STEEL

1956.

MINISTRY OF IRON & STEEL

CONTENTS

A contract for the supply of equipment for the Bhilai Steel Works being signed between India and the U. S. S. R. in New Delhi.

THE TARGET

The amount of steel which a country makes or uses is generally regarded as a measure of its industrial development. By this standard, the United States leads, producing over a 100 million tons a year. Next comes the Soviet Union with over 40 million tons. Britain and Germany follow with 20 million tons each. India has so far been very much behind, producing only a little over a million tons a year. With the emphasis on industry in the Second Five Year Plan, the country as a whole is getting conscious of the shortage of steel. The deficiency was markedly evident during the last year of the First Plan period. Government of India made a very rapid survey of the requirements and estimated that by 1960 the country would require 6 million tons of ingot steel or about 4.5 million tons of finished steel products (Annexure I). Today it looks as if this target may have to be increased sooner than one imagined. The target of 4.5 million tons is proposed to be attained as follows:

	Existing (in million tons)	Target for 1960 (in million tons)
I. By the expansion of existing works—		
Tata Iron and Steel Works	0·78	1·50
Indian Iron & Steel Works	0·33	0·80
Mysore Iron & Steel Works	0·03	0·10
II. By the establishment of new works in the public sector—		
Rourkela Plant	..	0·72
Bhilai Plant	..	0·77
Durgapur Plant	..	0·79
TOTAL	1·14	4·68

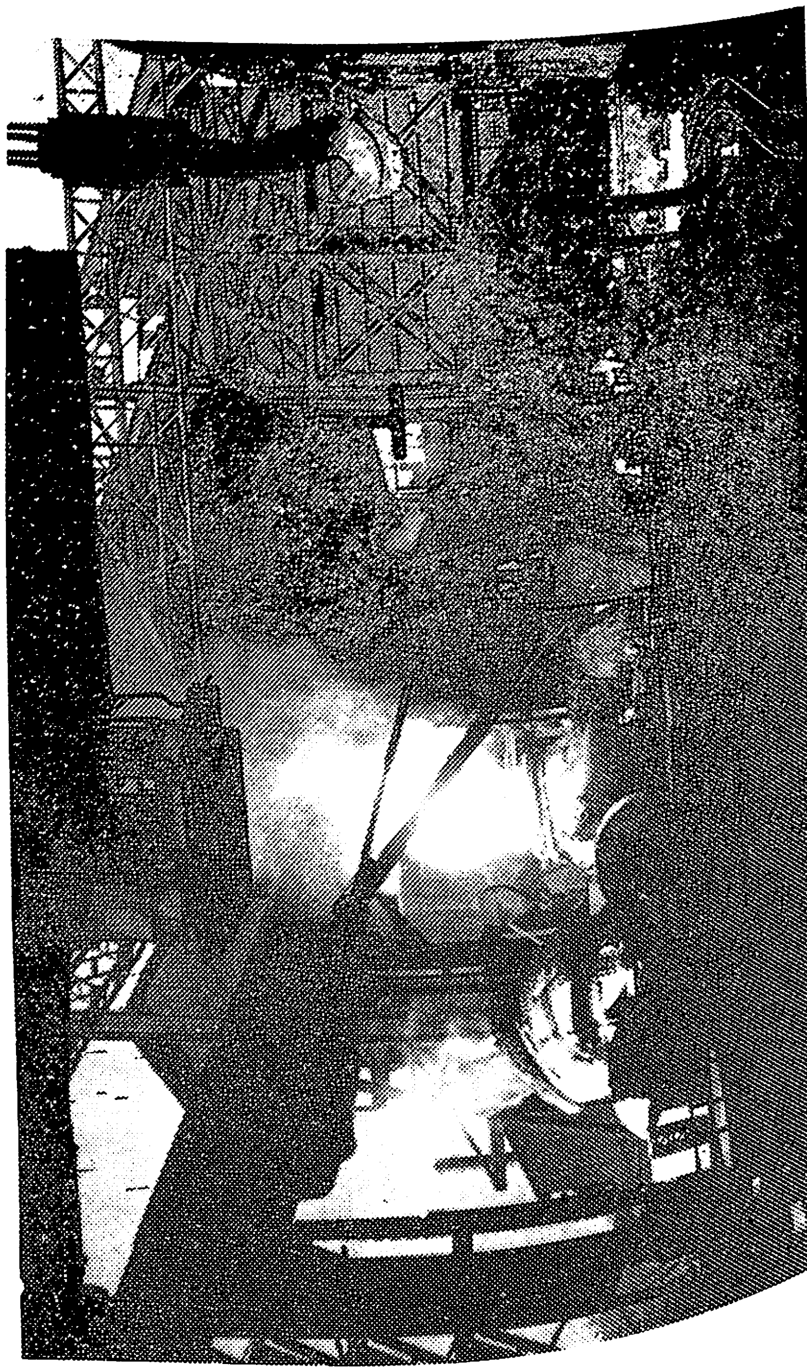
The allocation of products to be rolled by each of the steel works is given in Annexure II.

