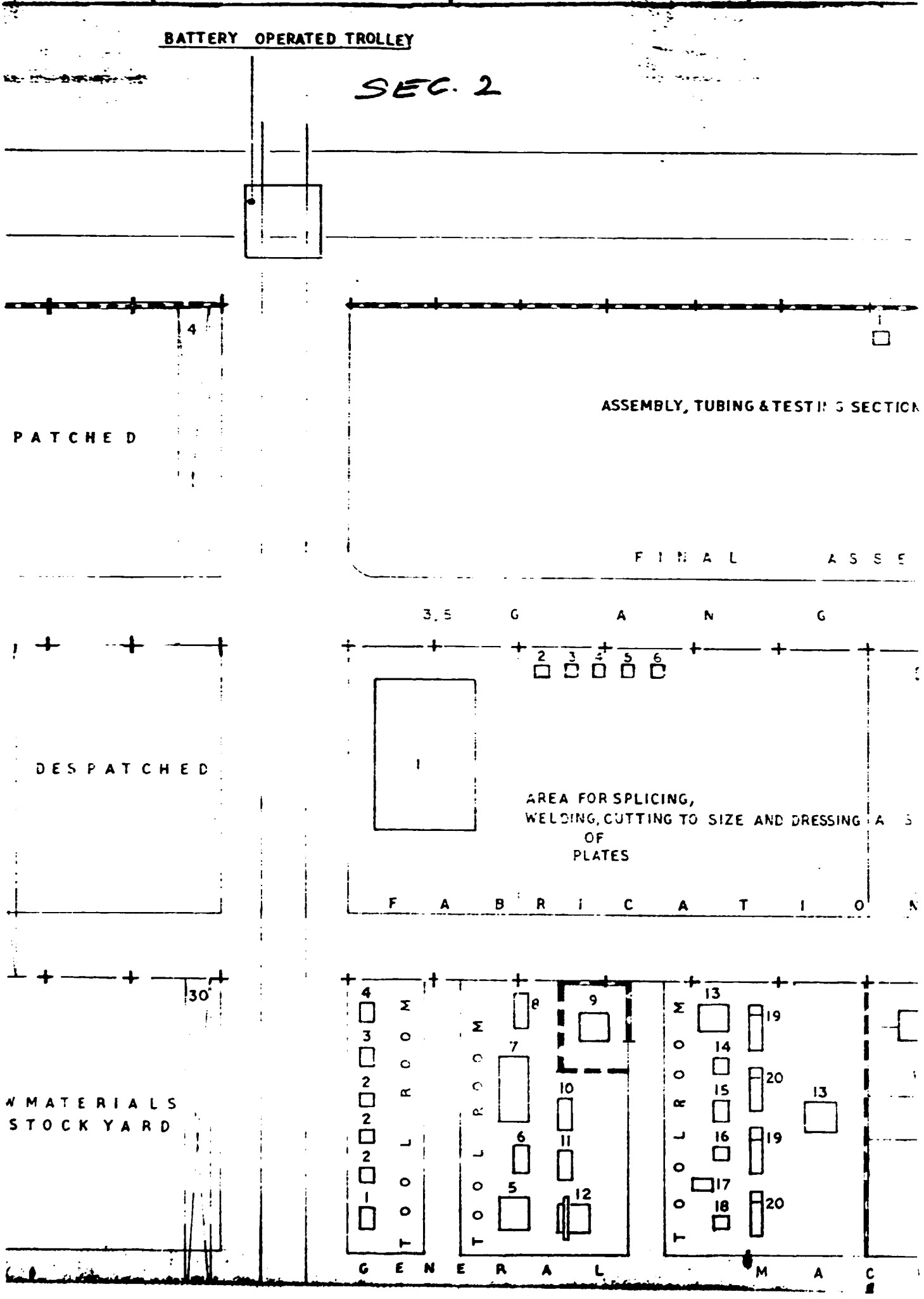
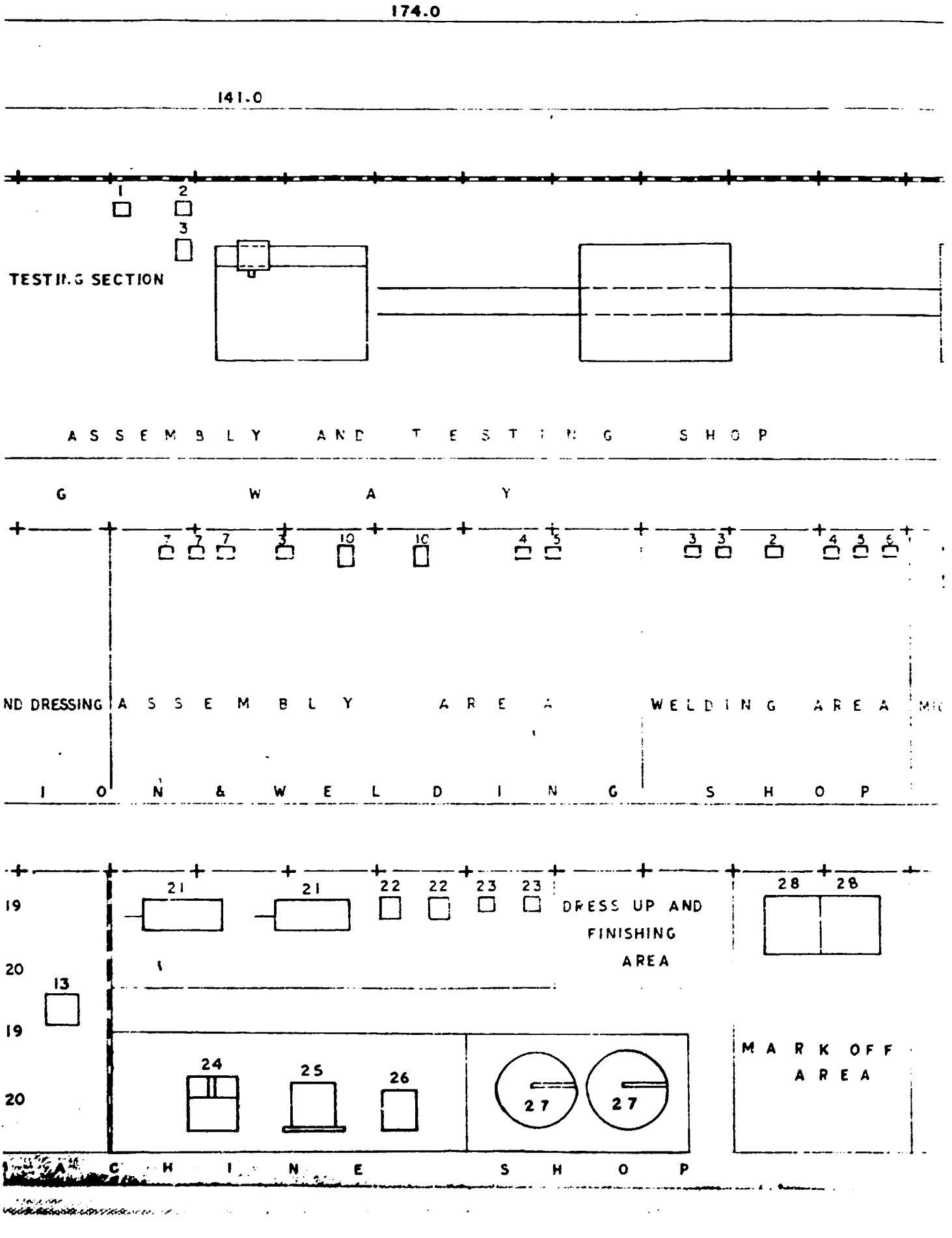

BATTERY OPERATED TROLLEY
SEC. 2
4
PATCHED
1
ASSEMBLY, TUBING & TESTING SECTION
FINAL ASSE
3.5 GANG
2 3 4 5 6
1
DESPATCHED
AREA FOR SPLICING,
WELDING, CUTTING TO SIZE AND DRESSING
OF
PLATES
FABRICATION
30'
MATERIALS
STOCK YARD
TOOL ROOM
4 3 2 2 2 1
8 7 6 5
9 10 11 12
TOOL ROOM
13 14 15 16 17 18
19 20 19 20
13
GENERAL
MAC

