Report of the Comptroller and Auditor General of India

for the year ended March 2000

Union Government (Commercial)

Public Sector Undertakings

National Aluminium Company Limited

No. 8 of 2000

CONTENTS

PREFACE

1. Audit Boards are set up under the supervision and control of the Comptroller & Auditor General of India to undertake comprehensive appraisals of the performance of Government Companies and Corporations.

2. The report on **National Aluminium Company Limited** was finalised by the Audit Board consisting of the following members:

1. Shri A.K.Chakrabarti	Chairman, Audit Board and Deputy Comptroller & Auditor General (From January 1998)
2. Shri B.B.Pandit	Principal Director (Commercial) & Ex-Officio Member Secretary, Audit Board
3. Ms. Anita Pattanayak	Principal Director of Commercial Audit & Ex-Officio Member Audit Board–I, Calcutta (From July 1998)
4. Ms. R.Rajalakshmi	Principal Director of Commercial Audit & Ex-Officio Member Audit Board–II, New Delhi (From July 1999)
5. Dr. T.R.Ramachandran	Part-time Member
6. Shri H.V.Paliwal	Part-time Member

3. The part-time members were appointed by the Government of India (in the Ministry of Mines & Minerals, Department of Mines) with the concurrence of the Comptroller & Auditor General of India.

4. This report as set out in the succeeding chapters is based on studies, made by the Audit Board, of various aspects of the functioning of the Company and the discussions held with the Secretary, Ministry of Mines & Minerals, Department of Mines and the Management of the Company

OVERVIEW

1. Introduction:

National Aluminium Company Limited (NALCO) was incorporated in January 1981 to undertake an integrated Aluminium project backed by captive mines and captive power plant. The project was commissioned in a phased manner between January 1987 and March 1996 at a cost of Rs.2408 crore. The Company had an annual capacity to produce 2.4 million MT of bauxite ore in mines, 0.8 million MT of alumina in Refinery and 0.23 million MT of aluminium in Smelter. The Company also had captive power plants with a capacity to generate 720 MW.

[Paragraph: 1]

Scope of Audit and main audit findings:

The present appraisal covers the working of the Company for the six years ending March 2000. The coverage has, however, been increased or decreased wherever considered necessary. The main findings of this review are as follows:-

(i) Despite the fact that the annual profit of NALCO ranged from Rs. 344.16 crore (1998-99) to Rs. 674.41 crore (1999-2000) there was cause for concern because certain structural and systems bottlenecks had been holding back the Company from attaining its full potential. The operational efficiency of the major plants viz. the Carbon Plant, the Cast House and the Smelter continued to be below optimal because of these bottlenecks. Even a debottlenecking scheme implemented at a cost of Rs. 45.77 crore, primarily to improve the operation of number of pots in the smelter plant, did not yield the desired results because it failed to address the problem areas in a comprehensive manner.

(ii) Underutilization of equipment, consumption of raw material in excess of norms and emphasis on primary products with relatively lower value addition were areas which required managerial attention.

(iii) The presence of the company had remained marginal and static in the global market, varying from 0.18 percent to 0.40 percent. Even in the domestic market the delay in execution of the expansion project had cost the company its leading position.

2. Objectives:

Some of the objectives envisaged in corporate plan viz. maximisation of capacity utilisation, operational efficiency, maintenance of leadership in domestic market and global presence were not achieved. The operational efficiency of the Company was not

optimal particularly in the smelter plant. The Company also failed to maintain its leadership position in domestic market due to delay in expansion projects as well as under-utilisation of existing capacity. Its presence in the global market remained more or less static varying from 0.18 per cent to 0.40 per cent.

[Paragraph: 1.3]

3. Capital Structure:

The paid-up share capital of the Company was Rs.1288.62 crore as on 31 March 1998. Despite earning substantial profit during the last 3 years ended March 1998, earning per share (EPS) was not impressive due to Company's huge equity capital base. In order to rationalise the imbalance of the capital structure, the Company converted (March 1999) 50 per cent of its equity capital into 14.5 per cent non-convertible debentures with the approval of the Government. As a result, paid-up share capital, net worth and borrowings of the Company as on 31 March 2000 became Rs.644.31 crore, Rs.3199.23 crore and Rs.663.54 crore respectively.

[Paragraph: 1.4]

4. Performance of Mines:

The production of bauxite ore had been satisfactory, but there was low availability of mining equipment due to frequent breakdown and the capacity utilisation of available hours of mining equipment was also low.

[Paragraph: 2.1 (c)]

5. Performance of Refinery:

Due to poor filtration in the hydrate filtration unit, loss of alumina in the spent liquor had reached a level of 4.20 gram per litre (GPL) in 1989 against the norm of 2 GPL. This had the effect of reducing the production by 24,600 MT per annum. The Company suffered loss of contribution of Rs.7.65 crore annually till March 1997 due to delay in installation of separating cyclones (installed in 1997-98) to arrest the loss of alumina. Similarly, due to delay in installation of 3 stage classifying cyclone as suggested by M/s Aluminium Pechiney (AP), the technical collaborator, the Company could not earn an annual additional contribution of Rs.5.23 crore on account of increased productivity and lower power consumption.

[Paragraphs: 2.2.1 to 2.2.3]

6. Performance of Smelter Plant:

(i) The smelter plant was designed to produce 0.218 million MT of aluminium metal from 480 electrolytic pots. Poor capacity utilisation of pots and consequent low level of production in smelter, due to under-utilisation of auxiliary carbon plant as well as technical problem in pot-lines, resulted in loss of contribution of Rs.255.91 crore during the five years ending March 2000.

[Paragraph: 2.3.1]

(ii) Major setback in Smelter Plant:

The Company had adequate capacity of captive power plant however, due to frequent power outages and consequent persistence of non-sustainable operating parameters in potlines, 193 pots were shunted between April 1998 and June 1998 against the norm of 5 pots per month, resulting in abnormal reduction in production and loss of contribution.

[Paragraph-2.3.1]

(iii) Consumption of inputs over and above the norms resulted in avoidable expenditure in the following cases:

- Value of excess consumption of energy over norms amounted to Rs.155.33 crore during the seven years ending March 2000. This was mainly due to decrease in current efficiency and general imbalance in pot-line parameters.

[Paragraph-2.3.1 (i)]

- Value of excess consumption of alumina compared to lowest recorded consumption amounted to Rs.21.28 crore during the six years ending March 2000.

[Paragraph-2.3.1 (ii)]

- The consumption of aluminium fluoride was about 50 per cent above norm in almost all years leading to an additional expenditure of Rs.45.11 crore in the last 7 years.

[Paragraph-2.3.1 (iv)]

7. Performance of Carbon Plant:

Many design problems were encountered in the carbon plant since its commissioning. As a result, the production of anodes was insufficient for operation of all 480 pots. Due to low capacity utilisation in the carbon plant, the Company had to import 31843 nos. baked anode at a cost of Rs.116.16 crore during the 7 years ending March 2000.

[Paragraph: 2.3.2 & 2.3.2.1]

The consumption of CP coke per MT of cast metal was always higher than the lowest consumption recorded in 1991-92, which resulted in excess expenditure of Rs.41.49 crore during the 8 years ending March 2000.

[Paragraph: 2.3.2(a)]

8. Performance of Cast House:

There was a high incidence of idle time and frequent break-down of equipment in Ingot Casting Machine and Wire Rod Mill which led to lower production of ingot/wire-rod and diversion of hot metal to the low value sow ingot production.

[Paragraph: 2.3.3]

As a result of lower capacity utilisation of Ingot Casting Machine and Wire Rod Mill as well as improper functioning of furnace tending vehicles, consumption of oil in the furnaces had increased beyond the norm leading to additional fuel cost of Rs.19.53 crore during the last 7 years.

[Paragraph: 2.3.3.2]

9. De-bottlenecking Scheme of Smelter:

A debottlenecking scheme implemented in smelter plant during June 1995 to January 1997 at a cost of Rs.45.77 crore did not yield the desired results because the scheme was not comprehensive and operational problems were not addressed in an appropriate manner at the time of its implementation.

[Paragraph: 2.3.5]

10. Captive Power Plant:

The Company installed six (6 x 120 MW) captive power plants for the operation of 480 pots. But one unit had to be kept under shutdown in view of operation of lesser number of pots. The Company could not tap any alternative source to sell its surplus power. Due to under-utilisation of installed capacity of the power plants the auxiliary consumption was above the norm leading to loss of revenue of Rs.20.13 crore during the last 7 years.

[Paragraph: 2.3.6]

11. Marketing and Sales Performance:

The Company had to divert the surplus alumina to the export market at a lower contribution compared to the metal due to lower intake of alumina in smelter plant. Further, the Company had laid more emphasis on production of primary products (ingot & wire rod) with low margin instead of high value added secondary products (wheel, sheet, coil etc.)

[Paragraphs: 3.1 & 3.2]

The Company supplied aluminium to a customer without any financial safeguard though the customer had defaulted in the past in payment of dues in time. This undue favour to the customer led to non-recovery of Rs.34.40 crore.

[Paragraph: 3.4(i)]

12. Inventory Management:

(i) The Company had not fixed any well considered optimum level for stock of stores & spares. Therefore, stores & spares were procured on ad hoc basis leading to high level of stock holding. The value of closing stock of stores & spares was Rs.211 crore as on 31 March 2000, which was equivalent to 18.44 months consumption.

[Paragraph: 5.1]

(ii) Value of stores & spares not moving for more than 3 years increased from Rs.30.67 crore as on 31 March 1994 to Rs.60.57 crore as on 31 March 2000. No effective steps had been taken for disposal of non-moving items leading to blocking up of working capital.

[Paragraph: 5.2]

Chapter 1 : Introduction

National Aluminium Company Limited (NALCO) was incorporated in January 1981 as a wholly owned Government Company to take over an aluminium project initially handled by Bharat Aluminium Company Limited (BALCO). The Government of India in November 1980 approved the project, which envisaged the setting up of –

i) Bauxite mines with capacity of 2.4 million MT per annum (MTPY) at Panchpatamali, Orissa.

ii) Alumina plant of 0.8 million MTPY at Damonjodi, Orissa.

iii) Smelter plant of 0.218 million MTPY at Angul, Orissa. The capacity was subsequently upgraded to 0.23 million MTPY after debottlenecking was completed in 1997-98.

iv) Port facilities at Vizag for export of alumina and import of caustic soda.

Besides, the Government also sanctioned (May 1981) setting up of a captive thermal power plant (400 MW) at Angul, Orissa, which was subsequently upgraded to 600 MW in June 1990 and to 720 MW in August 1994.

A comprehensive technical collaboration agreement with M/s Aluminium Pechiney (AP) of France, signed in January 1981, provided for supply of patents, know-how and technical services including basic engineering documents at a fee of French Franc (FF) 215 million. The detailed engineering, procurement services, construction supervision and monitoring of the project were entrusted (August 1981) to Engineers India Limited (EIL).

The original project cost of Rs.1242 crore (November 1980) was revised (1984) to Rs.2408 crore. The Government approved the revised project cost in December 1986. The project was completed at an actual cost of Rs.2408 crore and commissioned in a phased manner during the period from January 1987 to March 1996.

1.1 Organisation Structure:

The Company was under the administrative control of the Ministry of Mines & Minerals (Department of Mines). The Board of Directors was headed by a Chairman-cum-Managing Director (CMD) who was vested with executive and administrative powers. The CMD was assisted by four full time functional Directors viz. Director (Production), Director (Finance), Director (Project & Technical) and Director (Personnel and Administration) and a Secretary. Corporate office, Angul unit and Damanjodi unit were

three separate spheres. Executive Directors headed production units at Angul and Damanjodi. There was no Director (Marketing) at present. Though Board of Directors approved (July 1995) creation of a post of Director (Marketing), no one had been appointed as Director (Marketing). The Management stated (January 1999) that the matter was being constantly followed up with the Ministry. The Ministry clarified (June 2000) that they had agreed in principle on appointment of Director (Marketing) and had been trying to get the approval of Department of Public Enterprises (DPE) but without any success so far.

