REPORT OF THE

COMPTROLLER AND AUDITOR GENERAL OF INDIA

UNION GOVERNMENT (COMMERCIAL)

1981

PART III

BHILAI STEEL PLANT

ERRATA

Page	Reference	*For*	*Read*
(ii)	Annexure XVI line 4 from bottom.	app inted	appointed
(ii)	Annexure XVII line 2 from bottom	sh wing	showing
(iv)	Line 6 from bottom	Organisations	Organisation
2	Table (item V)	Insert comma after	Heavy structurals
3	Table-column 1 (item 2)	1071-72	1971-72
10	Line 11 from top	tons	tonnes
18	Line 9 from top	Remove comma after 'Management'	
23	Line 2 below table	Mechines	Machines
23	Para 2.03.02—first line	Excesive	Excessive
28	Table-line-2	per	per cent
33	Line 4 below table	1975-76 to 1977-78	1975-76 to 1976-77
46	Line 3 from bottom	0-9	0.9
55	Table—item (i)	—90 lb Rails (untested)	90 lb Rails (untested)
57	Line 3 from bottom	Add 'to' after	'Controller'
58	Table—heading column 2	Put comma after squares	
60	Line 14 from top	quartizite	quartzite
63	Line 7 from below	tarnsferring	transferring
68	Table	Remove '*' against 1976-77	
69	Insert "In lakh tonnes" above the table		
72	Line 1 from top	Eeven	Even
72	Line 8 from bottom	increase	increased
74	Line 5 from bottom	Insert full stop after Railways	
77	Line 13 from top	Benefication	Beneficiation
78	Line 7 from top	Director	Directors
78	Line 18 from top	Plants	Plant
85	Line 2 from top	renting	venting
87	Line 16 from top	lakh	lakhs
89	Table heading—column 5 & 6	Blas	Blast
89	Remove "Remarks" in the heading of the table		
94	Line 15 from top	Insert full stop after allowed	
95	Table—last line of the 2nd column	recrification	rectification
96	Note below table	*NOT	*NOTE
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Page	Reference	*For*	*Read*
101	Line 9 from below	Insert comma after 14.8 per cent	
104	Line 1 from top	year	years
105	Table-column 1	w rks	works
110	Line 13 from top	Insert comma after coking coal	
110	Line 20 from top	Committe	Committee
116	Insert '10' before Overall Summary		
116	Table—1st line	million	1 million
117	Line 3 from top	Performence	Performance
117	Line 8 from bottom	valued at	and a loss of contribution margin of
119	Line 8 from top	Noteable	Notable
123	Line 22 from top	tons	tonnes
123	Line 11 from top	consideration	considerations
132	Last column—line 7 from top	Remove')' after however,	
133	Note below 1st table	The value of output loss	The loss of contribution margin
137	Table—1974-75-column 5	71.12	74.02
141	Line 1 above table	(Figures n perc ent)	Figures in per cent
143	Table—Heading columns 8 to 10	Numner	Number
146	Table—Item 5, column 5 —line 2 from below	producton	production
146	Table—Item 5—column 6 line 5 from below	machinism	mechanism
147	Table—Item 7 column 5	11	9.41
147	Table—Item 8 column 4	quipment	equipment
147	Last column—line 2 from below	Insert semi colon after position	
147	Item 6—first line	Pilling	Piling
148	Item 11 column 4	commissionned	commissioned
149	Item 17	Insert comma after Centering Machine	
152	Item 21—last column line 2	disolving	dissolving
159	Note below table	Note :	Note : 1.

REPORT OF THE

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PREFATORY REMARKS

A reference is invited to Paragraph 5 of the Prefatory Remarks contained in Part I of the Report of the Comptroller & Auditor General of India—Union Government (Commercial) 1980 wherein it was *inter alia* mentioned that the Report on the working of the Hindustan Steel Limited—an undertaking selected for appraisal by the Audit Board—was under finalisation. In this case, Audit Board consisted of the following members :—

(1) Shri T. Rengachari, Chairman, Audit Board and Ex-officio Additional Deputy Comptroller and Auditor General (Commercial) up to 29th February, 1980.

(2) Shri P. P. Gangadharan, Chairman, Audit Board and Ex-officio Additional Deputy Comptroller and Auditor General (Commercial) with effect from 1st March, 1980.

(3) Shri K. S. Murthy, Member, Audit Board and Ex-officio Director of Commercial Audit, Ranchi up to 13th March, 1978 and as Member, Audit Board and ex-officio Director of Commercial Audit, Bangalore from 9th March, 1979.

(4) Shri M. Prem Kumar, Member, Audit Board and Ex-officio Director of Commercial Audit, Bangalore up to 23rd January, 1979.

(5) Shri A. Ghosh, Member, Audit Board and Ex-officio Director of Commercial Audit, Ranchi from 29th March, 1978 to 10th May, 1981.

(6) Shri T. K. Krishna Das, Member, Audit Board and Ex-officio Director of Commercial Audit, Ranchi with effect from 11th May, 1981.

(7) Shri B. R. Sule, Executive/Managing Director, Mahindra and Mahindra Limited, Bombay—Part-time Member.

(8) *Prof. N. S. Ramaswamy, Director, Indian Institute of Management, Bangalore—Part-time Member.

2. After consideration of the Report by the Audit Board, at its meeting held from 28th November to 1st December, 1977, the Report dealing with the following units and containing data up to 1975-76 was issued to the Ministry of Steel and Mines on 15th March, 1978, for acceptance of facts and comments, if any :—

(i) Bhilai Steel Plant.

(ii) Rourkela Steel Plant.

(iii) Durgapur Steel Plant.

(iv) Alloy Steels Plant.

(v) Central Coal Washeries Organisation.

(vi) General Chapters containing an overall summation of performance of various units including Central Sales Organisations, Central Transport & Shipping Organisation, Research & Development & Statistical Quality Control, and Internal Audit of the Company as a whole.

The replies of the Ministry to the Reports on Bhilai Steel Plant, Rourkela Steel Plant, Durgapur Steel Plant and Alloy

*Prof. N. S. Ramaswamy did not attend any meeting.

Steels Plant were received by November 1978. Partial reply of the Ministry relating to general portion was received between November 1978 and May 1980.

3. The meeting of the Audit Board with representatives of the Ministry and Steel Authority of India Limited (SAIL), for discussing the reports on the Bhilai and Rourkela Steel Plants was initially proposed to be held in October 1979 but had to be postponed at the request of the Ministry from time to time and ultimately could take place in February 1981. The initial Report which included data upto 1975-76 had, therefore, to be updated to include the data upto 1977-78. [From 1st May, 1978, Hindustan Steel Limited stood dissolved under the Public Sector Iron and Steel Companies (Restructuring) and Miscellaneous Provisions Act, 1978 whereby all the constituent units of the HSL stood transferred to SAIL].

4. This part contains the results of the appraisal undertaken by the Audit Board on the working of Bhilai Steel Plant of the erstwhile Hindustan Steel Limited.

5. The Report was finalised by the Audit Board after taking into account :

(a) the result of discussions held with the representatives of the Ministry of Steel and Mines and the Steel Authority of India Limited at its meeting held on 19th and 20th February, 1981; and

(b) the additional information furnished by the Ministry/ Steel Authority of India Limited in April/June 1981.

6. The Report on Rourkela Steel Plant for which meeting was held in February 1981 and those for Durgapur Steel Plant, Alloy Steels Plant and Central Coal Washeries Organisation for which discussion was held with the representatives of the Ministry/ SAIL in June 1981 are under finalisation and will be presented separately.

7. The Comptroller and Auditor General of India wishes to place on record the appreciation of the work done by the Audit Board and acknowledges with thanks the contribution, in particular, of Shri B. R. Sule, the part-time technical Member who is not an officer of the Indian Audit and Accounts Department.

BHILAI STEEL PLANT

1.01 *Introduction*

The Hindustan Steel Limited (HSL) was registered on 19th January, 1954 as a joint stock company under the Companies Act to construct and manage the Steel Plant at Rourkela. With effect from 1st April, 1957, the Bhilai and Durgapur Steel Plants which were being set up departmentally under the control of the then Ministry of Iron and Steel, were also transferred to it. In March 1973, Hindustan Steel Limited became a subsidiary of Steel Authority of India Limited (SAIL). It was decided *inter alia* at that time to constitute Bhilai Steel Plant which was a part of Hindustan Steel Limited as a separate company. Bhilai Ispat Limited was accordingly incorporated as a subsidiary of SAIL to take over the functions of Bhilai Steel Plant. However, transfer of assets and liabilities of Bhilai Steel Plant did not take place and the plant continued to function as a part of Hindustan Steel Limited. Under the "Public Sector Iron and Steel Companies (Restructuring) and Miscellaneous Provisions Act 1978" the Steel Authority of India Limited was restructured from 1st May, 1978. H.S.L. stood dissolved under this Act and Bhilai Steel Plant stands transferred to SAIL as one of its constituent units with effect from 1st May, 1978.

The construction of the integrated steel plant with a capacity of one million tonnes of steel ingots (0.77 million tonnes of saleable steel) was completed in September 1961 at a cost of Rs. 201.39 crores. The capacity was expanded to 2.5 million tonnes in terms of steel ingots (1.965 million tonnes of saleable steel) in October 1967 at a further cost of Rs. 149.45 crores. As a part of further expansion to 3.5 million tonnes of steel ingots, additional facilities for coke and iron making were provided by 31st July, 1971 (6th Blast Furnace) and 25th January, 1972 (7th Coke Oven Battery) at a cost of

Rs. 45.51 crores. These were provided in advance of steel making facilities in order to meet the shortage of foundry grade iron; as a result, only the capacity for saleable pig iron increased to 0.97 million tonnes but the capacity for the production of steel ingots remained the same. The total capital expenditure incurred on the project thus amounted to Rs. 396.35 crores.

The main units of the integrated steel plant including the units built under the 6th Blast Furnace Complex stage, their rated capacities, major inputs and outputs and the distribution of the outputs as per the DPR (6th Blast Furnace Complex) and as intimated by the Management in December 1977 upto Pig casting Machine stage, are indicated in Annexure I.

1.02 As per details given in Annexure I, the following is the product-mix envisaged in the Project Report :—

(Lakh tonnes)

(A) Saleable Steel	19.65
(*i*) Billets	3.15
(*ii*) Merchant Sections	5.00
(*iii*) Wire Rods	4.00
(*iv*) Rails	5.00
(*v*) Heavy structurals Steel bars and shapes	2.50
(*B*) Pig Iron for sale	10.05

According to the Ministry, the figure of 10.05 lakh tonnes of pig iron for sale should be 9.72 lakh tonnes after taking into account casting losses @ 3.25 per cent (Para 2.04 refers).

2. *PRODUCTION PERFORMANCE*

2.01 As against the rated capacity of 25 lakh tonnes for steel ingots and 19.65 lakh tonnes for saleable steel, actual production during 1970-71 to 1977-78 was as follows :—

(Figures in lakh tonnes)

Year		Budgeted production	Actual production	Percentage of actual production	
				To rated capacity	To budgeted production
1970–71	Steel Ingots	22.50	19.40	77.6	86.2
	Saleable steel	17.07	15.49	78.8	90.7
1071–72	Steel ingots	22.00	19.53	78.1	88.8
	Saleable steel	17.20	15.68	79.8	91.2
1972–73	Steel ingots	22.50	21.08	84.3	93.7
	Saleable steel	17.90	17.46	88.9	97.5
1973–74	Steel ingots	22.50	18.94	75.8	84.2
	Saleable steel	17.90	16.82	85.6	94.0
1974–75	Steel ingots	20.70	20.01	80.1	96.7
	Saleable steel	16.55	16.93	86.2	102.3
1975–76	Steel ingots	22.50	22.09	88.4	98.2
	Saleable steel	17.70	18.50	94.1	104.5
1976–77	Steel ingots	22.50	23.02	92.1	102.3
	Saleable steel	18.30	20.19	102.7	110.3
1977–78	Steel ingots	23.00	23.71	94.8	103.1
	Saleable steel	19.25	19.30	98.2	100.3

NOTE: During 1972–73 to 1977–78 the production of saleable steel included the production obtained from rolling of 26408 tonnes, 133520 tonnes, 60928 tonnes, 29288 tonnes, 94744 tonnes and 38400 tonnes of steel ingots procured from Durgapur, Rourkela and Bokaro Steel Plants. This contributed to the higher utilisation of capacity in respect of saleable steel during 1972-73 to 1977-78.

It will be seen from the details given above that, notwithstanding the use of steel ingots from Durgapur, Rourkela and Bokaro Steel Plants during 1972-73 to 1977-78, there was shortfall in production during 1972-73 to 1974-75. This together with

the shortfall in 1970-71 and 1971-72 was attributed by the Management to the following factors :—

1970-71 : Constraints in the quality and quantity of refractories available, longer time taken in the Completion of certain repairs and some unexpected difficulties in Blast Furnace No. 4 and in the Blooming Mill.

1971-72 : Choking of hydraulic mains of coke oven batteries installed under 1 million tonne stage (starting from May 1971), affecting the availability of coke to Blast Furnaces and gas to Steel Melting Shop and Rolling Mills.

1972-73 . (a) Heavy absenteeism among key categories of employees in the main production departments on account of severe summer conditions.

(b) Inadequate availability of good quality stopper sleeves leading to difficulties in house keeping, higher consumption and shortage of mould trains for a part of the year.

(c) Unsatisfactory quality of refractories resulting in low furnace availability and irregular supply of medium coking coal since September 1972 adversely affecting the quality of coke and consequently the performance of Blast Furnaces.

1973-74 : Short supply of coal affecting the production of steel ingots.

1974-75 : (i) Shortage of coal.

(ii) Labour trouble in Blast Furance Department and Steel Melting Shop.

(iii) Unsatisfactory quality of refractories resulting in low furnace availability.

(iv) Non-starting of oxygen lancing in some of the Open Hearth Furnaces.

The plant management have analysed the reasons for loss of contribution margin due to internal and external causes from the years 1973-74 to 1977-78; the extent of loss due to the internal and external causes aggregated to Rs. 20.38 crores. Details are given in Annexure II.

UNIT-WISE PERFORMANCE

2.02 *Coke Oven Batteries*

2.02.01 Six coke oven batteries each having 65 ovens were commissioned up to November 1966. While production capacity for steel ingots continued to remain at 2.5 million tonnes, the seventh coke oven battery with 65 ovens was built and commissioned in January 1972 as a part of the 6th Blast Furnace Complex to meet the shortage of pig iron in the country. The total cost of installation of these batteries was Rs. 40.88 crores.

The total input capacity of the seven coke oven batteries, as per the Project Report for 6th Blast Furnace Complex, is 40.10 lakh tonnes of coal (dry basis) per annum and they are expected to yield 30.63 lakh tonnes of coke (dry) of different sizes as indicated in Annexure I.

Some working parameters of the six coke oven batteries installed up to the 2.5 million tonnes stage as per the Soviet Project Reports were changed in the Project Report for the 6th Blast Furnace Complex prepared by the Design Cell of the Plant,

resulting in increase in the rated capacity of the six batteries as per details given blow :—

Particulars of para-meters	As per 2.5 MTP	As per P.R. for 6th BF complex
Dry Charge per oven (in tonnes)	16.4	17.1
Coking Time (in hours)	17	17
Yield(dry) in relation to input (in percentage) :		
Gross Coke dry	74	76.4
+25 mm coke	66.6	68.8
(—) 25 mm coke	7.4	7.6
Rated capacity for production of coke for 6 batteries :		
Gross coke (in lakh tonnes)	24.42	26.25
+25 mm coke (in lakh tonnes)	21.98	23.63
(—) 25 mm coke (in lakh tonnes)	2.44	2.62

On the basis of the revised parameters, the rated capacity of the seven Coke Oven Batteries for Blast Furnace grade coke was shown as 27.57 lakhs tonnes in the Detailed Project Report for the 6th Blast Furnace Complex. The Detailed Project Report made no provision for normal maintenance and capital repairs of the ovens and the aforesaid capacity was arrived at on the expectation that all the coke ovens would work throughout the year. The Management have, however, adopted the capacity of 25.11 lakh tonnes as the basis for reporting performance with effect from January 1974 as against the rated capacity of 27.57 lakh tonnes adopted earlier. The Management stated (December 1977) that as the rated capacity of the six Coke Oven Batteries built earlier was 21.98 lakh tonnes & the 7th Coke Oven Battery added in the 6th B.F. Complex was of the same capacity as that of the existing batteries *i.e.* 3.66 lakh tonnes; the rated capacity should be taken as 25.64 lakh tonnes, per annum without making provision for repairs or 25.11 lakh tonnes after making provision for repairs.

On this basis, the total input capacity, has been worked out by the Management as 38.50 lakh tonnes of coal (dry) per annum yielding 28.49 lakh tonnes of coke (dry) of different sizes as given in Annexure I.

The rated capacity both in terms of input and output, the capacity intimated by the Management (December 1977), the budgeted production and the actual production of coke during 1970-71 to 1977-78 are given in Annexure III.

2.02.02 *Productivity and Efficiency Analysis of Coke Ovens*

(1) The assumptions made in the Project Report of the 6th Blast Furnace Complex for achieving the rated capacity (input and output) of the coke ovens were :—

(a) Coking time—17 hours,

(b) Charge per oven—17.1 tonnes of coal,

(c) Yield of blast furnace grade coke—68.8 per cent of the input of raw coal,

(d) Yield of gas—304 NM^3 per tonne of raw coal.

The rated capacity had been fixed on the assumption that all the coke ovens should work throughout the year and consequently no provision had been made for normal maintenance and capital repairs of the ovens. Even in the 2.5 million tonne Project Report prepared by the Soviet Consultants, there was no provision for normal maintenance and capital repairs of the ovens.

According to the project estimates of Rourkela and Durgapur Steel Plants, prepared by MECON, however, the Coke Ovens in these plants are expected to be operated for 352 and 345 days respectively in a year.

The Management stated (December 1977) that the dry charge per oven and the yield of coke in relation to input as per the DPR for the 6th Blast Furnace Complex were on the higher side and that the figures as per the 2.5 million tonne Project Report should be adopted.

The table below compares the yield of Blast Furnace grade coke (+25 mm) and coke oven gas during the 8 years ended 31-3-1978 with the various prescribed norms :—

Year	Yields envisaged in the Project Report of the 6th B.F. Complex		Norms of yields per DPR of 2.5 MT plus Additional facilities in 6th Blast Furnace Complex as intimated by MECON and adopted by the Management (Dec. 1977)		Norms fixed by Norms Committee (1968)		Actuals	
	B.F. coke as percentage of raw coal	Gas NM^3 per tonne of raw coal charge	B.F. coke as percentage of raw coal	Gas NM^3 per tonne of raw coal charge	B.F. coke plus nut coke as percentage of coal charge	Gas NM^3 per tonne of dry charge	B.F. Coke	Gas NM^3
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1970-71	68.8	304	66.6	305	70	300	69.15	306
1971-72	68.8	304	66.6	305	70	300	68.81	286
1972-73	68.8	304	66.6	305	70	300	68.82	310
1973-74	68.8	304	66.6	305	70	300	68.53	314
1974-75	68.8	304	66.6	305	70	300	68.50	308
1975-76	68.8	304	66.6	305	70	300	68.81	308
1976-77	68.8	304	66.6	305	70	300	68.79	302
1977-78	68.8	304	66.6	305	70	300	68.22	290

Note :—Norms committee was constituted by the company in 1968 for developing norms of consumption of raw materials, etc.

It will be seen from above that actual yield of the BF coke was, approximately the same as envisaged in the 6th BF Complex Report but lower than the norms fixed by the Norms Committee.

(2) The standard oven hours as per DPR and the actual available oven hours during 1970-71 to 1977-78 are given below :—

Year	Total oven hours as per DPR	Available oven hours excluding time taken for capital repairs
	(In lakh)	(In lakh)
1970-71	34.16	34.16
1971-72	35.29	32.95
1972-73	39.86	35.19
1973-74	39.86	33.22
1974-75	39.86	32.50
1975-76	39.97	34.60
1976-77	39.86	37.67
1977-78	39.86	39.77

It may be mentioned that major breakdowns occurred in Coke Oven Batteries No. 2 and 3 in May 1971. A Technical Committee was constituted by the Management in July 1971 to investigate the causes of breakdowns, fixation of responsibility and suggest remedial measures. The Committee, in its report submitted in August 1971, came to the conclusion that, despite several reports clearly indicating various deficiencies and technological violations of recommendations made by Soviet Experts

during 1967 to 1971, technological violations were, by and large, continuing. A Soviet Expert also observed (March 1972) that damage to Coke Ovens took place due to gross violation of operational instructions.

A sum of Rs. 77.63 lakhs had been spent on emergency repairs of Coke Oven Battery No. 1 (which had in the meantime also deteriorated) and 2 and 3 during 1971-72.

As a result of breakdowns in Batteries No. 2 and 3 and deteriorating condition of Battery No. 1, there was lesser production of coke and gas. While the shortage of coke was made good by procuring 77,900 tons of coke from Rourkela and Durgapur Steel Plants as well as private parties, the shortage of gas was partly made up by injecting 9,506 kilolitres of benzene (a costlier fuel having other industrial uses) valued at Rs. 53.71 lakhs.

The Action Committee appointed by Government to study the working of public sector enterprises had also commented upon (May 1973) the improper maintenance of coke oven batteries. It had further suggested that an additional coke oven battery should be completed in two years so that old coke oven batteries could be rebuilt—one by one. The installation of the 8th battery was sanctioned by Government at an estimated cost of Rs. 11.50 crores in September 1975. The battery was actually commissioned on 2nd November, 1979, at a cost of Rs. 9.84 crores. According to Management, this is a stand-by battery.

(3) The standard number of ovens to be pushed as per the installed capacity, the number of ovens which should have been pushed on the basis of hours actually available and the projected coking time, the number of ovens to be pushed as per annual

plan and the number of ovens actually pushed during eight years ending 31st March 1978, were as follows :—

(Figures in lakhs)

Year	Number of ovens to be pushed as per installed capacity	Number of ovens that should have been pushed		Number of ovens actually pushed
		As per available time	As per annual plan	
1970-71	2.01	2.01	1.86	1.79
1971-72	2.08	1.94	1.97	1.64
1972-73	2.34	2.07	1.87	1.86
1973-74	2.34	1.95	1.96	1.53
1974-75	2.34	1.91	1.77	1.63
1975-76	2.35	2.04	1.92	1.82
1976-77	2.34	2.22	1.95	2.02
1977-78	2.34	2.34	2.09	2.08

The Management attributed (January 1977) the following reasons for lower pushing in relation to the annual plan :—

1970-71.—Initially, in framing the annual plan, a high coke rate of around 840 Kgs. was assumed. However, the actual coke rate was much less (at 810 Kgs/tonne) with usage of sinter of basicity 1.99. Hence the coke requirement, in spite of slightly higher hot metal production, was less. Pushing of ovens was thereby regulated as per requirements of coke for iron making. Pushing would have been even higher but for the breakdown in the blast furnace No. 4 in May 1970.

1971-72.—Because of operational difficulties caused by the extensive repair programme to older batteries, pushing was considerably reduced.

1973-74 *and* 1974-75.—Plant experienced unprecedented difficulties in the coal supplies necessitating a cut back in the pushing schedule. The plant was operated on a restricted schedule.

1975-76.—The coal supply position improved only in the latter part of the year.

(4) The table below shows the actual average coking time (annual average) taken by different batteries during 1970-71 to 1977-78 and the range of coking time taken as against 17 hours expected in the Project Report :—

(Figures in hours)

Year	Actual average coking time in each battery							Yearly range for all the batteries
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	
1970-71	19.4	19.6	19.7	19.7	18.2	18.2	..	18.2—19.7
1971-72	25.8	34.7	25.1	19.3	17.0	16.9	18.0	16.9—34.7
1972-73	25.2	23.1	22.2	19.1	17.2	17.1	16.0	16.0—25.2
1973-74	25.8	24.1	24.6	23.3	20.8	20.7	19.9	19.9—25.8
1974-75	22.1	..	22.3	21.2	19.4	19.5	18.9	18.9—22.3
1975-76	19.3	19.9	19.0	21.3	19.2	19.0	18.5	18.5—21.3
1976-77	19.2	18.9	18.6	19.4	18.3	18.3	17.9	17.9—19.4
1977-78	19.7	19.5	19.5	19.2	18.9	18.8	18.5	18.5—19.7

(5) *Charge rate of coal.*—The 1 million tonne and 2.5 million tonne Project Reports envisaged a charge rate of 16.4 tonnes of coal per oven (dry basis). On the basis of test check once in a year or so (assuming that the quantity charged had remained constant throughout the year), the Management had adopted from 1961-62 an estimated rate of about 17 tonnes to 17.34 tonnes per oven up to 1969-70 except during 1966-67 when it was 16.4 tonnes. In the Project Report for the 6th Blast Furnace Complex, the charge per oven has been adopted as 17.1 tonnes (dry basis).

The Norms Committee, in its Report of 1968, had recommended that weighment should be done in at least 10 per cent of the ovens charged in each shift but this was not done, as, according to the Management (April 1975), it was not possible to set the weighing scales of the charging cars in working order inspite of best efforts.

The actual charge rate which was worked out on the basis of periodical test check up to August 1972 ranged from 16.27 to 16.57 tonnes. From September 1972, the quantity of coal charged is being worked out by back calculation on the basis of consumption of coke in the Blast Furnaces.

Thus the percentage of actual yield is also like-wise derived figure and not based on actual weighment.

The table below compares the actual average charge rate as worked out by the Management for the eight years ending 31st March 1978, with the above-mentioned norms :—

(In tonnes)

Year	As per Project Report for 6th B.F. Complex	As per DPR for 2.5 MT plus Additional facilities in 6th Blast Furnace as intimated by MECON and adopted by the Management (December 1977)	Average charge per oven	Remarks
1970-71	17.1	16.4	16.57	During the years 1975-76, 1976-77 and 1977-78, the monthly average charge ranged from 17.15 to 17.49 tonnes, 17.12 to 17.62 tonnes and 17.56 to 17.80 tonnes respectively.
1971-72	17.1	16.4	16.47	
1972-73	17.1	16.4	16.80	
1973-74	17.1	16.4	17.28	
1974-75	17.1	16.4	17.35	
1975-76	17.1	16.4	17.34	
1976-77	17.1	16.4	17.43	
1977-78	17.1	16.4	17.68	

The Management stated (April 1974) as follows :—

"The weighing facility installed in the charging lorries goes out of order due to intense heat, shooting flames, dusty and gaseous atmosphere. The provision of a weigh-bridge on oven top is also difficult due to design limitation. Hence, under the circumstances the present practice of arriving at the Coal charge is by back calculation *viz.* arriving at the weight of +25 mm coke produced based on consumption at Blast Furnaces, variation in depletion and additions to stock, screen losses at Blast Furnaces, loadings at Coke Ovens and working out thereafter the coal charge based on C.F.R.I. formula.

