REPORT

1958-59

MINISTRY OF STEEL, MINES & FUEL
DEPARTMENT OF IRON & STEEL

CONTENTS

ORGANISATION

Department of Iron and Steel.—Consequent on the reorganisation of Ministries in April 1957, the Ministry of Iron and Steel became the Department of Iron and Steel in the Ministry of Steel, Mines and Fuel. The Ministry of Iron and Steel had come into being on the 15th of June 1955, as a result of the Presidential order dated the 28th May, 1955. It took over from the Ministry of Production the responsibility for the planning and execution of the two steel works at Rourkela and Bhilai and also the administration of the Nahan (Himachal) Foundries Limited. It also took over later from the Ministry of Commerce and Industry the work relating to the erection of the third steel plant at Durgapur. In February 1956, the work of the Mysore Iron and Steel Works was transferred to this Ministry from the Ministry of Commerce and Industry who took over the administration of the Nahan Foundries from this Ministry. After the formation of the Department of Iron and Steel, work relating to the administration of the Iron and Steel Control Order, imports and exports of iron and steel, establishment of the Iron and Steel Control Organisation, the steel projects in the private sector, re-rolling mills and ferro-alloy industry was transferred to this Department from the late Ministry of Heavy Industries. One Deputy Secretary and one Under Secretary along with other staff were also transferred to this Department from that Ministry.

2. With effect from the 1st of April 1957, the work relating to the setting up of the steel plants in Bhilai and Durgapur was transferred to the Hindustan Steel Limited which had been formed towards the end of 1953 to implement the Rourkela steel project. With this transfer of work relating to Bhilai and Durgapur to the Company, one Officer-on-Special Duty, one Deputy Secretary and three Under Secretaries who used to deal with matters relating to steel plants while in the Department were transferred to the Company. Five Section Officers who were assisting the above Officers were also deputed to work in the Company but they continued on the strength of the Department. Even these were formally transferred to the Company in July 1958. In addition, all the technical staff who used to assist the Department in matters of civil and electrical engineering etc., was also transferred to the Company. With these transfers, the Secretariat of the Department of Iron & Steel became small and at present it consists of one Secretary, three Deputy Secretaries, and four Under Secretaries with fourteen sections. Attempts have been made to organise most of the sections on unconventional lines, *i.e.*, one Section Officer, one or two

Assistants and one Lower Division Clerk. In these sections, in many cases, initial noting starts at the level of the Section Officer. Three of the sections are under the direct charge of the Deputy Secretaries who deal normally with Secretary and at times with Minister. There is no Joint Secretary in the Department.

3. There is one attached office under the control of the Department at Calcutta with two regional offices at Bombay and Madras. The Head Office of the Iron and Steel Controller at Calcutta is under the charge of an Iron and Steel Controller and it was set up when the Iron and Steel (Control of Distribution) Order 1941 was promulgated on 1st August 1941. This order was enacted to ensure that all available supplies of iron and steel were used only to meet Defence and essential civil requirements. During the course of time, its functions have undergone a few changes and the above offices are primarily responsible for the administration of the Iron and Steel Control Order 1956 as amended from time to time. This office is also responsible for the issue of licences for import of iron and steel from abroad on Government as well as private account to augment indigenous production. The Iron and Steel Controller also deals with the issue of licences for the export of iron and steel and the disposal of steel declared surplus by the Defence Services. He is also engaged in the barter deals i.e., exports of those categories of scrap which cannot be utilised in the country in exchange for import of finished steel items to conserve foreign exchange and for ensuring sale of iron and steel at uniform prices at all rail heads.

The two regional offices at Bombay and Madras issue import/export licences for iron and steel items on applications received from parties in their respective regions. They are responsible for arranging speedy clearance of iron and steel goods handled at the respective ports in order to avoid any congestion at the docks.

Hindustan Steel Limited.—The Hindustan Steel Limited had been originally formed in December, 1953 to construct and manage the Rourkela Steel Plant. Under the agreement with Krupp and Demag for the Rourkela Steel Plant, an Indian company was to be formed to own and operate the steel plant. The Company was to be incorporated and registered in India under the Indian Companies Act and it was to have an authorised share capital of Rs. 1,000 million. The German Combine of Krupp and Demag were to contribute share capital in German currency not exceeding Rs. 95 million approximately. The German investment was to be related to the volume of orders placed in Germany and the total share capital was to be five times the German share. The Board of Directors was to be constituted by the Government of India and the German Combine

was to have representation proportionate to the respective investments of the Government of India and the German Combine. The Chairman of the Board and the Managing Director were to be nominees of the Government of India.

2. The arrangements for the participation of German firms in the share capital of the Company were terminated by mutual agreement towards the end of 1956. It was ascertained during the discussions for settlement of the price of the plant to be supplied by the firms concerned that an element had been added to the price in order to compensate for the low return on the foreign capital to be invested in the Company. It was found that taking this element into consideration the effective rate of interest would be high. It was, therefore, considered that rather than pay a higher price for the plant for the sake of securing some foreign investment for a limited period, it would be preferable to dispense with the investment and secure a reduction of the price. As a result of this decision, the Hindustan Steel became a purely Government owned company and became free from the restriction that the total share capital should be five times the German shares.

3. While Rourkela which was under the management of the Company from the beginning, planning of the two other projects in Bhilai and Durgapur were under the direct control of the Ministry of Iron and Steel until March 1957. It was considered convenient for Government to undertake directly the planning and essential preliminary work connected with these projects. By March 1957, preparatory work had been finished; plant and machinery had been ordered and arrangements made for civil engineering in all the major sections of the plant. Government considered that it would be advantageous if all the three steel plants were thereafter brought under a unified Company management. It was accordingly decided that the Bhilai and Durgapur projects should be transferred to the Hindustan Steel Limited from 1st April, 1957.

4. The Articles of Association of the Company were suitably amended and the Board of Directors reconstituted. At present, the Board consists of ten members of whom one is a wholetime Chairman. Of the other nine, three are General Managers of the steel projects, four are officials belonging to Departments other than the Department of Iron and Steel and two are non-officials.

5. The authorised capital of the Company is Rs. 3,000 million divided into 3 million equity shares of Rs. 1,000 each. The President of India will determine from time to time the number of Directors, but it shall not be less than two. All the Directors, the Chairman

and the Deputy Chairman are to be oppointed by the President. The President has also the right to appoint General Managers and Financial Advisers and Chief Accounts Officers. Proposals or decisions of the Board of Directors in respect of the following are subject to the approval of the President:

(i) Any programme of capital expenditure for an amount exceeding Rs. 4 million;

(ii) Winding up of the Company; and

(iii) Any matter which in the opinion of a Director is of such importance as to be reserved for the approval of the President.

5. Auditors of the Company are to be appointed by the Central Government in the Department of Company Law Administration on the advice of the Comptroller and Auditor General. The President has the right to issue directives or instructions as considered necessary in regard to the finances, conduct of business and affairs of the Company. All appointments in the Company to grades carrying a maximum salary of Rs. 2,000 or above, require Government approval.

6. The Hindustan Steel Limited is owned entirely by the Government of India and out of the authorised capital of Rs. 3,000 million, Government have purchased shares worth Rs. 2,956 million and have also advanced a loan of Rs. 205 million till the end of February 1959. Before the end of March 1959, however, not only would the Government have purchased all the shares worth Rs. 3,000 million, but Government would also have made substantial further loans to enable the Company to incur the expenditure for the three steel plants.

7. For disposal of business in between the meetings of the Board of Directors, the Board has set up a Committee of Directors, consisting of the Chairman, the Director (Engineering) the Director, (Finance) and such of the other Directors who may be present at the headquarters and who might attend. The Head Officer of the Company is at present in New Delhi and its main work is to assist the Board to coordinate all the different functions of the three steel projects and any other work like setting up of washeries and future steel plants which may be entrusted to it by Government. Accordingly, the Head Office of the Company deals with all matters of policy, issues sanctions which are outside the competence of the heads of projects and secures Government's approval for matters

beyond its own powers. The Head Office is responsible for holding the meetings of the Board of Directors and shareholders, allotments of funds and finalisation of annual accounts and all matters arising out of the Indian Companies Act and other statutory regulations.

ROURKELA STEEL PROJECT

Rourkela is 257 miles west of Calcutta on the main Calcutta—Bombay line. The plant under construction, like the plants at Bhilai and Durgapur, has a capacity of a million tons of ingots which will all be rolled into flat products, e.g. plates, sheets, etc. With a few addditions, the capacity can be expanded to 1·6 million tons. The plant is ore based. The choice of Rourkela as a site was made mainly because of the nearness of good quality iron ore in the Bonai ore ranges, 50 miles from the site. The supplies of water required for the plant are drawn from the Brahmani river. Other raw materials, like limestone, dolomite and manganese ore are also available within easy reach.

2. The agreement for the establishment of an integrated iron and steel plant of a capacity of 1 million tons of ingot steel was entered into with a Combine of two German firms, Messrs Krupp and Demag, in July 1955. The project report for the 1 million ton steel plant was submitted in November 1955. The report was accepted by the Government in November 1956.

3. According to the agreement with the German firms, the Combine called the Indien-Gemeinschaft Krupp-Demag were to be appointed Technical Consultants for the 1 million ton plant and were to be responsible mainly for—

(a) investigating the processes best suited;

(b) recommending the location of the plant;

(c) preparing a preliminary project report;

(d) preparing the final project report, after the preliminary one had been approved;

(e) assistance in preparing tender documents for plant and machinery, examining tenders and making recommendations thereon, and in preparing purchase and services contracts; and

(f) supervision of the erection and later of the initial operation of the plant.

For their services as Consultants, the Combine were to receive a fixed fee equivalent to $4·5 million (Rs. 21·48 million) (later increased to Rs. 28·53 million for the bigger plant).

4. Orders for the coke oven and blast furnace were placed in April 1956. For other sections of the plant, orders were placed in October 1956.

5. The special features of the plant are that, of the 1 million tons of ingots, three-fourths will be produced by the L.D. process and the ingots will be finished all into flat products. It will have also the first continuous strip mill in the country. A large fertiliser plant is also to be set up using the hydrogen from the coke oven gas, the nitrogen which will be a by-product of the oxygen plant being installed to supply oxygen to the L.D. converters, and the limestone fines which cannot be used in the blast furnaces. The fertiliser plant will have an annual capacity of 580,000 tons of nitro-limestone.

6. The plant under construction will produce in the first stage nearly 1·2 million tons of metallurgical coke, 1 million tons of basic pig iron and 1 million tons of ingot steel. The 1 million tons of ingots will be finished into the following saleable products:

	Tons Year
(*i*) Wide heavy plates 3/16" thick and above—maximum width 110"	170,000
Narrow heavy plates 3/16" thick and above—in widths below 60"	30,000
Total : Heavy plates	200,000
(*ii*) Hot rolled sheets and strips in widths 60" and below and in thicknesses varying from 16 gauge to 3/16"	300,000
(*iii*) Cold rolled sheets and strips 60" and below in thickness varying from 29 gauge to 12 gauge	170,000
(*iv*) Tinplates 30 to 34 gauge	50,000
TOTAL	720,000

7. The main sections of an integrated steel plant are:

(a) Coke ovens and by-product plant

(b) Blast furnaces and gas cleaning plant

(c) Steel melting shops

(d) Rolling mills.

(a) Coke ovens and by-product plant:

The coal will be 'coked' in three batteries of 70 ovens each. These three batteries will convert 1·6 million tons of washed coals of Kargali/Bokaro/Jharia into 1·2 million tons of coke per year.

The gas from the coke ovens will be treated in a by-product plant with a capacity of 70,000 cubic metres of coke oven gas per hour. The principal units of the by-product plant are a tar recovery and

distillation plant, a benzol recovery and distillation plant, an ammonia recovery plant and a sulphuric acid plant. After the recovery of the by-products, the gas will be sent to the fertiliser plant where the hydrogen in the gas will be removed. Besides fertilisers produced in the separate fertiliser plant, the main-by-products that will be obtained from the by-product plant will be—

Benzole
Toluene
Xylene
Solvent-Naphtha
Phenol Oil
Naphthalene Oil
Wash Oil
Anthracene Oil
Naphthalene
Crude Anthracene
Crude Phenols
Pitch

(b) Blast furnaces:

There will be three blast furnaces each with a rated capacity of 1,000 tons of iron per day. The furnaces will be charged with iron ore, limestone and coke, and will yield 1 million tons of iron per year. Attached to the blast furnace plant will be a gas cleaning plant for cleaning the gas. Most of the iron produced will be used in the steel melting shops for conversion to steel. But a small part will be cast into pigs in a pig casting machine and used for foundry purposes.

(c) Steel melting shops:

It has been already stated that the main feature of the plant is the making of steel by the L.D. process. The steel melting shop will consist of—

(i) three 40-ton L.D. converters with a rated capacity of 750,000 tons of steel per year;
(ii) four 80-ton stationary basic open hearth furnaces with a capacity of 250,000 tons a year; and
(iii) two 1,100-ton mixers.

