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STUDY FOR DEVELOPMENT
OF
OPTICAL GLASS INDUSTRIAL PROJECT
IN INDIA

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(1 of 4)

SOMANAKI

SUMMARY AND CONCLUSIONS

FEBRUARY 1972

THE NATIONAL INDUSTRIAL DEVELOPMENT CORPORATION LIMITED
NEW DELHI, INDIA

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

STUDY FOR DEVELOPMENT OF CAPITAL GOODS INDUSTRIAL PROJECT IN IRAN

DRAFT FINAL REPORT

SUMMARY AND CONCLUSIONS

FEBRUARY 1972

THE NATIONAL INDUSTRIAL DEVELOPMENT CORPORATION LIMITED
NEW DELHI, INDIA

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SUMMARY AND CONCLUSIONS

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INTRODUCTION

In most developing countries, the seventies mark a turning on the old road: in Iran it will be even more so. The buoyancy of the economy, the re-negotiation of oil royalties and most important of all, the dynamism of industrial entrepreneurship gives the country great capacity to initiate activities beyond traditional capabilities. Collectively, these factors lend an element of optimism which, though largely intangible, is embedded in the facts.

It is therefore conceivable that the markets on which the wave of the future will rest will surpass what the pulls currently visible in the market place suggest. Capital Goods Industries recommended in this Study on a projection of the parameters of the current structure of demand are, therefore, only the minimum level of possibilities and the base for a more rapid take off. We are convinced that the recent acceleration in the tempo of growth, the massive addition to foreign exchange earnings permitting imports without restriction and finally the dynamic and entrepreneurial character of the administration will generate conditions for much greater development. The Capital Goods Industries suggested will themselves create a

new basis for more accelerated development later during the decade.

Even so, the framework of our Study must necessarily be set in the detailed structure of the consumer market in each of the numerous end-uses for which the machinery to be manufactured is to be deployed. The dominant factors here are the parameters of growth in domestic demand with annual growth rates in GNP, which, easily passing ten per cent, is steadily increasing to surpass targets deemed impossible a few years ago, and rapidly rising incomes.

Apart from the consumer demand in the domestic arena, a large group of products show an impressive potential for export. In the case of the oil and petrochemical industries, there are spectacular export possibilities which can be developed on Iran's obvious natural resources advantages. So also for Rubber Products, particularly Tyres and Tubes and Footwear, areas in which a well developed domestic industry is poised to take off into the export field. Even cement, a product which might look locked in because of high transport costs, has a rapidly growing export market, particularly in the Gulf States.

The study proceeds from a base of domestic consumer sales to forecast minimum exports that can be developed, to fix the lower point of market for planning capital goods industries. With active Government sponsorship for exports, there is reason to believe that estimates for the later part of the decade would in fact move upward so that the industries now suggested for implementation can be considered a safe minimum base and the requirements by the end of the decade will perhaps emerge higher than the demands currently visible.

In the net result, the study focusses on three new plants for Capital Goods and loading of Arak Machine Building Plant and Tabriz Machine Tool Plant to utilise fully and most profitably all existing units. The planning has been confined to the areas which have been specifically assigned to us. We are conscious that two large sectors - Electrical and Power Equipment and Consumer Durables including Automotive Plants - not to speak of the expanding Metallurgical Industry sector are outside the scope of our Report which is, therefore, only a fraction of Iran's total Capital Goods Industries plan.

Numbers can easily mislead on physical targets in volume or value of output. The three new units we have suggested together with loads we have allocated to AMBP and MEP represent an output in volume of about 72,000 tonnes annually and of value between 150 and 160 million dollars.

We are clearly of the view that Capital Goods Industries to be developed must become commercially viable when they have attained rated production after the appropriate price policies and import restrictions have been designed to prevent these infant industries from having to face undue competition from foreign imports. Where the tests of commercial viability are not likely to be achieved under these conditions, the cost to the country by protection could be prohibitive. If gestation periods are slightly longer than in more industrialized countries because of longer periods for training of labour, the position, we believe is justified since development of skills in sophisticated areas of manufacture is a national asset for which a price is legitimately to be paid.

The broad economic parameters presented in the Pre-feasibility Studies for the units indicate over the decade, a gross output of about 500 million US dollars (calculated at CIF prices of imported products) with

total investment of only 80 million dollars. Aggregated over the three new units Capital-Output ratio works out to 1:1.1 and Capital-Value Added ratio to 1:0.65 which compares favourably with plants of this type elsewhere. Foreign exchange requirements towards imported components will be 8.5 per cent of total output value, calculated at CIF prices.

Apart from the above identified units, we have envisaged development of existing medium scale fabricators of general engineering items both in terms of volume of output as well as in the deepening of technology and skills. A total of 13,500 tonnes per annum has been deliberately left for the smaller units in the private sector, particularly in the category of low pressure fabricated items, piping assemblies, and simpler varieties of construction equipment. There is no doubt that intensification of such small entrepreneurs strengthens the matrix of development.

The total picture is reassuring and, indeed, it is believed these proposals should make a notable contribution to development of the Capital Goods industries in Iran to the take-off stage for further accelerated growth.

2. THE STRUCTURE OF DEMAND

2.1. Of the items under study, the decade 1972-1982 is expected to witness a spectacular growth in production of Chemicals and Petro-chemicals, Rubber and Plastics and Oil Refinery operations. The Construction Group comprising cement, bricks, glass and construction equipment comes next, followed by the Food Processing Industries group.

2.2. Against present petroleum refining capacity of 595 MBD, Capacity by 1982 is expected to be around 1100 MBD. Growth in production of major petrochemicals and chemicals would be as follows:

	Tonnes per annum	
	1972	1982
Olefins and Aromatics	75,000	1,370,000
Fertilizers including Ammonia	728,000	1,782,000
Methanol	-	240,000
Fibres and Resins	3,000	348,000
Plastics and Rubber	20,000	295,000
Caustic Soda	24,000	274,000
Sulphuric Acid	430,000	860,000
Phosphoric Acid	158,000	308,000

The above, however, includes for export potential which, in this case, is very high on

account of Iran's obvious natural resources advantages.

2.3. Consumption of rubber products in terms of equivalent raw rubber is expected to move up from the 1970-71 figure of 28,350 tonnes to 111,000 tonnes by 1982, or an increase of 12 per cent per annum. The consumption of the most important group, in this category namely, tyres and tubes is expected to almost treble in the decade, and touch 145,000 tonnes in terms of finished product. In terms of percentage growth, however, the requirements of 'Other rubber products' including extruded, calendered and built up varieties would grow more considerably from 1760 tonnes in 1972 to about 33,000 tonnes by 1982, for increasing application in the expanding industrial nation.

2.4. Per capita plastic consumption is expected to rise at an average annual rate of 13.5 per cent over the decade so that the requirement of domestic plastic processing capacity would need to be expanded from around 40,000 tonnes per year existing to around 240,000 tonnes per year by 1982, even after allowing for marginal

imports in the form of finished equipment incorporating plastic components. The product-mix pattern of plastic processed foods will also undergo a radical change with an inevitable shift to industrial plastic goods such as 'extruded' and 'extruded and calendered' varieties.

2.5. Requirements of cement, bricks and sheet glass are closely dependent on investment in sectors involving construction activity. Even with moderate annual growth rates in these sectors as indicated in Table 1, domestic cement consumption is expected to rise from the present level of 3.0 million tonnes annually to over 16 million tonnes by the end of the decade representing an annual growth rate of 15 per cent.

Requirements of building bricks will follow a similar pattern and is expected to rise from around 3 billion pieces in 1972 to about 11 billion pieces in 1982. However, machine made brick usage would improve more considerably so that requirements of machine made bricks would go up from about 500 million pieces in 1972 to around 2700 million pieces by 1982, roughly an annual average growth of 18.5 per cent.

2.6 Such massive increases in construction activity as are foreseen obviously call for corresponding increases in construction equipment. A total of around 7800 Nos. of major items of construction equipment will be required during the period 1972-77, the corresponding requirements for the subsequent five year period being over 16,000 Nos. representing an annual increase of over 15 per cent. Requirements of a few selected items are given below :

	Requirements Nos.	
	1972-77	1977-82
Shovel Loader	1120	2350
Excavators	570	960
Scrappers	90	125
Dozers	1180	2360
Graders	1160	2350
Stone Crushers	170	285
Concrete Mixers	280	510

Sheet glass requirements for the domestic market would go up from around 48,000 tonnes in 1972 to over 140,000 tonnes in 1982.

Other major uses of glass are for glass bottles and glass shells for incandescent lamps and fluorescent tubes. Allowing for substitution by paper containers, forecast

demand for glass bottles is over 50,000 tonnes in 1982 against around only 16,000 tonnes in 1972, an average annual increase of around 12.5 per cent.

2.7. As may be expected, the increases in the major items of the 'Food Processing' group, are more moderate. Anticipated local demand for sugar by 1982 is only 1,325,000 tonnes as against the 1972 figure of 820,000 tonnes or an annual growth rate of only 4.8 per cent.

2.8. Similarly, growth in demand for vegetable oil is expected to rise at only 6.5 per cent per annum average for the decade, touching around 340,000 tonnes by 1982.

2.9. Demand for pasteurized milk and yoghurt will however rise faster, the projected annual growth rate being 11 per cent per annum over the decade. In terms of daily capacities, requirements are expected to rise from around 350 tons in 1972 to over 1000 tons in 1982.

2.10. Organised production of red meat is expected to nearly double in the decade from the 1972 figure of around 200,000 tonnes.

Vegetable and Fruit processing is expected to grow at about 14 per cent.

2.11. The expanding steel industry, as well as growth in cement, glass and other sectors will call for refractories of the order of around 210,000 tonnes in 1982 starting from a base figure of around 33,000 tonnes in 1972. Present local production of this item is negligible.

2.12. Present per capita consumption of footwear is already high, compared to many countries, including some in Europe. Even so, footwear consumption would increase significantly. Forecast requirements of all kinds of footwear is 125 million pairs in 1982, representing an annual increase over the decade of around 5 per cent. The consumption of plastic shoes, as a per cent of the total is likely to improve at the expense of the leather varieties.

2.13. Domestic availability of hides is expected to improve from 1.25 million pieces in 1972 to 1.47 million pieces in 1977 making it possible to taper down imports in spite of increased requirements of leather. In the

case of skins, the attempt should be to export them in the processed form rather than in the wet salted condition as at present. Finishing capacity of skins is therefore expected to nearly treble in the decade.

2.14. Ceramic Sanitaryware as well as ceramic tiles correspond in their growth pattern very closely with other items in the Construction Group. Forecast requirements of Ceramic Sanitaryware for 1982 is 8750 tons against 3000 tons at the beginning of the decade. The growth rate for ceramic tiles is somewhat higher, at 15 per cent, and likely demand in 1982 is 6.2 million square metres.

Demand for H.T. and L.T. Ceramic Insulators will increase in consonance with paver transmission programmes and will call for around 4,000 tonnes per annum of insulators by 1982.

3. POTENTIAL FOR EXPORT

3.1 Apart from requirements in the domestic arena, considerable export potential is foreseen for a large variety of the items under study. The greatest potential for export is clearly in the field of petrochemical products on account of the special position Iran enjoys from the point of view of raw material resources. In fact, many of the projects in this field, underway or being actively considered, are designed with a significant component of the export market in view. Though no detailed investigations as to the future export potential for such products has been undertaken by us, it is obvious that the potential will grow and will constitute a major parameter in the future development of this group. From indications available with various agencies, the probable projects in the decade, integrating export possibilities, have been identified to project the growth of the industry in the preceding section. However, we are of the opinion that the indications visible now underestimate the potential for the future and hence the growth forecast on such present

indications may be taken to represent only a safe minimum for immediate action.

3.2 Significant exports, though not as spectacular as for petrochemicals, can be foreseen for Rubber products, particularly Tyres and Tubes. in view of the well developed Tyre and Tube industry in the country. Export performance will no doubt be better in the later years since the establishment of export markets takes time. It is felt that by 1982, approximately 15 per cent of local production can be exported, starting at the beginning of the decade with around 7 per cent only. In terms of volumes, this would mean an almost ten fold rise from 2800 tons in 1972 to 21,500 tonnes in 1982. Ambitious as this may seem, it is clearly within the realm of achievement, given the dynamism and entrepreneurship which is so evident in Iran.

3.3 Even a commodity like cement which, at first sight appears locked in because of transportation costs, shows considerable potential for export, especially to the Gulf States. Already, cement

is being exported from Iran and entrepreneurs are thinking of export oriented projects. The high point of exports of 1965-1966 was already at around 100,000-120,000 tons, though in later years this has tended to taper down somewhat. A target of 100,000 tons, for 1972 is therefore clearly realistic for achievement. By the end of the decade, it should be possible to export approximately 10 per cent of local production or 2.5 million tons.

3.4 A fourfold increase in Sheet glass has been taken for our projections considering the increase in construction activity in adjacent countries. In terms of percentage of production, this would mean in increase from around 6 per cent in 1972 to 25 per cent by the end of the decade.

3.5 Exports of footwear are already well established and it should be possible to reach a target of 20 per cent of local production by 1982 rising from around 10 per cent in 1972/73.

3.6 Table 2 gives the levels of local production during the decade for major items, excluding Refinery Products and Chemicals.

4. SUPPLY - DEMAND BALANCE FOR CAPITAL GOODS

4.1 Grouped requirements of plant and equipment excluding electricals and instrumentation necessary for additional capacity that must be generated to meet forecast local production for the items under study are as follows :

Category of Equipment	Requirement (tonnes) 1972-77	1977-82	1982-87
Pressure Vessels	34,544	25,904	25,904
Storage tanks, Bins, Low pressure fabrications	62,200	63,042	66,607
Heat Exchangers	17,594	13,862	13,862
Furnaces & Kilns	1,341	15,732	16,873
Conveyor (Belt, Apron, Screw)	1,474	8,411	10,966
Bucket Elevators	48	111	201
Ball Mills & Batchers	161	6,636	7,805
Crushers & Feeders	702	4,924	6,766
Filters - Drum & Plate	644	1,983	2,893
Pumps & Compressors	1,911	2,854	3,031
Screws, cyclones, Ventilators	300	1,700	2,129
Mechanical Eqpt.	3,336	8,239	11,846
Technological structures	4,380	18,260	21,391
Miscellaneous	4,908	10,127	12,479
Plastic and Rubber processing eqpt(Nos.)	814	1,514	2,228
Tannery & Leather Equipment (Nos.)	340	557	986

4.2 A portion of the above requirements such as special duty compressors, special machinery for production of glass bottles, sheet glass etc. would have to be imported for some time to come, since they do not form viable loads for local manufacture and/or demand a highly developed industrial base for supply of parts and components. The remainder has been planned for production in existing establishments or new units. Of the existing units, Arak Machine Building Plant has basic process capability for making almost the whole range of requirements. However, in determining the most rational manner for bridging the gaps, it is essential to take cognisance of a new vital factors. Some of the major factors which have influenced the recommendations containe d in this report are discussed below :

4.2.1 Large facilities such as Arak Machine Building Plant are by nature capital intensive and their best utilisation lies in the manufacture of high technology items. At the same time, they are more likely to be uncompetitive in the lower technology categories

such as storage tanks, simple conveyors and elevators, normal varieties of cranes etc. where the smaller fabricator is likely to be able to offer better prices.

4.2.2 The A.M.B.P. has all the basic facilities required for making a large variety of plant and equipment that will be needed. Their total output capability which is in the range of 30,000 to 40,000 tonnes per annum, would however be required to be expanded considerably if the gaps are to be bridged. It is considered that the A.M.B.P. is already perhaps at a level slightly beyond the managerial optimum plant size in the current context of Iran. Hence substantial expansions to the A.M.B.P. programme have not been recommended even though there would be pockets of under-utilisation in plant and equipment at their envisaged level of output. The attempt has been to utilise such surplus capacities in the best possible manner by addition of balancing equipment, taking care to see that the plant size is not thereby greatly enhanced.

4.2.3 Since product design and production documentation for the items to be manufactured would have to be imported and cadres of technical personnel trained, it i s felt that duplication of manufacture for the same item must be avoided as far as possible. It may be argued that such a policy would tend to create monopoly suppliers in the country and may not be conducive to healthy competition which makes for efficiency. Even so, at the present stage, it is felt that the better alternative is to avoid duplication of manufacture for similar items.

4.2.4 The programme envisaged by A.M.B.P. authorities is a highly diversified one and it is felt that in the allocation of items for manufacture as between the existing facilities and new units, the attempt should be to reduce the variety of products in A.M.B.P. programme.

4.2.5 Some of the items of plant and equipment required are basically cutom-made and hence demand supporting design and drawing office facilities. The A.M.B.P. is already developing such a nucleus capability and hence the attempt

has been to allocate to it such items as warrant design and drawing office support. This is particularly significant because the development of design capability is time-consuming and considering the availability of superior levels of technical personnel in the country, proliferation of design capability may not be immediately feasible.

4.2.6 Customer preference in many industries is to have equipment supplies on as turn-key basis as possible. Therefore, it is recommended that the production programmes of the different units should be so designed as to offer the largest number of items that enter into a single plant, though, some integration with other manufacturers would be inevitable if the factors earlier mentioned are also taken into account.

4.3 In consideration of the above, the recommended production programme for Arak Machine Building (A.M.B.P.) plant is as follows :

	Stage I	Stage II
Pressure vessels	6500	6500
Heat Exchangers	2700	2700
Conveyors and Elevators	1725	Nil
Mine Cars	1000	1000
Gear assemblies	850	850
Boilers	2500	2500
Earth Moving Equipment	4500	8500
Rollers	2000	5000
Crushers etc.	300	500
Concrete mixers	300	600
Asphalt laying plants	250	250
Aluminium and Stainless Steel fabrications	700	700
Tower Cranes	800	1600
Parts for agricultural machinery	2500	Nil
Structurals	4000	1200
Castings and Forgings for sale	5000	4000
Total	35,625	35,900

4.4 Requirements of balancing equipment to enable A.M.B.P. take up the re-adjusted programme will call for an invetment of US $ 2.19 million.

No additional constructions will be required and the new items of equipment can be accommodated in the existing layout.

4.5 Plastic Injection Moulding machines can be easily made at Mettalurgical and Engineering Plant, Tabriz without any addition of equipment and will also fit in excellently into their machine tool manufacturing programme.

4.6 The new Pump Unit to be established as an adjunct of MEP, Tabriz can easily integrate manufacture of process pumps upto an upper limit of 100 cu.m. per hour and 500 m. head. Since the unit is in the planning stage, the additional requirement should be taken care of in selection and sizing of equipment for the new unit.

4.7 Much of the requirements of storage tanks and association technological structures pertains to on-site work, particularly for refineries. Centralised facilities for manufacture of this item is therefore not desirable, particularly as refinery locations may be dispersed to meet regional demand. Hence this gap is best

bridged by dispersed small scale capacity who would perhaps integrate also associated piping work in such facilities.

4.8 The balance of the requirements of plant and equipment are proposed to be met by creation of new facilities. Such facilities are proposed as follows :

Unit I : Plant for manufacture of rubber and plastic processing equipment;

Unit II : Plant for manufacture of cement, sugar and allied equipment;

Unit III: Plant for manufature of construction machinery.

4.9 The Supply-Demand balance is presented at Table 3.

4.10 However, it must be mentioned that two major sectotors namely, Power generation and Metallurgical industries are outside the scope of the present study. The Capital goods called for by these sectors are such as can be made in facilities such as Arak Machine Building Plant. Should the requirements of such sectors make it possible to reduce variety of AMBP programme by transferring some items now suggested into a separate facility, the same should be examined.

5. FEASIBILITY OF PROPOSED NEW UNITS

5.1 Proposed production programmes of the three new units are as follows :

Item	Unit	Annual Quantities Stage I	Stage II
Unit 1			
Plastic Extruders	Nos.	50	70
Film Extruders	Nos.	15	25
Blow Moulding Machines	Nos.	25	35
Profile Calenders	Nos.	75	100
Thermosetting Plastic Presses	Nos.	50	70
Tyre Presses	Nos.	25	30
Tyre Building Machines	Nos.	15	20
Total (Unit 1)		255	350
Unit 2			
Furnaces and Kilns	Tons	3250	3350
Fabricated Vessels	Tons	1950	2500
Heat Exchangers	Tons	250	275
Conveyors	Tons	400	2250
Ball Mills	Tons	1300	1750
Crushers	Tons	1000	1750
Filters	Tons	400	600
Screens	Tons	150	200

Item	Unit	Stage I	Stage II
Other Mechanical Equipment	Tons	800	1200
Technological Structures	Tons	500	625
Total (Unit 2)		10,000	14,500
Unit 3			
Dozers	Nos.	200	400
Graders	Nos.	200	400
Scrapers	Nos.	20	25
Shovels/Loader	Nos.	250	450
Total (Unit 3)		670	1,275
Spares	Tons	1,850	3,500

5.2 Broad financial estimates for the above units are given below :

	All figures in million US Dollars	
	Stage I	Stage II
Unit 1		
Fixed Investment	3.34	3.98
Working Capital	0.76	0.98
Annual Cost of Sales	3.13	4.03
Sales Value (at CIF prices of comparable products)	4.43	6.00
Gross return on total capital %	31.90	39.80

	Stage I	Stage II
Interest Rate of return %	21.40	24.90
Value Added, gross	3.40	4.63
Annual Savings in Foreign Exchange	4.06	5.49
Unit 2		
Fixed Investment	20.50	23.90
Working Capital	4.15	6.00
Annual Cost of Sales	15.54	21.95
Sales Value (at CIF prices of comparable products)	19.10	28.22
Gross Return on total capital %	14.50	21.00
Interest Rate of Return %	11.80	16.70
Value Added, gross	11.73	17.38
Annual Savings in Foreign Exchange	17.15	23.36
Unit 3		
Fixed Investment	24.20	32.60
Working Capital	6.95	12.41
Annual Cost of Sales	23.48	40.06
Sales Value (at CIF prices of comparable products)	28.00	52.60
Gross Return on total Capital %	14.50	27.90
Interest Rate of Return %	10.30	18.60
Value added	15.95	30.07
Annual Savings in Foreign Exchange	24.45	46.77

5.3 Stage I indicated may be considered to be only a stage in the build-up of plant capacities to final full rated values. The plants can, therefore, expect to graduate into stage II operations without any serious constraints of market. For Unit 2, in particular, substantial loads will be available from the very beginning from the volumes left for realisation for smaller general engineering facilities such as, low pressure fabrication and simpler varieties of construction equipment.

5.4 The plants are, by general tests, commercially viable propositions and are recommended for further detailed action for ultimate implementation. A suggested programme of investment and production build-up is presented in Table 4.

5.5 Manpower requirements for the ultimate stages of plant build-up are as follows :

	Units		
	1	2	3
Managerial	14	40	75
Supervisory technical	29	105	255
Supervisory non-technical	10	25	45
Skilled Workers	100	375	875
Semi-skilled Workers	80	300	650
Unskilled Workers	50	200	425
Clerical and Administrative	32	75	125
Total :	315	1120	2450

5.6 The following feeder industries are recommended for more detailed examination. Required annual quantities for programmes in this study are indicated for integration with requirements for other sectors :

	Tons per year by 1982
Pipes	10,500
Valves and Fittings	1,500
Castings	9,600
Forgings	1,100
Fasteners	600
Dies and Moulds	500
Forged Grinding Media	16,000
Hydraulics	1.87 million dollars.

6. TECHNICAL INFRASTRUCTURE AND INSTITUTIONAL ARRANGEMENTS

6.1 Apart from actual manufacturing capability, profitable plant operations depend, to a large extent, upon a number of other factors calling for institution and development of a technical infrastructure to support such facilities. Apart from other aspects such as availability of credit facilities, the major technical problems that must be resolved, are the following:

6.2 Product Designs

It is vital that the products selected for manufacture are the ones which have evidenced adequate consumer acceptance. Such a course will relieve the plants in their initial years of a major burden of creating markets and the aggressive selling that is inescapable when new products are to be introduced. At the same time, many of the industries under study have, in the past, been accustomed to designs emanating from selected countries mostly of the Western World. This factor needs to be kept in view when selecting products for manufacture so that

the best designs easily acceptable to the industries concerned are chosen. In some cases, like for the Oil or Petro-chemical industry, it is inescapable that some part of the total equipment requirements would still have to be imported and any equipment produced by local manufacturing facilities must necessarily conform to designs, standards, practices and usage adopted by the turn-key consultant/equipment supplier. It is therefore essential that a proper review of probable processes that will be adopted be made, sources of turn-key responsibility wherever applicable is identfied and product designs be inducted from countries or agencies which can fit into such a situation. This is particularly significant in the case of fabricated equipment for the Oil and Petro-chemical industry since equipment in these cases are custom made and must necessarily conform to the processes that are adopted, unlike in the case of machine tools where a much wider choice is often available.

6.3 Market Research

General engineering facilities, by their very nature, incorporate considerable flexibility for varying their productmix since they are, in a sense, an agglomeration of different process capabilities which can be deployed for manufacture of a wide range of products. It is also usual for requirements of the different types of products to fluctuate somewhat so that an absolutely steady load in terms of specific products might not always obtain. Such a situation calls for constant market forecasting to appraise plant managements of trends of demand and future potential. Specifically, the Market Research Agency would identify future potential customers, likely quantity requirements, trends relating to changes in designs and capacities of custom built equipment etc. so as to provide adequate load time to plant managements for re-organising production and concurrent design to respond adequately to needs. Unless this is done, it is often seen that, inspite of local manufacturing capability

existing, delivery schedules stipulated by customers cannot be met and imports would have to be countenanced. Advance planning and for design/fabrication drawings, material procurement and production scheduling is vital for general engineering facilities. Market Research and Forecasting has become specialised activity involving use of specialized techniques so much so that even large and established organizations are employing specialized agencies for this purpose. In view of this and considering that new plants have to contend with a number of problems of day to day working in the initial stages of their operations, it is recommended that a Central Market Forecastin Agency be set up to carry out this work on a continuing basis and feed the results of their studies to plant managements.

6.4 Collaboration

The choice of product design almost automatically guides the choice of the collaborator. Customer preference is an amalgam of a number of diverse

factors and even where two products are identical, a particular brand name to which the customer has been accustomed is invariably preferred. This is not to suggest that alternatives should not be examined in the light of terms and conditions available from alternative collaboration sources. The point that has to be borne in mind is that, even at the expense ofmarginal advantages, a collaborator whose product is already familiar and accepted in the country is to be preferred.

A number of alternative forms of collaboration is possible depending upon the circumstances. One method which is most likely to be successful is the joint venture manufacturing project with leading international manufacturers with acceptable brand names for setting up facilities in Iran. If such manufacturers already have a substantial share of the local market, it is also conceiveable that theymight be more anxious to enter into joint venture arrangements.

Both lumpsum payments and annual royalties as also varying admixtures of the two are possible. Generally speaking, the preferred arrangement would be for inducting product design and production technology through license fees or royalty payments rather than outright purchase on lumpsum payments. Such a procedure would not only relieve the new plants of a considerable financial burden in their capital outlays but would also ensure the collaborator participating more actively in the plant's operations and is more conducive to latest designs and technology being available to the local manufacturing facilities.

6.5 Design

Many of the items of plant and equipment required by the process industry are custom made for the particular process. At the same time, process development in this group is very rapid so that plant and equipment designs are quickly rendered obsolescent. In the Oil and Chemical industry, it is usual for process designers to supply skeleton drawings for pressure vessels

leaving it to the fabricator to develop detailed mechanical designing and shop fabrication drawings; for heat exchangers, engineering data and skeleton drawings are sometimes furnished by the process engineer though in many instances, only heat transfer capacities are stipulated so that it becomes essential for the equipment manuf cturer to develop the detailed designs and fabrication drawings; for specialised furnaces, in fact, design know-how owners throughout the world are few and often it becomes necessary for fabrication to be carried out from drawings purchased on a case by case basis. The above implies that design and drawing office capability must be available to the local manufacturer either through his own inhouse capability or through local consultants. In the beginning, it may perhaps be inescapable to obtain engineering data and skeleton drawings from foreign sources, usually the process designers. However, consultant engineering organisations in the country - such as Technolog - should be encouraged to enter into collaboration

arrangements to develop capability for design of pressure vessels, heat exchangers, cement kilns etc. so as to offer the necessary support to local manufacturing organisations. It is not considered desirable for manufacturing organisations to get involved in such detailed design work which calls for research and development and concurrently for a knowledge of process engineering. Such a procedure has been tried with excellent results in other developing countries and it is felt that Iran would also profit by adopting a similar pattern.

6.6 Standards

Local equipment, if it has to be acceptable, must necessarily conform to strict design and inspection standards. National standards for Iran are being developed but, as yet, there are many areas where they are still to be evolved. Till such time as national standards on a comprehensive basis are evolved and can be enforced, there is no escape for local manufacturing facilities adopting other countries' standards - often the standards desired by the customer.

Obviously, with customers who have been accustomed on account of prior equipment usage to a variety of standards - generally as applicable in the countries of origin of previous equipment purchased - this will involve additional strain on manufacturing facilities in the country as also of such consultant organisations who may be encouraged to develop for providing design support to the manufacturing facilities. With the increase in local manufacturing activity that is being suggested, the urgency of developing national standards is greatly enchanced so that a uniform design code is available for the manufacturing facilities to follow in all cases. Needless to say, the effort involved in developing inspectors on the shop floor will be greatly reduced if the variety of standards to be conformed to is decreased. It is therefore recommended that an action programme be drawn up stimulating the standards that needs to be evolved on a priority basis so that the Iranian Standards Institute can come up with the requisite standards in the next 4-5 years. If such an action programme is evolved and implemented, the new plants would have a set of national standards to go by when their operations commence.

6.7 Standardization of Plant Sizes

Quite apart from the question of standards is the other question of standardization of plant sizes. This would apply particularly to industries like cement, glass, refractories, vegetable oil, sugar and similar units where, throughout the world, there are already more or less standard plant sizes evolved from availability of series-produced equipment along the line. If one or two standard sizes in each of the industries is enforced, it would be possible for the plant manufacturing such equipment to procure designs from acceptable and internationally reputed sources for use on all the plants expected to be set up in the coming years, unless significant modifications are introduced by the original design suppliers. Such standardization would facilitate the distribution of the cost of product design and production documentation can be distributed over a number of customers, a factor which will make for reduced costs. It may be stressed that if product design and production documentation has to be purchased in each individual case, there does not seem to be any hope of local equipment being anywhere near

being competitive with imported equipment.

While it may be argued that a particular plant size not co-incidental with the standard size would lead to economies in operation, the question needs to be viewed against a totality of factors. If capacity for local manufacture is to be created, circumstances must be generated for such capacity to operate profitably. There will no doubt be some exceptions on account of special circumstances obtaining in particular cases.

As local design and development capability increases and export markets for manufactued products grow, the need for importing product design and production documentation will dwindle and the restrictions of specified standard sizes will automatically disappear.

It is, therefore, suggested that an authority be identified to review the situation for each industry and recommend suitable standard plant sizes for enforcement. Such an authority can be a committee comprising user industries and technical officers of Government and necessary

technical studies may be carried out by Consultants or industry experts obtained through UN offices. Early action in this regard is suggested so that identification of standard plant sizes can be completed in time for new plants obtaining necessary production documentation and arranging for training etc. before commencement of operations.

6.8 Testing and Certification

A significant portion of the equipment suggested for local manufacture is for use under severe conditions of stress and hazardous environment e.g. equipment for use in Oil and Chemical industry. It is, therefore, most essential that local plant manufacturers supply equipment to strict standards, in terms of quality of material, design and workmanship. This can best be ensured by instituting a National Inspecting and Testing Authority backed by adequate testing facilities and trained personnel to certify all equipment for use. Such certification should be enforced by statute where safety to life and property is involved. The creation

of such an authority with statutory backing will, it is believed, go a long way in ensuring quality and minimizing hazards due to faulty workmanship or design.

6.9 Statutory Codes

In addition to currently existing facotory laws and rules which are directed at such aspects as hours of work, working conditions in factories etc., it is recommended that a set of rules should be evolved early dealing with safety of equipment. Such rules would prescribe minimum standards for design, fabrication, testing and erection and would be enforced by statute. These rules are to be distinguished from design codes to be evolved by Iranian Standards Institute and would be directed at preventing hazards on account of inadequate equipment. Such rules would form the basis for the Testing and Certification authority mentioned earlier.

6.10 Protection

It is well known that heavy engineering facilities call for large investments and involve long

gestation periods. Such being the case, it will be necessary for concerned authorities to assist the plants with a measure of protection so as to ensure the production and sale of items manufactured. Till such time as the complete matrix of industrial infrastructure is developed including local availability of parts, components and raw material as well as design and development, prices of local products may tend to be somewhat higher than the prices of imported products. At the same time, it is also not unusual for exporting countries to subsidise exports in some form or the other so that export prices are lower than local prices even in the exporting country. Simultaneously, there are cases of exporting countries dumping products at untenably low prices for the purposes of capturing new markets. It is, therefore, not always as simple as it seems to say that because prices at which imported products are much lower than those of local manufactured goods, that local manufacture is inefficient.

It becomes, therefore, necessary during the initial years to afford protection to local industry though this may not always be co-incidental with general economic policies The problem has

often to be viewed in the context of establishing an industrial base in the country and reducing dependence on imports. It is conceded that the protection would have to be judicious to see that incompetence and inefficiency is not encouraged. Apart from marginal price protections, it must be ensured that if the local manufacturer is about to deliver the goods in reasonable time and of acceptable quality the same will be excluded from foreign suppliers even where total project agreement backed by liberal credits are concerned.

6.11 Turn-key Contracts

If local equipment usage has to be maximised, local manufacturers of plant and equipment must be encouraged to quote for execution of complete projects on a turn-key basis. Turn-key project countracts not only afford wider margins to manufacturers but are also conducive to building together an integrated work team and affording job satisfaction to the best technical men.

6.12. Investment Policies

Since the projects in developing countries have often to contend with a variety of problems which hinder rapid build up of production capability, it is oftenadvantageous to phase investment so that the entire investment is not blocked and left unutilised till full rated production comes into being. A usual pattern to get over this difficulty is to introduce production at an early stage through assembly from CKD components, tapering in higher contents of indigenous components as in-house manufacturing capability develops In such a case, the investment in plant equipment and buildings is judicially phased out so that only the minimum necessary for production at each stage is put in. It is felt that such a phasing of investment and production would be the most advantageous for manufacturing facilities suggested in this Study.

Table-1 : Growth Rate of Investment in Sectors Involving Construction Activity

Sector	Growth Rate Per Annum 1972-77	1977-82	1982-87	Related Economic Indicator
Agricultural and Allied Activities	8.5	7.5	7	National Income
Industry and Mining	12	11	10	Index of Industrial Production
Gas and Oil	12	11	10	Index of Industrial Production
Water	8.5	7.5	7.0	National Income
Communications & Transport	12	11	10	Index of Industrial Production.
Telecommunications	8.5	7.5	7	National income
Rural Development	8.5	7.5	7	National Income
Urban Development Construction and Housing.	12	11	10	Index of Industrial Production.
Education	8.5	7.5	7	National Income
Tourism	8.5	7.5	7	National Income
Health	8.5	7.5	7	National Income
Social Welfare	8.5	7.5	7	National Income
Power	Per MWP programme			

Table-2: Forecast demand for Selected Commodities 1972-1982

Item	Unit	1972	1977	1982
2.	3.	4.	5.	6.
Rubber Products	Tons	38,300	70,200	124,000
Plastic Products	Tons	61,000	140,000	282,800
Cement	'000 Tons	3,651	8,445	16,217
Bricks	Million Pcs.	3,294	5,944	10,622
Refractories	Tons	52,360	149,910	300,340
Glass :				
a) Sheet Glass	Tons	51,000	95,000	155,000
b) Glass Shells	Million Pcs.	36	63	98
c) Glass Bottles	Tons.	17,680	31,260	50,480
Ceramics :				
a) Sanitary Ware	Tons	3,000	5,250	8,750
b) Tiles	10^6 sq.m	1.5	2.6	6.2
c) Chinaware	Tons	3,000	4,500	6,000
d) L.T. & H.T. insulators	Tons	2,000	2,000	4,000
Sugar	'000 Tons	820	1,050	1,325

1.	2.	3.	4.	5.	6.
9.	Vegetable Oil -	'000 Tons	200	289	381
10.	Footwear	10^6 pairs	86.8	113.14	156.25
11.	Leather	10^6 pcs.	1.69	1.78	1.87
12.	Skins	10^6 pcs.	3.03	9.6	16.88
13.	Construction Equipment :				
	a) Loader/Shovel*	Nos.	-	224	470
	b) Excavator*	Nos.	-	113	192
	c) Dozer *	Nos.	-	236	472
	d) Grader*	Nos.	-	231	470
	e) Roller*	Nos.	-	547	1210
	f) Mixers	Nos.	279	512	914
	g) Vibrators	Nos.	420	750	1350
	h) Stone crushers	Nos.	34	57	100
	i) Tower Cranes	Nos.	25	57	111

* Nos. are average for the Plan periods 1972-77 and 1977-82.

TABLE 3

Supply-Demand Balance for Capital Goods under Study

Sl. No.	Category of Equipment	Unit	Yearly Requirements 1972-77	1977-82	1982-87	Annual Production Capacity AMBP 1977	AMBP 1982	Proposed Unit No.	Proposed 1977
1	2	3	4	5	6	7	8	9	10
1.	Pressure Vessels	Tons	8,000	6,500	6,500	6,500	6,500	-	-
2.	Storage Tanks, Bins Low Pressure Vessels	Tons	12,350	13,000	13,500	700	700	II	1,9
3.	Heat Exchangers	Tons	3,400	2,700	2,700	2,700	2,700	II	2
4.	Furnaces & Kilns	Tons	300	3,200	3,350	-	-	II	3,2
5.	Conveyors(Belt,Apron & Screw)	Tons	300	1,700	2,200	1,725*	Nil	II	
6.	Bucket Elevators	Tons	10	20	40			-	-
7.	Ball Mills and Batchers	Tons	40	1,350	1,600	-	-	II	1,3
8.	Crushers & Feeders	Tons	150	1,000	1,350	-	-	II	1,0
9.	Filters, Drum & Plate	Tons	150	400	600	-	-	II	
10.	Pumps & Compressors	Tons	400	570	600	-	-	-	-
11.	Screens, Cyclones, Ventilators	Tons	60	340	430	-	-	II	
12.	Mechanical Equipment	Tons	670	1,650	2,400	-	-	II	
13.	Technological Structures	Tons	900	3,350	4,300	1,200	1,200	II	
14.	Miscellaneous	Tons	1,000	2,000	2,500	-	-	-	-

For items 4,7,8,9 and 11 actual demand on manufacturing plants during 1972-77 will include part of stated demand for 1977-82 because of lead times in erection and commissioning.

*Mechahical hand can be taken t under Study.

SECTION 1

Goods under Study

Annual Production of AMBP		Proposed Units			Balance	
1977	1982	Unit No.	1977	1982	1977	1982
7	8	9	10	11	12	13
6,500	6,500	-	-	-	1,500	Nil
700	700	II	1,950	2,500	9,700	9,800
2,700	2,700	II	250	275	450	Nil
-	-	II	3,250	3,350	Nil	Nil
1,725	Nil	II	400	2,250	Nil	Nil
		-	-	-		
-	-	II	1,300	1,750	Nil	Nil
-	-	II	1,000	1,750	Nil	Nil
-	-	II	400	600	Nil	Nil
-	-	-	-	-	400	570
-	-	II	150	200	Nil	140
-	-	II	800	1,200	Nil	450
1,200	1,200	II	500	625	Nil	1,825
-	-	-	-	-	1,000	2,000

*Mechahical handling equipment in AMBP programme can be taken to be for uses other than in Sectors under Study.

SECTION 2

2	3	4	5	6	7	8	9	10
18. Extruders	Nos.	27	84	113	-	-	I	50
19. Film Extruders	Nos.	10	17	30	-	-	I	15
20. Blow Moulding Machines	Nos.	12	32	36	-	-	I	25
21. Profile/Extruder Calenders	Nos.	40	56	75	-	-	I	75
19. Thermosetting Plastic Presses	Nos.	27	62	80	-	-	I	50
20. Injection Moulding Machines	Nos.	8	13	23	-	-		-
21. Tyre Curing Presses	Nos.	19	22	36	-	-	I	25
22. Tyre Building Machines	Nos.	10	13	22	-	-	I	15
23. Stock Preparation Machines	Nos.	5	6	10	-	-	-	-
24. Banbury Mixers	Nos.	2	3	6	-	-	-	-
25. Rubber Extruder	Nos.	1	4	10	-	-	-	-
26. 3-Roll Calenders	Nos.	2	2	3	-	-	-	-
27. Moulding Machines	Nos.	1 (in 5 years)	3	2	-	-	-	-
28. Dozers	Nos.	236	472	-	-	-	III	200
29. Graders	Nos.	231	470	-	-	-	III	200
30. Scrapers	Nos.	19	25	-	-	-	III	20
31. Shovels/Loaders	Nos.	224	470	-	-	-	III	250
32. Excavators	Nos.	113	192	-	100 (4500)	190 (8500)	-	-
33. Rollers	Nos.	547	1210	-	400 (2000)	1000 (5000)	-	-
34. Concrete Mixers	Nos.	395	713	-	150 (300)	300 (600)	-	-
35. Vibrators	Nos.	585	1050	-	-	-	-	-
36. Crushers	Nos.	45	78	-	50(300)	83(500)	-	-
37. Tower Cranes	Nos.	41	84	-	41(800)	84(1600)	-	-

8	9	10	11	12	13
-	I	50	70	Nil	Nil
-	I	15	25	Nil	Nil
-	I	25	35	Nil	Nil
-	I	75	100	Nil	Nil
-	I	50	70	Nil	Nil
-		-	-	Full requirement met by IDP	
-	I	25	30	Nil	Nil
-	I	15	20	Nil	Nil
-	-	-	-	5	6
-	-	-	-	2	3
-	-	-	-	1	4
-	-	-	-	2	2
-	-	-	-	1 (in 5 years)	1
-	III	200	400	Negligible	Negligible
-	III	200	400	Negligible	Negligible
-	III	20	25	Nil	Nil
-	III	250	450	Nil	Nil
190 (8500)	-	-	-	Nil	Nil
1000 (5000)	-	-	-	147	210
300 (300)	-	-	-	245	413
-	-	-	-	585	1050
83(500)	-	-	-	Nil	Nil
84(1600)	-	-	-	Nil	Nil

Figures in brackets denote Tons

SECTION 2

NIDC

TABLE : 4 Pattern of Investment

	1972	1973	1974	1975	1976	1977	1978
Plastic and Rubber Machinery Plant (Unit 1)							
Investment (10^6 US $)	0.70	1.50	1.34	0.40	0.38	0.26	0.2(
Production (Nos.)	-	-	-	155	205	255	255
Demand (Nos.)				726			
Cement Sugar and Allied Machinery Plant (Unit 2)							
Investment (10^6 US $)	1.00	11.50	10.00	4.50	2.00	0.50	0.4
Production (Tonnes)	-	-	-	8000	10000	12500	135
Demand (Tonnes)				16500			
Construction Machinery Plant (Unit 3)							
Investment (10^6 US $)	2.00	5.00	11.50	5.80	5.60	4.70	4.5
Production (Nos. M/cs.)	-	-	-	270	400	535	670
(Tons spares)				750	1100	1500	185
Demand (Nos. M/cs.)				3545			

Note : 1. Investment includes working capital.

2. Actual demand on Unit 2 will be about 2 in advance of demand stated which refer erected equipment.

: 4 Pattern of Investment and Production

1975	1976	1977	1978	1979	1980	1981	1982
0.40	0.38	0.26	0.20	0.10	0.08		
155	205	255	255	310	330	350	350
726					1423		
50	2.00	0.50	0.40				
8000	10000	12500	13500	145[illegible]	[illegible]	[illegible]	14500
16500					[illegible]		
5.80	5.60	4.70	4.50	3.90	1.24		
270	400	535	670	960	1020	1275	1275
750	1100	1500	1850	2650	2800	3500	3500
3545					7186		

includes working capital.

and on Unit 2 will be about 24 months
of demand stated which refers to
uipment.

SECTION 2

وزارت اقتصاد

مرکز بررسیهای توسعه صنعتی و بازرگانی

STUDY UNITED

possible

100	Food Ind.
180	Mathy Metal
130	Mechan. and El. Transf.
111	Petrochemical
120	Non metallic Minerals
23	Handicraft and Carpet and Textile
80	Paper
12	Mining
20	Exploitation of Mine
44	others (24

900 Total 300 public 400 private

[redacted]

STUDY FOR DEVELOPMENT OF CAPITAL GOODS INDUSTRIAL PROJECTS IN IRAN

04461
(2 of 4)

SOHANAKI

ANNEXURES

VOLUME I

446

FEBRUARY 1972

THE NATIONAL INDUSTRIAL DEVELOPMENT CORPORATION LIMITED
NEW DELHI, INDIA.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

STUDY FOR DEVELOPMENT OF CAPITAL GOODS INDUSTRIAL PROJECTS IN INDIA

ANNEXURES

VOLUME I

FEBRUARY 1972

THE NATIONAL INDUSTRIAL DEVELOPMENT CORPORATION LIMITED
NEW DELHI, INDIA.

C O N T E N T S

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3. Methodology
4. Forecast of Commodity Requirements
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7. Rubber and Rubber products
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SPECIFICATIONS OF MAIN EQUIPMENT USED IN A PETROLEUM REFINERY

The following equipment have been covered in these specifications :-

1. Columns
2. Vessels
3. Pumps
4. Compressors
5. Reactors
6. Exchangers
7. Furnaces.

The above specifications have been presented in two parts :-

Part 'A' : Complete refinery without lube units

Part 'B' : Only Lube units.

The main processing units included in these two parts are as follows. Unit capacities are also indicated along with.

PART 'A'

I.	a) Atmospheric Unit	100,000 BPSD
	b) Vacuum Flash Unit	40,000 "
II.	a) Unifiner	10,500 "
	b) Platformer	12,500 "
III.	Visbreaker	16,000 "
IV.	Isomax Hydrocracker	14,400 "

V.	Caustic Treating	For Naphtha/Kero etc.
VI.	Light ends Recovery for LPG	1,000 BPSD of LPG
VII.	Hydrogen Plant	30 MM Scft/day
VIII.	Bitumen Unit	5,000 BPSD
IX.	Amine Treaters	For gas for H_2 Plant.