The coal charge thus arrived at is reconciled with the stock balances on physical survey. The method is found to be realistic."

(6) *Availability of coal*

Though shortage of coke and gas during 1971-72 and irregular supply of medium coking coal during 1972-73 were among the main reasons for lower production in Bhilai Steel Plant during those years, short receipt of coal was the major constraint during 1973-74 and 1974-75. In May and November 1974, the Board was apprised of the impact of the critical coal position on the working of Coke Oven Batteries at Bhilai. Due to the short receipt of coal, the pushing rate of ovens per day had to be varied from month to month.

Besides shortfall in supplies, there were highly erratic fluctuations in the receipts, both in regard to quantity and quality, of coal supplied to the Plant and, as a result, situations of stockout in one or the other type of coal had to be faced occasionally, resulting in frequent fluctuations in blend ratio. Such changes in blend, according to the Management, are highly undesirable, because the use of untested blend can affect the pressures on oven walls during coking, leading to formation of stickers. While this problem was overcome to the best extent possible, yet the effect of such blend changes on the quality of coke produced could not be controlled. Inconsistency in coke quality both from physical strength aspect and ash content in coke had its detrimental effect on the functioning of Blast Furnaces. Consequent on the use of direct feed coal (both prime and medium) and washed coal of higher ash content, the coke had higher ash content.

The short supply of coal affected the performance of the Plant as under :

(a) Owing to restricted operation of coke ovens, carbonisation time in all the batteries fluctuated widely and

was around twice the rated carbonisation time prescribed for normal operation, with the result that blanking of batteries had to be resorted to.

(b) Throughout the year 1973-74, uniformity in the coke produced and the stability of regime of blast furnaces could not be maintained.

(c) The high ash content in coke increased the silicon content of the hot metal. This had deleterious effect on the refractory lining and increased the duration of heat and slag volume of open hearth furnaces.

The sequence of less pushing of ovens and higher coking time, besides resulting in reduced coke reactivity and higher consumption of heat per unit of production, set in a chain reaction leading to reduced steel production

(7) *Coal blend*

The Project Report for 2.5 Million Tonne stage envisaged a blend of 50 per cent prime grade (Jharia) and 50 per cent medium coking coal (Bokaro). The Dutt Committee appointed by the Government of India in April 1969 on the Rational and Equitable Distribution of Coking Coal to Steel Plants in its report submitted in August 1969, recommended a blend of prime grade (55 per cent), medium grade (40 per cent), and blendable grade (5 per cent).

In a meeting held on 18-1-1970 between the Management and the representatives of the Ministry of Steel & Heavy Engineering (Department of Steel, Mines and Metals) and NCDC (Now CCL) it was decided that the Bhilai Steel Plant should use a blend of 66 per cent of prime grade and 34 per cent of medium grade. The Chari Committee in its report of September 1975, however, recommended a blend ratio of 55 : 38 : 7 from 1976-77.

The actual average blend, average ash content and average volatile matter of coal used during 1970-71 to 1977-78 are indicated below :—

(Figures in percentage)

Year	Prime grade washed	Medium grade washed	Blendable grade	Ash content	Volatile matter
1970-71 . .	68*	29	3	17.54	24.49
1971-72 . .	64	27	9	17.63	25.00
1972-73 . .	60	32	8	17.58	24.36
1973-74 . .	65	28	7	17.96	24.41
1974-75 . .	65	29	6	18.09	24.46
1975-76 . .	59	34	7	18.86	23.98
1976-77 . .	61	32	7	18.99	24.00
1977-78 . .	57	36	7	19.84	24.90

*Includes 11 per cent un-washed coal.

Erratic receipt of coal, both in quantity and quality, during 1973-74 caused by shortage of power in collieries and washeries, movement problem, etc. caused variation in blend ratio and ash content, the frequency of which had its detrimental effect on the working of coke ovens and blast furnaces as indicated in sub-paragraph (6) above.

(8) *Properties of Blast Furnace Coke*

According to the Project Report for the 6th Blast Furnace complex, the blast furnace coke should have fixed carbon of 76.48 per cent and ash content of 23.23 per cent. To achieve

this, the feed coal should have an ash content of 17 ± 0.5 per cent. However, as raw coal had a higher ash content, the composition of coke was also different. The Management stated (December 1977) that the fixed carbon and ash content should be 75.6% and 23.0% respectively. The analysis of Blast Furnace coke produced during the eight years ended 31st March 1978 is given in Annexure IV. It will be seen therefrom that while ash content was more than the figure intimated by the Management, in all the years, carbon content was lower during 1973-74 to 1977-78.

2.03 *Blast Furnaces*

2.03.01 Of the six blast furnaces, three were installed under one million tonne stage, two under 2.5 million tonne stage and one under the 6th Blast Furnace stage.

The daily output per furnace adopted in the million tonne Project Report was increased upward in the 2.5 million tonne Project Report and the 6th Blast Furnace Complex Project Report in respect of the three furnaces installed under one million tonne stage, as under :—

Daily output per furnace per day

	As per million tonne Project Report (tonnes)	As per 2.5 million tonne Project Report (tonnes)	As per 6th B.F. Complex Project Report (tonnes)
Open Hearth Grade i.e. Basic Grade . .	1135	1149	1300
Foundry Grade	900	935	1100

Accordingly, the rated capacity of these furnaces built under the one million tonne stage was increased. As regards the two furnaces built in the 2.5 million tonne stage and the one built

in 6th Blast Furnace stage, the capacity of each furnace is 1738 tonnes per day (volume being 1719 cum.). The present capacity of all the six furnaces put together, as per the 6th Blast Furnace Complex is, therefore, 30.50 lakh tonnes of hot metal consisting of 22.80 lakh tonnes of basic grade metal and 7.70 lakh tonnes of foundry grade metal, the number of working days per year being 350.

Distribution of the total production, as envisaged in the 6th Blast Furnace Complex Project Report is indicated in Annexure I.

The Management, however, stated (December 1977) that the capacity of the six Blast Furnaces worked out to 29.69 lakh tonnes, as per details given below :—

Sl. No.	Useful volume in Cum.	Grade of hot metal	Capacity in tonnes per day	No. of working days per year	Annual Production (in lakh tonnes)
1.	1719	Basic	1738	350	6.083
2.	1719	,,	1738	350	6.083
3.	1719	,,	1738	350	6.083
4.	1033	,,	1149	350	4.022
5.	1033	,,	1149	350	4.022
6.	1033 (a) Basic		1149	60	0.689
					26.982
	(b) Foundry		935	290	2.711
					29.693

The distribution of the 29.69 lakh tonnes of hot metal, as intimated by the Management, is also indicated in Annexure I.

The actual production of hot metal of different grades *vis-a-vis* the budgeted production during 1970-71 to 1977-78 was as follows :—

(Figures in lakh tonnes)

Year	Budgeted Production	Actual Production						
		Basic Grade			Foundry Grade			
	@ Total	Good quality	Off-grade	Total	Good quality	Off-grade	Total	Grand Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1970-71	21.00	7.95	2.48	10.43	10.43	0.66	11.09	21.52
1971-72	24.90	10.76	1.65	12.41	8.32	0.53	8.85	21.26
1972-73	24.00	13.00	1.38	14.38	8.80	0.11	8.91	23.29
1973-74	25.00	9.35	1.16	10.51	10.43	0.09	10.52	21.03
1974-75	23.33	10.85	0.88	11.73	10.47	0.25	10.72	22.45
1975-76	25.00	12.98	1.78	14.76	8.84	0.52	9.36	24.12
1976-77	25.00	14.31	1.85	16.16	11.19	0.61	11.80	27.96
1977-78	27.80	13.98	1.79	15.77	10.49	0.70	11.19	26.96

@ In the annual budgets, there is no distinction between basic grade and foundry grade.

It will be seen from above that the total production of hot metal (basic as well as foundry grades) was less than the rated capacity and budgeted production except in 1970-71 and 1976-77. The production of basic grade hot metal (silicon content upto 1.25 per cent) was always less than the rated capacity, while that of foundry grade (silicon content exceeding 1.25 per cent) was more.

The Management attributed (January 1977 and December 1980) the following reasons for shortfall in production :—

(i) The production of hot metal was regulated by the demand for steel making and availability of orders for disposal of cold pig.

(ii) Operation of blast furnaces was affected by inferior quality of coking coal and, therefore, of coke with high ash content.

(iii) Off-take of hot metal in steel making also suffered due to extraneous constraints like inadequate availability of refractories both in regard to quality and quantity.

(iv) Shortage of coking coal during the years 1971-72 and 1972-73 consequent upon break-down of Coke Oven Battery Nos. 2 and 3 in May 1971 and extensive repairs thereof.

(v) Acute short supply of coking coal during 1973-74 to 1975-76 resulting in restricted schedule of operation and stopping of blast furnaces one after the other suiting the availability of coal in stock.

(vi) The shortfall in production in 1977-78 was mainly due to shortage of coking coal and industrial relations problems at blast furnaces, besides deteriorating coal quality.

Production of off-grade hot metal represented 14.6 per cent, 10.2 per cent, 6.4 per cent, 5.9 per cent, 5.0 per cent, 9.5 per cent, 8.8 per cent and 9.3 per cent of total production during 1970-71 to 1977-78 respectively. A major portion of this off-grade production was charged to the Steel Melting Shop. The Management stated (December 1977) as follows :—

> "For the purpose of assessment and control of Blast Furnace operation casts-off in sulphur, are indicated as off-grade metal. However, when the off-grade metal is diverted to S.M.S. mixers it loses its identity and gets diluted and O.H. furnaces receive metal with desired limits of Sulphur only".

As mentioned in paragraph 1.01, the 6th Blast Furnace, the 7th Coke Oven battery and the associated facilities were provided in advance of steel making facilities to increase the capacity of pig iron in the country and hence the capacity for production of steel ingots remained unchanged at 2.5 million tonnes. The 6th Blast Furnace and the 7th Coke Oven battery were commissioned in July 1971 and January 1972 respectively. However, one or the other of the Blast Furnaces remained idle and the production of one or the other of the Coke Oven batteries was also low for long stretches during the period subsequent to the commissioning of the 6th Blast Furnace and the 7th Coke Oven battery. As a result of this, the production of hot metal was less than 24.42 lakh tonnes (which was the output envisaged with five Blast Furnaces after taking into account the increase in capacity of 3 blast furnaces) upto 1975-76. In other words, the production would have been still less in these years had the 6th Blast Furnace and the 7th Coke Oven battery not been installed. During 1976-77 to 1977-78 the production slightly exceeded the rated output of five Blast Furnaces but was 91.7 per cent and 88.4 per cent of the rated capacity for the six furnaces as per the D.P.R. The hot metal meant for production of pig iron had, therefore, to be diverted in all the years from 1972-73 onwards for production of steel ingots and hence the quantity of hot metal sent to the

pig casting machines was low as compared to the rated capacity of the pig casting machines. In fact, the quantity sent to the pig casting machines from 1971-72 to 1975-76 was even less than the quantity of hot metal sent in earlier years upto 1970-71 as shown below :—

Year	Hot metal required to be sent to the Pig Casting Machines as per the D.P.R.	Hot metal actually sent to the Pig Casting Machines
	(In lakh tonnes)	
1967-68	3.30	7.15
1968-69	,,	6.40
1969-70	,,	6.90
1970-71	,,	5.95
1971-72	4.31	5.11
1972-73	9.38	5.89
1973-74	,,	5.42
1974-75	,,	5.72
1975-76	,,	5.85
1976-77	,,	9.01
1977-78	,,	7.41

With the increase in the production of hot metal in 1976-77 and 1977-78 the diversion of hot metal to Pig Casting Mechines increased considerably.

2.03.02 *Excesive production of Foundry Grade Hot Metal* :

The Project Report envisaged that the blast furnaces would produce basic grade hot metal required for the Steel Melting Shop and foundry grade for sale. The main difference in the chemical composition of the two grades is in their silicon content.

It would be seen from the table given in previous sub-paragraph that the production of foundry grade hot metal was more and of basic grade was less than envisaged. Consequently, foundry grade hot metal containing more silicon which is bad for Steel Melting Shop (SMS) operation, had to be charged in the Steel Melting Shop.

The quantity of foundry grade hot metal charged in SMS during 1970-71 to 1977-78 was as under :—

Year	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Quantity(in lakh tonnes)	6.78	5.02	5.98	7.09	6.81	5.52	6.17	6.52

The Plant Management stated (February 1973) that the technological problem of containing the production of foundry grade metal had been tackled by a series of measures, like sizing of raw materials, increased use of superflux sinter etc. as a result of which unscheduled production of foundry grade hot metal had been more or less brought under control from the last quarter of 1971. It was also proposed to increase the use of sinter, in stages upto 60 per cent of the burden, to wash the iron ore at the mines and to standardise and decrease the variations in the quality of raw materials as well as the working parameters.

The Plant Management also stated (January 1976) that during 1972-73 and 1973-74, there was shortage of coking coal and blast furnaces had to be frequently stopped for want of coke. Before each stoppage, a lot of extra coke had to be charged to maintain the furnaces hot, resulting in production of more foundry grade pig iron. It was further stated that efforts to improve the Blast Furnace technology, its process and tackling of operational problems were continuously made for producing more basic grade hot metal.

It will, however, be seen that a substantial quantity of foundry grade hot metal in excess of its rated capacity continues to be

produced. According to the Management (November 1977), the main reasons for excess production of foundry grade hot metal were poor quality of raw materials, high alumina to silica ratio in iron ore and higher ash content in coke as compared to projected norms.

2.03.03 *Furnace availability*

According to the Project Reports, each blast furnace is expected to be in operation for 350 days in a year on 3 shifts basis *i.e.* 8400 hours.

It will, however, be seen from the details given in Annxure V that the blast furnaces were operated for less number of hours than envisaged in the Project Reports.

The time taken for capital and other repairs was more in all the years than the provision made in the Project Reports except in 1977-78. Non-availability of furnaces upto the expected level was attributed by the Management to the following reasons :—

(a) There were unexpected difficulties in blast furnace No. 4 for which the furnace was blown out for 404 hours during 1970-71.

(b) Due to choking of the hydraulic main of the million tonne stage coke oven batteries from May 1971, the availability of blast furnace coke to blast furnaces was affected (1971-72) (Paragraph 2.01 refers).

(c) There was shortage of coke for which the Blast Furnace No. 4, even though repaired, was not commissioned from May 1972 to September 1972.

(d) There was shortage of coke for which the furnace No. 3 was kept on reserve from 16th February, 1974 to 3rd May, 1975.

2.03.04 *Efficiency and Productivity Analysis of Blast Furnaces Input output ratio*

Annexure VI incorporates the data relating to the actual consumption of important raw materials and the slag arisings per tonne of hot metal produced during the eight years 1970-71 to 1977-78 as compared with the norms indicated in the Project Report, norms fixed by the Norms Committee in 1968 and the norms intimated by the Management in December 1977 :—

The following facts emerge from the data contained in Annexure VI :—

(i) The coke rate showed an improving trend reaching the norm during 1973-74. The Coke consumption was less than norm during 1974-75, 1975-76 and 1976-77 despite higher ash content in coke.

(ii) Higher use of sinter did not result in lower use of coke during 1971-72. The Management stated (August 1976) that coke rate of blast furnaces depends on a number of complex factors and not merely on the higher use of sinter.

(iii) Use of sinter during 1970-71 to 1972-73 was less than the provision made in the Project Report with corresponding increase in iron ore.

(iv) Consumption of iron ore and sinter put together for production of one tonne of hot metal was more than that envisaged in the Project Report. The actual consumption in terms of Fe content of input was also more than the norms fixed.

(v) Total input per tonne of hot metal produced during 1970-71 to 1973-74 was more than the projected norm, while during 1974-75 to 1977-78 it was less than the norm.

(vi) The slag arisings have increased gradually year after year upto 1973-74 even though the total quantity of input raw materials and the quality thereof remained more or less the same (except inferior quality of coke during 1973-74 to 1975-76). Slag arising decreased from 1974-75 onwards. The Management stated (November 1977) that the main reason for higher slag volume was poor quality of input materials, particularly the higher percentage of ash content in coke and that due to special efforts and technological improvements the higher slag arising was contained from 1974-75.

2.03.05 *Silicon Content*

The Project Report for the 2.5 million tonne stage envisaged silicon content of one per cent and 2.75 per cent in basic hot metal and foundry grade hot metal respectively. According to the Project Report of the 6th Blast Furnace Complex, the silicon content is 1 per cent and 2.5 per cent respectively. Although the average silicon content in foundry grade hot metal was less than the Project Report provision, it was slightly higher in basic grade hot metal. The average actual silicon content during 1970-71 to 1977-78 also differed from furnace to furnace.

High silicon content in hot metal is harmful to the furnaces in the Steel Melting Shop. It may also be mentioned that lower weight per heat from 500 tonnes furnaces is ascribed by the Management to higher silicon content in hot metal [Paragraph 2.06.03(4) refers].

In July 1965, Central Engineering and Design Bureau (C.E.D.B.) had recommended that silicon content in hot metal should not exceed 1.25 per cent for smooth operation of open hearth furnaces. However, production of hot metal in Bhilai Steel

Plant during 1970-71 to 1977-78 contained more than 1.25 per cent of silicon content as indicated below :—

Year	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Percentage of production containing more than 1.25 per silicon content.	52	42	38	50	48	39	42	42

While Durgapur Steel Plant has got a Desiliconisation Plant for reducing the silicon content in hot metal, no such facility is available in Bhilai Steel Plant. The Committee on Public Undertakings were informed by the Management (*vide* Paragraph 81 of 30th Report 1966 3rd Lok Sabha) that a Desiliconisation Plant could be fabricated at a total cost of about Rs. 2.5 lakhs only. In reply to the recommendation made by the Committee for early installation of the plant, the Ministry of Steel, Mines and Metals had informed the Committee in January 1968 that there had been gradual improvement in the silicon content in the hot metal and it was likely to improve further and as such the installation of a Desiliconisation Plant was not necessary. The Research and Development Department of the Steel Plant, however, later on (1971) suggested the installation of a pilot plant but did not find it feasible due to shortage of space in the mixer building; construction of a separate building was not considered economical.

2.03.06 *Quality of Raw Materials*

The quality of hot metal is dependent on the quality of raw materials. A statement showing the contents of the major raw materials during the eight years ending March 1978—*vis-a-vis* the provision in the Project Reports is given in Annexure VII. It will be seen therefrom that the quality of raw materials used varied considerably from the one provided for in the Project Reports.

The adverse variations in the quality of raw materials used are dealt with below :—

Coke

The ash content in coke was slightly more than the project provision during 1970-71 to 1972-73 but was high during 1973-74 to 1976-77 and was highest during 1977-78.

Lime Stone

The lime content was slightly less than the project provision.

Iron Ore

The iron content was lower than the provision in the 2.5 million tonne Project Report during 1970-71 to 1977-78 but was slightly more than the provision in the 6th Blast Furnace Complex Project Report during 1974-75 to 1977-78.

The lime stone and iron ore are obtained from the captive mines of the Plant. According to the findings of the Statistical Quality Control Department (July 1974) there was inadequate blending of iron ore and suitable measures (*e.g.* two stage blending) should have been adopted at the mines (December 1973) but the scheme of blending at the blast furnaces had not yet been implemented due to low stock of iron ore. The Management stated (August 1976) that the scheme of blending at blast furnaces had since been implemented.

2.03.07 *Productivity of Blast Furnaces*

According to the projections made in the DPR for 6th Blast Furnace and that intimated by the Management in December

1977, the productivity per cubic metre per day for each furnace was to be :—

		Big furnaces (in tonnes)	Small furnaces (in tonnes)	
As per 6th Blast Furnace Complex	Basic	1.16	Basic	1.46
			Foundry	1.24
			Average	1.31
As intimated by the Management in December 1977	Basic	1.16	Basic	1.30
			Foundry	1.06
			Average	1.23

The Management have not worked out the actual productivity for basic and foundry grade separately. The actual overall productivity has been computed by them by multiplying the quantity of hot metal produced with silicon content above 1.25 per cent by 1.15 and then adding the same to the quantity of hot metal produced with less than 1.25 per cent silicon content. As more foundry grade hot metal was produced than envisaged in the DPR, this resulted in augmenting the figure of actual productivity, which worked out as follows :—

Year	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Big furnace (in tonnes)	1.17	1.20	1.22	1.21	1.22	1.17	1.19	1.11
Small furnace (in tonnes)	1.36	1.33	1.28	1.32	1.32	1.38	1.35	1.31

2.03.08 *Blast rate, blast temperature and top pressure*

The 2.5 million tonne Project Report did not indicate the average blast rate, blast temperature and top pressure of the

Blast Furnaces, but mention was made of their maximum values as given below :—

Blast rate	2,200 M^3 per minute for small furnaces 3,000 M^3 per minute for big furnaces.
Temperature of the blast	900°C
Top pressure	1 Atm.

In connection with the above parameters of the Blast Furnace, the Management had informed the Committee on Public Undertakings in 1965 as under :—

(i) The blast temperature and top pressure were being raised to 900°C and 1 Atm. after the Class II repairs of Blast Furnace No. 1 and 3, which were not possible earlier due to the ageing of furnaces and leakages at the top mechanism arising from wear and tear.

(ii) Since all the blast furnaces at Bhilai erected or in process of erection were designed for operation at high top pressure, it was being increased as a long term measure to improve the blast furnace operations.

In the absence of any norms in the Project Report, the norms for average blast rate and temperature of the blast have been fixed by the Plant itself from time to time. Annexure VIII indicates the actual blast rate, temperature of the blast and top pressure *vis-a-vis* norms fixed by the Management during the last eight years ending 31st March, 1978.

It will be seen from the details given in Annexure VIII as also the maximum values of blast rate etc. as indicated in 2.5 million tonne project report that the average blast rate and

temperature in all the six years upto 1975-76 were much below the norms fixed by the Plant as well as the projected norms. In all these years upto 1975-76, the blast temperature and top pressure fell short of the levels intimated to the Committee on Public Undertakings in 1965. However, the average blast temperature and the average top pressure in respect of small furnaces was more than the norms during the years 1976-77 and 1977-78.

The Management stated (July 1974) as follows :—

> "keeping in view the safety of the equipment and to avoid frequent changing of top equipment the bigger furnaces are worked in the range of 0.7 to 0.9 Atm. gas pressure while the smaller ones in the range of 0.5 to 0.7 Atm. gas pressure. Other parameters are regulated to suit the requirements under actual working conditions."

2.04 *Yield of Pig Iron from Hot Metal*

There is no mention of casting losses in the Project Reports. The H.S.L. Norms Committee had recommended a pouring loss of 3.25 per cent in Pig Casting Machines. Loss, as worked out notionally by the Management ,also came to 3.25 per cent during the years 1970-71 to 1977-78.

2.05 *Sintering Plant*

(1) Plant obtains iron ore from its captive mines.

In order to utilise the entire quantity of ore mined, the iron ore fines are sintered with coke breeze, lime stone and dolomite in a Sintering Plant which has 4 machines commissioned during July 1961 to April 1971. The rated capacity of the Plant based on sinter of basicity one (based on the formula $\frac{CaO+MgO}{SiO_2+Al_2O_3}$) is 22.35 lakh tonnes which is reduced to 20.40 lakh tonnes if

sinter of higher basicity (1.8) is produced. The actual utilisation of the Plant during 1970-71 to 1977-78 is indicated below :—

Year	Budgeted production (lakh tonnes)		Actual production	
	Qty.	Basicity	Quantity (lakh tonnes)	Basicity $\frac{CaO+MgO}{SiO_2+Al_2O_3}$
1970-71	13.40	1.80	12.91	1.99
1971-72	17.25	1.90	14.45	1.92
1972-73	17.25	1.90	16.67	1.94
1973-74	17.75	1.90	16.16	1.87
1974-75	17.38	1.90	16.79	1.89
1975-76	17.75	1.90	17.80	2.05
1976-77	18.00	2.06	18.81	2.10
1977-78	18.50	2.06	18.23	2.18

It will be seen from above that during 1970-71 to 1977-78 actual production of sinter was less than the rated capacity. It was also less than the budgeted production (except during 1975-76 to 1977-78).

The Norms Committee had assumed (1968-69) the basicity of sinter at 3 based on formula $\frac{Ca^0+Mg^0}{Si^0_2}$ for the purpose of computing norms for consumption of raw materials. On the basis of the formula adopted by the Norms Committee, the basicity during 1970-71 to 1977-78 works out to 3.22, 3.01, 3.08, 3.05, 3.15, 3.46, 3.58 and 3.62 respectively.

The shortfall in production was attributed by the Management to (a) higher basicity of sinter produced during 1970-71 and (b) non-availability of transfer car during 1971-72 and 1972-73 in addition to intermittent working of machine No. 4. The Management further stated (December 1976) that the single track system was a major constraint in not bringing down the down-time, the productivity was less with the production of high MgO sinter for which raw dolomite was added and addition of the dolomite generated more fines on screening and gave less yield of the finished sinter (meant for Blast Furnace usage).

On account of the higher basicity of sinter produced there was less consumption of iron ore fines and 16.6 lakh tonnes of iron ore fines had accumulated upto 31st March, 1974. It may be mentioned that in January 1970 Central Engineering and Design Bureau (CEDB) had observed that ".....
..... both from the point of view of better working conditions and higher productivity of sintering plant and higher utilisation of ore fines and better quality of sinter produced from the point of view of mechanical strength, range of 1.3 to 1.5 basicity for sinter is desirable instead of 1.8 to 2 adopted at present ....." The Management, however, stated (September 1974) that "in view of the advantages gained at the blast furnaces by using high basicity sinter, it has not been felt necessary to reduce the basicity".