The making of steel by the L.D. process consists in blowing from the top 99·5 per cent pure oxygen over the surface of molten pig iron in the converters. The process has the advantage of lower capital and

operating costs, a higher rate of production and savings in space and auxiliary equipment compared with the conventional open hearth process. The L.D. process (Linzer Dusenstahl) was first tried in the steel works of Messrs Voest in Linz and Messrs Alpine Montangesellschaft in Austria. At the time of adoption of L.D. at Rourkela, about 4 million tons were being produced by this process in other countries. Since then, it has been increasingly adopted by steel works all over the world. It is eminently suited for production of low carbon or soft steel. Reports show that by 1959 there will be about 14 million tons of steel being made by L.D. process in other countries. The L.D. steel will be used in the production of all but plates in Rourkela. It is for the production of higher carbon steel plates that the 4 open hearth furnaces are being installed.

Attached to the steel melting shops will be a lime and dolomite calcining plant and dolomite brick plant for making dolomite bricks for lining the L.D. converters. An oxygen plant with a capacity of 9,900 cubic metres per hour is also being put up to supply oxygen for the L.D. plant.

(d) *Rollng mills.*—The rolling mills consist of

(I) Hot rolling mills:

(i) One 1,180 mm. 2 high reversing slabbing mill.
(ii) One 1·8 m. 2 high scale breaker. This unit will be common both for the plate mill and strip mill.
(iii) 3·1 m. single stand 4 high reversing plate mill.
(iv) Strip mill—roughing train consisting of one 1·8 m. 4 high reversing roughing stand and one 1·8 m. 4 high non-reversing second rougher. Finishing train consisting of six continuous 1·7 m. 4 high stands.

(II) Cold rolling mills:

(*i*) One 1·7 m. 4 high reversing cold reducing mill
(*ii*) One 1·7 m. 4 high reversing skin pass mill
} For autobody sheets.

(*iii*) One 1·2 m. 4 high reversing cold reducing mill
(*iv*) One 1·2 m. 4 high reversing skin pass mill
} For tinplates.

The mills, with a few additions, will have a capacity to roll about 1·6 million tons of ingots. In these mills will be produced wide plates up to 110 inches in width and hot and cold rolled sheets up to 60 inches in width. The fact that the rolling mills have an area of 185,000 sq. metres, a maximum length of nearly one kilometre and a width of 335 metres will give an idea of their size.

8. *Auxiliary plants.*—To serve the main plant, there will be a number of auxiliaries such as,

(i) a grey iron foundry capable of producing 30,000 tons of ingot moulds per year for the steel melting shop and 5,000 tons of miscellaneous castings for maintenance purposes;

(ii) a central repair shop which will undertake all repairs of machinery and other maintenance work; and

(iii) a modern metallurgical and chemical laboratory equipped with upto-date equipment for the testing and analytical work of raw materials and finished products.

9. *Power.*—The power required for the operation of the plant will be partly generated in the plant itself and partly drawn from the Hirakud project. The power plant in the steel works consists of boilers fired by blast furnace gas, coke oven gas and coke breeze—all by-products of the plant—and has a capacity of 75,000 k.w. During the time of peak operations, the plant will normally obtain from Hirakud about 35,000 k.w. of power but there will be provision to draw up to 60,000 k.w. in emergencies. During the comparatively slack hours of operation, power will be fed back into the Hirakud system.

10. *Water Supply.*—The Rourkela plant is located at the confluence of the Koel and the Sankh rivers which form the Brahmani river. This is the main source of water supply for the plant. The supply itself will be drawn from above a weir which has been constructed across the river. While, ordinarily, the flow in the Brahmani will be sufficient to meet the full requirements of the steel plant, it has been known that, occasionally during the summer months, the flow may be insufficient. As a measure of insurance, a dam has been constructed across the Sankh river at Mandira so that in case the flow in the river is insufficient, water could be let down from the storage.

11. *Raw materials.*—The Rourkela plant will require about 1·5 million tons of iron ore per year. This is to be supplied from the steel plant's own mines at Barsua about 50 miles from Rourkela. A fully mechanised ore mine capable of producing three million tons of iron ore per year, is being developed and will be ready for production by about the end of 1959. A small township for the mining staff is also being constructed.

12. Coal required for the plant will be drawn from two washeries —one at Kargali which is already in production and the other at Dugda which is under construction. Until Dugda is completed, selected unwashed coals from the Jharia area will be used.

13. Limestone is required for the blast furnaces, the steel melting shops and the fertiliser plant. The requirements of the blast furnaces will be about 350,000 tons. The melting shops will require about 170,000 tons of a higher quality. The sintering plant, when established, will also require about 70,000 tons of limestone. The principal source of supply will be the Purnapani quarry situated about 15 miles from Rourkela. A mechanised mine is being developed in this area. While this mine will meet most of the requirements of the plant, it may be necessary to draw the higher quality limestone required for the steel melting shops from other sources. The limestone used in the fertiliser plant will, however, mostly be the chips left over after limestone is screened for use in the blast furnaces and melting shops.

14. *Fertiliser Plant.*—The adoption of the L.D. process of steel manufacture at Rourkela has created favourable conditions for the manufacture of nitrogenous fertilisers. Both Hydrogen and Nitrogen which will be available in large quantities as by-products can be utilised for the production of synthetic ammonia. Hydrogen can be separated from the surplus coke oven gases at little cost without diminishing their calorific value. Large quantities of Nitrogen will be available from the oxygen plant. The limestone chips screened out from the blast furnaces and the steel melting shops can be conveniently used to produce calcium ammonia nitrate (nitro-limestone). Additional supplies of limestone can be obtained from the quarries near the steel works. In view of the availability of all the raw materials at cheap cost, it was decided to set up a fertiliser plant at Rourkela with a capacity of approximately 80,000 tons of Nitrogen per year (*i.e.*, 580,000 tons of nitro-limestone).

The fertiliser plant will consist of two main sections—the ammonia plant with auxiliaries and the nitric acid and nitro-limestone plant with auxiliaries. On the basis of competitive tenders, the contract for the ammonia plant has been placed on Messrs. Udhe of Germany at a cost of about Rs. 8·5 crores. The order for the nitric acid and limestone plant has been placed on Messrs. Sindri Fertilisers & Chemicals at a cost of about Rs. 7·75 crores. The fertiliser plant is expected to go into production before March 1962.

15. The steel plant has also its own transport system, consisting of about 60 miles of rail lines and 10 miles of roads. All internal traffic will be handled by 24 diesel electric locomotives.

16. *Township.*—To house the workers of the steel plant, a modern township is being built to the north of the plant site. The works and the township are separated by a range of low lying hills. The township site is flanked by the Koel and the Brahmani on the north and the west and the hills on the south. The town is being built

in accordance with a master plan which provides for the construction of 20,000 houses for a population of 100,000. The main water supply, sewerage and road communication systems are being developed in accordance with this plan. The construction of houses, however, will be limited to about 7,500 in the first stage. Further construction will be taken up when the plant itself is expanded. Provision has been made for amenities like hospitals, schools and community centres.

17. *Costs.*—The Rourkela steel plant proper is estimated to cost Rs. 1700 million. The cost of all other ancillaries including the township, the water supply system, the iron ore mines, the limestone quarries, cost of training, etc., will be about Rs. 440 million. The total cost will, therefore be about Rs. 2140 million. Out of this, the total foreign exchange element (including the foreign exchange required for the various ancillaries referred to) is about Rs. 1330 million.

18. The fertiliser plant is expected to cost about Rs. 180 million.

19. Late in 1957, the Government of India entered into a credit agreement with the Federal Republic of Germany. Under this agreement, a credit of DM 660 million (Rs. 750 million was made available at 6 per cent per annum. This credit is being used to meet payments due under the various contracts for the supply and erection of equipment for the steel plant proper. It is expected that the credit will be sufficient to meet all such payments as they fall due. Under the arrangements made for the operation of this credit, promissory notes are issued by the Government of India to the firms concerned for the amounts which would otherwise have been payable in cash. These promissory notes are redeemable three years after the date of issue. As they are negotiable, the supplying firms receiving the promissory notes will be free to negotiate them.

20. *Progress during the year* 1958-59.—The year 1958-59 marked the beginning of production in the steel plant. The steady arrival of plant and equipment at the project site and the increased tempo of construction has helped in the commissioning of the first coke oven battery and blast furnace, and good progress in the construction of the remaining parts of the plant. Details of the progress achieved are given in the following paragraphs.

21. A total quantity of about 345,000 tons of plant and equipment (including refractories) are required to be imported for the construction of the plant. By the end of December 1958, about 270,000 tons reached the site.

22. In construction, steady progress was maintained throughout the year. One battery of the coke oven plant was commissioned on

3rd December 1958. The section of the by-product plant required for the first coke oven battery, *viz.*, three primary coolers, three deterrers, two exhausters, one final cooler and one ammonia scrubber were also put into operation on the 3rd December 1958. Erection of the first blast furnace was completed and the plant was commissioned early in February 1959. The gas cleaning plant has been practically completed and two washers and two precipitators have been put into commission. In the power plant concerned, two boilers were ready for operation by the end of 1958. Two turbo-blowers were also ready in time for the starting up of the blast furnace. The erection in the open hearth steel melting shop is progressing according to schedule; erection of L.D. shop is ahead of schedule. The civil engineering and foundation work is making good progress in the oxygen plant, dolomite brick plant and the blooming mill. All the column foundations for the hot rolling mills are complete; those for the cold rolling mills are nearing completion.

23. All the power sub-stations, which are required in connection with the starting up of the coke ovens and by-product plant, and blast furnace were completed; so also the rolling mill power sub-station which receives power directly from the Hirakud sub-station. Power supply from Hirakud, both for construction and for the first phase of operation, has been arranged.

24. At the Barsua iron ore mines, civil engineering and foundation work for the ore handling system is progressing satisfactorily. Major portion of the mining equipment has arrived at site. Till the mine at Barsua goes into production, at the end of 1959, iron ore will be supplied by the State Trading Corporation from the Barajamda-Gua region. Despatches commenced from December 1958.

25. It has already been mentioned that a mechanised mine is being developed in Purnapani, 15 miles from Rourkela, for supplying limestone. Meanwhile, limestone is being raised from this very quarry by manual methods at the rate of 10,000 tons per month. For meeting the additional requirements until the mechanised mine is ready, limestone is being bought from the market.

26. The supply of washed coal from Kargali and selected unwashed coal from Jharia started in November 1958 and the requirements of the plant are now being regularly met.

27. Out of the total of 7,500 residential houses to be built, about 3,000 have been completed in all respects. About 4,000 houses were in various stages of construction at the end of the year. Contracts for the remaining houses have been awarded and work is expected to be taken up shortly. One community centre, five elementary schools and two health centres were also completed during the year.

Construction of eight more elementary schools, two high schools, a health centre, the main hospital and cinema house is progressing satisfactorily. At the iron ore mine, erection of a township has been taken up during the year. Construction of 170 permanent houses is on hand and six three-roomed houses already completed. Others are at various stages of construction and tenders have been invited for the construction of these houses.

28. Eighty engineers were sent to Germany for advanced training. 74 have returned till date. Eight engineers have been sent to the U.S.A. for further training. 249 graduate engineers have so far been allotted to Rourkela project out of which 230 have been sent abroad. The first batch of 60 engineers have already returned from the U.S.A.

The position of staff at the end of the year was as under:—

Class I	..	211
Class II	..	128
Class III	..	1,994
Class IV	..	837
TOTAL	..	3,170

In addition, about 9,000 were employed as departmental labour besides about 40,000 employed by the contractors.

29. The progress of construction at Rourkela has gathered tempo. The foundations of the project were laid in 1957; 1958 was the year when considerable difficulties were faced and overcome. It was in this year that the first units—coke ovens, one blast furnace and ancillaries—were ready for production. 1959-60 promises well as the year of consolidation. During the year, the steel melting shops, the blooming mill and the plate mill will be in production.

BHILAI STEEL PROJECT

Bhilai is on the main railway line between Bombay and Calcutta, 156 miles from Nagpur. It is in the district of Drug in Madhya Pradesh. Selection of this site in Madhya Pradesh for the location of a million ton steel plant was influenced primarily by the availability of good quality iron ore in the Dhalli and Rajhara hills nearby and the possibility of utilising the hitherto unexploited reserves of coal in Korba and Kanhan. Another factor was its proximity to the markets of Central and Western India. The plant under construction is for one million tons of crude steel to be rolled into 200,000 tons of rails, structural sections and sleeper bars, 160,000 tons of heavy structural sections, and 260,000 tons of medium structural sections, besides 150,000 tons of billets for the re-rolling industry and 300,000 tons of iron for the foundry industry. There will also be a variety of by-products from the coking of coals which will form the base of a large number of chemical industries in the country.

