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FOURTH FIVE YEAR PLAN

# REPORT OF THE WORKING GROUP FOR FERTILIZER AND CHEMICAL EQUIPMENT

ING GROUP ON MACHINERY INDUSTRIES

REPORT OF THE WORKING GROUP

FOR

# FERTILIZER AND CHEMICAL EQUIPMENT

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# 1. INTRODUCTION

1.1. The Government of India, by Notification No. M. E. Ind. 9(16)/63 dated the 30th September, 1963, constituted a Working Group for Fertiliser and Chemical Equipment to advise on planning for the manufacture of equipment for fertiliser, petroleum refining, petro-chemical and other heavy chemical industries as part of planning machinery industries, in the Fourth Plan. The Terms of Reference given to this Working Group and the names of the members and those associated with the group are reproduced as Annexure I to this Report. The Working Group had five meetings on 14-10-1963, 7-11-1963, 30-11-1963, 11-1-1964 and 18-5-1964.

1.2. The Working Group had submitted an Interim Report in December, 1963, particularly with respect to the establishment of a fabrication shop to meet the requirements of the chemical industries in pressure vessels, heat exchangers, etc. This report was necessitated consequent on a brief study made by the Group of the facilities available in the country. It was felt by the Working Group that immediate steps should be taken by the Government of India to set up a fabrication shop to meet the requirements in the early years of the Fourth Plan. While this report was being made, the Working Group had already sent round a questionnaire to various organisations in the country in order to obtain full details of the requirements of heavy chemical industries covered by this Working Group. These replies have been received subsequently and this final report is now based on the details that are available now to the Working Group.

## 2. ASSESSMENT OF REQUIREMENTS

2.1. The assessment of machinery has been based on the tentative production targets of petroleum, fertiliser and heavy chemicals etc., indicated by the Perspective Planning Division of the Planning Commission. The targets of increase in production during the Fourth and Fifth Five Year Plan periods have been indicated to be:

(a) 200,000 Tonnes of Nitrogen from two Nitrogen factories each of 100,000 tonnes per year capacity to be established every year.

(b) 100,000 Tonnes of $P_2O_5$ capacity to be established every year.

(c) 350,000 tonnes of Sulphuric Acid capacity to be established every year, each plant having a minimum capacity of 320 tonnes a day.

(d) 70,000 tonnes each of Caustic Soda and Soda Ash to be established every year. The minimum size of Caustic Soda Plant being 50 tonnes a day and that of Soda Ash 400 tonnes a day.

(e) 2 million tonnes of Petroleum refining capacity to be established every year.

The estimate of the requirements of equipment falling within the scope of the Working Group has been tabulated and consolidated in Tables attached to this report as Annexure II. As no firm data was available regarding the establishment of capacities of petro-chemical industries, for the purpose of estimating the requirements of such equipments, the Working Group has assumed an increase of 10% of total assessment made for the other industries.

2.2. The type of equipments, required, for these industries have been categorised as follows:

*Category:*

I—Vessels, Heat Exchangers and Large Diameter Pipes.

II—Steam Raising & Waste Heat Boilers.

III—Pipes and Pipe Fittings.

IV—Valves.

V—Conveyors and Elevators.

VI—Pumps, Compressors, Fans & Blowers.

VII—Electrical Equipment.

VIII—Furnaces.

IX—Crushers and Grinders

X—Air Separation Plants.

XI—Instruments.

XII—Others.

2.3. The above categories have been devised to enable a close assessment of equipments required for the industries covered by this Working Group. It will, however, be noted that many of the categories will have to be studied in relation to the development of other industries in the country, but which have not been included here. The overall assessment for the country for such categories is being made by other Working Groups. Such categories will require separate specific proposals. To enable such an overall assessment for the country, all the data collected by this group have been furnished to the respective groups. As an example, all the Electrical requirements studied by this Working Group for Petroleum refining, Fertilisers, Heavy Chemicals, have been furnished to the Working Group on Electrical Power Equipment (Group I) who will be obtaining similar data from other working groups as well, with a view to establishing the overall needs of the country.

2.4. Similarly Heavy forgings included under Category I are already planned to be manufactured in the Heavy Engineering Corporation Ltd., Ranchi. The requirements of the fertiliser industry, it is understood, were taken into account while the discussions were held in connection with this project with the Russian Team. The information collected by the group has, therefore, been forwarded to them and to the Working Group on Engineering Industries (Group X)—(*Vide* letter No. M.E. Ind. 9(16)/63, dated 30th September, 1963).

2.5. Under Category II, Steam Raising and Waste Heat Boilers have been listed, but it is felt that the fabrication of steam raising units of large capacities, either for process steam requirements or for power generation, should be preferably dealt with by factories established and specialised in the manufacture of boilers, although it would be advisable to take on the fabrication of waste heat boilers in the fabrication shop proposed mainly for catering to the requirements of the chemical industry. Therefore the information regarding the requirements of steam raising units, have been passed on to the Working Group on Electrical Power Equipment (Group I).

2.6. Pipes and Pipe Fittings (Category III) while required in fairly large quantities for use in the manufacture of heat exchangers as also for fabrication of pipelines in factories, do not normally come within the scope of a chemical process vessels manufacturing plant, and should be taken up by a factory installed for the manufacture of pipes and which will cover not only the requirements of industries coming under the scope of the present report, but also other similar industries being dealt with by separate Working Groups set up by the Government. The information collected in this connection therefore have been passed on to the Working Group on Engineering Industries (Group X).

2.7. The above remarks would apply to Valves (Category IV) with the exception of stainless steel valves which are normally required only by chemical industries, and which it would be reasonable to include within the scope of a chemical plant manufacturing unit.

2.8. Conveyors and Elevators (Category V) required also could similarly be treated along with similar requirements of other industries requiring handling equipment for large volume of solid handling such as cement, mining, etc. The Working Group on Industrial Machinery (Group VII) have been apprised of this requirement.

2.9. The requirements of Pumps, Compressors, Fans and Blowers (Category VI) can be dealt with by a plant specialising in the manufacture of such items and which it is understood is already under consideration. It is understood that a Russian Team is already working on setting up a factory for these types of equipment taking into account the overall requirements of the country wherein the requirements of the fertiliser and chemical industries have also been assessed. The information has therefore been passed on to the Working Group on Industrial Machinery (Group VII).

2.10. Electrical Equipment (Category VII) could similarly be more conveniently handled by the Group working on the manufacture of similar types of equipment. The data collected by this Working Group has been passed on to the Working Group on Electrical Power Equipment (Group I) for processing.

2.11. Category VIII deals with Furnaces which are predominantly items involving plate fabrication and which can conveniently be undertaken by the plate shop. An approximate plate work tonnage involved under this item has already been included within the estimated tonnage to be handled

in the plate shop, and no separate action is required in this regard.

2.12. Crushers and Grinders (Category IX) are proposed to be manufactured by the Heavy Engineering Corporation Ltd., Ranchi. They are understood to have started work on the design and standardisation of such equipment. The requirements of the fertiliser industry as envisaged at that time had already been passed on to the Committee which was entrusted with the job of finalising the agreement with the Russian Team for the Heavy Engineering Corporation Ltd., and therefore a certain percentage of the requirements indicated in the present report must have been included in the production programme of heavy machinery building plant. It is, therefore, felt that it would be sufficient if the present assessment of our requirements of this class of equipment is forwarded to the Heavy Engineering Corporation. The requirement has been passed on to the Working Group on Industrial Machinery (Group VII). In case some of the items have to be fabricated in the chemical plant equipment shop proposed, this can be done in most cases, as the types of operations involved in the manufacture of many of the equipment are within the scope of the proposed shop.

2.13. Air Separation and Gas Separation plants (Category X) involve the use of equipment which can be fabricated by the chemical plant manufacturing shop except for the compressors and turbines which will fall within the scope of the pumps and compressors plant, and therefore can be fabricated by co-ordination between these two shops. In this case the main requirement is the know-how for the design of the plant and facilities for handling special materials like aluminium, stainless steel, etc. Before these can be manufactured in the country, it will be necessary to establish a collaboration agreement with a firm or firms experienced in this line, under whose supervision and instructions designs can be made and fabrication undertaken to meet the special needs of operation of these units.

2.14. Instruments (Category XI) will, it is believed, fall within the scope of the proposed factories in Rajastan and Kerala being set up with Russian assistance, and therefore the requirements as compiled had been passed on to the concerned group.

2.15. Other equipment (Category XII) such as weighing and bagging machine, scrapers, etc., required by the fertiliser and allied industries will also have to be dealt with after collecting complete information on the total requirements of

the country, as the requirements indicated in this report by themselves will not justify the installation of a Separate Shop, or establishing special facilities. Many of the operations however may be of such a nature that can be undertaken in a normal fabrication shop, and if necessary some small additional equipment may be installed to cover the gap and make the shop capable of manufacturing this type of equipment also.

2.16. The information of the categories was furnished to other working groups for incorporation in their report. Likewise, the other working groups were requested to furnish information of their requirements of plate and vessel work for incorporation in this report. Since no replies have been received from the other working groups it has been presumed that, there will be no need to add to the quantities already circulated by this working group.

2.17. In view of the above, it is proposed to deal with the requirements, in detail, of the various industries falling within the category of plate work, heat exchangers, etc., with particular reference to the manufacture of pressed parts, vessels, operating under conditions of medium pressures, say up to 600 psig., vessels of special materials like stainless steel, and other alloy steel for valves, pumps, etc., used for corrosive duties. The last item, although it is not really within the scope of a plate shop, has been included only because there is practically no appreciable capacity in the country for the supply of quality stainless steel or similar alloy steel castings. This shop will also be equipped to prefabricate pressure pipes to the special requirements of heavy chemical plants, including bending, coiling, providing with flanges etc.

2.18. From a perusal of the tabulations made with particular reference to plate work and heat exchangers to be manufactured, it will be seen that the annual requirements for the industries covered by this working group as estimated would be approximately as follows:

| | | |
|---|---|---|
| (*i*) Mild Steel Fabrication up to | 20—mm thick | 16,700 tonnes |
| ,, | 20—40 mm thick | 3,800 tonnes |
| ,, | 40—70 mm thick | 1,100 tonnes |
| (*ii*) Heat Exchangers (tubes of up to 450 mm dia) including small waste heat boilers. | | 3,000 tonnes |
| (*iii*) Stainless steel and other alloy steel fabrication | | 1,400 tonnes |
| | TOTAL | 26,000 tonnes |
| (*iv*) Add 10% for Petro-chemical Industries | | 2,600 tonnes |
| | TOTAL | 28,600 tonnes |

Of the above, vessels to an aggregate tonnage of over 6,000 tonnes will have to be radiographed either fully or partly and over 6,000 tonnes of vessel will have to be fully stress relieved. Provision is therefore required for the installation of the necessary equipment for the assembly and welding of this quantity of equipment, in addition to necessary provision for radiography, stress relieving, etc. In view of the large tonnage of tubes to be expanded or welded on tube plates in the fabrication of heat exchangers, it will be necessary to provide sufficient number of mechanical tube expanders with control equipment to ensure proper expansion of the tubes into plates at a fast rate. Other equipment for manipulation of pipes for fabrication to customers' requirements for various plant units, will also have to be provided, although the amount of equipment required for this will be comparatively small.

2.19. The estimated cost of fabrication of the above quantities of equipment according to present rates obtainable from well known manufacturers in the country, would be as follows:

| | Rs. in lakhs |
|---|---|
| 16,700 tonnes of lighter vessels @ an average price of Rs. 2,700 per tonne. | 450.90 |
| 4,900 tonnes of heavy vessels @ Rs. 5,000 per tonne . . | 245.00 |
| 3,000 tonnes of heat exchanger work @ Rs. 3,500 per tonne . | 105.00 |
| 1,400 tonnes stainless steel and other alloy steel fabrication @ Rs. 12,000 per tonne. | 168.00 |
| | 968.90 |
| *Add* 10% for petrochemical Industries . . . . . | 96.89 |
| TOTAL Rs. | 1,065.79 |
| *or say* Rs. | 11 crores |

## 3. ASSESSMENT OF AVAILABLE CAPACITY

3.1. With a view to assessing the capacity available in India, for the production of similar equipments to the specifications required by the chemical industry, visits to a number of shops were undertaken by some of the members of the Working Group and other experts at the request of the Working Groups. The report of these visits are given in Annexure III.

3.2. As a result, it was found that practically all the shops in the country are busy, and deliveries of the order of 18 to 24 months appears to be the best that can be obtained under the present circumstances. Some of the shops, such as TELCO, UTKAL Machinery etc., seem to be expecting quite a volume of work to be done in the near future in connection with the expansion or additional units proposed to be installed by themselves, their associates or their collaborating companies, with the result that it may turn out that at the time we require equipment fabricated for chemical and fertiliser industry, these shops may not be in a position to undertake such work. Again, as in the case of AVB, Durgapur, although some of the shops are equipped to take on work of this nature, they are reluctant to undertake manufacture of such items as heat exchangers horton-spheres, etc., as they feel that it may not be worthwhile for them to diversify their output beyond a certain extent, as their main objective in installing the factory was the manufacture of steam generation equipment and equipments and machinery for the cement industry.

3.3. Besides the action taken as mentioned in 3.2 above, the Chairman, Convener and some of the members of the Working Group had a discussion with Fabricators in the country to assess the problems of the industry in all aspects. The minutes of this meeting held at Bombay with the representatives of various firms are given in Annexure IV.

3.4. It was clear from these visits and discussions that the country has only limited choice of manufacturers to undertake work for the fertiliser and chemical industry, with a guarantee on quality. Even among such Fabricators, it appears that it may not be possible for us to obtain our full requirements both as regards type of fabrication involved as well as in quantities that we may require. With the increase in the requirements for plant and machinery for other industries such as cement, paper, sugar, etc., even the comparatively small spare capacity that may be at present

available in the various shops would be fully utilised for those purposes.

3.5. This leads us to the conclusion that it will be necessary for the country to provide the necessary additional shop facilities, having sufficient capacity and capable of manufacturing high quality goods to meet the demands of the fertiliser, pertoleum and other heavy chemical industries. The stress on quality needs to be emphasised at this stage.

## 4. RECOMMENDATIONS

4.1. With this end in view, the working group proposes that a fabrication shop having the pattern of capacities as indicated below, be set up immediately even before the beginning of the Fourth Plan with a provision for expansion to double this capacity within two to three years of commencement of production.

| | | |
|---|---|---|
| (*i*) | Class I.M.S. Vessels . . . . . | 3,000 tonnes |
| (*ii*) | Class II ,, . . . . . | 1,000 tonnes |
| (*iii*) | Class III ,, . . . . . | 1,000 tonnes |
| (*iv*) | Miscellaneous Plate Work . . . . . | 1,500 tonnes |
| (*v*) | Heat Exchangers . . . . . | 3,000 tonnes |
| (*vi*) | S.S. and other Alloy Steel Vessels . . . | 1,000 tonnes |
| (*vii*) | S.S. Castings . . . . . | 200 tonnes |

(*viii*) Associated structural work to the extent needed will also be taken up.

In the other words the expansion is planned on high quality works only.

4.2. The capacity now recommended for immediate implementation, it may be seen, falls below 50 per cent of the requirements estimated for the Fourth Five Year Plan. This has been suggested to enable the execution of the project in stages due to the fact that shop of this nature requiring highly skilled techniques would take time in training workers to achieve high levels of productivity and attain proficiency in their jobs. The installation of a very large shop to start-with may be found to be more difficult than would be the case if the shops were of a modest capacity (to start with) and later on increased to the full required output in two stages. This is particularly relevant in the context of the directive that this shop should be ready to go into operation by the beginning of the Fourth Five Year Plan. This will also give us the benefit of actual working experience with the various operations involved and to enable taking correct decisions at the time of expanding the capacity in such a way that by the end of the Fourth Five Year Plan the fabrication shop will have sufficient equipment and floor space to operate efficiently. As by suitable layout of the factory and provisions made in the initial stages themselves, such a factory could be

expanded without interruption to work, it may not be disadvantageous if this is done in two stages rather than in one stage.

4.3. The Interim Report submitted by this Working Group had recommended that immediate steps be taken for organising the installation of a 5000 tonnes a year fabrication shop with the ultimate object of expanding the same to 10,000 tonnes per year within four years. At the time this Interim Report was made, the data required for the fertiliser, chemical and petroleum refining units were still being collected. Now more complete data has been received in the light of the proposals for the expansion of the above industries. An examination of the data received reveals that it is necessary to revise the capacity recommended in the Interim Report. The proposal now made is for the installation of a 10,000 tonnes per year capacity Fabrication Shop (Operating on a single shift basis) to start with. This shop can be operated in a two shift basis and a capacity of 20,000 could be achieved as the demand arises. Another similar shop can also be planned for construction by the middle of the Fourth Plan which will give a further capacity of over 20,000 tonnes on a two shift basis bringing the total available new capacity by the end of the Fourth Plan to about 40,000 tonnes.

4.4. This proposal, it will be seen, enables us to start with a comparatively modest planned output at the same time making it possible to increase the annual output to nearly 40,000 tonnes per annum by the end of the Fourth Plan giving sufficient time for training of the necessary skilled workmen, supervisory staff, etc. The units, as per this proposal will be of a sufficiently large size to be economical without at the same time being too large for effective control and management.

4.5. In addition to the tonnage indicated for the fabrication of equipment, provision should also be made in the shop for the manipulation and fabrication of pipes as required by the different plant units. The tonnage of work undertaken in this respect is variable and the layout of the plant should be such that a considerable amount of flexibility will be provided to take care of the demand of fabricated pipings.

4.6. Similarly, the manufacture of valves have not been dealt with in great detail as it is not considered advisable to lay down whether complete valves should be manufactured in this shop or whether this shop should only undertake the supply of proper quality castings for valves and other similar items, which will be further machined by the firms in India

who are specialising in the manufacture of valves, pumps, etc. However, an initial provision should be made in the shop for fully machining some part—say 50% of the total quantity of about 200 tonnes of alloy steel castings proposed to be made in this shop. This can also be expanded if necessary to meet the requirements at the appropriate time.

