

REPORT
OF THE
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&
AUDITOR
GENERAL
OF INDIA

PT. 3
1974

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**REPORT
OF THE
COMPTROLLER
AND
AUDITOR GENERAL OF INDIA**

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UNION GOVERNMENT (COMMERCIAL)

1974

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PART III

HINDUSTAN ZINC LIMITED

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ERRATA

Reference **128453** For **10053**

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Page No.		Reference	For	Read
2	Line 3		propōspecting	prospecting
2	Line 7		furnances	furnaces
2	—do—		posts	pots
6	Line 8		tones	tonnes
15	Line 12		Delete the word	'after'
16	Line 11		collaborations	collaborators
18	Note 2 below the table		5000	500
20	Item (b) of table		Mills	Mill
20	Item (d) of table		Mill	Mills
24	Line 9		Mac Nally	McNally
28	Line 10 from bottom		its	this
30	Item 3 in column 1 of table		26,000	36,000
30	Item 4 in column 1 of table		leased	based
37	Line 6		Magharigedda	Megharigedda
38	Line 8		Rs.111.86	Rs.111.87
38	Line 16		capitive	captive
40	Last line of table		9,35,000	8,35,000
41	Line 7 from bottom		Estimates	Estimated
44	Column one of table—Line 1		Delete 'March 65'	
44	Item (b) in remarks column line 6-7		substracting	subtracting
45	Lines 9, 14 and 25 remarks column		Tonne	Tonnes
47	Line 3		nay	day
47	Line 5		tonnns	tonnes
53	Line 7 from bottom		work	worked
56	Item (b) below the table		tezt	test
56	Item (c) below the table		from three months	for three months
58	Note 3 line 2		furhter	further
59	Line 12		86.1%	90.3%
61	Line 2 from bottom		page 51	pages 55—58
66	Heading-year column		968-69	1968-69
68	Note 4 line 3		quality	quantity
69	Line 19		Insert 'was' after	1972-73
72	Line 11		Omit ''''	
73	Last line		conductive	conductive
76	Line 2		Montague	Montagne
77	Line 13 from bottom		sledges	sludges

Page No.	Reference	For	Read
77	Line 7 from bottom	sledge	sludge
78	Table 1973-74 column	21.370	31.370
78	Sr. No. 7—Particulars column	(5)	(6)
80	Column 6, 1973-74 figure	91.97	91.27 (a)
80	—do—	omit (a) shown against	2865.20
85	Line 12	this	the
93	Item F column for 1970-71	2320.500	2302.500
93	Note 2 line 2	468 kgs.	368 kgs.
96	Line 9	as	at
103	(c) Zinc Smelter line 2	centres	centre
103	(c) Zinc Smelter line 3	service	services
106	Figure for 1969-70 under (b) concentrates	1048.8	1048.78
106	Figure for 1969-70 under sub-para (c)	4262.43	4264.43
108	Line 10 from bottom	December, 1965	December, 1967
108	Line 4 from bottom	Delete the word 'Act'	
109	Line 3 from bottom	Insert ')' after approximately	
111	Line 8	year	years
112	Line 10	Disposal	Disposals
113	Line 2	time	time
118	Closing balance of lead for 1967-68	880	890
122	Notes below table—line 4	Omit 'Note' and number the notes as 1, 2, 3.	
123	Line 3 from bottom	facories	factories
124	Line 7	year	years
126	Column 4, last line of table	68.11.	69.11
128	Line 3 from bottom	evel	level
132	Line 2	Insert 'tonnes' after 3,191	
132	Line 10	weighting	weighing
136	table—item (b)	Insert 'To' before total	
137	Line 3	into	in toto
137	Line 4	alternations	alterations
137	Line 4	adapptions	adaptations
142	Misc. facilities—item 2 in column 2	lands	land
143	Line 18 column 4	Plant	Plan
150	Item no. 3 column 3	8979	7979
151	Item 7		

Asterik against 1011 may be read against item 7(a) to (d).

REPORT
OF THE
COMPTROLLER
AND
AUDITOR GENERAL OF INDIA

UNION GOVERNMENT (COMMERCIAL)

1974

PART III

HINDUSTAN ZINC LIMITED

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PREFATORY REMARKS

A reference is invited to the prefatory remarks in Part I of the Report of the Comptroller and Auditor General of India—Union Government (Commercial), 1974 wherein it was mentioned that the Report of the Comptroller and Auditor General of India—Union Government (Commercial) in respect of the undertakings selected for appraisal by the Audit Board will be brought out in several parts.

2. This part contains the results of the appraisal undertaken by the Audit Board of the working of the Hindustan Zinc Limited. In this case, the Audit Board consisted of the following members :—

- (1) Shri R. P. Ranga, Chairman, Audit Board and *ex officio* Additional Deputy Comptroller and Auditor General (Commercial).
- (2) Shri S. L. Brahmachary, Member, Audit Board and *ex officio* Director of Commercial Audit, Bombay.
- (3) Shri R. Chinnappa, Member, Audit Board and *ex officio* Director of Commercial Audit, Bangalore.
- (4) Dr. V. A. Altekar, Director, National Metallurgical Laboratory, Jamshedpur.
- (5) Prof. K. V. Subrahmanyam, Chairman-cum-Managing Director, Bharat Gold Mines Ltd.

3. The Report was finalised by the Audit Board after discussions with the representatives of the Ministry of Steel and Mines and the Company on 7th May, 1975.

4. The Comptroller and Auditor General of India wishes to place on record his appreciation of the work done by the Audit Board and acknowledges with thanks the contribution, in particular, of the two members who are not officers of the Indian Audit and Accounts Department.

1. HISTORICAL BACKGROUND

Considering the importance of zinc and lead metals to the economic and strategic needs of the country, and the difficulties of the Metal Corporation of India (hereinafter referred to as MCI), a Public Limited Company having its registered office in Calcutta, to proceed with their project for the development of zinc-lead deposits at Zawar in Rajasthan and the construction of a zinc smelter of 18,000 tonnes capacity per annum near Udaipur, Government of India decided on 7th October, 1965 to acquire the undertaking of the MCI with a view to exploit the zinc-lead deposits to the fullest extent and to expedite completion of the zinc smelter. Accordingly, the undertaking of the MCI was acquired by Government with effect from 22nd October, 1965 by virtue of the Metal Corporation of India (Acquisition of Undertaking) Ordinance, 1965. The undertaking was managed by an Administrator appointed by Government till the incorporation of the Hindustan Zinc Limited (hereafter referred to as the Company) as a wholly owned Government Company on 10th January, 1966. On the formation of the Hindustan Zinc Ltd., all the properties, assets, liabilities and obligations of the MCI acquired by Government of India stood transferred to the Hindustan Zinc Limited from the date of acquisition of the undertaking.

The history of lead exploitation dates back to 1941 when the Eastern Smelting and Refining Company Private Limited, Calcutta was formed and started operations on a small lead deposit at Chowth-Ka-Barwara near Sawaimadhapur. By 1942-43, the above Company set up a small pilot lead smelting plant at Tundoo near Dhanbad in Bihar. In 1942 the Geological Survey of India took on lease a wide area and started developing the Zawar Mines in Rajasthan. In 1944 the MCI was formed and all the assets of the Eastern Smelting and Refining Company were transferred to the MCI. In 1945 when

Government of India had surrendered the mining rights over Zawar to Mewar Durbar, the MCI approached the Mewar Durbar and obtained a propopecting licence over Zawar for two years and subsequently in 1950 obtained a mining lease. In 1950, the MCI also obtained a loan of Rs. 30 lakhs from the Industrial Finance Corporation. After taking the lease of the Zawar Mines, two blast furnances and few sintering posts were added by the MCI to the lead smelter at Tundoo. Till 1950, when the ore dressing plant at Zawar was commissioned, hand-dressed lead ore was being sent to Tundoo for production of lead. While the lead concentrates were being sent thereafter to Tundoo for production of lead, the MCI started sending zinc concentrates to Japan from 1953 for being brought back after conversion into zinc metal.

In January, 1960 the MCI obtained a licence for establishing a 15,000 tonnes per annum zinc smelter at Udaipur with facilities for production of sulphuric acid (25,000 tonnes per annum) to be utilised for production of single superphosphate and cadmium (70 tonnes per annum) as by-products. A separate licence for production of 9,000 tonnes of lead and 5,40,000 ozs. of silver per annum was also obtained by the MCI in June, 1960. The above capacities for production of zinc and lead were later revised to 18,000 tonnes and 11,000 tonnes respectively per annum with corresponding increases in the capacity for by-products. The total financial requirement for the project was initially estimated in 1960 by the MCI at Rs. 6.70 crores which was proposed to be met by issue of additional share capital and loans including a loan of Rs. 100 lakhs from the Industrial Finance Corporation. The Industrial Finance Corporation sanctioned a loan of Rs. 100 lakhs (against which Rs. 75 lakhs were disbursed) and also guaranteed the deferred payment loan arranged from France for import of plant and machinery etc. valued at about Rs. 450 lakhs (against a counter-guarantee from Rajasthan Government). The MCI took up the above project with the help of M/s. Krebs and M/s. Penarroya of Paris. As, however, by 1963, the estimated cost of the project had considerably gone up to Rs. 12.63 crores (*i.e.* an additional requirement of about Rs. 5.93 crores), the MCI proposed to

finance it by a loan of Rs. 3 crores, additional equity issue of Rs. 1 crore and balance from internal resources. For the loan, the MCI approached different institutions/organisations. In August, 1963, Rajasthan Government brought to the notice of Government of India the financial difficulties of the MCI. In November, 1963, the Industrial Finance Corporation reported the lack of financial resources of the MCI and the disturbing conditions of the Zinc Smelter Project. In March, 1964, a committee headed by the Director General of Technical Development came to the conclusion that the project would not be viable based on the then ruling prices of zinc and lead in the international market and that the MCI would not be able to meet its financial obligations. The matter was then examined by the Government of India and a series of discussions and negotiations were held with the MCI in May-August, 1964. It was finally decided to acquire the undertaking and the ordinance was promulgated on 22nd October, 1965.

The Ordinance of October, 1965 was repealed by the MCI (Acquisition of Undertaking) Act, 1965 enacted by the Parliament in December, 1965. The validity of the Act was challenged by the MCI in the Punjab High Court which declared (March, 1966) it to be in violation of Article 31(2) of the Constitution on the ground that the principles enunciated therein for the determination of compensation in respect of plant and equipment in use did not ensure to the MCI the just equivalent of the properties acquired. The judgement of the Punjab High Court was upheld by the Supreme Court in September, 1966. Thereupon, Government promulgated (13th September, 1966) the Metal Corporation of India (Acquisition of Undertaking) Act of 1966 as an ordinance which was subsequently enacted by the Parliament in December, 1966 giving retrospective effect to the acquisition of the undertaking with effect from 22nd October, 1965.

The Act provided for payment of compensation to the MCI for acquisition of the undertaking and determination of the quantum of compensation in accordance with the principles laid

down in the Act. It also stipulated that in the event of disagreement between the Government and the MCI, the matter would be referred to a tribunal to be constituted within 3 months from the date on which the two parties failed to reach agreement. In accordance with the Act, the compensation to be paid by the Central Government to the MCI shall be an amount equal to the sum total of the value of the properties and assets of the MCI as on 22nd October, 1965 calculated in accordance with the provisions of the Act less the sum total of the liabilities and obligations of the MCI as on that date calculated in accordance with the Act together with interest on such amount from 22nd October, 1965 to the date of promulgation of the Ordinance *i.e.* 13th September, 1966. The amount of compensation is required to be paid in cash within six months of the date of its determination, failing which interest is payable at 4 per cent per annum. Under the Act the MCI was required to furnish a complete inventory of its properties and assets and liabilities and obligations at the commencement of the Act within a period to be specified by the Government. On 10th October, 1966, Government requested the MCI to furnish the inventory by 31st October, 1966, later on extended to end of January, 1967 at the request of the MCI. Under the Act some of the assets like land and buildings, plant, machinery, investments etc. held by the MCI were to be valued at market value at the commencement of the Act. The Government also asked the Company in November, 1966 to take up the valuation of assets etc. so as to determine the amount of compensation payable to the MCI. No inventory was, however, furnished by the MCI. A valuation team of the Company assessed (May, 1967) the net excess of assets over liabilities at Rs. 185.46 lakhs. On 16th January, 1968, Government decided that the Financial Adviser and Chief Accounts Officer of the Company and the Financial Adviser of the Ministry of Finance should evaluate the assets and liabilities of the undertaking on the basis of which an offer could be made to the MCI. In April, 1968 these officers assessed the compensation at Rs. 211.69 lakhs and the MCI was requested in June, 1968 to intimate whether the same was acceptable to them. For the purpose of its first annual accounts for the period ending 31st March, 1967, the Company adopted

Rs. 211.69 lakhs as the net excess of assets over liabilities taken over on the basis of the figures adopted in arriving at the amount of compensation considered reasonable by Government and quoted to the MCI. No letter of acceptance was received from MCI and the offer was withdrawn by Government in March, 1969.

A revised offer of Rs. 198 lakhs was made by Government in April, 1971 to the MCI for acceptance within 21 days failing which it was to be presumed that it was not acceptable and, therefore, required reference to a tribunal. On 10th May, 1971 the MCI contended that the offer was unilateral and the Government had not attempted to comply with Section 10(1) of the Act in taking steps to determine compensation by an agreement. The contention of the MCI was rejected on 8th July, 1971 by Government who informed the former that, if they were unable to accept the offer within four weeks of the receipt of the letter, action would be taken to refer the matter to the tribunal. On 10th August, 1971 the MCI informed that a meeting of the Board of Directors had been called to consider the matter in all its aspects and its decision would be intimated in the course of next fortnight or so. No further intimation was received from the MCI. Instead, Government received notice of a writ petition having been filed on 15th September, 1971 in the Calcutta High Court by certain shareholders of the MCI. No agreement having been possible regarding the amount of compensation, a one man tribunal was constituted on 29th November, 1971. The tribunal was expected to submit its report within a period of not later than 8 months. On 4th January, 1972, the petitioners sought to bring in a motion for injunction against the proceedings being taken up by the tribunal. The Court ordered the petition in regard to the appointment of the tribunal to be heard along with the main writ petition. The writ petition was withdrawn by the shareholders of MCI on 11th July, 1972 and the tribunal commenced its proceedings in September, 1972.

The date for submission of the report by the tribunal was initially extended by Government up to 31st December, 1973 and later on in two spells to 31st December, 1975.

At the time the MCI was acquired by the Government of India, it had a mining capacity of about 500 tonnes of ore per day and milling capacity (in two ball mills) of 475 tonnes per day. The integrated scheme prepared by the MCI in 1960 contemplated development of mining and milling capacity from 500 tonnes per day to 2000 tonnes per day, setting up of a zinc smelter of 18000 tonnes of zinc ingots, besides production of 29000 tones of sulphuric acid, 75000 tonnes of single superphosphate and 80 tonnes of cadmium per annum. Prior to take over of the undertaking by Government, about 75 per cent of the work of zinc smelter was reported to have been completed; further work was reported to have ceased some time in 1964 or early 1965, as the MCI was not in a position to finance it. For expansion of mining and milling capacity, equipment worth Rs. 80 lakhs, out of the total estimated value of Rs. 415 lakhs, had been received but was lying at the Bombay port due to inability of the MCI to pay the customs duty. In addition, at the time of taking over, the lead smelter at Tundoo was expected to produce 3,600 tonnes of lead and 5000 kgs. of silver as by-products per annum.

According to the Ministry (May, 1975) ".....
 When HZL took over the operations, it not only inherited a number of financial liabilities, but also faced problem of reorganising and activating an industry which has been sick for several years
 In hard rock mining along with lead-zinc floatation, the experience also was limited to what MCI could do on a small scale for about 10—15 years. The foreign expertise which MCI ultimately invited to hold their hands came very late in the day before the Company collapsed financially. HZLs task, therefore, was to first assess the amount of work already covered by MCI and with the limited experience at its own disposal, make the best use of the technological foundations conceived by a financially tottering organisation which necessarily took several decisions more to match its pocket than technological needs".

“Though in the initial stages HZL suffered organisationally due, *inter alia*, to departure of foreign experts who had been associated with the development of mines prior to take over and the loss of a few other key personnel taken over from MCI the position improved considerably from 1971-72 after the 2,000 tonnes per day beneficiation plant was installed and other works connected with the mines development were completed by Cementation.”

2. CAPITAL STRUCTURE

The Company was incorporated on 10th January, 1966 with an authorised capital of Rs.10 crores divided into 1,00,000 shares of Rs.1,000 each. As on 31st March, 1974 the authorised capital of the Company was Rs. 30 crores and the paid-up capital Rs. 17.40 crores. The Company also received Rs. 1.60 crores as share application money during 1973-74 against which allotment of shares was pending on 31st March, 1974. In addition, the Company had obtained long term unsecured loans from the Government of India and the Rajasthan Government which stood at Rs. 8.15 crores and Rs. 74,107 (inherited with the acquisition of Metal Corporation of India) respectively as on 31st March, 1974.

The debt equity ratio as on 31st March, 1974 was 0.43:1. In order to meet its working capital requirements, the Company had obtained cash credit facilities from the State Bank of Bikaner and Jaipur to the extent of Rupees one crore initially and then raised to Rs. 1.75 crores in April, 1971 to Rs. 2.90 crores in February, 1972 but restricted to Rs. 1.35 crores with effect from 1st November, 1973 against hypothecation of raw materials, finished and unfinished products, etc. No amount was outstanding against cash credit as on 31st March, 1974.

The long term loans granted by Government carry interest at the rate of 7% per annum (7½% per annum with effect from 14th September, 1971) and a liability for penal compound interest of 2½% on all overdue instalments of principal and/or

interest. A moratorium from the date of drawal of the loans up to the period of two years from the date of commencement of production has been allowed in respect of repayment of the principal subject to the condition that the total period of moratorium does not exceed five years from the date of disbursement of the loans and the repayment of loans is completed within 15 years from the date of drawal.

The first loan of Rs. 1.05 crores was disbursed by Government in two instalments in July, 1966 and August, 1966. The zinc smelter (with the exception of sice furnace) went into production in January, 1968 and accordingly the repayment of loan should have started from January, 1970, but the Company took the view that as the loan was granted to meet the expenditure on the composite project for the development of mines and the completion of the zinc smelter, its repayment should commence on the expiry of five years from the date of its drawal viz., July, 1971 by which time the development of Zawar mines was also expected to be completed. Government was requested in September, 1969 to confirm this view.

In October, 1971, Government decided that for the purpose of repayment of loans, 16th November, 1968 should be taken as the date of commencement of production *i.e.* six months after the initial commencement of production of zinc metal with the commissioning of the sice furnace. The Company was therefore, asked to make payment of the instalments of loans amounting to Rs. 5.42 crores which had already fallen due and which would fall due thereafter on due dates. In January, 1972, it was further clarified by Government that the instalments of loans should be repaid on the anniversary dates falling after 16th November, 1970. Out of the total instalments of Rs. 17.29 lakhs, Rs. 55.64 lakhs, Rs. 65.38 lakhs and Rs. 65.38 lakhs falling due for repayment during 1970-71, 1971-72, 1972-73 and 1973-74 respectively payments of Rs. 20.68 lakhs, Rs. 40.35 lakhs and Rs. 77.89 lakhs were made during the years 1971-72, 1972-73 and 1973-74 respectively leaving a balance of overdue instalments of Rs. 64.77 lakhs as on 31st

March, 1974. The penal interest on the overdue instalments of principal which worked out to Rs. 4.41 lakhs upto 31st March, 1974 was paid in April, 1975.

3. ORGANISATIONAL STRUCTURE

As mentioned in paragraph I, the undertaking taken over by the Government was managed by an Administrator appointed by Government till the formation of Hindustan zinc Limited on 10th January, 1966. The Company was formed with the following main objects :—

- (i) To acquire, take over, manage and develop the undertaking formerly belonging to the MCI and to exploit, to the fullest extent possible, zinc and lead deposits in and around the Zawar area, and
- (ii) To carry on trades and business of metallurgists and miners, and production/sale of zinc and lead metals and their products and by-products including fertilizers.

The activities of the Company comprise development and production of zinc-lead ore from the captive mines at Mochia-Magra and Balaria in the Zawar region, production of zinc and by-products (namely, sulphuric acid, zinc sulphate, copper sulphate, cadmium) from the Zinc Smelter at Debari and lead and silver from the lead Smelter at Tundoo near Dhanbad. Single superphosphate is produced as a down-stream product to utilize sulphuric acid. Rock Phosphate required for superphosphate is being extracted by the company from its captive mines at Maton (near Udaipur) from April, 1974.

Immediately after formation of the Company, the Administrator was appointed as the first Managing Director of the Company and on his relinquishment of the charge, another person was appointed as the Managing Director on 1st July,

1966 who continued to hold the office upto 30th March, 1968. Apart from the Managing Director there was :—

- a General Manager,
- a Financial Adviser & Chief Accounts Officer,
- a Chief Executive Officer,
- a Chief Mining Engineer,
- a Chief Engineer, Zinc Smelter, and
- a Factory Superintendent for Lead Smelter.

The Chief Executive Officer was appointed with effect from 26th February, 1969 as the Chief Sales Manager. On 1st April, 1968, the then General Manager was appointed as the Managing Director of the Company who continued till 25th May, 1970. There was a part-time Chairman all along till 15th May, 1970 when an acting full-time Chairman was appointed who ultimately took over on 25th May, 1970 as the Chairman-cum-Managing Director. An officer on Special Duty (Mines Development) was appointed during 1969-70 to look after the production from the mines and construction of the mill with a capacity of 2,000 tonnes per day. He was also placed incharge of planning and development cell (Mining). He was relieved in April, 1971 of his responsibilities with regard to mine production. Subsequently he was also relieved of the duties relating to mine planning as well as preparation of project reports for Balaria and Maton mines, leaving him free to devote entirely to the timely commissioning of the mill. There was delay in the completion of the mill [vide para 5.03(c)]. He was relieved of this duty also from 29th January, 1972 when he was on leave and the Ministry was informed accordingly. In February, 1972, while approving the Company's action, the Ministry placed his services at the disposal of the Bureau of Public Enterprises for further posting. In the absence of any orders from the Bureau of Public Enterprises and at the suggestion of the Ministry, the Officer was allowed to join, on the expiry of his leave on 29th February, 1972, the Delhi Office of the Company. He continues to be there without any work assigned to

him (December, 1974). The Company is incurring an expenditure of Rs. 3,700 per month on the Officer *i.e.* Rs. 44,400 per annum from 29th February, 1972. A Deputy General Manager (Mines) joined the head office of the Company on 18th September, 1972 to look after the work previously assigned to this officer.

The Ministry have stated (January, 1975) *inter alia* as follows :—

“Various attempts were made by the Government to find an alternative post for Shri Sehgal outside the Hindustan Zinc Limited, but without success. The cadre authority of the IMP does not have any post under its control to which Shri Sehgal could be transferred. The power to make appointment to posts below the top level vests in the public enterprises. This explains the difficulty of Government in finding an alternative post for Shri Sehgal outside Hindustan Zinc Limited. Efforts are still being made to find a suitable posting for him in one of the mining companies or establishments under the control of the Central Government.”

During 1969-70 the Works Manager, Zinc Smelter was appointed and this incumbent was appointed to the post of Chief of Planning and Development (Smelters) during 1970-71. The Chief Mining Engineer was re-designated as Superintendent of Zawar Mines and the Factory Superintendent of Tundoo was appointed as the Works Manager, Zinc Smelter, during 1970-71. The last mentioned officer was re-designated as General Superintendent (Construction) from 20th September, 1971. The Chief of Planning and Development (Smelters) was appointed to the post of Deputy General Manager (Smelters) from 1st February, 1972 and the Chief Sales Manager was appointed as the Chief Sales Manager and General Superintendent, Zinc Smelter from 20th September, 1971 the Superintendent of Zawar mines was appointed as the Chief of Planning and Development (Mines) from 1st February, 1972. Similarly

another officer was appointed as the Chief Geologist during 1971-72.

Keeping in view the needs of expansion in mining and smelting capacity a revised organisational chart (Annexure II) was approved by Board of Directors in January, 1973. Further changes have been made in this revised organisational chart from time to time. The posts of General Superintendent Zinc Smelter, Debari and General Superintendent, Visakhapatnam Smelter were subsequently up-graded to those of Deputy General Manager (Zinc Smelter) Debari and Chief Project Manager, Visakhapatnam Smelter respectively. In April, 1974, a new post of Deputy General Manager (Zawar Mines) was created and the post of Deputy General Manager (Mines) in the Head Office was re-designated as Deputy General Manager (Planning and Development).

The overall management of the affairs of the company vests in a Board of Directors consisting of a full-time Chairman-cum-Managing Director and several part-time Directors. The day to day business is conducted by the Chairman-cum-Managing Director who is the Chief Executive of the Company and has been delegated financial and other powers by the Board of Directors. He is assisted by other officers like (a) Financial Adviser and Chief Accounts Officer (b) Deputy General Manager (Smelters) (Planning Cell) (c) Deputy General Manager (Planning and Development) and (d) Deputy General Manager (Commercial) in the Head Office and by (a) Deputy General Manager (Zawar Mines) (b) Deputy General Manager (Zinc Smelter) and (c) Chief Project Manager (Vizag) in the units.

The Financial Adviser and Chief Accounts Officer is in charge of financial control and discipline, costing, internal audit and financial accounts. Financial control is exercised through budgets and all financial consultations are made at the Headquarters level with the Financial Adviser and Chief Accounts Officer. The functions of Deputy General Manager (Planning and Development) include planning and development of mines, running of mines and mills and managing drilling section and

geological operations. Similarly, Deputy General Manager (Smelters), Planning Cell, in the Head Office has three main functions viz., planning and development of new and existing smelters and technological control, development, investigation and research on ore dressing plants. The Deputy General Manager (Commercial) is in charge of sales and purchases of the Company. The Chief Project Manager (Vizag Smelter) is in charge of execution of the Vizag Project. The Deputy General Manager (Zawar Mines) and Deputy General Manager (Zinc Smelter) are in charge of Zawar group of mines and the Zinc Smelter, Debari respectively.

The Public Relations Officer, the Chief Administrative Officer, the Chief Personnel Officer, the Chief Engineer (Civil), the Secretary, the Industrial Engineer and the Part-time Legal Adviser are the other officers who assist the Chairman-cum-Managing Director in his day to day functions. The posts of Public Relations Officer and Chief Administrative Officer are, however, lying vacant (January, 1975). After the retirement of the Deputy General Manager (Smelters) in July, 1974, the post has not been filled up so far (April, 1975).

A Polish specialist joined the Company on 22nd August, 1974 as adviser to the Managing Director on technical matters connected with smelters, to assist in the preparation of project reports and to supervise research and development activities. Under the terms of the contract the specialist will work as adviser to the Managing Director for two years on a salary of Rs. 8,700 per month free of all taxes, charges and duties, besides certain other facilities like free furnished accommodation (including charges for consumption of gas and electricity), free transport between residence and place of work, free medical facilities, etc.