2. *Agreement with the USSR.*—An agreement was entered into between the Government of India and the Government of the USSR on the 2nd of February 1955, for the establishment of an integrated iron and steel works. The iron and steel works was to be of one million tons of ingot steel capacity with the following general pattern of products:

	Tons
(*i*) Rails	100,000
(*ii*) Heavy structurals including, if possible, broad flanged beams upto 75,000 tons	175,000
(*iii*) Sleeper bars and crossing sleepers	90,000
(*iv*) Merchant bars	235,000
(*v*) Billets	150,000
TOTAL	750,000

The works were to be capable of expansion to a capacity of one million tons of finished steel besides 100,000 to 300,000 tons of foundry pig iron for sale. The design of the works and its component parts as well as the manufacture of equipment was to be carried out by Soviet organisations.

3. According to the agreement with the USSR, the following is briefly the division of responsibility between the USSR and India:—

USSR:

(a) Preparation of the detailed project report, working drawings and schedule of construction and erection;

(b) Supply of the main plant and equipment;

(c) Technical supervision of the construction, erection and commissioning of the plant;

(d) Training of Indian personnel in the USSR and assistance in the training of personnel in India.

INDIA

(a) Levelling of the site;

(b) Preliminary investigation to determine the suitability of the site for foundations;

(c) Construction and erection of the plant under the technical supervision of the Soviet experts;

(d) Transhipment of USSR stores from the ports to the site and procurement of plant and machinery obtainable in India;

(e) Construction of the township, roads and railway tracks;

(f) All water supply and electric power supply arrangements upto the boundary of the steel plant;

(g) Supply of all raw materials including the development of ore mines, limestone quarries etc.

4. An Indian Chief Engineer assisted by a number of engineers is in charge of construction at site. For the technical supervision of construction, erection and commissioning of the plant and machinery and for giving technical assistance in the training of Indian personnel, in India, the Government of the USSR has provided a suitably qualified expert as Chief Engineer. He is assisted by a number of Soviet engineers.

5. Under the agreement, the USSR guarantees the performance of all plant and machinery supplied from the USSR. She will also provide a sufficient number of experts for a period of three years

after the works go into operation, to render technical supervision and consultant services as might be required by the Government of India.

6. For the preparation of the detailed project report, working drawings and schedule of construction and erection, a fee of Rs. 25 million is paid to the USSR. USSR supplies the main plant and equipment worth about Rs. 631 million on credit repayable in twelve equal annual instalments, interest being at 2½ per cent. Other stores which could not be obtained in time in India are supplied on cash terms. The salaries and other expenses of the Soviet engineers and technicians engaged on technical supervision of construction, erection and commissioning of the plant are borne by the Government of India. Training of Indian personnel in the USSR was originally arranged under United Nations assistance. Expenses on later batches of engineers and workers sent to the USSR for training is on credit repayable in twelve equal annual instalments as in the case of the main plant and equipment.

7. *Description of the Plant.*—The detailed project report which was received in December 1955 was for a plant with three coke oven batteries each of 65 coke ovens, three blast furnaces of 1,135 tons a day capacity, each, six open hearth furnaces each of 250 tons capacity, a blooming mill, a continuous billet mill, a rail and structural mill, a merchant mill, a power plant of 12,000 kw. capacity and necessary ancillaries. On the desire of an Indian Mission of experts which visited USSR earlier in 1955, provision had also been made for expansion of the steel works beyond a capacity of one million tons of finished products. The detailed project report was examined with the assistance of the general consultants —the International Construction Company—a team of Indian experts drawn from the steel works in Jamshedpur and Burnpur, the Iron and Steel Controller and experts of the Central Water & Power Commission. A team of Soviet experts came to explain the report and discuss details with the Indian experts. The report was accepted in March 1956 with certain modifications. The more important of these were:—

(i) The layout of the works will be such that no alteration would be required in communications like pipe lines, power conduits etc. when the capacity of the plant is increased ultimately to 2·5 million tons of ingots;

(ii) The standby power plant within the steel works will have a capacity of 24,000 kilowatts instead of 12,000 kilowatts;

(iii) Chrome-magnesite bricks to be used for lining the roofs of two open hearth furnaces;

(iv) The storage capacity for various raw materials and stores will be increased to meet Indian conditions; and

(v) Concrete to be used instead of steel wherever possible.

8. Indian experts were anxious that the layout should be such that the plant could be expanded to the maximum extent possible. The Soviet experts explained that the construction of the works with a capacity of 1·3 million tons of ingots per year with provision in the layout for expansion upto 2·5 million tons of ingots was economical. Expansion beyond 2·5 million tons would be uneconomic because of the increase in initial construction cost remaining unutilised for a long time. Operating costs during the interval would also be higher. The experts further explained that on the data available regarding raw materials in the region, particularly coking coals, expansion of the works beyond 2·5 million tons might not be justified.

9. The plant which is now under construction will produce, in the first stage, 1,145,000 tons of metallurgical coke, 1,110,000 tons of iron and 1,000,000 tons of crude steel to be processed into the following marketable products:—

	Tons/Year
(*a*) Rails, standard gauge	100,000
(*b*) Rails, narrow gauge	10,000
(*c*) Railway sleeper bars	90,000
(*d*) Standard and broad-flanged beams, channels, angles and other light and heavy structural sections (beams with section height upto 24")	284,000
(*e*) Rounds from 7/8" to 3" dia and squares with sides 7/8" to 3"	121,000
(*f*) Flats from 2" to 5" wide	15,000
	620,000
(*g*) Billets for re-rolling at outside rolling mills from 2" x 2" to 3" x 3" cross-section	150,000
	770,000
Pig iron	300,000
Metallurgical coke	45,000

10. In addition, in the carbonisation of coal into coke, a number of valuable by-products like coal tar, ammonium sulphate and benzol will be released. These will be further distilled and the following commercial fractions obtained:—

Ammonium sulphate
Benzole
Toluene
Zylene
Solvent-Naptha
Phenol oil
Naphthalene oil
Absorption oil
Anthracene oil
Naphthalene
Crude Anthracene
Crude Phenols
Pitch

11. The next stage of expansion—1·3 million tons of ingot steel—would be primarily by increasing the number of blast furnaces, building two more open hearth furnaces, re-lining the roofs of all the furnaces with chrome-magnesite bricks and improving the facilities in the rolling mills by adding to ancillaries like soaking pits, stands etc. The nature of the steel products cannot be varied very much as there will be no change in the rolling mills. Ordinarily, for the most economic working of an integrated steel works, all iron should be converted into steel and all steel into finished products for sale. In India, both because of the concentration of iron ore and metallurgical coal in one region of the country and because of the historical development of secondary industries where, particularly during the war years, a number of foundries and re-rolling mills were put up in distant parts of the country, the major iron and steel works have to produce pig iron for the use of these foundries and billets—a semi-finished steel product—for the re-rolling industry. As manufacture of billets is relatively uneconomic, the burden of producing billets has been spread on all the steel works on a uniform basis. Thus, except in Rourkela where because of the nature of the rolling mills billets cannot be produced, billets will form about 14 per cent of the steel capacity of each of the works. When the expansion of the existing works in Jamshedpur and Burnpur is completed and all the three new plants in Rourkela, Bhilai and Durgapur have gone into production, about 700,000 tons of billets will be available to the re-rolling industry in the country. With this and re-rollable and other scrap available to the industry, it should be able to work, generally, two shifts.

12. *Power and Water.*—An integrated steel plant consists, besides the four main sections *viz.*, coke ovens, blast furnaces, steel melting plant and rolling mills, of a number of ancillaries like a power plant for the generation of electricity, a blower plant which blows air at high velocity into the blast furnaces, structural and machine shops to repair and maintain the main steel plant, arrangements for the

supply and cooling of water, arrangements for distribution of electrical power, distribution of various gases for heating and other purposes, telephone communication, electrical lighting, roads, sewers etc., laboratories for carrying out experiments and tests, storages for storing raw materials and maintenance stores and offices for administration, sales etc.

13. The main source of power for the Bhilai Iron and Steel Works will be a 90,000 k.w. thermal station which is under construction in Korba. The first stage of this thermal station has been completed and power begun to be supplied. But any steel plant has to have, near at hand, a minimum unfailing supply of power for maintaining essential services particularly for the cooling water system of the blast furnaces. Apart from this, steam has to be raised in the steel works to run large blowers which blow air into the blast furnaces and for a variety of other purposes. In raising steam in boilers for all these, it is convenient and economic to use it in generating standby electrical power. Originally, in the detailed project report, it had been proposed that a power plant of 12,000 kw. capacity be installed within the perimeter of the works and balance of power obtained from the Korba thermal station which is being put up by the Madhya Pradesh Electricity Board primarily to meet the requirements of the steel works and it is based on the coals of Korba. During the examination of the detailed project report, it became clear that with the system of distribution and with the main source of supply being nearly 100 miles away, it would be unsafe to keep the capacity of the steel works, own station at 12,000 kw. It was necessary to have sufficient power available at hand not only to meet the demand of the essential services but to be able to respond quickly to the fluctuations in the demand from the rolling mills. It was, therefore, decided that the size of the power plant must be increased to 24,000 kw.

14. Integrated iron and steel works of this size are large consumers of water. The annual consumption of the million ton plant in Bhilai will be of the order of 25 million cubic meters. An existing system of reservoirs has been renovated and augmented to provide industrial water to the plant. Because of the somewhat limited availability, a circulating water supply system has been adopted, water returning from the steel works being cooled in a large cooling pond which has been specially built. Domestic water for drinking and other purposes is obtained from a river flowing nearby—Sheonath.

15. *Raw materials.*—Bhilai was selected, for the location of a steel plant, primarily on account of its proximity to the hitherto unexploited but rich deposits of Dalli Rajhara—about 60 miles away. Preliminary investigations have shown that there are adequate

reserves and the iron ore is rich (upto 69 per cent iron) in certain layers. The steel plant would require nearly 1·94 million tons of iron ore annually.

The ore mines have been designed by a team of Indian and Soviet experts. The mining equipment is supplied by the USSR. There would be a small township to house the mining staff. For the initial operation of the steel works, ore is mined manually, sized and sent to Bhilai.

Originally, it was expected that deposits of limestone and dolomite in Bhatpara and Bhanpuri, not far away from Bhilai, might be suitable. Later, investigations proved that a better and nearer source of limestone was available in Nandini (Deorjhal) about 14 miles from Bhilai. It is also fortunate that dolomite will also be available from the same area. Mining equipment for these quarries are coming from the USSR. A railway line has been laid to bring limestone to the steel works. For the initial operation of the works, limestone and dolomite is collected manually and stockpiled, as in the case of iron ore. About 550,000 tons of limestone and 300,000 tons of dolomite will be used in the plant every year.

About 33,000 tons of manganese ore required for blast furnace operation will be obtained from the market. Other raw materials like quartzite, bauxite, magnesite, ferro-manganese, ferro-silicon, ferro-chrome, copper, aluminium, sulphur etc, which are required in relatively small quantities will also be obtained from the market.

The Bhilai plant is designed to operate on coke produced from a blend of 50 per cent Jharia, 30 per cent Bokaro/Kargali and 20 per cent Korba coals. Initially, out of 1·8 million tons of coal, 0·5 million tons will be Bokaro/Kargali and the balance Jharia. These coals will be washed in the washing plants of Kargali and Dugda, which have been described in a later section.

16. *Township.*—In the detailed project report, the number of people required for the operation of the works has been estimated at 7,300 as follows:—

(*i*) Engineers of the rank of foreman and above.	925
(*ii*) Skilled and semi-skilled workers	5,935
(*iii*) Non-industrial workers (clerical staff, messengers etc.).	440

Houses would generally have to be built for all the engineers and skilled workers and most of the semi-skilled and non-industrial workers. In addition to these, there will be a number of people engaged in sales, town administration, water and power supply facilities etc. Accommodation would also have to be provided to some extent for a few shop keepers, barbers and washermen and such like who are essential for the life of a community. At the

same time, it could be expected that a number of these people might live outside the steel town proper. Taking a view on all these, a township for 7,500 employees has been planned. Besides these, there is a hostel with 120 rooms, a hotel to accommodate 250 persons and a hostel for 150 apprentices.

The township will have its own shopping centres, schools, dispensaries and recreational facilities. The hotel will initially accommodate Soviet and Indian construction engineers. Later, even when the plant goes into production, it is expected that there would be a number of engineers, representatives of business houses and those who would be visiting Bhilai in connection with the maintenance of the plant and commercial activities. It might be necessary, at a later stage, to enlarge the size of the hotel.

