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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

VIENNA, AUSTRIA

AND

ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

RABAT, MOROCCO

PROJECT PROFILE

ON

STEAM BOILERS

FINAL REPORT

DEVELOPMENT CONSULTANTS INTERNATIONAL LIMITED

MANAGEMENT CONSULTANCY DIVISION

24-B PARK STREET, CALCUTTA 700 016, INDIA

PROJECT PROFILE
ON
STEAM BOILERS

MARCH 1996

DEVELOPMENT CONSULTANTS INTERNATIONAL LIMITED
MANAGEMENT CONSULTANCY DIVISION

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DCIL-105/AC-5/1105 March 11, 1996

United Nations Industrial
Development Organization
Vienna International Centre
P.O. Box 300
A-1400 Vienna
Austria

Attn : Mr V. Koloskov

Project Profile on Steam Boilers

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
ASME	American Society for Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Wire Standards
BS	British Standards
CIF	Cost Insurance & Freight
CO_2	Carbon Dioxide
Cr	Chromimum
DC	Direct Current
EOT	Electric overhead travelling
ERW	Electric resistance welded
FOB	Free on board
HFS	Hot finished seamless
HP	Horse Power
IRR	Internal Rate of Return
KCal/hour	Kilo Calorie per hour
KV	Kilo volt
KVA	Kilo volt ampeare
KW	Kilowatt
LxH	Length x Height
MC	Medium Carbon
Mc/s	Megacycle per second
MCC	Machine control centre
MIG	Metal inert gas welding
Mo	Molybdenum
MW	Megawatt
NZ	New Zealand
PPM	Parts per milimetre
Psi	Per square inch
SWL	Safe working load
Temp.	Temperature
TIG	Tungsten inert gas welding
TR	Tonnes of refrigeration
TPA	Tonnes per annum
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, AIDMO in consultation with UNIDO, shortlisted 8 products for which it wanted to get project profiles prepared. One of the designated products is Steam Boilers. 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 AIDMO, was not required to be carried out prior to preparing this project profile as the information and projections contained in the Sectoral study conducted by them was indicated to be adequate for the purpose. Therefore, the Section titled. 'Market Analysis' is based entirely on the Sectoral study carried out by 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 the 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.

SECTION - 2
SUMMARY OF FINDINGS

SUMMARY OF FINDINGS

It is recommended that one (1) manufacturing plant with a capacity of 8,650 tonnes per annum (TPA) be set up to manufacture steam boilers within the designated region. Initially, this plant shall manufacture five numbers of 30 MW and two numbers of 150 MW boilers annually. Gradually, the product-mix can be expanded to include 300 and 600 MW boilers. 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 Egypt. It will cater to the requirement of entire Afro-Arabian 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.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 1

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

PROJECT PROFILE ON STEAM BOILERS

SUMMARY OF FINDINGS

Sl. No.	Project Parameters	Recommendations
1.	Location	Egypt
2.	Plant Capacity (TPA)	8,650
3.	Product-mix (Nos.)	
	- 30 MW boiler	5
	- 150 MW boiler	2
4.	Area Requirement (Square Metres)	87,700
5.	Manpower Requirement (Numbers)	806
6.	Implementation Period (Months)	33
7.	Project Cost (Million $)	57.26
8.	Break-Even Point (%)	69.10
9.	IRR (%)	39.60

SECTION - 3
PRODUCT ANALYSIS

PRODUCT ANALYSIS

Steam boilers used in power plants are universally of the water tube design. This type of boiler has a large heating surface and can operate in the super-critical range, with the steam temperature ranging up to 540°C. Operating pressures may be as high as 340 Kg/sq cm, but pressure of 240 Kg/sq cm is most commonly employed. Modern boilers can produce enough steam to drive a 1500 MW turbine.

The boiler is a custom-built, fired pressure vessel, designed and manufactured to suit specific requirements of customers. The fuels used for firing a utility boiler may be either coal, fuel-oil or gas, or a combination of these. It is mandatory that the design and manufacture of all power boilers conform to accepted boiler codes. These codes are developed by regulating agencies and/or renowned institutions in different countries. Exhibit-2 presents an indicative list of some such agencies/institutions.

Aside from conforming to the designated standards and codes, a boiler must be designed, keeping in mind the following characteristics :

- It should be able to achieve a high degree of heat transfer efficiency, with minimum heat loss.
- It should be able to supply required quantity of steam on a stable and continuous basis.
- It should be able to deliver dry steam which is free from dust and other extraneous matter.

- It should be capable of producing superheated steam over the specified temperature range, at full load and over the entire range of load.
- It should be able to accommodate variations in the rate of steam generation without affecting the steam pressure, surging of water levels, localised overheating or other similar transient phenomena.

CONSTRUCTION

The modern boiler is an integrated assembly of several components. These components are outlined in Exhibit-3. A large, two-drum steam boiler is shown in Exhibit-4. Its important and auxiliary parts are described below :

Boiler Drum

The boiler drum serves two functions. Firstly, it separates steam from the water-steam mixture discharged into it. Secondly, it houses the equipment used for purification of steam after it is separated from water. The length of the boiler drum generally depends on the width of the furnace. In case of large power plants, however, it may be determined by the space required for steam separating devices.

A boiler drum is made up of four cylindrical sections and two hemispherical heads. A number of stubs and nozzles are placed along the length of the drum. These are connected to the steam generating and superheating surfaces of the boiler unit. Large nozzles on the bottom of the drum and push-outs on the hemispherical head connect the drum to the down comers through which the water is supplied to various circuits of the generating system.

Heating Surfaces

Seamless steel tubes, water walls, superheater and reheaters, all absorb heat from the furnace gas as they perform their respective functions of heating water to the saturation point, and of superheating and re-superheating steam. Air heaters and economisers recover heat from the exit gases of the furnace. This pre-heats the combustion air and increases the temperature of incoming feed water. The heat utilisation pattern in a large utility boiler is given in Exhibit-5.

Superheaters - Reheaters

In view of the limitation of saturation temperature of steam (300.2° C at 88 kg/cm²), it becomes necessary to superheat the steam to raise its temperature. Tubes of 25.4 mm to 50.8 mm diameter are generally used. In the past, however, superheaters were built with tubes of larger diameter, and external fins to increase the heating surface available.

The location of superheating surfaces as shown in Exhibit-4 determines the classification of superheaters such as convection, radiant and interdeck types.

The heat transfer conditions vary with the load. Convection type superheaters exhibit rising temperature characteristics, while in radiant superheaters, the temperature falls with load. Radiant and convection superheaters, when connected in series, have opposing temperature characteristics that tend to cancel the variation in super heat. In this case, the final superheat is produced in the convection zone.

Water Walls

Water walls in the general circulation system of boiler greatly extends the evaporating capacity of water-tube boiler. At the same time, it provides protection against high temperature of combustion. Water enters the wall tubes at the lower headers and rises due to heat transfer, producing a mixture of steam and water in the tubes. This mixture is less dense than the water in the down-comer circulators. As these tubes receive radiant energy directly from combustion, the rate of heat transfer is very high.

Water walls were originally associated with pulverized coal-fired boilers. Nowadays, they are used with stoker and oil-fired boilers too.

Welded panel walls are used for manufacture of leakproof furnaces. The tubes are spaced about 10 to 12 mm apart by means of bars, which are then fused together with the tubes to form a continucus metal furnace lining.

Economisers

The boiler economiser is a feed water heater, deriving heat from the gaseous products of combustion that are discharged from the evaporative section or superheater section of the boiler. The feed water enters the boiler at a temperature appreciably lower than that of saturated steam. Generally, the economizers are arranged so as to cause downward flow of gas and upward flow of water. This arrangement results in maximum mean temperature difference for heat transfer and avoids water hammer action. The tubes forming the heating surface are closely spaced. These may either be of the plain type or provided with extended surfaces such as fins. The

tubes are made of low carbon steel, and hence, are susceptible to corrosion even if the concentration of oxygen in water is very low. It, therefore, becomes necessary to provide water that is absolutely free of oxygen. Deaerators are employed to remove oxygen.

Air Heaters

Air heaters are used to extract heat from the flue gases and pre-heat the air for combustion, thereby increasing the thermal efficiency of the boiler. Air heaters are classified as either recuperative or regenerative, depending on the method of heat transfer employed. Recuperative heaters are those which continuously recuperate the cooler side of the transfer surface by transferring heat from the hotter side. The regenerative type of heater works by alternative heating and cooling of the same convection surface.

The recuperative type of heater is made of parallel steel tubes of 50 to 75 mm diameter. Flue gases pass through tubes around which the air to be heated circulates.

The regenerative air pre-heater is built as a static double-chambered casing with tubular elements. It is provided with valves to alternate the gas/air flow. In power plants, however, valveless rotary regenerative heaters are more common. The elements of this type of heater are masses of metal in the form of crumpled or cellular steel sheets built in the form of a cylindrical rotor with its shaft so mounted that the rotation carries its elements alternatively through air and flue gas passages. The rotor turns at a speed of about 3 rpm. The casing in which the rotor is set is divided by diaphragms and seals so that the gas may

continuously flow through one side and the air may flow through the other.

Furnace

When pulverized-coal or cyclone furnace firing is used, the walls housing the burner or cyclones, are designed to accommodate the burners as well as the necessary fuel and air supply lines. Suitable clearance is maintained between burners to avoid interference of the fuel streams between one burner and another. Clearances must also be provided between side walls and between each burner to avoid flame impingement on the furnace walls. Flame impingement on the walls may result in overheating of wall tubes or excessive deposits of ash or slag.

When fuel is burned in stokers or heaters, the size of the furnace is usually set, based on a specified area per square foot of grate area.

The furnace should also be designed such that combustion is complete with due regard to the factors of temperature, turbulence and time.

Burner design is an important factor in achieving adequate combustion temperature. The burner should be designed to provide proper mixing of air and fuel. The size must be such that it is neither overloaded nor under-loaded. Likewise, there must not be too much cooling surface in the furnace in proportion to the fuel burnt. Pre-heated air is beneficial in obtaining adequate combustion temperature, and, is required for pulverized coal and cyclone furnace firing.

Turbulence is primarily a function of the fuel burning equipment and it helps in supplying air, not only to individual fuel particles but also to any unburnt or partially burnt gases until combustion is complete.

Furnace volume must be sufficient so that combustion gases remain in the furnace long enough to ensure complete combustion.

Most modern boiler furnaces have all walls water cooled. This not only reduces maintenance of the furnace walls, but also serves to reduce the gas temperature entering the convection bank to a point where slag deposit and superheater corrosion can be controlled by soot blowers.

Ash and slag from solid and liquid fuels cause many problems in boiler operation. The ash, when sintered or fused, forms clinkers in fuel beds and deposits on the furnace walls, superheaters, and boiler surfaces. This reduces heat absorption and increases draft loss. The furnace and burner are designed in a manner as to maintain a high-gas-temperature zone near the furnace floor and keep the ash molten for tapping. Additives, such as dolomite, lime and magnesia, are used to reduce the sintering strength of fly ash and to neutralise the acid in gases. Although fuel oils have a low ash content, slagging and high-temperature fuel-ash corrosion are experienced in oil-fired units. Dolomite added in appropriate quantities in oil-fired boilers helps to produce softer slag which can be removed easily by soot blowing.

To supply proper amount of combustion air and excess air to remove the combustion gases, furnaces are operated by

forced-draft, induced-draft or balanced-draft type of systems.

Combustion Equipment

Fuels burnt in boilers are mainly coal, oil and gas. All of them are composed of hydrocarbons. Coal has a fixed carbon content and traces of sulphur too. To burn these fuels into the desired end products, i.e. Co_2 and H_2O, combustion equipment must fulfill the following basic requirements :

- thorough mixing of fuel and air
- maintaining optimum fuel-air ratios leading to most complete combustion over full load range
- continuous and reliable ignition of fuel
- disposal of ash

Design and construction of combustion equipment and firing system will vary, depending on the type of fuel used. Commonly used firing systems are stoker, pulverised coal firing, cyclone furnace firing and fluidised bed combustion. Stoker system is suitable for boilers of smaller size and when coal is burnt as fuel. These are not widely used because of problems in ash-disposal and air pollution. Pulverised coal firing requires crushing the coal into fine particles. Pulverised firing system is not economical for small boilers because of high costs of pulverisers and other auxiliaries. Cyclone furnace is designed to burn low-ash fusion coals. In this furnace, crushed coal is admitted into the furnace together with primary air. Secondary air, admitted tangentially at the top of the cyclone, vigorously scrubs the coal particles on the wall and ensures complete

combustion. Gas, when used, is burned by injection through openings at the bottom of the secondary-air ports. Oil is burned by spraying it axially into the cyclone through the primary burner or by firing it tangentially through an oil element located in the secondary-air port.

Fluidised bed combustion is an emerging technology and offers effective utilisation of different types of fuels. Although application of this type of technology for industrial boilers is well established, its application in utility boilers is still in the nascent stage. The principle of fluidised bed combustion (FBC) technology is briefly discussed below.

The steep price rise in oil and other premium fuels has necessitated the development of new combustion technologies which utilise inferior fuels that are locally available like low grade coals, sulphur coals and agro wastes. FBC has been identified by many countries as an efficient, economically viable and environmentally acceptable technology.

The principle of FBC is quite simple. When air is passed upward through a mass of finely divided solid particles (such as coal ash, crushed refractory, sand or limestone) at low velocities, the particles are not disturbed. As the air flow is gradually increased, the particles become suspended. Further increase in the air flow gives rise to bubble formation and vigorous turbulence. The bed of solid particles now exhibits the same charateristics as a boiling liquid and the bed is thus termed a Fluidised Bed. Combustions of fuel in this bed is termed Fluidised Bed Combustion.

When hot, the Fluidised Bed provides the following necessary requirements for efficient combustion :

- Large surface area per unit mass of fuel (minus 6 mm particles are used - much larger surface area than stoker but less than pulverised coal combustor).
- Long time of contact or large residence time (residence time is many times greater than that of pulverised coal firing and stoker firing.
- High relative speed between air and fuel or turbulence. With these features and a large bed thermal storage, the fluidised bed combustion boiler is able to burn a wide variety of fuels including washery rejects containing 73% inerts (ash and moisture).

Principal advantages of fluidised bed combustion boilers are as follows :

- Ability to burn low grade fuel
- High efficiency
- Ability to burn fines
- Flexibility to burn agro-waste fuel
- No manual feeding - less manpower required
- No manual ash removal - easy removal - less manpower
- No slagging in the furnace - no spot blowing required
- Less excess air, higher CO_2 in flue gas
- Simple operation with quick start up and response
- Low maintenance cost
- 100% depreciation

Burners

The primary purpose of a fuel burner is to direct the flow of fuel and air so as to ensure their rapid ignition and complete combustion. In pulverised coal burners, fuel is mixed with primary air to accelerate the process of ignition. Circular type burners are used for firing coal,

oil or gas. When oil is fired, it can be atomised by the use of fuel pressure or by compressed gas in the form of steam or air. Atomisers utilising fuel pressure generally operate at high pressures and low volumes. Steam- and air-type atomisers, on the other hand, operate at low pressures and high volumes. The steam consumption required for adequate atomisation is usually less than one per cent of the boiler's steam output. Natural gas and other processed gases can be burnt by admission through a perforated ring, through radial spuds or through a centrally located centre-fire type fuel element.

BOILER ACCESSORIES

Boiler accessories are :

- Low-water safeguards
- Soot blowers
- Steam purifier

Low-water Safety Guards

Low water level can cause partial or complete ruin of the boiler by overheating. Alarms and automatic safety guards incorporated in each boiler are :

- Low-high water alarm whistles usually placed in water columns
- Float operated low water cut-offs for stopping electric motors that drive fuel feeders
- Fusible plugs of low melting temperature alloy placed in the boiler shell below the minimum safe water line

Soot Blowers

The heating surfaces of boilers, especially of the coal-fired, water tube boilers get coated with soot, cinder and fly ash. This loosely adhering layer is a definite impediment to the transfer of heat and should be removed once or twice a shift without stopping steam generation. Specially long, retractable blowers are available for boiler furnaces, flues and economisers. For large power boilers, the soot blowing operation is controlled electrically from one operating point.

Steam Purifier

Practically all the liquid and solid impurities in steam must be removed before it is suitable for use. The moisture content in the steam used for power generation must not exceed 0.5% and the solid content should be less than 0.1 PPM. This is ensured by steam purifiers fitted in the drum internals. Practically all drum internals are made up of plate baffles, banks of screens, arrangement of corrugated or bent plates, and devices employing radial acceleration of water from steam.

BOILER TRIM

Boiler trim usually consists of the following items :

- Feed water inlet comprising a stop valve and a check valve
- Blow-off valve
- Safety Valves : The boiler safety valve must be a spring-loaded valve; one which holds the valve against its seat by means of a compression coil spring. The pressure required to open the valve can be set by adjusting the compression in the spring.

- Water column, with gauge glass, high and low-water alarms
- Stop and Check Valve : This is mounted on the main steam outlet. The steam pipeline is connected to it.
- Steam Vent : It is a small outlet on the top of the drum, normally closed by a valve. The valve may be opened when it is desired to maintain atmospheric pressure in the boiler, as during initial boiling out.
- Steam pressure gauge with siphon, cock and inspector's test cock
- Various special openings, in accordance with purchasers requirements for the accommodation of feed water control elements, reagent feed, water sampling, etc.

BOILER AUXILIARIES

Boiler auxiliaries comprise a group of components which are secondary to the design of the boiler itself but are absolutely essential to its operation. Such auxiliaries are :

- Fans - forced-draft, induced-draft and gas re-circulation types
- Observation ports and Access doors
- Equipment for ash and soot removal
- Ducts
- Pumps
- Valves

Typical location of the above auxiliaries at a boiler plant is shown in Exhibit-6.

BOILER STRUCTURES

The boiler installation consists of significant structural support. These structures require heavy duty columns, joists, wide flanged beams, universal beams and rolled sections. Most of the structures are fabricated at site.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 2

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

PROJECT PROFILE ON STEAM BOILERS

PRINCIPAL INSTITUTIONAL CODES FOR BOILERS

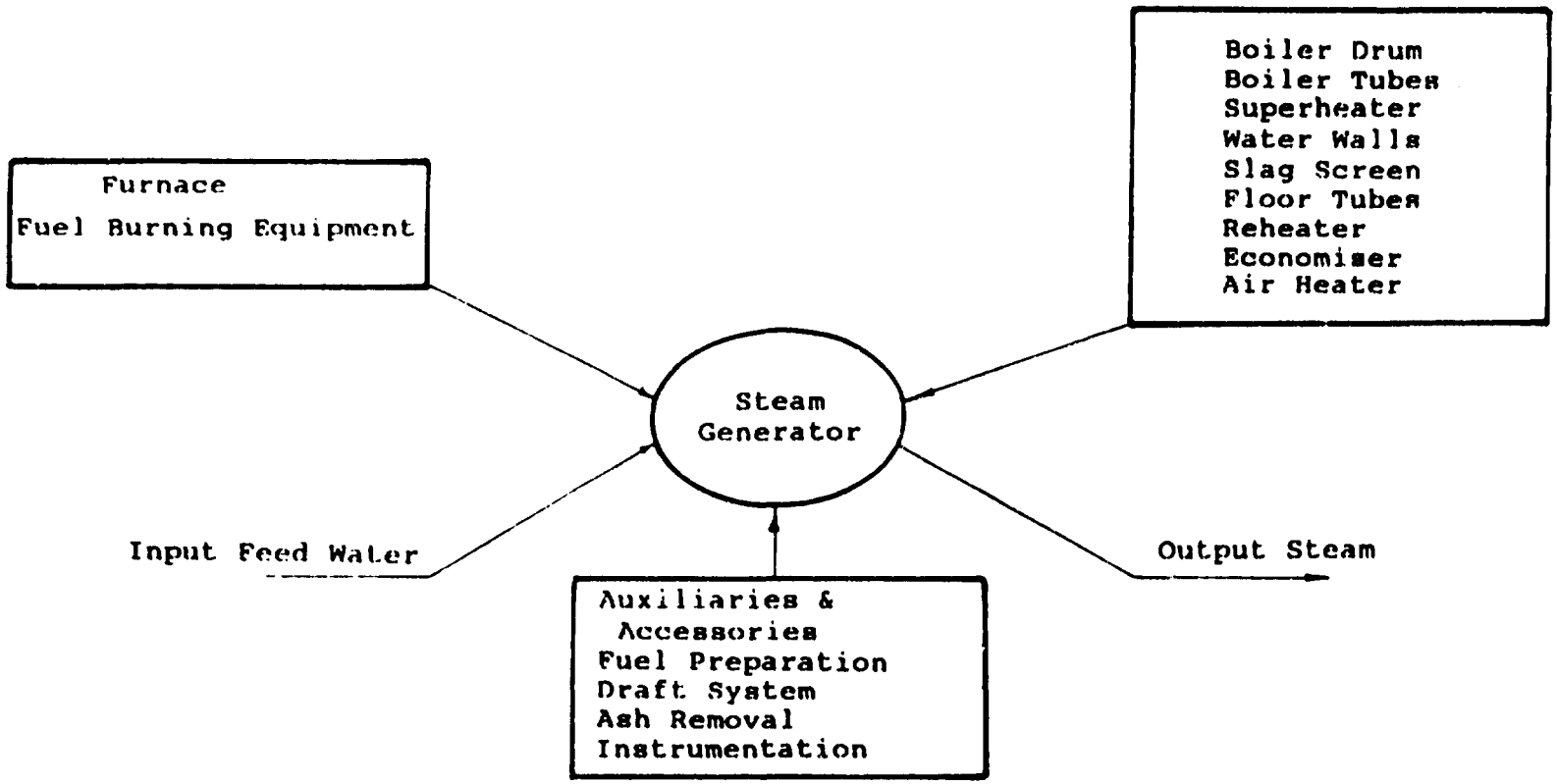
Country	Code Title
Australia	Standards Association of Australia Boiler Code Parts I-V
Austria	Dampfkessel Veror Dnung (DKV) RGBI No. 83/1948
Britain	Lloyd's Rules, Rules of the Associated Office, B.S. 1113 - 1958
Finland	Dimensioning, Materials and Welding of Steel Pressure Vessels
Germany	Workstoff und Bauvorschriften fur Dampfkessel und Dampfkessel Bestimmungen AD-Merkblatter DIN-2413
Holland	Grondslagen Waarop de becoordeling van de constructie en het material van stoomtoestelen, damptoestelen en druckhoudersterust
India	Indian Boiler Regulations 1950
Italy	Controllo della combustione
New Zealand	N.Z. Boiler Code
Sweden	Tryckkarlsnormer
Switzerlad	Regulations of the Swiss Association of Boiler Proprietors
U.S.A.	A.S.M.E. Codes

JOB NO. : DCIL-105 EXHIBIT : 3

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

PROJECT PROFILE ON STEAM BOILERS

MAIN COMPONENTS OF A POWER BOILER



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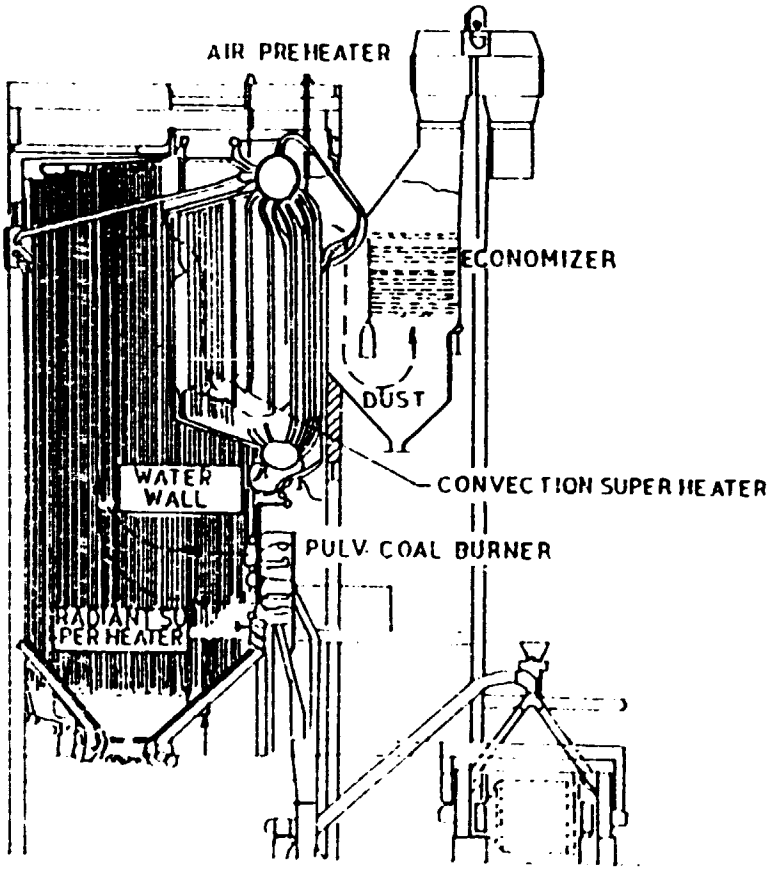
PROJECT PROFILE ON STEAM BOILERS

SECTIONAL VIEW OF TWO-DRUM STEAM BOILER



DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 5

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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PROJECT PROFILE ON STEAM BOILERS

HEAT UTILISATION PATTERN

Fuel	Coal
Capacity (Kg/hr)	16,89,732
Pressure (Kg/Cm^2)	181
Steam temperature (°C)	538
Reheat temperature (°C)	538
Feed water temperature (°C)	249
Boiler efficiency (%)	90.04
Sensible heat in feed water (%)	26.25
Latent heat of evaporation (%)	23.60
Superheat (%)	34.35
Reheat (%)	15.80

JOB NO. : DCIL-105 EXHIBIT 6

DEVELOPMENT CONSULTANTS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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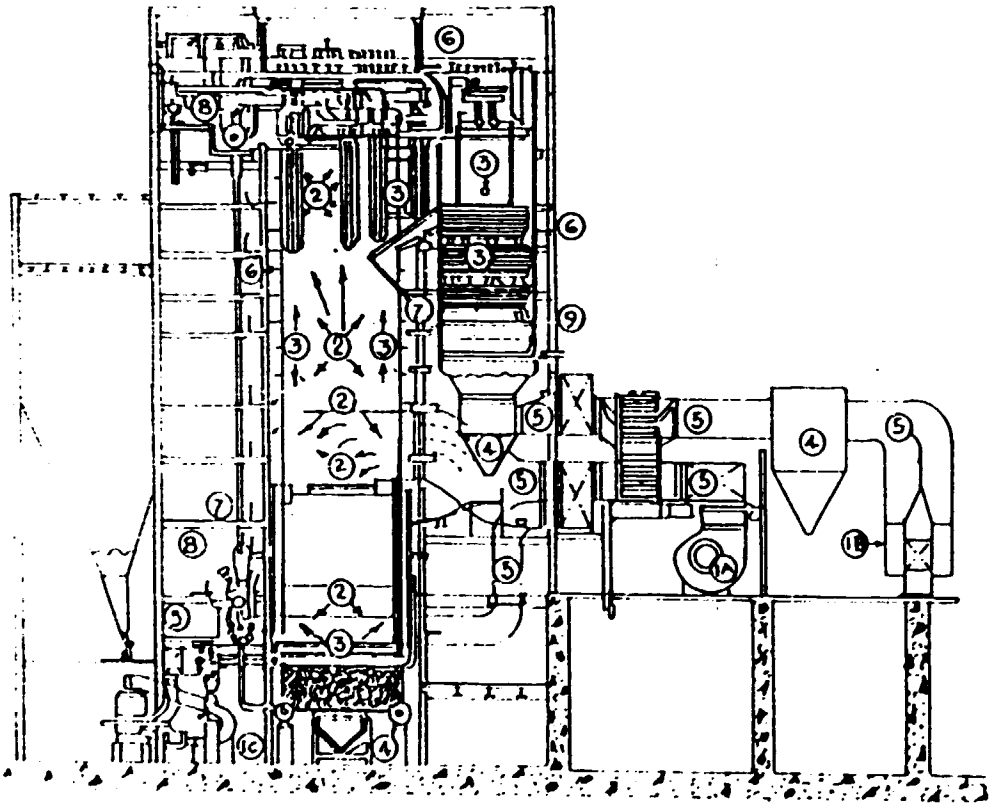
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM BOILERS

LOCATION OF AUXILIARIES AT A BOILER PLANT



LEGEND

1A	FORCED DRAFT FAN	4	ASH COLLECTION EQUIPMENT
1B	INDUCED DRAFT FAN	5	DUCT WORK
1C	PULVERIZER EXHAUSTER	6	CASING & INSULATION
2	SOOT BLOWERS	7	PUMP
3	OBSERVATION PORTS & ACCESS DOOR	8	VALVES

SECTION - 4
MARKET ANALYSIS

MARKET ANALYSIS

The steam boiler is a major equipment used in thermal power plants. Steam generated from the boiler is used to drive steam turbines, which are required to produce electricity. Any additional thermal power generating capacity, therefore, will lead to the demand for steam boilers.

According to the Sectoral Study carried out by the AIDMO, the average annual increase in power generating capacity in the designated region ranges from 6,700 MW in the early 1990s to nearly 9,300 MW by 2010 AD. Correspondingly, demand for various electrical equipment including steam boilers is estimated to increase substantially to cater to the additional power generation.

Annual requirement of steam boilers, by megawatt rating, number and tonnage, projected by the AIDMO for the entire Arab region, is presented in Exhibit-7. These projections, which are based on the additional generating capacities projected by AIDMO, present the requirement for four 5-year periods between 1991 and 2010 AD. However, gross power generating capacity during the period 1986-90 was only about 50-80% of the projections made by the AIDMO. As a conservative estimate, therefore, it may be assumed that only about 70% of the additional generating capacity proposed in the AIDMO Report will actually be implemented. The annual demand for steam boilers presented in our Report reflects this assumption.

Manufacturing and marketing of heavy equipment such as steam boilers and condensers requires considerable skill and expertise in project coordination. Therefore, it may not be possible for any new company to manufacture the entire range of equipment, viz., from 30 MW to 600 MW. Hence it is recommended that only one manufacturing unit be set up in the entire Arab region. This may initially manufacture five numbers of 30 MW and two numbers of 150 MW steam boilers per annum. Gradually the product-mix can be modified to include 300 MW and 600 MW boilers as well.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 7

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
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PROJECT PROFILE ON STEAM BOILERS

PROJECTED ANNUAL REQUIREMENT OF STEAM BOILERS

Year	600 MW		300 MW		150 MW		30 MW		Total	
	Nos	Tons	Nos	Tons	Nos	Tons	Nos	Tons	Nos	Tons
1991-95	5	36000	8	28800	3	5400	5	3000	21	73200
1996-2000	7	50400	10	36000	5	9000	5	3000	27	98400
2001-2005	10	72000	3	10800	5	9000	6	3600	24	95400
2006-2010	11	79200	3	10800	6	10800	1	600	21	101400

SECTION - 5
PLANT LOCATION

PLANT LOCATION

It is recommended that the plant that will cater to the demand for boilers in the designated region be set up in Egypt.

Egypt has been selected for establishing the manufacturing plant, 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 source of raw material, and the availability of road, rail or sea linkages
- local availability of bought-out auxiliary equipment like pumps, valves, motors, fans, blowers, 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

Egypt has been recommended as it is the most suitable location. Firstly, the technology and infrastructure required for manufacturing boilers exists in Egypt. It also has a well developed iron and steel industry from which it can obtain the various raw material requirements.

Installation of boilers requires that a host of auxiliary equipment be fitted alongside to make the entire power system functional. These equipment are listed in Section 3. Egypt, which has a well developed industrial infrastructure, would be in a position to procure these equipment locally. If the plant is set up in any other country, then the auxiliaries will have to be imported at additional cost.

Erection and commissioning of boilers at the site require constant coordination between the manufacturing centre and the power station. Qualified technical personnel are required to visit the erection site at regular intervals to solve operational problems. They are also responsible for guiding the production and design teams to make suitable modifications in product or systems design, and process planning. All these require a high degree of technical knowledge and experience. Egypt, a country with experience and expertise in the field of power generation, would be better placed to recruit local people to meet this requirement. Skilled manpower such as welders would be easily available in this country.

It will be better to locate the plant near the north-eastern border. From here, it will be convenient to ship the finished products to various countries within the designated region.

SECTION - 6
MANUFACTURING PROCESS

MANUFACTURING PROCESS

The main components comprising a steam generator can be divided into two categories as under :

- Customised items like drums, tube sheets, tubes of different configuration, superheaters, water walls, slag screens, floor tubes, re-heaters, economiser, air heaters, supporting structures, etc.
- Standardised, pre-engineered items consisting of furnace fuel firing equipment, feed water pumps, auxiliaries and accessories for fuel preparation, draft system, ash removal, and for instrumentation and control.

Steam generator manufacturers, in general, design and fabricate the first category of items in their own plants and prefer to procure the standardised, pre-engineered items from external sources.

Fabrication of the pressurised and non-pressurised parts of the generator and other auxiliary equipment require different types of skills and manufacturing methods. Various boiler regulating and inspection agencies have specified norms for engineering design, quality of raw materials and the manufacturing techniques involved in the construction of a steam generator. It is obligatory on the part of all boiler manufacturers to conform to any one of the above mentioned codes or their equivalent as approved or specified by the buyer.

Some of the important manufacturing processes are outlined below :

METAL-WORKING AND METAL-FORMING

Boiler drums, shells, end plates, tube sheets, etc., are cut and formed to shape in cold or hot conditions, depending upon the thickness of the sheet metal. High capacity presses, dished-end forming machines, plate bevelling and plate bending rolls, shearing and oxy-cutting machines, edge-planing, bevelling machines and plano-millers are necessary equipment for metal working and metal forming operations.

WELDING

Welding processes of various types like arc welding with coated electrodes, automatic submerged arc welding, TIG and MIG welding, electroslag welding, pressure welding and gas welding, play a significant part in fabrication of important boiler components. Development of better welding techniques have facilitated fabrication of vessels of large size with better functional capability.

With the exceptions of electroslag welding, pressure welding and gas welding, the source of heat in all the above-mentioned welding processes is an electric arc whose temperature may be as high as 5727°C. Among the various methods of arc welding, greater preference is being given to gas-shielded arc welding using carbon dioxide or argon as the shielding gas.

Carbon dioxide is employed in welding low carbon steels. The merits of this method of welding are its high output, low

cost and deep penetration. The possibility of automating the welding process without the use of fluxes makes this method a useful one.

Argon is mainly used in welding aluminium members or thin sheets of high alloy stainless and heat resisting steels.

Selection of Electrodes

Selection of the proper electrode for a given job is one of the most important decisions the welder must make. The American Welding Society (AWS) has developed a series of identification numbers, which has been approved by ASTM. Various AWS-ASTM electrode classifications and recommended positions, applications and polarity for each, are listed in Exhibit-8.

Electroslag Welding

The electroslag welding process makes use of the heat generated by the passage of an electric current from the electrode to the work piece. Current passes through a granulated welding composition (flux or slag), which is a high resistance conductor of electricity in the molten state. The weld is completed in one pass. Butt joints, tee and corner joints, and most other joints can be made by this process. The process is fast and requires no edge preparation of the metal. More than one electrode may be used. This permits a thick joint to be welded faster.

Preheating and Post-weld Heat Treatment

Preheating the parts to be welded effectively counteracts high stresses in deposited weld-metal and prevents cracks from developing in low-alloy steels after welding. The

proper preheat temperature varies from 65°C to 205°C, depending upon the chemical composition and thickness of the material being welded. Less preheating will be required while welding with low hydrogen electrodes. Preheat is generally applied by oxy-acetylene heating torches.

Post-weld heat treatment of weldments depends on the complexity of the structure and the composition and thickness of the material joined. The major reasons for post-weld heat-treatment are as follows :

- To reduce hard zones in the weld area of carbon and low-alloy steels
- To relieve residual stresses developed during welding
- To reduce corrosion in the material
- To reduce distortion during subsequent machining by removal of local concentration of residual stresses

The temperature required to accomplish the above varies from 590°C to 750°C, depending upon the material in use and its mode of application.

FABRICATION OF IMPORTANT BOILER COMPONENTS

Boiler Drum

Fabrication of the drum begins with cutting the flat plate to size, preparing the edges and then pressing it into half cylinders or rolling the plate into full cylindrical shells. For large drums, the normal procedure is to press plates into half cylinders of up to 13 metre length and to form a course by welding two half cylinders together longitudinally. The desired length is obtained by

circumferentially joining courses as required. Longitudinal and circumferential seams in drums are made by the automatic submerged arc welding process.

Drumheads are formed from plates by hot pressing, using suitable forming dies. These are attached to the complete cylinder by circumferential welds.

Automatic submerged arc welding technique is used for welding the greater part of the boiler drum. For longitudinal welds, the electrode carrier of the welding machine moves along the seam from one end to the other. For circumferential welds, the drum is mounted on a turning device and rotated, while the welding head and flux applying equipment remain stationary. Many passes may be required, depending on the plate thickness, the material specifications and the form of the welding groove.

Prior to and throughout all welding operations, the weld area is required to be preheated to avoid detrimental stress conditions and metallurgical transformations.

As the boiler drum requires full root penetration and a uniform inner surface contour that does not interfere with fluid flow, TIG welding is often specified for welding the root pass.

Nozzles and stubs are attached to the drum by manually shielded metal-arc process using coated electrodes, by MIG welding or by semi-automatic welding with the "flux core" gas shielded, metal-arc method. The latter uses portable equipment which need lesser set-up time than required under the MIG process. Every drum that is fabricated must be subjected to stress-releasing heat treatment after

completion of welding. In some cases, several heat treatments are required during the construction of the drum.