1.2 Process of making aluminium :

Bauxite ore is mined by drilling and blasting after removal of the overburden (i.e. topsoil and laterite covering the bauxite). The ore is transported by dumpers to a stationary crushing plant and transmitted to the refinery (14.87 Km. away) through a conveyor belt. In the refinery, crushed bauxite ore is first digested with steam and caustic soda. After de-silication and separation of mud, further precipitation of alumina hydrate takes place, which is then calcined, at high temperature to form calcined alumina. In the Smelter, alumina is dissolved in a cryolite bath at high temperature. Aluminium hot metal is then produced by electrolysis in electrolytic pots. These pots have carbon electrodes as anodes, which are produced in an auxiliary carbon plant. Anodes are prepared by baking anode paste in the bake-oven and fixed at the bottom end of iron rods in rodding shop. After electrolysis, aluminium is deposited at base of the pot, which is lined with carbon. Aluminium hot metal is sucked out into a ladle and then carried to the cast house to give it the shape of ingot, wire rod or billets as per market requirement.

Flow diagrams indicating the process involved in the production of alumina and aluminium metal are placed at Annexures-I & II.

1.3 Corporate Objectives :

The corporate plan of the Company for the year 1995 to 2005 envisaged, inter alia, the following objectives for the Company:

- To maximise capacity utilisation.
- To optimise operational efficiency and productivity.
- To maintain the highest international standards of excellence in product quality, cost efficiency and customer service.
- To provide a steady growth in business by technology up-gradation, expansion and diversification.
- To have a global presence and to earn foreign exchange.

- To maintain leadership in domestic market.

- To instill financial discipline at all levels for achieving cost and budgetary controls, optimise utilisation of working capital and effective cash flow management.

The above objectives were conceived by the Company on the philosophy of achieving growth and satisfaction through profitability. Though the Company was able to maintain international standard in quality of alumina and earned substantial foreign exchange by way of exports, it's operational efficiency was not optimal particularly in the Smelter Plant (refer para: 2.3.1 & 2.3.2). The Company failed to maintain its position as the leader in the domestic market of aluminium due to delay in expansion projects as well as under-utilisation of existing capacity. The Company's share in the domestic market of aluminium had come down from 33 per cent in 1993-94 to 22.43 per cent in 1999-2000. Its presence in the global market also remained more or less static ranging from 0.40 per cent (1999-2000) to 0.18 per cent (1998-99) during the seven years ending March 2000 (refer para: 3.2). The extent to which the objectives had been achieved is highlighted in the following paragraphs.

Management stated (January 1999) that, for augmenting leadership in the market, the Company had submitted (October 1988) a proposal to the Ministry of Mines for establishment of an integrated aluminium complex by expanding the capacity of the component units of the existing project. Government's approval to the expansion programme was considerably delayed. The approval for expansion of Mines & Refinery was granted in December 1996 and for Smelter & Power in February 1998 (Bauxite mines from 2.4 MTPY to 4.8 MTPY, Refinery from 0.8 MTPY to 1.575 MTPY, Smelter from 0.230 MTPY to 0.345 MTPY and captive power from 720 MW to 840 MW).

Ministry stated (May 2000) that there was some delay in getting environmental and PIB clearance and also stated that when the projects would be completed in 2001-2003, NALCO's capacity at 345,000 MT would have overtaken HINDALCO. However, it was observed that in case of take over of INDAL by HINDALCO, the capacity of HINDALCO would be 352,000 MT, which would be still higher than NALCO's proposed capacity.

1.4 Capital Structure :

The paid-up equity share capital of the Company was Rs.1288.62 crore as on 31 March 1998. The net worth as on that date was Rs.3177.38 crore against borrowing of Rs.594.10 crore. Despite earning substantial profits during the three years ended March 1998 Company's earning per share (EPS) was not impressive due to a huge equity capital base (refer para: 4.2). In order to rationalise the capital structure, the Company converted (March 1999) 50 per cent of its equity capital into 14.5 per cent Debenture with the approval of the Government. The paid-up equity share capital, net worth and borrowings of the Company as on 31 March 2000 became Rs.644.31 crore, Rs.3199.23 crore and Rs.663.54 crore respectively.

Prior to 1990-91, the share capital of Rs.1288.62 crore in the Company was fully owned by the Government of India. However, in pursuance of its decision of partial disinvestment of shares of selected PSUs, the Government sold 12.85 per cent of its holding of equity capital in the Company in several batches during 1991-92 to 1994-95. The shares of the Company are listed in the National Stock Exchange and the Stock Exchanges at Bombay, Madras, Calcutta, Delhi and Bhubaneswar.

1.5 Foreign Currency Swap and additional liability:

During implementation of its project, the Company obtained a loan of US $ 680 million in February 1981 and an additional loan of US $ 300 million in December 1984 from International Bankers. To partly safeguard its position against the upward trend in value of US Dollar in relation to Rupee, the Company finalised an interest rate and currency swap agreement with BA Asia Ltd. in May 1986. In terms of this agreement BA Asia Ltd. agreed to swap a sum of Swiss Franc (SF) 100 million against a sum of US$ 51.525 million from the Company. The two other salient features of this agreement were as follows:

a) On maturity date of the agreement, 27 February 1991, exchange of principal was to take place i.e. BA Asia Ltd. was to pay to the Company US $ 51.525 million and the Company was to pay to BA Asia Ltd. SF 100 million.

b) For converting SF 100 million into Dollars on 27 February 1991, conversion rate of US $ 1 = SF 1.9408 was agreed upon.

By converting a portion of the total loan amount into another currency, which was stable in relation to US Dollar, the main objective of the Company was to minimise loss on account of exchange rate fluctuation between US Dollar and Rupee. But due to strengthening of Swiss Franc in relation to US Dollar, the Company landed in a position with substantial additional liability on the maturity date of the swap agreement.

The Company sought (21 December 1990) an approval from the Ministry of Finance to roll over the existing swap agreement in order to shift and spread the liability to a later date. After obtaining approval (March 1991) from the Ministry of Finance, the swap transaction was rolled over in two trenches at historical exchange rate of US $ 1 = SF 1.9408 in anticipation of exchange rates taking a favorable turn in future as under:

i) For SF 40 million (US $ 20.610 million) maturing on March 28, 1996.

ii) For SF 60 million (US $ 30.915 million) maturing on March 28, 1995.

It was, however, observed that the Company's expectation of favorable turn in exchange rate did not materialise. The net outflow on swapping of SF 60 million and SF 40 million with reference to the date of original transaction (27 February 1986) amounted to Rs.66 crore and Rs.44.63 crore respectively (totaling Rs.110.63 crore). Had the existing swap agreement not been rolled over after expiry of its original period of 5 years as of 27 February 1991, the net outflow on US $ 51.525 million swapped against SF 100 million

would have been US $ 25.546 million (Rs.48.89 crore). Thus, against Company's expectation of favorable turn on roll over of the existing swap agreement, the Company actually incurred an additional loss of Rs.61.74 crore.

Management stated (December 1998) that the swap transaction was entered into after conducting sensitivity analysis and the loss was due to abnormal and unpredictable variation in market forces. Management added that if all swap transactions were taken together the Company had made a gain of Rs.134.55 crore. The roll over was effected with the advice of State Bank of India (SBI) and with the approval of the Ministry of Finance. However, it was observed that when asked for advice about roll over of swap in December 1990, SBI opined that it would be prudent to accept the loss and make necessary arrangement for meeting the liability either in one lump sum or in installments over a period of time by borrowing the amount of shortfall. Therefore, the Management's contention that it acted on the professional advice of SBI while deciding on the roll over is not tenable.

Ministry stated (May 2000) that the roll over was as per advice and approval of Department of Economic Affairs (DEA) and due to balance of payment (BOP) crisis in the country, the Company could not have paid out in February 1991. However, it was observed that had the Company followed the advise of SBI, there would have been no outgo of foreign exchange. The Company would have converted its liability in one currency (SF) into another currency (US$) and would have safeguard itself against further unfavourable fluctuations from market and thereby avoided the loss of Rs. 61.74 crore.

Chapter 2 : Production Performance

2.1 MINES:

a) Afforestation:

Panchpatamali Bauxite Mine of NALCO was being worked for more than 16 years after acquisition of forestland. After removal of over-burden and bauxite, soft clay is exposed and during reclamation, fragmented overburden is used for back filling of this mined out area. Topsoil is used as conditioner for growth of plantation. As per directive of Government, NALCO had taken up an afforestation programme within the mines and the surrounding area. The area actually afforested (up to March 2000) by the Company against the area and free area available is shown in the Annexure–III. The total number of trees planted by the Company for the last 16 years upto March 2000 were 12.08 lakh. The Company had been selected for the prestigious 'Indira Priyadarshini Vrishmitra Award 1997' by the Government of India for excellent performance in plantation.

b) Production Performance:

Production of bauxite ore against installed capacity of 24 lakh MT for the seven years ended March 2000 is shown below:

(In lakh MT)

Year	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000
Production	24.36	21.38	24.08	25.58	26.62	28.06	28.22

Production of bauxite over the seven years ending March 2000 excepting 1994-95 was satisfactory. The higher production against the capacity in the recent years was mainly because of utilisation of equipment procured for expansion project. But the installed capacity had not been reviewed and enhanced by the Company.

c) Utilisation of Mining Equipment

Average capacity utilisation of mining equipment was very low during the seven years ended March 2000 as would be evident from the following table:

Utilisation of equipment (as a percentage of scheduled hours)

	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2K
Wheel Loaders	31	34	33	35	33	31	30
Excavators	19	12	15	18	18	26	16
Dumpers	33	27	27	29	37	31	30

Management stated (February 1999) that the low utilisation was partly due to non-availability of the machines which were under preventive and break-down maintenance and partly due to inclusion in the books of equipment which were now old and unserviceable because the same were procured during the construction stage.

Management's contention was not tenable because (a) the utilisation of hours available even after excluding the maintenance/break-down hours was not satisfactory as the utilisation ranged between 72 per cent and 14 per cent during last 7 years (refer Annexure-IV), and (b) the capacity uitilisation of new equipment (wheel loader & excavator) procured in 1997 was also sub-optimal as it ranged between 32 per cent and 67 per cent during the year 1998-99 and 1999-2000. The low availability of equipment was a matter of concern and the system of preventive maintenance was required to be reviewed to reduce the high breakdown hours.

d) Bauxite Reserves

The work of preparation of the feasibility report for bauxite, alumina and aluminium project was assigned (March 1978) to AP by BALCO. Based on initial exploration data collected by Department of Mines, Government of Orissa, Geological Survey of India (GSI) and Mineral Exploration Corporation Limited (MECL), Aluminium Pechiney (AP) submitted the feasibility report (July 1979) indicating a total mineable reserves of 3098 lakh MT spread over North, Central and South blocks.

Sector-I of central block was under operation (June 2000) to produce 24 lakh MT of bauxite per annum. As per the original estimate of AP (1979) this block was having a mineable reserve of 937 lakh MT. Till 1996-97, 205 lakh MT of ores had been extracted in this sector. Thus as per the original estimate the balance of mineable reserves should have been 732 lakh MT (937 lakh MT – 205 lakh MT). However, AP revised its estimate and indicated a balance of mineable reserve in sector-I of Central block at 521 lakh MT. Thus, there was a down-gradation of ore reserves estimate by 211 lakh MT (732 lakh MT – 521 lakh MT) in this block. Such vast difference in two estimates in a single sector cast doubt upon the efficacy of measures used to estimate mineable reserves and is indicative of inaccurate groundwork.

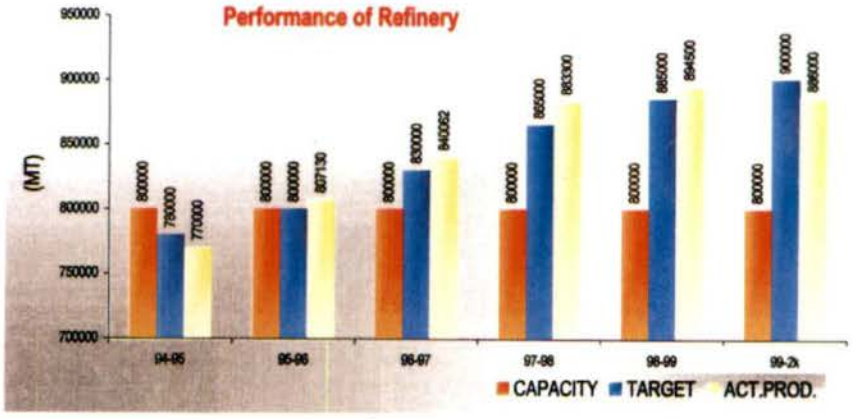
Management stated (January 1999) that initially the deposit was explored through broad based drilling at 400m x 400m grid by MECL. Subsequently, a part of the deposit in Sector-I of central block was explored through drilling on 100m x 100m grid based on which AP's revised estimate was made. Management also stated that the difference in reserves of 211 lakh MT was mainly due to (i) adoption of new and comparatively more accurate data base of vacuum drilling as against the earlier dry drilling data and (ii) modification in methodology of deposit estimation. The result obtained from vacuum suction drilling data was lower by about 7.52 per cent in mineable reserves, compared to that of dry drilling data.