SEC. 3


174.0
141.0
1
2
3
TESTING SECTION
ASSEMBLY AND TESTING SHOP
GANGWAY
7
7
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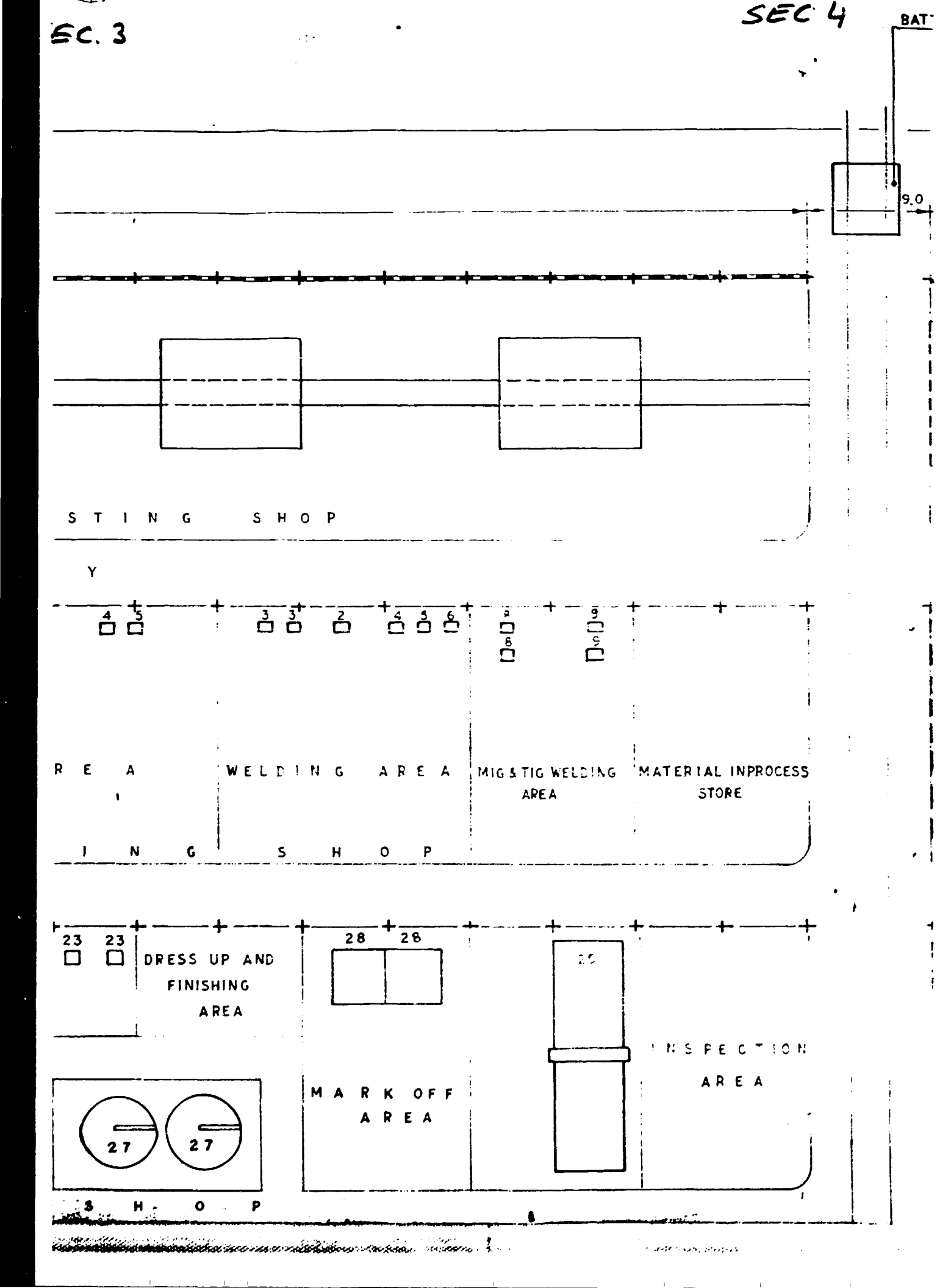
6
ND DRESSING
ASSEMBLY AREA
WELDING AREA
ION & WELDING SHOP
19
20
21
21
22
22
23
23
DRESS UP AND FINISHING AREA
28
28
13
19
20
24
25
26
27
27
MARK OFF AREA
MACHINE SHOP


EC. 3
SEC 4
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9.0
S T I N G S H O P
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8
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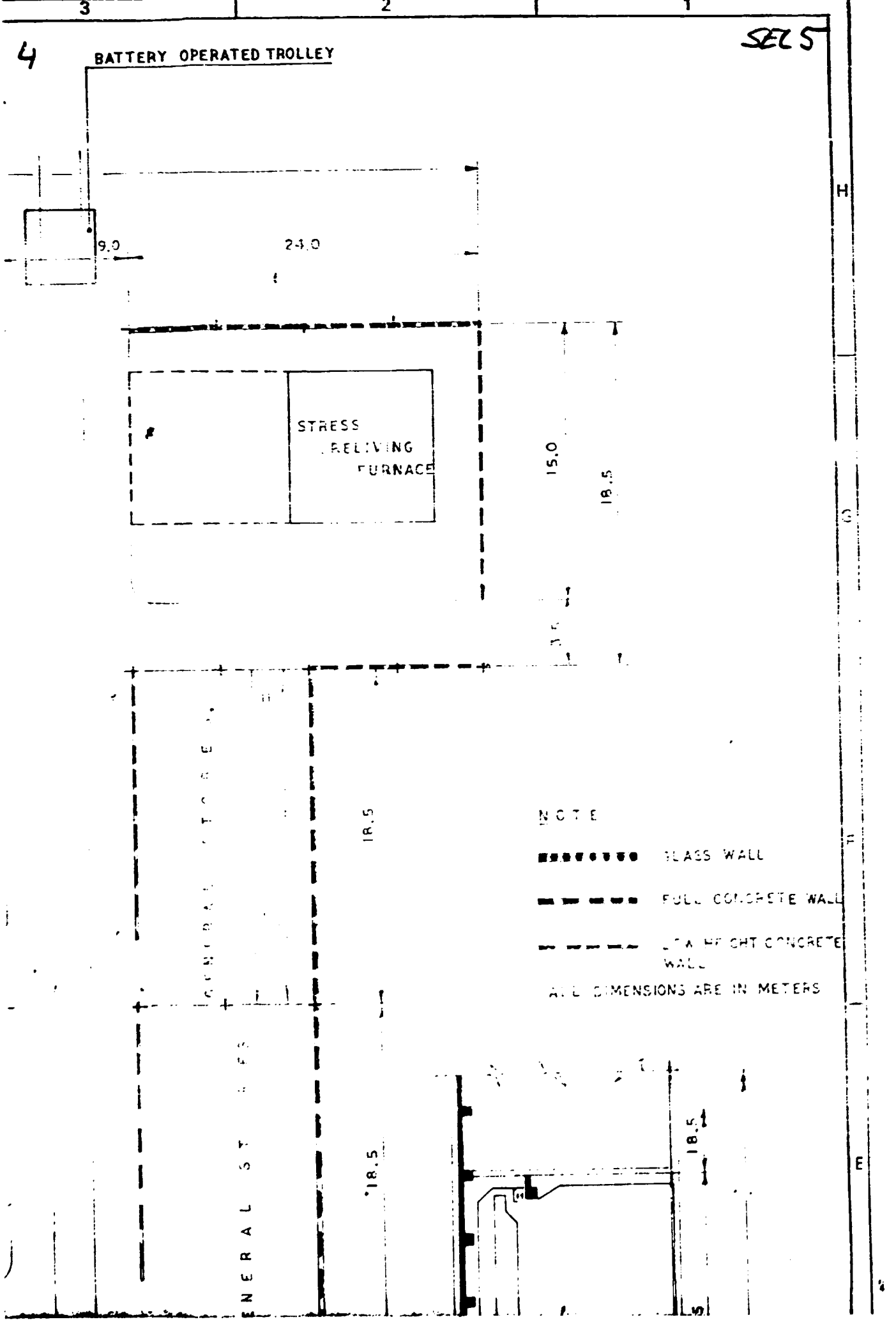
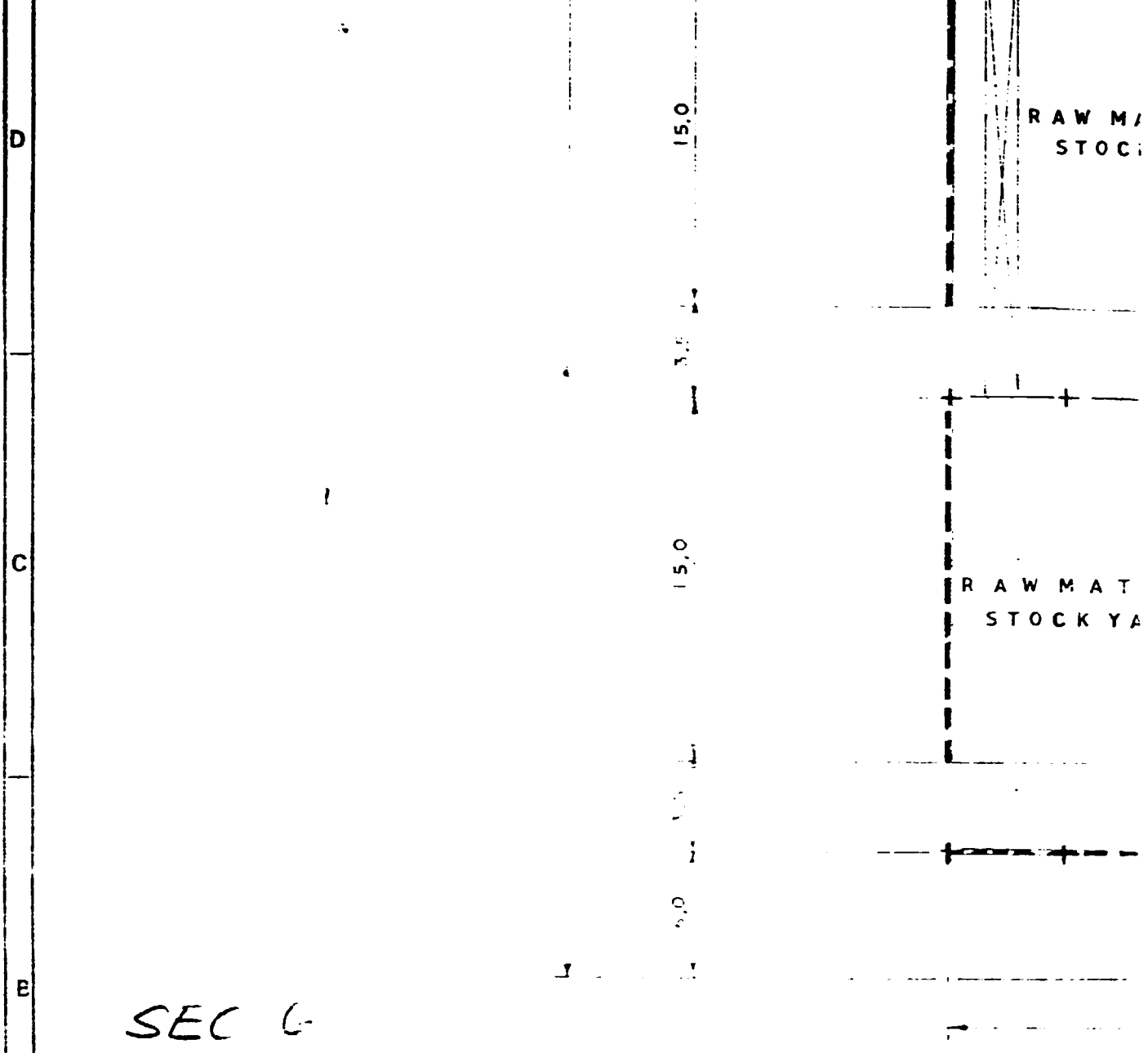
9
9
R E A
WELDING AREA
MIG & TIG WELDING AREA
MATERIAL INPROCESS STORE
I N G S H O P
23
23
DRESS UP AND FINISHING AREA
28
28
MARK OFF AREA
INSPECTION AREA
27
27
S H O P