After welding is completed and found satisfactory, the vessel is ready for the finishing operation, which includes installation of minor attachments and internals.

Headers

Headers are used extensively in modern steam boilers for joining two or more boiler circuits. Headers have a smaller diameter (under 600 mm) than the drum, and can be fabricated from seamless tubes, pipes or hollow forgings. Fabrication of a large header begins with circumferential welding of the required pieces of pierced and drawn hollow forging stock, to obtain the desired length. The welding is done by the submerged arc method. The ends of the header stock are then spun-hot until closed. To assure absolute tightness after spinning, the centre portion of the closure is drilled out and replaced by a fusion-welded steel plug. For large headers, the ends are closed by welding a formed hemispherical head, made by hot pressing.

Completion of the header includes drilling and machining of tube and nozzle holes; fitting and welding the nozzles, stubs and other attachments by manual and semi-automatic methods; heat treating; cleaning and finishing operations.

Panel Walls

The latest design of panel walls is a "membrane" construction of furnace and setting walls. The space between the wall tubes from the top header down to the bottom, is filled with a metal piece which is continuously welded on

both sides of the adjacent tubes. The result is a gas-tight metal wall surrounding the enclosed volume.

Walls of the above type can be assembled on a table in sections up to 3 metres wide and 27 metres long. The membrane is then welded to the tubes by the submerged arc process, with a travelling head feeding a number of electrodes simultaneously.

Wall panels may be bent to required radius and degree, after assembly of panels using a multiple die encompassing as many as 60 tubes.

Convection Superheaters

Most convection superheaters use continuous tube sections. Their platens are made from relatively short lengths of straight tubes which are first bent and then welded together to give the desired configuration. All the bends are made cold except the inside hair pin bend which must be made hot.

Close return bends are made by first upsetting a section of the straight tube to increase its wall thickness at the right location, and sizing to the desired dimension. The prepared end of the bent tubes are joined in an automatic butt-welding operation to form the section. In addition to forming the weld, the butt-welding machine also heat treats the weld.

To complete the platen, supporting legs are fitted and welded into position. The platen is tested hydrostatically at 1.5 times the design pressure. The section ends are milled to exact lengths and bevelled for field assembly.

MACHINING OPERATION

Construction of the boiler requires several hundreds of holes to be drilled, reamed, tapped and spot-faced or counter-sunk. These holes are of different diameter and depth, and are drilled by portable/radial drilling machines with universally adjustable drilling head. Standard mountings like safety valves, pressure gauges, water level gauges, automatic feed-water regulator, fusible plugs and valves for various functions are fitted to the boiler drum. Seating for the above mountings are machined with the help of special jigs and fixtures and machine tools.

Tube Bending and Fixing

Tubes of various diameter, wall thickness, length, material and construction (seamless, ERW, etc.) may be used for boiler construction, especially in the case of water tube boilers.

Tube Bending: Tubes of up to 50 mm dia meter can be bent in the cold condition by any one of the following four basic methods :

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

Rotary draw-bending is the most commonly used bending method. This method uses different types of mandrels for tube bending. The plain and duckbill mandrels are for heavier walled sections which require less internal support. The ball-type mandrels are used for thin walled sections.

The falls can go inside the bend to provide additional support against wall collapse.

Tube Fixing: Boiler tubes are bent to various configurations in the workshop and then sent to the site for final fixing. The tubes are attached to drum or header by any one of the following three methods :

- Expanding into the tube seats
- Expanding into the tube seats plus seal welding
- Welding to stubs attached during manufacturing

Tube expanding or tube rolling refers to the process of cold working of the ends of the tubes into intimate contact with the metal of the drum or header. When expanded, the outer and inner diameter and the length of the tube increase, while its wall thickness decreases.

Under axial loads, the expanded joint is almost as strong as the tube itself. However, for conditions of widely fluctuating temperature and bending loads, the expanded joint must be seal welded or replaced by a shop attached tube-stub.

Generally, tubes working above 100 Kg/Cm^2 gauge pressure are either expanded and seal welded or attached to shop welded stubs. Shop attached stubs are used for all economiser headers and for all superheater headers designed to operate at 850° F or higher, regardless of pressure.

QUALITY CONTROL

Each of the boiler manufacturing processes must conform to the specified design/manufacturing codes or standards. These norms can be best maintained by controlling the quality of base materials and weldments by means of non-destructive

testing. There are four basic tests used in the boiler industry. These are :

- o Radiography
- o Ultrasonics
- o Magnetic-particle testing
- o Liquid penetrant testing

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

PERFORMANCE TESTS

Every boiler manufactured must be tested and approved by the inspection officer. Tests normally carried out are as follows :

- o Hydraulic Tests : The boiler is tested by subjecting it to a pressure that is double the working pressure, or one and a half times the working pressure plus 50 lb per sq inch, whichever is less. In the case of water tube boilers of fusion-welded or composite construction, the test pressure shall be one-and-half times the working pressure.

- o Steam Tests : This test is primarily intended to test whether the safety valves can effectively relieve boiler of excess steam and whether they operate at the time when the maximum working pressure is reached.

In case of high capacity boilers which are erected at site, the above-mentioned tests are performed at site. But, packaged boilers that are completely shop-fabricated and erected, are tested at the shop before being despatched to the customer.

JOB NO. : DCIL-105

EXHIBIT : 8

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM BOILERS

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, DCRP 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

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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

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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

A large utility boiler is erected at the site by assembling the various sub-assemblies that form a part of the finished product. Some of these sub-assemblies are fabricated at the boiler manufacturing plant subject to the availability of transportation facilities, while others which are more cumbersome may be fabricated at the site. Most of the auxiliary equipment and accessories are procured from outside sources. The sub-assembly wise break up of the tonnage of a typical 30 MW and 150 MW boiler is indicated in Exhibit-9.

The plant will manufacture five numbers of 30 MW rating and two numbers of 150 MW rating steam boilers annually. Nearly 8,600 tonnes of steel plates and tubes will be required for this purpose. 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

The manufacturing workload is estimated in Exhibit-10.

On the basis of the production programme and the manufacturing processes discussed in the earlier section, it is planned to equip the boiler manufacturing plant with the following workshops :

- o Tube and Pipe Shop
- o Vessel Shop
- o Plate and Structural Shop
- o Machine Shop
- o Forge and Heat Treatment Shop

Machine tools and equipment to be installed in each of the above mentioned shops are listed in Exhibits 11 through 15 respectively.

Material Handling

Equipment for material handling is included in exhibits relating to list of equipment for individual manufacturing shops. 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 EOT cranes. Capacities 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.

As the production shops are spread over a large area, facilities have also been provided for intershop material handling. This will facilitate frequent transfer of components from one shop to another. List of equipment provided for this purpose is shown in Exhibit-16.

Maintenance

List of equipment for maintenance shop is shown in Exhibit-17.

Material Testing and Welding Development Centre

In order to ensure that the boilers function as specified by the designer of the equipment, they 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 required for destructive and non-destructive testing of the finished components have also been recommended. Welding plays an important role in manufacturing of boilers. Highly skilled welders are required. Thus, equipment required for welding development and welders' training have also been included in the above section.

List of equipment for material testing laboratory is presented in Exhibit-18. Equipment required for welding development and training centre are listed in Exhibit-19.

Auxiliary Equipment

List of auxiliary equipment is presented in Exhibit-20. This includes a 25 tonne weighbridge. In the case of railway siding facilities being available, capacity of the weighbridge may be revised upwards to 100 tonnes.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
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PROJECT PROFILE ON STEAM BOILERS

WEIGHT OF BOILER SUB-ASSEMBLIES

Sl. No.	Item	Weight in MT 150 MW	30 MW
1.	Boiler Drum	64	21
2.	Drum Fittings	5	2
3.	Water Walls		
	i) Headers	38	13
	ii) Tubes	165	55
	iii) Down Comers	80	27
4.	Economisers	274	92
5.	Superheaters	180	60
6.	De-superheaters	5	2
7.	Re-heaters	127	43
8.	Inspection Doors	1	1
9.	Air Heaters	645	216
10.	Casing	105	35
11.	Pipe Work	101	34
12.	Ducts and Wind Box, Dumpers and Expansion Joints	535	200
13.	Supporting Structures, Walkways and Stairways	2150	702
	Total	4475	1503

JOB NO. DCIL-105 EXHIBIT : 10

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

PROJECT PROFILE ON STEAM BOILERS

MANUFACTURING LOAD

Sl. No.	Items	Annual Production (Tonnes)
1.	Boiler Drum	240
2.	Drum Fittings	20
3.	Water Walls	
	i) Headers	150
	ii) Tubes	600
	iii) Down Comers	300
4.	Economisers	1000
5.	Super Heaters	660
6.	De-super Heaters	20
7.	Re-heaters	470
8.	Inspection Doors	10
9.	Air Heaters	2370
10.	Casing (50% of total weight) *	200
11.	Pipe Work (10% of total weight) *	40
12.	Ducts and Wind Boxes, Dumpers and Expansion Joints (45% of total weight) *	930
13.	Supporting Structures, Walkways and Stairways (20% of total weight) *	1560
	Total	8570
	Say	8600

* Total weight indicates the weight of these parts for five 30 MW and two 150 MW boilers.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 11

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
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PROJECT PROFILE ON STEAM BOILERS

LIST OF EQUIPMENT FOR TUBE AND PIPE SHOP

Sl. No.	Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
1.	Circular Cold Saw	Type	: Semi Automatic Hydraulically Operated	1	16	48,600	48,600
		Saw Blade Size	: 1010 mm				
		Cutting Capacity - Rounds	: Up to 350 mm				
2.	Horizontal Band Saw	Cutting Capacity in Steel - Rounds	: Up to 250 mm	1	1	30,000	30,000
3.	Abrasive Wheel Cut-off Machine	Type	: Dry Cutting with Pneumatic Chucking	1	18	35,000	35,000
		Cutting Capacity - Steel Pipes	: Up to 80 mm Dia				
		- Solid Section	: Up to 63 mm Dia				
4.	Tube Sawing and Milling Machine	Cutting Capacity - Tube Dia	: 120 mm	2	10	22,000	44,000
		- Tube Thickness	: 10 mm				
5.	Pneumatic Facing Machine	Facing Capacity	: 50 - 250 mm Dia	2	-	10,000	20,000
6.	Facing Lathe	Centre Height from Bed	: 1250 mm	1	40	3,65,000	3,65,000
		Swing in Gap	: 3150 mm				
		Centre Distance	: 3000 mm				

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EXHIBIT : 11

Sl. No.	Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
7.	Centre Lathe with Gap in Bed	Centre Height	: 220 mm	1	7.5	40,000	40,000
		Swing in Gap	: 720 mm				
		Centre Distance	: 2000 mm				
8.	Double ended Pedestal Grinders	Wheel Size	: 400x50x40 mm	2	5	1,200	2,400
9.	Heavy Duty Pedestal Grinder	Wheel Size	: 610x102x203 mm	1	6	1,400	1,400
10.	Tube Bending Machine	Type	: Rotary Draw	1	15	42,000	42,000
		Cold Bending Capacity	: Up to 100 mm Dia				
		Max. Tube Length	: 10 M				
11.	Hydraulic Tube Bending Machine	Bending Capacity	: Up to 150 mm Dia	1	10	40,000	40,000
12.	Compression Type Pipe Bending Machine	Bending Capacity	: Up to 150 mm Dia	1	15	30,000	30,000
13.	Flash Butt Welding Machine	Welding Capacity - Tube Dia - Tube Thickness	 : Up to 130 mm : Up to 5 mm	2	250	1,600	3,200
14.	Electroslag Welding Machine	Maximum Thickness	: 150 mm	1	20	1,800	1,800
15.	Submerged Arc Welding Machine	Electrode Wire	: 1.6 - 6 mm Dia	2	130	7,000	14,000
		Maximum Speed	: 200 M/hour				
		Maximum Current	: 1500 Amps.				
16.	TIG Welding Set Complete with Argon Arc Torch and Accessories, D.C. Suppressor Unit, High Frequency Unit and Water Circulation Unit and D.C. Rectifier Power Source	Type	: Semi-Automatic	1	20	4,400	4,400
		Range of Welding Current	40 - 450 Amps.				
		Rated Current	400 Amps.				
		Open Circuit Voltage Range	50 - 82 V.				

JOB NO. : DCIL-105

EXHIBIT : II

Sl. No.	Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
17.	Strip Straightening & Flatening Machine	Strip Width	: 10 - 40 mm	1	-	17,000	17,000
		Strip Thickness	: 10 mm				
		Maximum Width Reduction	: 2 mm				
18.	Stress Relieving Furnace	Chamber Dimension		1	90	80,000	80,000
		- Length	: 4.3 M				
		- Width	: 2.5 M				
		- Depth	: 1.4 M				
19.	Pin Welding Machine	Type	: Submerged Arc	2 Sets	100	4,000	8,000
		Capacity	: 6 mm thick plates on tubes without edge preparation				
		Maximum Tube Dia	: 76 mm				
		Width of Panel	: 800 mm				
20.	Welding Machine for Tube Wall Panels	Type	: Submerged Arc	1	60	6,000	6,000
		Max. Panel Width	: 3200 mm				
21.	TIG Tube Butt Welding Machine	Capacity		1	20	1,500	1,500
		- Tube Dia	: 37.5 - 150 mm				
		- Tube Length	: 30 M				
22.	Stud Welding Machine	Capacity		1	40	1,800	1,800
		- Round Studs	: 8.3 - 12.5 mm Dia				
23.	Portable Shot Blasting Plant	Capacity	: 600 lbs Metallic abrasive	3	-	2,100	6,300
		Working Air Pressure	: 7.5 Kg/Cm^2				
24.	Manually Operated Stud Welding Machine	Capacity		1	40	1,200	1,200
		Tube Dia	: 38 - 108 mm				
		Tube Length	: 10 M				
		Studs	: 8 - 12.5 mm				
25.	Tube Loop Heating Furnace	Max. Temperature	: 1000°C	1		10,000	10,000

JOB NO. : DCIL-105 EXHIBIT : 11

Sl. No.	Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
26.	Through Type Pipe Heating Furnace	Max. Temperature	: 1000° C	1	-	40,000	40,000
27.	Pipe Cutting & Bevelling Machine	Cutting Capacity	: 25 - 62 mm	1	1.5	80,000	80,000
			75 - 100 mm	1	1.5		
			125 - 200 mm	1	3.0		
			250 - 300 mm	1	3.0		
28.	Vertical Panel Bending Rolls	Panel Width	: 3 M	1	-	6,000	6,000
		Panel Length	: 30 M				
29.	Hydraulic Tube Testing Equipment	Capacity	: Up to 400 Kg/Cm² pressure for testing straight and bend tubes	1	-	1,200	1,200
30.	Radial Drilling Machine	Drilling Capacity in Steel	: 80 mm Dia	1	8	65,000	65,000
		Arm Length	: 2.7 M				
31.	Radial Drilling Machine	Drilling Capacity in Steel	: 80 mm Dia	2	15	60,000	1,20,000
		Arm Length	: 1.5 M				
Material Handling							
32.	E O T Crane	Capacity	: 10 Tonnes	1	30	50,000	50,000
		Span	: 27.5 M				
		Class	: III				
33.	E O T Crane	Capacity	: 20 Tonnes	1	60	1,10,000	1,10,000
		Span	: 27.5 M				
		Class	: IV				
34.	Hand Push Trolleys	Capacity	: 1000 Kg	2	-	100	200
			500 Kg	2	-	75	150
	TOTAL						13,34,150

JOB NO. : DCIL-105

EXHIBIT : 12

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

PROJECT PROFILE ON STEAM BOILERS

LIST OF EQUIPMENT FOR VESSEL SHOP

Sl. No.	Equipment	Brief Specification	Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
1.	Portal Type Plane Cutting Machine	Bevelling & Cutting Capacity - Length : 11 M - Width : 3 M - Thickness : 150 mm	1	2	19,000	19,000
2.	Line & Circle Gas Cutting Machine	Cutting Capacity - Square Plates : 3 - 150 mm thickness - Circles : 150 - 1500 mm Dia	2	0.2	1,400	2,800
3.	Universal Profile Gas Cutting Machine	Cutting Capacity - Length : 12.5 M - Width : 3.2 M - Max. Thickness : 200 mm	1	1.5	23,000	23,000
4.	4-Roll Plate Bending Machine	Type : Pinch Type Working Width : 8 M Max. Thickness of Plate - Cold Bending : 75 mm - Hot Bending : 150 mm	1	200	1,30,000	1,30,000
5.	Plate Edge Curving Press	Capacity : 800 Tonnes Plate Size : 1.8 M x 150 mm thick	1	110	1,50,000	1,50,000
6.	4-Column Dishing and Flanging Press	Capacity : 1000 Tonnes	1	110	1,90,000	1,90,000

JOB NO. : DCIL-195

EXHIBIT : 12

Sl. No.	Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
7.	Bogie Type Gas Fired Plate Heating Furnace	Bogie Size	: 4 M x 8 M	1	20	80,000	80,000
		Bogie Opening	: 2.5 M				
		Max. Temperature	: 1000° C				
8.	Heat Treatment Furnace	Type	: Bogie Hearth	1	52	11,59,300	11,59,300
		Capacity	: 250 T				
		Chamber Size	: 6 M x 24 M				
		Height	: 6 M				
9.	Boom and Column Type Automatic Submerged Arc Welding Machine with Rotators for Welding Longitudinal and Circumferential Seams	Capacity - Max. Seam Thickness - Max. Seam Dia - Seam Length	: 150 mm : 7.6 M : 8 M	1	60	8,000	8,000
10.	Portable Submerged Arc Welding Machine	Capacity - Max. Plate Thickness	: 150 mm	2	110	6,565	13,130
11.	Electroslag Welding Machine	Capacity - Max. Plate Thickness	: 300 mm	1		1,000	1,000
12.	Drawn Circularity Rectifying Frame	Capacity	: 300 Tonnes	1		1,000	1,000
13.	Radial Drilling Machine	Max. Drilling Capacity in Steel	: 50 mm	2	16	27,835	55,670
		Arm Length	: 2.7 M				
14.	Bench Grinder	Wheel Size	: 250x25x25 mm	2	2	1,400	2,800
15.	Double Ended Pedestal Grinder	Wheel Size	: 600x75x203 mm	2	12	1,400	2,800

JOB NO. : DCIL-105 EXHIBIT : 12

Sl. No.	Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
16.	Centre Lathe	Swing Over Bed	: 3150 mm	1	100	3,63,700	3,63,700
		Max. Length of Workpiece	: 13000 mm				
		Max. Weight of Workpiece	: 120 Tonnes				
17.	Vertical Boring Machine	Max. Dia	: 7000 mm	1	100	1,60,000	1,60,000
18.	Centre Lathe	Centre Height	: 220 mm	1	7.5	32,000	32,000
		Distance between Centres	: 1000 mm				
19.	Hydraulic Test Bed Equipment for Testing of Drums	Max. Testing Pressure	: 422 Kg/Cm^2 g	1	-	1,000	1,000
20.	Portable Shot Blasting Unit	Capacity	: 600 lbs Metallic abrasive	1	-	2,000	2,000
		Working Air Pressure	: 7.5 Kg/Cm^2				
21.	Welding A.C. Transformer Set	Type	: Air cooled	2	65	2,575	5,150
		Range of Welding Current	: 60-600 Amps				
		Rated Current	: 500 Amps				
22.	Horizontal Milling & Boring Machine	Spindle Dia	: 160 mm	1	70	42,000	42,000
23.	Planing Machine	Type	: Single column	1	70	2,57,700	2,57,700
		Max. Planing Width	: 2500 mm				
		Planing Length	: 10 M				
		Max. Job Height	: 2500 mm				

JOB NO. : DCIL-105 EXHIBIT : 12

Sl. No.	Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
24.	Plano Milling Machine	Type	: Single column	1	150 (3 motors)	1,40,000	1,40,000
		Max. Milling Width	: 2800 mm				
		Max. Milling Length	: 10 M				
		Max. Job Height	: 2600 mm				
25.	Semi Automatic "Flux Core" Gas Shielded Metal Arc Welding Set	Rated Current	: 400 Amps	1	17	900	900
		Open Circuit Voltage	: 55 V (DC)				
Material Handling							
26.	E O T Crane	Capacity	: 100/10 Tonnes	1	50	1,95,000	1,95,000
		Span	: 20 M approx.				
		Class	: III				
27.	E O T Crane	Capacity	: 25/5 Tonnes	1	45	1,29,000	1,29,000
		Span	: 20 M approx.				
		Class	: III				
28.	Hand Push Trolleys	Capacity	: 1000 Kg	2	-	100	200
			500 Kg	2	-	75	150
	TOTAL						31,67,300

JOB NO. : DCIL-105 EXHIBIT : 13

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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PROJECT PROFILE ON STEAM BOILERS

LIST OF EQUIPMENT FOR PLATE AND STRUCTURAL SHOP

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
Cutting Machines							
1.	Plate Shearing Machine	Type	: Hydraulic	1	25	49,590	49,590
		Shearing Length	: 2500 mm				
		Max. Plate Thickness	: 10 mm				
2.	Cropping, Punching and Section Shearing Machine	Max. Angle Size	: 130 x 130 x 12 mm	1	8	51,330	51,330
		Max. Plate Size	: 120 x 16 mm				
		Max. Dia of Holes to be punched	: 30 mm x 20 mm thick				
3.	Circular Cold Saw	Type	: Semi-automatic Hydraulically Operated	1	10	48,600	48,600
		Cutting Capacity	:				
		- Round	: 25 - 350 mm				
		- Square	: 306 mm				
		Saw Blade Size	: 1010 mm				

JOB NO. : DCIL-105

EXHIBIT : 13

Sl. No.	Name of Equipment	Brief Specification	Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
4.	Abrasive Wheel Cut off Machine	Type : Dry Cutting with Pneumatic Chucking	2	30	35,000	70,000
		Cutting Capacity :				
		- Solid Section : 63 mm Dia				
		- Hollow Section : 80 mm Dia				
		- Bevel Cut : 45°				
5.	Profile Cutting Machine	Type : Oxy-acetylene Profile Cutting Machine incorporating Coordinate Drive and Photoelectric Scanning System	1	1	25,000	25,000
		Cutting Length : 12500 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 : 40 - 300 Amps	1	29	20,350	20,350
		Max. Thickness of Plate : Up to 70 mm				
7.	Oxy-acetylene Line and Circle Cutting Machine	Plate Thickness for Square Cut : 3 - 100 mm	2	0.2	1,200	2,400
		Plate Thickness for Bevel Cut : 66 mm				
		Circle Cutting Dia : 150 - 1500 mm				

JOB NO. : DCIL-105 EXHIBIT : 13

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
8.	Universal Nibbling Machine	Throat Depth	: 1500 mm	1	4	2,950	2,950
		Max. Circle Dia Cut from Square to Blank	: 1235 mm				
		Length of Stroke	: 2 - 10 mm				
9.	Plate Edge Planer	Max. Planing Length	: 12500 mm	1	22	1,63,300	1,63,300
		Max. Plate Thickness	: 80 mm				
10.	Girder End Facing Machine	Machining Area	: 2 x 3 M			10,000	10,000
11.	Metal Cutting Circular Band Saw	Cutting Capacity	:	1	4	20,000	20,000
		- Steel	: 25 mm				
		- Non-ferrous Metal	: 150 mm				
		- Size of Table	: 600 x 600 mm				
12.	3-Roll Plate Bending Machine	Working Width	: 3000 mm	1	90	1,22,800	1,22,800
		Max. Plate Thickness	: 30 mm				
13.	7-Roll Plate Straightening Machine with 3 Rollers at the bottom and 4 Rollers at the top	Capacity	:			1,50,000	1,50,000
		- Plate Width	: 3200 mm				
		- Plate Thickness	: 32 mm				
		- Rolling Speed	: 3.5 - 6 M/min.				
14.	Beam Straightening Machine	Type	: Ram type	1	15	56,680	56,680
		Capacity	: 250 Tonnes				
		Ram Stroke	: 610 mm				
		Table Width	: 2500 mm				

JOB NO. : DCIL-105 EXHIBIT : 13

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
15.	Dish End Forming Machine	Max. Cold Spinning Dia	: 4.4 M	1	20	70,000	70,000
		Max. Cold Spinning Thickness	: 25 mm				
16.	Hydraulic Press	Capacity	: 200 Tonnes	1	30	59,250	59,250
		Standard Stroke Length	: 630 mm				
		Shut Height (Bolster to Platen)	: 710 mm				
17.	Hydraulic Press Brake	Capacity	: 500 Tonnes	1	75	85,000	85,000
		Max. Width of Plate	: 3200 mm				
		Max. Thickness of Plate	: 20 mm				
18.	Heavy Duty Pedestal Grinder	Type	: Double Ended	3	9	1,200	3,600
		Wheel Size	: 400 x 50 x 40 mm				
19.	Welding A.C. Transformer Set	Type	: Forced Air Cooled	1	30	920	920
		Range of Welding Current	: 60 - 600 Amps				
		Rated Current	: 500 Amps				
20.	Welding A.C. Transformer Set	Type	: Forced Air Cooled	1	17	625	625
		Range of Welding Current	: 40 - 300 Amps				
		Rated Current	: 250 Amps				

JOB NO. : DCIL-105

EXHIBIT : 13

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
21.	Welding A.C. Transformer Set	Type	: Forced Air Cooled	1	23	920	920
		Range of Welding Current	: 60 - 450 Amps				
		Rated Current	: 350 Amps				
22.	Rectifier D.C. Welding Set	Type	: Forced Air Cooled	1	39	2,600	2,600
		Range of Welding Current	: 70 - 600 Amps				
		Rated Current	: 600 Amps				
23.	Submerged Arc Welding Set	Type	: Constant Potential with D.C. Rectifier Power Source	2	108	6,565	13,130
		Rated Current	: 1200 Amps				
		Wire Feed Rate	: 0.9 - 7.5 M/min.				
24.	TIG Welding Set complete with Argon Arc Torch and Accessories, D.C. Suppressor Unit, High Frequency Unit and Water Circulation Unit and D.C. Rectifier Power Source	Type	: Semi-automatic	1	20	4,400	4,400
		Range of Welding Current	: 40 - 350 Amps				
25.	MIG Welding Set complete with D.C. Rectifier Power Source, Servo Wire Feeder Unit, CO_2 Regulator-cum-Flow Meter and Heater with Core Assembly	Type	: Automatic	1	17	3,200	3,200
		Rated Current	: 400 Amps				
		Open Circuit Voltage	: 55 V D.C.				
26.	Welding Positioners, Booms, Manipulators, etc.	Capacity	: 10 Tonnes	2	2		500
		Capacity	: 40 Tonnes	2	8		
27.	Electrode Drying Oven	Type of Control	Thermostat	2	3.6		300
		Temp. Range	: 50 - 300° C				

JOB NO. : DCIL-105

EXHIBIT : 13

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
Drilling Section							
28.	Radial Drilling Machine	Max. Drilling Capacity in Steel (UTS 50 kg/mm²)	: 50 mm	1	15	27,835	27,835
29.	Portable Drilling Machine	Type	: Heavy Duty Radial type with Universal Drilling Head	1	10	2,500	2,500
		Max. Hole Size	: 40 mm				
		Arm Length	: 2 M				
30.	Column Drilling Machine	Capacity in Steel:	50 mm	1	5	2,000	2,000
		Table Size	: 1000 x 650 mm				
31.	Pillar Drilling Machine	Capacity in Steel:	40 mm	1	2	1,400	1,400
		Table Diameter	: 335 mm				
Material Handling							
32.	O.T. Crane	Capacity	: 10 Tonnes	1	30	56,680	56,680
		Span	: 20 M (approx.)				
		Class	: III				
33.	E.O.T. Crane	Capacity	: 25 Tonnes	1	45	1,18,072	1,18,072
		Span	: 20 M (approx.)				
		Class	: III				
34.	Hand Push Trolley	Capacity	: 1000 kg	2	-	100	200
			500 kg	2	-	75	150
	TOTAL						12,46,282

JOB NO. : DCIL-105

EXHIBIT : 14

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
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PROJECT PROFILE ON STEAM BOILERS

LIST OF EQUIPMENT FOR MACHINE SHOP

Sl. No.	Name of Equipment	Brief Specification	Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
1.	Centre Lathe	Centre Height : 450 mm	1	20	45,000	45,000
		Centre Distance : 3000 mm				
2.	Turret Lathe	Centre Height : 237 mm	1	9.5	39,570	39,570
		Distance between Spindle Nose and Turret : Max. 1120 mm Min. 390 mm				
		Bar Capacity : 63 mm				
3.	Vertical Milling Machine	Table Size : 1600 x 355 mm	1	7.5	14,000	14,000
4.	Universal Milling Machine	Table Size : 1600 x 300 mm	1	7.5	22,000	22,000
5.	Column Type Drilling Machine	Drilling Capacity: 40 mm Dia in Steel	2	9	1,400	2,800
6.	Radial Drilling Machine	Drilling Capacity: 50 mm Dia in Steel	1	4.5	55,000	55,000
		Max. Drilling Radius : 1790 mm				
7.	Universal Cylindrical Grinder	Swing over Bed : 450 mm	1	4.5	2,000	2,000
		Centre Distance : 2000 mm				
		Internal Grinding: 25 - 200 mm Dia				
8.	Vertical Surface Grinder	Table Clamping Area 400 x 1500 mm	1	15	1,000	1,000

JOB NO. : DCIL-105

EXHIBIT : 14

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
9.	Slotting Machine	Slotting Length : 400 mm		1	9	9,000	9,000
		Table Diameter : 800 mm					
10.	Shaping Machine	Stroke Length : 660 mm		1	8	43,000	43,000
11.	Hand Hole Cap Profile Milling Machine	Type :	Fully Automatic Electronic Tracer Controlled 3-D Copying System	2	7.5	30,000	60,000
12.	Power Hacksaw	Cutting Capacity :		1	3	2,200	2,200
		- Rounds : Up to 400 mm					
		- Squares : Up to 325 mm					
13.	Horizontal Band Sawing Machine	Cutting Capacity in Steel :		1	1	1,800	1,800
		- Rounds : 250 mm					
Tool Room							
14.	Universal Tool and Cutter Grinder	Max. Dia : 280 mm		1	1	2,000	2,000
		Length between Centres : 760 mm					
		Working Surface : 980 x 140 mm					
15.	Drill Point Grinder	Size of Drill : 16 - 80 mm		3	6	1,300	3,900
		Included Point Angle : 90° - 150°					
16.	Carbide Tool Lapping Machine	Cup Wheel Size : 150 x 10 x 76.2 mm		1	2	2,300	2,300
		Table Size : 180 x 480 mm					

JOB NO. : DCIL-105

EXHIBIT : 14

Sl. No.	Name of Equipment	Brief Specification	Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
17.	Automatic Bandsaw and Circular Saw Sharpening Machine	Width of Bandsaw : 180 mm Dia of Circular Saw : 150 - 1500 mm Dia of Grinding Wheel : 254 mm Grinding Capacity: 30-60 Teeth/minute	2	2.4	3,000	6,000
18.	Universal Cylindrical Grinder	Height of Centre : 175 mm Distance between Centres : 625 mm Internal Grinding Dia: 25 - 200 mm Depth of Grinding: 125 - 200 mm	1	5	2,000	2,000
19.	Surface Grinder	Type : Vertical, Hydraulically Operated Table Clamping Area : 300 x 1500 mm Max. Grinding Width : 300 mm Max. Table Load : 400 kg	1	15	1,000	1,000
20.	Shearing and Cropping Blade Grinder	Size of Grinding Wheel : 300 mm Length of Blade : 1000 mm	1	4	2,000	2,000
21.	Jig Boring Machine	Type : Vertical Useful Table Dimension : 400 x 630 mm	1	11	1,30,000	1,30,000

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 14

Sl. No.	Name of Equipment	Brief Specification		No. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
22.	Precision Lathe	Centre Height	: 280 mm	1	11	3,500	3,500
		Max. Swing over Bed	: 560 mm				
		Max. Swing over Cross Slide	: 375 mm				
		Distance between Centres	: 1500 mm				
23.	Universal Milling Machine	Table Size	: 1600 x 355 mm	1	11	23,000	23,000
		Longitudinal Traverse	: 1200 mm				
		Cross Traverse	: 320 mm				
		Vertical Traverse:	425 mm				
24.	Pillar Drilling Machine	Drilling Capacity: in Steel	40 mm	1	2	1,400	1,400
		Table Diameter	: 335 mm				
25.	Surface Plate	Material of Construction	: Cast Iron	2	-	200	400
		Dimension	: 2 x 2 M				
26.	Arc Welding Set	Welding Current Range	: 50 - 600 Amps	1	40	2,600	2,600
		Rated Current	: 500 Amps				
27.	Heat Treatment Furnace with Quenching Tank	Type	: Electrically Heated, Batch type, Bogie Hearth Furnace	1	7	48,000	48,000
		Chamber Dimension:	500 x 500 x 150 mm				
		Temp. Range	: 700 - 1250° C				
		Cycle Time for Heating to Full Temperature	: 7 hours				

JOB NO. : DCIL-105 EXHIBIT : 14

Sl. No.	Name of Equipment	Brief Specification			Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
28.	Arbour Press	Type	:	Compound Hand type Lever Press	1	-	3,000	3,000
		Pressure	:	22.7 Tonnes				
29.	Bench Grinder	Wheel Size	:	250 x 25 x 25 mm	2	2	1,000	2,000
30.	Drill Web Thining Grinder	Drill Size	:	16 - 50 mm	2	2	1,200	2,400
31.	Double-ended Pedestal Grinder	Wheel Size	:	400 x 50 x 40 mm	1	3	1,200	1,200
32.	Abrasive Belt Grinding Machine	Belt Size	:	150 x 1219 mm	2	3	1,500	3,000
33.	Flexible Shaft Grinder	Type	:	Motor Swivel Suspension and Flexible Shaft type Two Speed Grinder	4	7	1,800	7,200
34.	Spray Metallising Equipment	Size of Spraying Wires	:	0.8 - 4 mm	1	-	800	800
		Spraying Metal	:	Steel, Stainless Steel, Copper, Brass, Bronze, Aluminium, Tin, Nickel, Molybdenum, Lead, etc.				
		Drive	:	Air Turbine				
Material Handling								
35.	E.O.T. Crane	Capacity	:	10 Tonnes	2	30	56,680	1,13,360
				5 Tonnes	2	30	39,000	78,000
		Span	:	16 M approx.				
		Class		III				
36.	Hand Push Trolley	Capacity	:	1000 kg	4		100	400
				500 kg	6		75	450
	TOTAL							7,16,080

JOB NO. DCIL-105

EXHIBIT : 15

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

PROJECT PROFILE ON STEAM BOILERS

LIST OF EQUIPMENT FOR FORGE AND HEAT TREATMENT SHOP

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
1.	Pneumatic Power Hammer	Force of Blow	: 170 kg	1	20	41,000	41,000
		Blow Energy	: 452 kg				
2.	Pneumatic Power Hammer	Force of Blow	: 580 kg	1	46	91,900	91,900
		Blow Energy	: 1530 kg				
3.	Gas/Oil-fired Forge Furnace	Max. Temp.	: 1200°C	2	-	50,000	1,00,000
		Size of Heating Chamber	: 600 x 600 x 1500 mm				
4.	Pedestal Grinder	Type	: Double Ended	1	4	1,200	1,200
		Wheel Size	: 400 x 50 x 127 mm				
		Wheel Centre Distance	: 745 mm				
5.	Double Ended Snagging Grinder	Type	: Individual Drive	1	6	6,000	6,000
		Wheel Size	: 500 x 75 x 203 mm				
6.	Circular Saw	Type	: Semi-automatic	1	10	48,600	48,600
		Cutting Capacity in Steel	:				
		- Rounds	: 240 mm				
		- Squares	: 220 mm				

JOB NO. DCIL-105

EXHIBIT : 15

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
7.	Power Hacksaw	Type	: Automatic	1	3	10,000	10,000
		Cutting Capacity in Steel	:				
		- Rounds	: 320 mm				
		- Squares	: 270 mm				
8.	Electric Heat Treatment Furnace	Temp. Range	: 900 - 1050°C	1	90	65,000	65,000
		Chamber Dimension:	1000 x 600 x 1600 mm				
9.	Gas-fired Bogie Hearth Annealing Furnace	Max. Temp.	: 1000°C	1	20	15,000	15,000
		Chamber Dimension:	4000 x 2500 x 1500 mm				
10.	Cyanide Pot Furnace	Max. Temp.	: 1200°C	1	165	50,000	50,000
		Chamber Dimension:	700 x 700 x 650 mm				
	Material Handling						
11.	E.O.T. Crane	Capacity	: 5 Tonnes	2	30	41,000	82,000
		Span	: 20 M				
		Class	: III				
12.	Hand Push Trolley	Capacity	: 1000 kg	2	-	100	200
			500 kg	4	-	70	280
	TOTAL						5,11,380