4. PROCESS OF PRODUCTION AND INTER-RELATIONSHIP OF VARIOUS ACTIVITIES

The two main products produced by the Company are zinc ingots and lead ingots. Different by-products and co-products

also arise in the course of production. Production involves different stages, the first stage being extraction of ore containing zinc and lead metals from the mines. Ore is then beneficiated by crushing, screening and milling to produce zinc and lead concentrates. The concentrates are then treated in zinc and lead smelters to produce zinc and lead as main products; sulphuric acid, cadmium, zinc sulphate, copper sulphate are produced as by-products in the zinc smelter and silver as a by-product from the lead smelter. Single superphosphate is produced as a down-stream product to utilise the sulphuric acid in the Zinc Smelter Complex.

Ore is now being extracted from Mochia-Magra mines and to some extent from the Balaria mine in the Zawar region, 40 Kms south of Udaipur. Promising reserves have been located in Zawar Mala and Baroi in this region, and in Rajpura Dariba region, about 90 Kms east of Udaipur.

For the purpose of mining, access to ore body is made through adits deep vertical shafts, and with the help of explosives rock is blasted and loaded by mechanical loaders into bundies/ rail cars and hauled out of the mine partly by locomotives through adits and partly in skips through the main shaft. Before winding the ore in the skip, the ore is crushed under ground to (—)150 mm size, from the mine head to the mill head. Ore is then crushed and screened to (—)12 mm. For the purpose of production of zinc and lead concentrates, ore is reduced further to 150 to 200 mesh in the ball mills. Pulp from the ball mills is then processed further there for the purpose of separating lead sulphide from zinc sulphide by differential floatation. Lead concentrate thus obtained as lead sulphide (in blackish powder) is transported by rail to Tundoo. Zinc concentrate (brownish powder) in the form of zinc sulphide is transported to the zinc smelter at Debari.

Zinc smelting is a continuous process consisting of 4 main stages, namely, 'Blende' roasting, leaching, purification and electrolysis. The electrolysis product (*i.e.* cathode sheets) is

then melted into ingots. In the course of purification of leached solution, copper cadmium cakes arise from which pure cadmium is obtained by filtration and electrolysis. Another by-product, namely, sulphuric acid is obtained from SO_2 gas from the roaster. Sulphuric acid is then diluted and used for treating rock phosphate, a separate input, to yield single superphosphate. Some sulphuric acid is used in the leaching process also.

Lead concentrate is subjected to roasting and agglutination for reducing sulphur content in the ore. The sinter thus produced is further crushed for feeding it into the blast furnaces, from which after hard lead of 98.5 per cent purity is obtained. This is then refined further for removing copper and also with the intention of removing silver which comes out as "top crust" after constant agitation by mechanical stirring. From the "lower crust" refined lead of 99.99 per cent purity is obtained and cast into ingots. The "top crust" is refined and silver of 99.97 per cent purity is obtained by fire assay.

Zinc smelter is electrolytic using hydrometallurgical process for leaching/purification, while lead smelter is pyro-metallurgical using blast furnace and fire refining.

Rock phosphate used in the production of single superphosphate was up to 31st March, 1974 being purchased from the Rajasthan Government's Jamar Kotra mines. From 1st April, 1974 the Company has switched over to its own rock phosphate produced at its captive Maton mine.

In the scheme of things, therefore, the Company, after producing lead-zinc ore and rock phosphate, is self sufficient in all its main inputs and has to purchase, apart from electricity, small quantities of chemicals for the zinc smelter and some coke, iron ore, limestone, etc. for the lead smelter.

For proper appreciation of the activities of the company, following features deserve consideration :—

The ore contains both the zinc and lead metals. The metal content in the ore is not uniform. However, in order to get 1 tonne of zinc concentrate, which is the more important product, about 16 tonnes of ore were required to be processed. Taking into account the guaranteed output of Zinc Smelter, number of working days of its different sections and the analysis of the Zawar Blende (*i.e.* 55.5 per cent zinc and 4.5 per cent iron contents) as specified in the agreement with the foreign collaborations, the zinc concentrate to zinc ingot ratio works out to 2.11:1. The Management have, however, worked out the attainable ratio as 2.33:1 due to higher iron and lower zinc contents in the concentrates than those specified in the above agreement. It, therefore, follows that in order to produce 1 tonne of zinc ingots 37.33 tonnes of ore were required. However, on current indications based on average zinc content obtained during the last three years ending March, 1974 about 42.7 tonnes of ore may have to be raised and processed to produce 1 tonne of zinc ingots. The utilisation of the end-product plants, namely zinc smelter and lead smelter, depends upon availability of zinc and lead concentrates from the beneficiation plants (*i.e.* the ball mills) which in turn is dependent upon the availability of required quantity of ore from the mines. It is in this context that the importance of mine development and availability of required quantity of ore at economic cost have to be viewed in considering the performance of the undertaking.

After the undertaking of the MCI was taken over, the Company proceeded to implement the integrated project conceived during the regime of the MCI, with suitable modifications. In addition thereto, as a part of implementation of the fourth plan contemplations, the Company has also taken up various expansion projects for mine development and augmentation of capacity of the plants for increasing production of zinc and other products in the country. The progress made in this regard by the Company is discussed in the succeeding paragraphs.

5. CAPITAL EXPENDITURE DECISIONS—INTEGRATED SCHEME

5.01 Estimates of the integrated scheme

The integrated scheme prepared by the MCI in 1960 was estimated to cost Rs. 670.35 lakhs, later on revised by them to Rs. 1,263 lakhs in early 1964. At the time of acquisition of the undertaking, it was roughly estimated by Government that, besides the compensation payable to the MCI, an additional investment of Rs. 350 lakhs would be required to complete the project. The estimated cost of the project was reassessed by the Company in November, 1966 at Rs. 1,664.47 lakhs and was further revised to Rs. 1,896.61 lakhs in October, 1969.

The table on next page indicates the comparative position of estimates made in November, 1966, their further revision and the actual expenditure incurred till 31st March, 1974 :—

(Rupees in lakhs)

	Estimates of November, 1966	Revised estimates of October, 1969	Value of assets taken over in 1965 as roughly estimated by Government	Revised estimates (October, 1969) exclusive of the value of assets taken over (Col. 3-4)	Estimates sanctioned by Govt. (August, 1970) exclusive of the value of assets taken over	Expenditure up to 31-3-74 (excluding the value of assets taken over in 1965)
1	2	3	4	5	6	7
Expansion of Zawar Mines and Mill Development to 2000 MT per day	702.47 (278.00)	983.80* (278.00)	279.78 (193.00)	704.02 (85.00)	634.02** (85.00)	699.85 (84.64)
Zinc Smelter to produce 18000 MT per annum	962.00 (398.00)	890.71 (398.00)	583.91 (263.20)	306.80 (134.80)	306.80 (134.80)	243.66 (134.80)
Tundoo Lead Smelter, Calcutta Office and Head Office	—	22.10	15.70	6.40	6.40	7.87
Total	1,664.47	1,896.61	879.39	1,017.22	947.22	951.38

- NOTES:—1. *Provides for mill capacity of 2975 tonnes of ore per day (475 tonnes at the time of take over and 2500 tonnes to be installed after acquisition) as against 2000 tonnes per day envisaged in earlier estimates.
2. **Difference of Rs. 70 lakhs between the revised estimates (Col. 5) and the sanctioned cost (Col. 6) represents the notional replacement value of the initially inherited milling capacity of 5000 tonnes per day to be met out of depreciation accruals.
3. Figures in bracket indicate foreign exchange component.
4. No further expenditure is expected to be incurred for completion of the project. The estimate has, however, not been closed so far (January, 1975) pending final settlement of the MCI's claim for compensation.

While revising the estimates in October, 1969, the Company re-arranged/re-grouped the various heads of expenditure in order to rationalise the existing headings in the estimates and to cover new areas of investment. As a result, it is not possible to correlate the estimates of November, 1966 with the revised estimates of October, 1969 so as to ascertain the reasons for increase in expenditure under the different heads. However, the increase of Rs. 633 lakhs in the estimates of October, 1969 over and above the MCI estimates of Rs. 1,263 lakhs has been attributed by the Management mainly to (i) the provision of additional milling capacity of 1,000 tonnes of ore per day, (ii) devaluation of the rupee, (iii) increase in the estimated value of assets taken over from MCI, (iv) construction of Tidi dam and residential houses at Zinc Smelter and Zawar Mines, (v) increase in the customs and other statutory duties, administrative and overhead charges, (vi) additional cost of shaft sinking, civil works, equipment etc. and (vii) additional payments to French Consultants.

5.02 Execution of the integrated scheme

The following major items of works have been undertaken by the Company in connection with the integrated scheme :—

(i) *Mines and Mill development*

- (a) Sinking and lining of shaft and development of mines ;
- (b) Installation of 500 tonnes Ball Mill ;
- (c) Installation of 2,000 tonnes Mill ;
- (d) Renovation including provision of additional facilities for existing (475 tonnes + 500 tonnes) Ball Mills. (This item did not form part of the scheme prepared by the MCI in 1960/1964 but was sanctioned by the Company in December, 1969 as a separate item in addition to those covered by the revised project estimates of October, 1969) ;
- (e) Construction of Tidi dam.

(ii) *Erection of Zinc Smelter*

5.03 Delay in completion and commissioning

The scheduled dates and the actual dates of completion of the items of works forming part of the integrated scheme are given in the table below :—

	Scheduled date of completion	Actual date of completion
<i>(i) Mines and Mill development</i>		
(a) Sinking and lining of shaft and mine development	To be completed according to a time schedule to be attached with the contract	May, 1972
(b) Installation of 500 tonnes Ball Mills	September, 1966	September, 1966 (Commissioned in December, 1967)
(c) Installation of 2,000 tonnes Mill	October, 1971	April, 1973
(d) Renovation of existing Ball Mill	December, 1970	August, 1971
(e) Construction of dam over river Tidi	June, 1970 (partial) June, 1971 (complete)	Completed by State Government of Rajasthan in June, 1973 up to a height of 1376 ft. (MSL)
<i>(ii) Zinc Smelter</i>		
Erection (residual work)	November, 1966	January, 1968 (partial production) June, 1968 (full production)

(a) Sinking and lining shaft and development of mines

The contract for sinking a shaft of approximately 302 metres in depth was awarded by MCI to M/s. Cementation Company at a cost of Rs. 18.50 lakhs in December, 1961. After sinking the shaft up to 232 metres, the firm suspended the work in

August, 1964 due to the breakdown of their winder motor and did not start it again as a sum of Rs. 10 lakhs due to them had not been paid by the MCI till the acquisition of the undertaking by Government. A fresh contract was, therefore, entered into with the firm (on the basis of fresh quotation from them and after further negotiations) by the Company in September, 1966 for shaft sinking up to 321 metres at an estimated cost of Rs. 40.62 lakhs (including the cost of certain new items not covered under the old contract). The value of the contract was revised to Rs. 78.83 lakhs in July, 1971 on account of the following reasons :—

- (1) The cost of certain items totalling Rs. 39.07 lakhs was revised to Rs. 50.44 lakhs mainly because the quantities had not been accurately estimated on the basis of the particulars given in the drawings. The estimate of Rs. 40.62 lakhs included an *ad hoc* provision of Rs. 1.55 lakhs for certain items in respect of which quantities had not been stipulated in the contract. This was revised to Rs. 19.14 lakhs after indicating the quantities.
- (2) Provision of extra items of work within the scope of the contract valuing Rs. 1.44 lakhs.
- (3) Provision of extra items of work outside the scope of the contract valuing Rs. 7.81 lakhs.

The contract stipulated the completion of work according to the construction programme. A time schedule for the entire contract was prepared in October, 1966 by M/s. Cementation Company according to which the work was expected to be completed by March, 1970. This time schedule was, however, not accepted by the Company as according to the Ministry (May, 1975), "any commitment by H.Z.L. with regard to its capability to supply drawings, machinery and steel was not possible at that time." It was also stated by the Ministry that the main shaft was sunk and completed in October, 1967 and the execution of

the remaining work was dependent upon the Company's organisational strength and availability of machinery, steel, etc. When all these were tied up, a firm programme was drawn up in 1970; the intervening period from October, 1967 onwards was used by the contractor to execute the work, as and when released, without any long base perspective projection. The work was actually completed by the contractor in May, 1972.

The Company approached the Ministry in August, 1971 for the approval of increase in contract value from Rs. 40.62 lakhs to Rs. 78.83 lakhs. However, the total expenditure incurred on the work as a whole, major portion of which had been completed by October, 1971, amounted to Rs. 114.84 lakhs (including a payment of Rs. 72.82 lakhs to M/s. Cementation Company) against the sanctioned estimate of Rs. 73.72 lakhs. The Ministry stated in April, 1975 that the cost of shaft sinking and furnishing was revised to Rs. 114.84 lakhs by the Company in October, 1971, and the case was examined in consultation with the Technical Division of the Ministry. It was decided that there was a justification for increase in the cost estimates. It was further decided in October, 1973 that approval for the revised estimates for shaft sinking should be considered along with the revised project estimate for the integrated scheme for which estimate of Rs. 9.47 crores had been sanctioned in August, 1970.

(b) *Installation of 500 tonnes Mill*

In order to increase the milling capacity to 1,000 tonnes per day under their short term scheme, the MCI had placed orders for import of a 500 tonnes ball mill from USA in September, 1962. The Mill was got released by the Company in May/June, 1966 from the Bombay Port where it was lying for quite some time due to inability of the MCI to pay customs duty.

Although the installation as well as the trial run of the 500 tonnes ball mill were completed in September, 1966, it was not commissioned till December, 1967 on account of inadequate supply of electric power from the Chambal Project by the

Rajasthan State Electricity Board ; against the total requirement of 2,000 KWs for the ball mill etc. (750 KWs) and other installations in the mines (1,250 KWs), only 1,000 KWs were released.

(c) *Erection of 2,000 tonnes Mill*

In June, 1961, the MCI entered into a contract with M/s. Penarroya of Paris for obtaining technical assistance for increasing the production of Zawar Mines to 2,000 tonnes of ore per day and for expanding the mill capacity to treat 2,000 tonnes of ore per day. On the basis of the reports submitted by the consultants, the MCI undertook the mine expansion but decided to launch a short-term scheme for the development of mill capacity to 1,000 tonnes instead of 2,000 tonnes per day. After the undertaking was taken over by Government in October, 1965, Government invited an expert from M/s. Penarroya of France, who arrived in November, 1966 and gave a report to Government/Company in December, 1966 recommending that the construction of 2,000 tonnes per day mill exclusively for Mochia should start from January, 1968 to be commissioned by January, 1970. The French expert expected that full production from Central Mochia Mine to feed the new mill would come up by January, 1972 thereby indicating a gap of about 2 years between the commissioning of the mill and the commencement of full production from the mine. The Board of Directors, however, expected that full production from Central Mochia Mine would not be achieved before July, 1973.

In March, 1967 the report submitted by the French expert was examined by the Board of Directors who directed the Management to send a proposal to Government for the construction of 2,000 tonnes per day mill in addition to the existing 975 tonnes per day ball mills. After examining the likely costs of constructing this Mill and the impact of overall economies of operation, the proposal to instal a new Mill of the capacity of 2,000 tonnes per day was sent by the Company to Government in January, 1968 indicating an investment of about Rs. 2.33 crores. In April, 1968 tenders were invited for the plant and these were opened in October, 1968. The offers were technically examined by the

Director, National Metallurgical Laboratory and the Chief Mining Adviser to the Government of India. After taking into account the views of these two officers, the Board of Directors appointed in February, 1969 a sub-committee of Directors which recommended in March, 1969 that revised quotations should be obtained from all the parties.

The revised offers were received in May, 1969 and Government approval sought in June, 1969 for awarding the work to M/s. Mac Nally Bird Engineering Company Limited, Calcutta was received in August, 1969. The letter of intent was issued to the firm in July, 1969 and formal acceptance of the offer was communicated on a turn key basis in May, 1970 for Rs. 261.69 lakhs. The work was to be completed for trial runs by October, 1971 subject to the conditions that the firm would *inter alia* get import licence from Government within 90 days of the submission of the application and that the Company would assist the firm in obtaining quotas etc. for controlled items, particularly steel.

In view of the difficulties encountered in obtaining the import licences and in procuring steel, the firm expressed (February, 1971) its inability to adhere to the stipulated date of completion which was extended by the Company (September, 1971) to April, 1972 subject to the condition that at least half of the stream with a capacity of 1,000 tonnes would be completed by December, 1971. The Company also approved some additions to the plant and change of specifications of the equipment the exact financial implications of which were not worked out.

The work was not completed even within the extended time limit. The plant with two ball mills of the capacity of 500 tonnes per day each was completed in July, 1972 against the revised stipulated date of December, 1971. The remaining two ball mills each of 500 tonnes per day capacity were completed in September, 1972 and April, 1973 respectively. The total payments made to the firm up to June, 1973 amounted to Rs. 263.12 lakhs against the contracted amount of Rs. 261.69 lakhs. The Company stated (April, 1974) that the total payment was more

than the contract value on account of **escalation** clause included in the contract and that as the delay in completion could not be solely attributed to the firm, no penalty was levied on them.

In regard to the delay in completion of the work of erection of the above mill, the Management stated in January, 1975 as follows :—

“The decision to construct 2,000 tonnes Mill was taken on 8th March, 1967 in the 10th Board Meeting. Before this decision was arrived at, H.Z.L. had to consider the possibility of using the capacity available in the old 975 TPD Mill. This apparently took some time and, therefore, the first action to initiate construction of 2,000 tonnes Mill was taken after some loss of time.

The Mill was known to be the major investment centre and, therefore, the Company had to prepare detailed specifications and tender terms and conditions before floating the tenders on turn-key basis. It may be mentioned in this connection that such a large plant had never been built in India from entirely indigenous resources. The flow-sheet and the basic equipment dimensions were given by H.Z.L. in terms of Penarroya's plan and, therefore, the tenderers (number naturally was very small) had to be given adequate opportunity to match their offer with the actual requirements. The Company negotiated and re-tendered the same job on various considerations and a final contract was awarded only in May, 1970. The gap between the decision to construct the mill and the actual award of the work was 3 years and 3 months.”

(d) *Renovation of existing Ball Mills*

Two ball mills of the capacity of 300 tonnes and 175 tonnes per day were taken over by the Company from the M.C.I. Another mill of 500 tonnes capacity was installed in September, 1966 and commenced production from December, 1967. As the two acquired mills were very old (14 and 20 years old), the Management felt that the existing 3 mills having a combined

capacity of 975 tonnes per day were not dependable even to deal with 800 to 850 tonnes of ore per day partly due to continuous operations for about 6 days in the week leaving little time for maintenance and partly due to non-availability of sufficient spares for the imported equipment. Accordingly, a scheme of renovation envisaging additions and modifications to the existing ball mills was approved by the Board of Directors in December, 1969 at a cost of Rs. 17.91 lakhs (including Rs. 4.60 lakhs for balancing equipment) in order not only to keep the mills running at the present capacity but also to increase the capacity to about 1,100—1,200 tonnes per day so that the expected increased production from the mines (about 1,200 tonnes per day by the 2nd quarter of 1970) could be handled till the installation of 2,000 tonnes mill which was expected to be completed by 1971.

The renovation was completed in August, 1971 against the expected date of December, 1970, at a cost of Rs. 14.73 lakhs (up to 31st March, 1972) while no expenditure was incurred on the purchase of balancing equipment as it was held in abeyance.

The Ministry stated (May, 1975) that the work of renovation had to proceed slowly keeping in view the need to keep the Mills running to capacity during renovation.

The order for the main equipment was placed in July, 1970 and was scheduled to be delivered by December, 1970. The equipment was ready with the supplier for despatch by the middle of October, 1970 and an amount of Rs. 0.46 lakh was paid to him as bonus in terms of penalty/bonus clause in the contract. Clear despatch instructions were, however, given only in December, 1970 after assessing the comparative economics of rail and road transportation.

(e) Construction of dam over river Tidi

To meet the water requirements of Zawar mines, the Government of Rajasthan, at the request of the MCI, agreed in 1960

to construct a dam over river Tidi at a cost of Rs. 25 lakhs on which the MCI guaranteed a return of 4%. The work was not commenced till the time of acquisition and in March, 1968 the Company decided to get it done through the State Government at an estimated cost of Rs. 42 lakhs. Accordingly, tenders were invited and received by the State Government in March, 1968 and it was decided to award the work to the lowest tenderer.

The date for acceptance of the tender was extended from 25th July, 1968 to 25th December, 1968 but the lowest tenderer commenced the work in October, 1968 in anticipation of the formal acceptance of his tender. However, he abandoned the work on 16th December, 1968 due to labour unrest.

The work was thereafter done departmentally by the State Government. The estimated cost was revised from time to time as indicated below :—

(Rupees in lakhs)

	October, 1969	April, 1970	October, 1970	April, 1971
1. Revision of estimates by State Government	60.42 (storage capacity 80 M. cft. of water with maximum capacity of 300 M. cft.)	66.25	79.79 (to raise the height to 1406 ft. MSL)	67.42 (to raise the height to 1376 ft MSL and storage capacity to 80 M. cft.)
2. Approval of estimates by the Company		February, 1970		April, 1971
3. Expected date of completion	The expected date of completion of the dam was not indicated by the State Government while revising the estimates.			

In April, 1972 the State Government further revised the estimate to Rs. 99.69 lakhs for a height of 1,407 ft. MSL and Rs. 85.07 lakhs for the height of 1,376 ft. MSL. The dam was partly completed in June, 1973 up to a height of 1,376 ft. MSL. Although it has not been formally handed over so far (January, 1975), the Company has started drawing water for its use. The question regarding formal transfer of the dam to the Company is under correspondence with the State Government.

While reviewing the revised estimate of April, 1972, the Central Water and Power Commission observed in June, 1972 that the dam at full height would generate only 95% availability of 140 million cft. and not 300 million cft. of water as originally planned by the Irrigation Department. The dam at its present height (1,376 ft. MSL) has the storage capacity of 80 million cft. and is considered sufficient to meet the existing requirement of Zawar mines. However, by 1976-77 when the requirement of water for exploitation of Zawar group of mines is expected to increase to 182 million cft. per annum, there would be shortfall of 42 million cft. of water even if the dam is extended to its full height of 1,407 ft. MSL.

The Ministry have stated (May, 1975) that "The State Government has informed that another dam further downstream of the Tidi river, called Tidi stage II (Dia Dam) will be constructed by the State Government for irrigation purposes and has agreed that H.Z.L. can draw 70—80 M. cft. of water from its Dam to meet shortfall of water availability from Tidi dam....."

(f) *Erection of Zinc Smelter*

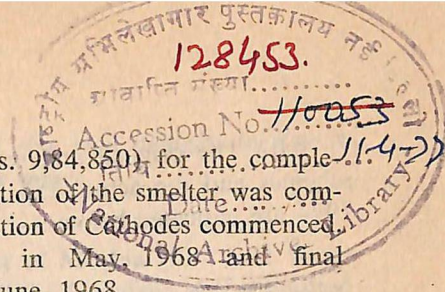
As mentioned in para 1, prior to take over of the undertaking by Government about 75% of the work on the erection of zinc smelter had been completed and further work had been stopped on account of financial difficulties of the MCI. As a result, a supplementary agreement had to be entered into with M/s. Krebs and Pennarroya of France, with whose technical assistance the smelter was being erected, in November, 1966 on a lump sum

payment of F.F. 6,50,000 (about Rs. 9,84,850) for the completion of the residual work. The erection of the smelter was completed in January, 1968 when production of cathodes commenced. The production of ingots started in May, 1968 and final acceptance tests were completed in June, 1968.

6. CAPITAL EXPENDITURE DECISIONS—EXPANSION/ NEW SCHEMES

6.01 At the time of taking over the undertaking, the daily average production of ore from Central Mochia Magra mines (which were the only mines under production) was about 500 tonnes per day. The Company decided in August, 1966 to increase the ore production to 750 tonnes per day from the existing mines and raise a quantity of 250—300 tonnes per day by developing the Balaria mines, the latter being synchronised with the commissioning of the new 500 tonnes ball mill by about February, 1967.

In August, 1968 the demand for zinc metal in the country was assessed by the Planning Group on non-ferrous metals at 1,42,000 tonnes by the end of the Fourth Five Year Plan (1973-74) and at 2,25,000 tonnes by the end of Fifth Five Year Plan (1978-79). The Fourth Five Year Plan, therefore, envisaged doubling of the capacity of the two existing zinc smelters (one owned by the Company with a capacity of 18,000 tonnes per annum and the other by a private firm, Cominco Binani Zinc Limited having a capacity of 20,000 tonnes located at Alwaye) and the setting up of a new zinc smelter at Vishakhapatnam for the production of 30,000 tonnes per annum. Simultaneously, the lead smelter at Tundoo in Bihar owned by the Company and having an annual capacity of 3,600 tonnes of refined lead, was proposed to be modernised in order to ensure more efficient working and for increasing its capacity. The Fourth Five Year Plan also envisaged the augmentation of ore production to 4,000 tonnes per day by increasing the production from the existing mines from about 1,000 tonnes to 2,000 tonnes per day and raising additional 2,000 tonnes of ore by developing new mines in the Zawar region.



6.02 The original and revised plan provisions for the above schemes and the actual expenditure incurred up to 31st March, 1974 are indicated below :—

Name of the Scheme	(Rupees in lakhs)		
	Plan Provision		Expenditure incurred upto 31-3-74
	Original	Revised	
	2	3	4
<i>Continuing Schemes</i>			
Development of Mochia Mines to increase the production of ore to 2,000 tonnes per day, installation of Zinc Smelter of 18,000 tonnes capacity, etc.	742.00	678.00	768.34
<i>New Schemes</i>			
1. Feasibility studies	30.00	—	—
2. Prospecting and mining of zinc lead deposits in Zawar region and development of additional production of 2,000 tonnes of ore per day	1,152.00	1,098.00	400.88(*)
3. Doubling of the capacity of the existing zinc smelter from 18,000 to 26,000 tonnes per annum	500.00	1,026.00	185.72
4. Establishment of a new smelter at Vishakhapatnam leased on imported concentrates	—	960.00	245.87
5. Modernisation of lead smelter at Tundoo	75.00	75.00	19.09
6. Development of rock-phosphate mine in Maton	50.00	33.00	131.14
TOTAL	2,549.00	3,870.00	1,751.04

NOTES.—(1) *Excludes Rs. 108.05 lakhs incurred on Rajpura Dariba Mines to the end of 1973-74 for which there was no plan provision.

2. The Zinc Smelter went into production in June, 1968. Provision of funds was made in the Fourth Five Year Plan to meet expenditure commitments on the continuing schemes against the sanctioned estimates.