17. *Costs.*—In the detailed project report, the cost of the plant was estimated at Rs. 1,100 million of which Rs. 541 million was the cost of equipment to be supplied from the USSR. The modifications to the report were expected to result in an increase of about Rs. 30 million in the cost. In the report, it had been assumed that all structural steel work, refractory bricks, pipes and pipe fittings and rolling stock would be obtained in India. The cost of equipment to be supplied from the USSR included the cost of freight and insurance. The costs were examined by the consulting engineers (International Construction Company). They were also compared with the preliminary quotations submitted by the Indian Steelworks Construction Company for the Durgapur plant. Making allowances for the difference in the two plants and in the context of the supplies to come from abroad, it was considered that the prices quoted by the USSR were reasonable. In approving the quotation, Government negotiated further to obtain credit, if possible, for some of the items which, in the detailed project report, had been assumed for supply from India but which would have to be imported from the USSR, *e.g.*, structural steel work, refractories. The negotiations resulted in the USSR agreeing to supply 60,000 tons of structural steel work and the rolling stock on credit. The other articles, if required, were to be supplied on ordinary commercial terms. Adjustments were then made to transfer 60,000 tons of structural steel work, special rolling stock and a few other items for supply from the USSR and to accept for supply from India a few items for which it was hoped that capacity might develop in time in India. The net result of these was a contract with the USSR for the supply of equipment (Rs. 553 million) and another for structural steel work (Rs. 77·8 million) respectively on credit. Since then, sixty more contracts have been concluded for supply, on ordinary commercial terms, of various other materials like castings, refractories, pipe and pipe fittings, construction equipment, cranes etc., to the value of Rs. 183 million.

18. In addition, contracts to the value of Rs. 40 million have also been concluded for the supply of plant and equipment to the iron ore mines and the limestone quarries.

19. Both because of the modifications made to the detailed project report and due to the switch over of a number of items of stores for supply from the USSR, it is estimated that the cost will go up from Rs. 1,100 million to about Rs. 1,160 million. In the detailed project report, it was explained that these estimates of costs did not include provision for land, designing and prospecting, cost of supervisory staff and departmental workers, cost of temporary buildings, structures and construction equipment, cost of the township, railways water and power supply arrangements outside the perimeter of the plant and the expenses on Soviet experts engaged on construction and design. To bring the costs of the three plants on an uniform basis, the cost of temporary buildings, structures and construction equipment was added to Rs. 1,160 million and thus the estimate for the steel plant proper was revised to Rs. 1,310 million. Other ancillaries like the township, the iron ore mines, limestone quarries, salaries and other expenses of Soviet staff, customs duty etc., are estimated to cost Rs. 477 million. In other words, the cost of the steel plant and its ancillaries will together be Rs. 1,787 million.

	Million Rs.
Steel plant proper	1310
Township	140
Ore mines and quarries	100
Fees to consultants and foreign experts	72
Water supply arrangements	15
Other expenditure	150

The foreign exchange element is estimated at Rs. 970 million. As has been explained earlier, USSR supplies plant and equipment worth Rs. 631 million on credit repayable in twelve equal annual instalments, interest being at 2½ per cent per annum. In addition, the cost of training of about 450 engineers and workers in the USSR will also be on similar terms of credit.

20. *Progress of construction.*—The pace of construction gained momentum progressively throughout the year. The construction of the first blast furnace, the first coke oven battery, the power and blower plant, the structural shops, the machine shop, a small oxygen plant and workshops required for the technical training institute has been completed and production of iron inaugurated by the President of India on the 4th of February 1959. The erection of the steel melting shops and the rolling mills made satisfactory progress during the year.

21. Under the contracts with the USSR, ships bringing stores for Bhilai are to be unloaded in the port of Visakhapatnam. This port had been selected on the recommendation of the Soviet experts and in consultation with the Railways as the most convenient port for Bhilai. Experience has however shown that, particularly with ships of the types chartered by USSR, it will not be possible to handle all the shipments in this port in time. The port of Calcutta has to handle, besides the growing commercial imports, plant and machinery and construction equipment for the three steel plants in Jamshedpur, Burnpur and Durgapur. It is not possible for the Railways to handle in addition, traffic from Calcutta to Bhilai. The port of Bombay was itself very heavily congested and could not receive any ships until about the end of 1957. Even then, the railway haulage from Bombay to Bhilai is very much longer and presents certain difficulties in regard to oversize consignments. Nevertheless, with the improvements carried out to the port of Visakhapatnam and arrangements made to receive three ships a month in the port of Bombay, most of the plant, equipment and stores coming from the USSR have been unloaded. Delays in handling which had been experienced late in 1956 and 1957 have been practically eliminated and in the last six months or so, practically no demurrage has been incurred. So far, 114 ships have brought over 375,000 tons of stores from the USSR. There is little left to come from that country. Difficulties experienced in the early stages in regard to civil engineering contractors have been mostly overcome. A large amount of the work, particularly of erection, has been undertaken departmentally. At the end of the year 1958, there were 700 Soviet experts, over 400 Indian engineers, over 6,000 Indian staff and nearly 29,000 departmental workers engaged on construction besides about 46,000 contractors' labour. In addition, 160 Soviet experts, 350 Indian engineers and about 1,800 skilled workers and staff are engaged on operation.

22. In the township, over 3,000 houses have been built and another 2,000 are nearing completion. These are in addition to a hotel with 250 rooms, a hostel with 120 rooms and hospitals, schools and other public amenities.

23. Although power from Korba was not available to commission the first blast furnace, it has since begun to be supplied. More units of the Korba thermal station will be commissioned in the next few months. Work on the permanent industrial water supply from a system of reservoirs has been completed. For supply of drinking water, the temporary scheme consisting of a weir across the river Sheonath will soon be replaced by permanent arrangements which have been taken on hand. Intake works, the raw-water pump house, coagulation tanks and other ancillaries of the permanent drinking water supply have been completed. Work on the filter plant has

progressed considerably. A part of the permanent scheme has been brought into commission to supply about one million gallons of water in addition to supplies through the temporary system.

24. Construction of the iron ore mines in Rajhara, about 58 miles away from Bhilai, is progressing. Plant and equipment from the USSR has begun to be shipped. The railway between the iron ore mines and the steel works has been completed and brought into use to transport float ore collected manually. So far, over 260,000 tons of float ore have been collected. The railway line connecting the limestone quarries in Nandini with the steel works in Bhilai has been completed and brought into use. Work of mechanising the quarries is progressing. Meanwhile to meet the requirements of the first blast furnace, limestone is collected manually and transported to the steel works. Work has begun on construction of the quarries in Hirri for the supply of dolomite. No difficulty is anticipated in maintaining supplies of raw materials to the steel works.

25. Before the end of the financial year 1959-60, two more blast furnaces, all the open hearth furnaces, the blooming mill, the billet mill and the rail and structural mill will be in operation and the merchant mill will be nearing completion. The market will have significant quantities of saleable steel from the Bhilai works.

DURGAPUR STEEL PROJECT

Durgapur is on the main railway line between Delhi and Calcutta, about 100 miles from Calcutta. It is in the district of Burdwan in West Bengal. The selection of this site was influenced, primarily, by the proximity of coals of the Raniganj and Jharia fields, easy accessibility and convenience and economy in transport, particularly of finished products to the eastern markets of India. The plant under construction is for one million tons of crude steel to be rolled into 40,000 tons of blooms, 60,000 tons of billets for forging, 60,000 tons of sleeper bars, 240,000 tons of merchant structural sections, 200,000 tons of light structural sections and 150,000 tons of billets for the re-rolling industry, besides 50,000 tons of wheels and axles for the railways and 300,000 tons of iron for the foundry industry. There will also be a variety of by-products from the coking of coals which will form the base of a large number of chemical industries in the country.

2. *Agreement with the Indian Steel Works Construction Company.*—Making use of the data which had been prepared in the investigations of the first steel plant and from the experience of negotiations for the Rourkela steel plant, a somewhat different arrangement was entered into for Bhilai and Durgapur. The arrangement in the case of Bhilai has been explained in a previous chapter. Following the interest shown by the United Kingdom to supply and construct a steel plant, a Technical Mission was invited from the United Kingdom, under the Colombo Plan, to study the economic and technical problems connected with the establishment of a steel plant. This Mission recommended the location of the plant in Durgapur and indicated that should the Government of India be interested in an all British Steelworks, it was likely that a Consortium then formed of steel and other relevant interests in the United Kingdom might be prepared to offer their services for the construction of the steel plant proper in its entirety.

3. In accepting, generally, the recommendations of the Technical Mission, the Government of India considered that it would help in speedy execution of the project, saving as much as eight to twelve months, if satisfactory arrangements could be made with a single agency for the supply of equipment and erection of the steel plant. With the planning of the projects in Rourkela and Bhilai, considerable experience had been gained with regard to a number of technical matters. The products for manufacture in the plant in Durgapur were clearly settled and there was no need, as in the

other two cases, to obtain project reports, particularly if a single agency was to be selected for the supply and construction of the plant as a whole. In keeping with the practice, in particular, in the United Kingdom and in the United States in the construction of large steel works, a well known firm of consulting engineers—The International Construction Company—who had some previous experience of work in India were appointed to advise the Government. A preliminary tender for a plant similar to the one described in the report of the United Kingdom Technical Mission, was obtained from the British consortium—the Indian Steelworks Construction Company—and this was examined primarily with the assistance of the Consulting Engineers. The quotation was also compared with the quotation for the plant to be supplied by the USSR for Bhilai and broad agreement reached on the size and nature of the plant and the basis of the final tender. Thereafter, the final estimates and specifications which corresponded to the detailed project reports in the case of the other two plants, and were in some ways even more precise, were examined in consultation with the Consulting engineers and the Civil Engineering Adviser to the then Ministry of Iron and Steel and a contract concluded on the 31st of October 1956 for the steel plant proper in its entirety. Because of the broad agreement reached earlier, it was possible to undertake considerable amount of preliminary planning work during the time that the final estimates and specifications were prepared and scrutinised.

4. Under the contract, the Indian Steelworks Construction Company is responsible for the supply, erection and construction of the steel plant which has an initial capacity of one million tons of ingots and is capable of expansion first to 1·25 million tons and ultimately to 2·5 million tons. The contract comprises the supply of plant, equipment and stores necessary, mainly from the UK, supplemented by purchases of equipment, stores and structures manufactured in India, and the erection of the whole plant according to an agreed time schedule to the satisfaction of the Consulting Engineers. The contract provides for the supply of the main plant and equipment from the UK at agreed prices, civil engineering work at agreed rates and the procurement of equipment and stores in India as well as the entire erection of the plant at actuals subject to a target, and a fixed consolidated amount for the organisation, management and the provision of the necessary services required for that work.

5. Transport of plant and equipment from the United Kingdom to the site in Durgapur, construction of the township and works outside the perimeter of the plant such as water and power supply facilities, railway connections etc., are all the responsibility of the Hindustan Steel Limited.

6. *Description of the Plant.*—The plant described in the report of the U.K. Steel Mission was one with three coke oven batteries of 72 ovens each, three blast furnaces each of 1,250 tons a day capacity, a steel melting plant in which 720,000 tons of steel were to be made by the Duplex process and the balance by the straight open hearth process, a blooming mill, a 30" intermediate breakdown mill, a continuous billet mill, a merchant bar mill, a medium section mill, a sleeper plant, a wheel, tyre and axle plant of 40,000 tons per year capacity and a standby power plant with two turbo-alternators of 4,000 kw. each. With experience of planning the other works and on the advice of the consulting engineers a number of improvements were incorporated in the plant as finally accepted, *e.g.*,

(i) a new item—a 360-ton an hour capacity coal washery—was added;

(ii) the number of coke ovens was increased from 72 in each battery to 78 in each;

(iii) two new items—a benzol rectification plant and a tar distillation unit—were added to produce saleable fractions from out of the crude by-products of the coke ovens;

(iv) the duplex process of steel making was replaced by the straight open hearth process with arrangements for desiliconising;

(v) the blooming mill was replaced by a more powerful mill capable of rolling 1·25 million tons per year of 7-ton ingots instead of one million tons per year of 5-ton ingots. The size of the intermediate breakdown mill was increased to be able to deal with the larger quantity and the bigger size of blooms. The size of the medium section mill was also increased;

(vi) the size and number of turbo-alternators was increased. Instead of two sets of 4,000 kw. three sets of 5,000 kw. each were provided and room left in the layout for a fourth set of 20,000 kw. to be added at a later date; and

(vii) a new item—an oxygen plant of 50 tons a day capacity with a complete standby plant—was provided.

As in the case of the other two plants, the Government of India have been anxious to ensure that plant and equipment provided initially, with a few additions, be capable of rapid expansion of the capacity to 1·25 million tons. This, along with the various improvements described above, has been incorporated in the final contract. The layout is such that the capacity can be increased ultimately to 2·5 million tons of ingots.