PART 'B'

Lube units for producing 100,000 t/year of lubes with the following processing units :-

I. Vacuum Unit
II. Furfural Extraction
III. MMK dewaxing
IV. Lube hydrofinishing
V. Propane deasphalting

Annexure 1.1
Sheet 3 of 49

PART 'A'

EQUIPMENT SPECIFICATIONS
(100,000 BPSD Refinery)

COLUMNS SPECIFICATIONS

Unit Sr.No.	Service	Specifications					Remarks
		Dia. (mm)	Ht. (mm)	Thickness (mm)	Empty weight(kg.)	Material	
1	2	3	4	5	6	7	8
I.	**Atmospheric Vacuum Unit**						
	i) Distillation Column	6069	41760	18/23	20,400	C.S.	Monel (2.8 mm)
	ii) Naphtha Stripper	1230	8382	10	6,400	C.S.	-
	iii) Kero/Lt. Diesel Stripper	2078	10973	11-15	24,400	C.S.	-
	iv) Kero/Lt. Diesel Stripper	2074	13160	11-15	24,400	C.S.	-
	v) Lt. Diesel Salt Tower	2914	9144	16.2-18	30,800	C.S.	-
	vi) Stabilizer	1524	8092	14-18	35,500	C.S.	-
	vii) Gasoline Splitter	2580	14021	9-11	26,580	C.S.	-
	viii) Vacuum Column	5486 9449 3353	41749	17-38	369,000	C.S.	2.8 mm Monel
II.	**UNIFINER/REFORMER**						
	Unifiner i) Stripper	1981 1219	11735 4724	9-15	16,060	C.S.	-
	ii) Ref.Stabilizer	2438 1676	15088 10820	18-25	46,000	C.S.	-

1	2	3	4	5	6	7	8
III.	**VISBREAKER**						
	i) Fractionator	1981	19202	11-30	33,650	C.S.	Alloy lined
	ii) Residuum Stripper	3048	6096	8-13	15,600	C.S.	Alloy lined
	iii) Stabiliser	924	18593	11.3-13	9,900		-
IV.	**ISOMAX HYDROCRACKER**						
	i) Sponge Absorber	914	20,422	9-12	8,035	C.S.	-
	ii) Recycle Splitter	3810	34,422				
	iii) Heavy Naphtha Stripper	914	10,058	6-7	4,800	C.S.	-
	iv) Kero Stripper	1372	9,754	7-8	7,300	C.S.	-
	v) Diesel Stripper	1684	6,706	8	6,600	C.S.	-
	vi) Gasoline Stabiliser	914	22,708	12-16	12,400	C.S.	-
	vii) Diesel Salt Tower	1981	9,144	10-11	17,200	C.S.	-
V.	**LIGHT END RECOVERY**						
	i) Deethaniser	1676	17,678	25-29	32,900	C.S.	-
	ii) Depropaniser	1372	16,459	16-18	15,500	C.S.	-
	iii) Depropstripper	5876	12,802	11	4,700	C.S.	-
	iv) Debutaniser	1219	27,432	8-13	12,400	C.S.	-

1	2	3	4	5	6	7	8
	v) Caustic Contactor	1372	13,411	11-15	9,990	C.S.	-
VI.	**HYDROGEN PLANT**						
	i) Co_2 Absorber	2438	20,270	16-26	46,740	C.S.	-
	ii) Methanator	2477	5,791	32-33	20,960	C.S.	-
	iii) Co_2 Stripper	3505	20,269	14-16	44,700	C.S.	-
	iv) Caustic Con'actor	1064	10,820	15-18	9,970	C.S.	-
VII.	**BITUMEN UNIT**						
	i) Asphalt Blowing Column	2580	10,973	10-11	14,549	C.S.	-
VIII.	**AMINE TREATERS**						
	i) Low Press Amine Contactor	785	15,850	6-9	4,581	C.S.	-
	ii) High Pr. Amine contactor	768	14,935	14-16	8,120	C.S.	-

VESSELS SPECIFICATIONS

Unit Sr.No.	Service	Dia. (mm)	Height (mm)	Shell thickness (mm)	Empty Weight (kg.)	Material	Remarks
1	2	3	4	5	6	7	8
I.	**ATMOSPHERIC VACUUM UNIT**						
	i) Crude Flash Drum	3658	13716	13	60463	C.S.	-
	ii) Atmospheric Col. Reflux Accum.	3658	9144	8-13	23601	C.S.	-
	iii) Atmospheric Col. O.H. Product Accum.	1829	5944	8	5638	C.S.	-
	iv) S.R. Gasoline Stabilizer Accum.	1675	4257	13-15	5372	C.S.	-
	v) Splitter Accumulator	1983	5020	8	5632	C.S.	-
	vi) Light S.R. Gasoline Caustic Settler	2427	6096	10-11	8571	C.S.	-
	vii) Compressor Interstage K.O. Drum	762	1524	6-10	705	C.S.	-
	viii) Fuel Gas K.O. Drum	914	1829	6-7	1141	C.S.	-
	ix) Compressor K.O. Drum	762	2438	6	881	C.S.	-
	x) Inhibiter Injection [illegible] Pot.	495	1067	6	282	C.S.	-
	xi) Vacuum Column Accum.	2131	5334	9-10	6750	C.S.	-

1	2	3	4	5	6	7	8
II.	**UNIFINER/PLATFORMER**						
	i) Unifining High Pressure Separator.	2438	7772	31	24500	C.S.	-
	ii) Stripper Receiver	1219	3658	9-10	2561	C.S.	-
	iii) Condensate Injection Tanks Chemical Injection Tank	445	1829	6	192	C.S.	-
	iv) Products Separator	2134	5486	28-29	21295	C.S.	-
	v) Stabilizer Receiver	1524	4572	16	5701	C.S.	-
	vi) Condensate Injection Tanks Chemical Injection Tank	445	1829	6	192	C.S.	-
	vii) Condensate Injection Tanks Chemical Injection Tank	445	1829	6	198	C.S.	-
	viii) Fuel Gas K.O. Drum	762	1829	6	784	C.S.	-
III.	**VISBREAKER**						
	i) Charge surge Drum	2743	9754	14-16	19810	C.S.	-
	ii) Stripper Receiver	1219	4572	8-11	2982	C.S.	-
	iii) Flash Fractionator Receiver	1524	4572	10-15	4284	C.S.	-
	iv) Stabilizer Receiver	914	2743	9-13	1799	C.S.	-
	v) Fuel Gas Drum	1829	3048	9-10	7371	C.S.	-

1	2	3	4	5	6	7	8
IV.	**ISOMAX H/C**						
	i) Jacket Cooling Water Surge Drum	914	5486				
	ii) High Pressure Separator	2438	7010	165	108000	C.S.	-
	iii) Chemical Drum	1984	6400	8	6394	C.S.	-
	iv) Low Pressure Separator	2438	9754	20-50	39928	C.S.	-
	v) Recycle Splitter Feed Flash Drum	2591	11582	17-21	51300	C.S.	-
	vi) Recycle Splitter Reflux Accum.	2281	6096	8-10	7790	C.S.	-
	vii) Recycle Splitter O.H. Prod. Accum.	1088	4572	6-8	2354	C.S.	-
	viii) Stabilizer Reflux Accum.	1067	4572	13-16	4113	C.S.	-
	ix) Chemical Calibration Drum.	445	1219	6	367	C.S.	-
	x) Stabilizer Feed Compr. K.O. Drum	914	2438	6	7460	C.S.	-
	xi) Fuel Gas K.O. Drum.	762	1829	6	784	C.S.	-
V.	**CAUSTIC TREATMENT**						
	i) Slurry Settler	5029	3048	19	33626	C.S.	-
	ii) Water Settlers	3048	10973	11	31265	C.S.	-
	iii) Water Settlers	3048	10973	11	31265	C.S.	-

1	2	3	4	5	6	7	8
	iv) Product Salt Filter	3660	3505	16	27849	C.S.	-
	v) Slurry Make-up Pot	495	914	6	730	C.S.	-
	vi) Caustic Wash Settler	3076	9144	12	16045	C.S.	-
	vii) Regeneration Air Receiver	445	914	6	304	C.S.	-
VI.	LIGHT END RECOVERY						
	i) Feed Surge Drum	2438	4572	23	12516	C.S.	-
	ii) Deethanizer Accum.	1219	4572	18-22	5382	C.S.	-
	iii) Caustic Settler	1829	5486	13-15	6910	C.S.	-
	iv) Caustic Regenerator	762	8839	10	4866	C.S.	-
	v) Caustic Regenerator Accum.	597	2134	6	610	C.S.	-
	vi) Water Settler	1825	5486	12-14	7041	C.S.	-
	vii) Depropanizer Accum.	1524	5182	6-20	6812	C.S.	-
	viii) Debutanizer Accum.	1219	4572	8-9	2671	C.S.	-
VII.	HYDROGEN PLANT						
	i) Carbon Drum	2294	4876	26-31	16140	C.S.	-
	ii) Carbon Drum	2294	4876	26-31	16140	C.S.	-
	iii) Shift Converter	2888	6477	29-31	46600	C.S.	-
	iv) Shift Converter	2892	4877	29-31	46600	C.S.	-

1	2	3	4	5	6	7	8
	v) Reboiler Effluent K.O. Drum	1372	3048	14-16	7431	C.S.	-
	vi) Contactor Feed K.O. Drum	1372	2438	13-15	6805	C.S.	-
	vii) Stripper Reflux Drum	1532	2438	3	2689	C.S.	-
	viii) Corrosion Inhibitor Gage Pot	485	1067	6	307	C.S.	-
	ix) Hydrogen Product K.O. Drum	762	2438	11-12	2293	C.S.	-
	x) Boiler Blowdown Drum	1067	2438	6	1496	C.S.	-
	xi) Feed Gas K.O. Drum	584	1981	12-13	2196	C.S.	-
	xii) Fuel Gas K.O. Drum	762	1829	6	784	C.S.	-
VIII.	BITUMEN UNIT						
	i) K.O. Drum	938	3048	6	3242	C.S.	-
IX.	AMINE TREATERS						
	i) Amine Stripper Overhead Accum.	788	1981	6	3072	C.S.	-
	ii) Amine Stripper Overhead Accum.	584	1829	12-13	1160	C.S.	-
	iii) H.P. Contactor O.H. K.O. Drum.	762	2438	14-16	3021	C.S.	-
	iv) L.P. Feed Gas K.O. Drum.	598	1829	6	1060	C.S.	-
	v) L.P. Contactor O.H. K.O. Drum.	598	1981	6	1295	C.S.	-
	vi) Compressor Inter-stage K.O. Drum.	592	1981	8-9	1335	C.S.	-

1	2	3	4	5	6	7	8
X.	OTHER VESSELS						
	i) Butane Storage	3658	15545	12-21	44247	C.S.	-
	ii) Butane Storage	3658	15545	12-21	44247	C.S.	-
	iii) LPG Refrigeration Surge Drum	1219	3048	9-10	6381	C.S.	-
	iv) Storage Tank	2286	6934	13	7720	C.S.	-
	v) Boiler Blowdown Drum	914	2438	6	1415	C.S.	-
	vi) Fuel Gas K.O. Drum	1067	1829	7	1322	C.S.	-
	vii) Intermittent Blowdown Drum	1834	3048	8	7404	C.S.	-
	viii) Plant Air Receiver	1676	5486	13-15	10571	C.S.	-
	ix) LPG Surge Drum	3054	6096	22	22710	C.S.	-
	x) Fuel Gas Mixing Drum	2128	3048	10-11	11027	C.S.	-
	xi) Flare, K.O. Drum	3048	7620	10-11	14105	C.S.	-
	xii) Flare, K.O. Drum	2642	7620	10	11375	C.S.	-
	xiii) Acid Day Tank	914	1524	6	804	C.S.	-
	xiv) LPG Day Storage	3658	15545	14-25	51088	C.S.	-

REACTORS SPECIFICATIONS

Spec. \ Service	UNIPINER/PLATFORMER (1)	(2)	(3)	ISOMAX (1)	(2)	(3)
Dia Meter (mm)	1836	1982	2269	2591	2132	2132	2132
Ht/Length (mm)	4420	5486	6024	7087	20200	20200	20200
Thickness (mm)	30.5	83	89	95.5			
Material	0.5 MO	1.25Cr 0.5MO	1.25Cr 0.5MO	1.25Cr 0.5MO	2.25 Cr 1 MO	2.25Cr 1 MO	2.25 Cr 1 MO
Lining Material (mm)	S.S. 3	S.S. 3	S.S. 3	S.S. 3	S.S. 3	S.S. 3	S.S. 3
Empty Wt. (Kg.)	11,600	37,782	48,970	67,342	305,000	305,000	305,000

FIN FAN COOLERS

Unit	No.	Tube		Wt. of Bundle M.T.
		Size mm	Material	
I Atm/Vacumm	9	25 x 3	C.S.	167
II Unifiner/ Flat former	5	25 x 3	C.S.	81
III V.B.U.	3	25 x 3	C.S.	100
IV Isomax	5	25 x 3	C.S.	112
	1	25 x 4.2	C.S.	76
V Hydrogen	2	25 x 3	C.S.	60
	1	25 x 1.65	S.S.	10
VI Aminetreater	1	25 x 3	C.S.	31
Total	27			637

Note: Each cooler contains several tube bundles ranging from 1 to 16 nos.

HEAT EXCHANGERS (SUMMARY)

Units	No. of Exch.	Tube Size (mm)	Material	Wt. of Heat Exchangers (MT) Shell dia. upto 1000 mm	Shell dia. beyond 1000 mm
1.	2.	3.	4.	5.	6.
I. Atm./Vacuum	9	25 x 3	C.S.	67	-
	8	20 x 2.1	C.S.	7	234
	16	25 x 2.76	C.S.	-	239
	17	20 x 1.65	Brass	36	88
	3	25 x 2.76	S.S.	8	36
II. Unifiner/ Platformer	6	25 x 3	C.S.	33	-
	5	20 x 2.1	C.S.	27	-
	10	20 x 1.65	Brass	49	-
	3	25 x 2.76	Cr./Mo	-	6
III. Visbreaker	43	25 x 2.76	C.S.	10	45
	4	20 x 2.1	C.S.	6	44
	3	25 x 2.1	S.S.	-	36
	1	25 x 2.76	S.S.	-	13
	6	20 x 1.65	Brass	24	-
IV. Isomax	9	20 x 1.65	Brass	36	-
	8	25 x 2.76	S.S.	76	-
	5	25 x 3	C.S.	31	-
	2	20 x 2.1	C.S.	7	-

1.	2.	3.	4.	5.	6.
V&VI Caustic Treat/LPG recovery	1	25 x 3	C.S	6	-
	10	20 x 1.65	Brass	16	32
	4	20 x 2.1	C.S.	10	-
VII Hydrogen Plant	3	40 x 3	C.S.	32	-
	5	20 x 2.1	C.S.	12	32
	2	25 x 3	C.S.	7	10
	2	20 x 2.1	No St.	10	-
	6	20 x 2.1	S.S.	15	60
	3	20 x 1.65	Brass	7	-
VIII Bitumen	1	25 x 3.4	C.S.	10	-
	1	25 x 2.76	C.S.	-	20
IX. Amine Treater	5	20 x 2.1	C.S.	16	-
	1	25 x 3	C.S.	5	-
	1	20 x 1.65	MO	5	-
	3	20 x 1.65	S.S.	11	-
	2	20 x 1.65	Brass	5	-
Total	169			580	913

400,000 T/YR. LUBE PLANT
- BOILERMER SPECIFICATIONS

1. COLUMNS

S.No.	DESCRIPTION	QTY.	SPECIFICATION Dia.mm	Height mm	Thickness MM	Weight Kg. Column	MAT.	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.
	I. VACUUM UNIT							
1.	Vacuum Column	1	4000/ 5950/ 2550	37,500	19/ 17+4/ 10+4	248,000		Bottom & middle lined with S.S.
2.	Stripper Column	1	1000/ 1420	24,225	7/ 10/ 9	9000		
	II. FURFURAL EXTRACTION UNIT							
3.	Dearater	1	850/ 1200	13750	9/9	4500		
4.	Extractor (RDC) Column	1	2340	22,775	12	22,500		
5.	Raffinate Flash Column	1	1960/ 1200	26,890	10/10	12,500		
6.	Extract Pressure Flash Column	1	2130/ 2130	22,800	6/8	17,000		

1.	2.	3.	4.	5.	6.	7.	8.	9.
7.	Extract Vac. Flash Stripper	1	1430/ 1130	26,650	10/11	14,200		
8.	Drying Solvent Column	1	1000/ 1700	21,210	9/10	9,200		
9.	Furfural Recovery column	1	700	17,630	8	4,300		
	III. [redacted]							
10.	Filtrate HP LP Flash Column	1	2700/ 1850	25,470	13/13	24,200		
11.	II stage Flash col./ D.W.O. Stripper	1	1000/ 1000	25,400	10/10	9,700		
12	I Stage Wax Mix Flash Column	1	1850	12,310	9	6,100		
13.	II Stage Wax Mix Flash Column	1	850	23,500	10/10	7,600		
14.	Azeotrope Column	1	640	17,680	8	3,200		

1.	2.	3.	4.	5.	6.	7.	8.	9.
	IV. HYDROFINISHING UNIT							
15.	Hydrogen Sulphide Absorber	1	460	7,600			C.S.	Packed Rings
16.	Oil Stripping Column	1	710	11,000			C.S.	
17.	Vacuum Dryer	1	710	7,000			C.S.	
	V. PROPANE DEASPHALTING UNIT							
18.	Extraction Column	3	2130	19,725	43	52,500		
19.	Evaporation Column	1	2000	11,400	24	15,500		
20.	-do-	1	1550	9,900	23	12,000		
21.	-do-	1	1280	11,670	17	7,500		
22.	Asphalt Stripper Column	1	700	15,000	8	3,200		
23.	Oil Strippar Column	1	570	14,450	6	2,500		
24.	Mix. Condenser Column	1	700	7,850	8	1,800		

1. FURNACE (ATMOSPHERIC UNIT)

DESIGN CHARACTERISTICS

Heat duty	-	66×10^6 Kcal/Hr.
Inlet temp. ^oC		
HC	-	275
Steam	-	152
Outlet Temp. ^oC		
HC	-	375
Steam	-	350
Pressure inlet kg/cm^2		
Steam	-	3.85
Pressure outlet kg/cm^2		
HC	-	3.48
Steam	-	3.45

CONSTRUCTION DETAILS

Material of Construction

Tubes & Fittings		
Radiation	-	5 Cr. 0.5 Mo
Convection	-	C.S. -do-
Tubular details		25 Cr. 12 Ni
Structurals	-	C.S.
Tube size	-	168.3 x 5.56
Design Temp. ^oC	-	415
Design pressure kg/cm^2		16
Approximate tonnage	-	550 M.T.

2. FURNACE (VACUUM UNIT)

Heat duty	-	21×10^6 Kcal/hr
Material	-	Convection section tubes = C.S. Radiation section tubes = 7% Cr 1/2 Mo.

FURNACE (UNIFINER/REFORMER)
(No. 3 -6)

	REMORMER			UNIFINER
	I	II	III	
Design Characteristics				
Heat duty 10^6 Kcal/hr	16.3	7.9	3.5	8.7
Inlet temp. ^oC	366	440	465	275
Outlet temp. ^oC	535	535	533	400 (max.)
Pressure inlet kg/cm^2	28.8	27.2	25.7	36.7
Pressure outlet kg/cm^2	27.6	26.3	25.2	35.2
Construction Details				
Material of construction				
Tubes/fittings				
Radiation	2.25 Cr 1MO	3.25Cr IMO	2.25 Cr 1MO	18/S.S.
Convection	-do-	-do-	-do-	-do-
Tubular details	25 Cr 12 Mi	25 Cr 12 Ni	25 Cr 12 Ni	25 Cr 12 Ni
Structurals	C.S	C.S	C.S	C.S
Maximum tube size, mm	168.3x4.4	168.3 x4.4	168.3 x 4.4	168.3 x7
Design Temp. ^oC	590	590	510	440
Design Press. kg/cm^2	31.8	30.0	23.4	40.4
Approximate tonnage	150	90	40	95

Annexure 1.1
Sheet 23 of 49

~~FURNACE (No.7)~~ (VISBREAKER)

DESIGN CHARACTERISTICS

Heat Absorbed, KC/HR	19.025×10^6
Inlet temp. °C	
Product	270
Water	30
Outlet temp. °C	495
Total surface area M^2	922.5
Inlet pressure, Kg/cm^2	40
Flow rate Kg/HR	62,100

CONSTRUCTION DETAILS

No. required	2
Material of construction:	
Tubes/fittings	5 Cr 0.5 Mo
Superheater coils	c.s
Tubular details	25 Cr 12 Ni ASTM 447
Tube size	114 x 10 mm
No. of Burners	16
No. of Soot blowers	26
Tubes/fittings	6.70 MT
Tubular details	48 "
Stack	9 "
Structural steel work	140 "

Refractory	40 MT
Insulation	120 MT
Refractory	40 MT
	467 MT
Total for two Nos.	934 MT

HEATER (ISOMAX)
(Nos 8-11)

Service	Reactor Charge heaters 2 Nos.	Debutariser Reboiler Heater 1 No.	Fractionator Feed Heater 1 No.	Stripper Heater 1 No.
Inlet Temp. ^{o}C	391	243	-	218
Outlet temp. ^{o}C	441	284	274	249
Outlet pressures Kg/cm^2	149	12.65	0.9	0.9
Design Pressure, kg/cm^2	158	24.6	14.05	14.05
Design Absorption rate 10^6 K.Cal/Hr	8.75	8.7	3.70	1.16
GENERAL SPECIFICATION				
Max. tube size	168.3 mm	168.3 mm	168.3 mm	168.3 mm
Material	18 Cr.8 Ni	C.S	C.S	C.S
Fittings	Forged ASTM A403 WP 304	ASTM 234 Grade WP	ASTM 234 Grade WP	ASTM 234 Grade WP
Burners	Oil/Gas fired.	Oil/Gas fired.	Oil/Gas fired	Oil/Gas fired
Approx. tonnage	195	95	40	16 = 346

PUMPS SPECIFICATIONS

Unit S.No.	Service	Nos.	Design Data: Capacity (M^3/hr)	Diff head (m)	Op temp (°F)	Visc. (SSU)	Pump Spec.: Type	BHP	Wt. kg	Motor Spec.: Type	HP
1	2	3	4	5	6	7	8	9	10	11	12
I.	ATMOSPHERIC/VACUUM UNIT										
1.	Crude Oil	2	655	213	346	<32	C.F.	580	3100	ST	520
2.	Reflux	2	477	71	220	<32	C.F.	139	1550	EM	125
3.	O H Product	2	125	210	100	<32	C.F.	125	1040	EM	125
4.	Blending Naphtha	2	42	120	390	<32	C.F.	33	450	EM	30
5.	Kerosene	2	380	190	475	<32	C.F.	250	1600	EM	250
6.	Circ. Reflux	2	413	95	438	<32	C.F.	122	820	EM	150
7.	Lt. Diesel Product	2	136	123	506	<32	C.F.	65	680	EM	100
8.	Red Crude	2	366	83	628	<32	C.F.	122	870	EM	150
9.	Sour Water	2	14.5	123	100	<32	C.F.	29.5	360	EM	30
10.	Stab O H	2	65	220	110	<32	C.F.	65	870	EM	75
11.	Splitter O H	2	108	97.5	200	<32	C.F.	62	550	EM	50
12.	Circulation	2	12.3	25	100	2.7CP	C.F.	3.7	270	EM	5

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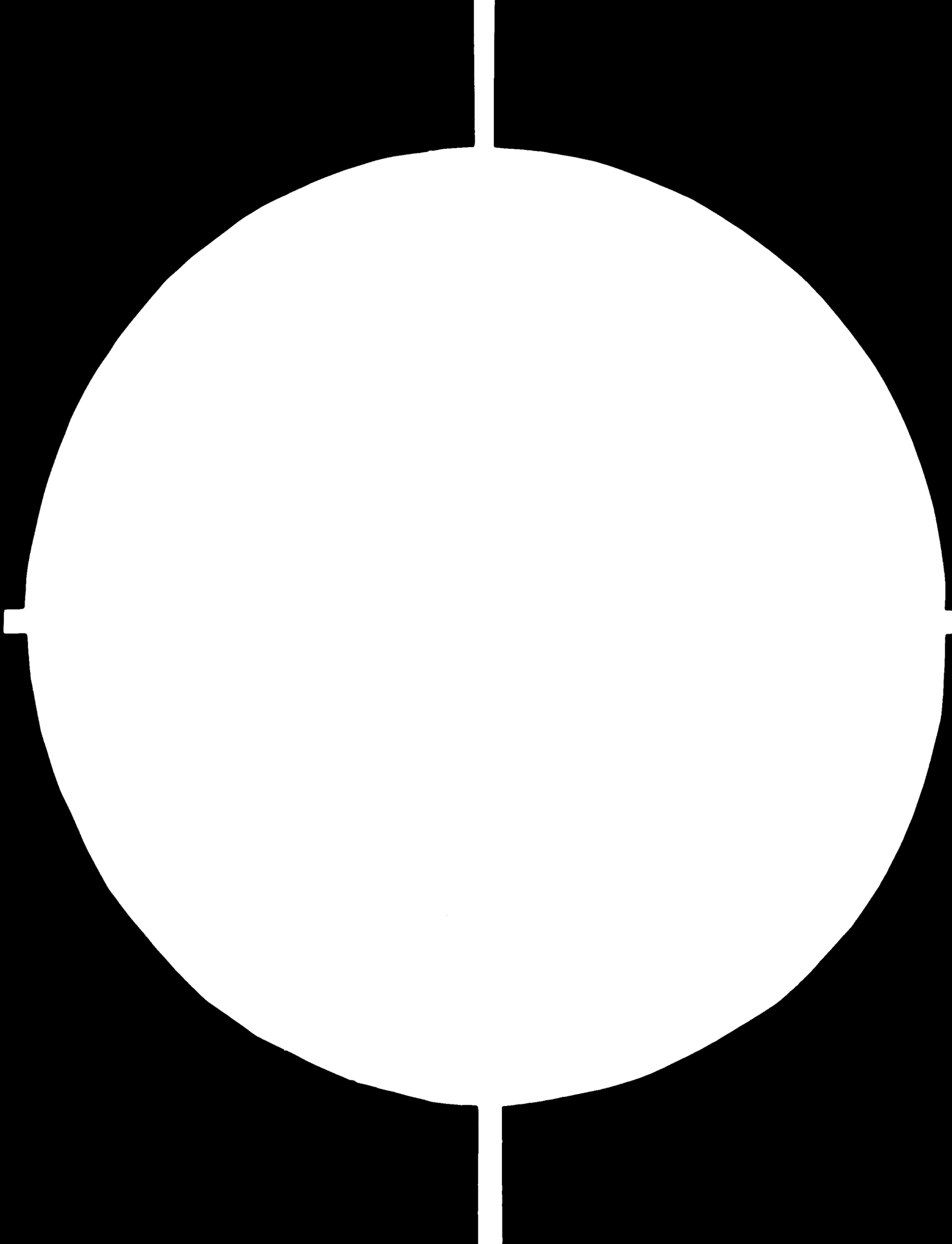

1	2	3	4	5	6	7	8	9	10	11	12
13.	Compressor Cond.	2	2	3.7	100	<32	R.P.	1.2	380	EM	3
14.	Vac. Colmn.Sour Water	2	16	127	153	<32	C.F.	40	445	EM	40
15.	Lt.S op Recycle	2	3.6	69	100	3.5	C.F.	8.5	310	EM	10
16.	Vac. Top Side Cut	2	172	95	350	33	C.F.	76	630	EM	75
17.	Vac. Mid Side Cut	2	425	114	575	33	C.F.	148	870	EM	200
18.	Vac. Slop Gas Oil	2	91	267	733	<32	C.F.	152	1030	EM	125
19.	Furnace Recycle	1	36	131	775	<32	C.F.	44	740	EM	40
20.	Vac. Col.Bottoms	2	237	134	670	34	C.F.	25.6	1600	EM	250
21.	Vac. Lub.Distillate	2	27	149	682	<32	C.F.	53	740	EM	40
22.	Gasoline Splitter Bott	2	95	150	307	.18CP	C.F.	71	610	EM	60
23.	INHIBITOR Ijection	1	1.34	-	100	-	R.P.	<1/3	-	EM	1/3,1
II.	UNIFINER/PLATFORMER										
24.	Unifier Charge	1	79.5	470	100	-	C.F.	200	2600	EM	200
25.	Uni.Stripper Reboiler	1	161	116	370	..	C.F.	68	680	EM	75
26.	Uni.Strip.Reflux	1	22.7	46	100	-	C.F.	.6	310	EM	7½

1	2	3	4	5	6	7	8	9	10	11	12
27.	Uni.Condenser Inj.	1	2	365	140	-	R.P.	2.6	235	E.M.	5
28.	Uni.Charge	2	98	498	180	-	C.F.	191	2800	E.M.	200
29.	Stab.Reboiler Circ.	2	352	112	451	-	C.F.	114	1100	E.M.	125
30.	Platformer Stab.Refl.	2	96.5	105	100	-	C.F.	35	-	EM	40
31.	Unicor.Inj.Metering	1	.113	-	100	-	R.P.	.25	-	EM	1,¼
32.	Condensate Chemical	1	.2	-	100	-	R.P.	.33	-	EM	1,1/3
33.	Comp.Turb.Condens	2	26	75	140	-	C.F.	20	350	EM	20
III.	VISBREAKER										
34.	Heater Charge	2	132	364	380	70	C.F.	275	-	EM	350
35.	Flashed Residium	2	185	248	700	-	C.F.	221	5055	EM	350
36.	Stripper O'H	2	40	353	140	-	C.F.	36.6	385	EM	30
37.	Side Cut Distillate	2	58	89.5	500	-	C.F.	32	385	EM	30
38.	Flashfrac.Reflux	1	47	58.2	100	-	C.F.	12	350	EM	15
39.	Stabliser Feed	2	10.8	173	100	-	C.F.	22	580	EM	20
40.	Stabliser Reflux	1	6.6	68	100	-	C.F.	6.9	-	EM	10

1	2	3	4	5	6	7	8	9	10	11	12
41.	Ram Pump	1	3.4	-	140	-	R.P.	=.10	1330	S	10
42.	Unicor Inj.Met.	1	.113	-	100	-	R.P.	.25	-	EM	¼,1
43.	Hvy.Oil Cooler Water	2	741	57.6	130	-	C.F.	235	1270	EM	250
IV.	ISOMAX UNIT										
44.	Jacket Cooling Water	2	79.5	25	135	-	C.F.	12.7	570	EM	20
45.	TURBINES COND.RETURN	2	64.2	75	140	-	C.F.	57.7	280	EM	50
46.	Reactor Feed Pump	2	236	2640	437	9CP	C.F.	2600	2950	ST	2580
47.	Water + Caustic		170	890	120	1.2CP		922			
48.	Splitter Bottoms		134	2610	670	.7CP		1320			
49.	Recyc.Splitter Feed	2	248	108	450	.32CP	C.F.	98	820	EM	100
50.	Recyc.Splitter Reflux	2	300	69	150	.21CP	C.F.	72	820	EM	75
51.	Stabiliser Feed	2	11.4	261	100	.25CP	C.F.	28	1045	EM	20
52.	Heavy Naphtha	2	23.4	130	300	.21CP	C.F.	27	430	EM	25
53.	Kerosene	1	50	67	420	.25CP	C.F.	17	385	EM	20
54.	Diesel Fuel	2	91	134	500	.32CP	C.F.	58	610	E.M.	60
55.	Recycle Feed	1	147	140	670	.41CP	C.F.	90	630	EM	75
56.	Stab.Reflux	2	26.8	166	100	.13CP	C.F.	45	740	EM	40
57.	Over Flash	2	123	234	700	.32CP	C.F.	107	940	EM	125

1	2	3	4	5	6	7	8	9	10	11	12
58.	Sulfide Injection	3	4	-	95	1.86CP	R.P.	=.30	-	EM	50
59.	Condensate Inj.	2	12	-	140	.5CP	R.P.	94	2300	EM	150
60.	Reflux+Prop.ACC S.W.	2	7	110	150	.45CP	C.F.	17	520	EM	15
V.	CAUSTIC TREATMENT										
61.	Kerosene feed	2	102	122	100	1.01CP	C.F.	69	590	EM	75
62.	Wash Circulation	1	25	32	130	.5CP	C.F.	6.5	-	EM	7.5
63.	Wash Circulation	2	345	32	130	5CP	C.F.	7.1	-	EM	7.5
64.	Metal Deactivator Inj	1	.207	-	100	26CP	R.P.	<¼4	-	EM	¼4,1
65.	Sweet Kero.Transfer	2	102	45.5	130	.91CP	C.F.	18	400	EM	25
66.	Caustic Circulation	2	30.2	25	100	1.5CP	C.F.	6.9	85	EM	7.5
VI.	LIGHT ENDS/LPG ROCOVERY										
67.	Deethaniser Charge	2	53	321	100	1.4CP	C.F.	110	2600	EM	100
68.	Deethaniser Reflux	2	33	66	149	30	C.F.	12	460	EM	10
69.	Caustic Circ.	2	11.5	13.4	100	34	C.F.	1.77	370	EM	2
70.	Reg.Caustic Circ.	2	5.4	90	133	33	C.F.	17.3	325	EM	15
71.	Sour Water	1	3.9	115	140	30	C.F.	17.4	520	EM	15
72.	Water Circ.	1	12	16.3	100	30	C.F.	2	-	EM	2

1	2	3	4	5	6	7	8	9	10	11	12
73.	Depropaniser Charge	1	34	192	100	30	C.F.	39	480	EM	40
74.	Depropaniser O/H	1	56	60	115	30	C.F.	13	465	EM	15
75.	Debutaniser Reflux	1	60	120	127	30	C.F.	50	820	EM	40
76.	Water Inj.	1	46.4	-	100	75CP	R.P.	< 2	-	EM	2
77.	Caustic	1	10.2	-	150	91	R.P.	1	-	EM	
78.	Caustic Dissolving	2	11.4	35	100	34	C.F.	16	310	EM	20
79.	Caustic	1	5.7	19.5	100	34	C.F.	1.6	-	EM	2
80.	Fresh Caustic	2	28	-	100	2.6CP	R.P.	<½	-	EM	½
81.	Caustic Inj.	1	69	-	100	2.6CP	R.P.	<2	-	EM	2
VII.	HYDROGEN PLANT										
82.	Boiler Circulation	2	70	37	422	.07CP	C.F.	13	390	EM	15
83.	Amine Circ.	2	382	207	183	.56CP	C.F.	533	-	ST	400
84.	Stripper Reflux	2	19	38	140	.5CP	C.F.	7	315	EM	7½
85.	Amine Sump	1	1.5	17.6	100	1.0CP	C.F.	1.6	-	EM	2
86.	Boiler Feed Water	2	95.4	264	225	0.25CP	C.F.	174	1140	EM	200
87.	Wash Water Circ.	1	11.4	21	100	0.8CP	R.P.	3.7	-	EM	5

1	2	3	4	5	6	7	8	9	10	11	12
88.	Chemical Inj.	1	.7	-	100	1.0CP	C.F.	<1/3	-	EM	1,1/3
89.	Sulphur Pl.Boiler Feed Water	1	6.8	84	225	1.0CP	R.P.	13.5	325	EM	15
90.	Inhibitor Inj.	1	1.34	-	100	1.0CP	C.F.	<1/4	-	EM	1/4,1
91.	Butane Feed	2	22.7	320	100	.15CP	C.F.	41	4600	EM	1 1/2
VIII.	BITUMEN UNIT										
92.	Asphalt Transfer	1	34	60	500	54CP	C.F.	8.5	227	EM	20
93.	Asphalt Loading	2	34	39	300	258CP	C.F.	8.5	500	EM	20
94.	Asphalt Slops	1	1.2	44	200	10CP	C.F.	.75	158	EM	1 1/2
IX.	AMINE TREATERS										
95.	Amine Circulation	2	41	264	177	.58CP	C.F.	95	820	EM	100
96.	Amine Feed H_2 Plant	2	2.27	35	100	.73CP	C.F.	5.5	270	EM	5
97.	Amine Sump Pump	1	2.27	17.6	100	1.25CP	C.F.	<1	-	EM	1
X.	OFF SITES/UTILITIES ETC.										
98.	Unifier Feed	2	79	39	100	<1CP	C.F.	17	400	EM	20

1	2	3	4	5	6	7	8	9	10	11	12
99.	Isomax Feed Booster	2	112	85	200	7CP	C.P.	70	430	EM	75
100.	Crude Booster	2	613	276	35	61CP	C.P.	900	3100	ST	900
101.	Visb.Feed Booster	2	6	128	200	875CP	C.P.	96	-	EM	125
102.	Gasoline Blending	2	272	32	100	<1CP	C.P.	29	380	EM	30
103.	Raw Kero.Feed	2	102	61	100	1.02CP	C.P.	39	525	EM	40
104.	Aw-410 Transfer	2	75	124	100	1 CP	C.P.	65	590	EM	75
105.	Fuel Oil Blending	2	272	38	150	80CP	C.P.	60	680	EM	75
106.	Diesel Blend	2	272	42	100	7CP	C.P.	50	680	EM	60
107.	Kero.Blending	2	272	40	100	1CP	C.P.	45	680	EM	50
108.	Diesel Transfer	2	545	112	100	5 CP	C.P.	260	760	EM	250
109.	Kero. Transfer	2	272	100	100	1CP	C.P.	110	820	EM	125
110.	At-100 transfer	2	75	115	100	<1CP	C.P.	55	590	EM	60
111.	AW-402	2	75	113	100	<1CP	C.P.	63	590	EM	75
112.	Gasoline Transfer	2	545	102	100	<1CP	C.P.	325	-	EM	250
113.	Fuel Oil Transfer	1	544	110	150	400CS	C.P.	410	760	EM	450
114.	Gasoline Circ.	1	34	140	100	<1CP	C.P.	38	740	EM	50
115.	Butane Transfer	2	34	55	100	-	C.P.	8		EM	10

1	2	3	4	5	6	7	8	9	10	11	12
116.	Lpg. Transfer	2	45.5	245	35	<1CP	C.P.	55	970	EM	60
117.	Refinary Slops	1	75	33	180	30CP	C.P.	18	210	EM	20
118.	Kerosene Fuel	1	11.4	127	100	1.2CP	C.P.	24	360	EM	25
119.	Slops Return	1	15.9	46	180	50CP	C.P.	9.5	270	EM	10
120.	Lube-Cut Loading	3	22.7	40	175	28.8CP	C.P.	8	-	EM	10
121.	Gasoline Drainsump	1	6.8	47	100	1CP	C.P.	1.2	-	EM	2
122.	Boiler Feed Water	1,2	205	596	225	-	C.P.	690	2850	EM/ST	700,58
123.	Boiler Phosphate Inj.	3	0.045		150	1000CPS	R.P.			EM	0.5
124.	Cond. Supply	1	87.5	42	170	-	C.P.	25	210	EM	25
125.	Treated Water Supply	2	130	42	125	-	C.P.	30	-	EM	40
126.	Plant Water	1,1	91	53	100	-	C.P.	37	435	EM/ST	40/29
127.	Treated W.B/Wash	1	255	37	219	-	C.P.	47	720	EM	60
128.	Treated W.B/Booster	1	238	44	219	-	C.P.	55	720	EM	60
129.	Desuperheater Feed	1	8.6	7.4	194	-	C.P.	11.5	310	EM	15
130.	Fuel Oil	1	52	19.4	180	984CP	C.P.	56	320	EM	75
		1								ST	60

1	2	3	4	5	6	7	8	9	10	11	12
131.	RefineryGasoline	1	39	217	100	-	C.F.	70	870	EM	60
		1								ST	60
132.	Lpg. Fuel	1	25	53	100	-	C.F.	6.5	310	EM	7.5
										ST	6
133.	Flare Knockout	2	11.4	53	450	1C	C.F.	10	270	EM	10
134.	Cooling Water Circ.	4	3070	46	85	-	C.F.	680	2550	ST	600
135.	Auounloading	1	11.4	11.4	100	-	C.F.	1.86	95	EM	2
136.	Condensate	1	91	76	130	-	C.F.	12	310	EM	15
		1								ST	11
137.	Fire Water	1	455	105	100	-	C.F.	325	1050	EM	300
		1								ST	260
138.	F/F Jockey Pump	1	18.2	-	100	-	C.P.	= 3	-	S	
139.	Separator w.Efflu.	1	170	28	100	1CP	C.P.	47	-	EM	40
140.	Separator Oil	2	22.7	25	100	-	C.P.	4.5	-	EM	5
141.	Separator Oil Return	1	45.5	60	100	-	C.P.	20	145	EM	25
142.	API Separator	1	341	28	80	-	C.P.	66	-	EM	60
143.	Sludge Pump	2	6.8	13.3	80	.86CP	C.P.	1.2	-	EM	2
144.	Sanitary Sewerage	2	11.4	9.2	100	-	C.P.	2	318	EM	2
145.	LPG Truck Loading	2	35	127	100	-	C.P.	23	870	EM	25

1	2	3	4	5	6	7	8	9	10	11	12
146.	C25L Lub.Oil Pumps	1 1	36	100	121	160	C.F.	27	-	EM ST	30 27.4
147.	C251 Seal Oil	1 1	3	-	122	-	C.F.	7.1	-	EM ST	9.1 7.9
148.	Turbo Generator Cond.	3 3	42	60	130	-	C.F.	13	225	EM ST	15 13
149.	Turbo Generator Lub. Oil	3 3	55	75	131	160	C.F.	27	90	EM ST	39.5 39.5
150.	Comp. Shaft Lub Oil	3	25	-	122	70	C.F.	9	305	-	
151.	Comp. Shaft Lub Oil	3	27	-	122	70	C.F.	9.1	96	EM	13.4
152.	Comp. Lub Oil	3	19.5	-	160	360	C.F.	6.4	-	-	
153.	Comp. Lub Oil	3	16.3	-	141	130	C.F.	3.8	100	EM	7.5
154.	Comp. Lub Oil	1	14.8	-	140	75	C.F.	11	30	EM	5
155.	Comp. Seal Oil	1 1	2.3 5.1	- -	140	75	C.F.	40 40	52 52	EM ST	40 60
156.	Lub Oil for P431A&B	2	6.8	-	110	150	C.F.	2	-	ST	2

COMPRESSORS SPECIFICATIONS

Service/ Specs.	Atm. Column Gas	Unifying Recycle	Platformer Recycle	Make-up hydrogen Booster	Isomax Recycle	Stabilizer Feedgas	LP Feed Gas	Utilities Comp.Air.
Nos. Reqd.	1	1	1	3	1	1	2	2
Capacity, Inlet M^3/h	1300	158	212,000	$28x10^6$	260,000	1800	3160	9000
Outlet Temp. °F	185	140	160	260	160	235	149	345
Inlet Pressure Psi	19	344	361	209	2603	22	67	Atm.
Outlet Pressure, Psi	387	448	523	473	2838	208	333	123
BHP Type	175 Recip.	54 Recip.	4350 C.F.	925 Recip.	1650 C.F.	334 Recip.	327 Recip	1195 C.F.
Wt., Kg.	5170	3700	7000	75,000	4700	10,700	4270	
Drive	EM	EM	ST	ST	ST	EM	EM	ST

C.F. : Centrifugal

EM : Electric Motor

ST : Steam Turbine

PART 'B'

EQUIPMENT SPECIFICATIONS

(100,000 T/yr. of Lube Refinery)

2. DRUMS AND VESSELS

S.No.	DESCRIPTION	QTY.	SPECIFICATIONS Dia. MM	Height (Length) MM	THICK-NESS MM	WEIGHT KG/ VESSEL	MAT.	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.
	I. VACUUM UNIT							
1.	Surge Drum	1	2220	(6800)	8	4700		
2.	Hot Well	1	1600/1200	(4050)	5	1050		
3.	Water Separator	1	635	(3700)	7	750		
4.	Coke Separator	2	800	2400	5	325		
5.	Condensate Separator	1	550	1000	7	270		
6.	Sample Water Cooler	1	220	1415	8	76		
	II. FURFURAL EXTRACTION UNIT							
7.	Refinnate Soln. Vessel	1	1600	5700	7	2000		
8.	Solvent Vessel	1	950	2500	8	750		
9.	Water Solvent Vessel	1	800	2400	8	550		
10.	-do-	1	1600	(5550)	7	2150		

1.	2.	3.	4.	5.	6.	7.	8.	9.
11.	Drainage Vessel	1	1430	(3900)	7	1550		
12.	Carbonate Soln.Drum	1	1600	2250	7	1920		
13.	Barometric Condenser	1	300	1660	5	150		
14.	Coke-Removal Vessel	1	280	960	5	120		
15.	Safety Valve Discharge Vessel	1	640/ 1280	11200	8/11	4400		
16.	Extrat Mix Settler	1	2140	(4370)		6100		
17.	Sample Water Cooler	2	220	1415	8	76		
	III. DEWAXING UNIT							
18.	Filter Feed Tank	1	1900	6100	7	2550		
19.	Filtrate Receiver	1	2380	(7150)	11	6400		
20.	Wax Mix Receiver	8	950	3260	8	780		
21.	Warm Wash Filtrate Receiver	1	1600	(6800)	7	2420		
22.	Drain Tank	1	1900	(4150)	8	2550		
23.	Propane Vessel	1	340	1440	7	170		

1.	2.	3.	4.	5.	6.	7.	8.	9.
24.	Wax Mix Settling Tank	1	2850	10900	8	7550		
25.	Solvent Receiver	1	2850	(7800)	11	8600		
26.	Dry Solvent Receiver	1	2850	(7800)	11	8600		
27.	Solvent Receiver	1	2850	(7800)	11	8600		
28.	Inert Solvent Receiver	1	3170	(7800)	14	12100		
29.	Knock out Drum	2	1270	2640	9	1370		
30.	Inert Gas Receiver	1	1270	4900	7	1550		
31.	Inert Gas Vessel	1	1270	3000	7	900		
32.	Ammonia Drain Vessel	1	1200	(5450)	18	3550		
33.	Separator	1	550	1165	6	195		
34.	-do-	1	380	350	5	85		
35.	Chilled Solvent Filter Pot	2	460	620	5	75		
36.	Hot Solvent Filter Pot	2	260	1070	7	130		

1.	2.	3.	4.	5.	6.	7.	8.	9.
37.	Spindle Vessel for Hydraulic Seal	1	640	1280	5	175		
38.	Hydraulic Seals	8				220		
39.	Sample Pot	8	203	530		37		
40.	Steam Condensate Separator	2	324			117		
41.	Gas Holder	1	5250	6200		10000		
	IV. HYDROFINISHING UNIT							
42.	Hydrofinishing Reactor	1	1430	10000				C ½ MO cladded
43.	Knockout Drum	1	475	1230			C.S.	
44	Ist HP Separator	1	1230	3400			C.S.	
45.	2nd HP Separator	1	360	1600			C.S.	
46.	LP Separator	1	1430	3900			C.S.	
47.	Settling Drum	1	800	(1430)			C.S.	
48.	Fuel Gas Drum	1	360	800			C.S.	
49.	Fuel Gas Separator	1	360	800			C.S.	

1.	2.	3.	4.	5.	6.	7.	8.	9.
	V. PROPANE DEASPHALTING UNIT							
50	Propane Vessel	1	2220	(13100)	24	19500		
51.	-do-	1	2220	(13100)	24	19500		
52.	Knock Out Drum	1	1110	4750	7	1300		
53.	Blowdown Drum	1	2400	7000	16	8200		
54.	Extract Drum	1	2400	2600	7	1720		
55.	Condensate Separator	1	340	1240	5	110		
56.	Oil Knockout Pot	1	650	2040	8	630		
57.	Butane Vaporiser	1	340	1320	5	110		

3. PUMPS

UNIT	S.No.	SERVICE	Nos. Reqd.	Design Data			Pump			Motor	
				Cap. M^3/hr	Diff. head, m	ap. temp. ^oC	Type	BHP	Wt.	Type	HP
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
I.Vacuum	1.	Feed Pump	2	90	154	140	CF			Electric	90
	2.	Transfer Pump	1	8	35.4	50	"			"	6.5
	3.	Gas Oil Pump	2	95	93	180	"			"	63
	4.	Spindle Oil Pump	1	6	58	200	"			"	5
	5.	Transfer Pump	2	25	83	275	"			"	15
	6.	Pumparound	2	75	68	290	"			"	30
	7.	Interned Oil.	1	14	74	310	"			"	7.5
	8.	Heavy Oil	2	16	86	335	"			"	10
	9.	Recycle Pump	2	7	140	375	"			"	7.5
	10.	Short Residue	2	50	120	350	"			"	40
	11.	Condensate	1	1.5	44	50	"			"	1
II.Furfural Extraction Unit.	12.	Charge Oil Pump	1	47	37.4	90	"			"	25

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
	13.	Charge Oil Pump	2	49	92.5	130	C.P.			Elec-tric	50
	14.	Raffinate Sol.	1	47	72.5	125	"			"	50
	15.	Furfural	2	47	83.4	60	"			"	6.2
	16.	Int. Oil LVI	2	43	58.4	211	"			"	25
	17.	Recycle	2	137	10.6	112	"		"	"	30
	18.	Extract Sol.	2	100	120	182	"			"	100
	19.	Extract Sol.	2	20	104	224	"			"	10
	20.	Extract	2	16	51	168	"			"	10
	21.	Furfural + Water	2	4	30.9	60	"			"	0.75
	22.	Furfural	1	85	99.5	165	"			"	60
	23.	Furfural+Water	1	4	30.4	60	"			"	0.75
	24.	Water+Furfural	1	2	56	60	"			"	0.75
	25.	Furfural + drain	1	3.5	61	100	"			"	1.0
	26.	Na_2Co_3 Sol.Pump	2	0.5	55	70	Prop.			"	10

1.	2	3.	4.	5.	6.	7.	8.	9.	10	11.	12.
III.Sov-vent Dewaxing Unit	27.	Charge Oil	3	16	197	40	C.F			Elec-tric	15
	28.	Filtrate	2	135	168	20	"			"	102
	29.	Wax Mix	9	10	68	20	"			"	25
	30.	Solvent+Reflux	1	67	195	50	"			"	50
	31.	Solvent	2	100	182	50	"			"	52
	32.	Feed to Column	2	110	104	98	"			"	38
	33.	Dewaxed Oil to Store	2	25	74	176	"			"	6.3
	34.	Feed to Column	2	38	66	54	"			"	7.5
	35.	Feed to Column	2	18	80	105	"			"	5.2
	36.	Slack Wax	1	10	76	148	"			"	4
	37.	Column Feed	2	9	42	50	"			"	1.5
	38.	Flushing Return	2	20	70	10	"			"	2.5
	39.	Drain Return	2	5	69	20	"			"	0.75
	40.	Water Recovery	2	30	53	40	"			"	13

PUMPS

1.	2.	3.	4.	5.	6.	7.	8.	9.	10	11.	12.
IV.Lube Oil Hydro-finishing	41.	Feed	2	24	948	50	CP	104		Elec-tric	125
	42.	Oil Product	2	23	108	210	"	11.5		"	15
	43.	Distillate	2	0.3	82	40	"	10		"	1.5
	44.	Sour Water	1	0.3	69	40	"	0.5		"	1
	45.	Corr.Inhibitor	1	0.5lit/hr	30	50	Prop.	-		"	-
V. Propane Deasphal-ting Unit	46.	Propane	4	125	558	54	C.P			Steam turbine	270
	47.	Asphalt	2	16	244	217	Recip			Direct-acting	40
	48.	Oil Pump	2	13	66	148	C.P.			Elec-tric	10
	49.	Recycle oil +Propane	4	12	33.7		"			Elec-tric	25

4. COMPRESSORS

Unit	S.No.	Service	Nos. Reqd.	Design Data: Cap. MM^3/hr	Pr. Ratio	Inlet Hr. Kg/cm^2 gauge	Inlet Tem. °C	Compressor: Type	BHP	Wt	Motor: Type	hP
III. Solvent Dewaxing Unit	1.	Inert Gas Compressor	2	3000	12.5	0.2	-20	Centri			Elec-trical	400
	2.	Inert Gas Compressor	1	150	2.34	2.0	35	Recip			"	30
	3.	Compressor for Ammonia	2					Centri			"	2200
	4.	Additional	1		4.4	0.15						
	5.	Compressor for Refrigeration Station	2	2700/ 4400/ 5000	2/3/3	0.97/ 2.15/ 6.35	-22/12/35					
IV. Lube Oil hydro-finishing	6.	Make-up gas compressor	1	925	2.60	27	45	Recip	56		Elec-trical	63
	7.	Recycle gas Compressor	2	2050	1.145	65	40	"	24		"	30
V. Propane Deasphalting Unit.	8.	Compressor for Propane	2	1800 kg/hr.	14	0.5		"			"	170

Heat Exchangers for Lube Refinery = 522.5 Tons
(For Breakdown See supplement to Annexure 1.1)

TANKAGE

BASIS:

Crude storage	7 days
Products	15 days
Total Tonnage (with structural steel)	13,750 M.T.

Steel Plate Requirements

Upto 8 mm thickness	7300 M.T.
10-12 mm thickness	4240 M.T.
Beyond 20 mm thickness	962 M.T.