## 5. GENERAL DETAILS AND ESTIMATES

5.1. With a view to assessing the requirements of machinery, space and estimation for the cost of various items that go to make a factory of this type, some preliminary offers were invited and quotations for a number of items were received from representatives in India of manufacturers of machine tools and fabrication shop equipment. These offers were mostly from the Continent including East European countries and in some cases from the United Kingdom. An estimate of the cost of equipment for the shops has been prepared on the basis of the above figures and has been taken as the basis in working out the capital cost and profitability statements. Thus the prices of equipment now received are more realistic than those available at the time of preparation of the Interim Report. In case of collaboration or capital participation from countries where the cost of equipment is likely to be considerably higher, the estimates also naturally will be exceeded and consequential changes in the working will have to be made.

5.2. In preparing the estimates, no provision has been made for the cost of land for the colony, residential and other buildings, etc., as these will depend to a very great extent on the location of the factory. If the factory is located near a city, it will be possible to manage with a small number of houses for essential senior and other staff, the majority of the employees living in accommodation available in the city. Facilities such as major hospitals, schools, etc. also may possibly be not necessary. These of course are factors which should be decided after the location is finalised. It will also have to be considered even if the factory is located near a city, whether it is really advisable to minimise residential accommodation and other associated facilities near the factory, or whether it will be preferable even in such a case to have these facilities provided for the employees which although would certainly mean a higher initial investment and cost of maintenance and administration, will attract skilled labour and supervision to a greater extent than if they have to live in comparatively less satisfactory surroundings and are not able to get medical and other facilities as easily as would be the case of the factory had its own Township. As far as the estimates are concerned, as stated earlier, no provision has been made for any of these items. The impact of additional expenses that may have to be incurred after finalising the location of the factory and policy regarding accommodation will have to be assessed separately and the operating expenses, profitability estimates, etc., must be suitably modified.



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5.3. FACTORY.—The Factory would be provided with stores building with an approximate floor area of 2,000 sq. metres and open storage yards served by Gantry crane, power bogey tracks, etc. The factory proper will consist of shops with a total area of approximately 20,000 sq. metres and will consist of the following sections.

5.3.1. The Preparation Shop will cover operations such as shearing, sawing, edge planning both with gas and edge planer machine, profile cutting and other similar operations. This area will also be provided with sufficient space and necessary tools for marking off plates, sections, etc., for the operations included under this section.

5.3.2. The next section will consist of plate bending machines with capacities varying from handling plates of 16 mm. thickness × 4 mm. width to 45 mm. thickness × 3 m width (cold) and also hot bending of plates up to 100 mm thickness × 4 m. width. This section will also contain a dishing press capable of handling plates of nearly 5 m. diameter × 75 mm. thickness for manufacture of dished ends, and spherical sections together with necessary furnaces, dies, etc. Facilities for manipulating and bending of pipes required for various plant units and fabrication of coils will also be provided by the side of the above equipment.

5.3.3. The above two sections will be accommodated in a covered shop with a span of 25 m. and a length of 200 m. served by overhead gantry cranes.

5.3.4. Situated side by side with the above shop and connected with the Preparation Shop by bogey tracks running across all the shops will be two bays, each of 25 m. span and 200 m. length which will be used for the assembly and welding of various pieces, shaped and rolled in the preparation shop. One of these bays will be used for the assembly and welding of heavy vessels using plates of thickness up to 75 mm. and individual completed equipment weighing up to 80 tonnes. This shop will be provided with a stress relieving furnace at one end which can be used for stress relieving completed welded vessels. Provision will also be made for the radiographing of welds in the shop itself.

5.3.5. Another bay will be divided into sections for light mild steel and stainless steel vessels and heat exchangers. Both these assembly and welding bays, will be provided with welding sets, (A.C. as well as D.C.). Welding Argon arc sets for welding special materials such as stainless steel, aluminium and other special materials required for operating under specific

working conditions. It is also proposed to have two automatic boom welders particularly for welding of heavy vessels subject to very stringent specifications, automatic trolley mounted and also semi-automatic welding machines, to obtain proper quality of welds and the necessary high speed of welding.

5.3.6. Separate from the above shops will be a heavy machine shop where large vertical and horizontal boring machines, planning machines, various lathes, drilling machines, etc., will be accommodated. Likewise the foundry, pattern shop and smithy will also be located in a separate building. These shops together with the maintenance area and the preparation and assembly shops will occupy a total covered area of about 20,000 sq. metres.

5.3.7. Within the factory limits will be situated other auxilary buildings, such as canteens, fire station, time office, laboratory, etc.

5.3.8. The administrative offices for the factory will be situated by the side of, but separated by a barrier from the main fabrication shop area. This building will accommodate the various administrative departments and senior engineering personnel. This building will also have the design and drawing offices, where preparation of detail designs and shop drawings for the various items to be fabricated in the shop will be prepared.

5.3.9. A building for a training centre will also be constructed at a suitable spot near the shop bays.

5.3.10. A provisional layout of the factory with the auxiliary and ancillary buildings is attached with this report as Annexure 'VI'.

5.4. Based on the above proposals, the prices of some of the equipment that were available to us and assuming certain other prices, an estimate of cost of the project has been prepared and is given below.

*5.4.1. Estimate Cost of Projects*

(Excluding Township and other amenities)

(Rs. in Lakhs)

| | Indian Currency | Foreign Currency |
|---|---|---|
| | 1 | 2 |
| 1. Land (80 acres) . . . . . | 7.00 | |
| 2. Development—Roads, Railways, Drainage etc. . | 15.00 | |

(Rs. in Lakhs)

| | | 1 | 2 |
|---|---|---|---|
| 3. | Factory buildings (20,000 sq. met. @ Rs. 350 per sq. met.) | 70.00 | |
| 4. | Auxilary and Ancilliary Buildings . . . | 15.00 | |
| 5. | Administrative Buildings, Design and Drawing Office. | 10.00 | |
| 6. | Plant and Machinery . . . . . | 70.00 | 130.00 |
| 7. | (*a*) Freight and Insurance @ 10% . . . | | 13.00 |
| | (*b*) Duty @ 22% on Rs. (130+13) . . . | 31.00 | |
| 8. | Engineering Consultancy fees . . . . | 15.00 | 10.00 |
| 9. | Mechanical and Electrical Services . . . | 15.00 | |
| 10. | Construction and Commissioning Expenses . . | 15.00 | 7.00 |
| 11. | Furniture, office equipment etc. . . . | 8.00 | 2.00 |
| | | 271.00 | 162.00 |
| 12. | Contingencies @ 5% . . . . . | 14.00 | 8.00 |
| | TOTAL | Rs. 285.00 | + 170.00 |
| | TOTAL = | Rs. | 455.00 Lakhs. |
| | Working Capital (3 months annual requirement at full output). | Rs. | 45.00 Lakhs |
| | Total including Working Capital . . . . | Rs. | 500.00 Lakhs |

5.5. The total investment of Rs. 500 lakhs requires as per the above statement may be financed by Equity-*cum*-loan capital on the basis of the current ratio of 1:1. The additional working capital requirement over and above Rs. 500 lakhs may have to be obtained by overdraft from commercial banks.

5.6.1. In the operation of the factory and the associated administrative departments, it is roughly estimated that a sum of Rs. 340 lakhs will be incurred annually. The details of the annual operating costs and the raw materials costs assumed are given in the tables given below. This operating cost is to be taken as an indication, as the number employed in different categories and the requirements of power, fuel, etc., can be assessed more correctly only when full details of the number and type of equipments required for the plant are finally decided upon. It has been estimated that the total requirements of manpower for the project will be approximately 1,200 skilled workers including draftsmen. It has also been assumed that an interest of six per cent on capital cost and a depreciation at the rate of ten per cent per annum

will have to be allowed for calculating the annual expenses. The maintenance cost of two per cent of the total cost of the plant has been taken into account.

*5.6.2. Annual Operating Cost*

| | | | |
|---|---|---|---|
| 1. | Raw materials: | | |
| | Cost as per statement 5.6.3 . . . . | 216.59 | |
| | 5% to cover transport to site and ST. . . | 10.83 | |
| | | | 227.42 |
| 2. | Wages and Salaries . . . . . | | 54.00 |
| 3. | Power, Fuel and Lubricants . . . . | | 8.00 |
| 4. | Maintenance and Repairs . . . . | | 8.88 |
| 5. | Overheads and Misc. Expenses . . . | | 16.50 |
| 6. | Selling Expenses and Contingencies . . . | | 25.50 |
| | TOTAL | | 340.30 |

5.6.3. The basis of the Cost of Raw Materials assumed for this purpose is as follows:

*Operating Costs (Raw Materials)*

| | | (Rs. in Lakhs) |
|---|---|---|
| 1. | 6000 tonnes of Tested Boiler Quality Steel @ Rs. 1200/tonne. (For Class I; Class II and Heat Exchangers). | 72.00 |
| 2. | 2500 tonnes M.S. @ Rs. 800/tonne (For Class III and Miscellaneous Job). | 20.00 |
| 3. | 1000 tonnes of Carbon Steel Heat Exchanger tubes @ Rs. 1500/tonne. | 15.00 |
| 4. | 1200 tonnes of S.S. Plates Tubes, Scrap etc. @ Rs. 6000/ tonne. | 72.00 |
| | | 179.00 |
| | *Add* 10% for electrodes gas etc. . . . . | 17.90 |
| | | 196.90 |
| | *Add* 10% for Wastage . . . . . | 19.69 |
| | Rs. | 216.59 |

5.7. In this an average price of Rs. 1,200 per tonne has been taken for carbon steel plates and about Rs. 1,500 per tonne for heat exchanger tubes. Under the present conditions, it is found that practically the entire quantity of carbon steel as well as stainless steel plates required for quality work has to be imported from foreign countries. Although

such plates are manufactured in India, the indigenous production appears to be mostly of untested quality plates which cannot be used for manufacture of pressure vessels and equipment operating under critical conditions of temperature and pressure.

5.8. Based on the suggested capacity for fabrication of different types of equipment and the current-day prices of fabricated items obtainable from within the country, an estimate of the value of the annual output from the shop (two years after the commencement) has been prepared:

| Capacity | Rate per tonne | | Rs. in Lakhs |
|---|---|---|---|
| Class I Vessels Mild Steel . . . | 3000 tonnes | Rs. 5000 | 150.00 |
| Class II Vessels Mild Steel . . . | 1000 tonnes | Rs. 3000 | 30.00 |
| Class III Vessels Mild Steel . . | 1000 tonnes | Rs. 2500 | 25.00 |
| Misc. Platework . . . . | 1500 tonnes | Rs. 2000 | 30.00 |
| Heat Exchangers . . . . | 3000 tonnes | Rs. 3500 | 105.00 |
| Stainless Steel Vessels . . . | 1000 tonnes | Rs. 12,000 | 120.00 |
| Stainless Steel Castings (Partly machined) | 200 tonnes | Rs. 25,000 | 50.00 |
| TOTAL | 10700 tonnes | | 510.00 |

5.9. The breakdown given under each category above is indicative and is by no means rigid, but a wide change from the pattern indicated will naturally alter the value of the annual output. The exact pattern to which we will eventually work can be found out only after the Plant goes into operation and conditions become steady, although the general pattern of output from these shops will have to be on such types and items of equipment, as would generally not be available elsewhere in the country. For instance it will be necessary for this shop to cater to the requirements of the industries in regard to medium pressure vessels (Class I), stainless steel vessels and critical heat exchangers, in addition to stainless steel castings, rather than devote time and energy to the fabrication of Class II or III vessels, although in the earlier stages it may possibly have to take a good percentage of Class II and III work to commence production early and also to train the workers and improve the quality of their output in preparation for undertaking work of a more critical nature. The total value of output as assessed and given above works out to Rs. 510 lakhs per annum.

5.10. The total requirement of fabricated items is approximately 30,000 tonnes. About half the quantity of this refers to Class III vessels, ducts, etc. The indigenous manufacturing capacity available in the country may be capable of handling a major portion of this type of work and by suitable expansion the proposed shop here can handle this. The approximate requirements of Class I and II vessels and heat exchangers come to about 10,700 tonnes. The shop proposed can handle about 80% of this requirement.

Government have already approved the proposal of the Fertilisers and Chemicals, Travancore Limited, to establish a Fabrication Shop at Alwaye for the manufacture of pressure vessels, stainless steel equipment and heat exchangers in collaboration with Davy-Ashmore of the U.K. This shop will have a capacity of about 3,000 tonnes to start with. This shop can supplement the demands of the chemical industry. The capacity of this shop can be increased to 5,000 tonnes subsequently.

5.11. The construction of a shop of this nature is expected to require two years and the development of full productive capacity a further three years, making five years in all. Hence if the shop starts operating now the full benefits can be obtained only by 1970. Till such time the gap has to be filled by imports. The programme of starting a second shop can be taken up immediately after the first plant is commissioned. The progress expected on the first year of production is expected to be 30%, on the second year 75% and full production in the third year.

5.12. *Estimate of Power, Fuel, transport and other requirements.*—The total requirement of power for a project of this nature will be about 3,000 kW.

Regarding transport, we have to take care of transport of raw materials (steel plates and tubes) and of finished products. The total tonnage of incoming materials will be about 12,000 to 15,000 tonnes a year. Till such time special steel is manufactured in India, they have to be imported Transport facilities by railway have to be provided, to the extent necessary.

For the finished products, the volume of the materials to be transported will be large and it will be difficult to handle a substantial portion by the railway over long distances. These materials have to be transported to the nearest port by means of coastal steamers Movement from port to the various sites has to be made by road/railway

5.13. A table showing the profitability based on the assumption already explained in the preceding paragraphs is given under:

| | | | (Rs. in Lakhs) |
|---|---|---|---|
| 1. | Total sale of output | 510.00 | |
| 2. | Operating Costs | 340.22 | |
| 3. | Gross profits | | 169.78 |
| 4. | Depreciation @ 10% | | 45.00 |
| 5. | Profit before interest and Tax | | 124.78 |
| 6. | Interest @ 6% on Rs. 250 lakhs | | 15.00 |
| 7. | Profit before tax | | 109.78 |
| 8. | Tax corporate tax @ 45% | 49.4 | |
| | Super Tax | 5.1 | |
| | | | 54.50 |
| 9. | Net Profit | | 55.28 |

5.13.1. The above table indicates the following percentages of profitability.

| | | |
|---|---|---|
| (*a*) | Percentage of Profit (5) on Total capital investment | 25% |
| (*b*) | Percentage of Net Profit after interest and before tax (7) on Equity Capital. | 43.9% |
| (*c*) | Percentage of Net Profit after tax (9) on Equity Capital | 22.1% |

5.14.1. The shop is intended to produce specialised vessels to meet the rigorous standards of approved codes and procedures such as for example—ASME, DIN, BSS, TEMA, Lloyds Class I, API, etc. It thus requires a highly quality-conscious Management and rigid control and adequate inspection facilities.

5.14.2. The success depends entirely on good management and gradual development of full trained skilled craftsmen and engineers. It is not possible to give such training through a training institute. It has to be secured through years of actual work under proper supervision. The skill developed and the number of men so trained will be limited by the number of supervisory and management staff available. It also depends on an adequate provision for testing facilities in the plant.

5.14.3. With resources and manpower available in India, it would be possible to plan and formulate a detailed project report for the design of the shop, to draw up specifications, to make selection from alternative possibilities of shop equipment and to provide for modern testing facilities. However, where specialised items of fabrication techniques are involved, it would be necessary to obtain collaboration on a limited basis with foreign firms. A list of foreign firms which are well known in the field are given in Annexure V. Negotiations may have to be initiated with selected firms from that list.

5.14.4. Foreign collaboration is required for specialised fabrication techniques. This can be secured either on the basis of payment of royalty or by persuading the foreign firm to participate in the equity capital of the new company to a reasonable extent. In case the foreign firm does not show an inclination to participate in the equity capital, the negotiations may be confined to supply of know-how on fabrication techniques on the basis of a royalty to be decided by mutual agreement and for a limited period.

*Training facilities*

5.14.5. A good deal of emphasis is required from the very beginning on a suitable organised Training Department. Special technique and skills have to be developed for training personnel, particularly in (a) welding and (b) non-destructive tests. In recent years, considerable advances have been made in both these aspects. Welders have to be trained and tested for autogenous gas welding, electric arc welding, argon arc welding for stainless steel, etc. Any facility for fabrication of such plant and equipment as envisaged in this report must emphasise largely on modern tools for welding specially inclusive of automatic welding tools, welding manipulating device and adequate facilities for stress relieving.

This is a *sine-qua-non* for the success of an enterprise of this type for fabrication of vessels to meet the rigid code requirements.

## 6. PROVISION FOR INDIGENOUS PRODUCTION OF ESSENTIAL RAW MATERIALS

6.1. In the tabulation for raw materials it will be noticed that considerable quantities of stainless steel are required as plates as well as ingots for melting. This item is not available in the country at all, but it is hoped that the alloy steel project at Durgapur when it goes into operation, will be able to meet fully the requirements of the country in this regard. It would also be possible by then to develop indigenous capacity for the manufacture of stainless steel heat exchanger tubes and pipes of various sizes. If this is not already under scrutiny, a suitable scheme for the manufacture of stainless steel pipes and heat exchanger tubes may have to be taken up as early as possible, to meet the country's requirements.

6.2. Heat exchanger tubes and pipes in carbon steel also are not available in sufficient quantities in the country, although there are a few units manufacturing these items in India. Early action to instal additional capacity for the manufacture of seamless, ERW and other quality and types of heat exchangers tubes etc., should be taken as otherwise import of tubes will have to continue on a very large scale.

*Carbon Steel Plates*

6.3. As stated earlier, while carbon steel plates are manufactured by Hindustan Steel, Tata Iron & Steel Co. etc., it is becoming increasingly difficult to obtain boiler quality plates or even ordinary tested quality plates. A fabrication shop of the type proposed will require most of its requirements of plates of boiler quality and higher tensile plates of tested quality, as the equipment fabricated will be operating under medium pressures of up to 40 atm. and in some cases operate at high temperature also.