(2) *Plant Shutdown*

According to the Project Report, the Sintering plant is to work for 365 days in a year and 3 shifts in a day. Though the plant worked three shifts during the years 1970-71 to 1977-78, the percentage of hours worked to total calendar hours was 84.8, 78.3, 80.2, 78.1, 80.0, 84.3, 87.7 and 85.4 only. One of the major causes of frequent stoppage of the plant was the lack of storing space for sinter after the loading bins were completely filled. As a result, the plant could re-start production only when the transfer car returned after unloading the sinter at

the Blast Furnaces. The situation improved after August 1973 when synchronised movement of sinter by two transfer cars was introduced. Machine hours lost due to non-availability of transfer car during 1973-74, 1974-75, 1975-76, 1976-77 and 1977-78 were 2743 hours, 2693 hours, 1145 hours, 617 hours and 1072 hours respectively.

2.06 *STEEL MELTING SHOP*

2.06.01 *Rated capacity*

The rated capacity of the Steel Melting Shop (SMS) is 25 lakh tonnes of rollable steel ingots to be produced out of 19.62 lakh tonnes of hot metal and 5.80 lakh tonnes of circulating scrap (steel scrap 5.06 lakh tonnes and cast iron scrap 0.74 lakh tonnes) with 5 lakh tonnes of high grade iron ore as oxidising agent.

In the one million tonne stage, the Plant had 6 open hearth furnaces of 250 tonnes capacity each. Four new open hearth furnaces with a capacity of 500 tonnes each were added in the 2.5 million tonne expansion stage. One furnace (No. 6) of the first stage of the Plant was reconditioned in April 1967 for operation with double the former output *i.e.* 500 tonnes. The ten units were commissioned on different dates upto April 1967.

In arriving at the rated capacity of 25 lakh tonnes of rollable steel ingots, recoverable scrap arising in the SMS itself has been assumed as 62,500 tonnes but the extent of irrecoverable scrap has not been mentioned in the Detailed Project Report.

The capacity of the Steel Melting Shop remained unchanged even after commissioning of the 6th Blast Furnace in July 1971.

2.06.02 *Production*

As against the rated capacity of 25 lakh tonnes (10 lakh tonnes for small furnaces and 15 lakh tonnes for big furnaces)

actual production of rollable steel for the eight years ending 31st March 1978 was as follows :—

(In '000 tonnes)

Year	Annual budgeted target	Actual production			Shortfall as compared to	
		250 T Furnace	500 T Furnace	Total	Rated Capacity	Annual targets
1	2	3	4	5	6	7
1970-71	2250	834	1106	1940	(—)560 (22.40)	(—)310 (13.78)
1971-72	2200	809	1144	1953	(—)547 (21.88)	(—)247 (11.23)
1972-73	2250	936	1172	2108	(—)392 (15.68)	(—)142 (6.31)
1973-74	2250	845	1049	1894	(—)606 (24.24)	(—)356 (15.82)
1974-75	2070	849	1152	2001	(—)499 (19.95)	(—) 69 (3.33)
1975-76	2250	930	1279	2209	(—)291 (11.64)	(—)41 (1.82)
1976-77	2250	982	1320	2302	(—)198 (7.92)	(+)52 (2.31)
1977-78	2300	1042	1329	2371	(—)129 (5.16)	(+)71 (3.09)

NOTES :—(*i*) The rejections have been reported in the operational statistics on the total basis. These rejections which are below one per cent have been rateably distributed between columns 3 and 4 to arrive at the rollable production for the 250 T. furnaces and 500 T. furnaces separately.

(*ii*) Figures in brackets indicate percentages.

It will be seen that there was shortfall with reference to rated capacity in all the years. As compared with the budgeted targets, the production was less in all the years except 1976-77 and 1977-78.

A review of the monthly production data, however, revealed that in the last month (March) of 1971, 1972, 1973 and 1976 the production was the highest. In March 1973, the production of rollable ingots was as high as 2,12,400 tonnes, which is 100 per cent of the proportionate rated capacity.

Apart from the reasons mentioned in paragraph 2.01, the following reasons also contributed to low production of steel ingots .

(a) Longer duration of heat than what was envisaged in the Project Report in the case of big furnaces in certain years.

(b) Weight per heat for bigger furnaces being less than what was envisaged in the Project Report.

(c) Lower availability of furnaces.

2.06.03 *Productivity and Efficiency analysis*

The Project parameters about productivity are as follows :—

(a) Tap to tap time—10 hours for 250 tonnes furnaces and 13.15 hours for 500 tonnes furnaces.

(b) Furnace availability—330 days per annum.

(c) Productivity—25 tonnes per hour for 250 tonnes furnaces and 37.7 tonnes per hour for 500 tonnes furnaces.

The productivity and efficiency actually achieved are discussed in the succeeding paragraphs :—

(1) *Furnace Utilisation*

On the basis of 330 working days, each of the 250 tonnes and 500 tonnes furnaces were expected to work for 39,600

hours per annum with provision of 4,200 hours for repairs. The actual number of hours these furnaces worked during 1970-71 to 1977-78 are compared in Annexure IX.

It will be seen from details given in the Annexure that actual working hours were less than the project norms in all the years and hours under repairs far exceeded the project norms. The extra time on repairs was spent mainly because of the fact that roof life differed from furnace to furnace & was much less than the estimated life of 400 heats for a 250 tonnes furnace and 250 heats for a 500 tonnes furnace. This is evident from the following data :—

(Figures in number of heats)

Year	Actual roof Life	
	Small Furnaces	Big Furnaces
1970-71	281 to 339	139 to 242
1971-72	205 to 325	160 to 211
1972-73	186 to 326	124 to 198
1973-74	168 to 314	121 to 177
1974-75	179 to 329	117 to 187
1975-76	152 to 289	112 to 164
1976-77	142 to 274	123 to 164
1977-78	150 to 249	107 to 176

The downward trend in the roof life of SMS furnaces was attributed by the Management (December 1977) to the following reasons :—

(a) Poor quality of indigenous refractories.

(b) Intensive oxygen lancing (though this resulted in reduction in heat duration and consequent higher production).

(c) Uncertainties and inadequate supplies of coking coal leading to keeping furnaces on reserve which caused thermal shock to refractory lining during 1973-74 and early 1974-75.

(d) Change over in roof thickness in furnaces from 460 mm to 380 mm one after the other from October 1973 onwards due to which the roof life in open hearth furnaces showed a declining trend. (However, this technological modification resulted in advantages of almost eliminating the mid-term hot repairs, thereby enhancing the furnace availability).

(2) *Excess Consumption of Refractories*

Table below compares the usage of refractories during 1970-71 to 1977-78 as compared to the projected consumption :—

Year	Estimated consumption of refractories based on the norm indicated in 2.5 MTPR (In lakh tonnes)	Actual consumption of refractories (in lakh tonnes) *	Consumption per tonne of steel ingots produced		
			As per Project Report. (Kgs.)	As per Norms fixed by Management (Kgs.)	Actual consumption (Kgs)
1970-71 . .	0.78	0.80	31.18	Not fixed	41.41
1971-72 . .	,,	0.89	31.18	Not fixed	45.72
1972-73 . .	,,	1.02	31.18	Not fixed	48.46
1973-74 . .	,,	0.97	31.18	Not fixed	51.29
1974-75 . .	,,	0.96	31.18	40	47.94
1975-76 . .	,,	1.00	31.18	40	45.29
1976-77 . .	,,	1.05	31.18	45	45.72
1977-78 . .	,,	1.12	31.18	45	47.28

*This includes use of some old bricks also.

Excess usage of refractories over the norms given in the Project Report involved an extra expenditure of about Rs. 19.54 crores during these years. The excess consumption of refractories was attributed by the Ministry (October 1978) to the reasons mentioned in sub-para (1) above.

(3) *Tap to tap time*

On the basis of projected tap to tap time and furnace availability already mentioned, the number of heats to be tapped works out to 3,960 for 250 tonne furnaces and 3,011 for 500 tonnes furnaces. As, however, the furnace availability was less than the projected norm, the number of heats to be tapped would be less than the projected norm. Table below compares the latter with the actual number of heats during 1970-71 to 1977-78 :—

Year	Number of heats that should have been tapped during the hours worked		Number of heats actually tapped	
	250 tonnes furnaces	500 tonnes furnaces	250 tonnes furnaces	500 tonnes furnaces
1	2	3	4	5
1970-71	3090	2469	3,264	2,338
1971-72	2899	2397	3,137	2,437
1972-73	3459	2526	3,671	2,490
1973-74	3167	2312	3,343	2,259
1974-75	3279	2504	3,339	2,509
1975-76	3589	2779	3,667	2,802
1976-77	3554	2791	3859	2,831
1977-78	3619	2790	4068	2,801

The main reasons for variation in number of heats was that the actual tap to tap time differed from the Project Report (10 hours for small furnaces and 13.15 hours for big furnaces) and also furnace to furnace. The average tap to tap time of smaller and bigger furnaces during these years was as follows :—

(Figures in hours)

Year	Small furnaces	Overall average	Big furnaces	Overall average
1970-71 . .	9.2 to 9.7	9.5	13.1 to 14.7	13.9
1971-72 . .	8.7 to 9.6	9.2	12.6 to 13.3	12.9
1972-73 . .	8.6 to 9.9	9.5	13.2 to 13.8	13.4
1973-74 . .	9.2 to 10.0	9.5	13.1 to 14.2	13.5
1974-75 . .	9.4 to 10.8	9.8	12.7 to 13.7	13.1
1975-76 . .	9.2 to 10.3	9.8	12.6 to 13.6	13.0
1976-77 . .	8.7 to 9.9	9.2	12.7 to 13.5	13.0
1977-78 . .	8.7 to 9.3	8.9	12.7 to 13.7	13.1

The average tap to tap time in the small furnaces was lower in all the years as compared to the DPR stipulations. However, in the case of big furnaces the average tap to tap time exceeded the D.P.R. stipulations marginally in 1970-71, 1972-73 and 1973-74 and was lower than the D.P.R. stipulations in other years.

(4) *Weight Per Heat*

Another reason for variation in production was that the average actual production of ingots per heat in small and big furnaces varied from the expectations *i.e.* 250 tonnes and 500 tonnes respectively for the small and bigger furnaces. The

average actual production per heat during 1970-71 to 1977-78 was as follows :—

(Figures in tonnes)

Year	Average production of steel ingot per heat-small furnaces of 250 tonnes (based on gross production)	Average production of steel ingot per heat-bigger furnaces of 500 tonnes (based on gross production)
1970-71	257.3	476.5
1971-72	260.0	473.6
1972-73	256.4	473.0
1973-74	253.5	465.8
1974-75	256.1	462.9
1975-76	255.1	459.5
1976-77	256.6	470.1
1977-78	257.7	477.6

While production per heat was more than the rated capacity in respect of small furnaces, it was lower in the case of big furnaces. According to the Management (November 1972), one of the reasons for the lower production was lesser charge of scrap per tonne of steel and higher silicon content in hot metal which resulted in extra volume of slag, thereby reducing the weight per heat. It was also stated that measures had been adopted to raise the door sills and gas port sills to increase the bath capacity as an experiment on one of the furnaces. The Management stated (January 1974) that door sills on four 500 tonne furnaces had been raised between October 1972 and April 1973 but the effect was not very perceptible. They further stated (July 1977) that the operation of the furnace and technological control of the bath was easier with smaller furnaces than with bigger one and also that their efforts to optimise production had been successful with smaller furnaces and similar efforts had not been so rewarding with bigger furnaces.

It may be mentioned that the scrap charge per tonne of steel produced was also more than that envisaged in the Project Report though less than that recommended by the Norms Committee vide paragraph 2.06.04. As regards higher silicon content in the hot metal, attention is drawn to paragraph 2.03.05.

(5) *Productivity of furnaces per hour*

According to the DPR average productivity per furnace/hour is to be 25 tonnes for 250 tonne furnace and 37.7 tonnes for 500 tonnes furnace. It will be seen from the data given below that, while actual productivity in respect of 250 tonnes furnace was higher than the project norm, the same was lower in the case of 500 tonne furnace :—

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
	(in tonnes per furnace/hour)							
250 tonnes furnace	27.1	28.3	27	26.7	26.1	26	27.9	29
500 tonnes furnace	34.3	36.6	35.4	34.5	35.3	35.3	36.3	36.5

Low productivity of 500 tonne furnaces was mainly because of less production per heat and more heat time.

(6) *Idle time*

As indicated in sub-paragraph (1) above, the furnaces did not work for a number of hours annually even though they were not under repairs, the period being particularly substantial during 1971-72, 1973-74 and 1974-75. The lower utilisation during 1971-72 was attributed by the Management (September 1972) to gas shortage caused by defects in the coke ovens. Inadequate supply of coal was the main factor responsible for lower utilisation during 1973-74 and 1974-75.

(7) *Impact of changes in operational parameters on production*

The variations in the above parameters resulted in lower production as indicated in paragraph 2.06.02. A further analysis of shortfall in production indicates that this was mainly due to utilisation variance in small as well as big furnaces; productivity variance also contributed to shortfall in production in respect of big furnaces. Details are given below :—

(.000 tonnes)

Year	250 Tonne Furnaces				500 Tonne Furnaces			
	Utilisation variance	Productivity variance	Rejections	Total	Utilisation variance	Productivity variance	Rejections	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1970-71	(—)217	(+)68	(—)6	(—)155	(—)269	(—)110	(—)8	(—)387
1971-72	(—)265	(+)91	(—)7	(—)181	(—)304	(—)35	(—)10	(—)349
1972-73	(—)125	(+)76	(—)5	(—)54	(—)241	(—)74	(—)6	(—)321
1973-74	(—)198	(+)56	(—)3	(—)145	(—)347	(—)94	(—)3	(—)444
1974-75	(—)170	(+)36	(—)6	(—)140	(—)252	(—)79	(—)9	(—)340
1975-76	(—)93	(+)36	(—)6	(—)63	(—)115	(—)88	(—)9	(—)212
1976-77	(—)102	(+)103	(—)8	(—)7	(—)109	(—)51	(—)11	(—)171
1977-78	(—)85	(+)145	(—)7	(+)53	(—)110	(—)44	(—)8	(—)162

Differences with figures given in paragraph 2.06.02 are due to rounding.

2.06.04 *Consumption Rate*

(1) The actual consumption of major raw materials per tonne of ingot during 1970-71 to 1977-78 as compared with the norms indicated in the Project Report as well as those fixed by the Norms Committee in 1968, are compared below :—

(Kgs. per tonne)

	Hot Metal	Scrap		Iron Ore	Mill Scale	Total Input of Fe	Lime Stone	Ferro manganese and Ferro silicon
		Iron	Steel					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
As per Project Estimate	785	29.6	202.3	200	..	1091.66	65	N.A.
As per Norms Committee	725		300	160	..	1077.48	75	15+0.9
Actuals								
1970-71	771	35.6	230.7	205	2.3	1112.79	67	16.4+1.6
1971-72	795	38.2	218.8	199	2.6	1121.43	66	17.5+1.50
1972-73	792	33.0	227.0	183	3.3	1112.45	64	18.3+1.30
1973-74	787	50.0	213.0	179	2.9	1107.38	69	19.5+1.00
1974-75	802	48.0	202.0	180	2.1	1108.70	58	18.7+0.60
1975-76	793	42.0	222.0	188	2.5	1119.64	64	18.1+0.86
1976-77	790	46.0	215.0	147	3.7	1088.02	60	20.2+1.10
1977-78	793	43.0	211.0	144	3.9	1081.37	60	19.0+1.2

The Management attributed (January 1977) following reasons for higher consumption of raw materials in Steel Melting Shop :—

(i) *Metallic input (hot metal and scrap)*

The metallic input during 1971-72 to 1975-76 was more or less around 1050 Kg/T which is the present norm set by the Management. There had been an increase in the metallic inputs since 1970-71, mainly because more and more furnaces were brought under oxygen lancing. The Silicon content of hot metal still continued to be high.

The usage of scrap was less than that prescribed by the Norms Committee.

(ii) *Iron Ore*

The consumption of iron ore was less than the Project Report norm of 200 Kgs/T except in the year 1970-71 when more than 91 per cent of hot metal sent to SMS contained silicon of more than 1 per cent. Moreover, increased top oxygen lancing resulted in lower consumption of iron ore in the later years.

(iii) *Ferro Manganese*

Due to intensive use of oxygen lancing in the process of steel-making, there had been an increase in the consumption of Ferro manganese since 1970-71.

(iv) *Ferro silicon*

During 1974-75 and 1975-76 the consumption of Ferro silicon was less than the norm of 0—9 Kg/tonne but during 1970-71 to 1973-74, the consumption was more, mainly because of higher production of Rails and Killed steel.

(2) *Metallic Yield*

According to the DPR, the ratio of metallic output to input was as follows :—

Metallic Input	Output in terms of rollable ingot steel	Percentage of (2) to (1)
(1)	(2)	(3)
(In lakh tonnes)		
29.13	25.00	85.8

The actual ratio was, however, less than the above norm upto 1976-77 as per details given below :—

1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
84.0	83.2	83.8	84.1	84.0	83.3	85.4	85.9

The actual ratios indicated above were much lower than the norm of 89.4 per cent fixed by the Norms Committee. However, there was excess in the yield of ingot steel as compared with the D.P.R. norm in the year 1977-78.

After taking into account the metallic content of excess arising of scrap recovered as compared with the D.P.R. norm, the lower yield in terms of short recovery of steel worked out to 1,31,824 tonnes valued at Rs. 9.55 crores during 1970-71 to 1975-76. The total excess recovery in terms of steel after taking into account the metallic content of excess arising of scrap recovered as compared with DPR norm during 1976-77 and 1977-78 was 1,19,991 tonnes and the value of excess recovery amounted to Rs. 5.10 crores.

As the Norms Committee had not laid down norms for rejection and scrap, the net short recovery of metal could not be worked out with reference to the ratios recommended by the Norms Committee.

In regard to the lower metallic yield, the Management stated (August 1977/April 1981) as follows :—

"(i) The 2.5 MTP DPR envisages hot metal deliveries to SMS with Silicon content not exceeding 1%. Because of non-availability of quality coking coal, coke supplies to Blast Furnaces are characterised by ash content (ranging over 25 to 26 per cent against the stipulated figure of 23 per cent) causing hot metal production with Si. content even exceeding 1.25%. This has led to difficulties with high slag volume and consequent heavy carry over of Fe as FeO in slag in steel making.

(ii) Intensive oxygen lancing which has been resorted to during melting also causes considerable escape of FeO alongwith the fumes in the flue gases.

(iii) Usage of sub-standard quality pouring refractories leading to loss of metal in teeming practice.

(iv) The input materials are weighed, whereas, measuring facilities are not adequate to determine exactly the extent of slag production, the FeO losses through flue gases and the metallic losses in teeming. These losses are, however, inescapable and became in-built in the process.

(v) Metal going out alongwith slag is recovered and charged as scrap into the furnaces. For our internal

calculation, we are assigning a lower monetary value to the scrap so received. Had the scrap not been recovered, we would have to purchase the scrap from the open market, the price of which has been much more and prohibitive.

(vi) The metallic yield at the stage of steel making is to be particularly watched by the Plant, in view of the lot of economy resulting from the differential cost of steel ingots and the resultant scrap arisings in the process".

2.06.05 *Excess consumption of ingot moulds and bottom plates*

According to the 2.5 million tonne Project Report, the consumption of ingot moulds and bottom plates should be 20 Kgs. and 3.6 Kgs. respectively for the production of one tonne of rollable steel. The Norms Committee had, however, fixed (1968) a norm of 19 kgs. for ingot moulds and 7 kgs. for bottom plates *i.e.* a total of 26 kgs. per tonne of rollable steel. The Management did not accept either of the norms but have fixed varying norms from year to year depending upon the conditions of actual working, the reasons for non-acceptance of norms mentioned in DPR and Norms Committee Report being :—

(i) "As the teeming practice has undergone a change and conventional narrow end up moulds are used whereby the stream of liquid steel directly impinges on the bottom plate leading to its higher consumption, comparison of DPR figures with actuals may not be realistic.

(ii) The Norms Committee figures were only preliminary fixation which were to be reviewed periodically....."

The table below compares the actual consumption of ingot moulds and bottom plates during 1968-69 to 1977-78 with the norms fixed by the Management :—

(Figures in kgs.)

Year	Yearly norms fixed by the Management			Actual consumption per tonne of steel ingot		
	Ingot Moulds	Bottom Plates	Total	Ingot Moulds	Bottom Plates	Total
1968-69	15.5	7.0	22.5	18.7	11.6	30.3
1969-70	18.0	9.5	27.5	21.6	11.8	33.4
1970-71	20.0	11.0	31.0	24.1	10.6	34.7
1971-72	21.0	10.0	31.0	22.8	12.0	34.8
1972-73	22.0	10.5	32.5	27.6	11.1	38.7
1973-74	22.0	10.5.	32.5	23.5	12.2	35.7
1974-75	22.0	10.5	32.5	22.6	12.0	34.6
1975-76	22.0	10.5	32.5	20.7	10.6	31.3
1976-77	22.0	10.5	32.5	21.1	9.3	30.4
1977-78	22.0	10.0	32.0	22.9	9.2	32.1

On the basis of the norms fixed by the plant Management, there was an excess expenditure of Rs. 1.97 crores during 1968-69 to 1977-78.

The following reasons were given by the Management (May 1974) for higher consumption of ingot moulds and bottom plates :—

(i) The steel pouring ladle, being of higher size, requires higher diameter stopper sleeves of superior quality. As the indigenous sources of refractories are not able to meet the demand of specified quality, a part of the requirement has to be met with sub-standard refractories. This causes bad teeming, resulting in more consumption of moulds and bottom plates.

(ii) Varying silicon content in hot metal reduces the life of ingot moulds.

The Management further stated (November 1977) that higher retention time, higher temperature heats and mould cycle also contributed to the higher consumption of moulds

2.07 *Rolling Mills*

2.07.01 The Rolling Mills consist of Blooming Mill, Continuous Billet Mill, Rail and Structural Mill, Merchant Mill and Wire Rod Mill which were commissioned from November 1959 to September 1967. Against an input of 25 lakh tonnes of steel ingots, the Rolling Mills are designed to produce 19.65 lakh tonnes of finished and semi-finished saleable products and the difference represents process loss which works out to 21.4 per cent of input (including burning loss of about 4 per cent), as per details given below :—

Mill	Percentage of		
	Wastage, discard and rejections	Burning loss	Total
Blooming Mill	11.8	2.5	14.3
Rail and structural Mill	6.3	2.5	8.8
Billet Mill	3.8	0.5	4.3
Merchant Mill	3.5	2.5	6.0
Wire Rod Mill	2.0	2.0	4.0
Average for all the Mills	16.96	4.44	21.4

2.07.02 *Mill Wise Performance*

The details of actual input, output and wastage in different mills during 1970-71 to 1977-78 are given in Annexure X. It will be seen therefrom that :—

(i) A number of Mills had operated below capacity, partly on account of feed stock and partly on account of other reasons.

(ii) In individual mills, the process loss differed from year to year. It was within the Project Report norm in all the mills except rail and structural mill in 1975-76 and wire rod mill in all the years.

2.07.03 *Provision of balancing facilities*

Upto 2.5 million tonne stage, the rolling mills were provided with 26 soaking pits to heat the steel ingots to the prescribed temperature before these were sent for rolling. While recommending the provision of two additional soaking pits, extension of receiving roll table and modification of straight line ingot buggy track to elliptical track in the Blooming Mill, the Action Committee observed (May 1973) as follows :—

> "Although this is not considered absolutely essential for achieving a production of 2.5 million tonnes per annum of ingot steel, the Committee feels that the extra expenditure of approximately Rs. 4 crores is advisable as it would ensure steady production at the 2.5 million tonnes per annum level by providing a margin against unforeseen break-downs and loss of production."

Two additional soaking pits were commissioned in December 1976 at a cost of Rs. 135 lakhs. The other two facilities *viz.*

elliptical track and extension of receiving roll table were not taken up. With the commissioning of the additional soaking pits, the production of the Mill increased appreciably from 1976-77.

The Ministry stated (June 1981) that in the proposed modernisation programme of Bhilai which is under scrutiny, there is again a provision for :

(1) Two additional pits.

(2) Elliptical track.

(3) Extension of roll table.

(4) Increasing the capacity of the main drive.

The Plant is already proceeding on increasing the capacity of the main drive. The other three will be taken up as and when the modernisation programme is implemented.

2.07.04 *Rail and Structural Mill*

(1) The 2.5 million tonne Project Report envisaged the production of 5 lakh tonnes of rails (3.70 lakh tonnes of 90 lb/yard rails and 1.30 lakh tonnes of 60—75 lb/yard rails) and 2.50 lakh tonnes of steel bars and shapes out of 8.22 lakh tonnes of blooms, the wastage (including burning loss) being 8 per cent in rails and 10 per cent in other structurals.

The rolling of 105 lb rails was not envisaged in the DPR. However, the Plant has been rolling substantial quantities of 105 lb. rails and lesser quantity of 90 lb rails ; 60—75 lb rails are not rolled.