JOB NO. : DCIL-105

EXHIBIT : 16

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

PROJECT PROFILE ON STEAM BOILERS

LIST OF EQUIPMENT FOR INTERSHOP MATERIAL HANDLING

Sl. No.	Name of Equipment	Brief Specification	Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
1.	Tyre Mounted Mobile Crane	Capacity : 12/7.5 Tonnes	2	-	66,000	1,32,000
		Max. Radius from Centre Line of Rotation : 12.2 M				
2.	Diesel Engine Operated Forklift	Capacity : 5 Tonnes	2	-	45,000	90,000
3.	Battery Operated Forklift	Capacity : 2 Tonnes	4	-	25,000	1,00,000
4.	Battery Operated Platform Truck	Capacity : 1 Tonne	6	-	20,000	1,20,000
5.	Truck	GVW : 8 Tonnes	4	-	7,000	28,000
6.	Trailer	Capacity : 25 Tonnes	1	-		
		12 Tonnes	2	-		1,90,000
		10 Tonnes	5	-		
		8 Tonnes	2	-		
7.	Dumper Truck	Capacity : 5 Tonnes	2	-	6,000	12,000
8.	Tractor	Capacity : 50 HP	2	-		
		35 HP	1	-		70,000
		15 HP	1	-		
9.	Hand Push Trolley	Capacity 1000 kg	4		100	400
		500 kg	4	-	70	280
	TOTAL					7,42,680

JOB NO. : DCIL-105

EXHIBIT : 17

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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PROJECT PROFILE ON STEAM BOILERS

LIST OF EQUIPMENT FOR MAINTENANCE SHOP

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
1.	Centre Lathe	Centre Height	: 450 mm	1	20	45,000	45,000
		Centre Distance	: 3000 mm				
2.	Centre Lathe	Centre Height	: 218 mm	1	11	32,440	32,440
		Centre Distance	: 2000 mm				
3.	Radial Drilling Machine	Max. Drilling Capacity in Steel	: 50 mm	1	8	27,835	27,835
4.	Pillar Drilling Machine	Max. Drilling Capacity in Steel	: 25 mm	2	4	1,300	2,600
5.	Bench Drilling Machine	Max. Drilling Capacity in Steel	: 13 mm	1	1.5	1,200	1,200
6.	Shaping Machine	Stroke Length	: 660 mm	1	8	43,000	43,000
7.	Universal Milling Machine	Table Size	: 1600 x 355 mm	1	11	23,000	23,000
8.	Slotting Machine	Slotting Length	: 400 mm	1	9	9,000	9,000
		Table Diameter	: 800 mm				
9.	Pedestal Grinder	Type	Double Ended	1	2.5	1,200	1,200
		Wheel Size	: 400 x 50 x 40 mm				
10.	Bench Grinder	Wheel Size	178 x 25 x 20 mm	2	1	1,300	2,600
11.	Gear Hobber	Max. Diameter	400 mm	1	7.5	30,000	30,000
		Max. Module	8 mm				

JOB NO. : DCIL-105 EXHIBIT : 17

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
12.	Power Hacksaw	Capacity for Cutting Steel Rounds :	300 mm	1	1.5	1,600	1,600
13.	Flexible Grinder	Type :	Swivel Suspension and Flexible Shaft type Two Speed Grinder	2	0.4	2,200	4,400
		Max. Size of Grinding Wheel :	100 x 10 mm				
14.	Abrasive Belt Grinding Machine	Belt Size :	150 x 1220 mm	2	3	1,500	3,000
		Working Surface :	150 x 250 mm				
15.	Three Legged Forged Pullers for Bearings, Gears, Pulleys, etc.	Size :	500 mm 400 mm 300 mm	2 2 2	- - -	-	1,000
16.	Pitting Press	Capacity :	30 Tonnes	1	15	6,000	6,000
17.	Hydraulic Pipe Bending Machine	Pipe Size :	12 mm to 50 mm	2	-	10,000	20,000
		Type :	Hand Operated				
		Pump Pressure :	20 Tonnes				
18.	Oil Bath Heating Tank	Chamber Size :	600 x 640 x 480 mm	1	10	28,000	28,000
		Max. Temp. :	100°C				
19.	Cleaning Tank	Type :	Suitable for cleaning parts with both Kerosene and Water with a grating in the Chamber separating them	1	-	2,400	2,400
		Overall Chamber Size :	2000 x 1200 x 800 mm				
20.	Insulating Oil Purifier	Standard		-	-	-	500
21.	Super Centrifuge Lubricating Oil Purifier	Standard		-		-	500

JOB NO. : DCIL-105 EXHIBIT : 17

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
22.	Electrical Test Board for Testing Welding Machines	Standard		-	-	-	200
23.	Vibration Meter	Type	: Portable Battery Operated	1	-	-	100
24.	Pressure Gauge	Pressure Range	: 0 - 100 kg/cm^2	2	-	100	200
25.	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	-	200	800
		Capacity	: 10 Tonnes				
		Closed Height	: 298 mm				
		Hydraulic Lift	: 150 mm				
		Max. Height	: 448 mm				
26.	Screw Jack	Type	: Ratchet Type, Lifting and Traversing Screw Jack	4	-	300	1,200
		Capacity	: 5 Tonnes				
		Closed Height	: 500 mm				
		Lift	: 200 mm				
		Dia of Head	: 88 mm				
27.	Chain Pulley Block	Type	: Balanced Spur Gear Fixed Mounting	2	-	150	300
		Load Capacity	: 2 Tonnes SWL				
		Lift	: 3 M				
28.	Collapsible Ladder	Type	: Self-supporting Extendable All Aluminium Ladder	2	-	150	300

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EXHIBIT : 17

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
29.	Hand Push Trolley	Max. Capacity	: 200 kg	3	-	75	225
30.	E.O.T. Crane	Type	: Single Girder	1	15	37,800	37,800
		Class	: III				
		Capacity	: 5 Tonnes				
		Span	: 16.5 M				
31.	A.C. Transformer Arc Welding Set	Range of Welding Current	: 60 to 450 Amps	2	48	4,700	9,400
		Rated Current	: 350 Amps				
32.	Soldering Iron	Capacity	: 200 Watts	2	0.4	20	40
			100 Watts	4	0.4	15	60
			60 Watts	4	0.25	10	40
	Electrical Testing Tools						
33.	Ammeter	Type	: Moving Iron type suitable for both A.C. and D.C. up to 100 Amps	2	-	80	160
		Accuracy	: ± 1% on effective scale				
34.	Meg Ohm Meter	Heavy Duty Hand operated Meg Ohm Meter with Shielded Voltage Leads and Ground Leads		2	-	100	200
		Voltage Range	: 0 - 11000 V				
35.	Multimeter (Ava Meter)	Portable Battery operated Multimeter with built-in Overload Protective Circuit		2	-	130	260
		Voltage	: 100 - 1500 V A.C./D.C.				
37.	Tachometer	Speed Range	: 0 - 15000 rpm	5	-	100	500
	TOTAL						3,37,860

DEVELOPMENT CONSULTANTS

JOB NO. : [illegible]-105

EXHIBIT : 18

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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PROJECT PROFILE ON STEAM BOILERS

LIST OF EQUIPMENT FOR MATERIAL TESTING LABORATORY

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
1.	Brinell Hardness Tester	Type	: Power operated	1	1	11,170	11,170
		Applied Load	: 250 - 3000 kgs				
2.	Rockwell Hardness Tester	Both steel and diamond cone can be used		1	1	9,080	9,080
		Minor Load	: 10 kg				
		Major Load	: 100 kg, 150 kg				
3.	Vickers Hardness Tester	Type of Penetrator	: Square base, Pyramid having an angle of 136° between opposite faces	1	-	700	700
		Load Range	: 1 - 120 kg				
4.	Universal Testing Machine	Type	: Hydraulically Loaded	1	6	18,000	18,000
		Capacity	: 100 Tonnes				
5.	Horizontal Beam Type Fatigue Testing Machine with Facilities for Elevated Temperature Test	Type	: Rotary	1	1	6,000	6,000
		Variable Load	: 0 - 100 kg				
		Motor and Test Piece Speed	: 2890 rpm				
		Motor Power	: 0.5 KW				
		Test Specimen Dia	: 8 - 12 mm				

JOB NO. : DCIL-105 EXHIBIT : 18

Sl. No.	Name of Equipment	Brief Specification			Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
6.	Impact Testing Machine	Type	:	Pendulum type Impact Tester, Chirpy System	1	1	1,000	1,000
		Capacity -						
		With Complementary Weight	:	30 kg				
		Without Complementary Weight	:	15 kg				
		Type	:	Provision for IZOD Test	1	1		
		Pendulum Impact Energy	:	16 kg				
7.	Crack Depth Detection and Die Penetrant Test Equipment	Standard Penetrants			1		600	600
8.	Compression Testing Machine	Capacity	:	100 Tonnes	1	1	800	800
9.	Metallographic Specimen Mounted Bakelite Press	Capacity	:	8 tonnes	1	1	800	800
10.	Surface Grinder	Type	:	Swing type, Floor Model with Cup Wheel	1	2	50	50
		Sample Size	:					
		- Diameter	:	30 - 50 mm				
		- Thickness	:	3 - 35 mm				
11.	Specimen Grinding and Polishing Machine for Metallography	Disc Size	:	200 mm	1	1	500	500
12.	Electrolytic Polishing Apparatus	Type	:	Laboratory type, Electrolytic Polishing Apparatus	1		200	200
		Max. Sample Diameter		250 mm				

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EXHIBIT : 18

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
		Max. Sample Height	: 40 mm				
13.	Metallographic Microscope	Type	: Projection-cum-Photomicrograph Laboratory type Microscope	1	-	100	100
		Magnification	: 58 - 1800 mm Dia				
14.	Material Testing Spectroscope	Used for Qualitative and Quantitative Analysis of Samples using Microphotometer and Photographic Plate or Film for recording		1	-	500	500
15.	Apparatus for Determination of Carbon and Sulphur Content	Max. Carbon Content	: 4.5%	1	-	100	100
		Max. Sulphur Content	: 0.15%				
16.	Bench Drilling Machine	Dia of Hole	: 13 mm	1	0.6	3,000	3,000
		Table Size	: 350 x 50 mm				
17.	Electric Muffle Furnace	Type	: Laboratory	1	5.0	2,000	2,000
		Dimension	: 475 x 175 x 175 mm				
18.	Ultrasonic Testing Equipment	Type	: Ultrasonic, Pulse Reflection, Portable type	1	-	26,000	26,000
		Measuring Range in Steel	: 1 - 1000 cm				
		Frequency Range	: 0.5 - 10 Mc/s				
19.	Ultrasonic Digital Thickness Measuring Equipment (Battery Operated)	Measuring Range in Steel	: 1.6 - 100 mm	1	-	15,000	15,000
		Accuracy	: ± 0.1 mm				

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Sl. No.	Name of Equipment	Brief Specification			Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
20.	Magnetic Crack Detector	Type	:	Capable of producing both Longitudinal and Circular Magnetic Fields	1	-	21,390	21,390
		Current Range	:	250 - 1200 amps				
		Voltage Range	:	4 - 8 volts				
21.	Abrasive Cutting Machine	Type	:	Submerged type, Wet Oscillating Cutting Machine for Laboratory use	1	12	8,000	8,000
		Max. Cutting Capacity	:	100 mm				
		Dia of Cutting Wheel	:	450 mm				
22.	Weighing Machine	Type	:	Micro Analytical Balance	1	-	100	100
		Capacity	:	200 gms				
		Sensitivity	:	0.1 mg				
23.	Air Hydraulic Pump	Testing Capacity	:	7030 kg/cm^{2}g	1	-	1,500	1,500
24.	Portable Hardness Tester	Type	:	Rockwell	1	-	500	500
25.	Portable Hardness Tester	Type	:	Poldi type Hardness Tester, Ferrous and Non-ferrous consisting of Tester, Standard Test Bar and measuring Magnifiscope	1	-	500	500
		Indentor	:	10 mm Dia Brinell Ball				
26.	Portable X-Ray Equipment	Type	:	Industrial	2	-	600	1,200
		Max. Thickness	:	100 mm				
		Sensitivity	:	1 - 2 %				
	TOTAL							1,28,870

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EXHIBIT : 19

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
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PROJECT PROFILE ON STEAM BOILERS

LIST OF EQUIPMENT FOR WELDING DEVELOPMENT AND TRAINING CENTRE

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (kW)	Unit Price ($)	Total Price ($)
1.	CO_2 Semi-automatic Welding Equipment	Rated Current	: 400 Amps	2	34	3,185	6,370
		Open Circuit Voltage	: 55 V D.C.				
2.	MIG Welding Equipment	Type	: Semi-automatic	2	34	3,185	6,370
		Rated Current	: 400 Amps				
		Open Circuit Voltage	: 55 V D.C.				
3.	TIG Welding Equipment	Type	: Manual	2	40	1,595	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 Set	Type	: Constant Potential with D.C. Rectifier Power Source	2	100	6,565	13,130
		Rated Current	: 1200 Amps				
		Wire Feed Rate	: 0.9 - 7.5 M/min.				
5.	Metal Spraying Machine	Size of Spraying Wires	: 0.8 - 4.0 mm	2	-	50	100
		Spraying Metals	: Steel, Stainless Steel, Copper, Brass, Bronze, Aluminium, Tin, Nickel, Molybdenum, Lead, etc.				
		Drive	Air Turbine				

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Sl. No.	Name of Equipment	Brief Specification	Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
6.	Manual Metal Arc Welding Set	Type : Forced Air Cooled Range of Welding Current : 60 - 600 Amps Rated Current : 500 Amps	2	60	3,750	7,500
7.	Oxy-acetylene Gas Cutting Set	Standard	2	-	2,500	5,000
8.	High Pressure Welder Training Booth	Standard	8	-	625	5,000
9.	Portable Gas Shielded Flux Core Metal Arc Welding Set	Rated Current : 400 Amps Open Air Current Voltage : 55 V	2	40	3,200	6,400
10.	Portable Line and Circle Gas Cutting Machine	Plate Thickness for Square Cut : 3 - 100 mm Plate Thickness for Bevel Cut : 66 mm Circle Cutting Dia. : 150 - 1500 mm	1	0.1	1,300	1,300
11.	Motor Driven Pipe Bevelling, Machine with Shape Cutting Attachment	Max. Diameter of Pipe to be cut : 900 mm	1	3	1,200	1,200
12.	Hand Operated Pipe Profile Cutting Machine	Max. Diameter of Pipe : 80 mm	2	-	1,100	2,200
13.	Plate Shearing Machine	Shearing Width 2500 mm Plate Thickness : 8 mm	1	20	42,000	42,000
14.	Heavy Duty Pedestal Grinder	Type : Double Ended Wheel Size 400 x 50 x 40 mm	2	5	1,200	2,400
15.	Shaping Machine	Stroke Length 460 mm	1	5	43,000	43,000

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 19

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
16.	Power Hacksaw	Type	: Hydraulically Operated	1	2.2	2,200	2,200
		Max. Cutting Capacity	:				
		- Round	: 320 mm				
		- Square	: 270 mm				
17.	Electric Heat Treatment Furnace	Temp. Range	: 900° - 1100°C	1	90	90,000	90,000
		Size	: 1800 x 600 x 1600 mm				
18.	Hydraulically Operated Guided Bend Test Machine	Capacity	: 10 Tonnes	2	6	12,600	25,200
19.	Pillar Drilling Machine	Drilling Capacity: in Steel	33 mm	2	4	1,400	2,800
		Table Diameter	: 335 mm				
20.	Flash Welding Machine	KVA Rating	: 25	2	40	3,500	7,000
		Push off Pressure:	4.5 Tonnes				
		Max. Gross Section	: 0.5 sq.inch.				
	TOTAL						2,72,360

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 20

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
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PROJECT PROFILE ON STEAM BOILERS

LIST OF AUXILIARY EQUIPMENT AND HAND TOOLS

Sl. No.	Name of Equipment	Brief Specification	Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
Hand Tools (Pneumatic)						Lump Sum
1.	Pneumatic Chipping Hammer	Chipper hammer shall be used for chipping and cleaning welds. Hammer shall be supplied with 200 mm long flat finish chisel, bush cap nut and other standard accessories No. of Strokes per Minute : 1050	8	-		10,200
2.	Pneumatic Grinder	Type : Surface and Cut-off Grinder with Reinforced Hub Wheel. Wheel Dia : 180 mm Free Speed : 8000 rpm	8	-		
3.	Spray Gun	Type : Gravity Fed, Top Cup type Spray Gun with Pot and Nozzle Capacity : 0.5 litre Air Pressure : 3 - 4 kg/cm²	8	-		
Electric Motor Driven Power Hand Tools						
4.	Electric Grinders	Type : Hand-held Horizontal Type Wheel Dia : 150 mm Speed : 4500 rpm	8	6		4,000

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EXHIBIT : 20

Sl. No.	Name of Equipment	Brief Specification		Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
5.	Electric Drill	Type	: Pistol Grip type	6	3		
		Max. Drill Size	: 9.5 mm				
		Speed	: 750 rpm				
6.	Electric Drill	Max. Drill Size	: 25 mm	4	3		
7.	Electric Disc Sander	Type	: Grip Handle type	6	4		
		Size	: 200 mm				
8.	Miscellaneous Tools						2,000
	o Measuring and Marking Tools including Measuring Tape, Ruler, Caliper, etc.						
	o Vises and Clamps						
	o Saws and Files						
	o Hammers						
	o Countersinks, Taps, Dies, Reamers						
	o Wrenches, Pliers, Screw Drivers and Torque Wrenches	Standard		Lump Sum			
	o Smithy Tools, Quenching Tank, Anvil Block, Hearth and Sewerage Block						
	o Welding Accessories						
	o Tube Expander						
	o Carpentry Tools						

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 20

Sl. No.	Name of Equipment	Brief Specification	Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
Auxiliary Equipment						10,000
9.	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	8	-		
10.	Work Bench	50 mm laminated wood top in an angle iron frame with four angle iron legs Area of Top Surface : 2000 x 850 mm Floor to Top Height : 900 mm	60	-		
11.	Work Table	All steel, welded construction work tables Top surface : 1000 x 3000 mm Min. Plate Thickness : 40 mm Height of Table : 950 mm	20	-		
12.	Workers' Tool Cabinet	Steel cabinets consisting of two shelves Size (W x D x H) : 600 x 450 x 750 mm	250	-		
13.	Bar, Pipe and Rod Storage Rack	Heavy duty double-arm six high storage rack of steel Capacity : 8 Tonnes	250	-		
14.	All Steel Open Storage Rack	The rack shall have six shelves Overall Size (W x D x H) : 1200 x 450 x 1950 mm Capacity 1500 kg/rack	60	-		

JOB NO. : DCIL-105 EXHIBIT : 20

Sl. No.	Name of Equipment	Brief Specification	Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
15.	Heavy Duty Wooden Skid	Made of hard wood with metal frame Top Surface : 900 x 1000 mm Load Capacity : 1500 kgs	60	-		
16.	Steel Tote Box	Welded steel construction covered with heavy duty wire mesh Size (L x W x D) : 1000 x 1000 x 450 mm	60	-		
17.	Closed Storage Shelf	Welded steel sheet shelf with lockable doors Overall Height : 2000 mm Tray Dimension (W x D) : 1000 x 450 mm Load Capacity : 500 kg/cm^2	60	-		
18.	Stillages	Stillages will be used for construction of platform for assembly work as well as for storing sheets, plates and long rolled section. It will be made of welded structure. Size (L x H) : 3000 x 750 mm Width of a Frame : 300 mm	400	-		
19.	Cradles	Type : Made out of steel angles or wire frames Carrying Capacity: 1 tonne	50	-		
20.	Weighbridge	Type : Lever Type, Road Transport Capacity : 25 Tonnes	1	-		
21.	Portable Platform Weighing Scale	Type : Arm type Capacity : 500 kgs	12			

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 20

Sl. No.	Name of Equipment	Brief Specification	Nos. Required	Power Consumption (KW)	Unit Price ($)	Total Price ($)
22.	Roller Stand	Length : 15 M	30	-		
		Width of Track : 1 M				
23.	Roller Stand	Length : 15 M	30	-		
		Width of Track : 0.5 M				
	TOTAL					26,200

SECTION - 8
RAW MATERIALS AND OTHER INPUTS

RAW MATERIALS AND OTHER INPUTS

The boiler manufacturing plant needs a large number and wide variety of basic materials, bought-out items and consumables. These may be categorised as under :

- Basic materials for shop-fabricated and site-fabricated sub-assemblies
- Pre-engineered, bought-out items
- Consumables

BASIC MATERIALS

The shop- and site-fabricated sub-assemblies require the following types of basic materials :

- Tubes and pipes
- Manifolds
- Boiler quality plates
- Supporting structures

Tubes and Pipes

Tubes and pipes are required in the fabrication of the following items :

- Economiser
- Generating Tubes
- Superheater
- Reheater.

Tubes in each of the sub-assemblies of a boiler are subjected to different working conditions and, therefore, require different types of materials.

Economiser

The economiser tube conducts only water, and therefore, the maximum temperature is likely to be in the region of 310°C. This is well within the oxidation limit of medium carbon (MC) steel. Hot finished seamless (HFS) or electric resistance welded (ERW) MC tubes (45 Kg/mm² tensile strength) with guaranteed high temperature properties is the normal choice.

Generating Tube

The enclosure for furnace, superheater and other zones is made out of generating tubes. These tubes handle the water-steam mixture. Therefore, the mean tube wall temperature is generally less than 40°C above the saturation temperature, in spite of being surrounded by red hot flames. MC tubes with guaranteed high temperature strength, like BS 3059/45 S_2 or its equivalent, perform the duties satisfactorily.

Superheater and Reheater

Steam is heated in these tubes to its final temperature, which is as high as 540°C. In order to obtain this temperature, the superheater and reheater tubes are placed in zones of very high gas temperature. The metal of the superheater tube should be 30-90°C hotter than the steam inside the tube. Depending upon the mean metal temperature of the tube, one of the following three steels is used -

- MC Steel (BS 3059/45) up to 455°C
- 1% Cr 0.5% Mo Steel (BS 3059/620) up to 538°C
- 2.25% Cr 1% Mo Steel (BS 3059/622) up to 577°C

Cold drawn tubes are employed to reduce the water pressure drop in the superheater.

Pipes

Pipes carry steam and water from one point to the other, outside the gas passes. Water and steam up to 455°C is conveyed through MC pipes while for steam beyond 455°C, alloy steel pipes are used.

Manifolds

A manifold is a large bore pipe used to join two or more boiler circuits. Besides the down-comers, which constitute the bulk of manifold requirement in a power boiler, there are several other manifolds associated with economiser, superheater, reheater and generating sections. Depending on the temperature of the fluid inside, one of the following manifold material is selected :

- o BS 3602/HFS 27S up to 455°C
- o BS 3604 HF 620 up to 538°C
- o BS 3604 HF 622.31 up to 577°C

Boiler Quality Plates

Boiler plates are used to fabricate the boiler drum. The drum is the single heaviest piece in the whole boiler, and has the longest manufacturing cycle. In a drum, the water and steam are separated by means of internals. These internals are always at the saturated temperature of the water inside. Drums of high pressure units are made of a material called DUCOL which is BS 1501-271, a Mn-Cr-Mo-V steel of 60 Kg/mm^2 tensile strength. The high yield strength/tensility ratio in DUCOL helps to increase the

allowable stress substantially. BS 1501-221-32B, a C-Mn steel (Si-killed), is used to manufacture drums for pressures beyond 80 Kg/cm².

Supporting Structures

The installation of a boiler requires substantial structural support. These structures consist of heavy duty columns, joists, wide flanged beams, universal beams and other rolled sections.

Overall requirement of basic materials along with their ASME/BS specifications is shown in Exhibit-21.

PRE-ENGINEERED BOUGHT-OUT ITEMS

Boiler auxiliaries and accessories comprise a number of components which are generally procured from outside sources. These components are briefly discussed below :

Fans

A combined flow of air and combustion gases in steam generating units is required to supply the proper amount of combustion air and to remove the gaseous combustion products. This flow is created and sustained by stacks and fans. A wide variety of fans such as radial, axial impulse, axial reaction of both single and double stage are employed for the above purpose.

Soot Blowers

Soot blowers are necessary for on-load clearing of the various heating surfaces in the boiler and the air heaters without causing erosion.

Soot blowers of various types such as the long-retractable type, single nozzle-retractable type, non-retractable type, swivel arm, valve and rotary types are available.

Refractories and Insulation

Fire-brick refractories are used in boilers. The insulating materials generally employed are listed below :

- o Diatomaceous-earth-based blocks
- o Mineral wools
- o Calcium silicate block
- o High temperature plastic
- o Ceramic fibre

Dust Collectors

The dust collectors are used for removal of fly ash before the gases enter the chimney. Many types of dust collectors with collection efficiencies between 95 and 99.8% are available in the market. The gas flow rates may go up to 1360800 M^3/hour.

Valves

Different types of valves for steam and water are used in boilers. The valve and steam lines must each withstand a pressure of 70 kg/cm^2 at 538° C. These valves may be forged or cast, depending upon the duty requirement.

Types of valves used include globe, gate, regulating, check, blow down, mud-manifold, safety valves, etc.

Pumps

Pumps activate the following two systems in a steam generating plant :

- Water loop
- Fuel oil transfer system

The water loop in a boiler is activated by reciprocating, rotary and centrifugal types of pumps. The first two types are generally used in smaller power plants while the third type is used in large power stations. Multistage centrifugal pumps are used for feeding modern power boilers, including those operating at steam pressures up to 105 kg/cm².

Motors

Both coal and oil fired boilers require substantial auxiliary power. At present, squirrel cage motors up to group IV sizes are preferred. These motors may be of single or double speeds.

Fuel Firing System

The burner is the principal equipment employed for firing of oil and gas. Burners are normally located in the vertical walls of the furnace. The most frequently used types of burners are the circular burner for oil firing and the cell burner for natural gas firing. The maximum capacity of the individual circular burner ranges up to 42 million KCal/hour while cell burners have a maximum capacity up to 124 KCal/hour.

In order to burn the fuel oil at high rates, it is necessary to atomise the oil. Steam atomisers, available in sizes up to 42 million KCal per hour, can atomise about 4107 Kg of oil per hour. Maximum oil pressure is usually 6.9 Kgf/Cm², while steam pressure is generally about 8.32 to 9.7 Kgf/Cm². A good steam atomiser uses about 0.1 Kg of steam per Kg of fuel oil at its maximum capacity.

Instrumentation and Miscellaneous Controls

Instruments for measuring and controlling pressure, temperature, flow and quality of steam are essential for the operation of a steam generating unit. These range from the simplest manual devices to sophisticated measuring devices used for automatic control of boilers.

Control systems for boilers include :

- o Boiler instrumentation system
- o Combined control system
- o Steam temperature control for superheater and reheater outlet
- o Drum level control
- o Burner sequence control
- o Integrated control system to connect all related equipment with turbine and electric generator
- o Data processing and control
- o Plant automation

Lifting Tackles and Hand Tools

A large number of shop fabricated sub-assemblies and auxiliary equipment are shifted to the site. Their erection requires efficient, organised and well engineered work methods. Some of the sub-assemblies need special purpose lifting tackles. These are generally supplied by the boiler manufacturer. Similarly, special purpose hand tools are also required to be supplied by the manufacturer.

Estimated requirement of bought-out items is shown in Exhibit-22.

CONSUMABLES

Consumables include electrodes, gases, welding flux, steel grits, furnace oil, etc. Estimated requirement of the above items is shown in Exhibit-23.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 21

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
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PROJECT PROFILE ON STEAM BOILERS

REQUIREMENT OF BASIC MATERIALS

Sl. No.	Item	Material Specification	Yearly Requirement (MT)	Price ('000 US $)
1.	Plates for boiler drum and fittings	ASME - SA 299 BS - BS 1501-271B	310	434.00
2.	Water Walls			
	- Headers	ASME - SA 106 Gr. B or SA 210 Gr. A_1 BS - BS 3059-1968-S_2-45	170	246.50
	- Tubes	ASME - SA 210 Gr. A_1 or SA 210 Gr. C	680	877.20
	- Down Comers	ASME - SA 106 Gr. B or SA 335 P_{22} BS - BS 3602-1962-HFS-27S or BS 3604-1963-HF-622.31	330	594.00
3.	Economiser			
	- Tubes	ASME - SA 210 Gr. A_1 BS - BS 3059-1968-S_2-45	720	986.40
	- Headers	ASME - SA 106 Gr. B BS - BS 3602-1962-HFS-27S		
	- Plates and Other Sections	ASME - SA 515 Gr. 70	160	504.00

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 21

Sl. No.	Item	Material Specification	Yearly Requirement (MT)	Price ('000 US $)
4.	Superheaters			
	- Tubes	ASME - SA 210 Gr. A_1, SA 213 T_{11}, SA 209 T_1, SA 213 T_{22}, SA 213 T_{11}, SA 213 T_{22}		
		BS - BS 3059-1968-S_2-45 BS 3059-1968-S_2-620 BS 3059-1968-S_2-622-50	845	1157.65
	- Header	ASME - SA 106 Gr. B, SA 335 P_{12}, SA 335 P_{22}		
		BS - BS 3602-1962-HFS 27S		
		BS - BS 3604-1963-HF 622.31		
5.	De-superheater	ASME - SA 335 P_{12}	22	28.38
		BS - BS 3604-1963-HF-622.31		
6.	Reheater			
	- Tubes	ASME - SA 209 T_1, SA 213 T_{11}, SA 213 T_{22}, SA 213 TP 3044		
		BS - BS 3059-1968-S_2-33, BS 3059-1968-S_2-620		
	- Header	ASME - SA 106 Gr. B, SA 335 P_{22}	366	501.42
		BS - BS 3602-1962-HFS 27S, BS 3604-1963-HF 622.31		
	- Plates and Other Sections	ASME - SA 515 Gr. 70	183	256.20
7.	Inspection Door - Plates	ASME - SA 515 Gr. 70	10	14.00

DEVELOPMENT CONSULTANTS

JOB NO. DCIL-105

EXHIBIT : 21

Sl. No.	Item	Material Specification	Yearly Requirement (MT)	Price ('000 US $)
8.	Air Heater Plates and Other Sections	ASME - SA 515 Gr. 70	2560	3,584.00
9.	Casing, Ducts, Wind Boxes, Dampers, Supporting Structures, Walkway and Stairways - Sheets, Plates, Joys, Wide Flange Beams, Universal Beams and Other Roll Sections	ASME - SA 285 C	11560	16,184.00
10.	Pipes	BS - BS 3602-1962-HFS-27S, BS 3604-1963-HF-622.31	390	1,443.00
	TOTAL			26,810.75

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 22

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

PROJECT PROFILE ON STEAM BOILERS

REQUIREMENT OF BOUGHT-OUT ITEMS

Sl. No.	Item	Weight (MT)	Price ('000 US $)
1.	Fans (230 nos. approx.)	500	460.00
2.	Soot Blowers	100	184.00
3.	Refractories and Insulation	1720	100.00
4.	Dust Collectors (E.P. Type)	6200	503.00
5.	Valves (only for Steam and Feed Water System) on MW basis	900 Nos.	90.00
6.	Pumps (only for Steam and Feed Water System) on MW basis	270 Nos.	81.00
7.	Motors	320	960.00
8.	Fuel Firing System including Oil and Gas Burners, Igniters and Scanners, etc.	150	200.00 10.00
9.	Instrumentation and Misc Controls	90	
10.	Lifting Tackles	180	12.00
11.	Hardware	150	
	TOTAL		2,600.00

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 23

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

PROJECT PROFILE ON STEAM BOILERS

REQUIREMENT OF CONSUMABLE MATERIALS

Sl. No.	Item	Weight (MT)	Price ('000 US $)
1.	Welding Electrodes	120	8.52
2.	Wire for Submerged Arc Welding	90	5.00
3.	Gases		
	- Oxygen - Acetylene	30,000 M^3	0.75
	- Argon	60 M^3	0.01
	- Carbon dioxide	60 M^3	0.01
4.	Flux for Submerged Arc Welding	30	10.00
5.	Steel Grits for Shot Blasting	25	10.00
6.	Primer and Finished Paints	950	14.80
7.	Lubricants including Oil, Grease and Cutting Compound	Lump sum	10.00
8.	Packing Woods	Lump sum	10.00
9.	Furnace Oil	920	29.40
	TOTAL		98.49

SECTION - 9
UTILITIES

UTILITIES

Utilities in the plant shall include power, water and compressed air. Apart from these, facilities have been suggested for air-conditioning, fire-fighting and transport.

Power

A summary of power requirement is presented in Exhibit-24. 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 2870 KVA. As the power rating required for production equipment and services is 415/220 volts, 4 transformers - each of 1000 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.

Water

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

- production
- heat treatment

- cooling the metal cutting tools
- cooling the central air-conditioning system
- cooling air compressors

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

The plant will also need water for :

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

For human and sanitary needs, the water consumption has been estimated at 60 litres per person per 8 hour shift.

Requirement of water for the above mentioned needs is estimated in Exhibit-25. The average requirement is estimated at 10 m^3 per hour.

It is proposed that the plant be equipped with a 4" dia deep tubewell, 2 pumps - each of 14 m^3 per hour capacity, and 2 overhead tanks of 13 m^3 capacity each.

Compressed Air

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

- operating hand tools like chipping hammers, hand grinders, etc.
- operating spray guns for painting of vessels
- operating shot blasting guns in shot blasting section
- combustion and atomisation of fuel oil in heat treatment furnace

The connected load of compressed air for the first three purposes, as shown in Exhibit-26 is estimated as 10.3 m^3 per minute. Considering a demand factor of 0.4, maximum rate of consumption is estimated as 4.1 m^3 per minute. Taking delivery losses and compressor efficiency into account, the compressor capacity required is about 8 m^3 per minute. Therefore, it is recommended that 2 compressors of 4 m^3 per minute capacity should be provided for delivering air at 7 Kg per cm^2 pressure.

In order to meet the compressed air requirement for combustion and atomisation of fuel oil, air blowers will be required. These will be supplied together with the furnaces.

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 68 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.

Fire Protection System

Sufficient number of fire extinguishers of different types will be required for fighting fires that break out within the workshop premises. 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. Buses may be provided to workmen. Therefore, in all, 2 cars and 2 buses should be sufficient.

Major equipment and accessories for utilities are listed in Exhibit-27.

JOB NO. : DCIL-105

EXHIBIT : 24

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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PROJECT PROFILE ON STEAM BOILERS

SUMMARY OF POWER REQUIREMENT

Sl. No.	Description	Connected Load (KW)	Load Factor	Max Demand (KW)	Power Factor	KVA Demand
	Voltage - 415/220 Volts					
1.	Production Equipment inclusive of Material Handling Equipment	4376	0.4	1750	0.8	2188
2.	Welding and Welding Development	490	0.4	196	0.6	327
3.	Material Testing Laboratory	40	0.3	12	0.8	15
4.	Tool Room	20	0.4	8	0.8	10
5.	General Lighting	380	0.4	152	0.8	190
6.	Air-conditioning, Air Circulation, Environment Dust and Fume Control Unit	120	0.6	72	0.8	90
7.	Miscellaneous (Water Pumps and Compressors)	100	0.4	40	0.8	50
					Total	2870

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JOB NO. : DCIL-105 EXHIBIT : 25

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

PROJECT PROFILE ON STEAM BOILERS

SUMMARY OF WATER REQUIREMENT

Sl. No.	Description	Water Consumption (M^3/Hour)
1.	Water for Technical Purposes (average)	5.0
2.	Average Requirement of Cooling Water for Central Air-conditioning Plant	1.5
3.	Average Requirement for human consumption and Sanitary Purposes for 806 Persons	3.5
4.	Peak Consumption for (3)	17.5
5.	Total Average Consumption (1+2+3)	10.0
6.	Total Peak Consumption (1+2+4)	24.0

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JOB NO. : DCIL-105 EXHIBIT : 26

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

PROJECT PROFILE ON STEAM BOILERS

SUMMARY OF COMPRESSED AIR REQUIREMENT

Sl. No.	Description	Air Consumption (m^3/Minute)
1.	Production Equipment, Tool Room and Painting Booth	6.0
2.	Shot Blasting Booth	4.3
	Total	10.3

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 27

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

PROJECT PROFILE ON STEAM BOILERS

MAJOR EQUIPMENT AND ACCESSORIES FOR UTILITIES

Sl. No.	Description	Price ($)
1.	**Electrical System**	
	o 4 x 1000 KVA step down Oil Cooled Transformer (Step down ratio 11 KV : 415/220 volts, 3 phase, 50 Hz)	87,600
	o 11 KV Switchgears, Isolator, Accessories, MCC, Distribution Boards, Cables & Grounding Materials	4,800
	o Lighting, Fans and Room Coolers	5,000
	o Intercommunication System	11,000
2.	**Water Supply System**	
	o Two Water Pumps (14 m^3/hour capacity each), 2 Overhead Tanks (13 m^3 capacity each), Valves and Other Fittings for water distribution and cost of digging 4" dia Tubewell	300 1,260
3.	**Compressed Air System**	
	o Two mobile compressors of 4 m^3 per minute capacity delivering air at 7 kg per cm^2 pressure	6,000
4.	Air-conditioning System for two storied Administrative Building - 68 TR Central Air-conditioning Unit with individual Air Handling Unit for each floor	76,780

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 27

Sl. No.	Description	Price ($)
5.	Fire-fighting Equipment	6,300
6.	Furniture, Fittings, Drawing Equipment, File Cabinets, Phones, Office Equipment, etc.	3,500
7.	Transport (2 Cars and 2 Buses)	83,000
	TOTAL	2,85,540

SECTION - 10
SPACE AND LAYOUT

SPACE AND LAYOUT

Space required for various sections in the plant is shown in Exhibit-28. 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 29,348 sq m, while the total land area is estimated as 87,700 sq m. This includes about 9,440 sq m open area for storage and despatch. 10,128 sq m of land area has been provided 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

Layouts of machine tools and equipment in different production shops are presented in Exhibits 29 through 33.