In the private sector, the greatest expansion will be that of the Tata Iron & Steel Company. Besides considerable modernization of their existing plants, new sections will be added increasing the output to a total of 2 million tons of ingot steel or 1.5 million tons of rolled products. The first phase of the Tatas programme will increase their productive capacity from 780,000 tons to 931,000 tons of saleable steel a year. This programme is estimated to cost about Rs. 43 crores. For the second phase of the programme which aims at increasing their productive capacity to 1.5 million tons of rolled products, Tatas have entered into an agreement with Henry J. Kaiser & Co. of the U.S.A. for technical assistance. It is estimated that this programme would cost over Rs. 65 crores and will be completed by May 1958.

The expansion plan of the Indian Iron & Steel Company also is being executed in two stages, raising the capacity to a total of 800,000 tons of saleable steel per year. This expansion is estimated to cost about Rs. 35 crores. The Government of India are assisting this expansion financially by the advance of interest bearing loans to the extent of Rs. 7.9 crores and a special advance of Rs. 10 crores from the equalisation fund. In addition IISCO have secured a loan of Rs. 13 crores from the World Bank, which has been guaranteed by the Government. The second phase of IISCO's expansion programme will be completed by 1958-59.

There is a programme of expansion suggested for the third existing steel works—the Mysore Iron & Steel Works at Bhadravati. The details of this programme have not yet been finalised and are still under examination.

The gap of nearly 3 million tons which will be left even after the expansion of the existing works is proposed to be closed by the establishment of three steel plants of a million ton capacity each at Rourkela (Orissa), Bhilai (Madhya Pradesh) and Durgapur (West Bengal). One would ask why these places have been chosen. The answer is fairly simple. For efficient and economic production a steel plant should be so situated that it can receive raw materials and send out the finished products in a smooth and even manner at as little cost as possible. Raw materials are needed in large quantities. Each of the steel plants will consume every year about 2 million tons of iron ore, a little less than 2 million tons of coal, 550,000 tons of limestone, 300,000 tons of dolomite, 100,000 tons of manganese ore and thousands of tons of other materials. A place which is near the sources of coal and iron ore and if possible, those of the other raw materials would, of course, be the ideal. But unfortunately there are not many places where coal of the right kind is found along side the iron ore. Nevertheless, the sites chosen are the most suitable from the point of view of proximity of all these raw materials. There are some other sites like Bokaro in Bihar which are equally close to the sources of raw materials but there have been other difficulties with these sites, like lack of good communications or water supply. With the anxiety to attain the target as rapidly as one could, these sites have been left to be exploited at a later stage.



A View of a portion of the Steel Melting Shop.

STEEL MAKING

Large scale production of iron and steel has developed gradually over centuries. Improvements have been directed towards the efficient and economic mining of iron ore, coal and limestone and to the economic manufacture of higher and higher qualities of steel. In order to separate iron from the ore it has to be refined by fire to remove impurities such as earth, sulphur, phosphorus, etc. In the early days charcoal was used. Coal lacks the mechanical strength and the chemical qualities required to smelt iron ore. It was not until about the middle of the 18th century that an efficient method of converting coal into a form where it could be used for smelting iron ore, was discovered. With this discovery of the manufacture of "coke" from coal, the possibility of refining large quantities of iron ore was thrown open.

1856 is the next land-mark in the history of iron and steel when Sir Henry Bessemer discovered a method of producing steel quickly and cheaply from molten pig iron. The Steel Age may be said to have commenced in that year. Developments in the iron and steel industry have since followed closely the developments in transport and economic generation of power, until today steel works are of dimensions unimagined even in the recent past.

After the raw materials are mined and transported to the steel works, coke is prepared form coal. Coal is "cooked" in "coke ovens" which are large chambers made of refractory material. Coal which is fed at the top of these ovens is heated to release its volatile matter. The residue, which is called "coke" is pushed out at the bottom. This will begin to burn if exposed to air in its hot condition. It is, therefore, cooled by spraying water on it and then removed. The coke is crushed and graded to the required sizes.

The iron ore is also prepared by crushing, screening, sintering, etc., in order to improve its quality. It is then heated in a "blast furnace" in order to separate the impurities from the iron. In effect, a blast furnace is a large vertical steel cylinder which is lined on the inside with refractory bricks. Refractory bricks are made of special types of clay which have properties of resisting heat. These steel cylinders which are as high as 100 ft. are fitted with nozzles at their base through which hot air is forced by blowers which are in turn driven by gas or steam turbine engines. The top of the steel cylinder is so made that iron ore, coke and limestone can be poured into the cylinder even while the furnace is in operation. First iron ore is poured from trucks which in the language of the steel-maker are called "skips". Iron ore is followed by a skipful of coke and limestone. Once the furnace is lighted, air is blown through the nozzles and this helps to keep the coke burning at intense heat. As this burning goes on, limestone combines with the impurities to form what is known as "slag". At the same time gases rush upwards acting on the ore. These hot gases together with the limestone convert the ore into a spongy mass which then turns into molten iron. This trickles down through the coke and collects at the botton of the furnace. The slag which is lighter floats on top of the molten metal. Iron and slag are taken out of the furnace at regular intervals. The molten metal is drawn off or "tapped" through a hole once every four hours or so. The metal which in this molten condition is white hot rushes, throwing sparks and is either taken into ladles to the next stage where it is converted into steel or is led into a channel from where it goes into a series of sand moulds where the iron cools. These moulds along the channel resemble a litter of pigs lying around their mother. Hence the name "pig iron".