It will be seen from the data (given below) relating to break-up of total production in the mill during 1970-71 to 1977-78

that percentage of wastage, by and large, conformed to the projected norm :—

(In lakh tonnes)

Product	Year	Input of blooms	Finished output	Percentage of wastage
Rails	1970-71	2.92	2.79	4.58
	1971-72	2.82	2.59	8.12
	1972-73	2.91	2.73	6.01
	1973-74	2.54	2.35	7.55
	1974-75	2.39	2.23	6.71
	1975-76	1.82	1.68	7.76
	1976-77	3.00	2.71	9.45
	1977-78	3.29	3.07	6.62
Structurals (including semis like hammer plates and slabs which were negligible in quantity)	1970-71	2.79	2.47	11.45
	1971-72	1.92	1.77	8.01
	1972-73	3.74	3.45	7.88
	1973-74	3.33	3.01	9.56
	1974-75	3.55	3.19	10.13
	1975-76	4.98	4.51	9.52
	1976-77	4.12	3.82	7.36
	1977-78	3.71	3.40	8.50
Total	1970-71	5.71	5.25	8.01
	1971-72	4.74	4.35	8.23
	1972-73	6.65	6.18	7.06
	1973-74	5.86	5.35	8.69
	1974-75	5.94	5.42	8.75
	1975-76	6.80	6.18	9.05
	1976-77	7.12	6.53	8.24
	1977-78	7.00	6.47	7.62

(2) *Rejection of Rails*

In addition to wastage in conversion of blooms into rails, certain quantities of rails are not found upto specifications during inspection and are categorised as untested. It was noticed that the production of untested rails was quite appreciable and was

generally more than the norm fixed by the Management, as detailed below :—

(In terms of percentages to total production)

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
(*i*)—90 *lb Rails* (*untested*)								
(*a*) Norm fixed by Management	..	..	11	12.5	12.5	12.5	Not	Fixed
(*b*) Actual	..	..	11.54	12.18	13.3	18.38	12.76	13.42
(*ii*) 105 *lb Rails* (*untested*)								
(*c*) Norm fixed by the Management	20	20	11	12.5	12.5	12.5	Not	Fixed
(*b*) Actual	24.90	11.01	13.26	16.38	12.67	19.29	16.12	14.83

Similarly, in respect of rails for export, the actual percentage of untested rails was, by and large, higher than the norms, wherever fixed, as indicated below :—

	Norm fixed (In terms of percentage)	Actual
Argentina Rails		
1970-71	25/30	47.86
1971-72	35	23
Egyptian Rails		
1970-71	25/30	66.49
1971-72	35	29.97
Egyptian Rails (short length)		
1971-72	Not fixed	45.54
Korean Rails		
1971-72	35	42.04
1972-73	*25	33.27 *with 10 per
1975-76	Not fixed	37.21 cent for short
1976-77	,,	41.09 length
1977-78	,,	38.71
Malaysian Rails		
1970-71	25/30	40.89
Iran Rails (U-33)		
1970-71	Not fixed	31.29
1972-73	,,	50.20
1973-74	35	35.64
1976-77	Not fixed	28.78
1977-78	,,	31.80
Iran Rails (UIC-50)		
1970-71	25/30	38.39
Iran Rails (UIC-60)		
1975-76	Not fixed	40.93
1976-77	,,	31.10
1977-78	,,	35.33
Iran Rails (UIC-54)		
1977-78	,,	38.13

The arisings of untested rails of 90 lb. and 105 lb. were mainly due to defects in steel. As regards rails for export, the arisings of untested rails were due to defects in steel, mill defects and hot bed and finishing defects and also due to stringent specifications.

(3) *Utilisation of capacity for manufacture of Rails*

The production of rails mainly depends on orders received from the Railways. The total requirement of the Railways, the quantity committed by the Company thereagainst and the actual production during 1970-71 to 1977-78 were as follows :—

(Figures in lakh tonnes)

Year	Total requirement of the Railways		Quantity committed by the Company		Actual production (Tested)		Despatches to Railways	
	105 lb.	90 lb.	105 lb.	90 lb.	105 lb.	90 lb.	105 lb.	90 lb.
1970-71	1.45	0.23	1.12	..	1.11	..	1.14	..
1971-72	1.14	0.22	1.08	..	1.22	..	1.10	..
1972-73	1.50	0.80	1.20	0.80	1.21	0.87	1.21	0.79
1973-74	1.26	1.13 revised to 1.50	1.10	0.92	1.13	0.71	1.10	0.51
1974-75	..	..	..	..	0.61	1.13	0.46	0.85
1975-76	..	..	..	..	0.45	0.13	0.37	0.16
1976-77	0.39	0.40	NA	NA	0.42	0.35	0.39	0.33*
1977-78	0.72	0.58	NA	NA	0.74	0.47	0.66	0.43

*Despatches include 301 tonnes of wear resistant Rail.

Due to increase of Railway demand to 1.50 lakh tonnes for 1973-74, Plant was expected by the Iron and Steel Controller supply balance of 0.38 lakh tonnes particularly because IISCO was already in bad shape and TISCO's Rail Mill was pretty old.

The quantity planned on and supplied by these 2 Mills was as follows :—

Year	Quantity planned		Actual supply.	
	TISCO	IISCO	TISCO	IISCO
			(In thousand tonnes)	
1972-73	10	18	3	1
1973-74	10	10	Nominal	1

(4) *Rolling of billets/squares in the Structural Mill*

According to the Project Report, billets are to be produced in the Billet Mill. Although this Mill had operated below capacity upto 1974-75, billets are also being produced regularly in the Rail and Structural Mill from 1966-67.

The quantity of billets produced in the Rail and Structural Mill during 1970-71 to 1974-75 and the capacity of the Billet Mill not utilised during these years was as follows :—

(Figures in lakh tonnes)

Year	Squares billets produced in Rail and Structural Mill	Un-utilised capacity of Billet Mill
1970-71	0.65	1.84
1971-72	0.27	1.63
1972-73	1.88	0.94
1973-74	1.71	1.18
1974-75	1.47	0.89

The production of billets in the Rail and Structural Mill involved extra expenditure in the form of fuel, labour and other services as the blooms are sent to the Structural Mill in cold condition and require reheating.

According to the Management, billets are being produced in the Rail and Structural Mill in order to improve its production as the product-mix as envisaged in the Project Report cannot be maintained on account of the demand pattern in the country. The Management further stated (August 1976) that the Billet Mill rolling has been maximised to the extent possible, its limitation to further rolling is that it works in tendem with the Blooming Mill.

(5) *Non-utilisation of Hot Bloom Transfer Car*

The 2.5 million tonne Project Report envisaged the transfer of blooms in hot condition from the Blooming Mill to the Rail and Structrural Mill. In actual practice, however, only cold blooms are being transferred to the Rail and Structural Mill which necessitates not only double handling of blooms but also higher consumption of heat. Further, the hot bloom transfer car installed at 1 million tonne stage at a cost of Rs. 8.53 lakhs for the transfer of blooms in hot condition was not utilised upto September 1976.

The Management stated (March 1972), that under the existing pattern of making rails, it was not possible to ensure steady supply of blooms in hot condition to match the rate of rolling in the Rail and Structural Mill and that the technology of re-heating furnaces in the Rail and Structural Mill did not permit frequent changes for the heating of hot blooms on one occasion and of cold blooms on the other ; the introduction of 100 per cent scarfing of blooms and their inspection presupposes the use of cold blooms and leads to improvement in the quality of finished product of the mill.

2.08 *Idle/Surplus Equipment*

Annexure XI contains the list of 24 cases where equipment has been lying idle for varying periods. The value available in 23 cases was Rs. 138.61 lakhs. The reasons for non-utilization of these equipment and action proposed to be taken for their utilisation/disposal are also indicated in the Annexure.

3. *Sources of Raw Materials*

3.01 The Plant obtains its requirements of most of the raw materials, other than coal and manganese ore, from its captive mines. The performance of the captive mines developed for meeting the requirements of major raw materials like iron ore, limestone and dolomite as also other raw materials like manganese ore and fluorspar is discussed in the succeeding paragraphs. Besides these mines, fireclay, bauxite and quartizite mines are also operated by the Plant.

3.02.01 *Iron Ore*

The Plant has developed a number of mines comprising the Rajhara group of mines which consist of (i) Rajhara Kokan mechanised complex and (ii) the manual mines at Jharandalli, Dalli, Aridengri, Kokan, Chikli, Mayurpani, Mahamaya and Rajhara East and West.

The total requirement of iron ore for the operation of the Plant at full rated capacity of the 6th Blast Furnace Complex has been estimated at 53 lakh tonnes (31.7 lakh tonnes of lump ore of blast furnace grade, 5 lakh tonnes of lump ore of open hearth furnace grade and 16.3 lakh tonnes of fines to be converted into sinter). The rated capacity at Rajhara (mechanised) mines is 35 lakh tonnes (21.87 lakh tonnes lump ore and 13.13 lakh tonnes fines) of iron ore per year. The quantity of iron ore

(lump) and fines actually used and the quantity despatched from different mines during 1970-71 to 1977-78 were as follows :—

(Figures in lakh tonnes)

Year	Quantity of ironore consumed			Mines	Quantity raised by different mines		
	Lump				Lump Ore		
	B.F. Grade	O.H. Grade	Fines		B.F. Grade	O.H. Grade	Fines
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1970-71	26.35	3.98	8.15	Rajhara	8.31	2.06	10.32
				Others	19.87	2.25	..
1971-72	24.37	3.88	9.84	Rajhara	7.89	2.16	11.13
				Others	20.57	1.38	..
1972-73	26.22	3.85	11.09	Rajhara	6.36	2.55	11.01
				Others	20.97	1.20	0.14
1973-74	22.79	3.40	11.13	Rajhara	5.51	2.66	11.08
				Others	21.42	..	..
1974-75	23.70	3.60	11.66	Rajhara	8.09	2.47	10.99
				Others	21.77	..	0.02

1	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1975-76	25.20	4.15	12.46	Rajhara	8.69	4.00	13.09
				Others	24.53	..	8.69
1976-77	29.96	3.39	13.26	Rajhara	9.60	3.55	14.18
				Others	23.46	..	8.36
1977-78	28.92	3.41	12.66	Rajhara	9.80	3.42	15.59
				Others	18.78	..	7.51

3.02.02 *Rajhara Iron Ore Mines*

(1) The Production in the Rajhara Mechanised mines was very low as compared to the rated capacity in all the years; it was low as compared to budgeted production also except in 1976-77, as indicated below :—

(In lakh tonnes)

(1)	1970-71 (2)	1971-72 (3)	1972-73 (4)	1973-74 (5)	1974-75 (6)	1975-76 (7)	1976-77 (8)	1977-78 (9)
Budgeted	37	28.5	23	28	26	28	27	29.20
Actuals								
Lump	10.37	10.05	8.91	8.17	10.56	12.69	13.15	13.22
Fines	10.32	11.13	11.00	11.08	10.99	13.09	14.18	15.59
Total	20.69	21.18	19.91	19.25	21.55	25.78	27.33	28.81

As a result, substantial quantities of iron ore had to be raised manually from other mines. In July, 1970 the Company's Director (Production) had observed that shortfall was on account of non-removal of over burden in proper sequence and deviations from the Project Report made by the local management in the development of the mine.

In February 1972 a technical committee, known as Malhotra Committee, was appointed by the Hindustan Steel Limited to review the performance of the mines of the Company. In its interim report submitted in January 1973, the Committee had *inter alia* made the following recommendations to improve the working of the Rajhara mine :—

(i) The Committee recommended that in order to remove track and transport limitations which were responsible for under-utilisation of the mines capacity, the second railway track could be laid without any capital expenditure.

(ii) The Committee, on examining the results of the three shift working, held that the third shift work was almost invariably slack and that the only way to reduce the wages was to improve the output per man shift and that working the mine in two shifts appeared to be distinct possibility. The manpower of the mine could be reduced from 2,250 to 1,350 by tarnsferring extra men to Dalli mine which was expected to come up by June 1977.

(iii) Jharandalli (situated at a distance of about 1.5 kms.) and Rajhara mine should share common facilities at Rajhara and be treated as a single complex.

The Management stated (April 1981) that two significant measures relating to laying of double track (commissioned in

October 1974) and operation of mechanised mines in two shifts instead of in three shifts (with effect from 1st May 1980) have been implemented.

2. *Utilisation of plant and equipment at Rajhara Mines*

It was noticed that utilisation of plant and equipment was below the norm indicated in the Project Report, as per details given below :—

(Figures in per cent)

Year	Churn drill machines	Urals	Excavators	Locomotives	Crushing Plant	
					Jaw Crusher I	Jaw Crusher II
As per DPR	Not indicated		52.00	85.00	76.1	76.1
Actuals						
1970-71	30.5	29.4	37.1	61.2	29.6	11.5
1971-72	30.6	35.6	37.5	65.1	34.6	6.7
1972-73	32.4	40.5	36.9	58.9	33.3	6.9
1973-74	26.6	34.5	32.9	53.8	29.4	6.6
1974-75	23.6	30.4	34.2	45.9	32.3	14.7
1975-76	35.3	37.8	38.2	60.4	35.6	8.8
1976-77	31.3	31.5	40.4	61.6	@	@
1977-78	50.2	52.6	40.4	69.1	@	@

@The utilisation percentage of Crushing Plant Jaw Crusher No. I and Jaw Crusher No. II is not available.

The Management stated (January 1977) that the under-utilisation of plant and equipment was due to non-attainment of rated production. The fact, however, remains that the production in the mines was very low even though (a) the mines were working on three shift basis, (b) there was surplus equipment, (c) there was surplus manpower and (d) there was adequate demand for ore.

(3) *Cost of production*

Actual f.o.r mines cost of production of lump ore and fines at Rajhara mines during 1971-72 to 1977-78 was higher than the standard cost fixed by the Management for the relevant years except in 1976-77 in respect of lump ore and in 1971-72 and 1976-77 in respect of fines.

The Malhotra Committee in its report of January 1973 had made a comparative study of the cost of production of Rajhara mechanised mines with the cost of production of Bailadila mines and come to the conclusion that though the cost of Rajhara ore was comparable to Bailadila ore on run of mines (ROM) basis, it was substantially higher when estimated in terms of lump ore. This was ascribed by the Committee to much higher wage component mainly on account of manning in Rajhara mine being far in excess of that in Bailadila.

According to the Committee, wages in Rajhara mine constituted 56.3 per cent of the total cost against 15.8 per cent in Bailadila. During 1973-74 to 1977-78 also the percentage of wages to total cost was more in Rajhara Mine as compared to Bailadila.

The manpower in the Rajhara mine during 1962, 1964 and 1972-73 to 1977-78 was as follows :—

	1962	1964	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Manpower (in number)	1010	1566	2103	2126	1999	2058	2398	2392

Out put of iron ore and fines per manshift was 5.91 tonnes, 5.65 tonnes, 6.73 tonnes, 7.83 tonnes, 7.12 tonnes and 7.53 tonnes during the years 1972-73, 1973-74, 1974-75, 1975-76, 1976-77 and 1977-78 respectively.

The Management stated (April 1981) that wage component at Rajhara and Bailadila is not comparable due to the following reasons :—

(i) The Mines are under different organisations having different conditions of working and different wage structures and benefits.

(ii) While Rajhara till recently was operated in three shifts, Bailadila is operated in two shifts.

(iii) Repairs and maintenance of plant, machinery and equipment at Rajhara was done through facilities and sources from within the organisation, this was not the case with other mines.

3.02.03 *Other Mines*

(1) On account of lower production of iron ore in the Rajhara mine (which resulted in unabsorbed fixed expenditure of Rs. 5.82 crores), ore was raised manually from other captive mines. As full requirements of iron ore by the steel plant could not be met even with the help of manual mining, 1.89 lakh tonnes of blast furnace grade ore were purchased during 1970-71, 1971-72 and 1977-78 (upto 30-4-1978) at a cost of Rs. 124.24 lakhs which was higher than the cost of manual mining by Rs. 57.65 lakhs (the quantity is exclusive of the unlinked wagons of 1,116 tonnes).

(2) The waste rock soil etc. arising in manual mining were dumped by contractors upto September 1967 on ore-bearing faces instead of in the approved places. The waste had again to be removed subsequently to other places by incurring an expenditure of Rs. 68.39 lakhs upto March 1978 when these places were taken up for mining of the ore underneath.

(3) The cost of manually mined lump ore worked out to 194.31 per cent in 1970-71, 324.77 per cent in 1971-72, 488.03 per cent in 1972-73, 269.68 per cent in 1973-74, 379.37 per cent in 1974-75, 361.42 per cent in 1975-76, 294.42 per cent in 1976-77 and 346.22 per cent in 1977-78 of the variable cost of mechanised mining in the relevant years.

In view of the lower production in the mechanised mines, ore was extracted manually through contractors and co-operative societies involving an extra expenditure of Rs. 7.22 crores during these years apart from the unabsorbed fixed expenditure of Rs. 5.82 crores dealt with in sub-para (1) above.

(4) Along with the expansion of Rajhara mines, development of Jharandalli deposits at a distance of 1.5 km from the Rajhara deposits was taken up for semi-mechanised working. An expenditure of Rs. 1 crore (approx.) was incurred on the mine for raising 8 lakh tonnes of lump ore annually and the mine started operating in December 1965. According to the scheme, the ROM ore was to be transported by dumpers to the siding and crushed there manually. However, it was decided by the Management in October 1966 to utilise the surplus capacity of the Rajhara crushing plant for crushing the ROM ore. On account of shortage of dumpers arising out of diversion of 5 dumpers (out of 10 purchased) to Rajhara mines and poor availability of dumpers, the production in the Jharandalli semi-mechanised mine did not proceed according to schedule and it was stopped for two years in 1970-71 and 1971-72. Thereafter also, the raising in the semi-mechanised unit is negligible and mining is done only manually at a distance of 600 metres from the semi-mechanised unit. The Management stated (April 1981) that the facilities created for Jharandalli semi-mechanised mines are being utilised in Kokan and other mines in the Iron Ore Complex of Bhilai.

As against 8 lakh tonnes of lump ore proposed to be raised from the semi-mechanised unit, the actual production during

1970-71 to 1977-78, both from the semi-mechanised unit and the manual unit, was very low as indicated below :—

Raising of lumps

(In lakh tonnes)

Year	Semi-mechanised	Manual	Total
1970-71	..	1.00	1.00
1971-72	..	0.90	0.90
1972-73	0.09	0.96	1.06
1973-74	..	1.23	1.23
1974-75	0.01	2.65	2.67
1975-76	..	5.14	5.14
1976-77	Nil	3.46	3.46
1977-78	Nil	2.79	2.79

The shortfall in the raising of iron ore was stated (May 1975) to be due to low utilisation of the Belaz dumpers as the same could not be maintained on account of non-availability of spares and garage facilities.

3.03 *Lime-stone*

3.03.01 Lime-stone required for the production of steel by the steel plant is obtained from its captive mines at Nandini.

3.03.02 *Mechanised Mines*

(1) The Nandini mechanised mine has a capacity of 21 lakh tonnes of (ROM) ore yielding 17.50 lakh tonnes of lump ore (+25 mm) and chips (12—25 mm) which is sufficient to meet the requirement of all the blast furnaces and sintering plant of the steel plant for the production of 2.5 million tonnes of steel ingots. The Project Report for the 6th Blast Furnace Complex did not contemplate increase in the capacity of the mine and envisaged the use of lower fractions of lime stone upto 5 mm size in order to meet the slightly higher requirement upto 18 lakh tonnes.

(2) The mechanised mine has two crushers. Although both crushers were expected to be used for two shifts each as per the Project Report with a view to producing 17.50 lakh tonnes of lumps and chips, one crusher is operated in two shifts daily and the other is used for one shift only, as the requirement of flux grade lime stone is stated (February 1977) to be much less than the anticipated estimate in the Project Report. The manning has, however, been provided to produce 14.02 lakh tonnes on total three shift basis.

Due to lower production in the mechanised mine, lime stone is raised manually also.

(3) The following table indicates the budgeted production and actual production during 1970-71 to 1977-78 :—

Year	Budgeted production (Lumps & Chips)	Actual production		
		Lumps (BF+SP Grade)	Chips	Total
(1)	(2)	(3)	(4)	(5)
1970-71	10.00	6.32	3.16	9.48
1971-72	11.56	6.93	3.39	10.32
1972-73	11.54	7.47	3.59	11.06
1973-74	11.07	8.16	3.49	11.65
1974-75	12.17	7.93	3.92	11.85
1975-76	11.70	8.14	4.37	12.51
1976-77	10.67	11.07	2.62	13.69
1977-78	11.28	11.46	2.70	14.16

According to Management (July 1974), shortfall in production of the mechanised mine was mainly on account of :—

(i) Bad condition of Russian locos, there being no facility for major repairs either at the mine or in the plant.

(ii) Vibrators of new crusher not working properly during 1972-73.

The Management further stated (January 1977) that the production plan was based on the actual requirements.

The short-fall in production with reference to the under-utilisation of capacity resulted in unabsorbed fixed expenses to the extent of Rs. 2.72 crores during 1970-71 to 1977-78. According to the Management (March 1977/October 1979), the unabsorbed fixed expenses should be computed to the extent manual mining of blast furnace grade lumps was resorted to. On this basis, the amount works out to Rs. 0.54 crore.

The f.o.r. mines cost of production of limestone showed a continuous upward trend except in 1976-77. The cost of production represented 103.59 per cent in 1971-72, 105.32 per cent in 1972-73, 113.12 per cent in 1973-74, 134.52 per cent in 1974-75, 139.90 per cent in 1975-76, 128.89 per cent in 1976-77 and 142.67 per cent in 1977-78 of the cost of production in 1970-71. The higher cost of production was attributed by the Management, besides under utilisation of capacity, to surplus manpower and higher rates of wages on account of Wage Board award. The Malhotra Committee had recommended (January 1973) the transfer of about 200 surplus men to Hirri Dolomite Quarry when mechanised. This did not, however, materialise as mechanisation scheme had been dropped.

(4) According to the Project Report, over-burden at the mechanised mine was to be removed by scrappers available at the construction site of the steel Plant. The over-burden was, however, removed manually through contractors. During September 1965 to March 1978 an expenditure of Rs. 90.37 lakhs was incurred on this account. The Management stated (November 1974) that due to bouldery nature of the terrain it was considered (1961) technologically not feasible to remove the over-burden to desired efficiency by mechanical means.

(5) The Crushing plant at the mine is situated outside the area taken on mining lease from the Government of Madhya

Pradesh. As a result, royalty is being paid by the Steel Plant on the entire quantity of ROM ore raised from the mine and transported to the Crushing Plant *i.e.* including the quantity of rejects arising from crushing. If the Crushing Plant had been located within the leased area, payment of royalty aggregating Rs. 38.39 lakhs made on the rejects during 1960 to March 1978 would have been avoided.

(6) Even though the mechanised plant had adequate capacity, the actual production of B.F. and sintering plant grade was not sufficient to meet the requirements of the Steel Plant, and hence manual mining through contractors and cooperative societies was also resorted to. Further, manual mining was considered necessary for Open Hearth and Refractory Material Plant Grade lime stone, which was available in pockets and for which there was no provision for mining mechanically.

The details of lime-stone(lump) manually raised during 1970-71 to 1977-78 are given below :—

Year	Quantity raised (lakh tonnes) O.H. Grade	RMP Grade	B.F. Grade	Total	Percentage of manual production of BF Grade to mechanical production (Lumps)
(1)	(2)	(3)	(4)	(5)	(6)
1970-71 . .	1.17	0.62	2.30	4.09	36.39
1971-72 . .	1.15	0.77	3.05	4.91	44.01
1972-73 . .	1.71	0.76	2.52	4.99	33.73
1973-74 . .	1.33	0.73	0.93	2.99	11.40
1974-75 . .	1.24	0.82	1.74	3.80	21.94
1975-76 . .	1.17	0.79	0.72	2.68	8.84
1976-77 . .	1.48	0.86	0.09	2.43	1.24
1977-78 . .	2.48	..	Nil	2.48	..

Eeven though capacity for full production was created in the mechanised mines, substantial quantity of B.F. Grade was raised manually during 1970-71 to 1974-75; the quantity raised during 1975-76 was, however, less. In justification of the extraction of higher quantities of B.F. Grade ore manually, the Management stated (July 1974) that the production of B.F. Grade ore in the mechanised mines resulted in arising of more chips which were beyond the requirement of the blast furnaces and therefore manual mining was resorted to.

It was, however, noticed that during 1977-78 the extraction by manual mining had come down considerably with corresponding increase of production in the mechanised mines and corresponding increase of chips production.

(7) The cost per tonne of manual mining worked out to 177.15 per cent in 1970-71, 234.52 per cent in 1971-72, 206.97 per cent in 1972-73, 211.05 per cent in 1973-74, 175.77 per cent in 1974-75, 144.96 per cent in 1975-76, 180.05 per cent in 1976-77 and 207.21 per cent in 1977-78 of the variable cost per tonne (mechanised mining) in the relevant years.

3.04 *Manganese ore*

According to the Project Report, 0.5 lakh tonnes of manganese ore (with 33.5 per cent manganese content) were required for the production of 2.5 million tonnes of steel. With the installation of facilities for the 6th Blast Furnace Complex, the requirement of manganese ore increase to 1.39 lakh tonnes (with 30.35 per cent manganese content).

Between 1962 and 1972 the Company took on lease a mining area of 1669.85 acres having a reserve of 0.84 lakh tonnes of manganese ore. As the progress of mining was slow and the cost was very high, further raisings were stopped from 8th June 1973 after surrendering 756.62 acres; the balance of 913.23 acres was surrendered in July 1975 and July 1976.

The quantity of manganese ore consumed by the Steel Plant and the quantity produced in the mines and that purchased from the market during 1970-71 to 1977-78 are given below :—

Year	Total consumption (in lakh tonnes)	Production from leased area (tonnes)	Quantity purchased (in lakh tonnes)
(1)	(2)	(3)	(4)
1970-71	1.09	291	1.07
1971-72	1.09	..	1.18
1972-73	1.15	2212	1.15
1973-74	0.94	9771	0.77
1974-75	1.06	..	1.08*
1975-76	1.01	..	1.23@
1976-77	1.03	..	0.98
1977-78 (13 months)	1.09	..	1.02

*Includes 500 tonnes(estimated) in unlinked wagons.

@Includes 1386 tonnes (estimated) in unlinked wagons.

The Management stated (November 1977) as follows :—

"The mining leases of these properties were taken not with intention of mining them. In the normal course properties should have been taken up for prospecting but since the State Government had earlier given these areas on mining lease to different parties as per the statutory provisions of the Mineral Concession Rules, it was not possible for the State Government to give prospecting licences for these areas. Our intention was to prospect these properties. The raising of ore was incidental to this process and the cost has to be viewed in this context."

3.05 *Dolomite*

3.05.01 (a) The requirement of dolomite is met by the Plant from its captive mines at Hirri which are operated manually. Some quantity of dolomite is also supplied to Rourkela and Durgapur Steel Plants. The production of dolomite for Bhilai and Durgapur Steel Plants and the quantity consumed in Bhilai Steel Plant during 1970-71 to 1977-78 were as follows :—

(Figures in lakh tonnes)

Year	Actual production for			Consumption in Bhilai Steel Plant
	BSP	DSP	Total	
(1)	(2)	(3)	(4)	(5)
1970-71	3.01	0.28	3.29	2.83
1971-72	2.85	0.18	3.03	2.86
1972-73	2.99	0.06	3.05	3.28
1973-74	2.80	..	2.80	3.06
1974-75	3.00	..	3.00	3.55
1975-76	4.34	..	4.34	4.31
1976-77	5.11	..	5.11	4.88
1977-78	4.94	..	4.94	4.40

The production during 1972-73 to 1974-75 was less than the consumption. The Management stated (February 1977) that production was oriented to despatches that could be made with the available manpower and wagons from the Railways The shortfall was met by purchasing about 1 lakh tonnes from outside sources at a price higher than the cost of raising except in 1973-74, involving extra expenditure of Rs. 4.36 lakhs during 1972-73 and 1974-75.