Ministry stated (May 2000) that introduction of better technology, i.e. vacuum drilling at closed grid drill led to improvement in accuracy of assessment and resulted in revaluation of reserves. However, it is not clear how the extrapolation of data available for small worked out area onto the whole mineable area can be a more reliable indicator of

mineable reserves as against the broad-based data, which AP collected for its earlier estimate of 1979.

2.2 PERFORMANCE OF REFINERY:

The performance of refinery in terms of actual production against installed capacity as well as target fixed by Management is shown in the graph.



Though performance of refinery was satisfactory over the last 6 years, the plant witnessed production problems/quality problems, which remained unresolved for long periods and resulted in loss to the Company as explained below:

2.2.1 Separating Cyclone

The production of calcined alumina started in August 1987 but within two years of operation it was observed (May 1989) that due to poor filtration in the hydrate filtration unit, loss of alumina in the spent liquor had reached a level of 4.20 gram per litre (GPL) against the norm of 2 GPL (fixed by AP in 1982). This had the effect of reducing the production by 24600 MT per annum as estimated by the Management.

To arrest the loss of alumina, AP suggested (May 1989) installation of separating cyclones which would facilitate filtration. Management was also of the view (November 1995) that the loss would continue if the installation of separating cyclones was deferred. The separating cyclones were actually installed in 1997-98 at a cost of Rs.5.03 crore. The delay in installation resulted in annual loss of contribution of Rs.7.65 crore (24600 MT x Rs.3110 being average contribution per MT during 1994-95 to 1996-97) till March 1997.

Management stated (May 1998) that instead of implementing AP's proposed system yielding solid content of 1.5-2 GPL, the Company developed an in-house separating cyclone which guarantees solid content of less than 1 GPL. The Company installed the in-house improved system, as the same was likely to yield better performance for years together. However, it was observed that the loss of alumina in the spent liquor was still higher than 1 GPL and on an average it was 1.78 GPL during 1998-99 and 2.30 GPL during 1999-2000. Had the separating cyclone proposed (May 1989) by AP been

installed early the Company could have earned additional Rs.7.65 crore annually. Thus, the contention of the Management regarding delay in installation and commissioning the separating cyclone is not tenable.

Ministry admitted (May 2000) that indigenous development had taken some time.

2.2.2. Classifying Cyclone

AP guaranteed that with the use of its technology alumina grains having size of –45 microns would not go beyond 10-12 per cent. In February 1990, AP recommended installation of 3 stage cyclone system at an estimated cost of Rs.2.27 crore to reduce –45 micron content of hydrate from 15 per cent to 2 per cent. The percentage of –45 micron grain increased beyond 12 per cent in 1992-93 and even touched 24 per cent on some of the days during 1993-94. This resulted in serious quality and marketing problem, as foreign customer did not prefer alumina rich in granules below the -45 micron size on account of the increased dust generated during smelting operation. The Company therefore decided (August 1993) not to export any alumina containing more –45 micron granules than the specified norm. These were diverted to smelter plant for captive consumption.

The Company controlled (since 1994-95) the grain size by adding Crystal Growth Modifier (CGM) by incurring an additional expenditure of Rs.17 crore during the six years ending March 2000.

2.2.3 Though the quality problem regarding the size of the granules was reduced after use of CGM, disturbances still persisted in the existing classifiers, which resulted in loss of productivity as stated below:

i) To keep –45 micron of granules content within specified limit, there was huge injection of liquor (caustic soda and bauxite) resulting in production loss of 5000 MT of alumina annually and loss of contribution of Rs.1.96 crore (based on average contribution in last 5 years i.e. Rs.3924 x 5000 MT).

ii) Excess consumption of spent liquor @ $50m^3$/per hour, which if saved, could have increased production of alumina by 7000 MT annually yielding a contribution of Rs.2.75 crore (Rs.3924 x 7000 MT).

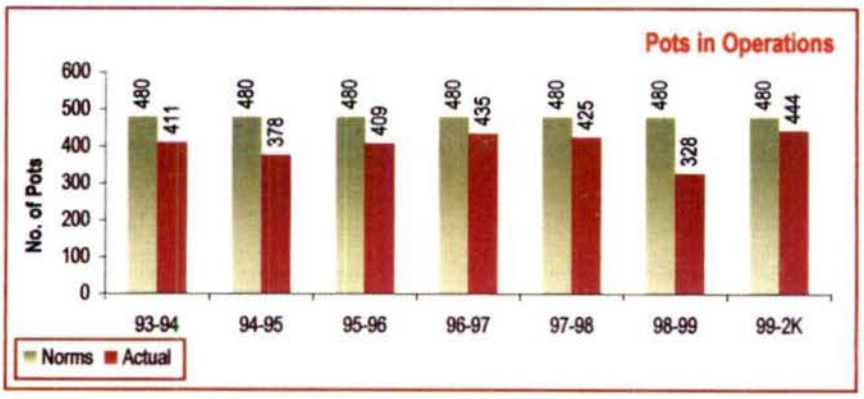
iii) Unproductive energy consumption of 6000 MWH annually valuing Rs 0.52 crore (based on cost of Rs.0.87 per KWH in 1997-98) due to operation of both over-flow pumps which could have been avoided with the installation of additional classifiers.

To overcome the above productivity constraints, the Management felt (November 1995) the necessity to install 3 stage classifying cyclones at an estimated cost of Rs.13.05 crore. However, the classifying cyclones had not yet (June 2000) been installed but included in the debottlenecking/expansion programme resulting in further delay and consequential loss of revenue of Rs.5.23 crore (Rs.1.96 crore + Rs.2.75 crore + Rs.0.52 crore) per annum.

Management stated (December 1998) that the classifying cyclone was not an urgent necessity because the problems of product quality and power consumption had been effectively tackled with the use of CGM and the classifier would be installed to cope with the increased plant capacity to 10.50 lakh MTPY under the debottlenecking scheme. However, it was observed that 16 months after regular use of CGM the Company reviewed (November 1995) the performance of CGM and found that the classifying cyclones should be installed on the consideration of minimising the quality problem related with the size along with the aforesaid expected benefits. Had the classifying cyclones been installed early, as suggested by AP in February 1990, the Company would have benefited on account of aforesaid increased productivity and lower power consumption and saved an amount of Rs.5.23 crore annually.

2.3. PERFORMANCE OF SMELTER PLANT:

The capacity of the Smelter Plant at Angul, Orissa was designed to produce 0.218 million MT aluminium metal per annum which was to be processed from 0.425 million MT of alumina transported from the Refinery.



2.3.1. All the 480 pots were commissioned in a phased manner between 1987-88 and 1995-96. Average number of pots in operation in the last 7 years is depicted in the graph. From the graph, it would be observed that the Company could not achieve full capacity utilisation in the field of pot operation during the 7 years ending March 2000. The average number of pots in operation varied between 328 in 1998-99 and 444 in 1999-2000. The reasons for the poor pot performance were:

i) Non-availability of uninterrupted power supply in the initial stages (i.e. prior to synchronisation of the 6th unit of the captive power plant in 1994);

ii) Low production of anodes in the carbon plant (refer para:2.3.2);

iii) Abnormal shunting of pots in 1998-99 resulting from persisting non-sustainable operating parameters [discussed below].

It is seen that average number of pots in operation never exceeded 444 during 7 years ending March 2000. Considering the life of a pot to be about 8 years, around 60 pots (i.e. 5 pots per month) in a year are expected to be relined. Thus, 475 pots (480-5) should have been operational at any point of time at least from 1995-96 onwards.

As a result of low capacity utilisation, the Company sustained a potential contribution loss of Rs.255.91 crore (against production loss of 136886 MT of hot metal) over a period of 5 years ending March 2000 as shown below:

Year	Installed capacity (MT)	Actual production of hot metal (MT)	Shortfall in production (MT)	Net loss of contribution per MT of hot metal (Rs.)	Loss of contribution (Rs. in crore)
(1)	(2)	(3)	(4)=(2)-(3)	(5)	(6)=(4)X(5)
1995-96	221000	193796	27204	25230	68.64
1996-97	221000	207028	13972	21581	31.15
1997-98	221000	202909	18091	24260	43.89
1998-99	221000	147456	73544	13935	102.48
1999-2k	221000	216925	4075	23931	9.75
			136886		**255.91**

Note: *(i) The abnormal shortfall in production in 1998-99 was due to major setback in smelter plant (explained in succeeding paragraph)*

(ii) For computation of loss of contribution, average sales price of metal (net of excise duty) and variable cost of wire-rod had been considered.

Ministry accepted the audit observation and stated (May 2000) that short supply of anodes by carbon plant was the constraint leading to reduced number of operational pots. Management stated (June 2000) that in early period the imported anodes could not be useful beyond a limit due to problem in anode rodding shop. Contention of the Ministry/Management was not tenable because the rodding shop was only a small portion of the carbon plant and ought not to have adversely affected the entire operation of the Smelter plant. Had the Management given due attention to this fact and taken timely action to increase the effective capacity of the rodding shop the Company could have avoided the aforesaid loss of contribution (i.e. cash loss) of Rs. 255.91 crore during 5 years ended March 2000.

MAJOR SET-BACK IN SMELTER PLANT:

Non-sustainable operating parameters like low bath height, low current efficiency high no. of fallen anodes and high iron content (as explained in succeeding paragraphs) persisted during the period covered under the present report, as a consequence of which a large number of pots were shunted against the norm of 5 pots per month as detailed below:

	Number of pots shunted		
Month	Potline – I	Potline – II	Total
April 98	8	14	22
May 98	47	50	97
June 98	25	49	74
Total	**80**	**113**	**193**

Out of 193 pots mentioned in the preceding table, only four pots were shunted due to old age whereas the other pots were shunted either due to metal/bath leakage or abnormal pot conditions. The average number of pots in operation during 1998-99 came down sharply to 328 as stated above.

The reasons for such failure are analysed chronologically as below:

i) Frequent power outages disturbed the thermal balance of the pots, which reduced the bath level and increased pot instability.

It may be stated here that operation of 480 pots requires (as per AP norms) continuous supply of 400 MW power. With an installed capacity of 720 MW (6 x 120 MW) at present and with back up of State Power Grid, such frequent outages were not justified.

ii) On analysis of the pot parameters, it was observed that right from the beginning of March 1998 the pot parameters were adverse as stated below:

(a) Iron (Fe) content in the first week of March 1998 was 0.36 per cent in the potline – II (against norm between 0.15 per cent to 0.25 per cent) and increased to 0.83 per cent in the first week of May 1998, thus impairing the quality of the product. The shortage of anode (mentioned earlier) contributed to the abnormal rise in iron (Fe) content [para 2.3.1 (iii) refer].

(b) Bath height at the end of first week of April 1998 came down abnormally to 12.65 cm. against a norm of 18 cm, which severely affected pot parameters. Number of fallen anodes also increased from 576 (April 1998) to 824 nos. (June 1998) in potline – I and from 520 nos. (April 1998) to 700 nos. (June 1998) in potline – II.

(c) The current efficiency also fell sharply from 78 per cent (April 1998) to 74.29 per cent (June 1998) as against norm of 89.4 per cent.

The other main factors, which contributed to the deterioration of the situation, are habitual absenteeism and lack of discipline and poor equipment availability particularly of the pot-tending machine without which almost no operation can be done on the pots. Moreover, industrial relation (IR) problem had been persisting since long and no effective action had been taken to resolve the problem. AP expert also opined (June 1998) that the Company needed sufficient number of skilled and motivated worker to overcome the present situation. The Ministry emphasised (August 1998) the need for foreign training of various levels of staff. No foreign training was, however, imparted to

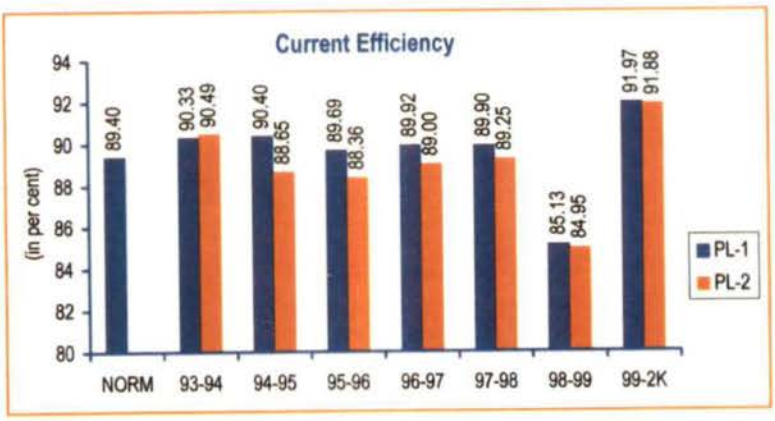
the operators (non-executive staff) in the smelter plant to improve their skill. It was observed that as many as 32 executives were sent abroad for training whereas not a single operator (non-executive staff) was sent for the training during three years ended March 1998. Moreover, it was observed that absenteeism of executives (16.45 per cent) was almost at par with the non-executive (16.91 per cent) during 1997-98 that further aggravated the situation. Further absenteeism of executives (13.6 per cent) and non-executives (13.5 per cent) was still on the higher side during 1999-2000.