7. The plant which is now under construction will produce in the first stage, 1,250,000 tons of metallurgical coke, 1,200,000 tons of iron and 1,000,000 tons of steel ingots to be processed into the following marketable products:—

	Tons/Year
(a) Heavy forging blooms	10,000
(b) Forging blooms	30,000
(c) Forging billets	60,000
(d) Billets for re-rolling industry	150,000
(e) Merchant bar sections	240,000
(f) Light and medium sections	200,000
(g) Sleepers	60,000
(h) Wheels and axles	50,000
	800,000
(i) Pig iron	350,000
(j) Metallurgical coke (about)	100,000

In addition, the following coke oven by-products will be available for sale:—

(i) Ammonium Sulphate
(ii) Benzene
(iii) Toluene
(iv) Xylene
(v) Solvent Naphtha
(vi) Naphthalene
(vii) Road tars
(viii) Wood preserving creosote.

8. *Power Supply.*—The Domodar Valley Corporation, which is putting up a thermal station of 150,000 kw. capacity near the steel works, will be the main source of supply. This thermal station is designed to burn middlings and surplus gases from the steel works. A minimum unfailing supply of electrical power is also necessary at the steel works to maintain essential services. In raising steam in boilers it is convenient and economic to use it in generating the necessary stand by power. 15,000 kw. of power will be generated in the stand by works.

9. *Water Supply.*—Water will be drawn from the river Damodar which flows by. With the large Damodar Valley Corporation thermal station being built adjacent to the works certain common water supply arrangements are being made both for the thermal station and for the steel plant. The construction of a canal with the

necessary headworks has been taken by the Damodar Valley Corporation and the cost will be shared between that Corporation and the Hindustan Steel Ltd. Water from the canal will be pumped into a big reservoir which is being built by the Hindustan Steel Limited. The steel works will draw water from this reservoir.

10. *Raw Materials.*—The Durgapur Plant will require about 2 million tons of iron ore, nearly 1·8 million tons of coal and about 660,000 tons of limestone and dolomite every year. Iron ore for Durgapur will come from a new mine (Bolani) being developed in the Gua region of Orissa. Mining operations in this region are in the hands of private industry and the best areas are already held on lease by them. With the limited resources of Government already committed to the development of two mines at Barsua and Rajhara, it was considered desirable to develop the mine in Bolani in collaboration with the existing firms who have the necessary experience and trained personnel. It was also expected that thereby suitable areas in this region could be secured conveniently. The mines for Durgapur are being developed by Bolani Ores (Private) Limited in which the Government of India have a share of 50·5 per cent. 49·5 per cent shares are owned by the Orissa Minerals Development Corporation, who until recently had the lease of the area and had undertaken preliminary investigations. Work on the mines is progressing and it is hoped that the Company will be able to supply iron ore to the steel plant in time.

11. Limestone and dolomite will initially be obtained from the Birmitrapur-Hathibari region which will also supply Rourkela. This source may not be able to supply full requirements of both the steel plants when they are expanded. Other sources of limestone are, therefore, being investigated. As in the case of Rourkela and Bhilai, manganese ore, ferro alloys and other materials will be obtained from the market.

12. For the Durgapur Steel Plant metallurgical coals of Jharia will be blended with the high volatile semi-coking coals of Barakar. Jharia coals will be washed in a washery of a capacity of 360 tons per hour which is being put up as a part of the main steel plant in Durgapur.

13. *Use of Slag.*—As in the case of the other two plants, the question of manufacture of cement from blast furnace slag was kept in mind while planning the layout of the steel works. Before slag is used for the manufacture of cement, it has to be granulated. Room has been left in the layout for a slag granulation plant to be put up when required. Not all the slag is suitable for cement-making and a decision on granulation can be taken only after the suitability of slag is established after the plant has been in production sometime.

14. *Township.*—As in the case of the other two plants, a township to house the workers of the steel plant is being developed near the main steel works. The layout of the water supply, sewerange and other services has been designed for a township with about 20,000 houses to accommodate 100,000 people. Initially, the township will have its own hospital, shopping centre, schools, dispensaries and recreational facilities along with accommodation for about 7,500 employees of the Durgapur Steel Project in the first stage. Further construction of residential houses will be taken up when the plant itself is expanded. Water will come from river Damodar and the Damodar Valley Corporation thermal station will supply power to the township as well.

15. *Land Acquisition.*—The total land required at Durgapur is about 5,735 acres for the plant and 10,490 acres for the township. Nearly all the land required for the plant and over 9,000 acres for the township have already been acquired.

16. *Costs.*—The original estimates, on the basis of which a provision of Rs. 1,150 million was made in the Second Five-Year Plan for the Durgapur Steel Plant, proper, were based on the preliminary specifications and summary of prices submitted by the Indian Steelworks Construction Company in January, 1956. These related generally to the plant described in the report of the United Kingdom Steel Mission. By their very nature, the prices were tentative and were subject to a variation of 5 per cent for the main plant and equipment. Costs of civil engineering and erection were only broad estimates and were to be determined to closer approximation after site conditions had been determined more closely. The plant which is now under construction has a number of improvements which have been described earlier in this chapter. This plant is estimated to cost Rs. 1,380 million. The costs of other items are estimated as follows:—

	Rs.
(i) Township	140 million
(ii) Fees to consultants	24 million
(iii) Other ancillaries, including water supply arrangements, expenditure on electrical and railway works outside the perimenter of the plant, customs, training schemes etc.	126 million

The total cost of the project will, therefore, be about Rs. 1,670 millions excluding escalations, and of this the total foreign exchange element is likely to be about Rs. 950 million.

17. *Credit.*—To meet a part of the foreign exchange element of the cost of the project, two loans have been obtained—one of £11·5 million sterling from a syndicate of British banks and the other of £15 million sterling from the Government of U.K. The rate of

interest on the loan given by the syndicate of British banks will be 1 per cent above the bank rate whereas the British Government will charge interest at the same rate at which they will be able to borrow in the market plus 1/8 per cent as administration charges.

18. *Progress of Construction.*—During the year, considerable progress was made in the construction of the steelworks. Nearly 100,000 tons of plant equipment and stores had been shipped from the United Kingdom. Because of the congestion which had been experienced in Calcutta on earlier occasions, a transhipment centre with a jetty has been built in Bhadreshwar, about 26 miles up stream on the river Hooghly. This jetty has been handling about 5,000 to 6,000 tons of shipment a month.

19. Most of the concrete work and refractory brick work in the first coke oven battery has been completed. Foundations for the second battery were completed and refractory brick work taken up. Work on the coal handling system and the by-product plant has advanced considerably.

20. The entire foundation work for all the three blast furnaces as well as the hot blast stoves has been completed. Over 80 per cent of mechanical erection work has been done on the first blast furnace. On this furnace, the erection of the stoves and the necessary platforms have also been completed. Refractory work has been taken on hand. Foundation work for the steel melting plant and concreting of sub-structures in the rolling mills have been progressing satisfactorily.

21. The Damodar Valley Corporation which is to supply power to the steel plant has reported that it will be able to supply power in time for the first blast furnace to be ready by October, 1959. In the 15,000 kw. power house, which is being built as a part of the steel project, concreting work on the operating floors and for the control house roof has been completed. Work on boilers is progressing well and Boiler No. 1 is almost ready. The turbo-blowers and turbo-alternators are expected to be ready for operation in time.

22. The reports from the Damodar Valley Corporation indicate that the water supply canal is expected to be completed before the middle of 1959. Work on the pump house which will pump water from the canal into the reservoir has progressed satisfactorily and is expected to be completed in time. Work on the reservoir has also progressed well.

23. Messrs. Bolani Ores (Private) Limited have also reported that they will be able to supply iron ore to the Durgapur Plant in time for the commissioning of the first blast furnace even though their mechanised plant may not be ready by that time. They will be mining ore manually in the initial stages.

24. In the township, 1,400 houses have been completed and 1,400 houses are under construction. It is expected that about 2,600 residential houses will have been completed by the end of March, 1959. Two hostels and a marketing centre has been completed and a permanent school building is under construction.

25. At the end of the year 1958, there were 180 British experts and technicians employed by the contractors and eight by the consultants at Durgapur. The total number of persons working in the project was about 27,000 including over 23,000 contractors' labour and over 1,600 departmental labour. There were about 160 Indian officers, 200 graduate apprentices and geologists, over 400 non-gazetted technical staff and about 250 operatives and skilled workers.

26. The prospects for 1959-60 are that the first blast furnace will go into production in November, 1959 and before the end of the financial year, it is hoped that a part of the steel melting shop, the blooming mill and the billet mill, will have commenced operation.

COAL WASHERIES

With the limited resources of metallurgical coal in the country, two measures of conserving these coals were kept in view in locating and in designing new steel works—washing of metallurgical coals and blending, to the extent convenient, of metallurgical coals with non-metallurgical coals.

2. The annual requirements of washed coals for the three new steel plants in the public sector and the expanded steel plants in the private sector are estimated at—

	Million tons
Rourkela Steel Works	1·60
Bhilai Steel Works	1·80
Durgapur Steel Works	0·80
Tata Iron & Steel Works	2·47
Indian Iron & Steel Works	1·60
TOTAL	8·27

3. There are at present three washeries, which with certain improvements, will supply 1·2 million tons of washed coal. The new 500-ton washery, which has been set up by the National Coal Development Corporation at Kargali, will supply 1·1 million tons to Rourkela and 0·5 million tons to Bhilai. In the contract for the steel plant at-Durgapur is included a washery to supply 0·8 million tons of washed coals to that steel plant.

4. For the balance—about 4·15 million tons—three washeries are proposed to be put up—in Dugda, Bhojudih and Patherdih, all in the Jharia coalfields. Generally, it is the intention that the washery at Dugda will supply washed Jharia coals to Bhilai and Rourkela, the washery in Bhojudih to the Tata Iron and Steel Works Rourkela, the washery in Bhojudih to the Tata Iron and Steel Works and that in Patherdih to the Indian Iron and Steel Works. Construction and management of these three washeries has been entrusted to the Hindustan Steel Limited.

5. Following global tenders invited in May 1957 the Hindustan Steel Limited has concluded a contract with Messrs. McNally Pittsburg International Incorporated of the U.S.A. for the supply of the Dugda Washery. Messrs. Asiatic Oxygen & Acetylene Co. Ltd., of India are the sub-contractors for civil works and erection, etc. In terms of the agreement, Hindustan Steel Limited will provide power, water, access road to plant site and rail road sidings.

6. The total cost is estimated at about Rs. 43·8 million of which the foreign exchange component is nearly Rs. 27 million. In addition, there will be expenditure on a marshalling yard and a township. It is proposed to utilise the credit extended by the Export-Import Bank of the U.S.A. to the tune of Rs. 27 million ($6 million) to finance the foreign exchange cost of the washery.

7. All the preliminary civil and railway works are in various stages of completion. Work on the construction of the railway track from Chandrapura to the washery site is progressing satisfactorily. An access road to the site, a cause-way across the river Jamuni and work on temporary supply of drinking water and power to the site have all been completed.

8. The washery is expected to be commissioned towards the end of 1960. Until then, selected unwashed Jharia coals will be used along with washed Kargali coals for the Bhilai and Rourkela Steel Works. Tenders have been invited for the washery in Bhojudih. Specifications for the washery in Patherdih have been drawn up with a view to invite tenders as soon as the layout on the ground is settled.

RECRUITMENT AND TRAINING

For the three steel plants in the public sector, the estimated requirement of technical personnel is 2000 engineers and about 19,000 operatives and skilled workers.

The recruitment and training of personnel required for the construction as well as operation of the plants has been a difficult task. Had there been a large iron and steel industry in existenc, it would have been possible to draw experienced men from these industries. In India the scope has been limited as both the major steel works in Jamshedpur and Burnpur are themselves engaged on massive schemes of expansion. There is also a limited use of these plants as training ground for new workers. Reliance has had, therefore, to be placed mainly on picking up and training new men. Until the 1st April, 1957, when the Bhilai and Durgapur projects were directly under the Ministry of Iron & Steel, recruitment of engineers was made through the Union Public Service Commission. Since then the Hindustan Steel Limited has undertaken the recruitment. Applications are generally invited by advertisement and selection is made by a Committee of Senior Officers in which experts from outside are also associated. Two Selection Committees presided over by the Ministers Economic, London and Washington have also been selecting Indian engineers in the U.K., the Continent and the United States. More than 1700 engineers have been recruited.

Certain highly skilled categories of operatives were initially selected by the Hindustan Steel Limited centrally so as to avoid competition. Recruitment of skilled workers and others is done by each of the project separately.

Association in the construction of the plant will help in training engineers and workers required for maintenance of the plant later. On the other hand, for the operation of the plant, as distinct from maintenance, engineers and skilled workers have to be trained in steel works. The Tata Iron and Steel works, the Indian Iron and Steel works and the Mysore Iron and Steel Works are cooperating by making available facilities for training. Even so, many engineers and some of the highly skilled workers have to be sent abroad to acquire further skill and experience. Training has been so arranged that the engineers and operatives required for each section will be ready to take over as that section is commissioned.