(b) The f.o.r. mine cost showed a rising trend, as indicated below :—

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Cost per tonne (in percentage)	100.00	110.32	137.17	153.49	178.45	212.34	194.45	253.43

(c) The Refractory Material Plant (which is to calcine 1,61,500 tonnes of raw dolomite) is provided with two crushers for sizing the dolomite—one in the one million tonne stage to which dolomite of size 25—80 mm is fed and another installed in the 2.5 million tonne stage the size of feed dolomite being 200 mm. The dolomite is, however, received from the mine duly sized and almost the entire quantity is below 80 mm size. The new crusher installed in 1965 at a cost of Rs. 13.35 lakhs thus remained idle since installation.

The Management stated (January 1977) that it was not possible to receive, store and handle two sizes of dolomite in the Refractory Material Plant. The BOBX wagons in the circuit have also restricted opening, causing difficulty in unloading of lumps around 200 mm.

3.05.02 *Transportation of dolomite*

Railway freight for dolomite transported from the mine to the Steel Plant is being paid on the basis of carrying capacity of wagons since July 1965.

Despite reduction in the marked carrying capacity of wagons in December 1969 the quantity actually loaded continued to be less than the reduced capacity. As a result, the Company paid an extra freight of Rs. 5 lakhs during 1970-71 to 1972-73. Excess freight paid for the period from 1966-67 to 1969-70 on the basis of difference between the original and the reduced carrying capacity amounted to Rs. 50.78 lakhs approx. (November 1977). No formal claims for these extra

payments were preferred with the Railways who have, however, agreed to refer the matter to arbitration and an arbitrator has since been appointed to adjudicate upon the disputed claims (April 1980).

3.06 *Fluorspar*

3.06.01 During 1962-63 to 1970-71 the Plant was using fluorspar, though not envisaged in the Project Report, as flux material in the Steel Melting Shop. While upto 1964-65 a quantity of 462 tonnes was used, the consumption was substantially reduced later on account of the use of bauxite as a substitute ; this raw material is now used in the Alloy Steels Plant, Durgapur. For this purpose, the Plant took on lease certain areas from the State Government of Madhya Pradesh for prospecting and mining. The table below indicates the details of area, quantity raised, etc :—

Name	Date & period of lease	Purpose	Quantity raised in tonnes	Royalty paid	Remarks
Area 'A'	For 2 years in February 1963	Prospecting	—	—	—
Area 'B'	For 20 years in July 1963	Mining	Experimental mining was done	—	Lease was revoked on 6-9-71. A sum of Rs. 5982 was paid as dead and surface rent.
Area 'C'	For 20 years in July 1967	"	25457	Rs. 1.20 lakhs	In addition, an amount of Rs. 1639 was paid towards dead and surface rent.

A total expenditure of Rs. 81.53 lakhs was incurred upto 1977-78 in addition to royalty etc. and development expenditure of Rs. 14.36 lakhs (royalty, dead rent and surface rent of Rs. 2.39 lakhs up to April 1978 and development expenditure of Rs. 11.97 lakhs from 1972-73 to 1974-75).

3.06.02 To up-grade the ore for use in the Alloy Steels Plant, a beneficiation plant wtih a capacity of 400 tonnes per year was installed in the Bhilai Steel Plant area in 1967-68 at a cost of Rs. 4 lakhs. Additional equipment valued at Rs. 2.38 lakhs was later on installed in 1970 to increase the capacity of the plant to 900—1,000 tonnes per annum. The additional equipment has not been utilised so far (January 1980). As regards utilisation of expanded unit of Fluorspar Benefication Plant, Management have stated (January 1980) as follows :—

> "For the closure of the Fluorspar Beneficiation Plant, it was decided to explore the possibilities of using the plant and equipment for conducting Laboratory/Pilot Plant scale studies on the input raw materials. The existing Plant has facilities for Froth Flotation and Pelletisation. The entire aspect of conversion of the Fluorspar Beneficiation Plant into experimental Plant for mineral dressing studies is under examination by Research & Control Laboratory and Mines Department and steps as required will be taken as per the result of the study."

The quantity of ore beneficiated in the Plant during 1970-71 to 1977-78 and the cost of beneficiation are indicated below :—

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Production (in tonnes)	365	298	360	371	371	312	316	399
Cost per tonne (in Rupees)	1,714	2,306	2,394	2,562	3,481	5,779	4,776	2,795

Alloy Steels Plant paid the full cost upto 1971-72. For later years it was, however, ready to pay only at the rate of Rs. 1,660 per tonne at which Gujarat Mineral Development Corporation, a State Government Undertaking, was ready to supply fluorspar. As the mine was working at a loss and its operation on a proper scale involved a considerable investment on prospecting and developmental work, the Board of Director decided in November 1974 that the Alloy Steels Plant should make payment at the prevailing market rate plus Rs. 500 per tonne for the stock lying at the Bhilai Steel Plant and that further supplies of ore need not be made. The plant continued to supply fluorspar to the Alloy Steels Plant till December 1978 when the stock lying at the Plant was exhausted. The Alloy Steels Plant paid for the supplies at the rate of Rs. 1,500 (market rate) plus Rs. 500 per tonne.

4. *Services and Fuel*

4.01 In addition to raw materials and refractories, different units of the Steel Plants require various types of services and fuel for the production of iron and steel. Some of the important services required are steam, electricity, oxygen, compressed air, water and air blast. The fuel requirements comprise gases like coke oven gas and blast furnace gas and liquid fuel such as coal tar fuel (pitch creosote mixture), benzene, naphtha and furnace oil. For the production of some of these services and fuel, separate units have been set up, while other items are produced as concomitants of the regular operation of certain other units of the Steel Plant. The production and consumption of important services and fuels are discussed in the succeeding paragraphs.

4.01.01 *Steam*

(1) Steam is produced in the main boilers installed in the Power Plant itself and in the waste heat boilers of O.H. furnaces and Sulphuric Acid Plant. According to the Project Report, the main boilers are expected to be operated with the help of surplus gases supplied by Coke Ovens and Blast Furnaces supported by

coal to the extent of 50,000 tonnes per annum. On account of inadequate availability of gases due to operation of Steel Plant units at lower capacity, coal and other liquid fuel had to be used in large proportions for the production of steam in the main boilers, as indicated below :—

Year	Consumption of fuel as per D.P.R.		Actual Consumption of fuel		
	Gases (10^6K calories)	Coal (Grade 'A') (in tonnes)	Gases (10^6K calories)	Coal (in tonnes)	Liquid fuel (Kl)
(1)	(2)	(3)	(4)	(5)	(6)
1970-71	2988100 (91.2)	50,000 (8.8)	7,70,374 (33.4%)	2,11,634 (54.7%)	26,075 (11.9%)
1971-72	,, ,,	,, ,,	6,34,770 (24.5%)	2,95,539 (65.0%)	24,827 (10.5%)
1972-73	,, ,,	,, ,,	6,80,277 (23.9%)	3,01,654 (63.6%)	33,992 (12.5%)
1973-74	2988100 (91.2)	50,000 (8.8)	6,33,203 (21.4%)	3,33,056 (63.0%)	43,452 (15.6%)
1974-75	,, ,,	,, ,,	6,33625 (22.0%)	3,61,865 (63.3%)	40,033 (14.7%)
1975-76	,, ,,	,, ,,	7,34,754 (23.8%)	3,39,070 (62.9%)	38,911 (13.3%)
1976-77	,, ,,	,, ,,	12,02,881 (35.4%)	3,16,848 (56.6%)	25,867 (8.0%)
1977-78	,, ,,	,, ,,	11,94,815 (36.1%)	3,22,736 (56.0%)	25,011 (7.9%)

NOTES : (1) Figures in brackets indicate percentage of consumption of each type of fuel to total consumption.

(2) The Project Report envisaged that the calorific value of coal 'A' grade would be 5800 K. Cal./Kg. The percentage of input fuel has been worked out on this basis.

The Management stated (February 1977) that whatever blast furnace and coke oven gas was available for power and blowing station was made use of.

(2) As mentioned in the 2.5 million tonne Project Report, the efficiency of the boilers envisaged in the 1 million tonne and 2.5 million tonne stages is as follows :—

(*i*) With 100 per cent blast furnace gas as fuel . 85 per cent

(*ii*) With 100 per cent coal (5500 Cal/kg) as fuel . 90 per cent.

(*iii*) With mixture of both in the proportion of 30 per cent B.F. gas and 70 per cent coal . . 82 per cent.

The thermal efficiency and heat consumption per kg. of steam produced during 1970-71 to 1977-78, however, showed wide variation, as indicated below :—

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Heat consumption per Kg. of steam produced (in K/Calories)	767	805	809	820	800	799	790	805
Thermal efficiency (in percentage)	84.3	80	79.9	78.9	80.8	80.9	81.8	79.1

The Management attributed (May 1975) the following factors for variation in heat consumption and thermal efficiency :—

Reasons for variation in boiler efficiency

(a) Gradual decrease in heat supply from coke oven gas from 12.2 per cent to 3.2 per cent of the total heat supply to boilers.

(b) Gradual decrease in heat supply from blast furnace gas.

(c) Increase in heat supply from coal and liquid fuel.

Reasons for decrease in thermal efficiency and increase in heat consumption.

(i) Absence of facilities in the Plant for weighment of each wagon and checking the percentage of moisture in each of them.

(ii) Varying ash and moisture content in coal received from different collieries.

(iii) Calculation of gas consumption from hourly average consumption and liquid fuel by estimation.

(iv) Running of 4 boilers from 1973 onwards with less thermal load, leading to drop in thermal efficiency.

4.01.02 *Electricity*

(1) The requirement of electricity for the operation of the Steel Plant (7,07,310 $\times$ 10^3 KWH per annum) is mainly met by the Madhya Pradesh State Electricity Board. However, two turbo generators of 12 MW each were installed in one million tonne stage with a view to ensuring un-interrupted power supply to the essential loads of the Plant and a third generator of the same capacity was installed in the 2.5 million tonne stage. Against the theoretical generation capacity of 3,15,360 Megawatt hours, of the three generators, the firm capacity of these generators has been fixed in the D.P.R. for the 2.5 million tonne stage at 2,52,000 Megawatt hours.

The following table indicates the total consumption of electricity in the Steel Plant, power generated in the captive plant and power purchased from the Electricity Board during 1970-71 to 1977-78 :—

(In Megawatt hours)

Year	Total consumption of electricity	Power generated in captive plant	Purchased from Electricity Board	Percentage of own generation to consumption
(1)	(2)	(3)	(4)	(5)
1970-71	6,43,183	1,62,810	4,80,373	25.31
1971-72	6,57,213	1,55,156	5,02,057	23.61
1972-73	6,96,947	1,66,115	5,30,832	23.83
1973-74	6,91,880	1,66,062	5,25,818	24.00
1974-75	7,07,294	1,74,868	5,32,426	24.72
1975-76	7,41,567	2,14,029	5,27,538	28.86
1976-77	7,78,773	2,50,420	5,28,353	32.16
1977-78	7,70,118	2,21,240	5,48,878	28.73

The Management stated (February 1977) that :—

> "the level of generation at the captive power plant was governed by (a) technical considerations and (b) optimum sharing of load and maximising import from M.P.E.B. within the limits of the contract demand".

The actual consumption of steam per Kwh of electricity produced *vis-a-vis* the norm as per the Project Report and the thermal

efficiency of the generators achieved during 1970-71 to 1977-78 were as follows :—

Year	Consumption of steam as per D.P.R. (per Kwh)	Acutal consumption of steam (per Kwh)	Steam input per Kwh (K. Cal)	Efficiency of generators (860 K. Cal per Kwh=100% efficiency)	Thermal Efficiency of boiler-cum-generators
(1)	(2)	(3)	(4)	(5)	(6)
	(Kg.)	(Kg.)		(%)	(%)
1970-71 . .	5.75	7.6	5854	14.69	12.38
1971-72 . .	,,	7.4	5916	14.54	11.63
1972-73 . .	,,	7.7	6229	13.81	11.03
1973-74 . .	,,	8.4	6888	12.49	9.85
1974-75 . .	,,	8.6	6880	12.50	10.10
1975-76 . .	,,	7.8	6232	13.80	11.16
1976-77 . .	,,	7.4	5846	14.71	12.03
1977-78 . .	,,	7.5	6038	14.24	11.26

NOTES : (1) Thermal efficincy of generators has not been indicated in the D.P.R.

(2) The Management stated (February 1977) that credit for 80 per cent of the steam bled from Turbogenerator at 8 Atm. should also be given and the effective input of steam should be taken into account. However, as the consumption in column 2 (i.e. as per D.P.R.) is on gross basis and Management have also adopted the gross figures in ths annual operational statistics and the credit has not been given in the cost sheet, gross figure has been maintained.

The consumption of steam per Kwh of power generated varied from year to year and was more than the norm indicated in the Project Report. Similarly thermal efficiency showed wide variations.

(2) *Transmission losses*

It will be seen from data given below that transmission losses (in distribution and transforming) ranged from 2.4 per cent to 3.6 per cent of the total available power supply during 1970-71 to 1977-78 :—

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Transmission Loss in MWH	18144	19746	22817	21748	24885	26512	23819	18430
In terms of percentage	2.8	3.0	3.3	3.1	3.5	3.6	3.1	2.4

4.01.03 *Oxygen*

Oxygen is produced in the Oxygen Plant which consists of three units each (including one unit as a stand by) having a rated capacity of 5000 M^3 of technological oxygen per hour required by the Steel Melting Shop.

From the data given below, it will be seen that there was excess consumption of gas as well as renting of gas during 1970-71 to 1977-78 :—

Year	Qty. of techno-logical oxygen produced (10^3 M^3)	Qty. of techno-logical oxygen actually consumed in SMS (10^3 M^3)	Oxygen bled out (Col. 2–3) (10^3 M^3)	Projected norm of consump-tion of oxygen per tonne of steel (M^3)	Rollable Steel ingots produced (Tonnes)	Qty. of oxygen required as per norms (35 M^3 per tonne of steel (ingot) (10^3 M^3) (5) × (6) / 10^3	Excess consum-ption of oxygen (3–7) (10^3 M^3)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1970-71	96,336	83,052	13,284	35	19,39,794	67,893	15,159
1971-72	1,05,121	89,495	15,626	35	19,53,200	68,362	21,133
1972-73	1,10,228	93,694	16,534	35	21,07,920	73,777	19,917
1973-74	1,10,271	96,065	14,206	35	18,94,150	66,295	29,770
1974-75	1,18,532	96,150	22,382	35	20,01,280	70,045	26,105
1975-76	1,14,984	89,209	25,775	35	22,08,730	77,306	11,903
1976-77	1,18,610	97,699	20,911	35	23,02,110	80,574	17,125
1977-78	1,19,002	1,02,702	16,300	35	23,70,715	82,975	197 27

On account of excess consumption of oxygen, all the three units of the Oxygen Plant had to be operated simultaneously except during the period of repairs. In this connection the Management stated (November 1977) as follows :—

> "Due to intensive oxygen lancing, oxygen consumption per tonne of steel had been more than the projected value of 35 M^3 per tonne. The increased rates of consumption have resulted in appreciable reduction in the heat duration which was less than the Projected estimations".

4.01.04 *Compressed Air*

Compressed Air (at 6 to 8 Atm. pressure) is used for liquid fuel pulverization, pneumatic instruments and mechanism, fanning cranes and motors and for water spraying in ventilation devices. Ten compressor sets (including two stand bys), each having a capacity of 100 M^3 per minute at a pressure of 9 Atm ; have been set up to meet the requirement of compressed air for 2.5 million tonne stage of the Steel Plant and no additional facilities were provided in the 6th Blast Furnace Complex. According to the D.P.R. a consumption of 298500 10^3 M^3 units of compressed air was envisaged to be consumed for a rated production of 25 lakh tonnes of steel ingots. A loss of 6% (18000 10^3 M^3 units) was also envisaged therein. Actual consumption of compressed air as well as losses were, however, much higher than the stipulation made in the Detailed Project Report, despite non-attainment of rated production of steel as per details given below :—

(Unit—1000 M^3)

Year	Compressed air actually produced	Compressed air actually consumed	Losses
1972-73	477521	450300	27221
1973-74	481064	453645	27419
1974-75	485386	457719	27667
1975-76	499096	470648	28448
1976-77	498666	470242	28424
1977-78	581037	547918	33119

In this connection, the Management stated (December 1973) as follows :—

> "As per original design, separate flow meters for measuring the quantity of compressed air for each consuming unit have not been provided. The entire consumption as recorded in the centralised compressed air station is allocated to the different consuming units based on experience. We are, therefore, not in a position to indicate clearly the reasons for higher consumption in any shop for any year".

Though the production capacity for compressed air was more than the requirement, the Board of Directors approved (March 1972) the installation of two additional centrifugal compressors of 250 M^3/minute capacity each at an estimated cost of Rs. 47.94 lakhs to overcome the serious problem of pressure drop in the pipelines. An expenditure of Rs. 73.14 lakh was incurred upto 31st March 1979. The scheme was expected to be completed by 31st March 1977. However, two units were commissioned in July 1977 and March 1978.

The Ministry stated (October 1978) as follows :-

> "the consumption of compressed air largely depends upon the demand from different users and the pressure under which this is supplied to the different users. In case, due to technological reasons the pressure of compressed air produced by the plant falls below the prescribed minima, there will not be any flow of compressed air to the consumer, even though, in volumetric terms, the production will appear to have been achieved. In order to maintain the requisite pressure of the compressed air, the plant decided to install two additional certrifugal compressors of 250 M^3/minute capacity. These have since been commissioned".

4.01.05 *Air Blast*

Air blast is produced in the Power and Blower Plant for supply to Blast Furnaces.

The table below shows the actual consumption of air blast per tonne of hot metal during 1970-71 to 1977-78 vis-a-vis that envisaged in the Project Report and norms fixed by the Management :—

(M^3)

Year	Consumption per tonne of hot metal		Actual consumption per tonne of hot metal
	As envisaged in the Project Report (2.5 MT)	Norms fixed by the Management	
1970-71	2224	2600	2779
1971-72	2224	2700	3119
1972-73	2224	2700	3009
1973-74	2224	2800	3216
1974-75	2224	2800	2905
1975-76	2224	2800	2855
1976-77	2224	2800	2774
1977-78	2224	2800	2929

The Management stated (December 1971) that turbo blowers supplying air blast to Blast Furnaces were required to be operated within narrow parameters to maintain steady and stable conditions and it was not possible for the blowers to cut down air blown in order to meet reduced or varying requirements of air from time to time. Further, on consideration of safety of blowing equipment, it was inevitable to let some air blow into the atmosphere by operating the blowers at a steady regime. It was further stated in January 1977 that the higher ash content in coke also was one reason for higher consumption of air blast per tonne of hot metal.

4.01.06 *Fuel*

(1) All the units of Steel Plant which consume fuel for operation, use gas as principal fuel. It was noticed that the

production of gas was less than that envisaged in the Project Report, as indicated below :—

(In 10^9 Kilo calories)

year	Coke Oven Gas			Blas Furnace Gas			Remark
	As per Project Report (6th B.F. Complex)	As per Project Report for 2.5 M.T. plus Addi-tional facilities in the 6th Blast Furnace as intimated by MECON and adopted by the Manage-ment Decem-ber '77)	Actual	As per Project Report (6th B.F. Complex)	As per Project Rport for 2.5 M.T. plus Addi-tional facilities in the 6th Blast Furnace as intimated by MECON and adopted by the Manage-ment Decem-ber, '77)	Actual	
1970-71	5301	5049	3834	7411	6220	4657	
1971-72	,,	,,	3281	,,	,,	4469	
1972-73	,,	,,	4115	,,	,,	4691	
1973-74	,,	,,	3540	,,	,,	4316	
1974-75	,,	,,	3694	,,	,,	4497	
1975-76	,,	,,	4091	,,	,,	4911	
1976-77	,,	,,	4505	,,	,,	5917	
1977-78	,,	,,	4524	,,	,,	5948	

The Management attributed (November 1977) the following reasons for less production of gas :—

"Until 1975-76 neither all the six Blast Furnaces nor all the seven batteries were in operation due to extraneous constraints in coal supplies..... In the case of B.F. gas, the gas make has been less mainly because of improved working of Blast Furnaces with considerable reduction in the coke rate as compared to projected values. With lower coke consumption, the gas make has also been less".

(2) The rate of consumption of fuel was more in consuming units, especially Coke Ovens, Open Hearth Furnaces, Soaking Pits, Rail and Structural Mill, Merchant Mill and Wire Rod Mill than the Project norm and the norm intimated (December 1977) by the Management, as per details given below :—

(In 10^3 K. Cal.)

Heat consumption	As per Project Report (6th Blast Furnace Complex)	As per DPR of 2.5 MT plus Additional facilities in 6th Blast Furnace complex intimated by MECON and adopted by the Management (Dec. 77)	ACTUAL CONSUMPTION							
			1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Per tonne of dry charge (Coke Ovens)	*617 608	608	668	704	696	688	676	671	673	639
Per tonne of steel (SMS)	900	900	1026	978	1000	1032	1015	1031	1049	1001

Per tonne of ingot rolled (Soaking pits)	280	280	439	391	415	419	407	429	376	405
Per tonne of finished products (Rail and Structural Mill)	560	560	985	1078	987	967	991	942	801	877
Per tonne of finished products (Merchant Mill)	638	638	765	896	703	706	761	731	687	707
Per tonne of finished products (Wire Rod Mill)	520	520	628	636	625	583	618	605	567	556

*As per the 2.5 M.T.P.R.

4.02 *Internal Rail Transport*

(1) The Project Report envisaged the provision of 42 diesel locomotives in the Plant area (including two as stand bys). The actual fleet strength was, however, 53, 53, 55, 69, 69, 71, 74 and 71 during the 8 years from 1970-71 to 1977-78 respectively. 2 Hanschal and 2 Telco Locos, though included in the fleet, were not working. Further, the fleet includes quite a large number of Russian Locomotives (27 in 1974-75 and 1975-76) and according to the Management (March 1971) the performance of the Russian Locomotives was sub-standard. The Plant had also to take on hire steam locomotives from the Railways. The Management stated (March 1971) that locos were hired mostly for exchange of pilots, a job which could not be done by Hitachi or Hanschal locos due to limitation in their hauling capacity. Steam locos have a shunting capacity of about 2500 tonnes as against 1500 tonnes and less of Hitachi and Hanschal Locos.

The sub-standard performance and lesser availability of imported locomotives was considered by the Committee on Public Undertakings in Paragraphs 3.42—3.47 of their First Report (Fifth Lok Sabha—1971-72). The Ministry had informed the Committee in January 1973 of the steps taken to ensure adequate availability of locomotives. It was also stated that there would be no more bottlenecks in the internal transport of the Plant.

(2) *Demurrage and Wharfage Charges*

The amount of demurrage and wharfage paid and the number of wagons handled during 1970-71 to 1977-78 are indicated below :—

Year	No. of Wagons handled	Demurrage (Rs. in lakhs)
(1)	(2)	(3)
1970-71	5,34,295	60.87
1971-72	5,30,035	46.78
1972-73	5,32,223	62.89
1973-74	4,95,996	219.55
1974-75	5,20,411	259.88
1975-76	5,87,672	242.27
1976-77	6,49,442	186.92
1977-78	6,42,634	130.67

This includes substantial amount of demurrage & wharfage paid to Railways for detention of wagons for a period longer than the free time allowed.

The Management attributed (February 1974) following reasons for excessive payment of demurrage :—

(a) Unrealistic Railway rules which do not take into account detention inherent in the system of railway operations inside the Plant and limitation of Railway Exchange Yard.

(b) Unregulated flow of traffic, bunching, over-supplies, under-supplies, use of wagons not suitable to the internal lay-out.

(c) Hold-up of wagons inside the plant due to sudden imposition of restrictions by Railways.

It may be mentioned that this was also due to defects in the Railway Yard which had been pointed out by Railways as early as in 1970.

A study made by the Statistical Quality Control Department in February to July 1972 and May 1974 to January 1975 had indicated that the railway wagons loaded with finished products were being detained inside the Plant for 36 hours, on an average, against the free time of 24 hours. It was stated by Management (December 1975) that implementation of certain measures suggested had helped in bringing down the average detention time.

The free time allowed by Railways had been increased during 1973-74, but, according to Management (January 1975), this did not lead to any material benefit on account of the withdrawal of certain other concessions previously allowed.

4.03 *Stores and Spares*

The value of consumption of stores and spares as compared with the total expenditure incurred on the production of steel during 1970-71 to 1977-78 is given below :—

(Rs. in crores)

Year	Expenditure on stores and spares	Total expenditure	Percentage
1970-71	26.65	171.35	15.55
1971-72	33.03	196.37	16.82
1972-73	38.71	244.55	15.83
1973-74	42.77	265.44	16.11
1974-75	48.62	311.62	15.60
1975-76	59.75*	352.40	16.96
1976-77	66.32*	431.33	15.38
1977-78	74.24*	486.40	15.26

*Includes naphtha, benzene and boiler coal as in earlier years.

A committee appointed by Steel Authority of India Limited observed (October 1973) that it was possible to bring down

progressively the consumption of spares to the extent of 5 to 10 per cent per annum from 1975-76 onwards by introducing systematic forward planning for spares, stores and tools and regular inspection of machinery etc.

The Management stated (November 1977) as follows :—

> "..... it is very difficult to cut down the stores and spares consumption by 5 to 10 per cent per annum. With the ageing of the plant, consumption of maintenance spares would go up."

5. *By-Product and arisings*

5.01 *By-products*

5.01.01 In order to recover valuable chemicals from crude coke oven gas and also to remove harmful and corrosive ingredients therefrom, a by-product plant, with the following units, has been installed (cost as on 30th April, 1978 was Rs. 8.19 crores).

Units	Final product produecd.
Ammonium Sulphate Plant.	Ammonium Sulphate.
Benzol Rectification Plant.	Benzene, Toluene, Xylene, Solvent Naphtha
Tar Plant.	Pitch, Tar Products, Crude Tar Oil, Naphthalene, Crude Anthracene, Creosote oil, Fuel Oil, Wash oil.
Sulphuric Acid Plant.	Mainly to meet the requirement of Sulphuric Acid for Ammonium Sulphate Plant and Benzol recrification plant.