3
2
1
SEC 5
4
BATTERY OPERATED TROLLEY
H
G
F
E
9.0
24.0
STRESS
RELIVING
FURNACE
15.0
18.5
18.5
18.5
18.5
NOTE
GLASS WALL
FULL CONCRETE WALL
HALF HEIGHT CONCRETE WALL
ALL DIMENSIONS ARE IN METERS
GENERAL STORES



SEC C-

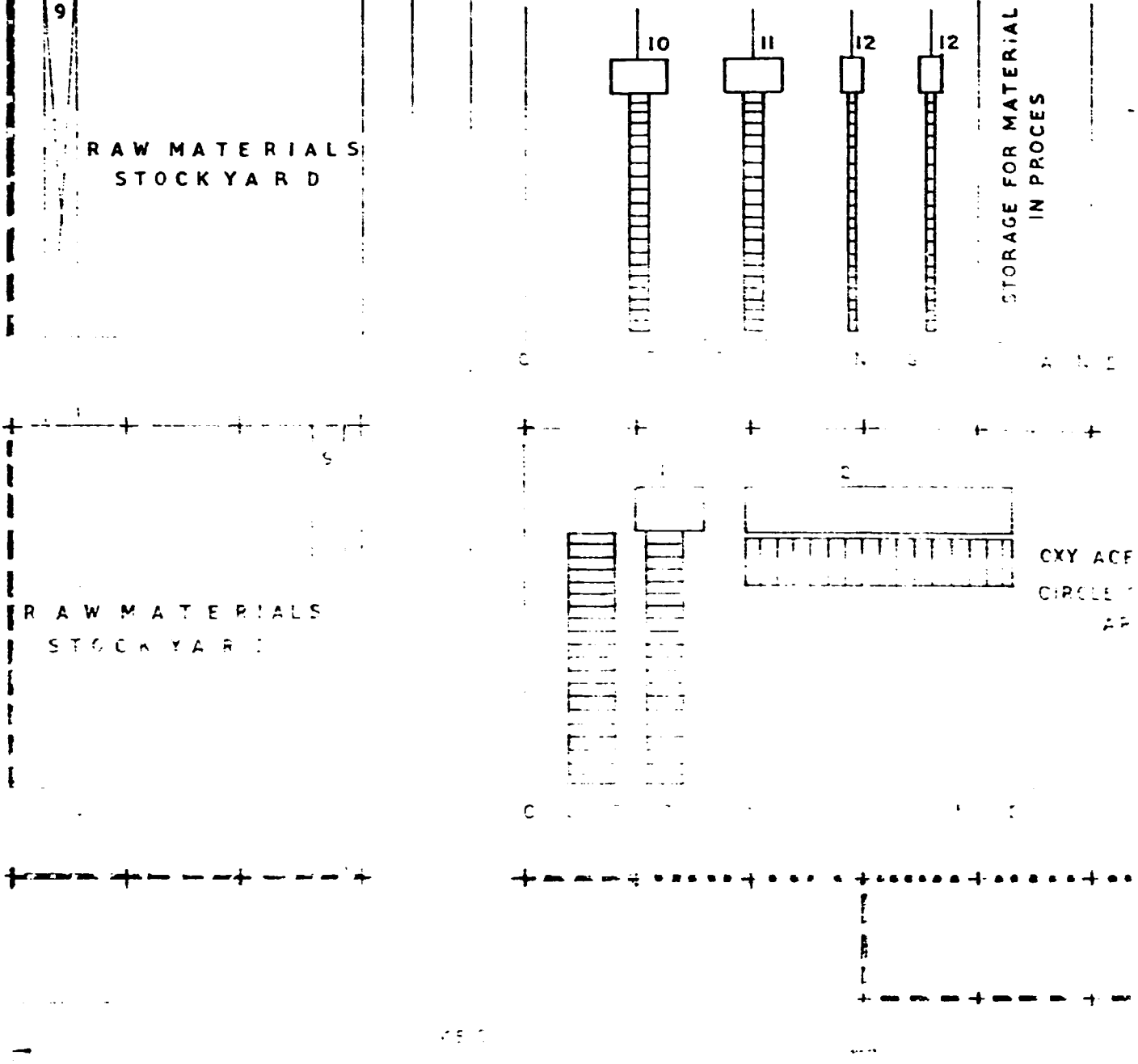
LEGEND

CUTTING & FORMING SHOP

1 GUILLOTINE SHEARING MACHINE
2 OXY ACETYLENE PROFILE CUTTING MACHINE
3 PEDESTAL GRINDER
4 SURFACE PLATE
5 EDGE PLANING MACHINE
6 HYDRAULIC PRESS BRAKE
7 PLATE BENDING ROLL
8 PLATE STRAIGHTENING MACHINE
9 HAND GUILLOTINE SHEAR
10 UNIVERSAL CUTTING & PUNCHING MACHINE
11 CIRCULAR COLD SAW
12 ABRASIVE WHEEL CUT OFF MACHINE 2 NOS
13 BEAM STRAIGHTENING MACHINE
14 HYDRAULIC ROTARY DRAW TYPE TUBE BENDING MACHINE
15 DISHED END COLD FORMING MACHINE
16 HY
17 UN
18 G
19 F
21 FR
22 GU
23 FE
24 SE

REVISIONS						APPROVED BY
REV. NO.	RELEASE DATE	LOCATION & MARK	ARCH.	STR.	MECH.	ELEC.