6.03 (a) Prospecting and mining of zinc lead deposits in Zawar region and development of new mines

The feasibility reports in respect of Mochia (East and West) and Balaria Mines were prepared by the Company and submitted to Government in January, 1970. In October, 1970 Government approved an expenditure of Rs. 232.85 lakhs to be incurred during 1970-71 and 1971-72 for the completion of the essential items of work like sinking of auxiliary shaft and development of two horizons at Balaria mine in the course of preparation of the detailed project report which was required to be submitted to Government within the maximum period of 8 months (*i.e.* by June, 1971) and for the exploratory mining at Mochia (East and West) and Zawarmala. The actual expenditure incurred during the two years amounted to Rs. 88.60 lakhs. The detailed project report for Balaria Mines envisaging a capital outlay of Rs. 12.28 crores (including foreign exchange element of Rs. 94 lakhs) was approved by the Board of Directors in August, 1972 and sanctioned by Government in September, 1973 at a cost not exceeding Rs. 11.61 crores only (including foreign exchange element of Rs. 90 lakhs). No separate detailed project report for East and West Mochia Mines has been prepared as these are being treated a part of Mochia/Balaria Mines Complex.

The feasibility report for Zawarmala was also submitted to Government in January, 1970 who sanctioned (October, 1970) an amount of Rs. 32.50 lakhs and Rs. 47 lakhs to be incurred on exploratory mining during 1970-71 and 1971-72. The actual expenditure incurred amounted to Rs. 9.02 lakhs and Rs. 15.63 lakhs respectively. In May, 1973 Government approved the proposal of the Board of Directors to entrust the preparation of conceptual engineering-*cum*-feasibility studies for Zawarmala and Baroi mines to M/s. Arthur G. Mekee and Company, U.S.A. at a cost of \$ 2,34,600. The report was received in June, 1974 and the Board approved the same in September, 1974. The report provides for the production of 9,00,000 tonnes of ore, 41,310 tonnes of zinc concentrates and 23,460 tonnes of lead

concentrates per annum by 1979-80 involving a capital outlay of Rs. 37.57 crores.

Besides the above mines, the Company has also undertaken the development of Rajpur-Dariba mines for which no provision existed in the Fourth Five Year Plan. The project report for these mines (accepted up to the stage of production of concentrates) for the production of 9 lakh tonnes of R.O.M. and 1,09,500 tonnes of concentrates (88,500 tonnes of zinc concentrates and 21,000 tonnes of lead concentrates) per annum involving a total capital outlay of Rs. 19.53 crores was sent to Government in February, 1973. In October, 1973 Government sanctioned an amount not exceeding Rs. 1.98 crores for essential items of preliminary works like shaft sinking etc. for the first two years subject to the condition that further tests, additional data collection and analysis etc. required should be carried out as early as possible and firm proposals regarding the shape of the project (including firm capital cost estimates) should be submitted to Government in two years time for consideration. In March, 1974 Government approved the development of these mines and the setting up of ore beneficiation facilities at an estimated cost of Rs. 19.53 crores with a foreign exchange component of Rs. 1.25 crores subject to the condition *inter alia* that financial sanction for the actual expenditure on the project would be restricted to the ceiling of Rs. 1.98 crores for the first two years pending consideration of firmer cost estimates for the project as a whole by the Public Investment Board for which proposals should be submitted by the Company as early as possible. The Ministry have stated (May, 1975) that "Appropriate proposal will be submitted by the Company during 1975-76."

(b) *Balaria shaft sinking and Mochia Balaria interconnecting driveage work*

The contract for the above work for Rs. 46.92 lakhs was awarded to M/s. Cementation Company on 9th June, 1972 on the basis of negotiations. The same firm was entrusted with a

similar work in Central Mochia Mines as mentioned in Para 5.03(a). The following features connected with the finalisation/implementation of the contract deserve mention :—

- (i) The contract, *inter alia*, envisaged (a) the drawing up of a programme for completion of work to be appended to the contract and (b) furnishing of a performance bond for Rs. 4.69 lakhs by the contractor within 15 days of the signing of the contract. Neither any programme for completion of the work was drawn up nor was the performance bond furnished by the contractor. The Management have stated (April, 1975) that the programme of the work was mutually discussed and drawn up for each quarter and that the performance bond for such work was not obviously necessary.
- (ii) The contract provided for issue of materials, like explosives, high speed diesel, petrol, steel, cement, etc. at *stipulated prices* but no detailed estimates for the work were prepared *inter alia* indicating the requirements of these materials except for steel. The Management stated (April, 1975) that materials were issued to M/s. Cementation on the recommendation of the Engineer-in-Charge who exercised proper control over the issue and consumption *vis-a-vis* the estimates. As, however, detailed estimates were not prepared, there was no yardstick against which actual consumption could be watched.
- (iii) Under the contract, the contractor was entitled to construct houses conforming to Company's specifications for its workers on Company's land; at the conclusion of the contract, the Company could take over these houses at depreciated cost. Houses built by the contractor have not yet been taken over as under another contract entered into with M/s. Cementation Company, the existing free accommodation is to be provided to them.

- (iv) The work was completed in September, 1974 against the scheduled date of January, 1974. As there was delay on the part of the Company in supplying various services and materials in terms of the contract, the penalty clause could not be invoked. On the other hand, in terms of the contract the contractor claimed a sum of Rs. 1.36 lakhs on account of his labour rendered idle due to Company's failure to supply the materials and services in time. A sum of Rs. 0.65 lakh has been paid so far (March, 1975) and the remaining claim is under scrutiny by Management.
- (v) The awarding of the work to M/s. Cementation Company at a cost not exceeding Rs. 46 lakhs was approved by Government on 21st February, 1972. While the total amount paid to the firm was Rs. 49.06 lakhs, the total expenditure on the work including the cost of free services, like power, water, etc. provided in the contract amounted to Rs. 62.88 lakhs. The excess expenditure has not been regularised so far (April, 1975).

6.04 Expansion of the capacity of zinc smelter at Debari

The zinc smelter with a capacity of 18,000 tonnes was completed in June, 1968. The preparation of a project report for the expansion of the smelter to a capacity of 36,000 tonnes was entrusted to M/s. Krebs (India), (agents for M/s. Krebs of Paris who provided technical collaboration for the original plant) in October, 1969. The project report was received in September, 1970 and was forwarded to Government, with recommendations for acceptance, in December, 1970. Government approved the implementation of the project in September, 1971 (including adjustment of the existing superphosphate plant for the production of triple superphosphate) at a cost not exceeding Rs. 10.49 crores.

According to the project report, the construction of the entire plant is expected to take a period of 3½ years. The Company entered into an agreement with M/s. Krebs of Paris in May, 1973 for a period of 3 years for technical collaboration for the expansion of the smelter. The collaborators will provide basic know-how and basic engineering services on a payment of F.F. 26.50 lakhs, free of all Indian taxes and levies, to be made in France under the framework of French credit granted in 1973-74. The capacity of the plant would be expanded to 45,000 tonnes of zinc ingots and 190 tonnes of cadmium per year. The scheme for the production of triple superphosphate was, however, dropped by the Company in June, 1973 on account of uncertainty of market.

It was reported in September, 1974 that in terms of the above agreement, transfer of basic engineering had been completed and detailed engineering work had made significant progress. The civil construction work was also stated to have commenced in August-September, 1974.

The expansion is expected to be completed by 1976-77 and the cost is likely to go up to Rs. 21 crores and the foreign exchange component to Rs. 4.14 crores. The Company further indicated in January, 1975 that the expansion cost would rise to Rs. 21 crores and that the final cost would be known only after all equipment are ordered by beginning of 1975.

6.05 Future Plans for smelters

It will be seen that even after expansion of the zinc smelter at Debari it will not have enough capacity to handle the concentrates to be produced out of the ore raised from Rajpura Dariba and Zawarmala Baroi mines. The Company has stated (January, 1975) that it has taken up preliminary studies for construction of an electrolytic zinc smelter with an annual capacity of 1 lakh tonnes of zinc and lead smelter with a capacity of 50,000 tonnes per annum at an estimated cost of Rs. 100 crores with foreign exchange component of Rs. 20 crores. The

new smelter will be fed by the concentrates to be produced out of ore raised from Rajpura Dariba and Zawarmala Baroi mines together with the concentrates likely to be available from Ambamata and Deri deposits which are being developed by the Governments of Gujarat and Rajasthan respectively.

6.06 Construction of a zinc smelter of 30,000 tonnes per annum capacity at Vishakhapatnam

The preparation of a detailed project report for an electrolytic zinc smelter was entrusted by Government in February, 1966 to M/s. Centrozap of Poland who collected the design data in May, 1966. Thereafter, the scheme was kept in abeyance by Government on account of constraint of resources and was revived in September, 1968 when M/s. Centrozap were asked to complete the unfinished part of the detailed project report. The project report was submitted in September, 1970 for a plant based on imported concentrates and was accepted by Government in November, 1970. According to the project report, the construction of the smelter will involve a capital expenditure of Rs. 21.24 crores and will take three years from the commencement of engineering work. The scheme includes manufacture of cadmium and sulphuric acid as by-products and also production of 2,000 tonnes of lead and zinc dust. A lead smelter of 10,000 tonnes capacity based on indigenous concentrates has, however, been included subsequently within the scope of the project and the additional cost of this lead smelter is estimated (1974) at Rs. 5 crores. Arrangements for the import of concentrates for this smelter on long term basis from the middle/end of 1975 onwards have been made with four foreign firms and agreements were entered into with them in November, 1972. As the plant is expected to be completed by August, 1976, the concentrates to be imported from the middle/end of 1975 will have to be stock-piled.

It was reported in September, 1974 that in terms of the agreement entered into with foreign consultants, viz. M/s. Centrozap of Poland and M/s. Lurgi of Frankfurt and prime

Indian consultants, viz. M/s. Engineers India Limited, basic engineering work for all the sections of the plant had been completely transferred and detailed engineering was in progress. The plant is expected to be completed by August, 1976. The civil and structural works for the plant were also started in October, 1974. Work on Magharigedda Dam, the main source of water for the zinc smelter is in progress. As regards power supply, orders for all principal sub-station equipment have been placed by Andhra Pradesh State Electricity Board (January, 1975). Against a provision of Rs. 17.70 crores for plant and machinery in the revised estimates of the project, orders to the extent of Rs. 8.31 crores had been placed up to March, 1975. According to the Ministry, most of the equipment will arrive by early 1976.

The Company has estimated that the cost of the project would go up to Rs. 30 crores (excluding the cost of the new lead smelter) and the foreign exchange element is likely to be around Rs. 3.92 crores.

6.07 Development of rockphosphate mines in Maton area

A project report for Maton Rockphosphate mine prepared by the Company for the production of 600 tonnes per day of R.O.M. and 300 tonnes per day of beneficiated rockphosphate involving a capital outlay of Rs. 234.37 lakhs was sent to Government in November, 1971 which was approved in August, 1972.

On the basis of the rated capacity, the Company's requirement of rockphosphate is 135 tonnes per day which will increase to 300 tonnes per day with the doubling of the capacity of the zinc smelter at Debari. The Company was procuring rockphosphate from the State Government at a concessional rate of Rs. 90 per tonne (excluding royalty of Rs. 4.25 per metric tonne and sales tax) F.O.R. Debari Zinc Smelter till March, 1973. With effect from April, 1973, the State Government withdrew

the above concessional rate and started charging a higher rate (which ranged between Rs. 112 and Rs. 361 per tonne F.O.R. grinding plant exclusive of royalty of Rs. 4.25 per tonne and sales tax during 1973-74) in view of the grant of the mining lease of the Maton mines to the Company. According to the project report, production of rockphosphate from the Maton mines was expected to commence from the middle of 1972-73 and the cost of beneficiated rockphosphate was estimated at Rs. 111.86 per tonne. Although the Maton mines started regular production of ore from January, 1974, the related ore dressing plant at Maton is not ready so far (October, 1974). Further, as the production of rockphosphate from the Maton mines till the end of March, 1974 was not adequate to meet the requirements of superphosphate plant, the Company had to continue to make purchases from the State Government. The Company has, however, switched over completely to rockphosphate from its captive Maton mines with effect from 1st April, 1974. The actual cost of beneficiated ore at Maton Mines will, however, be known only after the ore dressing plant is installed. The plant is expected to be commissioned in July, 1975.

The Management have stated (January, 1975) as follows :—

“The Project report was sanctioned by the Government in August, 1972 and, therefore, to that extent the entire time schedule of the project got delayed by almost a year.”

Certain beneficiation tests were carried out on a large scale by diverting a part of the old ore-dressing plant at Zavar for this purpose. The beneficiation of rock phosphate was undertaken for trial purposes in order to have more details to enable the issue of tender enquiries for phosphoric acid Plant at Debari, installation of appropriate drier for the beneficiated rock phosphate and also to check the process.”

7. PERFORMANCE ANALYSIS

7.01 Overall performance of integrated scheme

In 1965, when the undertaking was taken over, production of ore was about 500 tonnes per day. The capacity of the ball mill was 475 tonnes per day and another ball mill of 500 tonnes per day was on order. This mill was got released by the Company in May-June, 1966. The Management decided in August, 1966 to step up production from the Central Mochia-Magra mine to 750 tonnes per day and raise additional 250—300 tonnes per day by development of the Balaria mines within six months, thereby bringing the overall production to 1000 tonnes per day by February, 1967. In June, 1967 the target of ore production was reduced to 900 tonnes per day and further reduced to 850 tonnes per day in December, 1968. The targets of average production were again revised as follows :—

	Tonnes per day
July, 1969—December, 1969	900
January, 1970—June, 1970	1050
July, 1970—December, 1970	1400
January, 1971—June, 1971	1750
July, 1971—December, 1971	2200
January, 1972—June, 1972	2500

The ball mill of 500 tonnes per day capacity was installed in September, 1966 but operated regularly from December, 1967. The zinc smelter with 18,000 tonnes ingot capacity went into partial production from January, 1968 and regular production from June, 1968. The new mill of 2,000 tonnes capacity was completed in three phases *i.e.* up to 1,000 tonnes in July, 1972, up to 1,500 tonnes in September, 1972 and up to 2,000 tonnes in April, 1973.

From the analysis contained in paragraph 5, it will be evident that one of the serious lacunae in the integrated scheme inherited by the Company from the MCI was the absence of synchronization of different activities. Particularly, required efforts for

development of the mines with a view to feed the zinc smelter were not initiated in time. The zinc smelter was initially expected to be commissioned in November, 1966. The erection was actually completed in January, 1968. The proposal to set up the new mill with a capacity of 2,000 tonnes per day was approved by the Board of Directors in March, 1967. The letter of intent was issued only in July, 1969 and the formal orders placed in May, 1970 as mentioned in paragraph 5.03(c). It may be mentioned that according to the plan drawn up by the Company, the mill was required to be in position before development of mine. Thus no substantial development of Mochia-Magra mine could have been made without the erection of 2,000 tonnes per day mill.

From 1968-69, when the zinc smelter at Debari went into regular production, the annual requirement of ore was about 6,72,000 tonnes for producing 42,000 tonnes of concentrates. The capacity of the ball mills at that time was about 975 tonnes per day or 2,92,500 tonnes per annum (on the basis of 300 days of working). From July, 1972 the capacity of the ball mills was augmented by 1,000 tonnes per day, from September, 1972 by another 500 tonnes per day and from April, 1973 by further 500 tonnes per day. Broadly speaking, therefore, the capacities of the ball mills and the zinc smelter *vis-a-vis* the actual production of ore at different points of time were as follows :—

Year	Capacity of ball mills	Zinc smelter	Actual production of ore
1968-69	2,92,500 tonnes of ore	18000 tonnes of ingots or 6,72,000 tonnes of ore	1,91,604
1969-70	2,92,500 " "		2,29,949
1970-71	2,92,500 " "		2,70,006
1971-72	2,92,500 " "		3,18,861
1972-73	5,67,500 " "		3,51,883
1973-74	9,35,000 " "		4,56,340

In view of the inability of the mines and the ball mills to provide the required quantity of concentrates, the Company had to import 44,702 tonnes of concentrates during 1969-70 to 1972-73 at a total cost of Rs. 5.27 crores. Even with the imported concentrates the utilisation of the rated capacity of the zinc smelter ranged between 53 and 70 per cent during 1969-70 to 1973-74.

There were also serious design deficiencies in the roaster of the zinc smelter which is expected to be set right when the new roaster with spare capacity under the expansion scheme is in position by 1976-77.

A detailed analysis of the performances of the various sections appears in the succeeding paragraphs.

7.02 Mining Operations

(a) *Exploration, proving and development*

The mining activities are directed towards proving of ore by exploration, development of stopes and actual raising of ore to provide the feed for the zinc and the lead smelters. At the time the undertaking of the MCI was taken over, precise indication of reserves of ore was not available. However, according to the annual return for the year 1964 filed by the MCI and for the year 1965 filed by the Hindustan Zinc Limited, the following information was reported to be available :—

Proved Reserves	8 million tons.
Estimates reserves	14.5 million tons.

The state of proving work done by the MCI before the acquisition of the Undertaking is also not precisely known.

The consultants (M/s. Penarroya), appointed by the MCI for mine development, mentioned in their report as follows :—

“Taking into account the above facts as well as the general trend of the ore body and all the knowledge previously acquired

in the upper levels, a mineralisation forecast has been established down to —142 m. by the Chief Geologist at Zawar Mines.

Due to incomplete exploration at level 3 & 4, the mineralisation forecast plan do not extend horizontally beyond departure line 5970 and 6330. The most interesting part of the ore body has thus been extrapolated.

We have carefully examined the above referred plans. Due to the present state of knowledge, they can only show a probable outline which have been built on certain assumptions.

Since it was not possible to get more accurate data in a reasonable period of time we have accepted those plans as a basis for working out the development scheme.

Quite obviously—and we would like to underline this point—the project submitted hereafter is valid only insofar as the assumptions made in establishing the referred plans No. IV and V will be confirmed by the exploration to be made at a later stage.

In other words, the development scheme submitted herewith should be considered as a guiding project, to be carried out until further information is obtained. It will have to be revised from time to time and possibly altered by taking due consideration of the exploration results in depth. This is particularly true for plans No. VIII, IX & X showing the development working at level 5, 6 & 7.”

According to the information furnished by the Company, the proved reserves of all the mines under the Company, as on 31st March, 1974, were 12.24 million tonnes. The average lead content varied between 0.92% and 2.90%, and the average zinc content varied between 2.30% and 7.26%.

The Company treated the Central Mochia-Magra mines as established mine up to level IV, while Mochia-Magra-East and West and Central-Mochia-Magra mines from level V and below, Balaria, Zawarmala, Rajpura-Dariba and Baroi as mines under development.

The details of drilling and development work actually carried out by the Company to end of 1973-74 are shown below :—

Name of mine	(in metres)			
	Surface drilling	Under-ground diamond drilling	Driveage-exploratory mining	Driveage-mine development
Mochia-Magra	6047	12,055	6,797	13,531
Balaria	12567	11,845	6,040	4,534
Zawarmala	3731	2,321	3,126	—
Baroi	9906	—	—	11 (Adit just started)

In respect of the development of Central Mochia mines to produce 2,000 tonnes of ore per day for which a project report was got prepared by MCI in December, 1962 through M/s. Penarroya, the Company modified the Bar Chart (originally prepared on 28-2-1963 by MCI) on 2-11-1965, 1-12-1965 and 16-8-1966 according to which the production of 2,000 tonnes of ore per day was expected to be achieved by July, 1972. This time schedule was revised in January, 1970 postponing the expected date of production to December, 1972.

An assessment of the yearly performance and the cost thereof against the targets and the ascertainment of the balance of work to be done at the end of each year was not possible, as yearwise targets—physical and financial—for drilling, driveages, stope preparation, etc. to achieve the production according to the time schedule referred to above were not laid down in respect of the Mochia Mines.

As mentioned earlier the Central Mochia mines up-to level IV was treated as established mine by the Company and it is from this mine that mostly the raisings have been made up-to

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1972-73. The table below indicates the extent of mine development drilling etc. and ore reserves in different form of Central Mochia Mines up to 1973-74, as furnished by the Management :—

Year	Underground Diamond Drilling in metres	Underground Developed			Ore broken in stopes (tonnes)	Ore Reserves in million tonnes				Remarks, if any
		Expl. Dev.	Mine Dev.	Total		Proved	Probable	Possible	Total	
March 65		(in metres)								
1965-66 .	747.21				1,48,665	1.23	3.23	1.20	5.66	
1966-67 .	379.17				1,33,072	1.10	3.23	1.20	5.53	(a) Reserves blocked in pillars above 4th level (around one million tonnes) has not been considered.
1967-68 .	574.43				1,37,771	0.81	3.23	1.20	5.24	
1968-69 .	927.05	774.20	341.35	1115.55	1,18,725	0.65	3.23	1.20	5.08	(b) The detailed exploration & Mine development was in progress. The figures have been arrived by subtracting production from available reserves for comparison.
1969-70 .	1490.88	1717.00	413.95	2130.95	1,30,191	0.47	3.23	1.20	4.90	

1970-71 .	2318.54	924.39	1780.00	2704.39	1,18,063	1.64	1.80	1.04	4.57	The reserves block- ed in Pillars above 4th level (around 1 million tonnes), between 4th and 5th level crown pillar (0.24 million tonne) and in vertical stope pillars between 5th & 6th level (around 0.53 million tonne) have not been included.
1971-72 .	1275.70	64.05	2164.74	2228.79	77,481	1.69	2.45	0.63	4.77	
1972-73 .	2148.08	484.85	2062.13	2546.98	79,423	1.93	2.42	0.46	4.81	
1973-74 .	2193.60	974.36	2311.66	3286.02	1,19,813	4.64	1.85	1.03	7.52	Reserves are including pillars below 4th level (around 1.20 mil- lion tonnes) but excluding that of above 4th level (around 1 million tonne).

It will be seen that while 'probable' and 'possible' reserves remained static up to 1969-70, there was no addition to the proved reserves. The proved reserves came to a low level at the end of 1969-70.

In April, 1975 the Ministry stated that "The mine development activities undertaken up to 1969-70 were not indicated each year in the form of addition to the reserves of ore, but it was done after a couple of years. It would be seen from the 'proved' ore reserves shown during 1970-71 that the additions to the reserves of ore during the period from 1965-66 to 1969-70 were reflected in the 'proved' ore reserves from this year..... Similarly, the additions to the reserve of ore during the years 1970-71 to 1972-73 were reflected in the figures of the 'proved' ore reserves for 1973-74..... Thereafter, the additions to the reserves of ore are being reflected every year."

It will appear from the above that the system of documentation was not complete up to 1973-74. There seems to have been no system of setting the task in physical and financial terms for exploratory and development work with projection of the results to be achieved, proper documentation of the efforts made and the results achieved and periodical self-appraisal for evaluating the results of the efforts with reference to the task set for the Management.

In May, 1975 the Ministry further stated that, "Migration from the possible category to probable category or probable to proved is not always positive. Therefore, there cannot be any likely relationship between the meterage drilled or driven with the ore reserves proved..... In base metal mining, particularly in ore bodies of the type that are being handled by HZL, ore reserves cannot be treated as proved unless the degree of confidence crosses 90%. Several checks and cross-checks including sampling, drilling and exploratory driveage have to be carried out before a figure of proved reserves is arrived at".

However, the Ministry agreed that "A self assessment of the progress of exploratory work should be reported to the Board of Directors of the Company by the Management every year."

(b) *Actual raisings;*

At the time of acquisition of the undertaking, the production of ore from Central Mochia-Magra Mines (which were the only mines under production) was 500 tonnes per day. The Management decided (August, 1966) to step up the production from these mines to 750 tonnes per day and raise additional 250—300 tonnes per day by developing the Balaria mines (where the zinc content of ore is roughly double that of Mochia-Magra mines) within 6 months, thereby bringing the overall production to 1,000 tonnes per day by February, 1967. These targets were subsequently revised in June 1967 and December, 1968. The actual production as compared with the revised targets is indicated in the table below :—

Actual production vis-a-vis June, 1967 and December, 1968 targets

(Tonnes per day)

	July 1967	Decem- ber, 1967	July, 1968	Decem- ber, 1968/ January, 1968	July, 1969	Decem- ber, 1969/ January, 1970	July, 1970	Decem- ber, 1970/ January, 1971	July, 1971	Janu- ary, 1972
	2	3	4	5	6	7	8	9	10	11
<i>Established Mines :</i>										
<i>Mochia-Magra</i> (Up to level IV)										
Targets—June, 1967	600	700	600	600	600	500	300	—	—	—
December, 1968	—	—	—	600	600	450	450	300	200	—
Actuals	467	474	501	490	452	542	529	438	232	286
<i>Mines under Development :</i>										
<i>Mochia-Magra</i> (level V & below)										
Targets—June, 1967	100	100	350	350	500	1,000	1,700	2,000	—	—
December, 1968	—	—	—	100	100	250	500	1,000	1,500	2,000
Actuals	—	42	60	85	124	121	149	228	554	546

	1	2	3	4	5	6	7	8	9	10	11
<i>Balaria</i>											
Targets—June, 1967		200	300	300	300	300	400	500	500	—	—
December, 1968.		—	—	—	150	200	250	250	250	250	250
Actuals		53	101	99	109	167	232	236	250@	302@	302@
<i>Rajpura—Dariba</i>											
Targets—June, 1967		—	—	—	—	—	—	—	—	—	—
December, 1968.		—	—	—	—	—	100	150	150	150	150
Actuals		—	—	—	—	—	—	—	—	—	—
<i>Zawarmala</i>											
Targets—June, 1967		—	—	—	50	100	200	300	300	—	—
December, 1968.		—	—	—	—	—	—	50	50	100	100
Actuals		—	—	—	—	—	—	—	—	16	—
<i>Total</i>											
Targets—June, 1967		900	1,100	1,250	1,300	1,500	2,100	2,800	2,800	—	—
December, 1968.		—	—	—	850	900	1,050	1,400	1,750	2,200	2,500
Actuals		520	617	660	684	743	895	914	916	1,104	1,134
Percentage of total actual production to targets		58	56	53	81*	83*	85*	65*	52*	50	45

NOTES—1. *Worked out with reference to December, 1968 targets.

2. The above figures represent daily average production of the following six months.

3. @Includes production of East and West Mochia-Magra Mines.

4. The schedule of daily target of average production from July, 1972 onwards is not available with the Company.

It will be seen that the targets for the expected level of production from the mines under development were brought down in December, 1968 as compared with those fixed in June, 1967. The actual daily average production from the established mines as well as the mines under development fell short of the expected level of production till December, 1969. However, from January, 1970 onwards the daily average production from the established mines exceeded the revised targets (as fixed in December, 1968). The actual production from the mines under development was still less than the targets except in the case of Balaria mines (including East and West Mochia Mines) from July, 1971 onwards. The reasons for shortfall in production were not analysed by the Management during 1966-67 and 1967-68. The fall in production from Mochia-Magra mines (up to level IV) during 1968-69 was, however, attributed (November, 1968) mainly to 'go slow' tactics during April and May, 1968, acute shortage of water during June-July, 1968 and frequent trippings of power.

The reasons for shortfall in production were again not analysed during 1970-71. On being asked to clarify the reasons for shortfall in production during 1969-70 and 1971-72 as compared with the schedule of daily average production, the Management stated (February, 1974) that "..... during exploration and development of mines no targets of production are fixed and as such the question of non-achievement of these targets should not normally arise".

In this connection it may be mentioned that ore was being raised during these years both from established mines and mines under development and the schedule of daily average production from both the categories of mines had been fixed in December, 1968.