5.01.02 The data given below will indicate that the average yield of some principal by-products during 1972-73 to 1977-78 was less than the norms given in the Project Report and those

fixed by the Norms Committee appointed by the Company in March, 1968;

Product	Norms of yield as per Project report*	Norms of yield as fixed by the norms Committee*	Actual yield				
			1972-73	1973-74	1974-75	1975-76	1976-77
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crude Tar (as percentage of dry coal charge)	3.0	3.0	2.93	3.20	3.04	3.04	3.02
Crude Benzol (as percentage of dry coal charge)	0.9	0.8	0.59	0.64	0.61	0.68	0.75
Ammonium Sulphate (as percentage of dry coal charge)	1.2	1.1	0.91	0.99	1.01	0.99	1.03 1977-78
							2.99
							0.73
							1.03

*Not :—Two departmental Committees appointed by the Company in 1967 and 1972 to review the performance of the By-products plant had fixed the following norms of yields.

	1967 Committee (Raju Committee)	1972 Committee (Nagarkatti Committee)
Crude tar.	3 per cent	3 per cent
Crude benzol	0.8 per cent	0.55 per cent
Ammonium Sulphate	1.1 per cent	0.9 per cent

The Central Fuel Research Institute correlates the recovery of primary by-products to the volatile matter in the coal and not to the ammonia and benzol content in the gas. The Management stated (January 1975) that the yield of by-products, as per the C.F.R.I. formula, would vary with different values of volatile matter in the coal used. It was also stated that the primary aim of coke ovens being the production of coke suitable for blast furnaces, the carbonisation conditions were regulated to obtain the best quality of coke consistent with the quality of coal available.

5.01.03 The rated capacity of the Sulphuric Acid Plant, set up in two stages, is 27,000 tonnes against the total requirement of 29,200 tonnes of 78% acid and 2,800 tonnes of regenerated 40% acid, upto the 2.5 million tonne stage of the steel Plant. Another Plant with a capacity of 18,000 tonnes of acid was also commissioned in November, 1975 as part of the 6th Blast Furnace complex.

As against the total capacity of 45,000 tonnes, actual Production of Sulphuric Acid was as follows :—

	1970-71	1971-72	1972-73	1973-74	1974-75
(1)	(2)	(3)	(4)	(5)	(6)
Production in tonnes	17,970	18,397	21,949	18,261	23,011
		1975-76	1976-77	1977-78	
		26,930	33,256	36,150	

It was stated (February 1974) that production was regulated to meet the requirement of Ammonium Sulphate Plant and Benzol Plant.

5.02 *Other Arisings*

(1) Scrap is an important arising in the production of steel. It arises in the form of iron scrap or steel scrap; the former mainly arises in Blast Furnaces, Pig Casting Machines, Foundry and in the form of broken moulds and bottom plates in the Steel Melting Shop, while the latter mostly arises in the Steel Melting Shop and Rolling Mills. Iron scrap is consumed in the Blast Furnaces and the Steel Melting Shop, while steel scrap is mainly consumed in the Steel Melting Shop. The Project Report for the 2.5 million tonnes stage envisaged iron and steel scrap arisings to the extent of 1.05 lakh tonnes and 5.22 lakh tonnes respectively which was just equal to the expected consumption.

The data relating to actual arisings of iron and steel scrap during 1970-71 to 1977-78 are given in Annexure XII. It will be seen therefrom that the recovery of steel scrap (in terms of percentage of input) in Rolling Mills was less than the Project norms except during 1975-76 and 1977-78 while in the Steel Melting Shop it was more than that contemplated in the detailed Project Report. The consumption of steel scrap in the Steel Melting Shop was more than the total arisings except during 1973-74 and 1975-76 to 1977-78 and the shortfall was made good by making purchases of small quantities from the market. In this connection, it may be mentioned that a part of the steel scrap (including defectives and cutting) recovered especially from the Wire Rod Mill and Merchant Mill, was sold to out-side parties as this was stated to be not suitable for remelting in the Steel Melting Shop, as per details given below :—

	1970-71	1971-72	1972-73	1973-74	1974-75
Qty. sold (in tonnes)	20,810	15,642	13,093	14,089	9,511
		1975-76	1976-77	1977-78	
		16,734	15,456	13,010	

It may be mentioned that defectives and cut pieces fetch higher realisation than scrap.

(2) *Mill Scale Arisings*

Mill Scale is one of the arisings in the Rolling Mills and is used primarily in the Sintering Plant. The Project Report envisaged a burning loss of 1.11 lakh tonnes of metal constituting 4.4 per cent of steel ingots input (25 lakh tonnes) in the Rolling Mills and this results in arising of mill scale. According to the Project Report the quantity of 1.50 lakh tonnes rolling mill scale (which represents 6% of rollable ingots) was expected to be consumed in the Sintering Plant.

The actual mill scale arisings and consumption during 1970-71 to 1977-78 were, however, as follows :—

(Figures in lakh tonnes.)

Year	Arisings as per Cost Sheet	% of arisings to Steel ingots rolled	Consumption		Total
			Sintering Plant	Steel Melting shop	
1970-71 . .	0.48	2.5	0.60	0.05	0.65
1971-72 . .	0.42	2.3	0.49	0.05	0.54
1972-73 . .	0.54	2.5	0.73	0.07	0.80
1973-74 . .	0.49	2.4	0.64	0.05	0.69
1974-75 . .	0.64	3.2	0.60	0.04	0.64
1975-76 . .	0.87	3.9	0.81	0.06	0.87
1976-77 . .	0.94	3.9	0.86	0.08	0.94
1977-78 . .	0.85	3.6	0.70	0.09	0.79

The arisings of the scales at certain points are not reported in the operational statistics. Hence, the arisings indicated above represent only the quantity for which credit has been given in the cost sheet.

(3) *Blast Furnace Slag*

The Project Report for 6th Blast Furnace Complex envisaged the arisings of blast furnace slag to the extent of 19.41 lakh tonnes annually, *i.e.* 64 per cent of hot metal and the Management intimated in December, 1977 the arising as 16.63 lakh tonnes *i.e.* 56% of hot metal.

This slag has different uses in different forms *e.g.* in the form of granulated slag for the manufacture of cement, slag aggregates as ballast for railway track and road making and slag wool as mineral wool products. On the basis of the experiments made by M/s. Associated Cement Company Limited at the instance of Government, the blast furnace slag of Bhilai Steel Plant was found suitable for the manufacture of Cement.

A slag Granulation Plant with a capacity of 9.50 lakh tonnes was commissioned in November, 1964 at a cost of Rs. 51.18 lakhs. A slag aggregate Plant with a capacity of 4.12 lakh tonnes was commissioned in July, 1965 at a cost of Rs. 58.54 lakhs. A slag wool Plant, though envisaged in the Project Report has not, however, been set up due to lack of demand. The arising of the blast furnace slag, the quantity consumed in the Slag Granulation Plant and Slag Aggregate Plant and quantity dumped during 1970-71 to 1977-78 are indicated below :—

(Figures in lakh tonnes)

Year	Slag arising	Quantity of Slag consumed		Quantity of slag Dumped
		Slag Granulation plant	Slag Aggregate Plant	
1970-71	12.96	5.85	0.10	7.01
1971-72	13.53	4.78	0.28	8.47
1972-73	14.89	4.87	0.31	9.71
1973-74	13.65	5.05	0.19	8.41
1974-75	13.95	6.01	0.38	7.56
1975-76	14.34	7.30	0.40	6.64
1976-77	15.07	8.06	0.46	6.55
1977-78	14.86	8.51	0.31	6.04

NOTE : The Project Report for the 2.5 million tonne stage envisaged consumption of 4.82 lakh tonnes of Slag in the Slag Aggregate Plant and 0.41 lakh tonnes of Slag in the Slag Wool Plant. As regards Slag Granulation Plant the consumption has been shown as 2.55 lakh tonnes for production of 2.50 lakh tonnes of granulated slag. On this basis, the total consumption of Slag comes to 9.69 lakh tonnes for the Slag Granulation Plant with a rated capacity of 9.5 lakh tonnes. Thus the total consumption comes to 14.92 lakh tonnes of the total arising of 19.41 lakh tonnes as per the 6th Blast Furnaces Complex report.

It will be seen that the utilisation of slag in the Slag Granulation and Slag Aggregate Plant was much less than the rated capacity. This has been stated to be due to lack of balancing facilities and low off-take due to the absence of loading facilities/non-availability of wagons in the former case and extremely low demand in the later case.

(4) *Arising of small size coke*

The Blast Furnaces of the Bhilai Steel Plant are designed to use coke of the size of 25 mm and above. Coke of lower sizes (0—25 mm) is known as pearl coke and coke breeze depending upon the size. These arise at the coke ovens and blast furnaces and are partly consumed in some shops of the Plants.

As per the D.P.R. for the 6th Blast Furnace Complex, the arisings of the small size coke are to constitute 14.1 per cent of the total production of coke (32.11 lakh tonnes wet). According to the revised figures intimated by the management in December 1977, the percentage is, however, 15.2 per cent of the total production of coke (30 lakh tonnes wet). The actual arisings during 1970-71 to 1977-78 were, however, 14.8 per cent. 16.6 per cent, 15.5 per cent, 19.6 per cent, 18.5 per cent, 20.4 per cent, 18.37 per cent and 16.43 per cent respectively. There was more arising of 0—25 mm coke at the Blast Furnaces as compared to norms during 1973-74 to 1977-78, which was ascribed to the following factors :—

(i) Less efficient separation at coke ovens with the result that some—25 mm fractions were carried forward to Blast Furnaces.

(ii) More breakage during transit—poor quality of input materials *i.e.* coal.

6. *Costing system and analysis of cost*

6.01 The operations in different units of the Bhilai Steel Plant widely differ from one another, extending from extraction of ores and minerals from captive mines to production of iron and steel, recovery of chemicals in by-products plants and manufacturing operations in engineering shops. As a result, unit costing is followed in mines and quarries, process costing in the case of manufacture of iron and steel, by-product costing in by-product plants and job-costing in engineering workshops.

In pursuance of the recommendations made by the COPU in its Fifteenth Report (1967-68), standard costing system was introduced in Bhilai Steel Plant from April, 1970. Physical norms for consumption of raw materials and services are determined each year. On the basis of budgeted production determined after taking into account the anticipated level of activity and efficiency, cost is estimated for each product at the beginning of the year. The cost so worked out, is treated by the Management as standard cost. Norms are fixed at plant level based on its actual performance and are to be reviewed once in every year so that necessary corrections may be incorporated.

In addition to a monthly cost statement for each unit, an annual cost statement based on financial accounts is prepared. Variance reports analysing the causes of variations on the basis of the standard cost are also prepared every month. In compiling the cost data, expenditure pertaining to abnormal events *e.g.* strike etc. is not segregated but is allocated along with other expenditure to the unit of production.

A comparison of actual cost with the estimated cost indicated that, in a number of cases, actual cost was higher than the estimated cost.

The extent of variance in cost during 1973-74 to 1977-78 due to various causes is indicated in Annexure XIII.

Increase in actual cost as compared with the estimated cost has been attributed by the Management to the following reasons except in 1976-77 when actual cost was lower than the standard cost.

Years	*Reasons for variations*
1973-74	Low volume of production, higher consumption of iron scrap, ferro manganese and higher rates of inputs (including coal).
1974-75	Low volume of production, higher consumption of ferro manganese and hot metal, higher provision for re-lining and re-building, increased cost of coal and other raw materials.
1975-76	Lower volume of production and higher consumption of operating supplies including coal.
1977-78	Higher expenditure on re-lining and re-building, higher usage of coke and increased expenditure on ferro alloys.

6.02 *Cost versus Selling Prices*

The selling prices of standard steel products of plant are fixed by the Joint Plant Committee with the approval of Government from time to time. The table below indicates the average net ex-works selling prices of finished products

during the year 1970-71 to 1977-78 as a percentage to the cost of production of the relevant year.

	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
1. Billets	90.70	79.65	83.89	99.59	108.62	106.18	91.93	97.83
2. Rails	87.82	79.95	91.56	79.79	75.37	81.56	99.90	93.15
3. Structurals . . .	99.31	84.16	95.19	94.14	89.99	91.17	96.72	91.82
4. Merchant Products . .	111.13	94.82	101.59	100.64	104.07	96.56	100.86	96.31
5. Wire Rods . . .	116.36	103.48	108.75	131.83	143.25	130.42	121.64	119.14

It will be seen that the selling prices fixed by the Joint Plant Committee were less than the cost of production in Rails and Structurals Mill in all the years and in respect of billets during 1970-71 to 1973-74 and 1976-77 to 1977-78. In the case of wire rods and merchant products, selling prices were higher than the cost of production except in 1971-72, 1975-76 and 1977-78 in regard to merchant products.

7. *Man Power Analysis*

7.01 The number of regular men employed in the Steel Plant during 1971-72 to 1977-78 *vis-a-vis* the provision made in the Project Report is indicated below :—

Deptt.	DPR provision No.	Actual 1971-72 No.	1972-73 No.	1973-74 No.	1974-75 No.	1975-76 No.	1976-77 No.	1977-78 No.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(8)
Works	13,464	27,709	28,133	28,694	29,222	29,638	30,200	30,298
Mines & Quarries . . .	Not given	5,931	5,847	9,428	9,741	9,709	9,251	9,264
Admn. & Township . .	–do–	6,609	6,865	7,316	7,402	7,866	8,791	9,232

NOTE:—1. The figures exclude number of men employed on construction activity but include executives as below:

	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Works	1,552	1,685	1,876	1,995	2,102	2,156	2,188
Mines & Quarries	156	176	198	211	216	226	235
Admn. & Township . . .	364	417	457	477	502	553	579

In November, 1968 the staff strength of the works Departments of the Plant was frozen by the Board of Directors at 1319 executives and 24,186 non-executives. As a result of a study made by the Management in consultation with the Administrative Staff College, Hyderabad, the staff strength of the Works Department was fixed at 20,415 (Non-executives) in September 1971. This was subsequently revised in December, 1972 to 26,279 after making a further study. It will, however, be seen that the actual strength was more not only than the provision made in the D.P.R. but also in comparison, with the strength fixed in September, 1971 and December, 1972.

The Management attributed (November, 1977) the increase in manning to installation of additional units, strengthening of the maintenance department due to ageing of equipments, departmentalisation of some mines etc.

7.02 *Labour Productivity and Cost*

The Mahtab Committee in its report submitted in June, 1966 had observed that it should be possible to increase the productivity of Works personnel from the existing level of 55 to 70 ingot tonnes per man year to about 125 ingot tonnes per man year and above in each Steel Plant. The Management fixed the target of 100 tonnes per man year for Bhilai Steel Plant. The actual productivity attained during 1971-72 to 1977-78 was 76 tonnes, 78 tonnes, 68 tonnes, 70 tonnes, 76 tonnes, 82 tonnes and 87 tonnes per man year respectively.

The cost of labour (direct and indirect) for producing one tonne of ingot steel during 1971-72 to 1977-78 was as follows :—

(Figures in rupees)

	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Works Deptt.							
Wages and Salaries.	65.60	69.44	83.52	95.30	105.87	95.37	108.73
Overtime	6.30	6.80	7.02	6.81	7.18	6.56	7.45
Incentive bonus	7.70	14.40	14.53	16.53	23.07	29.41	29.70
TOTAL	79.60	90.64	105.07	118.64	136.12	131.34	145.88
Admn. & Township :							
Wages and Salaries	15.80	16.56	21.24	25.00	29.50	28.63	31.90
Overtime	0.61	0.66	0.52	0.73	0.70	0.47	0.60
Incentive.	..	..	..	..	..	1.14	1.60
TOTAL	16.41	17.22	21.76	25.73	30.20	30.24	34.10
GRAND TOTAL	96.01	107.86	126.83	144.37	166.32	161.58	179.98

8. *Inventory Control*

8.01 Annexure XIV indicates the inventory holding of the Plant at the end of 1970-71 to 1977-78.

In March 1973 the Bhilai Steel Plant had engaged a private firm of material management consultants (Messrs. A. R. Palit and Company Limited, New Delhi) on a fee of Rs. 15,000 plus out of pocket expenses to carry out detailed survey of various aspects of material management. The consultants submitted the report in September, 1973. Among other things, the build-up of inventories during last several years was attributed by the consultants to the following main factors :—

(a) Indiscriminate and rush purchases;

(b) Absence of commonality and inter-changeability studies;

(c) Recoupment of stores on the basis of lead time instead of 'cycle time';

(d) Higher levels of safety stocks;

(e) Long time taken in releasing R. Rs due to lack of liaison between Purchase and Accounts Departments. This had led to longer lead time and consequently higher inventories.

The Management stated (November, 1977) *inter alia*, that the following improvements were effected in pursuance of the report of the consultants :—

(a) Improvement in the inventory control since 1973-74;

(b) Introduction of the inventory control at the indenting stage itself;

(c) Special efforts were made from 1975-76 for analysis of slow moving/non-moving items on continuous basis for identification of surpluses based on guidelines given by the B.P.E.

To strengthen the material management functions of the Plant, keeping in view the recommendations of the consultants, the Management has constituted (September, 1974) a Material Management Committee; the Committee meets once in a quarter. For conducting the follow-up survey of the materials management of the Plant, the services of the consultants (M/s. A. R. Palit and Co.) were again requisitioned by the Management in September/October, 1975. The consultants in their report of October, 1975 observed as under :—

(i) The imbalance of purchase over consumption during the year 1974-75 alone was of the order of Rs. 10 crores.

(ii) There was poor sale of surplus items due to tardiness in both scrutiny as well as disposal of surplus and non-moving/slow moving surplus items.

(iii) Much progress in regard to declaration of surplus and disposal of non-moving and slow moving items was not noticed.

(iv) Only a very small percentage of total number of items in the vocabulary was covered by A.B.C. analysis.

The consultants again drew attention to the need of purchase holiday. This suggestion was accepted by the Management and a purchase holiday was declared from 15th December, 1975 to 15th January, 1976.

The Ministry stated (October, 1978) as follows :—

"Since 1975 distinct progress has been made towards review of slow moving and non-moving stores and declaration of surpluses. Risk insurance spares have been mostly indentified and all spares have

been brought under a uniform and rationalised material coding system. It has also been possible to reduce varieties in a number of items."

8.02 *Minimum and maximum limits*

(1) *Raw Materials*

In April 1969 the Board of Directors had fixed the limits of holdings for different raw materials as indicated in annexure XV.

The holdings in respect of coking coal, non-coking coal and dolomite were generally below the critical level during 1973-74 to 1975-76 (except during certain months). In the case of Iron ore (B.F. Grade) the holdings were generally above the maximum limit during 1974-75 and 1975-76. However, the holding in respect of coking coal non-coking coal, dolomite, ferro-manganese were generally between minimum and maximum level during 1976-77 and 1977-78. In the case of iron ore and lime stone (both B.F. Grade) the holdings were generally above the maximum limits.

2. *Stores and Spares*

The maximum limits for different kinds of stores as fixed in 1970 by a Committe on Inventory Control appointed by Government and in March, 1974 by the Steel Plant, are given in Annexure XVI. It will be noticed from the details given in Annexure XVII that actual holdings of certain stores and spares during 1973-74 to 1977-78 were in excess of the norms fixed.

The increase in stock during 1975-76 in terms of number of months' consumption was attributed by the Management (October, 1976), *inter alia*, to presence of large number of non-moving, slow-moving and risk insurance items in the inventory and non-development of indigenous sources.

According to the minutes of the 3rd meeting of the Material Management Committee dated 24th September, 1975 a Committee

was to examine the stores of USSR spares and take decisions on their disposal.

As mentioned in the Report dated 13th September, 1976 of the consultant on inventory holding in Steel Plants, Bhilai Steel Plant has already set up a high level Technical Committee to segregate insured items. A target date for completion of the job was laid down as 30th September, 1977. The Ministry have stated (October, 1978) that the work of the Committee has since been completed.

8.03 *Non-moving and Slow-moving Stores*

A comprehensive analysis of all slow moving items of stores and spares was not made (January, 1977) by the Management although it was recommended by the consultants in their report submitted in September, 1973. On the basis of orders issued by General Manager in March, 1976 comprehensive Review has been started from April, 1977.

As on 30th April, 1978 total value of stores declared surplus, remaining to be disposed of amounted to Rs 102.51 lakhs (Rs. 30.00 lakhs relating to expansion stores). The value of non-moving stores which had not moved during the last three years as on 30th April, 1978 amounted to Rs. 155.95 lakhs (10,037 items).

8.04 *Physical verification*

Physical verification of raw materials, stores and spares and finished and semi-finished products at the Plant is conducted by a separate unit placed under the control of Financial Adviser and Chief Accounts Officer (now Controller of Finance & Accounts) of the Plant. Stores and spares are verified physically on perpetual inventory system so as to cover all the items once in a year; the physical verification of raw materials and finished and semi-finished products is conducted quarterly.

The physical verification during 1973-74 to 1977-78 indicated the following results :—

(Rupees in lakhs)

Year	Stores & Spares		Raw Materials			Finished & Semi-finished goods	
	Excess	Shortage	Excess	Shortage		Excess	Shortage
				Normal	Abnormal		
1973-74	9.44	2.49	9.76	220.14	27.42	162.86	323.66
1974-75	7.64	1.71	2.38	264.34	103.73	295.56	281.21
1975-76	15.47	3.69	64.56	361.26	170.25	245.86	334.99
1976-77	59.48	19.60	14.13	466.43	94.92	266.56	340.13
1977-78	25.29	28.14	2.55	319.62	48.79	472.88	414.93

NOTE: The above figures include excesses/shortages found out in stock yards and export yards also.

Shortages in raw materials to the extent indicated below are treated by the Management as normal loss and charged to consumption without further investigation. Shortages in excess of these norms are also charged to consumption during the year but are separately investigated :—

	Percentage of total Receipt
Coal.	5
Iron ore	4
Other raw materials	2

During 1973-74 shortages noticed in non-coking coal were to the extent of 13 per cent of the quantity received. This was mainly due to short receipt of coal from Korba Collieries of the Western Coalfields Limited on account of the introduction of BOB and KOH types of wagons by the Railways from June, 1972 although these were not meant for carrying coal. Random weighments made in December, 1972 to October, 1973 revealed that, on an average, 36 tonnes and 26 tonnes of coal were received against the carrying capacity of 46 tonnes (BOB wagons) and 34 tonnes (KOH wagons) respectively on the basis of which payment was made to the supplier and freight was paid to the Railways. On this basis, the short receipt of coal worked out to 1.71 lakh tonnes during 1972-73 to 1977-78 as per details given below :—

	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Short receipt (in lakh tonnes)	0.14	0.47	0.39	0.27	0.24	0.20

The suppliers maintained that wagons were being loaded to full carrying capacity and shortages occurred due to pilferage *en route*. The matter has, however, not been finally settled.

After taking into account the normal loss of 5 per cent, the abnormal loss of coal during 1973-74 to 1977-78 worked out to 0.98 lakh tonnes valued at Rs. 73.73 lakhs and was written off by the Board of Directors in the meeting held in January 1975, February 1976, December 1976, September 1977 and July 1979.

In this connection, it may be mentioned that all the incoming wagons of raw materials are not weighed by the Steel Plant and only test weighment is made. For the purpose of accounting, the receipt of raw materials is adjusted on the basis of Railway receipts and issues are worked out with reference to consumption in the Blast Furnaces. The book balance thus arrived at is compared with the physical balance and shortages/excesses worked out. As a result, the handling and transit losses cannot be separately ascertained.

9.00 *Profitability Trends*

(1) The following table indicates the working results of the Plant for the last eight years ending 30th April, 1978 :—

(Rs. in crores)

Year	Profit+ Loss (—) after prior period adjustment and write back of provisions made in earlier years	Cumulative Loss (—) Profit (+) upto the end of the year
1970-71	(+)11.04	(—)14.99
1971-72	(—)4.30	(—)19.29
1972-73	(+)6.00	(—)13.29
1973-74	(+)17.78	(+)4.49
1974-75	(+)38.70	(+)43.19
1975-76	(+)28.22	(+)71.41
1976-77	(+)45.83	(+)117.24
1977-78	(+)39.76	(+)157.00

It will be seen from above that the plant has earned a cumulative profit of Rs. 157.00 crores upto 30th April 1978, since its commissioning in September 1961.

The above working results include profit (+)/Loss(—) on common trading activities such as canalised imports of steel, export of other than the H.S.L. products, the data available for these activities for the period 1973-74 to 1977-78 are indicated below :—

Year	(Rs. in Crores)
1973-74	(+)2.25
1974-75	(+)2.49
1975-76	(+)2.87
1976-77	(—)0.66
1977-78	(—)1.45

(2) An analysis of the cost of sales for the last six years ending 30th April, 1978 (given below) indicated that the cost of sales as percentage of net sales showed a downward trend upto 1974-75 and it rose thereafter :—

(Rupees in crores)

Year	Net Sales realisation	Cost of Sales	Percentage of cost of sales to net sales realisation
1972-73	158.77	153.53	96.7
1973-74	179.26	163.89	91.4
1974-75	218.41	182.50	83.6
1975-76	187.38	162.32	86.6
1976-77	326.36	280.60	86.0
1977-78	359.31	319.58	88.9

OVERALL SUMMARY

The following are the important features emerging out of the detailed analysis given in the preceding paragraphs.

(1) *Introduction*

Construction of Bhilai Steel Plant which was being set up departmentally by the then Ministry of Iron and Steel, was entrusted to Hindustan Steel Limited (HSL)—a wholly owned Government company registered on 19th January, 1954—from 1st April, 1957. It remained a constitutent unit of HSL (which had become a subsidiary of the Steel Authority of India Limited with effect from 21st March, 1973) up to 30th April, 1978. Under the "Public Sector Iron & Steel Companies (Restructuring) and Miscellaneous Provisions Act, 1978," HSL was dissolved and Bhilai Steel Plant became a constituent unit of the Steel Authority of India Limited (SAIL) from 1st May, 1978.