In the process discovered by Bessemer and developed later to overcome some of the drawbacks, molten iron is poured into a large vessel lined with refractory material and air is blown through it under pressure. The oxygen in the air burns the carbon in the iron as also most of the impurities like silicon and manganese. The heat generated by this burning in itself keeps the iron in a molten condition. As the impurities are burnt, there is the most brilliant display of fireworks as the flames leap dazzling high into the air. During this process the metal is boiling. As the flame subsides, the blast is kept on to remove the phosphorus out. A modern development is the use of oxygen to speed up the process and to control it. Use of oxygen allowed some scrap steel to be added.

While the Bessemer process heralded the Steel Age, it was the next development "the open hearth process" which increased significantly the production of steel and brought about rapid improvements in the equality of steel. In this process, which lends itself to the manufacture of higher quality steels, large quantities of scrap steel are added. The open hearth furnace looks like a shallow covered swimming bath. The walls and roof are made of heat-resisting refractory bricks. Modern open hearth furnaces make 200 to 300 tons of steel at a time. From one side are charged the raw materials, iron, scrap and limestone, in appropriate quantities. The charging is done in long rectangular boxes by means of heavy overhead cranes. The high temperature required in the furnace is obtained by burning the gases coming from the coke ovens and tar which also is obtained as a by-product from the coke ovens.

Yet another process which has been very recently developed is what known as "the Linzer Dusen Stahl" or "L.D." process. In this the molten iron is poured into huge egg-shaped converter vessels which can hold 35 to 40 tons and oxygen is blown at an enormous speed for about 20 minutes or so. This is a quick and economical way of making steel but so far it has been used only in making what are known as "soft steels" of the kind required for making sheets. Yet another method of making steel is by the use of electric power to generate heat. This is known as the "electric furnace process".

Steel which is made by any of these processes is in a molten condition. This molten steel is poured into receptacles called "ingot moulds" and allowed to cool in them. When they are taken out, they are heavy rectangular blocks weighing anything from 3 to 10 tons. These are called "ingots". Ingots are then "stripped" from their moulds and transferred to rectangular furnaces situated generally below ground level. These furnaces called "soaking pits" bring the ingots to the correct temperature for working or "rolling".

These ingots are then "rolled" between heavy rollers to produce the required shapes and sizes—plates, sheets, rails, channels, beams, etc. The heavy ingots cannot be passed directly to the various finishing mills. They are first reduced to smaller sections in a "blooming" or "slabbing" mill. Here the white hot ingots are squeezed in between rollers which are brought closer and closer together. At the end of this initial thinning process, the ingot is reduced to a "bloom" usually about 5″ square. When the ingot is squeezed into a thinner section for rolling plates, the pieces are called "slabs" instead of "blooms". The blooms or slabs are again reheated before being passed to the finishing mills. At the finishing mills, the rollers have profiles cut into them to give the particular shape desired—a rail, a channel, a beam or a plate.

Instead of being cast into ingots for rolling, molten steel may be poured directly into sand moulds of the desired shape to form steel castings.

Again, instead of being finished into rolled products, blooms may be heated and hammered or "forged" to make other desired shapes like wheels and axles for locomotives and wagons.

At all the three steel works in the public sector the processes for the manufacture of coke from coal and iron from ore will be practically the same. At Bhilai and Durgapur steel will be made by the open hearth process. At Rourkela which will specialise in the manufacture of plates and sheets, most of the steel will be made by the L.D. process and some by the open hearth process. The rolling mills at the three plants will be different depending on the nature of the products to be rolled (Annexure II). At Durgapur there will also be a special plant to hammer blooms to form wheels, tyres and axles for the Railways.

THE ROURKELA STEEL WORKS

Rourkela is a small village 257 miles from Calcutta on the main railway line between Calcutta and Bombay. It is at the confluence of the rivers Sankh and Koel which go to form the Brahmani. Iron ore for this plant will be drawn from the rich deposits of Taldih which are about 60 miles away. Coal will be obtained largely from the Bokaro and Kargali fields and partly from Jharia. Limestone will come from the nearby deposits of Hathibari or Birmitrapur. The multi- purpose dam at Hirakud over the river Mahanadi will supply about 40,000 to 60,000 KW of power. The balance of the demand for electric power will be met by a big thermal station of approximately 75,000KW which is being set up at site. This plant, which is being set up with the technical and financial association of the two well-known German firms of Krupp and Demag, will specialise in the production of flat products.