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Breakdown of Heat Exchangers for Lube Refinery

Unit	Service	Heat Duty x10^6 KCal/hr.	Area sq.m.	Design Temp. °C Steel	Design Temp. °C Tube	Design Pres. K/sq.m Steel	Design Pres. K/sq.m Tube
1	2	3	4	5	6	7	8
I Vacuum Unit	1. Gas Oil Exchanger	0.94	3x100	175	195	17.6	7.0
	2. Gas Oil Cooler	2.1	1x128	165	60	10	5.5
	3. Gas Oil Cooler	2.1	1x128	165	60	10	5.5
	4. Spindle Oil Cooler	0.28	1x25	216	60	13	5.5
	5. Light Oil Exchanger	0.93	1x100	291	196	12	17.6
	6. Light Oil Exchanger	0.93	1x1000	291	196	12	17.6
	7. Light Oil Cooler	0.96	1x[illegible]	195	60	12	5.5
	8. Heat Exchanger	2.1	3x100	306	196	6	17.6
	9. Int. Oil Exch.	0.38	1x78	336	250	7	17.6
	10. Int. Oil Cooler	0.78	1x37	263	60	7	5.5
	11. Hy. Oil Exch.	0.55	1x100	348	250	7	17.6
	12. Hy.Oil Cooler	0.99	1x46	270	80	7	5.5
	13. Short Res.Exch	1.0	1x109	360	275	11	17.5
	14. Short Res.Cooler	1.59	1x83	185	60	11	5.5
	15. Short Res.Cooler	1.59	1x83	185	60	11	5.5
	16. Steam Generator	1.79	2x115	160	333	5	11
II-Furfural Extraction Unit	17. Feed Exchanger	0.7	1x[illegible]	255	145	9	9
	18. Feed Exchanger	0.7	1x84	255	145	9	9
	19. Feed Steam	0.13	1x42	220	150	15	7
	20. Column Charge Cooler	1.05	1x155	150	75	8	55
	21. Raffinate Exchanger	1.236	1x123	180	240	5	5

ers for Lube Refinery

Supplement to Annexure 1.1
Sheet 1 of 4

C	Design Pres. k/sq.m Steel	Tube	Size 1.Dxlength mm	Weight kg	Remarks
	7	8	9	10	11
	17.6	7.0	565x7117	2x4200	
	10	5.5	565x7135	5080	
	10	5.5	565x7135	5015	
	13	5.5	287x6908	1415	
	12	17.6	565x7244	5710	
	12	17.6	565x7244	5700	
	12	5.5	424x7056	2175	
	6	17.6	565x7274	3x5450	
	7	17.6	495x7239	4660	
	7	5.5	339x6981	1860	
	7	17.6	565x7239	5820	
	7	5.5	360x6993	2375	
	11	17.5	635x7356	6820	
	11	5.5	495x7108	3930	
	11	5.5	495x7108	3850	
	5	11	1150x9230	2x8450	Kettle Type
	9	9	500x6878	2875	
	9	9	500x6878	2836	
	15	7	360x6839	1650	
	8	55	655x7130	6550	
	5	5	565x6901	3682	

22.	Rafinate Exchanger	1.236	1x123	180	240	5	5	565
23.	Furfural Condenser	1.506	1x187	140	75	2	5.5	720
24.		1.367	2x160	100	25	2	5.5	720
25.	Raffinate Cooler	1.12	1x68	210	75	4.5	5.5	440
26.	Cooler	1.616	1x208	115	75	9	55	720
27.	Extra Solv./Furfural	1.59	1x135	140	200	6	11	65
28.	Extra Solv./Col.Vap	3.28	2x230	210	200	2	7	800
29.	Extra Soov./Col.Vap	4.54	4x197	230	210	2.5	5	720
30.	Steam Generator	0.656	1x21	220	75	2	55	50
31.	Steam Generator	0.2	1x	220	75	2	55	45
32.	Extract Cooler	0.351	1x66	200	75	5.5	5.5	44
33.	Azcotrope Cond	0.882	1x62	150	75	5	5.5	44
34.	Furfural Cooler	0.881	1x44	190	75	6	5.5	37
35.	Surface Cond	0.42	1x18					30
36.	Surface Cond	0.76	1x33					37
37.	Surface Cond	0.246	1x25					34
III - Solvent								
	Unit							
38.	Feed Mix Steam	0.24	1x16.5	180	100	5	15.5	34
39.	Feed Mix Steam	0.24	1x16.5	180	100	5	15.5	34
40.	Feed Mix Cooler	0.25	1x100	100	7.5	145	6	65
41.	Feed Mix Cooler	0.25	1x100	1.00	7.5	145	6	65
42.	Solv. Ammonia Cooler	0.32	1x60	-15	55	16	6	51
43.	Solv. Ammonia Cooler	0.32	1x60	-15	55	16	6	51
44.	Solv. Ammonia Cooler	0.38	1x60	-30	-2	16	5	51

Supplement to Annexure 1.1
Sheet 2 of 4

7	8	9	10	11
5	5	565x6901	3648	
2	5.5	720x7305	7000	
2	5.5	720x7010	2x5750	
4.5	5.5	440x6901	2158	
9	55	720x7310	8500	
6	11	655x7156	4830	
2	7	800x7200	2x6850	
2.5	5	720x7300	4x5650	
2	55	500/1000x 3854	2280	
2	55	450/1000x 7277	3345	
5.5	5.5	440x6900	2600	
5	5.5	440x6925	2900	
6	5.5	375x6900	1825	
		300x7000	1100	Condenser for Ejectors
		375x7000	1700	
		340x6800	1450	
5	15.5	340x4000	975	
5	15.5	340x4000	975	
145	6	650x7200	5000	
145	6	650x7200	5000	
16	6	510/655	3200	
16	6	510/655x 7151	3200	
16	5	510/655x 7151	3200	

1	2	3	4	5	6	7	8
	45. Solv.Ammonia cooler	0.34	2x60	-30	-20	16	3.5
	46. Solv.Oil & Solv.	1.95	2x110	150	90	2	6
	47. Oil & Wax Mix.Exch	0.68	1x75	200	175	5	3.5
	48. Solv. Oil Cond	4.24	4x125	160	130	3.2	2
	49. Filtrate Steam	6.68	2x162	230	180	15.5	7
	50. Filtrate Steam	6.68	2x98	230	180	15.5	7
	51. Oil & Solv.Steam	1.05	1x125	230	200	15.5	6
	52. Solv.Water Cond.	2.9	3x125	140	75	2	6
	53. Wax Mix preheat	1.06	1x75	180	105	5	3
	54. Wax Mix Preheat	1.67	1x75	230	135	15.5	3
	55. Wax Mix Preheat	0.72	1x76	310	170	15.5	6
	56. Wax Wax mix	1.1	1x43	170	90	6	4
	57. Solv. Water	4.19	4x175	135	75	2	6
	58. Oil Solv.Cooler	0.24	1x50	120	75	5	6
	59. Solv.Water Cooler	2.74	4x100	150	75	2	6
Solvent Dewaxing	60. Steam Solv.	0.081	1x13	180	110	5	3
	61. Inert Gas Cooler	0.121	1x23	190	75	2	6
	62. Inert Gas	0.066	2x60	-15	80	16	2
	63. Double Pipe Exch.	0.18/ 0.77	12x41				
	64. Double pipe chiller	0.08/ 0.77	12x41				
	65. Double Pipe Chiller	0.12/ 0.49	12x41				
	66.						
IV.Lube Oil Hydro finishing	66. Feed Effluent	1.87	3x60	380	425	80.5	75.5
	67. Vapor Cooler	0.28	1x15	265	55	73.5	
	68. Vapour Cond	0.27	1x45	55	55		
	69. Ejector Vap.Cond.	0.78					
	70. Oil Prod.Cooler	0.60	1x53	165	60	8	

7	8	9	10	11
16	3.5	510/655x 3200 7151		
2	6	635x7314 2x4880		
5	3.5	495x6920 2970		
3.2	2	720x7200 4x6250		
15.5	7	700x7318 2x6300		
15.5	7	565x7270 2x4320		
15.5	6	635x7225 5250		
2	6	635x7200 3x5750		
5	3	580x7231 3410		
15.5	3	510x7000 3750		
15.5	6	495x7033 3375		
6	4	425x6656 2085		
2	6	795x7300 4x6750		
5	6	440x6900 2600		
2	6	585x7100 4x4400		
5	3	340x4000 975		
2	6	375x6750 1370		
16	2	520x928 2x3150		
		145x13500		
		145x13500		
		145x13500		
80.5	75.5			
73.5				

1	2	3	4	5	6	7
	71. Feed-Oil Prod.	0.75	1x56	165	265	81.5
	72. Vapour Cond.	0.016		225	55	5.6
	73. Make-up Cooler	0.006		105	55	30.4
V-Propane Deasphalting Unit	74. Feed Cooler	0.24	1x69	310	180	19
	75. Propane Cooler	0.45	1x127	85	75	23
	76. Oil Propane Sol Preheater	5.3	2x116	100	190	27.5
	77. Oil Propane Sol Preheater	2.9	1x15	120	190	24
	78. Oil Propane Sol Reboiler	0.39	2x39	310	180	19
	79. Propane Cond	12.4	18x115	205	75	23
	80 Comp .Prop.Cond	0.145	1x29	120	75	23
	81. Heat Exch.	0.224	1x70	100	180	27.5
	82. Asphalt Cooler	0.5	1x119	75	250	5.5
	83. Oil Propane Sol. Preheater	2.02	3x31			

Supplement to Annexure 1.1
Sheet 4 of 4

7	8	9	10	11
81.5	8.5			
5.6				Double Pipe
30.4				
19	46	500x7349	4425	
23	55	635x7147	6140	
27.5	6	590x7050	2x5250	
24	6	635x7189	6500	
19	23	530x5026	2x2280	
23	5.5	565x7160	18x5430	
23	5.5	360x6974	1920	
27.5	9	500x7118	4100	
5.5	11	600x7283	4950	
		425x4277	3x2340	

Category-wise equipment requirement for Petro-Chemical projects

Annexure 1.2
Sheet 1 of 4

S.No.	Product	Capacity TPA	Requirements of Fabricated Equipment (Tons)				Remarks
			Furnace	Heat Exchanger	Process Vessels	Tanks	
1	2	3	4	5	6	7	8
1.	Polyviny Chloride I	20,000	240	386	584	608	
2.	Soda Ash	63,000	175	286	437	458	
3.	Sodium tripoly phasphate	30,000	100	161	243	258.5	
4.	Carbon Black-I	15,000	98.5	159	240	251	
5.	Mixed Fertilisers-II	50,000	149	240	364	379	
6.	Ethylene-I	340,000	400	644	975	1015	
7.	Propylene-I	120,000	120	193	292	304	
8.	Butadiene	25,000	50	80.5	122	127	
9.	Benzene	60,000	80	128	194	203	
10.	Ethyl Benzene	200,000	144	232	351	367	
11.	Cumene	150,000	1000	1610	2440	2540	
12.	Oxylene and mixed oxylene	120,000	445	712	1081	1125	
13.	Ethylene Dichloride	30,000	1750	2730	4150	4325	

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1	2	3	4	5	6	7	8
14.	Low density polyethylene	100,000	543	875	1325	1382	
15.	High density polyethylene	50,000	400	644	975	1011	
16.	Ethylene glycol	50,000	508	813	1235	1382	
17.	Ethylene benzene	200,000	144	232	351	367	
18.	Caustic Soda	250,000	-	-	-	-	
19.	Polypropylene	-	-	-	-	-	
20.	Ammonia-I	330,000	320	515	781	814	
21.	Urea-I	230,000	133	214.5	325	339	
22.	Urea-2	132,000	100	161	224	254	
23.	Sulphuric Acid	430,000	66.5	107.5	162	169.5	
24.	Phosphoric Acid	150,000	66.5	107	162.2	169	
25.	Triple sufer Phosphat:/ Di Ammonium Phosphate.	142,000	400	644	975	1011	
26.	Caprolactum	50,000	415	670	1010	1055	
27.	Mixed Fertilizers	250,000	149	321	486	506	
28.	Plasticizers	40,000	400	644	975	1011	
29.	Pthalic Anhydride	20,000	60	96.5	146	152	

1	2	3	4	5	6	7	8
30.	Oxo-Alcohols	30,000	200	322	487	507	
31.	Methanol	240,000	186	300	454	474	
32.	Polyester Fibers:						
	i) Stabhfilament ii) Filament iii) Resin	3,500 1,000 1,000	260	417.5	632.5	658	
33.	Carbon Black-II	15,000	98.7	157	240	251	
34.	Polyester Fibre-I	15,000	430	690	1050	1090	
35.	Malamine & Urea Formaldehyde-I	4,500	40	64.4	97.5	101.1	
36.	Urea Formaldehyde	5,500	40	64.4	97.5	101.1	
37.	Rayon Viscose-I	15,000	133	214.5	325	339	
38.	Formaldehyde	7,500	80	129	195	203	
39.	Nylon-6 I	4,000	80	129	195	203	
40.	Polyester Fibre	20,000	240	386	584	608	
41.	Acrylie Fibre	20,000	399	631	956	1000	
42.	Nylon-6 II	60,000	600	965	1460	1520	
43.	Rayon viscose-II	35,000	160	256	388	406	
44.	Styrene Monomer	50,000	160	256	388	406	

1	2	3	4	5	6	7	8
45.	Polystyrene	25,000	160	256	388	406	
46.	Polybutadine	15,000	120	193	292	304	
47.	Styrene Butadierene Rubber-I	50,000	173.5	279	422	441	
48.	Dimethyl Tere Phathelat.	30,000	175	286	437	458	
49.	Synthetic profien	30,000	240	386	584	608	
50.	Acrylonitrile	15,000	220	353	530	555	
51.	Urea and Malamine formeldehyde-II	4,500	40	64.4	97.5	101.5	
52.	Polyvinyl Chloride-II	40,000	358.7	575.5	875	910	
53.	Olifins and Aronatics-II	-	1939	3120.5	4725	4923	
54.	Ammonia-II	330,000	320	515	781	814	
55.	Ethylene-II	41,000	76	122.5	185	194.5	
56.	Propylene-II	50,000	50	80.5	112	127.0	
57.	Cyclohexane	100,000	60.	96.5	146	152.0	
58.	Styrene Butadiene Rubber	50,000	173.5	279.0	422	441.0	
59.	Isoprene & polyprene	72,000	350	572	874	916	
60.	Ethanol	50,000	800	1288	1950	2030	
61.	Carbardisulphide	22,000	133	214.5	325	339	

Indicative List of Plant & Equipment for production of Ethyl Benzene & Styrene

Capacity: Ethyl Benzene - 200,000 tons/year
Styrene - 50,000 tons/year

S. No.	Description	Size	Qty.
1	2	3	4
1.	Vessel	4 cu.m	6
2.	Alkylator	2600x12500 mm	2
3.	Settling Vessel	25 cu.m	2
4.	Settling Vessel	50 cu.m	2
5.	Vessel	100 cu.m	3
6.	Settling Vessel	5 cu.m	2
7.	Vessel	5 cu.m	9
8.	Vessel	10 cu.m	4
9.	Vessel	32 cu.m	1
10.	Vessel	20 cu.m	4
11.	Vessel with Agitator	25 cu.m	4
12.	Vessel	50 cu.m	3
13.	Vessel	25 cu.m	1
14.	Vessel	3.2 cu.m	18
15.	Vessel with Agitator	0.63 cu.m	1
16.	Collector	2 cu.m	1
17.	Drum	1 cu.m	1
18.	Collector	3 cu.m	1
19.	Collector	3.2 cu.m	1

Annexure 1.3
Sheet 2 of 5

1	2	3	4
20.	Settler	20 cu.m	1
21.	Clarifier	6000 o.d., 16000 H.mm	2
22.	Filter	ϕ 2000 mm	1
23.	Tank	100 cu.m	6
24.	Tank	63 cu.m	4
25.	Tank	25 cu.m	1
26.	Condenser	102 sq.m	1
27.	Condenser	31 sq.m	5
28.	Cooler	22 sq.m	2
29.	Heat Exchanger	13 sq.m	1
30.	Heat Exchanger	50 sq.m	8
31.	Heat Exchanger	164 sq.m	7
32.	Condenser	110 sq.m	3
33.	Condenser	250 sq.m	1
34.	Heat Exchanger	18 sq.m	4
35.	Condenser	44 sq.m	5
36.	Cooler	13 sq.m	2
37.	Condenser	9 sq.m	3
38.	Cooler	6 sq.m	3
39.	Cooler	45 sq.m	1
40.	Condenser	86 sq.m	15
41.	Cooler	42 sq.m	1
42.	Heater	28.5 sq.m	4
43	Heater	28.5 sq.m	2

1	2	3		4
44.	Heat Exchanger	3 sq.m		1
45.	Condenser	340 sq.m		5
46.	Condenser	630 sq.m		2
47.	Heat Exchanger	54 sq.m		4
48.	Heat Exchanger	21 sq.m		1
49.	Heat Exchanger	117 sq.m		1
50.	Condenser	150 sq.m		1
51.	Cooler	24 sq.m		1
52.	Condenser	890 sq.m		2
53.	Centrifugal pumps of sizes	Q(cu.m)	H.(m)	
		0.07	30	2
		0.15	30	2
		20	20	1
		10	57	9
		4.8	65	1
		2	65/40	30
		10	25	1
		2.5	35	1
		2.6	40	4
		3.8	30	1
		7.30	40	2
		10-35	40	2
		0.5-1	9.5-37	2
		30-61	58-45	2
		10-25	57-45	20
		126-182	23-17	2
		20-40	120-140	4
		2-6	65	4
		1.1	145	2
		20	50	7

Annexure A.3
Sheet 4 of 5

1	2	3	4
54.	Scrubber	ø 400 mm	2
55.	Washing tower	ø 1600x10000 mm	1
56.	Column	ø 1800mm25 trays	1
57.	Column	ø 2600 mm, 60 trays	3
58.	Column	ø 1200 mm, 40 trays	3
59.	Column	ø 1400 mm, 37 trays	3
60.	Column	ø 1600 mm, 44 trays	3
61.	Stripping Column	ø 600 mm	1
62.	Stripping Column	-	2
63.	Evaporator	-	1
64.	Washing Tower	-	2
65.	Column	ø 4400 mm, 50 trays	2
66.	Rectification Column	ø 4400 mm, 37 trays.	2
67.	Rectification Column	ø 3000 mm, 30 trays.	2
68.	Boiler	35 sq.m	1
69.	Boiler	260 sq.m	2
70.	Boiler	178 sq.m	1
71.	Boiler	117 sq.m	1
72.	Boiler	42 sq.m	1
73.	Boiler	28 sq.m	1
74.	Boiler	102 sq.m	2

1	2	3	4
75.	Waste Heat Boiler	710 sq.m	1
76.	Waste Heat Boiler	230 sq.m	1
77.	Collector	2 cu.m	2
78.	Steam Jet Ejector	-	6
79.	Steam Super Heater	1300 sq.m	4
80.	Cyclone Separator	50 cu.m	1
81.	Air Blower	13000 cu.m	2
82.	Furnace	1000 kg/hr.	1

Butadiene Plant

Capacity: 25,000 Tons/Year

Annexure 1.4
Sheet 1 of 4

Indicative List of Plant & Equipment for the Manufacture of Butadiene

Capacity: 25,000 tons/year

S.No.	Description	Size	Quantity
1	2	3	4
	COLUMNS		
1.	Extractive Distillation column	Ø1820x31000 mm	1
2.	Extractive Distillation column	Ø1820x37000 mm	1
3.	Stripper	Ø1420x25000 mm	1
4.	Tapping Column	Ø900x18000 mm	1
5.	Tailing column	Ø1050x20000 mm	2
6.	Butaliene Washer	Ø7200x5320 mm	1
7.	Acetonitrile Recovery column	Ø900x16000 mm	1
	VESSELS		
8.	Extractive Distillation column Reflux drum	Ø1610x3220 mm	1
9.	Stripper Reflux Drum	Ø1610x3220 mm	1
10.	Drips Accumulator	Ø965 x 1030 mm	1
11.	Topping Column Reflux Drum	Ø1030x2160 mm	1
12.	Tailing column Reflux Drum	Ø695x2020 mm	1
13.	Tailing Column Nitrite Solution Settler	Ø695x2020 mm	1
14.	Nitrite Solution Make-up vessel	Ø915x1830 mm	1

Annexure 1.4
Sheet 2 of 4

1	2	3	4
15.	Topping Column Nitrite Solution Settler	Ø1260x3800 mm	1
16.	Butaliene Settler	Ø630x1890 mm	1
17.	Acetonitrile Recovery Column Reflux Drum	Ø865x1730 mm	1
18.	Sodium Bicarbonate Dissolving Vessel	Ø915x1830 mm	1
19.	HEAT EXCHANGERS		
19.	Feed Vaporizer	46.5 sq.m	1
20.	Extractive Distillation Column Condenser	27 sq.m	1
21.	Extractive Distillation Column Reboiler	396 sq.m	1
22.	Extractive Distillation Tops cooler	105 sq.m	1
23.	Stripper Condenser	19.6 sq.m	1
24.	Stripper Reboiler	340 sq.m	1
25.	Steam Generator	312 sq.m	1
26.	Solvent Start-up cooler	55 sq.m	1
27.	Solvent Cooler	110 sq.m	1
28.	Topping Column Condenser	65 sq.m	1
29.	Topping column Reboiler	37 sq.m	1
30.	Tailing Column Condenser	10 sq.m	1
31.	Tailing Column Reboiler	132 sq.m	1
32.	Tailing Column Top Cooler	6 sq.m	1
33.	Acetonitrile Recovery Column Heat Exchanger	60 sq.m	1

Annexure 1.4
Sheet 3 of 4

1	2	3	4
34.	Acetonitrile Recovery Column Condenser	70 sq.m	1
35.	Acetonitrile Recovery Column Water Cooler	64 sq.m	1
36.	Acetonitrile Recovery Column Tops Cooler	4.8 sq.m	1
	PUMPS		
37.	Extraction Distillation Column Reflux Pump	38 cu.m/hr	2
38.	Extraction Distillation Column Bottom Pump	80 cu.m/hr	2
39.	Extraction Distillation Column Transfer Pump	120 cu.m/hr	2
40.	Stripper Reflux Pump	35 cu.m/hr	2
41.	Stripper Bottom Pump	80 cu.m/hr	2
42.	Drip Recovery Pump	4 cu.m/hr	1
43.	Topping Column Reflux Pump	10 cu.m/hr	2
44.	Topping Column Bottom Pump	6 cu.m/hr	2
45.	Topping Column Nitrile Pump	0.25 cu.m/hr	1
46.	Solution Circulation Pump	-	-
47.	Tailing Column Reflux Pump	25 cu.m/hr	2
48.	Tailing Column Transfer Pump	22 cu.m/hr	2
49.	Nitrile Solution Circulation Pump	0.6 cu.m/hr	2
50.	Nitrile Solution Make-up Pump	0.6 cu.m/hr	1
51.	Sodium Nitrile Solution Make-up Pump	0.1 cu.m/hr	1

Annexure 1.4
Sheet 4 of 4

1	2	3	4
52.	Acitonitrile Recovery Column Reflux Pump	5. cu.m/hr	2
53.	Acetonitrile Recovery Pump	10 cu.m/hr	-
54.	Column Bottoms Pump	-	1
55.	Acetonitrile Make-up Pump	2 cu.m/hr	1
56.	Acetonitrile Slops Pump	10 cu.m/hr	1
57.	Acetoritrile Transfer Pump	-	1
58.	Acetonitrile Recovery Pump	0.1 cu.m/hr	1
59.	Column Bicarbonate Supply Pump		1

Annexure 1.5
Sheet 1 of 5

Indicative List of Plant & Equipment for Manufacture of Urea

Capacity: 230,000 tons/year

S.No.	Description	Size	Quantity
1	2	3	4
	TOWER AND REACTORS		
1.	High pressure decomposer	ø 2800x5600 mm	1
2.	High pressure absorber	ø 2000x50000mm (Upper part) ø 1500x10000mm (Lower part)	1 1
3.	Urea synthesis reactor	ø155x28900 mm	1
4.	Low pressure decomposer	ø1075x12600 mm	1
5.	Gas Separator	ø1420x6100 mm	1
6.	Off Gas absorber	ø1110x6400 mm	1
	HEAT EXCHANGER		
7.	No.1 Ammonia Preheater (Shell and tube type)	Heat Duty $6.3x10^5$ KCal/hr.	1
8.	No.2 Ammonia Preheater (Shell and tube type)	$6.3x10^5$"	1
9.	Reboiler for High Pressure decomposer	$99x10^5$"	1
10.	Reboiler for Low pressure decomposer (Shell and tube type)	$23.5x10^5$"	1
11.	Melter (submerged box type)	$31x10^5$"	1

1	2	3	4
12.	High Pressure Absorber Cooler (Shell and tube type)	71×10^5 KCal/hrs.	1
13.	Low Pressure absorber	41×10^5 "	1
14.	Off Gas Condenser (Shell & tube type)	25×10^5 "	1
15.	Off Gas Absorber cooler	5×10^5 "	1
16.	Vacuum Generator	Barometric Condensor with steam ejector	1 set
17.	Ammonia Condenser (Shell & tube type)	Heat duty 19×10^5 K Cal/hr.	4
18.	Ammonia Recovery absorber (Shell & tube type)	5.3×10^5 "	1 set
19.	Purge ammonia condenser (Shell & tube type)	1.37×10^5 "	2
20.	Air Heater Dryer	1.34×10^5 "	1

TANK SEPARATORS, FILTER AND DRYER

		Circulating Part	Crystalising Part	
21.	Crystallizer	ϕ 58800 x550mm	ϕ 6200 mm x4450mm	1 set
22.	Filter (Pressure leaf)		30 sq.m.	2
23.	Trommel (Basket care)	40 tons/hrs.		1
24.	Pneumatic Fluidising dryer	40 tons/hr.		1
25.	Steam Condensate tank	ϕ2380x3120 mm		1
26.	Flash Drum			1
27.	Hot Water tank	ϕ2360x2620 mm		1
28.	Head Tank	ϕ160mmx1200mm		1

1	2	3	4
29.	Ammonia Carbonate solution tank	Ø5000x5300 mm	1
30.	Cyclone	Ø1345mm x 4035mm	1 set
31.	Mother Liquor Tank	2000x3000x2000mm	1
32.	Mixing tank for filter	Ø1200x2000 mm	1
33.	Dissolving tank	4000x750x750mm	1
34.	Recovery Ammonia tank	Ø2000x10,000 mm	1
35.	Ammonium Carbonate solution tank	Ø5000x5300 mm	1
36.	Strainer	Ø750x530mm	1
37.	Fluidising Cooler	Ø6700 mm	
	ROTATING MACHINES		
38.	Liquid Ammonia Feed pump (Reciprocating type)	30 cu.m./hr	4
39.	Recycle solution Feed pump (Reciprocating pump)	20 cu.m./hr	4
40.	High pressure flooding pump (Reciprocating pump)	0.25 cu.m./hr	1
41.	Circulating pump for crystalliser	500 cu.m./hr	2
42.	Water Pumps (Reciprocating type)	4 cu.m./hr	2
43.	Co_2 Compressor (Reciprocating type)	10000 N.cu.m./hr	2
44.	Co_2 Booster Compressor (Multi stage centrifugal type)	15,000 N cu.m./hr	1

Annexure 1.5
Sheet 4 of 5

1	2	3	4
45.	Air Compressor (Reciprocating type)	120 cu.m./hr.	1
46.	Centrifugal (continuous discharge)	15 cu.m.$hr	4
47.	Low pressure flooding pump (Centrifugal type).	20 cu.m./hr	1
48.	Steam condensate Pump	40 cu.m./hr	1
49.	Slurry feed pump (Centrifugal type)	150 cu.m./hr	1
50.	Mother liquorpump (Centrifugal type)	120 cu.m./hr	2
51.	Filter Pump (Centrifugal type)	60 cu.m./hr	2
52.	Water Pump for prilling tower (centrifugal type)	3 cu.m./hr	2
53.	Circulating Pump for dust chamber (Centrifugal type).	40 cu.m./hr.	2
54.	Dissolving tank pump	5 cu.m/hr	1
55.	Low pressure absorbant pump	8 cu.m/hr	2
56.	High pressure absorbent pump(centrifugal type)	60 cu.m/hr	4
57.	Ammonia boost-up pump (Centrifugal type)	120 cu.m./hr	2
58.	Aqua Ammonia Pump (centrifugal type)	4 cu.m./hr	2
59.	Ammonia carbonate solution pump(centrifugal type)	6 cu.m./hr	1

Annexure 1.5
Sheet 5 of 5

1	2	3	4
60.	Off Gas absorber recycle pump (centrifugal type)	60 cu.m./hr	2
61.	Forced fan for dryer (centrifugal type)	50000 cu.m./hr	1
62.	Blower for fluidizing cooler (centrifugaltype)	210,000 cu.m./hr	
63.	Off gas circulation blower (Centrifugal type)	2000 cu.m./hr	1
	ROTATING MACHINES		
64.	Induced fan for dryer	210,000 cu.m./hr	1
	TRANSPORTATION EQUIPMENT		
65.	Screw conveyor for centrifuge	8 tons/hr	1
66.	Screw conveyor to melter	25 tons/hr	1
	MISCELLANEOUS EQUIPMENT		
67.	Dust Chamber	100°C	1

Annexure 1.6
Sheet 1 of 4

Indicative List of Plant & Equipment FOR Manufacture of Benzene

Capacity: 60,000 tons/year

S.No.	Description	Size	Quantity
1	2	3	4
1.	Hot Oil heater	451° F-600° F 120 PSIG	1
	VESSELS & COLUMNS		
2.	Extractive Column	∅ 2.94m x 24m	1
3.	Raffinate Settler	∅ 1.95m x 4.5m	1
4.	Extract Settler	∅ 1.95m x 4.5m	1
5.	Stripper Column	∅ 3 x 41m	1
6.	Extract Column	∅ 1.8 x 5.1m	1
7.	Stripper Receiver	∅ 2.1 x 6.3m	1
8.	Water Receiver	∅ 1.2 x 3.6m	1
9.	Vent Tank	∅ 1.2 x 3.6m	1
10.	Clay Tower	∅ 2.4 x 6.6 m	2
11.	Benzene Column	∅ 1.95 x 30 m	1
12.	Benzene Receiver	∅ 1.65 x 6.6 m	1
13.	Water Still Column	∅ 9 x 14.8 m	1
14.	Water Still Receiver	∅ 1.2 x 3.6 m	1
15.	Solvent Regenerator	∅ 1.35 x 6 m	1
16.	Solvent Regenerator Receiver	∅ 1.05 x 2.55 m	1
17.	Solvent Sump Tank	2.1 m / 1.05) x 2.1 m	1

Annexure 1.6
Sheet 2 of 4

1	2	3	4
18.	Hot Oil Surge Drum	ø 4.3b x 8.4 m	1
	TANKS		
19.	Fresh Solvent	ø 4.3 x 8.6 m	1
20.	Plant Solvent	ø 5.3 x 12 m	1
21.	Wet Solvent	ø 4.3 x 8.6 m	1
22.	Clay Tower Charge	ø 4.3 m x 8.6 m	1
	HEAT EXCHANGER		
23.	Extract Charge Preheater	Heat Exchanged 9.4×10^5 KCal/hr	1
24.	Charge Raffinate Exchanger	" 6.66×10^5 "	1
25.	Raffinate Cooler	" 3.94×10^5 "	1
26.	Solvent Cooler	" 1.94×10^5 "	1
27.	Solvent Exchanger	" 30×10^5 "	1
28.	Stripper Reboiler	" 102×10^5 "	1
29.	Extract Condenser	" 34×10^5 "	1
30.	Stripper Condenser	" 73×10^5 "	1
31.	Clay Tower Charge Exchanger	" 8.5×10^5 "	1
32.	Clay Tower Charge Preheater	" 2.8×10^5 "	1
33.	Benzene Reboiler	" 30×10^5 "	1
34.	Benzene Side Cut Cooler	" 1.9×10^5 "	1
35.	Benzene Condenser	" 30×10^5 "	1
36.	Water Still Feed Preheater	" 12×10^5 "	1
37.	Water Still Reboiler	" 8.5×10^5 "	1
38.	Water Still Side Cut Cooler	" 1.9×10^5 "	1

1	2	3	4
39.	Solvent Regenerator Feed Preheater	Heat Exchanged 2.3KCal/hr	1
40.	Solvent Regenerator Reboilder	" 0.56 KCal/hr	1
41.	Solvent Regenerator Condenser	" 4.0 "	1
42.	Hot Oil Pump Outlet Cooler	" 3.8 "	1
43.	Water Still Condenser	" 18×10^5 "	1
	CENTRIFUGAL PUMPS & DRIVES		
44.	Extract Charge Pump	Motor BHP 75	1
45.	Raffinate Wash Water Pump	" " 40	1
46.	Extract Wash Water Pump	" " 6	2
47.	Lean Solvent Pump	" " 125	4
48.	Extract Pump	" " 25	2
49.	Extractor Reflux Pump	" " 80	2
50.	Stripper Water Pump	" " 10	2
51.	Clay Tower Charge Pump	" " 75	2
52.	Benzene Bottoms Pump	" " 6	2
53.	Benzene Side Cut Pump	" " 10	1
54.	Benzene Reflux Pump	" " 30	2
55.	Solvent Transfer Pump	" " 10	1
56.	Solvent Sump Pump	" " 4	2
57.	Hot Oil Circulation Pump	" " 75	4

Annexure 1.6
Sheet 4 of 4

1	2	3	4
58.	Process Pump	-	1
59.	Process or Gaddle Mounted Pump	-	4
60.	Process Pump	Single Suction, Single stage	8
61.	Vertical Multistage Pump	Single Suction	1
62.	Submerged Vertical Pump	Single Suction, Single Stage	1

Indicative List of Plant & Equipment for Manufacture of Ammonia

Capacity : 330,000 tons/year

S.No.	Description	Size		Quantity
1	2	3		4
		Pressure (atm)	ø mm x Ht. (mm)	
	VESSELS			
1.	Steam Drum	110	2100 x 7500	1
2.	Ammonia Convertor	227	2800 x 1500	1
3.	Ammonia Catchpot	210	100 x 5700	1
4.	Naptha K.O. Drum	38	1500 x 3300	1
5.	Naptha Stripping Column	10	1600 x 23000	1
6.	Flue Gas Stack	1	2300 x 35000	1
7.	L.T. Shift Vessel	27	4400 x 45800	1
8.	Quench Drum	27	2400 x 9600	1
9.	Condensate K.O. Drum	25	1300 x 2200	1
10.	Let Down Vessel	21	1800 x 7400	1
11.	Ammonia Absorber	21	575 x 11000	1
12.	Ammonia Still	26	550 x 23000	1
13.	Still Overhead Receiver	25	875 x 2200	1
14.	Refrigerent Receiver	17	1750 x 5300	1
15.	H.P. Suction Drum	4	1500 x 3100	1
16.	Blow Dowr Vessel	3	950 x 2800	1

1	2	3		4
17.	Stripped Gas K.O. Drum	25	1400 x 4200	1
18.	Hydrofine Catalyst Vessel	40	2100 x 4500	1
19.	Desulphurisation Tower	36	2100 x 28000	1
20.	Secondary Reformer	29	4700 x 8500	1
21.	HT Shift Guard Vessel	29	2300 x 3900	1
22.	HT Shift Vessel	29	4300 x 12500	1
23.	Methanation Vessel	25	2800 x 5500	1
24.	Ultra-Methanator			
25.	Condensate K.O.Drum No.1	25	1300 x 2200	1
26.	Condensate K.O. Drum No.2	26	2100 x 4800	1
27.	Absorber	26	3000 x 14100	1
28.	Vetrocoke Regenerator	13	4300 x 21000	1
29.	Hot Acid Gas K.O.Drum	1	3000 x 2800	1
30.	Direct Contact Acid Gas Cooler	1	5000 x 6300	1
31.	Cold Acid Gas K.O.Pot	1	2400 x 2700	1
32.	Ammonia Storage Vessel	4	22300	1
	FURNACES & FIRED HEATERS			
33.	Raw Naptha Vaporiser/ Preheater		-	1
34.	Process Naptha Vaporiser/ Preheater		-	1
35.	Reforming Furnace Inch Structures, Refractories		-	1
36.	Process Air Preheater		-	1

2		3	4
37.	Ammonia Convertor Start-up Heater	-	1
	HEAT EXCHANGERS	Heat Duty 10^6 xK.Cal/hr	
38.	Reformed Gas Boiler	55.44	1
39.	Flue Gas Boiler	3.712	1
40.	Combustion Air Heater	6.14	1
41.	Methanation Heat Exchanger No.1	3.534	1
42.	Methanation Heat Exchanger No.2	6.96	1
43.	Boiler Feed Water Heater	9.59	1
44.	Boiler Feed Water Preheater	9.59	1
45.	Vetrocoke Reboiler	46.03	1
46.	Acid Gas Cooler	2.48	1
47.	Lean Solution Cooler	21.75	1
48.	Loop Boiler Feed Water Heater	18.9	1
49.	Loop Cooler/Condenser	18.06	1
50.	Convertor Feed Interchanger	6.8	1
51.	Primary Chiller	5.0	1
52.	Turbine Steam Superheater (H.T. Section)	9.6	1
53.	Turbine Steam Superheater (L.T. Section)	11.8	1
54.	Secondary Chiller	5.0	1
55.	Process Steam Superheater	8.6	1

1	2	3	4
56.	H.P. Boiler Feed Water Heater	8.4	1
57.	Fuel Oil Preheater	-	1
58.	Sweet Naptha Cooler	1.27	1
59.	Feed Effluent Exchanger	5.27	1
60.	Effluent Condenser	1.4	1
61.	Stripper Reboiler	1.3	1
62.	Reflux Condenser	0.288	1
63.	Final Cooler	4.75	1
64.	Semilean Solution Cooler	18.02	1
65.	Vetrocoke Seal Water Cooler	6.429	1
66.	Refrigeration Condenser	14.2	1
67.	Inerts Purger	3.5 kg/hr	1
68.	Absorber Recycle Cooler	69,000	1
69.	Liquor Interchanger	600000	1
70.	Absorber Feed cooler	170000	1
71.	Still Condenser	690000	1
72.	Still Reboiler	810000	1
73.	Boiler Blowdown Cooler	1.06×10^6	1
74.	Stripper Feed/Bottoms Exchanger	2.3×10^6	1
75.	Vent Naptha Condenser		1
76.	Auxiliary Boiler Economiser	88 tons of Steam/hr	2

1	2	3	4
	COMPRESSORS	N.cu.m/hr	
77.	Hydrogen Gas Compressor	3000	2
78.	Synthesis Gas Compressor	130500	1
79.	Synthesis Gas Compressor	533000	1
80.	Refrigeration Compressor	23500	1
81.	Vacuum Pump	185	1
82.	Instrument Air Compressor	1600	2
83.	Process Air Compressor	43200	1
84.	Start-up Compressor(Reciprocating)	690	1
85.	Flu Gas Fan	121000	2
86.	Combustion Air Blower	106000	2
	PUMPS	m/hr	
87.	Raw Naptha Supply Pumps	38500	2
88.	Process Naptha Supply Pumps	30000	2
89.	Fuel Naptha Supply Pumps	30000	2
90.	Lean Vetrocoke Solution Pumps	616300	2
91.	Ammonia Feed Pumps	50500	2
92.	H.P. B.F.W. Pumps	340000	2
93.	Fuel Oil Supply Pumps	22000	2
94.	Vetrocoke Make-up Pumps	66000	1
95.	Concentration Tank Pumps	22000	1
96.	Flash Water Pumps	585000	2
97.	Absorber Bottoms Pumps	9500	2

1	2	3	4
98.	Still Reflux Pumps	3500	2
99.	Quench Water Pumps	21000	2
100.	Turbines - For Synthetic Gas turbines, process air compressor, Refrigeration Compressor Vacuum Pump, I.D. Fan, Air Blower, Hydraulic Let-down Turbines, Fuel Oil Pump, Process Naptha Pump, Fuel Naptha Pump, Quench Water Pump etc.	-	Lot
101.	Storage tanks of various sizes	-	Lot

Annexure 1.8
Sheet 1 of 6

Indicative List of Plant and Equipment

for

Manufacture of Nylon - 6

Capacity : 1,000 tons/year

S.No.	Description	Size	Quantity
1	2	3	4
	SPINNING AND WINDING		
1.	Stainless Steel Electric Mixer		6
2.	Pumps for Oil Recirculation	4.2 cu.m/hr	6
3.	Jacketed St. Steel autoclaves with rending column and accessories	4200 l	4 sets
4.	Jacketed St.Steel autoclaves	3.5 cu.m	6
5.	Stainless steel metering Rotocells	1.1 KW	18
6.	Stainless steel metering Rotocells	0.75 KW	22
7.	Vacuum Units with 1 No. Root type, 1 No. liquid type vacuum pumps	1500 cu.m/hr	10
8.	Jacketed Stainless Steel Rotary Drying Vessel	16 cu.m	4
9.	Jacketed Stainless steel Rotary Drying Vessel	8 cu.m	2
10.	Bunch Exchangers	-	10
11.	Pelletizers for Stands	7.5 KW	6 sets
12.	Pelletizers for Stands	10 KW	2 sets

1	2	3	4
13.	Tape up Machine complete with motor reducing drive for Nylon 6 Standards	-	
	SPINNING & WINDING		
14.	Balances for metering	-	4
15.	Automatic Reels for metering	-	4
16.	Spinnerettes	Ø52 x 8 mm	1280
17.	Spinnerettes with special section monofilament		1280
18.	Distribution plates with 49 holes	Ø52 x 8 mm	1280
19.	Spinning head with steeves for 4 circular spinnerettes	Ø 52 mm	160 sets
20.	Extruders	Ø 75 mm	8 sets
21.	Stoves for spinnerettes	-	6
22.	Colloidal Mill	-	2
23.	Spinning Pumps	1 x 2.4 CC	480
24.	Rotary Filters for Referigeration	12000 cu.m/hr	4
25.	Micros Micron Filter Unit	10 micron	2
26.	Regulator Control double-line with double shaft boxes	For 40 position	4
27.	Regulator control double line with double shaft boxes	For 20 position	6
	DRAW TWISTING & COPS TESTING		
28.	Draw Twisting Machine for synthetic fibres with 156 spindles	-	26

1	2	3	4
29.	Draw Twisting Machine for synthetic fibres with 144 spindles	-	4
30.	Cops for initial run	-	4056
31.	Bobbins for initial run	-	10000
32.	Gretener Yarn cutter for cops	-	2
33.	Greel Chuck Carriers for drew twisting machines	-	200
	<u>TWISTING & BOBBIN WINDING</u>		
34.	Twisting Machines suitable for synthetic fibre	180 spindles	4
35.	Small spindles for tubes for initial run	-	800
36.	Holed Bobbins for initial run	-	1000
37.	Precision Cross Machines for synthetic fibre	48 Position	4
38.	Heat Setting Equipment for twist setting of synthetic fibres		2
	<u>DOWTHERM HEATING AND CIRCULATING SYSTEM</u>		
39.	Dowtherm Boilers complete with fuel oil combustian plant, draught plant, control panel	Heat duty : 600000 KCal/hr. Temp. of Dowtherm 300°C to 350°C	6
40.	Liquid Dowtherm for initial filling of the entire system	-	-
41.	Nitrogen Production plant (high purity, high pressure, fully automatic)	50 N,Cum/hr. Impurities Allowance O - 8ppm n_2- 100m H_2O vapour:5ppm	2 sets

2	3	4
42. Conveying Belt for Monomer bags	12.6 m	1
43. Fork Lift	2400 kg	1
44. Pallets	24 manomer bags (80 kg each)	2
45. Scales	-	4
46. Pumps for conditioned water circulation	-	4
47. Electric Pumps	-	22
48. Steel jacketted Electric Pumps for recycling molten monomer	-	4
49. Heat Exchanger	-	6
50. Tanks of various sizes	-	20
51. Expansion Vessel complete with feeding float valve	-	4
52. Mixers	-	16
53. Melter with heating jacket	300 kg	2
CUTTING AND STORAGE		
54. Tanks	-	6
55. Heat Exchangers	-	4
56. Pumps	-	10
57. Cooling and Ventilation Plant for Polymerisation room	-	-
58. Demineralisation Plant	-	-
59. Electric fan for fumes condensation	-	2
60. Mixers	-	2

2	3	4
61. Elect. compressors for Chip Delivery	-	8
FLASHING & DRYING		
62. Heat Exchangers	-	14
63. Expansion Vessels	-	6
64. Tanks	-	40
65. Pumps	-	32
66. Extractors	-	4
67. Filters	-	4
68. Compressors	-	16
69. Cyclones	-	24
70. Skin Separators	-	4
71. Fans for Skin Extraction	-	4
SPINNING & WINDING		
72. Electric Fans	-	4
73. Pumps	-	18
74. Air Treatment for Refrigeration Apparatus	-	4
75. Air-conditioning system	-	10
76. Tanks	-	6
77. Expansion Vessels	-	2
78. Tanks	-	6
79. Pumps	-	12
80. Conditioning Plant for the twisting room	-	2
81. Heat Exchangers	-	2

1	2	3	4
	DOWTHERM CIRCULATION AND HEATING		
82.	Tanks	-	14
83.	Pumps	-	32
84.	Exchangers	-	12
85.	Expansion Vessels	-	10
86.	Dowtherm Distiller	-	2
87.	Dowtherm Condenser	-	2

Annexure 1.9
Sheet 1 of 2

Indicative List of Plant & Equipment

for the Manufacture of

Urea Formaldehyde Moulding Powder Plant

Capacity: 4500 tons/year

S.No.	Description	Size	Quantity
1	2	3	4
1.	Formaline Pump(Centrifugal Type)	1500 lit/min	1
2.	Reaction Kettle with Reflux Condenser	1.95 cu.m	1
3.	Resin Pump (Centrifugal type)	300 lit/min.	1
4.	Filter	0.6 cu.m	1
5.	Kneader	5.0 cu.m	1
6.	Dryer System	520 kgs	1
7.	Blowers	30-1200 cu.m/min	7
8.	Air-conditioner	534000KCal/hr	1
9.	Blower (Turbo)	30 cu.m/min.	4
10.	Grasin Tanks	18 cu.m	4
11.	Scrubber	-	1
12.	Ball Mills	3 cu.m	24
13.	Screen Feeder	600 kg/hr	10
14.	Compacting Machine	Tablets Ø-30mm Tabletting Cap: 1152 Tablets/min Tabletting Pr= 15000 kg/sq.cm	6

1	2	3	4
15.	Cooling Tower	58500 KCal/hr	1
16.	Granulator	Rotor Size 124 mmØ x 355 mm	6
17.	Other Equipment & Machinery - Scrubber, Weighing Machine, Air-conditioner, Elevator	-	Lot
18.	Pipes, Valves, Fittings	-	Lot

Annexure 1.10
Sheet 1 of 2

Indicative List of Plant & Equipment for Manufacture of Urea Formaldehyde Resin

Capacity: 5500 tons/year

S.No.	Description	Size	Quantity
1	2	3	4
	UNCONCENTRATED ADHESIVES		
1.	Hopper	0.9 cu.m	2
2.	Reaction Kettle	5 cu.m	1
3.	Filters	Surface Area 0.1 sq.m	4
4.	Adhesives Pumps(Gear type)	15 cu.m	2
5.	Mixing Tank	10 cu.m	1
6.	Product Tank	25 cu.m	1
7.	Auto Packer	100 kgs	1
8.	Acid Tank	2.5 cu.m	1
9.	Alkali Tank	0.5 cu.m	1
10.	Alkali Tank	0.5 cu.m	1
11.	Inhibitor Tank	2.5 cu.m	1
12.	Pumps (Gear type, Product Pump)	100 lit/min.	1
13.	Adhesive Pump(Gear type)	100 lit/min	1
	CONCENTRATION SECTION		
14.	Reaction & Dehydration Tank with Reflux Condenser	1 cu.m	1

1	2	3	4
15.	Mixing Tank	1 cu.m	2
16.	Condenser & Water Receiver	5 sq.m	1
17.	Vacuum Pump	1.6 cu.m/min.	1
18.	Other Equipments - Hoists, Reflux Condensers, Weighing Machine		Lot

Annexure 1.11
Sheet 1 of 3

Indicative List of Plant & Equipment for Manufacture of Polyester Staple Fibre

Capacity : 3500 tons/year

S.No.	Description	Size	Quantity
1.	2.	3.	4.
1.	Agitator	RPM 840 operating temperature 160°C	1
2.	Special Turbo Agitator	280°C	4
3.	Special Agitator	-	1
4.	Feed Pump	160°C/350°C 30 cu.m/hr.	7
5.	Water Ring Pump	100 cu.m/hr.	2
6.	Special Pump Set	100 kg/hr. min. 900 kg/hr. max.	1 5
7.	Precision Pumps	330°C, 220 kg/sq.cm	36
8.	Glycol Pump	25 cu.m/hr.	6
9.	Methanol Pumps	2 cu.m/hr.	2
10.	Dowtherm Pumps	25 cu.m/hr. 350°C	4
11.	Watering Pumps	100 cu.m/hr.	6
12.	Mixers	327°C - 200 kg/sq.cm	2
13.	Special Filter	64 kg/sq.cm.	1
14.	Filter	-	6
15.	Heating Vessel	350°C, 15 kg/sq.cm.	1
16.	Drying Conveyors	-	2

Annexure 1.11
Sheet 2 of 3

1.	2.	3.	4.
17.	Condenser	30 sq.m	2
18.	Heat Exchanger	-	2
19.	Heat Exchanger	350°C	3
20.	Air Cooling Lines	10 sq.m	1
21.	Vent Condenser	-	7
22.	Spinning Manifolds	-	6
23.	Spinning Blocks	-	36
24.	Thermo Setting Arrangement System	16 kg/sq.cm	2
25.	Three roll units	-	2
26.	Staple Fibre cutters	-	4
27.	Nitrogen Purification Unit	Oxygen content 1-3 ppm	1
28.	Roller thread guides	-	2
29.	Dancer Roller Arrangement	-	4
30.	Beeling Presses	Cap. 20 tons	2
31.	Container	3 cu.m	3
32.	Container	5 cu.m	3
33.	Circulation Water Boxes	0.3 cu.m	2
34.	Container	100 litres	1
35.	Container	50 litres	1
36.	Containers	75 litres	9
37.	Container	15 cu.m	1
38.	Horizontal container	3 cu.m	1

1.	2.	3.	4.
39.	Silo	10 cu.m	1
40.	Silo	150 litres	1
41.	Gasket Reactors	280°C	8
42.	Methanol Column	-	1
43.	Reactor	16.8 cu.m, 327°C	1
44.	Vessel	0.3 cu.m	1
45.	Vessel	7 cu.m	2
46.	Heating medium evaporator	7 sq.m	7
47.	Three rolling unit	100 kg/sq.cm	1
48.	Rotary slide vacuum pump	8 cu.m/hr.	1
49.	S.S. Dipping Bath	-	2
50.	Washing machines	-	2
51.	Conveyors	-	2
52.	Hot Water System	1 expansion vessel 6 kg/sq.cm	4
53.	Warm Water System	-	2
54.	Pneumatic Conveying System	-	2
55.	Sand Preparation System	-	1
56.	Nitrogen Containers	6 cu.m	-
57.	Discharge screw	7 kg/hr.	1
58.	Main Driers	Motor 150 KW 1500 RPM	2
59.	Feeding Screw without motor	-	1
60.	Motors	-	5

Annexure 1.12
Sheet 1 of 2

Indicative List of Plant & Equipment For Manufacture of Formaldehyde

Capacity : 7500 tons/year

S.No.	Description	Size	Qty.
1	2	3	4
	SYNTHESIS SECTION		
1.	Tank	2 Cu.m; 100°C	1
2.	Accumulator	1.75 cu.m, 75°C; 1.5 kg/sq.m	1
3.	Methanol Preheater	9400 K.Cal/hr.	1
4.	Air Preheater	18400 K.Cal/hr.	1
5.	Crude Formaline Cooler (Plate type heat exchanger)	100°C, 5 kg/sq.cm	1
6.	Evaporator	150°C, 4 kg/sq.cm	1
7.	Reactor	-	
8.	Absorber	80°C, 1.5 kg/sq.cm. 25 trays 650 mm (top) ø 980 mm (Bot.) ø 17600 mm height	1
9.	Methanol Feed Pump	20 m	2
10.	Absorber Pump	25 m	2
11.	Spray Pump	52.7 m	2
12.	Crude Formation Pump	Centrifugal 50 cu.m per hour, 21m head	2
13.	Suction Filter	100°C, 0.1 kg/sq. cm.	2

Annexure 1.12
Sheet 1 of 2

1	2	3	4
14.	Mixer	130°C, 1.5 kg/sq.cm. Ø 350 x 1400 mm	1
15.	Spray filters	23 lit. 100°C; 7.5 kg/sq.cm.	2
16.	Centrifugal Blower	7500 cu.m	2
	SCRUBB MIXING SECTION		
17.	Methanol Tank	75 cu.m; 100°C; 1 kg/sq.cm.	1
18.	Pure Water Tank	75 cu.m; 100°C, 1 kg/sq.cm.	1
19.	Crude Formaline Tank	75 cu.m, 100°C, 1 kg/sq.cm.	2
20.	Mixing Tank	75 cu.m; 100°C 0.5 kg/sq.cm.	2
21.	Hydrochloric Acid Tank.	7.5 cu.m; 100°C; 0.5 kg/sq.cm.	1
22.	Sodium Hydroxide Tank	7.5 cu.m,100°C, 0.2 kg/sq.cm.	1
23.	Neutralisation Tank	1.75 cu.m; 100°C 0.2 kg/sq.cm.	1
24.	Ion Exchanger	3 tons/hr	1
25.	Ion Exchanger Centrifugal Pump	Head 27 m	2
26.	Mixing Pump, centrifugal.	7 cu.m/hr x 27m	1
27.	Product Pump; Centrifugal	15 cu.m/hr. x 27m	2

Annexure 1.13
Sheet 1 of 8

Indicative List of Plant and Machinery For Manufacture of Oxylene

Capacity: 20,000 tons/yr.