Ministry accepted the facts and stated (May 2000) that corrective steps had since been taken in accordance with the recommendation of an Enquiry Report and now all the 480 pots were in operation.

Apart from the shortfall in production the following operational deficiencies were noticed:

i) **Current Efficiency:–**

Current efficiency, which is a direct measure of productivity of potlines, was below the norm of 89.4 per cent in potline–1 (PL-1) in 1998-99 and in all the last 6 years in potline–2 (PL-2) except in 1993-94 and 1999-2000 as depicted in the graph.



Note: *Current efficiency is expressed as percentage of actual aluminium produced (per day/Kg.) to the theoretical maximum production per unit of current flow (ampere).*

It may be mentioned that AP, the technology consultant, had observed that optimum current efficiency of 92 per cent was approachable by NALCO by application of better work procedures, so that the main operations on the pot like anode changing, metal tapping etc. could be carried out correctly. The fact that current efficiency approached 88 per cent pointed to a need for a serious investigation to ascertain the reasons for such a poor performance. It may also be stated that the plants abroad utilising the same AP-18 technology operate with current efficiency exceeding 95 per cent. Management stated (December 1998) that efforts were being taken to improve the current efficiency.

Ministry stated (May 2000) that there was a marginal variation from the norm and the Company had now achieved 92 per cent current efficiency. It was, however, noticed that

though the above current efficiency was achieved in 1999-2000 the same declined again to 88.37 per cent in April 2000 even on operation of nearly 480 pots.

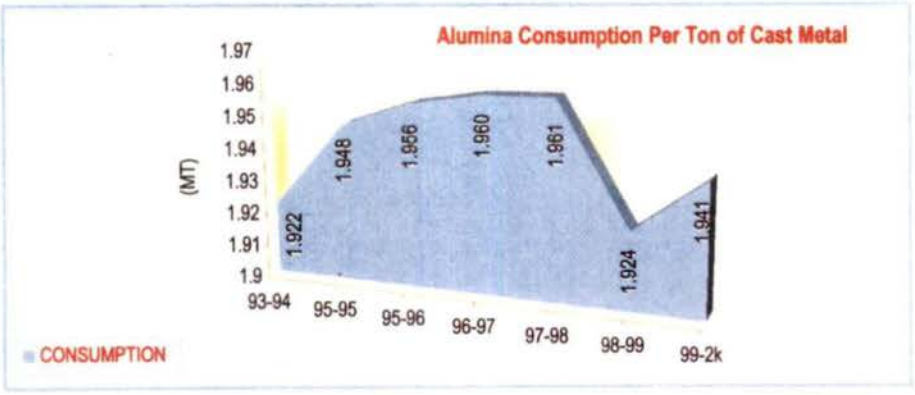
Decrease in current efficiency combined with general imbalance in potline parameters (i.e. the physical and chemical conditions prevailing in the pots) had an effect of excess consumption of energy over norms prescribed by AP. The excess consumption of energy over norms led to excess expenditure of Rs.155.33 crore during the seven years ending March 2000 as detailed below: -

Year	Total hot metal production (MT)	Standard consumption of energy @ 13540 kwh per MT of hot metal as fixed by AP (MKWH)	Total actual energy consumption (MKWH)	Excess consumption of energy (MKWH)	Rate per kwh (based on cost of captive generation of power) (Rs.)	Value of excess consumption (Rs. in crore)
(1)	(2)	(3)	(4)	(5)=(4-3)	(6)	(7)=(5x6)
1993-94	196410	2659.391	2773.058	113.667	0.69	7.84
1994-95	180161	2439.380	2629.360	189.980	0.77	14.63
1995-96	193796	2623.998	2839.499	215.501	0.80	17.24
1996-97	207028	2803.159	3047.410	244.251	0.73	17.83
1997-98	202909	2747.388	3184.782	437.394	0.87	38.05
1998-99	147456	1996.554	2458.590	462.036	0.93	42.97
1999-2K	216925	2937.165	3111.865	174.700	0.96	16.77
						155.33

It may be observed that there was a trend of enhanced excess power consumption during the seven years ended March 2000 excepting the year 1999-2000. Management stated (May 1998) that consumption of power was influenced by many factors like general imbalance in potline parameters, frequency in power outages, number of pots shunted in the pot-line etc. which was inherent in plant operation and could not, therefore, be avoided. However, the power consumption of 16673 kwh/MT in 1998-99 clearly indicated 23.14 per cent extra consumption compared to the DPR norm of 13540 kwh/MT. Ministry admitted (May 2000) that the energy consumption was high but it had been brought down to an average of 13800 kwh/MT. It was, however, observed that even after operation of 480 pots in April 2000 the average energy consumption was 14585 kwh/MT that was still higher than the norm of 13540 kwh/MT. The consumption of power in NALCO was compared with that of three plants abroad namely ABI (Canada), Norsk Hydro (Karmoy, Norway) and Tomago (Australia) and found to be comparatively much higher. The best value achieved by Norsk Hydro (Karmoy, Norway) was 12592 kwh/MT. When there is a tendency the world over to reduce power consumption gradually, consumption of power at such high level at NALCO, which operated with the latest technology, lacks justification.

ii) **Alumina Consumption**:–

The actual consumption of alumina during the seven years ending March 2000 is depicted in the graph.



It was observed that the alumina consumption had shown an increasing trend upto 1997-98 and thereafter continued to be higher than the lowest recorded consumption of 1993-94. This had resulted in excess alumina consumption amounting to Rs.21.28 crore during the six years ending March 2000 compared to the lowest recorded consumption (1993-94).

iii) **Bath Height: -**

Bath, the liquid form of cryolite, is a dissolving agent of alumina for conversion of alumina into aluminium by the process of electrolysis. From operational angle it is advantageous to operate pots with 17-18 cm of bath level as was advised by AP. However, the average height of bath in which the alumina and anodes are immersed always remained below 17-18 cm excepting pot-line –1 in 1999-2000 as shown below:

Year	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2k
Potline-I	15.86	14.85	15.46	15.11	14.21	16.85	17.43
Potline-II	16.15	15.80	15.90	15.48	14.88	16.77	16.63

The low bath height led to inefficiency in pot operation. Management stated (January 1999) that the Company deliberately maintained the bath level at 15-16 cm against AP's norm of 17 cm to avoid contamination of iron in the metal. It was, however, observed that the Company had to maintain the low bath level due to use of lower thickness carbon anodes which in turn was due to the following factors:-

1) Shortage of baked anode, which resulted in having more than 76-shift anode change cycle against norm of 68-shift anode change cycle.

2) Industrial Relation (IR) problem or break-down of pot tending machine (PTM) leading to backlog in anode changing which in turn extended the anode change cycle further.

3) Inadequacy of protection from external air burning of anodes due to lack of covering by crushed bath adversely affected life of Anode.

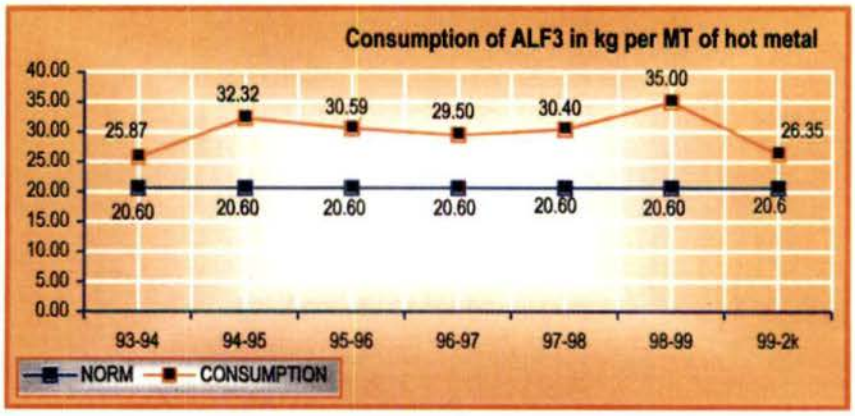
Had the above factors been controlled by the Company, the problem of contamination of iron in the metal would not have arisen and the decrease in bath level could be avoided. It may also be stated that only optimal bath level could ensure improved insulation by

submersion of anode and better conductivity, which could prevent pot imbalance and yield better operative results.

Ministry while admitting the above contention of Audit stated (May 2000) that bath height was now being maintained at the desired level of 17 cm through improvement in industrial relation and import of anodes to make good the shortfall for running 480 pots.

iv) **Consumption of Aluminium Fluoride:-**

In Smelter, inadequate covering of anodes by crushed bath led to thermal imbalance in pot and imbalance in anodic current distribution, which, in turn, affected the pot productivity. Addition of aluminium fluoride (ALF3) in molten bath is a corrective measure. Due to persistent problems as shown above, the consumption of aluminium fluoride was very high compared to norm (20.6 kg. per MT of hot metal) and ranged between 25.87 Kg/MT of hot metal (1993-94) and 35 Kg/MT of hot metal (1998-99) during the seven years ending March 2000 as depicted in the graph.



Due to consumption of aluminium fluoride in excess of norm the Company had to incur an additional expenditure of Rs.45.11 crore during the seven years ended March 2000 (Annexure-V).

Management stated (August 1995) that higher consumption was due to operational reasons and general imbalance in pot parameters and steps were being taken to control the consumption. The fact remains that the increasing trend could not be arrested even in 1998-99 and the consumption registered an increase of about 70 per cent over the norm.

Ministry agreed (May 2000) that consumption of aluminium fluoride had been on the higher side but currently the consumption was reduced to about 22 to 24 kg per MT. It was, however, observed that average consumption was 26.36 kg/MT during 1999-2000 and 26.90 during April 2000, which was higher than the norm of 20.6 kg/MT. It may also be mentioned that in plants abroad operating with the same technology, the best value achieved ranged between 6.3 kg and 17.7 kg of aluminium fluoride per MT of hot metal.

v) Fallen Anodes:-

Due to delayed anode changing and lack of adequate anode covering, there was high incidents of fallen anodes as can be seen from the table below:

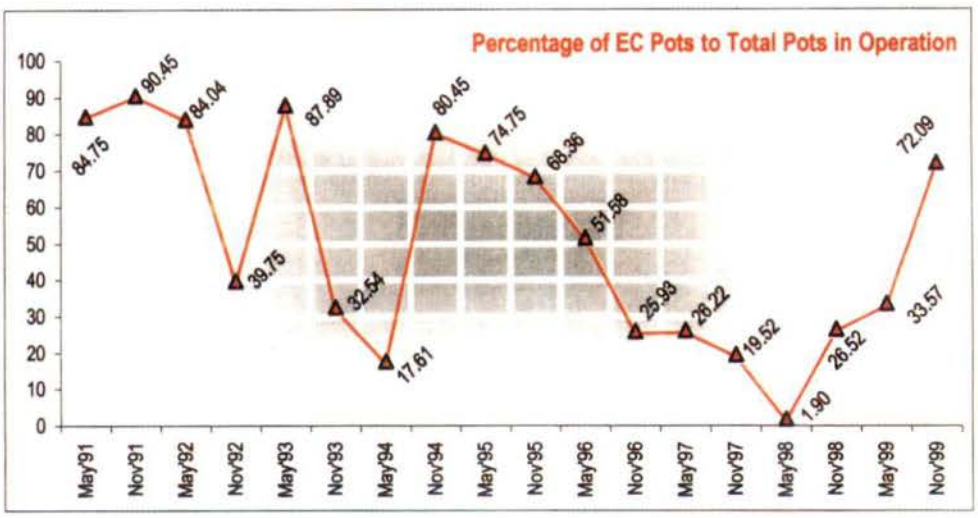
Year	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2K
Nos. of Fallen Anodes	1053	2792	2021	2358	3244	5759	817

Every pot contained 16 number of anodes. Operating pots with lesser number of anodes, which might occur on account of fallen anodes, resulted in flow of more current than normal in the remaining anodes leading to imbalance in the pot operation and ultimately adversely affecting production. While admitting the audit observation, Management stated (December 1998) that efforts were then being made to reduce the number of fallen anodes.