An outstanding feature of the Rourkela Plant will be the adoption of the Linzer Dusen-Stahl oxygen blowing process which was developed in Austria and is now employed in about eight steel works in the world. This process is expected to have the advantages of lower capital and operating costs, higher rate of production and saving in space and ancillary equipment. While these would be very significant advantages, an incidental but more interesting advantage would be the utilisation of the by-products for the manufacture of fertilizers and a series of important chemicals which would form the basis of a wide chemical industry. The L.D. process will require large quantities of oxygen. In obtaining this oxygen from the atmosphere nitrogen will be available as a by-product. This would be used for the manufacture of fertilizers. In turn, by-products of this fertilizer industry together with the by-products from the coke ovens would be used for the manufacture of various chemicals.

The German Combine—Indien Gemeinschaft Krupp Demag—has submitted its Final Project Report for a one million ton plant. This report has been scrutinised by the Government with the help of experts and approved with certain modifications. The main sections of the plant as approved are :—

(a) A coking plant with a capacity of about 1·6 million tons of coal "through-put" per annum ;

(b) A blast furnace plant consisting of 3 furnaces to start with (to be increased to 4 furnaces later on) with a rated output of 1,000 tons per furnace per day ;

(c) A steel melting shop employing mainly the oxygen blowing process (L.D. Process) ; and

(d) A large rolling mill plant of modern design for hot and cold rolling, including a broad strip mill for strips upto 1·525 mm in width.

Tenders for the following have been obtained and are under examination :—

(1) Coke ovens and by-products plant;

(2) Blast furnaces ;

(3) Blast furnace gas cleaning plant disintegrators ;

(4) Blast furnace gas cleaning plant electrostatic fitters ;

(5) Store houses ;

(6) Skull cracker steel construction ;

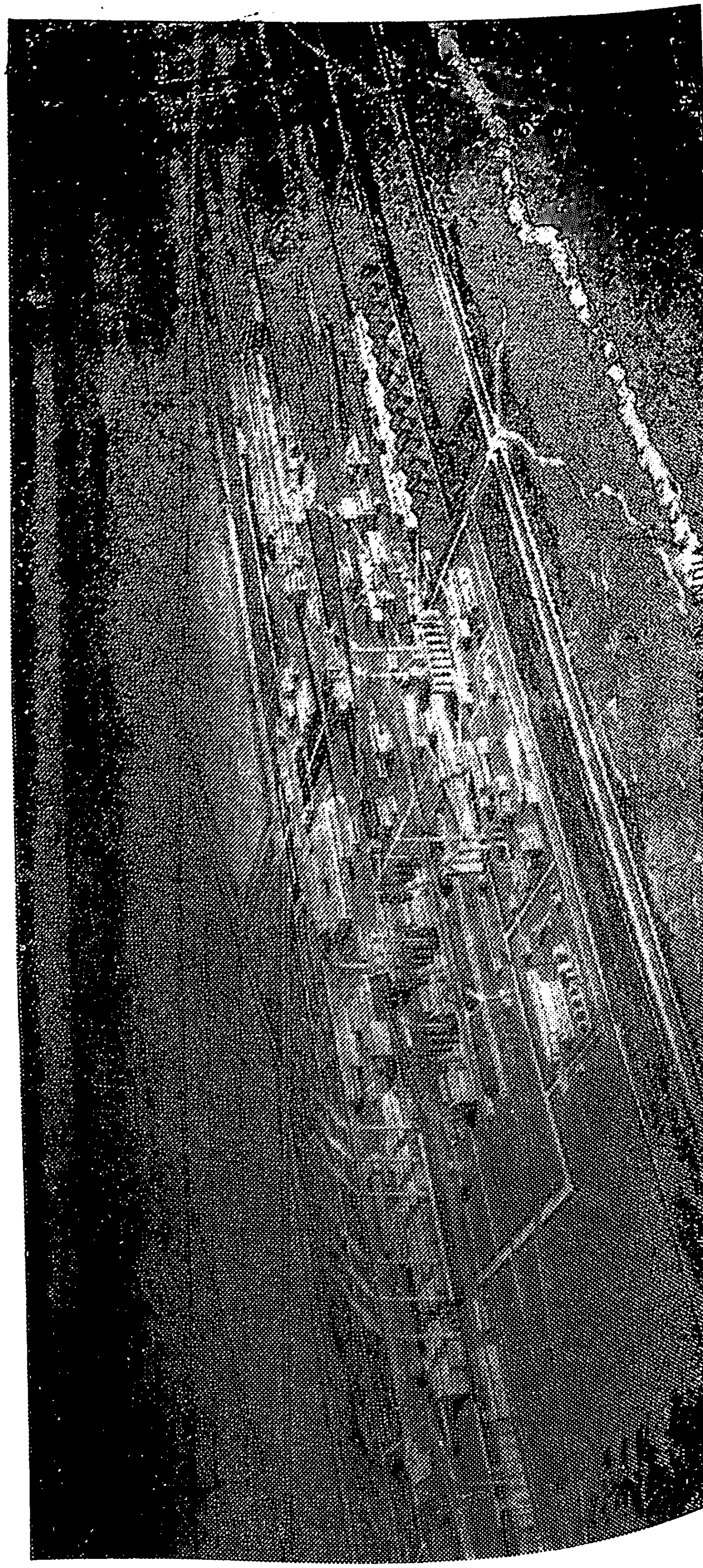
(7) Skull cracker cranes ;

(8) Scrap yard steel construction ;

(9) Slab yard steel construction.