During the visits to the various works, the invariable criticism that was heard was about the non-availability of tested steel plates in the country. Unless this situation is remedied, the drain on valuable foreign exchange will continue at a high rate. It is suggested that this fact is brought to the notice of the management of steel plants and action taken to immediately increase the production of quality steel plates to meet the requirements of the country.

6.4. Another point in this connection is the size of steel plates. The present maximum width to which steel plates

can be rolled apparently is not more than 2.5 m. In the fabrication of vessels for medium pressures where thick material is being used, it will be of great advantage if we could restrict the number of welded joints both circumferential and longitudinal. This can be achieved only if we can get plates of widths up to 3 or 4 metres. Equipment in the fabrication shop are being provided for handing plates up to 3 m. width where the thicknesses are of the order of 60-70 mm. and above and up to 4 m. width for plates up to 25 mm. It would, therefore, be useful if indigenous manufacturing capacity could be established for manufacture of plates of 3 to 4 m. width and in maximum lengths possible, say up to 8 to 10 metres, as they will reduce the number of welds in the finally fabricated vessels. The Steel Ministry may be requested to keep this in view and instal the necessary wider plate mills in the extension to the Rourkela Plant and the Bokaro Steel Plant so that at least a few years hence we will be in a position to obtain wider plates for fabrication of vessels. Their attention may also be drawn to the need for the manufacture of plates of weldable quality with higher tensile strength, *i.e.*, tensile strength of 50 to 60 kg/sq. mm., as this will effectively reduce the thickness of shells, the total weight of equipments and consequent economy on other incidental operations as well.

6.5. There is a total absence of manufacturing capacity for forged steel welding neck type of flanges and this is an industry that will have to be started very soon, so that flanges covering the full ranges of sizes and pressures would be supplied to the various consumers. There are a few forging shops in India, but it is very doubtful whether any of them have started manufacture of flanges. While planning the fabrication shop, it may even be worthwhile simultaneously to find out the possibilities of manufacture of these flanges in this shop itself, or in the alternative, encourage the establishment of an ancillary industry in the neighbourhood, so that when the fabrication shop is ready some progress would have been made in the matter of supply of forged steel flanges. Here again, manufacture of such items in stainless steel cannot be undertaken till the proposed alloy steel plant goes into production.

6.6. While the present conditions of supply of tested quality steel plates, tubes, stainless steel and other alloy steels the annual F.C. requirement on account of raw materials will be as follows:

| | Rs. in Lakhs |
|---|---|
| 6000 tonnes of Carbon Steel Plates at the Rate of Rs. 900 per tonne | 54.00 |
| 1000 tonnes Heat Exchanger tubes at the rate Rs. 1100 per tonne | 11.00 |
| 1200 tonnes of S. steel at Rs. 6000 per tonne . . . . . | 72.00 |
| Add 10% for electrodes etc. . . . . | 13.70 |
| | 150·50 |
| Add 10% for wastage . . . . . | 15.07 |
| | 165.77 |

It is however expected that the position regarding the availability of these materials will improve in the near future when the above foreign exchange expense can be reduced.

## 7. CO-ORDINATION WITH CONSUMING SECTORS

7.1. As the fabrication shop is likely to be in the public sector and many of the consuming industries like the fertiliser, petroleum refining, petrochemical and other units also are likely to be in the public sector, it is felt that it should not be difficult to co-ordinate between the Manufacturing Shop and consuming industries effectively. It may be suggested that the consuming industries may keep the fabrication shop informed of their proposals in good time, so that necessary action may be taken in regard to fabrication of equipment, procurement of raw materials etc. A working arrangement for this can be possibly arrived at by discussion between the Heavy Engineering Department and the Ministry dealing with the consuming industries. An effort should also be made by the Heavy Engineering Department to keep the consuming industries advised of spare capacity in particular types of jobs, if any, so that all the available capacity is fully utilised.

## 8. GENERAL

8.1. While dealing with the cost estimates, it has already been stated that the cost estimates and operating economy will to a great extent depend upon the location of the factory. This is a matter on which considerable attention will have to be bestowed to arrive at proper selection, but in general, the following points have to be considered subject to the availability of sufficient amount of power, *i.e.*, about 3,000 kW and sufficient water for drinking and industrial uses.

8.2. In general one of the important items to be considered before selection of site is the nearness to raw materials and nearness to the ultimate destination of the finished products. In this particular case, the latter should play a more important part in the selection of site, in view of the fact that while the tonnage of equipment to be transported will be the same, or even less than the tonnage of raw materials brought into the factory, sizes of most of the equipment leaving the factory will make it impracticable or at least difficult to reach many of the destinations. Vessels of up to 4 m. diameter will have to be fabricated in one or possibly two pieces and despatched to various sites which excepting in certain areas will not be acceptable to the railways as the clearances under the bridges and from other structures, prohibit the handling of such large shells. Facilities for road transport to tide over these problems are also practically absent. Transport on the other hand of 10,000 or 12,000 tonnes of steel plates or tubes is comparatively a very minor problem.

8.3. As this factory is expected to cater mostly to the petroleum and petrochemical units proposed to be set up in the next five year plans, and as per present thinking, the fertiliser factories are more often than not, likely to be based on refinery gas, naptha or other petroleum products, it appears reasonable to suggest that the fabrication shop should be located near a fairly well-developed port through which equipment fabricated can be shipped to other parts of the country. As in any case factories of the magnitude of 100,000 tonnes or more per year Nitrogen fertiliser plant or two million tonnes per year Refinery can normally not be expected to be installed at a place which cannot be approached from the nearest harbour, it appears that the location of this factory near a good harbour would be considerably more advantageous than if it were located near a steel producing centre or a geographically central point in the country.

8.4. Another important point on this connection would be that the location should be such that skilled labour or at least labour likely to develop the skills speedily are available in sufficient quantities.

8.5. The likely location of Fertiliser and Refinery Projects are given as Annexure VII.

8.6. *Further Capacity*

The proposal given herein envisages the establishment of a 10,000 tonnes fabrication shop. It is essential for the Government to initiate simultaneously or at least one year hence, discussions for the installation of another 10,000 tonnes plant.

8.7. The requirements of Pipes, Pipe Fittings and Valves are estimated under Categories III and IV. The requirements of pipes and valves for other industries have also to be taken into account while planning to manufacture them in India. But it can be assumed that a major portion of high pressure pipes and valves which are to be imported at present is required mainly for the chemical industry. Though in the proposed shop provision has been made for the prefabrication of pipes, it is expected that these special pipes have to be imported. A tabulated statement of the valve of these items and the foreign exchange involved is given below. The figures of import given justify the establishment of a factory to manufacture the special pipes and valves.

| Industry | Category III Pipes and Pipe Fittings | | Category IV Valves | |
|---|---|---|---|---|
| | Imported Rs. | Indian Rs. | Imported Rs. | Indian Rs. |
| 200,000 T/Y N Fertiliser Plant . | 63,04,080 | 36,26,330 | 19,29,050 | 8,02,350 |
| 22,50,000 T/Y Petroleum Refining | 66,32,810 | 14,62,760 | 14,56,770 | 5,81,170 |
| 4× 50 T/D Caustic Soda . . | 11,70,360 | 8,28,040 | 4,58,290 | 1,47,380 |
| 400 T/D Soda Ash . . . | 17,34,590 | 6,63,000 | 2,41,500 | 94,200 |
| 3× 120 T/D Phosphoric Acid . | 10,44,000 | 12,71,880 | 2,61,000 | 3 17,970 |
| 3× 320 T/D Sulphuric Acid . | 54,000 | 23,34,000 | 1,59,690 | 63,750 |
| 2× 800 T/D Ammonium Sulphate, Phosphate. | 54,000 | 81,000 | 90,000 | 1,35,000 |
| TOTAL . | 1,69,93,840 | 1,02,67,010 | 45,96,300 | 21,41,820 |
| Adding 10% of the above for petro-chemical industries . | 16,99,384 | 10,26,701 | 4,59,630 | 2,14,182 |
| Total Cost in . . Rs. | 1,86,93,224 | 1,12,93,711 | 50,55,930 | 23,56,002 |

8.8. *Design and Engineering Organisation*

Simultaneously with the establishment of the Fabrication Shop, steps should be taken to establish a Design and Engineering Group within the Fabrication Shop. The scope of this organisation should include chemical and mechanical engineering design of the type required for the fabrication of Pressure Vessels, Heat Exchangers and allied equipments. The intention should be to develop the organisation as rapidly as circumstances permit so that maximum possible work in this field could be done in India, thus keeping the foreign exchange requirements to a minimum. Such an organisation supported by guidance and basic know-how provided by reputed foreign collaborators can contribute in chemical and mechanical engineering design. It will also be possible with this arrangement to buy out standard design and drawings for important types of chemical plants if that could be found feasible. The establishment of the Engineering Organisation is also essential for securing a steady load to the proposed fabrication shop.

## 9. STEPS FOR IMPLEMENTATION AND TIME SCHEDULE

9.1. It will be necessary to draw up a time schedule for implementation of this project. This would start with the decision of the Government accepting this report in principle and taking steps to implement the project. The immediate task would then be (a) to prepare a detailed project report by February, 1965. (b) to start simultaneously negotiating for foreign collaboration and secure an agreement by the end of February, 1965. The material available in this report should be considered reasonably adequate to initiate negotiation with a foreign firm. The final project report will no doubt be modified on the basis of discussions with the collaborator. Hence the suggestions that these negotiations should take place simultaneously with the preparation of the detailed project report. (c) To decide the location of the project; this will have to be finalised by Government at least by January, 1965, so that the step can be taken in drawing up the final plans. (d) To provide adequate funds in the budget. It should be reasonable if an amount of Rs. 75 lakhs is provided in the financial year 1965-66. (e) To finalise preliminary work connected with the registration of the new company.

9.2. Once the above steps are taken, it should be reasonable to presume that the project will come into production by the middle of 1967. It will take about two to three years to reach the capacity envisaged in this project. But from 1967 onwards the shop will be in a position to supply increasing quantities of equipment to meet the growing needs of the country especially in the Chemicals and Fertiliser field.

## 10. ACKNOWLEDGEMENT

The Working Group wishes to acknowledge the assistance received from the representatives of the industries for their valuable suggestions, and to the experts who had made visits to selected fabrication shops in the country and submitted detailed reports. Further the assistance provided by the various organisations in the country who had replied to the questionnaire of the Working Group has been equally valuable. The Working Group would like to take this opportunity to express their thanks to them also.

# ANNEXURES

# ANNEXURES

I. Terms of Reference given and the names of Members of the Working Group.

II. Summary of Data collected under Category I to XII.

III. Report of visits to various Fabrication Shops by Members and their nominees.

IV. Minutes of the discussion held with the representatives of fabricators at the Board Room of A.C.C., Ltd.

V. List of Foreign Firms.

VI. Layout of the proposed Fabrication Shop.

VII. Likely Location of Fertiliser and Refinery Projects.

# ANNEXURE I

## TERMS OF REFERENCE

The general terms of reference of the Working Group will be—

(i) to make an estimate of the requirements of equipment falling within the scope of the Working Group, having regard to the production programmes and investment in the Sectors requiring such equipment envisaged during the Fourth and Fifth Plans, in so far as they are relevant to the establishment of capacity for the manufacture of such equipment during the Fourth Plan. In making this estimate, the requirements of replacements and possibility of exports should be taken into account.

(ii) to make analysis of these requirements in terms of category of equipment and value.

(iii) to work out in detail the requirements of each category of equipment, by type and by range, during each of the years of the Fourth Plan.

(iv) to recommend the capacity and production targets for 1970-71, for each category of equipment, by type and by range, to the extent indigenous manufacture is considered feasible and desirable.

(v) to make an assessment of the production capacity of existing and projected manufacturing facilities and to work out the gaps for each category of equipment.

(vi) to investigate the best manner in which the gaps could be covered to the extent feasible and desirable by the end of the Fourth Plan, and to make specific proposals to this end, by way of expansion of new projects, etc.

(vii) to make an estimate of the investment and foreign exchange on capital and maintenance account required for implementing the production programmes as recommended.

(viii) to make an estimate of power-fuel, transport and other requirements of a significant order.

(ix) to make an estimate of raw materials, components, etc., required for the manufacture of such equipment and to suggest measures for the indigenous manufacture of such items.

(x) to recommend measures by which utilisation of manufacturing capacity and programmes of production in the consuming sectors are coordinated to the fullest extent.

(xi) to make such other recommendations as may be relevant.

## ANNEXURE I(a)

## MEMBERS OF THE PLANNING GROUP ON MACHINERY INDUSTRIES—WORKING GROUP FOR FERTILISER AND CHEMICALS EQUIPMENT

(1) Shri M. K. K. Nayar,
Managing Director,
Fertilisers And Chemicals Trav. Ltd.,
Udyogamandal P.O.,
Alwaye.

(2) Dr. S. K. Mukherjee,
General Manager,
The Fertiliser Corpn. of India Ltd.,
Rourkela Project,
Rourkela-1 (Orissa).

(3) Dr. K. R. Chakravarthy,
Superintendent,
Planning and Devpt. Dn.,
Fertiliser Corpn. of India Ltd.,
Sindri Unit, Sindri.

(4) Dr. J. S. Ahluwalia,
Assistant Director,
Indian Institute of Petroleum,
C.R.R.I., Mathura Road,
New Delhi-20.

(5) Shri M. S. Pathak,
Sr. Mechanical Engineer,
Gujarat Refinery Project,
Bajuwa,
Baroda.

(6) Dr. G. P. Kane,
Dy. Director General (Chemicals),
Directorate General of Technical Development,
New Delhi.

(7) Dr. B. D. Kalelkar,
Dy. Director General (E),
Directorate General
of Technical Devpt.,
New Delhi.

(8) Dr. N. B. Prasad,
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(9) Dr. B. V. Bhoota,
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(10) Dr. B. N. Bhargava.
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(11) Shri M. S. Satyapal,
Director (Industry),
Planning Commission,
New Delhi.

(12) Shri R. V. Raman,
Joint Secretary to Government,
Department of Heavy Industries,
Ministry of Steel & Heavy Industries,
New Delhi.

(13) Shri P. K. Seshan,
Development Officer,
Paper and Pulp Directorate,
Directorate General of
Technical Development,
New Delhi.

(14) Shri S. K. Sinha,
Development Officer,
Machinery,
Directorate General of
Technical Development,
New Delhi.

(15) Shri V. N. Kasturirangan,
General Manager,
The Fertilisers and Chemicals
Travancore Limited,
Udyogamandal P.O.

(16) Shri I. V. Chunkath,
Under Secretary to
Government, Ministry of
Steel & Heavy Industries,
New Delhi.

(17) Dr. K. S. Chari,
Director,
Central Design & Engg. Unit
Council of Scientific &
Industrial research,
New Delhi.

(18) Shri Hari Bhushan,
Director,
Industry Division,
Planning Commission,
New Delhi.

(19) Shri K. S. Sharma,
Officer on Special Duty,
Ministry of Industry & Supply,
New Delhi.

## ANNEXURE II

## SUMMARY OF DATA COLLECTED UNDER CATEGORY I—XII

### SUMMARY

### Category I—Vessels, Heat Exchangers and Large Diameter Pipes

**A. VESSELS**

| | | Materials of Construction | Total tonnage |
|---|---|---|---|
| **GROUP I** . . . . | 0-20 mm thick | MS | 2566 |
| | 0- 2 m diameter | SS | 408 |
| | 0-30 tons weight | Ni | 32 |
| | | CI | .. |
| | | Alloy Steel | 90 |
| **GROUP II** . . . . | 0-20 mm thick | MS | 6144 |
| | 2- 4 m diameter | SS | 330 |
| | 0-40 tons weight | Ni | .. |
| | | Alloy Steel | 35 |
| **GROUP III** . . . . | 20-40 mm thick | MS | 3752 |
| | 0- 4 m diameter | SS | .. |
| | 0-75 tons weight | Ni | .. |
| | | CI | 1990 |
| **GROUP IV** . . . . | 40-75 mm thick | MS | 1125 |
| | 0- 3 m diameter | SS | .. |
| | 0-75 tons weight | NI | .. |
| | | CI | .. |
| | | Alloy Steel | 560 |
| **GROUP V** . . . . | 0-20 mm thick | MS | 8003 |
| | 4-12 m diameter | SS | .. |
| | 0-90 tons weight | Ni | .. |
| | | CI | .. |

**B. HEAT EXCHANGERS**

| | Max. tube plate thickness | | Total No. | Total weight of the Heat Exchanger in tonnes |
|---|---|---|---|---|
| (Tubes to be expanded) | | | | |
| (*i*) Dia of tubes . . | 0-20 mm | 30 mm | 14900 | |
| (*ii*) Dia of tubes . . | 20-40 mm | 50 mm | 102100 | |
| (*iii*) Dia of tubes . . | 40-100 mm | 50 mm | 23425 | |
| | | | | 2900.0 |

## C. RADIOGRAPHY

| | |
|---|---|
| (*i*) Total tonnage . . . . . | 6414 |
| (*ii*) Max. plate thickness . . . . . | 60 mm |
| (*iii*) Type of test required . . . . . | X-Ray and Gama Rav |

## D. STRESS RELIEVING

| | | |
|---|---|---|
| (1) Total tonnage . . . . | 6414 | |
| (2) Maximum diameter . . . | 3000 mm | |
| (3) Maximum length . . . | 20000 mm | |
| (4) Maximum thickness of plate . . | 60 mm | |
| (5) Special requirement such as inderect heating, electric heating etc. | Should also be able to stress relieve dished ends of 4000 mm dia and SS vessels. | |

## E. HIGH PRESSURE FORGED/LAMINATED

| | |
|---|---|
| (1) Total tonnage . . . . | 1200.00 |
| (2) Maximum length . . . | 20000 mm |
| (3) Maximum diameter . . . | 1370 mm |
| (4) No. of vessels . . . . | 126 Nos. |
| (5) Max. Shell thickness . . . | 185 mm |
| (6) Max. weight per plate . . . | 80 tons |
| (7) Pressure range . . . . | 365 Kg/cm$^2$ |
| (8) Temperature . . . . | 190° C. |
| (9) Special materials of construction. | (*i*) Open hearth or electric furnace: alloy steel.<br>(*ii*) Open hearth or electric furnace: Steel.<br>(*iii*) Some of the vessels are of alloy steel as (*i*) and with SS or titanium lining. |