12 11 10

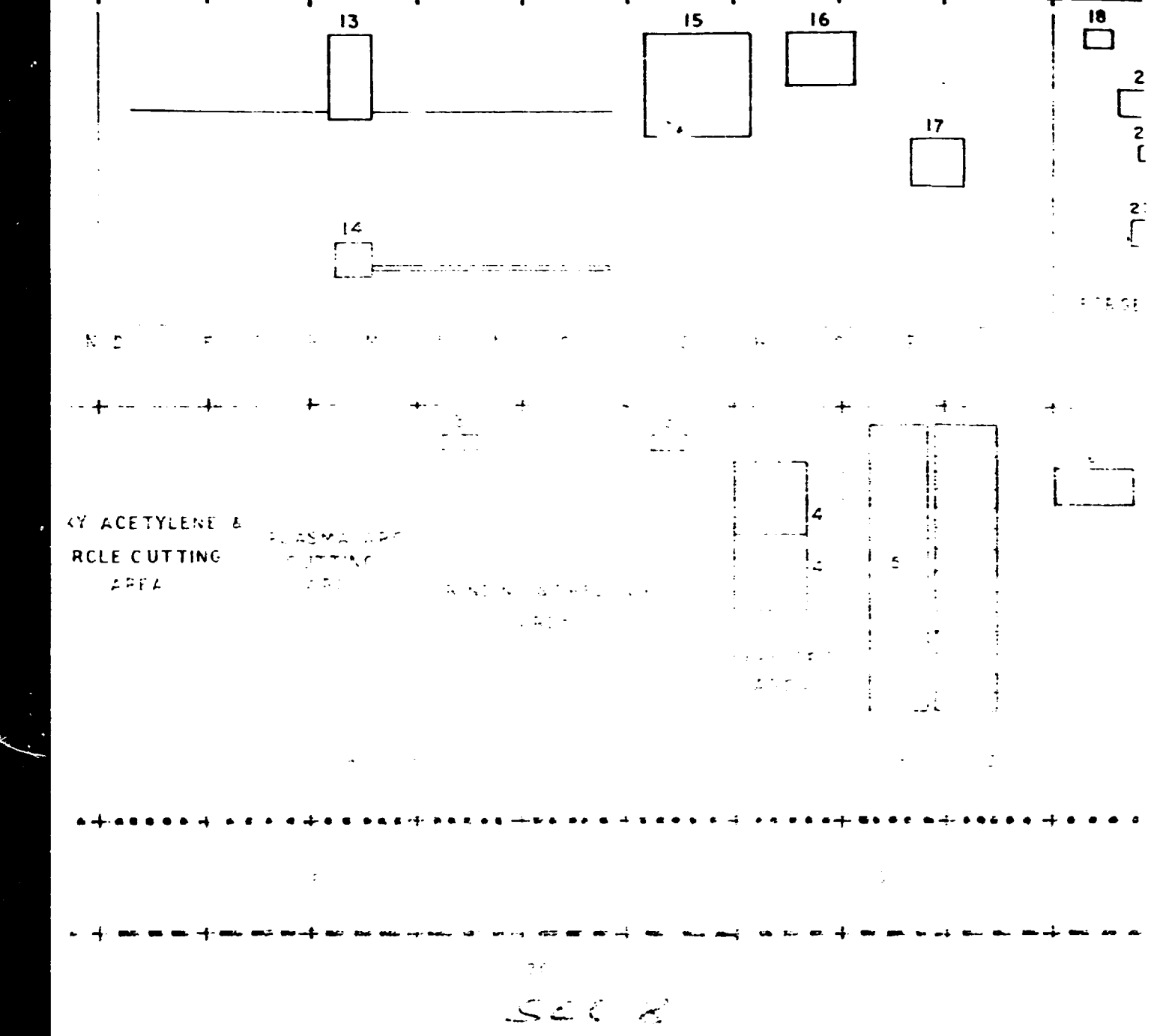


SEC 7

24 SEWAGE BLOCK WITH

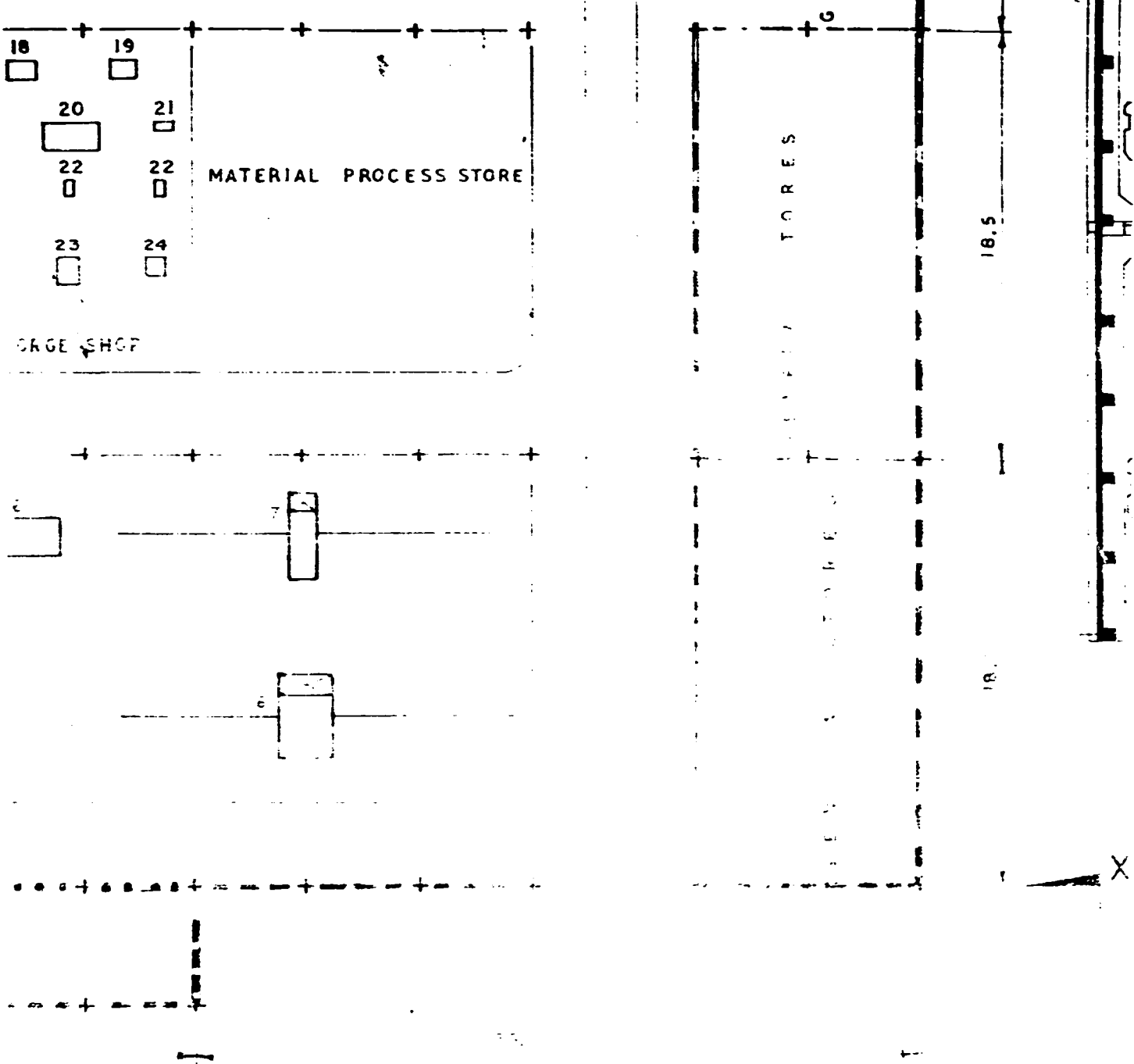
MACHINE

1 RADIAL DRILLING MACHINE
12 UNIVERSAL MILLING MACHINE
13 SURFACE PLATE – 2 NoS
14 ARC WELDING SET — 500 AMPS
15 DOUBLE ENDED PEDESTAL GRINDER



26 SHAPING MACHINE
25 UNIVERSAL MILLING MACHINE
26 SLOTTING MACHINE
27 RADIAL DRILLING MACHINE _ 2 NOS
28 SURFACE PLATE _ 2 NOS
29 CNC DRILLING MACHINE _ 1 NOS
30 E.O.T CRANE _ 10 TONNE _ 1 NOS

11 E.O.T CRANE _ 25 TONNE
12 E.O.T CRANE _ 150/10 TONNE



SECT

FINAL ASSEMBLY & TESTING

1 ARC WELDING SET 500 AMP

1 RECTIFIER

3 PEDESTAL GRINDER

4

3 NOS

LAYOUT OF PRODU

STEAM CONDENSER

UNITED NATIONS INDUSTR

ARAB INDUSTRIAL DEVELO

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
FOR TENDER ONLY		
FOR CONSTRUCTION		
CHECKED BY ARCH.		
CHECKED BY STR.		
CHECKED BY MECH.		
CHECKED BY ELEC.		

DEVELOPME

CONSULTING ENGINE

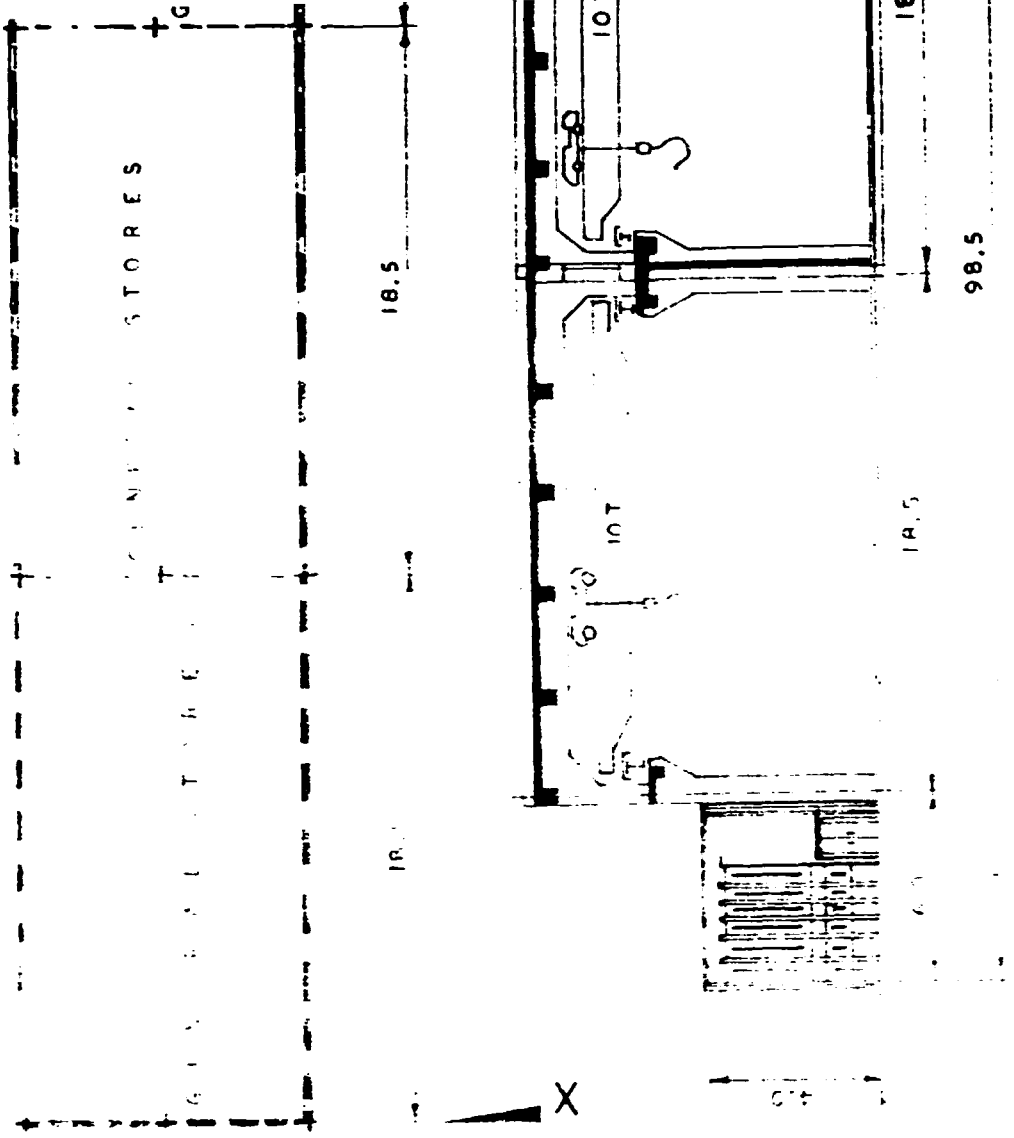
BOMBAY • CALCUTTA • MAD

DRAWN MUKUL CHOWDHUR | DESIGNED

PROJ. ENGR. PCD / MC | ISTC E

DEPT. HEAD

DWG. NO. EXHIBIT — 19



SEC 10

LAYOUT OF PRODUCTION SHOP.