Ministry stated (May 2000) that the number of fallen anodes had since been reduced by timely covering of anodes with crushed bath and by strictly following 68 shifts anode changing cycles.

vi) **Number of Pots producing Electrical Conductor (EC) Grade Metal:-**

The purity of the metal produced in the pots is defined in terms of iron and silicon content. The performance guarantee as per AP clearly provided that at least 65 per cent of the pots should have less than or equal to 0.15 per cent iron and 0.06 per cent silicon and at least 90 per cent of the pots should have less than or equal to 0.25 per cent iron and 0.15 per cent silicon respectively. Details of total number of pots operated and the number of operating pots producing metal of purity exceeding 99.7 per cent (i.e. EC grade metal) during 1991-92 to 1999-2000 (May and November) is given in Annexure-VI. Percentage of the number of operating pots producing EC grade metal to total pots operated is depicted in the graph.



It may be observed from the graph that while encouraging results were obtained in the year 1991, deterioration started from November 1992 and reached an alarming position by May 1999. Deterioration in quality of metal resulted in low sales realisation, high inventory level and lesser off take of metal in international market.

Ministry accepted (May 2000) the contention of Audit and stated that EC grade metal was since being produced as per AP norm envisaged in the performance guarantee. The records, however, revealed that AP's guaranteed performance had not been achieved since the percentage of pots having silicon <=0.06 and iron <= 0.15 ranged only between 16.48 per cent and 7.08 per cent, against 65 per cent as per AP's performance guarantee, during the period from October 1999 to March 2000.

vii) **Human Factors: -**

To achieve cast metal production of 2.18 lakh MT, AP had suggested that a lot of effort had to be put into the quality of work and the organisation of the operation. AP opined that work procedures should be better applied so that the operators carry out the main operations correctly. A team constituted by the Management to review the potlines operation recommended (June 1994) that better performance can be achieved by improving the morale of employees, improving work discipline, re-organising maintenance activities, re-training and reducing absenteeism.

The fact, however, remained that work culture in the smelter plant could not be improved as was evident from the followings:

i) Absenteeism of non-executives ranged between 13.50 per cent to 17.99 per cent and that of executives was no better at 13.6 per cent to 16.5 per cent during the seven years ended March 2000.

ii) Due to uncontrolled absenteeism the Company had to pay overtime and the percentage of overtime cost to total wages ranged between 28.27 per cent (1994-95) and 34.32 per cent (1997-98) during the six years ending March 2000.

Ministry admitted (May 2000) that there was scope to improve discipline and the Company had initiated action in recent past to improve the same.

NON-IMPLEMENTATION OF COMPUTERISED ATTENDANCE SYSTEM:

An electronic punching system was procured (1988-89) for use in the captive power plant and smelter units at a cost of Rs.10 lakh but the same was discarded without being used for even a single day. Subsequently, in order to impose strict control over attendance, the Company acquired (1996-97) a computerised attendance system at a total cost of Rs.29.09 lakh but the same could not also be put to use. It was further observed that apprehending aggravation of further industrial relation problem, Management could not take a decision to implement the attendance-punching system.

It can be construed from the above that the efforts of the Management to improve work discipline did not yield significant results. Management stated (December 1998) that

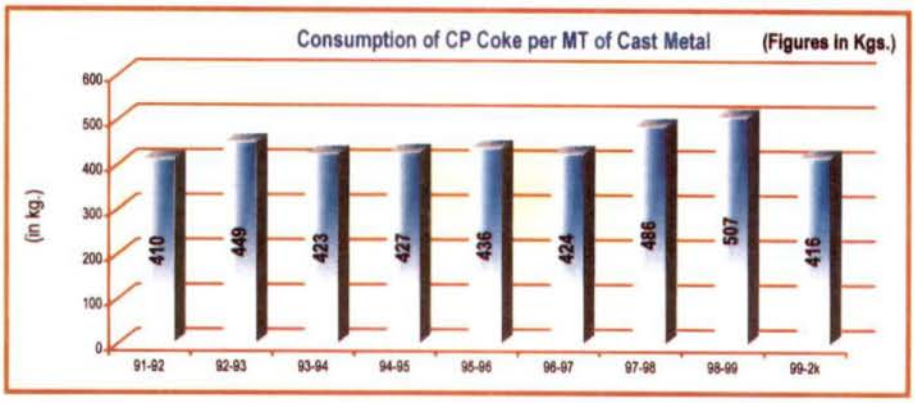
attempts were being made to convince the labour and to introduce the computerised attendance system at an opportune time.

2.3.2. PERFORMANCE OF CARBON PLANT:

Carbon plant consists of three main shops namely anode paste plant, bake oven and rodding shop. Rodding shop has two auxiliary shops namely, butt crushing and bath crushing. Anodes are prepared by baking anode paste in bake oven and are fixed at the bottom end of iron rods in rodding shop. After commissioning of the smelter plant in 1987, many design problems were encountered in the carbon plant as a result of which sufficient number of anodes and crushed bath could not be supplied to the potline. The performance of various shops is highlighted below:

a) Anode Paste Plant:

In the anode paste plant, green anodes are produced by mixing calcined petroleum (CP) coke and coal tar (CT) pitch. The actual consumption of CP coke (per MT of cast metal) during the nine years ended March 2000 is depicted in the graph.



It is seen from the graph that consumption of CP coke had increased considerably over the years since 1992-93. This resulted in excess consumption of CP coke by Rs.41.49 crore during the 8 years ending March 2000 compared to the lowest recorded consumption in 1991-92. Ministry stated (May 2000) that the situation had since been rectified and CP coke consumption was now within the normal tolerance level and the capacity utilisation of the anode paste plant was now nearing 100 per cent.

The consumption of CT pitch had also increased considerably over the years. During the nine years ended March 2000 the lowest consumption was 93 Kg/MT of cast metal in 1991-92 against which corresponding figure for 1999-2000 was 118 Kg/MT, i.e. 27 per cent higher than the minimum recorded figure.

The capacity utilisation of anode paste plant during the seven years ended March 2000 was also low and ranged between 65 per cent to 93 per cent. The Management attributed (December 1998) the low capacity utilisation to low plant availability, shortage of requisite quality of raw material and poor human productivity.

b) Baking Furnace:

133400 numbers of anodes were required annually to achieve full capacity of 480 pots in the smelter. During the seven years ending March 2000, the number of baked anode produced ranged between 89538 nos. (67 per cent) in 1998-99 and 118917 nos. (90 per cent) in 1999-2000 as against installed capacity of 132780 numbers.

The reason for poor performance of the baking furnace were as given below:

i) The basic engineering package furnished by AP stipulated installation of 3 nos. furnace tending assemblies (FTA). However, it was decided (November 1981) in a technical conference to delete one FTA by substituting it with 3 nos. 6-MT capacity overhead crane with the object of reducing the project cost.

The decision to delete one FTA called for 95 per cent availability of two existing FTAs. FTA availability fell short of expectation (95 per cent) as is evident from the following table:

FTA AVAILABILITY (per cent)

Year	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000
FTA-1	84.22	86.25	83.92	83.55	69.59	78.15	84.04
FTA-2	83.11	85.98	83.38	84.26	84.97	75.30	84.44

The lower availability of FTAs was mainly due to various operational constraints and lack of high level operating skill. To overcome the shortage of availability of FTAs thereby increasing the supply of baked anode to the rodding shop, the Company installed (May 1996) a third FTA at a cost of Rs.7.46 crore under debottlenecking scheme. However, even after installation of third FTA, baking furnace failed to produce adequate number of baked anodes for supply to the rodding shop as shown below:

Year	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000
No. of anodes baked	100785	98296	97402	99534	108066	89538	118917
Fire permuting time (Hours.)*	25.48	26.04	25.78	25.26	23.42	28.84	21.09

**The interval of time required for baking anodes in the bake-oven for which norm is 19 hours.*

ii) It may be observed from the preceding table that fire-permuting time in baking furnace far exceeded the norm of 19 hours resulting in lower output of baked anodes.

iii) The life of bake oven flue walls was low due to poor quality of indigenous refractory bricks. Hence, FTA was engaged for considerable time in the flue wall changing.

iv) Butt cleaning was carried out manually leading to incomplete cleaning with the result that sodium level in the butts was unacceptably high. This high level of sodium in the anode damages the refractory linings in the bake oven. This ultimately affects the productivity of the bake oven plant.

Ministry stated (May 2000) that the capacity utilisation had since improved to about 90 per cent and firing cycle had also improved to about 20 hours. Despite improvement, as stated by the Ministry, the utilisation continued to be sub-optimal and the Company had to import 9375 nos. baked anodes at a total cost of Rs.41.83 crore to meet the requirement of operating pots during 1999-2000.

c) Anode Rodding Shop:

After the anodes are baked, these are rodded with cast iron for use in the potline. During the seven years ending March 2000, capacity utilisation of anode rodding shop ranged between 70 per cent (1998-99) and 90 per cent (1999-2000) of the installed capacity of 1,32,600 nos. rodded anodes. The shortfall in capacity utilisation was attributable to the fact that the layout of the rodding shop was designed on a single stream assembly line and in the event of any unscheduled stoppage of any production station, the shop would come to a standstill. There were other problems in anode bath and butt cleaning equipment and casting zone equipment that further restricted availability of rodding shop.

To improve the efficiency of the rodding shop, the Company undertook a debottlenecking scheme and installed (June 1996) additional equipment worth Rs.15.74 crore. Even after execution of the debottlenecking scheme, production of rodded anodes did not increase appreciably as would be evident from the following table:

Year	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2K
No. of anodes rodded	100253	96055	104820	109272	108787	92169	118824
Capacity (Nos.)	132600	132600	132600	132600	132600	132600	132600
Capacity utilisation (Percentage)	76	72	79	82	82	70	90

Due to lower capacity utilisation of the rodding shop, the Company had to get the anodes rodded through outside contractors at a cost of Rs.27 lakh (16267 nos.) in 1996-97 and Rs.22 lakh (13476 nos.) in 1997-98.

Management stated (December 1998) that debottlenecking of the rodding shop did not change the basic "single line" characteristics of the production cycle. It may be stated that the purpose of introducing debottlenecking scheme was frustrated as the same had failed to take care of the basic problem of single stream operation.

Ministry stated (May 2000) that now most of the constraints in the rodding shop had been removed and it was supplying as many rodded anodes as required to run all the 480 pots.

2.3.2.1 Import of Baked Anode:

Low capacity utilisation in the carbon plant forced the Company to import 31843 nos. of baked anode at a cost of Rs.116.16 crore during the seven years ended March 2000. Debottlenecking scheme in carbon area was completed in 1996-97. Even after introduction of debottlenecking scheme, the Company had incurred an additional expenditure of Rs.12.33 crore towards consumption of imported anodes (3810 nos.) in 1997-98, Rs.8.19 crore (1825 nos.) in 1998-99 and Rs.23.51 crore (5343 nos.) in 1999-2000. Management stated (December 1998) that the import of baked anode was inevitable to avoid production loss since anode production was inadequate to meet the requirement of potline due to mismatch of facilities in the plant.

Ministry stated (May 2000) that import of baked anode was necessary since Bake Ovens were shutdown for implementing debottlenecking. It was, however, observed that even after completion of debottlenecking in 1997-98, the import of baked anode continued due to persistent problems in the Carbon Plant.

2.3.2.2 Butt Crushing System:

In the butt crushing system the available carbon scraps in the form of spent carbon anodes (from potlines) and rejected anodes (from carbon plant) are recycled for use in making of anodes. The performance of butt crushing system for the seven years ended March 2000 is shown in the following table:

Year	Installed capacity (MT)	Butt crushed by Jaw crusher (MT)	Capacity utilisation (Percentage)	Butts crushed by other sources (MT)	Inventory of rejected anodes (MT)
1	2	3	4 (col. 3/2x100)	5	6
1993-94	46,200	12819	27.75	19636	31388
1994-95	46,200	11078	23.98	16053	36361
1995-96	46,200	12625	27.33	16365	40811
1996-97	46,200	22246	48.15	1913	55386
1997-98	46,200	16064	34.77	3503	73283
1998-99	46,200	20340	44.03	4690	87830
1999-2K	46,200	30490	66.00	11967	87383

It may be observed that butts crushed remained below the installed capacity (46200 MT) of the crusher. The capacity utilisation remained very low even though adequate butt rejects were available. The capacity utilisation was low due to frequent breakdown in the conveyor system and moving parts of the crusher as well as accumulation of uncrushable material between the deck plate and the jaw.