SUMMARY

## Category II.—Steam Raising/Waste Heat Boilers

| | Description | No. of boilers required |
|---|---|---|
| **GROUP I** . . . | Capacity 100-1500 kg/hour<br>Size 3′-6′ dia & 9′-12′ long<br>Pressure 1-10 kgm/cm²<br>Temperature 10-250° C | 2 |
| **GROUP II** . . . | Capacity 1500-4000 Kg/hour<br>Size 6′-8′ dia & 13′-15′ long<br>Pressure 10-40 kgm/cm²<br>Temperature 250-300° C | 3 |
| **GROUP III** . . . | Capacity 4000-8000 kgm/hour<br>Size 8′-10′ dia & 16′-17′ long<br>Pressure 10-40 kgm/cm²<br>Temperature 100-250° C | 11 |
| **GROUP IV** . . . | Capacity 8000-20000 kgm/hour<br>Size More than 10′ dia & 17′ long<br>Pressure 10-40 kgm/cm²<br>Temperature 250-450° C | 5 |
| **GROUP V** . . . | Capacity 20000-65000 kg/hour<br>Size More than 10′ dia & 17′ long<br>Pressure 10-40 kgm/cm²<br>Temperature 250-450° C | 2 |

SUMMARY

## Category III—Pipes

| Nominal bore in mm | Mild Steel or carbon steel (in tonnes) | | Galvanised iron (in tonnes) | H.P. tubing (in tonnes) | Rigid PVC (in metres) | | Cast-iron (in tonnes) | Stainless steel (in tonnes) | Steel-saran lined (in meters) | Steel rubber lined (in metres) | Lead (in metres) | Nickel (in tonnes) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sch. 20-60 | Sch. 80 & above | Sch. 20-40 | Unscheduled | Sch. 20-40 | Sch. 80 | Sch. 20-60 | Sch. 20 | Sch. 40 | Sch. 60 | Sch. 60 | Unscheduled |
| 10 | 27.15 | 0.14 | 2.89 | 20.9 | .. | .. | .. | 1.02 | .. | .. | .. | 8.0 tonnes for sizes 15, 25, 40 & 50 mm nominal bore |
| 15 | 38.78 | 1.10 | 4.14 | 11.0 | .. | .. | .. | 2.09 | .. | .. | .. | |
| 25 | 119.70 | 0.60 | 30.90 | 12.0 | 2250 | .. | .. | 1.75 | .. | .. | .. | |
| 40 | 103.50 | 0.10 | 24.90 | .. | 213 | 144 | .. | 0.85 | 90 | .. | 150 | |
| 50 | 257.00 | 3.23 | 67.20 | 9.50 | 1214 | .. | 1.5 | 9.25 | 901 | .. | 200 | |
| 65 | 122.30 | 1.00 | 6.30 | 37.2 | .. | .. | .. | .. | 1037 | .. | 60 | |
| 80 | 513.50 | 9.00 | 16.00 | 70.7 | 101 | .. | 2.0 | 19.90 | 473 | .. | 210 | |
| 100 | 687.00 | 10.00 | 65.10 | .. | 473 | .. | 21.0 | .. | 690 | .. | 40 | |
| 125 | 13.00 | .. | 36.00 | .. | .. | .. | 340.0 | 38.40 | .. | 126 | .. | |
| 150 | 1007.00 | 4.00 | .. | .. | 45 | .. | 165.0 | 155.50 | .. | 126 | .. | |
| 200 | 1274.00 | .. | .. | .. | .. | .. | 165.0 | 14.10 | .. | 60 | .. | |
| 250 | 1555.00 | .. | .. | .. | .. | .. | 52.0 | .. | .. | 36 | .. | |
| 300 | .. | 731.00 | .. | .. | .. | .. | 244.0 | .. | .. | .. | .. | |
| 400 | 979.00 | 51.00 | .. | .. | .. | .. | 96.0 | 32.10 | .. | .. | .. | |
| 450 | 3.00 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 500 | .. | 801.00 | .. | .. | .. | .. | 90.0 | 30.90 | .. | .. | .. | |
| Above 500 | .. | .. | .. | .. | .. | .. | 204.0 | .. | .. | .. | .. | |

## Category III (contd.)—Pipe Fittings

| Nominal bore in mm | Mild Steel and wrought iron | | | | | | | Rubber-lined | | Nickel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Elbows | | Crosses & Tees | | Unions Sch. 40 | Plugs Sch. 40 | Caps Sch. 40 | Elbows Unscheduled | Crosses & Tees Unscheduled | Stubends for flanges (Unscheduled) | Welding Elbows (Unscheduled) | Welding Tees (Unscheduled) |
| | Sch. 20-40 | Sch. 80 & above | Sch. 40 | Sch. 80 | | | | | | | | |
| 10 | 800 | 650 | 6450 | 2000 | 5200 | 2650 | .. | .. | .. | .. | .. | .. |
| 15 | 13628 | 4 | 2879 | .. | 6800 | 4250 | 1250 | .. | .. | 24 | 40 | 8 |
| 25 | 12810 | 360 | 2876 | .. | 6250 | 1300 | 125 | 400 | 80 | 40 | 40 | 8 |
| 40 | 7818 | 636 | 860 | 60 | 3750 | 750 | 125 | 400 | 80 | 120 | 80 | 32 |
| 50 | 9350 | 284 | 2650 | 80 | 3750 | 750 | 125 | 400 | 80 | .. | 80 | 24 |
| 65 | 1125 | .. | .. | .. | .. | .. | .. | .. | .. | 80 | .. | .. |
| 80 | 4456 | 208 | 400 | 60 | .. | .. | .. | 400 | 80 | .. | 60 | 16 |
| 100 | 2340 | 250 | 200 | .. | .. | .. | .. | 200 | 40 | .. | .. | .. |
| 125 | 70 | 8 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 150 | 2600 | .. | 200 | .. | .. | .. | .. | 400 | 80 | .. | .. | .. |
| 200 | 1050 | .. | 80 | .. | .. | .. | .. | 120 | 32 | .. | .. | .. |
| 250 | 540 | .. | 16 | .. | .. | .. | .. | 40 | 16 | .. | .. | .. |
| 300 | .. | 1000 | .. | .. | .. | .. | .. | 40 | 8 | .. | .. | .. |
| 350 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 400 | 125 | 250 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 500 | .. | 750 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Above 500 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |

## Category III (contd.)—Pipe Fittings (contd.)

| Nominal bore in mm | Cast Iron | | | | PVC and plastics | | | | | Carbon steel | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Elbows Sch. 80. | Tees and Crosses Sch. 80 | Unions Sch. 120 | Plugs Sch. 120 | Caps Sch. 120 | Elbows Sch. 40 | Tees and Crosses Impact and Socket type | Unions Sch. 120 | Plugs | Brass Couplings Sch. 20-40 | Flanges Sch. 20-60 | Flanges Sch. 80 | Elbows Nos. | Reducers Nos. | Tees Nos. |
| 10 | .. | .. | 4 | .. | .. | .. | .. | .. | .. | 344 | .. | .. | .. | .. | .. |
| 15 | 15 | .. | 31 | .. | .. | .. | 20 | .. | .. | 8 | .. | .. | .. | 2 | .. |
| 25 | 195 | 23 | 164 | .. | .. | .. | .. | .. | .. | .. | 124 | 42 | .. | 14 | .. |
| 40 | 99 | 69 | 170 | 4 | 5 | 127 | 8 | 106 | .. | .. | 262 | 90 | .. | .. | .. |
| 50 | 222 | 84 | 12 | .. | .. | 199 | 9 | .. | .. | .. | 1550 | 399 | 54 | 8 | .. |
| 65 | 287 | 19 | .. | .. | .. | .. | .. | .. | .. | .. | 214 | 108 | 1748 | 50 | .. |
| 80 | 148 | 60 | .. | .. | 12 | 70 | 4 | .. | .. | .. | 2125 | 49 | 351 | 10 | .. |
| 100 | 256 | 52 | .. | .. | .. | 106 | 13 | .. | .. | .. | 877 | 261 | 1693 | 37 | .. |
| 125 | 40 | 10 | .. | .. | .. | .. | .. | .. | .. | .. | 4 | 31 | 1795 | 63 | .. |
| 150 | 44 | 27 | .. | .. | 8 | 8 | .. | .. | .. | .. | 1146 | 148 | 1921 | 47 | .. |
| 200 | 44 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 538 | 48 | 8 | .. | .. |
| 250 | 24 | 15 | .. | .. | .. | .. | .. | .. | .. | .. | 974 | 162 | 1047 | 44 | .. |
| 300 | 4 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 289 | 66 | 683 | 19 | .. |
| 350 | Plus 15 tons of cast iron pipe fittings | | | | .. | .. | .. | .. | .. | .. | 189 | 21 | 359 | 6 | 4 |
| 400 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 55 | .. | 63 | 14 | 2 |
| 500 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 4 | .. | 62 | .. | 15 |
| Above 500 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 98 | .. | .. | 32 | .. |

SUMMARY

## Category IV Valves

| Nominal bore in mm | (*i*) Cast, carbon, mild and alloy steel valves (Pressure: Atmosphere) | | | | | | (*ii*) Stainless steel valve (Pressure:Atmosphere) | | | | (*iii*) Cast Iron Valves (Pressure: Atmosphere) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Data in Nos. | | | Data in tonnage | | |
| | 0-6 | 6-10 | 10-25 | 25-64 | 64-100 | above 100 | 0-6 | 6-10 | 25-64 | 64-100 | 0-6 | 6-10 | 10-64 | 6-10 | 10-25 | 25-64 |
| 10 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 15 | 252 | 121 | 221 | 481 | 35 | 210 | 190 | 582 | 70 | 15 | 265 | 413 | 580 | 0.3 | .. | .. |
| 25 | 52 | 82 | 82 | 145 | 20 | 161 | 340 | 95 | 100 | .. | 401 | 95 | 86 | .. | 0.2 | 0.4 |
| 40 | 8 | 40 | 58 | 53 | 10 | 160 | 30 | 3 | 52 | .. | 276 | 48 | 222 | .. | 0.2 | .. |
| 50 | 25 | 77 | 113 | 335 | .. | .. | 13 | 45 | 30 | .. | 335 | 41 | 359 | .. | 1.6 | 0.4 |
| 65 | .. | 3 | 8 | 90 | 15 | .. | 12 | .. | 5 | .. | 200 | 54 | 98 | 0.3 | .. | 1.0 |
| 80 | 82 | 163 | 486 | 109 | .. | .. | 28 | 65 | 25 | .. | 314 | 197 | 631 | 1.0 | 2.0 | .. |
| 100 | 10 | 35 | 387 | 153 | .. | 4 | 30 | 150 | 75 | .. | 633 | 179 | 209 | .. | 6.5 | .. |
| 125 | .. | .. | 30 | .. | 23 | .. | .. | 162 | .. | .. | .. | .. | .. | .. | 2.5 | .. |
| 150 | 73 | 10 | 501 | 46 | 3 | .. | 47 | 23 | 30 | .. | 234 | 120 | 192 | .. | 13.5 | .. |
| 200 | 18 | 5 | 247 | 41 | 42 | .. | 10 | 18 | 55 | .. | 210 | 69 | 68 | .. | 26.5 | .. |
| 250 | .. | 5 | 78 | 135 | 10 | .. | .. | .. | .. | .. | 96 | 21 | 133 | .. | 5.0 | .. |
| 300 | 20 | .. | 65 | 31 | .. | .. | .. | 3 | .. | .. | 61 | 35 | 179 | .. | 7.5 | .. |
| 400 | 3 | 13 | 45 | .. | .. | .. | .. | .. | .. | .. | 54 | .. | 89 | .. | 19.5 | .. |
| 500 | 3 | 3 | 3 | .. | .. | .. | .. | .. | .. | .. | 8 | .. | 1 | .. | 3.0 | .. |
| Above 500 | .. | .. | Plus 0.6 tonnes of alloy steel valves | | | | .. | .. | .. | .. | 2 | .. | 42 | .. | 19.0 | .. |
| TOTAL | 546 | 557 | 2324 | 1619 | 158 | 535 | 700 | 1140 | 437 | 15 | 2792 | 1272 | 2889 | 1.6 | 107.0 | 1.8 |

## Category IV (contd.) Valves (contd.)

| Nominal bore in mm | (iv) Gunmetal and Bronze valves (Pressure: Atmosphere) | | | | (v) Special Diaphram Valves | | | | (vi) Special Valves | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Diaphram | | Rubber-lined | Lead-lined | Nickel Valves | P.C.V. Valves | Sulphur Valves jacketed (Data in tonnage) |
| | 0-6 | 6-10 | 10-25 | 25-64 | 0-6 | 6-10 | (0-6) | (0-6) | (0-6) | (0-6) | |
| 10 | 12 | 124 | 24 | 10 | .. | .. | .. | .. | 16 | 40 | |
| 15 | 12 | 272 | 40 | 110 | 130 | .. | .. | .. | 16 | 240 | |
| 25 | 20 | 273 | 44 | 45 | 183 | .. | 84 | 2 | 24 | 240 | |
| 40 | 26 | 152 | 60 | 38 | 40 | .. | 140 | .. | 60 | 400 | |
| 50 | .. | 200 | 70 | 33 | 160 | 15 | 204 | 12 | 60 | 400 | 0.9 |
| 65 | .. | 23 | .. | .. | .. | .. | 8 | .. | .. | .. | tonnes |
| 80 | .. | 100 | 106 | .. | 125 | .. | 132 | 4 | 20 | 100 | |
| 100 | .. | 43 | 20 | .. | 165 | .. | 80 | .. | .. | .. | |
| 125 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 150 | .. | .. | .. | .. | .. | .. | 180 | .. | .. | .. | |
| 200 | .. | .. | .. | .. | .. | .. | 32 | .. | .. | .. | |
| 250 | .. | .. | .. | .. | .. | .. | 16 | .. | .. | .. | |
| 300 | .. | .. | .. | .. | .. | .. | 24 | .. | .. | .. | |
| 400 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 500 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| Above 500 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| TOTAL | 70 | 1187 | 364 | 236 | 803 | 15 | 900 | 18 | 196 | 1420 | |

SUMMARY

## Category V—Conveyors and Elevators

### A. BELT CONVEYORS

| Sl. No. | Size mm | Capacity MT PH. | Material handled | Length in metres | Unit Nos. |
|---|---|---|---|---|---|
| 1. | 350-500 | .. | Coal, Urea and phosphate Granular salt; Limestone-coke; Soda ash | 2284 | .. |
| 2. | 600-760 | | Gypsum & rock phosphate; Urea and gypsum; Limestone, coke | 7887 | .. |
| 3. | 1100-1200 | .. | Gypsum and rock phosphate | 100 | .. |
| 4. | .. | 20-50 | Ammonium phosphate; Ammonium sulphate Gypsum and rock phosphate | 243 | 10 |
| 5. | .. | 150 | Ammonium phosphate | .. | 4 |
| 6. | .. | 700 | Phosphate rock | .. | 6 |
| 7. | 500 | 50-90 | | 7-90 | 4 |

6 units in 10 bags/min. capacity; Ammonium phosphate.

### B. SCREW CONVEYORS

| Sl. No. | Capacity Tons/hr. | Size mm | Material handled | Length metres | Unit Nos. |
|---|---|---|---|---|---|
| 1. | .. | .. | Caustic flakes | 16 | .. |
| 2. | 20-25 | .. | Gypsum, rock phosphate | 50 | 2 |
| 3. | 40-50 | .. | Coal, Urea and phosphates | 55 | .. |
| 4. | .. | 300-600 | Light Soda ash, lime dust | 170 | .. |

### C. ELEVATORS

| Sl. No. | Capacity Tons/hr. | Size mm | Materials handled | Height metres | Unit Nos. |
|---|---|---|---|---|---|
| 1. | 1 | .. | Lime Power | 20 | .. |
| 2. | 20-50 | .. | Coal, granular salt, Ammonium Phosphate, Ammonium Sulphate Rock phosphate | 141 | 8 |
| 3. | 140-150 | .. | Ammonium phosphate | .. | 8 |
| 4. | .. | 1300 × 500 | Coke | 20 | .. |
| 5. | .. | 1200 × 800 | Light Soda Ash | 15 | .. |
| 6. | .. | 1400 × 1000 | Lime Stone | 25 | .. |

In addition, 12 Nos. of 35 MT. PH pneumatic conveyors.