STEAM CONDENSER MANUFACTURING PLANT

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

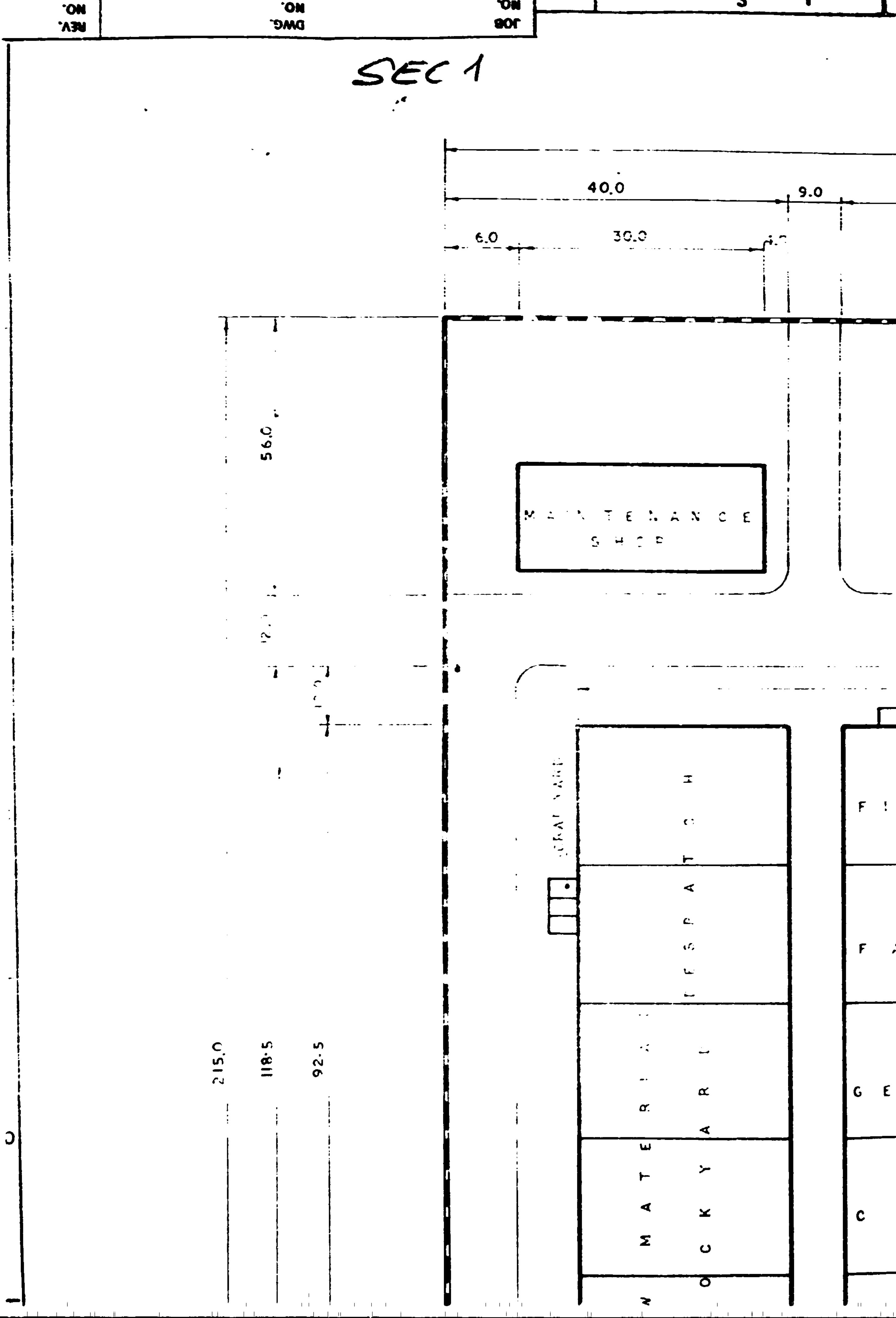
DATE	SIGNATURE

DEVELOPMENT CONSULTANTS

CONSULTING ENGINEERS

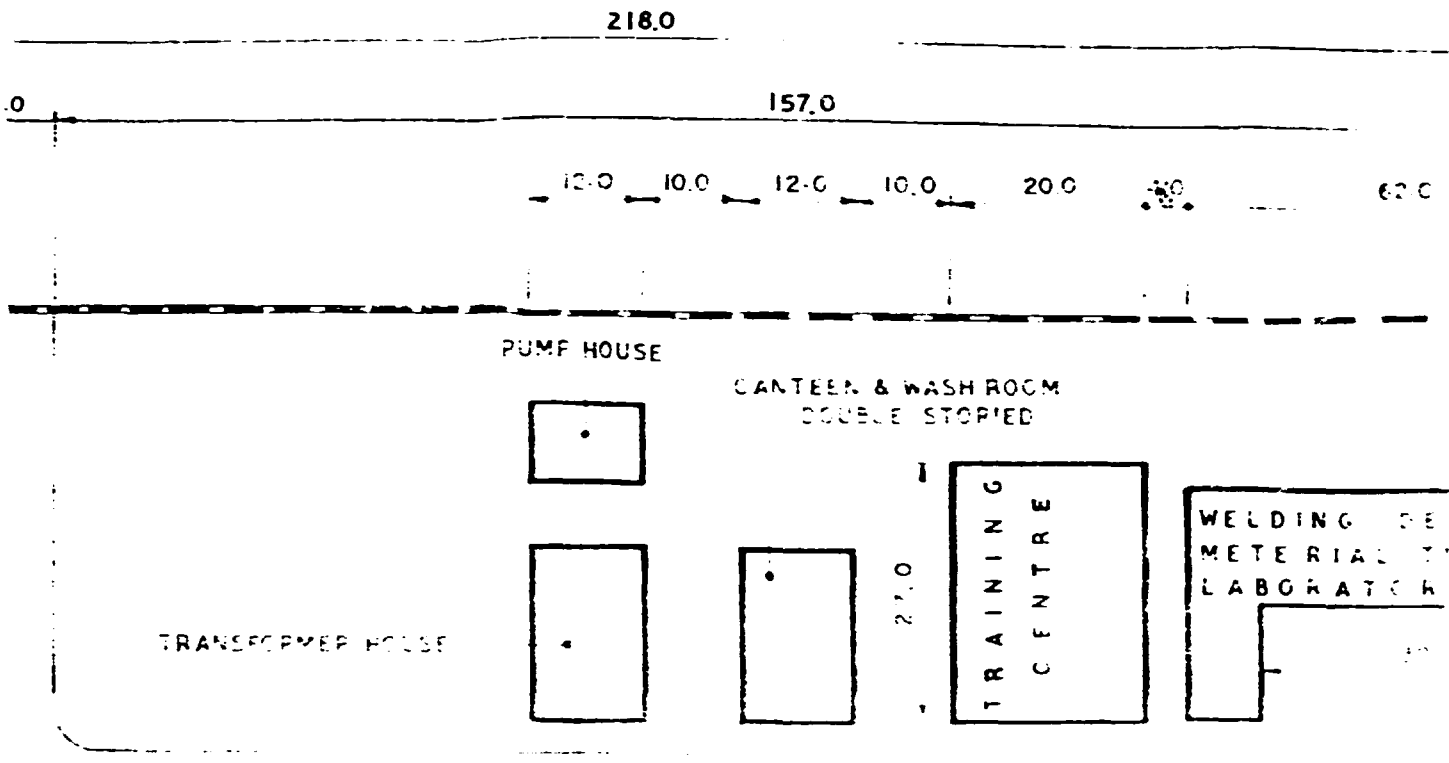
BOMBAY • CALCUTTA • MADRAS • NEW DELHI

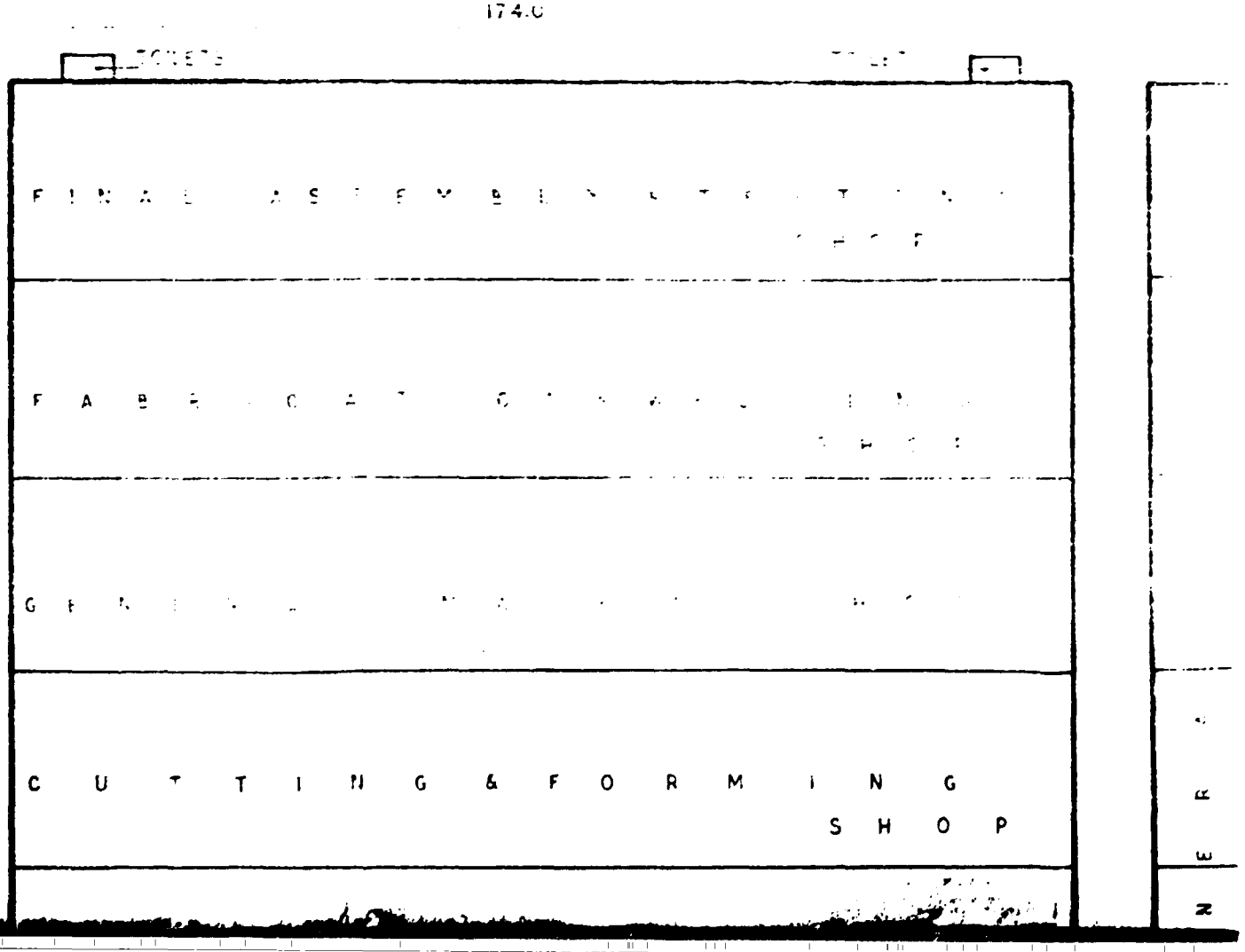
DRAWN MUKUL CHOWDHURY	DESIGNED M.C.	SCALE 1:300
PROJ. ENGR. PCD / M.C.	I.S.T.C. ENGR.	DATE 3.2.92
DEPT. HEAD		JOB NO. 45010
DWG. NO. EXHIBIT 19		REV. NO.