For operatives, arrangements have been made with the Tata Iron & Steel Works to train 450 operatives per year. For the training of skilled workers, arrangements have been made with 75 engineering works in the country where partly trained men from Training Centres run by the Directorate General of Resettlement and Employment, are given further training. Other sources of recruitment of skilled workers are from those engaged in the erection and construction work at Rourkela, Bhilai and Durgapur, Jamshedpur and Burnpur and the surplus technical personnel, of Kulti, the Ordnance Factories, the Damodar Valley Corporation and other Government development projects.

A programme has been worked out for the training of 2000 engineers in the steelworks in the USSR, USA, UK, West Germany, Canada and Australia. The following table shows the details of 1040 engineers and operatives sent to foreign countries for training till the end of the year 1958. Of these, 673 have so far returned on completion of their training:

	Deputed		Returned	
	Engineers	Operatives	Engineers	Operatives
U. K.	90		20	
U.S.A.	298		193	
U.S.S.R.	249	262	221	148
Australia	28		5	
Canada	1		1	
West Germany	110	2	85	
	776	264	525	148

For the Bhilai steel plant, the engineers and skilled supervisory staff are being trained mostly in the USSR. Under the agreement with the USSR, training of Indian personnel in the USSR and assistance in the training of personnel in India is the responsibility of the USSR and under this agreement about 200 more engineers and operatives have to be sent for training in 1959. It may be necessary to send a further 100 graduate engineers to the USSR for training during 1959. For the training of engineers in the USA, two agreements were reached in 1957-58 with the Ford Foundation whereby the entire cost of training of engineers in the USA is met by that Foundation. The passage for trainees from India to America and back is paid by India. Negotiations are going on with the Ford Foundation and the U.S. Government for training 100 more graduate engineers in the United States during 1959. A further 75 engineers

and 48 engineers are expected to go for training to the U.K. and Australia during 1959 under the Colombo Plan. The steel works in the U.K. will, on the whole, train 300 engineers and skilled supervisory staff. A large training establishment is also being run at Jamshedpur where every young engineer is given preliminary training before going abroad.

ALLOY AND SPECIAL STEELS PLANT

The target of six million tons for steel, in the Second Plan, is primarily for ordinary steels produced by conventional processes in large integrated iron and steel works. While the demand for such steels is large and production is generally undertaken in big integrated works, there are other steels usually called "alloy and special steels" which are required in relatively small quantities but in a variety of qualities. They generally have alloying elements other than carbon—*e.g.*, nickel, chromium, vanadium—to give special properties to the steel. Both because of the small quantities in which they are required and because of the high degree of quality control and finish which goes into the manufacture of these steels, they are not convenient of manufacture in integrated iron and steel works. It is usual to make these steels in electric furnaces and to roll them in special rolling mills.

2. Some of these steels are produced in small quantities in the Ordnance factories and in a few small electric furnances in the private sector. But the bulk of the demand has so far been met by imports. The import of these steels which was about 6000 to 7000 tons five or six years ago, has been rising and is now about 30,000 tons a year. Judging by the likely tempo of development in the Third Plan, the demand might grow to over 50,000 tons by 1965. The Ordnance factories who at present manufacture certain grades of special steels have a proposal to modernise and expand existing facilities. It has been agreed that no wasteful capacity should be set up in the country but there is room both for the expansion of existing facilities in the Ordnance factories and for a unit outside, primarily, to meet the demands of civilian industry. It is proposed to put up a plant for the manufacture of these alloy and stainless steels. The plant would be designed to produce 40,000 tons of ingots per year which is expected to yield about 25,000 tons of saleable special steel products, with provision for expansion at a later stage to 80,000 tons of ingots. Quotations for the preparation of the detailed project report and other services have been obtained from four firms who had shown interest in the project. One or more firms will be selected for the preparation of the detailed project report. A decision on the location of the plant will be based on the detailed project report.

TATAS, INDIAN IRON AND MYSORE

The production target of six million tons of ingot steel set for the Second Five Year Plan was to be shared equally by the private and public sectors. The Tata Iron & Steel Co., Jamshedpur, and the Indian Iron & Steel Co. Burnpur, were to increase their production to two and one million tons of ingot steel respectively. These, with Mysore, were, until the first blast furnaces in Bhilai and Rourkela were blown in, the only three existing integrated iron and steel works in the country.

Tata Iron and Steel Company

2. Of the three, the Tata plant is the oldest. It is situated at Jamshedpur, 156 miles from Calcutta on the main Calcutta-Bombay line. The plant produced its first iron in 1911 and its first steel in 1912. It was gradually built up. By 1939, it had a capacity of about a million tons of ingots but by the end of the Second World War production had dropped by nearly 100,000 tons. Owing to the old age of the plant, it became necessary to modernise the plant. The two expansion programmes undertaken by the Company—the Modernisation and Expansion Scheme of 1952 and the two Million Ton Programme of 1955—are designed not only to modernise the plant but to double its capacity of a million tons of ingots.

3. The first stage, the Modernisation and Expansion Programme of 1952 sought to raise the capacity of the plant from 750,000 tons of finished steel a year to 931,000 tons by 1958. At the time this expansion was undertaken, the Company had five blast furnaces with an annual capacity of about 1·2 million tons of iron and the necessary coke ovens; and three steel melting shops. The rolling mills consisted of a 40" blooming mill and a continuous sheet bar billet mill, a rail and structural mill, a plate mill, sheet mills, a merchant mill, three bar mills, a sleeper plant and a wheel, tyre and axle plant. The programme undertaken in 1952 included the installation of a new coke oven battery, re-modelling of the steel melting shop No. 3, improvements to the blooming mill, soaking pits, plate mill and calcining plant, the installation of a new skelp mill and expansion of the steam and power supply. The scheme was to be completed by the end of 1958; it is complete except for the plate mill where two re-heating furnaces and the finishing stand are expected to be ready by the middle of 1959.

4. The second expansion scheme of Tatas, which was undertaken as part of the Second Five Year Plan, consists of two parts. The

first part is generally known as the Two Million Ton Programme (TMP). It includes the construction of a new coke oven battery and expansion of the existing batteries, expansion of the boiler and power house and installation of two new boilers, installation of a new crushing plant, a new sintering plant, construction of a new blast furnace, expansion of the steel melting shop No. 3 by the addition of two 100-ton open hearth furnaces and a 132-ton converter, a new 46" blooming mill, a new sheet bar and billet mill, a new medium and light structural mill and a new roll shop. This programme was undertaken in collaboration with an American firm, Kaisers, and was originally due for completion by the 31st of May 1958. There has been, however, some delay and it is now expected that it will be complete only by the end of March 1959. Upto date, all items except the sintering plant are complete.

The second part of the 1955 expansion includes modernisation of the steel melting shops, calcining plant, the old sheet bar billet mill, the old rail and structural mill, the old merchant mill, construction of an ingot mould foundry and the development of the collieries and mines. These items of work are being undertaken by the Company directly and are scheduled to be completed only by 1960.

5. As a part of their expansion programme, Tatas have also undertaken some ancillary works. These consist of a new ferro manganese plant at Joda with a capacity of 30,000 tons a year, a new refractory plant at Belpahar in collaboration with Didier International, a ferro sulphate washing plant and a plant for the recovery of scrap from slag by the Heckett process. By the Heckett Process, slag from the open hearth furnaces and from the converters is transported in slag pots to the Heckett area and dumped into pits. The slag is cooled by water spray in the pits and then lanced by oxygen flame or broken by a ball with a magnet crane. Of these, the ferro-manganese plant and the Heckett plant are ready. The rest expected to be ready by the end of 1959.

6. The Tata expansion programmes have meant a very large capital investment. It was estimated that the Modernisation and Expansion Programme undertaken in 1952 would cost about Rs. 43 crores. It was to assist this programme that Government gave Tatas in 1953 a special advance of Rs. 10 crores. The loan is interest-free during the period of construction. The initial estimate for the Two Million Ton Programme was about Rs. 63 crores. For this Tatas have obtained two loans, the first for $ 75 million from the International Bank for Reconstruction and Development and the second for $ 32·5 million from the International Bank for Reconstruction and Development and a group of American banks. Both loans have been guranteed by Government. Government have also assisted by altering the price structure of steel and including

in the retention price a special element for development. While the final costs are yet to be ascertained, Tatas have stated that owing to higher costs of plant and machinery than estimated, and other factors, their expansion costs have considerably exceeded their expectations.

The Indian Iron and Steel Company

7. The Indian Iron & Steel Company has two plants, one at Kulti and the other at Burnpur. It consisted of two blast furnaces each with a capacity of about 300 tons per day, coke ovens and a large pipe foundry mostly for the manufacture of cast iron pipes. The plant at Burnpur consisted of two blast furnaces each with a capacity of 600 tons a day and steel melting facilities; the rolling mills consisted of a blooming mill, a rail and structural mill, a 18″ Morgan mill and sheet mills.

8. The Indian Iron and Steel Company have, like Tatas, undertaken a large expansion programme designed to increase their capacity from about 300,000 tons of finished steel to about 800,000 tons per year. Like the Tatas scheme again, it falls into two main parts. The first part undertaken in 1953 consists of expansion and mechanisation of the Gua ore mines, installation of two coke oven batteries, and two blast furnaces, expansion of the converter house and the installation of a third converter, the addition of a second melting shop and four soaking pits and the expansion of the finishing departments of the two mills along with the expansion of ancillary services, *e.g.* water, gas, power and steam. This would have increased the production of the plant to 700,000 tons of saleable steel including 280,000 tons of billets with 400,000 tons of "free" iron for sale. But in 1955, it was decided that part of the production of free pig iron for sale should be planned on Bhilai and Durgapur with a corresponding reduction in the quantity to be produced by Indian Iron, and that the Company should be allowed to produce 800,000 tons of saleable steel. The 1955 programme as it is called consists of the addition of two stands to the billet mill and one to the rail and structural mill, a new bar mill, a new 20,000 kw. steam turbine generator and necessary boilers and provision of the necessary ancillary facilities. Both the programmes are due for completion by the end of 1959.

9. So far as the 1953 extensions are concerned, the Company has completed all except the last furnace in the melting shop; erection is in progress for the two basic hearth furnaces and the 34″ and 18″ mill. In regard to the 1955 programme, 89% of the orders have been placed and most of the shipments received. Erection is in progress. It is expected that the programme will be completed in time.

10. Government has helped the Indian Iron and Steel Company with financial assistance for these programmes. Two loans—an interest bearing loan of Rs. 7·9 crores and a special advance of Rs. 10 crores (as in the case of Tatas, interest free during the period of construction)—were given. To meet the foreign exchange cost of the project, the International Bank for Reconstruction and Development have advanced two loans of $30·02 and $20 million. These two loans have been guaranteed by Government.

Mysore Iron and Steel Works

11. The Mysore Iron & Steel Works, Bhadravati, set up in 1923, was planned to manufacture wood distillation chemical products and had then a small blast furnace to consume its charcoal output for making iron from local ore. When the imported chemicals made wood distillation unprofitable, the plant was taken over to the production of iron and steel. It had by 1936 adequate facilities to roll about 25,000 tons of steel products and make 8,000 tons of cast iron pipes. In 1938, a cement unit was added to the plant. In 1942, a ferro silicon plant was set up. Even so, owing to the high raw material assembly costs, the limited supply of charcoal and its uneconomic size, the plant faced difficulties. From 1946 onwards, efforts were made to correct the situation by enlarging the plant's capacity. To avoid dependence on charcoal, two electric pig iron furnaces were set up, an additional kiln was added to the cement unit, and the ferro silicon capacity increased. These were included in the First Plan programme. The plant today consists of a small conventional 80-ton blast furnace and two electric furnaces with a rated daily capacity of 100 tons each for iron making; two 25-ton open hearth furnaces; a 20″ roughing mill; a 20-12″ mill to roll rounds, squares, flats and small angles; and a rod and strip mill operating on purchased billets. The Works' present annual capacity is about 30,000 tons. Besides, Bhadravati has an iron foundry where castings for maintenance, pipes and sleepers are made; a steel foundry; and furnaces to make both ferro manganese and ferro silicon. (Incidentally, of ferro silicon, Bhadravati is the only producer.) Besides, Bhadravati also has a small structural fabrication shop and a fire brick and refractories plant. The cement unit has now a rated daily capacity of 260 tons.

The production of steel at Bhadravati would be more economic if steel making and rolling facilities could be installed to use the 100,000 tons of pig iron they make. It was with this end in view that in 1955 a firm of technical consultants undertook a technical study of the plant. They recommended the installation of adequate steel making and rolling facilities. The programmes included in Mysore's Second Plan were:

(a) the completion of the cast iron spun pipe plant with a capacity of 15,000 tons;

(b) the setting up of a sintering plant;

(c) the expansion of the ferro silicon plant from 5,000 tons to 20,000 tons a year;

(d) the installation of steel making facilities and a billet and light structural mill; and

(e) extensions to electric supply and tramways.