While preparing the layout of machines in different shops, care has been taken to ensure unidirectional flow of material as far as possible. The machines have been placed in a way that will facilitate easy movement of men, material and equipment for material handling. Gangways of 3 metres width have been provided between bays in different production shops.

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

Administrative Building

The administrative building shall be made a two-storeyed RCC brick structure. 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 at a distance, sufficient to ensure that it is least affected by the hustle and bustle in the workshops.

Exhibit-34, enclosed in a pouch at the end of this Report, shows the relative location of different shops and buildings. Estimated costs of civil work including land development, fencing, drainage, roads and building construction are shown in Exhibit-35.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 28

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

PROJECT PROFILE ON STEAM BOILERS

ESTIMATE OF SPACE REQUIRED

Sl. No.	Desription	Area (sq m)
A.	**Workshop**	
	o Tube and Pipe Shop	4512
	o Vessel Shop	5916
	o Plating and Structural Shop	5184
	o Machine Shop	2412
	o Forge and Heat Treatment Shop	1512
	o Maintenance Shop	720
	Sub-total :	20256
B.	**Storage and Transport**	
	o Raw Material	
	- Covered	2500
	- Open	2000
	o Finished Goods	
	- Covered	1300
	Open	3000
	o Loading and Unloading	
	Open	1000

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 28

Sl. No.	Desription	Area (sq m)
	o Transport Yard	
	- Covered	1080
	- Open	1440
	o Fuel Oil Storage	540
C.	**Administrative Building - Double Storeyed**	648
D.	**Auxiliary Buildings**	
	o Transformer House and Distribution Centre	324
	o Pump House	144
	o Compressor House	324
	o Oxygen House	144
	o Acetylene House	144
	o Canteen and Wash Room	324
	o Welding Development and Material Testing Laboratory	936
	o Training Centre	540
	o Security, Time Office and First Aid	144
	Sub-Total :	3024
E.	Total Covered Area	29348
F.	Open Area	9440
G.	Land Area Required at present (2E + 2F)	77576

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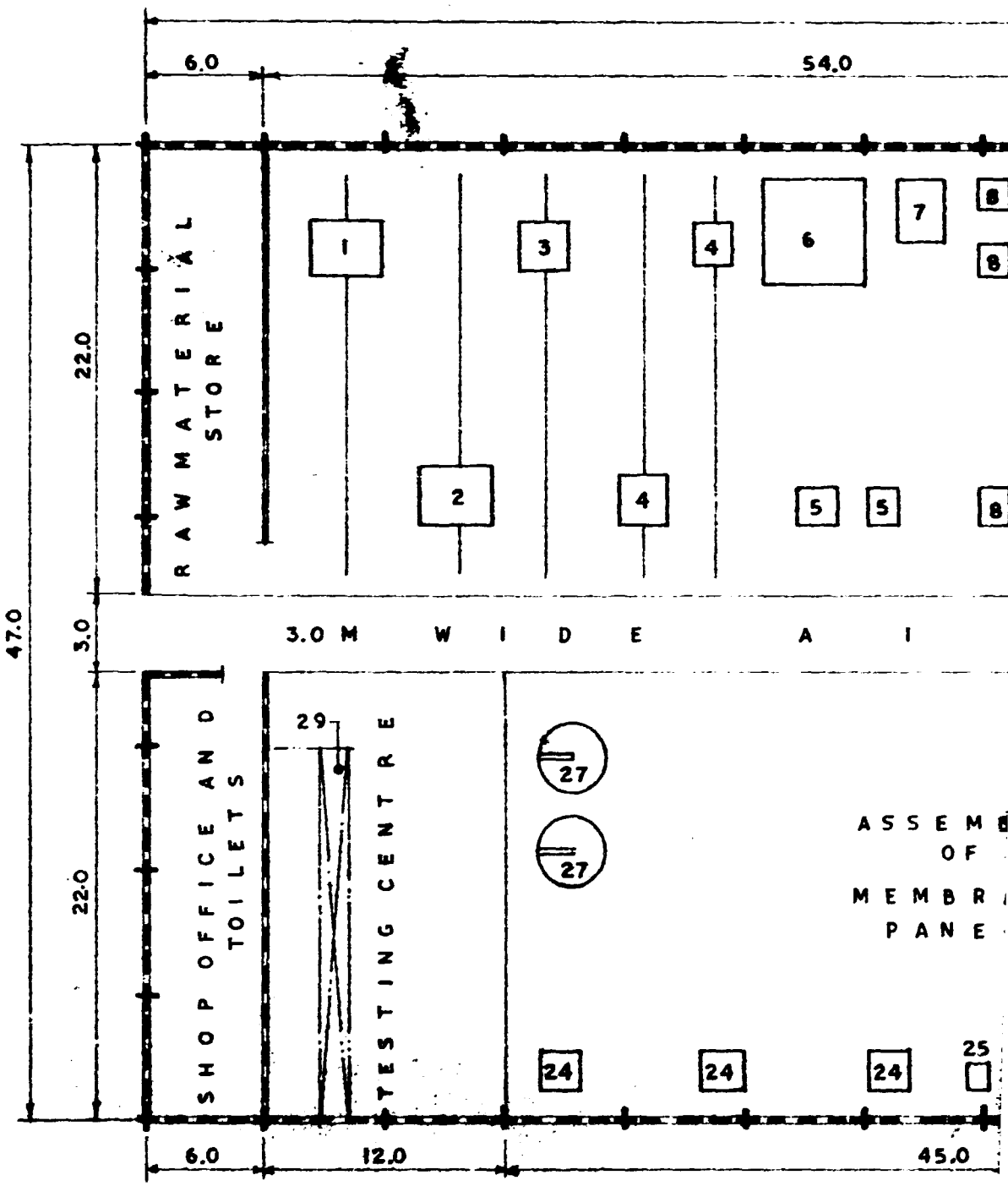
JOB NO. : DCIL-105 EXHIBIT : 28

Sl. No.	Desription	Area (sq m)
H.	Area for Future Expansion (50% of Workshop Built-up Area)	10128
I.	Total Land Area inclusive of Area for Future Expansion (G + H)	87704

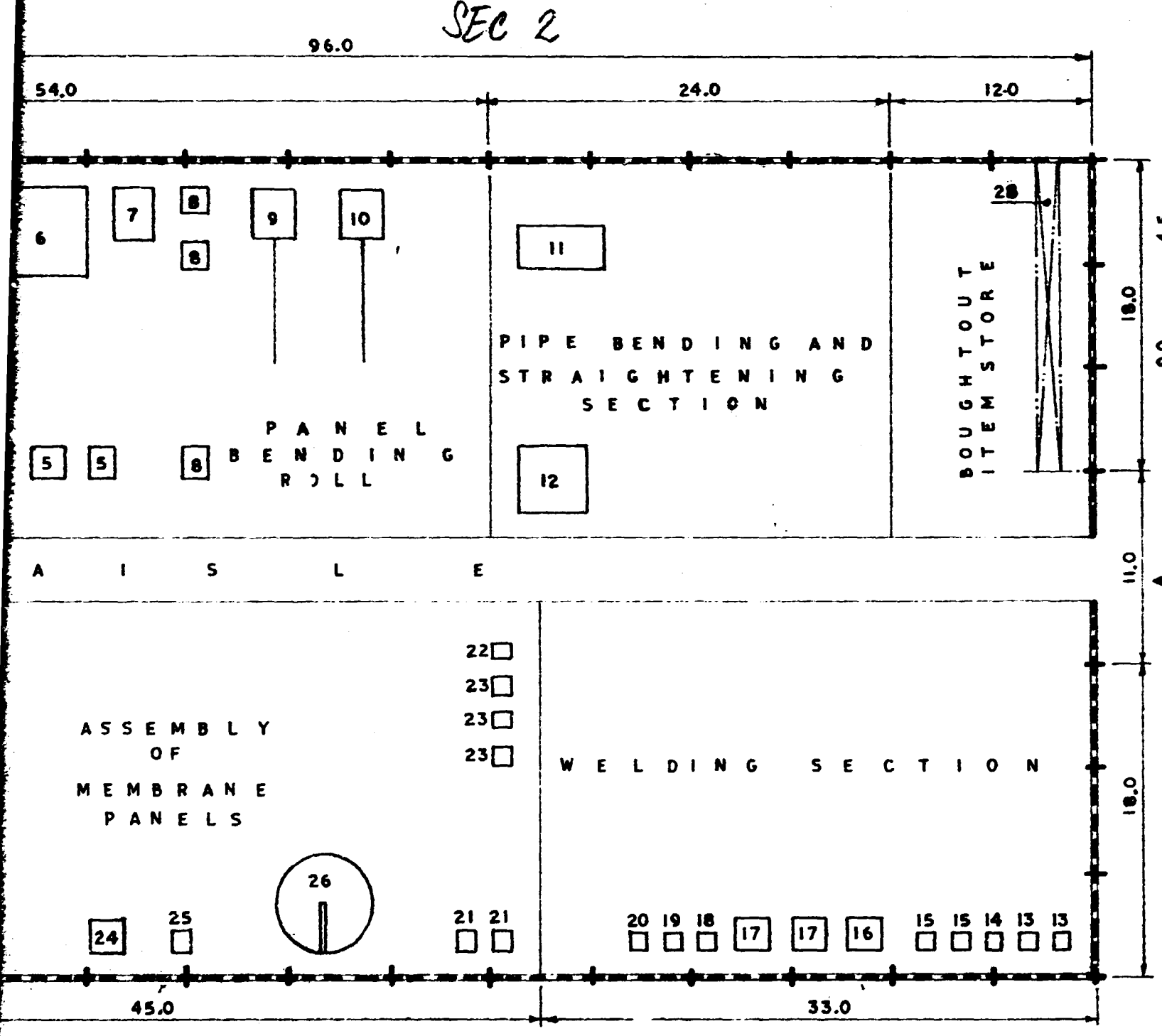
SEC 1



LEGEND

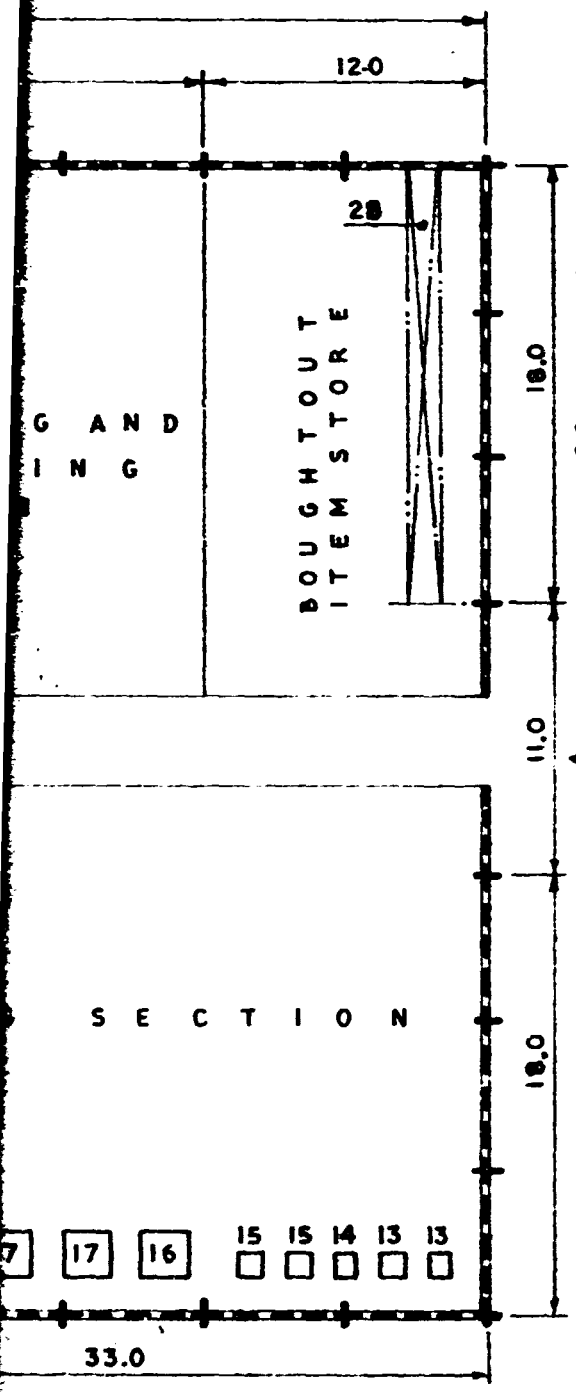
1	CIRCULAR COLD SAW	1	10	HYDRAULIC TUBE BENDING MACHI	
2	HORIZONTAL BAND SAW	1	11	COMPRESSOR TYPE PIPE BENDING	
3	ABRASIVE WHEEL CUTOFF MACHINE	1	12	STRIP STRAIGHTENING & FLATEN	
4	TUBE SAWING AND MILLING MACHINE	2	13	FLASH BUTT WELDING MACHIN	
5	PNEUMATIC FACING MACHINE	2	14	ELECTROSLAG WELDING MACHIN	
6	FACING LATHE	1	15	SUBMERGED ARC WELDING MACH	
7	CENTRE LATHE	1	16	TIG WELDING SET	
8	DOUBLE ENDED PEDESTAL GRINDER	3	17	FIN WELDING MACHINE	
9	TUBE BENDING MACHINE	1	18	TIG TUBE BUTT WELDING MACH	

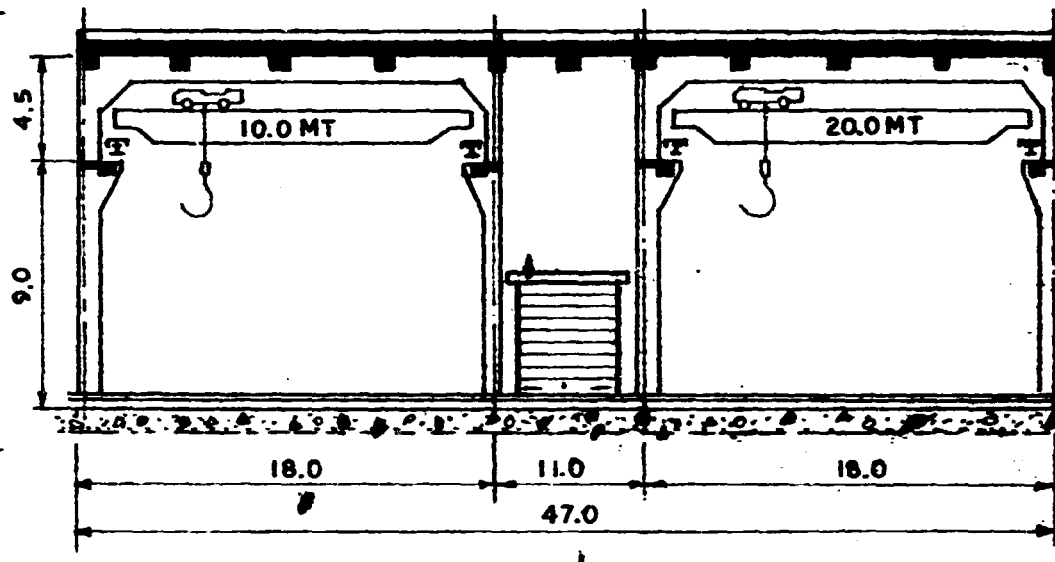
SEC 2



TUBE BENDING MACHINE	1	19	STUD WELDING MACHINE	1
R TYPE PIPE BENDING M/C.	1	20	MANUALLY OPERATED STUD WELDING M/C.	1
AIGHTENING & FLATENING M/C.	1	21	PIPE CUTTING & BEVELLING MACHINE	2
T WELDING MACHINE	2	22	THROUGH TYPE PIPE HEATING FURNACE	1
AG WELDING MACHINE	1	23	TUBE LOOP HEATING FURNACE	3
ARC WELDING MACHINE	2	24	PORTABLE SHOT BLASTING UNIT	3
G SET	1	25	TUBE WALL PANEL WELDING MACHINE	1
G MACHINE	2	26	RADIAL DRILLING MACHINE	1
UTT WELDING MACHINE	1	27	RADIAL DRILLING MACHINE	2
		28	E.O.T. CRANE (20MT)	1
		29	E.O.T. CRANE (10MT)	1

SEC 3





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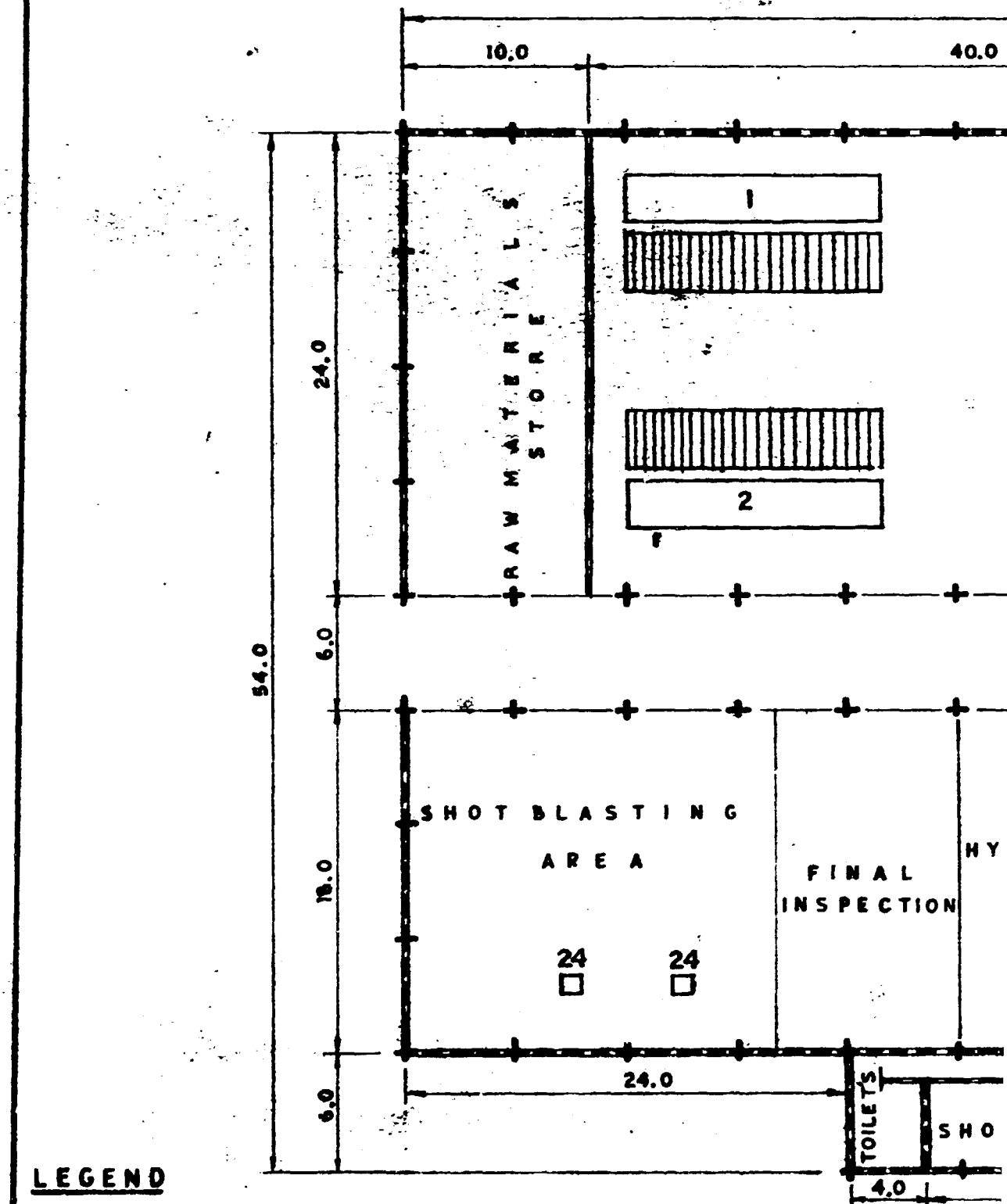
LAYOUT OF TUBE & PIPE SHOP
BOILER MANUFACTURING PLANT

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

DEVELOPMENT CONSULTANTS LIMITED
CONSULTING ENGINEERS
BOMBAY • CALCUTTA • MADRAS • NEW DELHI

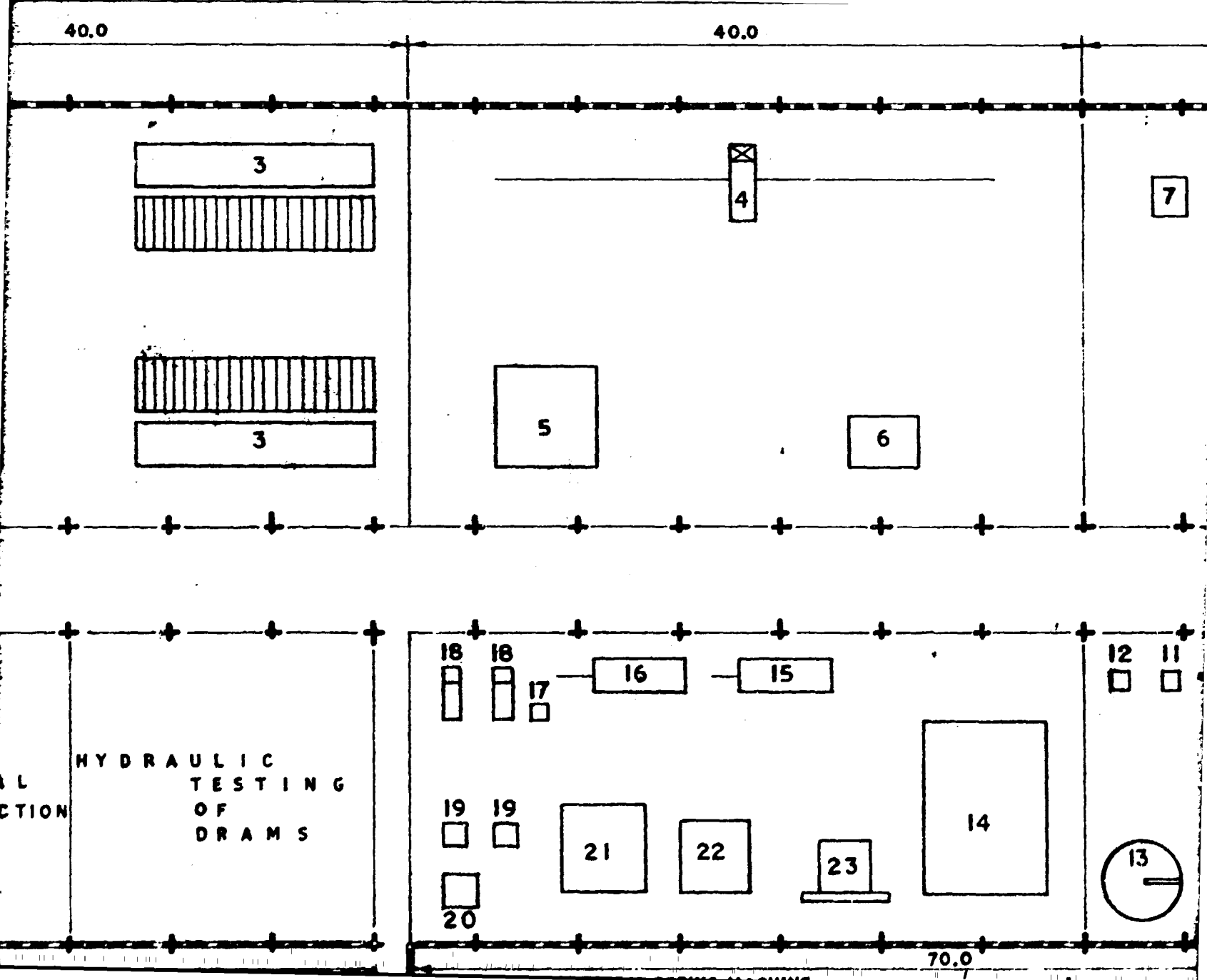
DRAWN MUKUL CHOWDHURY	DATE 28.6.93
PROJ. ENGR. MC/SR	SCALE 1:300
DEPT. HEAD	JOB NO. DCIL_45010

DWG. NO. EXHIBIT_29 REV. NO.



LEGEND

1	PORTAL TYPE FLAME CUTTING MACHINE	1	8	HEAT TREATMENT
2	UNIVERSAL PROFILE GAS CUTTING MACHINE.	1	9	DRUM CIRCULARITY
3	LINE & CIRCLE GAS CUTTING MACHINE	2	10	ELECTRO SLAG WEI
4	4 ROLL PLATE BENDING MACHINE	1	11	PORTABLE SUBMEI
5	4 COLUMN DISHING & FLAMING PRESS	1	12	BOOM & COLUMN TYI
6	PLATE EDGE CURVING PRESS	1		ARC WELDING SET
7	BOGIE TYPE GAS FIRED PLATE HEATING FURNACE	1	13	RADIAL DRILLING M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SHOP OFFICES

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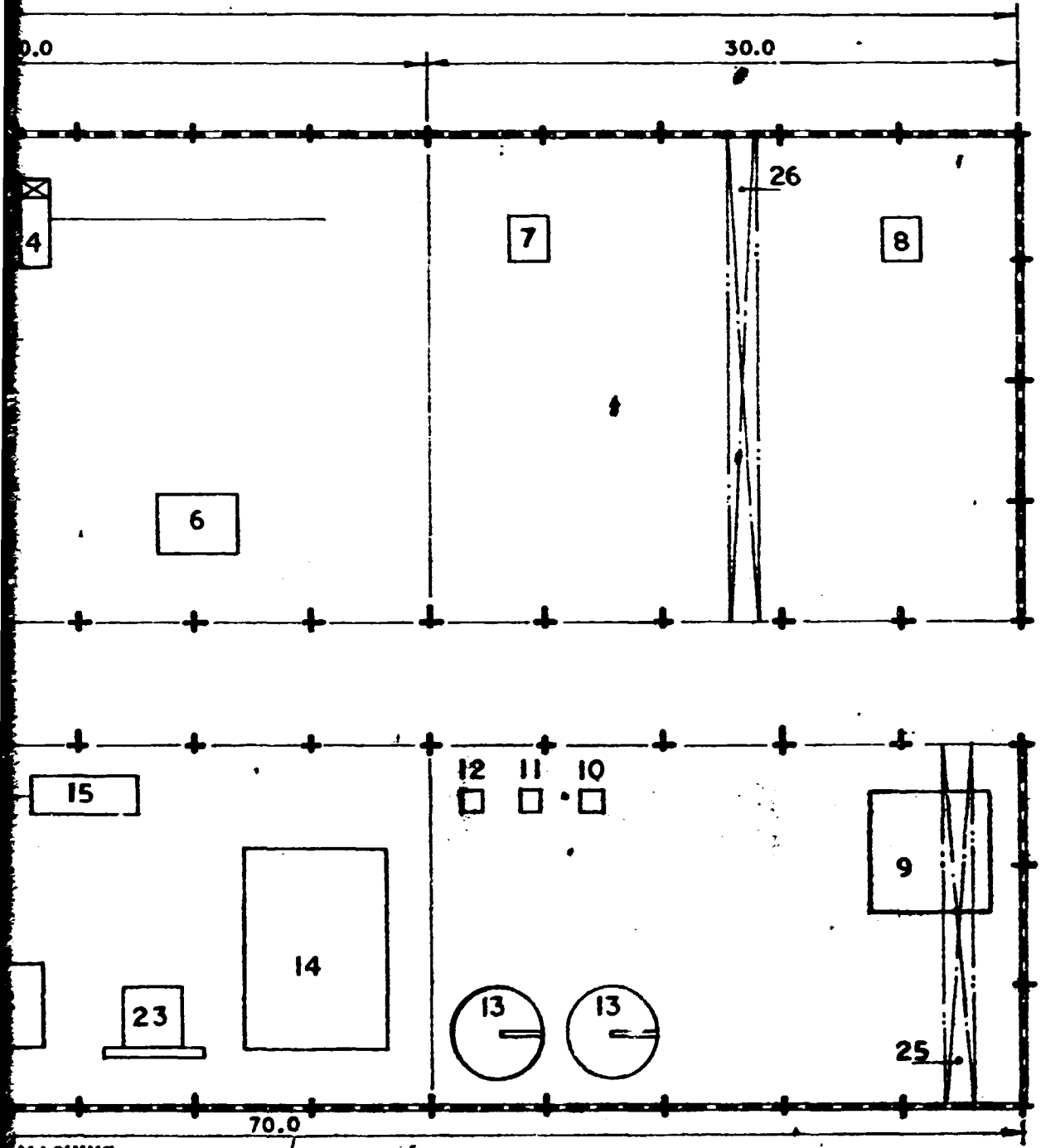
TMENT FURNACE	1
ULARITY RECTIFYING FRAME	1
AG WELDING MACHINE	1
SUBMERGED ARC WELDING SET	1
MN TYPE AUTOMATIC SUBMERGED	
G SET	1
LLING MACHINE	2

LATHE	1
LATHE	1
A.C TRANSFORMER SET	2
RINDER	2
NDED PEDESTRAL GRINDER	2
OMATIC METAL ARC WELDING SET	1
ILLING MACHINE	1
MACHINE	1
TAL MILLING & BORING MACHINE	1
E SHOT BLASTING MACHINE	1
ANE 100/10 TON.	1
ANE 25/ 5 TON	1



MACHINE	1
	1
	1
ANSFORMER SET	2
	2
EDESTRAL GRINDER	2
METAL ARC WELDING SET	1
MACHINE	1
	1
NG & BORING MACHINE	1
LASTING MACHINE	1
0/10 TON.	1
5/ 5 TON	1

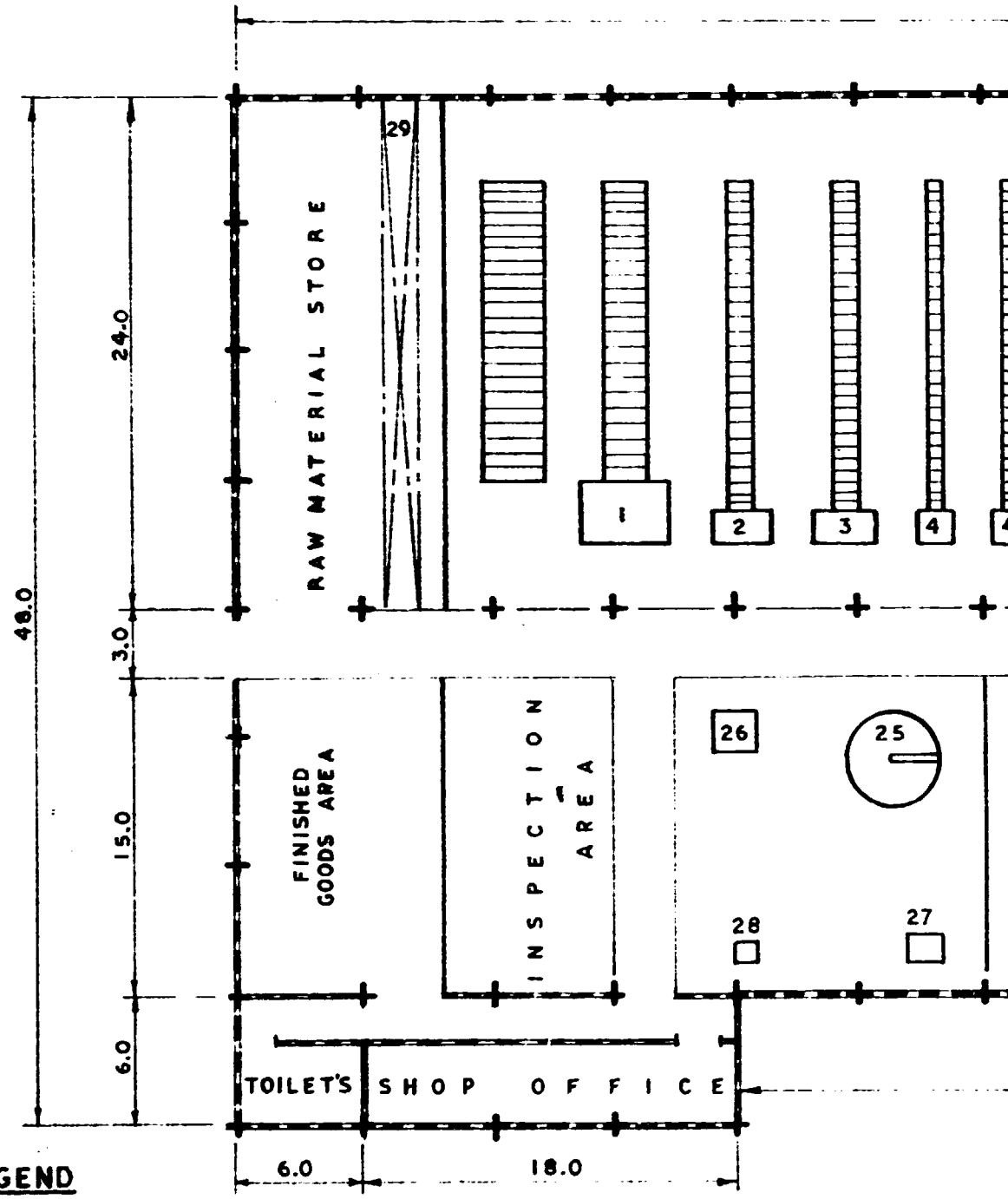
LAYOUT OF VESSEL SHOP
BOILER MANUFACTURING PLANT

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

DEVELOPMENT CONSULTANTS LIMITED
CONSULTING ENGINEERS
BOMBAY ● CALCUTTA ● MADRAS ● NEW DELHI

DRAWN MUKUL CHOWDHURY	DATE 24.6.93
PROJ. ENGR. MC/SR	SCALE 1:300
DEPT. HEAD	JOB NO. DCIL-45010

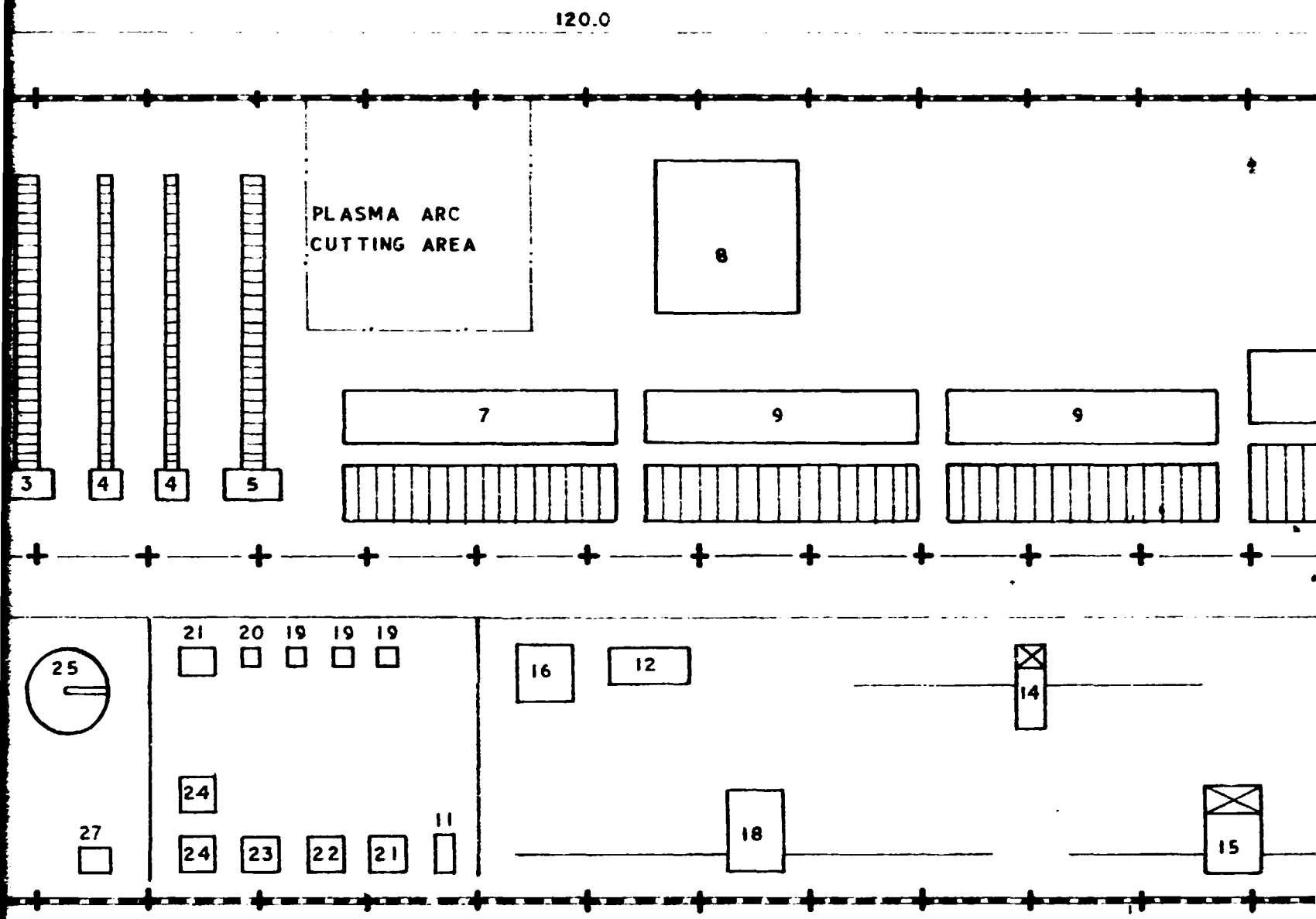
DWG. NO. EXHIBIT-30 | REV. NO.