A group of German firms has been invited to submit tenders by the middle of May 1956 for the various sections of the rolling mills. Global tenders have been invited for the thermal power station.

It is expected that iron will be produced at Rourkela towards the end of 1958 and full production of steel reached by 1960. The plant is estimated to cost approximately Rs. 128 crores.



Artist's View of the proposed Bhilai Steel Works.

THE BHILAI STEEL WORKS

Bhilai is 156 miles from Nagpur on the main Bombay—Calcutta line. Iron ore for this plant will be obtained from the Dalli Rajahra Pahar deposits about 60 miles away. Coal to be used at this plant will be a blend of metallurgical coal from Bokaro-Kargali fields and Jharia fields and the otherwise non-coking coal of Korba. Limestone is found in the vicinity of the works. This plant will thus exploit not only the iron ore deposits of Madhya Pradesh but will also make the best use of the coal from the Korba fields which otherwise cannot be used for matallurgical purposes. Water will be supplied by the Tandula canal. The main power will come from a thermal station at Korba about 100 miles away. The steel works are being set up with the technical and financial assistance of the Government of the USSR and will consist of the following principal departments:

(a) a coke oven plant;
(b) a blast furnace plant and auxiliary equipment;
(c) a steel melting plant;
(d) facilities for casting, handling and stripping ingots;
(e) soaking pits;
(f) mills and plants to roll the various products;
(g) a sintering plant;
(h) plants for the production, supply and transmission of water, power and gas for the works and the township;
(i) plants for the recovery of by-products; and
(j) repair and other auxiliary shops.

According to the agreement with the Government of the USSR, the Soviet Organizations will undertake the responsibility for the technical supervision of the construction of the steel works, erection, installation and commissioning of the plant, machinery and equipment. They will also supply most of the plant, machinery and equipment and train Indian personnel in the USSR. The Soviet Organizations will be paid Rs. 2.5 crores for their services and approximately Rs. 63 crores for the plant and equipment. The plant and equipment will be initially supplied on credit repayable in 12 equal instalments. Interest will accrue at 2½ per cent per annum. The expenditure on supplies from India and the engineering work to be done at Bhilai is estimated at Rs. 47 crores making a total of Rs. 110

crores for the works exclusive of the salaries of Soviet experts and Indian staff at Bhilai.

The Soviet Organizations submitted the detailed project report on the 9th of December 1955. This was examined by the Government of India and accepted with certain modifications on the 8th of March 1956. Contracts have been concluded for the supply of equipment worth Rs. 55 crores and structural steelwork worth approximately Rs. 8 crores. The first consignment of equipment is expected towards the end of June, 1956. Three coke oven batteries, two blast furnaces, two open hearth furnaces and a blooming mill will be commissioned by the 31st of December 1958 and the rest of the steel works by the 31st of December 1959.

THE DURGAPUR STEEL WORKS

This plant will be at Durgapur 110 miles from Calcutta on the main railway line between Calcutta and Delhi. Iron ore for this plant will come from the well-known deposits of Gua which also supply TISCO and IISCO. The coking coals of Jharia will be blended with the weakly coking coals of Barakar. Water will be taken from the Damodar river which flows along side the site. The main supply of electric power will be from a big thermal station which will be erected close to the steel works. There will be a smaller plant as stand-by at the steel works.

Broad agreement has been reached with a British Consortium of manufacturers known as the Indian Steel-works Construction Co., for the construction of this plant. This contract with a single agency for the entire work is expected to help in the speedy execution of the project and thereby save as much as eight to twelve months which would otherwise be spent in the preparation of detailed plans, designs and specifications and inviting global tenders. Under the agreement reached with the British Consortium, the value of F.O.B. supplies will be nearly £50 million. This is subject, in the final quotation to be submitted in May 1956, to a variation of plus or minus 5% for errors and omissions from the original proposals. The estimate of rupee expenditure in India is Rs. 40 crores.

Part of the foreign exchange needed for this project will come from two sources:—

(a) a loan of £11·5 million from a syndicate of banks in the United Kingdom;

(b) a loan of £15 million from the United Kingdom Government.

The bank loan will be taken, as at present arranged, mainly during the years 1957—1960 and will be repaid during the years 1960—1964. The loan will carry interest at 1% over the bank rate for the time being but subject to a minimum of 4½%. Although the present bank rate is 5½% it would probably go down by the time the loan is taken.

The loan to be advanced by the United Kingdom Government would be repaid after the loan from the banks. The rate of interest for this loan would be the United Kingdom Government's borrowing rate at the time the loan is taken plus a small element to cover administrative charges.