S.No.	Description	Size	Quantity
1	2	3	4
1.	Filters	ø 220 mm x 1200 mm	2
2.	Reactor	ø 1200 mm x 2700 mm	1
3.	Reactor	ø 1400 mm x 2700 mm	1
4.	Reactor	ø 2100 mm x 3220 mm	1
5.	Heater for Reactors	4000x9000x2700 mm	1
6.	Radiation section		1
7.	Pre-heater	202 sq.m.	1
8.	Pre-heater	270 sq.m.	2
9.	Jet Ejector	5 kg/hr.	1
10.	Storage vessels	12 cu.m.	4
11.	Booster Compressor	125 N cu.m/hr.	1
12.	Effluent Condenser	5650x2630x300 mm	1
13.	Axial Ventilator with Variable pitch blades	ø 2470x500 mm	3
14.	Axial Ventilator	ø 2470 x 500 mm	1
15.	Slop Drum	20 cu.m.	1
16.	Pump for Slop	20 cu.m/hr., 40m	2
17.	Cooler 139 sq.m.	139 sq.m	1
18.	Separator	4 cu.m	1
19.	Recycle Gas Compressor	2600 N cu.m/hr. 16.8 atmospheres	1

1.	2.	3.	4.
20.	Steam Turbine for Recycle Gas Compressor	540 KW, 8070 RPM	1
21.	Condensate Pump	5.2 cu.m/hr.	2
22.	Condenser	140 sq.m	1
23.	Jet Ejectors	5.5 kg/hr. at 0.1 atm.	2
24.	Preheater	17 sq.m	1
25.	Reboiler	66 sq.m	1
26.	Oil Pump for Compressor	24.6 cu.m/hr.,8 m	2
27.	Heat Exchanger	30 sq.m	1
28.	Stabilizer	∅ 800 x 26700 mm	1
29.	Preheater	20 sq.m	1
30.	Condenser	34 sq.m	1
31.	Reflux Drum	1 cum.	1
32.	Pump for Reflux Drum	7 cu.m/hr., 45 m	2
33.	Heater for Dehetaniser	4800 x 27000 mm	1
	Radiation Section	1.65×10^6 K Cal/hr.	
	Convection Section	0.385×10^6 K Cal/hr.	
34.	Dehetanizer	∅ 14000 x 36300 mm	1
35.	Pumps	42 cu.m/hr., 55 m	1
36.	Condenser	5650 : 1755x300 mm	1
37.	Axial Ventilator	∅ 1430x300	2
38.	Reflux Drum	6.3 cu.m	1
39.	Pumps for Reflux	35 cu.m./hr., 50 m	1
40.	After Cooler	17 sq.m	1
41.	Oil Cooler	21 sq.m	2

1.	2.	3.	4.
42.	Oil Filter	∅ 194 x 525 mm	2
43.	Ventilator	10000 M cu.m/hr.	1
44.	Orthometa Splitter	∅ 4000x67000 mm	1
45.	Reformer Cooler	86 sq.m	1
46.	Xylene Pre-condenser	45 sq.m	1
47.	Xylene Pre-condenser	28 sq.m	1
48.	Xylene Condenser	5650x22300x300 mm	3
49.	Reflux Drum	25 sq.m	1
50.	Pumps for Reflux Drum	225 cu.m/hr., 85 m	2
51.	Pumps for Reflux Drum	225 cu.m/hr., 85 m	2
52.	Pumps for Crystalliser Feed	26 cu.m/hr., 30 m	2
53.	Pumps for Circulation	273 cu.m/hr., 70 m	2
54.	Heater	624 sq.m.	1
55.	O-Xylene Drum	25 cu.m	1
56.	Pumps for O-Xylen.	20 cu.m/hr., 30 m	
57.	O-Xylene Column	∅ 1400 x 40000 mm	1
58.	Circulation Pump	23 cu.m/hr., 30m	2
59.	Reboiler	124 sq.m	1
60.	Cooler	17 sq.m	1
61.	O-Xylene Condenser	5650x1370x250 mm	1
62.	Axial Ventilator	∅ 1430 x 300	2
63.	Reflux Drum	3.2 sq.m	1

1.	2.	3.	4.
64.	Pumps for Reflux	18 Cu.m/hr., 45m	2
65.	O-Xylene Cooler	17 sq.m	1
66.	By-product Vessel	25 cu.m	1
67.	Pump	20 cu.m/hr., 30m	1
68.	Stabilizer	∅ 1000 x 34000 mm	1
69.	Circulation Pump	45 Cu.m/hr., 60 m	2
70.	Reboiler	43 sq.m	1
71.	Condenser	48 sq.m	1
72.	Reflux Drum	8 cu.m	1
73.	Pumps for Reflux	8 Cu.m/hr., 45 m	2
74.	Filters	∅ 219 x 1200 mm	2
75.	Preheater	152 sq.m	2
76.	Preheater	270 sq.m	2
77.	Heater Radiation Section	80.9 sq.m	1
78.	Reactor	∅ 3000 x 4670 mm	1
79.	Jet Ejector	5 kg Air/hr. at 0.2 atm.	1
80.	Effluent Condenser	5650x2280x300 mm	1
81.	Axial Ventilator	2470 x 500 mm	2
82.	After Cooler	35 sq.m	1
83.	Separator	4 cu.m	1
84.	Recycle Gas Compressor	30240 N cu.m/hr. at 15 atm.	1

1.	2.	3.	4.
85.	Oil Pump	24.6 cu.m/hr, 10m	2
86.	Steam Turbine for compressor	450 KW, 9850 R.P.M.	1
87.	Startup condenser	∅ 682 x 3500 mm	1
88.	Oil Cooler for Compressor	∅ 419 x 3050 mm	2
89.	Oil Filter for Compressor	∅ 194 x 325 mm	2
90.	Oil Vessel	1990 x 2110 x 2235mm	1
91.	Oil Strainer	∅ 600 x 850 mm	1
92.	Ventilator	2880 cu.m/hr., 2900 RPM	1
93.	Naptha Charge Tank	3000 Cu.m	2
94.	Reformate Tank	3000 cu.m	1
95.	Tank for Light Reformate	1000 cu.m	2
96.	Aromatics Tank	500 cu.m	1
97.	Benzene Tank	150 cu.m	1
98.	Crystallizer Storage Tank	3000 cu.m	1
99.	Tank for Mother Liquor	3000 cu.m	1
100.	Tank for O-xylene	1000 cu.m	2
101.	Fuel Oil Tank	500 cu.m	1
102.	Tank for Gas	500 cu.m	1
103.	Tank for Methanol	1000 cu.m	1
104.	Xylene Pre-cooler	∅ 6000x3840 mm	1

1.	2.	3.	4.
105.	Heat Exchanger	94 sq.m	1
106.	Chiller	77 sq.m	1
107.	Ethylene Separator	2.5 cu.m	3
108.	Centrifugal Compressor for Propane	3115 cu.m/hr.	1
109.	Oil Pump for Compressor	6.9 cu.m/hr.	2
110.	Oil Drum	ø 600 x 1300 mm	1
111.	Propane Condenser	355 sq.m	1
112.	Propane Receiver	3 cu.m	1
113.	Reciprocating Compressor	4400 cu.m/hr.	1
114.	Oil Pump for Compressor	2.7 cu.m/hr.	2
115.	Heat Exchanger	435 sq.m	1
116.	Booster Propane Compressor	80 cu.m/hr.	1
117.	Pre-cooler	46 sq.m	1
118.	Propane Expansion Vessel	1.5 cu.m	1
119.	Ethylene Receiver	3 cu.m	1
120.	Ethylene Storage Vessel	ø 2480 x 7000 mm	3
121.	Pre-Cooler	86 sq.m	1
122.	Xylene Heater	26 sq.m	4
123.	Air Cooler	350 x 460 x720mm	1

1.	2.	3.	4.
124.	Xylene Melter	3.5 cu.m	1
125.	Feed Tank	150 cu.m	1
126.	Xylene Storage Tank	70 cu.m	1
127.	Storage Drum	8 cu.m	2
128.	Xylene Tank	12 cu.m	1
129.	Vacuum Blower	8700 cu.m/hr.	1
130.	Vacuum Rotary Filter	∅ 3000x3400 mm	1
131.	Screw Press	1.5 t/hr.	3
132.	Conveyor	5.5 kW	7
133.	Absorber	4.7 cu.m	1
134.	Blower	450 cu.m/hr.	1
135.	Condenser	24 sq.m	1
136.	Heater	10 sq.m	1
137.	Separator	1.9 cu.m	1
138.	Water Separator	0.75 cu.m	1
139.	Feed Pumps	22 cu.m/hr.	2
140.	Feed Pumps	30 cu.m/hr.	2
141.	Feed Pumps	40 cu.m/hr	2
142.	Feed Pumps	18 cu.m/hr.	2
143.	Xylene Pumps	25 cu.m/hr.	2
144.	Xylene Pumps	50 cu.m	2
145.	Pump for Fuel Oil	50 cu.m/hr.	2
146.	Fuel Pump for Heater	5 cu.m/hr.	2
147.	Pump for Methanol	5 cu.m/hr.	2

Annexure 1.13
Sheet 8 of 8

1.	2.	3.	4.
148.	Circulation Pump	150 cu.m/hr.	2
149.	Feed Pump	30 cu.m/hr.	2
150.	Xylene Circulation Pump	150 cu.m/hr.	2
151.	Pump for Filterate-I	20 cu.m/hr.	2
152.	Pump for Filterate-II	16 cu.m/hr.	2
153.	Xylene Pump	20 cu.m/hr.	1
154.	Xylene Pump	5 cu.m/hr.	1

Annexure 1.14
Sheet 1 of 3

Indicative List of Plant and Equipment For Manufacture of TSP/DAP

Capacity : 142,000 tons/year

S.No.	Description	Size	Quantity
1.	2.	3.	4.
1.	Fume Scrubber Fan	1090 cu.m/min.	1
2.	Dryer Fan	1840 cu.m/min.	1
3.	Dust Fan	1090 cu.m/min.	1
4.	Neutralizer Agitator	22 KW	1
5.	Fume Scrubber Centrifugal Pump	231 cu.m/hr.	2
6.	Slurry Pump - Centrifugal type	25 cu.m/hr.	2
7.	Dust Scrubber - Centrifugal Pump	198 cu.m/hr.	2
8.	Sump Pump - Centrifugal type	4 cu.m/hour	1
9.	Sludge Pump - diaphragm type	120 cu.m/hr.	1
10.	Process Pump - Square type	4 cu.m/hour	1
11.	Neutralizer	Dia. 4400 mm, Height 5400 mm	1
12.	FumeScrubber	1090 cu.m/hr.	1
13.	Dryer Scrubber	2120 cu.m/min.	1
14.	Dust Scrubber	1010 cu.m/min.	1
15.	Product Conveyor	21 t/hour.	1
16.	Granulator	187 t/hour	1

Annexure 1.14
Sheet 2 of 3

1.	2.	3.	4.
17.	Lump Crusher - Rotary Drum Type	5000 kg/hour	1
18.	Double Deck magnetic type	50 t/hour	1
19.	Oversize Mill	40 t/hour	1
20.	Condensate Pump - Centrifugal type	5 cu.m/hour	2
21.	Fume Stack	ø 3240 x 27000 mm	1
22.	Condensate Tank	1.7 cu.m	1
23.	Sulphuric Acid Head Tank	1 cu.m	1
24.	Dust Scruboer Tank	13 cu.m	1
25.	Screen Feed Conveyor No. 1	187 t/hr	1
26.	Screen Feed Elevator	187 t/hr.	1
27.	Screen Feed Conveyor No. 2	93 t/hr.	2
28.	Screen Product Conveyor	75 t/hr.	1
29.	Screen Oversize Conveyor	40 t/hr.	1
30.	Recycle Conveyor	166 t/hr.	1
31.	Dryer Dust Conveyor	5 t/hr.	1
32.	Dust Cycle Conveyor	5 t/hr.	1
33.	Product Elevator	21 t/hr.	1
34.	Coating Agent Elevator	10 t/hr.	1
35.	Screen Fins Conveyor	75 t/hr.	1

Annexure 1.14
Sheet 3 of 3

1.	2.	3.	4.
36.	Oil fired Dryer Furnace	6 x10^6 K.Cal/hr.	1
37.	Coater Screw Conveyor	21 t/hr.	1
38.	Coating Agent Screw Feeder	1 t/hr.	1
39.	Coating Agent Hopper	5 cu.m/hr.	1
40.	Dryer Cyclone	1490 cu.m/min.	1
41.	Dust Cyclone	1610 cu.m/min.	1
42.	Ammonia Vapor-iser	1.65x10^6 K.Cal/hr.	1
43.	Fume Scrubber Tank	10 cu.m	1
44.	Rotary Drum Dryer	5 t/hr.	1
45.	Rotary DrumCooler	21 t/hr.	1

Annexure 1.15
Sheet 1 of 1

Indicative List of Plant & Equipment

for

Production of Tyres and Tubes

Capacity : 500,000 Nos/year

S.No.	Description	Size	Quantity
1.	Banburry Mixer	-	1
2.	Tube Extruder	-	1
3.	3-Roll Calender	-	2
4.	Bias Machine	-	1
5.	Band Building Machine	-	7
6.	Bead Former	-	1
7.	Bead Wrapper	-	2
8.	Bead Flipper	-	1
9.	Slitting Machine	-	1
10.	Tyre Building Machine	-	15
11.	Radial Tyre Building Machine	-	1
12.	Curing Presses		28

Annexure 1.16
Sheet 1 of 5

Indicative List of Plant & Equipment For Manufacture of Cement

Capacity : 1500 tons/day

S.No.	Description	Size	Quantity
1.	2.	3.	4.
	STORAGE AND MATERIAL HANDLING		
1.	Grab bucket overhead travelling crane	12.5 tonsx30m, grab capacity 3.5 cu.m	2
	CRUSHING PLANT		
2.	Jaw crusher	400 tons/hr.	1
3.	Apron feeder	-	1
4.	Feeding chute	-	2
5.	Troughed belt conveyor	200 tons/hr.	1
6.	Double rotor Hammer Mill	-	1
7.	Belt Conveyor	1000x7000 mm 400 tons/hr.	1
8.	Troughed belt conveyor	400 tons/hr.	1
	GRINDING AND DRYING PLANT		
9.	Raw grinding mill, closed circuit side drive, central discharge.	70 tons/hr.	2
10.	Single reduction helical gearbox for raw grinding mill	1600 KW	2

1.	2.	3.	4.
11.	Auxiliary Gear Box	30 KW	2
12.	Table Feeder with woom drive	ø 2000 mm	2
13.	Table feeder with woom drive	ø 1000 mm	4
14.	Oil pumps	-	4
15.	Pump with auxiliary equipment	-	2
16.	Air compressor	-	6
17.	Oil Service tank	-	2
18.	Hot air furnace	-	2
19.	Overhead crane, hand operated	10 tons	2
20.	Equipment for Blending Silo	-	4 Sets
21.	Dust collector	-	2
22.	Storage silo	-	4
23.	Silo Aeration equipment	-	4
	ROTARY KILN SECTION		
24.	Pump	-	1
25.	Rotary Air Compressor	-	2
26.	Discharge Boxes	-	1
27.	High/Low Level Indicator	-	1
28.	Rotary Feeder	-	1
29.	Constant head Feeder	-	1
30.	Weigh belt feeder	-	1

1.	2.	3.	4.
31.	Dust collector	-	1
32.	Overflow air slide	-	1
33.	Preheater complete with cyclone and other equipment	-	1
34.	Waste gas fan	-	1
35.	Dust collector	-	1
36.	Rotary kiln complete	72m, 65 tons/hr.	1
37.	Blower for cooling nose ring	-	1
38.	Triple reduction helical gear unit	-	1
39.	Diesel Engine for Auxiliary drive	-	1
40.	Discharge chute	-	1
41.	Air quenching cooler	78 t/hr.	-
42.	Cyclone dust collector	-	1
43.	Dust screw conveyor	-	1
44.	Worm reduction gear box	-	1
	GYPSUM HANDLING SECTION		
45.	M.S. Damper & Feed chute	-	1
46.	Push feeder	-	1
47.	Worm reduction gear box	-	2
48.	Gypsum crusher	30 t/hr.	1
49.	Troughed belt conveyor	-	2
	CLINKER TRANSPORT		
50.	Drag chain conveyor	-	1

Annexure 1.16
Sheet 4 of 5

1.	2.	3.	4.
51.	Triple reduction gearbox	-	1
52.	Heat resistant troughed belt conveyor	-	1
	CEMENT MILL SECTION		
53.	M.S. Grill for hoppers	-	6
54.	Table feeder	∅ 2000 mm	2
55.	Worm reduction gearbox	-	2
56.	Table feeder	∅ 1000 mm	4
57.	Worm reduction gearbox	-	4
58.	Open circuit clinker grinding mill	44 T/hr.	2
59.	Single reduction helical gear unit	1600 KW	2
60.	Pump	-	2
61.	Pump hoppers	-	2
62.	Rotary air compressor	-	2
63.	Dust collector	-	2
64.	Exhaust fan	-	2
	CEMENT PACKING & STORAGE		
65.	Single entry discharge box	-	4
66.	Dust filter	-	2
67.	Fan for dust collector	-	2
68.	High/low level indicators	-	4 sets
69.	Silo aeration equipment	-	4 sets
70.	Chain bucket elevator	-	2

1.	2.	3.	4.
71.	Worm reduction gearbox	-	2
72.	Rotary screen	-	2
73.	Surge hopper	-	2
74.	12-Spout rotary packing machine	80 tons/hr.	2
75.	Feed hopper	-	2
76.	Laminated conveyor	700x2500 mm	2
77.	Flat rubber belt conveyor	800x1000 mm	2
78.	Flat rubber belt conveyor	800x3000 mm	2
79.	Worm reduction gearbox	-	2
80.	Dust collector	-	2

Indicative List of Plant & Equipment

for

Production of Bricks

Capacity : 40 Million Bricks/year

S.No.	Description	Size	Quantity
1	2	3	4
	CLAY QUARRYING		
1.	Excavators	-	1
2.	Excavator, Universal Type	-	1
3.	Tip Wagons	-	30
4.	Locomotives	-	2
	RAW MATERIALS PROCESSING		
5.	Box Feeders	90 cu.m/hr	2
6.	Clay Crushers with teethed rollers	20 cu.m/hr	2
7.	Double Shafted Pug Mill	11 cu.m/hr	2
8.	Clay Cleaner	12 mc/hr	2
9.	Coarse Roller		2
10.	Smooth Roller Crusher	16 cu.m/hr	2
11.	Grinding Machine for Rollers	-	2
12.	Metal Salt Conveyor	25 m	2
13.	Belt Conveyor	-	2
	MOULDING		
14.	De-airing Pug Mill		2
15.	De-airing Mixer	6000 bricks/hr	2
16.	De-airing Pump		2

Annexure 1.17
Sheet 2 of 2

1	2	3	4
17.	Dies	-	4
18.	Automatic Brick Cutting Tables	6000 bricks/hr	2
	TRANSPORT TO DRYERS		
19.	Revolving Column Loader	8 brackets, 6000 bricks/hr	2
20.	Shelves Truck	Capacity 112 bricks 8 shelves	18
21.	Electric Transfer Trolleys	Capacity 2 shelved truck	4
22.	Transfer Platform Hand operated or hauled	-	6
23.	Transfer Platform with turnable & 2 bridges	-	6
24.	Elevator for dried bricks	4000-5000 bricks/ hr	3
25.	Storied Platform Car	-	12
	TRANSPORT TO KILNS		
26.	Platform Car for dried bricks to kiln		12
27.	Platform Cars for transport of fired bricks	-	16
28.	Kiln Cars	-	20
	MISCELLANEOUS		
29.	Fans for Kiln and Dryer	-	4

Annexure 1-18
Sheet 1 of 6

Indicative List of Plant and Equipment for Production of Refractories

S.No.	Description	Size	Quantity
1.	2.	3.	4.
	A. **FIRE BRICK PLANT** : 30,000 TPA		
	Crushing Section		
1.	Laminated Trough Conveyor	20 Tons/hour	1
2.	Jaw Crusher, Single toggle type	6 Tons/hour	1
3.	Impact Mill	10 Tons/hour	2
4.	Centrifugal Clay Mill	3 Tons/hour	1
5.	Table Feeder	500 litres	1
6.	Ball Mill	1 Ton/hour	1
7.	Dalecon Mill	1 Ton/hour	3
8.	Belt Elevator	20 Tons/hour	3
9.	Belt Elevator	5.6 Tons/hour	2
10.	Vibrating Screen	20 Tons/hour	3
11.	Air separators	2.5 Tons/hour	3
12.	Magnetic Separator, Drum Type	20 Tons/hour	1
13.	Vibrating Trough Conveyor	20 Tons/hour	1

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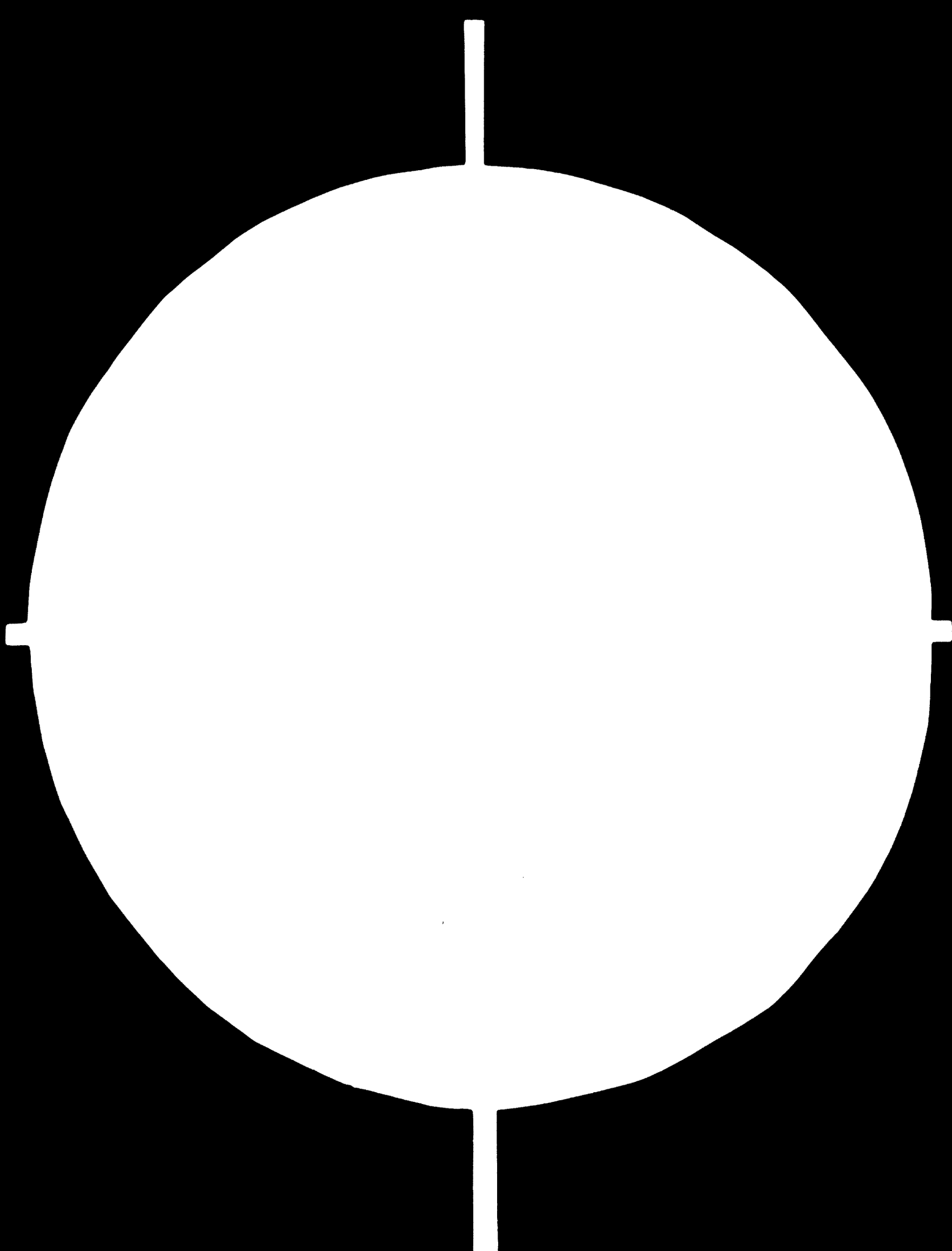

1.	2.	3.	4.
14.	Vibrating Pipe Conveyors	10 Tons/hour	7
15.	Dust Filter, bag type 6 chamber	Air handling Cap. 15,000 cu.m/hr.	2
	Mixing Section		
1.	Travelling balance	750 kg.	2
2.	Eirich Mixer with skip hoist	500 litres	5
3.	Extrusion machine with double shaft	-	1
4.	Automatic Cutter	800/1000 pieces/hr.	1
	Moulding Section		
1.	Lifting arrangement with pumping set for presses	1500 Kg.	13
2.	Stopper Press	2000 Pcs./2½ hrs.	1
3.	Elevator Press	2500 Pcs/8 hr. shift	2
4.	Runner Brick Press-Hand operated	120 Pcs/hour	1
5.	Rotary Table Press	1000/2000 per hour	1
6.	Hydraulic Spengler Press	1000 pcs/hour	1
7.	Frictional Screw Press	-	8.
8.	a) Oil Hydraulic Press	300 tons	1
	b) Oil Hydraulic Press	800 Tons	1
	c) Oil Hydraulic Press	600 Tons	1
	d) Oil Hydraulic Press	1200 tons	1
9.	Electric Hoist	1 ton	5

1.	2.	3.	4.
	Drying and Burning Plant		
1.	Channel Dryers	40 Trolleys, 33m	12
2.	Pusher machines		3
3.	Lifting and lowering arrangement for tunnel kiln cars.	10 Tons	3
4.	Tunnel kiln	121 m, output 2200 tons/month.	1
5.	Chamber kiln	20 chambers	1
6.	Shaft kiln	33 tons/24 hours	3
	B. **SILICA PLANT** :	10,000 Tons/Year	
	Crushing Section:		
1.	Jaw Crusher	15 tons/hour	1
2.	Cone Crusher	10 tons/hour	1
3.	Belt Elevator	20 Tons/hour	1
4.	Belt Elevator	6 Tons/hour	1
5.	Magnetic Separator	400 x1000 mm	2
6.	Vibrating screen	20 tons/hour	1
7.	Ball Mill	1 ton/hour	1
8.	Air Separator	2.5 tons/hour	1
9.	Dalecon Mill	2 tons/hour	1
10.	Dust Filter	20,000 m^3/hr.	1
	Mixing Section		
1.	Travelling Balance	750 kg.	2
2.	Eirich Mixer	250 litres	1

1.	2.	3.	4.
3.	Pan Mill	750 Kg.	3
4.	Lime Mixing Plant	-	1
	Moulding Section:		
1.	Boyd Press	1920/hour	1
2.	Lifting and lowering equipment	1½ Tons	9
3.	Friction Screw Press	-	6
4.	Oil Hydraulic Press	600 Tons	2
5.	Hand Moulding Tables	-	8
6.	Pneumatic Rammers	-	8
	Drying and Burning Plant:		
1.	Channel Dryer	33 m	8
2.	Pushing machines		2
3.	Chamber Kilns	20 Chamber 1000 tons/month	2
	C. BASIC PLANT :	Capacity : 20,000 Tons/Yr.	
	Crushing Section		
1.	Cone Crusher	19-17 tons/hr.	1
2.	Maxecoh Mill	1 Ton/hour	4
3.	Air Separator	∅ 2100 mm	2
4.	Vibrating Screens	2500x1000 mm	1
5.	Belt Elevators	20 Tons/hour	3
6.	Belt Elevtors	6 Tons/hour	1

1.	2.	3.	4.
7.	Box Feeder	15 Tons/hour	1
8.	Impact Mill	8 Tons/hour	3
9.	Vibrating trough conveyor	20 Tons/hour	1
10.	Vibrating pipe Conveyor	10 Tons/hour	6
11.	Dust Filter	15,000 cu.m/hr.	1
12.	Hoppers	25 Tons	28
	<u>Mixing Section</u>		
1.	Travelling balance,	750 kgs.	2
2.	Birich Mixer	750 litres	3
3.	OCL Mixer	600 litres	2
	<u>Moulding Section:</u>		
1.	Hydraulic Press	800 tons	2
2.	Brick Press	2000bricks/hour	1
3.	Friction Screw Press	-	4
4.	Lifting and Lowering arrangement	1½ Tons	10
5.	Electric hoist	2 Tons	4
6.	Oil hydraulic press	-	2
7.	Hand moulding pneumatic rammers	-	10
8.	Electric hoist	1 Ton	1

1.	2.	3.	4.
	Drying and Burning Section		
1.	Channel Dryers	-	10
2.	Pusher machines	-	3
3.	Tunnel kilns	15 m width x 168 m long	2

Annexure 1.19
Sheet 1 of 2

Indicative List of Plant & Equipment for Manufacture of Window Plate and Sheet Glass

Capacity: 30,000 tons/year

S.No.	Description	Size	Qty.
1.	Rotating Drum	6 min. cycle, 2 tons	1
2.	E.O.T. Crane	3 tons	1
3.	Disintigrator complete with accessories.	750 mm	2
4.	Electromagnetic Separator	300x600 mm	2
5.	Batch Weighing Scale with Hopper	1000 kg x 2 kg	1
6.	Batch Weighing Scale with Hopper.	500 kg x 1 kg	2
7.	Batch weighing Scale with Hopper.	250g x 0.5 g	1
8.	Bucket Elevator with two way chutes.	5 tons	3
9.	Bucket Elevator with two way chutes.	10 tons	1
10.	Sheet Glass Drawing Mach nes system 'Pittsburgh'	Band width 2400 mm	3
11.	Border cutting devices suitable for Pittsburgh sheet glass drawing machines.	2 cutting heads with fine adjustment and widia cutting wheels.	3
12.	Automatic Breaking off & longitudinal and cross cutting device fitted with air cushion for removal of glass.	-	3

Annexure 1.19
Sheet 2 of 2

1	2	3	4
13.	Cooling Flasos	-	2 sets
14.	Asbestos Rollers	-	10 pair
15.	Batch Feeders Blanket type	2 tons/hr	3
16.	Glass level recorder	-	1
17.	Furnace Pressure Control	-	1
18.	Oil firing equipment	For 90 tons of glass per day	1
19.	Electrocast refractory blocks.	-	80 ton

Annexure 1.20
Sheet 1 of 5

Indicative List of Plant & Equipment for Production of Glass Bottles

Capacity: 12,000 tons/year

SNo.	Description	Size	Quantity
1.	2.	3.	4.
	BATCH HOUSE SECTION		
1.	Rotating drum	6 Min. Cycle 2 tons	1
2.	E.O.T. Crane	3 tons	1
3.	Disintigrator complete with accessories	750 mm	2
4.	Electromagnetic Separator	300x600 mm	2
5.	Batch weighing scale with hopper	1000 kg x 2 kg.	1
6.	Batch weighing scale with hopper	500 kg. x 1 kg.	2
7.	Batch weighing scale with hopper	250 kg. x 0.5 kg.	1
8.	Burkeet elevator with two-way chutes	5 tons	3
9.	Burkeet elevator with two-way chutes	10 tons	1
	FURNACE HOUSE		
10.	Regenerator glass tank furnace complete with refractories and steel work.	80 t	1
11.	Batch Charger	ø 250 mm	1

Annexure 1.20
Sheet 2 of 3

1.	2.	3.	4.
12.	Furnace, Instrument Panel and feeder radiamatics	-	Full Set
13.	Glass level recorder and controller	-	1
	MACHINE SECTION		
14.	M.L.P. Press machine with fire polishing and feeder	4.2m - 200mm	1
15.	L-10 machine with feeder	4.2m - 200mm	1
16.	IS-6 Sec. machine with single and double gob attachment and accessories including conveyor with 90° pusher and installed automatic lubrication and feeder	5.4m - 220mm	3
17.	Temperature control instrument panel and feeder heating elements.	-	5 Sets
	LEHR SECTION		
18.	Charlton lehr complete with heaters, totally muffled	1200-260 mm	2
19.	Charlton lehr	900-260 mm	3
	COMPRESSOR HOUSE		
20.	Air compressor complete with motor, starter, after cooler and air receivers.	80 cu.m/min.	2

Annexure 1.20
Sheet 3 of 3

1.	2.	3.	4.
21.	Air compressor complete with motor, starter, after cooler and air receivers.	25 cu.m/min.	2
22.	Generating set	250 KVA.	1
23.	Water softening Plant	11 cu.m/hr.	1
24.	1 No. Softner Shell with chlorination and dosing plant		1
25.	Water storage tank	ø 1000 x 1200 mm	1
	BOTTLE PRINTING SECTION		
26.	Double colour printing machine	20 bottle/min. in double colour	1
27.	Decorating lehr	1100 m x 27 m, 200 mm/min.	1

Annexure 1.21
Sheet 1 of 3

Indicative List of Plant & Equipment for Manufacture of Glass Bulbs and Tubes

Capacity: 15 Million Pcs. Per Year

S.No.	Description	Size	Quantity
1	2	3	4
	BATCH HOUSE		
1.	Saxonia glass aggregate mixer	400 litres	1
2.	Electric Hoist	2 tons	1
3.	Batch Bins	1200 kg.	3
4.	Weighing Platform Balance	1000 kg.	1
5.	Turn Table	-	1
6.	Magnetic Separator	-	1
7.	Glass Melting Tank Furnace	12 tons/day	1
	BULB BLOWING PLANT		
8.	Thin Ware Rotary Bulb Blowing Machine	15-60 pcs/min.	1
9.	Feeder	Width 320 mm	1
10.	Lubricant Circulating Pump	6 litres/minute 5 kg./cm^2	1
11.	Annealing Lehr	560 mm x 12 metres	1
12.	Abbestos Conveyor	130 mm x 4 m	1
13.	Inspection Conveyor	540 mm x 6 m	1
14.	Air compressor	4 cu.m./min.	1
15.	Oil Pump	-	1

Annexure 1.21
Sheet 2 of 3

1	2	3	4
	TUBE DRAWING SECTION		
16.	Carborundum Baffle	-	1
17.	Sleeve Dr[illegible]	-	1
18.	Sleeve Shaft, Nuts, Collar and Stop ring	-	set
19.	Refractory Sleeve	-	1
20.	Tube Alley [illegible] Rollers	30 m	1
21.	Turbo Blower and Receiver for Tube Blowing	-	1
22.	Drawing Tools	-	set
23.	Glass Tube Drawing Machine	Ø10-40 mm, 9t/day	1
24.	Inspection Conveyor	1100 mm x 4 m	1
25.	Recut and Glazing Machine for 20 Watt with Annealing Conveyor	40 pcs/min.	1
26.	Recut and Glazing Machine for 40 Watt with Annealing conveyor	40 pcs/min.	1
27.	Sorting [illegible]	-	1
28.	Refractory Gate	-	1
29.	Refractory Gate operating equipment		1
30.	Refractory Trough	-	1
31.	Tip [illegible]	-	1
32.	Burner for Muffle and Feeder	-	1
33.	Sleeve Carrying Vehicle	-	1

Annexure 1.21
Sheet 3 of 3

1	2	3	4
34.	Trough Carrying Vehicle	-	1
35.	Sleeve Preheating Furnace	-	1
36.	Trough Preheating Furnace	-	1

Annexure 1.22
Sheet 1 of 5

Indicative List of Equipment for Manufacture of Insulators

Capacity : 2400 tons/yr.

S.No.	Description	Specification	Quantity
1.	2.	3.	4.
1.	High Lift Loader	1600 kg, 3200 mm	1
2.	Platform truck	800 kg.	2
3.	Box Feeder	2-15 tons/hr.	2
4.	Single toggle Crusher	600-180 mm 5 ton/hr.	1
5.	Movable Belt Conveyor	400 mm x 8000 mm 400 mm x 3800 mm	4 4
6.	Roller mill	2.5 cu.m/hr.	1
7.	High speed belt and bucket type elevator	10 m 10 tons/hr.	4
8.	Clay crusher	5-12 tons/hr.	1
9.	Toughed Reverse Belt Conveyor	400 mm x 4000 mm	2
10.	Edge Runner	2.5 t/hr.	1
11.	Ball Mill for wett grinding	4, 400 lit/1500 lit./ 100/mill.charge,2,200/ 700/45 kg.	7
12.	Goods platform lift	2 tons, 4000 mm	1
13.	Magnetic separator	500 x 3000 mm	7
14.	Vibrating shifter	3-5 cu.m/hr.	9
15.	High speed agitator, propeller type	12 cu.m - 0.3 cu.m	13

1.	2.	3.	4.
16.	Diaphragm pump	100 lit/min. 50 lit/min.	2 4
17.	Semi-automatic filter press	600 lit, 16 atm.	5
18.	Belt Conveyor	1000x6000 mm 1000x18000 mm	5 1
19.	Cutter for filter cakes	-	1
20.	Cutting taking of device	-	6
21.	De-airing pug mill	4-8 tons/hr.	3
22.	Platform Car	1200x700 mm 80 kg.	12
23.	Hand operated wing pump	22 lit/min.	2
24.	Vessel for glaze distribution		6
25.	Edge runner	300 kg/hr.	1
26.	Dosing vessel	10 lit.	8
27.	Wing type mixer	150 lit.	1
28.	Disintegrator	1 ton/hr.	1
29.	Movable platform	400 kg.	10
30.	Stationary piston compressor	25 cu.m/hr.	1
	INSULATORS FORMING, PRESSING AND CASTING		
31.	Cutting of device	-	1
32.	Semi-automatic Jolley machine	700 pcs/hr.	1
33.	Counter current channel sectional dryer.	650 x 29000 mm	3

1.	2.	3.	4.
34.	Hand Operated lever Press	-	3
35.	Vertical turning machine	-	8
36.	Hydraulic press	-	6
37.	Mechanical Jigger and tools	-	3
38.	Spindle revolving press	-	1
39.	Vertical turning and copying machine	-	2
40.	Automatic press	8000 kg.	1
41.	Semi-automatic press	6000 kg.	2
42.	Drying and glazing production line	800 x 18000 mm Length of the dryers - 10000 mm	1
43.	Air Compressor	50 cu.m/hr.	2
44.	High Speed propeller type agitator	1 cu.m	2
45.	Mechanical jolley	-	1 set
46.	Pre press jolleying machine	-	1 set
47.	Vibrating sifter	-	1
48.	Hand operated wing pump	-	1
49.	Vessels for casting slip	5 & 10 lit.	10
50.	Intermittent chamber dryer	-	1
51.	Twin Tunnel dryer	45 L	2

1.	2.	3.	4.
	GLAZING		
52.	Circular automatic glazing machine	-	2
53.	Propeller type agitator	-	4
54.	Belt type glaze cleaning machine	-	5
55.	Oval shaped tub for glaze	-	2
56.	Automatic glazing line	-	1
57.	Pressure glaze container	10 lit.	3
58.	Air Compressor	50 cu.m/hr.	2
	TUNNEL KILN		
59.	Tunnel preheater	-	1
60.	Preheater cars	-	16
61.	Direct fired tunnel kiln	-	1
62.	Kiln car	2020x1380 mm	120
63.	Oil tank	2 cu.m.	1
64.	Diesel Oil Burners		50
65.	Hydraulic Shifting device	-	1
	SORTING, CEMENTING AND GRINDING		
66.	Platform trucks	1300x700	18
67.	Mixing machine	60 lit.	2
68.	Grinding machine	-	3

1.	2.	3.	4.
69.	Flexible Shaft Grinding		4
	STORAGE AND DESPATCH		
70.	Tilting weigh bridge	500 kg.	2
71.	High lift truck	1000 kg.	1
72.	Low lift truck	-	2

Indicative List of Plant & Equipment For Production of Chinaware

Capacity: 1200 tons/year

S.No.	Description	Size	Quantity
1	2	3	4
	DRY GRINDING SECTION		
1.	Jaw & Roller Crusher	1 ton/hr.	1
2.	Edge Runner with Pan and Grinding Stone	4 ton/8 hr.	1
3.	Edge Runner (large) with Pan and Grinding Stone with automatic conveyor and sieving arrangements.	4 ton/8 hr.	1
	CLAY MAKING SECTION		
4.	Ball Mills	1 ton/charge	5
5.	Ball Mills	0.6 ton/charge	7
6.	Double Acting Diapharam Pump for Filter Unit	50 litres/min.	1
7.	-do-	-do-	1
8.	Single Acting Diapharam Pump for Filter Pump Unit	-	4
9.	Pugging Rotary Machine	-	1
10.	Pugging Rotary Machine	-	1
11.	Automatic Vacuum Pug Mill with Rotary Cutters and Pushers, with Vacuum pumps	1 ton/hr	3

1	2	3	4
12.	Screw Blungers for mixing clay.	1	6
13.	Agitators	-	Set of 4
14.	36 Chamber Filter Press	-	4
15.	Vibrating Sieves	-	4
16.	Magnet, Stationery	-	1
17.	Ferro Filters with Rectifiers	-	1
18.	Weighing Machine	-	1
	MAKING SECTION		
19.	Jolly & Jiggers (Crockery making machine)	11800 pc/8 hr.	27
20.	Semi Automatic Cups Making Machine	3000 Pc./8 hr.	1
21.	Semi Automatic Plate Making Machine	-	1
22.	Drier	Handling 10,000 pcs. each/8 hr.	1
23.	Driers		2
24.	Driers		1
25.	FINISHING SECTION		
25.	Vertical Jiggers (Crockery Finishing Machine)	-	14
	HARD DRYING SECTION		
26.	Drier	8000 pcs/8 hr.	5
27.	Drier	10000 pcs/8 hr	3

1	2	3	4
	SPRAYING SECTION		
28.	Spray Guns	-	15
29.	Air Compressors	-	3
	GLAZING & GLAZE CLEANING SECTION		
30.	Glaze removing machine	-	4
31.	Glaze Sieving and cleaning Unit	-	1
32.	Vibrating Sieve	-	1
	CASTING SECTION		
33.	Casting Blungers	-	6
	WASTE HEAT UTILISING PLANT CONSISTING OF DUCT LINES, HEAT EXHAUSTERS & BLOWERS		
34.	Heat Exhaust Fans	120 cu.m/min.	8
35.	Blowers	-	4
36.	Heat Exhaust Fans	-	4
37.	Duct Lines fully insulated	-	1
38	Duct Lines	Length 215 m	1
	CROCKERY BAKING SECTION		
39.	Kiln	ø 5400mm, 6.5 tons	1
40.	Kiln	6000mm ø 7.5 tons	6
41.	Kiln	6600mm ø, 9 tons	2
42.	Chimney	-	4
43.	Biscuit Kilns	-	2

Annexure 1.23
Sheet 4 of 4

1	2	3	4
	DECORATION SECTION		
44.	Electric Furnaces	1 ton/8 hrs.	12
45.	Electric Kiln (Truck Type)	-	1
46.	Printing Machines for Cups & Plates	-	2
47.	Rotary Conveyor	-	1
48.	Conveyor	600 mm x 6m	1
49	**TEMPERATURE RECORDERS AND THERMOCOUPLES**		
	a) Pyrometers	-	12
	b) Thermocouples	-	30
	SAGGAR MAKING SECTION		
50.	Decentigator	400 mm	1
51.	Sieving Chamber with Rotary Screen	-	1
52.	Saggar Clay Pugging Machines Vertical Type	-	2
53.	Friction Presses	-	4

Annexure 1.24
Sheet 1 of 5

Indicative List of Plant & Equipment for Production of Sanitarywars

Capacity : 5000 tons/year

S.No.	Description	Size	Quantity
1.	2.	3.	4.
	SLIP HOUSE		
1.	Blunger with elec. motor starter, switch, gear box and rotating blades	1800x1500 mm	4
2.	High Speed blunger with elec. motor, starter, switch, gear box and rotating blades.	1800x1500 mm	1
3.	Blunger with elec. motor, starter, switch, gear box and rotating blades.	2400x1500 mm	4
4.	Blunger for scrap and press with elec. motor, starter, switch, gear box and rotating blades.	1500x1500 mm	4
5.	Agitator with elec. motor, starter, switch, gear box and rotating blades.	ø3000 mm	12
6.	Motorised Sifters with electric magnets	-	4
7.	Filter Press, hydraulic closing.	ø900 mm /	1
8.	Ram Pump	4 cum/hr 225 mm stroke	6
9.	Diaphragm Pump	2.5 cum/hr	1

1	2	3	4
10.	Centrifugal Pump, rubber lined	40 cu.m./hr	3
11.	Ball Mill	ø 600 x 600 mm	1
12.	De-airing Pug Mill with vacuum Pump	500 kg/hr	1
13.	Dewatering pump	700 cu.m./hr, 50 mm ø	1
	MILL HOUSE		
14.	Ball Mill with elec. motor, starter, drive etc.	1500 kg.	5
15.	-do-	500 kg.	2
16.	Pump, rubber lined	6.7 cu.m./hr	2
17.	Ram Pump	2 cu.m./hr., 225 mm stroke	2
18.	Agitator	3000x3000 mm	2
19.	Electric Travelling Hoist	750 kg.	1
20.	Jaw Crusher	2 t/hr.	2
21.	Water SupplyPump	8 cu.m./hr.	2
22.	Dewatering pump	13.4 cu.m./hr	1
	GLAZE PREPARATION		
23.	BallMill with elec. motor etc.	900x900 mm	2
24.	Glaze Mixers	200 kg.	3
25.	Blungers	1500x1200 mm	2
26.	Agitators	-	5

1	2	3	4
27.	Motorised Sifters		2
28.	Diaphragm Pump, Reciprocating type	-	2
	CASTING		
29.	Agitators	-	9
30.	Ram Pump	225 mm stroke, 2.9 cu.m./hr	2
31.	Ram Pump	150 mm stroke, 1.8 cu.m./hr.	1
32.	Diaphragm Pump	-	5
33.	Pump	3.6 cu.m./hr.	1
34.	Humidification plant with dampers and ducts	800 l/hr.	6
35.	Humidification plant including steam heating arrangement	1600 l/hr.	6
36.	Fully automatic oil fired boiler	2750 t/hr.	1
37.	Shop Heater	200,000 K.Cal.	5
	PILOT PLANT		
38.	Ball Mill	500 kg.	1
39.	-do-	50 kg.	1
40.	Diaphragm Pump	2200 l/hr.	1
41.	Agitator	-	2
42.	Blunger	-	2

1	2	3	4
43.	Filter Press	∅ 450 mm	1
44.	Jar Mill	-	1
45.	Motorised Sifter	450 mm	1
46.	Top Hat Electric Kiln	60-70 pcs.	1
47.	Tile Press	-	1
	INSPECTION & GLAZING		
48.	Inspection booth with exhausting arrangements	-	17
49.	Spray Booth	-	8
50.	Spray Booth (Refire)	-	4
	KILNS		
51.	Kiln Oil fired fully muffled tunnel with hydraulic propelling gear.	120 m	2
52.	Kiln, oil fired, fully muffled tunnel with hydraulic propelling gear.	67 m	1
53.	Gear Pump	2.7 cu.m./hr.	3
	GYPSUM PLANT		
54.	Pulveriser	-	1
55.	Calcining Kiln	-	3
56.	Disintegrator	-	1
57.	Dust Extractor	-	1
58.	Jaw Crusher	-	1

1	2	3	4
	MOULDING		
59.	Mixer complete		2
60.	Jigger Jolly	-	1
61.	Exhaust fan	-	4
	COMPRESSOR/GEN. HOUSE		
62.	Standby Diesel Generating Set	375 KW	1
63.	Centrifuge	-	1
64.	Cooling Tower		1
65.	Centrifugal Pump Unit	6.7 cu.m/hr.	1
66.	-do-	1.6 cum/hr	2
67.	-do-	22.5 cu.m./hr	1
68.	Air Compressor for Generating Set.	-	1
69.	Air Compressor	300 cfm.	2
70.	Battery Charger		1
	CONVEYOR CASTING		
71.	Complete unit for casting 23" IWC including steam heated dryer, controls etc.	900 pcs/day	1
72.	Agitator	-	1
73.	Diaphragm Pump	-	2

Annexure 1.25
Sheet 1 of 2

Indicative List of Plant & Equipment for Production of Tiles

- Capacity: 2100 tons/year

S.No.	Description	Size	Quantity
1	2	3	4
	Slip and Mill House		
1.	Ball Mills	8800 kg.	4
2.	Air Compressor	50 cfm.	1
3.	Transfer Pumps, rubber lined	-	6
4.	Measuring and Mixing Tanks	18,500 lit.	4
5.	Blungers	10,800 lit.	3
6.	Scales	500 kg.	3
7.	Run off Arc.	5800 lit.	1
8.	Flow Control Pump	150 mm	2
	Dust Preparation and Press		
9.	Filter Press	800mm x 60 plates	2
10.	Cake Drying Kilns	20 tons	4
11.	Tippler and Clay Braker	3 tons/hr	1
12.	Elevator	10 tons/hr.	3
13.	Hoppers	90 tons	5
14.	Conveyor	10 tons/hr	1

1	2	3	4
15.	Tile Presses	235 sq.m./hr.	17
16.	Sifter	3 tons/hr.	1
17.	Air heater	3 million BTU	1
18.	Magnetic Separator	9000 litres/hr.	3
19.	Dust Extractor	24000 cfm.	1
	<u>Kiln Section</u>		
20.	Drying & Biscuiting Kiln complete	55 m/75 m	1
21.	Glost Kiln complete	84 m.	1
	<u>Glaze Preparation</u>:		
22.	Ball Mills	1800x1800 mm	2
23.	Agitator	-	1
24.	Ball Mills	750 x 750 mm	2
25.	Set Jar Mills	6 Jars	1
26.	Hoists	3 tons	2
27.	Frit Kiln Complete	500 kgs.	1
28.	Mixer	400 litres	1
	<u>Glazing</u>		
29.	Glazing Machines	210 sq.m./hr.	3
30.	Manorail Conveyor	110 m.	
31.	Sorting	155 sq.m./hr.	1

Annexure 1.26
Sheet 1 of 6

Indicative List of Plants & Equipment for Manufacture of Cane Sugar

Capacity: 4000 tons cane/day.