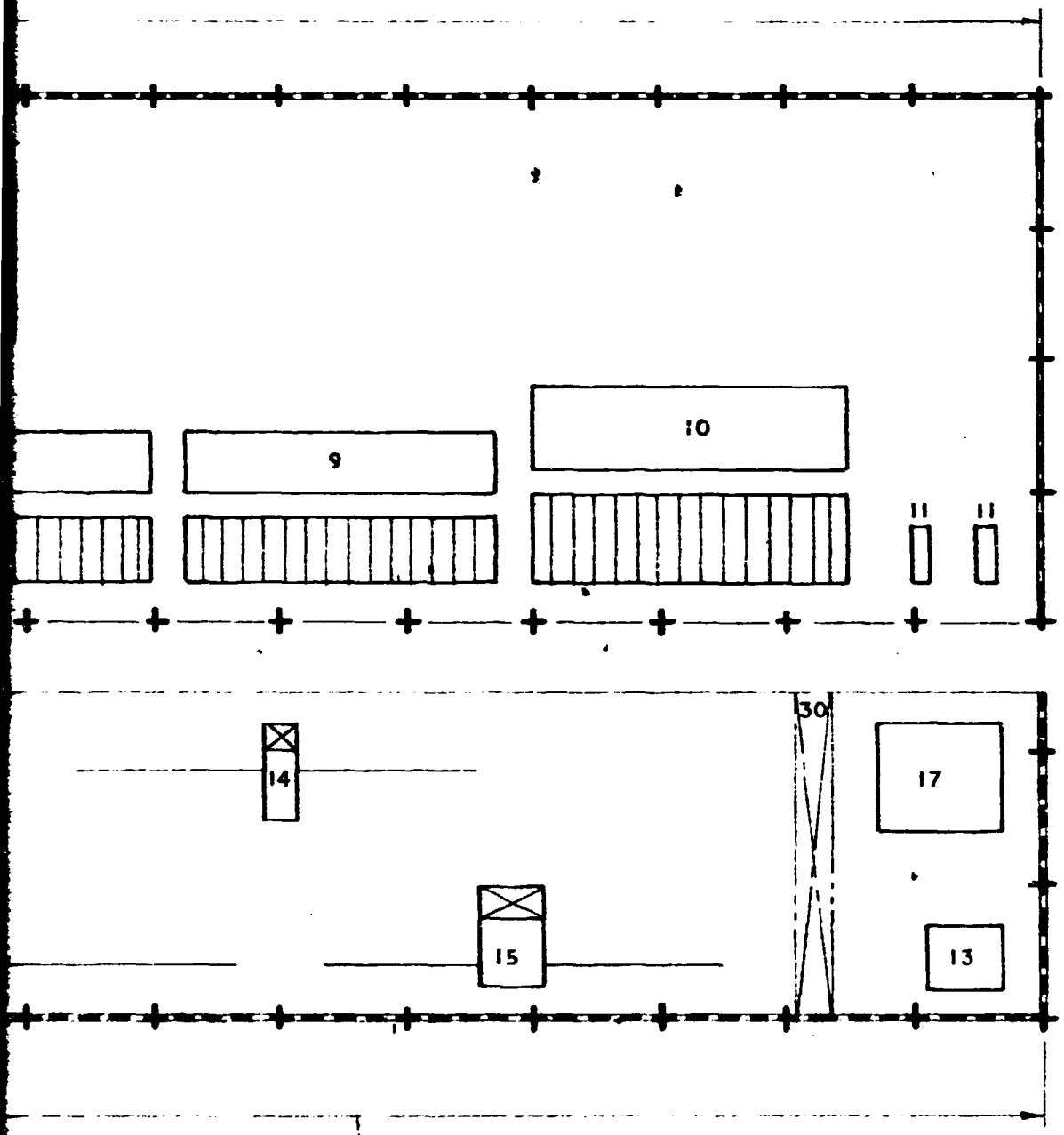
LEGEND

1	PLATE SHEARING MACHINE	1	10	PLATE EDGE PLANNER	
2	CROPPING PUNCHING & SECTION SHEARING MACHINE	1	11	HEAVY DUTY PEDEST	
			12	HYDRAULIC PRESS BI	
3	CIRCULAR COLD SAW	1	13	HYDRAULIC PRESS	
4	ABRASIVE WHEEL CUT-OFF M/C.	2	14	3-ROLL PLATE BENDI	
5	METAL CUTTING CIRCULAR BAND SAW	1	15	7-ROLL PLATE STRAI	
6	PLASMA CUTTING MACHINE	1	16	UNIVERSAL NIBBLING	
7	PROFILE CUTTING MACHINE	1	17	DISHED-END FORMING	
8	GIRDER END FACING MACHINE	1	18	BEAM STRAIGHTENING	
9	OXY-ACETYLENE LINE & CIRCLE CUTTING M/C.	2	19	WELDING A.C TRANSFO	

SEC 2



		20	RECTIFIER D.C WELDING SET	1
		21	SUB MERGED ARC WELDING SET	2
EDGE PLANNER	1	22	TIG WELDING SET	1
DUTY PEDESTAL GRINDER	3	23	MIG WELDING SET	1
ULIC PRESS BRAKE	1	24	ELECTRODE DRYING OVEN	2
ULIC PRESS	1	25	RADIAL DRILLING MACHINE	1
L PLATE BENDING MACHINE	1	26	PORTABLE DRILLING MACHINE	1
L PLATE STRAIGHTENING MACHINE	1	27	COLUMN DRILLING MACHINE	1
RSAL NIBBLING MACHINE	1	28	PILLAR DRILLING MACHINE	1
END FORMING MACHINE	1	29	E.O.T CRANE 10T	1
STRAIGHTENING MACHINE	1	30	E O T CRANE 25T	1
NG A.C TRANSFORMER SET	3			



LDING SET	1
WELDING SET	2
T	1
ET	1
ING OVEN	2
G MACHINE	1
ING MACHINE	1
NG MACHINE	1
NG MACHINE	1
10 T	1
25 T	1

ALL DIMENSIONS ARE IN METRE

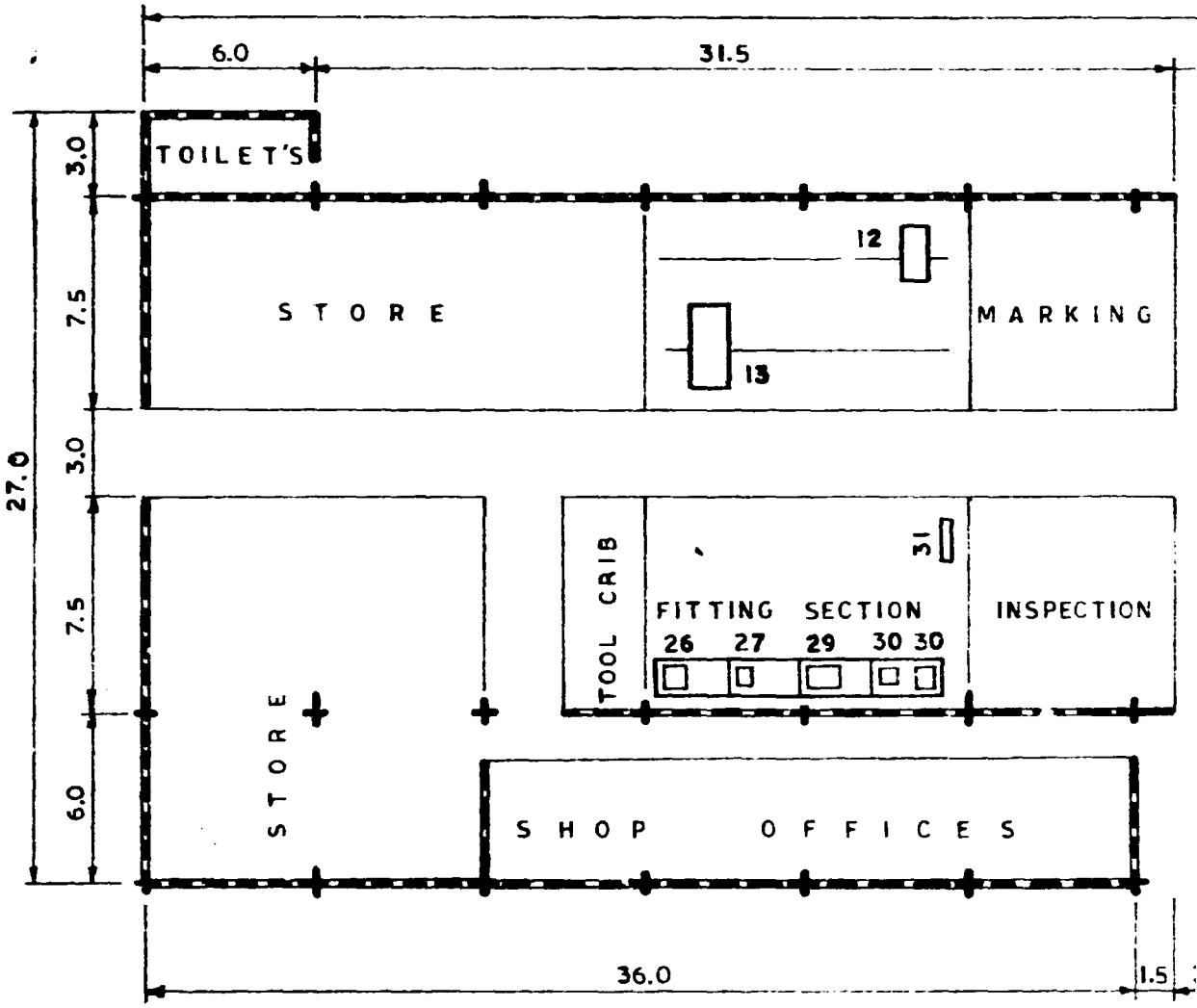
LAYOUT OF PLATE AND STRUCTURAL SHOP.
BOILER MANUFACTURING PLANT

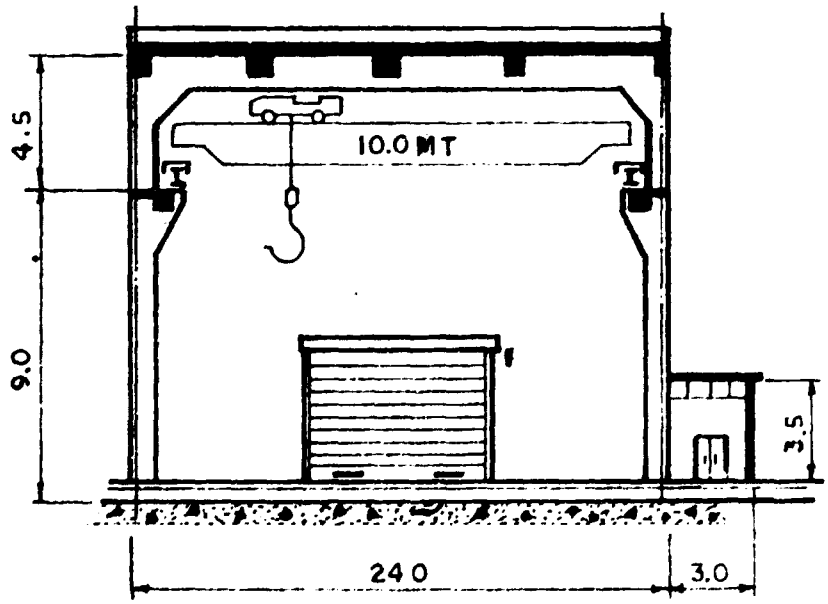
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

DEVELOPMENT CONSULTANTS LIMITED
CONSULTING ENGINEERS
BOMBAY ● CALCUTTA ● MADRAS ● NEW DELHI

DRAWN MUKUL CHOWDHURY	DATE 21.6.93
PROJ. ENGR. MC/SR.	SCALE 1:300
DEPT. HEAD	JOB NO. DCIL-45010

DWG. NO. EXHIBIT — 31 | REV. NO.


6.0
31.5
TOILET'S
3.0
7.5
STORE
12
13
MARKING
3.0
27.0
7.5
TOOL CRIB
31
FITTING SECTION
26 27 29 30 30
INSPECTION
STORE
6.0
SHOP OFFICES
36.0
1.5


4.5
10.0 MT
9.0
3.5
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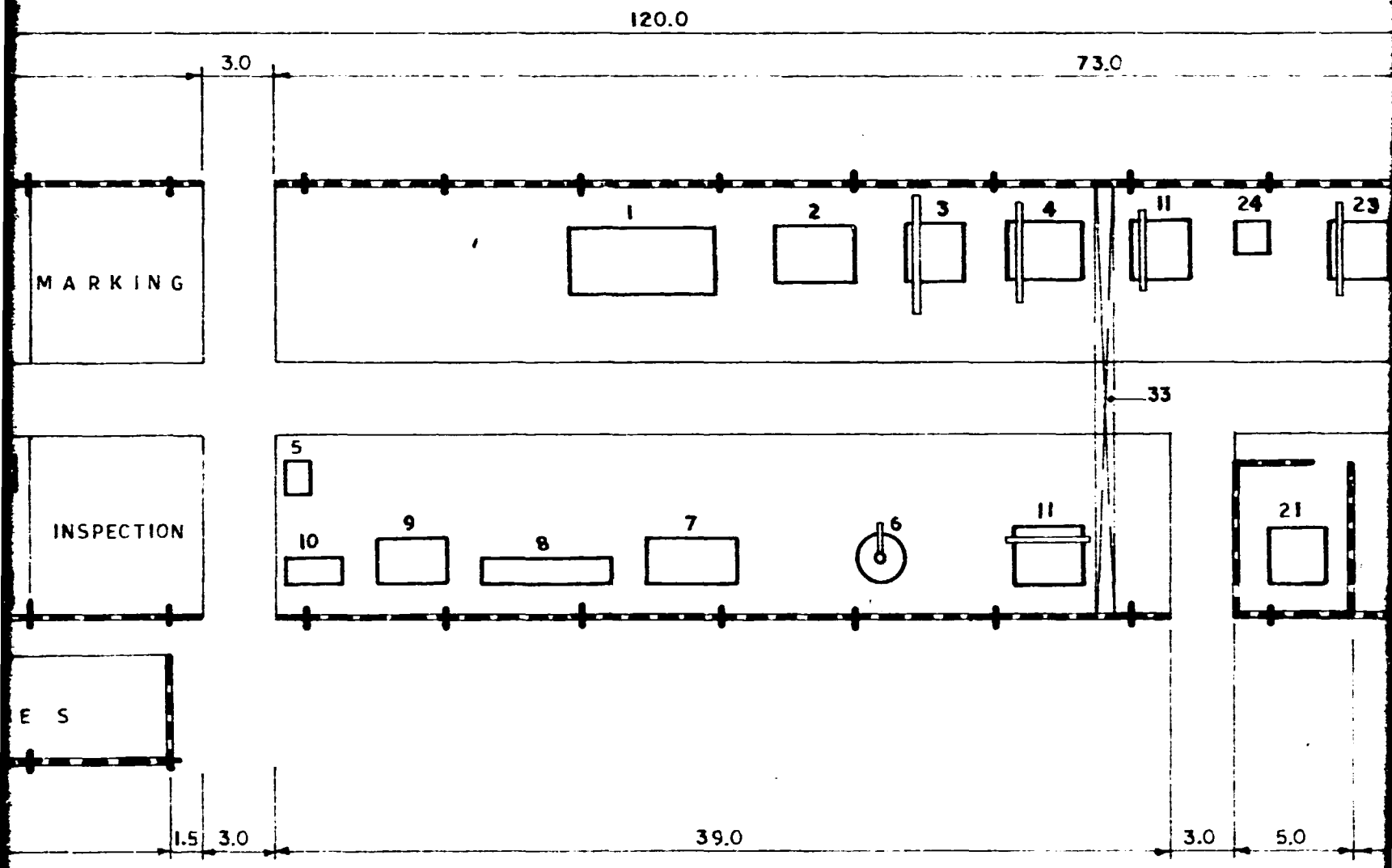
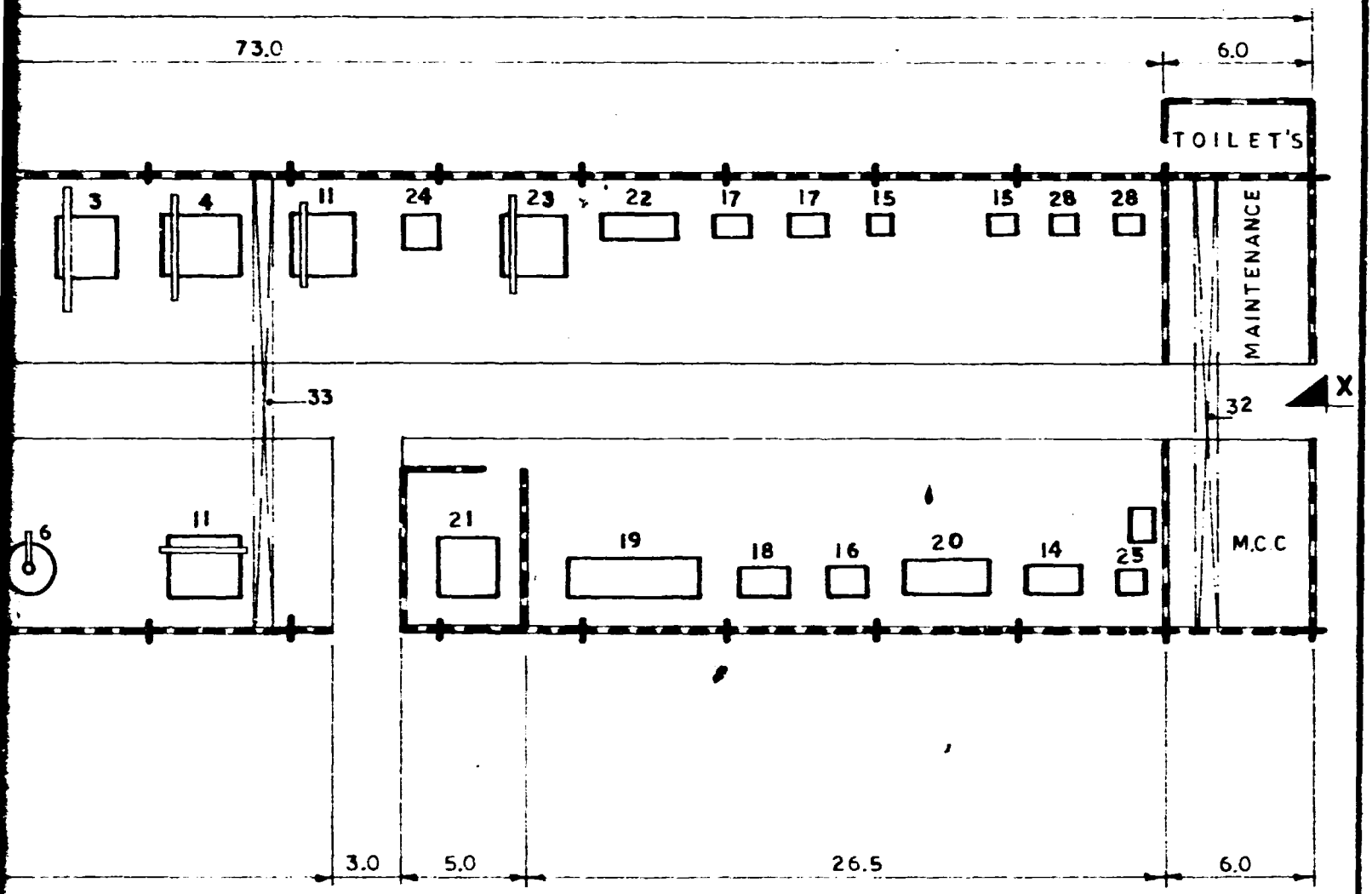


LEGEND

1	CENTRE LATHE
2	TURRET LATHE
3	VERTICAL MILLING MACHINE
4	VERTICAL MILLING MACHINE
5	COLUMN TYPE DRILLING MACHINE
6	RADIAL DRILLING MACHINE
7	UNIVERSAL CYLINDRICAL GRINDER
8	VERTICAL SURFACE GRINDER
9	SLOTTING MACHINE
10	SHAPING MACHINE
11	HAND HOLE CAP PROFILE MILLING MACHINE
12	POWER HACKSAW
13	HORIZONTAL SAWING MACHINE
14	UNIVERSAL TOOL & CUTTER GRINDER
15	DRILL POINT GRINDER
16	CARBIDE TOOL LAPPING MACHINE
17	AUTOMATIC BAND SAW & CIRCULAR SAW SE
18	UNIVERSAL CYLINDRICAL GRINDER
19	SURFACE GRINDER
20	SHEARING & CROPPING MACHINE
21	JIG BORING MACHINE
22	PRECISION LATHE
23	UNIVERSAL MILLING MACHINE
24	PILLAR DRILLING MACHINE
25	HEAT TREATMENT FURNACE & QUENCHING
26	ARBOUR PRESS
27	BENCH GRINDER
28	DRILL WEB THINNING GRINDER
29	DOUBLE ENDED PEDESTAL GRINDER
30	ABRASSIVE BELT GRINDING MACHINE
31	FLEXIBLE SHAFT GRINDER
32	E.O.T CRANE (10.0 MT)
33	E.O.T CRANE (5.0 MT)

3.5



16 CARBIDE TOOL LAPPING MACHINE
17 AUTOMATIC BAND SAW & CIRCULAR SAW SHARPENING MACHINE
18 UNIVERSAL CYLINDRICAL GRINDER
19 SURFACE GRINDER
20 SHEARING & CROPPING MACHINE
21 JIG BORING MACHINE
22 PRECISION LATHE
23 UNIVERSAL MILLING MACHINE
24 PILLAR DRILLING MACHINE
25 HEAT TREATMENT FURNACE & QUENCHING TANK
26 ARBOUR PRESS
27 BENCH GRINDER
28 DRILL WEB THINNING GRINDER
29 DOUBLE ENDED PEDESTAL GRINDER
30 ABRASSIVE BELT GRINDING MACHINE
31 FLEXIBLE SHAFT GRINDER
32 E.O.T CRANE (10.0 MT)
33 E.O.T CRANE (5.0 MT)

ALL DIMENSIONS ARE IN METER

LAYOUT OF MACHINE SHOP
BOILER MANUFACTURING PLANT

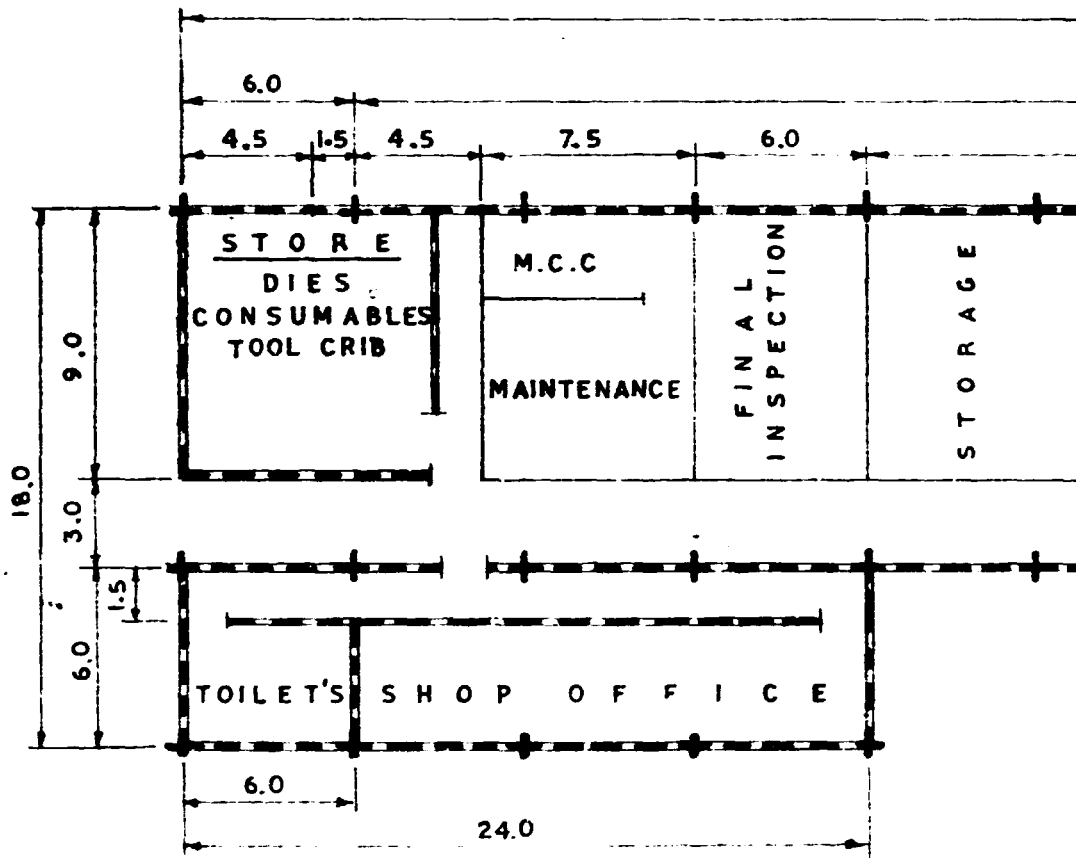
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

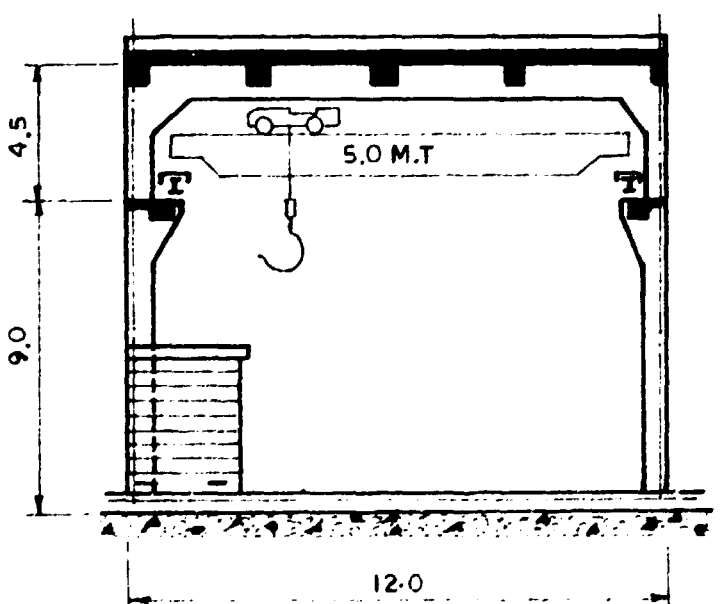
DEVELOPMENT CONSULTANTS
CONSULTING ENGINEERS
BOMBAY ● CALCUTTA ● MADRAS ● NEW DELHI

DRAWN MUKUL CHOWDHURY	DATE 28.10.92
PROJ. ENGR. PCD/MC	SCALE 1:250
DEPT. HEAD	JOB NO. DCIL-45010

DWG. NO. EXHIBIT_32 | REV. NO.

SEC 1





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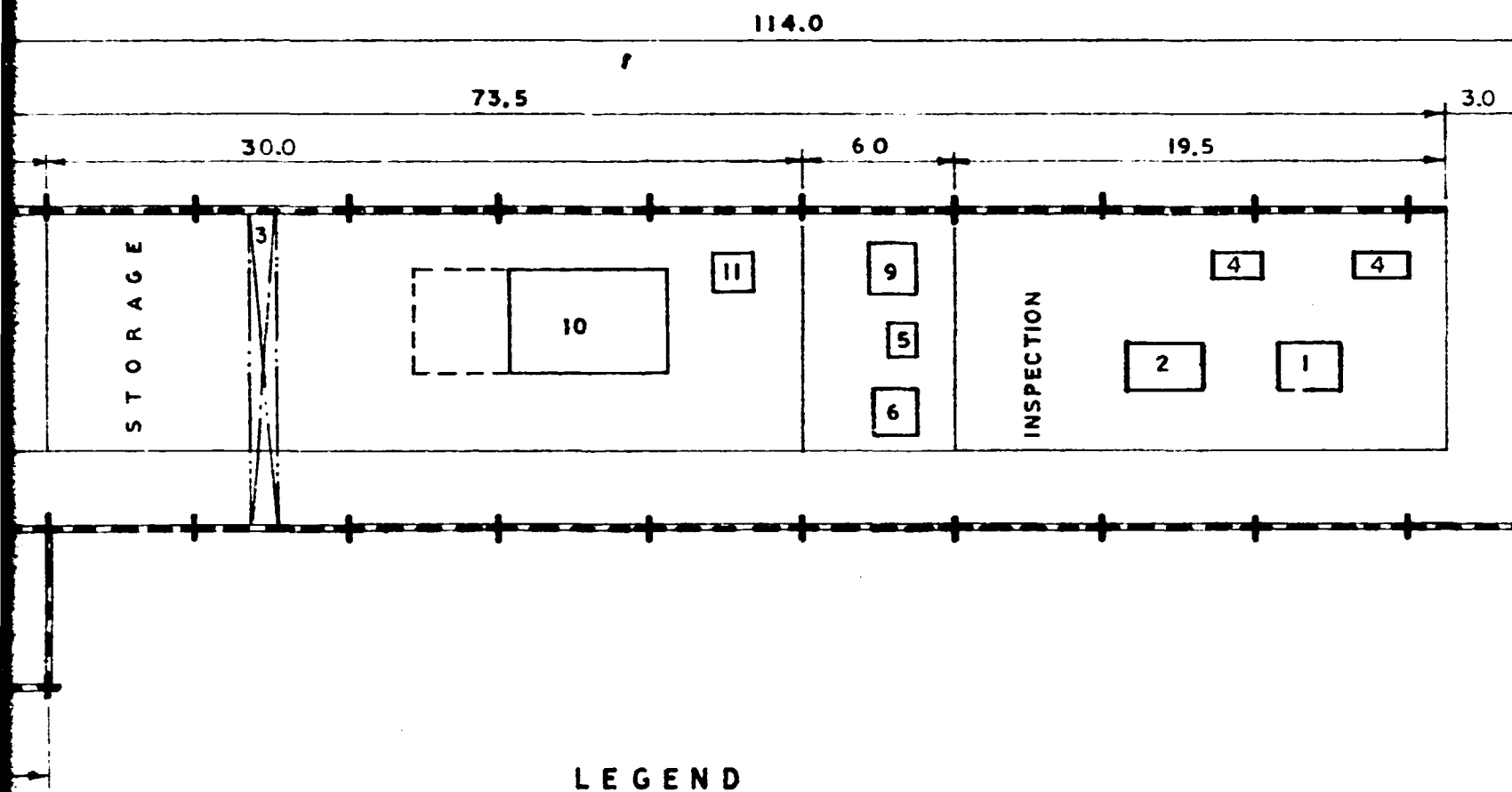
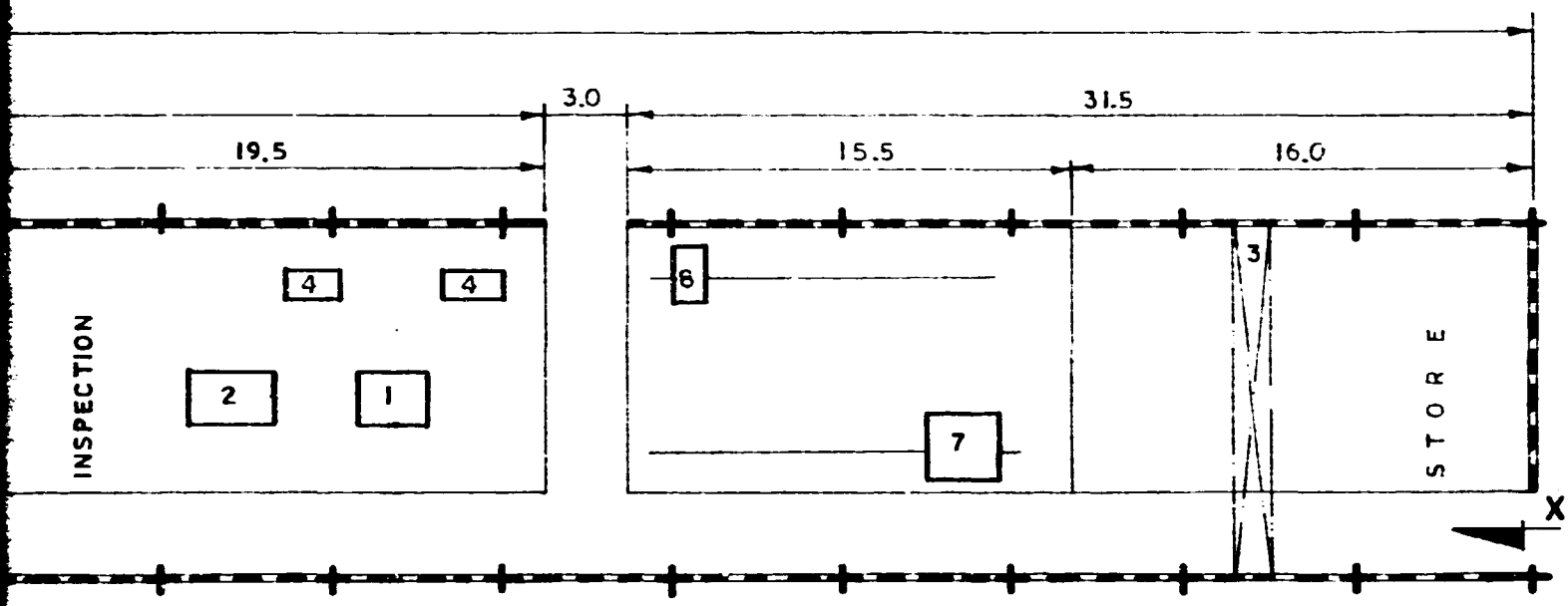


LEGEND

1	PNEUMATIC POWER HAMMER	1
2	PNEUMATIC POWER HAMMER	1
3	E.O.T CRANE	2
4	GAS OIL FIRED FORGE FURNACE	2
5	PEDESTAL GRINDER	1
6	DOUBLE ENDED SNAGGING GRINDER	1
7	CIRCULAR SAW	1
8	POWER HACKSAW	1
9	ELECTRICAL HEAT TREATMENT FURNACE	1
10	GAS FIRED BOGIE TYPE ANNEALING FURNACE	1
11	CYANIDE POT FURNACE	1

SEC 3



ER	1
ER	1
	2
NACE	2
	1
GRINDER	1
	1
	1
MENT FURNACE	1
NEALING FURNACE	1
	1

ALL DIMENSIONS ARE IN METER

LAYOUT OF FORGE AND HEAT TREATMENT SHOP
BOILER MANUFACTURING PLANT

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

DEVELOPMENT CONSULTANTS
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BOMBAY ● CALCUTTA ● MADRAS ● NEW DELHI

DRAWN MUKUL CHOWDHURY	DATE 30.10.92
PROJ. ENGR. PCD/MC	SCALE 1:250
DEPT. HEAD	JOB NO. DCIL-45010
DWG. NO. EXHIBIT 33	REV. NO.

JOB NO. : DCIL-105 EXHIBIT : 35

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

PROJECT PROFILE ON STEAM BOILERS

ESTIMATED COST OF CIVIL WORK

Sl. No.	Description	Area (sq m)	Cost ('000 US $)
1.	Land and Land Development including fencing, drainage and road construction	87,704	7,098.20
2.	Workshop Building having a height of 13.5 metres from floor to top of crane rail	20,256	18,574.75
3.	Administrative Building - double storeyed	648	714.14
4.	Auxiliary Buildings comprising compressor house, pump house, transformer house, oxygen and acetylene house, security, time office, first aid centre, wash room and canteen, training centre and material testing laboratory	3,024	3,335.47
5.	Raw material, finished goods, loading and unloading area, storage and transport yard	5.420	4,970.14
	TOTAL		34,693.30

SECTION - 11
MANPOWER AND ORGANIZATION

MANPOWER AND ORGANISATION

The organisation has been designed to meet the functional needs of a plant in which 8,600 tonnes of steel plates and tubes will be processed annually to manufacture boilers of varying capacities. The organisation will carry out all the activities performed by a typical manufacturing unit. In order it can plan, execute, co-ordinate and control all the necessary activities, the deployment of manpower has been categorised under the following heads :

- Production
- Maintenance and Inter-shop Material Handling
- Quality Control and Welding Development
- Engineering
- Materials
- Marketing
- Finance and Accounts
- Personnel and Administration

The organisation will be headed by the General Manager. Based on the above eight activities/functions, the organisation has been divided into eight departments. Each department will be placed under the charge of a departmental head. Four of the eight departmental heads shall report to the General Manager, while the remaining four shall report to the Works Manager, who, in turn, shall report to the General Manager. Organisation chart for the top management is presented in Exhibit-36.

Production

All Sections within the Production Department will work in two shifts. Production has been placed under the overall

supervision of a Production Manager, who will report to the Works Manager. The Production Manager will be assisted by one Welding Engineer and four Superintendents, who will be in charge of different sections within the Production Department.

Manpower requirement and organisation chart for different sections within the Production Department are shown in their respective exhibits as indicated below.

Sl. No.	Shop	Exhibit for Manpower	Exhibit for Organisation Chart
1.	Tube and Pipe Shop	37	38
2.	Vessel Shop	39	40
3.	Plate and Structural Shop	41	42
4.	Machine Shop	43	44
5.	Forge and Heat Treatment Shop	45	46

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 of work can not be estimated at this stage, for the sake of convenience, only the manpower required in the shop is being considered here. The manpower required at the site will be additional. It is suggested that very few skilled people be drawn from the shop during this phase. Unskilled workmen may be hired locally. It is estimated that about 35-40 people including both skilled and unskilled, will be required at various stages of the boiler erection period.