In February, 1975 the Management furnished the following break-up of ore raisings from Central Mochia mines during 1971-72 to 1973-74.

(Figures in tonnes)

Year	Upto level IV	From level V and below	Total
1971-72	1,66,693	73,680	2,40,373
1972-73	2,16,116	54,408	2,70,524
1973-74	1,35,534	2,29,386	3,64,920

It will be seen that during 1971-72 and 1972-73 major portion of the ore was raised from levels I to IV. The figures of actual average daily raisings, however, indicate that the raisings from level V and below were more than that from levels I to IV.

It would seem that a proper system of documentation indicating correctly the raisings of ore from different parts of the mine was not also adopted as it was explained by the Ministry in May, 1975 that "The annual production figures distributed between the upper levels and lower levels are not indicative of the quantum of actual ore drawn from these horizons. Central Mochia Mine has got three outlets for drawing the ore out of the Mines—No. 6 adit and the main shaft interconnected by an auxiliary shaft. Any ore which ultimately emerges with the surface from the 6th adit is treated as if drawn from upper levels while the ore coming out from the main shaft, is treated as if drawn from the lower levels. In actual day-to-day mining practice the ore has to be taken out by the most convenient route and very often the ore which should have normally come out from the main shaft was transported out of the mine through the 6th adit viz. the auxiliary shaft. There are also instances where ores from the upper levels were chuted down to lower levels for being hoisted by the main shaft."

The Company did not have the system of preparing properly integrated annual production budgets up to 1971-72. It started preparing production budgets dovetailing the production of end-products with production of ore and concentrates from 1972-73. Apart from the schedule of daily average production mentioned above, the annual targets for raising ore from different mines were not fixed before 1973-74. The actual production of ore from different mines during 1966-67 to 1973-74 is given below :—

(Figures in tonnes)

Year	Mochia-Magra	Balaria	Zawar-mala	Total	
	Actuals	Actuals	Actuals	Target	Actuals
1966-67	140072	13519	—	—	153591
1967-68	151840	22186	—	—	174026
1968-69	162764	28840	—	—	191604
1969-70	174396	55553	—	—	229949
1970-71	198214	71792	—	280,000	270006
1971-72	240373	76164	2324	300,000	31,8861
				(revised from 343,300)	
1972-73	270524	81358	—	500,000	351883
1973-74	364920 (Original target—480000)	84186 (Original target—96000)	7234 (Original target—24000)	500,000 (revised from 600,000)	456340

The shortfall in production during 1972-73 was attributed by the Management (January, 1974) to stoppage of power and water, delay in receipt of imported equipment and acute frequent power trippings.

The production of ore during 1973-74 was stated by the Management to have been affected by problems created by power cuts and floods.

The Management stated in January, 1975 as follows :—

“In preparing these plans, Penarroya had projected simultaneous operation of 10 stopes between 5th and 6th levels, each stope to produce 200 tonnes per day on an average.....

Developing of 10 stopes of sub-level operations involve significant quantity of driveage through the ore body. The ore thus produced along with the waste rock obtained from the development of these stopes was designed to be hauled to the surface through the Main Shaft. The intention was to use underground crusher, and the winding skip for hauling the crushed ore and the skip was to discharge directly into the crushed ore bin of the new ore dressing Plant. In terms of the time-schedule prepared by Penarroya, the ore dressing Plant construction was to precede actual stope development operations. In other words, the sinking of the shaft, installation of underground Crusher, erection of the hoist and skip, had to be done simultaneously with the construction of the 2,000 tonnes per day Mill so that as and when the mining operation reached the stage of stope development, the consequent ore could be fed to the Mill. In the very scheme of things therefore, the mill was to be progressively rolled to its full capacity, in a period of 3 to 4 years, thus enabling the entire process to be established while stope development continues.

Sinking of the Main Shaft, construction of the Crusher Chamber and development required for mining facilities were entrusted to Cementation Co. Limited, on contract by MCI. Orders for Main Hoist, skip and other winding equipment, along with underground crusher installation were placed by MCI. During the period of suspension of working by Cementation the Shaft, in progress, got drowned. Some of the equipments which were ordered, had already reached Indian Ports and were affected

adversely by storage. HZL took some time to re-negotiate the contractual terms with Cementation Co. for resuming the shaft sinking operations and also had to spend some time on rehabilitating the machinery which had suffered storage damages in the Docks. These put the clock back in the matters of mine development by almost two years.

As mentioned earlier, stope development for establishing a capacity of 2,000 tonnes of ore per day was associated with considerable amount of linear driveage inside and outside the ore bodies. Chart at annexure III indicates the metres of development carried out in these levels year to year from 1969-70 onwards and it will be noticed that the volume of work done after start up of the 2,000 tonnes mill was substantially higher than that of the previous years. As apprehended by Penarroya the ore body became much leaner in the levels in which the stopes were formed. Ultimately instead of 10 stopes considered by Penarroya, only 8 stopes were considered worthwhile by the Company for preparation. In the stopes which were developed, the metal contents were lower and that was also foreseen in Penarroya's report. With an average production of 200 tonnes from each stope, with 8 stopes now formed, the Company can produce 1,600 tonnes per day but with lower metal contents. Additional requirement of ore and/or metal will have to be met from lower levels of Central Mochia as also by extending the working to East and West Mochia. These steps have been taken.

Penarroya had anticipated that upper levels which have been partly developed by MCI and work would be exhausted in 3 years time. The Company has been able to establish additional lenses of ore bodies and extended the life of these workings."

7.03 Beneficiation Operations (Mills)

As already mentioned, the capacity of the inherited mill was 475 tonnes per day which increased to 975 tonnes per day from September, 1966 after the completion of a new ball mill (having

a capacity of 500 tonnes per day). This capacity was further expected to increase to 2,975 tonnes from October, 1971 when another mill of 2,000 tonnes capacity was scheduled to be completed (actually completed in three phases up to 1,000 tonnes in July, 1972, 1,500 tonnes in September, 1972 and 2,000 tonnes in April, 1973). However from the targets of daily production as fixed in June, 1967 and December, 1968 it will be seen that the expected level of production of ore per day exceeded the total milling capacity of the Company during the year 1968 and again from January, 1970 onwards. The actual production of ore also exceeded the milling capacity during July, 1971 to July, 1972.

The following table indicates the rated capacity of the mills, the quantity of ore treated, the short-fall in ore treated, the concentrates produced and the metal recovery since the formation of the Company :—

Year	Rated capacity (475 tonnes upto Dec. 1967 and 975 tonnes thereafter) (MT) (a)	ROM Produced (M.T.)	ROM treated (M.T.)	Short-fall in ROM treated (2-4) (M.T.)	% of shortfall to rated capacity (Col. 5 to 2)	% of metal in feed		Total Metal in feed	
						Pb%	Zn%	Pb%	Zn%
1	2	3	4	5	6	7	8	9	10
<i>Old Mill</i> 1965-66 (11/65 to 3/66)	59,375	62,485	53,230	6,145	10.34	—	—	—	—
1966-67	1,42,500	1,53,591	1,51,060	+8,560	—	2.8	4.22	4,230	6,375
1967-68	1,80,000	1,74,026	1,74,005	5,995	3.33	1.77	4.2	3,080	7,308
1968-69	2,92,500	1,91,604	2,09,650	82,850	28.32	1.44	3.88	3,019	8,134
1969-70	2,92,500	2,29,949	2,41,945	50,555	17.28	1.24	3.8	3,000	9,194
1970-71	2,92,500	2,70,006	2,74,695	17,805	6.08	1.1	3.62	3,022	9,944
1971-72	2,92,500 (c)	3,18,861	2,83,620	8,880	3.03	1.38	3.54	3,914	10,040

1	2	3	4	5	6	7	8	9	10
1972-73	2,92,500 (b)	3,51,883	2,90,580	1,920	0.65	0.98	3.52	2,843	10,228
1973-74	2,47,500	4,56,340	1,95,446	52,054	21.04	0.81	3.92	1,599	7,663
<i>New Mill (2000 tonnes capacity)</i>									
1972-73	2,75,000		60,993	2,14,007	77.82	2.5	3.29	1,525	2,007
1973-74	5,87,500		2,68,827	3,18,673	54.24	2.12	3.13	5,699	8,414

(a) Rated capacity calculated on the basis of 300 working days although the Mill worked for longer period in a year e.g. 325 days in 1966-67, 316 days in 1967-68, 320 days in 1971-72 etc.

(b) 300 tonnes ball mill utilised for test of Maton rock-phosphate from October, 1973 to June, 1974.

(c) 500 tonnes per day ball mill was out of order from three months from June, 1971 due to burning of 400 H. P. motor.

(+) Indicates excess.

Year	Concentrates Produced		Metal in concentrates produced		% of metal recovery		% of Lead concentrate to ROM treated (Col. 11 to 4)	% of Zinc concentrate to ROM treated (Col. 12 to 4)	% of concentrate to ROM treated (Col. 17+18)
	Pb.	Zn.	Pb.	Zn.	Pb%	Zn%			
	11	12	13	14	15	16			
1	11	12	13	14	15	16	17	18	19
<i>Old Mill</i>									
1965-66 (11/65 to 3/66)	—	—	—	—	—	—			
1966-67 . . .	5,242	9,548	3,800	5,223	89.8	81.9	3.47	6.32	9.79
1967-68 . . .	3,765	11,204	2,622	6,039	85.1	82.6	2.16	6.44	8.60
1968-69 . . .	3,462	12,523	2,472	6,767	81.9	83.2	1.65	5.98	7.63
1969-70 . . .	3,600	14,350	2,440	7,505	81.6	81.6	1.49	5.93	7.42
1970-71 . . .	3,514	15,978	2,415	8,235	79.9	84.8	1.28	5.82	7.10
1971-72 . . .	4,765	16,098	3,445	8,645	88.0	86.1	1.68	5.68	7.36
1972-73 . . .	3,325	15,808	2,400	8,440	84.3	82.5	1.14	5.44	6.58
1973-74 . . .	1,804	12,164	1,341	6,926	84.0	90.3	0.92	6.22	7.14

1	11	12	13	14	15	16	17	18	19
<i>New Mill</i>									
1972-73	1,718	2,708	1,255	1,465	82.3	73.0	2.82	4.44	7.26
1973-74	6,543	12,911	4,828	7,033	84.7	83.6	2.43	4.80	7.23

- NOTES.—1. There was pre-ordinance stock of about 60,000 tonnes of ore at the time of takeover.
2. The ball mill of 500 tonnes per day capacity operated regularly from December, 1967 although it had been completed in September, 1966.
3. As the Zinc Smelter at Debari went into partial production only in January, 1968 the Zinc concentrates produced during October, 1965 to December, 1967 were stocked by the Company without any further processing except for some quantity sold to M/s. Cominco Binani.
4. The new mill is of 2,000 tonnes capacity per day and was completed in three phases *i.e.* upto 1,000 tonnes in July, 1972, 1,500 tonnes in September, 1972 and 2,000 tonnes in April, 1973.
5. For the purpose of calculation of the rated capacity, month following the month of commissioning of the ball mills etc. has been taken as the month from which regular production started.

It will be seen that the percentage of concentrates produced to the quantity of ROM treated (old Mill) has shown a declining trend except in 1971-72 when there was slight improvement over 1970-71. The Management explained in October, 1971 that the gradual decline in the production of concentrates was on account of the fact that the mines had been working for the last more than 20 years and apart from the selective mining resorted to by the MCI, the grade of ore at lower horizons was going down with consequent fall in metal content.

There was no set pattern between the recovery efficiency and the richness of ore. The recovery efficiency of the old mill varied from 81.6% to 86.1% in the case of zinc and 79.9% to 89.8% in the case of lead. In the new mill the corresponding percentages were 73% to 83.6% and 82.3% to 84.7% against the expected recovery efficiency of 85.6% in the case of zinc and 88.3% in the case of lead indicated in the report of M/s. Penarroya. The variations were attributed by the Management in January, 1975 to the following reasons :—

(i) *Old Mill*

- (a) Power interruption leading to loss of slurry due to spillage.
- (b) Oxidisation in old stock of ore and in the ore drawn from upper levels connected with ancient workings.

(ii) *New Mill*

- (a) The mill was put into operation in October, 1972 and only 60,993 tonnes of ore was treated in the first 6 months of operation. In any new plant it takes some time before the process gets stabilised and during the stabilisation of the process the recovery tends to be low as the metal escapes into the tailings. It will be observed from the table that in the year 1973-74 the recovery improved.
- (b) Power interruption leading to loss of slurry due to spillage.

In May, 1975, the Ministry further stated as follows :—

“Recovery efficiency depends both in the metal content in the input and also metal content desired in the concentrates. If the ore becomes leaner there would be lower recovery if the same concentrate quality is sought to be maintained. Even otherwise, rich concentrates generally indicate a lower recovery but HZL has to go in for rich concentrate as the roaster is designed for it. Only when the drop in the mill-head grade of ore and availability of total concentrate start conflicting, a deliberate decision is taken to lower concentrate results in the interest of better recovery.”

The number of power interruptions in the Zawar Mines during the years 1971-72 to 1973-74 was as follows :—

1971-72	313
1972-73	291
1973-74	315

The Ministry have stated (May, 1975) that “In view of the erratic behaviours of the ore in terms of the metal content which, on occasions, are reaching uneconomic levels, the Management is already considering the possibility of introducing an on-line computerised analyser so that instantaneous adjustments in feeds and reagents can be made”.

The quantity of ROM treated was less than the rated capacity of the mills except in 1966-67 and also the quantity available (including opening stock) for beneficiation. The shortfall in the quantity treated *vis-a-vis* the capacity of the mills has been attributed to the following reasons :—

1965-66

- (1) Power shortage due to non-availability of Light Diesel Oil
- (2) Shortages of water
- (3) Changing of liners and other maintenance jobs.
- (4) Shortage of copper sulphate.

1967-68

- (1) Power shortage/failure (2) Ore shortage
 (3) Shortage of bundies (i.e. 'U' shaped wagons used for transportation of ore in mines)
 (4) Major maintenance and renovation work, change of liner, gyratory crusher foundation work, etc. (5) Strike for about 10 days.

1968-69

- (1) Shortage of ore (2) Shortage of water (3) Power failure/shortage (4) Maintenance work.

1969-70

- (1) Shortage of ore (2) Shortage of water (3) Power failure/shortage (4) Maintenance work and accident in mines.

1970-71

- (1) Shortage of ore (2) Shortage of water (3) Power shortage/failure (4) Maintenance work (5) Breakdown of Cone crusher in mill No. 3 and also in crushing floatation sections.

1971-72

Largely attributable to the power failure and power trippings.

1972-73

- (Old Mills) (1) Shortage of power (2) Frequent power trippings and (3) Maintenance of machine.

1973-74

The production of concentrates was stated by the Management to have been affected by problems created by power cuts and floods.

So far as shortfall in production attributable to shortage of ore is concerned, it will be seen from the table on page 51 that the quantity of ore available was in many years more than the

quantity treated in the mills. The Management have explained (November, 1973) that the ore was lying in different dumps and required to be transported for being fed into the mills. At times transportation of ore was possible only after secondary blasting and/or preliminary crushing. Therefore, a limited quantity could be drawn from the dumps for treatment in the mills.

7.04 Zinc smelter

(a) The zinc smelter, which went into regular production in May, 1968 consists of the main plant for the production of zinc and two by-product/co-product plants for the production of cadmium and superphosphate (single superphosphate is produced by mixing the sulphuric acid—a by-product, and rockphosphate). The capacity of each plant is so designed and coordinated that the production in the first stage is further processed up to the final stage of the product. Likewise the capacity of the two by-product/co-product plants has also been designed in a manner so as to ensure the processing of the entire by-products coming from the main plant without any accumulation at any intermediary stage.

(b) *Production process of zinc metal*

The continuous process used for production of zinc metal consists of the following four main stages :—

(i) *Roasting of zinc concentrates*

Zinc concentrates contain zinc in the form of zinc sulphide. They are roasted in a fluo-solid roaster to convert sulphide into oxide. Sulphur contents of the concentrates are converted into sulphate dioxide gas which is removed and converted into sulphuric acid. Roasted material *i.e.* zinc oxide (also known as calcine) is conveyed by screw conveyors, raddlers and bucket elevators to storage silos from where it is transferred to next process for further processing.

(ii) *Leaching of zinc oxide and purification of zinc sulphate solution*

Zinc oxide is leached with return acid from electrolysis section to convert zinc oxide into zinc sulphate solution. Impurities are also got dissolved in the solution and are removed at different stages by use of chemicals.

(iii) *Electrolysis of purified zinc sulphate solution*

The purified zinc sulphate solution is electrolysed in cells bearing lead anodes and aluminium cathodes. Zinc sulphate gets ionised into zinc and sulphate ions and zinc get deposited on aluminium cathodes and sulphate ions get converted into sulphuric acid. Zinc so deposited on aluminium cathodes is collected manually. Spent electrolyte rich in sulphuric acid is sent back to leaching section.

(iv) *Melting of zinc cathodes for production of zinc ingots*

Zinc cathodes are in the form of thin brittle sheets. These are melted in low frequency induction furnace. Dross found during melting is removed and crushed in a mill to separate oxide from metallic zinc, particles of which are returned to furnace again and fine powder of zinc oxide discarded. Molten zinc is removed from the furnace manually by spoons and cast into ingots.

(c) *Production process of by-products*

(i) *Cadmium*

During purification of leached solution in Leaching and Purification Section, Copper Cadmium cakes produced are separated using the filter pressure. The cake so produced is dissolved in spent electrolyte (received from electrolysis plant) and cadmium is separated in the form of sponge which is again dissolved in the sulphuric acid. The solution is electrolysed to produce cadmium sheets which are further melted and cast into cadmium pencils and balls.

(ii) *Single Superphosphate*

The sulphuric acid produced is diluted and used for treating rockphosphate yielding single superphosphate.

(iii) *Sulphuric Acid*

Sulphur dioxide gas obtained from Roaster is scrubbed, purified and treated in the acid plant using vanadium pentoxide as catalyst, to convert it into sulphur trio-oxide gas and subsequently into acid.

(iv) *Other products*

The Company has a pilot plant (set up in June, 1969 at a cost of Rs. 71,000) with a capacity of one tonne per day. This is being utilised since 1969-70 for the production of zinc sulphate. Zinc sulphate is produced from zinc dross arising in the smelting furnace and spent electrolyte coming from cell house. In order to utilise the increased production of zinc dross to be available after expansion of the smelter and also to use the copper cement sludge—a waste material—for the production of copper sulphate, the Board of Directors approved in January, 1972 the installation of a new plant for the production of zinc sulphate with a capacity of 5 tonnes per day and the modification of existing pilot plant for the production of copper sulphate at a total cost of Rs. 17 lakhs. The plants were expected to be ready by the second half of 1972 but the zinc sulphate plant was commissioned in February, 1975 and the copper sulphate plant is now (May, 1975) expected to be commissioned towards the end of 1975-76.

(d) *Actual production vis-a-vis rated capacity and targets of production*

The agreement with the french collaborators (M/s. Krebs of Paris) for the existing zinc smelter at Debari provided for a guaranteed output of 51.5 tonnes of zinc ingots per day, 90 tonnes of sulphuric acid per day and 15 tonnes of superphosphate per hour, besides recovery of (without any guarantee)

72% of cadmium contents in the concentrate. On the basis of the analysis of the Zawar Blende (concentrate) given in the agreement and the daily rated capacity of the Roaster to treat the same and taking into account the number of working days for the different sections of the smelter and the availability of the material, the annual rated capacity of the plant for the production of zinc ingots, sulphuric acid, superphosphate and cadmium has been worked out by the Management as 18,000 tonnes, 29,000 tonnes, 75,000 tonnes and 80 tonnes respectively.

The table below indicates the rated capacity of the smelter, the annual production targets fixed by the Management and the actual production during 1968-69 to 1973-74 :—

(Quantity in tonnes)

Product	Rated capacity	Targets						Production					
		1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>Main Product</i>													
Zinc Ingots By Products	18,000	—	12,000	12,000	12,500	14,000	11,210	13,402*	9,926	9,490 ^(a)	12,125 ^(a)	9,565 ^(a)	12,512 ^(s)
Cadmium	80	—	45	30	30	20	20	52	32	23	15	20	27
Single Super-phosphate	75,000	—	45,000	60,000	55,000	49,500	35,000	48,933	42,650	51,054	46,778	43,257	27,300
Sulphuric Acid	29,000	—	24,000	24,000	27,000	27,000	—	18,119	18,403	21,195	24,357	22,887	14,494
Zinc Sulphate	N.A.	—	—	—	—	150	200	—	142	227	222	200	160

(Quantity in tonnes)

Product	Percentage of actual production to rated capacity						Percentage of actual production to targets					
	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
1	15	16	17	18	19	20	21	22	23	24	25	26
<i>Main Product</i>												
Zinc Ingots	74.45	55.14	52.72	67.36	53.14	69.51	—	82.74	79.08	97.00	68.32	111.61
<i>By-Products</i>												
Cadmium	65.00	40.00	28.75	18.75	25.00	33.75	—	71.11	76.66	49.93	100.00	135.00
Single Super-phosphate	65.24	56.87	68.07	62.37	57.68	36.40	—	94.78	85.09	85.05	87.39	78.00
Sulphuric Acid	62.48	63.46	73.09	83.98	78.92	49.98	—	76.68	88.31	90.20	84.77	—
Zinc Sulphate	—	—	—	—	—	—	—	—	—	—	133.33	80.00

NOTES:—1. No targets were fixed for 1968-69 and the plant went into full production in June, 1968.

2. @ Exclude 1308 tonnes, 135 tonnes and 3115 tonnes of zinc cathodes (equivalent to 1244 tonnes, 126 tonnes and 2960 tonnes of zinc ingots) produced during 1970-71, 1971-72, and 1972-73 respectively. Although the zinc cathodes lying as at the end of 1970-71 and 1971-72 were melted in the subsequent year, only 3016 tonnes of cathodes could be melted during 1973-74 out of 2534 tonnes of unmelted cathodes lying at the end of 1972-73 and 11393 tonnes of cathodes produced during the year 1973-74 due to breakdown of SICE furnace. The furnace worked for 159 days only during 1973-74 and that too at truncated capacity.
3. *Includes 4807 tonnes of cathodes (equivalent to 4327 tonnes of zinc ingots) produced in 1967-68 but melted during 1968-69.
4. As the existing pilot plant, which is at present being used for the production of zinc sulphate, has not been modified so far (*vide* sub-para c(iv) above) to produce copper sulphate, copper cement sludge to be used for the production of copper sludge is accumulating at present. A quantity of roughly 250 tonnes of copper cement sludge had accumulated up to 31st March, 1973.
5. § Includes 10911 tonnes of cathodes equivalent to 10365 tonnes of zinc ingots.

The targets of production were fixed lower than the rated capacity. According to the Management these targets were fixed on the basis of the capacity of zinc smelter which could be achieved during the year. The actual production was, however, still less than the annual targets except in case of cadmium and zinc sulphate during 1972-73 and zinc ingots and cadmium during 1973-74. In the Company's annual reports for 1968-69 to 1970-71, it was mentioned that one of the reasons for non-achievement of target production during these years was the non-availability of adequate quantity of zinc concentrates. To meet the shortage of zinc concentrates, the Company drew up plans for import of concentrates in February, 1968. Imports could, however, be finalised only in August, 1969 and a quantity of 10,000 tonnes was imported for the first time in October, 1969. Altogether a quantity of 44,702 tonnes valued at Rs. 5.27 crores (at average landed cost of Rs. 1,180 per tonne at Kandla) — 10,866 tonnes in 1969-70, 7,024 tonnes in 1970-71, 21,884 tonnes in 1971-72 and 4,928 tonnes in 1972-73 imported.

However, the Management stated in January, 1975 as follows :—

“If the production build up of the plant was allowed in the ideal manner, the actual production of ingots after first year of operation should have been 60% of the rated capacity, namely, 10,000 tonnes, 80% in the next year, namely, 14,400 tonnes and 100% in the third year, namely, 18,000 tonnes.

The slippage against production capacity continued even after the third year. Availability or otherwise of concentrates would not have changed the position because.....there were (i) heavy power interruptions militating against a stable operation, (ii) power failures as well as lack of appropriate maintenance organization caused damages to certain parts of the plant, particularly, the Roaster and Sulphuric Acid Section, (iii) eagerness to utilise

full capacity of the plant immediately after start up resulted in what is known as "flogging" of the plant with consequent harm to the health of the organization, personnel psychology and equipment life, and (iv) large variation in the quality of the feed stock *i.e.* concentrates imported from abroad.

The Company was handicapped for want of experience as even at national level, there was no experience with a process of this type. It had no experienced personnel on roll either in operation or in maintenance".

The Management while explaining the reasons for short-fall in production further stated (January, 1975) as follows :—

"During 1971-72 when the concentrate position was satisfactory a doubt arose whether the plant had a genuine production capacity of 18,000 tonnes per year. The company, therefore, decided to invite two Polish experts to examine the Leaching, and Purification section in particular. It also invited the General Manager of an identical plant in Italy to examine the entire plant from the Roaster onwards.

The Polish experts categorically stated that the leaching purification section had adequate capacity and recommended incorporation of only marginal balancing equipment on the filtration side.

The General Manager of Crotone plant pointed out several deficiencies in the operational aspects, but confirmed that the plant as a whole, has adequate capacity. He was, however, not very confident that the Roaster would be able to perform to full rated capacity without modifications or alternatively without reduction in the number of working days in the year so as to enable a routine cleaning to be taken up of the boiler section. He expressed

hopes, that as and when the organisation gets lined up for routine cleaning the number of hours of shut down required per year will go on progressively reducing.

The Company also invited experts from Lurgi-Frankfurt who are the basic designers for the Fluo-solid roasters on the licence of Veille Montagne of Belgium. They recommended certain modification to enable better capacity utilisation of the Roaster and these have been incorporated. One balancing intermediate fan which they recommended has yet to be procured.

A major designal feature, created by placement of the boiler next to the roaster in a manner which attracts a change in the direction of the flow of dust laden hot gases will continue, however, to be a constraint. Any modification to this designal feature will involve major reconstruction and it is not considered worthwhile. The marginal short-fall which will be the result of this designal constraint is proposed to be made good by providing a marginal extra capacity in the new roaster which is now under erection for expanded smelter. The existing roaster, however, should be able to reach over 90% capacity utilisation if stability in power supply can be ensured."

While considering the question regarding full utilisation of the existing smelter capacity of 18,000 tonnes per annum the question regarding working of the roaster also came up for discussion in the meeting held in the Planning Commission on 15th January, 1974. It was brought out that the main impediment in attaining a production higher than 13,500 tonnes (revised to 15,000 tonnes per year in March, 1974) even in 1974-75 was the limited capacity of the roaster which suffers from design defects. It was, further pointed out that major repairs and renovation would be needed to bring it up to the

designed capacity and this would involve a prolonged shut down of the plant leading to significant loss of production. The relative advantages of running the plant until 1976 (by which time the new roaster with spare capacity under the expansion scheme of Debari Zinc Smelter is expected to come) on the reduced level of production as compared to immediate shut down were considered in the Board meeting held on 2nd/3rd August, 1974. It was not considered worthwhile to lay off the entire plant at present for a thorough overhaul to remove deficiencies in the existing roaster complex as some of these deficiencies were stated to be not removable except at considerable cost."