During the year under review, the cast iron spun pipe plant was completed. The ferro silicon plant scheme was approved by the Government of India and orders for plant and machinery have been placed. It is expected to be ready in 1960-61. Work is on on the sintering plant and the electric supply and tramways. In regard to the installation of steel making and rolling facilities alone, progress has been till now rather slow. These were tendered for in 1956 and negotiations with the tenderers are now in the final stage. It is interesting to note that Mysore has decided to use the L.D. process for steel making.

PRODUCTION, IMPORTS AND DISTRIBUTION OF STEEL

The year 1958-59 has been a significant one for the iron and steel industry in this country. During the year, the major items of the work relating to the expansion programmes of Tatas and Indian Iron were completed and trial operations began. The only large part remaining to be done is the new bar mill in Indian Iron and revamping of some of the older mills in Tatas. The completion of these programmes would mean that the steel making capacity will increase from about 1·5 million ingot tons to 3 million. The first fruits of the expansion were witnessed in December, 1958. In this month, the production of saleable steel from the two main works recorded a sharp increase from the average level of 100,000 tons to 140,000 tons. In the public sector, production started in the first two blast furnaces at Bhilai and Rourkela in February, 1959. The production of these furnaces, with the production from the Indian Iron's furnaces at Burnpur, will mean not only self sufficiency in foundry grade iron, but some surplus for export. In steel, however, the prospects for 1959-60 are not so good. The increased production of Tatas and Indian Iron will, no doubt, help in the supply position becoming easier in some categories of steel. But in many others, *e.g.* plates, sheets, etc., the position will continue to be difficult.

During 1958-59, however, the supply position of steel continued to be extremely difficult. This was due to two factors. The first was the month-old labour strike at Tatas and the second the dislocation caused by the expansion schemes of Tatas and Indian Iron. With the limited foreign exchange availability, imports were also less.

2. The production, distribution and prices of steel have been controlled since 1941, when the Iron and Steel (Control of Production & Distribution) Order was promulgated. In 1943, the Iron & Steel (Scrap Control) Order was issued. Under these orders, the Iron & Steel Controller has the power to arrange for the production of iron and steel and the distribution of iron, steel and scrap at reasonable prices. With the enactment of the Essential Commodities Act, 1955, it was considered desirable to amalgamate and reissue the two orders mentioned above. Accordingly, the Iron & Steel (Control) Order, 1956, was issued. The powers of the Iron & Steel Controller under the new Order are substantially the same as the powers under the earlier Control Orders.

3. *Production*:

Finished steel is produced by the following categories of producers:

(i) Main Producers	...	Tata Iron & Steel Co. Indian Iron & Steel Co. Mysore Iron & Steel Works.
(ii) Secondary Producers	...	Guest Keen Williams Tinplates Co. of India. Indian Steel & Wire Products. Eagle Rolling Mills Indian Tub Co. Kalinga Tubes Indian Steel Rolling Mills Negapatam. J. K., Rishra.
(iii) Re-rollers	...	143

The main producers have integrated steel works. In other words, they start from raw materials and produce saleable steel. The secondary producers depend on semi-finished products, mainly billets. Guest Keen, Williams, for example, make rods, which they convert into bolts, nuts and screws. The Tinplate Co. make tinplate for tinbars supplied by Tatas. The Indian Steel & Wire Products have a rod mill; and the rods are drawn by them into all types of wire. Both Indian Tube Co. and Kalinga Tubes make tubes from Tata skelp. Besides these two, there is also a tube mill in Madras where electric resistance welded tubes are made from imported strip. J. K. Ltd., Rishra, make hoops and box strappings. The Eagle Rolling Mills and the Indian Steel Rolling Mills, Negapatam, are really large re-rollers who make light sections and bars and rods.

The re-rollers convert billets or scrap supplied by Tatas and Indian Iron and from imports, mostly into bars and rods. Of these, 67 use billets; the rest use scrap. It is expected that with the increase in producion from Tatas and Indian Iron particularly of billets, the re-rollers who have for years been working below capacity owing to shortage of raw material will be able to utilise fully their existing capacity.

Production of finished steel during 1958 at 1·30 million tons was slightly less than that of previous years. This, as explained above, was the result of the strike in Tatas and dislocation caused by the modernisation and expansion programmes undertaken by the two steel works. Production of saleable pig iron at 441,000 tons in 1958 was higher than in any previous year; in 1957 and 1958 iron production was only 383,150 tons and 351,630 tons respectively. The category-wise production of steel by producers and by categories is given in the following tables:

By Producers in 1958

	Tons
(i) Tata Iron & Steel Co	468,762
(ii) Indian Iron & Steel Co	298,741
(iii) Mysore Iron & Steel Works	35,894
(iv) Secondary producers and registered re-rollers	408,934
	1,212,331
(v) Unregistered re-rollers who have opted to work on billets	35,865
(vi) Unregistered re-rollers	50,887
TOTAL	1,299,083

Billets and semis produced by the main producers are reflected in the production of (iv) to (vi).

By categories

		(Jan.-Nov., 1958) Tons
1.	Rails, Fishplates and Spikes	75,200
2.	Wheels, Tyres and Axles	20,803
3.	Structurals	198,413
4.	Sheets	258,514
5.	Plates	68,746
6.	Bars and Rods	498,359
7.	Hoops and Strips	12,637
8.	Castings (unmachined)	23,326
9.	Spring Steel	24,633
10.	Tool and Alloy Steel	3,716
11.	Tinplate	57,878
12.	Bolts, Nuts and Rivets	12,614
13.	Wire	34,244
		12,99,083

Besides the above, Tatas also produced 84,036 tons of skelp for tube making.

4. *Imports*:

The acute shortage of foreign exchange restricted imports of steel during 1958-59. It will be recalled that till the beginning of 1957 imports of steel were liberal. However, from 1957, owing to exchange difficulties, restrictions had to be imposed. No import licences were issued for prime quality mild steel on commercial account. Imports were arranged by the Iron & Steel Controller directly. The only item licensed were special categories of steel and some quantity of industrial and re-rollable scrap. The bulk of these licences were issued to actual users. Even the comparatively smaller import of steel during the year as compared to previous years flowed to a large extent from outstandings of old orders placed earlier and the longterm contracts entered into in 1955-56 with USSR and West Germany. The total imports amounted to 1.17 million tons

against 1·74 million tons in 1956 and 1·67 million tons in 1957. The categorywise break-up of the imports in 1957 and 1958 are given below:—

	1957	1958
A : Steel		
Blooms, slabs billets etc.	270,044	220,079
Steel castings (unmachined)	5,014	301
Steel forgings (unmachined)	2,722	637
Structurals	202,062	143,327
Sheets, black, galvd plain	61,749	36,753
Plates, M. S.	193,666	68,436
Sheets, black, galvd corr.	95,367	362
Bars & Rods	257,756	87,460
Hoops & Strips	17,868	22,864
Rails	165,360	205,831
Wheels, tyres and axles	38,778	48,361
Rail fittings (sleepers and fishplates)	51,873	75,320
Tinplate, prime	7,999	32,382
Tinplate, waste/waste	20,287	12,791
Terneplate, prime & waste/waste	502	107
Wire black, galvd	50,840	46,964
Wire telegraph	2,523	172
Tool & alloy steel	25,076	26,013
Scrap, industrial	62,744	43,398
Scrap, melting /re-rollable	3,522	12,070
B : Pig Iron :	119,266	89,674
GRAND TOTAL	1,655,018	1,173,302

Out of these imports, the quantities imported on Government account and distributed by the Steel Controller amounted to 1,037,063 tons in 1957 and 753,805 tons in 1958. The balance in each year was imported by the trade and actual users directly.

Bulk purchase contracts for the import of 265,000 tons of steel were concluded during the year with the USSR, Poland and Hungary.

For 1959, the prospects from indigenous production are brighter. It is expected that here the improvement will be to the extent of about half a million tons. During the year, it is also expected that the first saleable steel—billets and plates—will come out of the public sector plants at Bhilai and Rourkela. Overall supplies in 1959 are not likely to be less than in 1958. This is because about 200,000 tons of steel is being brought from the USSR. Arrangements are also being made to purchase about 200,000 tons during the year with funds coming from the U.S. Government D.L.F. Loan, Substantial quantities of steel for Railway use are being purchased by the Railways, again out of funds coming from the U.S. Development loan. A few contracts for the purchase of steel against the export of scrap, iron ore and manganese ore have been concluded. Others are under negotiation. The overall prospects, therefore, indicate an easier supply position in 1959.

So far as 1958 is concerned, the total supplies amounted to 2·47 million tons (1·30 million tons from indigenous sources and 1·17 million tons from imports.)

5. *Distribution.*—Distribution of prime steel is regulated. Allocations of steel are made quarterly, after an assessment of demand and availability. The demand for steel—as ascertained from the demand statements given by various classes of consumers, Government and non-Government—which was about 2:1 million tons in 1953 rose to 4:1 million tons in 1958-59. Having regard to the limited availability, rationing was inevitable. The procedure for distribution is somewhat as follows.

Demands by the various classes of users are sent to the Iron and Steel Controller well ahead of a quarter. Some demands come direct, *e.g.* from the Defence, Railways, etc. Others are sponsored, *i.e.* they are screened by the sponsoring authorities, like the Central Water and Power Commission which looks after all irrigation and power—projects and the Development Wing of the Ministry of Commerce and Industry which looks after scheduled industries. The demands are co-ordinated by the Steel Controller. The Steel Controller sends his proposals to the Ministry in the light of what is likely to be available, both from Indian production and imports. The Ministry, after discussion with the concerned authorities, decides what to allocate. In the allocations, the requirements of the 'core' projects are met in full; others get only a *prorata* share. Once the allocations are made, the Steel Control or the sponsoring authority concerned issues quota certificates. The recipients of quota certificates then place indents of orders on the Steel Controller specifying in detail categories, sizes, etc. The Steel Controller then "plans" supply by transmitting the orders to the producers or by arranging imports. The steel supplied against quota certificates is sold at uniform prices at all railway stations throughout the country, whether the supply is of indigenous or imported steel. For each category of steel, the price is fixed f.o.r. destination railway station.

The following statement shows the allotments made in 1957-58 and 1958-59:

	1957-58	1958-59
	(Tons)	
Railways	480,000	370,000*
Industrial maintenance & packing	108,000	108,700
Steel processing industries (Central)	383,500	541,000
Government development schemes	562,500	631,200
Private industrial development schemes	144,000	163,300
State non-agricultural, State steel processing industries and State Govennment development schemes	266,000	385,600
Agriculture	80,000	100,800
Housing of displaced persons	12,000	13,500
Export	8,000	10,500
Miscellaneous	..	2,700
TOTAL	2,044,000	2,327,300

*Besides direct imports by the Railways against Foreign Credits.

Although the actual availability of steel in 1958 was less than in 1957, the allotments in 1958-59 were higher than in 1957-58. Supplies generally materialise against allotments only after six to nine months. The allotments in the second half of 1958-59 were therefore increased on the basis of the estimated increase in the indigenous production during 1959.

The actual distribution of steel is made in three ways. In most cases, supplies are arranged direct from the works. Steel works, however, do not accept orders for below one wagon load. Steel is sold by the works at what are known as Column 1 prices. Smaller users can get steel through controlled or registered stockholders. The controlled stockholders, who number 202, are really large wholesalers. They stock either indigenous or imported steel and sell against quota certificates at Column 2 prices which are Rs. 30 more than col. 1 prices. The registered stockholders, who number about 2500, are small retailers in the trade. They sell steel against permits issued by the State authorities at Column 3 prices. The difference between Column 1 and Column 3 is Rs. 45 on the average.

6. *Prices.*—The price structure of steel is uniform. All controlled categories of steel excepting tinplate and wire are sold at uniform f.o.r. destination prices. These prices are notified from time to time. During the year under review, there was no change in the controlled selling prices.

The controlled selling prices, however, are not the prices which the producers get. The producers get only the retention price *i.e.*, the price which they are allowed to retain. The retention prices are uniform. At the beginning of the year, the average retention price stood at Rs. 405 per ton. As a result of the representation made by the Companies for a higher retention price, resulting from increases in costs and the higher rate of excise duty levied in the May, budget, and after enquiry by the Tariff Commission, the retention prices were increased, in October, 1958, by Rs. 14 on the average and by the actual increase in the incidence of excise duty. The retention prices are considerably lower than the controlled selling prices. The difference between the retention and the selling prices goes into the Equalisation Fund, and is used for various purposes like the subsidisation of imported steel and of billets to the re-rolling industry, the equalisation of freight, etc.

7. *Scrap.*—Scrap is generally classified into three groups, *viz.*, industrial re-rollable and melting. Industrial scrap, *e.g.* plate and sheet cuttings, is used for the manufacture of finished items, *e.g.* agricultural implements and buckets. Re-rollable scrap is used by

the re-rolling mills for the manufacture of bars and rods. Melting scrap is mostly used by electric furnaces for the making of steel ingots or steel castings. In both industrial and re-rollable scrap, there is a shortage. Therefore, these varieties of scrap are being imported for use in the country.