Maintenance and Inter-shop Material Handling

Maintenance functions and inter shop material movement will be looked after by this department. It will be headed by the

Chief Engineer (Plant Maintenance) who will also report to the Works Manager.

Manpower requirement and organisation chart for this department are shown in Exhibit-47 and Exhibit-48, respectively.

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

Sl. No.	Shop	Exhibit for Manpower	Exhibit for Organisation Chart
1.	Quality Control and Welding Development	49	50
2.	Engineering	51	52
3.	Materials	53	54
4.	Marketing	55	56
5.	Finance and Accounts	57	58
6.	Personnel and Administration	59	60

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 Department who reports to the Production 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-49 and Exhibit-50, respectively.

Engineering

Manpower requirement and organisation chart for Engineering Department are shown in Exhibit-51 and Exhibit-52 respectively. This division will be headed by the Manager (Design Engineering and Planning).

Materials

The Materials department will be headed by a Materials Manager who will be assisted by a Senior Materials Engineer, Stores Manager and Inventory Control Manager.

Manpower requirement and organisation chart for this department are shown in Exhibit-53 and Exhibit-54, respectively.

Marketing

The marketing department will be under the charge of a Marketing Manager, who will be assisted by four Sales Engineers. Manpower requirement and organisation chart for Marketing Department are shown in Exhibit-55 and Exhibit-56, respectively.

Finance and Accounts

Finance and Accounts Manager will head this department. He will be supported by three Senior Accountants.

Manpower requirement and organisation chart for this department are presented in Exhibit-57 and Exhibit-58 respectively.

Personnel and Administration

Exhibit-59 presents the requirement of manpower for this department. Organisation chart is presented in Exhibit-60.

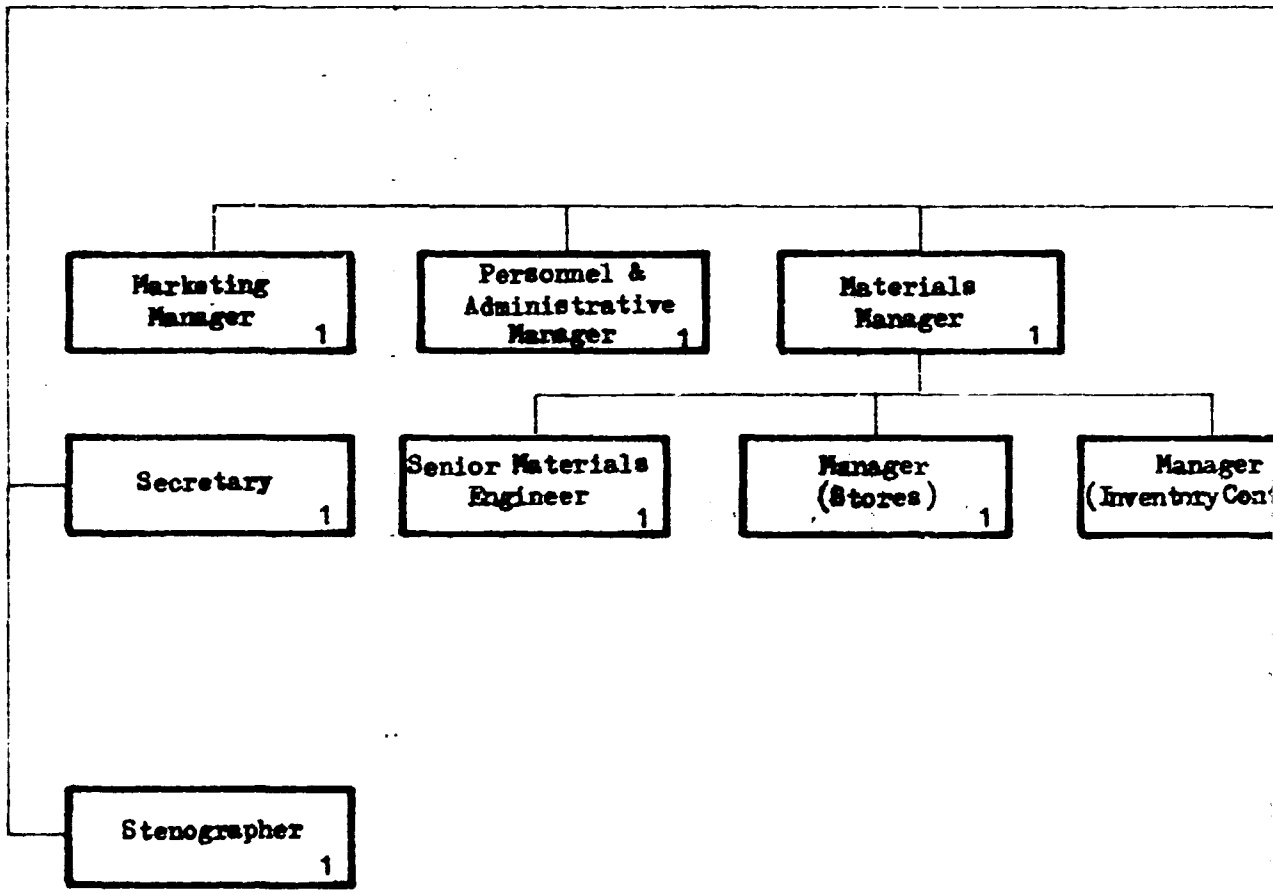
Exhibit-61 presents a summary of manpower requirement for the entire plant.

Manpower has been grouped into ten 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-62.

SEC I

JOB NO. DCIL-105



SEC 2

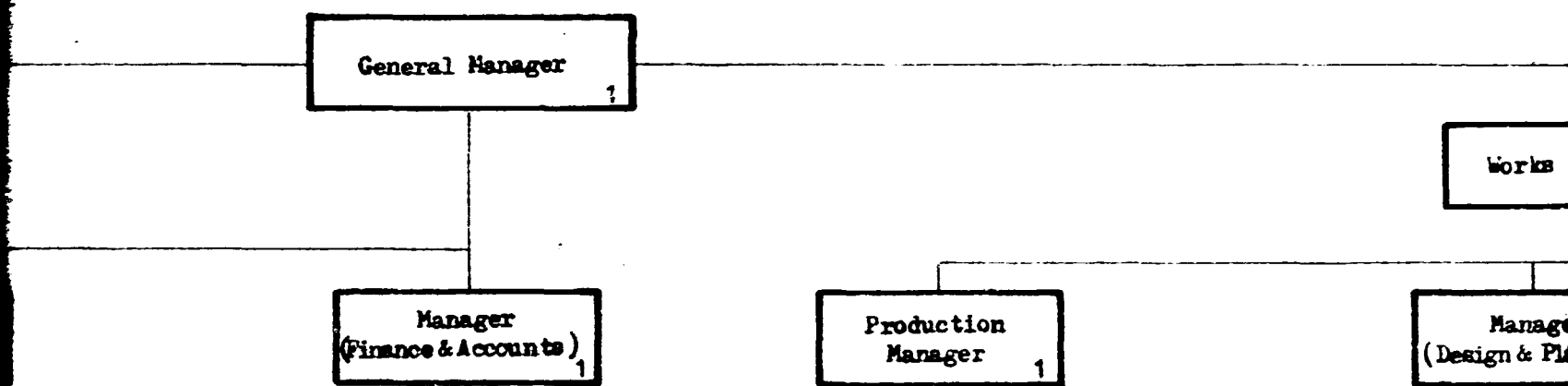
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

AND

ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : SENIOR LEVEL MANAGEMENT



SEC 3

EXHIBIT - 36

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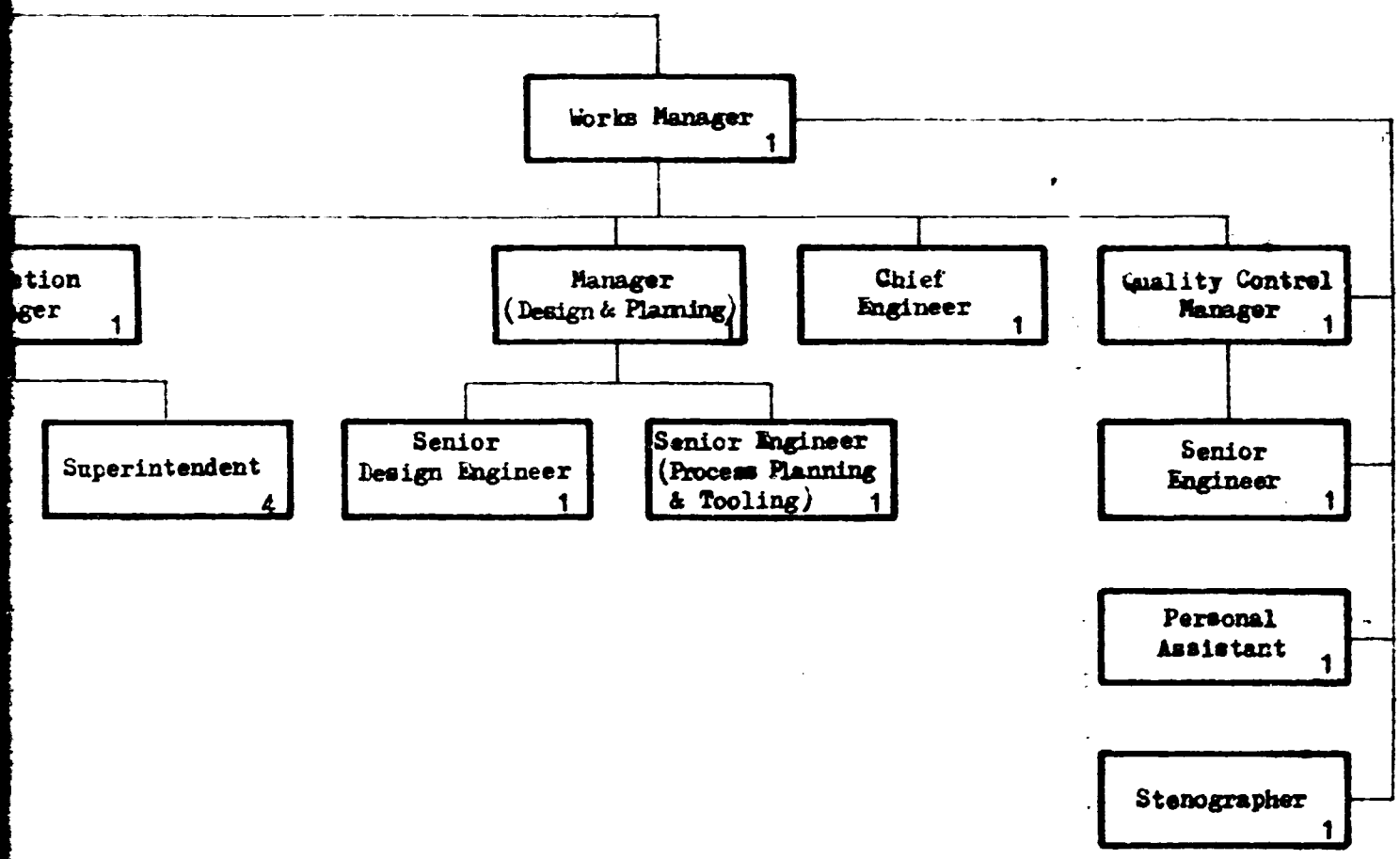


DEVELOPMENT CONSULTANTS

11-6

DEVELOPMENT CONSULTANTS

JOB NO. DCIL-105 EXHIBIT : 37

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

PROJECT PROFILE ON STEAM BOILERS

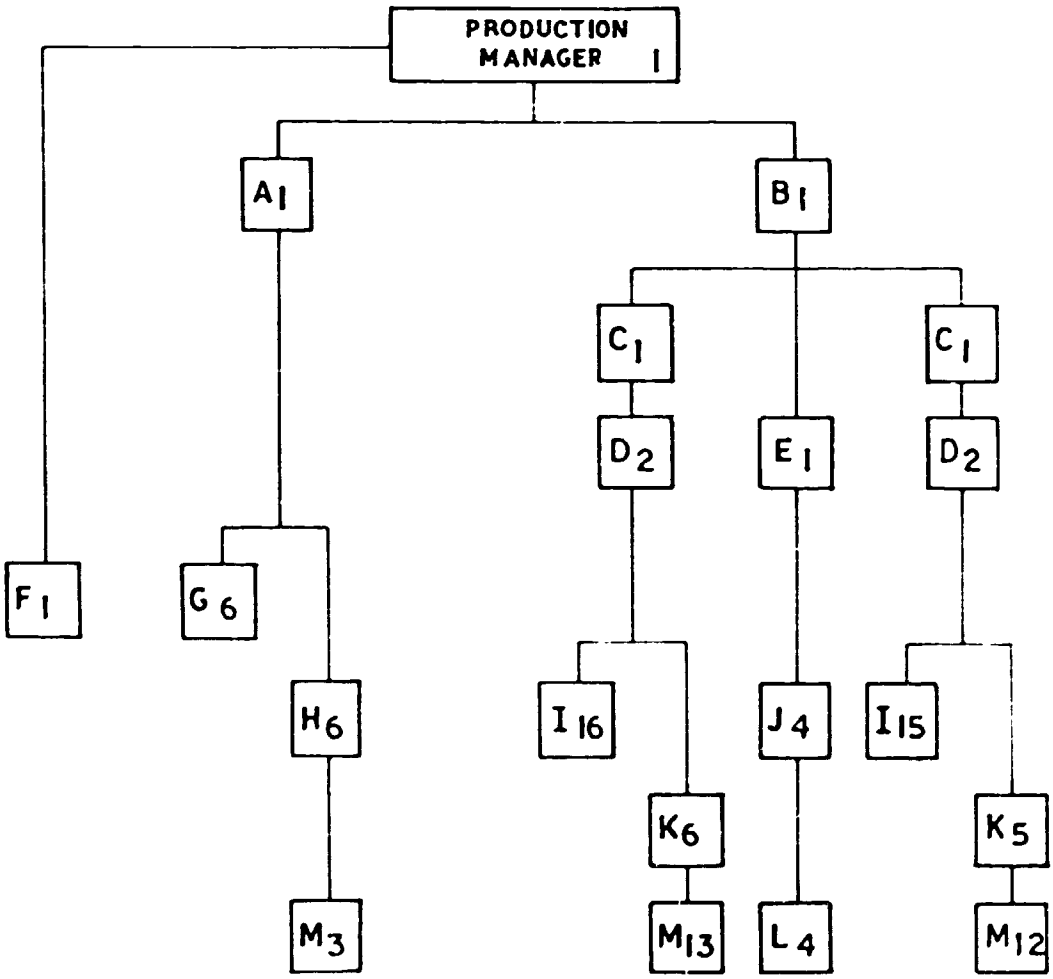
MANPOWER REQUIREMENT : TUBE AND PIPE SHOP

Sl. No.	Designation	Salary Level	Number
A.	Welding Engineer	4	1
B.	Superintendent (Production and Process)	4	1
C.	Production Engineer	5	2
D.	Foreman	6	4
E.	Technical Assistant	6	1
F.	Steno Typist	7	1
G.	Highly Skilled Welder	7	6
H.	Skilled Welder	8	6
I.	Skilled Machine Operator	8	31
J.	Crane Driver	8	4
K.	Semi-skilled Machine Operator	9	11
L.	Material Handler	10	4
M.	Unskilled Worker	10	28
		Total	100

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

PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : TUBE AND PIPE SHOP



JOB NO. DCIL-105 EXHIBIT : 39

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

PROJECT PROFILE ON STEAM BOILERS

MANPOWER REQUIREMENT : VESSEL SHOP

Sl. No.	Designation	Salary Level	Number
A.	Superintendent (Production and Process)	4	1
B.	Production Engineer	5	2
C.	Foreman	6	4
D.	Technical Assistant	6	1
E.	Highly Skilled Welder	7	4
F.	Highly Skilled Marker	7	2
G.	Skilled Welder	8	10
H.	Skilled Machine Operator	8	11
I.	Skilled Marker	8	2
J.	Fitter	8	19
K.	Chipper	8	2
L.	Crane Driver	8	4
M.	Semi-skilled Machine Operator	9	6
N.	Painter	9	1
O.	Material Handler	10	4
P.	Unskilled Worker	10	34
		Total	107

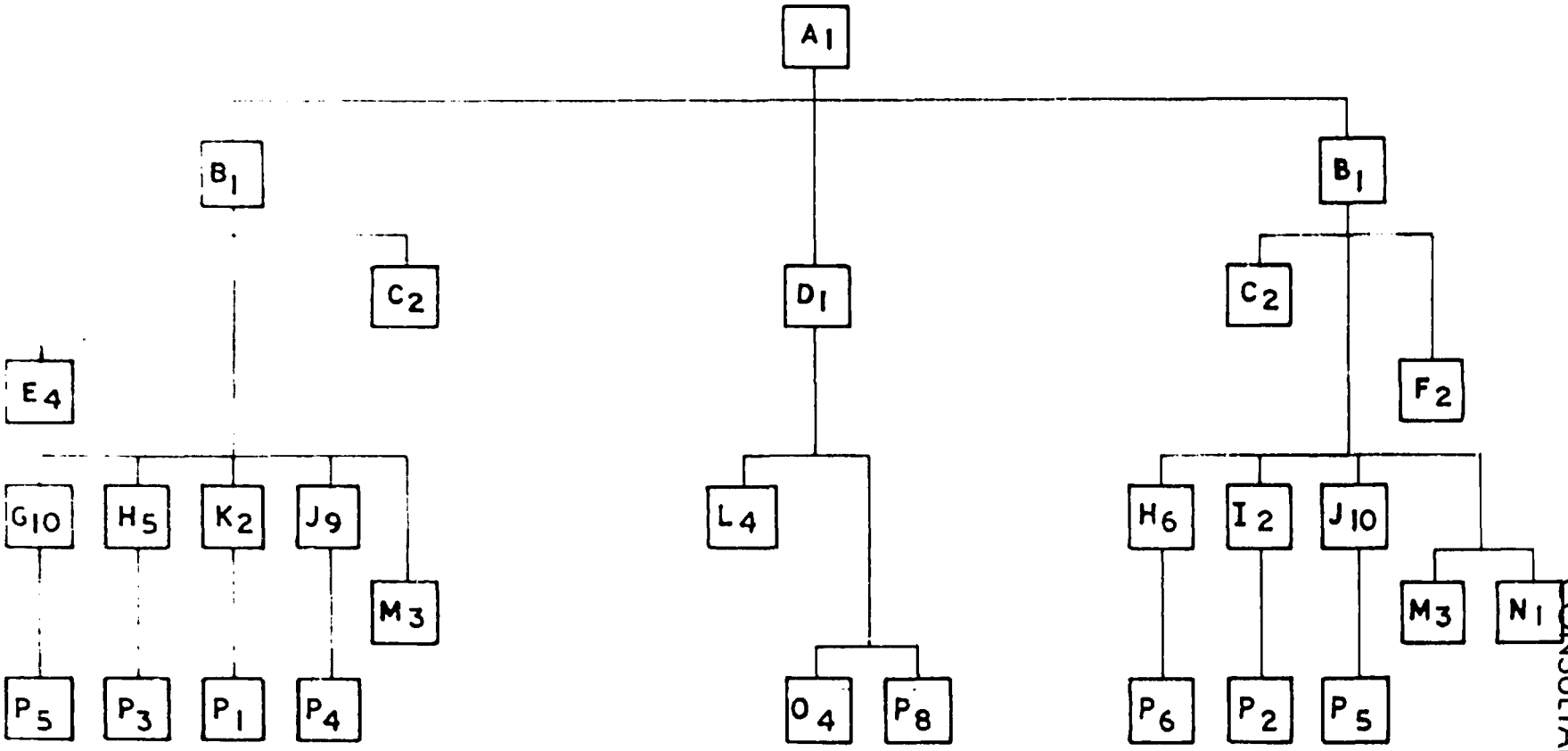
JOB NO. : DCIL-105

EXHIBIT : 40

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

PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : VESSEL SHOP



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JOB NO. DCIL-105 EXHIBIT : 41

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

PROJECT PROFILE ON STEAM BOILERS

MANPOWER REQUIREMENT : PLATE AND STRUCTURAL SHOP

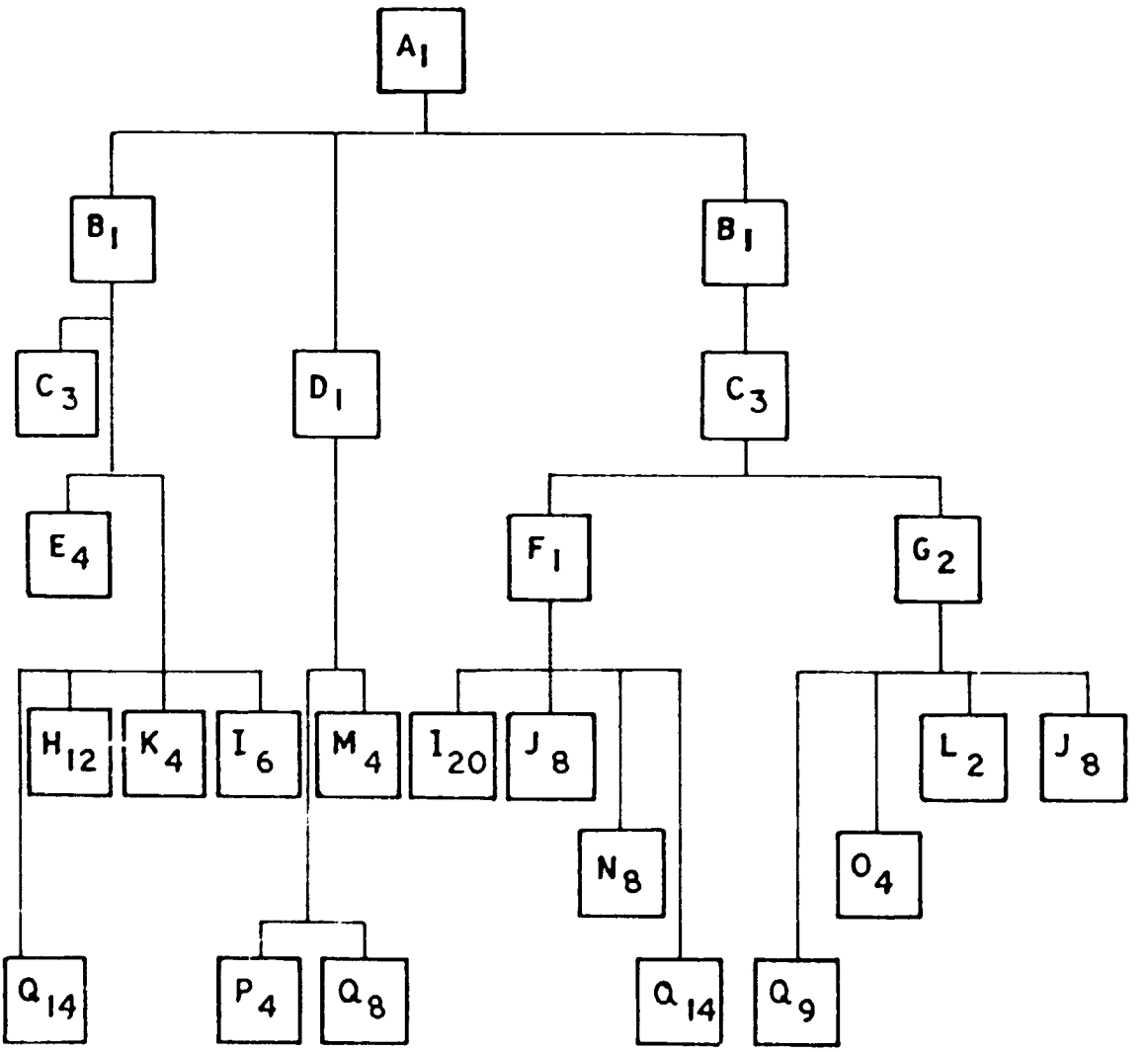
Sl. No.	Designation	Salary Level	Number
A.	Superintendent (Production and Process)	4	1
B.	Production Engineer	5	2
C.	Foreman	6	6
D.	Technical Assistant	6	1
E.	Highly Skilled Welder	7	4
F.	Highly Skilled Machine Operator	7	1
G.	Highly Skilled Marker	7	2
H.	Skilled Welder	8	12
I.	Skilled Machine Operator	8	26
J.	Fitter	8	16
K.	Chipper	8	4
L.	Skilled Marker	8	2
M.	Crane Driver	8	4
N.	Semi-skilled Machine Operator	9	8
O.	Painter	9	4
P.	Material Handler	10	4
Q.	Unskilled Worker	10	45
		Total	142

JOB NO. : DCIL-105 EXHIBIT : 42

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

PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : PLATE AND STRUCTURAL SHOP



JOB NO. DCIL-105

EXHIBIT : 43

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

PROJECT PROFILE ON STEAM BOILERS

MANPOWER REQUIREMENT : MACHINE SHOP

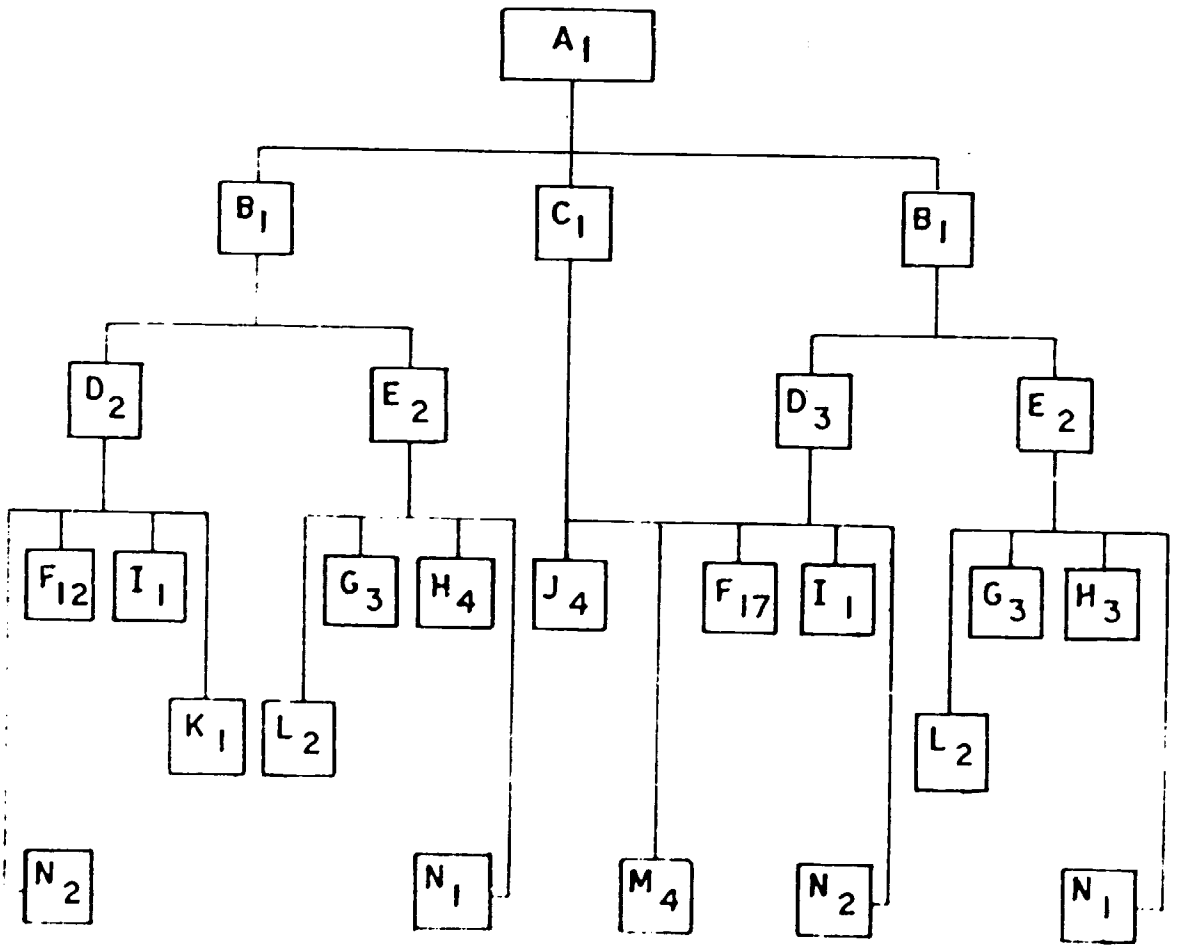
Sl. No.	Designation	Salary Level	Number
A.	Production Engineer	5	1
B.	Foreman	6	2
C.	Technical Assistant	6	1
D.	Highly Skilled Machine Operator	7	5
E.	Highly Skilled Marker	7	4
F.	Skilled Machine Operator	8	29
G.	Skilled Marker	8	6
H.	Fitter	8	7
I.	Welder	8	2
J.	Crane Driver	8	4
K.	Painter	9	1
L.	Semi-skilled Worker	9	4
M.	Material Handler	10	4
N.	Unskilled Worker	10	6
		Total	76

JOB NO. : DCIL-105 EXHIBIT : 44

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

PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : MACHINE SHOP



JOB NO. DCIL-105 EXHIBIT : 45

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

PROJECT PROFILE ON STEAM BOILERS

MANPOWER REQUIREMENT : FORGE AND HEAT TREATMENT SHOP

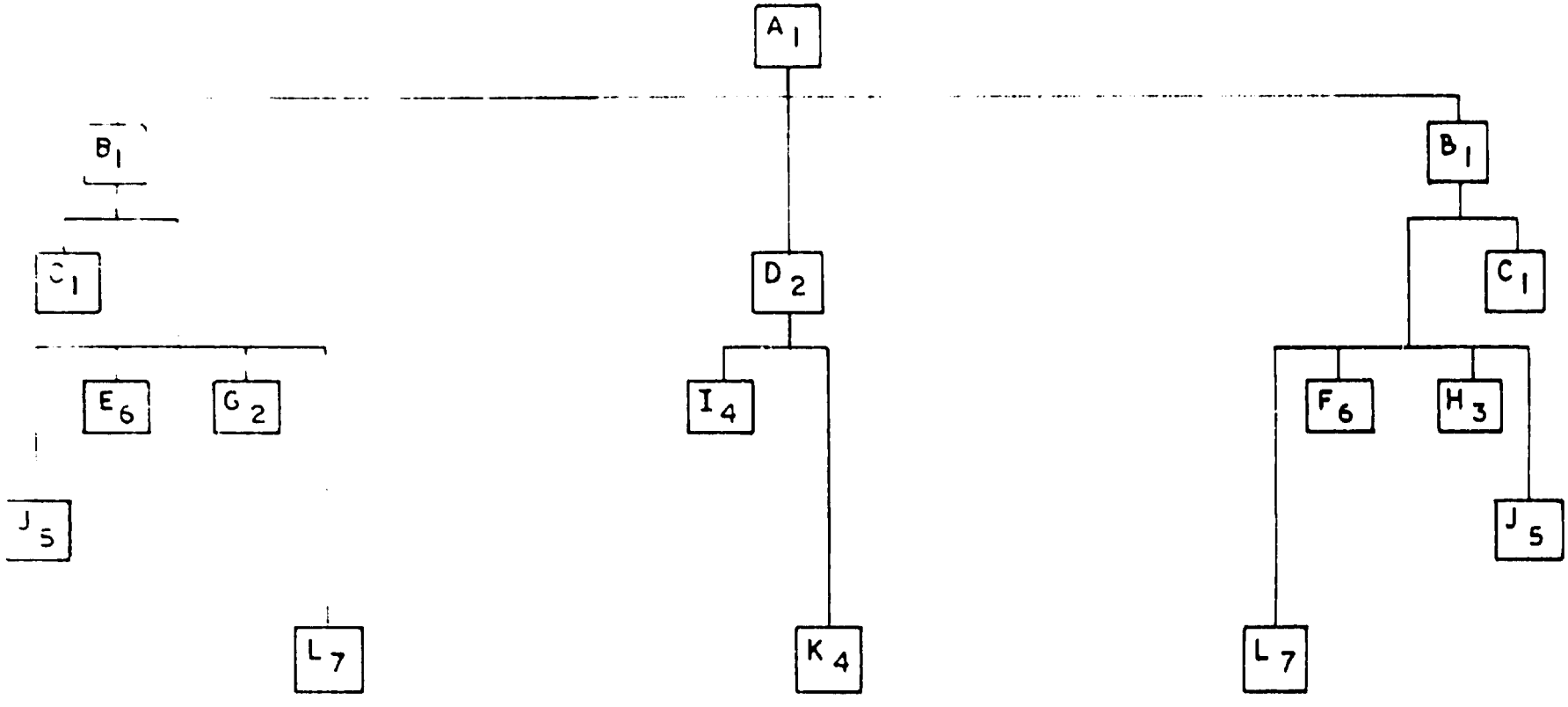
Sl. No.	Designation	Salary Level	Number
A.	Superintendent (Production and Process)	4	1
B.	Production Engineer	5	2
C.	Foreman	6	2
D.	Technical Assistant	6	2
E.	Furnace Operator	8	6
F.	Skilled Machine Operator	8	6
G.	Blacksmith	8	2
H.	Fitter	8	3
I.	Crane Driver	8	4
J.	Semi-skilled Worker	9	10
K.	Material Handler	10	4
L.	Unskilled Worker	10	14
		Total	56

JOB NO. : DCIL-105 EXHIBIT : 46

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

PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : FORGE AND HEAT TREATMENT SHOP



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JOB NO. DCIL-105

EXHIBIT : 47

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

PROJECT PROFILE ON STEAM BOILERS

MANPOWER REQUIREMENT : MAINTENANCE AND INTERSHOP MATERIAL HANDLING

Sl. No.	Designation	Salary Level	Number
A.	Chief Engineer (Plant Maintenance)	3	1
B.	Maintenance Engineer (Mechanical)	5	2
C.	Maintenance Engineer (Electrical)	5	2
D.	Maintenance Foreman	6	4
E.	Highly Skilled Fitter (Mechanical)	7	4
F.	Highly Skilled Fitter (Electrical)	7	4
G.	Skilled Fitter (Mechanical)	8	34
H.	Skilled Fitter (Electrical)	8	16
I.	Mason/Carpenter/Plumber	8	2
J.	Attendant (Utilities)	8	3
K.	Electrician (Wiring)	8	1
L.	Welder	8	1
M.	Machine Operator Central Maintenance Shop	8	6
N.	Truck Driver	8	10

JOB NO. DCIL-105 EXHIBIT : 47

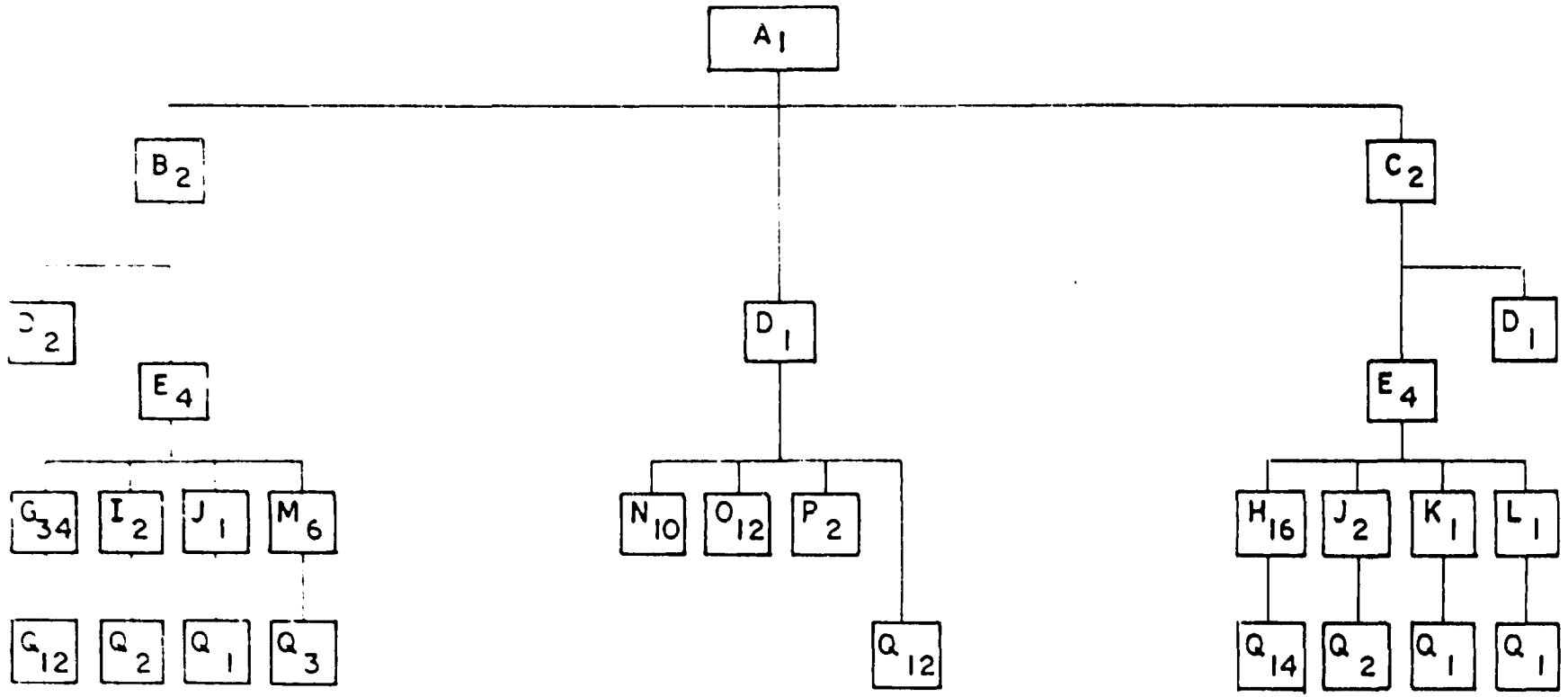
Sl. No.	Designation	Salary Level	Number
O.	Forklift Driver	8	12
P.	Crane Operator	8	2
Q.	Material Handler and Helper	10	48
		Total	152