(e) *Characteristics of zinc concentrates*

According to the suppliers (M/s. Krebs), the plant was designed to give the zinc recovery of 86% (excluding the recovery of zinc from the leaching plant residue) provided the zinc content in the blend was 55.5% and the iron content did not exceed 4.5%. However, the characteristics of zinc concentrates actually fed into the plant widely varied as will be seen from the tables below :—

(i) *Average analysis of zinc and iron content of concentrates used up to 31st March, 1971 and quantity of concentrates consumed sourcewise*

	Zawar	Sikkim	Bolivia	Australia	Algeria
Quantity of concentrates consumed (M. Ton on dry basis)	69,867	492	9,391	1,561	4,328
Percentage of zinc content (on dry basis)	51.5	37.5	53.8	53.6	59.5
Percentage of iron content (on dry basis)	6.0	16.5	7.6	9.8	3.5

(ii) *Average analysis of zinc and iron content of concentrates used in 1971-72 and quantity of concentrates consumed sourcewise*

	Zawar	Australia	Canada	Peru		Algeria
				Lower	Higher	
Quantity of concentrates (MT on dry basis)	12,327	1,102	5,620	9,738	1,030	130
Percentage of zinc content (on dry basis)	53.7	53.6	55.7	55.9	59.1	59.4
Percentage of iron content (on dry basis)	5 to 6	9.8	4.6	8.0	3.7	4.0

(iii) *Average analysis of zinc and iron content of concentrates used in 1972-73 and quantity of concentrates consumed sourcewise*

	Zawar	Canada	Peru
Quantity of concentrates (MT on dry basis)	18,649	9,785	288
Percentage of zinc content (on dry basis)	54	55.7	55.92
Percentage of iron content (on dry basis)	6.5	4.7	8.0

(iv) *Average analysis of zinc and iron contents of concentrates used in 1973-74 and quantity of concentrates consumed sourcewise*

	Zawar	Canada
Quantity of concentrates (M T on dry basis)	23,630	189
Percentage of zinc content (on dry basis)	54.0	56.70
Percentage of Iron content (on dry basis)	6.4	4.6

According to the Management (August, 1971) the deteriorating quality of Zawar concentrates and the different grades of imported concentrates were not conducive to attain

the recovery efficiency of 86% in the plant. The recovery efficiency actually obtained was 84.2%, 80.66%, 77.36%, 73.97%, 78.47% and 77.94% during 1968-69 to 1973-74 respectively as shown below :—

	(In tonnes)					
	Janu- ary, 68 to March, 69	1969- 70	1970- 71	1971-72	1972-73	1973-74
1. Input of zinc through and zinc hydroxide	18,187	12,758	14,440	16,572	15,881	13,347
2. Cathodes produced	15,887	11,136	11,795	13,175	13,185	11,393
3. Percentage of recovery (Blende and zinc hydroxide to zinc cathodes)	90.6(*)	87.29	81.68	79.50	83.02	85.40
4. Cathodes melted	14,743	11,135	10,487	13,625	10,712	3,016
5. Total zinc input in respect of the cathodes melted	16,272	12,756	12,839	17,138	12,903	3,532
6. Zinc produced (including zinc powder)	13,702	10,289	9,932	12,678	10,125	2,752
7. Percentage of recovery (Blende and zinc hydroxide to zinc)	84.2	80.66	77.36	73.97	78.47	77.94

NOTES:—1. As separate figures of recovery of zinc from zinc hydroxide used are not ascertainable, the above table indicates combined figures of production of zinc both from zinc concentrates and zinc hydroxide.

2(*) The recovery efficiency from January, 1968 to March, 1969 has been computed after taking into account system's inventory of 600 M.T.

The Ministry have stated (May, 1975) that "the recovery efficiency of 86% could not be reached, *inter alia*, due to higher iron content in the ore."

In May, 1971 the Company appointed M/s. Chemical and Metallurgical Design Company (P) Ltd., New Delhi on a payment of Rs. 1.25 lakhs—a firm approved by the Planning Commission for rendering consultancy services and introduced by the Ministry in 1970 for reviewing the project report for Vizag Zinc Smelter submitted by M/s. CENTROZAP, to

- (i) study the operations of the zinc plant and make recommendations for improving zinc and cadmium recovery from the roasted concentrates, and
- (ii) carry out laboratory investigations to develop suitable hydrometallurgical scheme to recover additional zinc from the moore cake (leached residue).

The firm was required to submit the report within 4 months. The report was, however, submitted in two parts—the first part in May, 1972 and the second part in September, 1972. While submitting the reports to the Board of Directors, the Managing Director observed as follows :—

Part I :

While making observations regarding low recovery of zinc and cadmium, the firm had failed to identify the handling losses in the plant contributing to low recovery and had concentrated their attention on the mechanical improvement of the existing plant and machinery instead of giving specific guidelines on the process side.

Part II :

- (1) On going through the scheme recommended by the firm for recovering additional zinc from leached residue, it appeared that they were not familiar with the latest development of the Jarosite process which was being progressively adopted in the new electrolytic zinc plants all over the world.

- (2) The firm had claimed that their process was unique but M/s. Societe Vielle Montague of Belgium had been using the same material in their residue treatment plant.
- (3) The firm had estimated that the proposed plant might cost Rs. 2.5 crores whereas information available with HZL revealed that Jarosite plant might cost slightly more than Rs. 1 crore. Considering the operating cost along with the capital cost involved, the process could not be useful for the treatment of Debari sludge.
- (4) The firm had categorically stated that their scheme needed a thorough testing in a pilot plant before any commercial plant could be designed. How long and at what cost the pilot scheme was to be carried out had, however, not been indicated in the report.

While seeking certain further clarification from the firm in December, 1972, the Management observed in regard to Part I of the report that in the absence of a clear definition of the various causes contributing to such high losses, it had not been possible to derive any benefit from the report. Regarding the second part, the firm was asked to indicate the estimated capital cost of the pilot plant as well as the operating cost of such plant so that a positive decision could be taken in the matter. In April, 1974, the Company stated that even after receipt of clarification, the report was not found technically suitable for implementation. Moreover, the financial involvement was very heavy which was not considered commensurate with the result to be achieved.

(f) *Disposal of moore cake (leached residue)*

The residue left over in the process of leaching of zinc oxide is known as moore cake. As the existing plant at Debari does

not provide for recovery of zinc and lead from the moore cake the entire quantity of moore cake (approx. 45,500 tonnes to the end of 1973-74 having an average metal content of 20.7 per cent zinc and 4.4 per cent lead) has been stock piled at the zinc smelter since inception. As stated in para 7.04 (e) attempts made through M/s. Chemical and Metallurgical Design Company to develop suitable hydrometallurgical scheme to recover additional zinc from the moore cake did not succeed. A plant for treatment of moore cake of zinc smelter and blast furnace slag of lead smelter of the capacity of 6,000 tonnes per annum and estimated to cost Rs. 3.50 crores is being installed at Vizag smelter.

In October, 1974, the Management stated that the scheme for transporting moore cake from Debari to Vizag for treatment in the plant at Vizag Smelter was under re-assessment on account of the substantial freight involved with a view to find out some other alternative scheme for its treatment. The Management further stated in February, 1975 as follows :—

“In the Project Report prepared for the Vizag Zinc Smelter it was envisaged that Moore Cake produced at Vizag would be treated using Waelz Kiln for recovery of zinc and lead. The size of Waelz Kilns was originally envisaged to treat sledges from Debari and Alwaye also. Subsequently, the size of Waelz Kiln at Vizag was suitably modified to treat its own sludge.”

The Management also stated that there would be marginal spare capacity of the kiln at Vizag which might be utilised for treating Debari sledge as a temporary expedient and that a decision to add to the kiln capacity and its location or incorporation of hydrometallurgical, Jarosite or any other process to treat the Debari sludge might be taken by 1980 when the accumulated stock at Debari would be about 1,50,000 tonnes. It was also mentioned that moore cake from Debari would have about 16 to 20 per cent zinc, and recovery would be 80 per cent (more or

less) up to ingot stage. Moore cake lying at the Zinc Smelter at the end of 1973-74 was estimated (October, 1974) by the Management to contain 8959 tonnes of zinc and 1906 tonnes of lead, the value of which, on an assumption of 50 per cent recovery, was estimated at Rs. 4.40 crores.

(g) *Production of cadmium—a by-product*

The agreement entered into with M/s. Krebs for engineering services and supply of equipment etc. of the zinc smelter, Debari in November, 1966 indicated without any guarantee that about 72 per cent of cadmium in the concentrate would be recovered as electrolytic cadmium.

As against the above, the cadmium contents in the concentrates processed, cadmium actually recovered, the percentage of recovery to input, etc. during the years 1968-69 (January, 1968 to March, 1969) to 1973-74 are indicated below :—

Particulars	(In tonnes)					
	1968-69 (Jan. 1968 to March 1969)	1969- 70	1970- 71	1971- 72	1972- 73	1973- 74
1. Cadmium input through blende	62.500	52.030	73.010	59.000	64.580	65.000
2. Actual production of cadmium ingots	52.030	32.250	22.686	14.986	19.565	26.730
3. Granules	—	—	2.930	3.340	2.635	4.640
Total	52.030	32.250	25.616	18.326	22.200	21.370
4. Percentage of recovery	83.25	61.98	35.09	31.06	34.37	48.26
5. Expected output (at 50% as assessed by Management)	31.250	26.150	36.505	29.500	32.280	32.500
6. Difference in the actual recovery and the expected output	—	—	10.889	11.174	10.080	1.130
7. Value of the quantity of cadmium at (5) above (Rs. in lakhs)	—	—	11.70	11.00	10.00	1.32

The low recovery efficiency even as compared to the expectation of the Management during 1970-71 to 1972-73 have been attributed by the Management (November, 1974) to bad functioning of Moore Filter Unit and excess impurities in the imported blende used during this period resulting in cadmium locked-up in the leached residue. It may be mentioned that the percentages of consumption of imported concentrates were 50.38, 58.84 and 35.08 respectively of the total consumption. The high percentage of recovery during the period up to March, 1969 (from January, 1968 when the plant went in partial production) and in 1969-70 (when the percentage of imported concentrates used was 12.38 per cent) has been stated by the Management to be due to more cadmium content in Zawar concentrates, less impurities and excellent functioning of the Moore Filter Unit in the initial stages. In 1973-74, however, when 99.21 per cent indigenous concentrates were consumed the recovery efficiency was less than that expected by the Management. The Management have stated (November, 1974) that "the difference is mostly attributable to manual handling and transporting of cakes and sludges at various stages. M/s. Krebs are also carrying out experiments for necessary modifications of the flow sheets for our expansion to minimise this loss."

(h) *Recovery efficiency of zinc cathode melting furnace*

The recovery of metal from cathodes according to the consultants is 95 per cent without guarantee. The Company, however, informed Government in December, 1972 that the conversion ratio between zinc cathodes to zinc ingots should normally be 96-97 per cent. The quantity of zinc cathodes melted in the furnace, zinc powder and ingots produced, percentage of actual recovery to input, etc. during the years 1968-69 to 1973-74 are indicated as follows :—

(Quantity in tonnes)

Year	Cathodes melted	Production			Percentage of recovery to input	Production at 95% as indicated by consultant without guarantee	Shortfall in production	Value of shortfall (Rs. in lakhs)
		Zinc powder	Zinc ingots	Total				
1968-69	14,743.065	293.901	13,408.124	13,702.025	92.94	14,005.85	303.82	8.20
1969-70	11,134.685	363.696	9,925.706	10,289.402	92.41	10,578.25	288.85	7.80
1970-71	10,487.590	435.119	9,497.179	9,932.298	94.70	9,963.60	31.30	.89
1971-72	13,624.993	552.610	12,124.920	12,677.530	93.05	12,943.75	266.82	7.60
1972-73	10,711.809	559.321	9,565.370	10,124.691	94.52	10,176.40	51.71	2.11
1973-74	3,015.849	605.800	2,146.930	2,752.730	91.97	2,865.20 (a)	112.47	9.80
						Total		36.40

NOTES.—(1) (a) Low recovery due to trouble in the Sice furnace.

(2) The above figures of production are exclusive of recovery from metallic dross.

It would appear from the above that even taking the lower percentage as indicated by the consultants there was shortfall in recovery every year. The value of such shortfall calculated at the selling price prevalent in the respective years worked out at Rs. 36.40 lakhs. It was stated by the Company (January, 1975) that low melting recovery was due to non-treatment of metallic dross on account of difficulties faced in Sice furnace. The stock of metallic dross on 31st March, 1974 was approximately 600 tonnes containing 90 per cent total zinc and 60 per cent metallic zinc. *i.e.* total metallic zinc locked up in the form of screw conveyor product was 360 tonnes. In addition to this, approximately 1,000 tonnes of zinc dross (oxide) was lying at the end of 1973-74.

In a note submitted to the Board of Directors on 23rd March, 1973, it was stated that "the melting furnace had suffered a damage somewhere in 1969 and this condition deteriorated in January, 1971. Certain repairs were carried out and it was expected that this would keep the furnace going on a truncated capacity for a couple of years by which time the new furnace against the expansion project would be in position, thus enabling the old furnace to be completely dismantled and repaired with the help of the foreign expertise. With repeated power failure and also perhaps due to the fact that the life of the repaired furnace was over estimated by us, this furnace broke down completely on 12th February, 1973. Fresh efforts were made to repair it but at the end of the month it was found that this was no longer possible. While steps have already been taken to locate a furnace expert familiar with this type of equipment in France and Italy, we are exploring the possibilities of adopting alternative approaches to restore it to working order even at truncated capacity within a month or two. Meanwhile, firm orders have been placed on Demag of West Germany for supply of a new furnace against the expansion project but this furnace is not expected to be in position till the end of this calendar year or early next year. Meanwhile, therefore, production of smelter will have to be confined to only the cathodes which have to be allotted to those consumers who can use cathodes in place of

zinc ingots. Rourkela Steel Plant and few other major consumers are in a position to use cathodes and these details are being worked out. A separate report about this has been sent to Ministry."

The melting furnace purchased from M/s. Demag of West Germany at a cost of Rs. 14.19 lakhs was commissioned on 13th May, 1974.

The percentage of recovery to cathodes melted in the new Demag furnace during the period from May, 1974 to December, 1974 worked out to 93.6 per cent without taking into account the metallic drosses which could not be charged during this period.

The Ministry further stated (May, 1975) that "the recovery efficiency depends on various factors. For example, if a pump is used instead of a ladle the surface skin of the molten zinc is not broken frequently and this exposes less zinc to oxidation. Use of a pump entails use of automatic casting machines but the pump delivery is naturally a continuous process. If a pump is not used and more oxidation is caused due to frequent tipping of the ladle use of ammonium chloride and rabbling also becomes more frequent. When this frequency increases the dross produced also increases and along with it, apart from zinc oxide significant quantity of metallic zinc comes out with the dross. This metallic zinc after screening can be recharged into the furnace but a vicious circle is thereafter created due to imbalancing melting characteristics.

The Demag furnace is new and it is not advisable to try melting of the screened zinc dross in it. In the past when the SICE furnace was working to truncated capacity, any effort to melt the metallic zinc from dross would, to that extent, reduce the cathode melting efficiency.

For these various reasons dross is being accumulated for metal recovery in the future depending upon the stability attained in the furnace, the dross will also be charged."

7.05 Lead Smelter—Tundoo

The lead smelter is one of the plants taken over from the MCL. It produces refined lead of 99.99 per cent purity and silver of 99.97 per cent purity as a by-product.

The smelter consists of 3 main sections *viz.* sintering plant, blast furnaces and refining unit. The lead concentrates received from Zawar mines (situated at a distance of about 1800 Kms.) are formed into sinter in the sintering plant. The sinter is then fed into the blast furnaces to produce hard lead which in addition to lead, contains impurities like iron, zinc, copper and silver. The hard lead is refined in kettles and impurities are removed. From the impurities thus removed, silver is isolated and extracted.

(a) Determination of capacity

In the absence of any project report for the smelter which was set up sometime in 1942-43 with a small capacity, the Company estimated the realistic capacity of the plant in terms of refined lead production and found that a production of 3600 tonnes per year or 300 tonnes per month was possible if certain worn out equipment were replaced and repairs were carried out to the various ducts and pipes. In January, 1970 the Company constituted a Technical Committee under the chairmanship of Prof. V.A. Altekar, Director, National Metallurgical Laboratory, Jamshedpur to examine the present working and potentialities of the Lead Smelter at Tundoo, the only such smelter in the country, and to recommend its development. The Committee assessed (January, 1971) the annual achievable capacity of the 3 sections, as shown below, after taking into account the then prevailing conditions :—

Section	Input	Output	(Figures in tonnes)
			Equivalent in terms of refined lead
Sintering Plant . . .	Concentrates and fluxes	15,000 (sinters)	5,400
Blast Furnaces . . .	Sinters	12,000* (hard lead)	9,000
Refining unit . . .	Hard lead	9,000 (fine lead)	9,000

NOTES.—1. *Credited with a potential capacity of 18,000 tonnes per annum subject to improvement in working conditions.

2. The quantity of inputs for different plants was not indicated by the committee in its report.

In regard to overall capacity of the plant, the Committee observed that the various equipment of the smelter were not properly matched. Whereas the blast furnace and the refining unit had annual achievable capacity of 9,000 tonnes each (in terms of refined lead), the sintering plant could produce 15,000 tonnes of sinter from which 5,400 tonnes of refined lead could ultimately be produced. Under the prevailing conditions of working, the sinter plant was a real bottleneck and special attention would have to be given in making this plant more productive by modernisation and mechanisation. The Committee came to the conclusion that the blast furnaces and the refining section already had adequate inbuilt capacity to produce at least 6,000 tonnes of lead ingots yearly provided the sintering plant was modernised and mechanised replacing the present manual operations from critical areas.

The Committee pointed out certain serious lacunae in the plant which were holding up the achievement of the potential capacity. The various problems as analysed by the Committee, their implications and the recommendations made to overcome them are given in Annexure I.

The Committee recommended that the modernisation of the plant should be taken up in three phases. During the first phase immediate action should be taken towards modernisation of the materials handling, dust collection, etc. so that by 1972 the capacity was increased to handle 500 tonnes of concentrates per month (or 300 tonnes of pig lead). During the second phase a slag fuming plant of the capacity of 50 tonnes per day should be set up, while in the third phase, to be completed by 1974, the capacity of the plant should be increased to treat 1,000 tonnes of concentrates per month. (*i.e.* 600 tonnes of pig lead).

The report of the Committee was considered by the Board of Directors in its meeting held on 21st July, 1971 and it was decided to implement the modernisation programme in two phases, setting up of the slag fuming plant envisaged by the Committee to be taken up in the second phase, was not considered feasible by the Company. The first phase was taken up

by the Company in January, 1972 at an estimated cost of Rs. 12.40 lakhs (subsequently revised to Rs. 18.75 lakhs in April, 1972) and was scheduled to be completed by 7th May, 1973 (later on revised to August, 1973). The work was actually completed in December, 1973—January, 1974.

The Engineers India Limited, a Government of India undertaking, was entrusted with the preparation of a project report for the implementation of the second phase of modernisation and expansion on a payment of Rs. 60,000 (exclusive of the cost of outstation travel and printing and binding of the report). The report for the second phase modernisation of this smelter to increase the capacity to 500 tonnes per month or 6,000 tonnes of lead per annum was received in January, 1973 and it was decided to wait for the details of the new Lead smelter (of the capacity of 10,000 tonnes per annum) at Vizag to be finalised to enable standardisation of critical equipment.

(b) *Actual production vis-a-vis targetted production*

As stated in the preceding paragraph, according to the Management the lead smelter was capable of producing 3,600 tonnes of lead ingots per year after replacement of certain worn-out equipment and repairs to the various ducts and pipes. The replacement/repairs were completed as part of the first phase of modernisation in December, 1973/January, 1974. The table below indicates the annual production targets fixed by the Management and the actual production of lead during the years 1965-66 to 1973-74 :—

(Quantities in tonnes)

Years	Targeted production	Actual production	Shortfall(—) Excess(+) over targets
1965-66 (from Oct. '65 to March '66)	—	1,137.99	—
1966-67	—	2,514.55	—
1967-68	N.A.	2,335.58	—
1968-69	1,800	1,853.39	(+)53.39
1969-70	1,800	1,892.14	(+)92.14
1970-71	2,000	1,719.20	(—)280.80
1971-72	1,800	1,768.00	(—)32.00
1972-73	2,500	2,892.00	(+)392.00
1973-74	2,800	2,700.00	(—)100.00

The actual production showed a declining trend during 1968-69 to 1971-72 except a slight improvement in 1969-70 and 1971-72 as compared with the immediately preceding year. The production during 1973-74 was less than that in 1972-73. In January, 1975, Management stated that capacity utilisation of the lead smelter to the extent of 3,600 tonnes per year was prevented by :—

- (1) poor condition of the plant in the earlier years after take over;
- (2) non-availability of concentrates owing to :
 - (i) low production of concentrates up to 1970-71 and
 - (ii) slow movement of concentrates from the mines in 1973-74.

Apart from the fact that the quantity of concentrates received from the mines gradually came down up to 1970-71, there was no even-flow of supplies which varied from month to month and ranged between 61.55 tonnes (August, 1968) to 1,523 tonnes (January, 1974). The smelter has storage capacity of about 500 tonnes of lead concentrates which is sufficient to meet the requirement for a month. In the absence of buffer stocks, the smelter was without concentrates for the following number of days during 1965-66 to 1973-74 and had, therefore, to be closed down :—

Year	Number of days for which there was no stock	Maximum number of days in a month for which there was no stock
1965-66	49	18 (February, 1966)
1966-67	—	—
1967-68	70	17 (March, 1968)
1968-69	105	25 (August, 1968)
1969-70	90	22 (September, 1969)
1970-71	96	18 (December, 1970)
1971-72	114	23 (June, 1971)
1972-73	—	—
1973-74	54	22 (December, 1973)

The slow movement of concentrates up to December, 1973 and production of lead concentrates in excess of the capacity of the lead smelter resulted in accumulation of stock (5,380 tonnes) at the close of the year 1973-74.

(c) *Production efficiency—refined lead*

The lead content in the concentrates processed, the actual recovery of lead and the percentage of recovery to input during the years 1965-66 to 1973-74 are indicated in the next page.

(Figures in tonnes)

Particulars	22-10-65 to		1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
	31-3-67*								
(A) Lead contents in the concentrates-in-process at the beginning of the year	312.14	550.59	74.27	201.11	176.30	212.49	251.81	228.58	
(B) Lead contents in the concentrates fed during the year	5,016.85	2,545.30	2,396.12	2,334.51	2,177.72	2,165.28	3,677.83	3,491.72	
(C) Total : A + B	5,328.99	3,095.89	2,470.39	2,535.62	2,354.02	2,377.77	3,929.64	3,720.30	
(D) Lead contents in the concentrates-in-process at the close of the year	550.59	74.27	201.11	176.30	212.49	251.81	228.58	239.01	
(E) Total input of lead content (C)—(D)	4,778.40	3,021.62	2,269.28	2,359.32	2,141.53	2,125.96	3,701.06	3,481.29	
(F) Actual recovery	3,543.25	2,335.58	1,853.39	1,892.14	1,719.20	1,768.88	2,891.50	2,700.20	
(G) Percentage of recovery	74.15	77.29	81.68	80.20	80.28	83.20	78.12	77.56	

NOTES:—1. The lead content in the concentrates fed for processing is ascertained through laboratory tests.

2. *Yearwise figures are not available with the Company.

3. While working out the above recovery efficiency, the opening and closing stocks of hard lead under process in the refinery have not been taken into account. The closing stock of hard lead at the end of 1967-68, 1968-69, 1969-70, 1970-71, 1971-72, 1972-73 and 1973-74 was, however, only 21,13,15,40,18,11 and 61 tonnes respectively, closing stock as on 31st March, 1967 being not available.

It will be seen that the process loss of lead varied between 16.80 per cent and 25.85 per cent during these years. The percentage of loss which during 1960-61 to 1968-69 amounted to 24 per cent was considered to be on the very high side by the Altekam Committee and it was held that there was scope for reduction of the same.

(d) *Transit Losses*

The quantity of concentrates despatched from Zawar mines, the quantity received at Tundoo smelter and the shortage in transit during the years 1967-68 to 1973-74 are given as follows :—

(Quantity in tonnes)

Sl. No.	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
1. Quantity despatched	3,809.92	3,492.32	3,493.16	3,333.14	4,916.50	5,160.10	6,663.90
2. Quantity in transit/under claims	420.31	320.00	241.01	225.75	494.00	435.70	1,161.79
3. Net quantity receiveable (1-2)	3,389.61	3,172.32	3,252.15	3,107.39	4,422.50	4,724.40	5,502.11
4. Quantity actually received	3,486.45	3,225.76	3,347.19	3,167.37	4,490.96	5,016.42	5,775.31
5. Previous year's despatches included in item 4	221.25	386.23	271.44	230.00	196.00	494.00	426.45
6. Receipt from current despatches	3,265.20	2,939.53	3,075.75	2,937.37	4,294.96	4,522.42	5,348.06
7. Loss in transit (3—6)	124.41	232.79	176.40	170.02	127.54	201.98	153.25
8. Percentage of loss in transit to despatches	3.27	6.66	5.05	5.01	2.77	3.87	2.58
9. Cost per tonne of concentrates (Rs.)	769.82	945.62	1,048.78	1,163.14	1,148.53	1,278.60	1,388.90
10. Value of loss in transit as at item 7 (Rs. in lakhs)	0.96	2.20	1.85	1.98	1.46	2.58	2.13

NOTE:—Quantities indicated above are in dry weight.

The Ministry have stated (May, 1975) that "There being no weighing facilities of railway wagons either at Udaipur or at Tundoo siding the quantity despatched indicates the R/R weight only (which is issued on said to contain basis). It also involves transshipment *en route* from M/G wagons to B/G wagons resulting in handling and slippage losses. Therefore, the figures of quantity despatched and quantity received may not indicate the correct quantity either at despatching point or at receiving point. Nevertheless improved polythene bags are now being used to avoid and reduce transit losses to the minimum extent possible. In view of improved packing and standard weights of the bags, clear RRs are being now issued by Railways.

Necessary instructions to further streamline the existing system to despatch lead concentrates from Zawar mines to Tundoo by rail have also been issued in September, 1973".

(c) *Production of silver—a by-product*

The silver contents in the concentrates processed during the year, the silver actually recovered and the percentage of recovery to input during 1965-66 to 1973-74 are indicated on the next page :—

(Quantity in Kg.)