S.No.	Description	Size	Qty.
1	2	3	4
	MILLING PLANT		
1.	Unloading Crane	Capacity: 5 tons-30 M.	2
2.	Feeder Tables	6100x6700 mm	2
3.	Main Cane carrier with roller chain and drive	2100 mm wide x 25m long.	1
4.	Auxiliary Cane carrier with Roller Chain.	2100 mm wide x 30m long.	1
5.	Cane Carrier Drive.	60 HP, Speed 3-12 metres/minute.	1
6.	Cane Levellers and Cutter.	2200 mm wide x 44 knives.	1
7.	Cane Crusher.	3 Rollers each 960 mm dia. x 2100 mm long.	1
8.	Cane Mills complete.	3 rollers each 960mm dia. x 2100 mm long.	3
9.	Juice Gutter.	Plate thickness 6mm, copper sheet lined.	1
10.	Bagasse discharge chute.	-	1
11.	Mill reduction gearings.	-	1 set
12.	Steam Turbines	900 BHP, superheated steam 18/21 kg/cm^2, 300/400 deg.C.	4

1	2	3	4
13.	Mill Gearing.	900 BHP	4
14.	Water meter.	100 cu.m/hr x 30 mts.	1
15.	Measuring Tank	5 cu.m	2
16.	Centrifugal Pump.	100 cu.m/hr.	1
17.	Screen.	400 tons/day	1
18.	Chokeless Pumps	100 cu.m/hr x 10 mts.	2
19.	Chokeless Pumps	250 cu.m/hr x 10 mts.	2
20.	Juice Tanks, Copper lined.		
21.	Centrifugal pumps	250 cu.m/hr x 15 mts.	2
22.	E.O.T. Cranes	20 tons capacity, span 24 metres.	1
23.	Bagasse Elevator	1500 mm width x 17 mts.	1
24.	Bagasse Conveyor, Return type.	1500 mm width	1
	CLARIFICATION PLANT		
25.	Automatic Juice Weighing Scale.	Cap. 100 ton/hr.	2
26.	Centrifugal pumps.	250 cu.m/hr x 30 mts.	2
27.	Vertical juice Heater.	250 sq.metres	5
28.	Condensate Receiver.	-	5
29.	Hot Water Condensate Receiver.	-	5
30.	Hot Water Condensate Pump (Centrifugal Type)	-	5
31	Continuous juice Sulphitation Vessel.	250 tons/hour	1

1	2	3	4
32.	Milk of lime proportioning device.	-	1
33.	Sulphited juice Collecting Tank	25 cu.m.	1
34.	Centrifugal Pump.	250 cu.m/hr x 40 mts.	2
35.	Cane juice Clarifier.	11 mts. dia, 4 compartments.	1
36.	Clear Juice Receiving Tank.	-	1
37.	Centrifugal Pump.	250 cu.m/hr x 48 mts.	1
38.	Continuous sulpher burner with scrubber gas cooler.	80 kg/hr, tray area - 1 sq.mt.	2
39.	Continuous Sulphur burner with Scrubber Gas Cooler.	60 kg/hr. Tray area - 0.6 sq.m.	1
40.	Air Compressor	800 cu.m/hr	1
41.	Air Compressor	400 cu.m/hr	1
42.	Rotary lime slaker and Classifier.	1220 mm dia x 4800 mm	1
43.	Lime milk storage Tank.	Cap. 25 cu.m	2
44.	Milk of Lime Pumps.	0.8 cu.m/hr	2
45.	Vacuum Filters.	2400 mm dia x 4900 mm 40 sq.mts. filtering area.	3
46.	Condenser injection and Vacuum Pump.	20 HP	1
47.	Centrifugal Pumps.	50 mm	2
48.	Feeder Mixer.	5 HP	1
49.	Overflow Tank	5 cu.m	1

1	2	3	4
50.	Mud Circulation pump	-	1
51.	Hot Water Pump	1100 litre/hr, 60 m head.	1
52.	Cyclone Separator	-	1
53.	Bagcillo shifter		1
54.	Belt Conveyor	20 m	1
	EVAPORATION & BOILING PLANT.		
55.	Quadruple effect evaporator.	5000 sq.m (Total)	1
56.	Condensate Extraction Pump.	-	2
57.	Syrup Extraction Pump	100 cu.m/hr, 30 m.	2
58.	Continuous Sulphation Tower	85 tons/hr	1
59.	Syrup and Molasses Storage Tank.	450 cu.m	15
60.	Vacuum Pan	280 sq.m	7
61.	Crystallizer	30 tons/hr.	1
62.	Vacuum Crystalliser	50 tons/hr	2
63.	Condensate Receiving Tank.	2450 mm dia., 3650 mm/hr	1
64.	Centrifugal Pumps (GM)	70 cu.m/hr, 15m	2
65.	CONDENSATION Multijet Spray Barometer Condenser.	1830 mm	1
66.	Multijet Spray Barometer Condenser.	1220 mm	7
67.	Centrifugal Injection Water Pump.	1800 cm/hr. 20m	7

1	2	3	4
68.	Centrifugal Injection Water Pump.	900 cu.m/hr,20m	7
69.	Centrifugal Spray Pump.	2500 cu.m/hr, 14m	4
70.	Spray Pond Equipment with Chokeless nozzles.	-	1 set
71.	Crystallizer	65 tons	7
72.	Water cooled type M.S Crystallizers.	65 tons	8
73.	Semi-automatic Centrifugals (High Speed)	500 kg, ø 1250 mm x 260 mm	20
74	High speed semi-automatic centrifugal machine.	500 kg, ø 1220 mm x 610 mm	12
75.	Pug mills		6
76.	Molasses Tank		8
77.	Hot water pump	110°C, 5 kg/m^2	1
78.	Compressed Air Plant	For 32 Centrifugal Machine.	1 Plant
79.	Magma mixers	-	5
80.	Molasses Tanks	-	6
81.	Magma Pumps	-	6
82.	Sugar melting Tank	10 tons/hr.	2
83.	Centrifugal Pump	75 cu.m/hr, 30m	1
84.	Grass Hopper complete with hot air blowing arrangement.	1500 x 1500 mm	2

1	2	3	4
85.	Sugar Elevator	15 tons/hr	2
86.	Vibratory sugar Feeder	10 tons/hr 4 duets	4
87.	Sugar weighing machine	150 kgs.	3
88.	Bagging machine	150 bags/hr.	3
89.	Molasses pump	-	6
90.	Molasses wigh scale	10 tons/hr	1
	STEAM GENERATING PLANT		
91.	Steam boilers, bagasse/ oil fired.	35 tons/hr, 21 kg/cm^2 340°C	3
	POWER PLANT		
92.	Steam Tubro alternator set.	2500 kw.	2
	MISCELLANEOUS EQUIPMENT		
93.	Supporting Structures, pipes, valves, platforms, railings etc. etc.	-	Lot

Annexure 1.27
Sheet 1 of 7

Indicative List of Plant & Equipment For the Manufacture of Sugar From Beet Roots

Capacity: 2000 tons Beet/day

S.No.	Description	Size	Quantity
1	2	3	4
	RECEPTION AND TRANSPORT		
1.	Weigh Bridges	3x12 m, 45 tons	2
2.	Beet Roots piling machine	100 t/hr	1
3.	Washing and Cleaning machine	25 taps 30 kg each	1 set
4.	Silo		1
5.	Leaves separator	-	1
6.	Stone remover	-	1
7.	Centrifugal Pump	750 lit/min, 15m	1
8.	Vertical Pump	400 l/min, 8 m	1
	PREPARATION SECTION		
9.	Separator	-	1
10.	Crusher	-	1
11.	Root Washer	3000x1000 mm	1
12.	Collector (Tank)		1
13.	Centrifugal Pump	250 l/min, 15m	1
	WASHING AND TRANSPORT OF BEET ROOT		
14.	Beet Root Lifting wheel	ø 12m; 800 mm broad 600 mm deep	1

1.	2.	3.	4.
15.	Vertical Pump	100 l/min. 10m	1
16.	Washer of beet root	Length : 8 m width: 1600/2000mm	1
17.	Air Compressor	10.8 cu.m/hr, 8atm.	1
18.	Jigging Sieve	600 x 5000 mm	1
19.	Disinfectioner		1
20.	Elevator	17 m	1
21.	Centrifugal Pumps	7500 l/min. 15 m	2
22.	Clarifier	600 cu.m/hr.	1
	PUMP TREATMENT SECTION		
23.	Silo	2.5 x 4.5 x 3 m	1
24.	Cutter for Beet Root	ø 2m, 22 opening knifes box	2
25.	Chutes	-	2
26.	Belt Conveyor	60 t/hr. 650 mm x 10 m	1
	DISTRIBUTION		
27.	Pump Separator	1000 x 6500 mm	2
28.	Pulp Mixer	ø 2000x5000 mm	1
29.	Extraction Machine	1500 t/24 hrs.	1
30.	Screw Distributor	-	1
31.	Squeeser	ø 1500 x 1200 mm	1
32.	Pump	2200 l/min.33 m	1
33.	Heater	110 sq.m	2
34.	Heater	30 sq.m	1

1.	2.	3.	4.
35.	Pump	3501 'Min.,35 m	2
36.	Tank	ø 1500 x 2000 mm	1
37.	Fresh water Pump	625 l/min, 35 m	2
38.	Centrifugal Pump	2000 lit/min. 10m	1
39.	Juice Distributing Pump	970 lit/min.,20 m	2
40.	Pulp and Raw Juice Separator	ø 1400 x 2100 mm	1
41.	Pulp Pump	100 lit./min.,15 m	1
42.	Pump	60 cu.m/hr.,8 m	1
	PULP PRESSING SECTION		
43.	Rake Conveyor	ø 500x14000 mm	1
44.	Pulp Press	ø 900 mm	3
45.	Belt Conveyor	500 x 12000 mm	1
	JUICE PURIFICATION SECTION		
46.	Pulp Separator	1000 x 6500 mm	1
47.	Pre-lime washer	1200x2300x7200 mm	1
48.	Milk of Lime Dosager	1400 mm x 1650/2250x 1650 mm	1
49.	Sand/Stone Separator	ø450 mm x 525 mm ø600 x 900 mm	4
50.	Centrifugal Pumps	70 cu.m/hr., 35 m	2
51.	Heat Exchanger	65 sq.m	2
52.	Heater	65 sq.m	
53.	Trough	1200x.200x7200 mm	1

1.	2.	3.	4.
54.	Centrifugal Pump	70 cu.m/hr, 12 m	2
55.	Saturation Vat	∅ 1400x 10000 mm	2
56.	Circulation Pump	360 cu.m/hr	1
57.	Filters	20 sq.m	2
58.	Carbonate Juice Vat	5000 mm high	1
59.	Condenser	∅ 800 x 1430 mm	1
60.	Air Pump	24 cu.m/min.	1
61.	Centrifugal Pump	6 cu.m/hr., 25 m	2
62.	Screw Conveyor	∅ 400x12000 mm	1
63.	Mixer	∅ 1000 x 4000 mm	1
64.	Container	10 cu.m	1
65.	Centrifugal Pump	63 cu.m/hr., 55 m	5
66.	Filters	10 sq.m	6
67.	Vat	1500 l	2
68.	Pump	350 l/min, 10 m	1
69.	Mixing Vat	1800 x 2000 mm	1
70.	Centrifugal Pump	6 cu.m/hr, 25 m	2
71.	Air Compressor	22.3 cu.m/hr.∅ atm.	1
72.	Juice Purification Container	8 cu.m	1
73.	Sweetener and Softner	48 cu.m/hr.	1
74.	Vat	8 cu.m	1

1.	2.	3.	4.
	EVAPORATION		
75.	Evaporators	2300 sq.m	4
76.	Centrifugal Pumps	400 l/min, 30 m	2
77.	Centrifugal Pump	800 l/min, 30 m	2
78.	Centrifugal Pump	100 l/min, 30 m	2
79.	Vats	1000 x 1500 mm	2
80.	Hot Steam Cooler	20 t/hr.	1
81.	Pump	100 l/min., 80 m	1
	BAKING, PROCESSING AND DRYING & STOCKING		
82.	Reservoir	ø 1250 x 2000 mm	1
83.	Pump	200 l/min, 40 m	2
84.	Reheater	-	-
85.	Filter	15 sq.m	2
86.	Vat	ø 1400 x 1600 mm	1
87.	Centrifugal Pump	420 l/min, 25 m	1
88.	Vat	ø 1250 x 2000 mm	1
89.	Centrifugal Pump	200 l/min, 30 m	2
90.	Reservoir	12 cu.m, 30 t	3
91.	Boiler	75 sq.m	2
92.	Oil Pump	-	1 set
93.	Mixers	35 tons	2
94.	Distributor	800 x 3500 mm	1
95.	Centrifuge	25 tons/hr.	2

1.	2.	3.	4.
	CONDENSATION AND WATER SYSTEM		
96.	Counter current barometric condenser	7 t/hr.	2
97.	Separator	ø 1400x2000 mm	2
98.	Container	ø 1200x1200 mm	2
99.	Vacuum Air Pump	22 cu.m/min.	3
100.	Centrifugal Pump	7000 l/min., 30 m	3
101.	Vat	20 cu.m	2
102.	Vat	30 cu.m	1
103.	Reservoir	80 cu.m	1
104.	Pumps	840 l/min.	6
	DRYING, BRIQUETTING AND STORING OF PULP		
105.	Rake Conveyor	500 x 12000 mm	1
106;	Screw Conveyor	ø 400 x 3000 mm	1
107.	Furnace		1 set
108.	Rotary drum drier	ø 2600 x 14000 mm	1
109.	Fan	55 kW	1
110.	Dust Collector	ø 3800x3000 mm	1
111.	Tube Dust Collector	ø 300x4000 mm	1
112.	Tube for Hot Vapour	ø 2150 x 4000 mm	1
113.	Extraction Helix	ø 400 x 8000 mm	1
114.	Bagging Screw Conveyor	ø 400 x 5000 mm	1
115.	Bagging Weigh Bridge	100 kg.	1

Annexure 1.27
Sheet 7 of 7

1.	2.	3.	4.
116.	Magnetic Separator	ø 300x 700 mm	1
117.	Feeding Screw Conveyor	ø 300 x 2000 mm	1
118.	Dry Pulp Press	3 tons/hr.	1
119.	Screen	-	1
120.	Cyclone	ø 1200 mm	1
121.	Screw Conveyor	ø 150 x 5000 mm	1
122.	Hoist Block with Trolley	500 kg.	1
123.	Feeding Silo	ø 1250 x 1500 mm	1
124.	Belt Conveyor	650 x 12000 mm	1

Indicative List of Plant & Equipment for manufacture of Vegetable Oil from Cotton Seed

Capacity : 100 tons/day

S.No.	Description	Size	Quantity
1	2	3	4
	SEED CLEANING SECTION		
1.	Seed Cleaner	-	2
2.	Drum type Electro-magnet	-	1
3.	Cyclone and Sheet Metal Piping	-	1
4.	Feed Elevator, Screw Conveyor	-	1
	HULLING AND SEPARATING SECTION		
5.	Cotton Seed Huller	-	2
6.	Shaker Separator	-	2
7.	Hull and Seed Separator	-	2
8.	Hull Beater	-	2
9.	Mechanical Transport Equipment comprising Rotor Lifts, Screw Conveyors, etc.	-	1
	DELINTING SECTION		
10.	Ist Cut Linters	-	6
11.	2nd Cut Linters	-	6
12.	Automatic Saw Sharpening Machine	-	1
13.	Saw Cylinder Assemblies	-	1
14.	Lot Dust Control System	-	1
15.	Lot Lint Flue System	-	1

1	2	3	4
16.	Lint Cleaner	-	1
17.	Mechanical Transport Equipment comprising Rotor Lift, Screw Conveyors, Ventilators	-	1
	OIL MILL PLANT		
18.	Bucket Elevator	-	1
19.	Roller Mill	-	1
20.	Elevator	5 m	1
21.	Oil Expeller	-	2
22.	Cake Conveyor	10 m	1
23.	Oil Conveyor	5 m	1
24.	Centrifugal Pumps	-	3
25.	Rotary Screen	-	1
26.	Unfiltered Oil Tank	-	1
27.	Filter Presses	-	2
28.	Filtered Oil Tank	-	1
	SOLVENT EXTRACTION PLANT		
	Preparatory Equipment		
29.	Feed Elevator	-	1
30.	Magnetic Drum	-	1
31.	Cake Breaker	-	1
32.	Corrugated Roller Mill	-	1
33.	Inclined Chain Conveyor	25 m	1
	EXTRACTION		
34.	Inlet Rotary Valve	-	1

Annexure 1.26
Sheet 3 of 4

1	2	3	4
35.	Feed Hopper	-	1
36.	Bindicators	-	2
37.	Solvent Tight Intermediary Meal Chain Conveyor	-	1
38.	Extracted Meal Hopper	-	1
39.	Intermediary Rotary Valve	-	1
	MEAL DESOLVENTISING		
40.	Steam Jacketed Driers	-	3
41.	Desolventiser Toaster	-	1
42.	Jacketed Rotary Valve	-	1
43.	Wet Dust Catcher	-	1
44.	Horizontal Surface Condenser	-	1
45.	Final Gas Cooler	-	1
46.	Safety Waste Water Desolventiser	-	1
	DISTILLATION		
47.	Main Miscella Tank & Decanter	-	1
48.	Miscella Still	-	1
49.	Horizontal Surface Condenser	-	1
50.	Oil Heater	-	1
51.	Stripping Column	-	1
52.	Surface Condenser	-	1
53.	Main and Safety Water Solvent Separator	-	1
54.	Solvent Receiver	-	1

1	2	3	4
55.	Steam Ejectors	-	4
	SOLVENT RECOVERY		
56.	Special Solvent/Oil Absorption Unit	-	1
57.	Miscella Evaporator	-	1
58.	Surface Cooler	-	1
59.	Measuring & Automatic Safety Controls	-	Lot
	CONDITIONING AND CONVEYING		
60.	Meal Cooling Conveyor	25 m	1
61.	Dry Cyclone	-	1
62.	Rotary Valve	-	1
63.	Air Fan	-	1
64.	Final Wet Cyclone	-	1
65.	Twin Screw Humidifier	-	1

Annexure 1.29
Sheet 1 of 2

Indicative List of Equipment

for

Milk Pasteurisation Plant

S.No.	Description	Size	Quantity
1	2	3	4
1.	Mechanical Can Conveyor	-	1
2.	Weighing Machine	-	1
3.	Milk Receiving Tank	-	2
4.	Centrifugal Milk Pump	-	4
5.	Drip Saver	-	1
6.	Semi Automatic Can Washer	-	1
7.	Can Washing Trough	-	1
8.	Can Steaming Block	-	1
9.	Plate Heat Exchanger	-	1
10.	Milk Storage Tank	-	1
11.	Centrifugal Milk Pump	-	1
12.	Float Controlled Tank	-	1
13.	Milk Pump	-	1
14.	Plate Heat Exchanger	-	1
15.	Milk Filter	-	1
16.	Hot Water Heater	-	1
17.	Hot Water Pump	-	1
18.	Cream Separator	-	1

Annexure 1.29
Sheet 2 of 2

1	2	3	4
19.	Milk Storage Tank	-	1
20.	Detergent Tank	-	1
21.	Centrifugal Pump	-	1
22.	Cream Balance Tank	-	1
23.	Centrifugal Cream Pump	-	2
24.	Cream Holding Tank	-	1
25.	Chilled Water Pump	-	1
26.	Milk Bottling Plant	-	1
27.	Refrigeration Plant	-	1

Annexure 1.30
Sheet 1 of 3

Indicative List of Plant & Equipment

for

Production of Leather Shoes

Capacity: 1000 pairs/day

S.No.	Description	Size	Quantity
1	2	3	4
1.	Electro Hydraulic Swing Arm Cutting Press	18 tonnes pressure - Swing arm 350x600 mm	6
2.	Bank Knife Splitting Machine	Working width 305 mm	1
3.	Upper Leather Skiving Machine		2
4.	Perforating & Embossing Press	Pressure 125 tonnes Stroke - 12 mm	1
5.	Upper and Lining Stamping Machine		2
6.	Bottom Leather Rapid Beam Cutting Machine	Pressure 18 to 25 tonnes - Stroke 100 mm	1
7.	Leather Splitting and Evening Machine	Working width 33 cms	1
8.	Stiffener Skying Machine		1
9.	Heel Building Machine		1
10.	Heel Compressing Machine	60 Tonnes pressure	1
11.	Sole Stamping Machine		1
12.	Sole Roughing Machine		1
13.	Edge Cementing Machine	25 mm width	1
14.	Upper Folding Machine		2

1	2	3
15.	Upper Sewing Machine of different types a. Flatbed b. Past Bed c. Cylinder bed d. Zig Zag - e. Twin Needle etc.	16
16.	Punching and Eyelitting Machine	1
17.	Forepart Cement Lasting Machine	2
18.	Hydraulic Heel Seat Lasting Machine	2
19.	Bottom Roughing Machine	2
20.	Lasted Upper Cementing Machine	2
21.	Bottom Cementing Machine	2
22.	Hydraulic Sole Attaching Press - Twin pad	3
23.	Last Removing Machine	1
24.	Electro Hydraulic Universal Heel Attaching Machine	1
25.	High Speed Sole Trimming Machine	2
26.	High Speed Heel Trimming Machine	2
27.	Top Piece Nailing Machine	1
28.	Heel Screwing Machine	1
29.	Edge Setting Machine	2
30.	Sole Buffing Machine	4

Annexure 1.30
Sheet 3 of 3

1	2	3	4
31.	Bottom Polishing Machine		1
32.	Conveyor for Closing		1
33.	Conveyor for Assembly		1
34.	Automatic Pattern Grading Machine		1

Annexure 1.31
Sheet 1 of 2

Indicative List of Plant & Equipment for Production of Tannery

Capacity: Tanning 3000 skins/day
Finishing 1000 skins/day

S.No.	Description	Size	Quantity
1	2	3	4
	TANNING		
1.	Soaking and lining drum	2500 x 2000 mm	6
2.	Fleshing Machine	Width 1500 mm 200 skins/hr.	2
3.	Bating and Tanning Drums	2500 x 2000 mm	6
4.	Unhairing and Sendin machine	Width 1500 mm 200 skins/hr.	2
5.	Hydraulic Sammyling machine	Width 1800 mm 200 skins/hr.	2
	FINISHING		
6.	Hydraulic Shaving Machine	Working width 24 m (600 mm)	2
7.	Dyeing drums	2500 mm x 1500 mm	4
8.	Hydraulic Setting out machine	1370 mm width capacity 200 skins/hr.	1
9.	Staking Machine	Working Stroke - 762 mm 60 skins/hr.	2

Annexure 1.31
Sheet 2 of 2

1	2	3	4
10.	Lightning Buffing Machine	Working width 1270mm 150-200 skins/hr.	1
11.	Brushing and Dusting Machine	Capacity 250/hr. Working width 1220mm	1
12.	Glazing Machine	-	2
13.	Ironing Machine	-	2
14.	Hydraulic Press	200 skins/hr. Manual 400 skins/hr.-Auto	
15.	Electronic Measuring Machine	Width 1500 mm	1
16.	Automatic Spraying and Drying machine	-	1

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

STUDY FOR DEVELOPMENT OF CAPITAL GOODS INDUSTRIAL PROJECTS IN INDIA

04461
(3 of 4)

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VOLUME 2

FEBRUARY 1972

THE NATIONAL INDUSTRIAL DEVELOPMENT CORPORATION LIMITED
NEW DELHI, INDIA.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

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DRAFT FINAL REPORT

VOLUME 2

FEBRUARY 1972

THE NATIONAL INDUSTRIAL DEVELOPMENT CORPORATION LIMITED
NEW DELHI, INDIA.

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3. Methodology
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7. Rubber and Rubber products
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1. PROCESSES OF MANUFACTURE AND GROUPED EQUIPMENT REQUIREMENTS

1.1 The previous volume has specified, in general terms, requirements of plant and equipment for new production units that may be expected to come up to meet forecast demand of the commodities under study. It will be seen therefrom that the equipment requirements fall into the following major categories:

a) Fabricated equipment for process industries;

b) Special mechanical equipment involving heavy duty general engineering operations e.g. Ball Mills, Crushers, Kilns etc.

c) Equipment requiring high precision machined work such as, various items of rubber and plastic processing machinery;

d) Material handling equipment;

e) Pumps andcompressors;

f) Electrical equipment;

g) Instrumentation and controls.

It is to be understood that the above are not rigidly defined categories and the basic manufacturing processes involved in each is the same, as for instance, fabrication, machining and assembly, though in varying

relative proportion. Of the above, the present study excludes electrical and electronic equipment and is limited to analysis of requirements for mechanical equipment only.

1.2 Grouping of products for evolving production facilities that must be established must necessarily take into account not only the basic similarity in the manufacturing processes involved, but also the levels of accuracy that are called for, sophistication of technology and the normal usage of customer industries in procurement of equipment. For instance, while it might be theoretically possible to postulate a plant for making a very limited range of cement mill equipment, it would be difficult for such a plant to tie up its own products with those manufactured by diverse agencies in order to meet customer requirement,, which in this case is largely tilted towards turn-key procurement. As a first step the above equipment requirements have been grouped taking into account the range of manufacturing facilities involved in terms of process capabilities in Tables 1 and 2.

The same have thereafter been integrated in accordance with the other consideration mentioned in recommending plant sizes and production programmes.

1.3 Grouped equipment requirements for all industries under study are as follows:

Category of Equipment.	Requirement (tonnes) 1972-77	1977-82	1982-87
Pressure Vessels	39,680	31,040	31,040
Storage tanks, Bins, Low pressure fabrications	62,600	63,342	66,907
Heat Exchangers	16,946	13,286	13,532
Furnaces & Kilns	1,341	15,732	16,673
Conveyors (Belt, Apron, Screw)	1,474	8,411	10,966
Bucket Elevators	48	111	201
Ball Mills & Batchers	161	6,636	7,805
Crushers & Feeders	702	4,924	6,766
Filters -Drum & Plate	644	1,983	2,893
Pumps & Compressors	1,911	2,854	3,031
Screws, cyclones, Ventilators	300	1,700	2,129
Mechanical Eqpt.	3,336	8,239	11,846
Technological structures	4,380	18,260	21,391
Miscellaneous	4,908	10,127	12,479
Plastic and rubber processing eqpt.(nos)	814	1,514	2,228
Tannery & Leather equipment (nos)	340	557	986

1.4 It is conceivable that for some time to come, some equipment for the Oil and Chemical industry, such as, specialized furnaces will continue to be imported even though the wherewithal for actual manufacture might exist in the country. It may be mentioned in this connection that design and know-how owners for this category of equipment throughout the world are only few and process designers with turn-key responsibilities for production output might continue to insist on their import from preferred vendors abroad. It is, therefore, felt that such items cannot be realistically taken in computing loads that might be available for local manufacturing capabilities. The same applies to the group of heat exchangers where some imports will be inescapable because of the specialised designs and materials involved. A 20% reduction on this account has been made in arriving at the above estimates.

1.5 In the category of Pumps & Compressors, the requirements of compressors for the items covered in the Study refer largely to special duty compressors, such as for ammonia, urea

carbon dioxide and other hydro-carbons duties. The manufacture of this item not only involves a very high level of technology, but also calls for a sophisticated industrial base to supply a variety of parts and components. Compressors of this category as well as special duty pumps as are involved for hydro-carbon duties, require special manufacturing facilities and are normally not integrated with general engineering facilities. In view of the existing industrial infra-structure in Iran, as also the volumes of requirements of these specialised items, the same are not recommended for local production and hence no further detailed analysis has been carried out for this category.

However, pumps falling in a lower range and for operation under less severe conditions, have been considered for local manufacture and recommendations in this regard are contained later in this report.

1.6 Certain items of special mechanical equipment, such as, automatic machines for the production of sheet glass, glass bottles, glass shells for

incandescent lamps, fluorescent tubes as well as specialised machines for shoe-making industry etc. are normally made by only a few firms around the world. Designs of such machines are being constantly modified by such specialised manufacturers. Requirements of such equipment are fortunately also low and these items are therefore not considered to form viable loads for examination of local manufacturing capacity.

1.7 Apart from the equipment for rubber and plastic processing and for manufacture of construction equipment, the bulk of the equipment is such as can be made in general purpose engineering facilities. The break-down of the total volumes of such requirements by industries is as follows:

	Per cent of Total 1977-82	1982-87
a) Chemicals and Refinery	53.50	52.00
b) Cement	25.00	26.00
c) Sugar	7.00	13.00
d) Vegetable oil	2.50	2.40
e) Bricks and Refractories	3.50	6.00
f) Others	2.50	0.60

1.8 The group of'miscellaneous equipment' consists of diverse types of equipment each with relatively low volumes. This group, therefore, does not call for any detailed examination for establishment of local manufacture.

GROUPED EQUIPMENT REQUIREMENT

Sr.No.	Plant	Plant Capacity	Period	No. of Plants	Category wise 1	2	3	4
1.	Refineries	-	1972-77	-	a) 12,500	31,250	3,250	-
			1977-82	-	12,500	31,250	3,250	-
			1982-87	-	12,500	31,250	3,250	-
2.	c) Petro-Chemicals	-	1972-77	-	a) 37,100	27,280	17,580	-
			1977-82	-	d) 26,300	d) 19,720	d) 12,120	-
			1982-87	-	e) 26,300	19,720	12,120	-
3.	Rubber	-	1972-77	-	f)			
			1977-82					
			1982-87					
4.	Plastic	-	1972-77	-	f).			
			1977-82					
			1982-88					

(a) Includes Columns, Towers, Reactor Vessels, Furnaces etc.

(b) Excludes Compressors for Petro-chemicals & Refineries.

(c) Includes 20% allowance for miscellaneous chemical industries.

(d) Some parts of these requirements refer to Plants expected to come on stream in 1982-87 taking into account probable lead time for equipment delivery.

(e) Assumed at previous level.

(f) See Table 2 for requirements of Equipment.

QUIPMENT REQUIREMENTS TABLE - 1

Category wise tonnage requirements												
3	4	5	6	7	8	9	10	11	12	13	14	
,250	3,250	-	-	-	-	-	-	b) 390	-	-	3,125	-
,250	3,250	-	-	-	-	-	-	390	-	-	3,125	-
,250	3,250	-	-	-	-	-	-	390	-	-	3,125	-
,280	17,580	-	-	-	-	-	-	b) 710	-	-	2,690	-
,720 d)	12,120	-	-	-	-	-	-	510	-	-	d) 1,940	-
,720	12,120	-	-	-	-	-	-	e) 510	-	-	e) 1,940	-

ces etc.

neries.

al industries.

s expected
t probable

Category Legend

1. Pressure Vessels.
2. Storage Tanks, Bins, Low Pressure fabrications.
3. Heat Exchangers.
4. Furnaces & Kilns.
5. Conveyors - Belt, Apron, Screw.
6. Bucket Elevators.
7. Ball Mills and Batchers.
8. Crushers & Feeders.
9. Filters - Drum & Plate.
10. Pumps & Compressors.
11. Screens, Cyclones, Ventilators.
12. Mechanical Equipment.
13. Technological Structures.
14. Miscellaneous.

S.No.	Plant	Plant Capacity	Period	No.of Plants	Category-wise Tonnage							
					1	2	3	4	5	6	7	8
5	Cement	1500 Tons/ day	1972-77	-	-	-	-	-	-	-	-	-
			1977-82	18	-	3,924	-	12,420	4,680	-	5,868	2,0
			1982-87	21	-	4,578	-	14,490	5,460	-	6,846	2,1
6	Bricks	40×10^6 bricks/ year	1972-77	15	-	-	-	-	300	36	90	
			1977-82	38	-	-	-	-	760	91	228	1,0
			1982-87	81	-	-	-	-	1,620	194	486	2,1
7	Fire Bricks	30,000 tons/ year	1972-77	-	-	-	-	-	-	-	-	
			1977-82	3	-	-	-	-	65	-	64	
			1982-87	5	-	-	-	-	108	-	107	
8	Refrac-tories	20,000 tonnes/ year	1972-77	-	-	-	-	-	-	-	-	
			1977-82	3	-	-	-	720	-	-	-	
			1982-87	5	-	-	-	1,200	-	-	-	
9	Glass Bottles	12,000 tonnes/ year	1972-77	2	-	8	-	2	-	3	-	
			1977-82	2	-	8	-	2	-	3	-	
			1982-87	-	-	-	-	-	-	-	-	
10	Glass Shells & Tubes		1972-77	2	-	8	-	2	-	3	-	
			1977-82	3	-	12	-	3	-	5	-	
			1982-87	-	-	-	-	-	-	-	-	
11	Glass Plate & Sheet	30,000 Tonnes/ year	1972-77	2	-	8	-	160	-	4	-	
			1977-82	3	-	12	-	240	-	7	-	
			1982-87	3	-	12	-	240	-	7	-	

ategory-wise Tonnage Requirements

5	6	7	8	9	10	11	12	13	14
-	-	-	-	-	-	-	-	-	-
4,680	-	5,868	2,016	-	396	1,080	828	12,960	1,620
5,460	-	6,846	2,352	-	462	1,260	966	15,120	1,890
300	36	90	429	192	-	-	547	-	171
760	91	228	1,046	486	-	-	1,387	-	437
1,620	194	486	2,315	1037	-	-	2,947	-	884
-	-	-	-	-	-	-	-	-	-
65	-	64	13	18	-	6	[illegible]	-	[illegible]
108	-	107	23	30	-	10	[illegible]	-	[illegible]
-	-	-	-	-	-	-	-	-	-
-	-	-	46	15	-	6	460	-	10
-	-	-	77	25	-	10	767	-	16
-	3	-	-	-	-	-	205	-	19
-	3	-	-	-	-	-	205	-	19
-	-	-	-	-	-	-	-	-	-
-	3	-	-	-	-	-	205	-	[illegible]
-	5	-	-	-	-	-	307	-	[illegible]
-	-	-	-	-	-	-	-	-	-
-	4	-	-	-	-	-	-	-	50
-	7	-	-	-	-	-	-	-	75
-	7	-	-	-	-	-	-	-	75

Sl. No.	Plant	Plant Capacity	Period	No. of Plants	Category-wise Tonn			
					2	3	4	5
12	Sanitary ware	2,400 tons/ year.	1972-77	-	-	-	-	-
			1977-82	1	83	-	274	-
			1982-87	2	165	-	547	-
13	Crockeries	,200 tons/ year	1972-77	-	-	-	-	-
			1977-82	1	17	-	76	3
			1982-87	1	17	-	76	3
14	Insulators	2,400 tons/ year	1972-77	1	33	-	1,177	14
			1977-82	1	33	-	1,177	14
			1982-87	-	-	-	-	-
15	Tiles	17 tons/ day	1972-77	-	-	-	-	-
			1977-82	1	35	-	1,100	7
			1982-87	-	-	-	-	-
16	Cane Sugar	4,000 tons/ day	1972-77	-	-	-	-	-
			1977-82	1	1100	80	120	605
			1982-87	1	1100	80	120	605
17	Beet Sugar	2,000 tons/ day	1972-77	5	4000	350	-	1150
			1977-82	7	5600	490	-	1610
			1982-87	11	8800	770	-	2530
18	Sunflower Oil	100 tons/ day	1972-77	-	-	-	-	-
			1977-82	8	115	405	-	180
			1982-87	8	115	405	-	180

Category-wise Tonnage Requirements

4	5	6	7	8	9	10	11	12	13	14
-	-	-	-	-	-	-	-	-	-	-
274	-	-	8	21	-	22	2	5	-	101
547	-	-	15	41	-	43	3	9	-	202
-	-	-	-	-	-	-	-	-	-	-
76	3	-	36	13	24	6	1	22	-	172
76	3	-	36	13	24	6	1	22	-	172
1,177	14	2	71	23	..	5	-	9	-	1143
1,177	14	2	71	23	..	5	..	9	-	1143
-	-	-	-	-	-	..	..	..	-	-
-	-	-	-	-	-	-	-	..	..	..
1,100	7	3	46	21	-	2	-	149	-	126
-	-	-	-	-	-	-	..	..	..	-
-	-	-	-	-	-	-	-	-	..	-
120	605	-	315	980	610	125	-	85	-	720
120	605	-	315	980	610	125	-	85	-	720
-	1150	-	-	250	450	800	300	2350	1250	3500
-	1610	-	-	350	630	1120	420	3290	1750	4900
-	2530	-	-	550	990	1760	660	5170	2750	7700
-	-	-	-	-	-	-	-	-	-	-
-	180	-	-	325	12	45	35	125	66	295
-	180	-	-	325	12	45	35	125	66	295

S.No.	Plant	Plant Capacity	Period	No.of Plants	Category-wise Tonnag					
					1	2	3	4	5	6
19	Cotton Seed Oil	100 tons/ day	1972-77	-	-	-	-	-	-	-
			1977-82	7	-	105	95	-	140	-
			1982-87	9	-	130	150	-	170	-
20	Hydrogenated Oil	50 tons/ day	1972-77	-	-	-	-	-	-	-
			1977-82	8	-	1280	160	-	320	-
			1982-87	7	-	1020	140	-	290	-
21	Milk Pasteurization and Bottling	40 tons/ day	1972-77	1	-	13	2	-	10	-
			1977-82	3	-	39	6	-	30	-
			1982-87	-	-	-	-	-	-	-
22	Milk Pasteurization and Bottling	15 tons/ day	1972-77	-	-	-	-	-	-	-
			1977-82	1	-	5	1	-	4	-
			1982-87	-	-	-	-	-	-	-
23	Milk Pasteurization and Bottling	10 tons/ day	1972-77	-	-	-	-	-	-	-
			1977-82	1	-	4	1	-	3	-
			1982-87	-	e) -	-	-	-	-	-
24	Tannery		1972-77		f)					
			1977-82							
			1982-87							
25	Shoes		1972-77		f)					
			1977-82							
			1982-87							

f) See Table 2 for requiremen

ategory-wise Tonnage Requirements

4	5	6	7	8	9	10	11	12	13	14
-	-	-	-	-	-	-	-	-	-	-
-	140	-	-	70	10	40	30	110	60	245
-	170	-	-	90	15	50	40	130	80	325
-	-	-	-	-	-	-	-	-	-	-
-	320	-	-	-	170	170	120	480	280	200
-	290	-	-	-	150	150	110	430	250	180
-	10	-	-	-	2	6	-	20	5	6
-	30	-	-	-	6	18	-	60	15	18
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	4	-	-	-	1	3	-	8	2	3
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	3	-	-	-	1	2	-	6	2	2
-	-	-	-	-	-	-	-	-	-	-

SECTION 2

e 2 for requirement of Equipment

GROUPED EQUIPMENT REQUIREMENTS - TABLE 2

S.No.	Equipment	Equipment Numbers Required in 1972-77	1977-82	1982-87
1.	Rubber - Tyres & Tubes Plants			
1.1	Banbury Mixers	3	4	7
1.2	Rubber Extruders	3	4	7
1.3	3-Roll Calenders	7	8	13
1.4	Stock Preparation Machines	26	31	52
1.5	Tyre Building Machine	49	63	110
1.6	Tyre Curing Presses	95	108	181
2.	Other Rubber Products			
2.1	Banbury Mixers	6	9	23
2.2	Rubber Extruders	3	18	43
2.3	3-Roll Calenders	1	1	2
2.4	Moulding Machines	1	3	9
3.	Plastic Working Plants			
3.1	Profile Extruders Calenders.	200	279	375
3.2	Extruders	135	419	563
3.3	Blow Moulding Machines	62	160	180
3.4	Injection Moulding Machines	38	63	113
3.5	Film Extruders	49	33	150
3.6	Thermosetting Plastic Presses	136	311	400

			1972-77	1977-82	1982-87
4.	Tanning Plant: Capacity 3000 skins/day.				
	No. of Plants	-		11	11
4.1	Soaking Lining Drums.	-		66	66
4.2	Bathing & Tanning Drums	-		66	66
4.3	Fleshing Machines	-		22	22
4.4	Unhairing and Scudding Machines	-		22	22
4.5	Hydraulic Slammying Machine	-		22	22
5.	Leather Finishing Plant:	Capacity		1000	skins/day.
	No. of Plants	-		8	17
5.1	Dyeing Drums	-		32	68
5.2	Hydraulic Shaving Machine	-		16	36
5.3	Hydraulic Setting out Machine	-		8	17
5.4	Staking Machines	-		16	34
5.5	Lightning Buffing Machine	-		8	17
5.6	Brushing & Dusting Machine	-		8	17
5.7	Glazing Machine	-		16	34
5.8	Ironing Machine	-		16	34
5.9	Hydraulic Presses	-		8	17
5.10	Electronic Measuring Machine	-		8	17
5.11	Automatic Spraying and Drying Machine	-		8	17

		1972-77	1977-82	1982-87
6.	Leather Shoes Plant:	Capacity	1000 Pairs/day.	
	No.of Plants	5	3	7
6.1	Electro-Hydraulic Swing-Arm Cutting Press.	30	18	42
6.2	Upper Leather Skiving Machine	10	6	14
6.3	Bank Knife Splitting Machine	5	3	7
6.4	Perforating & Embossing Press.	5	3	7
6.5	Upper and Lining Stamping Machine	10	6	14
6.6	Bottom Leather Rapid Beam Cutting Machine	5	3	7
6.7	Leather Splitting and Evening machine	5	3	7
6.8	Stiffner Skiving Machine	5	3	7
6.9	Heel Building Machine	5	3	7
6.10	Heel Compressing Machine	5	3	7
6.11	Sole Stamping Machine	5	3	7
6.12	Sole Roughing Machine	5	3	7
6.13	Edge Connecting Machine	5	3	7
6.14	Upper Folding Machine	10	6	14
6.15	Upper Sewing Machine	80	48	112
6.16	Punching & Eye letting Machine	5	3	7
6.17	Fore Part Cement Lasting Machine	10	6	14
6.18	Hydraulic Heel Seat Lasting Machine	10	6	14

		1972-77	1977-82	1982-87
6.19	Bottom Roughing Machine	10	6	14
6.20	Last Upper Cementing Machine	-	-	-
6.21	Bottom Cementing Machine	10	6	14
6.22	Hydraulic Sole attaching Press Twin Pad.	15	9	21
6.23	Last Removing Machine	5	3	7
6.24	Electro Hydraulic Universal Heel attaching Machine	5	3	7
6.25	High speed Sole Trimming machine	10	6	14
6.26	High speed heel Trimming machine	10	6	14
6.27	Top piece nailing machine	5	3	7
6.28	Heel Screwing Machine	5	3	7
6.29	Edge Setting Machine	10	6	14
6.30	Sole Buffing Machine	20	12	21
6.31	Bottom Polishing Machine	5	3	7
6.32	Conveyor for Closing	5	3	7
6.33	Conveyor for Assembly	5	3	7
6.34	Automatic Pattern Grading Machine	5	3	7

	Equipment	Equipment numbers required in 1972-77	1977-82	1982-87
7.	CONSTRUCTION MACHINERY			
7.1	Dozers	1182	2358	-
7.2	Graders	1155	2350	-
7.3	Scrapers	88	125	-
7.4	Shovel/Loaders	1120	2353	-
7.5	Excavaters	567	958	-
7.6	Rollers	2735	6050	-
7.7	Concrete Mixers	1975	3565	-
7.8	Vibrators	2925	5250	-
7.9	Crushers	225	390	-
7.10	Tower Cranes	205	420	-

2. PRESENT CAPABILITY FOR LOCAL MANUFACTURE

2.1 Some well-equipped and organised heavy engineering facilities already exist in the country, capable of manufacturing a wide variety of the products discussed in the earlier chapter. Of these, two units, namely, Arak Machine Building Plant and Metallurgical & Engineering Plant, Tabriz have only recently commenced production. and are, by far, the best equipped manufacturing facilities in this category in the country. Additionally, general engineering facilities of a fair size exist in the Cyrus Arzomand Works, Tehran. A large number of relatively small manufacturing plants in and around Tehran and further down at Ahwaz produce, mostly against job orders, light to medium fabricated equipment.

2.2 In terms of process capability, Arak Machine Building Plant has been estimated to be as follows:

Production Facility (1)	Production Capacity Availability (2)
Iron Foundry	2,500 tonnes
Steel Foundry	7,800 "
Aluminium Foundry	60 "

1	2
Steel Forge Shop	4,270 tonnes
Turning and Boring	241,800 Direct machine hrs.
Milling	60,450 "
Shaping and Slotting	13,950 "
Drilling	223,200 "
Gear Cutting	18,600 "
Grinding	32,550 "
Plate Rolling	9,300 "
Dishing	4,650 "
Agricultural Machinery Assembly	10,000 tonnes
Galvanizing	7,000 "
Facilities of cutting, welding, assembly	47,000 "
Other Facilities	30,000 " (including Capacity of Metal Plating Shop as 1300 tonnes)

2.3 The Metallurgical and Engineering Plant at Tabriz has been designed for a diversified programme of manufacture of a variety of machine tools, portable and stationary compressors of low to medium duty, electrical motors and pumps. The ultimate production on the basis of which the unit was designed, is as follows:

	pcs/year	tons/year
Machine tools	2,250	2,419.3
Forming machines	350	902.9
Compressors	1,000	129.25
Pumps	10,000	2,142.32
Electric motors	50,000	1,372.5
Diesel engines	4,300	1,491.76

2.4 Cyrus Arzonanl Works are engaged mainly in the manufacture of steel structures, storage tanks and other plate work with a small proportion of tube work. Their existing capacity has been estimated at around 24,000 tonnes per year in terms of straight and simple steel structures. Their capability includes manufacture of dished ends upto 12 mm thickness and 4 m diameter. Additionally, plate work upto 25 mm thick and 3 m long can be produced. The facility has facilities for x-ray testing of weldments and for tube bending for incorporation in heat exchangers.