**D. CHAIN CONVEYOR**

| | |
|---|---|
| Capacity | 1500 cylinder/hr. |
| Size | 350 mm |
| Materials handled | Filled Butance gas cylinders |
| Length | 77 metres |
| Unit Nos. | 2 |

**E. SLUDGE SCRAPER**

| | |
|---|---|
| Capacity | .. |
| Size | 1250 mm |
| Materials handled | For oil separator |
| Height/length | 29.78 metres |
| Unit Nos. | 10 |

SUMMARY

## Category IV—Pumps

| Group No. | Head Range | Capacity $M^3/hr.$ | Materials of Construction | No. of Pumps required | Drive H.P. |
|---|---|---|---|---|---|
| *(i) (a) Centrifugal Single Stage* | | | | | |
| 1. 1—10m | | 1—30 | SS | 26 | 1—4 |
| | | | Alloy Rubber-lined | 16 | |
| | | | RL | 4 | |
| | | 31—60 | SS | 26 | 5—10 |
| | | | MS Rubber-lined | 3 | |
| | | 61—80 | SS | 12 | 5—10 |
| | | | Sp. Alloy | 2 | |
| | | 81—110 | SS | 4 | 11—20 |
| | | | Sp. Alloy | 2 | |
| | | 111—150 | SS | 4 | 10 |
| | | 151—220 | CI | 2 | 10 |
| | | 1620 | SS | 2 | 75 |
| 2. 11—30m | | 1—30 | Sp. Alloy | 8 | 1—15 |
| | | | CI | 240 | |
| | | | SS | 70 | |
| | | | Alloy Rubber-lined | 96 | |
| | | | CS | 4 | |
| | | | Bronze | 6 | |
| | | | RL | 4 | |
| | | | MS Rubber-lined | 15 | |
| | | 31—60 | CI | 24 | 10—20 |
| | | | SS | 30 | |
| | | | Alloy Rubber | .. | |
| | | | CS | 2 | |
| | | | Bronze | 6 | |
| | | | Sp. Alloy | 4 | |

| Group No. | Head Range | Capacity $M^3$/hr. | Materials of Construction | Number of pumps required | Drive H.P. |
|---|---|---|---|---|---|
| 2. *(contd.)* | | 61—120 | CI | 22 | 10—40 |
| | | | SS | 8 | |
| | | | Alloy Rubber | .. | |
| | | | CS | .. | |
| | | | Bronze | 2 | |
| | | | MS Rubber | 9 | |
| | | | Sp. Alloy | 6 | |
| | | 121—200 | CI | 32 | 14—55 |
| | | | SS | 74 | |
| | | | Alloy Rubber | 56 | |
| | | | CS | .. | |
| | | | Bronze | 6 | |
| | | | MS Rubber | .. | |
| | | | Special Alloy | 10 | |
| | | 201—400 | CI | 2 | 21—50 |
| | | | SS | 6 | |
| | | 401—1000 | CI | .. | 51—130 |
| | | | Bronze | 6 | |
| | | | Sp. Alloy | 2 | |
| | | 1001—1500 | CI | 18 | 51—175 |
| | | Above 1500 | Sp. Alloy | 3 | |
| *(i) (b) Centrifugal Multistage* | | | | | |
| 1. | 31—50 | 1—30 | CI | 8 | 0.5—15 |
| | | | SS | 13 | |
| | | | MS Rubber-lined | 6 | |
| | | | Bronze | 4 | |
| | | | Spl. Alloy Steel | 21 | |

| Group No. | Head Range | Capacity $M^3$/hr. | Materials of Construction | No. of Pumps required | Drive H.P. |
|---|---|---|---|---|---|
| 2. (*contd.*) | | 31—60 | CI | 4 | 10—18 |
| | | | Spl. Alloy Steel | 2 | |
| | | 61—80 | CI | 12 | 15—20 |
| | | | Sp. Alloy Steel | 13 | |
| | | 81—150 | CS | 2 | 20—75 |
| | | | MS | 4 | |
| | | | SS | 3 | |
| | | | Bronze | 2 | |
| | | | Sp. Alloy Steel | 6 | |
| | | 150—250 | CI | 4 | 40—60 |
| | | | SS | 33 | |
| | | | Bronze | 2 | |
| | | 251—500 | CI | 28 | 60—110 |
| | | | Bronze | 2 | |
| | | | Sp. Alloy Steel | 13 | |
| | | 501—1000 | CI | 6 | 100—215 |
| | | | Sp. Alloy Steel | 2 | |
| | | 1001—4000 | CI | 21 | 540—600 |
| | | | Sp. Alloy Steel | 4 | |
| | 51—100 | 1—30 | SS | 18 | 3—25 |
| | | | CS | 10 | |
| | | | Sp. Alloy Steel | 21 | |
| | | 31—60 | SS | 4 | 11—20 |
| | | | Sp. Alloy Steel | 2 | |
| | | 61—150 | Sp. Alloy Steel | 19 | 18—50 |
| | | | Carbon Steel | 12 | |
| | | 151—300 | Bronze | 8 | 100 |
| | Above 300 | | Sp. Alloy Steel | 1 | 100 |

| Group No. | Head Range | Capacity $M^3$/hr. | Materials of Construction | No. of Pumps required | Drive H.P. |
|---|---|---|---|---|---|
| 3. | 101—250 | 1—30 | CS | 6 | 6—34 |
| | | | Bronze | 6 | |
| | | | Sp. Alloy Steel | 15 | |
| | | 31—60 | Sp. Alloy Steel | 11 | 6—33 |
| | | 61—100 | Sp. Alloy Steel | 14 | 38—100 |
| | | 101—180 | CS | 12 | 200—280 |
| | | 181—250 | SS | 4 | 400—600 |
| | | | CS | 4 | |
| 4. | 251—360 | 8—15 | SS | 2 | 7.5—45 |
| | | | Sp. Alloy Steel | 2 | |
| | | 37—150 | SS | 2 | 60 |
| | | | Sp. Alloy Steel | 1 | |
| | | 750 | Sp. Alloy Steel | 4 | 278 |
| 5. Above 360 | | 1—50 | Sp. Alloy Steel | 3 | 140—670 |
| | | 50—100 | Sp. Alloy Steel | 6 | |

*(i) c Special Type*

| Group No. | Head Range or pressure | Capacity in $M^3$/hr. | Materials of Construction | No. of Pumps reqd. | Drive HP | Type of pump |
|---|---|---|---|---|---|---|
| 1. | Head | 5—9 | RL Steel | 9 | .. | Diaphram Pumps |
| | | 16—20 | MS Rubber-lined | 8 | .. | |
| | | | CI with Neoprene lining | 6 | .. | |
| | Head 20 M | 30 | .. | 8 | .. | Gear pump |
| | 30 M | 18 | .. | 4 | 6.1 | |
| | 50 M | 0.04-0.2 | .. | 16 | .. | Metering pump |
| | Pressure: | | | | | |
| | 2-20″ Hg | 60-1700 | Steel, CI | 29 | 20-50 | Vacuum type. |
| | | 4000-4100 | Steel | 5 | 150 | |
| | 10-20″ Hg | 9 | CI | 2 | 10 | Reciprocating vacuum pump |
| | | 85-91 | CI | 5 | 150-200 | Rotary Vacuum pump |
| | | 600 | Steel | 3 | .. | Do. |
| | | 50 | SS | 1 | .. | Do. |
| | 2″ Hg | 8.7 | Sp. Alloy Steel | 1 | 19 | Do. |
| | 7.5″ Hg | 217.2 | Sp. Alloy Steel | 1 | 5.5 | Do. |
| | Head: 18.7M | 27.2 | Illium | 6 | 40 | Submerged Centrifugal pumps. |
| | 47M | 2.7 | CI | 3 | Turbine | |
| | 200-400M | 1.5-18 | SS | 17 | 15.81 | Reciprocating pumps |
| | 700M | 4 | A. ISI.329 | 6 | 182 | |
| | | | SS | 2 | 81 | |
| | 1400M | 1 | Sp. Alloy Steel | 1 | .. | Steam driven reciprocating pump |

*(ii) Centrifugal Blowers*

| Group No. | Head Range MM.WG. | Capacity in $M^3$/hr. | Materials of Construction | Duty | No. reqd. | Drive HP. |
|---|---|---|---|---|---|---|
| 1. . . | 55-100 | .. | .. | .. | 14 | 0.055-1 |
| | | 3500-10000 | MS | Air | 9 | 3 |
| | | | Rubber-lined MS | Phosphoric Acid fumes | 5 | .. |
| | | 14000-60000 | SS | Air with Acid fume | 24 | .. |
| | | | MS | Air | 4 | 20 |
| 2. . . | 101-200 | 500 | .. | .. | 1 | .. |
| | | 3000-13000 | MS | Air | 61 | 7.5-15 |
| | | 25000-51000 | MS | Air | 22 | 25-50 |
| 3. . . | 201-500 | 220-450 | MS | Air | 10 | 2-5 |
| | | 1000 | | Wet $Cl_2$ gas | 8 | 5 |
| | | 13000-22000 | RL Steel | Fumes<br>Air coal gas | 4<br>6 | 150<br>30-150 |
| | | 51000-72000 | SS | Fumes | 8 | 150 |

| Group No. | Head Range MM.WG. | Capacity in $M^3$/hr | Materials of Constructions | Duty | No. reqd. | Drive HP |
|---|---|---|---|---|---|---|
| | | | RL Steel | Fumes | 3 | 100 |
| | | | MS | Air | 3 | 75 |
| | 501-700 | 170 | MS Rubber lined Air | | 3 | 50 |
| | | 2000-5100 | SS | Corrossive gases | 2 | 25 |
| | | | MS | Air | 25 | 27-120 |
| | | 40000 | SS | Air with acid | 16 | .. |
| | 2100-4850 | 340-765 | MS | Air | 14 | 3-15 |
| | | 1500-2200 | MS | $N_2$gas | 6 | 40-50 |
| | | 47600 | MS | Air | 3 | Turbine. |

(*ii*) (*a*) *Roots Type Blowers*

| Head in MM. Wg. | Capacity in $M^3$/hr. | Gas handled | Materials of Construction | Number required | Drive H.P. |
|---|---|---|---|---|---|
| 300 . . . | 6500 | $O_2$ gas | CI | 3 | 188 |
| 475 . . . | 176 | Air | CI | 3 | 12.5 |
| 750 . . . | 1000 | $H_2$ gas | MS | 8 | 3.0 |
| 3750 . . . | 3390 | Air | CI | 3 | 7.5 |

(*iii*) *Exhausters*

| Head in MM. Wg. | Capacity in $M^3$/hr. | Gas handled | Materials of Con-struction | No. reqd. | Type | Drive H.P. |
|---|---|---|---|---|---|---|
| 50 . . . | 3400 | Fumes | Steel | 2 | Centrifugal | 3.0 |
| 130 . . . | 57 | $H_2O$ & dust | SS | 1 | Axial | 5.4 |
| 380 . . . | 290 | Air & lime dust | MS | 2 | Centrifugal | 49.0 |
| 7.5-25 . . . | 430-1500 | .. | .. | 2 | Do. | 0.8 |
| 26-50 . . . | 1000-5600 | .. | .. | 12 | Do. | 1.34-8.0 |
| 51-80 . . . | 1200-12000 | .. | .. | 2 | Do. | 9.4 |
| 5-11 . . . | 3000-13700 | .. | .. | 11 | Axial | 0.8-2,3 |
| 8-30 . . . | 1700-25000 | .. | .. | 5 | Do. | 3.75 |

(*iv*) *Reciprocating Compressors*

| Discharge Pressure in $Kg/cm^2$ | Capacity in $NM^3/hr.$ | Gas handled | Number required | Drive H.P. |
|---|---|---|---|---|
| 1-25 . . . | 9-200 | Air | 19 | 13.2-80 |
| | | $CO_2$ gas | 5 | 500-700 |
| | 250-500 | Air | 10 | 40-50 |
| | | Liquid ring compressor for $Cl_2$ | 16 | 125 |
| | 1200 | Hydrogen | 1 | .. |
| | 3000 & 28000 | Air | 2 & 1 | 3325 |
| 26-40 . . | 26500 | Hydrogen | 4 | .. |
| | 4500 | Oxygen | 2 | 1500 |
| | 18000 | Raw coal gas | 4 | 4300 |
| | 960 | Air | 1 | .. |
| 200-500 . . . | 276 | $N_2+3H_2$, Inert | .. | .. |
| | .. | Gas | 9 | 600 |
| | 2800 | $CO_2$ | 5 | 950 |
| | 4500 | Nitrogen | 2 | 1600 |
| | 17250 | $N_2+3H_2$ | 8 | 4000 |

(iv) (a) REFRIGERATION COMPRESSORS—40-60 Tonnes capacity : 24 Nos,

## Category VII—Electrical Equipments

### (*i*) *Transformers*

| Sl. No. | Capacity | Voltage ratio | No. required |
|---|---|---|---|
| 1. | 1000 and 2000 KVA | 11 KV/440V | 68 |
| 2. | 150 and 750 KVA | II KV/440 V | 20 |
| 3. | 3000 and 5000 KVA | 11 KV/3.3 KV | 8 |
| 4. | 750 KVA | 6.6/0.4 KV | 6 |
| 5. | 560 KVA | 6.6/0.4 KV | 5 |
| 6. | 300 KVA | 3.3 KV/400 V | 2 |
| 7. | 10 and 37.5 KVA | 132/11 KV | 14 |
| 8. | 20 KVA | 440/230 V | 15 |

### (*ii*) *Circuit Breakers*

| Sl. No. | Type | Voltage | Normal operating amperes | Rupturing capacity MVA | No. required |
|---|---|---|---|---|---|
| 1. | OCB | 11 KV | 200 to 3000 | 250 | 179 |
| 2. | OCB | 440 V | Do. | 25 | 528 |
| 3. | ACB | 440 V | 1500 | 250 | 31 |
| 4. | OCB | 3.3 KV | 100 and 800 | 125 | 122 |
| 5. | OCB | 110 KV | 60 | 2500 | 14 |
| 6. | OCB | .. | 40 to 160 | .. | 256 |

## (iii) *Motors*

| No. | KW | Voltage | Type | R.P.M. | No. reqd. |
|---|---|---|---|---|---|
| 1. | Less than 10 | 400/440V | TEFC, Synchronous motors, induction motors, explosion proof etc. | 1400/1450, and 2940/2980, | 1032 |
| 2. | 10-30 | Do. | | | 517 |
| 3. | 30-50 | Do. | | | 214 |
| 4. | 50-70 | Do. | | | 122 |
| 5. | 75-150 | Do. | | | 700 |
| 6. | 150-750 | 3.3 KV | | | 80 |
| 7. | Above 750 | 6.6 & 11 KV | | | 34 |

## (iv) *Switchgears Relays & Instruments*

| Sl. No. | Type | Volt | KW | No. required |
|---|---|---|---|---|
| 1. | Control switchgear, cubicle type automatic starters | 11000 | Large KW motors | 1 off 9 units |
| 2. | Metal clad cubicle type automatic starters | 440 | Do. | 12 off 25 MVA |
| 3. | Oil immersed automatic starters | 440 | Up to 38 KW motors | 36 off 25 MVA |
| 4. | Oil immersed automatic starters | 440 | Up to 22.5 KW motors | 48 off 25 MVA |
| 5. | Oil immersed automatic starters | 440 | Up to 7.5 K.W. motors | 120 off 25 MVA |
| 6. | Metal clad combination fused switchboards with 35 MVA HRC fuses | 440 | .. | 15 off 35 MVA |

| | | | | |
|---|---|---|---|---|
| 7. | D.O.L. Starters . . . . . | .. | 0.37 to 75 KW | 1123+ n |
| 8. | Star Delta starters . . . . . | .. | up to 40 KW | n |
| 9. | Auto transformer type starters . . . . . | .. | Above 50 KW | n |
| 10. | Reduced voltage starters . . . . . | 400 | 75-150 KW | 98 |
| 11. | Unit type distribution switchgear . . . . . | 6.6 KW | .. | 2 |
| 12. | Unit type stepdown transformer substation . . . . . | .. | .. | .. |
| 13. | Set type power equipment and low voltage apparatus . . . | .. | .. | 20 |
| 14. | Remote control unit . . . . . | 400 V | .. | 5 |
| 15. | Relay unit comprising 8 relays . . . . . | .. | .. | .. |
| 16. | Oil filled magnetic starter . . . . . | 500 V | .. | 3 |
| 17. | Relay block of synchronous motors . . . . . | 230 V | .. | 4 |
| 18. | Switchgear panel . . . . . | 400 V | .. | 1 |
| 19. | Magnetic oil starter . . . . . | 400 V | .. | 6 |
| 20. | Triple pole push starter . . . . . | 400 V | .. | 1 |

(v) *Cables*

| No. | Volt | Type | Size in sq. cm. | Length in k.m. reqd. |
|---|---|---|---|---|
| 1. | 11 KV | AL PILCDSTA | 3×0.13 to 3×0.24 | 68.55 |
| 2. | 6.6 KV | Do. | Do. | 15.5 |
| 3. | 6.6 KV | PVC Copper | Various sizes | 85.0 |
| 4. | 3.3 KV | AL PILCDSTA Tropodor & PVC | 3×0.15 to 3×2580 | 240.5 |
| 5. | 1.1 KV | PILCA | Various sizes | 8.15 |
| 6. | 600 V | PVC & Tropodor | 3×16 to 3×192 | 472.8 |

## Category VIII—Furnaces

| Sl. No. | Type | Duty | Materials of construction | Other Data | No. |
|---|---|---|---|---|---|
| 1. | Rectangular Vertical . . . | Hot Air | MS Shell, firebrick lining | By burning fuel gas | 2 |
| 2. | Do. | Air & Fuel gas 13,000 $NM^3$/hour | Do. | Gas fired | 3 |
| 3. | Do. | Air 18000 Kg/hr Gas 125 $NM^3$/hr | Do. | Fuelgas fired | 3 |
| 4. | Oil fired . . . . . | Heat transfer salt heating | Steel firebrick lining | | 4 |
| 5. | HCl combustion chamber . . | Burning $Cl_2$ and hydrogen | Karbate | | 8 |
| 6. | Vertical Mixed feed (lime kiln) | Burning limestone | Steel 140 T<br>CI 33 T<br>CS 14 T<br>Refractory 210 T<br>Redbrick 70 T<br>Insulation 35 T | | 3 |
| 7. | Cylindrical Horizontal . . | | MS Shell with refractory lining | Oil gas burner | 4 |
| 8. | Do. | | Do. | Oil burner | 2 |
| 9. | Finned type shear heater . . . . | | | | 6 |
| 10. | Air heater . . . . . | Air heater | Shell of MS refractory lined | | 3 |

| Sl. No. | Type | Duty | Materials of construction | Other data | No. |
|---|---|---|---|---|---|
| 11. | Sulphur furnace . . . . | Sulphur burning | Steel construction | Wt. 18 T | 3 |
| 12. | Galciner Rotary kiln type (8′ dia -75′1) | Calcining sodium bi-carbonate to soda ash. | Steel<br>CI<br>CS<br>Refractory | 185 T<br>60T<br>20T<br>460 T | 8 |
| 13. | Crude heater . . . . | 50,000 barrels/day of crude. | Structure: CS Tubes: Chrome Moly Steel Lining Refractory Bricks and materials. | Equipped in the servicing platform burners and supporting chimney stack. | 1 |
| 14. | Charge heater for kerosene . . | 123500 lbs/hour of kerosene. | Do. | Do. | 1 |
| 15. | Naphtha heater . . . . | 111000 lbs/hr. | Do. | Do. | 1 |
| 16. | Heater for Naphtha . . . | 284600 lbs hydrocarbon/hr. | Tubes-CS | Do. | 1 |
| 17. | Vacuum unit charge heater . . | 222400 lbs heavy hydro-carbon/hr. | Do. | Do. | 1 |
| 18. | Cracking heater . . . . | 210000 lbs. hydrocarbon/hour. | Tubes 7% chrome steel | Equipped in the Servicing platform burners and supporting Chimney stack. | 1 |
| 19. | Fractionation feed furnace . . | 11842 barrels per day | Tubes; 5% chrome steel | Do. | 1 |
| 20. | Reform heater . . . . | 473180 lbs./day | Structure: CS Tubes: Chr. Moly. Steel Lining: Refractory bricks and materials. | Do. | 1 |

## Category IX—Crushers/Grinders

| | All Mn Steel lined | | |
|---|---|---|---|
| GROUP I . . . . . | Capacity: 6-10 T/hr<br>Feed Size: lumps<br>Product size: 1″ & ground powder<br>Power HP—10-40 | 9 Nos.<br><br>4 Nos. | Hardinge Mills<br><br>Roll Crushers |
| GROUP II . . . . . | Capacity: 6-10 T/hr<br>Feed size: lumps<br>Product: 200 mesh Power HP:50 | 3 Hardinge Mills | |
| GROUP III . . . . . | Capacity: 11-50 T/hr<br>Feed size: 15 mm<br>Product size: ground powder<br>Power:41-125 HP | 9 Nos.<br>5 Nos.<br>6 Nos. | Double Roll<br>Ball Mill &<br>Hammer Mills |
| GROUP IV . . . . . | Capacity: 51-100 T/hr<br>Feed size: 15 mm<br>Product : ground<br>Power:125-150 HP | 7 Nos.<br>7 Nos. | Hammer &<br>Ball Mill |
| GROUP V . . . . . | Capacity:100-125 T/hr<br>Feed:Lump<br>Product:15 mm<br>Power:150 HP | 5 Nos.<br>1 No. | Hammer Mills<br>Hammer Mill |

SUMMARY

## Category X—Air Separation Plant

(1) Units Capacity Equipments required for each unit.