REV. NO.
DWG. NO.
JOB NO.
SEC 1
40.0
9.0
6.0
30.0
56.0
MAINTENANCE
SHOP
215.0
118.5
92.5

SEC 2


218.0
157.0
12-0
10.0
12-0
10.0
20.0
PUMP HOUSE
CANTEEN & WASH ROOM
DOUBLE STORIED
TRANSFORMER HOUSE
21.0
TRAINING CENTRE
WELDING
METERIAL
LABORATORY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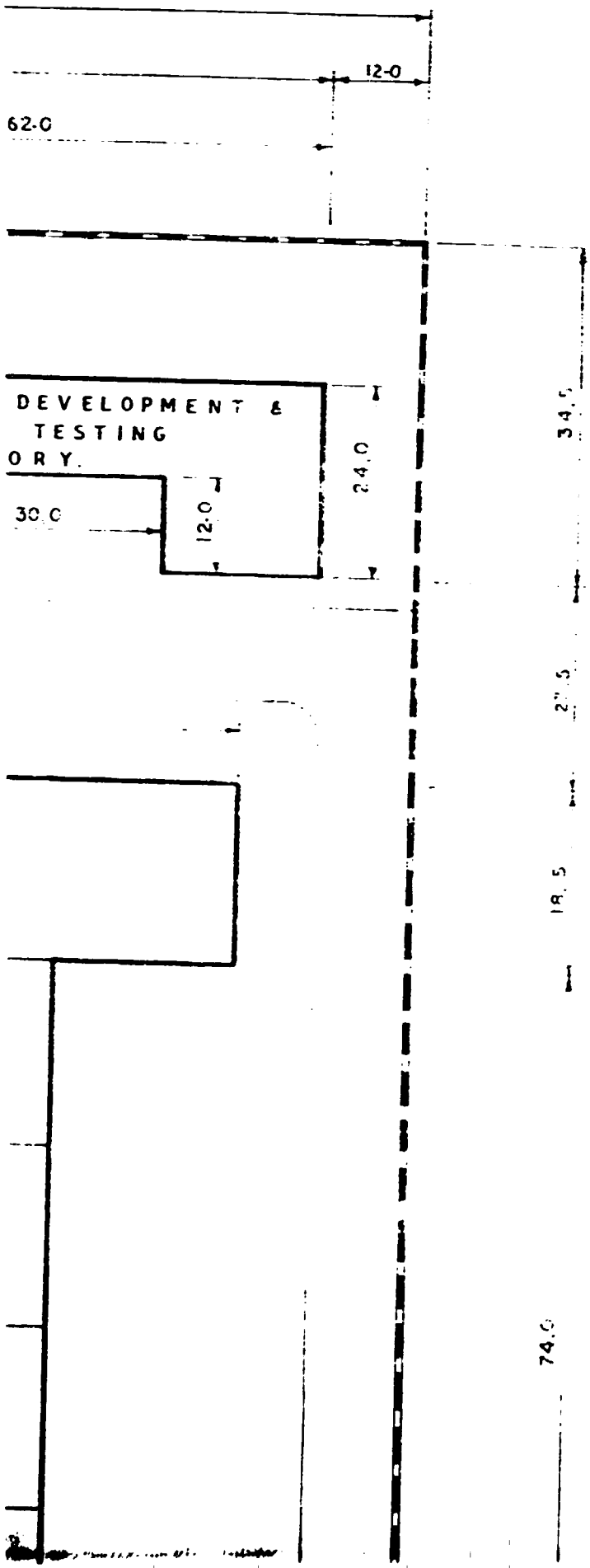
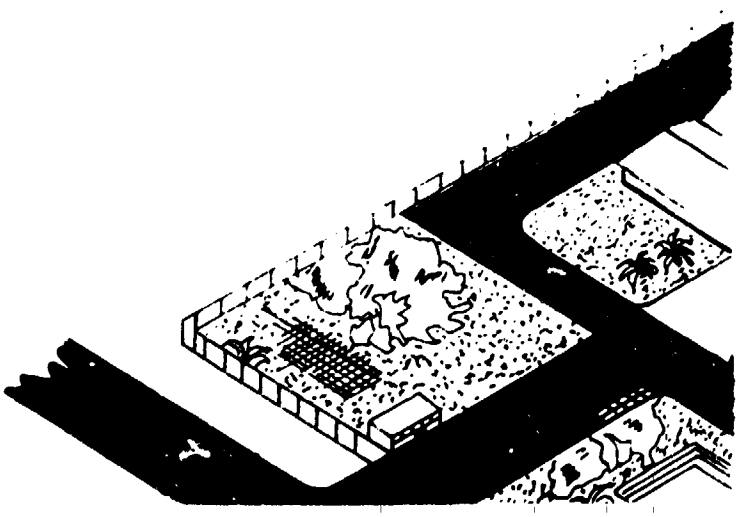
FINAL ASSEMBLY
FABRICATION
GENERAL
CUTTING & FORMING
SHOP