2.5 The Arak Machine Building Plant has, on the basis of a detailed diversification study made recently, evolved a manufacturing programme for attainment by 1974-75. The programme

envisages manufacture of a total of around 32,000 tonnes annually of which around 12,000 tonnes fall directly in the category of equipment required for the plants covered in the Study. The break-down is as follows:

Category of Equipment	Qty. per year
Pressure vessels	5,000
Heat exchangers	1,000
Storage tanks, Bins and low pressure fabrications	2000 including 700 tonnes for aluminium and stainless steel fabrications.
Material handling equipment	1.725
Crushers and feeders	300
Technological structures	1,200

2.6 The Metallurgical and Engineering Plant at Tabriz is currently still preparing for immediate production on the basis of the original Detailed Project Report though not at the full rated volumes recommended therein. Programmes of manufacture tentatively established for 1972-73 is as follows:

Machine tools	2,160	Nos.
Centrifugal pumps	7,159	"
Electric motors (Asynchronous 3-Phase)	29,150	"

2.6.1 However, it must be mentioned that arrangements have already been finalised for transferring the manufacture of pumps to a new unit to be set up with German collaboration. Pumps to be manufactured in the new Pump Division, will serve the needs of water duty pumps of the country in both centrifugal and submersible categories. The range, as at present envisaged, does not, however, include circulating pumps for heating systems, sewage and waste water pumps, chemical and specialised pumps for the process industry. Range of the pumps proposed to be manufactured include for 1500 cu.m. per hour and 100 m. head for centrifugal pumps, water duty and 60 cu.m. per hour for submersible pumps.

2.6.2 Additionally, it is understood that the Plant would take up for manufacture in the parent unit, new items in volumes as indicated below :

Precision forgings	1800 tonnes/year
Fork lift trucks	200 Nos.
Tool and die centres	100 x 10^6 Rials
Grinders	120 Nos.
Hydraulic units	92 x 10^6 Rials
Turret Lathes	200 Nos.
Special valves	42 x 10^6 Rials
Single Spindle Autos &	100 Nos./year

Precision connectors	30×10^6 Rials
Injection Moulding M/C	30 Nos.

2.7 As has been stated earlier, a number of small manufacturing facilities exist in and around Tehran as well as in Ahwaz. Their total present capacity is estimated at around 20,000 tons per year. These firms have produced in the past a variety of light and medium fabricated works including crane bridges, concrete mixers, portable conveyors and elevators, trailers and dumpers, storage tanks and bins, as well as items of pressure vessels on job orders. While equipment in many cases is not very sophisticated and skills evidenced not of an extremely high order, nevertheless, the group mentioned is capable of undertaking simpler items in the fabricated category, such as the following:

(a) Storage tanks, bins and low pressure fabrication;

(b) Concrete mixers in the lower & simpler ranges;

(c) Portable conveyors & elevators for light duty & taking advantage of buy-out possibility preferably from the larger units, trailers, dumpers etc.

It must be pointed out, however, that some of the units have shown a remarkable ability for producing fairly complicated heavy equipment though only against occasional job orders, and show potential for expansion to take up larger volumes of the simpler categories of equipment mentioned.

3. SUGGESTED EXPANSIONS AND NEW UNITS

3.1 In the previous sections of the Report, the requirements of plant and equipment for meeting the needs of forecast local production for the various commodities under study as well as existing capability in the country for manufacturing such equipment have been discussed. As has been stated therein, certain categories of equipment are not considered feasible for local manufacture on account of peculiar attendant circumstances. The requirements of other categories of equipment and existing capability for meeting for the same are summarised below:

Category of Equipment	Average Annual Requirements (Tons) 1977-82	1982-87	Existing Capacity (Tons per year)
Pressure vessels	6500	6500	5000
Storage tanks, etc.	13,000	13,500	4000/5000
Heat Exchangers	2700	2700	1000
Furnaces and Kilns	3200	3350	Nil
Material Handling Equipment	1720	2240	1725
Ballmills and Batchers	1350	1600	Nil
Crushers & Feeders	1000	1350	Nil
Filters etc.	400	600	Nil

Screens, Cyclones etc.	340	430	Nil
Other mechanical Equipment	1650	2400	Nil
Rubber & Plastic Equipment	316 Nos	446 Nos.	Nil
Earth moving Equipment	1630 Nos	1630* Nos.	4500
Technological Structures	3650	4300*	1200
Other Construction Equipment	9500	9500*	4000

*Assumed at previous levels in absence of projections for the period.

The estimates of existing capacity given above take into account envisaged production programme of Arak Machine Building Plant (AMBP) for implementation by 1974-75. Furthermore, out of approximately 20,000 tonnes per annum estimated existing capacity in the small sized fabricating workshops, around 5000 has been assumed to be available for manufacture of storage tanks and similar items. It must be stressed that by their very nature, general engineering fabricators can manufacture a wide variety of fabricated products and hence the above allocation should not be taken as meaning that no capability whatsoever exists for manufacture of the items against which no existing capacity has been shown. The purpose of the above allocation of existing capacity is to distribute the same into the most desirable groups for the purposes of identifying gaps in capacity to be bridged.

3.2 In determining the most rational manner for bridging the gaps, it is essential to take

cognisance of a few vital factors. Some of the major factors which have influenced the recommendations contained in this report are discussed below :

3.2.1 Large facilities such as Arak Machine Building Plant are by nature capital intensive and their best utilisation lies in the manufacture of high technology items. At the same time, they are more likely to be uncompetitive in the lower technology categories such as storage tanks, simple conveyors and elevators, normal varieties of cranes etc. where the smaller fabricator is likely to be able to offer better prices.

3.2.2 The A.M.B.P. has all the basic facilities required for making a large variety of plant and equipment that will be needed. Their total output capability which is in the range of 30,000 to 40,000 tonnes per annum, would however be required to be expanded considerably if the gaps are to be bridged. It is considered that the A.M.B.P. is already perhaps at a level slightly beyond the managerial optimum plant size in the current context of Iran. Hence substantial expansions to the A.M.B.P. programme have not been recommended even though

there would be pockets of under-utilisation in plant and equipment at their envisaged level of output. The attempt has been to utilise such surplus capacities in the best possible manner by addition of balancing equipment, taking care to see that the plant size is not thereby greatly enhanced.

3.2.3 Since product design and production documentation for the items to be manufactured would have to be imported and cadres of technical personnel trained, it is felt that duplication of manufacture for the same item must be avoided as far as possible. It may be argued that such a policy would tend to create monopoly suppliers in the country and may not be conducive to healthy competition which makes for efficiency. Even so, at the present stage, it is felt that the better alternative is to avoid duplication of manufacture for similar items.

3.2.4 The programme envisaged by A.M.B.P. authorities is a highly diversified one and it is felt that in the allocation of items for manufacture as between the existing facilities and new units, the attempt should be to reduce the variety of products in A.M.B.P. programme.

3.2.5 Some of the items of plant and equipment required are basically custom-made and hence demand supporting design and drawing office facilities. The A.M.B.P. is already developing such a nucleus capability and hence the attempt has been to allocate to it such items as warrant design and drawing office support. This is particularly significant because the development of design capability is time-consuming and considering the availability of superior levels of technical personnel in the country, proliferation of design capability may not be immediately feasible.

3.2.6 Customer preference in many industries is to have equipment supplies on as turn-key basis as possible. Therefore, it is recommended that the production programmes of the different units should be so designed as to offer the largest number of items that enter into a single plant, though, some integration with other manufacturers would be inevitable if the factors earlier mentioned are also taken into account.

3.3 A.M.B.P. Programme

3.3.1 In the light of the above considerations, it is felt that the A.M.B.P. Programme should be modified so that it can meet the country's

needs of pressure vessels and heat exchangers for oil and Petro-chemical. Additionally, the A.M.B.P.'s programme for manufacture of a variety of earth moving equipment should be revised so that they concentrate on one or two types only. Since their present capability, if substantial expansions are to be avoided, cannot meet the needs of a large variety of equipment required for Cement mills, it would be desirable to integrate the requirements of equipment for Cement mills for production in a new unit. On account of similarity of processes and equipment requirements, such a new unit can also take up manufacture of equipment for other industries, particularly sugar, refractories, glass etc.

3.3.2. The programmed production of pressure vessels of 5000 tonnes in A.M.B.P. is some what short of forecast requirements which are placed at 6500 tonnes. However, in case of heat exchangers for Oil Chemical Industries, their envisaged programme is only 1000 tonnes per annum against forecast requirement of 2700 tonnes. The gap can be made up by addition of a few items of balancing equipment in A.M.B.P.

3.3.3 The envisaged production of 4500 tonnes of earth moving equipment will be fully utilised by the anticipated needs for excavators, which item has been set down by A.M.B.P. in their production programme. Hence it would be desirable for A.M.B.P. not to enter into the manufacture of dozers, scrapers, graders etc. The requirements of additional excavators likely to be generated in the subsequent period can be met by off-loading from the A.M.B.P. programme, parts and components for the agricultural equipment, material handling equipment and lighter components for the residual programme to small sattelite industries.

3.3.4 It may be mentioned that even in the present envisaged programme of A.M.B.P., agricultural machinery has been exoluded in view of the indications that the same will be made in a new specialised unit perhaps in participation with foreign interests. The present intention of A.M.B.P. is to supply forgings, castings and fabricated parts to such new unit. By the time the expanded demand for excavators will materialise, it is conceivable that the new unit for agricultural implements will either set up its own in-house facilities for the above items or draw its requirements of castings

and forgings from the Central Foundry and Forge Shop under consideration of the Government.

3.3.5 Conveyors and Bucket Elevators which forms part of the envisaged programme of A.M.B.P. do not, in any case, represent the category of products which best utilise the heavy manufacturing capabilities in the Plant and can easily be off-loaded to smaller fabricators who would be able to offer more competitive prices.

3.3.6 With such a large nucleus unit as A.M.B.P., satellite development must be encouraged by A.M.B.P. themselves and lighter and less sophisticated components transferred to such satellite units if A.M.B.P. is to widen its margins of profit. Such satellite development can however only be successful if A.M.B.P. undertakes the satellite units with material procurement, technical know-how, inspection and testing facilities and assures the small scale units of long term viable loads.

3.3.7 The present programme of A.M.B.P. for Crushers and Feeders can fully cater to the requirements of stone-crushing units for construction and road making. As the demand grows in the subsequent period, marginal additions to A.M.B.P. capability will be needed to the tune of 200 tonnes of annual output.

Out of the total requirements of concrete mixers, estimated at around 800 tonnes by weight in 1972-77, A.M.B.P. has already programmes for making 300 tonnes per annum. As has been discussed earlier, small sized concrete mixers are already being made by the smaller fabricators in and around Tehran, who cater at present approximately to 50% of the local market. Expansions of these small fabricators must be encouraged particularly for items involving relatively less sophisticated technology. The gap can, therefore, be expected to be bridged by such small fabricators. In the subsequent period, requirements of concrete mixers are expected to double so that A.M.B.P.'s share would have to be increased by 300 tonnes per annum, This can be done by very little marginal equipment.

A.M.B.P. is also already programmed to manufacture approximately 100 rollers of the vibratory class. Forecast requirements are much larger, being placed at around 547 units for all types of rollers. It is suggested that A.M.B.P. should take up a larger share of the demand, particularly in the specialised categories leaving the simple machines for smaller fabricators, buying out quality castings etc. from A.M.B.P. or

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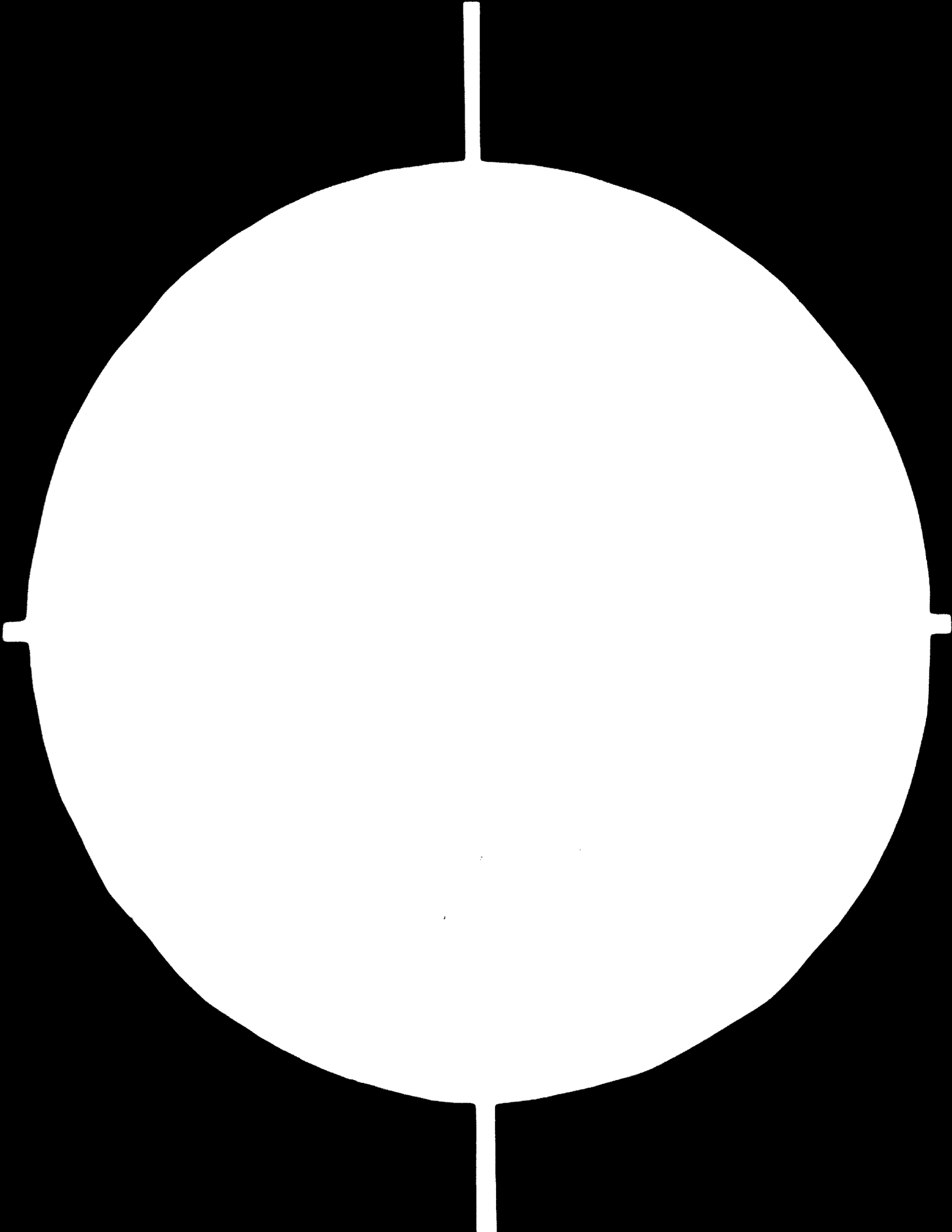

similar units. A.M.B.P.'s share has therefore, been placed at 2000 tons per year in Stage I and 5000 tons per year in Stage II.

3.3.8 The re-adjusted production programme of A.M.B.P. would thus be as follows:

	Stage I	Stage II
Pressure vessels	6500	6500
Heat Exchangers	2700	2700
Conveyors and Elevators	1725	Nil
Mine Cars	1000	1000
Gear assemblies	850	850
Boilers	2500	2500
Earth moving Equipment	4500	8500
Rollers	2000	5000
Crushers etc.	300	500
Concrete mixers	300	600
Asphalt laying plants	250	250
Aluminium and Strainless Steel fabrications	700	700
Tower Cranes	800	1600
Parts for agricultural machinery	2500	Nil
Structurals	4000	1200
Castings and Forgings for sale	5000	4000
Total	35,625	35,900

3.4 The readjusted programme would overload certain items of plant and equipment installed in A.M.B.P. The requirements of balancing equipment to meet the recommended programme and approximate additional investment is given below:

Item	Brief Specification	Qty.	Total Estimated Cost(US$)
Dished End Turning Machine	32 x 4000 mm	1	75,000
Press Brake	500 tons, 4000 mm	1	400,000
Stress Relieving Furnace	6 x 4.8 x 6 m, (L x B x H)	1	850,000
Gear Shaper	2400 - 3000 mm	1	150,000
Argon Arc Welding Sets.	-	10	30,000
Testing facilities for X-Ray for welding	-	1	100,000
Plate Bending Roll	65 x 4000 mm	1	400,000
Vertical Boring Mill	ϕ 2600 mm	1	75,000
Horisontal Boring & Milling Machine	ϕ 63 mm	1	20,000
Slotting Machine	500 mm	1	12,500
Tube Coiling attach	-	1	8,000
		Total:	21,90,500

3.5 After a thorough review of the existing layout of plant and equipment and the logical placement of the additional items now suggested, it is felt that no new areas will need to be added. Suggested placement of balancing equipment is given below :

Equipment	Location (Shop/Section)
Dished End Turning Machine.	Structural Shop - Dish End Section.
Press Brake	Structural Shop - Plate Metal Section.
Plate Bending Roll	Structural Shop
Tube Coiling attach	Structural Shop
X-Ray Equipment	Structural Shop - X-Ray Section.
Argon Arc Sets	Structural Shop - Sheet Metal Section/Plate Metal Section.
Stress Relieving Furnace	Annexe to Structural Shop
Gear Shaper	Machine Assembly Shop
Gear Hobbing Machine	Machine Assembly Shop
Horizontal Boring & Milling Machine	Machine Assembly Shop
Slotting Machine	Machine Assembly Shop
Vertical Boring Machine	Machine Assembly Shop.

3.6 M.E.P.C. Tabriz

3.6.1 Of the requirements of plastic and rubber machinery, it is felt that Plastic Injection Moulding machines

which demand high levels of skill and accuracy in machining, should be taken up by the Metallurgical and Engineering Plant at Tabris (MEP). Production of these machines has similarity with the production of machine tools which represents a major portion of the product mix of M.E.P. No additional equipment will be required for this purpose and only necessary collaborative arrangements for procurement of design and production documentation as well as dies, tools and fixtures will be needed.

3.6.2 It is understood that a new unit is to be set up at Tabris as an adjunct to the M.E.P. The new unit is still in the planning stage and tentative production programme is reported as follows :

	1975	1980	1985
Centrifugal Pumps, max. range 1500 cu.m./hr. 100 m head.	6180	7080	7980
Submersible Pumps, upto 60 cu.m./hr. capacity.	660	760	860
Motors for submersible Pumps.	706	1011	1141

3.6.3 Considering the expanding demands for pumps by the Oil and Chemical Industry, it would appear desirable to include for manufacture of process pumps in the above unit. The total requirements

of process pumps within the range of 100 cu.m. per hour and 500 m. head are estimated very broadly at 160 tons per annum during the period 1977 - 1987. Basic requirements of production equipment for manufacture of these pumps is similar to that involved in water duty pumps except such additional facilities required for castings in the range of alloys that are called for by process duty. Normal materials of construction are Ductile Iron, Chrome.-Nickel and Chrome - molybednum steel, cast bronze and Siemens Martin steel. It is recommended that possibilities should be investigated of incorporating this range of pumps in the production programme of the new unit while evolving the layout and equipment specifications.

3.7 New Units

3.7.1 The balance of the requirements of plant and equipment are proposed to be met by creation of new facilities. Such facilities are proposed as follows :

Unit I : Plant for manufacture of rubber and plastic processing equipment;

Unit II : Plant for manufacture of cement, sugar and allied equipments;

Unit III : Plant for manufacture of construction machinery.

3.8 Some items of equipment required for processing of rubber and plastics do not form viable loads for local production. These are :

(a) Stock preparation machines of which a maximum of 2 numbers are required per annum;

(b) Banbury mixers, the requirements for which are placed at 6 numbers in 1982 - 1987;

(c) Rubber extruders forecast demand of which is only 2 per annum;

(d) Three Roll Calenders;

(e) Moulding machines requirements for which are only 2 in the period 1982 - 1987.

The exclusion of these items yields the following production programme for the new unit postulated :

Product	Nos. per year	
	Stage I	Stage II
Extruders	50	70
Film Extruder	15	25
Blow Moulding Machines	25	35
Profile Calenders	75	100
Thermosetting Plastic Presses	50	70
Tyre Curing Presses	25	30
Tyre Building Machine	15	20
Total:	255	350

3.9 Since the requirements of stone crushers, concrete mixers, excavators and rollers are proposed to be met by addition to the A.M.B.P. programme and by

additional contribution from expanding small scale fabricators, the following items in the quantities indicated are proposed to be manufactured in the Construction Machinery unit :

Product	Nos. per year Stage I	Stage II
Dozers	200	400
Graders	200	400
Scrapers	20	25
Shovel Loaders	250	450
Total:	670	1275

3.10 The proposal for the cement, sugar and allied machinery unit, incorporates all requirements for such industries except for items of specialised design required in low volumes. The following is the production programme recommended for this unit:

	Tons per year Stage I	Stage II
Furnaces and Kilns	3250	3350
Conveyors	400	2250
Ball Mills	1300	1750
Crushers	1000	1750
Filters	400	600
Screens	150	200
Storage Tanks and Bins and Low pressure fabrications	1950	2500
Heat Exchangers	250	275
Mechanical Equipment	800	1200
Technological Structures	500	625
Total :	10,000	14,500

3.11. The Supply - Demand balance for the capital goods requirements, as discussed above is presented in Table on next page. As can be seen therefrom, the gap not specifically bridged by identified units in this study refers to the category of storage tanks and associated technological structures. Much of these requirements pertain to storage of refinery and petrochemical products, a very substantial portion of which is on-site work. Centralised facilities for manufacture of this item is therefore not desirable, particularly as refinery locations may be dispersed to meet regional demand. Hence this gap is best bridged by dispersed small scale capacity who would perhaps integrate also associated piping work in such facilities.

Supply Demand Balance for Capital Goods und

Sr. No.	Category of Equipment	Unit	Yearly Requirements (Period)			Annual pro A.M.B.P.	
			1972-77	1977-82	1982-87	1977	1982
1	2	3	4	5	6	7	8
1.	Pressure Vessels.	Tons	9000	6500	6500	6500	6500
2.	Storage tanks, Bins, Low Pressure Vessels.	"	12350	13000	13500	700	700
3.	Heat Exchangers.	"	3400	2700	2700	2700	2700
4.	Furnaces and Kilns.	"	300	3200	3350	-	-
5.	Conveyors (Belt, Apron and Screw)	"	300	1700	2200	*1725	Nil
6.	Bucket Elevators.	"	10	20	40		
7.	Ball Mills and Batchers.	"	40	1350	1600	-	-
8.	Crushers and Feeders.	"	150	1000	1350	-	-
9.	Filters, Drum and Plate.	"	50	400	600	-	-
10.	Pumps and Compressors.	"	400	570	600	-	-
11.	Screens, Cyclones, Ventilators.	"	60	340	430	-	-
12.	Mechanical Equipment.	"	670	1650	2400	-	-
13.	Technological Structures.	"	900	3650	4300	1200	1200
14.	Miscellaneous.	"	1000	2000	2500	-	-
15.	Extruders.	Nos.	27	84	113	-	-
16.	Film Extruders.	"	10	17	30	-	-
17.	Blow Moulding Machines.	"	12	32	36	-	-

For items 4, 7, 8, 9 and 11 actual demand on manufacturing plants duri[illegible] 1972-77 will include part of stated demand for [illegible] because of lead times in erection and commissioning.

* Mecha[illegible] progr[illegible] than

SECTION 1

Balance for Capital Goods under Study

rements (t)		Annual production of A.M.B.P.		Proposed Units			Balance	
-82	1982-87	1977	1982	Unit no.	1977	1982	1977	1982
	6	7	8	9	10	11	12	13
	6500	6500	6500	-	-	-	1500	Nil
	13500	700	700	II	1950	2500	9700	9800
	2700	2700	2700	II	250	275	450	Nil
	3350	-	-	II	3250	3350	Nil	Nil
	2200	*1725	Nil	II	400	2450	Nil	Nil
	40			-	-	-		
	1600	-	-	II	1300	1750	Nil	Nil
	1350	-	-	II	1000	1750	Nil	Nil
	600	-	-	II	400	600	Nil	Nil
	600	-	-	-	-	-	400	570
	430	-	-	II	150	200	Nil	140
	2400	-	-	II	800	1200	Nil	450
	4300	1200	1200	II	500	625	Nil	1825
	2500	-	-	-	-	-	1000	2000
	113	-	-	I	50	70	Nil	Nil
	30	-	-	I	15	25	Nil	Nil
	36	-	-	I	25	35	Nil	Nil

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of lead

* Mechanical handling equipment in A.M.B.P. programme can be taken to be for uses other than in Sectors under Study.

1	2	3	4	5	6	7	8
18.	Profile/Extruder Calenders.	Nos.	40	56	75	-	-
19.	Thermosetting Plastic Presses.	"	27	62	80	-	-
20.	Injection Moulding Machines.	"	8	13	23	-	-
21.	Tyre Curing Presses.	"	19	22	36	-	-
22.	Tyre Building Machines.	"	10	13	22	-	-
23.	Stock Preparation Machines.	"	5	6	10	-	-
24.	Banbury Mixers.	"	2	3	6	-	-
25.	Rubber Extruder.	"	1	4	10	-	-
26.	3-Roll Calenders.	"	2	2	3	-	-
27.	Moulding Machines.	"	1 (in 5 yrs.)	3 (in 5 yrs.)	2	-	-
28.	Dozers.	"	236	472	-	-	-
29.	Graders.	"	231	470	-	-	-
30.	Scrapers.	"	19	25	-	-	-
31.	Shovels/Loaders.	"	224	471	-	-	-
32.	Excavators.	"	113	192	-	100 (4500)	190 (8500
33.	Rollers.	"	547	1210	-	400 (2000)	1000(5000
34.	Concrete Mixers.	"	395	713	-	150 (300)	300 (600)
35.	Vibrators.	"	585	1050	-	-	-
36.	Crushers.	"	[illegible]	78	-	50 (300)	83 (500)
37.	Tower Cranes.	"	41	84	-	41 (800)	84 (1600)

Note: Figures in brackets denote tons.

6	7	8	9	10	11	12	13
75	-	-	I	75	100	Nil	Nil
80	-	-	I	50	70	Nil	Nil
23	-	-	-	-	-	Full requirement met by MEP.	
36	-	-	I	25	30	Nil	Nil
22	-	-	I	15	20	Nil	Nil
10	-	-	-	-	-	5	6
6	-	-	-	-	-	2	3
10	-	-	-	-	-	1	4
3	-	-	-	-	-	2	2
2	-	-	-	-	-	1 (in 5 Yrs.)	3 (in 5 Yrs.)
-	-	-	III	200	400	Negligible	Negligible
-	-	-	III	200	400	Negligible	Negligible
-	-	-	III	80	25	Nil	Nil
-	-	-	III	250	450	Nil	Nil
-	100 (4500)	190 (8500)	-	-	-	Nil	Nil
-	400 (2000)	1000(5000)	-	-	-	147	210
-	150 (300)	300 (600)	-	-	-	245	413
-	-	-	-	-	-	585	1050
-	50 (300)	83 (500)	-	-	-	Nil	Nil
-	41 (800)	84 (1600)	-	-	-	Nil	Nil

brackets denote tons.

4. REQUIREMENTS OF TECHNICAL INFRASTRUCTURE AND INSTITUTIONAL ARRANGEMENTS

4.1 The previous sections have discussed the requirements of manufactured equipment grouped by commonalty of manufacturing processes, existing manufacturing capability and the gaps to be bridged by creation of additional capacity in the country. In suggesting such additional capacity as has been discussed earlier the volumes of requirements as well as skills and technologies involved in their manufacture have been taken into account.

4.2 Items of plant and equipment which belong to the very highly specialised category such as Ammonia, Urea and Carbon Dioxide compressors or specialized pumps have not been recommended for local production since, apart from the levels of technology involved in their manufacture, considerable ancillary development for supplying parts and components warranted before local manufacturing capability can be reasonably expected for such complicated items. There are other items which are simpler in manufacture, but belong to the category of specialised products often marketed by few agencies around

the world such as some specialised equipment for shoe making industry, automatic equipment for sheet glass, glass bottles and shells etc. etc. Such highly automated equipment calls for incorporation of significant quanta of components normally obtained from specialist component manufacturers. Fortunately forecast requirements for many of such items of plant are not also large enough to justify consideration of local manufacture.

4.3 The bulk of the plant requirements fall in the nature of items which can be manufactured by general engineering facilities incorporating process capabilities for heavy plate fabrication, matching and assembly, very similar to the capabilities already created at Arak Machine Building Plant. A nucleus of technical skills required for such processes is already available and with accelerated training schemes already set in motion, the requisite fund of artisans and shop floor personnel may be expected to be available. Volumes of requirements for the items that can be manufactured in such general engineering facilities are also considerable and offer reasonable sized plants

to ensure viable operations.

Apart from the above, requirements of Construction Equipment can ensure a steady load for a reasonable sized facility and technical skills as are demanded for such operations would be generally available in view of the tractor and agricultural machinery industry already established in the country.

4.4. While the above can ensure that necessary wherewithal for the actual manufacturing operations can be expected to materialise, it must be stressed that profitable plant operations depend, to a large extent, upon a number of other factors calling for institution and development of the necessary technical infra-structure - apart from the normal physical infra-structural requirements such as power, water, transportation etc. - to support such facilities. Such infra-structural and institutional arrangements refer to arrangements for ensuring that a steady load is guaranteed to the units through a measure of protection and that adequate design facilities are built up and a measure of standardization is enforced. The subsequent paragraphs discuss the major technical problems that must be

resolved if manufacturing facilities created are to be fully utilised to meet the needs of the country. There is, no doubt, that apart from the aspects of 'technical infrastructure' discussed herein, other aspects such as availability of credit facilities would need to be attended to.

4.5 Product Designs

It is vital that the products selected for manufacture are the ones which have evidenced adequate consumer acceptance. Such a course will relieve the plants in their initial years of a major burden of creating markets and the aggressive selling that is inescapable when new products are to be introduced. At the same time, many of the industries under study have, in the past, been accustomed to designs emanating from selected countries mostly of the Western world. This factor needs to be kept in view when selecting products for manufacture so that the best designs easily acceptable to the industries concerned are chosen. In some cases, like for the Oil or Petrochemical industry, it is inescapable that some part of the total equipment requirements would still have to be

imported and any equipment produced by local manufacturing facilities must necessarily conform to designs, standards, practices and usage adopted by the turn-key consultant/equipment supplier. It is therefore essential that a proper review of probable processes that will be adopted be made, sources of turn-key responsibility wherever applicable is identified and product designs be inducted from countries or agencies which can fit into such a situation. This is particularly significant in the case of fabricated equipment for the Oil and Petrochemical industry since equipment in these cases are custom made and must necessarily conform to the processes that are adopted, unlike in the case of machine tools where a much wider choice is often available.

4.6 Market Research

General engineering facilities, by their very nature, incorporate considerable flexibility for varying their product-mix since they are, in a sense an agglomeration of different process capabilities which can be deployed for manufacture of a wide range of products.

It is also usual for requirements of the different types of products to fluctuate somewhat so that an absolutely steady load in terms of specific products might not always obtain. Such a situation calls for constant market forecasting to appraise plant managements of trends of demand and future potential. Specifically, the Market Research Agency would identify future potential customers, likely quantity requirements, trends relating to changes in designs and capacities of custom built equipment etc. so as to provide adequate lead time to plant managements for re-organising production and concurrent design to respond adequately to needs. Unless this is done, it is often seen that, inspite of local manufacturing capability existing, delivery schedules stipulated by customers cannot be met and imports would have to be countenanced. Advance planning for design and fabrication drawings, material procurement and production scheduling is vital for general engineering facilities.

Market Research and Forecasting has become specialised activity involving use of specialised techniques so much so that even large and

and established organisations are employing specialised agencies for this purpose. In view of this and considering that new plants have to contend with a number of problems of day to day working in the initial stages of their operations, it is recommended that a Central Market Forecasting Agency be set up to carry out this work on a continuing basis and feed the results of thier studies to plant managements.

4.7 Collaboration

The choice of product design almost automatically guides the choice of the collaborator. Customer preference is an amalgam of a number of diverse factors and even where two products are identical, a particular brand name to which the customer has been accustomed is invariably preferred. This is not to suggest that alternatives should not be examined in the light of terms and conditions available from alternative collaboration sources. The point that has to be borne in mind is that, even at the expense of marginal advantages, a collaborator whose product is already familiar and accepted in the country is to be preferred.

A number of alternative forms of collaboration

is possible depending upon the circumstances. One method which is most likely to be successful is the joint venture manufacturing project with leading international manufacturers with acceptable brand names for setting up facilities in Iran. If such manufacturers already have a substantial share of the local market, it is also conceiveable that they might be more anxious to enter into joint venture arrangements.

Both lumpsum payments and annual royalties as also varying admixtures of the two are possible. Generally speaking, the preferred arrangement would be for inducting product design and production technology through license fees or royalty payments rather than outright purchase on lumpsum payments. Such a procedure would not only relieve the new plants of a considerable financial burden in their capital outlays but would also ensure the collaborator participating more actively in the plant's operations and is more conducive to latest designs and technology being available to the local manufacturing facilities.

4.8 Design

Many of the items of plant and equipment required by the process industry are custom made for the particular process. At the same time, process development in this group is very rapid so that plant and equipment designs are quickly rendered obsolescent. In the Oil and chemical industry, it is usual for process designers to supply skeleton drawings for pressure vessels leaving it to the fabricator to develop detailed mechanical designing and shop fabrication drawings; for heat exchangers, engineering data and skeleton drawings are sometimes furnished by the process engineer though in many instances, only heat transfer capacities are stipulated so that it becomes essential for the equipment manufacturer to develop the detailed designs and fabrication drawings; for specialised furnaces, in fact, design know-how owners throughout the world are few and oftentimes it becomes necessary for fabrication to be carried out from drawings purchased on a case by case basis.

The above implies that design and drawing office capability must be available to

the local manufacturer either through his own inhouse capability or through local consultants. In the beginning, it may perhaps be inescapable to obtain engineering data and skeleton drawings from foreign sources, usually the process designers. However, consultant engineering organisations in the country - such as Technolog - should be encouraged to enter into collaboration arrangements to develop capability for design of pressure vesseles, heat exchangers, cement kilns etc. so as to offer the necessary support to local manufacturing organisations. It is not considered desirable for manufacturing organisations to get involved in such detailed design work which calls for research and development and concurrently for a knowledge of process engineering. Such a procedure has been tried with excellent results in other developing countries and it is felt that Iran would also profit by adopting a similar pattern.

4.9 **Standards**

Local equipment, if it has to be acceptable, must necessarily conform to strict design and inspection standards. National standards for Iran are being developed but, as yet, there

are many areas where they are still to be evolved. Till such time as national standards on a comprehensive basis are evolved and can be enforced, there is no escape for local manufacturing facilities adopting other countries' standards - often the standards desired by the customer. Obviously, with customers who have been accustomed on account of prior equipment usage to a variety of standards - generally as applicable in the countries of origin of previous equipment purchased - this will involve additional strain on manufacturing facilities in the country as also of such consultant organisations who may be encouraged to develop for providing design support to the manufacturing facilities. With the increase in local manufacturing activity that is being suggested, the urgency of developing national standards is greatly enhanced so that a uniform design code is available for the manufacturing facilities to follow in all cases. Needless to say, the effort involved in developing inspectors on the shop floor will be greatly reduced if the variety of standards to be conformed to is decreased. It is therefore recommended that an action programme be drawn up stipulating the standards that needs to be evolved on a priority basis so that the Iranian Standards Institute can come up with the requisite standards in the next 4-5 years. If such an action

programme is evolved and implemented, the new plants would have a set of national standards to go by when their operations commence.

4.10 Standardization of Plant Sizes

Quite apart from the question of standards is the other question of standardization of plant sizes. This would apply particularly to industries like cement, glass, refractories, vegetable oil, sugar and similar units where, throughout the world, there are already more or less standard plant sizes evolved from availability of series-produced equipment along the line. If one or two standard sizes in each of the industries is enforced, it would be possible for the plant manufacturing such equipment to procure designs from acceptable and internationally reputed sources for use on all the plants expected to be set up in the coming years, unless significant modifications are introduced by the original design suppliers. Such standardization would facilitate the distribution of the cost of product design and production documentation can be distributed over a number of customers, a factor which will make for reduced costs. It may be stressed that if product design and production documentation has

to be purchased in each individual case, there does not seem to be any hope of local equipment being anywhere near being competitive with imported equipment. While it may be argued that a particular plant size not coincidental with the standard size would lead to economies in operation, the question needs to be viewed against a totality of factors. If capacity for local manufacture is to be created, circumstances must be generated for such capacity to operate profitably. There will no doubt be some exceptions on account of special circumstances obtaining in particular cases.

As local design and development capability increases and export markets for manufactured products grow, the need for importing product design and production documentation will dwindle and the restrictions of specified standard sizes will automatically disappear.

It is, therefore, suggested that an authority be identified to review the situation for each industry and recommend suitable standard plant sizes for enforcement. Such an authority can be a committee comprising user industries and technical officers of government and necessary

technical studies may be carried out by Consultants or industry experts obtained through UN offices. Early action in this regard is suggested so that identification of standard plant sizes can be completed in time for new plants obtaining necessary production documentation and arranging for training etc. before commencement of operations.

4.11 Testing and Certification

A significant portion of the equipment suggested for local manufacture is for use under severe conditions of stress and hazardous environment e.g. equipment for use in Oil and Chemical industry. It is, therefore, most essential that local plant manufacturers supply equipment to strict standards, in terms of quality of material, design and workmanship. This can best be ensured by instituting a National Inspecting and Testing Authority backed by adequate testing facilities and trained personnel to certify all equipment for use. Such certification should be enforeced by statute where safety to life and property is involved. The creation of such an authority with statutory backing will, it is believed, go a long way in ensuring

quality and minimising hazards due to faulty workmanship or design.

4.12 Statutory Codes

In addition to currently existing factory laws and rules which are directed at such aspects as hours of work, working conditions in factories etc., it is recommended that a set of rules should be evolved early dealing with safety of equipment. Such rules would prescribe minimum standards for design, fabrication, testing and erection and would be enforced by statute. These rules are to be distinguished from design codes to be evolved by Iranian Standards Institute and would be directed at preventing hazards on account of inadequate equipment. Such rules would form the basis for the Testing and Certification authority mentioned earlier.

4.13 Protection

It is well known that heavy engineering facilities call for large investments and involve long gestation periods. Such being the case, it will be necessary for concerned authorities to assist the plants with a measure of protection so as to ensure the production and sale of items

manufactured. Till such time as the complete matrix of industrial infrastructure is developed including local availability of parts, components and raw material as well as design and development, prices of local products may tend to be somewhat higher than the prices of imported products. At the same time, it is also not unusual for exporting countries to subsidise exports in some form or the other so that export prices are lower than local prices even in the exporting country. Simultaneously, there are cases of exporting countries dumping products at untenably low prices for the purposes of capturing new markets. It is, therefore, not always as simple as it seems to say that because prices at which imported products are much lower than those of local manufactured goods, that local manufacture is inefficient.

It becomes, therefore, necessary during the initial years to afford protection to local industry though this may not always be co-incidental with general economic policies. The problems has often to be viewed in the

context of establishing an industrial base in the country and reducing dependence on imports. It is conceded that the protection would have to be judicious to see that incompetence and inefficiency is not encouraged.

Apart from marginal price protections, it must be ensured that if the local manufacturer is able to deliver the goods in reasonable time andof acceptable quality, the same will be excluded from foreign suppliers even where total project agreement backed by liberal credits are concerned.

4.14 Turn-key Contracts

If local equipment usage has to be maximised, local manufacturers of plant and equipment must be encouraged to quote for execution of complete projects on a turn-key basis. Turn-key project contracts not only afford wider margins to manufacturers but are also conducive to building together an integrated work team and affording job satisfaction to the best technical men.

4.15 Investment Policies

Since the projects in developing countries have often to contend with a variety of problems

which hinder rapid build up of production capability, it is often advantageous to phase investment so that the entire investment is not blocked and left unutilised till full rated production comes into being. A usual pattern to get over this difficulty is to introduce production at an early stage through assembly from CKD components, tapering in higher contents of indigenous components as in-house manufacturing capability develops. In such a case, the investment in plant equipment and buildings is judicially phased out so that only the minimum necessary for production at each stage is put in. It is felt that such a phasing of investment and production would be the most advantegeous for manufacturing facilities suggested in this Study.

5. AUXILIARY AND FEEDER INDUSTRIES

5.1 The demand and supply pattern for process equipment required for the various sectors under study have been discussed in the earlier section. Apart from process equipment, production facilities call for auxiliary equipment for repair and maintenance, utilities and service facilities. Such auxiliary equipment as machine tools, power distribution equipment, in-plant transport equipment, compressed air generation and distribution equipment, water treatment and distribution plant etc. are however common to all forms of industrial activity though to varyj- extent. Equipment for water and power has an even larger area of application extending to civic development and domestic requirements. Hence, planning for such auxiliary equipment must necessarily consider all user areas, of which requirements for industries under study in this Report represent only a portion.

5.2 A broad indication of the likely additional requirements of machine tools for repair and maintenance purposes and demands for major

utilities for the industries under study is given below to provide general level information for integration into any study that may be taken up for such auxiliary items of equipment :

Item	Unit	Average Annual Requirement		
		1972-77	1977-82	1982-87
A. Machine Tools				
Lathes	Nos.	67	100	130
Semi Automatic and Automatic Lathes	"	3	3	3
Bench/Pillar Drills	"	23	38	42
Radial Drills	"	8	10	14
Milling Machines	"	7	9	10
Planers	"	6	10	12
Shapers	"	16	23	30
Threading Machines	"	1	6	8
Grinders (Surface, Cylindrical, Centreless Tool & Cutter etc.)	"	15	16	17
Grinders(Bench/ Padestal)	"	22	27	34
Boring Machines	"	6	7	7

	Sawing Machines	Nos.	14	23	30
	Forging Machines	"	2	9	10
	Presses	"	7	7	7
	Bending Machines (Rolls & Brakes)	"	-	5	6
	Shearing Machines	"	3	9	10
	Total		200	300	370
B.	Power (Max. demand)	MW	280	410	790
C.	Water	'000 M^3 per day	200	400	700
D.	Process steam	T/hr	1800	2400	3000

5.3 While the above provide an indication as to the requirements of auxiliary plant and equipment to be actually installed in the production facilities, requirements of major operating inputs would also call for establishment of manufacturing facilities. Likely requirements from such feeder industries for the sectors under study are given below. These requirements, combined with requirements of other industries outside the scope of this Report, can form viable loads for reasonable sized facilities.

5.3.1 **Pipes**

Total requirements of pipes for the industry branches covered are estimated as follows:

Seamless Pipe under 8" dia.	4,000 Tons/yr.
Seamless Pipe over 8" dia.	2,500 Tons/yr.
E.R.W. Pipes under 8" dia.	2,000 Tons/yr.
E.R.W. Pipes over 8" dia.	2,000 Tons/yr.

5.3.2 **Valves and Fittings**

Likely requirements are as follows:

Forged flanges, heads and reducers	500 Tons/yr.
Valves --	900-1000 Tons/yr

5.3.3 **Castings and Forgings**

The estimated requirements of castings and forgings for the equipment proposed to be produced in the new units is given below:

	1977	1982
Castings:		
Grey Iron	1650	3000
Alloy Igon	50	70
Steel	3250	6500
Non Ferrous	15	25
Forgings	650	1100

5.3.4 Bearings (For the new units proposed)
Annual requirements are estimated at 300 tons per year rising to around 600 tons.

5.3.5 Dies and Moulds
The total annual requirements of Dies and Moulds for Plastic and Rubber Industry would amount to 250 tons in 1977 rising to 500 tons in 1982.

5.3.6 Grinding Media for Cement etc.
Annual requirements of forged steel balls will be of the following order;

1972	3,500 Tonnes
1977	8,400 Tonnes
1982	16,000 Tonnes
1987	25,000 Tonnes

5.3.7 Hydraulics : Hydraulic elements and actuating devices are required as parts/components for a wide range of equipment. For the equipment under the manufacturing programme, the requirements will be of the order by dollar value of $50,000 and 1,870,000 in 1977 and 1982 respectively.

5.4 Brief Project Profiles for reasonable sized Feeder Industry Units in the above category are presented at pages 66 to 69.

5.5 Considering the volumes of instrumentation that will be involved, a plant for Instrument Assembly and Repair would be indicated.

UNIDO

PROJECT PROFILE
for
STEEL BALL GRINDING MEDIA

Capacity: 10000 TPA on 2-shift working

Investment (Million Dollars)

Equipment	-	1.05
Civil Works	-	0.50
Projecting Costs	-	0.25
		1.80

Manpower 220

Utilities:

Power:	-	500 KW(Max. demand)
Water:	-	30 M^3/day

Major Raw Materials:

Alloy Steels

PROJECT PROFILE FOR INDUSTRIAL FASTENERS

Capacity - 3000 tonnes/annum On two shifts basis.

Investment (Million US Dollars)

Equipment	-	1.25
Civil works	-	0.70
Others	-	0.35
Total		2.30

Manpower - 25

Utilities

Power	-	300 KW
Water	-	3 M^3/Day

Major Raw Material

i) Medium Carbon Steel - Wire Rods.

ii) Medium Carbon Alloy Steel -Wire Rods.

iii) Mild Steel - Wire Rods.

PROJECT PROFILE FOR DIES AND MOULDS FOR RUBBER AND PLASTIC INDUSTRY

Capacity : 400 T/annum on partial 2 shift basis.

Investment (US Dollars)

Equipment	:	700,000
Civil Works	:	380,000
Others	:	200,000
Total		1,280,000

Manpower : 125

Utilities :

Power	:	200 KW (Max. Demand)
Water	:	20 M^3/Day

Major Raw Materials :

Hot die steel

Manganese steel

Other alloy steels

Electroplating salts

PROJECT PROFILE
ON
PROCESS CONTROL VALVES

Capacity : 20,000 Nos PA or 1500 TPA of gate, globe, check and diaphragm valves on 2 shift working.

Investment (U.S. Dollars)

Equipment	650,000
Civil works	200,000
Others	100,000
Total	950,000

Manpower : 170

Utilities:

Power:	200 KW(Max. demand)
Water:	20M^3/Day.

Major Raw Materials:

C.I. Castings

Steel Castings

Non Ferrous Castings

MSK Rods

Alloy Steel

Fastuers

Gaskets

6. Sources for Procurement of Product Design and Manufacturing Know-how.

For the products recommended for local manufacture, product designs and manufacturing know-how would require to be imported. Some of the leading designers and manufacturers of such equipment are listed below:-

CEMENT MACHINERY

1. Vickers, U.K.
2. Klockner Humboldts, West Germany.
3. Fullers Co., U.S.A.
4. Traylor Engg. & Mfg. Co. U.S.A.
5. Allis-Chalmas, USA.
6. Gebr.-Hischmann, West Germany.
7. Five Lille Cail, Paris.
8. Krupps, West Germany.
9. Ansaldo, Italy.
10. Miag, West Germany.
11. Ingra, Yugoslavia.
12. Skoda, Czechoslovakia.
13. Polysius Gmbh, West Germany.
14. Kawasaki Dockyard Co. Ltd., Japan.
15. Monally Pittsburg Mfg. Corporation of Pittsburg, Kansas, U.S.A.
16. F.L.Schmidt & Co., Denmark.

17. Clandius Peters, West Germany.
18 Nordberg, London, UK.

REFRACTORY, CERAMIC & BRICK MACHINERY.

1. Abbe Engineering, USA.
2. International Clay Machinery, USA.
3. Chisholm Boyd & White, USA.
4. Gebruder Netzsch Maschinenfabrik ,West Germany.
5. Ceramische Industrie, West Germany.
6. Didier, West Germany.
7. Prumoinvest, Chechoslovakia
8. Nichimen, Japan.
9. Willian Bolton, U.K.
10. Gibbon Bros., U.K.
11. Bradley & Craven, U.K.
12. Nordberg, U.K.

GLASS MAKING MACHINERY

1. Asahi Glass, Japan.
2. Central Glass, Japan.
3. Soga Glass, Japan.
4. Tabakashi, Japan.

5. Paragon Glass, USA.
6. Rodefur Gleeson Glass, USA.
7. Johnson Radley, U.K.
8. House, Maleves & Simon Reunis, Belgium.
9. Hermans, Belgium.
10. Hanres, Belgium.
11. Cnud, Belgium.

SUGAR MILL EQUIPMENT

1. Perrel Co. Division of USM Corporation, USA.
2. A.T.M. Centrifuge Division of De Laval, U.S.A.
3. British Jeffrey Diamond, U.K.
4. Jenkins (Robert) U.K.
5. Skoda, Czechoslovakia.
6. Hitachi, Japan.
7. Mokuriku, Japan.

VEGETABLE OIL EQUIPMENT

1. De Smet
2. Neumanns, U.S.A.
3. Fritz Homann, West Germany.
4. Connemann, West Germany.
5. Andrews Bros., U.K.
6. Fiji Oil, Japan.
7. Ajinomoto, Japan.