JOB NO. : DCIL-105 EXHIBIT : 48

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

PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : MAINTENANCE AND INTERSHOP MATERIAL HANDLING



DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 49

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

PROJECT PROFILE ON STEAM BOILERS

MANPOWER REQUIREMENT : QUALITY CONTROL AND WELDING DEVELOPMENT

Sl. No.	Designation	Salary Level	Number
A.	Manager (Quality Control)	3	1
B.	Senior Engineer (Mechanical Testing Laboratory)	4	1
C.	Engineer (Quality Control)	5	6
D.	Inspector (Process)	6	10
E.	Inspector (Incoming Materials)	6	2
F.	Chemist	6	1
G.	Supervisor (Mechanical Testing)	7	1
H.	Highly Skilled Machine Operator	7	1
I.	Steno-Typist	7	2
J.	Skilled Machine Operator (Laboratory)	8	7
K.	Clerk	9	2
L.	Helper	10	4
		Total	38

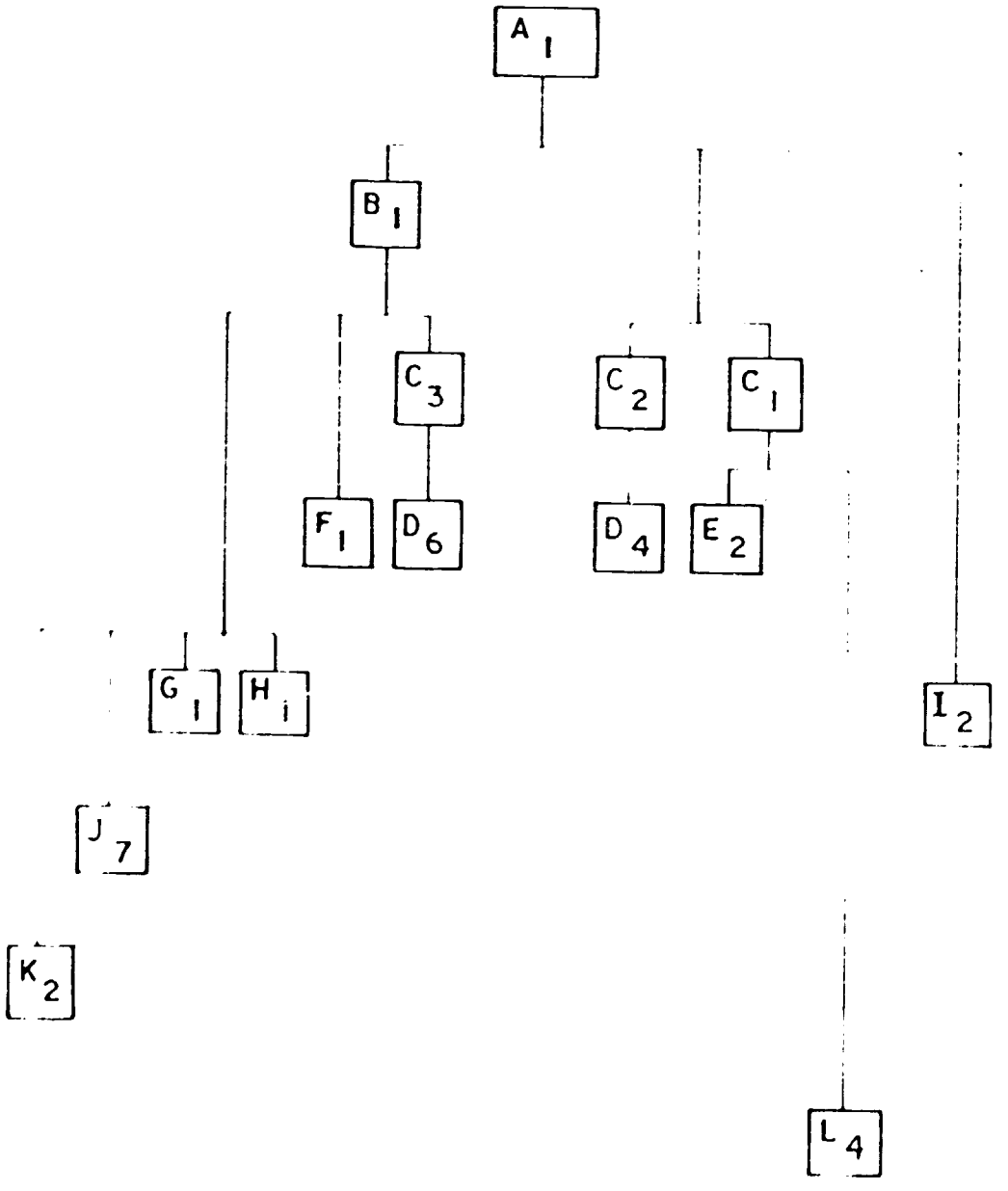
JOB NO. : DCIL-105

EXHIBIT : 50

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

PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : QUALITY CONTROL & WELDING DEVELOPMENT



DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 51

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

PROJECT PROFILE ON STEAM BOILERS

MANPOWER REQUIREMENT : ENGINEERING

Sl. No.	Designation	Salary Level	Number
A.	Manager (Design Engineering and Planning)	3	1
B.	Senior Design Engineer	4	1
C.	Senior Engineer (Process Planning and Tooling)	4	1
D.	Design Engineer (Product)	5	1
E.	Design Engineer (Process)	5	1
F.	Engineer (Process Planning and Tooling)	5	2
G.	Industrial Engineer	5	2
H.	Technical Assistant	6	2
I.	Draftsman	6	4
J.	Steno Typist	7	2
K.	Printing Machine Operator	8	1
L.	Clerk	9	1
		Total	19

DEVELOPMENT CONSULTANTS

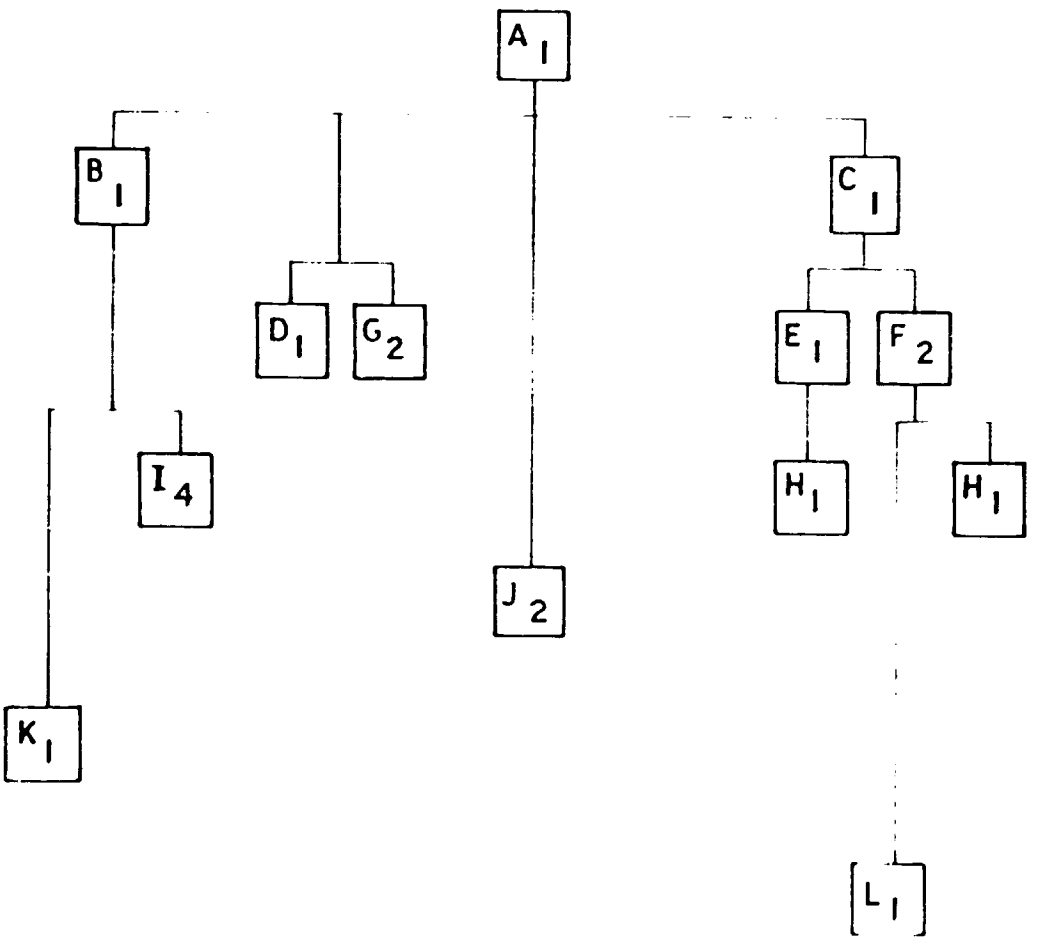
JOB NO. : DCIL-105

EXHIBIT : 52

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

PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : ENGINEERING



JOB NO. : DCIL-105 EXHIBIT : 53

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

PROJECT PROFILE ON STEAM BOILERS

MANPOWER REQUIREMENT : MATERIALS

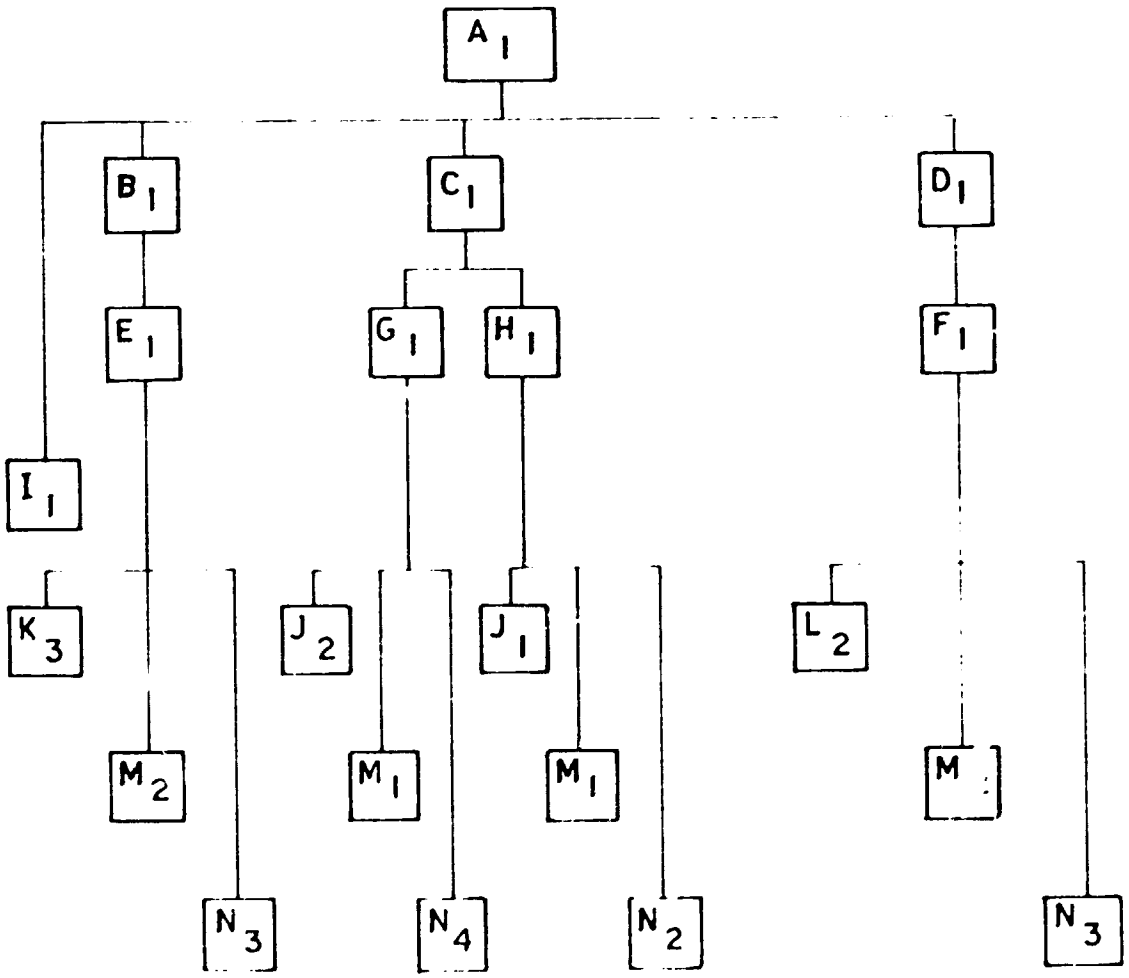
Sl. No.	Designation	Salary Level	Number
A.	Materials Manager	3	1
B.	Senior Materials Engineer	4	1
C.	Manager (Stores)	4	1
D.	Manager (Inventory Control)	4	1
E.	Purchase Officer (Basic Materials and Consumables)	5	1
F.	Purchase Officer (Tools and Bought-out items)	5	1
G.	Stores Officer (Raw Materials, Consumables and Tools)	5	1
H.	Stores Officer (Bought-out items)	5	1
I.	Steno Typist	7	2
J.	Stores Assistant	8	3
K.	Purchase Assistant	8	3
L.	Inventory Control Assistant	8	2
M.	Stores Clerk	9	6
N.	Material Handler	10	12
		Total	36

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 54

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION
PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : MATERIALS



DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 55

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

PROJECT PROFILE ON STEAM BOILERS

MANPOWER REQUIREMENT : MARKETING

Sl. No.	Designation	Salary Level	Number
A.	Marketing Manager	3	1
B.	Sales Engineer	5	4
C.	Steno Typist	7	3
		Total	8

DEVELOPMENT CONSULTANTS

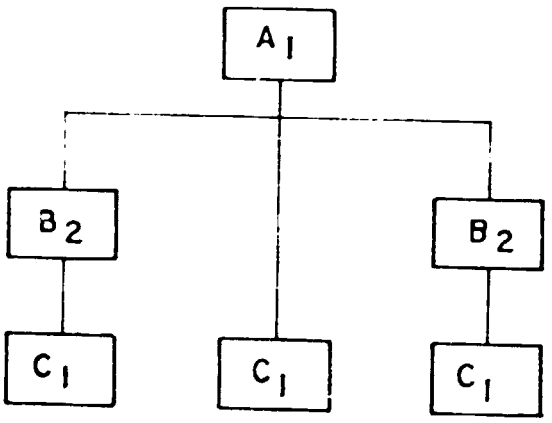
JOB NO. : DCIL-105

EXHIBIT : 56

PROJECT PROFILE ON STEAM BOILERS
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : MARKETING



DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 57

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

PROJECT PROFILE ON STEAM BOILERS

MANPOWER REQUIREMENT : FINANCE AND ACCOUNTS

Sl. No.	Designation	Salary Level	Number
A.	Manager (Finance and Accounts)	3	1
B.	Senior Accountant (Planning and Control)	4	1
C.	Senior Accountant (Wages and Salaries)	4	1
D.	Senior Accountant (Receipts and Payments	4	1
E.	Accountant	5	5
F.	Steno Typist	7	2
G.	Accounts Assistant	8	5
H.	Cashier	8	2
I.	Accounts Clerk	9	5
		Total	23

DEVELOPMENT CONSULTANTS

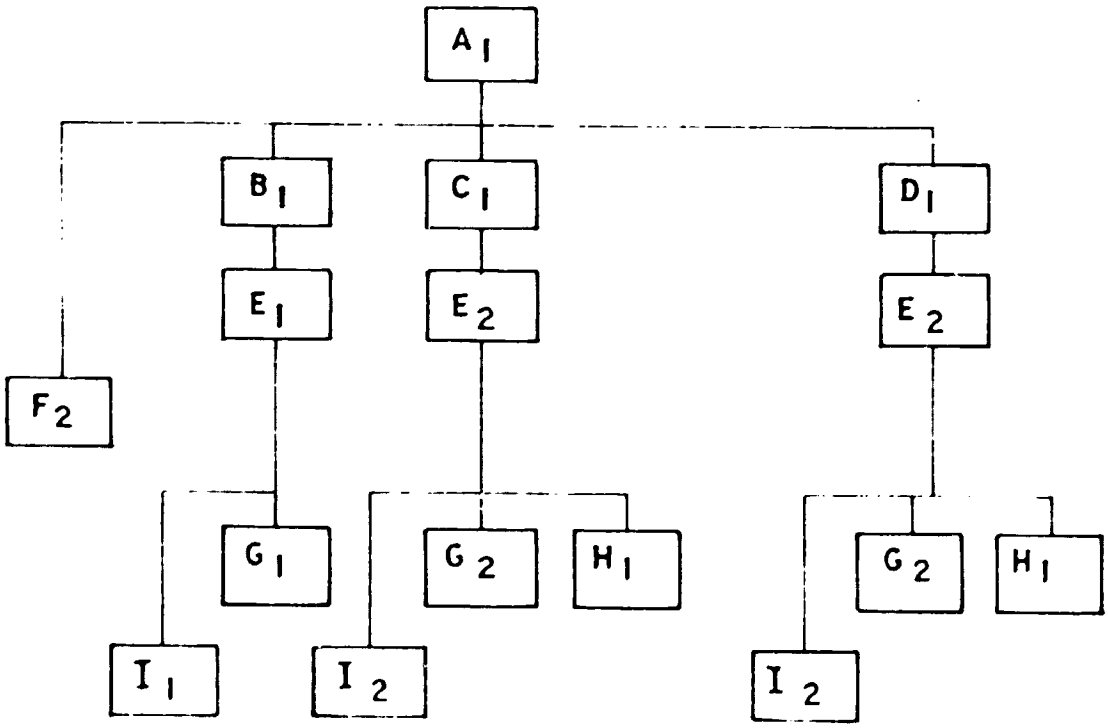
JOB NO. : DCIL-105

EXHIBIT : 58

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

PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : FINANCE AND ACCOUNTS



DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 59

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

PROJECT PROFILE ON STEAM BOILERS

MANPOWER REQUIREMENT : PERSONNEL AND ADMINISTRATION

Sl. No.	Designation	Salary Level	Number
A.	Manager - Personnel and Administration	3	1
B.	Personnel Officer	5	1
C.	Welfare Officer	5	1
D.	Chief Security Officer	5	1
E.	Office Superintendant	6	1
F.	Canteen in-charge	7	1
G.	Steno-Typist	7	3
H.	Receptionist-cum-Telephone Operator	8	1
I.	Office Assistant	8	3
J.	Security Guard	8	3
K.	Driver	8	4
L.	Watchman	10	10
M.	Office Boy	10	4
N.	Waiter and Helper	10	2
O.	Sweeper and Gardener	10	6
		Total	42

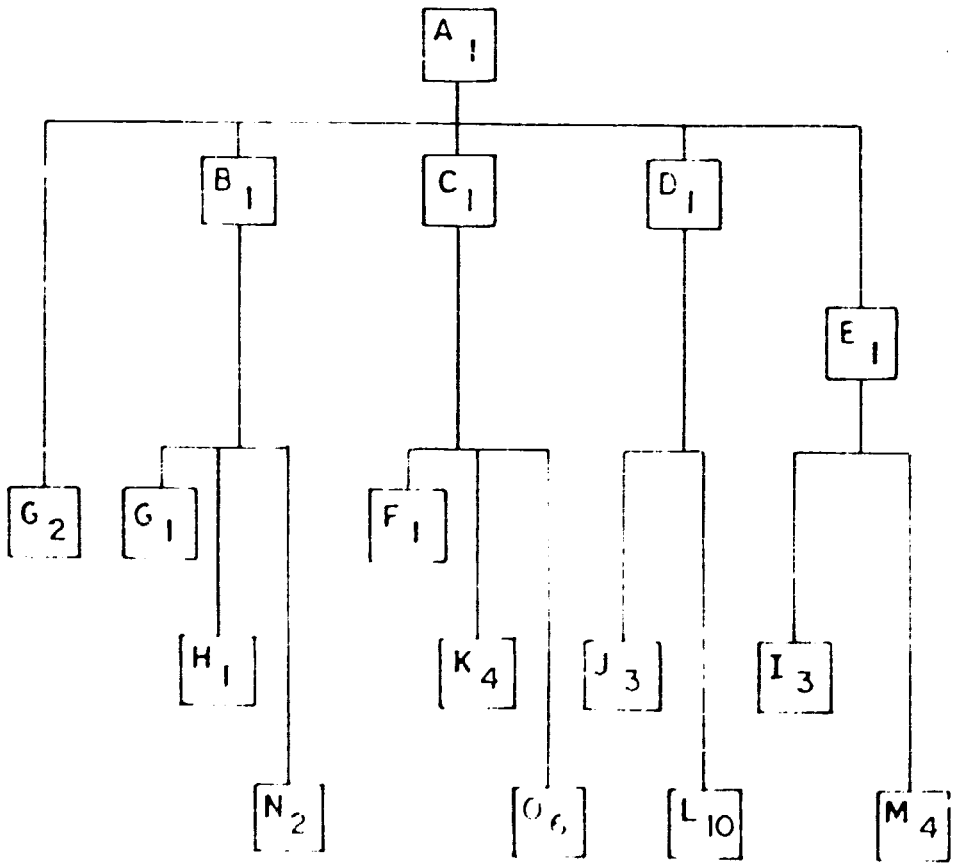
DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105

EXHIBIT : 60

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION
PROJECT PROFILE ON STEAM BOILERS

ORGANISATION CHART : PERSONNEL AND ADMINISTRATION



DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 61

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

PROJECT PROFILE ON STEAM BOILERS

SUMMARY OF MANPOWER REQUIREMENT

Sl. No.	Designation/Department	Number
1.	General Manager	1
2.	Works Manager	1
3.	Production Manager	1
4.	Chief Engineer	1
5.	Quality Control Manager	1
6.	Manager (Design Engineering and Planning)	1
7.	Materials Manager	1
8.	Marketing Manager	1
9.	Manager (Finance and Accounts)	1
10.	Personnel and Administrative Manager	1
11.	Secretary to General Manager	1
12.	PA to Works Manager	1
13.	Steno Typist	2
14.	Sub-Total (1 thru' 13)	14
15.	Production	481
16.	Maintenance	151

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 61

Sl. No.	Designation/Department	Number
17.	Quality Control	37
18.	Engineering	18
19.	Materials	35
20.	Marketing	7
21.	Finance and Accounts	22
22.	Personnel and Administration	41
23.	Sub-Total (15 thru' 22)	792
24.	Total (14 + 23)	806

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 62

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

PROJECT PROFILE ON STEAM BOILERS

STATEMENT OF MONTHLY SALARIES AND WAGES

Salary Level	Numbers	Monthly Salary ($) Basic	Other Benefits	Gross Salary Per Month ($)
1	1	9,000		9,000
2	1	4,000		4,000
3	8	2,000		16,000
4	15	1,146		17,190
5	42	859		36,078
6	48	700		33,600
7	56	687		38,472
8	343	400		1,37,200
9	59	350		20,650
10	233	229		53,357
TOTAL	806			3,65,547

SECTION - 12
FINANCIAL ANALYSIS AND EVALUATION

FINANCIAL ANALYSIS AND EVALUATION

COUNTRY : EGYPT

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

Project Cost

The estimated cost of the project for setting up a Steam Boilers plant manufacturing 5 numbers of 30 MW boilers and 2 numbers 150 MW boilers annually is around US $ 57.26 million as can be seen from Exhibit-63. 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 64 and 65 respectively.

Margin money for working capital is presented in Exhibit-66. 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 67 and 68 respectively. Capacity utilisation is assumed at the rate of 100% from the first year onwards.

Costs

The annual costs of production and sales computed over 10 years are presented in Exhibit 69. 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-70. The average profit before tax works out to 10.4% of average revenue.

Statement of fixed assets and depreciation under straight line method is presented in Exhibit-71. Tax computation and depreciation for tax are presented in Exhibits 72 and 73 repspectively.

Working capital requirements are shown in Exhibit-74.

Projected cash flow statement and balance sheet over 10-year period are shown in Exhibits 75 and 76 respectively. The term loan will be repaid in 15 years including a 2-year moratorium.

The project breaks even at around 69.1% and shows internal rate of return of 13.6% as can be seen from Exhibits 77 and 78 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 : 63

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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PROJECT PROFILE ON STEAM BOILERS

ESTIMATED PROJECT COST

('000 US $)

Sl. No.	Items	Value	Total
1.	Land and Land Development (@ US$ 183 per m² for 38,788 m²)	7098.20	7098.20
2.	Building and Civil Work		
i)	Workshop Building (@ US$ 917 per m² for 20,256 m²)	18574.75	
ii)	Administrative Building (@ US$ 1103 per m² for 648 m²)	714.74	
iii)	Auxiliary Buildings (@ US$ 1103 per m² for 3024 m²)	3335.47	
iv)	Storage and Transport Yard (@ US$ 917 per m² for 5420 m²)	4970.14	
	Sub-total (2)		27595.11
3.	Plant and Machinery		
i)	Imported		
	- Tube and Pipe shop equipment	1334.15	
	- Vessel shop equipment	3167.30	
	- Plate and Structural shop equipment	1246.28	
	- Machine shop equipment	736.08	
	- Forge and heat treatment shop equipment	511.38	
	- Inter-shop material handling equipment	742.68	
	- Material Testing Laboratory	128.87	
	- Maintenance shop equipment	337.86	
	- Welding development equipment	272.36	
	- Auxiliary Equipment & Handtools	26.20	
	Total F.O.B. Value	8503.16	
ii)	Insurance & Freight (@ 10% of FOB Value)	850.32	
iii)	C.I.F. Value	9353.48	
iv)	Import duty @ 6% on CIF value	561.21	
v)	Transportation @ 1% of CIF Value	93.53	
	Landed Cost of Sale (Sub total (3))		10008.22

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 63

('000 US $)

Sl. No.	Items	Value	Total
4.	Miscellaneous Fixed Assets		
i)	Transformers	87.60	
ii)	Switchgears	4.80	
iii)	Central Airconditioning system	76.78	
iv)	Illumination,Fans and Room Coolers	5.00	
v)	Water Pumps and Tank	1.56	
vi)	Compressors	6.00	
vii)	Fire fighting system	6.30	
viii)	Telecommunication system	11.00	
ix)	Office Furniture and Equipment	3.50	
x)	Vehicles	83.00	
	Sub-total (4)		285.54
5.	Preliminary Expenses	50.00	50.00
6.	Pre-operative Expenses		
i)	Establishment	1685.10	
ii)	Travelling Expenses	166.00	
iii)	Miscellaneous	55.00	
			1906.10
7.	Technical Know-how Fees	1791.00	1791.00
8.	Sub-total (1 thru 7)	-	48734.17
9.	Contingency @ 5% on above	-	2436.71
10.	Sub-total (8 & 9)	-	51170.88
11.	Interest during Construction	-	5603.30
12.	Margin Money for Working Capital	-	488.23
	TOTAL COST	-	57262.46

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILE ON STEAM BOILERS

PHASING OF CAPITAL EXPENDITURE

('000 US $)

	Total	Construction Period in quarters										
		1	2	3	4	5	6	7	8	9	10	11
[illegible]	[illegible]	0.00	2366.07	2366.07	2366.06	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]
[illegible]	7595.11											
[illegible] building	18574.75	0.00	0.00	3714.95	3714.95	3714.95	3714.95	3714.95	0.00	0.00	0.00	[illegible]
[illegible] building	714.74	0.00	0.00	0.00	0.00	238.25	238.25	238.24	0.00	0.00	0.00	[illegible]
[illegible] buildings	3335.47	0.00	0.00	0.00	0.00	1111.82	1111.82	1111.83	0.00	0.00	0.00	[illegible]
[illegible] transport [illegible]	4970.14	0.00	0.00	0.00	0.00	1656.71	1656.71	1656.71	0.00	0.00	0.00	[illegible]
[illegible]	30008.22											
[illegible]	3002.47	0.00	0.00	0.00	1501.23	1501.24	0.00	0.00	0.00	0.00	0.00	[illegible]
[illegible] delivery, and [illegible]	7005.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3415.30	3415.30	105.10	[illegible]

JOB NO. : DCIL-105

EXHIBIT : 64

('000 US $)

	Total	Construction Period in Quarters										
		1	2	3	4	5	6	7	8	9	10	11
[illegible] Assets	285.54											
[illegible]	87.60	0.00	0.00	0.00	0.00	17.52	0.00	0.00	0.00	70.08	0.00	0.00
[illegible]	4.80	0.00	0.00	0.00	0.00	0.96	0.00	0.00	3.84	0.00	0.00	0.00
[illegible] wing system	76.78	0.00	0.00	0.00	0.00	15.36	0.00	0.00	0.00	61.42	0.00	0.00
[illegible] Fans and [illegible]	5.00	0.25	0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.75
[illegible] and Tank	1.56	0.00	0.00	0.00	0.39	0.39	0.39	0.39	0.00	0.00	0.00	0.00
[illegible]	6.00	0.00	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.00	4.80	0.00
[illegible]	6.30	0.00	0.00	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	1.26
[illegible]	11.00	0.00	1.10	0.00	0.00	1.10	1.10	1.10	1.10	0.00	0.00	5.50
[illegible] Furniture and Equipment	2.50	0.00	0.18	0.18	0.00	0.00	0.18	0.00	0.00	0.18	0.00	1.79
[illegible] Vehicles	33.00	0.00	16.60	16.60	0.00	0.00	8.30	0.00	0.00	8.30	0.00	16.60
[illegible]	50.00	25.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
[illegible] Expenses	1306.10											
[illegible]	1685.10	0.00	20.95	49.34	63.44	63.44	75.86	75.86	75.86	81.86	81.86	1096.64
[illegible] Expenses	166.00	0.00	2.00	5.00	6.00	6.00	7.00	7.00	7.00	8.00	8.00	110.00
[illegible]	55.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
[illegible] Working Capital	1791.00	89.55	89.55	179.10	179.10	179.10	179.10	179.10	179.10	179.10	179.10	179.10
[illegible]	49314.17	119.80	2526.45	6337.37	7837.30	8514.17	6999.79	6991.31	3688.33	3830.37	384.99	1504.29
[illegible] Contingency @ 5% on above	2436.71	5.99	126.32	316.87	391.86	425.71	349.99	349.57	184.42	191.52	19.25	75.21
[illegible]	51170.88	125.79	2652.77	6654.24	8229.16	8939.88	7349.78	7340.88	3872.75	4021.89	404.24	1579.50

JOB NO. : DCIL-105

EXHIBIT : 65

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

PROJECT PROFILE ON STEAM BOILERS

ESTIMATION OF INTEREST DURING CONSTRUCTION

	Construction Period in Quarters											Total
	1	2	3	4	5	6	7	8	9	10	11	
[illegible] Expenditure	125.79	2652.77	6654.24	8229.16	8939.88	7349.78	7340.88	3872.75	4021.89	404.24	1579.50	51170.88
[illegible] Money	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	488.28	488.28
Total	125.79	2652.77	6654.24	8229.16	8939.88	7349.78	7340.88	3872.75	4021.89	404.24	2067.79	51659.16
Equity	63.45	1339.22	3381.25	4235.35	4668.63	3948.98	4014.20	2335.70	2452.17	670.67	1521.61	28631.23
Loan	63.45	1339.21	3381.25	4235.36	4668.62	3948.98	4014.21	2335.70	2452.16	670.67	1521.62	28631.23
Total	126.90	2678.43	6762.50	8470.71	9337.25	7897.96	8028.41	4671.40	4904.33	1341.34	3043.23	57262.46

JOB NO. : DCIL-105

EXHIBIT : 65

	Construction Period in Quarters											Total
	1	2	3	4	5	6	7	8	9	10	11	
Interest on loan												
- @ 14% p.a.	1.11	23.44	59.17	74.12	81.70	69.11	70.25	40.87	42.91	11.74	26.63	501.05
		2.22	46.87	118.34	148.24	163.40	138.21	140.50	81.75	85.83	23.47	948.83
			2.22	46.87	118.34	148.24	163.40	138.21	140.50	81.75	85.83	925.36
				2.22	46.87	118.34	148.24	163.40	138.21	140.50	81.75	839.53
					2.22	46.87	118.34	148.24	163.40	138.21	140.50	757.78
						2.22	46.87	118.34	148.24	163.40	138.21	617.28
							2.22	46.87	118.34	148.24	163.40	479.07
								2.22	46.87	118.34	148.24	315.67
									2.22	46.87	118.34	167.43
										2.22	46.87	49.09
											2.22	2.22
Total	1.11	25.66	108.26	241.55	397.37	549.18	687.53	798.65	882.44	937.10	975.45	5603.30
Debt/Equity	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

MEANS OF FINANCING :

EQUITY	28631.23
LOAN	28631.23
TOTAL	57262.46

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 66

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

PROJECT PROFILE ON STEAM BOILERS

MARGIN MONEY FOR WORKING CAPITAL

('000 US $)

Sl. No.	Item	Period (Days)	Cost	Bank Finance Available (%)	Bank Finance Available (Amount)	Margin Money
1.	Raw materials and Consumables	60	3056.03	100%	3056.03	0.00
2.	Finished Stock	30	1821.38	100%	1821.38	0.00
3.	Sundry Debtors	30	2465.75	100%	2465.75	0.00
Sub-total			7343.16		7343.16	0.00
4.	Expenses	30	488.28	0%	0.00	488.28
	Total		7831.44		7343.16	488.28

JOB NO. : DCIL-105 EXHIBIT : 67

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

PROJECT PROFILE ON STEAM BOILERS

STATEMENT OF PRODUCTION AND SALES

(in MT)

		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		60%	80%	100%	100%	100%	100%	100%	100%	100%	100%
30 MW Boiler											
Capacity	(No.)	5	5	5	5	5	5	5	5	5	5
Annual Output	(No.)	3	4	5	5	5	5	5	5	5	5
Sales	(No.)	3	4	5	5	5	5	5	5	5	5
150 MW Boiler											
Capacity	(No.)	2	2	2	2	2	2	2	2	2	2
Annual Output	(No.)	1	2	2	2	2	2	2	2	2	2
Sales	(No.)	1	2	2	2	2	2	2	2	2	2

JOB NO. : DCIL-105 EXHIBIT : 60

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

PROJECT PROFILE ON STEAM BOILERS

STATEMENT OF REVENUE

('000 US $)

	Average Selling Price (US $/MT)	OPERATING YEARS 1	2	3	4	5	6	7	8	9	10
50 MW Condenser	3600.00	10800.00	14400.00	18000.00	18000.00	18000.00	18000.00	18000.00	18000.00	18000.00	18000.00
150 MW Condenser	16000.00	19200.00	25600.00	32000.00	32000.00	32000.00	32000.00	32000.00	32000.00	32000.00	32000.00
Total		30000.00	40000.00	50000.00	50000.00	50000.00	50000.00	50000.00	50000.00	50000.00	50000.00

JOB NO. : DCIL-105

EXHIBIT : 69

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

PROJECT PROFILE ON STEAM BOILERS

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	17705.54	23607.39	29509.24	29509.24	29509.24	29509.24	29509.24	29509.24	29509.24	29509.24
Power	298.30	396.77	495.25	495.25	495.25	495.25	495.25	495.25	495.25	495.25
Water	6.62	8.83	11.04	11.04	11.04	11.04	11.04	11.04	11.04	11.04
Sub-total	18010.46	24012.99	30015.53	30015.53	30015.53	30015.53	30015.53	30015.53	30015.53	30015.53
Contingency (@ 5% on above)	900.52	1200.65	1500.78	1500.78	1500.78	1500.78	1500.78	1500.78	1500.78	1500.78
Total 'A'	18910.98	25213.64	31516.31	31516.31	31516.31	31516.31	31516.31	31516.31	31516.31	31516.31
B. Fixed Cost										
1) Labour & Plant Overhead *										
a) Direct labour	2355.86	2473.66	2591.45	2709.24	2827.04	2944.83	3062.62	3180.42	3298.21	3416.00
b) Indirect labour	640.28	672.30	704.31	736.33	768.34	800.36	832.37	864.38	896.40	928.41
c) Supervision	403.20	423.36	443.52	463.68	483.84	504.00	524.16	544.32	564.48	584.64
Sub-total	3399.34	3569.32	3739.28	3909.25	4079.22	4249.19	4419.15	4589.12	4759.09	4929.05

JOB NO. : DCIL-185 EXHIBIT : 69

('000 DS $)