SEC 3





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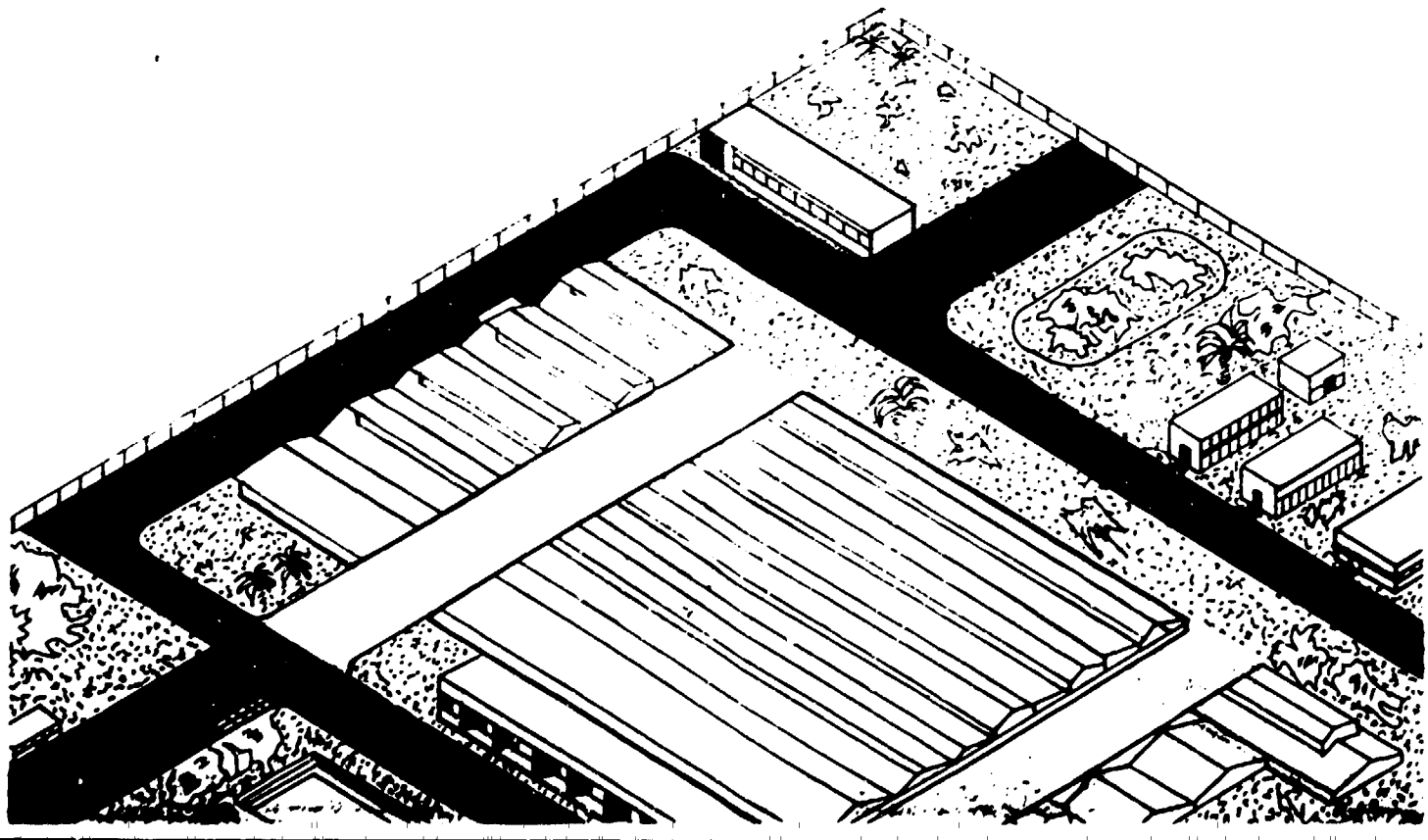
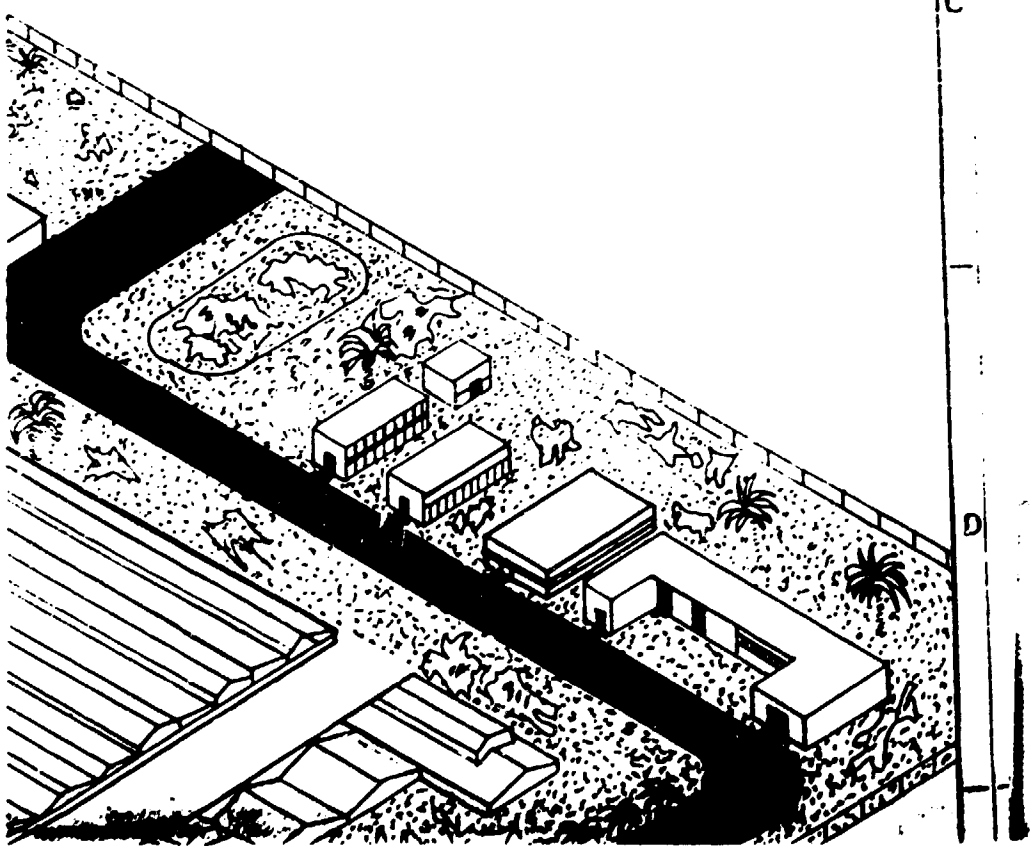
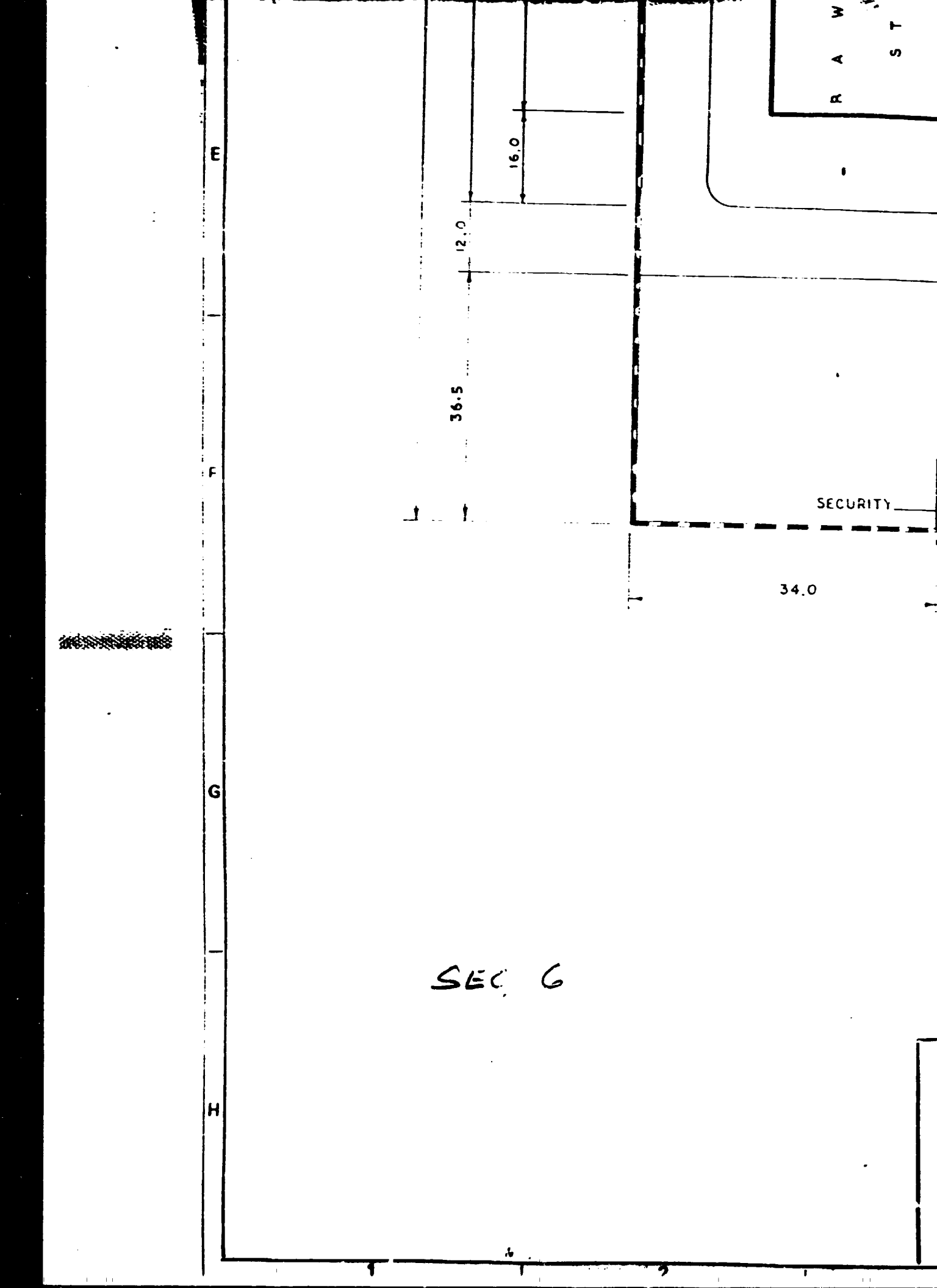