SUBSIDIARIES

The sources of the four principal raw materials, iron ore, coal, limestone and dolomite for each of the plants have been mentioned.

Iron ore for the Rourkela steel works will be obtained from Taldih 60 miles away. Investigations are now going on at site to determine the exact location of the deposits to be worked. Mining of iron ore at Taldih will be undertaken by the Government directly. An American firm of engineers has been appointed as Consultants to advise on the technical problems of mining iron ore at this place. Similarly the Government will undertake directly the mining of iron ore at Dalli Rajahra. At the request of the Government of India the Soviet Organizations have submitted a preliminary project report. The mines will be designed and worked with the technical assistance of the Government of the USSR. Equipment for these mines will also be supplied by that country on ordinary commercial terms. The steel works at Durgapur will obtain iron ore from either the existing mines or from mines to be developed in extension of the existing ones in Gua, which are the most accessible deposits from this place.

The three steel plants together will require about 5·2 million tons of coking coal per annum. A number of expert committees have gone into the question of coal reserves in the country and their utilisation. The consensus of their opinion is that while the reserves of non-metallurgical coal are sufficiently large, the same is not the case with metallurgical coal. The conservation of metallurgical coal is not a problem peculiar only to this country. It might, therefore, be expected that there would be technical advances which would find alternative methods of making iron and steel which would either eliminate the necessity for the use of metallurgical coal or at least reduce the dependence on good quality metallurgical coal to a large extent. But the immediate problem is of making the most economical use of the known reserves of metallurgical coal. Measures have been taken to conserve this coal by ensuring that the non-essential consumers adopt gradually other alternative fuels. At the same time, it has been recommended that metallurgical coal should be washed so that its ash content might be reduced. Thereby it would be possible to blend it with coals which otherwise cannot be used directly for metallurgical purposes.

The major sources of coking coal are in Kargali/Bokaro and Jharia. A Government washery is being installed at Kargali to

wash the coking coals which would be raised by Government in that area. 1·6 million tons of washed coal from Kargali will be used in the steel works at Rourkela and Bhilai. To augment these supplies, coal from Jharia will also be required. The Ministry of Iron & Steel is now exploring the best method of washing coking coals from Jharia. The steel works at Durgapur will be so designed that the coals in that area which would otherwise be unsuitable for metallurgical purposes would be used after suitable blending. The Durgapur works will use Jharia coal which will be washed at the site of the steel works, blended with coal from Barakar which by itself cannot be used for steel making.

The steel works at Bhilai will use a blend of metallurgical coals from Kargali and Jharia and coal from Korba which by itself is not fit for metallurgical purposes.

Limestone and dolomite for the Rourkela and Bhilai works will be quarried directly by the Government. For the Durgapur steel works, the proposal is to obtain at least in the initial stages limestone from the existing sources at Birmitrapur in Orissa.

Mention was made earlier of the utilisation of the by-products at the Rourkela steel works, for the manufacture of fertilizers and other chemicals.

In the carbonisation of coal which will be carried out at each of the steel works for the production of coke, a number of valuable by-products like coal tar, ammonia liquor and benzole will be released. It is proposed to set up at each of these works facilities for the distillation of these by-products and thereby obtain valuable chemicals which form the basis of a number of industries like dyestuffs, paints, varnishes, medicines, scents and antiseptics.

TOWNSHIPS

It is estimated that for the operation of the three steel plants the following staff would be required:

(i) 120 experienced engineers who would be entrusted with higher technical direction.

(ii) 1200 qualified engineers.

(iii) 10000 skilled workers of different categories.

(iv) 7000 semi-skilled workers.

For the second category of qualified engineers, the problem has been one of finding the requisite number of experienced engineers. To overcome this, young engineers, mechanical, electrical, metallurgical and chemical, will be sent, after some initial training, abroad for advanced courses. A large number of applications have been received and these are now under scrutiny in consultation with the Union Public Service Commission.

For the training of skilled workers, efforts are being made to develop training facilities within the country. A technical committee has surveyed the existing training facilities and expects to submit its recommendations before the end of April 1956. To augment the facilities available within the country and to maintain a regular inflow, after the works come into operation, training centres will be established at each of the steel works.

Experienced engineers who would be entrusted with higher technical direction are very few in the country. With the expansion programme of the existing steel works it has not been possible, nor would it be desirable, to recruit any significant number of people from those works. Initially the shortage will be made up by the employment of foreign technicians. These will be replaced by Indian engineers as they gain experience.

A modern industrial township is being developed at each of the three sites to accommodate the large number of workers. It is estimated that each of these townships, which will have all the modern conveniences and will be laid out such as to be capable of acommodating larger numbers of workers who would be required when the capacity of each of the plants is increased, will cost Rupees twelve to fifteen crores.