Particulars	22-10-1965 to 31-3-1967*	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
A. Quantity of silver in the work-in-progress at the beginning of the year . . .	376.730	543.730	150.337	395.735	376.690	1,142.780	1,036.800	829.810
B. Quantity of silver in the concentrates fed during the year .	4,661.096	2,616.145	3,055.060	2,821.110	3,102.420	3,322.100	4,875.560	4,192.090
C. Total (A+B)	5,037.826	3,159.875	3,205.397	3,216.845	3,479.110	4,464.880	5,912.360	5,021.900
D. Silver contents in the concentrates in-process at the close of the year .	543.730	150.337	395.735	376.690	1,142.780	1,036.800	829.810	1,031.360
E. Total input of silver (C—D) .	4,494.096	3,009.538	2,809.662	2,840.155	2,336.330	3,428.080	5,082.55	3,990.540

F. Actual recovery of silver	4,494.000	3,249.537	2,781.450	3,250.430	2,320.500	3,399.770	5,060.21	4,181.735
G. Percentage of recovery	99.9	107.97	99.00	114.44	98.55	99.18	99.56	104.79

NOTES.—1. *Yearwise figures are not available with the Company.

2. The figures of actual recovery of silver given above for the years 1965—67, 1969-70, 1971-72, 1972-73 and 1973-74 include about 2,400 Kgs., 1113 Kgs., 492.77 Kgs., 468 Kgs. and 390.553 Kgs. of silver respectively used in the production of high grade lead for zinc smelter.

The percentage of recovery has varied from year to year. The reasons for higher recovery of silver during 1967-68 and 1969-70 were explained by the Management (February, 1972) as follows :—

- “(a) One reason may be due to cumulative effect of inaccurate determination of weights of lead concentrates received here at Tundoo and incorrect sampling and assay of silver in concentrates.
- (b) The samples drawn from the secondaries are not always correct as the secondaries contain metallics also, and hence the assay of silver does not reflect correct values.
- (c) The secondary inventories were given by eye estimates and not by actual weighment and this naturally lead to error in quantities and consequently silver content in them”.

(f) *Utilisation of fuel and fluxes*

Norms of consumption of various fuel and fluxes per tonne of refined lead produced were tentatively fixed in September, 1971 on the basis of past experience and the actual consumption during the years 1971-72, 1972-73 and 1973-74 was, by and large, near those norms. The final norms have not, been fixed so far (April, 1975).

7.06 *Utilisation of plant and machinery*

(a) *Non-installation of mining equipment*

Out of the mining equipment valuing Rs. 137 lakhs ordered by the MCI but cleared by the Company from the customs authorities in February, 1966, equipment valuing Rs. 48.38 lakhs approximately (comprising the equipment for main shaft, under crusher, power cables and trolley electric locos) were commissioned during 1971 to October, 1972.

The Management stated in December, 1971 that the above equipment could not be installed on account of the following reasons :—

The equipment imported by the MCI was lying at Bombay Port for 2/3 years. When brought to the mines it was found in damaged/rusted and corroded condition. In order to lodge claims against Railways and Insurance Companies, the equipment were not opened for installation. Missing parts and components as also those damaged in a fire during transit had to be imported for replacement. However, some of the equipment meant for the expansion and development of Mochia-Magra mines were used at Balaria mines to get additional production of ore but the remaining equipment imported for specific jobs could not be used elsewhere.

(b) Non-utilisation of ball mill equipment

Fourteen floatation cells were purchased by the MCI at a cost of Rs. 1.50 lakhs for recovering pyrites in the ore. These cells were lying unutilised till December, 1973. The Management have stated (November, 1974) that these cells are now being utilised for beneficiation of rockphosphate ore from Maton mines since January, 1974.

(c) Plant performance—zinc smelter

The working of the various sections of the plant as compiled by Audit from monthly progress reports, etc. is indicated in Annexure IV. It will be seen that the actual number of

hours worked in all the four plants was generally much less, particularly in case of Roaster and Acid plant and Superphosphate Plant, than the normal working hours.

The shortfall in Roaster utilisation adversely affected the output of the Leaching and Purification Plant and the Electrolysis Plant. As referred to in the Company's reply reproduced in Para 7.04(d) the services of two experts from M/s. Lurgi Frankfurt were obtained in May, 1972 in order to improve the production of calcine qualitatively and quantitatively as a cost of Rs. 55,000. An expenditure of Rs. 40,000 was incurred on ducting besides other modifications in civil works etc. done departmentally. However, in January, 1973 the Board of Directors was informed that the Roaster had been showing unfavourable symptoms calling for shut down earlier than the scheduled time *viz.*, April, 1973. The Roaster was, however, kept running with the help of patch repairs and was shut down on 11th April, 1973. It started functioning again in June, 1973 after repairs had been carried out at a cost of Rs. 5.77 lakhs.

(d) *Plant performance—lead smelter*

The total number of hours available, the actual hours worked and the idle hours of the three important sections of the lead smelter at Tundoo from 1965-66 to 1973-74, are indicated in Annexure V. No record is maintained by the Company to indicate the number of idle hours attributable to different reasons as is done in the case of zinc smelter.

8. MANPOWER ANALYSIS

8.01 Mines

(a) The following table indicates the output per manshift as estimated by the consultants, M/s. Penarroya (December,

1962) for Mochia-Magra mine and as given in the project report of Balaria mine :—

	Mochia-Magra mine		Balaria mine
	On the basis of existing practice of providing 2 helpers for each skilled worker	On the basis of normal conditions of working including the reduction of number of helpes from two to one for each skilled worker	
Mining	2.2**	3.35*	2.32
Overall	2.0**	3.00**	2.0

* A labour force of 624 men for underground and 700 men for underground and surface was recommended by the consultants on the assumption of normal conditions of working at Zawar mines including the reduction of the number of helpers from 2 to 1 for each skilled worker. They had expressed the view that under French and Italian conditions the labour force required for an output of 2,000 tonnes per day would be 250 or 260 men giving an output of 8 tonnes per manshift.

** On the basis of 2 helpers for each skilled worker the consultants recommended the increased underground labour force as 950 men and 1050 men for underground and surface together.

As against the above estimated output per manshift, the actual overall output per manshift as furnished by the Management in respect of the two mines during the years 1966-67 to 1973-74 was as follows. The mining output per manshift has not been worked out :—

Year	Output per manshift in tonnes	
	Mochia-Magra mine	Balaria mine
1966-67	0.904	0.635
1967-68	1.129	0.840
1968-69	1.038	0.851
1969-70	0.995	1.047
1970-71	0.914	1.032
1971-72	0.996	0.997
1972-73	0.998	0.896
1973-74	1.271	0.878

NOTE :—In calculating the output per manshift, the overtime hours have not been taken into account.

It will be seen that the output per manshift in Mochia-Magra mine has generally come down from 1968-69 up to 1972-73 but it increased in 1973-74. In the case of Balaria mine, the output per manshift showed a downward trend from 1970-71.

The Ministry have stated (May, 1975) that "These figures are not indicative of the productivity of the work precisely. The figures have been arrived at by dividing the total ore production by the number of manshifts worked in the mine. No distinction has been made between the men employed on developmental works and those employed on production. In Mochia-Magra mine, for example, a significant mine development activity to raise the production capacity from 500 tonnes per day to 2,000 tonnes was exerted to with additional manpower, and therefore, there would be a dip in the OMS figure if the total manpower employed is taken into account. Same remarks apply to Balaria. OMS figures become comparable only after the mine has reached its stage of maturity and produce year after year different tonnages with different manpower employed on compensatory developmental works being rightfully included as production personnel".

It may be mentioned that the figures of OMS given in the above table are based on the information furnished by the Company. It was also stated in May, 1975 that "the breakup of the manpower between exploitation and development was always furnished by the Mines Manager for the purpose of booking the expenditure to the appropriate capital and revenue heads". It should, therefore, have been possible for the Management to calculate the OMS with reference to the men employed on ore production alone.

(b) As stated in para 8.02, M/s. IBCON were requested to undertake a study of manpower in Zawar mines. They had

submitted 22 reports up to August, 1973 which indicated the following position :—

Sections	Actual strength (No.)	Standard strength as per report (No.)	Re-deployable surplus (No.)	Annual wage bill for the surplus labour at average current wage rates including overtime, provident fund, bonus payment etc. (Rs. in lakhs)
1	2	3	4	5
Underground operations (March, 1971)	614	323	291	1.2
Surface operations (April, 1971)	244	174	70	2.6
Ore Dressing Mills (975 tonnes per day capacity) (Sept., 1971)	153	101	52(a)	1.82
Ore Dressing Mill (2,000 tonnes per day capacity) (Oct., 1971)	..	135	..	..
Other sections (May 1, 1971 to November, 1972)	433	321	112	(b)

- NOTES :—1. (a) The surplus labour force of 52 was expected to be absorbed against the strength recommended for the Ore Dressing Mill of 2,000 tonnes per day capacity.
2. The months within brackets in Col. 1 indicate the dates of submission of reports by M/s. IBCON. The exact date(s) on which the actual strength, as given in these reports, was employed has not been indicated.
3. The standard force proposed by M/s. IBCON for 'underground' and 'surface' operations in mines is based on 650 tonnes of output per day.
4. (b) The saving has been indicated in certain cases while in others it has not been done.

8.02 Zinc smelter

The table below indicates the requirements of manpower as assessed (November, 1961) by the Consultants in the project report, that assessed by the Institute of Applied Manpower Research (August, 1969) and the actual average strength as at the end of last six years :—

Year	As recommended by the Consultants	As recommended by I.A.M.R.	Actual yearly average	Excess over project report	Excess over IAMR recommendations
1968-69	694	851	1,178	484	327
1969-70	694	851	1,167	473	316
1970-71	694	851	1,030	336	179
1971-72	694	851	1,065	371	214
1972-73	694	851	1,001	307	150
1973-74	694	851	960	266	109

In September, 1970, the Board of Directors felt that the Institute of Applied Manpower Research did not have sufficient expertise or organisation to undertake the industrial studies of the nature required by the Company but observed that compared to the staff/workers strength in similar plants in other countries and also taking into account the strength of the private sector smelter of M/s. Cominco Binani, there was reason to believe that substantial economy in manpower was possible. Consequently, the Board authorised a fresh study of manpower by M/s. IBCON.

Accordingly, M/s. IBCON were asked in December, 1970 to undertake the study of manpower in Zinc smelter, Zawar mines and Head office on a payment limited to Rs. 1,65,000 (at the rate of Rs. 6,000 per Consultant month subject to a

maximum of 27½ months). Mention has been made in para 8.01 of the reports submitted by M/s. IBCON in respect of Zawar mines. In respect of Zinc smelter, they had submitted 18 reports up to August, 1973 which indicated the following position :—

	Actual strength	Standard strength as per IBCON report	Re-deploy-able surplus	Annual savings on re-deployable surplus (Rs. in lakhs)
Roaster and Acid Plant (May, 1971)	98	48	50	2.20
Electrolysis Plant (June, 1971)	120	77	43	1.52
Superphosphate Plant (February, 1971)	130	47	83	2.63
Leaching and Purification, Cadmium and Zinc Sulphate Plant (October, 1971)	130	69	61	2.20
Other Departments (June, 1971 to September, 1972)	580	311	269	2.68*

NOTES:— 1. Standard strength includes weekly off and leave reserve.

2. *Out of 14 departments, the savings in monetary terms had not been indicated in respect of 10 departments.
3. The months within brackets in Col. 1 indicate the dates of submission of reports by M/s. IBCON. The exact date(s) on which the actual strength, as given in these reports, was employed has not been indicated. The standard strength proposed by M/s. IBCON is, however, based on current level of production and volume of work.

The additional cost on account of excess men employed in the Roaster and Acid Plant and the Electrolysis Plant and the Leaching and Purification, Cadmium and Zinc Sulphate Plant works out to Rs. 32.88 per tonne of zinc metal at the rated capacity of the smelter (18,000 tonnes) ; similarly, the incidence of extra cost on account of surplus manpower in Superphosphate Plant comes to Rs. 3.51 per tonne.

The Management have stated (August, 1972) that the report of the foreign consultants did not include the requirement of many service departments and gave only a broad indication of the designations of persons to be employed without prescribing the job descriptions. Adherence to the manpower pattern suggested by the consultants was not possible also due to the fact that the capacity of freshly recruited workmen and supervisors to develop multivalency in skill was highly restricted on account of inadequate training facilities and the general operating climate in the country discouraging such multiskills. Surplus manpower has been located and is being progressively redeployed. Job description study in depth has been made and jobs have also since been more clearly defined and rationalised.

As regards the action taken on the various reports (including those pertaining to Zawar mines) submitted by M/s. IBCON, the Management stated (November, 1974) as follows :—

“Many of the reports are still under examination of the Industrial Engineering Department and other concerned departments of the Company. However, as earlier stated, manpower assessment by IBCON has, by and large, been accepted and surplus manpower is being deployed to other expansion/development schemes/works of the Company”.

9. COSTING SYSTEM AND COST TREND

9.01 Costing system

Up to 1970-71 the Company followed the integrated cost and financial accounting. It is, however, maintaining separate cost records from 1971-72.

(a) *Mining operations*

The major cost centres are operation, maintenance and supervision. Under each cost centre, cost is compiled for labour,

stores, electricity and others. The cost per tonne of ore mined is arrived at by dividing the total expenditure under the various cost centres with the total quantity produced.

(b) *Milling operations*

The cost centres in the case of milling are operation (including crushing, grinding, floatation and filter plant), maintenance and supervision. Cost of milling per tonne is arrived at by dividing the expenditure under each cost centre with the quantity of ore treated. Expenditure on common services (e.g. water supply, power distribution, central stores), administrative services and overheads is collected separately and added to the mining and milling costs to arrive at the per tonne cost of concentrates produced.

(c) *Zinc smelter*

Process costing is followed in the zinc smelter with each plant/unit being the cost centres. Costs are grouped under four major categories : (i) production, (ii) service, (iii) general factory and administration, and (iv) selling and distribution. While cost of raw materials, direct wages, direct expenses (viz., spares, chemicals etc.) are booked directly under respective processes, the cost of power (on the basis of units consumed), the cost of water, transport, maintenance and laboratory (on the basis of technical estimates) and general factory overheads (in proportion to number of employees engaged) are allocated to the processes. Separate cost of production of bye-products—cadmium, superphosphate, sulphuric acid etc. is also worked out for purposes of internal control. However, credit is being afforded to the cost of zinc on the basis of sale realisation of by-products.

(d) *Lead smelter*

There was no proper costing system prior to January, 1971 when the process costing system was introduced. During the period from July, 1966 to December, 1967 the cost per tonne

of lead was worked out by dividing the total expenditure incurred during the quarter (after adding depreciation at the rate of Rs. 7,000 per month and interest and overhead expenses at the rate of Rs. 20,000 per month) by the total production of lead during the quarter. Neither the cost of silver, a by-product, was worked out separately, nor was its sale price deducted from the total expenditure. Further, no adjustment was made for the work-in-progress at the beginning of the quarter as well as at the end of the quarter.

From the quarter beginning from 1st January, 1968 to the quarter ending 31st December, 1968 separate costs were worked out for lead and silver. Thereafter, separate cost of silver was not worked out but in working out the cost of production of lead, credit was taken for silver produced at the average selling price prevailing during the quarter.

Under the process costing introduced from January, 1971 cost is collected under the cost centres *viz.*, production, services and general factory and administration. The production cost centre is further sub-divided into (i) bedding and sintering (ii) blast furnace and (iii) lead refinery/silver refinery. Raw materials/inter-process materials, direct wages and fluxes and other stores consumed are directly debited to each cost centre. Cost of power (on the basis of number of units consumed), cost of water and laboratory (on the basis of services rendered), expenses on maintenance other than stores (on the basis of technical estimates) and factory overheads, depreciation and interest on capital (on the basis of ratios of sale value of lead produced and market value of silver contained in retort lead—an intermediate product, produced during the month) are allocated to the cost centres. Separate cost of silver is also worked out.

As the existing costing and information system was considered inadequate to meet the fast growing needs of the Company, the Administrative Staff College of India was requested in July, 1972 to make a survey and report on the methods of streamlining and modernising the existing system. The College submitted its survey report on the 13th October, 1972 and its final report on

the 6th September, 1973. The following are some of the important deficiencies in the costing practices at different units noticed by the Administrative Staff College :—

- (i) Salary and wage lists of the mines are not prepared according to productive cost centres as labour is mobile.
- (ii) There are no effective standards for variable expenses or budget for fixed expenses.
- (iii) Volume and efficiency variances are not ascertained.
- (iv) Usage variances are not separated from rate variances.
- (v) Monthly Reporting is in terms of product unit costs.

From the year 1972-73 onwards the Company started working out budgeted cost under broad headings. From April, 1973 variations in actual cost are analysed under broad headings with reference to anticipations made in the budgeted cost for consideration at the top management level. The Company has also fixed norms for consumption of explosives, chemicals, drill rods etc. and the actual consumption is analysed with reference to these norms. However, no records indicating the basis for fixation of these norms and the authority with whose approval these norms were fixed could be shown.

9.02 Cost trend

(a) Cost of mining of ore

The cost of mining of ore per tonne from 1969-70 is indicated below :—

Year	Cost per tonne Rs.
1969-70	23.80
1970-71	28.09
1971-72	24.52
1972-73	32.79
1973-74	40.34

(b) Concentrates

The actual cost of production of concentrates (both zinc and lead concentrates) is given below :—

Year	Cost per tonne (Rs.)
1965—67 (1-10-65 to 31-3-67)	Not available
1967-68	769.82
1968-69	945.62
1969-70	1,048.8
1970-71	1,163.14
1971-72	1,148.53
1972-73	1,278.60
1973-74	1,395.42

(c) Zinc ingots and refined lead

The actual cost of sales of zinc ingots and refined lead is given below :—

Year	Zinc Ingots	Refined Lead
	(Rs. per tonne)	(Rs. per tonne)
1965—67 (1-10-65 to 31-3-67)	..	1,688.08
1967-68	..	1,799.86
1968-69	3,123.08	2,182.83
1969-70	4,262.43	3,243.92
1970-71	4,221.14	3,568.40
1971-72	3,918.71	3,031.75
1972-73	3,982.77	3,136.34
1973-74	4,823.52	3,438.11

NOTES:— 1. The cost of production of concentrates for the period from 1-10-65 to 31-3-67 is not available with the Company as indicated in sub-para (b) above. For the purpose of ascertaining the cost of sales of refined lead for this period, the Company worked out the cost of production of concentrates on the basis of expenditure booked in financial accounts.

2. Figures of cost of sales have been given in the table as separate figures of selling and distribution overheads have not been worked out by the Company.

It will be seen from the foregoing trend of cost that the cost of mining has been increasing from year to year excepting in 1971-72. The cost of mining ore and the metal content in ore are important factors which influence the cost of production of end products. The decline in grade of metal in feed had its effect in the form of increased cost of production. Similarly, the recovery efficiency in the mills and in the smelters had its effect on cost, apart from increase in the salaries and wages and other elements of cost. The extent of capacity utilisation, the composition of input in the form of indigenous and imported concentrates, the iron content in concentrates etc. also had their effect on cost of production in different years. The budgeted cost worked out by the Company did not serve the purpose of standard cost. The Company could not show records indicating that the budgeted cost had been determined after taking into account :—

- (i) expected metal content in ore,
- (ii) anticipated metal content in concentrates ;
- (iii) recovery efficiency in the beneficiation plant ;
- (iv) recovery efficiency in the smelter ;
- (v) expected O.M.S. and wages per employee ;
- (vi) number of men required in beneficiation plant and smelter and average wages per employee ;
- (vii) rate of consumption of important consumable stores and chemicals and the prices thereof and expected capacity utilisation, etc.

In the absence of such projections and comparison of the actuals with reference to the projections, the system of costing did not serve as an effective instrument of control.

The Management stated in May, 1975 that “..... The budgeted cost for 1975-76 have been prepared after taking into consideration the various factors indicated by audit, *i.e.*

- (i) expected metal content in ore ;

- (ii) anticipated metal content in concentrate ;
- (iii) recovery efficiency in the beneficiation plants ;
- (iv) recovery efficiency in the smelter ;
- (v) rate of consumption of important consumable stores and chemicals and the prices thereof ;
- (vi) expected capacity utilisation of mills, smelter and expected ore production.

As regards (i) number of men required for mining and average wages (OMS also), (ii) Number of men required in beneficiation plant and smelter and average wages—the position is that the number of men required at various units are based on requirements/study and the wages are based on agreements entered into with the unions.”

10. PRICING POLICY AND SALE PERFORMANCE

10.01 Pricing policy

(a) *Zinc ingots*

Prior to the taking over of the undertaking in October, 1965, the zinc concentrates were being sent by M.C.I. to Japan for conversion into zinc metal as they had no zinc smelter of their own. The construction of the zinc smelter started by M.C.I. was completed by the Company and went into partial production in January, 1968. During October, 1965 to December, 1965, the zinc concentrates produced were stocked by the Company without any further processing except for some quantity sold to M/s. Cominço Binani.

At the time of acquisition, the distribution and pricing of zinc was regulated under the Scarce Industrial Materials Control Order Act, 1965. After withdrawal of the Control Order in June, 1966, the Board of Directors of the Company decided to refer the matter of future pricing to Government for advice and also contacted the Minerals and Metal Trading Corporation of

India Limited to ascertain the principles followed by them in fixing the selling price of imported zinc metal. According to the Company's estimate (August, 1966) the landed cost of zinc metal (including excise/import duty) roughly worked out to Rs. 2,950 to Rs. 3,000 per tonne. Since the zinc concentrates had been lying in stock with the Company for a long time and it had incurred considerable expenditure on godown rent and interest charges, it was proposed by the Management to fix the price of zinc at Rs. 3,250 per tonne ex-godown (inclusive of a profit margin of $3\frac{1}{2}\%$ over the landed cost and also to make provision for normal fluctuations in the LME market prices). In January, 1967, however, Government advised that in the absence of information regarding the all inclusive cost of production of zinc to the Company the sale price should be such that the Company was not put to loss while at the same time undue advantage was not taken of the very high prices artificially ruling in the market.

Accordingly the sale price of zinc was fixed by the Company in May-June, 1968 in consultation with Government at Rs. 2,700 per tonne. This price was to be operative up to 31st March, 1969 and was based on full capacity working of the zinc smelter using Zawar concentrates, partly from accumulated stocks and partly from current production and taking credit for superphosphate at Rs. 280 per tonne and cadmium at Rs. 50 per Kg.

In view of the increase in cost of indigenous concentrates and the need for import of concentrates to operate the zinc smelter at full capacity, the Company approached Government in April, 1969 for a price increase of Rs. 100 per tonne from April, 1969. Shortly thereafter (May, 1969), the Company and M/s. Cominco Binani, the only other producer of zinc metal in the country, made a joint representation to Government for an increase of Rs. 150 per tonne over the prevailing price of Rs. 2,700 per tonne in view of the fact that the ruling open market price was around Rs. 3,900 per tonne and that the imported high grade zinc would cost about £ 125—10—0 (Rs. 2,375 approximately per ton c.i.f. In February, 1970 Government agreed to a price increase of Rs. 150 per tonne over the prevailing price to take

effect from 1st February, 1970 and subject to the condition that a sum of Rs. 100 per tonne would be kept separately for developmental purposes.

In regard to the price to be fixed from 1st April, 1971 the Company requested the Government (February, 1971) that as the actual cost of production of zinc per tonne during 1969-70 and 1970-71 was Rs. 3,790 and Rs. 3,734 respectively and as the cost of production during 1971-72 at 70 to 75% capacity utilisation of the smelter was estimated at Rs. 3,500 per tonne, a suitable selling price might be fixed.

The matter was examined by the Bureau of Industrial Costs and Prices and on the basis of their recommendations, Government decided in February, 1972 to increase the selling price of zinc to Rs. 4,090 per tonne ex-works, exclusive of excise duty and regulatory excise duty, with effect from 1st February, 1972.

While increasing the selling price, Government directed that a sum of Rs. 600 per tonne should be earmarked and kept under a separate account for utilisation in the expansion schemes of the Company and should not be accounted for towards profit. The amount required to be kept in the separate account at the appropriate rate ruling from time to time up to March, 1974 works out to Rs. 109.33 lakhs. The manner in which the amount was to be retained and accounted for by the Company was not decided by Government who ultimately withdrew the orders on 19th May, 1975.

With effect from 1st April, 1973 the Government have, with a view to providing relief to the indigenous producers and at the same time providing uniform prices to the consumers, allowed the Company and the other producer of zinc viz. M/s. Cominco Binani Zinc Limited to sell their production of Zinc at a price not exceeding the Mineral and Metal Trading Corporation's ruling prices (Company's delivered price should match point to point the MMTC's delivered price). Supplies to parties who had opened clean letters of credit in favour of the Company on or

prior to 28th February, 1973 for supplies of zinc in March, 1973 were, however, required to be made at the old price, *viz.* Rs. 4,090 per tonne. While allowing the company to sell zinc at MMTC's prices the Government, however, stipulated that the Company would equitably share the buffer stock charges (provisionally fixed at Rs. 84 per tonne) being incurred by MMTC. The Company's prices *vis-a-vis* MMTC's prices during the year 1971-72 and 1972-73 are indicated below :—

Quarterly period	Company's selling prices (inclusive of excise duty)	MMTC's prices
	Rs.	Rs.
April—June, 1971	3,350	3,150
July—Sept., 1971	3,350	4,200
Oct.,—Dec., 1971	3,350	4,800
January, 1972	3,725	5,260
Feb.—March, 1972	4,965	5,260
April—June, 1972	4,965	5,330
July—Sept., 1972	4,965	5,360
October—Dec., 1972	4,965	5,510
Jan.—March, 1973	4,965	5,675(*) 6,215(**)

(*) Pre-budget.

(**) Post budget.

It will be seen from the above that up to March, 1973 prices charged by MMTC were higher (except in the quarter ending June, 1971) than the prices allowed to the Company. The zinc price was not under any statutory control but it was under informal price control of the Government. This dual price was maintained on the ground that it will have repercussion on other industries like steel and aluminium where price of indigenous product was generally lower than the imported price and also to

discourage in-efficiency caused by low level of production in zinc industry. However, with effect from 1st April, 1973 the uniform pricing was introduced both for the imported and the indigenous products subject to the payment of buffer stock charges to MMTC.

The distribution of indigenously produced zinc is controlled by the Ministry of Steel & Mines which makes broad allocations to Director General, Technical Development, D.C. Small Scale Industries, Iron & Steel Controller, Director General, Supplies and Disposal and to Public Sector Undertakings. The Company then sells zinc on the basis of allocations made by different authorities. According to the data furnished by the Management, the despatches made by the Company to Government Departments, Public Sector Undertakings etc. and parties in the private sector during the last three years were as follows :—

(In tonnes)

	Government Depart- ments/Public Sector Undertakings	Private parties
1971-72	2,572	5,807
1972-73	5,591	8,122
1973-74	2,108*	930
	+948 (Zinc ca- thodes equivalent to 901 tonnes of Zinc ingots)	+8,768 (Zinc ca- thodes equivalent to 8,330 tonnes of Zinc ingots)

*Excludes 34 tonnes of imported Zinc lying in stock prior to acquisition of M.C.I.