SEC 5




E
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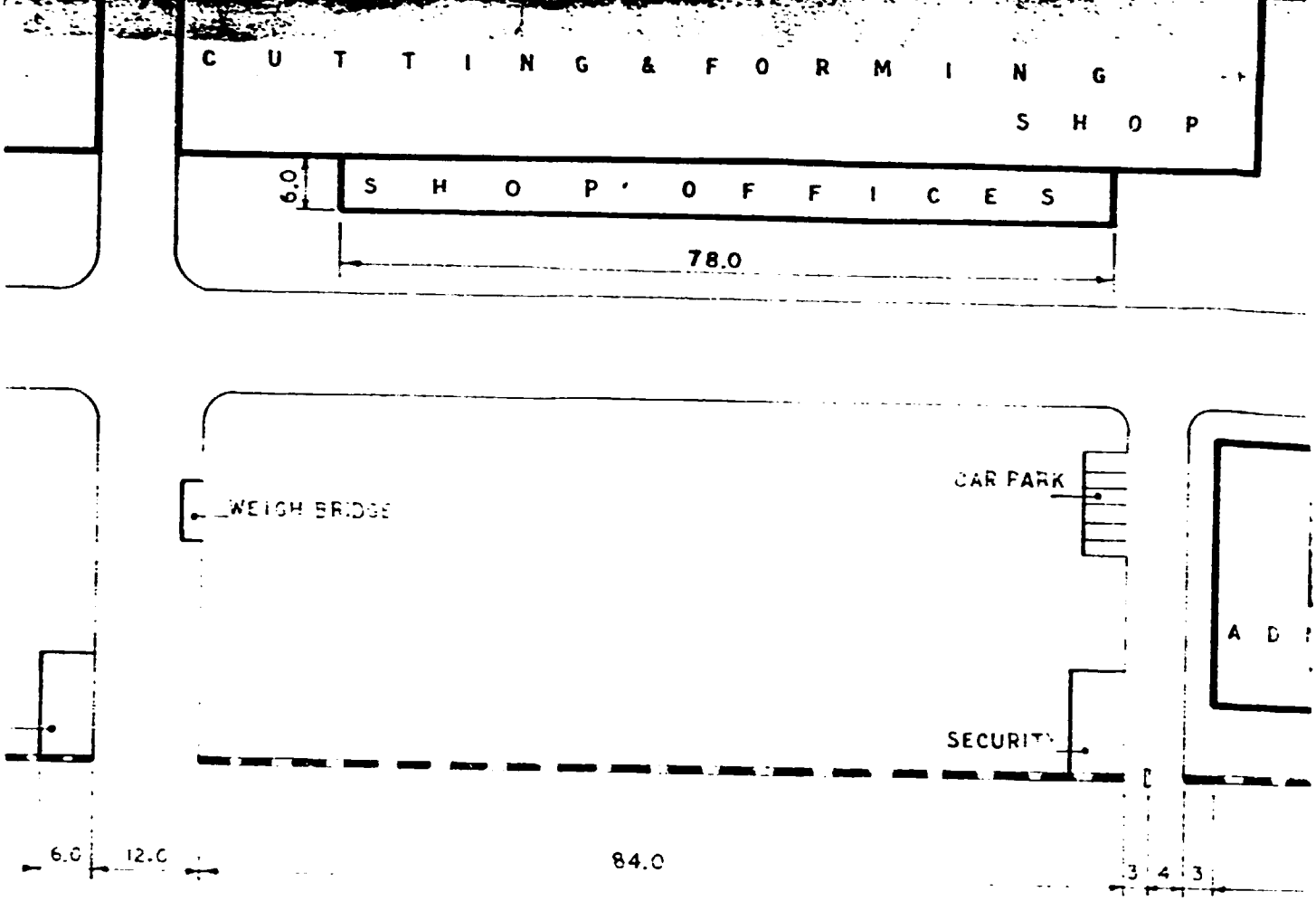
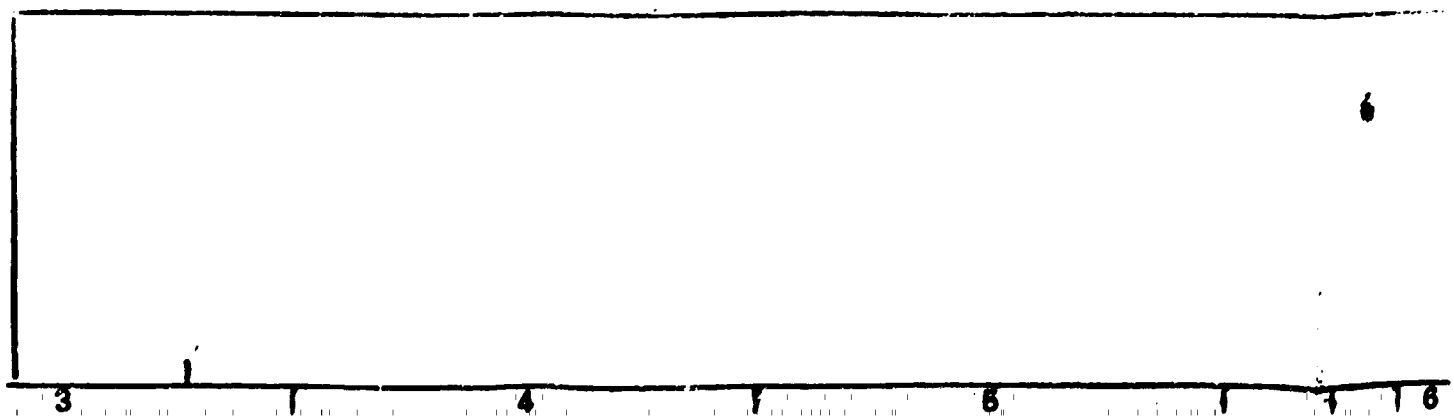
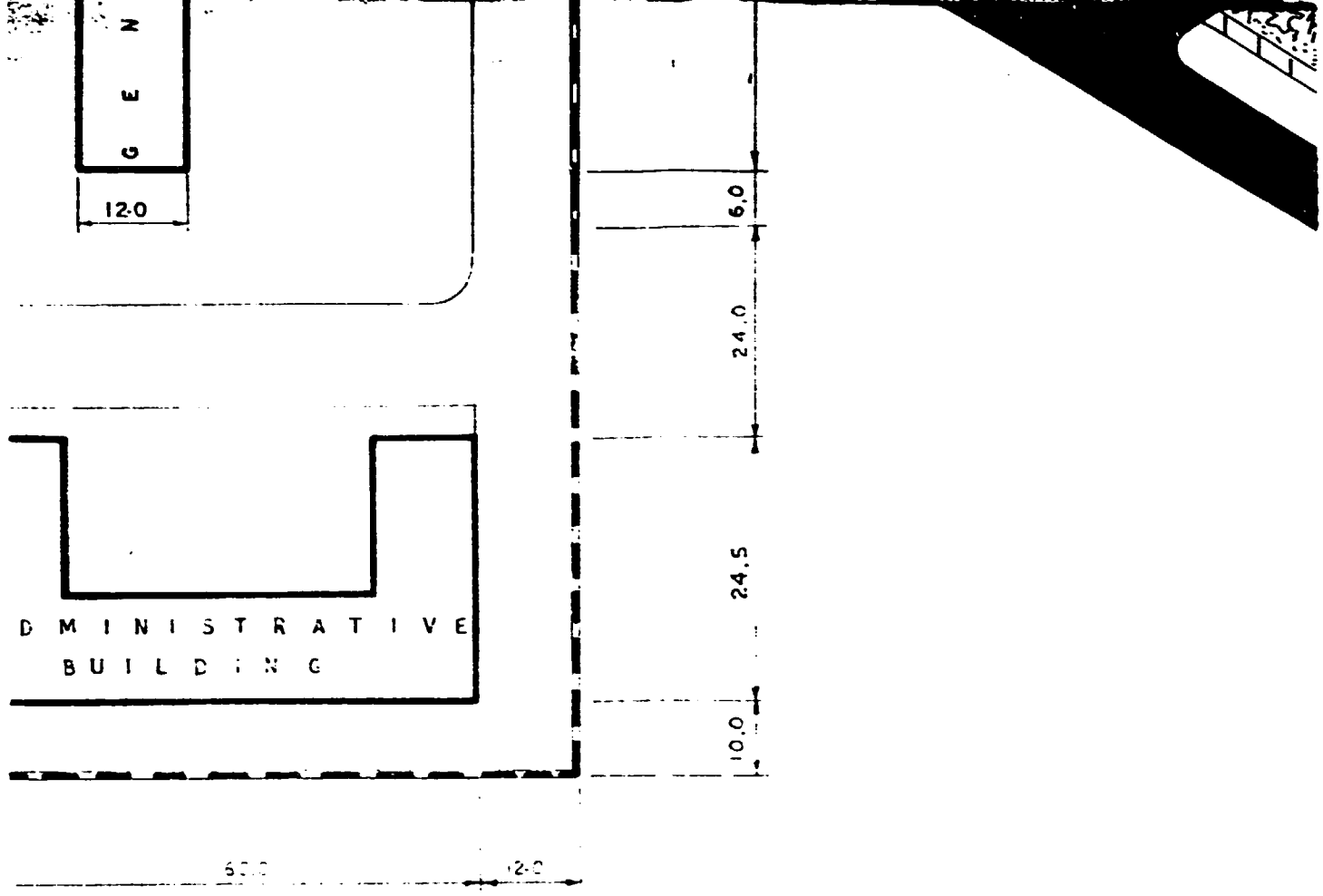
H
16.0
12.0
36.5
SECURITY
34.0
SEC 6



BLOCK LAYOUT

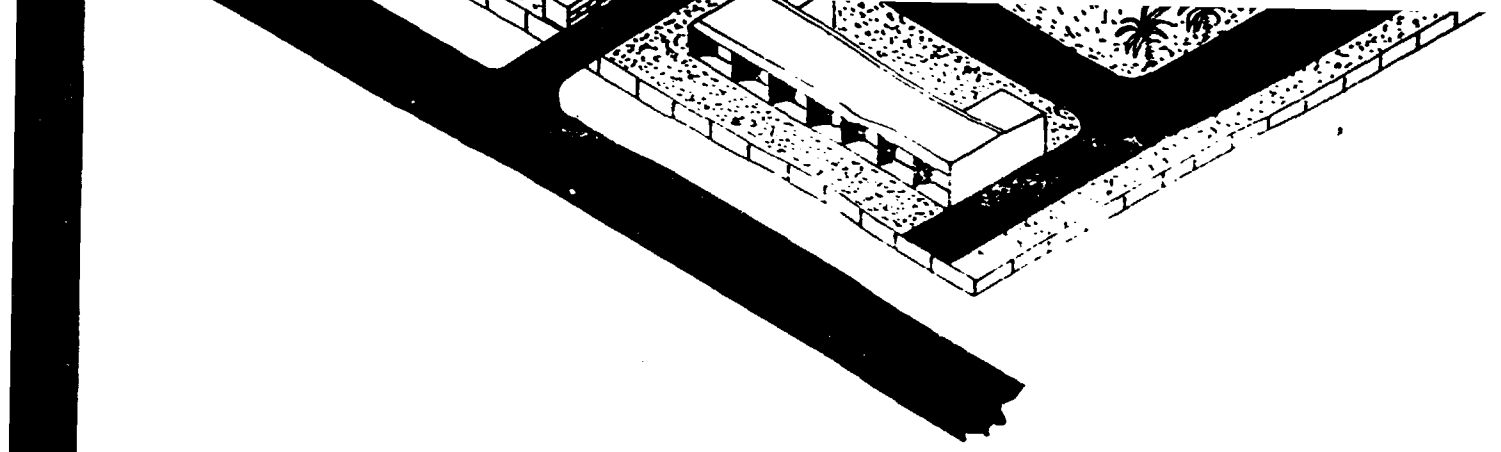
SEC 7





SEC B

ELEC.	MECH.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION



AERIAL VIEW

SEC 4

BLOCK LAYOUT FOR STEAM (
MANUFACTURI

UNITED NATIONS INDUSTRIAL DEVELOPM
ARAB INDUSTRIAL DEVELOPMENT AND

DEVELOPMENT CON

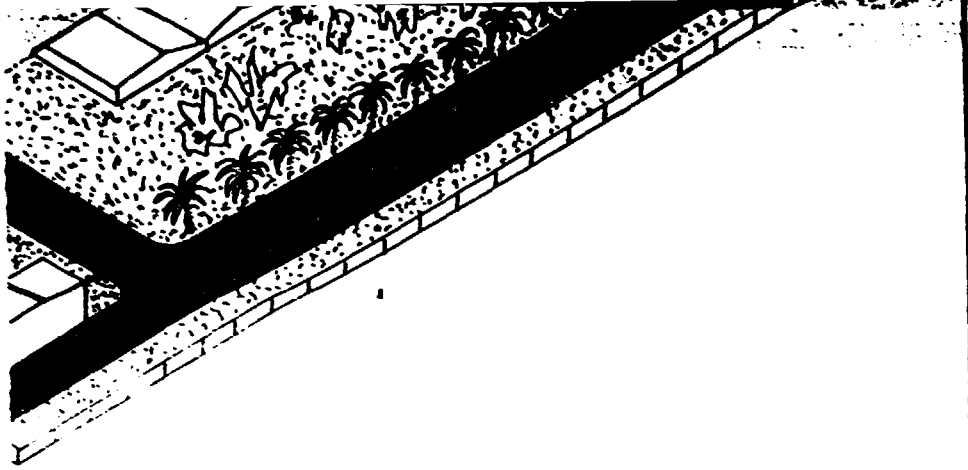
CONSULTING ENGINEERS

BOMBAY • CALCUTTA • MADRAS • N

DRAWN MUKUL	DESIGNED MC
PROJ. ENGR. PCD / MC	ENG. MGR.
DEPT. HEAD	

DWG. NO. EXHIBIT_20

DESCRIPTION	RELEASE STATUS	DATE	REV. NO



SEC
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CK LAYOUT FOR STEAM CONDENSER
MANUFACTURING PLANT.

ED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND
3 INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

DEVELOPMENT CONSULTANTS

CONSULTING ENGINEERS

BOMBAY • CALCUTTA • MADRAS • NEW DELHI

N MUKUL	DESIGNED MC	SCALE 1:750
ENGR. P C D / M C	ENG. MGR.	DATE 14.2.92
HEAD		JOB NO 45010
). NO. EXHIBIT_20		REV. NO.

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