Due to under-utilisation of the crusher during the seven years ending March 2000, the Company had to get the butts crushed partly by contract workers at a total cost of Rs.40 lakh and partly by departmental labour (not quantifiable).

Use of CP coke in the anode paste plant can be substituted by recycled butts upto 35 per cent for production of paste anodes. The actual use of crushed butts as a substitute of CP coke for the seven years ending March 2000 is given below:

Year	Use of butts as a per cent of carbon per anode		Under-utilisation of recycled butts (compared to the maximum limit of 35 per cent)	Excess coke consumption	Average rate of CP coke	Value of inventory blocked up
	%	Qty. (MT)	(per cent)	(MT)	(Rs./MT)	(Rs. in crore)
1	2	3	4	5 (=3x4/2)	6	7 (=5x6)
1993-94	28.71	31245	6.29	6845	7071	4.84
1994-95	26.49	26682	8.51	8572	6135	5.26
1995-96	26.94	28883	8.06	8641	6221	5.38
1996-97	22.17	23479	12.83	13588	7275	9.88
1997-98	16.82	19184	18.18	20735	9054	18.77
1998-99	23.44	21221	11.56	10466	8765	9.17
1999-2K	33.96	44560	1.04	1365	6579	0.90
				70212		**54.20**

It may be seen from the preceding table that the use of butts was low at 28.71 per cent in the year 1993-94 and it continuously decreased to 16.82 per cent in 1997-98. There was an improvement from 1998-99 but it was still below the norm. The reason was mainly under-utilisation of the crusher. Under-utilisation of recycle butts resulted in higher consumption of CP coke and also progressive accumulation of inventory of butts to the extent of 87383 MT at the end of March 2000. The Company could have substituted 70212 MT CP coke with corresponding units of recycled butts and thereby avoided blocking up of funds to the extent of Rs.54.20 crore.

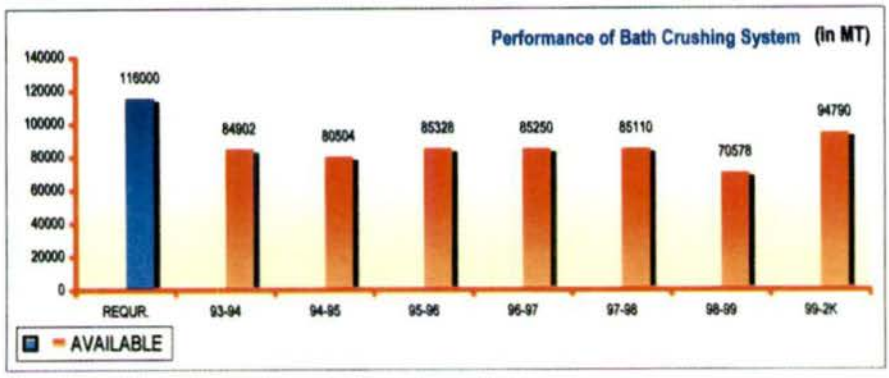
To increase the crushing facilities, one vertical jaw crusher (part of the debottlenecking scheme) with capacity of 70 TPH was installed (August 1996) at a total cost of Rs.7.75 crore with the object of improving the availability of the system which had come down due to frequent breakdown of conveyor system and the crusher jamming. Even after installation of the additional crusher, no significant improvement was noticed. The

feeding system of the crusher required further modification for direct manual feeding of butts from the old stock to increase the quantity of butts to be crushed, which was not envisaged in the debottlenecking scheme.

The Ministry accepted (May 2000) audit's contention.

2.3.2.3 Bath Crushing System:

Crushed bath is required to cover the anodes in the pots to prevent oxidisation of carbon anodes by air. The bath is collected from the pots along with returned butts (spent anode) for crushing. As per AP's original specification, 500 Kg of bath was required for covering each anode. However, as per revised specification (1989) of AP and as a result of Company's working experience the requirement of bath was fixed at 800 Kg for each anode. As such, annual requirement of crushed bath was also fixed at 1,16,000 MT to cover the anodes of all pots. The performance of the bath crushing system for the seven years ending March 2000 is summarised in the graph.



The maximum bath crushing in the last seven years was 94790 MT in 1999-2000. Thus, shortfall in supply of crushed bath led to inadequate covering of anodes resulting in pot instability, increased pot voltage, air burning of anode, pin exposure and fallen anodes.

To increase the bath crushing capacity, the Company installed (January 1997) a second impact crusher with rated capacity of 16 MT per hour at a total cost of Rs.10.91 crore. It was expected that about 315 MT of bath would be generated per day with 480 pots in operation. Since 480 pots could not be operated, generation of bath was inadequate to feed both the crushers. Apart from the above, bath availability was inadequate due to the fact that substantial amount of bath was trapped by butts which was not recovered or lost in the surroundings causing environmental pollution. Thus, the additional bath crushing facility could not be utilised purposefully due to non-availability of adequate bath and the crusher had to be retained as a standby.

Ministry stated (May 2000) that availability of bath from pots was a constraint since 480 pots were not operated. Bath crushing facility was now fully utilised and non-availability of bath was not experienced since 1998-99. Ministry's contention was not entirely tenable because the Company imported 1541.78 MT of crushed bath at a cost of Rs.4.48 crore during 1999-2000.

2.3.3 PERFORMANCE OF CAST HOUSE:

The original basic engineering data furnished by AP stipulated installation of 4 Ingot Casting Machines (ICMs). It was decided at the project implementation stage to replace two ICMs by two Wire Rod Mills (WRMs) with the object of realising higher price for wire rods compared to ingots. Based on the above decision the Company installed two ICM and two WRM having annual installed capacity of 1.18 lakh MT and 1 lakh MT respectively. Frequent breakdown of ICM and low market demand of wire rods caused problem of evacuating hot metal from smelter. To overcome the above problem, the Company installed (September 1994) billet casting facility having annual installed capacity of 0.30 lakh MT.

The performance of cast house is depicted in the following table:

Year	Hot Metal Available (MT)	Ingot Produced		Wire Rod Produced		Billet Produced		Sows Production (MT)	Total Production (MT)
		Installed Capacity (MT)	Actual Pro-Duction (MT)	Installed Capacity (MT)	Actual Pro-Duction (MT)	Installed Capacity (MT)	Actual Pro-Duction (MT)		
1993-94	196410	106880	90337	87500	36337	-	-	67658	194332
1994-95	180161	78465	76092	89165	43678	26750	5837	52465	178072
1995-96	193796	88000	88114	100000	50553	26750	8191	45430	192288
1996-97	207028	88000	83384	100000	55735	30000	12451	52253	203823
1997-98	202909	100000	75246	100000	43248	30000	10529	70869	200162
1998-99	147456	100000	53666	100000	30996	30000	6742	54332	146206
1999-2k	216925	100000	81871	100000	35932	30000	12179	81059	212663

Note: *1) Installed capacity is as indicated in the Annual Reports of the Company.*
2) Difference in total hot metal available and total production was due to process loss.
3) Total production included the production of busbar, anode stems, wedges and strip coils also.

As the problem of evacuating hot metal persisted even after installation of billet casting facility, the Company resorted to production of sow ingot outside cast house (i.e., in the smelter) by employing contract labour and incurred an expenditure of Rs.40.18 lakh during the seven years ending March 2000.

2.3.3.1 Performance of ICM & WRM :

There was a high incidence of breakdown/maintenance hours and idle time (see Annexure-VII) which led to shortfall in production. It would be further seen from the Annexure that in case of ICM the average rate of production per hour was also much lower compared to the rated capacity of 15 MT per hour. The average rate of production ranged between 10.50 (1998-99) to 12.10 MT (1995-96) per hour during the seven years ended March 2000. In case of WRM, the average rate of production per hour was showing a declining trend. Against the rated capacity of 9 MT per hour the actual average rate of production in WRM ranged between 7.56 MT per hour in 1993-94 and 4.92 MT per hour in 1999-2000.

Management stated (December 1998) that idle time and lower utilisation was the consequence of market forces and non-availability of appropriate metal quality.

Management further stated that attempts were being made to tackle the high incidence of breakdown and consequent maintenance problem.

Ministry agreed (May 2000) that scope existed to improve productivity, down-time, maintenance practices and proper planning of metal.

2.3.3.2 Excess Fuel Consumption in Cast House:

Due to lower capacity utilisation in ICM & WRM and inability of the furnace tending vehicle (FTV) to carry out refractory bricking and chiseling operations properly, consumption of oil in the furnaces of cast house had increased beyond the norm. This resulted in excess consumption of fuel oil of Rs.19.53 crore (Rs.6.72 crore in ICMs and Rs.12.81 crore in WRMs) during the seven years ending March 2000 as shown below:

Year	INGOT CASTING				WIRE ROD			
	Actual consu-mption (Lit/ MT)	Excess consumption over norm of 26 (Lit/MT)	Total excess consu-mption (KL)	Value of excess consum-ption (Rs. in lakh)	Actual consu-mption (Lit/ MT)	Excess consumption over norm of 35 (Lit/MT)	Total excess consu-mption (KL)	Value of excess consu-mption (Rs. in lakh)
93-94	34.84	8.84	798.58	46.30	99.36	64.36	2338.65	135.82
94-95	36.69	10.69	798.00	39.90	109.89	74.89	3271.00	163.55
95-96	38.10	12.10	1062.00	53.10	99.73	64.73	3272.00	163.60
96-97	38.11	12.11	1010.00	64.54	88.86	53.86	3002.00	191.83
97-98	46.20	20.20	1517.00	100.16	119.34	84.34	3648.00	240.88
98-99	77.26	51.26	2750.92	169.84	157.91	122.91	3809.70	235.21
99-2k	56.10	30.10	2464.32	198.03	87.07	52.07	1870.98	150.35
				671.87				**1281.24**

The Company had refixed the oil consumption norm per MT of metal of ingot casting machine and wire rod mill as 35 & 95 litres against the original norm of 26 & 35 litres respectively. Management stated (February 1999) that the norm was refixed on the basis of experience and technical constraints viz., aging of equipment, idle time etc. It was, however, observed that no technical evaluation by a committee of experts was made to refix the norm.

Ministry noted (May 2000) the audit observation and agreed to make a technical reevaluation to improve the situation.

2.3.4 DOWNSTREAM PROJECTS:

2.3.4.1 Billet Casting Plant:

A review of the performance of the billet casting plant (refer table at para – 2.3.3) indicated that the capacity utilisation was low. Apart from low capacity utilisation, there were problems in quality of the product leading to customer dissatisfaction. To improve the quality and marketability of the product, the Management decided (May 1995) to install an additional homogenising furnace and degassing unit at a total cost of Rs.7.15

crore. Both the additional homogenising furnace and degassing unit were under "trial run" as stated (September 1999) by the Management.

The Ministry stated (May 2000) that the erection and commissioning trials of homogenising furnace and degassing unit was in progress.

2.3.4.2 Strip Caster Project:

The Company finalised (November 1994) the proposal for a strip caster project with the capacity to produce 26000 MTPY (stream I&II) at an estimated cost of Rs.47.95 crore, which was subsequently revised (December 1997) to Rs.76.43 crore. The strip caster project (stream I) was commissioned in September 1998 at a cost of Rs.53.99 crore and the operation was suspended after 24 days of commissioning. Management stated (December 1998) that the caster had been temporarily suspended due to certain teething problem as well as manufacturing defect of the shells. The plant was again put to use in February 1999. However, it was observed that the viability of the project was doubtful due to the following reasons:

i) There were very few buyers in India, viz. Sterlite Industries, BALCO & Pennar Aluminium Company (PALCO). The strip caster project was conceived assuming that the entire production of the project could be sold to these Companies. Since then BALCO and PALCO had set up their own casters. The marketing prospect in the domestic front was therefore, not very much encouraging.

ii) Originally, it was planned to import the caster machinery under EPCG license with zero customs duty considering a saving of around Rs.6 crore. But when the vessel carrying the strip casting machinery arrived at Calcutta port (November 1997), the Company changed their stand and shifted from EPCG to Open General Licence (OGL). The Company, thereafter, paid Rs.7 crore as customs duty and got the strip caster machinery cleared from customs. The above decision of shifting from EPCG to OGL was taken in view of the fact that the Company's own marketing department expressed their inability to export strip product. Thus, the Company itself was not confident about its ability to export the rolled product.