(b) *Refined lead*

The Company is the only producer of refined lead in the country. Like zinc metal, the question of fixing the selling price of refined lead was also referred to Government in September, 1966 and Government advised the Company to follow the same

guidelines as for zinc metal *i.e.* to fix the price in such a manner that the Company was not put to any loss but at the same time not to take undue advantage of the very high prices artificially ruling in the market.

In February, 1967 the Company, however, decided to sell the refined lead at the average rates prevailing in Calcutta market during the month preceding the month of despatch ; this was not in accordance with the guidelines given by the Government. Sales are, however, being effected to Director General T. D. units at MMTC's prices with effect from 1973-74.

(c) *Cadmium*

During 1968-69 the Company fixed a price of Rs. 60 per Kg. for orders of small quantity and Rs. 57 per Kg. for bulk supplies. Since April, 1969 Cadmium is being sold at ruling market price.

(d) *Single superphosphate*

This fertiliser is sold by the Company at the best available price within the ceiling price fixed by the Fertiliser Association of India quarterly for each manufacturer.

(e) *Sulphuric acid*

This is mainly used for producing single superphosphate. However, a small quantity is also sold to chemical industries at market price.

(f) *Silver*

Prior to January, 1969, silver was being disposed of through M/s. Metal Distributors Limited, Calcutta, on payment of a commission of 1% of the sales price plus brokerage. From January, 1969 it is being exclusively sold to the Hindustan Photo Films Manufacturing Company Limited—another Government Undertaking, on the basis of closing prices ruling in the Calcutta

bullion market on the date of actual despatch from the plant at Tundoo. The MCI had entered into an agreement with M/s. Metal Distributors Limited for 3 years from 1st April, 1964 for the sale of lead and silver. This agreement was, however, terminated by the Company with effect from 25th March, 1966 and in March, 1967 (while permitting a sale of 1,800 Kgs. through this firm) the Board of Directors asked the Management to make permanent arrangements for the sale of silver in consultation with the Reserve Bank of India and to Government undertakings like Hindustan Photo Films Manufacturing Company Limited.

The agreement for the sale of the entire production of silver to Hindustan Photo Films Manufacturing Company Limited was finalised only in December, 1968. In the meantime, a quantity of 6,871 Kgs. (approximately) of silver was sold through M/s. Metal Distributors Limited during April, 1967 to February, 1969 without obtaining any approval from the Board of Directors for relaxation of the decision taken in March, 1967.

While seeking the approval of the Board of Directors in March, 1967 for the sale of 1,800 Kgs. of silver through M/s. Metal Distributors Limited, it was stated that as silver rates were regularly quoted in Calcutta Bullion Exchange, there appeared to be no chance of any manipulation by the selling agents and the two rates could be easily compared. There is, however, no record indicating that the rates at which the silver was sold by M/s. Metal Distributors Limited up to February, 1969 were actually compared with rates quoted at the Calcutta Bullion Exchange; the latter rates are also not now readily available with the company.

10.02 Sales performance

(a) The distribution of indigenously produced zinc is controlled by the Ministry of Steel and Mines which makes broad allocations bi-annually to Director General, Technical Development (for large industries), D.C., Small Scale Industries (for small scale industries), Iron & Steel Controller (for steel plants) Director

General, Supplies & Disposals (for Railways, P&T, Ordnance Factories, etc.) and to Public Sector Undertakings. Zinc is then sold by the Company against allocations made by these authorities.

Similarly, refined lead is supplied to Government Departments, Government Undertakings and other parties against allocations made by Director General Supplies and Disposals and Director General, Technical Development.

The procedure followed for the sale of by-products is as follows :—

Cadmium

Allocations are made either by the Director General, Technical Development or State Directorate of Industries.

Informal distribution control on cadmium was withdrawn in March, 1974 and the Company is now free to sell the metal to actual users and Government Departments.

Superphosphate

The Company sells this product through distributors in Rajasthan, West Bengal, Maharashtra, Madhya Pradesh and Gujarat. The Company had appointed Fertiliser Corporation of India Limited as their sole selling agents for certain States and Union Territories in August, 1968 but this arrangement was discontinued from May, 1971. Since July, 1972 the distribution of superphosphate is controlled by the Ministry of Agriculture through Fertiliser Corporation of India allocations.

Sulphuric Acid

This is mainly used for production of single superphosphate and some quantity is also sold. The Company

has entered into contracts for the sale of this product with M/s. Udaipur Chemicals Industries, Debari (Udaipur), M/s. Prabhat Chemicals, Udaipur and M/s. Bhanu Prasad N. Joshi, Ahmedabad.

The contract with M/s. Udaipur Chemical Industries was entered into, after inviting offers from interested parties normally engaged in the manufacture of chemicals for establishment of ancillary industries, in April, 1969 for a period of 15 years providing for sale of 300 tonnes of sulphuric acid per month. The price is to be fixed quarterly on the basis of the cost of imported sulphur. The contracts with the other two parties were entered into for a period of 6 months from 1st March, 1971 for sale of 250 tonnes per month to each of them at a price to be fixed with reference to market conditions subject to review every quarter.

According to the Company, the sale of sulphuric acid to these parties has not affected the production of single superphosphate wherein it is used as one of the raw materials.

Silver

The entire production is supplied to M/s. Hindustan Photo Films Manufacturing Company Limited, another Government of India Undertaking, since January, 1969.

(b) Company's share in the total requirements of the country

As already mentioned, Zinc metal is produced in the country by the Company and a company in the private sector, M/s. Cominco Binani Zinc Limited, Alwaye. The existing Zinc Smelter owned by the Company has a production capacity of 18,000 tonnes per annum while that set up by the private sector company can produce 20,000 tonnes per annum. So far as

refined lead is concerned, the Company is the only producer of this metal in the country. The capacity of the Lead Smelter at Tundoo has been assessed by the Company at 3,600 tonnes per annum up to 1973-74 and 4,200 tonnes per annum as on 31st March, 1975.

The following table indicates the total quantity of zinc metal and refined lead available for consumption in the country during 1968-69 to 1972-73 :—

(In tonnes)

Year	Zinc			Total quantity available
	Quantity produced by indigenous producers		Quantity imported	
	Company	Cominco Binani Zinc Ltd.		
1968-69	13,402	14,622	89,856	1,17,880
1969-70	9,926	13,800	36,554	60,280
1970-71	9,490	12,160	91,000	1,12,650
1971-72	12,125	12,482	70,500	95,107
1972-73	9,565	14,000	93,475	1,17,040

Year	Lead		Total quantity available
	Quantity produced by the Company	Quantity imported	
1968-69	1,853	32,800	34,653
1969-70	1,892	29,215	31,107
1970-71	1,719	40,000	41,719
1971-72	1,768	35,000	36,768
1972-73	2,892	71,108	74,000

It will be seen that out of total supplies of zinc and lead in the country, indigenous producers of zinc and lead contributed to the extent of about 19% to 39% and 4% to 6% respectively.

(c) Sales vis-a-vis product availability

The product availability to the Company and the sales effected by it during the last eight years is given below :—

	(Quantity in tonnes)				
	Zinc ingots	Cadmium	Super- phosphate	Lead	Silver (in Kgs.)
	1	2	3	4	5
<i>1966-67</i>					
Opening Balance . . . . .	..	..	..	665	938
Production . . . . .	..	..	..	2,515	1,425
Sales . . . . .	..	..	..	2,481	448
Closing Balance . . . . .	..	..	..	699	1,915
<i>1967-68</i>					
Opening Balance . . . . .	..	..	..	699	1,915
Production . . . . .	..	0.978	21,226	2,336	3,250
Sales . . . . .	..	..	382	2,145	4,963
Closing Balance . . . . .	..	0.978	20,844	880	202
<i>1968-69</i>					
Opening Balance . . . . .	..	0.978	20,844	890	202
Production	13,402\$	51.936	48,993	1,853	2,781
Sales	12,749	34.733	54,139	2,462	2,536
Closing Balance	653	18.181	15,698	257@	447
<i>1969-70</i>					
Opening Balance	653	18.181	15,698	257	447
Production	9,925	32.328	42,650	1,892	2,137**
Sales	10,457	47.027	47,434	1,952	2,532
Closing Balance	121	3.482	10,914	197	52
<i>1970-71</i>					
Opening Balance	121	3.482	10,914	197	52
Production	9,490	22.620	51,054	1,719	2,302
Sales	7,775	19.568	54,026	1,381	1,853
Closing Balance	1,850\$\$	6.534	5,937£	535	501

	1	2	3	4	5
<i>1971-72</i>					
Opening Balance	1,850	6.5	5,937	598@@	502
Production	12,125	14.9	46,778	1,768	2,907
Sales	8,379	14.7	40,124	1,907	3,294
Closing Balance	5,596	6.7	12,581££	459	115
<i>1972-73</i>					
Opening Balance	5,596	6.7	12,581	459	115
Production	9,565	19.6	43,257	2,892	4,692***
Sales	13,713	4.0	47,075	2,796	3,975
Closing Balance	1,448	22.3	10,800£££	565@@@	832
<i>1973-74</i>					
Opening Balance	1,448	22.3	10,800	565	832
Production	2,147(aa)	26.7	27,300	2,700	3,791
Sales	3,038(d)	25.2	33,358	1,983	3,833
Closing Balance	557(b)	23.8	2,692(a)	1,282	790

NOTES :— \$Includes 4,807 tonnes of cathodes produced in 1967-68 but melted during the year and equivalent to 4,327 tonnes of zinc ingots.

\$\$Includes 14 tonnes found in excess on stock verification.

£The closing balance has been arrived at after adjusting the shortage of 2,005 tonnes.

££Arrived at after adjusting 10 tonnes as a result of reconciliation with despatch figures.

£££Includes 2,037 tonnes representing excess found on stock verification.

@The closing balance works out to 281 tonnes. The difference of 24 tonnes is under reconciliation.

@@Includes the stock of 63 tonnes at Hindustan Cables Limited.

@@@Includes 9 tonnes on account of sales returns.

**Excludes 1113 Kgs. of silver used in production of high grade lead.

***Excludes 368 Kgs. of silver used in the production of high silver lead for zinc smelter.

(a) Difference of 2,050 tonnes under reconciliation.

(aa) Does not include production of 10,912 tonnes of cathodes equivalent of 10,365 tonnes of zinc Ingots.

(b) Does not include closing stock of zinc cathodes.

(d) Does not include sale of 9,716 tonnes of cathodes.

It will be seen that although zinc is a scarce metal, the Company was not in a position to sell its entire production which itself was much less than the rated capacity of the smelter. As a result, the closing stock gradually increased from 653 tonnes in 1968-69 to 5,596 tonnes in 1971-72 involving the blocking of funds to the extent of Rs. 228.88 lakhs (as on 31st March, 1972 at the selling price of Rs. 4,090 per tonne). The closing balance, however, came down to 1,448 tonnes at the end of 1972-73 and to 557 tonnes at the end of 1973-74.

The Management stated (January, 1975) as follows :—

“The present allocation system results in a time-lag of 2-3 months in the movement of zinc stocks from Hindustan Zinc Limited, inasmuch as ‘allocation letters’ which follow Distribution Meeting decisions are received frequently up to 6 to 8 weeks after the commencement of the ‘allocation period’, and a further 3-4 weeks (minimum) period is taken up by the allottees in making payment arrangements. This situation becomes worse when MMTC prices are anticipated to fall (as assessed in relation to international prices); and allottees withhold acceptances of sales offer, sometimes not responding at all. As a consequence huge finished goods inventory builds up.”

The Ministry have stated (April, 1975) as follows :—

“Informal distribution control on Zinc has been relaxed in February, 1975 permitting producers to sell the metal to Government Departments, steel plants and DGTD units without formal allocation and without any quantity limit. This step was taken on account of large stocks held by MMTC and the indigenous zinc producers. MMTC has fixed its sale price of zinc on a six monthly basis

from April—September, 1975 which will also help HZL to move its metal as speculative tendencies in the market will tend to get reduced.”

Although the closing stock of superphosphate came down gradually from 20,844 tonnes as on 31st March, 1968 to 5,937 tonnes on 31-3-71 but again went up next year. It, however, came down in 1973-74. The closing balances of cadmium and silver as on 31st March, 1973 and 31st March, 1974 were considerably higher than those of earlier years.

(d) *Selling price vis-a-vis actual cost of sales*

The following table indicates the selling price *vis-a-vis* the cost of sales of zinc, lead and by-products during 1968-69 to 1973-74 :—

(Figure in rupees)

Product	1968-69		1969-70		1970-71		
	Cost of sales	Selling price	Cost of sales	Selling price	Cost of sales	Selling price	
	1	2	3	4	5	6	7
Zinc (per tonne)	3,123.08	2,700	4,264.43	2,700*	4,221.14	2,850	
Lead (per tonne)	2,182.82	3,071.14	3,243.92	3,855.03	3,568.49	4,298.09	
Super-phosphate (per tonne)	(b)	298.17	(b)	268.11	(b)	262.55	

1	1971-72		1972-73		1973-74	
	Cost of sales	Selling price	Cost of sales	Selling price	Cost of sales	Selling price
8.	9	10	11	12	13	
Zinc (per tonne)	3,918.71	2,850*	3,982.77	4,090	4,823.52	8,814.85
Lead (per tonne)	3,031.75	3,500 (provisional)	3,136.34	3,647.14	3,438.11	5,183.42
Super-phosphate (per tonne)	204.16	308.67	198.75	314.41	305.17	383.27

NOTES: — *The price was increased to Rs. 2,850 per tonne from 1st February, 1970 and then to Rs. 4,090 from 1st February, 1972.

(b) Not available.

NOTE :— The selling prices in respect of lead and superphosphate represent the average selling price during the year. The selling price of zinc for 1973-74 also represents average selling price.

It will be seen that the selling price of zinc was always less than the cost of sales till 1971-72. The price was increased to Rs. 4,090 per tonne (excluding excise duty) w.e.f. 1st February, 1972. With effect from 1st April, 1973 the company was allowed to sell zinc at MMTC's ruling prices which ranged from Rs. 6,417 to Rs. 13,710 per tonne (inclusive of excise duty) during the year 1973-74.

10.03 Loss in the sale of lead

As already mentioned in para 10.01(b) lead is normally sold at the average rate prevailing in the Calcutta market during the month preceding the month of despatch from the plant at Tundoo. But in April, 1968 the Company entered into an agreement with the Director General, Supplies and Disposals for the supply of 2,485 tonnes of pig lead to the Defence Department at the rate of Rs. 3,000 per tonne (inclusive of excise duty of Rs. 500 per tonne). The agreement did not contain the price variation clause. The supply was to be completed by the end

of October, 1968—1,000 tonnes in the first 3 months and the balance quantity during 1st May, 1968 to 30th October, 1968.

The contracted quantity was subsequently increased to 3,715 tonnes in July, 1968 and 4,988 tonnes in October, 1968 and the delivery period extended to May, 1969 and April, 1970 respectively (further extended up to October, 1972). The originally stipulated quantity of 2,485 tonnes was supplied by September, 1970 on which the Company incurred a loss of Rs. 12.14 lakhs with reference to ruling Calcutta market prices. A further quantity of 2,503 tonnes was supplied by the Company up to October, 1972, against the increase in the stipulated quantity subsequently agreed to.

The Management stated in November, 1971 that at the time of entering into original agreement in April, 1968 the ruling price ranged between Rs. 2,750 and Rs. 2,850 per tonne (inclusive of excise duty) on account of recession in the market and the finalisation of selling price of Rs. 3,000 per tonne FOR Tundoo gave a margin of about Rs. 300 to Rs. 350 per tonne over the ruling market price. When the Director General, Supplies and Disposals asked for further supplies of lead for defence purposes, the Company initially expressed its inability, but subsequently agreed to do so on account of urgent defence requirements for which no foreign exchange was available with Government. Even at this stage the ruling price in Calcutta market was lower than Rs. 3,000 per tonne. Normally the Director General, Supplies and Disposals does not agree to price variation clauses in their contracts.

In September, 1971 Government asked the Bureau of Industrial Costs and Prices to examine the Company's cost of production of pig lead and suggest a reasonable price to be applied to the supplies made over and above the initially contracted quantity of 2,485 tonnes. The Bureau advised the Government that as the matter was primarily of interest to the ordnance factories and the Company, the question of a fair price for the supplies made might be decided through inter-ministerial discussions based on general principles. Accordingly, the

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Company was asked by Government in March, 1972 to furnish detailed cost data in respect of production of pig lead on receipt of which a meeting among the representatives of the Department of Mines, the Ministry of Defence, the Director General, Supplies and Disposals and the Company was proposed to be convened. The price in respect of supplies of pig lead made during the year 1970-71 and 1971-72, over and above the initially contracted quantity of 2,485 tonnes was finally agreed upon in June, 1974 as Rs. 4,016.37 and Rs. 3,710.46 per tonne (exclusive of excise duty) respectively. Although in regard to the despatches made during 1972-73, final price is yet to be fixed (January, 1975) payment at a provisional price of Rs. 3,500 per tonne up to September, 1972 and at Rs. 4,000 per tonne thereafter has been made by the D.G.S. & D.

10.04 Non-recovery of excise duty

Government levied an excise duty of 10 per cent *ad valorem* on all fertilizers from 1st March, 1969. On 28th February, 1969 the Company had a stock of 16,753 tonnes (loose 14,136 tonnes and bagged 2,617 tonnes) of superphosphate. This stock was declared to the Central Excise Department who gave to understand, according to the Company, that materials manufactured up to 28th February, 1969 midnight and declared to them were to be considered as duty free stock. However, the Deputy Collector of Central Excise who visited the Company's factory on 10th April, 1969, held that excise duty was leviable on loose stock as on 28th February, 1969/1st March, 1969. In the meantime, the Company had sold 2,541 tonnes on which excise duty amounting to Rs. 0.80 lakhs (out of total excise duty payable of Rs. 1.64 lakhs) could not be recovered.

11. PURCHASE PROCEDURE AND INVENTORY CONTROL

11.01 Purchase Procedure

Till January, 1971 when a centralised purchase organisation was established in the Company's head office, purchases were

being made by the heads of the Units in accordance with the delegated powers. The detailed purchase procedure was prescribed in December, 1970.

A test check of 44 purchase orders for amounts exceeding Rs. 50,000 each placed during 1966-67 to 1970-71 for a total value of Rs. 74.57 lakhs revealed that in 42 cases involving Rs. 71.79 lakhs open tenders were not invited and the purchases were made on limited tenders.

In December, 1971 the Management stated that a large number of stores and equipments required for the mines were mostly proprietary items and the invitation of open tenders would, therefore, mean wastage of money only. In the 42 cases mentioned above it was observed in Audit that more than one offer was received and, therefore, the question of these orders being of proprietary nature does not arise.

The Company is, by and large, making major purchases on the basis of open tenders from 1971-72 onwards.

11.02 Non-acceptance of tenders within the validity period

Tenders were invited for supply of G.I. pipes of various sizes in May, 1969, and were to be opened on 13th June, 1969. The date up to which the offers should remain valid was not indicated. M/s. Bharat Steel Tubes, one of the tenderers, or whom the order was placed on 13th November, 1969 had indicated that the rates quoted by them on 13th June, 1969 were valid up to 23rd July, 1969. As the validity of their offer had already expired, they were prepared to supply the pipes only at their current prices. The material was ultimately purchased at higher rates from M/s. Shivmoni & Company, Delhi against fresh tenders invited on 16th December, 1969. This resulted in an extra expenditure of Rs. 45,299.

The Management have *inter alia* stated (October, 1971) that M/s. Bharat Steel Tubes Limited, New Delhi had given a very short period of validity of about a month only after opening of the tenders. The processing of the case, namely, the

scrutiny of tenders, examination of the case by the finance and the approval by the competent authority took a few months and the case could be finalised only in October, 1969. As the rate of steel had considerably gone up during this period, the firm in spite of Company's best efforts did not agree to increase the validity for the supply of these tubes.

11.03 Inventory Control

(a) The following table indicates the comparative position of the stock of stores and spares (excluding raw materials like ore, concentrates etc., finished and semi-finished products and stores-in-transit) at the close of the last eight years :—

(Rupees in lakhs)

	Closing balance at the end of the year	Consumption during the year	Closing balance in terms of months' consumption	Purchases during the year
	1	2	3	4
<i>Mines</i>				
1965—67 (22-10-1965 to 31-3-1967)	48.55	47.57	17.35	62.00
1967-68	53.16	40.57	15.72	45.18
1968-69	58.69	40.42	17.42	45.95
1969-70	59.40	47.06	15.15	47.77
1970-71	73.87	74.44	11.91	88.91
1971-72	84.07	96.76	10.43	106.96
1972-73	116.99	250.53	5.60	283.50
1973-74	135.38	126.77	12.82	145.16
<i>Zinc Smelter</i>				
1968-69*	34.38	74.77	5.52	63.12
1969-70	38.26	75.62	6.07	79.50
1970-71	44.07	108.49	4.87	114.30
1971-72	46.10	79.70	6.94	81.73
1972-73	108.64	60.11	21.68	104.51
1973-74	115.41	62.34	22.22	68.11

	1	2	3	4
<i>Lead Smelter</i>				
1965—67 (10/65 to 31-3-1967)	6.07	5.83	17.70	8.10
1967-68	7.06	8.29	10.22	9.28
1968-69	6.78	6.19	13.11	8.62
1969-70	4.53	8.66	6.29	6.41
1970-71	4.69	8.25	6.79	8.41
1971-72	7.15	7.88	11.00	7.69
1972-73	5.69	9.67	7.01	10.67
1973-74	6.88	10.66	7.73	11.85
<i>Maton Mines</i>				
1973-74 (for 3 months) up to March, 1974	5.70	3.09	—	—
<i>Total</i>				
1965—67 (10/65 to 31-3-1967).	54.62	53.40	17.39	70.10
1967-68	60.22	48.86	14.79	54.46
1968-69	99.85	121.38	9.87	117.69
1969-70	102.19	131.34	9.34	133.68
1970-71	122.63	191.18	7.70	211.62
1971-72	137.32	184.34	8.94	196.38
1972-73	231.32	320.31	8.74	398.68
1973-74	263.37	202.86	15.58	226.12

*The Smelter went into full production in June, 1968.

It will be seen that the closing balance of stores and spares had gradually increased year after year except in the case of lead smelter up to 1970-71 although the consumption had also increased. The purchases made during the year, generally exceeded the consumption. The heavy stock of stores and spares in hand at Zawar Mines was attributed by the Management (November, 1971) to the stocking of steel materials in excess of immediate requirements in order to avoid delay in the development programme. It was further stated in January, 1974, that the increase in the closing balance as on

31st March, 1973 was mainly due to holding of large stocks of steel and cement for the expansion programme of Zinc Smelter and other incoming projects.

The Management stated further in January, 1975 as follows :—

“The larger inventory holdings (excluding Raw materials, Intermediate and semi-finished products as well as finished goods), are a direct result of, and are justified by the following :—

- (i) Considerably increased activities of the Company, *i.e.* higher production.
- (ii) Considerably increased cost of various inputs which is reflected in value of the inventory, even though incremental units, are not necessarily in the same proportion.
- (iii) Erratic and varying “Lead-time” supply conditions as a result of the “Seller’s market”, requiring higher stock levels of essential spares, chemicals, etc.
- (iv) These inventory holdings also include steel and cement, although these are part of construction materials bank, required for new and expansion projects of HZL.

‘b) Non-fixation of maximum, minimum and ordering levels

The maximum, minimum and ordering levels for each store item have not been fixed.

As regards mines, the Management stated (November, 1971) that these limits are normally fixed after the project comes into production. Till the targeted level of production is achieved the requirement of stores needed for this level of production cannot be fixed at a realistic basis.

In regard to Zinc Smelter, the Company has stated (August, 1972) that “.....zinc smelter having started production in 1968-69 and as the production has not yet established the levels have not been fixed so far except for a few items of consumable nature.....”

With the mechanisation of stores accounts and the experience gathered for the level of inventory to be maintained for the smooth running of the plant, action is being taken to fix the various levels of keeping the stores.”

The Management stated (January, 1975) that maximum, minimum and reordering level was put into force from December, 1973 in respect of ‘A’ category of items *i.e.* those items where annual consumption value is more than Rs. 10,000 per item and those cover up approximately 80 per cent of the total value of inventory. It was further stated that ‘B’ and ‘C’ categories of items would also be covered up progressively.

(c) Physical Verification

(i) The physical verification of stores, raw materials, finished goods etc., was not done properly and systematically and in November, 1970 the Board of Directors desired that urgent steps should be taken for the physical verification of stores/spares. The work was taken up from January, 1971 and has been completed to the following extent till the end of November, 1971 :—

Name of the Unit	Total No. of items	Items verified	% of items verified to total No. of items
Zinc Smelter	9,000	5,961	66.23
Lead Smelter	2,200	593	26.95
Zawar Mines	10,000	1,097	10.97

The Management have stated (May, 1973) that cent per cent verification of finished goods, raw materials and stores as on 31st March, 1972 has been completed at Zinc Smelter, Lead Smelter and, with the exception of few items of stores, at Zawar Mines also.

(ii) Instances of shortages/excesses observed during the physical verification of raw materials and finished products carried out on certain occasions are stated below in brief :—

Zawar Mines

- In December, 1970 a shortage of 1,193 tonnes of concentrates valuing Rs. 10,87,300 (at the average rate of Rs. 911.40 per tonne as on 31st March, 1971) was noticed and adjusted in the accounts for the year ended 31st March, 1971 pending investigation.

As regards the shortage of about 900 tonnes forming part of the shortage of 1,193 tonnes, the Ministry informed (May, 1975) as follows :—

“While, there may be some shortage on account of handling and storage losses in the mill, storage yard and storage losses at other places, a bulk of alleged shortage is attributable to the errors in the theoretical calculation. The total shortage works out to about 5 per cent of the total production of about 18,500 tonnes in 14 months ending December, 1970. Out of this, about 2 per cent could be attributable to the handling, flying and long storage losses, the rest could safely be assumed on account of errors in theoretical calculation on production of concentrates.”

As regards the balance of 293 tonnes the following note was recorded in the Company's file in January, 1974 :—

“The balance alleged loss of 293 tonnes was also discussed and it transpired that this loss also pertained to the same period and was attributable to, by and large, the same reasons as given for the theoretical loss of 900 tonnes of Zinc concentrates.”

The results of investigation have not been reported to the Board of Directors so far (May, 1975).

Zinc Smelter

1. *Zinc Concentrates*.—An excess of 1695.489 tonnes of indigenous zinc concentrates was observed on physical verification of the stock in the smelter for the first time on 30th April, 1971. Considering the possibility that the excess might be due to (i) moisture content (ii) inaccurate recording of the weight by weighbridge (iii) non-preparation of daily requisitions (iv) possibility of showing an inflated consumption of Zinc concentrates by Roaster section to show more production of calcine (v) quantity assessed on physical verification being estimates on account of volumetric measurement and the full density indicated by laboratory being possibly inaccurate, a fresh verification of stock was suggested in August, 1971 and was conducted in December, 1972 and again in June, 1973 and a shortage of 643.495 tonnes valuing Rs. 8.57 lakhs was finally noticed.