Capital cost incurred on completion of various stages of the Plant together with production capacity were as follows :—

Capacity	Date of completion	Capital cost (Rs. in crores)
million tonnes of steel ingots (0.77 million tonnes of saleable steel) . . .	September, 1961	201.39
2.5 million tonnes of steel ingots (1.965 million tonnes of saleable steel) . .	October, 1967	149.45
Additional facilities (6th blast furnace and 7th coke oven battery) for coke & iron making, as part of expansion of capacity to 3.5 million tonnes of steel ingots .	July, 1971 & January, 1972	45.51
	TOTAL	396.35

(2) *Production Performance*

(i) *Overall Analysis* : An analysis of overall production performence for the years 1970-71 to 1977-78 revealed that the production of;

(a) steel ingots ranged from 75.8 per cent to 94.8 per cent of the capacity of 2.5 million tonnes; and

(b) saleable steel ranged from 78.8 per cent to 102.7 per cent of the capacity of the 1.965 million tonnes. These percentages take into account rolling of certain quantities of steel ingots procured from Durgapur, Rourkela and Bokaro Steel Plants during 1972-73 to 1977-78.

Production of steel ingots and saleable steel was also less than the budgeted production (which was lower than the rated capacity) during 1970-71 to 1975-76 except for saleable steel in 1974-75 and 1975-76.

According to the Plant Management, external (shortage of power and difficulties in movement of raw materials and shortages thereof) and internal causes (industrial disputes, break-downs and shut downs over the planned down time, etc.) accounted for an output loss of 5.39 lakh tonnes of pig iron and saleable steel valued at Rs. 20.38 crores during 1973-74 to 1977-78.

(ii) *Unit-wise Performance* : The performance of main and auxiliary units was as follows :—

(A) *Coke Oven Batteries*

There are seven coke oven batteries (7th commissioned in January 1972) having an input capacity of 40.10 lakh tonnes of coal (dry basis) expected to yield 30.63 lakh tonnes of coke of different sizes (dry basis). A productivity and efficiency

analysis of these batteries indicated that, despite charge rate of coal per oven being more than the projected norm, the production of coke was below rated capacity due to—

— low availability of ovens caused by break-down, improper maintenance, etc. and higher coking time.

— low pushing rate because of difficulties caused by extensive repair programme and lack of coal supplies.

— short and erratic supply of coal, both quantitatively and qualitatively.

The other important aspects of the operation of the batteries were :—

— While yield of blast furnace coke almost conformed to project norm (68.8 per cent of coal charged), it was below the norm (70 per cent of coal charged) fixed by the Norms Committee. This has, however, to be viewed in the context that quantity of coal charged and output of coke were calculated theoretically and not based on actual weighment.

— Yield of gas per tonne of coal charged was less than the project norm during 1971-72, 1976-77 and 1977-78.

— The coal charged did not conform to the blend ratio prescribed by the various Committees and the Management in order to conserve prime grade coking coal, resulting in more of prime grade coking coal being charged. Besides, average ash content of coal charged was not only higher than the project norm, but showed a continuously deteriorating trend. This

also resulted in ash content being higher than the project norm in the blast furnace coke.

(B) *Blast Furnaces*

There are six blast furnaces (3 big and 3 small) with a production capacity of 30.50 lakh tonnes of hot metal (22.80 lakh tonnes of basic grade with silicon content up to 1.25 per cent and 7.70 lakh tonnes of foundry grade having silicon content more than 1.25 per cent). Noteable features of hot metal production during 1970-71 to 1977-78 were :—

— Although total production was less than rated capacity and the budgeted production except in 1970-71 and 1976-77 in respect of budgeted production, production of foundry grade hot metal in all the years was more than the rated capacity of 7.70 lakh tonnes. Consequently, foundry grade hot metal containing more silicon content which is bad for Steel Melting Shop (SMS) operation, had to be charged to SMS.

— Total production of basic and foundry grade hot metal included off-grade production which ranged between 5 and 14.6 per cent of the total production during 1970-71 to 1977-78.

— The installation of 6th Blast Furnace and 7th Coke Oven Battery at a cost of Rs. 45.51 crores was provided in advance of steel making facilities, to increase the capacity of pig iron in the country. This anticipation did not materialise as the production of hot metal, after commissioning of 6th Blast Furnace and 7th Coke Oven Battery, was below the level of output envisaged for 5 blast furnaces up to 1975-76; it was slightly higher than the capacity of 5 blast furnaces in 1976-77 and 1977-78.

— Average blast rate, blast temperature and top pressure were below the project norms as well as yearly varying norms fixed by the plant except :—

(a) in the case of blast temperature during 1976-77 in respect of big furnaces.

(b) in the case of blast temperature and top pressure during 1976-77 and 1977-78 in respect of small furnaces.

These also fell short of the levels intimated to the Committee on Public Undertakings in 1965. This affected the performance of blast furnaces.

— There was no mention about casting losses in the project report for production of pig iron from hot metal. A pouring loss of 3.25 per cent had been recommended by the Norms Committee in 1968. Actual loss was also assumed by the Management at 3.25 per cent.

— Sintering Plant was set up between July 1961 and April 1971 with a rated capacity of 22.35 lakh tonnes of sinter per annum to utilise the iron ore fines produced in the course of mining of iron ore. Actual production showed gradual improvement but was still less than the rated capacity. Further, sinter produced contained basicity higher than that envisaged in the project report. Although Central Engineering and Design Bureau (CEDB) of the Company had recommended (January 1970) a lower range of basicity so as to ensure better working conditions, higher productivity of sintering Plant and higher utilisation of ore fines, the Management have not reduced the basicity of sinter produced to the level recommended by the CEDB in view of advantages gained in the operation of blast furnaces by using high basicity sinter.

(C) *Steel Melting Shop*

The shop has 10 open hearth furnaces with a rated capacity of 25 lakh tonnes (10 lakh tonnes for small furnaces and 15 lakh tonnes for big furnaces) of rollable steel ingots. Actual production during 1970-71 to 1977-78 was below the rated capacity as well as budgeted production (except during 1976-77 and 1977-78 in respect of budgeted production).

The main reasons attributable to low production in SMS were :—

— Lower productivity of big furnaces on account of higher tap to tap time and lower weight per heat as compared with the project norms accounting for a loss of production of 5.75 lakh tonnes of steel ingots during 1970-71 to 1977-78.

— Lower availability of furnaces accounting for a loss of production of 30.02 lakh tonnes in big (17.47 lakh tonnes) and small furnaces (12.55 lakh tonnes) during 1970-71 to 1977-78. Lower availability was partly caused by idle time and partly by excess time spent on repairs owing to roof life of the furnaces being much below the estimated life. According to the Management poor quality of indigenous refractories, intensive oxygen lancing, uncertain and inadequate supplies of coking coal and change over of roof thickness from October 1973 to eliminate mid-term hot repairs were responsible for poor life. This led to consumption of refractories in excess of the Project Report norms and involved an extra expenditure of Rs. 19.54 crores during 1970-71 to 1977-78.

While the actual consumption of major raw materials per tonne of steel ingots was more than the Project Report norms as well as the norms fixed by the Norms Committee, the metallic

yield was below the norms envisaged in the Project Report during 1970-71 to 1975-76. Short recovery in terms of steel during 1970-71 to 1977-78, after taking into account excess recovery in 1976-77 and 1977-78, worked out to 0.12 lakh tonne of steel valued at Rs. 4.45 crores.

The consumption of ingot moulds and bottom plates for producing one tonne of steel ingots was more than the yearly norms prescribed by the Management; extra expenditure on the excess consumption being Rs. 1.97 crores during 1968-69 to 1977-78.

(D) *Rolling Mills*

As against the input of 25 lakh tonnes of steel ingots, the Rolling Mills are designed to produce 19.65 lakh tonnes of finished and semi-finished saleable products and the difference represents process loss which works out to 21.4 per cent of the input. An analysis of the performance of Rolling Mills, (Blooming, Billet, Rail and Structural, Merchant and Wire Rod Mills) for the years 1970-71 to 1977-78 indicated that many of these had operated below capacity, partly on account of feed stock and partly on account of other reasons.

The process loss differed from year to year and was more than the project norm in the Wire Rod Mill and Rail and Structural Mill in 1975-76. Further, considerable quantities of rails, not found upto specifications, were produced.

In order to improve the performance of Rolling Mills, certain balancing facilities were proposed by the Action Committee in May 1973; these are, however, yet (April 1981) to be implemented.

An important aspect of the performance of Rail & Structural Mill is that the product mix as envisaged in the Project Report, could not be maintained in this Mill on account of varying demand pattern in the country. In order to utilise its capacity,

billets are produced in this mill in addition to their production in the Billet Mill. Up to 1974-75, the production of billets in the Rail and Structural Mill resulted in not only under-utilisation of the capacity of the Billet Mill but also involved extra expenditure in the form of fuel, labour and other services as the blooms in the Rail and Structural Mill require reheating. It is relevant to mention that provision was made in the Project Report for transferring these billets in hot condition through the Hot Bloom Transfer Car installed by 1961 at a cost of Rs. 8.53 lakhs, but this car was not utilised on account of operational constraints and quality consideration.

(E) *Mines*

Plant has its own captive mines for meeting its requirement of raw materials other than coal and manganese ore. The important features noticed in the operation of iron ore and lime stone—2 major raw materials—mines were as follows :—

Iron ore mines

Rajhara mechanised mine has a capacity of 35 lakh tonnes per annum (21.87 lakh tonnes as lump ore and 13.13 lakh tonnes as fines). Actual production, however, ranged between 19.25 lakh tonnes (including 8.17 lakh tonnes lump ore) and 28.81 lakh tones (including 13.22 lakh tonnes lump ore) during 1970-71 to 1977-78, notwithstanding the fact that the mines were having surplus equipment and manpower and were operating on 3 shift basis. As a result of low production in mechanised mines,

(a) substantial quantities of iron ore had to be raised manually from other mines (developed at a cost of Rs. 1 crore to yield 8 lakh tonnes of lump ore annually) through contractors and co-operative societies, involving an extra expenditure of Rs. 7.22

crores, apart from fixed expenditure of Rs. 5.82 crores, during 1970-71 to 1977-78, and

(b) 1.89 lakh tonnes of blast furnace grade ore had to be purchased in 1970-71, 1971-72 and 1977-78 from outside sources at an extra cost of Rs. 57.65 lakhs over the cost of manual raising.

Actual raising of iron ore in other mines ranged between 0.90 lakh tonnes and 5.14 lakh tonnes during 1970-71 to 1977-78 and was thus significantly below the capacity of 8 lakh tonnes.

Lime stone mine

Production in Nandini lime stone mechanised mine during 1970-71 to 1977-78 ranged between 9.48 lakh tonnes and 14.16 lakh tonnes as against the capacity of 21 lakh tonnes. This was ascribed to poor performance of mine equipment. The shortfall in production resulted in unabsorbed fixed expenditure of Rs. 2.72 crores during 1970-71 to 1977-78.

Instead of removing the overburden mechanically, manual operation was resorted to at a cost of Rs. 90.37 lakhs upto 1977-78.

Because of locating the crushing Plant outside the mine area, royalty had to be paid on the entire quantity raised and transported to the crushing Plant. This led to an avoidable payment of royalty on the rejects which aggregated to Rs. 38.39 lakhs upto 1977-78.

(F) *Services and Fuels*

Steam—On account of inadequate availability of gases due to operation of Steel Plant below capacity, coal and other liquid

fuel had to be used in large proportions for the production of steam in the main boilers.

The thermal efficiency and heat consumption per kg. of steam produced during 1970-71 to 1977-78 showed wide variations.

Power generation—The consumption of steam per kwh of power generated varied from year to year and was more than the projected norm.

Transmission loss of electricity ranged from 2.4 per cent to 3.6 per cent of the total available power supply during 1970-71 to 1977-78.

Oxygen—Consumption of oxygen was more than the projected norm.

Fuel—There was lower yield of blast furnace gas as compared with the project norms. Further. rate of consumption of fuel was more than the project norm, particularly in Coke Ovens, Open Hearth Furnaces, Soaking Pits, Rail and Structural Mill, Merchant Mill and Wire Rod Mill.

(3) *Costs vs. Selling Prices*

While cost of production of billets, rails and structurals was more than the average net *ex* works realisation during 1970-71 to 1977-78 except in regard to billets in 1974-75 and 1975-76, the same was less than the average net ex-works realisation in respect of wire rods for all the years and in respect of merchant products during 1970-71, 1972-73, 1973-74, 1974-75 and 1976-77.

(4) *Man-power Analysis*

The actual strength in the works department of the Plant was not only more than the provision in the project report but also more than that fixed by the Board/Management.

The actual labour productivity during 1971-72 to 1977-78 ranged from 68 tonnes to 87 tonnes per man year as against 125 tonnes fixed by the Mahtab Committee in 1966 and 100 tonnes fixed by the plant.

(5) *Inventory Control*

Actual holdings of certain stores and spares were in excess of the norms fixed. A comprehensive analysis of all slow moving items of stores & spares had not been made.

The total value of stores declared surplus and awaiting disposal amounted to Rs. 1.03 crores.

The value of stores not moved for 3 years amounted to Rs. 1.56 crores. Further, equipment of the value of over Rs. 1.39 crores was lying idle/undisposed of.

In view of test weighment of incoming raw materials, accountal thereof was made on the basis of weight indicated in the railway receipts. Consequently, handling and transit losses could not be ascertained separately.

(6) *Profitability Trends*

During the period from 1970-71 to 1977-78, the Plant had been earning profit except in 1971-72. As against the total investment of Rs. 396.35 crores, the cumulative profit earned

by the Plant since its commissioning in September 1961 to 30th April, 1978 amounted to Rs. 157.00 crores. This has to be viewed in the context of observations made above.

(P. P. GANGADHARAN)
Chairman, Audit Board and Ex-officio Additional Deputy Comptroller and Audit General (Commercial)

New Delhi
The 26 November, 1981

Countersigned

(GIAN PRAKASH)
Comptroller and Auditor General of India

New Delhi
The 30 November, 1981
30

ANNEXURES

ANNEXURE I

(Referred to in Paragraph 1.01)

Statement showing the main units of the integrated steel plant, their rated production, main inputs and outputs and distribution of the outputs as per the D.P.R. and as intimated by the Management in December, 1977 upto Pig Casting Machine Stage. (in lakh tonnes)

Sl. No.	Unit	No.	Rated capacity as per D.P.R. (6th B.F. Complex)		Distribution of output	Rated capacity as per DPR of 2.5 MT plus Additional facilities in 6th Blast Furnace Complex intimated by MECON and adopted by the Management (Dec. 77)			Remarks
			Input	Output		Input	Output	Distribution of output	
1	2	3	4	5	6	7	8	9	10
1.	Coke Oven Batteries	7	40.10 of Coal (dry)	27.57(+25 mm coke) (dry) 28.72 (wet) 1.22(10–25 mm) (dry) 1.38 (wet) 1.84(—)10 mm (dry) 2.16 (wet)	For Blast Furnaces For Sale. For Sintering Plant	38.50 of Coal (dry)	25.64 (+25 mm coke) (dry) 26.71 (wet) 1.14(10–25 mm) (dry) 1.28 (wet) 1.71(—10 mm) (dry) 2.01 (wet)	For Blast Furnaces For sale For Sintering Plant	*On the basis of basicity higher than one, the rated output was to be 20.40 lakh tonnes. **Excluding screening losses.
1(*a*)	Sintering Plant	4 (Strands)	14.55 Iron Ore fines (dry basis) 0.82 Flue dust. 1.42 Mill scale. 5.97 Limestone. 2.94 Limestone chips. 1.90 Coke breeze. 15.54 Sinter returns.	22.35 (Sinter)* (On basicity of one)	For Blast Furnaces	14.28 Ore fines. 0.48 Flue dust. 0.05 Mill scale 7.10 Limestone. 2.12 Coke breeze. 11.90 Return fines. 4.11 Hearth layer. 1.13 Dolomite.	20.40 Sinter (On basicity higher than one).	For Blast Furnaces	
2.	Blast Furnaces	6	(*a*) 31.10 Iron Ore (Lumps) (*b*) 22.35 Sinter ** (*c*) 27.00 Skip coke (+25 mm) (Wet) (*d*) 6.56 Limestone	30.50 Hot metal.	(*a*) 19.62 to Steel Melting Shop. (*b*) 0.72 to Foundry (*c*) 10.16 to Pig Casting Machine.	30.89 Iron Ore lumps. 20.40 Sinter. 25.42** Skip Coke (+25 mm) (wet) 4.74 Lime stone.	29.69 Hot metal	19.62 to Steel Melting Shop 0.69 to Foundry 9.38 to Pig Casting Machines	

1	2	3	4	5	6	7	8	9	10
3.	Pig Casting Machine	4	10.16–Hot metal (installed pouring capacity as per DPR at the rate of 1600 tonnes per day per machine comes to 22.40 lakh tonnes.)	10.16 Pig Iron***	(*i*) 0.11 to Foundry (*ii*) 10.05 for sale.	9.38 Hot metal (installed pouring capacity according to the Management at the rate of 1100 to 1200 tonnes per day per machine comes to 16.10 lakh tonnes)	9.08 Pig Iron.	0.03 to Foundry 9.05 for sale	***There was no provision for casting losses in the DPR. The HSL Norms Committee (1968), however, assumed the casting losses at 3.25 per cent of the input. According to the Ministry (Oct., 1978) the quantity of Pig Iron for sale is 9.72 lakh tonnes after taking into account casting loss @ 3.25 per cent.
4.	Steel Melting Shop.	10 OH Furnaces	19.62 Hot Metal 5.06 Steel Scrap 0.74 Cast Iron Scrap 5.00 High Grade Iron Ore.	25.00 steel ingots	To Blooming Mill.				
5.	Blooming Mill		25.00 Ingots	21.42 Blooms	(*a*) 13.20 to Billet Mill. (*b*) 8.22 to Rail and Structural Mill				
6.	Billet Mill		13.20 Blooms.	12.63 Billets.	(*a*) 5.32 to Merchant Mill (*b*) 4.16 to Wire Rod Mill (*c*) 3.15 for sale				
7.	R & S Mill.		8.22 Blooms.	7.50 (Rails-5.0 and Heavy structural—2.50)	For sale				
8.	Merchant Mill		5.32 Billets.	5.00	For sale				
9.	Wire Rod Mill		4.16 Billets.	4.00	For sale				

ANNEXURE II

(Referred to in Paragraph 2.01)

Statement showing loss in contribution margin

(Quantity in tonnes)

Year	Particulars	External causes		Internal causes		Grand Total
		Shortage of Power	Difficulty in Movement of raw materials & shortages	Industrial Disputes	Breakdowns & shut downs in excess of planned down time & other causes	
1	2	3	4	5	6	7
1973-74	(a) Pig Iron	..	94020	..	..	94020
	(b) Steel	865	105715	1290	..	107870
1974-75	(a) Pig Iron	..	50717	..	14340	65057
	(b) Steel	..	74274	542	2176	76992
1975-76	(a) Pig Iron	..	17840	6979	23250	48069
	(b) Steel	..	..	..	..	..
1976-77	(a) Pig Iron	..	..	..	..	2555
	(b) Steel	2555	..	..	..	
1977-78	(a) Pig Iron	1210	28783	77400	1577	108970
	(b) Steel	13220	640	21380	..	35240

NOTE :—The value of the output loss was as follows :—

(Rs. in lakhs)

	1973-74	1974-75	1975-76	1976-77	1977-78
(a) Pig Iron . .	189.92	221.84	153.82	..	366.14
(b) Steel . .	502.67	396.51	..	12.65	194.17

ANNEXURE III

(Referred to in para 2.02.01)

Statement showing the rated capacity, the capacity intimated by the Management in December 1977, the budgeted production and actual production of Coke

(Figures in lakh tonnes)

Year	Rated capacity as per DPR (6th BF Complex)					Capacity as per DPR for 2.5 MT plus Additional facilities in 6th Blast furnace as intimated by MECON and adopted by the Management (Dec. 1977)					Budgeted production		Actual input/output			
	Coal	Coke Output (dry)				Coal	Coke output (dry)				Coal	Coke	Coal	Output		
	Input (dry)	B.F. grade (+25mm)	10–25 mm size	0–10 mm size	Total	Input (dry)	B.F. Gr. +25mm	10–25 mm size	0–10 mm size	Total	Input (wet)	+25 mm output (dry)	Input (dry)	B.F. grade (+25mm)	Coke Breeze (—25 mm)	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1970-71	33.00	21.98	0.98	1.46	24.42	33.00	21.98	0.98	1.46	24.42	35.00	22.87	29.65	20.50 (69.1)	2.14 (7.2)	22.64 (76.3)
1971-72	34.28	22.99	1.01	1.51	25.51	34.00	22.64	1.01	1.51	25.16	37.15	23.05	27.03	18.60 (68.8)	1.94 (7.2)	20.54 (76.0)
1972-73	40.10	27.57	1.22	1.84	30.63	38.50	25.64$	1.14	1.71	28.49	32.87	20.93	31.20	21.47 (68.8)	2.38 (7.6)	23.85 (76.4)
1973-74	40.10	27.57	1.22	1.84	30.63	38.50	25.64$	1.14	1.71	28.49	36.10	22.70	26.47	18.15 (68.5)	2.08 (7.9)	20.23 (76.4)
1974-75	40.10	27.57	1.22	1.84	30.63	38.50	25.64$	1.14	1.71	28.49	33.43	20.57	28.22	19.33 (68.5)	2.22 (7.9)	21.55 (76.4)
1975-76	40.10	27.57	1.22	1.84	30.63	38.50	25.64$	1.14	1.71	28.49	36.60	22.74	31.56	21.72 (68.8)	2.49 (7.9)	24.21 (76.7)
1976-77	40.10	27.57	1.22	1.84	30.63	38.50	25.64$	1.14	1.71	28.49	37.46	22.83	35.26	24.25 (68.8)	2.79 (7.9)	27.04 (76.7)
1977-78	40.10	27.57	1.22	1.84	30.63	38.50	25.64$	1.14	1.71	28.49	40.06	24.41	36.77	25.08 (68.2)	2.88 (7.8)	27.96 (76.0)

Notes : (1) Figures in brackets indicate percentage of different sizes of coke produced to coal charged.
(2) The break-up of actual production of 10-25 mm and 0–10 mm of coke is not reported by the Management.
(3) As the 7th Coke Oven battery was commissioned on 25th January 1972, rated capacity for the year 1971-72 has been worked out taking into account proportionate capacity for the 7th Coke Oven battery from that date.

$ 25.11 lakh tonnes after making provision for repairs.

ANNEXURE IV

[Referred to in Paragraph 2.02.02(8)]

Statement showing the analysis of blast furnace coke

(Figures in percentages)

Year	Moisture	Ash content	Volatile matter	Fixed carbon	Micum drum test	
					+40 mm	—10 mm
1	2	3	4	5	6	7
1970-71	2.6	23.17 to 23.96	0.30	75.80 to 76.57	75-76	10-11
1971-72	2.5	23.02 to 23.98	0.34	75.59 to 76.68	74-75	10-12 (12 in one month)
1972-73	2.8	23.52 to 23.91	0.31	75.66 to 76.12	74-75	11-12 (12 in one month)
1973-74	2.9	24.47 to 25.05	0.36	74.56 to 75.17	74-78	10-11
1974-75	2.6	24.39 to 25.66	0.33	71.12 to 75.28	75-78	10-11
1975-76	2.6	25.41 to 26.77	0.32	72.88 to 74.30	75-76	11
1976-77	3.0	25.19 to 26.12	0.34	73.53 to 74.47	76-77	11
1977-78	2.9	25.08 to 27.67	0.67	71.63 to 74.40	76-77	11

ANNEXURE V

(Referred to in Para 2.03.03)

Statement showing data relating to operating hours of Blast furnaces

Year	Total furnace hours during the year	Expected furnace hours utilisation as per project report	Project provision for repairs	Furnace hours spent on capital repairs	Available furnace hours	Furnace Hours utilised		Total	Furnace hours lost w.r.t. available hrs.	Furnace hours lost due to				
						Wind on	Low wind			Furnace kept on reserve	Wind off.			
											Mechanical	Electrical	Operation	Copper changing	Misc.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1970-71	43800	42000	1800	2910	40890	38142	609	38751	2139	..	25	14	173	663	1264
1971-72	49783	47600	2183	6068	43715	36602	1017	37619	6096	..	85	19	296	713	4984
1972-73	52560	50400	2160	8831	43729	38196	1657	39853	3876	..	60	29	633	1125	2028
1973-74	52560	50400	2160	10355	42205	32526	1626	34152	8053	1056	107	33	717	630	5510
1974-75	52560	50400	2160	3996	48564	34924	1283	36207	12357	8760	39	23	612	709	2215
1975-76	52704	50400	2304	7856	44848	39873	1527	41400	3448	796	49	9	447	714	1433
1976-77	52560	50400	2160	2914	49646	46332	1051	47383	2263	..	61	18	253	728	1203
1977-78	52560	50400	2160	1627	50933	47155	1502	48657	2276	..	110	20	388	724	1034

ANNEXURE VI

(Referred to in Para 2.03.04)

Statement showing the input/output ratios of Blast Furnaces

(Figures in Kgs.)