Thus, it may be concluded that inspite of recommendation (November 1997) of MECON that the project would be viable by import under OGL, the strip caster project may not prove to be economically viable.

Ministry stated (May 2000) that there was sufficient demand for cast strips and the project would be viable at break-even capacity of 58.50 per cent and pre-tax internal rate of return (IRR) would be 20.58 per cent. However, the production of strip coils had not yet stabilised (June 2000) even after 21 months of commissioning of the plant. During 1999-2000, the Company produced 625 MT (capacity utilisation 4.81 per cent) of strip coil against target of 5000 MT (installed capacity 13000 MTPY of stream-1), which was much below the break-even point. Production at such low level cast doubts over the marketability of the product.

2.3.5 DEBOTTLENECKING OF THE SMELTER:

After commissioning of smelter plant in 1987, the Company could never operate all 480 pots at any point of time till February 2000 (480 pots were operated on 26 March 2000 for the first time). This was mainly due to problems in carbon area (refer para: 2.3.2), cast house (refer para: 2.3.3) and operational problem in potlines (refer para: 2.3.1). To remove these obstacles and to augment production from 2.18 lakh MT to 2.30 lakh MT of metal per annum, the Company decided (July 1993) to undertake a debottlenecking scheme at an estimated cost of Rs.44.80 crore. An annual benefit of Rs.43.63 crore was expected with the implementation of this scheme. The scheme was completed in a phased manner from June 1995 to January 1997 at a cost of Rs.45.77 crore. However, after completion of debottlenecking scheme, the production of metal in fact decreased from 203823 MT (1996-97) to 200162 MT in 1997-98 and to 146206 MT in 1998-99 against the projection of 230000 MT. The average number of pots in operation also decreased from 435 pots (1996-97) to 328 pots (1998-99). As such the debottlenecking scheme did not yield the desired results and consumption of inputs increased as detailed hereunder:

i) Debottlenecking in butt crushing facility was expected to increase availability of crushed butts by 22,000 MT per annum yielding a saving of Rs.9.80 crore per year. However, availability of crushed butts increased by only 17865 MT i.e. from 12625 MT in 1995-96 to 30490 MT in 1999-2000. (refer para 2.3.2.2).

ii) Debottlenecking in bath crushing facility for anode covering was expected to yield an annual benefit of Rs.9.42 crore by increasing availability of crushed bath, pot stability and lower consumption of aluminium fluoride. However, there was no improvement in availability of crushed bath, which was 70578 MT in 1998-99 against 85328 MT in 1995-96 (refer para: 2.3.2.3). Excess consumption of aluminium fluoride over norm was Rs.7.38 crore in 1997-98, Rs.8.11 crore in 1998-99 and Rs.4.66 crore in 1999-2000 compared to Rs.6.34 crore in 1996-97.[refer para: 2.3.1(iv) & Annexure-V]

iii) Installation of 3rd FTA in bake oven plant was expected to make it possible to increase the number of pots in operation beyond 425 yielding a benefit of Rs.9.75 crore per year by increase in production of hot metal by 27000 MT and consequent increase in contribution margin. However, the average number of pots in operation did not improve appreciably till March 2000. Production of hot metal also showed an erratic trend. It increased by 9113 MT from 193796 MT in 1995-96 to 202909 MT in 1997-98. The year 1998-99 saw a decline to 147455 MT but production increased once again in 1999-2000 to 216925 MT. [refer para: 2.3.2(b) & 2.3.3 (table)].

iv) Debottlenecking in rodding shop was expected to yield a benefit of Rs.9.81 crore by increase in availability of rodded anodes to 121000 nos. by increase in metal production and improvement in metal purity. However, there was no improvement in availability of rodded anodes and the quality of metal during 1997-98 & 1998-99 [refer para: 2.3.2(c) & 2.3.1(vi)].

v) Excess consumption of fuel oil over and above the norm worked out to Rs.3.41 crore in 1997-98 and Rs.4.05 crore in 1998-99 and Rs. 3.48 crore in 1999-2000 compared to Rs.2.56 crore in 1996-97 (refer para: 2.3.3.2).

vi) The overtime wages increased from Rs.3.88 crore (33.16 per cent of wages) in 1996-97 to Rs.4.46 crore (34.32 per cent of wages) in 1997-98, Rs.4.84 crore (31.99 per cent) in 1998-99 and Rs.5.41 crore (33.24 per cent) in 1999-2000.

Thus, the debottlenecking scheme, which was expected to generate an annual benefit of Rs.43.63 crore did not give the necessary fillip to production since it did not increase productivity as envisaged. Management stated (January 1999) that several efforts were made to run more pots that could be sustained for short period but could not be maintained due to inadequate availability of inputs (anode).

The requirement of carbon plant had not been adequately met even after completion of debottlenecking scheme. Therefore, the debottlenecking scheme was not comprehensive since operational problems were not addressed in an appropriate manner at the time of implementing the debottlenecking program.

Ministry stated (May 2000) that the performances of different operations in these divisions had started showing better results and the Company was now operating all the 480 pots. It was observed that Management operated all the 480 pots on 26 March 2000, but during 1999-2000 the average number of pots in operation was 444, which was below the capacity of 480 pots. The above improvement was not attributable to proper implementation of debottlenecking scheme, but to import of inputs, viz. crushed bath and anode involving additional cost as is evident from the following table:

Year	Import of baked anode		Import of crushed cryolite bath	
	Qty(Nos)	Value(Rs.in crore)	Qty(MT)	Value(Rs. in crore)
1997-98	2006	6.02	-	-
1998-99	2006	7.88	-	-
1999-2K	9375	41.83	1541.78	4.48
Total	**13387**	**55.73**	**1541.78**	**4.48**

Management stated (June 2000) that a combination of various efforts simultaneously contributed to the success and the entire activity became self-propelling. It was, however, observed that the Company had not documented, for future guidance, the measures taken to arrest the occurrence of the factors that were responsible for poor performance of the smelter. While admitting that all the measures were not documented, the Management agreed (June 2000) in principle to the justification warranting such complete documentation.

2.3.6 CAPTIVE POWER PLANT

2.3.6.1 Capacity Utilisation:

The Company installed six (6 x 120 MW) captive power plants (CPP) in two phases – the first five units being installed between April 1987 to June 1990 and the 6th unit coming

on stream in August 1994. The table below indicates the installed capacity, actual generation and plant load factor (PLF) for the six years ending March 2000:

Year	Installed capacity (on the basis of six uints of 120 MW each) (MU)	Generation feasible w.r.t. actual hours utilised (M.U.)	Actual generation (M.U.)	Percentage of generation feasible to installed capacity (%)	Percentage of actual generation to installed capacity (PLF)	Percentage of actual generation to generation feasible (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1993-94	5256.00	4329.59	4144.57	82.37	78.85	95.73
1994-95	5630.50	4673.17	4405.04	83.00	78.24	94.26
1995-96	6324.48	4865.01	4620.77	76.92	73.06	94.98
1996-97	6307.20	4891.28	4654.39	77.55	73.79	95.16
1997-98	6307.20	4942.49	4389.69	78.36	69.60	88.82
1998-99	6307.20	4553.25	4036.46	72.19	64.00	88.65
1999-2k	6307.20	5032.70	4469.19	79.79	70.86	88.80

The actual generation ranged between 64 per cent (1998-99) and 78.85 per cent (1993-94) of the installed capacity during the period 1993-94 to 1999-2000.

With the commissioning of 6th unit (August 1994), the overall capacity utilisation decreased. In fact, one unit had to be shutdown in rotation in view of operation of lesser number of pots in smelter plant. Management stated (December 1998) that one unit remained shutdown in rotation under statutory provision for annual preventive maintenance required for Boiler/Turbines. Fact, however, remained that the actual power generation was lower than the maximum feasible generation, even after taking into account the requirement of shut down of one unit by rotation, during the seven years ended March 2000. Frequent power outages in 1998 resulted in a major set back in the smelter plant.

The Company also could not tap any alternative source till date (June 2000) to sell its surplus power to customers other than GRIDCO. Ministry stated (May 2000) that the State Government Rules did not permit NALCO to sell power to a third party other than State Grid.

2.3.6.2 Auxiliary Consumption of Power :-

The table below indicates that actual auxiliary consumption of power increased from 9.75 per cent in 1993-94 to 11.09 per cent in 1997-98 and exceeded the norm of 9.5 per cent during all the 7 years ending March 2000:

Year	Actual generation (MU)	Percentage of actual auxiliary consumption to generation (%)	Excess consumption over norm of 9.5 per cent (%)	Total excess consu-mption (MU)	Sale price/ Kwh (Rs.)	Loss of revenue (Rs. in lakh)
1993-94	4144.57	9.75	0.25	10.36	0.70	72.52
1994-95	4405.04	9.67	0.17	7.49	0.79	59.17
1995-96	4620.77	10.26	0.76	35.12	0.82	287.98
1996-97	4654.39	10.03	0.53	24.67	0.84	207.23
1997-98	4389.69	11.09	1.59	69.80	0.90	628.20
1998-99	4036.46	10.59	1.09	44.08	0.91	401.11
1999-2K	4469.19	10.36	0.86	38.44	0.93	357.49
					TOTAL	**2013.70**

The percentage of auxiliary consumption was more than the norm in all the 7 years resulting in loss of revenue to the tune of Rs.20.14 crore. This was primarily due to under-utilisation of installed capacity.

Management stated (December 1998) that auxiliary consumption in 1997-98 was higher due to inclusion of power transmitted to intake pump house. The contention of the Management was not tenable in view of the fact that auxiliary consumption in 1998-99 did not include power consumed in intake pump house and still remained much higher than the norm.

2.3.6.3 Failure To Avail Concessional Excise Duty:

The Company had placed an order on Bharat Heavy Electricals Limited (BHEL) on April 1990 for design, manufacture, despatch of equipment, erection and commissioning of boiler components, turbine generator (TG) set, electro-static precipitator (ESP), piping etc. at a total cost of Rs.107.23 crore. Of this the value of pollution control equipment (viz., ESP, piping etc.) was Rs.6.78 crore on which a concessional rate of duty @ 5 per cent was available. Because of incorrect classification, excise duty on this part of the supply was levied at a rate of 15.75 per cent to 17.25 per cent upto February 1993. As the Company failed to avail of concessional duty it had to incur an avoidable expenditure of Rs.78 lakh by way of payment of excess central excise duty.

Ministry conceded (May 2000) that the lapse had resulted in the Company paying higher duty.

Chapter 3 : Marketing and Sales Performance

The Company had an installed capacity to produce 8 lakh MT alumina annually, out of which 3.75 lakh MT was earmarked for export and the balance 4.25 lakh MT was to be transferred to the smelter plant for production of 2.18 lakh MT aluminium.

3.1 Marketing of alumina:

The year-wise export of alumina vis-à-vis target fixed by the Company for the seven years ended March 2000 is shown below:

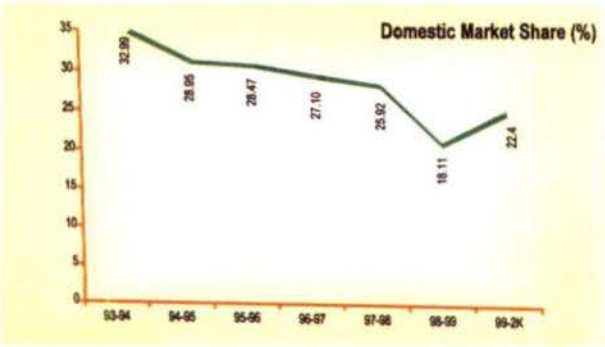
(In MT)

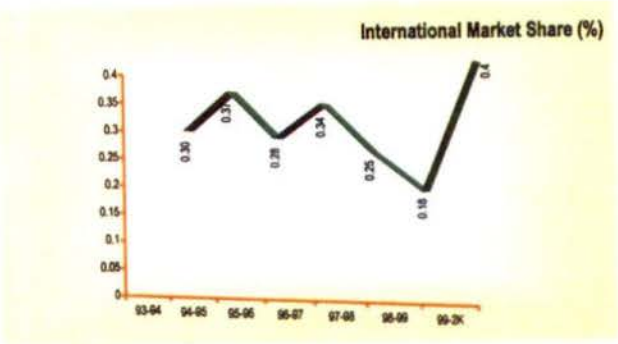
Year	Target of export	Actual export
1993-94	4,20,000	3,71,286
1994-95	4,00,000	4,07,405
1995-96	4,00,000	4,15,209
1996-97	4,00,000	4,65,139
1997-98	4,30,000	4,79,801
1998-99	4,25,000	6,10,940
1999-2K	4,83,000	4,79,620

It could be observed that the target fixed for export was higher than the quantity (3.75 lakh MT) earmarked in the feasibility report, whereas the actual export exceeded even the target in all the years excepting 1993-94. The higher export of alumina was a direct consequence of low intake of alumina in smelter plant due to persistent pot problems. There was no domestic market for alumina as such.