In melting scrap, however, which is used for conversion into steel castings or rolled steel, there is a surplus, the surplus being in light varieties of scrap which cannot be now used in the country. According to an assessment made by a Committee in 1956, the arisings and the requirements of the different types of melting scrap are:

	Arisings	Requirements	Surplus
Heavy, Medium, Borings and Turnings	215,000	173,339	41,661
Skulls, Rolls etc.	22,000	4,576	17,424
P. B. Sheets	15,000	25,008	(—)10,000
Detinned Pressed Bales	12,000	6,000	6,000
Nos. 2, 2a & 3 Pressed Bales	200,000	..	200,000
	464,000	208,923	255,085

The export of light scrap has been liberal because it could not be used in the country. During 1957 and 1958, however, exports fell steeply owing to the recession in the foreign buying markets. To encourage greater exports therefore, a certain amount of liberalisation in the export policy became necessary. Heavy scrap, which was hitherto banned for export was allowed to be exported along with light scrap in the ratio of 1:5. This step, as also the purchase of steel against scrap helped the export trade somewhat. Even so, the volume was very small. Only 60,972 tons of scrap were exported in 1957-58 as against 162,571 tons in 1956-57 and 185,5(tons in 1955-56. Much scrap is unutilised and not collected. It is to encourage the collection of scrap and their increasing use in the furnaces within the country that the Government are encouraging the setting up of more electric furnaces.

RE-ROLLING INDUSTRY

Integrated iron and steel works usually produce rolled steel sections required in bulk. It is more economic to manufacture Special sections or very narrow sections which are required in small quantities in small rolling mills called re-rolling mills. These mills generally process rolled sections from the integrated iron and steel works further to obtain special sections and often use cast-away rails and the like to make some of the products. The steel re-rolling industry in India had its beginnings about the year 1928. The industry began as a salvaging and processing industry making mostly wire rods and wire products from cast-away rails. It began to grow in the thirties and notice of the industry had to be taken in 1934 when the Indian Tariff Board expressed the opinion that "as in England and elsewhere, there is a place for these re-rolling mills in a well organised industry, and that the growth of a re-rolling section of the industry capable of dealing with small orders, even of steel products which may compete with the output of the main steel producing works, will be a natural and desirable outcome of the present tendency..... There is scope for the smaller mills in supplying part of the balance of demand, and that they can play their part in overcoming what is certainly the gravest handicap today of the Indian industry, the difficulty of distribution." At that time the Board also recommended assistance from Messrs Tata Iron and Steel Company Limited in regard to supply of billets, commenting that a protected parent industry had under-estimated its responsibility to the smaller industry in the matter of supply of raw material.

2. Once the principle of supplying billets to the re-rollers from out of production in Jamshedpur and from imports was accepted, the industry continued to develop. The import duty on billets was removed and a fair price fixed for indigenous billets in relation to prices of imported billets. During the war years, in conditions of extreme scarcity, the re-rolling industry grew rapidly to meet the demand for products which otherwise would have been produced by integrated iron and steel works. At present, there are over 160 re-rolling mills in the country of which three make distinctly special products—tin plates and tubes.

3. The Committee which reported on re-rolling mills (in April 1957) estimated the capacity of all the re-rollers in the country at about 700,000 tons on single shift. To meet this demand, about

700,000 tons of billets will be produced by the steel works in Jamshedpur, Burnpur, Bhilai and Durgapur. With these billets and with the increasing quantities of scrap which will be available, the industry should be able to run two shifts comfortably.

4. While in the country as a whole there is an adequate number of re-rolling units, the Committee which enquired into the re-rolling industry had recommended new re-rolling units in certain States where there are no units at present. One new re-rolling unit each has been sanctioned in Assam Andhra Pradesh, Bihar (North of Ganges) and Kerala.

FERRO-MANGANESE INDUSTRY

Ferro-manganese is mostly used in the manufacture of steel. Although India has large reserves of manganese ore, the primary raw material for the manufacture of ferro-manganese, it had until recently been exported abroad to be processed in the consuming countries. Production of ferro-manganese in India was small and was meeting only the internal demands. In the Second Five Year Plan, a target of 160,000 tons of ferro-manganese was fixed so as to meet the growing demands of the steel industry in India and to encourage export of the finished product instead of raw-manganese ore. Five new plants with a capacity of 86,000 tons have gone into production. Another three plants with a capacity of 67,000 tons are under construction and are expected to go into production during the coming year.

DEVELOPMENT OF THE IRON & STEEL INDUSTRY

Steel is essentially an alloy of iron and carbon. Traces of metals like manganese, silicon, chromium and vanadium are added to give varying strengths and qualities. Iron occurs in nature as an oxide and is mixed with earth, sulphur, phosphorus and such minerals. The process of steel making is therefore one of liberating iron from this natural form and then adding to it the requisite quantities of carbon and other alloying elements. Early attempts at freeing iron from the other 'impurities' were to refine the ore with charcoal fire. This could not meet the growing demands and it was realised by the middle of the 18th century that a fuel, cheap and available in abundance, had to be used. The obvious fuel was coal. But coal lacks the mechanical strength and the chemical qualities required. It is therefore converted into a form where it gains the necessary strength and the chemical qualities—'coke'. When coke burns with iron ore, the carbon in the coke mixes with the oxygen in the ore to form carbon monoxide which goes up as a gas. Other impurities like sulphur, phosphorus and earth are removed by adding limestone which collects the impurities to form what is known as 'slag'.

2. An integrated steel plant thus consists of four main sections:—

1.	Coke Ovens	To convert coal into coke
2.	Blast furnaces	To smelt iron ore to iron
3.	Steel Melting plant	To alloy iron with carbon and other metals to form steel
4.	Rolling Mills	To roll the steel into saleable products.

3. The other things in a steel plant are ancillaries like a power plant for the generation of electricity a blower plant which blows air at high velocity into the blast furnaces, structural and machine shops to repair and maintain the main steel plant, arrangements for the supply and cooling of water, laboratories for carrying out experiments and tests, storages for storing raw materials and maintenance stores and offices for administration, sales, etc.

4. The produce one million tons of crude steel, about 1¾ million tons of iron ore, a little less than 1¾ million tons of coal, half a million tons of limestone and half a million tons of other materials like dolomite, manganese ore and alloying elements, are required.

5. The location of an integrated steel plant is determined primarily by its proximity to sources of iron ore and coking coal. Availability

of water and convenience of transport are other important considerations. The sites chosen for the new steel plants—Rourkela, Bhilai and Durgapur—are the most suitable from these points of view.

6. The trend in most of the countries of the world, particularly in the UK, the USSR, the USA, Germany and France has been for steel to be produced in large integrated steel works. The size of the steel works have been increasing because the experience in those countries has been that as the size grows so do the economics of production improve.

7. Steel plants are generally tailor-made in the sense that the size of each section of the plant is determined according to the nature of the requirements, availability of raw materials etc. Most of the sections consist of units whose numbers are adjusted according to the nature of the demand on them. Coke ovens are just added if the demand grows for coke. So also blast furnaces and open hearth furnaces. For instance at each of the new steel plants there will be three blast furnaces, each blast furnace with a corresponding battery of coke ovens. The section which determines the size of the plant as a whole, more than the others, is the rolling mills. Here again, it is not so much the finishing mills as the blooming mill which has the most influence. Depending on the products and in consequence the size of ingots or blooms to be produced, development has been in standardising blooming mills at a size required for an ultimate output of about two to three million tons.

8. Generally beyond the two million tons stage, other difficulties arise particularly with regard to transport, economic working of mines and quarries for raw materials, convenience of management etc. The tendency therefore is to start off steel plants with one million tons output provided other conveniences like adequate and regular supply of raw materials, water and power are available.

9. In certain countries which do not have good quality ores or good metallurgical coals, attempts have been made in recent years to produce iron in small furnaces called low-shaft furnaces. Despite the higher cost of production, iron in low-shaft furnaces which can produce only about 50 to 150 tons a day, these are coming increasingly into use in Germany and a few other countries where metallurgical coals are not available and the extra cost of production is more than off-set by the cost of import of metallurgical coals from other countries. Small units for the production, particularly of steel, are also preferred in the manufacture of alloy and special steels where the demand for each variety of steel would be no more than a few tons at a time.

10. There have been various reports about spectacular increases in iron and steel production in China. It is claimed that an output of over ten million tons of steel has already been reached and the target for 1959 is said to be eighteen million tons.

11. If these reports are true, the rate of increase is very much higher than that ever achieved even in the more advanced countries like the US, the USSR, the UK or Germany. It appears that along with a number of new and big integrated steel works thousands of small blast furnaces with capacities of 5 to 10 tons a day are being put up in the rural areas. The plants are said to be fabricated within the country from local resources and are operated with almost unskilled labour.

12. From such reports as appear in the press, the small blast furnaces of China seem to be similar to furnaces used in the early years of iron making. These furnaces are mostly made of ordinary refractory bricks with a sheath of refractory lining on top. It is from such beginnings that the modern methods of iron making have developed. While certain economic factors peculiar to that country might provide the answer to what otherwise seems a somewhat unusual kind of development, there must be some other compelling reasons for China to adopt what appear to be less economic methods of iron making. With her known reserves of iron ore and coal dispersed almost over every province, it might be that she has chosen these methods to create extensive employment and to make the people industry-conscious. A pressing need to meet the sharp increase in demand for farm implements for the large agricultural programme also appears to have led to these methods of iron and steel production. Whatever the reasons, it is worth examining whether these could be adapted to Indian conditions in supplementing production from large steel works, particularly in areas like Rajasthan, Karnatak and Madras which have considerable reserves of iron ore but are far removed from sources of metallurgical coal.

13. In any future expansion of the iron and steel industry in India, it is clear that the expansion of the existing works to their economic balanced output should receive priority. With increased use of steel in the country, there will be a corresponding increase in the amount of scrap. To utilise this scrap and to encourage regional development, it is proposed to permit a certain number of electric furnaces to manufacture steel from scrap. In certain circumstances, it would be economic for some of the large consumers of pig iron to make their own iron. In recognition of such special needs, to encourage dispersal of the industry and to save transport,

a certain number of low-shaft furnaces and cupolas have been permitted to be put up by private parties to produce iron. Depending on the success of these small furnaces and cupolas, it might be desirable to permit more of these to come up in regions which have iron ore but no coking coal. Experiments are now going on in a pilot plant in the National Metallurgical Laboratory in Jamshedpur to explore the possibility of utilising iron ores of Salem in Madras, with lignite of Neyveli to produce iron. If these experiments are encouraging, there may be a case for a steel plant based on the ores of Salem and lignite of Neyveli.

14. The demand for steel and consequently the capacity for steel production in the Third Five Year Plan will depend to a large extent on the nature of the Plan itself—the rate of development and the sectors of development. For instance, if emphasis is to be on agriculture and social services, the demand for steel will be of one kind; on the other hand if emphasis is to be on building construction it will be of another kind. A very different type and size of demand will be there if industries claim a significant proportion of new investment. While the nature and size of the Third Five Year Plan are still to be determined, it appears that judging by trends and taking a view of the likely dimensions of the Third Five Year Plan, about ten to eleven million ingot tons of steel might be a realistic target as a basis of preliminary planning. To achieve this target, there would have to be at least one new integrated iron and steel works, in addition to the expansion of the existing works, manufacture of steel in electric furnaces and manufacture of iron in low-shaft furnaces and cupolas.

15. For the location of the third steel plant, the Bokaro area in Bihar had been considered very suitable. But Durgapur in West Bengal was selected in preference to Bokaro mainly because of the lack of communication to the site at Bokaro. The site has, however, many advantages. It is nearest to the coal fields of Kargali, Bokaro and Jharia. Although iron ore will be a little far away, wagons which will carry coals from Kargali and Jharia to Rourkela and Bhilai will bring back iron ore on their return journey. Bokaro is, therefore, being developed as a possible site for the fourth integrated steel plant.

16. It has been agreed that preparatory work at the Bokaro area should be taken up immediately. For this purpose a provision of Rs. 5 lakhs has been made in the revised budget estimates for 1958-59. A preliminary site survey of the Bokaro site was made by the International Construction Company, Consultants to the Department of Iron and Steel and the then Civil Engineering Adviser to

the Department. They recommended that planning be based on the assumption that it would be economic to have a plant of 2 to 3 million tons capacity. On the basis of visual investigation and judgment of the ground conditions the Consulting Engineers selected approximate locations of the steel plant and the appurtenant township. A broad layout was prepared so as to permit further planning. The Hindustan Steel Limited were asked to take up preparatory work required. Questions relating to the size and nature of the plant, arrangements for construction, machinery that will be necessary for designing the plant and for dovetailing it with the programme of the heavy machinery plant at Ranchi, etc., have yet to be considered.

17. Hindustan Steel Limited have entrusted Messrs M. N. Dastur and Co. (P) Ltd., an Indian firm of consulting engineers, with the responsibility of preparing a preliminary project report which is expected to be received by December, 1959.

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