3 Nos.
Air intake 15,000 $Nm^3$/hour

1. One turbo air compressor multistage with intercoolers and suction pressure 1 atm abs; discharge pressure 6.3 atm. abs. motor driven with gear boxes, Motor H.P. 1500 KW.

2. Two expansion turbines to expand cold gas from approx. 5.0 to 1.15 atm. with brake generators 57 and 90 KW.

3. Spray coolers for air

4. After cooler water pump 6 KW

5. Cold box consisting of—
   (*a*) reversible regenerator
   (*b*) cross counter current heat exchangers.
   (*c*) rectification column
   (*d*) acetylence absorber
   (*e*) argon column
   (*f*) blades with heating device 90 KW for thawing.

(2) Units Capacity Major Equipment required for each unit.

3 Nos.
28,000 $Nm^3$/hr

1. One turbo air compressor—multistage: inlet pressure 1 kg/$om^2$ outlet pressure 6.2 kg/$cm^2$motor 3300 HP.

2. One expansion turbine from 5 to 1.15 atm with brake generator 90 KW.

3. Spray cooler for air

4. After cooler water pump, 10 KW

5. Cold box consisting of—
   (*a*) reversible regenerator
   (*b*) cross counter current heat exchanger
   (*c*) rectifier column
   (*d*) acetylene absorber
   (*e*) argon column
   (*f*) blowers for thawing 150 KW
   (*g*) start-up turbine and brake generator.

SUMMARY

## Category XI—Instruments

| Type | | No. reqd. | Service |
|---|---|---|---|
| *(1) Controlling Devices* | | | |
| **FLUID FLOW** | Controller | 23 | |
| | Controller recorder | 98+n | |
| | Controller, Recorder, Totallizer | 12 | |
| **TEMPERATURE** | Controller | 192 | |
| | Controller recorder | 54+n | |
| **LEVEL** | Indicator controller | 162 | |
| | Controller | 31 | |
| | Controller, recorder | 7+n | |
| **PRESSURE** | Controller | 91+n | |
| | Controller recorder | 8+n | |
| Ratio Controller | | 27 | |
| Vacuum controllers | | 33+n | |
| Auto time cycle controller | | 14 | Air separation regeneration cycles. |
| Density indicating controller | | 2 | |
| Control valves | | 304 | Steam, gases and liquid. |
| Remote Control station | | 140 | |
| *(2) Measuring Instruments* | | | |
| **FLUID FLOW** | Indicators | 173+n | |
| | Indicator recorders | 222 | |
| | Indicator, recorder and totallizer | 9 | |
| **LEVEL** | Indicators | 127 | |
| | Recorders | 15 | |
| **TEMPERATURE** | Indicators | 26+n | |
| | Recorders | 648 | |
| **PRESSURE** | Indicators | 176 | |
| | Recorders | 120 | |
| Vacuum Recorders | | 2 | |
| Gas Analyser and recorders | | 18 | |
| Flow meters (Rotameter etc.) | | 556 | |

| Type | No. reqd. | Service |
|---|---|---|
| Precent solids indicators | n | |
| Differential pressure transmitter | 520 | |
| Pneumatic pressure transmitter | 283 | |
| Pneumatic temperature transmitter | 148 | |
| Pneumatic level transmitter | 191 | |
| Pressure gauges | 2165 | |
| Draught gauges | 138 | |
| Multipoint electronic temperature recorder | 100 | |
| Single point temperature recorder | 34 | |
| Radiation Pyrometers | 18 | |
| Thermocouples | 971 | |
| Moving coil tray indicators | 33 | |
| Infra-red analysers | 9 | Co, $Co_2$ $CH_4$ & $NH_3$ |
| Thermal conductivity analysers | 15 | $H_2$ $CO_2$ and $SO_2$ |
| Para magnetic analysers | 9 | Oxygen analyser |
| Electrochemical analyser | 8 | Traces of Oxygen |
| pH analysers | 10 | |
| Magnetic flowmeters | 3 | Corrosive conducting liquids with suspended solids. |
| Pressure switches | 309 | |
| Air filter regulators | 1335 | To provide dust, oil and water free air to pneumatic instruments. |
| Chamber type orifice | 166 | |
| Pneumatic electric contacts | 68 | |
| Pressure indicator transmitter | 137 | |
| Transducers | 62 | |
| 12 point potentiometer | 19 | |
| Indicating potentiometers | 14 | |
| Jack panel 72 points | 1 | |

| Type | No. reqd. | Service |
|---|---|---|
| Gas thermometers | 4 | |
| Mercury in glass industrial thermometers | 138 | |
| Electronic self-balancing bridge | 3 | |
| Indicating milli-volt metal | 1 | |
| Multi-point switch | 34 | |
| Resistance thermometers | 12 | |
| Universal switches | 16 | |
| Annunciator buttons | 80 | |
| Annunciator lamps | 78 | |
| Tubular fuses | 60 | |
| Pneumatic integrators | 12 | |
| 36-point jack panel | 6 | |
| *(3) Alarm Devices* | | |
| Level alarm | 26+n | |
| Level indicating alarm | 16+n | |
| Temperature indicating alarms | 4+n | |
| Timers | 3 | |
| Conductivity alarms | 3 | |
| Flame failure devices | 12 | |
| Alarm devices | 718 | |
| Relays (electric) | 237 | |

## Category XII—Miscellaneous

| Group No. | Type | Description | Duty | Capacity | Nos. reqd. |
|---|---|---|---|---|---|
| 1. FILTER | | | | | |
| | Pressure Type . . . | Filter Press Plate & Frame | .. | 43 $m^3$/hr | 2 |
| | | Kelly type Pressure Filter (rubber-lined)— 150 $m^2$ | To filter brine | .. | 8 |
| | | Continuous centrifuges (of 316 SS construction) | .. | .. | 4 |
| | | Tippling pan type filter 500 sq. ft. RL SS pans: Hastealloy C Valves | .. | .. | 3 |
| | Vacuum Type . . . | Chalk Filters | .. | .. | 13 |
| | | Salt filter (drum dia 1.8 m) | .. | .. | 3 |
| | | Rotary drum filter (rubber-lined) 25 $m^2$ | To handle brine clarifier sludge | .. | 4 |
| | | Oliver Hor. filters 15/ dia. (of 316 SS construction) | .. | .. | 8 |
| | | Vacuum filter (2.5 m dia. × 2.5 m face) | .. | .. | 2 |
| 2. SEPARATORS . . . . | | Electrolytic mist seperator | .. | 39300 $M^3$/h | 3 |
| | | Entrainment separator | .. | .. | 4 |
| | | Filter feed strainer (of 316 SS Construction) | .. | .. | 2 |
| | | Dorrclone | .. | .. | 2 |
| | | Dryer cyclones | .. | 46000 CFM | 4 |
| | | Dust cyclones | .. | 23000 CFM | 4 |
| | | Cooler cyclones | .. | .. | 2 |
| 3. TIPPLERS . . . . | | Wagon tipplers | To handle open box type wagons | 75 tons | 1 |

| | | | | | |
|---|---|---|---|---|---|
| | Wagon tipplers End rock Wagon tipplers | Do. | Closed | 37.5 T | 2 |
| | End rock Wagon tipplers | | .. | 200 T/hr | 1 |
| 4. EJECTORS . . . . | Ejectors | | .. | 215 $m^3$/hr | 12 |
| | Ejectors (Steel) | | .. | . | 8 |
| | Ejectors (Karbate) | | .. | . | 8 |
| 5. FEEDERS . . . . | Mill Feeders (Volumetric belt type) | | .. | 30 T/hr | 3 |
| | Ground rock feeder (belt) | | .. | 6-20 T/hr | 8 |
| | Antifoam reagent feeder (Steel construction) | | .. | 0-27 GPM | 3 |
| | Lime feeder Wheel type 1/8 HP | | .. | 0-6 GPM | 3 |
| | Phosphate rock feeders | | .. | 350 T/h | 4 |
| | Electric Vibrating Pan Feeders | | .. | 60-140 T/hr | 4 |
| 6. AGITATORS . . . . | Impeller & Paddle type 5 HP | | .. | .. | 32 |
| | Injector Mixer (Carbon Steel) | | .. | 63 kgms | 4 |
| 7. CLARIFIER . . . . | Scrubber water clarifier | | .. | .. | 2 |
| | Brine clarifier (100/ dia ) | | .. | .. | 4 |
| 8. SCREENS . . . . . | Vibrating screens | | .. | 100 T/hr | 8 |
| | | | | 15 T/hr | 2 |
| | Double deck screen (4m×15m) | | .. | 200 T/hr | 1 |
| | Double deck screen 25 mm×25 mm upper 8 mm×8mm lower | | .. | 100-120$m^3$/hr | 1 |
| | Single deck screen (1.5×1.5 m) | | .. | .. | 1 |
| 9. DRIERS . . . . . | Rotary drier (10/ dia. × 85/1) | | .. | .. | 4 |
| | Rotary drier (6/ dia. × 48/1) | | .. | .. | 2 |
| 10. COOLING TOWERS . . | Induced draft cooling towers | | .. | 400 $m^3$/hr | 4 |
| | Cooling towers (5×7×5m) | | .. | .. | 1 |

| Group No. | Type | Description | Duty | Capacity | Nos. reqd. |
|---|---|---|---|---|---|
| 11. | MATERIAL HANDLING EQUIPMENTS. | Empty bag conveyor (Chain type) | .. | 4000 bags/hr | 2 |
| | | Overhead travelling cranes | .. | up to 2 tons | 14 |
| | | (span between 10×20m) | .. | ,, 2-10 ,, | 8 |
| | | | | ,, 10-20 ,, | 10 |
| | | Travelling Cranes (span 16m) | | ,, 10 ,, | 8 |
| | | Hoist | | 4 ,, | 3 |
| | | Electric Hoist | | 5 ,, | 2 |
| | | Drag flight conveyor (450 mm wide & 12 m long) | .. | .. | 2 |
| | | Pulley Blocks | | 1000 kg. | 8 |
| | | | | 2000 kg. | 16 |
| | | | | 5000 kg. | 8 |
| | | Salt scrapers | | 200 T/hr | 1 |
| | | | | 100 T/hr | 1 |
| | | Drag scraper & winch (110 m radius) | | 150 T/hr | 1 |
| 12. | WEIGHING, SEWING, BAGGING & PRINTING MACHINES. | Weighing machine for bagging Plant (tippings 5/min) | | 50 kg/batch | 20 |
| | | Sewing machines—To sew bags | | 500 bags/hr | 10 |
| | | Bag printing machine | | 2000 bags/hr of 26½″×44″ | 4 |
| | | Ammonia Weigh tank scales | | (Up to 60000) lbs. each | 6 |
| | | Automatic belt scales | .. | .. | 3 |
| | | Weigh Scales | .. | 0-2000 kg. | 16 |
| | | Weigh Scales | .. | 0-1000 kg. | 8 |
| | | Weigh bridge | .. | 0-15000 kg. | 4 |
| | | Proportioning scale | .. | 65 T/hr | 1 |

## Category XII—Miscellaneous—Contd.

| Group No. | Type | Description | | Wt. in tons or numbers repuired |
|---|---|---|---|---|
| 13. | REFRACTORY BRICKS, INSULATING MATERIALS AND CEMENT, PACKING MATERIALS ETC. . . . . | A.P. Bricks | | 270,000 pcs |
| | | Refractory bricks Class A | | 45 T |
| | | Do. Class B | | 527 T |
| | | Fire Bricks and Insulation bricks | | 195,000 pcs |
| | | Chammote coating | | 6.34 T |
| | | Wedge type refractory bricks 2-sides | Cl.A | 12 $m^3$ |
| | | | Cl.B | 12 $m^3$ |
| | | Light wt. chammote straight bricks | Cl.A | 12$m^3$ |
| | | | Cl.B | 150 $m^3$ |
| | | Diatomite Mark 600 | | 12 $m^3$ |
| | | Refractory mortar Class I | | .. |
| | | Class II | | .. |
| | | Diatomite powder | | 4.5 $m^3$ |
| | | Asbestos cardboard | | 140 $m^3$ |
| | | Chord 10-29 | | 5110 $m^3$ |
| | | High alumina shaped bricks | | 3 $m^3$ |
| | | High alumina straight bricks | Cl.A | 200 $m^3$ |
| | | | Cl.B | 150 $m^3$ |
| | | Silicate of soda | | 15 T |
| | | A.P. Cement | | 24 T |
| | | Pipe insulation | | 13.5 T |
| | | Crushed quartz and quartz pebbles | | 60 T |
| | | Partition rings & Rasching rings | | 19,20,000 |
| 14. | GENERAL . . . . . | Scrubber—Doyle type (6" W.G.) (pressure drop—rubber lined) | | 43000 CFM 3 |
| | | Cyclone valves | | .. 8 |
| | | Feed Table (2.2 m dia.) | | .. 2 |
| | | Caustic soda flakers | | 2000 kg/hr 4 |

| Group No. | Type | Description | Wt. in tons or numbers required |
|---|---|---|---|
| | | Air lock valve | 0.14 $m^3$ 2 |
| | | Water softening equipment | 15$m^3$/hr 4 |
| | | Catalyst | 158,400 ltrs. |
| 15. STEEL STRUCTURES . . . . | | Heavy structurals | 3000 T |
| | | Light structurals | 2000 T |
| | | Workshop equipment for maintenance purposes | 200 T |
| | | Coke chambers (4.6×25m) Carbon Steel 4 units. | 1440 T |

ANNEXURE III

## REPORT OF VISITS

## To Various Fabrication Shops

| *Name of Shop* | *Members Visited* |
|---|---|
| (1) M/s TELCO., Jamshedpur M/s | Paul Pothen, General Superintendent, FACT K.S. Sarma, Chief Mechanical Engineer, FCI. |
| (2) M/s Utkal Machinery, Kansbahat | Do. |
| (3) M/s A.P.V. Engineering Co., Calcutta | Do. |
| (4) M/s Triveni Engineering Co., Allahabad | Do. |
| (5) M/s A.V.B. Engineering Co., Durgapur | K. S. Sarma, FCI, H. H. Jethanandani, B. S. Kakkar, FCI. |
| (6) M/s Elecon Engineering Co., Vallabha Vidyanagar, Gujarat State. | K. S. Sarma and S. R. Seshan. |
| (7) M/s Walchand Nagar Industries, Walchand Nagar, Maharashtra. | Do. |
| (8) M/s Testeels Ltd., Ahemadabad | Do. Sri R. S. Chana FCI. |
| (9) M/s Larsen & Toubro., Bombay (Powai) | Do. |
| (10) M/s Indian Sugar & General Engineering Corporation, Jagadhiri. | Mr. Jethanandani Dy. Chief Engineer, FCI. |
| (11) M/s Bhakra Nangal Shops | Do. |

# ANNEXURE III

## 1. TELCO

"We had discussions with Sri D'Costa, General Manager, Telco at his office on the 12th instant. The General Manager explained that at the moment, the Telco Works are fully booked and the present commitments alone will keep them busy till the end of 1965. He also stated that even when some of the jobs being undertaken by them for other agencies are completed their jobs themselves will keep the entire shop busy. Further it is expected that M/s. Telco will have to take up the fabrication of part of the equipment required for the Bokaro Steel Plant when this is taken up. Even for the present volume of work, M/s. Telco appear to be having some difficulty due to the shortage of trained skilled workmen, particularly welders.

All these factors together indicate that we cannot expect to get any job done through M/s. Telco. Sri D'Costa mentioned that although they were prepared to undertake outside jobs over three years ago, the position has completely changed and they have never been in a position to take up any fabrication work for others during the last three years and are not likely to be so in the near future either."

## 2. UTKAL MACHINERY LTD.

"We met Mr. Buchmann, Deputy General Manager, Mr. Kraft, Development Engineer and Mr. Rollinger, Works Manager. This firm has equipment for plate and structural fabrication as well as fairly heavy machinery and they are already making some machines for paper mills. They have at present a capacity of approximately 500 tons per month on the plate and vessels fabrication side and are equipped to roll plates of up to 3 meter width and thickness up to 28 mm. They are also suitably equipped with edge preparation machines, a 500 ton press etc., but do not have any Radiography or stress relieving equipment. At present they also do not have equipment for rolling plates of more than 28 mm. thickness. (They may be also to take thicker plates provided they are proportionately smaller in width.).