PROFITABILITY

It might well be asked why each of the plants is of 1 million tons capacity and not more or less. A balance has to be struck between a large number of small works and one or two very big works. If there are too many plants, then the central organisation to co-ordinate the activities of all would become uneconomical. Generally, it would also require greater investment and involve higher overheads. On the other hand, one single plant of two or three million tons capacity would mean a heavy strain on the transport system which would have to carry the raw materials to and the finished products away from the works. In choosing three plants of 1 million tons capacity each, advantage has been taken of the assistance coming from the various countries in expediting the construction of the works. This apart, from a technical point of view, a plant of 1 million tons capacity can with slight adaptation be expanded to produce 1·3 million tons of steel with relatively minor additional investment. A plant of this capacity has the internal problem of handling 6 to 7 million tons of materials in and out of the works and between departments. While the layout of each of the works has been so chosen that this could be done effectively and economically, provision has been made in the layout for the works to be expanded to double its capacity at each of the places so that at a later stage if it were decided to increase the production of steel, there would not be much difficulty in doing so.

The requirements of constructional material and operational equipment for a steel works will differ according to the capacity of the works and the nature of the products. But allowing for variations in design and also in sizes and numbers of each type of equipment, the manufacturing capacity required in the country to produce these constructional materials and items of equipment would be practically of the same nature. For a steel plant of 1 million tons ingot capacity, the following will be required:

Building bricks	45 million	pieces
Stone blocks	100,000	sq. m.
Fire clay bricks and fire clay products	90,000	tons
Silica bricks and silica products	40,000	tons
Magnesite bricks and magnesite products	3,000	tons
Chrome-magnesite bricks and chrome-magnesite products	3,500	tons
Asbestos cement sheets	700,000	sq. m.
Concrete for structures	500,000	cu. m.
Prefabricated reinforced concrete structures, pipes, etc.	120,000	cu. m.

Asphalt concrete	40,000 tons
Rails	10,000 tons
Railway sleepers	10,000 tons
Structural steelwork	100,000 tons
Castings	6,000 tons
Pipe work	10,000 tons
Locomotives	24 Nos.
Specialist rolling stock	175 Nos.
Electrical motors	about 8,500 Nos.
Electrical transformers	about 100 Nos.
Cranes of various types and sizes	about 50 or 60 Nos.
Machine tools of various types and sizes	about 100 Nos.
Instruments	Of various types.

At present the country is capable of manufacturing practically all the constructional material but very little of the steelwork, castings or equipment. If the industrial projects proposed for the Second Five Year Plan are all completed, then it is estimated that almost 80% in value of the equipment and material required for a steel works of 1 million tons capacity could be produced within the country. The balance of 20% which will have to be imported will consist mainly of very heavy castings, forgings, specialist machine tools, some optical stores and intricate instruments.

The capital investment on the three steel works themselves would be approximately Rs. 360 crores. Besides there would be the capital expenditure for working new mines for iron ore, limestone, etc., the cost of the townships and the cost of ancillary services.

The average retention price i.e. the price which is earned by the existing steel works is Rs. 393 per ton of steel sold. The average controlled selling price of steel products is about a hundred rupees more than this; while, the world market price will be over Rs. 150 to Rs. 200 more than the average controlled selling price. One of the objects of producing the country's own requirements of steel is to sell it at reasonable prices. Assuming that the output of the new steel works will be sold at about the same level as the existing retention price—say Rs. 400 per ton, the gross sale value of the steel and pig iron sold by each of the steel works would be approximately Rs. 30 to 35 crores per year.

According to the estimates of the technical advisers to the Government the direct cost of production *i.e.* of materials, fuel, water and power, labour, staff and maintenance, would be well below Rs. 200 per ton. For each of the steel works, therefore, the excess of revenue over current expenditure or gross profits would be

Rs. 15 to 20 crores per annum. Experience shows that the average life of a steel plant is about thirty years. It could be longer if the plant is maintained properly. Even assuming a shorter life of twenty to twenty-five years, a provision of Rs. 5 crores per year would be more than adequate to meet the needs of depreciation in the strict sense of the term *i.e.*, expenditure needed to maintain the plant in the same state and efficiency as it was when new. Each plant will, therefore, have Rs. 10 to 15 crores per year from its internal resources, which could be used for building other plants. These resources would amount to about Rs. 200 crores in about five years of production. By that time the cost of new plants would have become less largely because of the ability of the country to make a large portion of these. It should, therefore, be possible to build at least two plants with those 200 crores of rupees.