DAIRY EQUIPMENT

1. Alfa Laval, Denmark.
2. Paasch & Silkeborg, Denmark.
3. Brodrene Gram, Denmark.
4. A.P.V. Co., U.K.
5. Wright Hargreaves, U.K.
6. U.D. Engineering, U.K.
7. Kustner Freres, Switzerland.
8. Borsig, West Germany.
9. Agric Machinery, U.S.A.

PLASTICS WORKING MACHINERY

1. G.K.N. Windsor, U.K.
2. Bone Cravens, U.K.
3. Barand, U.K.
4. Berry Henry, U.K.
5. Armstrong (Leeds) U.K.
6. Battenfeld, West Germany.
7. Berner, West Germany.
8. Paul Troaster, West Germany.
9. Bekum, West Germany.
10. Anger Plastic-Verbeitungsmachinen, West Germany.
11. Cosmoplastics, Italy.
12. Ikegai Iron Works, Japan.

13. Ormapress, Switzerland.
14. Tos, Czechoslovakia.
15. F.J.Stokes, Corporation, U.S.A.
16. Hydraunatic Air & Hydraulics, Denmark.

RUBBER MACHINERY.

1. Iddon Bros., U.K.
2. Francis Shaw, U.K.
3. Harberger Eisen - Und Brozewerke, West Germany.
4. Maschinenbarges, West Germany.
5. B.F. Goodrich, U.S.A.
6. Kobe Steel, Japan.

CONSTRUCTION MACHINERY.

1. Caterpillar Tractor Co., U.S.A.
2. Allis-Chalmers, U.S.A.
3. Le-Tourneau Westing house Co. of U.S.A.
4. Vickers Armstrong(Tractor) Ltd.,U.K.
5. General Motor Corpn.,Euclid Div.,U.S.A.
6. Komatsu Mfg. Co. Ltd. of Japan.
7. Harnishforger Corpn., U.S.A.

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STUDY FOR DEVELOPMENT OF CERTAIN FOODS INDUSTRIAL PROJECTS IN INDIA

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(4 of 4)

VOLUME 3

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THE NATIONAL INDUSTRIAL DEVELOPMENT CORPORATION LIMITED
NEW DELHI, INDIA

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STUDY FOR DEVELOPMENT OF CAPITAL GOODS INDUSTRIAL PROJECTS IN INDIA

DRAFT FINAL REPORT

VOLUME 3

FEBRUARY 1972

THE NATIONAL INDUSTRIAL DEVELOPMENT CORPORATION LIMITED
NEW DELHI, INDIA.

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
STUDY FOR CAPITAL GOODS INDUSTRIAL PROJECTS IN IRAN

VOLUME III

PRE-FEASIBILITY STUDIES

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1. SUGGESTED PLANTS AND PRODUCTS

1.1. In the previous Volume of the Report, total requirements of plant and equipment to meet forecast levels of production for the various commodities under study have been discussed in detail. The requirements of plant and equipment have been grouped therein taking into account commonality of manufacturing processes and other relevant factors to examine whether viable loads for setting up local manufacturing capability exist. In determining the requirements for establishing new manufacturing capability in the country, full cognizance has been taken of existing capabilities in Iran for manufacturing the types of capital goods required and possibilities of their expansion.

1.2. Arising out of the above analysis, potential for local manufacture is indicated for certain items of plant and equipment for which new manufacturing facilities have been postulated. These are :

Unit - 1	Plant for manufacture of selected items for Plastic and Rubber processing.
Unit - 2	Plant for manufacture of equipment for Cement,

Sugar and Vegetable Oil Industries. Additionally the plant would also make various items of equipment for Brick Making, Refractories, Glass and Tannery industries.

Unit - 3 — Plant for manufacture of various items of Construction Equipment

1.3. The present volume examines the feasibility and viability of the above units and presents an integrated investment and production pattern for items recommended for local manufacture. Additionally support requirements for the production patterns envisaged are also presented with time phasing.

2. NOTES ON PRE-FEASIBILITY STUDIES

2.1. Pre-Feasibility Studies for each of the following projected manufacturing units are presented at Annexure II-1 through II-3.

a) Plastic and Rubber Machinery Unit;

b) Cement, Sugar and allied machinery unit;

c) Construction equipment unit

2.2. The Feasibility Studies presented herein have been carried out in broad general terms and are in the nature of Pre-Feasibility Studies. The purpose of these studies is not to present final conclusions for the purpose of investment decisions for the implementation of the project but merely to examine whether the proposal for local manufacture as postulated for the different units is generally a viable proportion and merits more detailed investigation through detailed feasibility studies/ project reports. Consequently the estimates of capital and operating inputs contained herein must be considered to be general level estimates only and variations therefrom can be expected when more detailed studies are carried out.

Even so, it is felt that such variations will not be significant enough to materially alter the nature of the conclusions with regard the viability of the projects.

2.3. In the subsequent paragraphs, the manner in which the estimates have been developed and the assumptions made are discussed.

2.3.1. Cost of land has been assumed at US $ 2 per square metre, though it is conceded that the same would vary depending upon the location.

2.3.2. Buildings

Estimates of building costs have been derived from area requirements by applying unit rates for various types of constructions collected by the Project Area Team by discussions with various agencies. The requirements of area have been worked out for main production facilities on the basis of equipment layouts; for storage spaces, the areas have been derived from anticipated levels of storage; for office and welfare facilities, estimates of area requirements have been made generally on the basis of NIDC's judgement with similar industries taking into account the estimates of manpower of various categories. Unit rates applied

for building construction including heating, lighting, ventilation are as follows :

Category of Building	Unit Rate US $ per sq.m
Buildings without Cranage	50
Buildings with Cranage upto 5 tons	85
Buildings with Cranage of 5-10 Tons	90
Buildings with Cranage of 10-20 tons	100
Buildings with Cranage of 20-30 tons	110
Covered Storage areas	55
Administration and Welfare Buildings	65
Open Paved Areas	20
Car Parks	10

2.3.3. Site Development Works

The cost of site development works have been presented as a single lump sum estimate though this has been calculated by pricing the various elements of work involved, namely -

Site Grading and levelling

Internal roads and sidings

Paved areas

Faecal Sewerage and drainage

Land Scaping and Fencing

Clearly, some of the items of work such as site grading, drainage and sewerage can vary widely depending upon the actual topography of the site finally selected for the plant. A reasonable level site has been assumed in developing the estimates. A general level computation of the length of internal roads, drainage and sewerage lines and fencing as well as the areas of paved spaces has been made. Based on the rough computations of costs so derived for the layouts proposed for the different plants, a normalised unit cost for site development works has been worked out at US $ 3 per sq.m of fenced area.

2.3.4. Off Site Facilities

No provision has been made for offsite facilities since this can vary so widely that reasonable approximation is not considered possible. In other words, the assumption made in the pre-feasibility studies is that the site is provided with basic infra-structural facilities such as approach roads, power lines, water lines etc. upto the plant boundary. Considering that the new plants would perhaps be set up in one of the poles of development

such as Arak, Tabriz, Ahwaz, Ghazin, etc., the above assumption would appear to be reasonably justified.

2.3.5 Equipment

Equipment prices are based on normalised international prices prevailing. As is well known, prices of equipment can vary a great deal for the same rating depending upon the source of supply and variation in special features of the equipment. Hence an averaged normalised price prevailing in the international market has been assumed for the present Study. Some items of equipment will probably be available locally by the time the plant is implemented. However, no indications of the prices for local equipment are available and hence the same have been priced at international levels. Since an allowance has been made to international prices of equipment in order to provide for freight, insurance, port duties, handling

charges etc. It may be said that local equipment has been priced at roughly the C.I.F. price of imported equipment. An allowance of 15% on F.O.B. prices has been made to account for the following :

Bank Charges	5.5%
Insurance Fees	1.5%
Export Help	1.0%
Port Handling charges	3.0%
Red Lion and Sun Charges	1.0%
Inland Freight	3.0%

No provision has been made for custom duties towards imported equipment.

2.3.6. Additionally allowance has been made for accessories, jigs and tools, spares, industrial furniture etc. as follows :

Category	% of basic equipment cost
Accessories	10
Jigs & Fixtures	10
Cutting Tools and Hand Tools	5
Initial Spares for 3 years operation	7.5
Industrial Furniture & Fittings	5

Erection of equipment has been allowed for at 10 per cent of delivered costs of erected equipment.

2.3.7. Projecting Costs

Costs, other than those pertaining to the physical assets mentioned above, have been provided for under the heating 'Projecting Costs' to include preliminary and promotional expenses, engineering and know-how fees, start-up and commissioning expenses, training of personnel etc. Provision for these costs have been made as stated below :

Preliminary and Promotional Expenses	Approx. 1% of Project Cost
Engineering Fees	7½-10% of Project Cost
Technical Know-how and Production documentation	10% of annual sales
Training Costs	On rough estimates
Start-up expenses	On rough estimates

2.3.8. A contingency provision of 10 per cent of estimated costs of fixed assets has been made to allow for miscellaneous items not covered.

2.3.9. A broad estimate of probable Rial and foreign currency requirements has been made on the basis of the following broad divisions of costs:

Land, Buildings and Civil Works	Rial Currency
CIF Value of equipment including accessories, jigs, fixtures, tools, etc.	Foreign Currency
Additional expenditure on equipment including for internal transportation erection and commissioning	Rial Currency
Preliminary and promotional expenditure	Rial Currency
Engineering Fees	50% Rial Currency 50% Foreign Currency
Know-how Fees	Foreign Currency
Start-up Expenses	Rial Currency

2.4. <u>Working Capital</u>

Working capital has been calculated on the basis of an average inventory of 4 months for raw materials and bought-outs. Additionally, provision has been made for in-process and product inventories approximating to 1 month's cost of production excluding depreciation and amortisation. Accounts Receivable has been computed at the value of one month's average

sales excluding depreciation and amortization, and Accounts Payable at one month's cost of raw materials and bought-outs.

2.5. Operating Inputs

2.5.1. Raw Materials, Bought-outs and Process Commodities

Cost of raw materials has been assumed at prevailing international prices making allowances for freight, transportation etc. upto plant site. In so far as intermediate products such as castings, forgings etc. are concerned, the same has been priced at levels that have been used in recent analyses for the Arak Machine Building Plant. It may be mentioned that the prices presently obtaining in the Tehran Market are not considered a valid base for estimation since the present prices in the local market relate essentially to small lot sales and would be considerably different from the prices that will actually prevail for bulk purchases negotiated through long-term arrangements.

2.5.2. Utilities and Consumables

Utilities and consumables have been allowed for in the operating cost estimates on the basis of Indian experience adjusted for

variations in prices of major items as between India and Iran.

2.5.3. Wages & Salaries

Wages and salaries have been estimated on the basis of manpower requirements developed from the estimate of workload for each section by applying the following wage rates:-

	Rials per month
General Manager	1,20,000
Senior Managerial Personnel	72,000
Managers	60,000
Supervisory Personnel (Technical)	24,000
Supervisory Personnel (Non-technical)	18,000
Clerks, Typists, etc.	14,400
Skilled Workers	14,400
Semi-skilled Workers	9,600
Un-skilled Workers	5,400

Additionally, provision has been made for fringe benefits at 40 per cent of basic wages.

2.5.4. Depreciation and Amortisation

Depreciation of fixed assets has been provided for in the estimates of Cost of Production at the following rates; straight line basis :

Civil Works	3%

Plant and Equipment 10%

Projecting Costs have been amortised uniformly at the rate of 10 per cent per annum.

2.5.5. Maintenance of plant and equipment has been provided for at 2.5 per cent per annum of erected costs, the corresponding figure for civil works being 1 per cent.

2.6. Sales Expenses

A provision of 15% of annual sales value has been allowed in the estimates towards sales expenses including advertising and commissions to dealers for Units 1 and 2, the corresponding figure for Unit 3 (Construction Equipment) is 7.5 per cent.

2.7. Royal-ties

It is considered that the preferred method of payment for induction of know-how and patents will be the method of annual royal-ties on sale. Even so, it becomes normally necessary to make an initial lump sum payment to partially meet the cost of obtaining know-how and licences, production documentation and training facilities. As has been stated earlier, such initial lump

sum payment has been allowed at 10% of the average annual sales value. Additionally, an annual royalty of 5% of sales value has been allowed. The exact percentages can be fixed only after detailed negotiations with prospective collaborators. The figures indicated here are normally adopted average figures.

2.8. Sales Prices for Products

Generally speaking, sales prices of products have been assumed as equal to the CIF prices of comparable imported products. However, as is well known, there is no such thing as an 'International price' for a particular type of plant and equipment. The price of equipment can vary widely in the international market depending on the source of procurement, reputation of the manufacturer, variation in the extent of fitments included in the basic machine and differences in the features incorporated. At the same time, a machine with the same rating may have differences in duty and accuracy standards, so that the prices quoted by different manufacturers for a machine with the same rating are not strictly comparable.

The prices assumed in the Study are, therefore, normalised fair prices after making allowances for the variations mentioned above. Such prices do not, therefore, necessarily correspond with the price of any single manufacturer.

Normal allowances for ocean freight and marine insurance have been added to such normalised fair international prices to derive the sales prices of the products adopted in the Pre-Feasibility Studies.

2.9. Profitability

Profitability of the units have been projected for a standard year of full rated production both for the initial and expanded stages in the form of the following profitability indicators :

a) Gross Return on Fixed Investment

b) Pay Back Period

c) Value Added

d) Interest rate of return

Each of the above indicators has been projected for initial as well as expanded plant sizes as though they are completely different units,

though in actual practice, the profitability of operations in the expanded stage would be influenced by working results in the previous stage and the time after commencement of initial operations when such expansions would have got underway.

In order to present working results invarient to the method of financing, cost of production and profitability have been estimated on the assumption that the entire capital is Owners Equity not liable to interest charges.

2.10. A reasonable construction schedule has been assumed as also the schedule for build-up of production to final rated values. It must be stressed that one of the most important factors in achieving rated production will be the level of sales itself and this will be contingent upon the measures taken to provide protection to local industry and other institutional arrangements discussed in another Volume of the Report.

3. ANALYSIS OF FINANCIAL ESTIMATES FOR SUGGESTED UNITS

3.1 The criteria for evaluating alternative projects are many and are dependent upon the major objectives that policy making agencies have for implementation of the projects. Depending upon the objectives, one or more of the following criteria for evaluation would be applicable :

a) Estimated savings in foreign exchange by creation of local manufacturing activity;

b) Value added;

c) Return on investment;

d) Employment generated;

3.2 The above indicators have been worked out for each of the units under study and are discussed below:

3.2.1 Plastic and Rubber Machinery Plant

Against the total capital, including working capital of US $ 4.09 million for the first stage of plant operations, value added is estimated at US $ 3.4 million and annual savings in foreign exchange at US $ 4.06 million. The first stage of operations is really, however, only the early

stage of plant build-up into the subsequent stage. when value added improves to US $ 4.63 million and annual savings in foreign exchange to US $ 5.49 million against total invested capital (including working capital) of US $ 3.98 million. Gross returns on total capital during the first and second stages work out to 31.9 and 39.8 per cent, corresponding interest rate of return allowing for time value of moneybeing 21.4 and 24.9 per cent respectively.

3.2.2 Construction Machinery Plant

As may be expected, the results are not as spectacular as in the previous case, largely because of the large investments called for. Even so the results are very favourable considering that products have been priced at levels applicable to comparable imported products, without custom duties. The annual savings in foreign exchange is estimated at US $ 23.70 million in the first stage of operations against total investment, including working capital of US $ 31.15 million, the corresponding value added being US $ 15.95 million. Gross return on total capital during

this stage is 14.5 per cent, corresponding interest rate of return being 10.3 per cent.
However, the plant will no doubt quickly graduate into the subsequent expanded stage of operations because, apart from the home market, there would be excellent possibilities for export. During this stage, against total capital invested of US $ 45.01 million, value added is US $ 30.07 million, and gross return on capital employed is 27.90 per cent. The plant can also be expected to stimulate considerably ancillary development for quality grade castings and forgings, hydraulics, gear assemblies and electricals.

3.2.3 Cement Sugar and Allied Machinery Plant

Forecast financial results for this plant show excellent improvement in the expanded stage namely at annual production level of approximately 15,000 tons. While, in the initial stage, against total capital employed of US $ 24.65 million value added is US $ 11.72 million, gross return on total capital improves to 21 per cent, value added to US $ 17.38 million and foreign exchange savings to US $ 25.36 million per annum against total capital invested of US $ 29.90 million.

It should be possible for the plant to improve output to around 15,000 tons per annum without difficulty of market considerations. As has been stated earlier, a very large portion of fabricated and general engineering category equipment has been left for providing increasing shares of market to the smaller fabricators though the same can form viable load for a large sized operation. The items that have been deliberately left uncovered in the large units proposed are storage tankage for refinery and chemicals, simpler concrete mixers, road rollers, concrete vibrators and cranes. However, till such time that the smaller fabricators do not adequately respond, the present plant can easily manufacture the above items which can be shed once the market for the plant's basic product mix materialises.

3.2.4 Employment

Employment generation capacity is highest in the case of the plastic and rubber machinery unit being 70 to 80 per million dollar investment; the corresponding figures for the construction machinery plant are 65 to 70 and for the cement, sugar and allied machinery plant only 40 to 50.

3.3 All the above plants would appear to be favourable and warrant further detailed studies to specify the projects more clearly for implementation.

4. INVESTMENT AND PRODUCTION PATTERN & SUPPORT REQUIREMENTS

4.1 A feasible build up of production for the units suggested and the phasing of investment is presented in Table 1. The pattern suggested would be achievable only if immediate action is initiated for detailed studies and necessary collaboration arrangements can be finalised early.

4.2 As may be expected, demands during the period 1972-1977 cannot be met in any major way by the new units, which will commence operations earliest by 1975 only. Production has been suggested to commence even before construction and erection of the whole plant is complete since initial production will be from CKD components. In the subsequent five year period, the plants satisfy the demand more fully and towards the later years of this period, the total demands would be met.

4.3 The Cement, Sugar and Allied machinery unit has a large measure of in-built flexibility to take up new products within the range of its process capability. Hence, even during the period 1972-1977, production is suggested to be built up to over 80 per cent of its ultimate rated value even though the demand for the items in its staple

production programme is lower. The idea is that, during this period, items such as low pressure fabrications, concrete mixers and technological structure, which are ultimately to be left for the smaller fabricators, can be taken up by the plant since such smaller fabricators would require time to respond adequately to the demand.

4.4 Table 2 presents requirements of major inputs for the various units during the earlier and later stage of their operations.

Table : 1 Pattern of Investm

	1972	1973	1974	1975	1976	1977	19
Plastic and Rubber Machinery Plant (Unit 1)							
Investment (10^6 US $)	0.70	1.50	1.34	0.40	0.98	0.26	0.
Production (Nos.)	-	-	-	155	205	255	25
Demand (Nos.)				726			
Cement Sugar and Allied Machinery Plant (Unit 2)							
Investment (10^6 US $)	1.00	11.50	10.00	4.50	2.00	0.50	0.
Production (Tonnes)	-	-	-	8000	10000	12500	13
Demand (Tonnes)				16500			
Construction Machinery Plant (Unit 3)							
Investment (10^6 US $)	2.00	5.00	11.50	5.80	5.60	4.70	4.
Production (Nos. M/cs.)	-	-	-	270	400	535	6
(Tons spares)				750	1100	1500	18
Demand (Nos. M/cs.)				3545			

Note : 1. Investment includes working cap

2. Actual demand on Unit 2 will be of demand stated which refers t

SECTION 1

able : 1 **Pattern of Investment and Production**

4	1975	1976	1977	1978	1979	1980	1981	1982
4	0.40	0.38	0.26	0.20	0.10	0.08		
	155	205	255	255	310	330	350	350
	726					1423		
0	4.50	2.00	0.90	0.40				
	8000	10000	12500	13500	14500	14500	14500	14500
00					76630			
0	5.80	5.60	4.70	4.50	3.90	1.24		
	270	400	535	670	960	1020	1275	1275
	750	1100	1500	1850	2650	2800	3500	3500
45					7186			

nvestment includes working capital.

ctual demand on Unit 2 will be about 24 months in advance
f demand stated which refers to erected equipment.

Table 2 : Phased Requirements of major Inputs Requirements by

Item	Unit	1977	1982
A. Raw Materials			
M.S. Plates and Sheet	Tonne	14,000	19,500
M.S. Sections and Bars	Tonne	3,500	7,000
Steel Pipes	Tonne	325	400
Alloy Steel	Tonne	550	650
B. Intermediates and Buy-Out			
G.I. Castings	Tonne	1,650	3,000
Alloy Iron Castings	Tonne	50	70
Steel Castings	Tonne	3,250	6,500
Non-Ferrous Castings	Tonne	15	25
Steel Forgings	Tonne	650	1,100
Fasteners	Tonne	410	600
Electric Motors	10^6 $	4	6
Engines	Nos.	-	960
Bearings	1000 $	170	400
Hydraulics and Pneumatic elements	1000 $	850	1,870
Wheel rims	Nos.	2,230	5,220
Tyres and Tubes	Nos.	2,230	5,220
Gear Boxes	Nos.	350	820
Power Take off Units	Nos.	235	510

Item	Unit	1977	1982
C. **Manpower**			
Managerial	Nos.	115	130
Technical Supervisory	Nos.	310	390
Skilled Workers	Nos.	1,055	1,350
Semi-skilled Workers	Nos.	810	1,030
Unskilled Workers	Nos.	540	675
D. **Utilities**			
Power (Max. Demand)	KW.	6,850	8,630
Water	m^3/day	375	465
Compressed Air (Max. simultaneous demand)	Nm^3/hr.	4,700	6,130

ANNEXURE III.1

PRE-FEASIBILITY STUDY

FOR

RUBBER AND PLASTIC MACHINERY PLANT

	STAGE I	STAGE II
ANNUAL OUTPUT	255 Machines	350 Machines
WORKING DAYS/ANNUM	300	300
NO. OF SHIFTS	2	2

I.1

SECTION I: PRODUCT MIX

	Product	Size Range	Annual Output (No. of Machines)	
			STAGE I	STAGE II
1.	Extruders	30-65 mm dia.	50	70
2.	Film Extruders	750-1000 mm tube width	15	25
3.	Blow Moulding Machines	Upto 5000 C.C.	25	35
4.	Profile Calenders	1000-2000 mm width	75	100
5.	Thermo-setting Plastic Presses	50-1000 tonnes	50	70
6.	Tyre Presses	Upto 1650 mm dia. tyres	25	30
7.	Tyres Building Machines	Upto 1650 mm dia. tyres	15	20
		Total:	255	350

SECTION II: BUY-OUTS

It is proposed that the plant shall buy-out all castings and forgings (fully fettled), electric motors, heating elements, controls, hydraulic and pneumatic elements, bearings etc. While the castings and forgings shall be machined in the plant, the other items will be merely assembled into the final products. The annual requirements of the bought-out items are estimated as follows :

Bought-out Item	Unit	Annual Quantity Stage I	Stage II
1. Intermediates (Castings & Forgings)			
a. G.I. Castings	Tonne	440	595
b. Alloy Iron Castings	Tonne	45	60
c. Steel Castings	Tonne	155	210
d. Non-ferrous Castings	Tonne	15	20
e. Steel Forgings	Tonne	30	40
2. Electric Motors (2 to 10 KW)	No.	375	525
3. Heating Elements	US $	17,000	24,000
4. Controls	US $	75,000	100,000
5. Hydraulic and Pneumatic Elements	US $	160,000	229,000
6. Ball & Roller Bearings	No.	2,800	3,800
7. Fasteners & Fittings	Tonne	7	9

SECTION III - PRODUCT(S) DESCRIPTION

Outline descriptions of the products proposed for manufacture are given below :

I. Plastic Extruder

Range of Manufacture : 35 mm screw dia. to 65 mm screw dia.

Specification of Representative Product:

Type:	Horisontal
Dia.of Screw:	45 mm
Screw Length:	24 D
Power:	7.5 KW
Max. Output	13.6 kg/hr.
Overall dimensions	2760x1220x650
Weight:	2.4 Tons

Possible Attachments

Take off equipment for Pipes
Pelleting attachment
Wire winding equipment
Take off equipment for sections

II. Film Extruder

Range of Manufacture: 750 mm to 1000 mm

Specification of Representative Product:

Screw	63 mm dia.
Main Motor:	10 HP(7.5 KW)
Heating Load:	7.55 KW

	Range of Film Extruded:	125 mm - 920 mm
	Output:	5 kg to 28 kg per hour
	Vertical take-up equipment to match customer's requirements	
Net Weight:	4 Tons	

III. Blow Holding Machine

Range of Manufacture:	1000 CC to 5000 CC	
Specification of Representative Product:	Extruder Screw dia.	50 mm
	Container size:	2000 CC
	Capacity:	2 to 5 shots/min.
	Power:	10 KW
	Heating	7.5 KW
Net Weight:	2 Tons	

IV. Extruder Calender

Range of Manufacture:	1000 mm to 2000 mm width	
Specification of Representative Product	Extruder Screw dia.	75 mm
	Width of Sheet	1200 mm
	Total Electrical Load	50 KW (including heating)
Net Weight :	4.0 Tons	

V. Thermosetting Plastic Presses

Range of Manufacture	50 Tons - 1000 Tons	
Specification of Representative Product:	Closing Pressure	250 Tons
	Ejector	65 Tons
	Area in parting moulds	1670 cm^2
	Electric motor for Pumps	7.5 KW
	Power for heating the moulds	30 KW
	Dimensions :	
	Overall (LxWxH)	2000x1500x3450
Net Weight :	6 Tons	

VI. Tyre Curing Presses

Range of Manufacture	Upto 1650 mm tyre dia.	
Specification of Representative Product:	Max. mould dia.	1030 mm
	Max. mould thickness	330 mm
	Uncured tyre height	6860 mm
	Max. internal pressure	28 kg/cm^2
	Closing in force	120 Tons
	Bead dia.	300-400 mm
	No. of Moulds	Two
	Operation	Automatic/semi automatic
	Heating	Steam
Net Weight :	9 Tons	

VII. Tyre Building Machine

Range of Manufacture	Upto 1650 mm tyre dia.	
Specification of the representive product.	Max. height (width) of uncured tyre	6800 mm
	Max. dia. of tyre	6500 mm
	Operation	Automatic Cycle (15 operations
	Power	5 KW
Net Weight :	3.00 Tons	

SECTION IV : MANUFACTURING PROCESS

The processes involved in the manufacture of the products envisaged are :

a) Material Preparation including

- Layout and marking
- Cutting and sawing

b) Machining including:

- Turning
- Milling
- Drilling
- Boring
- Shaping, planing and slotting
- Grinding
- Gear Cutting

c) Fabrication and Assembly including

- Welding
- Assembly and subassembly
- Sub-assembly dismantling

d) Finishing including

- Surface preparation
- Painting

e) Reassembly, packing and despatch.

SECTION : PLANT FACILITIES

Based on the operations involved in the manufacture of the products, the following plant facilities would be included :

1. Production Facilities
   a) Material Preparation Shop
   b) Machine Shop
   c) Heat Treatment Shop
   d) Fabrication and Assembly Shop
   e) Paint Shop
   f) Reassembly, Packing & Despatch Section
2. Auxiliary Facilities
   a) Tool Room
   b) Maintenance Shop
   c) Material Handling Facilities
3. Utilities and Service Facilities:
   a) Electrical Sub-station and Distribution Network
   b) Compressed Air Generation and Supply Network
   c) Water Reservoir and Supply Network
   d) Transport Equipment
   e) Space Heating Installation
   f) Ventilation Equipment
   g) Weak Current Facilities
   h) Fire Fighting Facilities
   i) Medical and First Aid Facilities
   j) Canteen and other Welfare Facilities
   h) Administration Offices, Furniture and Office Equipment

SECTION VI : PLANT AND EQUIPMENT

PRODUCTION EQUIPMENT

		Quantity (Nos.) Stage I	Stage II
(a)	**Material Preparation Shop:**		
1.	Horizontal Band Saw 250	2	2
2.	Guillotine Shear 5 x 2500	1	1
(b)	**Machine Shop:**		
1.	Light Duty Centre Lathe 330 dia. x 1000	3	4
2.	Light Duty Centre Lathe 500 dia. x 1500	2	2
3.	Heavy Duty Centre Lathe 1000 dia. x 5000	2	3
4.	Turret Lathe - 375 dia.	1	2
5.	Turret Lathe - 760 dia.	1	1
6.	Special Lathe for Injection Screw	1	2
7.	Universal Milling Machine 320 x 1300	1	2
8.	Universal Milling Machine 360 x 1600	1	1
9.	Vertical Milling Machine 360 x 1600	1	1
10.	Column Drilling Machine 38 dia.	2	3
11.	Column Drilling Machine 50 dia.	1	1
12.	Radial Drilling Machine 40 dia. x 1250	2	3
13.	Double Column Planer 1000 x 1000 x 2400	1	1
14.	Double Column Planer 1500 x 1500 x 3000	1	1

	Quantity (Nos.) Stage I	Stage II
15. Shaper - 500 stroke	1	1
16. Shaper - 610 stroke	1	2
17. Slotter - 250 stroke	1	1
18. Vertical Boring Mill 1600 dia.	1	1
19. Horizontal Boring Machine 63 dia.	1	1
20. Horizontal Boring Machine 100 dia.	1	1
21. Roll Grinder 630 dia. x 2500	1	1
22. Universal Grinding Machine 450 x 2500	1	1
23. Horizontal Surface Grinder 300 x 1000	1	1
24. Horizontal Surface Grinder 400 x 2000	1	1
25. Double-ended Pedestal Grinder - 350 dia.	1	1
26. Planetary Key Seating Machine	1	1
27. Gear Shaper 250 dia. x 4 module	1	1
(c) **Heat Treatment Shop**		
1. Chamber Furnace - 1000°C. 1500 x 1000 x 600	1	2
2. Miscellaneous Equipment		
(d) **Fabrication and Assembly Shop**		
1. Welding Transformer 350 A	3	4
2. Welding Transformer 500 A	2	3

		Quantity (Nos.) Stage I	Stage II
3.	Welding Manipulators 1000 x 1500	2	3
4.	Oxy-acetylene Cutting Sets	2	2
5.	Vertical Allcut Bandsaw - 450	1	1
6.	Open Front Hydraulic Press - 40 T.	1	1
7.	Miscellaneous Equipment		
(e)	Paint Shop		
1.	Painting Booth - 4000 x 3000	1	1
2.	Painting Guns	5	7
3.	Miscellaneous Equipment		
(f)	Reassembly, Packing and Despatch Section		
1.	Assembly Stands		
2.	Miscellaneous Equipment		
	AUXILIARY EQUIPMENT		
(a)	Tool Room		
1.	Centre Lathe - 330 dia. x 700	1	1
2.	Tool and Cutter Grinder 200 x 480	1	1
3.	Carbide Tip Tool Grinding and Lapping Machine - 200 dia.	1	1
4.	Double-ended Pedestal Grinder - 300 dia. (One side cup wheel)	1	1

		Quantity (Nos.) Stage I	Stage II
(b)	**Maintenance Shop**		
1.	Arc Welding Set - 350 A	1	1
2.	Column Drilling Machine 38 dia.	1	1
3.	Centre Lathe - 330 dia. x 700	1	1
4.	Shaper - 500 stroke	1	1
5.	Fly Press No.3	1	
(c)	**Material Handling Equipment**		
1.	E.O.T. Crane - 10 tonnes x 12 metres	1	2
2.	E.O.T. Crane - 15 tonnes x 12 metres	1	1
3.	E.O.T. Crane - 20 tonnes x 18 metres	1	1
4.	Jib Crane - 2 tonnes x 6 metres	2	3
5.	Battery-operated Fork Lift Truck - 2 tonnes capacity	1	1
6.	Hand-operated Platform Truck	4	6
7.	Wheel Barrow	4	6

UTILITIES AND SERVICE FACILITIES EQUIPMENT

(Both for Stages I & II)

(a) Electric Power System including H.T. & L.T. Switchgear, 2 Nos. of 750 KVA transformers and cable network.

(b) Compressed Air System including 2 Nos. of 180 cu.m/hr. air compressors, inter-coolers, after-coolers, air receivers, piping network, valves and fittings.

(c) Water Supply System including water reservoir, pumps and supply network.

(d) Transport Equipment.

(e) Space Heating Installation including Boilers.

(f) Ventilation Equipment.

(g) Weak Current Network including external and internal telephones, fire alarm system, public address system etc.

(h) Fire Fighting Equipment.

(i) Medical and First Aid Equipment.

(j) Canteen Furniture and Equipment.

(k) Office Furniture and Equipment.

SECTION VII : AREA REQUIREMENTS

	Stage I	Stage II
Land	20,000 sq.m.	20,000 sq.m.
Buildings	**Covered Area in Sq.m.**	
1. **Production Buildings**		
a) Material Preparation Shop, Raw Material and Bought-out Store	288	400
b) Machine Shop	1440	1600
c) Heat Treatment Shop	144	144
d) Fabrication and Assembly Shop	360	470
e) Paint Shop	144	170
f) Reassembly, Packing and Despatch Section	216	250
Sub Total (1)	2592	3034
2. **Auxiliary Buildings**		
a) Tool Room	144	144
b) Maintenance Shop	168	168
c) Electric Sub-station	120	120
Sub Total (2)	432	432
3. **Non-Production Buildings**		
a) Administration Building	1000	1000
b) Canteen Building	400	400
c) Main Gate, Time Office and First Aid Room	300	300

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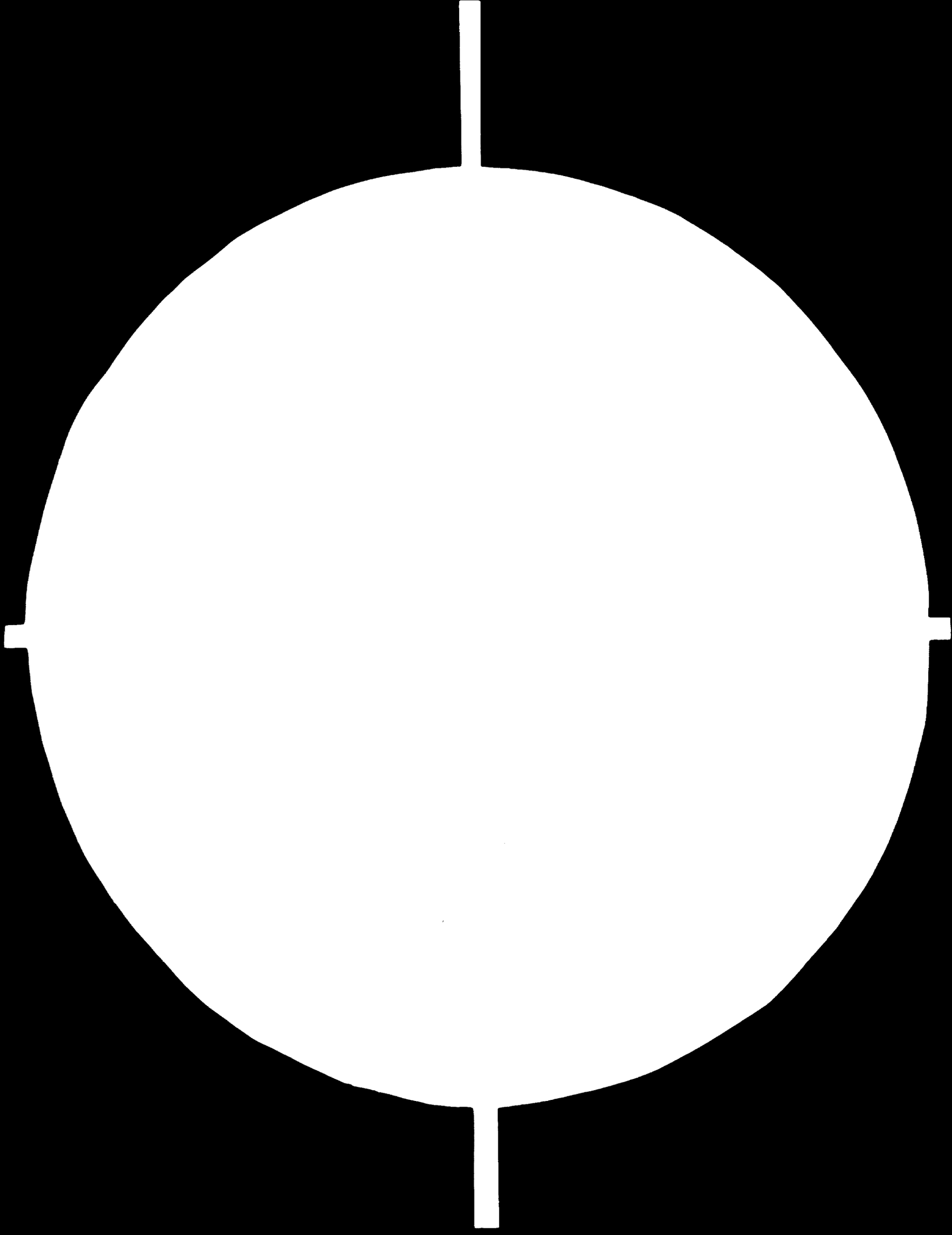

d) Cycle Stand-cum-Car Park	200	250
Sub Total (3)	1900	1950
TOTAL COVERED AREA (1+2+3)	4924	5416

SECTION VIII : LAYOUT

A Layout Plan for the proposed plant is appended as Drawing No. 01.001. This has been developed bearing in mind the usual criteria such as flow of materials, minimum movement of materials and men, safety considerations etc.

A Key Plan of the Production Block, which houses the main production as well as auxiliary facilities is appended as Drawing No. 01.002

Besides, an Equipment Layout Plan is attached as Drawing No. 01.003. This shows the relative dispositions of the equipment which will be installed in the various production and auxiliary sections.

SECTION IX : RAW MATERIALS AND PROCESS INPUTS

RAW MATERIALS

	Item	Stage I	Stage II
1.	M.S. Plates	295 tonnes	395 tonnes
2.	M.S. Structurals and Rounds	130 tonnes	175 tonnes
3.	Alloy Steels	10 tonnes	15 tonnes
4.	Steel Pipes	10 tonnes	15 tonnes
	Total :	445 tonnes	600 tonnes

AUXILIARY MATERIALS AND CONSUMABLES

The various auxiliary materials and consumables required will include the followings :

1. Oils and Greases
2. Tools, Jigs and Fixtures
3. Welding Electrodes
4. Painting Materials
5. Packing Materials etc.

UTILITIES AND ENERGIES

		Stage I	Stage II
1.	Electrical Energy		
	Power Load	700 KW	900 KW
	Lighting Load	100 KW	130 KW
		800 KW	1030 KW

	Stage I	Stage II
Maximum Demand	450 KW	530 KW

2. Compressed Air

Maximum Simultaneous Demand	100 NM^3/hr.	130 NM^3/hr.

3. Water

Average Requirements	24 m^3/day	32 m^3/day

4. Others

These include Fuel Oil/Gas, Acetylene, Oxygen etc.

SECTION X : MANPOWER

		Number of Personnel	
		Stage I	Stage II
1.	General Manager	1	1
2.	Senior Managers	4	4
3.	Managers	9	9
4.	Supervisors (Technical)	24	29
5.	Supervisors (Non-technical)	8	10
6.	Clerical and Administrative Staff	28	32
7.	Labour		
	(a) Skilled Workers	80	100
	(b) Semi-skilled Workers	60	80
	(c) Unskilled Workers	40	50
	TOTAL MANPOWER	254	315

SECTION XI : ECONOMICS

FIXED CAPITAL INVESTMENT

Item	STAGE I	STAGE II
	Value in 1000 U.S.Dollars	Value in 1000 U.S.Dollar
1	2	3
A. Civil Works:		
A.1 Land	40	40
A.2 Site Development	60	60
A.3 Buildings		
(a) Production Buildings	250	292
(b) Auxiliary Buildings	36	36
(c) Non-Production Buildings	151	153
Sub-Total(A.3)	437	481
A.4 Contingencies @ 10% of A.1 to A.3.	53	59
Total (A)	590	640
B. Plant & Equipment:		
B.1 Production Equipment.		
(a) Material Preparation Section	10	10
(b) Machine Shop	555	650
(c) Heat Treatment Shop	13	25
(d) Fabrication & Assembly Shop	25	35
(e) Paint Shop	13	15
(f) Reassembly, Packing and Despatch Section	4	5

1	2	3
B.2 Auxiliary Equipment:		
(a) Tool Room	11	11
(b) Maintenance Shop	12	12
(c) Material Handling Equipment	128	155
B.3 Utilities & Services Equipment:		
(a) Electric Power Distribution System	100	135
(b) Compressed Air System	10	12
(c) Water Supply System	5	6
(d) Transport Equipment	8	8
(e) Space Heating Instal-lation.	50	55
(f) Ventilation, Weak Current, Fire Fighting, First Aid, Canteen and Office Equipment.	40	45
Total Equipment Cost(FOB/FOR) = (B.1 to B.3)	984	1179
B.4 Machine Accessories	98	118
B.5 Jigs and Fixtures	98	118
B.6 Cutting Tools & Hand Tools	49	59
B.7 Furniture & Fittings	49	59
B.8 Initial Spares	74	89
B.9 Procurement Charges, Freight, Insurance, Handling etc.	203	243
B.10 Erection and Commissioning of Equipment	113	135

1		2	3
B.11	Contingencies @ 10% of B.1 to B.11.	167	200
	Total (B)	1835	2200
C.	Projecting Costs:		
C.1	Preliminary and Promotional Expenses	25	30
C.2	Project Reports, Designing and Engineering Fees.	250	275
C.3	Technical Know-how, Production Documentation and Training (in addition to Royalties)	490	660
C.4	Start-up Expenses	45	55
C.5	Project Establishment	100	115
	Total (C)	910	1135
TOTAL FIXED CAPITAL INVESTMENT.		3335	3975
	(FOREIGN CURRENCY)	(1,650)	(2,030)

WORKING CAPITAL

	Item	Period in months	Amount in 1000 US $ Stage I	Stage II
1.	Raw Materials and Bought-outs	4	253	344
2.	Auxiliary Materials and Consumables	4	67	85
3.	Utilities & Energies	1	5	6
4.	Salaries & Wages	1	66	80
5.	Administrative Overheads	3	11	15
6.	Insurance	3	6	8
7.	Maintenance Materials	3	13	16
8.	Stock of goods in process and finished goods(Cost of Production excluding Depreciation)	1	162	206
9.	Accounts Receivable (Cost of Sales excluding Depreciation)	1	235	306
10.	Total (1 to 9)		818	1,066
11.	Less Accounts Payable (Cost of Raw Materials and Bought-outs)	1	(-) 63	(-) 86
12.	NET WORKING CAPITAL (10-11)		755	980
	(Foreign Currency)		(80)	(110)

TOTAL CAPITAL INVESTMENT

1.	Fixed Capital Investment	3,335	3,975
2.	Working Capital	755	980
	Total Capital Investment(1+2)	4,090	4,955
	(Foreign Currency)	(1,730)	(2,140)

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ANNUAL COST OF SALES

Item	Unit	Unit Price in U.S. Dollars.	Stage I		Stage II	
			Quantity	Amount in 1000 U.S. Dollars	Quantity	Amount in 1000 U.S. Dollars
1	2	3	4	5	6	7
A. Raw Materials:						
a) M.S. Plates	Tonne	230	295	68	395	91
b) M.S. Bars and Sections	Tonne	200	130	26	175	35
c) Alloy Steels	Tonne	700	10	7	15	11
d) Steel Pipes	Tonne	335	10	4	15	6
Sub-Total (A)				105		143
B. Intermediates (Bought-out)						
a) G.I. Castings	Tonne	330	440	146	595	197
b) Alloy Iron Castings	Tonne	360	45	17	60	22
c) Steel Castings	Tonne	600	155	93	210	126
d) Non-Ferrous Castings	Tonne	1700	15	26	20	34
e) Steel Forgings	Tonne	670	30	21	40	27
Sub-Total (B)				303		406
C. Bought-outs:						
a) Electric Motors (2-10 KW)	No.	120	375	45	525	63
b) Heating Elements	U.S.$	-	-	17	-	24
c) Controls	U.S.$	-	-	75	-	100

1	2	3	4	5	6	7
d) Hydraulics and Pneumatic Elements	U.S.$	-	-	160	-	225
e) Ball & Roller Bearings	No.	3	280	9	3800	12
f) Fasteners and Fittings	Tonne	1100	7	8	9	10
Sub-Total (C)				314		434
D. Auxiliary Materials & Consumables				200		255
E. Energies and Utilities				58		66
F. Salaries and Wages				760		909
G. Contingencies (@ 5% of A to F)				83		106
H. Administrative Overheads				45		60
I. Insurance				25		30
J. Depreciation of Fixed Assets				202		240
K. Amortization of Projecting Costs				91		114
L. Maintenance				52		62
M. Cost of Production (A to L)				2238		2825
N. Selling Expenses including Dealer's Commission.				665		900
O. Royalties				222		300
ANNUAL COST OF SALES (M+N+O)				3125		4025
(Foreign Currency)				(375)		(510)

SALES REALIZATION

Product	Unit Price (U.S.$)	Annual Sales (1000 U.S. Dollars) Stage I	Stage II
1. Extruders	7,000	350	490
2. Film Extruders	12,000	180	300
3. Blow Moulding Machines	26,000	650	910
4. Calenders	16,000	1,200	1,600
5. Thermosetting Plastic Presses	21,000	1,050	1,470
6. Tyre Presses	31,000	775	930
7. Tyre Building Machines	15,000	225	300
TOTAL.		4,430	6,000

PROFITABILITY	Unit	Stage I	Stage II
1. Gross Annual Profits	1000 U.S. Dollars	1,305	1,970
2. Total Capital Investment	1000 U.S. Dollars	4,090	4,955
3. Gross Annual Return on Total Capital Investment	%	31.9	39.8
4. Value Added/annum	1000 U.S. Dollars	3,400	4,630
5. Internal Rate of Return (Discounted Cash Flow Analysis)	%	21.4	24.2
6. Pay Back Period	Years	3.75	3.25
7. Foreign Exchange Savings/annum	1000 US $	4,055	5,490

ANNEXURE III.2

PRE-FEASIBILITY STUDY
FOR
CEMENT, SUGAR & ALLIED MACHINERY PLANT

	STAGE I	STAGE II
ANNUAL OUTPUT	10,000 tonnes	14,500 tonnes
WORKING DAYS/ANNUM	300	300
NO. OF SHIFTS	2	2

II.1

SECTION I : PRODUCT-MIX

	Product	Unit	Annual Output Stage I	Annual Output Stage II
1.	Fabricated Vessels, Storage Tanks & Bins	Tonne	1,950	2,500
2.	Heat Exchangers	Tonne	250	275
3.	Furnaces & Kilns	Tonne	3,250	3,350
4.	Conveyors	Tonne	400	2,250
5.	Ball Mills	Tonne	1,300	1,750
6.	Crushers	Tonne	1,000	1,750
7.	Filters	Tonne	400	600
8.	Screens	Tonne	150	200
9.	Mechanical Equipment	Tonne	800	1,200
10.	Technological Structures	Tonne	500	625
	Total	Tonne	10,000	14,500

I.2

SECTION II : BUY-OUTS

It is proposed that the plant shall buy out all castings and forgings (fully fettled), electric motors, controls, bearings, etc. While the castings and forgings shall be machined in the plant, the other items will be merely assembled into final products. The annual requirements of the bought-out items are estimated as follows :

Bought-out Item	Unit	Annual Quantity Stage I	Annual Quantity Stage II
1. Intermediates (Castings & Forgings)			
a. G.I. Castings	Tonne	495	915
b. Steel Castings	Tonne	885	1,535
c. Steel Forgings	Tonne	325	530
2. Electric Motors	Tonne	510	765
3. Controls Panels	US $	250,000	350,000
4. Bearings	Nos.	20,000	29,000
5. Fasteners and Fittings	Tonne	270	400
6. Miscellaneous Materials	US $	270,000	370,000

SECTION III: PRODUCT DESCRIPTION

The Plant will manufacture a variety of equipment for the Cement, Sugar, Vegetable Oil and allied industries. However, by the nature of the facilities provided, the plant can produce a wide range of equipment for other process industries as well as for material handling etc. within the range of the following process capabilities:

1. Plate Shop

Plate Shearing	15 x 5000 mm
Plate Bending(Rolling)	50 x 5000 mm
Plate Bending (Brake Work)	15 x 5000 mm
Dished ends	Upto 40 mm plate
Crane Capacity	30 t x 24 m

2. Machine Shop

Maximum Sizes

Vertical Turning	6000 mm dia.
Horizontal Turning	160 mm dia.
Bar Turning	85 mm dia.
Milling	360x1600 mm
Planing	3000x2500x12000 mm
Surface Grinding	400 x2000 mm
Gear Making	5000 mm dia.
Crane Capacity:	20 T x 24 m

II.4

3. **Structural Shop**

Section Cutting	100 x 100x8 mm
Section Bending	100x100x10 mm
Crane Capacity	10 T x 24 m

4. Assembly:

Crane Capacity:	60 t x 24 m

SECTION IV : MANUFACTURING PROCESS

The processes involved in the manufacture of the ... products envisaged are :

a) Material Preparation including

- Plate straightening
- Layout and marking
- Cutting of plates, sheets and sections including shearing, Oxy-Acetylene profile cutting and nibbling.
- Punching, notching and blanking of sheets, plates and sections.
- Pipe bending.

b) Structural Fabrication including

- Cropping, notching and punching
- Drilling
- Section Bending
- Tube coiling and expanding
- Layout
- Welding
- Testing

II.6

c) Machining including

- Turning
- Milling
- Drilling

- Boring
- Shaping, planing and Slotting
- Pipe Screw Cutting

Grinding - Surface, Cylindrical

Gear Cutting

c) Assembly including

- Spot drilling
- Corrective welding
- Sub assembly
- Assembly

II.7

SECTION V: PLANT FACILITIES

Based on the operations involved in the manufacture of the products, the following facilities would be incorporated.