We were told that as per their present commitments, they will be busy till the middle of 1965. In case we place orders by the later half of 1964, they felt that they will take these jobs and complete them during 1965. They also stated that they expect to get heavier plate bending rolls within a year or so. They promised to let us have a list of machines that they have in their shops shortly.

They were also installing two electrical furnaces of 4 tons capacity each and they propose making grey iron as well as steel castings using these furnaces.

Both at Telco and Utkal Machinery, we heard that one of the main difficulties in taking up fabrication work is the non-availability of tested and boiler quality plates in time. At Utkal, they stated that some orders placed over 18 months back are still to be completed and expressed the view that if we can supply the material the work could be done quicker."

### 3. A.P.V. ENGINEERING COMPANY

"We had discussions with Mr. Brown, Managing Director and Mr. Tandavan their Engineer-in-charge of fabrication. We also visited their shop where they have plate bending rolls and other equipment suited for handling plates up to a maximum of 3/4" thickness, as normally thicker plates are not required on stainless steel fabrications. They stated that they have a capacity of approximately 500 tons of stainless steel work per year of which after allowing for their normal regular line of production, they may be able to spare about 300 tons per year for other jobs. This, of course will be governed by the loading in their shops at the time of our enquiry."

### 4. TRIVENI ENGINEERING WORKS

"This firm has a good machine shop, but they do not have any facilities for fabrication of plate work or manufacture of castings of any nature. During discussions with their Works Manager, Sri K. N. Rao, he stated that they intend starting a fabrication section shortly. At present, they get castings from other firms specialised in particular types of castings required and they do the design and manufacture of these machine in consultation with their collaborators. We saw a heavy sugar-cane crusher which the firm manufactured with most of the castings, procured in India, but with the heaviest pieces imported. The standard of workmanship appears to be quite high.

They are also intending to manufacture back pressure steam turbines of up to 1,000 H.P. capacity in collaboration with M/s. Peter Brotherhood of U.K. They have, in their shops, under manufacture vacuum engines of up to 36" diameter also manufactured in collaboration with the above firm."

### 5. A.V.B. ENGINEERING CO., DURGAPUR

"We met Mr. Younger, Director, Mr. Canteenwala head of technical and sales and Sri Sen. Their shop is well equipped to take pressure vessels of all grades but they stated that they prefer to take up jobs involving grade I & II vessels only. At present they are engaged in making high pressure boilers, grinding mills etc. They have a capacity of 8,000 tons per annum. They can bend cold M.S. Plates up to 2" thick 12" wide and hot plates up to 5"-12' wide. Maximum dia up to which dished ends can be made is 9'-0". (A list of various ranges of dies for dished ends is enclosed).

The shop is divided into following bays.

1. Vessel bay No. 1 (700 ft.-70 ft.) housing submerged arc welding m/c. horizontal boring and facing m/c. and stress relieving furnace (20'-20'-56').

2. Vessel bay No. 2 (700'-70') housing plate heating furnace, 3000 ton hydraulic bending m/c. (2¼"), 1,000 ton Dishing and flanging press, plate edge curving press plate Bending m/c. (1¼"), flame cutting machine, etc.

3. Plate and structural bay (700'-70') housing plate and beam straightening machines, plate-bending roll (½"×10') profile gas cutting machine, etc.

4. Tube shop (700'-100') for bending and manipulating tubes and pipes required for boilers.

5. Medium Machine Shop Bay No. 1 (350'-70') housing centre lathes, capstan and turret lathes, milling machines, grinders, etc.

6. Heavy Machine Shop Bay No. 2 (350'-70') housing 22' dia vertical boring mill, planing machine etc.

7. Testing facilities:

The workshop is well equipped for testing the plates and welds. They are not only equipped with the tensile and compression testing machines, hardness tester etc., but also have X-ray equipments capable of testing up to 3" thick plates and Cobalt unit to give results up to 6" thick plates. Equipments have also been installed for flaw detection (Ultrasonic Method and magnetic crack detection).

We were quite impressed with the quality of present jobs being done at AVB. They are well equipped to fabricate high pressure vessels and have arrangement to get them inspected by an independent authority (M/s. Lloyd). In view of the fact they can take up the fabrication of vessels up to 5" thick, we may possibly be able to replace some of the forged pressure vessels with welded vessels. Besides, their welders are fully trained to weld not only M.S. plates, but also carbon steel plates (SA-212.C.31%) alloy steel plates etc.

According to them it is not economical to use SA-212 plates for thickness of less than 2". However, they could not give us their idea of cost if we use alloy steel plates for pressure vessels, in case the plates have to be imported.

M/s. Younger and Canteenwala also informed us that they are making an effort to keep stock of Boiler quality plates but they seem to be experiencing great difficulty in this respect. We were however supplied with a list of raw materials at present surplus with them.

A.V.B. are also taking up the manufacture of raw Crushers, hammer mills and ballmills. They will be prepared to offer pneumatic conveying systems also.

We had also enquired about the possibility of their taking up Horton sphere. They informed us that even though they have equipment to fabricate spheres their design department is not presently trained to take up this work. They may be in a position to handle these jobs after about a year and half.

They are not interested in taking up Heat Exchangers at present and they do not have sufficient machining capacity to spare at present."

## 6. ELECON ENGINEERING COMPANY

"We visited the works of M/s. Elecon Engineering Company on the 18th September, 1963 and had discussions with their technical and administrative officers. This firm has equipment for manufacture of large numbers of conveyor components such as idlers, pulleys, etc. They have automatic machines for machining to close tolerances, the cast iron ends for idlers, hydraulic dimpling machines for attaching the ends to the steel tube idlers, etc. They have also got necessary press brakes, shearing machines, etc., for fabrication of idler bases, decking plates, etc.

We where told that they can manufacture about 80 to 100 troughing idler sets per day and they are hoping to increase this very shortly to nearly double this number. They also manufacture self-aligning idlers of various sizes.

In addition to the manufacture of components, this firm undertakes design, supply and erection of complete conveyor plant for specified duties. The workmanship has been found to be quite good and as they have a satisfactory final inspection before despatch of these components, the quality of equipment supplied by this firm can be considered to be quite satisfactory. They normally manufacture idlers with "sealed for life" bearings, but they are prepared to undertake the supply of ordinary idlers provided with grease nipples if necessary."

## 7 WALCHANDNAGAR INDUSTRIES

"We visited this firm on the 20th of September 1963 and were impressed by the variety of jobs that they are able to undertake. They have some of the largest machines for some duties and they manufacture some very interesting equipment for the sugar industry. With the equipment and technical capacity available, they can undertake manufacture of many other items of equipment also.

They have a number of lathes, shaping and planing machines, horizontal and vertical boring mills, gearhobbing machines, etc. Amongst these, they have machines like vertical boring machines capable of taking jobs up to 4 metre diameter, gear cutting machines also capable of cutting gears up to 4 metre diameter and planing and other machines of comparable capacities.

They have plate bending machines which can normally take plates of $1\frac{1}{2}$"-2" and thickness which can also be used for bending thicker plates with some adjustment. They have already got in the Bombay Port a thousand ton press for manufacture of dished ends and they expect to be able to take on dishing of plates by the end of this year. At present, they are getting their dished ends from other firms like A.V.B., Indian General Sugars Ltd., etc. They also have facilities for manufacture of shell and tube type of heat exchangers, the equipment available including an automatic controlled torque tube expander unit. They make quite a large variety of heat exchangers required for the sugar industry.

Another interesting item of manufacture that we saw was centrifuges with stainless steel baskets. They make all the items required with the exception of the ball and roller bearings and including oil operated fluid couplings between the motors and the centrifuges.

They already manufacture worm gears for various equipment and they stated that they have entered into collaboration with M/s. Philadelphia Gear Company of U.S.A. for manufacturing various sizes of helical and double helical gear units.

It appears that this firm will be able to manufacture a lot of heavier equipment that does not normally fall within the scope of the smaller firms. We had suggested that one of their Engineers be sent here to see the plant and assess for himself the types of equipment that they will be able to fabricate for us for our proposed fertilizer units. They have agreed to this suggestion and it is expected that he will be coming sometime this month."

## 8. TESTEELS LIMITED

M/s. Testeels Ltd., have been established at Ahmedabad since 1961 and they are collaborating with the Japanese firm of M/s. Mitsibushi. They have at the moment one fairly large size fabrication shop where they undertake mild steel fabrication and are now expanding to gear up for the fabrication of stainless steel equipment also. Their present capacity for mild steel jobs is 200 tons per month and they are not heavily booked for it and can promise fairly early deliveries. At the time of my visit to their works I could see a number of fixed head heat exchangers, pressure vessels for medium pressures (200 lbs/sq. inch range) and number of other large tanks, reaction vessels and kettles under fabrication. The quality of the work was above average and they are constantly endeavouring to improve it. I was told by their Technical Adviser, Dr. Subramaniam, that they had appointed Lloyds Register of shipping to certify each job that was turned out of their works. This was with a view to establish a minimum standard of quality under the responsibility of an independent third party who has no business interest in the matter and are know for their integrity and high standard.

Testeels Ltd., are fairly well equipped with the fabrication jobs and they have a union-melt welding machine and a 400 tons hydraulic press for making dished ends among other things. They have a set of dies available with them for manufacturing dished ends up to 1300 mm. dia and these are manufactured by hot pressing. Beyond this dia they are also able to make dished ends up to about 3200 mm. dia with the help of the same press which has got a horizontal hydraulic ram. This is done by slow repetitive process. Their existing dies are of cast iron and they are prepared to make new dies provided there is demand for goods numbers. Any way they propose to go on adding to their stock of dies. Besides, they are now planning to device with the help of two Japanese experts a new machine for producing the kuckleradius and flanging of large dia dished ends by the process of spinning. They are also adding a heat-treatment furnace of size approx. 10′ × 12′ × 16′ and this is expected to be ready within a couple of months. The heat treatment furnace will be oil fired and shall be suitable for temperature up to 700°C. Testeels have a machine shop, but machines are few in numbers and small in sizes. They have no facilities for X-ray and they make use of the service of a Bombay firm, whenever necessary, by a fixed arrangement with them. Apart from the plate fabrication shop, they have also set up a steel structural shop of about 200 tons capacity per month.

It may be of interest to mention here that they have their own stock of 304 quality stainless steel plates and are able to offer stainless steel equipment jobs in this quality steel including the supply of material without any import licence.

## 9. LARSEN AND TOUBRO

M/s. Larsen & Toubro in Bombay at Powai have expanded their fabrication and machine shops and are equipped to do large/small size fabrication jobs. They however are specialising in fabrication of stainless steel and other non-ferrous jobs also whenever capacity is available. They manufacture lot of stainless steel equipment such as tanks, containers, mixing vessels, etc. for the Dairy and Pharmaceutical industry. The quality of their workmanship is excellent. They are also able to manufacture and supply agitators for open/close vessels complete with propeller and the drive unit. For this purpose they are manufacturing their own special year box which is suitable for installation at the top of the tank or for side entry. They have well equipped machine shop; the

main machines of mention are: A floor bed lathe which can accommodate appr. 12 ft. dia. by about 45 ft. length jobs. For the manufacture of dished ends they have a 200 ton press and some gadgets with it and the process is a slow and skilled one. But they are able to produce good quality dished ends with it. For producing Knuckleradius and flanging, they have a proper machine which does the job by spinning the dished ends.

They are also at the moment experimenting with the manufacture of rubber-lined mild steel equipment and are collaborating with M/s. Dunlop Ltd. in this connection. I could see only one rubber-lined rectangular tank which was fairly well done. They are prepared to accept orders for rubber-lined equipment.

At their Powai works, M/s. Larsen & Toubro are manufacturing cast iron lubricated plug cocks up to 4 inch size. They are also proposing manufacture of Telfon impregnated plugs with cast iron bodies in the near future and cast steel plug cocks at a later date.

Other items of manufacture at their Powai works are electrical switchgear, petrol pumps for service stations, portable conveyors and wooden storage tanks. They have no facilities for heat-treatment or X-ray and for this purpose they take the help of some local firms.

## 10. INDIAN SUGAR AND GENERAL ENGINEERING CORPORATION

I visited the Indian Sugar & General Engineering Corporation, Jagadhri on 8th November, 1963 and had discussions with their Mr. Chunilal, Secretary and Mr. Albert Jeavoies. Manager, Boiler Shop. They gave me a list of the equipment and layout of Boiler Shop, Plate Shop, Machine Shop, etc., and the latest list of dies available with them. Regarding the equipment mention may specially be made of stress relieving furnace 35′ × 15′ × 14′ inside. 400 ton press for dishing which can take plates up to 7½′ only, plate bending rolls capacity 12′ × 1¼″ cold and 4″ hot, pneumatic tube expanding tools capacity 4″ dia tube, facing lathes 4′—8″ chuck, planer 20′ stroke × 10′ 6″ × 9′ 0″ horizontal travel, 60″ swing × 30′ between centre lathe etc.

They are manufacturing sugar mill machinery and are particularly interested in quoting for boilers including coal and ash handling equipment. They seemed to be unaware of our requirement or Tender for Boilers for Gorakhpur. They are also interested in making pressure vessels provided we supply them dished ends above 7½′. They have otherwise adequate arrangements for making pressure vessels and heat exchangers, but their capacity appeared to me to be limited. At present they are booked up to middle of 1964. Their capacity of boiler shop only is 100 tons/month. They are also likely to expand their boiler shop to double the capacity within 8—9 months. They have recently supplied welded chlorine cylinders of one ton capacity tested to 1500 psi to D.C.M.

Other information collected from them is as follows:—

1. M/s. Testeels near Idgah Gate, Ahmedabad-11 also make dished ends by spinning and they had recently got quotation from them for 1½″ thick × 10′ dia dished end.
   M/s. Testeels also make dies for dished ends. M/s. I.S.G.E.C. also can make C.I. dies for dishing and have a 6 ton cupola for such heavy castings.

2. The price of a 8 dia. (2600 mm.) dia. may be about Rs. 50,000 and since we require about 36 dished ends of this dia., the cost of die/plate will be appoximately Rs. 1,500.

3. M/s. I.S.G.E.C. can undertake design, supply and erection of hortonsphere. in collaboration with John Thompson. M/s. John Thompson, U.K. are now putting up a hortonsphere of 50 dia. with max. 3" thick plate for Atomic Energy Commission.

4. For stress relieving of stainless steel vessels, they intend to put up separate system of supply of sulphur free on which according to them should be satisfactory.

5. They are prepared to give us indicative prices of vessels if we send them sketches of the type shown by me to them.

6. According to them dished ends in segments X-rayed, stress relieved should be acceptable for pressure vessels.

7. They can also supply bucket elevators, filter presses, over-head travelling cranes up to 20 tons capacity gas holders, vibrating screen, Ni-hard castings.

8. They don't have at present equipment or the personnel for stainless or aluminium welding but they are placing order for Argon welding equipment.

9. Their quotation for welded pipes will be approximately Rs. 1,700 per ton and for structures Rs. 1,300—1,500 per ton including material based on the procurement of material from open market. In case the material is obtained on column I rates, the prices will be suitably reduced.

10. They will like us to examine the following points:

(a) Limitation on size of (dia. & length) vessels that can be transported by train. According to them 9' dia. is the max. size that can be transported.

(b) Who will be the inspecting authority?

In the case of their boiler, they import all the plates and they give Lloyds' certificates. Since in this case, plates will be purchased in India, Lloyds won't agree for inspection. Moreover plates made in Rourkela by L. D. process are not accepted by Lloyds.

(c) Since according to their experience, supply of tested plates in India nearly takes 12—18 months we should take this factor into consideration.

11. (a) Cost of their boiler shop including building is Rs. 35 lakhs excl. colony, etc. which is approx. Rs. 300 per ton of product.

(b) No. of workmen employed in boiler shop is 90, *i.e.*, approximately 13 tons output/worker/year.

(c) Output of boiler shop is approximately Rs. 60 lakhs/year.

(d) Area of boiler shop 25 sq. ft/ton of product.

## 11. BHAKRA NANGAL SHOPS

I visited Bhakra Nangal structural and plate shop on 9th. They had manufactured penstocks for Bhakra and have at present sufficient idle capacity for plate work. They can also undertake structural work and are prepared to tender.

They have the following machines:

1. Stress relieving furnace oil fired capacity 20′ length × 19′ dia. vessels.
2. Plate rolling machines:
   - ½″ × 15′ capacity 1 No.
   - 1″ × 20′ capacity 1 No.
   - 2″ × 15′ capacity 1 No.
3. Radial drilling machines up to 3″ capacity 10 Nos.
4. Galvanising shop which can take jobs up to 30′.
5. Punching, hearing, bar cutting machines 4 Nos.
6. Plate edge planer 25′ length.
7. Brake Press 400 tons.
8. Plate shearing machines 2 Nos. capacity 7/8″.
9. 36″ and 28″ saw cutting machines.
10. Section straightening machine which can take sections up to 12″ wide flanges.
11. Automatic submerged are welding plant.
12. Oxygen and acetylene plant.
13. Equipment for making special shaped rubber gaskets etc.

Besides, they have a very big machine shop.

No. of workmen in plate and structural shop: 280.

| | | |
|---|---|---|
| Output max. | 4500 tons | } on three shifts. |
| Average | 3600 tons | |

Area of plate shop (excl. out door area for penstock section) —130′×380′ approx. 50,000 sq. ft.

Area/ton 40 sq. ft.

Output/worker/year 13 tons.

# ANNEXURE IV

**A. Minutes of the discussions held with the representatives of fabricators at the Board Room of the A.C.C. Limited, Bombay on the 29th November, 1963**

PRESENT

Shri Nambiar of New Standard Engg. Co.
Shri P. D. Parekh of A.C.C. Ltd.
Shri Pradhan of Larsen & Toubro Ltd.
Representative of Binny & Co. Ltd., Madras.
Shri Gupta of D.C.M.
Shri Shah of Garlick & Co.
Shri E. K. Sen of A.V.B.
Shri A. V. Joshi of Walchandnagar Industries.
Shri Peacock of Khandelwel Udyog.
Shri Parekh of Parekh Engg. Co.
Shri Prabhu of Prabhu Engg. Co.
Shri M. K. K. Nair, Chairman of Working Group.
Shri V. N. Kasturirangan, Convenor of Working Group.
Shri K. S. Sarma, Chief Engineer, FCI, Ltd.