ANNEXURE I

Serial No.	Categories	Demand (in thousand tons)
1	Heavy rails and fish plates	265
2	Heavy structurals	485
3	Broad and parallel flanged beams	75
4	Crossing sleepers	30
5	Sleeper bars	170
6	Medium and light structurals	510
7	Deformed and prestressed concrete bars	30
8	Rounds and flats 1/2" and above	780
9	Rounds and flats below ½"	360
10	Spring steel	30
11	Wheels, tyres and axles	70
12	Tinplates	150
13	Plates 3/16" and above	300
14	Wire and wire products	100
15	Wire ropes	5
16	Tool and alloy steel	10
17	Stainless steel	15
18	Hoops and box strappings	60
19	Bloom and billets for forging	100
20	Sheets and strips (hot rolled)	650
21	Strips upto 12"	60
22	Strips over 12"	145
23	Skelp (for tubes and pipes)	100
	TOTAL FINISHED STEEL	4,500
24	Semins for re-rollers	700

ANNEXURE II

	Tons/Year
Rourkela :	
1. Plates—3/16″ and above	200,000
2. Sheets and strips (hot rolled)	380,000
3. Strips up to 12″	40,000
4. Strips over 12″	100,000
	720,000
Bhilai :	
1. Rails, standard gauge	100,000
2. Rails, narrow gauge	10,000
3. Railway sleeper bars	90,000
4. Standard and broad-flanged beams, channels, angles and other light and heavy structural sections (beams with section height up to 24″)	284,000
5. Rounds from 7/8″ to 3″ dia. and squares with sides from 7/8″ to 3″	121,000
6. Flats from 2″ to 5″ wide	15,000
	620,000
7. Billets for re-rolling at outside rolling mills from 2″ × 2″ to 3″ × 3″ cross-section	150,000
	770,000
Pig iron	300,000
Durgapur :	
1. Heavy forging blooms	10,000
2. Merchant sections	240,000
3. Forging billets	60,000
4. Sleeper bars	60,000
5. Light sections	200,000
6. Forging blooms	30,000
7. Axles	12,000
8. Wheels and tyres	28,000
	640,000
9. Billets for sale	150,000
	790,000
Pig iron	350,000

	Tons/Year
Tata Iron & Steel Co. Ltd. :	
1. Heavy rails and fish plates	135,000
2. Heavy structurals	110,000
3. Crossing sleepers	30,000
4. Sleeper bars	50,000
5. Medium and light structurals	297,000
6. Rounds and flats	144,000
7. Spring steel	4,000
8. Wheels, tyres and axles	30,000
9. Plates 3/16″ and above	100,000
10. Blooms and billets for forging	22,000
11. Sheets and strips (hot rolled)	150,000
12. Strips up to 12″	42,000
13. Skelp (for tubes and pipes)	106,000
	1,220,000
14. Semis for re-rollers	280,000
	1,500,000
Indian Iron & Steel Co. Ltd. :	
1. Heavy rails and fish plates	100,000
2. Heavy structurals	110,000
3. Broad and parallel flanged beams	40,000
4. Medium and light structurals	120,000
5. Rounds and flats	160,000
6. Blooms and billets for forging	10,000
7. Sheets and strips (hot rolled)	120,000
	660,000
8. Semis for re-rollers	140,000
	800,000

GIPD—DME—2 M of I&S—10-4-56—1000

ANNEXURE II

	Tons/Year
ROURKELA :	
1. Plates—3/16″ and above	200,000
2. Sheets and strips (hot rolled)	380,000
3. Strips up to 12″	40,000
4. Strips over 12″	100,000
	720,000
BHILAI :	
1. Rails, standard gauge	100,000
2. Rails, narrow gauge	10,000
3. Railway sleeper bars	90,000
4. Standard and broad-flanged beams, channels, angles and other light and heavy structural sections (beams with section height up to 24″)	284,000
5. Rounds from 7/8″ to 3″ dia. and squares with sides from 7/8″ to 3″	121,000
6. Flats from 2″ to 5″ wide	15,000
	620,000
7. Billets for re-rolling at outside rolling mills from 2″ × 2″ to 3″ × 3″ cross-section	150,000
	770,000
Pig iron	300,000
DURGAPUR :	
1. Heavy forging blooms	10,000
2. Merchant sections	240,000
3. Forging billets	60,000
4. Sleeper bars	60,000
5. Light sections	200,000
6. Forging blooms	30,000
7. Axles	12,000
8. Wheels and tyres	28,000
	640,000
9. Billets for sale	150,000
	790,000
Pig iron	350,000

	Tons/Year
TATA IRON & STEEL CO. LTD. :	
1. Heavy rails and fish plates	135,000
2. Heavy structurals	110,000
3. Crossing sleepers	30,000
4. Sleeper bars	50,000
5. Medium and light structurals	297,000
6. Rounds and flats	144,000
7. Spring steel	4,000
8. Wheels, tyres and axles	30,000
9. Plates 3/16″ and above	100,000
10. Blooms and billets for forging	22,000
11. Sheets and strips (hot rolled)	150,000
12. Strips up to 12″	42,000
13. Skelp (for tubes and pipes)	106,000
	1,220,000
14. Semis for re-rollers	280,000
	1,500,000
INDIAN IRON & STEEL CO. LTD. :	
1. Heavy rails and fish plates	100,000
2. Heavy structurals	110,000
3. Broad and parallel flanged beams	40,000
4. Medium and light structurals	120,000
5. Rounds and flats	160,000
6. Blooms and billets for forging	10,000
7. Sheets and strips (hot rolled)	120,000
	660,000
8. Semis for re-rollers	140,000
	800,000

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