1. Manufacturing Facilities
   a) Material Preparation Shop
   b) Pipe Fabrication Shop
   c) Structural Fabrication Shop
   d) Machine Shop
   e) Assembly & Testing Shop
   f) Painting & Reassembly Shop
2. Auxiliary Facilities
   a) Tool Room
   b) Maintenance Shop
   c) Material Handling Facilities
3. Utilities and Service Facilities
   a) Electrical Sub-station and Distribution Network
   b) Compressed Air Generation & Supply Network
   c) Water Reservoir & Supply Network
   d) Transport Equipment
   e) Space Heating Installation including Boilers
   f) Ventilation Equipment
   g) Weak Current Facilities
   h) Fire Fighting Facilities

II.8

i) Medical & First Aid Facilities

j) Canteen and other Welfare Facilities

k) Administration Offices, Furniture and Office Equipment

SECTION VI: PLANT AND EQUIPMENT

PRODUCTION EQUIPMENT	Quantity (Nos.) Stage I	Stage II
(a) Material Preparation Shop		
1. Automatic Circular Saw 710 dia.	1	2
2. Horizontal Band Saw 200	1	2
3. Oxyacetylene Planer	1	1
4. Oxyacetylene Profile Cutting Machine	1	1
5. Punching Shearing & Cropping 16	1	1
6. Guillotine Shearing Machine 5000x15	1	1
7. Nibbling Machine 1250x8	1	1
8. Mechanical Blanking Machine 200 T	1	1
9. Mechanical Blanking Press 100 T	1	1
10. Pipe Bending Machine 75 dia.	1	1
11. Plate Straightening Machine 40	1	1
(b) Plate Fabrication Shop		
1. Plate Bending Roll 6000x16	1	1
2. Plate Bending Roll 4000x22	-	1
3. Plate Bending Roll 5000x50	1	1
4. Section Bending Machine 110x110x14	1	1
5. Press Brake 5000x10	1	1

I.10

	6. Press Brake 5000x15	1	1
	7. Radial Drilling Machine 40 dia x 1250	1	1
	8. Radial Drilling Machine 65 dia x 1500	1	1
	9. Column Drilling Machine 38 dia.	2	3
	10. Double-Ended Grinder 350 dia.	2	2
	11. Double Ended Grinder 600 dia.	1	1
	12. Oxy-Acetylene Welding Set	2	3
	13. Oxy-Acetylene Portable Cutting Machine	2	3
	14. Dished End Spinning Machine 40	1	1
	15. Hydraulic Straightening Press 40 T	-	1
	16. Hydraulic Straightening Press 100 T	1	1
	17. Welding Rectifiers	25	40
	18. Automatic Circular Welding Machine 1000 A	1	1
	19. Automatic Plate Welding Machine 1000 A	1	2
	20. Welding Manipulators	4	5
II.11	21. Argon Arc Welding Machine 350 A	2	2
	23. Portable Grinder 150 dia.	2	2
	24. Vertical Boring & Turning Mill 6000	1	1
	25. Planer 3000x2500x12000	1	

26.	Gear Shaper 5000 dia.	1	1
27.	Oil-fired Annealing Chamber 6000x6000x12000	1	1
28.	Shot Blasting Equipment	1	1
29.	Sand Blasting Equipment	1	1
30.	Edge Planer	1	1

(c) Structural Fabrication Shop

1.	Column Drilling Machine 38 dia	1	1
2.	Twist Drill Grinder 50 dia.	2	2
3.	Punching Shearing & Cropping Machine 16	1	1
4.	Welding Manipulators	2	3
5.	Section Bending Machine 110x110x14	1	1
6.	Portable Grinder 150 dia.	2	2
7.	Welding Transformers 300 A	4	4
8.	Welding Transformers 500 A	3	5
9.	Welding Set 350 A	2	3
10.	Tube Expander	3	4
11.	Tube Cutter 100 dia.	1	1
12.	Tube Bending Machine 75 dia.	1	1
13.	Frame Grinder 75 dia.	-	1
14.	Storage Tank	2	2
15.	Hydraulic Pump with Test Stand	1	1
16.	X-Ray Testing Machine 100	1	

I.12

17. Film Processing Equipment	1	1
18. X-Ray Film Viewing Equipment	1	1
19. Ultra sonic Flame Detection	1	1

(d) Machine Shop

1. Centre Lathe 330 diax2000	2	2
2. Centre Lathe 500 diax4000	2	2
3. Centre Lathe 800 diax5000	1	2
4. Centre Lathe 1000 diax5000	2	2
5. Centre Lathe 1250 diax6000	1	2
6. Centre Lathe 1600 diax6000	1	1
7. Shaper 500 stroke	2	2
8. Shaper 610 stroke	1	1
9. Universal Milling Machine 320x1300	-	1
10. Universal Milling Machine 360x1600	1	1
11. Vertical Milling Machine 360x1600	1	1
12. Column Drilling Machine 25 dia.	2	2
13. Column Drilling Machine 38 dia.	2	2
14. Column Drilling Machine 50 dia.	1	
15. Radial Drilling Machine 40 dia.x1250	1	
16. Radial Drilling Machine 65 dia.2150	1	

II.13

17. Vertical Boring & Turning Machine 1050 dia.	-	1
18. Horizontal Boring Machine 63 dia.	1	1
19. Horizontal Boring Machine 100 dia	-	1
20. Horizontal Boring Machine 160 dia	1	1
21. Vertical Slotting Machine 900 stroke	1	1
22. Planetary Key Seating Machine 20	1	1
23. Planer 1500x1500x5000	-	1
24. Planer 1000x1000x3000	1	1
25. Chucking Turret 375 dia.	1	2
26. Bar Turret/Capstan 85 dia.	1	1
27. Automatic Cut Off Type Lathe 25 dia x 75	1	1
28. Screw Cutting Up Machine for Pipes 100 dia.	1	1
29. Vertical Surface Grinder 1500 dia	1	
30. Horizontal Surface Grinder 300x1000	1	1
31. Horizontal Surface Grinder 400x2000	1	1
32. Universal Grinder 300 diax1500	1	1
33. Gear Hobbing Machine	1	1
34. Double Ended Grinder 350 dia	3	3

(e) **Assembly and Testing Shop**

1.	Pillar Drill 38 dia.	1	1
2.	Alcut Bandsaw 20	1	1
3.	Pedestal Grinder 350 dia	2	2
4.	Welding Transformers 350A	2	2
5.	Work Benches	20	25
6.	Hydraulic Assembly Press 100 T	1	1
7.	Sulphur Testing Apparatus	1	1
8.	Carbon Testing Apparatus	1	1
9.	Composition Analysis - Apparatus	1	1
10.	Metallurgical Testing Apparatus	1	1
11.	Projection Microscope	1	1
12.	Electric Muffle Furnace	1	1
13.	Profile Projector	1	1
14.	Hardness Testing Machine	1	1
15.	Impact Testing Machine	1	1
16.	Tensile Testing Machine	1	1
17.	Universal Tool Room Microscope	1	1

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(f) Painting and Reassembly Shop

1.	Paint Booth	3	5
2.	Painting Guns	12	18
3.	Assembly Stands		
4.	Miscellaneous Equipment		

AUXILIARY EQUIPMENT

(a) Tool Room

1.	Saw Blade Sharpending Machine, 1200 dia.	1	1
2.	Twist Drill Grinder 80 dia.	1	1
3.	Tool and Cutter Grinder 250 dia.	1	1
4.	Tool Grinding & Lapping Machine 150 dia.	1	1
5.	Pedestal Tool Grinder 350 dia	2	2
6.	Tool Room Lathe 410 dia.x1000	1	1
7.	Universal Grinding Machine 250 dia x 1000	1	1
8.	Shaper - 610 Stroke	1	1
9.	Horisontal Milling Machine 360 x 1600	1	1

I.16

10. Induction Type Tool Tip Brazing Machine	1	1
11. Horizontal Surface Grinder 300 x 1000	1	1
12. Column Drilling Machine 38 dia	1	1
13. Chamber Furnace 450x450x250;1000°C	1	1
14. Chamber Furnace 250x250x150;1350°C	1	1
15. Vertical Alcut Bandsaw with Butt Welder	1	1

(b) Maintenance Shop

1. Centre Lathe 410 diax1000	1	1
2. Centre Lathe 410 diax1400	1	1
3. Centre Lathe 500 diax3000	1	1
4. Shaper - 610 stroke	1	1
5. Planer - 900x900x3600	1	1
6. Slotting Machine - 320 stroke	1	1
7. Radial Drilling Machine 40 diax 1250	1	1
8. Gear Shaper 100 dia x 1200	1	1
9. Surface Grinder 300 x 1000	1	1
10. Pedestal Grinder 300 dia.	2	2
11. Hand Lever Shear - 6	1	1
12. Arc Welding Set	1	2
13. Gas Welding Set	1	1
14. Pipe Cutting Machine	1	1
15. Pipe Bending Machine	1	1

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(c) **Material Handling Equipment**

1. E.O.T. Crane 5 T x 24 m	2	2
2. E.O.T. Crane 10 T x 24 m	3	3
3. E.O.T. Crane 20T x 24 m	2	2
4. E.O.T. Crane 30T x 24 m	1	1
5. E.O.T. Crane 60 Tx 24 m	1	1
6. Mobile Crane 5 T	3	3
7. Fork Lift Trucks 2 T	2	3
8. Swing Cranes 2 T x 8 m	3	5
9. Swing Crane 3 T x 8 m	2	3
10. Swing Crane 5 T x 8 m	2	3
11. Tractor 65 HP	1	1
12. Trailer 20 T	2	2

UTILITIES & SERVICE FACILITIES EQUIPMENT

	STAGE I	STAGE II
a) Electric Power Equipment including LT & HT Switchgears, transformers and cable network	3x1250 KVA Transformers	4x1250 KVA Transformers
b) Compressed Air Equipment including air compressors, inter coolers, after-coolers, air receivers and piping network	3x1000 NM^3/hr Compressors	4x1000 NM^3/hr Compressors
c) Water Supply System including water reservoir, pump and supply net work	-	-

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		STAGE I	STAGE II
d)	Transport Equipment including 2 Nos. of passenger cars and 2 Nos. of station wagons	-	-
e)	Space Heating Installation including boilers	2x10 T/hr Boilers	3x10T/hr Boilers
f)	Ventilation Equipment	-	-
g)	Weak Current Network including external and internal telephones, fire alaram system, public address system etc.	-	-
h)	Fire Fighting Equipment	-	-
i)	Medical and First Aid Equipment	-	-
j)	Canteen Furniture and Equipment	-	-
k)	Office furniture and equipment	-	-

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SECTION VII: AREA REQUIREMENTS

	Stage I	Stage II
Land	100,000 sqm	100,000 sq.m.
Buildings	Covered Area in sq.m	
1. Production Buildings		
a) Material Preparation Shop	1,728	1,728
b) Plate Fabrication Shop	4,608	5,760
c) Structural Fabrication Shop	1,152	1,728
d) Machine Shop	2,304	2,880
e) Assembly & Testing Shop	1,728	2,016
f) Painting & Reassembly Shop	1,152	1,440
Sub-Total (1)	12,672	15,552
2. Auxiliary Buildings		
a) Tool Room	1,152	1,152
b) Maintenance Shop	864	864
c) Electric Sub-station	480	480
d) Compressed Air Station	288	432
e) Boiler House	576	864
f) Stores	864	1,152
g) Open Stores for Rolled Stock	1,152	1,440
h) Fuel Oil Storage	288	432
i) Steel Yard for Casting & Forgings	576	864
j) Finished Product Storage	1,152	1,152
Sub-Total (2)	7,392	8,872

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		Stage I	Stage II
3.	**Non-Production Buildings**		
	a) Administration Building	864	864
	b) Canteen Building	864	1,148
	c) Main Gate, Time Office, First-Aid Room, Lockers, Fire Station, etc.	700	900
	d) Car Parks	400	600
	Sub-Total (3)	2,828	3,512
	TOTAL AREA (1+2+3)	22,892	27,896

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SECTION VIII : LAYOUT

A Layout Plan for the proposed plant is appended as Drawing No. 02.001. This has been developed bearing in mind the usual criteria such as flow of materials, minimum movement of materials and men, safety considerations etc.

Besides, an Equipment Layout Plan is attached as Drawing No. 02.002. This shows the relative dispositions of the equipment which will be installed in the various production and auxiliary sections.

SECTION IX : RAW MATERIALS & PROCESS INPUTS

RAW MATERIALS

	Stage I (Tonnes)	Stage II (Tonnes)
1. M.S. Plates	6,350	7,660
2. M.S. Sheets	645	850
3. M.S. Bars & Sections	1,520	3,240
4. Steel Pipes	240	320
5. Alloy Steels	425	640
Total :	9,180	12,710

AUXILIARY MATERIALS AND CONSUMABLES

The various auxiliary materials and consumables required will include the following :

1. Oils, Chemicals and Paints
2. Welding Electrodes
3. Packing Materials
4. Tools, Jigs and Fixtures
5. Miscellaneous Materials

UTILITIES AND ENERGIES

	Stage I	Stage II
1. Electrical Energy		
Power Load	4000 KW	4800 KW
Lighting Load	400 KW	500 KW
Total Connected Load	4400 KW	5300 KW
Maximum Demand	2400 KW	2900 KW

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	Stage I	Stage II
2. Compressed Air		
Maximum Simultaneous Demand	2000 NM^3/hr.	3000NM^3/hr
3. Water		
Average Requirements	100 m^3/day	150 m^3/day

4. Others

These include fuel oil/gas, Oxygen, Acetylene, Carbon Dioxide etc.

SECTION X: MANPOWER

	Number of Personnel	
	Stage I	Stage II
1. General Manager	1	1
2. Senior Managers	10	10
3. Managers	24	29
4. Supervisors (Technical)	85	105
5. Supervisors(Non-technical)	20	25
6. Clerical and Administrative Staff	60	75
7. Labour		
a) Skilled Workers	275	375
b) Semi-skilled workers	200	300
c) Unskilled Workers	125	200
TOTAL MANPOWER	800	1120

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SECTION XI : ECONOMICS

FIXED CAPITAL INVESTMENT

Item	Amount in 1000 US Dollars Stage I	Stage II
1	2	3
A. Civil Works		
A.1 Land	200	200
A.2 Site Development	300	300
A.3 Buildings		
1. Production Buildings	1,348	1,648
2. Auxiliary Buildings	407	479
3. Non-Production Buildings.	218	267
Sub Total(A.3)	1,973	2,394
A.4 Contingencies (@ 10% of A.1 to A.3)	247	286
Total (A(	2,720	3,180
B. Plant and Equipment		
B.1 Production Equipment		
(a) Material Preparation Shop	220	235
(b) Plate Fabrication Shop	3,445	3,515
(c) Structural Fabrication Shop	225	235
(d) Machine Shop	620	900

1	2	3
(e) Assembly & Testing Shop	40	40
(f) Painting and Re-assembly Shop	65	75
B.2 Auxiliary Equipment		
(a) Tool Room	70	70
(b) Maintenance Shop	200	200
(c) Material Handling Equipment	555	590
B.3 Utilities & Services Equipment		
(a) Electric Power Distribution System	575	650
(b) Compressed Air System	450	600
(c) Water Supply System	20	25
(d) Transport Equipment	35	50
(e) Space Heating Installation including Boilers	420	600
(f) Ventilation Weak Current, Fire Fighting, First Aid, Canteen & Office Equipment.	200	260
Total Equipment Cost(FOB/FOR)(B.1 to B.3)	7,140	8,045
B.4 Machine Accessories	714	805
B.5 Jigs & Fixtures	714	805

1		2	3
B.6	Cutting Tools & Hand Tools	357	402
B.7	Furniture and Fittings	357	402
B.8	Initial Spares	536	604
B.9	Procurement Charges, Freight, Insurance, Handling etc.	1,470	1,660
B.10	Erection & Commissioning of Equipment	821	977
B.11	Contingencies (@ 10% of B.1 to B.10)	1,211	1,370
	Total 'B'	13,320	15,070
C.	Projecting Costs		
C.1	Preliminary and Promotional Expenses	160	180
C.2	Project Reports, Designing and Engineering Fees	1,400	1,440
C.3	Technical know-how, Production Documentation & Training (In addition to Royalties)	2,050	3,025
C.4	Start-up Expenses	220	275
C.5	Project Establishment	640	730
	Total (C)	4,460	5,650
TOTAL FIXED CAPITAL INVESTMENT		20,500	23,900
	(Foreign Currency)	(11,925)	(13,850)

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WORKING CAPITAL

		Period in Months	Amount in 1000 US Dollars Stage I	Stage II
1.	Raw Materials & Bought Outs	4	2,147	3,172
2.	Auxiliary Materials & Consumables	4	245	350
3.	Energies and Utilities	1	17	23
4.	Salaries & Wages	1	145	198
5.	Administrative Overheads	3	56	83
6.	Insurance	3	40	46
7.	Maintenance	3	90	102
8.	Stock of Goods in Process (Cost of Production less Depreciation)	1	820	1,178
9.	Stock of finished goods(cost of sales less depreciation)	1	1,140	1,648
10	Total 1 to 9		4,700	6,800
11	Less Accounts receivable(Raw Materials & Bought Outs)		(-) 550	(-) 800
	Working Capital (10-11)		4,150	6,000
	(Foreign Currency)		(500)	(725)

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TOTAL CAPITAL INVESTMENT

	Amount in 1000 US Dollars	
	Stage I	Stage II
Fixed Capital Investment	20,500	23,900
Working Capital	4,150	6,000
Total Capital Investment	24,650	29,900
(Foreign Currency)	(12,425)	(14,575)

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ANNUAL COST OF SALES

#	Item	Unit	Unit Price in 1000 $	Stage I		Stage II	
				Qty.	Amount in 1000 US $	Qty.	Amount in 1000 US $
	1	2	3	4	5	6	7
A.	**Raw Materials**						
	(a) M.S.Plates	Tonne	230	6,350	1,461	7,660	1,762
	(b) M.S.Sheets	Tonne	250	645	161	850	213
	(c) M.S.Bars & Sections	Tonne	200	1,520	304	3,240	648
	(d) Steel Pipes	Tonne	335	240	81	320	107
	(e) Alloy Steels	Tonne	700	425	298	640	448
	Sub Total (A)				2,305		3,178
B.	**Intermediates (Bought Outs)**						
	(a) G.I. Castings	Tonne	330	495	164	915	302
	(b) Steel Castings	Tonne	600	885	531	1,535	921
	(c) Steel Forgings	Tonne	670	325	218	530	355
	Sub Total (B)				913		1,578
C.	**Bought Outs**						
	(a) Electric Motors	Tonne	4,000	510	2,040	765	3,060
	(b) Control Panels	US $		-	250	-	350

	1	2	3	4	5	6	7
	(c) Bearings	No	3	20,000	60	29,000	87
	(d) Fasteners & Fittings	Tome	1,100	270	297	400	440
	(e) Miscellaneous Materials	US $		-	270		370
	Sub Total (C)				2,917		4,307
D.	Auxiliary Materials and Consumables.				700		1,000
E.	Energies & Utilities				190		260
F.	Salaries & Wages				1,657		2,264
G.	Contingencies (@ 5% of A to F)				433		629
H.	Administrative Overheads				225		330
I.	Insurance				160		183
J.	Depreciation of Fixed Assets				1,414		1,603
K.	Amortization of Projecting Costs				446		565
L.	Maintenance				360		409
M.	Cost of Production(A to L)				11,720		16,306
N.	Selling Expenses including Dealer's Commission				2,865		4,233
O.	Royalties				955		1,411
	ANNUAL COST OF SALES(M+N+O)				15,540		21,950
	(Foreign Currency)				(1,950)		(2,[illegible])

SALES REALIZATION

Product	Unit	Unit Price (US $)	Annual Sales (1000 US $) Stage I	Stage II
1	2	3	4	5
1. Fabricated Vessels, Storage Tanks & Bins	Tonne	600	1,170	1,500
2. Heat Exchangers	Tonne	2,100	525	578
3. Furnaces & Kilns	Tonne	2,600	8,450	8,710
4. Conveyors	Tonne	2,500	1,000	5,625
5. Ball Mills	Tonne	2,000	2,600	3,500
6. Crushers	Tonne	1,500	1,500	2,625
7. Filters	Tonne	1,800	720	1,080
8. Screens	Tonne	1,800	270	360
9. Mechanical Equipment	Tonne	3,300	2,640	3,960
10 Technological Structures.	Tonne	45	225	282
Total			19,100	28,220

PROFITABILITY

	Unit	Stage I	Stage II
1. Gross Annual Profits	1000 US $	3,560	6,270
2. Total Capital Investment	1000 US $	24,650	29,900
3: Gross Annual Return on Total Capital Investment.	%	14.5	21.0

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4.	Value Added/annum	1000 US $	11,725	17,380
5.	Internal Rate of Return (Discounted Cash Flow Analysis)	%	11.8	16.7
6.	Pay Back Period	Years	5.5	4.5
7.	Foreign Exchange Savings/annum	1000 US $	17,150	23,360

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ANNEXURE III.3

PRE-FEASIBILITY STUDY

FOR

CONSTRUCTION MACHINERY PLANT

	Stage I	[illegible]
ANNUAL OUTPUT	670 Machines	1275 Mach[illegible]
WORKING DAYS/ANNUM	300	300
NO. OF SHIFTS	2	2

SECTION I : PRODUCT-MIX

PRODUCT	UNIT	Annual Output STAGE I	STAGE II
1. Dozers	No.	200	400
2. Graders	No.	200	400
3. Scrapers	No.	20	25
4. Shovel Loaders	No.	250	450
Sub-Total (1 to 4)	No.	670	1275
5. Spares	Tonne	1850	3500

SECTION II: BUY-OUTS

It is proposed that the plant shall buy out all castings and forgings (fully fettled), electric motors, controls, bearings etc. While the castings and forgings shall be machined in the plant, the other items will be merely assembled into final products. The annual requirements of bought-out items are estimated as follows :

S.No.	Bought-out Items	Unit	Annual Quantity Stage I	Stage II
1.	Intermediates (Castings & Forgings)			
	a) G.I. Castings	Tonne	730	1400
	b) Steel Castings	Tonne	2450	4650
	c) Steel Forgings	Tonne	260	500
2.	Engines	No.	804	1530
3.	Gear Boxes	No.	430	820
4.	Power Take Off Units	No.	265	510
5.	Wire Ropes	Metre	8700	16500
6.	Wheel Rims	No.	2785	5220
7.	Tyres & Tubes	No.	2785	5220
8.	Electricals	Tonne	335	640
9.	Hydraulics	Tonne	215	410
10.	Bearings	Tonne	40	77
11.	Fasteners and Fittings	Tonne	80	150

SECTION III : PRODUCT(S) DESCRIPTION

Product: BULL DOZER

Range of Manufacture 125 FWHP to 270 FWHP

Specification of Representative Product

Engine 180 FWHP at 1850 RPM

Draw Bar Pull 19600 Kg. (Max.)

Blade

Length x Height : 4260 x 1060 mm

Type : Angling and tilting

Controls : All hydraulic

Dimensions

Overall (LxWxH) : 5890x4260x3060 mm

Net Weight : 21 Tons

Attachments Possible

Angledozer

Rakedozer

Straight Tilt Dozer

Straight Dozer

Hydraulic Ripper

Towing Winch

Product SCRAPER

Range of Manufacture $10M^3$ to 29 M^3 (Heaped)

Specification of Representative Products

Capacity (Struck/Heaped) : 10.7 M^3/15.3 M^3

Engine : 307 BHP at 2100 RPM
285 FWHP at 2100 RPM

Speed Range : Forward : 6.4 to 28.00 Km/hr.
Reverse : 3.35 km/hr.

Gear Box : 6 Forward
1 Reverse

Controls : Hydraulic

Blades : Total Cutting : 2900
Centre Blades : 625 x 450 x 715
End Blades : 625 x 450 x715

Dimensions

Overall : 12230 x 3470 x 3390 mm

Net Weight: 24 Tons

Product LOADER

Range of Manufacture 93 FWHP to 180 FWHP

Specification of Representative Product

Engine 115 FWHP at 2000 RPM

Speed Range: 5.8 KM/hr. to 30 Km/hr.

Gear Box 3 forward
3 reverse

Shovel Bucket 1.5 M^3 heaped
1.3 M^3 Struck

Dimensions

Overall (LxWxH) - 3980x2660x2750

Net Weight - 9.6 T

Possible Attachments

Shovel

Front loader

Towing winch

Trench digger/back hoe

Side Crane

Scarifier or ripper

Product MOTOR GRADER

Range of Manufacture 90 FWHP to 150 FWHP

Specification of Representative Product

Engine	115 FWHP at 2000 RPM
Speed Range	3.5 KM/hr. to 40.7 Km/hr. (Toward)
	2.7 Km/hr. to 19.4 Km/hr. (Reverse)
Gear Box	6 forward
	3 reverse
Controls	Mechanical
Blade Dimensions	3660 x 634 (Around curve)
Maximum cutting Angle	90°
Shoulder reach	2.2 Mk, 2.37 M

Dimensions

Overall (LxWxH) - 7840 x 2340 x 2340

Net Weight : 10.6 T

Possible Attachments

Grader Blade

Scarifier

SECTION IV : MANUFACTURING PROCESS

The process involved in the manufacture of the products envisaged are :

a) **Plate Work** including

- Plate straightening
- Layout and marking
- Sawing and cutting (profile cutting, nibbling, sawing etc.)
- Plate bending
- Press work (Drawing, forming, blanking)
- Drilling
- Initial Welding - Arc

b) **Fabrication** including

- Section Straightening
- Welding
- Drilling
- Annealing
- Shot blasting

c) **Machining** including

- Turning
- Milling
- Boring
- Shaping, planing, slotting
- Screw cutting
- Broaching
- Grinding

d) **Assembly** including

- Corrective welding
- Sub-assembly and assembly

e) **Finishing** including

- Surface preparation
- Painting

SECTION V : PLANT FACILITIES

Based on the operations involved in the manufacture of the end-products, the following plant facilities would be included :

1. Production Facilities
   - (a) Plate Shop
   - (b) Fabrication Shop
   - (c) Machine Shop
   - (d) Paint Shop
   - (e) Assembly Shop.
2. Auxiliary Facilities
   - (a) Tool Room
   - (b) Maintenance Shop
   - (c) Material Handling Facilities.
3. Utilities and Service Facilities
   - (a) Electrical Sub-station and Distribution Network
   - (b) Compressed Air Generation and Supply Network
   - (c) Water Reservoir and Supply Network
   - (d) Transport Equipment
   - (e) Space Heating Installation including Boiler House
   - (f) Ventilation Equipment
   - (g) Weak Current Facilities
   - (h) Fire Fighting Facilities
   - (i) Medical and First Aid Facilities
   - (j) Canteen and other Welfare Facilities
   - (k) Administration Offices, Furniture and Office Equipment.

SECTION VI : PLANT AND EQUIPMENT

PRODUCTION EQUIPMENT

	Quantity (Nos) Stage I	Stage II
a) Plate Shop		
1. Cold Circular Saw 710 dia.	1	2
2. Band Saw 200	3	4
3. Hacksaw 225	1	1
4. Other saw	2	2
5. Flame Cutting Machine	10	15
6. Section Shear 20	1	1
7. Hand Shear for Plates - 5	2	2
8. GuillotineShear 3200 x 20	1	2
9. Nibbling Machine 8 x 1250	1	1
10. Press Brake 250 T (5000 x 10)	2	2
11. Press Brake 400 T (5000 x 15)	1	2
12. Hydraulic Press 250 T	1	1
13. Hydraulic Press 400 T	1	2
14. Mechanical Press (Box Type) 40T	1	2
15. Mechanical Press (Box Type) 150T	1	2
16. Mechanical Press (Box Type) 250 T	1	1
17. Plate Straightening Machine 4000 x 25	1	1
18. Edge Planer 6000	1	2

19. Angle Bending Machine 50 x 50 x 6	1	1
20. Plate Bending Roll 4000 x 25	1	2
21. Shaper - Stroke 610	1	1
22. Double Column Planer 900 x 900 x 3600	1	1
23. Radial Drilling Machine 50 dia x 2150	2	3
24. Radial Drilling Machine 65 dia x 2150	1	2
25. Column Drilling Machine 50 dia	1	2
26. Arc Weding Machine 400 A	4	6
27. Arc Welding Machine 600 A	3	5
28. Arc welding Machine 1000 A	1	2
29. Double-ended Pedestal Grinder 300 dia.	5	7

b) **Fabrication Shop**

1. Welding Transformer 400 A	30	40
2. Welding Transformer 600 A	40	45
3. Welding Rectifier 500 A	15	22
4. Argon Arc Welding Set 350 A	10	15
5. Projection Welding 150 kVA	1	2
6. Spot Welding Machine 100 kVA	2	3
7. Continuous Submerged Arc Welding machine 500 A	1	1
8. Radial Drilling machine 40 dia. x 1250	1	2
9. Radial Drilling, 50 dia. x 2150	1	1

10. Column Drilling Machine 25dia.	2	3
11. Straightening Press 40 T	1	1
12. Straightening Press 100 T	1	1
13. Annealing Furnace 3600x5000x 5400	1	1
14. Electrode Drying Oven 1000 x 1000 x 600	1	1
15. Shot Blasting Equipment 3000 x 10000	1	1
16. Double End Pedestal Grinder 300 Dia	2	3

c) Machine Shop

1. Centre Lathe 410 dia x 1000	29	40
2. Centre Lathe 410 dia x 3000	5	8
3. Centre Lathe 500 dia x 1500	8	12
4. Turret Lathe 375 dia.	5	7
5. Turret Lathe 500 dia.	5	7
6. Vertical Turret 1050 dia.	1	1
7. Vertical Turret 3000 dia	1	1
8. Copying Lathe 410 dia x 1000	1	1
9. Horizontal Boring Machine 63 dia	5	7
10. Horizontal Boring Machine - 100 dia.	3	3
11. Horizontal Boring Machine - 160 dia.	1	2
12. Special Boring Machine	1	1
13. Shaper - 500 Stroke	1	2

14. Shaper - 610 stroke	2	3
15. Shaper - 700 Stroke	.2	3
16. Slotter - 900 Stroke	2	3
18. Planer 3000 x 3000 x 12000	1	1
19. Broaching Machine 25 Tx1000	1	1
20. Horizontal Milling Machine 310 x 1100	4	6
21. Horizontal Milling Machine 360 x 1600	2	3
22. Universal Milling Machine 360 x 1600	4	6
23. Universal Milling Machine 425 x 2000	4	6
24. Vertical Milling Machine 360 x 1600	3	4
25. Bench Drill 13 dia.	3	4
26. Radial Drilling Machine 25 dia x 1600	2	2
27. Radial Drilling Machine 40 dia x 1250	3	4
28. Radial Drilling Machine 50 dia x 2150	2	4
29. Multispindle Drills 10 x 13 dia.	2	3
30. Deep Hole Drills 15 x 800	1	1
31. Column Drilling Machine 50 dia.	5	8
32. Internal Grinder 80 dia	3	5
33. Horizontal Surface Grinder 200 x 630	2	3

34. Horizontal Surface Grinder 400 x 2000	1	2
35. Cylindrical Grinder 260 x 800	2	3
36. Cylindrical Grinder 450 x 2000	2	3
37. Centerless Grinder 3 dia -60	2	2
38. Keyway Milling Machine 25 x 200	1	1
39. Thread Milling Machine, 100 dia.	1	1
40. Centering Machine	1	1
41. Honing Machine 150 dia.	1	1
42. Tapping Machine 25 dia.	3	4
43. Pipe Threading Machine 100 dia.	1	1
44. Hacksaw 200	4	6
45. Cold Circular Saw 710 dia.	4	7
46. Bar Straightening Machine 25 dia.	1	1

d) **Paint Shop**

1. Paint Booth	3	5
2. Painting Guns	12	18
3. Miscellaneous Equipment		

e) **Assembly Shop**

1. Link Assembly Press, 150 T (hydraulic)	2	2
2. Link Assembly Press (50 - 150 T) (Mechanical)	11	11

3. Arbour Press 300 T	4	4
4. Arc Welding Set 300 A	4	4
5. Gas Welding Set	2	2
6. Washing Equipment	2	2
7. Oil Heater	4	4
8. Static Balancer	3	3
9. Pedestal Grinder	7	7
10. Bolt Clamping Device	12	12
11. Assembly Stands		

AUXILIARY EQUIPMENT

a) Tool Room

1. Centre Lathe 330 dia x 700	3	3
2. Centre Lathe 410 dia x 1000	1	1
3. Shaper - 500 stroke	1	1
4. Slotter - 250 stroke	1	1
5. Universal Milling Machine 360x1600	3	3
6. Universal Tool Milling Machine 640 x 220	1	1
7. Radial Drilling Machine 25 dia x 1600	2	2
8. Column Drilling Machine 25 dia.	2	2
9. Surface Grinder 300 x 1000	1	1
10. Cylindrical Grinder 260 x 800	1	1

11. Internal Grinder 80 dia	2	2
12. Twist Drill Grinder 50 dia.	1	1
13. Profile Grinder 25 dia.	1	1
14. Pedestal Grinder 300 dia.	3	3
15. Carbide Tip Tool Grinder 153 dia.	2	2
16. Knife Grinder 4000	1	1
17. Saw Blade Grinder 20diax350	1	1
18. Universal Tool & Cutter Grinder 200 dia x 230	3	3
19. Jig Boring Machine	1	1
20. Engraving Machine	1	1
21. Hacksaw 225 dia.	1	1
22. Hacksaw 300 dia.	1	1
23. Furnace	3	3

b) Maintenance Shop

1. Centre Lathe 410 dia x 1000	2	2
2. Centre Lathe 440 dia x 1500	1	1
3. Centre Lathe 500 dia x 3000	2	2
4. Shaper - 700stroke	1	1
5. Planer - 900 x 900 x 3600	1	1
6. Slotter - 400 stroke	1	1
7. Radial Drilling Machine 40 Dia x 1250	1	1
8. Universal Milling Machine 400 x 1600	2	2
9. Gear Shaper 750 dia.	1	1
10. Surface Grinder 300x1000	1	1

11. Cylindrical Grinder 350x1200	1	1
12. Pedestal Grinder 300 dia.	2	2
13. Hand Lever Shear 6 mm	1	1
14. Arc Welding Machine	1	1
15. Gas Welding Set	1	1
16. Pipe Cutting Machine 220 dia.	1	1
17. Pipe Bending Machine 100 dia.	1	1

c) Material Handling Equipment

1. E.O.T. Crane 5 T x 24 m	5	5
2. E.O.T. Crane 5 T x 30 m	1	1
3. E.O.T. Crane 10 T x 24m	5	5
4. E.O.T. Crane 15 T x 24m	2	2
5. E.O.T. Crane 30 T x 24 m	3	3
6. Jib Crane 0.5 T x 4 m	4	6
7. Floor Operated Crane 1.5 T	1	1

UTILITIES AND SERVICE FACILITIES EQUIPMENT

a) Electric Power equipment including H.T. and L.T. Switchgear, transformers and cable network.	4x1250 KVA Trans-formers	6x1250 KVA Trans-formers
b) Compressed Air equipment including air compressors, intercoolers, after-coolers, air receivers, piping network.	3 x1000 $NM^3/hr.$ compress-ors	4 x 1000 $NM^3/hr.$ Compre-ssors

c) Water supply system including water reservoir, pump and supply network.		
d) Transport Equipment including 2 Nos. of station wagons.		
e) Space Heating Installation including boilers	2x10T/hr Boilers	3x10 T/hr. Boilers
f) Ventilation Equipment		
g) Weak current Network including external and internal telephones, fire alarm system, public address system etc.		
h) Fire Fighting Equipment		
i) Medical and First Aid Equipment.		
j) Canteen Furniture and Equipment		
k) Office Furniture and Equipment		

SECTION VII : AREA REQUIREMENTS

	Stage I	Stage
Land	200,000 sq.m	200,000 sq.m
Buildings	**Covered Area in sq.m.**	
1. **Production Buildings**		
a) Plate Shop	3,168	4,000
b) Fabrication Shop	6,336	9,000
c) Machine Shop	4,896	6,500
d) Paint Shop	2,016	3,000
e) Assembly Shop	3,168	5,200
Sub Total (1)	19,584	27,700
2. **Auxiliary Buildings**		
a) Tool Room	864	864
b) Maintenance Shop	1,152	1,152
c) Electric Sub-Station	480	480
d) Compressed Air Station	480	480
e) Boiler House	864	864
f) Main Stores	1,440	1,440
g) Open Stores for Rolled Stock	3,960	5,000
h) Fuel Oil Storage	360	500

i) Oils, Paints & Chemical Storage	576	576
j) Finished Product Stores	4,800	6,200
Sub-Total (2)	14,976	17,556

3. Non-Production Buildings

a) Administration Building	4,000	5,000
b) Canteen Building	1,152	1,600
c) Fire Depot	720	720
d) Main Gate, Time Office & First Aid Room	720	720
e) Cycle Stand-Cum-Car Park	480	600
Sub-Total (3)	7,072	8,640
Total Area (1+2+3)	41,632 m	53,896

SECTION VIII: LAYOUT

A Layout Plan for the proposed plant is appended as Drawing No.03.001. This has been developed bearing in mind the usual criteria such as flow ofmaterials, minimum movement of materials andmen, safety considerations etc.

Besides, an Equipment Layout Plan is attached as Drawing No. 03.002. This shows the relative dispositions of the equipment which will be installed in the various production and auxiliary sections.

SECTION IX : RAW MATERIALS AND PROCESS INPUTS

RAW MATERIALS

	Item	Stage I	Stage II
1.	M.S.Plates	5,475 tonnes	10,425 tonnes
2.	M.S.Bars and Sections	1,825 tonnes	3,475 tonnes
3.	Steel Pipes	15 tonnes	30 tonnes
	Total	7,315 tonnes	13,930 tonnes

AUXILIARY MATERIALS AND CONSUMABLES

The various auxiliary materials and consumables required will include the following:

1. Oils, Chemicals & Paints
2. Welding Electrodes & Fluxes
3. Packing Materials
4. Tools, Jigs & Fixtures
5. Miscellaneous Materials

UTILITIES AND ENERGIES

		Stage I	Stage II
1.	Electrical Energy		
	Power Load	6000 KW	9000 KW
	Lighting Load	500 KW	700 KW
	Total Connected Load	6500 KW	9700 KW
	Maximum Demand	3500 KW	5200 KW

	Stage I	Stage II
2. Compressed Air		
Maximum simultaneous Demand	1600 NM^3/hr	3000 NM^3/hr
3. Water		
Average Requirement	200 m^3/day	280 m^3/day

4. Others

These include Fuel Oil/Gas, Acetylene, Oxygen etc.

SECTION X : MANPOWER

		No. of Personnel	
		Stage I	Stage II
1.	General Manager	1	1
2.	Senior Managers	14	14
3.	Managers	45	60
4.	Supervisors (Technical)	180	255
5.	Supervisors (Non-Technical)	35	45
6.	Clerical and Administrative Staff	100	125
7.	Labour		
	(a) Skilled Workers	600	875
	(b) Semi-skilled Workers	450	650
	(c) Unskilled Workers	300	425
	TOTAL MANPOWER	1725	2450

SECTION XI : ECONOMICS

FIXED CAPITAL INVESTMENT

Item		Value in 1000 US Dollars	
		Stage I	Stage II
1		2	3
A.	**Civil Works**		
A.1	Land	400	400
A.2	Site Development	450	600
A.3	**Buildings**		
	1. Production Buildings	1,846	2,625
	2. Auxiliary Buildings	658	710
	3. Non-Production Buildings	573	700
	Sub Total (A.3)	3,077	4,035
A.4	Contingencies (@ 10% of A.1 to A.3)	393	505
	TOTAL (A)	4,320	5,540
B.	**Plant and Equipment**		
B.1	**Production Equipment**		
	a) Plate Shop	1,025	1,530
	b) Fabrication Shop	915	975
	c) Machine Shop	2,030	2,690
	d) Paint Shop	55	75
	e) Assembly Shop	260	265

1		2	3
B.2	Auxiliary Equipment		
	a) Tool Room	220	220
	b) Maintenance Shop	200	200
	c) Material Handling Equipment.	640	645
B.3	Utilities & Services Equipment		
	a) Electric Power Distribution System	900	1,300
	b) Compressed Air System	450	600
	c) Water Supply System	35	40
	d) Transport Equipment	45	60
	e) Space Heating Installation.	700	1,000
	f) Ventilation, Weak Current, Fire Fighting, First Aid, Canteen and Office Equipment.	275	400
	Total Equipment Cost (FOB/FOR)(B.1 to B.3)	7,750	10,000
B.4	Machine Accessories	775	1,000
B.5	Jigs & Fixtures	775	1,000
B.6	Cutting Tools and Hand Tools.	387	500
B.7	Furniture & fittings	387	500
B.8	Initial Spares	581	750

1.		2.	3.
B.9	Procurement Charges, Freight, Insurance, Handling etc.	1,599	2,063
B.10	Erection & Commissioning of Equipment.	891	1,150
B.11	Contingencies (@ 10% of B.1 to B.10)	1,315	1,697
	TOTAL (B)	14,460	18,660
C.	Projecting Costs		
C.1	Preliminary and Promotional Expenses	200	250
C.2	Project Reports, Designing and Engineering Fees.	1,500	1,815
C.3	Technical Know-how, Production Documentation and Training (In addition to Royalties)	2,650	4,850
C.4	Start-up Expenses	320	515
C.5	Project Establishment	750	970
	TOTAL (C)	5,420	8,400
	TOTAL FIXED CAPITAL INVESTMENT	24,200	32,600
	(Foreign Currency)	(11,530)	(16,140)

III.28

WORKING CAPITAL

	Item	Period in months	Amount in 1000 US $ Stage I	Stage II
1.	Raw Material & Bought Outs	4	3,410	6,500
2.	Auxiliary Materials & Consumables	4	413	863
3.	Utilities & Energies	1	24	35
4.	Salaries and Wages	1	416	580
5.	Administrative Overheads	3	106	185
6.	Insurance	3	48	61
7.	Maintenance Materials	3	101	130
8.	Stock of Goods in Process and Finished Goods (Cost of Production Excluding Depreciation)	1	1,505	2,581
9.	Accounts Receivables (Cost of Sales excluding Depreciation)	1	1,780	3,100
10.	Total (1 to 9)		7,803	14,035
11.	Less Accounts Payable (Cost of Raw Materials &Bought Outs)	1	(-) 853	(-)1,625
	Net Working Capital (10-11)		6,950	12,410
	(Foreign Currency)		(1,395)	(2,680)
	TOTAL CAPITAL INVESTMENT			
1.	Fixed Capital Investment		24,200	32,600
2.	Working Capital		6,950	12,410
	Total Capital Investment (1+2)		31,150	45,010
	(Foreign Currency)		(12,925)	(18,820)

II.29

ANNUAL COST OF SALES

Item	Unit	Unit price in US $	Stage I Qty.	Stage I Amount in US $	Stage II Qty.	Stage II Amount in US $
1	2	3	4	5	6	7
A. Raw Materials						
a) M.S. Plates	Tonne	230	5,475	1,259	10,425	2,398
b) M.S Bars and Sections	Tonne	200	1,825	365	3,475	695
c) Steel Pipes	Tonne	335	15	5	30	10
Sub Total (A)				1,629		3,103
B. Intermediates (Bought-out)						
a) G.I. Castings	Tonne	330	730	241	1,400	462
b) Steel Castings	Tonne	600	2,450	1,470	4,650	2,780
c) Steel Forgings	Tonne	670	260	174	500	335
Sub Total (B)				1,885		3,577
C. Bout-outs						
a) Engines	No.	2,500	804	2,010	1,530	3,825
b) Gear Boxes	No.	1,000	430	430	820	820

1	2	3	4	5	6	7
c) Power Take off Units	No.	1,200	265	318	510	612
d) Wire Ropes	Metre	4	8,700	35	16,500	66
e) Wheel Rims	No.	70	2,785	195	5,220	365
f) Tyres & Tubes	Set	300	2,785	836	5,220	1,566
g) Electricals	Tonne	4,000	335	1,340	640	2,560
h) Hydraulics	Tonne	4,000	215	860	410	1,540
i) Bearings	Tonne	3,000	40	120	77	291
j) Fasteners and Fittings	Tonne	1,100	80	88	150	165
Sub Total (C)				6,232		11,910
D. Auxiliary Materials and Consumables				1,455		2,465
E. Energies and Utilities				275		400
F. Wages and Salaries				4,756		6,633
G. Contingencies (@ 5% if A to F)				810		1,400
H. Administrative Overheads				425		740
I. Insurance				190		243

1.	2.	3.	4.	5.	6.	7.
J.	Depreciation of Fixed Assets.			1,576		2,032
K.	Amortization of Projecting Costs			542		840
L.	Maintenance			405		522
M.	Cost of Production (A to L)			20,180		33,865
N.	Selling Expenses including Dealer's Commission			2,100		3,945
O.	Royalty			1,200		2,250
	ANNUAL COST OF SALES			23,480		40,060
	(Foreign Currency)			(4,300)		(8,225)

SALES REALIZATION

Product	Unit	Unit Price in US $	Annual Sales Value (1000 U.S. $ Stage I	Stage II
1. Dozers	No.	36,000	7,200	14,400
2. Graders	No.	22,500	4,500	9,000
3. Scrapers	No.	65,000	1,300	1,625
4. Shovel Loaders	No.	36,000	9,000	16,200
Sub-Total (1 to 4)			22,000	41,225
5. Spares	Tonne	3,250	6,000	11,375
Total Annual Sales Value			28,000	52,600

PROFITABILITY

	Unit	Stage I	Stage II
1. Gross Annual Profits	1000 US $	4,520	12,540
2. Total Capital Investment	1000 US $	31,150	45,010
3. Gross Annual Return on Total Capital Investment	%	14.5	27.9
4. Value Added/Annum	1000 US $	15,950	30,070
5. Internal Rate of Return	%	10.3	18.6
6. Pay Back Period	Years	6.5	4.55
7. Foreign Exchange Savings/annum	1000 US $	24,450	46,770

I.I.33

SOME FIGURES
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AND WILL NOT
BE PHOTOGRAPHED.

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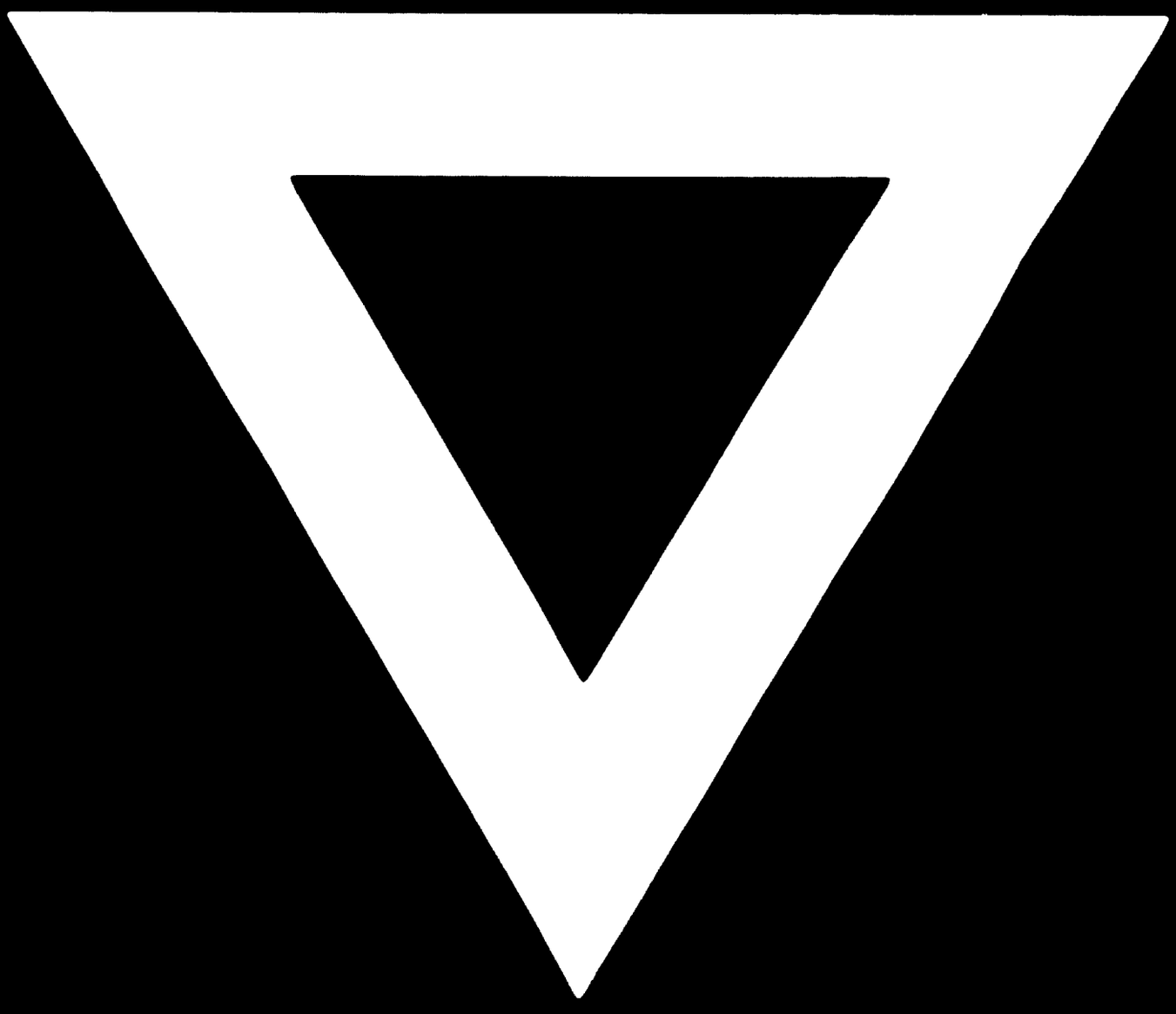

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