1. The Chairman invited the various representatives to the meeting and thanked them for having taken the trouble to attend the meeting at short notice. The Chairman also explained the purpose of the conference *viz.*, to determine the extent of fabrication facilities available in the country with regard to medium pressure vessels and stainless steel equipment and to find out the problems that are experienced by in their day-to-day working.

2. **WALCHANDNAGAR INDUSTRIES (Mr. A. V. Joshi)**

The following points were made out by the representatives of Walchandnagar Industries, Maximum thickness of fabrication of stainless steel: 70 mm., length: 3 metres, which can be welded for additional lengths are required. Pressure: 450 lbs.

Testing facilities available: Radiography, X-Ray, Ultrasonics.

Capacity: 3,000 tons per year on a single shift basis at present. However, they expect to manufacture up to 4,500 tons in 1963-64, since the annual capacity is 10,000 tons.

For the next 16 months, they are fully booked with orders.

They have a design organisation who will carry out all shop drawings based on basic designs that would be furnished by the customer.

No. of people employed: 1,400 out of which 80 are engaged in the design work.

Raw materials affect 30% of capacity in view of the fact that plates and sections are in short supply. Rourkela is in a position to supply only 12 months after placing orders. At present boiler quality plates are being obtained on the firm's own licences abroad.

Indigenous quality of electrodes for boiler quality automatic welding has been found unsatisfactory. (This may be due to the flux used.)

There are Czech technicians in the shop who arrange for the training of Indian technicians and in one year's time it has been possible to train welders who can pass the accuracy tests according to the boiler code.

Another problem is shortage of oxygen and acetylene which are not sufficient in the country at this time. With the starting up of the Bombay Oxygen plant, it is expected that the situation will somewhat ease.

The shop fabricates stainless steel centrifuge baskets for the sugar industry.

Generally they are engaged in the manufacture of equipments required for the sugar industry. The required dished ends are being obtained from A.V.B. or John Thompson of Yamunanagar, having a small press of capacity of 500 tons.

### 3. A. C. C. LTD. (Mr. Parekh)

They are very busy with manufacture of cement machinery at the moment. No other offers are therefore made for the fabrication of other types of vessels required for general chemical plant requirements. They have a licensed capacity of 3,600 tons while they have actually achieved a capacity of 2,500 tons. It was pointed out that for the next three years they are very busy and will be unable to handle any work other than their own.

They have no dished end capacity and have no plans either to instal any.

They can manufacture tube mills required by the cement industry (2,000 HP). They have a Grey Iron Foundry of their own.

### 4. GARLICK AND CO. (Mr. Shah)

They are heavily booked with orders at the present moment. They are doing work for Dorn-Oliver. They undertake fabrication of equipments required for the sugar and paper industries. They can carry out fabrication of medium pressure vessels of up to 250 lbs. per sq. in. Their present capacity is 350 to 400 tons pr. year. They have an expansion programme for 1965—66.

### 5. NEW STANDARD ENGINEERING CO. (Mr. Nambiar)

This is a shop which undertakes both structurals and normal pressure vessels, etc. Their installed capacity is 850 tons a month while they have achieved a capacity of 500 tons. The number of people employed is 2,500.

The thickness of the plates used for pressure vessels would be half an inch. They can take up work of up to 1" thick plates. This shop

was established 25 years ago for carrying out structural steel fabrication work. For the last three years they are doing pressure vessel work also. They have plans to establish dishing capacity of up to 3/4" thick plates within the next 3 to 6 months. They have a Grey iron Foundry, where casting wheels of up to 30 tons in capacity could be made. They are also manufacturing bridge cranes in their shop. Besides, they are manufacturing plate bending machines in collaboration with John Gibson of England. They have 2,500 people on their rolls.

### 6. BINNY AND CO.

Their Madras factory has been manufacturing normal atmosphere pressure vessels for sulphuric acid plants. Their plant at Cochin would be in a position to manufacture penstock pipes required for hydroelectric projects commencing from January, 1964. They are considering the installation of equipments for the manufacture of dished ends in their plant. Next year they expect to manufacture graphite exchangers in collaboration with Paul Dufferin. At the Madras plant, the capacity is for manufacture of non-pressure vessels up to 4,000 tons, plates having a maximum thickness of 5/8". By 1965-66 they expect to start work in stainless steel also.

They have a design office of their own. They can do up to 8 tons mechanite casting in their own shops.

Tubes and plates are found to be in short supply for their fabrication.

### 7. A. V. B. LIMITED (Mr. E. K. Sen)

They have got a capacity for the manufacture of pressure vessels. They have a design office. They manufacture equipments for low temperature operation also and have facilities for impact testing at low temperatures.

Their standard dished end sizes are 36", 48", 54", 60" and 108" diameters. The length of vessels is 2 to 2.5 metres. The thickness of the 108" dia dished end would be 1.1/4". Their press has got capacity of 1,000 tons. The dished ends are 2 to 1 semi-elipsoidal. For their own boiler work they intend to press 4.1/2" thick plates for 60" dia boilers operating 1,000 lbs. per sq. inch. They are not interested in anything less than 20 mm in thickness. They have two 70-ton cranes and have facilities for Lloyds Class I inspection in their factory. They have manufactured LPG tanks where the impact test was done at 30 ft. at @ 20°C.

They have difficulties in obtaining tested plates from Rourkela. They are at the moment importing plates. Another difficulty is relating to the sizes of the plates manufactured at Rourkela. The Rourkela Steel Plant manufactures plates only up to 2.5 metres width, while their factory can use 12' wide plates. Wider plates are most necessary, as otherwise their will be too many weldings involved. They are also in a position to manufacture tank wagons for LPG. They have manufactured 14 anhydrous ammonia storage tanks 21' long and with a plate thickness of 1.5/8". The total number of wagons that they can manufacture in a year would be 60. In the field of cement machinery, they manufacture tube mills and Fuller Kenyon Pumps. They could manufacture sphere of 37' 6" dia. and plate thickness of 1.1/2". They have their own mechanical testing laboratory facilities and employ 1,000 people and they have their own design and engineering organisation.

## 8. PAREKH ENGINEERING CO. (Mr. Parekh)

They manufacture fabricated pipes of 4 to 16 inches dia. from steel plates for thickness up to a maximum of 5/8"

## 9. PRABHU ENGINEERING CO.

They are not having a workshop at present. Their representative merely indicated they have a proposal to have a fabrication shop installed in collaboration with a UK Group. Their intention is to manufacture one-third of a Urea Plant completely in their Workshop. Full details of this organisation are not available.

## 10. KHANDELWAL UDYOG

This shop has a capacity of 1,800 tons per annum and they carry out structural as well as plate and vessel work. They can roll up to 15 mm. thickness plates. They are at the moment supplying pressure vessels on a small scale as per customers' designs. They are starting aluminium fabrication work. They have in fact fabricated a bridge out of aluminium extrusions. They have carried out a large amount of work for Neyveli of low pressure tanks. They have also carried out fabrication of pipes up to 1,200 mm. dia.

They have a 100 ton hydraulic press. They have also got an X-ray equipment for testing purposes. They have expansion plans to increase the capacity of the fabrication shop to 3,000 tons per annum.

They have a small foundry. They are booked with orders for the next six months to come and cannot undertake any fabrication work now.

Their main problem has been to obtain tested quality plates for fabrication of vessels. The commercial quality plates now being sold are not satisfactory for fabrication of vessels, because of the laminations developing and a large amount of wastage is experienced. Their recommendation is that a minimum amount of mild steel sheets manufactured in the steel mills should be tested. It is also necessary that a minimum quality even for mild steel be prescribed by the Government. They have agreed to give us a technical note on the question of plates (Mr. Joshi of Walchandnagar Industries also agreed to give a note on the problems of raw materials supply).

## 11. LARSEN AND TOUBRO (Mr. Pradan also representing Utkal)

They have a capacity for 4,000 tons of mild steel work per year and 400 tons of stainless steel work per year, on a two-shift basis. They have experienced shortage of skilled workers. They could manufacture 1" thick pressure vessels out of mild steel and 3/4" pressure vessels out of stainless steel. They are specialising in stainless steel work. They have a press for 500 tons to make dished ends of 1" thickness in mild steel and 3/4" in stainless steel having a diameter of 7 ft. maximum. They are manufacturing large heat exchangers. They have been operating a small stainless steel foundry for the past two years. There are small foundries in the country using scrap for the manufacture of stainless steel castings and they are reported to be progressing satisfactorily.

The Utkal plant has a capacity of 6,000 tons.

12. D. C. M.

Their representative indicated that they are at the moment only carrying out design work and not fabricating any vessels.

13. A general discussion was held towards the end of the meeting about raw materials supply and standards etc. It was the concensus of opinion that high tensile bolts are not available in the country. Besides it was felt that standards must be established with respect to the threads to be used in fabrication work. Another item in short supply has been seamless and ERW tubes required for heat exchangers.

14. The shortage of tested quality boiler steel plates in the country has been one of the reasons standing in the way of utilising the capacity for pressure vessel fabrication. Government must give high priority to the question of available of raw materials for this industry.

15. After the Chairman thanked the representatives for their presense, the meeting came to a close at 5-30 p.m.

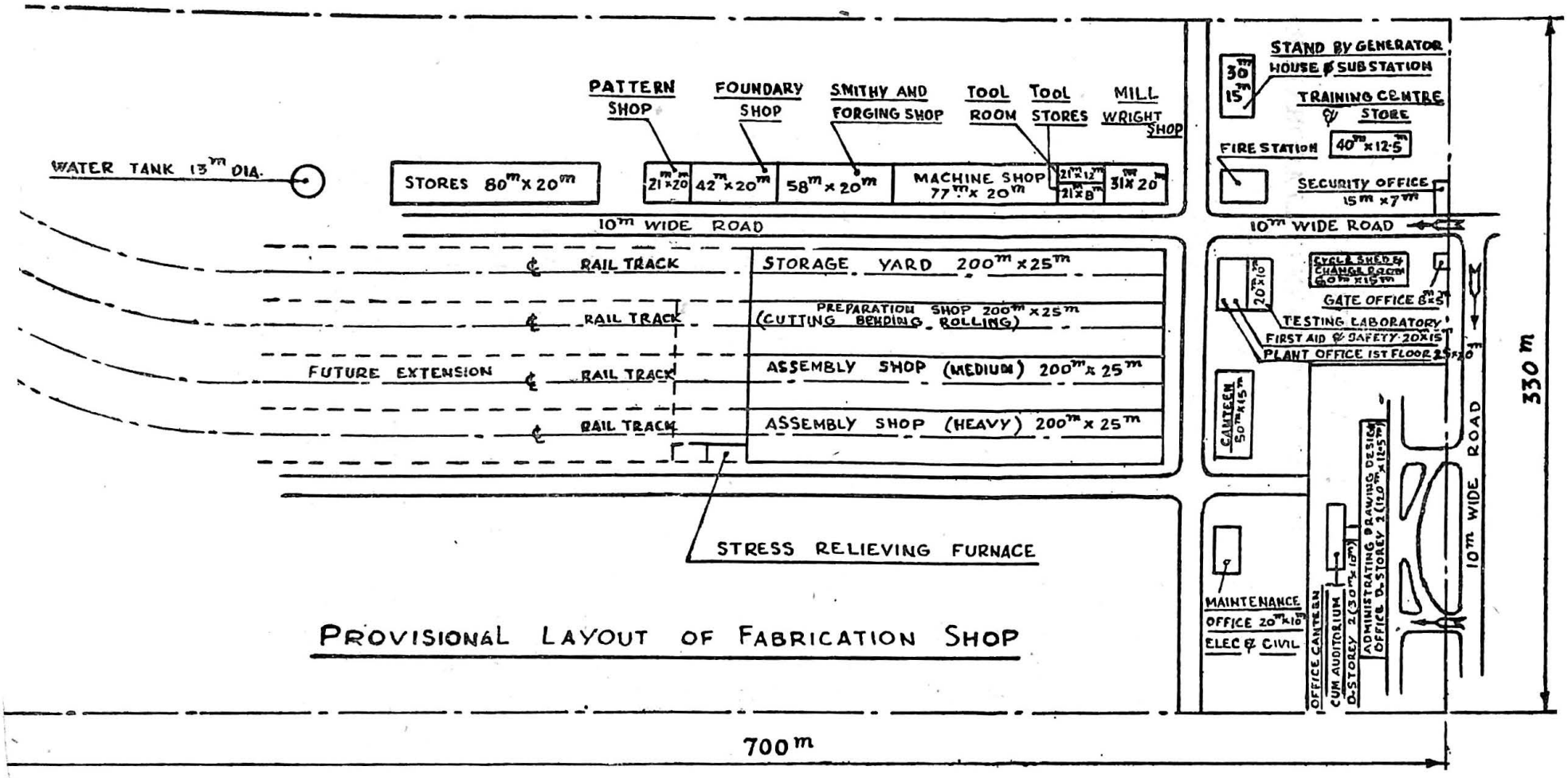
## ANNEXURE V

## LIST OF SUITABLE FOREIGN COLLABORATORS

| | | |
|---|---|---|
| 1. | A.O. Smith* | U.S.A. |
| 2. | E.B. Badger | U.S.A. |
| 3. | C.F. Braum | U.S.A. |
| 4. | Catalytic Construction | U.S.A. |
| 5. | Blaw-Knox | U.S.A. |
| 6. | Foster-Wheeler | U.S.A. |
| 7. | Kellogg | U.S.A. |
| 8. | Chicago Bridge & Iron Co. | U.S.A. |
| 9. | Struthers-Wells | U.S.A. |
| 10. | Rhurstahl* | West Germany |
| 11. | Krupp | West Germany |
| 12. | Skoda | Czechslovakia |
| 13. | TERNI* | Italy |
| 14. | ANSALDO | Italy |
| 15. | VOEST | Austria |
| 16. | WERKSPOOR | Holland |
| 17. | Davy-Ashmore | U.K. |
| 18. | Chiyoda Engineering Works | Japan |

*Also capable of furnishing technical know-how for high pressure equipment for Ammonia Synthesis plant, urea reactors, etc. should that become necessary at a later date.

# ANNEXURE VI




PROVISIONAL LAYOUT OF FABRICATION SHOP

# ANNEXURE VII

## LIKELY LOCATION OF FERTILIZER AND REFINERY PROJECTS PHASED DEVELOPMENT OF CAPACITIES

### (i) FERTILIZER PROJECTS

| Year & Location | Capacities in Thousand Tonnes | | | | | |
|---|---|---|---|---|---|---|
| | $N_2$ | $P_2O_5$ | Total for the period | | Cumulative Total | |
| | | | $N_2$ | $P_2O_5$ | $N_2$ | $P_2O_5$ |
| *Up to* 1966-1967 | | | | | | |
| Sindri | 117.0 | ... | | | | |
| Nangal | 80.0 | .. | | | | |
| Varanasi | 10.0 | .. | | | | |
| Alwaye | 70.0 | 56.0 | | | | |
| Rourkela | 120.0 | .. | | | | |
| EID Ennore | 8.25 | 20.6 | | | | |
| Mysore Chemicals | 1.30 | .. | | | | |
| Trombay | 90.00 | 45.0 | | | | |
| Neyveli | 70.00 | .. | | | | |
| Namnup | 45.00 | .. | | | | |
| Gujarat | 100.00 | 51.0 | | | | |
| Misce. | 20.00 | 140.00 | 731.55 | 312.60 | 731.55 (750) | 328.66 (370) |
| *Up to* 1967-1968 | | | | | | |
| Gorakhpur | 80.00 | .. | | | | |
| Visakhapatnam | 80.00 | 73.00 | | | | |
| Kothagudem | 80.00 | .. | 240.0 | 73.0 | 971.55 (1000) | 401.66 (500) |
| *Up to* 1968-1969 | | | | | | |
| Korba | 100.0 | .. | | | | |
| Durgapur | 100.0 | 108.0 | | | | |
| Talchen | 40.0 | | 240.0 | 108.0 | 1211.55 (1300) | 509.66 (650) |

(Capacities in Thousand Tonnes)

| Year & Location | $N_2$ | $P_2O_5$ | Total for the period $N_2$ | Total for the period $P_2O_5$ | Cumulative total $N_2$ | Cumulative total $P_2O_5$ |
|---|---|---|---|---|---|---|
| *Up to* 1969-1970 | | | | | | |
| Madras | 100.0 | 100.0 | | | | |
| Goa | 80.0 | 75.0 | | | | |
| Cochin | 100.0 | .. | | | | |
| Kota | 80.0 | .. | | | | |
| Nangal Expansion | 70.0 | .. | | | | |
| Udaipur | 69.0 | 69.0 | | | | |
| | | | 499.0 | 244.0 | 1710.55 (1600) | 753.66 (800) |
| *Up to* 1970-1971 | | | | | | |
| Rihand | 100.00 | .. | | | | |
| Barauni | 100.0 | | | | | |
| Haldia | 100.0 | 100.0 | | | | |
| Sindri Expansion | .. | 94.0 | | | | |
| Ramagundam | 50.0 | .. | 350.0 | 194.0 | 2060.55 (2000) | 947.66 (1000) |

## (ii) REFINERY PROJECTS

| Year | Location | Capacity in thousand tonnes |
|---|---|---|
| *Up to* 1966-67 | | |
| | Bombay (Shell) | 3750 |
| | Bombay (Esso) | 2500 |
| | Vizag (Caltex) | 1050 |
| | Digboi | 50 |
| | Gauhati | 1000 |
| | Barauni | 2000 |
| | Koyali | 2000 |
| | Cochin | 2500 |
| | TOTAL | 17000 |
| End of Fourth Plan | | |
| | Madras | 2500 |
| | Haldia | 2500 |
| | Delhi-Punjab area | 2500 |
| | Expansion of existing units | |

MGIPCBE—S1—4 M of I & S/65—8-3-66—500.

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