Basis of the Norms	Iron Ore	Sinter	Fe compo-nent	Lime stone	Manganese Ore	Coke	% of sinter in burden (aggregate of iron ore and sinter)	Total input of raw materials per tonne of hot metal	Slag arising
1	2	3	4	5	6	7	8	9	10
As per project report for the 6th Blast Furnace complex.	979	733	949	211	46	885	42.8	2888	636
As per Norms Committee Report (1968).	Only Fe input was specified on the basis of 40% of sinter and 60% of iron ore in burden.		965	270	50 (On the assumption that 50% of the total foundry iron sent to pig casting machine is higher manganese grade).	800 On the basis of average ash in coke as 23.5% and with 40% sinter in burden.	40	Not indicated	600

1	2	3	4	5	6	7	8	9	10
As per DPR for 2.5 MT plus Additional facilities in 6th Blast Furnace as intimated by MECON and adopted by the Management (December, 1977).	998 (wet)	687	957	160 with use of dolomite.	35	856 (wet)	40.7	2797	560
Actual									
1970-71 . .	1224	573	1006	270	51	810	31.9	2939	602
1971-72 . .	1146	674	995	244	51	810	37.0	2932	637
1972-73 . .	1126	707	1007	222	50	808	38.6	2914	639
1973-74 . .	1084	762	995	206	45	800	41.3	2 897	649
1974-75 . .	1055	741	983	179	47	779	41.2	2801	621
1975-76 . .	1045	730	981	179	42	794	41.1	2791	595
1976-77 . .	1071	666	980	171	37	792	38.3	2737	539
1977-78 . .	1072	668	982	190	37	834	38.4	2801	551

ANNEXURE VII

(Referred to in Para 2.03.06)

Statement showing the contents of major raw materials

(Figuresi n per cent)

	Ash content in coke	Lime content in lime stone	Sinter			Iron Ore		
			Iron	Alumina	Silica	Iron	Alumina	Silica
1	2	3	4	5	6	7	8	9
As per								
2.5 MTPR . . .	23.0	42.0	54.1	4.83	7.13	64.3	2.49	2.78
6th Blast Furnace Complex . As per DPR for 2.5 MT plus additional facilities in 6th Blast Furnace as intimated by MECON & adopted by the Management (Dec '77)	23.23	41.66	46.10	5.16	7.69	62.39	3.49	3.40
	23.0	40.41	..	..	..	..	..	..
ACTUALS								
1970-71	23.40	41.06	46.71	4.28	6.89	62.22	3.47	3.51
1971-72	23.47	41.03	45.90	4.32	7.57	62.20	3.38	3.40
1972-73	23.75	41.04	46.30	4.39	7.37	62.12	3.45	3.38
1973-74	25.02	40.62	45.16	4.90	7.68	61.86	4.15	3.31
1974-75	26.16	41.50	45.28	4.96	7.42	62.56	3.57	3.01
1975-76	26.30	41.16	46.21	4.64	6.69	63.09	3.20	2.75
1976-77	25.88	40.83	46.58	4.53	6.42	63.73	2.88	2.32
1977-78	26.44	39.60	46.78	4.27	6.40	63.83	2.72	2.42

ANNEXURE VIII

(Referred to in Para 2.03.08)

Statement showing the actual blast rate, temperature of the blast and top pressure vis-a-vis norms fixed by the Management

Particulars	Unit	1970-71		1971-72		1972-73		1973-74		1974-75		1975-76		1976-77		1977-78	
		Norm fixed	Actual	Norm fixed	Actual	Norm fixed	Actual	Norm fixed	Actual	Norm fixed	Actual	Norm fixed	Actual	Norm fixed	Actual	Norm fixed	Actual
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Average Blast rate.	M^3 per minute.	2000 / 2600	1841 / 2426	2000 / 2500	1784 / 2448	Not fixed	1700 / 2353	Not fixed	1757 / 2382	Not fixed	1804 / 2373	Not fixed	1807 / 2292	Not fixed	1754 / 2300	Not fixed	1792 / 2331
Average Blast Temperature.	°C	840 / 900	789 / 844	810 / 850	740 / 816	800 / 850	764 / 820	800 / 850	777 / 827	850 / 900	783 / 819	850 / 900	797 / 844	850 / 900	867 / 910	850 / 900	853 / 880
Average top pressure	Atm.	Not fixed	0.59 / 0.60	Not fixed	0.58 / 0.68	Not fixed	0.59 / 0.74	Not fixed	0.66 / 0.80	Not fixed	0.65 / 0.77	0.80 / 0.85	0.75 / 0.73	0.80 / 0.80	0.84 / 0.69	0.80 / 0.80	0.87 / 0.75

NOTE :—Figures above the line relate to the three small furnaces and below the line to 3 bigger furnaces.

ANNEXURE IX

[Referred to in Para 2.06.03(1)]

Statement showing the actual hours for which the furnaces worked

Year	Actual working hours			Hours under repair			Numner of hours under repair in excess of projected norms			Idleness of furnaces for other reasons		
	250 tonnes furnaces	500 tonnes furnaces	Total	250 tonnes furnaces	500 tonnes furnaces	Total	250 tonnes furnaces	500 tonnes furnaces	Total	Reserve idle period	Down-time for other reasons	Total
1	2	3	4	5	6	7	8	9	10	11	12	13
1970-71	30905	32462	63367	10997	9395	20392	6797	5195	11992	565	3,272	3837
1971-72	28990	31524	60514	9511	8960	18471	5191	4640	9831	4231	4,648	8879
1972-73	34594	33216	67810	6513	7912	14425	2313	3712	6025	7	5,358	5365
1973-74	31675	30408	62083	6823	7132	13955	2623	2932	5555	6422	5,136	11558
1974-75	32789	32928	65717	7561	6171	13732	3361	1971	5332	4008	4,143	8151
1975-76	35895	36547	72442	6029	5533	11562	1709	1213	2922	539	3,297	3836
1976-77	35536	36706	72242	6301	5241	11542	2101	1041	3142	NIL	3,816	3816
1977-78	36193	36687	72880	5856	5545	11401	1656	1345	3001	NIL	3,319	3319

ANNEXURE X

(Referred to in Paragraph 2.07.02)

Statement showing input, output and wastage in Rolling mills

(Quantity in '000 tonnes)

Sl. No.	Name of the Rolling Mill	Year	Input	Output	Wastage & Scrap etc.	Percentage of actual wastage
1.	Blooming Mill	1970-71	1950	1704	246	12.6
		1971-72	1872	1644	228	12.2
		1972-73	2139	1878	261	12.2
		1973-74	2056	1829	227	11.0
		1974-75	2033	1811	222	10.9
		1975-76	2215	1946	269	12.1
		1976-77	2455	2163	292	11.9
		1977-78	2361	2048	313	13.3
2.	Billet Mill	1970-71	1113	1079	34	3.1
		1971-72	1128	1100	28	2.5
		1972-73	1202	1169	33	2.7
		1973-74	1181	1145	36	3.1
		1974-75	1217	1174	43	3.5
		1975-76	1295	1267	28	2.2
		1976-77	1422	1384	38	2.7
		1977-78	1352	1317	35	2.6
3.	Rail & Structural Mill.	1970-71	571	525	46	8.0
		1971-72	474	435	39	8.2
		1972-73	665	618	47	7.1
		1973-74	586	535	51	8.7
		1974-75	594	542	52	8.8
		1975-76	680	618	52	9.1
		1976-77	712	653	59	8.3
		1977-78	700	647	53	7.6
4.	Merchant Mill	1970-71	473	453	20	4.2
		1971-72	359	347	12	3.3
		1972-73	554	535	19	3.4
		1973-74	470	456	14	3.0
		1974-75	432	419	13	3.0
		1975-76	475	458	17	3.6
		1976-77	569	546	23	4.0
		1977-78	530	505	25	4.7
5.	Wire Rod Mill	1970-71	316	298	18	5.7
		1971-72	314	298	16	5.1
		1972-73	426	406	20	4.7
		1973-74	400	380	20	5.0
		1974-75	393	373	20	5.1
		1975-76	412	392	20	4.8
		1976-77	496	473	23	4.6
		1977-78	503	481	22	4.6

ANNEXURE XI

(Referred to in Para 2.08)

Statement showing the details of Idle Equipment

Sl. No.	Particulars of equipment	Date of purchase/ commissioning	Cost of equipment (in lakh rupees)	Purpose for which machinery was purchased	Reasons for non-utilisation of equipment	Recommendation of the Committee (October 1972)	Present position as intimated by the management (Dec., 1977)
1	2	3	4	5	6	7	8
1.	Floor type ingot stripping machine (Steel Melting shop).	1959 (1 MT Stage)	1.96	For stripping ingots with narrow bottom moulds and wider tops.	Originally the machine was meant for stripping narrow bottom ingots. This practice is not being followed under present operating conditions. At present it is lying in partly damaged condition in the Shop.	To be disposed of.	The practice for stripping narrow bottom ingots is not being followed under the present operating conditions. Representative of ASP Durgapur also examined but did not find it suitable for them. Disposal action will be taken.
2.	25 tonne Intermediate ladle 3 Nos. (Steel Melting shop).	1959 (1 MT stage)	1.66	To be used as intermediate ladles during teeming for making special steel.	The production of spl. steel is limited and simpler metallurgical method has been adopted. This equipment has not been utilised.	—do—	These are not useful for the shop. Disposal action will be taken.

1	2	3	4	5	6	7	8
3.	Stamping machine for 800 tonnes shears (Blooming and Billet Mill).	—do—	1.06	For stamping billets after they have been cut. The machine was giving a lot of trouble and maintenance was a problem.		—do—	The equipment is not required by the shop. Disposal action is to be taken.
4.	Pitch conveyor of Tar Distillation Plant with cooling towers, fans, pumps.	1961 (1 MT stage)	2.48	The equipment was provided to convert hot pitch into granules.	There is no market for granulated pitch in India. The climatic conditions in India are not favourable for transportation of pitch granules into wagons as they get fused together in packing bags due to higher ambient. temperature	Two motors of 2900 rpm each of two pumps have already been utilised in Sintering Plant. A 3-blade fan and pitch conveyor is ready for sale.	The equipment has been used on trial. This equipment is likely to be used when order for this type of pitch will be available. Samples of granulated pitch have already been sent to various parties and market reaction is awaited.
5.	Tilting carriages for tilting rolled products on Inspection beds 6 Nos. (R&S Mill).	Not commissioned (2.5 MT stage).	3.08	For tilting rolled producton inspection bed.	Manual operation was found to be simple and more convenient. The machanism is quite complicated and lot of maintenance is requirred.	To be disposed of.	Some of the spare parts have been used as spares. Disposal action will be taken.

6. Pilling Machine for piling structurals rolled stock upto 15 T (R&S Mill.)	1960 (1 MT stage)	6.82	Provided as per Project report for piling the rolled stock.	Different cut lengths etc. made use of the machine difficult. Difficulty of sorting out defective materials.	Recommended for disposal.	—do—
7. Hot bed with Tilter in Billet Mill.	Received as part of 1 MT equipment from USSR.	Not used.	41	For tilting the billet for conditioning.	In the present circumstances this is not required as the process is very slow and is required for only special steel.	Disposal action will be taken.
8. Ingot turning device in Blooming Mill.	—do—	The quipment was tried in early days of commissioning the mill.	1.02	To turn the ingot and weigh it.	It was not found necessary. It gave more obstruction than help in the production.	—do—
9. Area of Billet trimming in Billet mill.	—do—	Not used.	6.82	To eliminate surface defects and grind ends of billets for quality steel.	The equipment is not required in the present circumcumstances.	—do—
10. Rail finishing zone in Merchant Mill	—do—	This was commissioned in 1966.	8.39	For finishing 16, 18 & 24 lbs rails.	This was used while rolling 24 lbs Rails once.	The equipment was used once to roll 24 lb rails. The early study has revealed that rolling of 24 lb rails was not an economical proposition will be reviewed.

1	2	3	4	5	6	7	8
11.	Packing Zone in Merchant Mill.	Received as part of 1 MT equipment from USSR.	This was tested and commissioned alongwith 1 MT equipment.	17.7	For packing finished products.	This was not found necessary.	The electrical equipment like motor etc. have been utilised as spare for other equipments. The rest can be disposed of. Disposal action will will be taken.
12.	3rd Straightening Machine in Merchant Mill.	Received as part of 1 MT equipment from USSR.	Never used.	7.7	For straightening heavy rounds.	Rounds are at present sold as direct rolled products.	If customers specify higher standards of straightness this will need to be utilised. This is therefore retained; can be reviewed in future.
13.	Skew bar straightening machine.	—do—	—do—	3.84	For removing waves from the surface of rounds.	Rounds at present sold as direct rolled products.	If customers specify higher standards of straightness this will need to be utilised. This, therefore can be reviewed in future.
14.	Other Machine in Merchant Mill.	—do—	—	9.72	These equipments are linked with items 4 to 7 above.		The shop does not require these equipments. Disposal action will be taken.

15. 8 Nos. weighing machine in the Wire Rod Mill.	Received as part of 2.5 MT equipment from USSR.	May, 1967; but never worked afterwards.	1.44	For weighing wire rods coils.	Not considered necessary technologically in the shop.	One weighing machine installed in ferro alloy storage. Others will be used alternatively by weigh bridge department. As per recent decision one machine is being installed in Foundry Shop.
16. Door and Door Frame cleaning mechanism attached to pusher cars and door extractor mechanism.	Received as part of 2.5 MT equipment from USSR.	Commissioned in 1964–65.	N.A.	Equipment meant for cleaning the doors and opening in batteries.	Did not work due to design defect.	Four door cleaning mechanisms have been installed in the end benches and they are working satisfactorily. All will be used.
17. Centering Machine wobbling machine and Profile Milling machine.	Received as part of 1 MT and 2.5 MTP stage.	Installed in 1960 and 1967 in the Roll Turning Shop.	4.43	For machining of steel cast rolls under 4.5 tonnes weight received from plant's foundry.	Manufacture of two cast iron rolls attempted in the foundry during 1969-70 was not successful as the addition of ferro silicon showed an adverse effect on the furnace lining disturbing the normal steel castings	Disposal action will be taken.

1	2	3	4	5	6	7	8
						and showed cracking tendency. Further requirement of rolls weighing less than 4.5 tonne was too low to justify for going in for their manufacture in the Plant.	
18.	Cold Shear	—	Feb., 1961	6.77	—	The present rate of production in the rolling mill does not justify its use as the entire production can be cut on the hot saws.	As regards items at Sl. No. 1 to 23 Management stated (December, 77) as follows. "In view of the fact that these items of equipment are of Russian origin and rarely find application in areas other than for what they are meant..... no action for their disposal at present would be appropriate. However,

a constant review of the equipment lying with us will be carried out from time to time so as to ensure that—

(*i*) their possession and occupation of space does not affect the movement in and performance of the plant;

(*ii*) their disposal would fetch sizeable revenue to the plant; and

(*iii*) their disposal may not result in the re-purchase of the same type of equipment at exhorbitant cost."

1	2	3	4	5	6	7	8
19.	Machine in the Rail Finishing line.	—	Feb. 1961	8.97	—	The facility has been provided to be used as and when the development of sections takes place.	
20.	Machine in the straightening and cutting line.	—	—do—	25.84	—	This facility was proivided by the designers to deal with special alloy steel sections and rounds. The machines were not put to use as the Plant did not develop any special alloy steel profiles.	
21.	Limetank Unit.	—	—do—	0.77	—	This is meant for making lime solution for the extraction of fixed ammonia from ammoniacal liquor. The tank has not been used as the ammonia content in the ammonia liquor is very negligible.	The eqiupment is being used for dissolving Anthrecene (March, 1980).

22. End hardening machine.	—	Not available.	0.61	—	This is meant for end-hardening the rails for better life and performance. This has not been put to use as the Railways have not accepted the end-hardened rails.	
23. Dephenolising Tower.	—	—do—	3.96	For extraction of Phenol in the form of sodium phenolate from ammoniacal liquor.	This is provided for extraction of phenols in the form of sodium phenolate from ammoniacal liquor. This has not been put to use as there is no firm demand for the product.	
24. —do—	—	Put to trial runs only in Jan, Feb. 1969.	4.16	—do—	Phenol content in the ammonia liquor was very low and therefore, the use of the equipment was uneconomical. The operating economics as worked out in 1968 was found to be adverse.	The Management stated in Feb., 1977 that the equipment can be used as and when the phenol content in the ammonia liquor becomes recoverable economically and that on receipt of import

1	2	3	4	5	6	7	8
							substituted special instruments required for commissioning and after commissioning of auxiliary jobs one of the towers will be commissioned; in case after the fresh trial the performance of the tower is not found satisfactory, action will be taken for disposal of the equipment.
			TOTAL :	138.61			

ANNEXURE XII

(Referred to in Paragraph 5.02)

Statement showing the quantities of scrap arisings as envisaged in the project report and actual arising and the consumption thereof

(Figures in tonne)

1. *Iron Scrap :*		
Quantity envisaged in the D.P.R.		
B.F.	24,000	(a)
S.M.S.	62,500	
Foundry & other shops	18,600	
TOTAL	1,05,100	
Consumption as per D.P.R.		
B.F.	24,000	
S.M.S.	74,100	
Foundry & other shops	7,000	
TOTAL	1,05,100	

Year		Quantity recovered/consumed			
		B.F.	S.M.S.	Foundry & other shops	Total
1970-71	Qty. recovered	8,971 (b)	67,355	13,717	90,043
	Qty. consumed	..	69,020	5,594	74,614
1971 72	Qty. recovered	14,919 (b)	67,329	15,467	97,715
	Qty. consumed	—	74,528	5,137	79,665
1972-73	Qty. recovered	10,433 (b)	81,480	13,974	1,05,887
	Qty. consumed	6,697	69,342	4,643	80,682
1973-74	Qty. recovered	44,632 (b)	67,699	12,005	1,24,336
	Qty. consumed	10,065	94,710	3,234	1,08,009
1974-75	Qty. recovered	46,258 (b)	69,301	10,890	1,26,449
	Qty. consumed	8 576	96,968	772	1,06,316
1975-76	Qty. recovered	42,646 (b)	69,133	13,280	1,25,059
	Qty. consumed	16,618	92,772	4,217	1,13,607
1976-77	Qty. recovered	29,285 (b)	69,871	21,222	1,20,378
	Qty. consumed	20,517	1,05,876	3,208	1,29,601
1977-78	Qty. recovered	24,082 (b)	76,063	21,903	1,22,048
	Qty. consumed	24,748	1,01,205	1,772	1,27,725

NOTE : (a) With the commissioning of 6th Blast Furnace from July, 1971 the arising of iron scrap as per project report should be more. 24,000 tonnes is based on 2.5 M.T. project report.

(b) D.P.R. does not provide for loss in the Pig casting machine. Actual recovery is based on cost sheet of cold metal in the Pig casting machines.

Steel Scrap

Qty. envisaged in the D.P.R. Rolling Mills . .	4,23,900	(17.0)
S.M.S. . . .	62,500	(2.5)
Foundry and other shops & wear scrap . .	35,500	
TOTAL .	5,21,900	
Consumption envisaged in the D.P.R.—S.M.S. . .	5,05,800	
Foundry & other shops & wear scrap . . .	16,100	
TOTAL .	5,21,900	

Year	Quantity recovered/consumed				Total	
		Rolling Mills	S.M.S.	Foundry & other shops and wear scrap		
1970-71 .	Qty. recovered	289006 (14.8)	51786 (2.7)	(a)	4,18,000	(b)
	Qty. consumed	..	447603	..	4,47,603	
1971-72 .	Qty. recovered	296618 (15.8)	62301 (3.2)	(a)	4,23,000	(b)
	Qty. consumed	..	427415	..	4,27,415	
1972-73 .	Qty. recovered	313998 (14.7)	64186 (3.0)	(a)	4,33,000	(b)
	Qty. consumed	..	479250	..	4,79,250	
1973-74 .	Qty. recovered	266033 (12.9)	72764 (3.8)	(a)	4,07,000	(b)
	Qty. consumed	..	402923	..	4,02 923	
1974-75 .	Qty. recovered	288092 (14.2)	90070 (4.5)	(a)	4,03,000	(b)
	Qty. consumed	..	404407	..	4,04,407	
1975-76 .	Qty. recovered	405941 (18.3)	127525 (5.8)	(a)	5,17,000	
	Qty. consumed	..	491363	..	4,91,363	
1976-77 .	Qty. recovered	389582 (15.87)	123571 (5.03)	(a)	5,13,153	
	Qty. consumed	..	495385	..	4,95,385	
1977-78 .	Qty. recovered	407111 (17.24)	119623 (5.07)	(a)	5,26,734	
	Qty. consumed	..	501452	..	5,01,452	

(*a*) Credit in terms of value given but quantity not indicated in 13th cost sheet.

(*b*) Represents the total arisings as intimated by Management.

NOTE : (*i*) Figures in brackets indicate percentage of recovery to steel ingot input.

(*ii*) According to Management the scrap arises from other sources also viz. steel skull scrap recovered at the scrap and salvage department, recovery at the slag yard, contractual collection from muck dump etc.

ANNEXURE XIII

(Referred to in para 6.01)

Statement showing the extent of variance in cost due to different causes

(Rs. in lakhs)

Sl. No.	Name of product	Year	Variance in actual cost over standard cost	Variance analysis					
				Material usage/ yield	Utilisation	Price	Expenditure	Coal blend	Productivity
1	2	3	4	5	6	7	8	9	10
1.	Saleable steel and saleable pig iron and by-products .	1973-74	2154(A)	22(A)	508(A)	1786(A)	88(A)	18(F)	232(F)
2.	Saleable steel and saleable pig iron and by-products .	1974-75	247(A)	171(F)	233(A)	995(A)	604(F)	..	206(F)
3.	Saleable steel and saleable pig iron and by-products .	1975-76	1744(A)	2(A)	46(A)	1584(A)	111(A)	3(A)	2(F)
4.	Saleable steel and saleable pig iron and by-products .	1976-77	1466(F)	363(F)	111(F)	872(F)	83(F)	12(A)	49(F)
5.	Saleable steel and saleable pig iron and by-products .	1977-78 (13 months)	778(A)	495(A)	129(A)	61(F)	256(A)	16(A)	57(F)

(A) Adverse

(F) Favourable.

ANNEXURE XIV

(Referred to in para 8.01)

Statement showing the inventory holding of the Plant at the end of the year

(Rs. in crores)

Year	Total inventories of raw materials, stores & spares (excluding in transit) finished & semi-finished products & other misc. stores at the end of the year	Stores and spares excluding in transit		Raw materials excluding in transit	Finished, semi-finished products including in transit	Total consumption of stores & spares during the year (excluding expansion)	Total consumption of raw materials during the year	Inventories as no. of months' consumption		Total sales excluding excise duty, freight etc.	Finished and semi-finished stocks as no. of months' sales	
		Operation	Expansion					Raw materials	Stores & spares (operation)		On value basis	On tonnage basis
1	2	3	4	5	6	7	8	9	10	11	12	13
1970-71	67.80	36.67	5.84	2.95	22.11	26.65	49.48	0.72	16.51	130.89	2.03	2.21
1971-72	87.03	49.86	5.16	4.80	27.03	33.03	49.41	1.17	18.11	120.52	2.69	2.76
1972-73	91.26	51.69	6.43	3.19	29.69	38.71	57.06	0.67	16.02	158.77	2.24	2.57

1973-74	101.89	48.11	10.14	3.92	38.45	42.77	59.19	0.80	13.50	179.26	2.57	2.83
1974-75	120.40	51.92	14.50	6.10	46.93	48.62	76.56	0.96	12.81	218.40	2.58	2.98
1975-76	209.55	63.39	21.66	11.62	112.27	59.75	100.99	1.38	12.73	187.38	7.19	7.02
1976-77	202.05	66.57	21.24	12.21	100.90	66.32	121.40	1.21	12.05	326.36	3.71	3.94
1977-78(*)	164.29	66.16	16.14	12.01	69.42	74.24	135.34	1.15	11.58	359.31	2.51	2.59

(*) (13 months).

NOTE : The consumption of naphtha and of benzene Rs. 524.49 lakhs for 1975-76, Rs. 207.02 lakhs for 1976-77 and Rs. 141.29 lakhs for 1977-78 which is shown in the accounts under power and fuel has been shown under consumption of stores and spares to bring them on comparable basis with previous years. Similarly, consumption of boiler coal amounting to Rs. 365.53 lakhs (1975-76), Rs. 403.50 lakhs (1976-77) and Rs. 445.10 lakhs (1977-78) shown in the accounts under power and fuel has been included under stores and spares as was done in previous years.

2. The figures for stores and spares are net after taking into account the provision for insurance spares.

ANNEXURE XV

[Referred to in Paragraph 8.02(1)]

Statement showing the minimum and maximum limits fixed by the Board in 1969

(In number of days' consumption)

Raw material	Critical level	Minimum level	Maximum level
1	2	3	4
1. *Coal*			
(*a*) Coking	10	12	15
(*b*) Non-coking	10	15	30
2. *Iron Ore*			
(*a*) Lump—B.F. Grade	10	17	24
(*b*) Lump—O.H. Grade	7	8	15
(*c*) Fines	10	15	24
3. *Manganese Ore*	20	30	45
4. *Lime Stone*			
(*a*) B.F. Grade	8	14	20
(*b*) S.M.S. Grade	7	12	24
5. *Dolomite*			
(*a*) B.F. Grade	10	15	30
(*b*) S.M.S. Grade/RMP	7	7	10
6. *Quartzite*	15	30	60
7. *Ferro-manganese*	30	45	90
8. *Ferro-Silicon*	30	45	90

ANNEXURE XVI

[Referred to in Paragraph 8.02(2)]

Statement showing maximum limits for different kinds of stores as fixed in 1970 by a committee on Inventory control appointed by Govt. and in March 1974 by the Plant

	As fixed in 1970	As fixed in 1974
(*i*) Imported Spares .	12 months to be reduced to 9 months.	48 months to be reduced to 36 months (imported spares excluding risk insurance items).
(*ii*) Indigenous Spares .	12 months to be reduced to 6 months.	10 months.
(*iii*) Emergency/Insurance Spares and slow moving spares.	Limits to be decided in each case.	..
(*iv*) Rolls	24 months to be reduced to 12 months.	24 months.
(*v*) Refractories	..... imported 6 months (indigenous)	12 months (imported) 6 months (indigenous)
(*vi*) Construction stores	—	9 months.
(*vii*) General stores (indigenous).	2 months to 6 months.	9 months. critical 13.5 days.
(*viii*) Raw Materials	17 days	Minimum 20.83 days Maximum 37.25 days.

ANNEXURE XVII

[Referred to in paragraph 8.02.(2)]

Statement showing inventory holdings of stores and spares in terms of number of month's consumption

(Rs. in lakhs)

Sl. No.	Description of stores	1973-74		1974-75		1975-76		1976-77		1977-78	
		Inventory as on 31-3-74	No. of months' consumption	Inventory as on 31-3-75	No. of months' consumption	Inventory as on 31-3-76	No. of months' consumption	Inventory as on 31-3-77	No. of months' consumption	Inventory as on 30-4-78	No. of months' consumption
1	2	3	4	5	6	7	8	9	10	11	12
1.	*Spares*										
	(*a*) U.S.S.R. .	2176.71	64.55*	2243.68	97.64@	2274.00	99.96	2225	95.02	2205	92.84
	(*b*) Indigenous .	674.57	11.79	892.00	17.92	1250.00	19.16	1339	14.24	1495	14.79
2.	*Refractories*										
	U.S.S.R. . .	267.14	24.62	212.19	26.72	180.00	30.41	177	101.13	177	112.74
3.	Rolls . .	593.43	50.51	576.53	48.72	643.00	58.04	588	38.52	615	32.87

* (Excluding the value of risk insurance spares—38.4 months).

@ (Excluding the value of risk insurance spares—58.8 months).

A (Excluding the value of risk insurance spares—62.4 months).

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