The matter was further investigated in December, 1973 according to which an excess of 65.974 tonnes of Zinc concentrates was found at the smelter. The investigations made in December, 1973 further revealed a shortage of 453.108 tonnes (dry) valuing Rs. 5.35 lakhs (at average landed cost of Rs. 1,180 per tonne at Kandla) in respect of concentrates imported during 1968 to 1973. The shortage has not been reported to the Board of Directors so far (May, 1975).

2. *Rock Phosphate*.—Shortages in the stock of rock phosphate were noticed on 10th July, 1968 (3,191), 18th August, 1970 (5,575 tonnes) and 28th April, 1971 (339 tonnes). The value of the shortage noticed in July, 1968 was Rs. 7 lakhs and that noticed in August, 1970 and April, 1971 together amount to Rs. 5.52 lakhs.

The shortage observed in July, 1968 was 11 per cent of the total rock phosphate received during January, 1967 to July, 1968. Of the shortage, 4 per cent was attributed to loss due to moisture, crushing, weighting errors, etc. and another 5 per cent to loading, unloading and transit losses from port to zinc smelter. Reasons for balance 2 per cent shortage could not be ascertained. The loss was written off by the Board of Directors on 7th May, 1970. The other two shortages of 5,575 tonnes and 339 tonnes of rock phosphate were also written off in April, 1971 and December, 1972 respectively.

3. *Single Superphosphate*.—Out of a shortage of 4,000 tonnes observed in August, 1970, the shortage of only 2,005 tonnes was written off. During the course of investigation of the remaining shortage and subsequent verification of stock of superphosphate, the shortage was finally established at 455 M.T. in May 1974. The shortage of 455 M.T. is, however, awaiting investigation. (January, 1975).

(iii) The Board of Directors desired in November, 1970 that urgent steps should be taken for the physical verification of machinery and equipment but no census of the machinery and equipment was taken since the formation of the Company.

In Note 9 forming part of the accounts for 1973-74, which were certified in September, 1974, the Company stated "While the fixed assets registers for Lead Smelter, Head Office in full and for Zawar Mines in part (plant and machinery) have been completed, for other units these are under compilation. Stock verification of the assets will be carried out after the assets registers of all the units are completed."

12. FINANCIAL POSITION AND PROFITABILITY ANALYSIS

12.01 Financial Position

The table below summarises the financial position of the Company under broad headings for the last six years :—

	(Rupees in lakhs)					
	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
	1	2	3	4	5	6
<i>Liabilities</i>						
Paid-up capital	617.00	661.17	784.67	955.18	1,340.19	1,900.19*
Reserve and surplus	3.49	3.49	3.49	3.49	3.49	317.99
Borrowings:						
(i) from the Govt. of India	542.71	631.67	785.22	983.52	943.17	819.66
(ii) from the Govt. of Rajasthan	1.38	1.29	1.09	1.09	0.87	0.74
(iii) Foreign credit (Deferred payments including interest)	59.66	48.76	35.19	23.35	10.98	—
(iv) Bank-Cash Credit	35.33	34.84	72.80	293.53	198.25	—
Trade dues and other current liabilities (including provisions)	370.91	412.31	435.15	448.66	489.39	666.09
TOTAL	1,630.48	1,793.53	2,117.61	2,708.82	2,986.34	3,704.69

	1	2	3	4	5	6
<i>Assets</i>						
Gross block	1,219.36	1,313.88	1,405.78	1,689.44	1,852.87	2,028.30
Less : Depreciation .	168.06	305.47	188.27	252.99	347.21	505.72
Net fixed assets .	1,051.30	1,008.41	1,217.51	1,436.45	1,505.66	1,522.58
Capital works-in-progress	—	—	—	8.02	24.65	59.72
Current assets, loans and advances	459.09	509.08	662.72	952.60	978.87	1,330.00
Investment .	0.27	0.27	0.27	0.27	0.27	0.27
Miscellaneous expenditure						
(i) Mines exploration & development expenses	27.64	33.63	59.90	101.32	219.23	451.97
(ii) Expenditure during construction	—	—	—	8.93	79.26	311.11
(iii) Deferred revenue expenditure	56.41	58.06	51.10	48.76	43.35	29.04
(iv) Profit & Loss Account	35.81	184.08	126.11	152.47	135.05	—
TOTAL .	1,630.48	1,793.53	2,117.61	2,708.82	2,986.34	3,704.69

	1	2	3	4	5	6
Capital employed	1,155.92	1,122.61	1,466.50	1,966.30	2,030.20	2,274.86
Net worth	500.63	388.89	551.05	647.19	866.79	1,426.07

- NOTES:—1. Capital employed represents net fixed assets plus working capital.
 2. Net worth represents paid-up capital plus reserves and surplus less intangible assets.
 3. *Includes share application money—Rs. 160 lakhs.
 4. During 1970-71 the Company switched over from Reducing Balance method to Straight Line method of depreciation as per Government's instructions and wrote back a sum of Rs. 175.75 lakhs in the accounts for 1970-71 (Sept., 1974). The depreciation, so far written off, is provisional. The management stated that when the final valuation of assets was known, the amount of depreciation would also be recalculated, where-ever necessary, taking into account the pre-acquisition use of assets taken over from the MCI.

12.02 Working results

The working results of the Company for the last six years are indicated below :—

	(Rupees in lakhs)					
	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
	1	2	3	4	5	6
Sale proceeds	616.43	538.33	455.18	496.37	882.18	1367.55
Cost of products sold	651.24	674.60	576.92	525.50	839.76	862.90
Loss (—)/ Profit(+)	(—)34.81	(—)136.27	(—)121.74	(—)29.21	(+)42.42	(+)504.65
Percentage of cost of products sold to sale proceeds	105.6	125.3	126.7	105.9	95.19	63.10
Value of production (including unsold stock)	473.73	518.77	493.77	779.16	863.24	1436.35

	1	2	3	4	5	6
Percentage of value of production:						
(a) To net worth	94.6	133.4	89.5	120.4	99.6	100.7
(b) Total net assets	29.1	28.9	23.3	28.8	28.9	38.8

It will be seen that the percentage of cost of sales to sales gradually increased upto 1970-71 but came down in 1971-72, 1972-73 and 1973-74. The percentage of value of production to total net assets came down in 1970-71 as compared with 1969-70 but improved in 1971-72, 1972-73 and 1973-74. The percentage of value of production to net worth also came down in 1970-71 as compared with 1969-70; with some improvement in 1971-72, it again has shown an unfavourable trend.

The price of zinc ruling in 1972-73 was Rs. 4,090 per tonne. This was increased to Rs. 6,417, Rs. 6,660, Rs. 9,435 and Rs. 13,710 per tonne with effect from 1st April, 1973, 1st July, 1973, 1st October, 1973 and 1st January, 1974 respectively. The gross additional sales revenue earned from increase in price of zinc during 1973-74 as compared to that prevailing in 1972-73 amounted to about Rs. 5.46 crores leading to substantial improvement in the working results of the Company.

13. FINANCIAL CONTROL

In their 15th Report (Fourth Lok Sabha—April, 1968) on Financial Management in public Undertakings, the Committee on Public Undertakings recommended that the main functions, responsibilities and powers of the Financial Adviser should be clearly laid down. In pursuance of this recommendation,

Government circulated in May, 1969 a note *inter alia* indicating the main functions and responsibilities of the Financial Adviser and asked the public sector undertakings to adopt the same into or with such alternations, adaptations as might be necessary. The note also provided that the Board of Directors should determine matters which would be reserved (i) for concurrence of the Financial Adviser (ii) for consultation with the Financial Adviser and (iii) where the Financial Adviser need not be consulted.

While inviting attention to the observations of the Committee on Public Undertakings as contained in para 10.42 of their 19th Report (5th Lok Sabha) on Heavy Electricals (India) Ltd. regarding delay in the consideration of the BPE's guidelines issued in May, 1969 by the Board of Directors, the Bureau of Public Enterprises desired in their O.M. of 24th November, 1972 that all important orders issued by the Government should be brought to the notice of the Board of Directors who, in turn, should consider them promptly and take follow up action without delay. This office memorandum alongwith that of May, 1969 was placed before the Board of Directors for information in its meeting held on 13/14 January, 1973. It was explained by the Chairman in this meeting that a further paper would be placed in due course with regard to the powers to be exercised by the Financial Adviser. No such paper has been placed before the Board of Directors so far (May, 1974). The Company has stated (November, 1973) that under the existing procedure, the Financial Adviser is associated in all decisions connected with policy matters; all financial proposals and other matters having financial bearing are invariably routed through him.

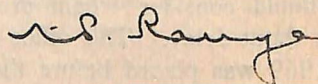
14. ACCOUNTING SYSTEM AND INTERNAL AUDIT

14.01 Accounting System

Although the Company was formed in January, 1966, an Accounting Manual laying down the detailed procedure for compilation and maintenance of accounts has been introduced only in June, 1974 with the result that no uniform accounting procedure could be followed in the various units of the Company till then.

14.02 Internal Audit

The mines and the lead smelter are in production since the very beginning and the zinc smelter started production from January, 1968. The Company, however, introduced a full fledged internal audit system from July, 1973. The internal audit manual, prepared in September, 1973, was submitted to the Board in August, 1974. The Board authorised the Managing Director to approve it with such modifications as may be considered necessary. The manual is under consideration of the Managing Director (January, 1975). The reports of the internal audit section are submitted to the Financial Adviser and important points are brought to the notice of the Chairman-cum-Managing Director. No report is, however, submitted to the Board of Directors.

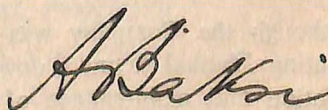


(R. P. RANGA)

*Chairman, Audit Board and
Ex-officio Additional Deputy
Comptroller and Auditor
General (Commercial)*

New Delhi,
The 21st July, 1975

Countersigned



(A. BAKSI)

New Delhi,
The 21st July, 1975

Comptroller & Auditor General of India

ANNEXURE I

[Referred to in para 7.05(a)]

Statement showing the various problems as analysed by Technical Committee, their implications and the recommendations

Sl. No.	Statement of the problem	Implications	Remarks
1	2	3	4
<i>I. Raw material handling and sinter preparation</i>			
1.	Quality of concentrates has gone down of late and percentage of lead had reached a level of 60% from average 70% Pb.	Not only lead input of the plant decreases but processing becomes complicated and costly.	Every effort should be made by the concentrator to produce constant high grade concentrate.
2.	The material losses during transport amount to 2—3%.	At 500 tonnes/month production level it means a loss of 150—180 tonnes of lead/year equivalent to a loss of revenue of Rs. 4,50,000 per year.	Economics of use of metal containers should be explored.
3.	The operation is mostly manual in important critical areas.	There is no effective control on the quality and output of the sinter.	The Committee has recognised this as the most important problem needing urgent attention.
4.	Crushing and screening capacity can handle only 50% of the sinter fines.	Proper sizing of the sinter is very essential for sinter quality.	The material preparation section should be modernised by replacement of the present obsolete and inadequate equipment.
5.	Sinter breaking is done manually.	In absence of care and attention the workers break it to only 150—200 mm. size instead of 100—150 mm. size. Also they sprinkle water on cake to make it friable. This saves them from hard work but this generates greater amount of fines.	This operation, being very arduous, should be mechanically done by a right type of breaker.

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|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| 6. Sinter pots bay has poor ducting with poor suction. The ducting is in poor condition. The chimneys are of low height. | Poor suction not only results in leakage of SO ₂ and poor working conditions, but also results in poor sinter. | } The Committee recommends modernising the ducting ventilation and installation of an efficient dust collection system. |
| 7. There is at present no arrangement for dust and fume recovery. | Apart from atmospheric pollution, this represents an important source of loss of lead from the Smelter. | |
| 8. Air blow nozzles have no control and locking arrangement. Air-pressure provided is also on the low side. | Low air pressure results in poor sulphur elimination and sulphate formation. | Additional high pressure blower is indicated along with control and locking arrangement. |
| 9. Generation of fines and heavy circulating load. | Return of large amount of sinter fines back into the sinter pot lowers its productivity. | The Committee identifies this as a crucial problem needing process study. |

II. Blast furnaces and slag disposal

- | | | |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| 1. Charging of furnaces is manual needing 17 men per shift. | It has been reported that this becomes often irregular and slow and seriously affects production. Furnaces presently can produce only 33 M.T./day instead of potential 48 M.T./day. | The Committee strongly recommends mechanisation of charging of blast furnaces as also a time and motion study. |
| 2. Syphon tap is not in operation. | — | The syphon tap should be put back in use and its advantages properly assessed. |
| 3. Slag pots are hauled manually by six men/shift. | It is reported that slag disposal is not properly attended to by workers. | This problem needs a closer study and should be included in the terms of reference for feasibility report. |

1	2	3	4
4. Furnaces are connected by 125 ft. ducting to the bag filter plant.	Lot of dust settles in the ducting and often chocks it completely. Dust losses from the furnace stack increases to 50% carrying as much as 80% Pb.	The Committee recommends installation of dust catchers and/or scrubbers in the circuit.	
5. The furnace height is only 15 ft. as against the usual 20-22 ft.	Higher stack height may lead to higher productivity and lower coke consumption.	The Committee recommends that the stack height be increased.	
6. The rate of slag production is 2.7 M.T./ton of metal of which 1.7 M.T. is recycled.	The slag fall is more than usual and recirculation of large quantity of slag unnecessarily dilutes the blast furnace burden.	The Committee identifies this as an important problem for process study.	
7. Recovery of metal from blast furnace slag.	—	The Committee recommends that in the first instance pilot plant investigations should be immediately sponsored.	

III. Refinery section

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|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. The dross formation constitutes 22% of hard lead input into the refining. | This is indeed very heavy and puts an unnecessary burden on circulating lead. | The Committee recommends that this should be assigned as a process study for improving the practice. The Committee recommends installation of a softening furnace. |
| 2. The refinery section is congested. | This results in poor working conditions, poor fuel efficiency and lower throughput. | The Committee recommends that the matter should be referred to the consultants preparing feasibility report since a better layout is called for. |

1	2	3	4
3.	Vacuum dezincing unit has been in disuse.	Vacuum dezincing will greatly reduce the need for air blowing and production of heavy dross.	Vacuum system should be repaired, if necessary, and its use restarted.

IV. Miscellaneous facilities

- | | | | |
|----|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | Storage space is inadequate for :
(a) storage of fluxes and hard coke.
(b) fuel oil buffer stock
(c) refined lead. | Lack of storage space for adequate buffer stocks for operational continuity can create serious bottlenecks, congestions, accidents, thefts and other losses. | Provision for adequate storage space should be referred to while assigning the feasibility report preparation. |
| 2. | Land.—The present 4 acres of lands for factory is very inadequate even for the present level of production. | For increased production levels of 500 TPM and 1000 TPM the area requirements could easily exceed 15.20 acres. | The Committee strongly recommends that land acquirement proceedings be expedited and the additional 30 acres be obtained. |
| 3. | Siding.—The present 5 wagons siding is just adequate for present capacity of the plant. | Additional siding facility will be required for handling greater raw materials for higher output. | This problem can be solved by extending the siding facility across the bridge into area to be acquired. This should be referred to in the feasibility report. |
| 4. | Workshop | — | The committee strongly recommends that it is absolutely essential to have adequate workshop facilities in a plant as at Tundoo. The job assessing the exact requirements could be assigned to consultants to be appointed for preparation of the feasibility report. |

1	2	3	4
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5. Layout

A study of the present layout and the history of growth of facilities at Tundoo reveals that there apparently was no master plan or a project report for its layout, growth and development.

In fact such a study may support the view that the present units in the Smelter are the result of *ad hoc* solutions of problems that cropped up from time to time.

The layout plant of the Smelter leaves much to be desired.

The Committee recommends that one of the terms of reference to the proposed consultants to be assigned the work of preparation of feasibility report should be the study of the possibility of improving the present layout of the factory in its entirety so as to cater to the needs of modernisation and expansion.

6. Staff

In this metallurgical smelter staff with metallurgical qualifications and background are conspicuous by their absence. This is the most ironical lacuna and it is recommended that steps be

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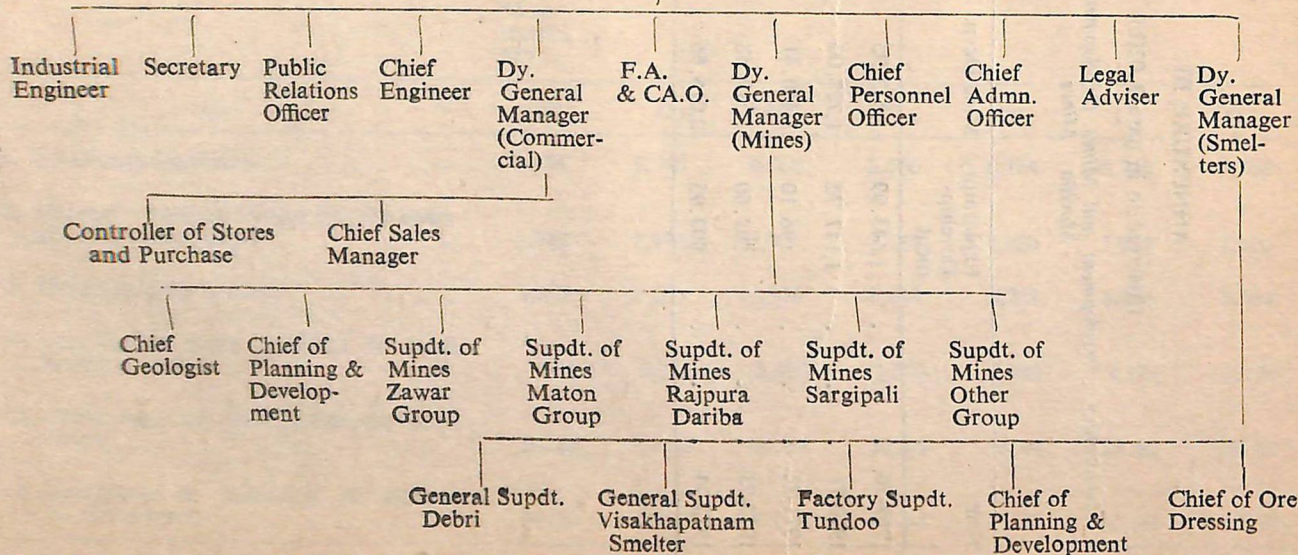
taken to provide the Management with at least three young, enthusiastic and trained metallurgical engineers to ensure adequate and intelligent process control and development.

7. Labour

—

The Committee feels that with mechanisation at several important and critical areas, a number of hands would be made surplus and available. These hands can wholly meet the labour requirements of increased plant capacity. The Committee feels that judicious re-deployment of the excess hands will obviate the necessity for any retrenchment or fresh recruitment.

ANNEXURE II
 (Referred to in para 3)
 ORGANISATION CHART
 BOARD OF DIRECTORS
 MANAGING DIRECTOR



ANNEXURE III

[Referred to in para 7.02(b)]

*Exploratory Development and Mines Development below 5th Level—
Mochia Mines*

(Figures in metres)

Year	Exploratory Develop- ment	Mine Devp.	Stope pre- paration	+Sub- level stopping
1969-70 . . .	1,643.99	513.95		
1970-71 . . .	1,147.70	1,787.00		
1971-72 . . .	96.10	1,450.41	2,443.01	
1972-73 . . .	504.60	1,519.48	2,446.95	
1973-74 . . .	903.95	2,016.66	4,106.45	

ANNEXURE IV

[Referred to in para 7.06(c)]

*Statement showing the working of the various sections of the Zinc Smelter**(i) Roaster and Acid Plant*

Particulars	1967-68 (Jan., '68 to March, '68)	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Total hours available	2,184	8,760	8,760	8,760	8,784	8,760	8,760
2. Normal working hours (on the basis of 330 working days)	1,980	7,920	7,920	7,920	7,920	7,920	7,920
3. Hours actually worked	1,873	6,005	5,810	6,688	6,765	6,566	5,381
4. Idle hours (with reference to total hours available)	311	2,755	2,950	2,072	2,019	2,194	3,379
5. Percentage of idle hours to total hours	14.24	31.45	33.68	23.65	23.00	25.05	38.57
6. Percentage of utilisation to normal working hours	94.59	75.82	73.36	84.44	85.42	82.90	67.94

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
7. Reasons for idle hours :							
(a) Closure due to heavy stock of acid and superphosphate	N.A.	1,560	240	528	198	—	—
(b) Breakdown/repairs	N.A.	792	1,032	864	675	638	1,103
(c) Process troubles	N.A.	283	960	504	261	431	606
(d) Shortage of water/power, planned shut down etc.	N.A.	120	718	176	885	1,125	1,668
8. Daily rated capacity (M.T.)	120	120	120	120	120	120	120
9. Daily average production Blende treated (M.T.) (on the basis of 330 working days)	120.61	68.26	70.63	84.31	94.85	91.78	76.5

NOTE.—Planned shut down represents closure of the plant for major repairs and overhaul. Separate figures for planned shut down are not available.

(ii) *Leaching and Purification Plant*

Particulars	1967-68 (Jan. '68 to March, '68)	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Total hours available	2,184	8,760	8,760	8,760	8,784	8,760	8,760
2. Normal working hours (on the basis of 350 working days)	2,088	8,400	8,400	8,400	8,400	8,400	8,400
3. Hours actually worked	2,184	7,080	8,496	7,992	7,711	7,259	6,542
4. Idle hours (with reference to total hours available)	—	1,680	264	768	1,073	1,501	2,218
5. Percentage of idle hours to total hours	—	19.2	3.00	8.8	12.2	17.13	25.3
6. Percentage of utilisation to normal working hours	104.59	84.28	101.14	95.14	91.79	86.41	77.88
7. Reasons for idle hours :							
(a) Heavy stock of acid	—	1,680	—	360	—	—	—
(b) Shortage of water/power	—	—	—	—	—	42	79
(c) Process troubles	—	—	—	—	192	565	359
(d) Breakdown/repairs	—	—	264	408	89	247	724
(e) Planned shut down	—	—	—	—	792	647	1,056
8. Daily rated capacity (M.T.)	100	100	100	100	100	100	100
9. Daily average production calcine treated (M.T.) (on the basis of 350 working days)	87.44	50.47	55.54	60.43	N.A.	69.19	58.3

(iii) *Electrolysis Plant*

Particulars	1968-69 (*) (Jan., '68 to March, 1969)	1969-70	1970-71	1971-72	1972-73	1973-74
1	2	3	4	5	6	7
1. Total hours available	10,944	8,760	8,760	8,784	8,760	8,760
2. Normal working hours (on the basis of 350 working days)	10,488	8,400	8,400	8,400	8,400	8,400
3. Hours actually worked	9,162	8,979	7,758	7,929	8,114	7,132
4. Idle hours (with reference to total hours available)	1,782	781	1,002	855	646	1,628
5. Percentage of idle hours to total hours	16.3	8.9	11.4	9.7	7.4	18.6
6. Percentage of utilisation to normal working hours	87.36	94.99	92.36	94.39	96.59	84.90
7. Reasons for idle hours :						
(a) Breakdown/repairs	—	—	—	—	20	24
(b) Shortage of calcine solution	1,680	600	912	—	—	—
(c) Shortage of Power/Water and Minor repairs	102	181	90	44	79	129
(d) Planned shut down	—	—	—	606	533	1,251
(e) Process trouble	—	—	—	205	14	223
8. Daily rated capacity (Cubic metres)	780	780	780	780	780	780
9. Daily average production Electrolyte treated (cubic metres) (on the basis of 350 working days)	520.67	429.96	467.99	N.A.	535.52	472

(*) Separate figures for the period January to March, 1968 are not available.

(iv) Superphosphate Plant

Particulars	1967-68 (Oct., 1967 to March, 1968)	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
1	2	3	4	5	6	7	8
1. Total hours available (on the basis of two shift working)	2,928	5,840	5,840	5,840	5,856	5,840	5,840
2. Normal working hours (on the basis of 330 working days)	2,640	5,280	5,280	5,280	5,280	5,280	5,280
3. Hours actually worked	1,478	3,541	3,043	3,338	3,591	2,648	1,781
4. Idle hours (with reference to total hours available)	1,450	2,299	2,797	2,502	2,265	3,192	4,059
5. Percentage of idle hours to total hours	49.52	39.37	47.89	42.84	38.68	54.66	69.50
6. Percentage of utilisation to normal working hours	55.98	67.06	57.63	63.22	68.01	50.15	33.73
7. Reasons for idle hours :							
(a) Process trouble	(*)1,011	1,447	1,987	1,498	1,428	3,148	2,281
(b) Plant maintenance							
(c) Breakdown/repairs							
(d) Accumulation of stock							
(e) Shortage of raw material	395	629	604	823	837	—	1,732
(f) Shortage of power/water	44	223	206	181	—	44	46
8. Daily rated capacity (Tonnes)	220	220	220	220	220	220	220
9. Daily average production (tonnes), (on the basis of 330 working days)	128.64	148.46	129.24	154.71	141.75	131.08	82.73

(*) Exact break up not readily available.

ANNEXURE V

[Referred to in para 7.06(d)]

Statement showing the performance of different sections of Lead Smelter

	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
<i>Sintering Plant</i>									
1. Total hours available . . .	3,682	8,400	8,784	8,760	8,760	8,760	8,784	8,760	8,760
2. Normal working hours . . .	3,682	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400
3. Hours actually worked . . .	N.A..	N.A.	7,248	6,408	N.A.	N.A.	N.A.	8,000	7,760
4. Idle hours . . .	N.A	N.A.	1,536	2,352	Not available		—	760	1,000
5. Percentage of idle hours to total hours . . .	—	—	17.49	26.85	Not available		—	8.68	11.41
6. Percentage of utilisation to normal working hours . . .	—	—	86.28	76.28	—	—	—	95.23	92.38
<i>Blast Furnace</i>									
1. Total hours available . . .	3,030	6,912	8,784	8,760	8,760	8,760	8,784	8,760	8,760

2. Normal working hours	3,030	6,912	6,912	6,912	6,912	6,912	6,912	6,912	6,912
3. Hours actually worked	N.A.	N.A.	5,712	4,896	4,776	3,936	3,872	5,675	N.A.
4. Idle hours	N.A.	N.A.	3,072	3,864	3,984	4,824	4,912	3,085	N.A.
5. Percentage of idle hours to total hours	—	—	34.97	44.11	45.48	55.07	55.92	35.22	—
6. Percentage of utilisation to normal working hours	—	—	82.63	70.83	69.09	56.94	56.01	82.10	—

Lead Refinery

1. Total hours available	3,472	7,920	8,784	8,760	8,760	8,760	8,784	8,760	8,760
2. Normal working hours	3,472	7,920	7,920	7,920	7,920	7,920	7,920	7,920	7,920
3. Hours actually worked	N.A.	N.A.	7,128	6,024	6,072	5,760	5,496	7,104	6,528
4. Idle hours	N.A.	N.A.	1,656	2,736	2,688	3,000	3,288	1,656	2,232
5. Percentage of idle hours to total hours	—	—	18.85	31.23	30.68	34.25	37.43	18.90	25.48
6. Percentage of utilisation to normal working hours	—	—	90.00	76.06	76.66	72.72	69.39	89.69	82.42