	OPERATING YEARS									
	1	2	3	4	5	6	7	8	9	10
ii) Other Factory Expenses										
a) Maintenance @ 3%										
on Plant & Equipment	300.25	300.25	300.25	300.25	300.25	300.25	300.25	300.25	300.25	300.25
b) Maintenance @ 1%										
on Building & Civil Work	275.95	275.95	275.95	275.95	275.95	275.95	275.95	275.95	275.95	275.95
c) Miscellaneous	115.24	115.24	115.24	115.24	115.24	115.24	115.24	115.24	115.24	115.24
Sub-total	691.44	691.44	691.44	691.44	691.44	691.44	691.44	691.44	691.44	691.44
iii) Administrative & Sales Expenses										
a) Salaries *	987.22	1036.58	1085.94	1135.30	1184.66	1234.02	1283.38	1332.74	1382.10	1431.46
b) Overheads	197.44	207.32	217.19	227.06	236.93	246.80	256.68	266.55	276.42	286.29
Sub-total	1184.66	1243.90	1303.13	1362.36	1421.59	1480.82	1540.06	1599.29	1658.52	1717.75
Total (i+ii+iii)	5275.44	5504.66	5733.85	5963.05	6192.25	6421.45	6650.65	6879.85	7109.05	7338.24
Contingency (@ 5% on above)	263.77	275.23	286.69	298.15	309.61	321.07	332.53	343.99	355.45	366.91
Total B	5539.21	5779.89	6020.54	6261.20	6501.86	6742.52	6983.18	7223.84	7464.50	7705.15
Total Cost of Production and Sales (A+B)	24450.19	30933.53	37536.85	37777.51	38018.17	38258.83	38499.49	38740.15	38980.81	39221.46

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

JOB NO. : DCIL-105 EXHIBIT : 70

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

PROJECT PROFILE ON STEAM BOILERS

PROJECTED PROFITABILITY STATEMENT

('000 US $)

Elements	OPERATING YEARS									
	1	2	3	4	5	6	7	8	9	10
Raw Materials and Consumables	17705.54	23607.39	29509.24	29509.24	29509.24	29509.24	29509.24	29509.24	29509.24	29509.24
Power	298.30	396.77	495.25	495.25	495.25	495.25	495.25	495.25	495.25	495.25
Water	6.62	8.83	11.04	11.04	11.04	11.04	11.04	11.04	11.04	11.04
Labour & Plant Overhead	3399.34	3569.32	3739.28	3909.25	4079.22	4249.19	4419.15	4589.12	4759.09	4929.05
Other Factory Expenses	691.44	691.44	691.44	691.44	691.44	691.44	691.44	691.44	691.44	691.44
Administrative & Sales Expenses	1184.66	1243.90	1303.13	1362.36	1421.59	1480.82	1540.06	1599.29	1658.52	1717.75
Sub-total	23285.91	29517.66	35749.38	35978.58	36207.78	36436.98	36666.18	36895.38	37124.58	37353.77
Contingency	1164.29	1475.88	1787.47	1798.93	1810.39	1821.85	1833.31	1844.77	1856.23	1867.69
Total	24450.20	30993.54	37536.85	37777.51	38018.17	38258.83	38499.49	38740.15	38980.81	39221.46
Stock Variation	-1821.38	-524.01	-524.00	-14.67	-14.67	-14.67	-14.67	-14.67	-14.66	-14.67
Cost of Production and Sales	22628.81	30469.53	37012.85	37762.84	38003.50	38244.16	38484.82	38725.48	38966.15	39206.79
PROJECTED REVENUE	30000.00	40000.00	50000.00	50000.00	50000.00	50000.00	50000.00	50000.00	50000.00	50000.00
Profit before Interest and Depreciation	7371.19	9530.47	12987.15	12237.16	11996.50	11755.84	11515.18	11274.52	11033.85	10793.21

JOB NO. : DCIL-185 EXHIBIT : 70

('000 US $)

Elements	OPERATING YEARS 1	2	3	4	5	6	7	8	9	10
Interest										
On Term Loan - @ 14% p.a.	4008.37	4008.37	4008.37	3700.04	3391.70	3083.36	2775.03	2466.69	2158.36	1850.02
On Working Capital Loan - @ 16% p.a.	1174.91	1174.91	881.18	587.45	293.73	0.00	0.00	0.00	0.00	0.00
Sub-total	5183.28	5183.28	4889.55	4287.49	3685.44	3083.36	2775.03	2466.69	2158.36	1850.02
Profit before Depreciation	2187.92	4347.19	8097.60	7949.67	8311.07	8672.48	8740.15	8807.83	8875.49	8943.19
Depreciation and Amortisation	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85
Profit before Tax	-402.93	1756.34	5506.76	5358.82	5720.22	6081.63	6149.30	6216.98	6284.64	6352.34
Tax	0.00	374.43	1446.46	1440.98	1560.79	1678.72	1721.45	1762.56	1802.14	1840.33
Distributable Profit	-402.93	1381.91	4060.29	3917.84	4159.43	4402.91	4427.85	4454.42	4482.50	4512.01
Dividend	0.00	0.00	0.00	2863.12	3578.90	4294.69	4294.69	4294.69	4294.69	4294.69
Retained Earnings	-402.93	1381.91	4060.29	1054.72	580.53	108.22	133.16	159.73	187.81	217.32
Add Back : Depreciation & Amortisation	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85
NET CASH ACCRUAL	2187.92	3972.76	6651.14	3645.57	3171.38	2699.07	2724.00	2750.58	2778.66	2808.17

JOB NO. : DCIL-105 EXHIBIT : 71

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

PROJECT PROFILE ON STEAM BOILERS

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 Construct	Sub-Total	50% of Pre-op Expenses	Total	Rate (%)	Amount
1. Land & Land Development	7098.20	0.00	7098.20	0.00	7098.20	0.00	7098.20	0.00	7098.20	0%	0.00
2. Building & Civil Work	27595.11	1304.42	28899.53	1774.70	30674.23	4080.98	34755.21	694.17	35449.38	4%	1417.98
3. Plant & Mahinery	10008.22	473.08	10481.30	643.65	11124.95	1480.09	12605.04	251.76	12856.80	8%	1028.54
4. Miscellaneous Fixed Assets	285.54	13.50	299.04	18.36	317.40	42.23	359.63	7.17	366.80	12%	44.02
5. Preliminary Expenses	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	10%	5.00
6. Pre-operative Expenses	1906.10	0.00	1906.10	0.00	1906.10	0.00	1906.10	-953.10	953.00	10%	95.30
7. Technical Know-how Fees	1791.00	-1791.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0%	0.00
Sub-total	48734.17		48734.17		51170.88		56774.18		56774.18		2590.85
8. Contingency	2436.71	0.00	2436.71	-2436.71	0.00	0.00	0.00	0.00	0.00		
Sub-total	51170.88		51170.88		51170.88		56774.18		56774.18		
9. Interest during Construction	5603.30	0.00	5603.30	0.00	5603.30	-5603.30	0.00	0.00	0.00		
Total	56774.18		56774.18		56774.18		56774.18		56774.18		

JOB NO. : DCIL-105

EXHIBIT : 72

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

PROJECT PROFILE ON STEAM BOILERS

TAX COMPUTATION

('000 US $)

	OPERATING YEARS									
	1	2	3	4	5	6	7	8	9	10
Profit before Depreciation	2187.92	4347.19	8097.60	7949.67	8311.07	8672.48	8740.15	8807.83	8875.49	8943.19
Less : Current Depreciation	2187.92	2446.55	2311.75	2185.74	2067.89	1957.60	1854.34	1757.59	1666.91	1581.86
Balance	0.00	1900.64	5785.85	5763.92	6243.18	6714.88	6885.82	7050.24	7208.58	7361.33
Less : Unabsorbed Depreciation	0.00	402.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taxable Income	0.00	1497.72	5785.85	5763.92	6243.18	6714.88	6885.82	7050.24	7208.58	7361.33
Tax @ 25%	0.00	374.43	1446.46	1440.98	1560.79	1678.72	1721.45	1762.56	1802.14	1840.33

JOB NO. : DCIL-105

EXHIBIT : 73

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

PROJECT PROFILE ON STEAM BOILERS

DEPRECIATION FOR TAX

('000 US $)

	WDV Rate	Building & Civil Work 4%	Plant and Machinery 8%	Misc. Fixed Assets 10%	Amortisation 10%	Total
Value		35449.38	12856.80	366.80	1003.00	
Depreciation Year 1		1417.98	1028.54	44.02	100.30	2590.84
Balance		34031.41	11828.25	322.79	902.70	
Depreciation Year 2		1361.26	946.26	38.73	100.30	2446.55
Balance		32670.15	10881.99	284.05	802.40	
Depreciation Year 3		1306.81	870.56	34.09	100.30	2311.75
Balance		31363.34	10011.43	249.97	702.10	
Depreciation Year 4		1254.53	800.91	30.00	100.30	2185.74
Balance		30108.81	9210.52	219.97	601.80	
Depreciation Year 5		1204.35	736.84	26.40	100.30	2067.89
Balance		28904.46	8473.68	193.57	501.50	
Depreciation Year 6		1156.18	677.89	23.23	100.30	1957.60
Balance		27748.28	7795.78	170.34	401.20	
Depreciation Year 7		1109.93	623.66	20.44	100.30	1854.34
Balance		26638.35	7172.12	149.90	300.90	
Depreciation Year 8		1065.53	573.77	17.99	100.30	1757.59
Balance		25572.81	6598.35	131.91	200.60	
Depreciation Year 9		1022.91	527.87	15.83	100.30	1666.91
Balance		24549.90	6070.48	116.08	100.30	
Depreciation Year 10		982.00	485.64	13.93	100.30	1581.86
Balance		23567.91	5584.84	102.15	0.00	

WDV : Written Down Value

JOB NO. : DCIL-105

EXHIBIT : 74

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

PROJECT PROFILE ON STEAM BOILERS

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	3056.03	6112.05	7640.06	7640.06	7640.06	7640.06	7640.06	7640.06	7640.06	7640.06
2. Finished Stock	1821.38	2345.39	2869.39	2884.06	2898.73	2913.40	2928.07	2942.74	2957.40	2972.07
3. Sundry Debtors	2465.75	2465.75	2465.75	2465.75	2465.75	2465.75	2465.75	2465.75	2465.75	2465.75
TOTAL	7343.16	10923.19	12975.20	12989.87	13004.54	13019.21	13033.88	13048.55	13063.21	13077.88
Increase/(decrease)	7343.16	3580.03	2052.01	14.67	14.67	14.67	14.67	14.67	14.66	14.67
Stock Variation	1821.38	524.01	524.00	14.67	14.67	14.67	14.67	14.67	14.66	14.67

JOB NO. : DCIL-105 EXHIBIT : 75

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

PROJECT PROFILE ON STEAM BOILERS

PROJECTED CASH FLOW STATEMENT

('000 US $)

	Construction Period	Y 1	Y 2	Y 3	Y 4	Y 5	Y 6	Y 7	Y 8	Y 9	Y 10
A. SOURCES											
Increase in Share Capital	28631.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Increase in Term Loan	28631.23	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	7343.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Profit before Tax with Interest added back	0.00	4780.35	6939.63	10396.30	9646.31	9405.66	9164.99	8924.33	8683.67	8443.00	8202.36
Depreciation	0.00	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85	2590.85
TOTAL 'A'	57262.46	14714.35	9530.47	12987.15	12237.16	11996.51	11755.84	11515.18	11274.52	11033.85	10793.21
B. APPLICATIONS											
Increase in Capital Expenditure	51170.88	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	7343.16	3580.03	2052.01	14.67	14.67	14.67	14.67	14.67	14.66	14.67

JOB NO. : DCIL-105

EXHIBIT : 75

('000 US $)

	Y	E	A	R						
Construction Period	1	2	3	4	5	6	7	8	9	10
Interest										
a) Term Loan - @ 14% p.a.	5603.30	4008.37	4008.37	4008.37	3700.04	3391.70	3083.36	2775.03	2466.69	2158.36	1850.02
b) Working Capital Loan - @ 16% p.a.	0.00	1174.91	1174.91	881.18	587.45	293.73	0.00	0.00	0.00	0.00	0.00
Total Interest	5603.30	5183.28	5183.28	4889.55	4287.49	3685.44	3083.36	2775.03	2466.69	2158.36	1850.02
Tax	0.00	0.00	374.43	1446.46	1440.98	1560.79	1678.72	1721.45	1762.56	1802.14	1840.33
Dividend	0.00	0.00	0.00	0.00	2863.12	3578.90	4294.69	4294.69	4294.69	4294.69	4294.69
Repayment of Term Loan	0.00	0.00	0.00	2202.40	2202.40	2202.40	2202.40	2202.40	2202.40	2202.40	2202.40
Repayment of Working Capital Loan	0.00	0.00	1835.79	1835.79	1835.79	1835.79	0.00	0.00	0.00	0.00	0.00
TOTAL 'B'	56774.18	12526.44	10973.53	12426.20	12644.44	12877.99	11273.84	11008.24	10741.01	10472.25	10202.11
Opening Balance	0.00	488.28	2676.20	1233.14	1794.08	1386.79	505.31	987.31	1494.25	2027.76	2589.36
Surplus '(Deficit) during the Year (A - B)	488.28	2187.92	-1443.06	560.94	-407.29	-881.48	482.00	506.94	533.51	561.60	591.10
Closing Balance	488.28	2676.20	1233.14	1794.08	1386.79	505.31	987.31	1494.25	2027.76	2589.36	3180.46

JOB NO. : DCIL-105 EXHIBIT : 76

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

PROJECT PROFILE ON STEAM BOILERS

PROJECTED BALANCE SHEET

('000 US $)

		Y			B		A			R	
		1	2	3	4	5	6	7	8	9	10
	Share Capital	28631.23	28631.23	28631.23	28631.23	28631.23	28631.23	28631.23	28631.23	28631.23	28631.23
Add	Reserves & Surplus	0.00	978.98	5039.27	6093.99	6674.52	6782.74	6915.90	7075.63	7263.44	7480.76
	SHAREHOLDERS' FUND	28631.23	29610.21	33670.49	34725.22	35305.75	35413.97	35547.13	35706.86	35894.67	36111.99
Less	Intangible Assets	902.70	802.40	702.10	601.80	501.50	401.20	300.90	200.60	100.30	0.00
	TANGIBLE NET WORTH	27728.53	28807.81	32968.39	34123.42	34804.25	35012.77	35246.23	35506.26	35794.37	36111.99
Add	Term Loan	28631.23	28631.23	26428.83	24226.43	22024.03	19821.63	17619.23	15416.83	13214.43	11012.03
	CAPITAL FUND	56359.76	57439.04	59397.22	58349.85	56828.28	54834.40	52865.46	50923.09	49008.80	47124.02
Less	Net Fixed Assets	53280.63	50790.08	48299.53	45808.98	43318.43	40827.88	38337.33	35846.78	33356.23	30865.68
	Loss	402.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NET CURRENT ASSETS	2676.20	6648.96	11097.70	12540.87	13509.85	14006.52	14528.13	15076.31	15652.57	16258.34
A.	CURRENT ASSETS										
	Working Capital	7343.16	10923.19	12975.20	12989.87	13004.54	13019.21	13033.88	13048.55	13063.21	13077.88
	Cash & Bank Balance as per Cash Flow Statement	2676.20	1233.14	1794.08	1386.79	505.31	987.31	1494.25	2027.76	2589.36	3180.46
	TOTAL 'A'	10019.36	12156.33	14769.28	14376.66	13509.85	14006.52	14528.13	15076.31	15652.57	16258.34
B.	CURRENT LIABILITIES										
	Bank Loan	7343.16	5507.37	3671.58	1835.79	0.00	0.00	0.00	0.00	0.00	0.00
	TOTAL 'B'	7343.16	5507.37	3671.58	1835.79	0.00	0.00	0.00	0.00	0.00	0.00
	NET CURRENT ASSETS (A-B)	2676.20	6648.96	11097.70	12540.87	13509.85	14006.52	14528.13	15076.31	15652.57	16258.34

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JOB NO. : DCIL-105 EXHIBIT : 77

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

PROJECT PROFILE ON STEAM BOILERS

BREAK-EVEN ANALYSIS

('000 US $)

Sl. No.	Particulars		Amount
1.	Raw Materials and Consumables		29509.24
2.	Power		495.25
3.	Water		11.04
4.	Sub-total (1 thru 3)		30015.53
5.	Contingency		1500.78
6.	VARIABLE COSTS		31516.31
7.	REVENUE		50000.00
8.	CONTRIBUTION (7 - 6)		18483.69
9.	Labour & Plant Overhead*		4164.20
10.	Other Factory Expenses		691.44
11.	Administrative & Sales Expenses*		1451.21
12.	Sub-Total (9 thru 11)		6306.85
13.	Contingency		315.34
14.	Sub-Total (12+13)		6622.19
15.	Interest*		3556.25
16.	Depreciation		2590.85
17.	FIXED COSTS		12769.29
	BREAK-EVEN SALES	17*7/8	34542.05
	BREAK-EVEN POINT		69.1%
	CASH BREAK-EVEN SALES		27533.58
	CASH BREAK-EVEN POINT		55.1%

* Average over 10 years

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EXHIBIT : 78

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

PROJECT PROFILE ON STEAM BOILERS

INTERNAL RATE OF RETURN

('000 US $)

Year	Outflow	Inflow	Net Inflow
0	-57262.46	0.00	-57262.46
1	0.00	7371.19	7371.19
2	0.00	9530.47	9530.47
3	0.00	12987.15	12987.15
4	0.00	12237.16	12237.16
5	0.00	11996.50	11996.50
6	0.00	11755.84	11755.84
7	0.00	11515.18	11515.18
8	0.00	11274.52	11274.52
9	0.00	11033.85	11033.85
10	0.00	10793.21	10793.21

IRR 13.6%

Outflow Project Cost

Inflow Profit before Interest, Depreciation & Tax

SECTION - 13
PROJECT IMPLEMENTATION PLAN

PROJECT IMPLEMENTATION PLAN

The Steam Boiler manufacturing plant will be set up in Egypt. The implementation schedule of the key activities involved in setting up the plant is presented in Exhibit-79.

The programme covers a time span of 33 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 15 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 six 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 : 79

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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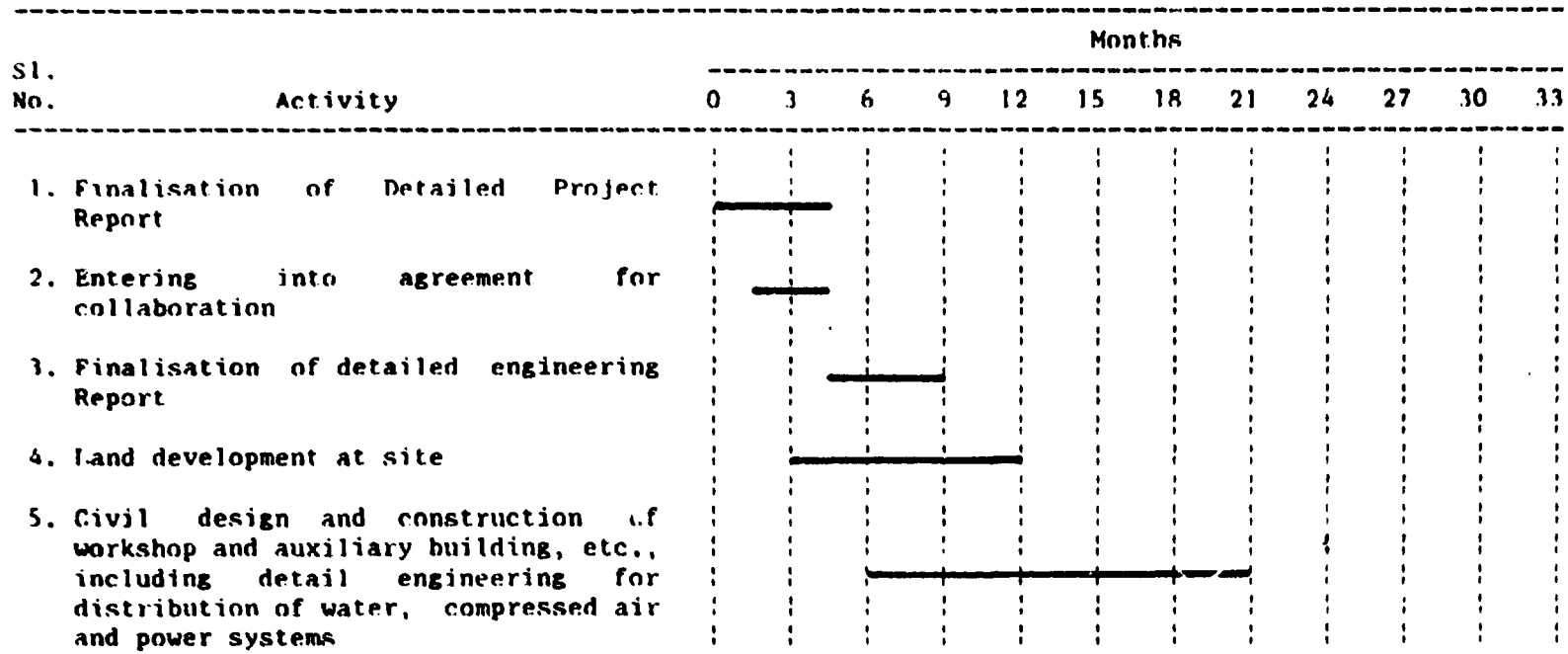
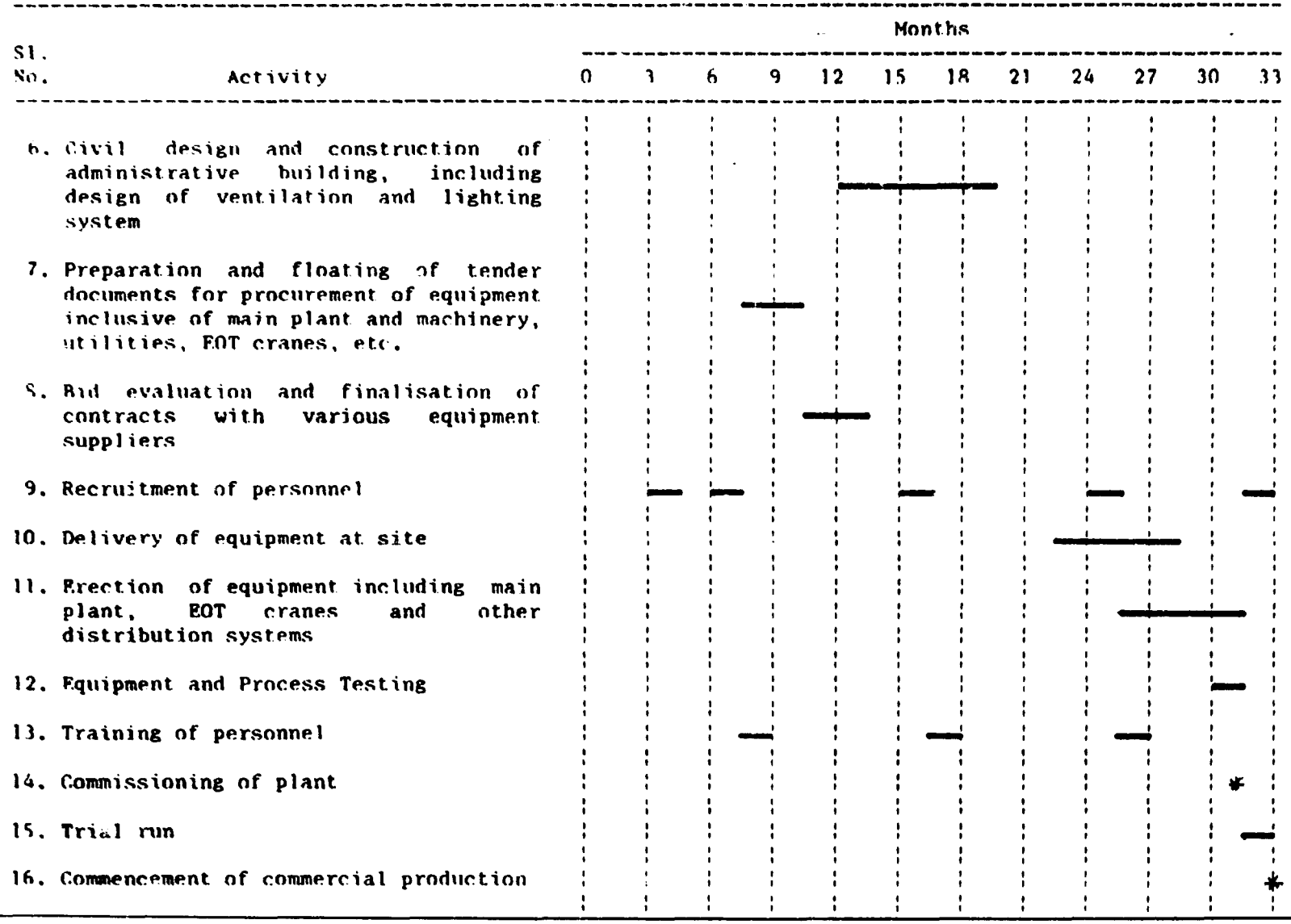
PROJECT PROFILE ON STEAM BOILERS

PROJECT IMPLEMENTATION SCHEDULE : STEAM BOILERS



JOB NO. : DCIL-105

EXHIBIT : 79



DEVELOPMENT CONSULTANTS

JOB NO.

DWG. NO.

REV. NO.

50.0

12.5

A

B

C

D

MAINTENANCE SHOP

24.0

12.0

254.0

154.0

12.0

V E S

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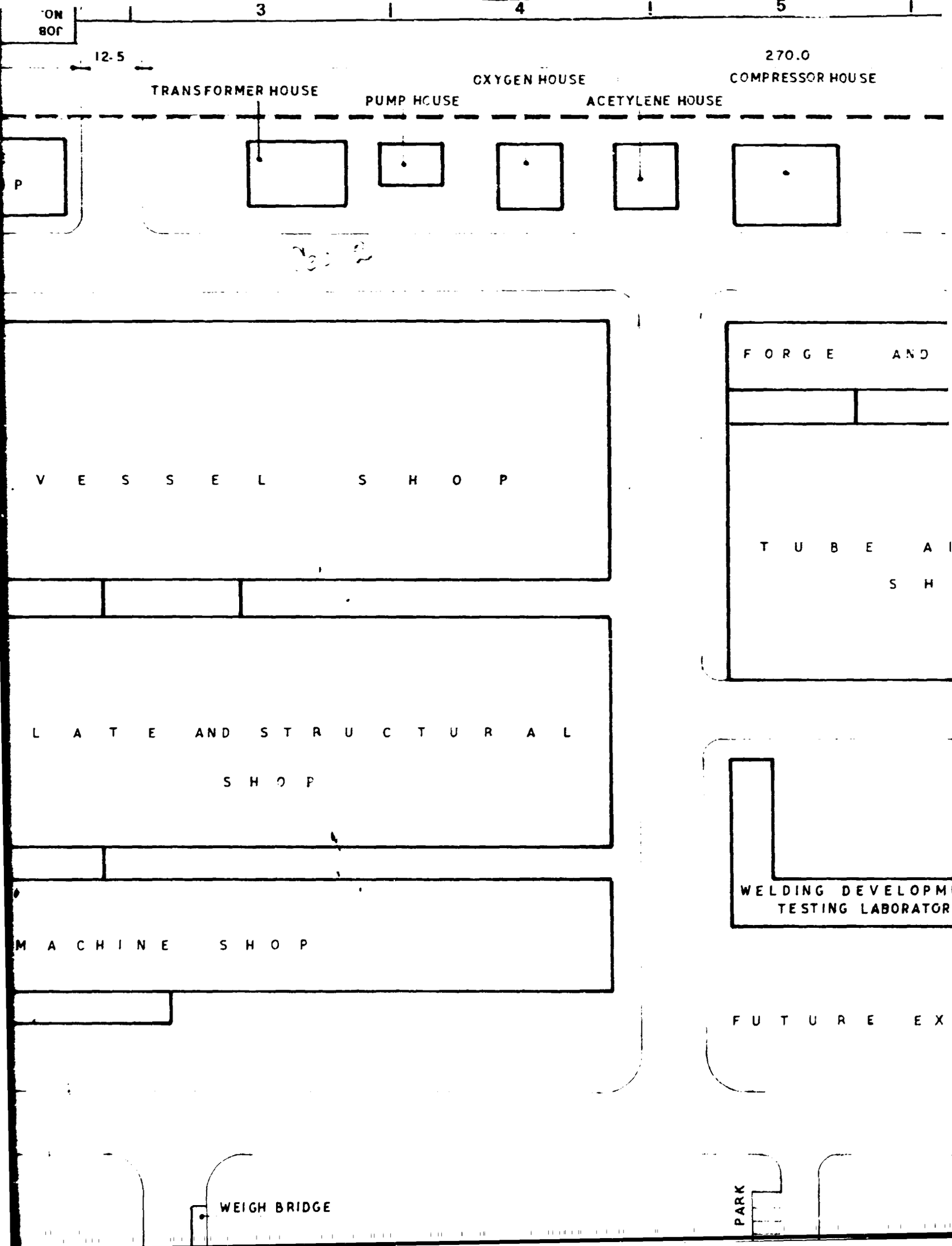
M A CHI


JOB NO.
3
4
5
12-5
270.0
TRANSFORMER HOUSE
PUMP HOUSE
OXYGEN HOUSE
ACETYLENE HOUSE
COMPRESSOR HOUSE
P
VESSEL SHOP
FORGE AND
TUBE A
SH
LATE AND STRUCTURAL
SHOP
WELDING DEVELOPM
TESTING LABORATOR
MACHINE SHOP
FUTURE EX
WEIGH BRIDGE
PARK

USE

TRAINING CENTRE

CANTEEN

12.5

AND HEAT TREATMENT SHOP

E AND PIPE SHOP

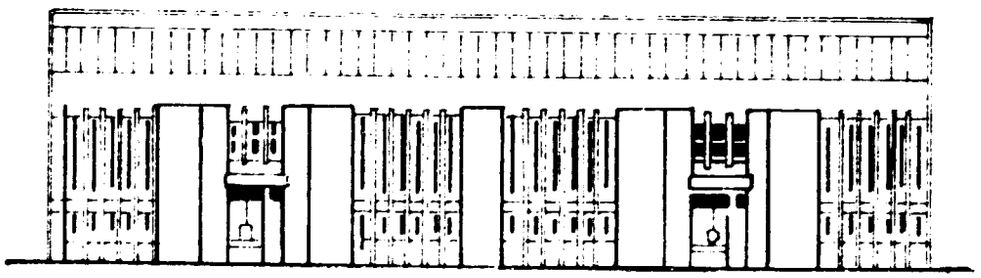
LOADING & UNLOADING AREA

FINISHED GOODS STORAGE

EVELOPMENT AND MATERIAL LABORATORY

RAW MATERIAL STORAGE

E EXPANSION



ADMINISTRATIVE BUILDING

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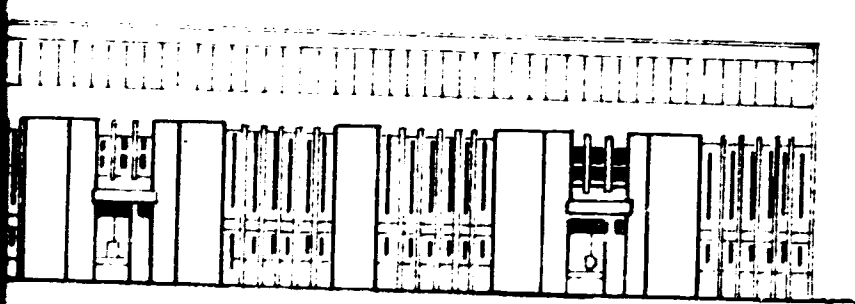
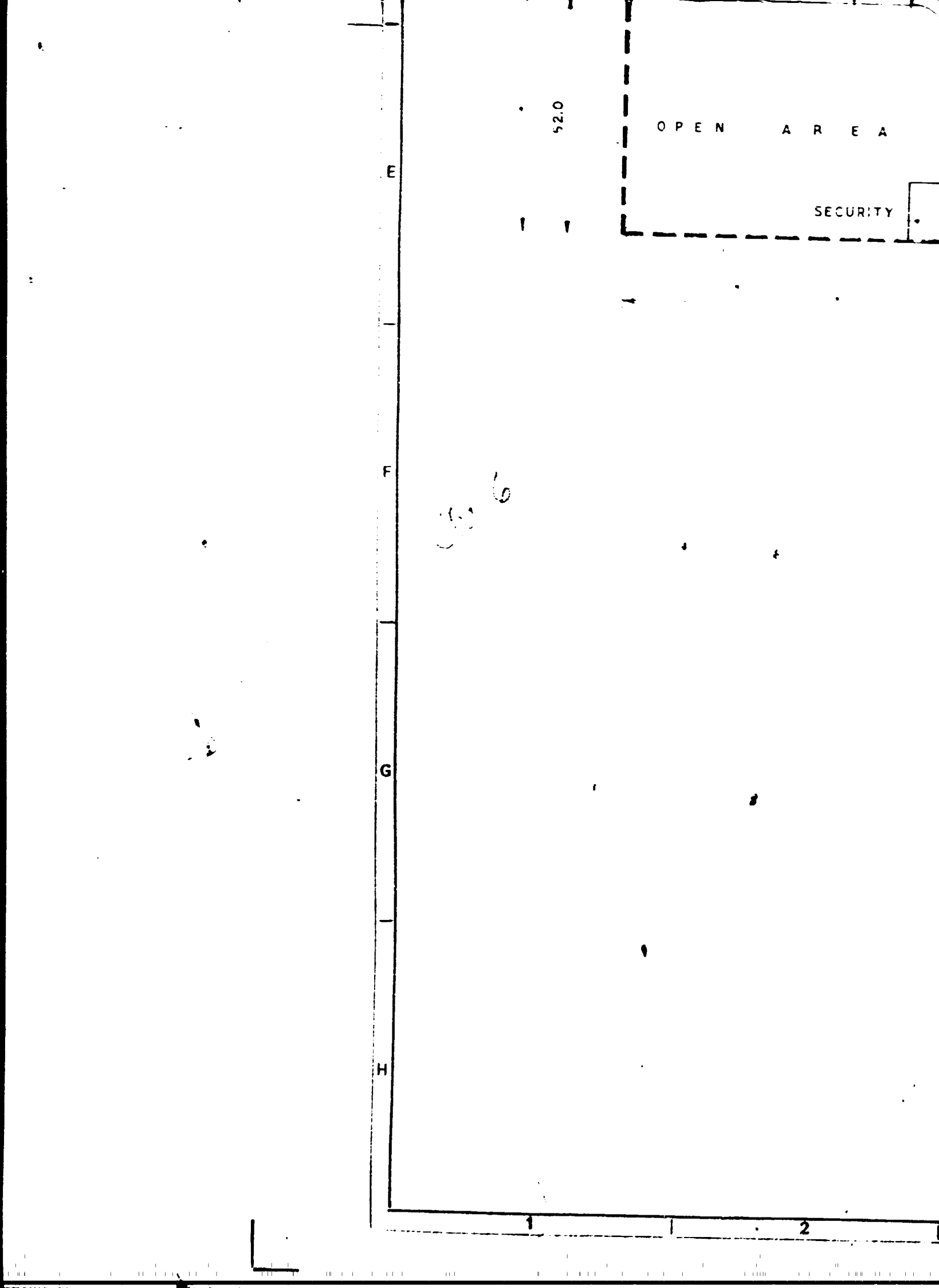


ADMINISTRATIVE BUILDING


52.0
OPEN AREA
SECURITY
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2

E A

URITY

WEIGH BRIDGE

O P E N A R E A

CAR PARK

SECURITY
&
FIRST AID

ADM I
B U I

345.0

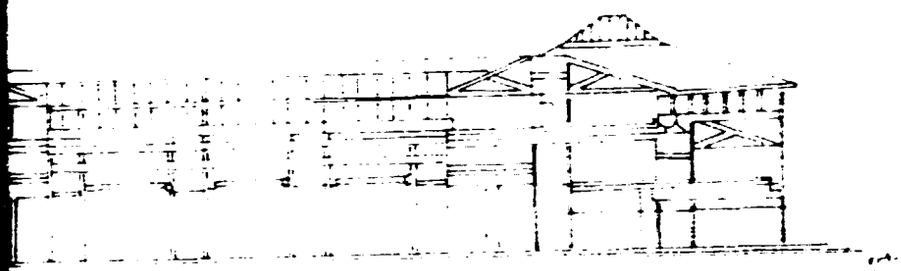
BLOCK LAYOUT

WELDING DEVEL

3 4 5

ADMINISTRATIVE BUILDING

TRANSPORT YARD



DEVELOPMENT AND MATERIAL TESTING LABORATORY

	ELEC	MECH	STRL	ARCH	NATURE OF REVISION & DESCRIPTION

BLOCK LAYOUT FOR STEAM BOILER MANUFACTURING

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZ
ARAB INDUSTRIAL DEVELOPMENT & MINING ORGANI

DEVELOPMENT CONSULTANTS

CONSULTING ENGINEERS

BOMBAY • CALCUTTA • MADRAS • NEW DELHI

DRAWN M.C	DESIGNED M.C	SCALE 1:7
PROJ ENGR.	ENG MGR	DATE 9.7.
DEPT. HEAD		JOB NO. DCIL

DWG. NO. EXHIBIT_34

RIPTION	RELEASE STATUS	DATE	REV NO

9 10 11 12

BLOCK LAYOUT FOR STEAM BOILER MANUFACTURING PLANT

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION &
ARAB INDUSTRIAL DEVELOPMENT & MINING ORGANIZATION

DEVELOPMENT CONSULTANTS LTD

CONSULTING ENGINEERS

BOMBAY • CALCUTTA • MADRAS • NEW DELHI

DRAWN M.C	DESIGNED M.C	SCALE 1:750
PROJ. ENGR.	ENG MGR.	DATE 9.7.93
DEPT. HEAD		JOB NO. DCIL-45010
DWG. NO. EXHIBIT_34		REV. NO.

STATUS	DATE	REV NO.

10 11 12

E F G H