3.2 Marketing of aluminium:

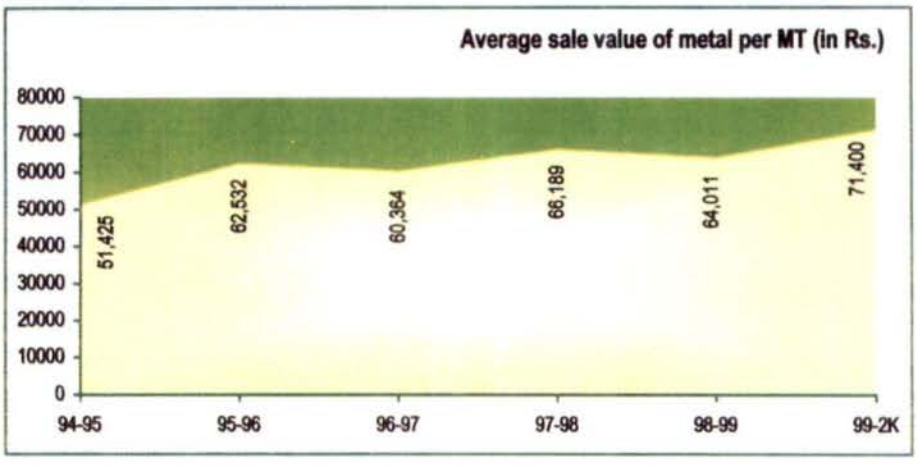
The percentage of Company's share in the domestic market as well as export market during the seven years ended March 2000 is depicted in the following graph.





It would be evident that the Company's share in both domestic market as well as international market showed a declining trend. This was due to lower metal production because of persistent problems in smelter. This compelled the Company to divert the surplus alumina to the export market. Lower margin in alumina compared to metal had resulted in loss of contribution to the extent of Rs.255.91 crore during the five years ended March 2000 (para 2.3.1 refer).

The average sales realisation per MT of metal during the six years ended March 2000 are depicted in the graph. It was observed that the Company had laid greater emphasis on primary products (sow ingot, ingots & wire rod) with low margin instead of high value added secondary products (wheel, sheet, coil etc.). Management stated (January 1999) that initially the Government policy was that the public sector should concentrate on production of primary metal to combat the shortage of primary product in the country. After liberalisation, the above notion had changed gradually over the years and the Company had undertaken various projects for value added products. The rationale for giving more emphasis on production of primary metal instead of secondary metal when there was shortage of both primary as well as secondary metal in the country remained unexplained.



Ministry stated (May 2000) that foreign exchange saving was an important objective at that time and while the Company's Smelter capacity was limited, it exported the surplus alumina to earn valuable foreign exchange. The facts remains that due to underutilisation of the existing capacity of the smelter plant, the Company had to divert the surplus alumina (which could have been consumed in the Smelter to produce metal) to the export market and thereby sustained a potential loss of contribution of Rs.255.91 crore during 5 years ending March 2000 (para 2.3.1 refer).

3.3 Sundry Debtors and Turnover :

The position of outstanding debts for the seven years ending March 2000 is given below:

(Rs. in crore)

Details	As on 31.03.94	As on 31.03.95	As on 31.03.96	As on 31.03.97	As on 31.03.98	As on 31.03.99	As on 31.03.2000
a) Domestic	138	89	159	212	222	147	156
b) Export	54	25	50	32	27	70	51
c) OSEB/ GRIDCO	69	77	93	102	115	119	149
Total	261	191	302	346	364	336	356

The outstanding debts representing number of days sales is shown below:

Year	Debts outstanding at the end of the year (Rs. in crore)	Sales during the period (Rs. in crore)	Debts representing no. of days of sales
1993-94	261	1207	79
1994-95	191	1478	47
1995-96	302	1746	63
1996-97	346	1781	71
1997-98	364	1863	72
1998-99	336	1585	77
1999-2K	356	2233	58

The outstanding debtors in terms of number of days' sales were high and showed an upward trend from 1994-95 excepting in the year 1999-2000.

Ministry stated (May 2000) that the outstanding debts were high because of outstanding dues with GRIDCO and the Ministry had taken up the matter with the Government of Orissa.

3.4 The review of marketing performance of the Company highlighted the following irregularities:

i) Non-recovery of dues amounting to Rs.34.40 crore:

An agreement was signed (October 1993) between the Company and Pennar Aluminium Company Limited (PALCO) for sale of aluminium metal. PALCO was given the status of preferred customer as it agreed to lift more than 1000 MT per month and was allowed interest free unlimited credit without any financial security. Subsequently, M/s Pennar Profiles, a sister concern of PALCO, was also given preferential status (March 1994) without assessing the credit worthiness of the customer.

Supply of material started from 1994-95 but within a year both companies had defaulted several times in making the payments. Though, it was decided (November 1995) to withdraw the preferential status of the customer, it was again decided (April 1996) to resume supplies to the group only against letter of credit (LC). The Company resumed supply (May 1996) to the sister concern only on clean credit basis in view of their relatively steady payment compared to PALCO. Though discount offered earlier to the group was based on combined offtake of metal, the decision to resume supply on the basis of single entity appeared to be incompatible and, therefore, indicated an undue benefit to the customer.

The supply was again resumed (January 1997) to the Pennar group without LC and the Company supplied 5850 MT metal till March 1997 on the plea that there was no overdue debt by the group at that point of time. As a result of bulk offtake in a short period (between January 1997 to March 1997), there was a huge accumulation of overdue debt of Rs.34.40 crore which could not be realised till date (June 2000). The Company made a provision for the doubtful recovery of dues of Rs.34.40 crore in the annual accounts of 1999-2000. Thus, undue favour granted to a defaulting customer at the cost of the Company's interest resulted in blocking up of fund of Rs.34.40 crore.

ii) Loss of Rs.5.24 crore due to lacuna in export contract:

Lyong Heung Trading Co. LTD. (LHTC) a firm in Macau had been procuring alumina from NALCO since 1989. As per the MOU signed in December 1992 between LHTC and NALCO, LHTC was to lift 32,000 MT of calcined alumina in four equal shipments between March 1993 and January 1994 at a price of US $ 173.50 per MT. The purchaser did not lift any alumina after initial lifting of 16,000 MT. In the absence of a penalty clause in MOU, the Company could not take any action against LHTC and had to enter into a second MOU in December 1993 with the condition that LHTC would lift the balance quantity of 16,000 MT against the old MOU and an additional 22,000 MT during 1994-95 at a premium of 13.95 per cent of LME cash settlement price (average of month prior to the month of shipment). The second MOU also did not include any penalty

clause. As LHTC did not lift any alumina even against the second MOU, NALCO had to dispose of the stock on spot sale basis incurring a loss of Rs.5.24 crore. The two contracts were cancelled in May 1995.

However, in a further contract entered into with LHTC in November 1995, the penalty clause in case of failure in lifting alumina was re-instated. Out of contracted quantity of 24,000 MT, LHTC lifted only 8368 MT. The Company invoked the arbitration clause towards its claim of US $ 1.92 million for breach of contract. The matter regarding appointment of arbitrator was pending with Hon'ble Supreme Court.

Management stated (June 1997) that no legal action was taken earlier in view of the long-term relationship with North Korean buyer (LHTC), legal process being costly and time consuming and expected higher sales realisation on new contract as agreed in meeting held in July 1995. It was, however, observed that the expectation regarding higher sales realisation on future contracts had not materialised till date (June 2000).

Ministry stated (May 2000) that arbitration proceedings had been initiated against M/s LHTC.

Chapter 4 : Financial Performance

4.1 Financial position of the Company during the seven years ended March 1999-2000 is given below:-

(Rs.in crore)

Sources of Funds	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2k
A) Paid-up Capital	1288.62	1288.62	1288.62	1288.62	1288.62	644.31	644.31
B) Reserves & Surplus							
i) Free reserves	503.12	540.40	1109.86	1488.22	1893.44	2189.93	2554.92
ii) Committed reserves	-	198.46	198.46	199.06	199.74	1.24	1.27
C) Borrowings :							
i) From consortium of international bank	2321.54	1774.28	1024.91	580.00	594.10	-	
ii) Other Borrowing (incld. Cash credit & Export packing credit)	-	-	-	-	-	643.58	663.54
D) Current Liabilities & Provisions.	249.71	302.65	228.48	320.41	361.52	414.43	493.02
Total	4362.99	4104.42	3850.33	3876.30	4337.42	3893.49	4357.06
Application of Funds							
E) Gross Block	4168.75	4525.32	4649.04	4688.48	4771.67	4883.36	5037.81
F) Depreciation	1157.44	1433.74	1700.84	1957.93	2226.32	2503.91	2785.82
G) Net Block (e-f)	3011.31	3091.58	2948.20	2730.55	2545.35	2379.45	2251.99
H) Capital work-in-progress	292.01	92.65	63.16	98.95	189.31	379.68	939.77
I) Misc. Expenditure to the extent not Written off	27.71	21.81	7.65	5.37	4.68	-	
J) Investments	97.76	29.28	20.50	31.50	43.91	84.92	154.29
K) Current Assets,Loans & Advances	1022.20	869.10	810.82	1009.94	1554.17	1049.44	1011.01
Total	4362.99	4104.42	3850.33	3876.30	4337.42	3893.49	4357.06
L) Working capital (K-D)	772.49	566.45	582.34	689.53	1192.65	635.01	517.99
M)Capital Employed (G+L)	3783.79	3658.03	3530.54	3420.08	3738.00	3014.96	2769.98
N) Net Worth [A+B(i)-I]	1764.04	1807.21	2390.83	2771.47	3177.38	2834.24	3199.23
O) Debt-Equity Ratio	1.31:1	0.98:1	0.43:1	0.21:1	0.19:1	0.23:1	0.20:1

Debt-Equity ratio of 1.31:1 in 1993-94 came down to 0.19:1 in 1997-98 due to repayment of borrowing and increase in free reserves. However, the debt-equity ratio went up to

0.23:1 in 1998-99 on account of restructuring of equity base by converting 50 per cent of share capital to 14.5 per cent non-convertible redeemable debentures.

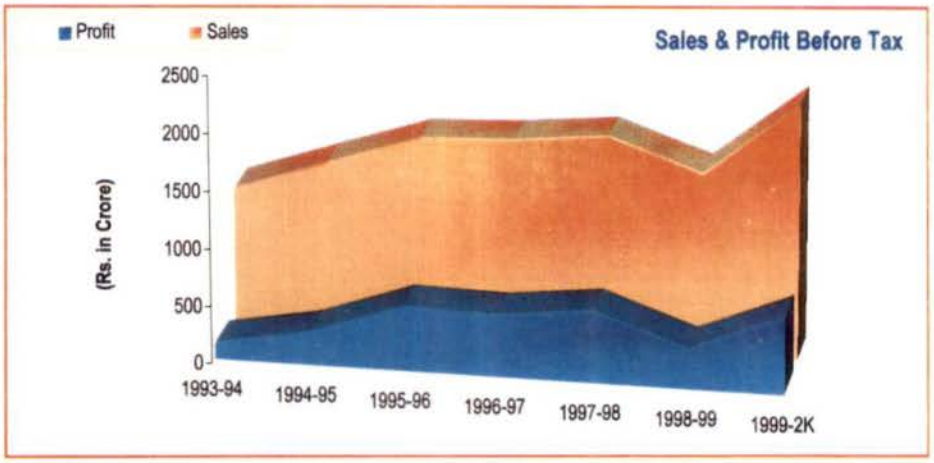
4.2 Working Results :

The working results of the Company as a whole for the last seven years are given in the following table:

(Rs. in crore)

		1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2K
1	Sale (incl. excise duty)	1206.77	1478.98	1745.59	1781.84	1863.80	1585.75	2233.82
2	Profit for the year	136.00	279.23	558.10	538.19	626.13	344.16	674.41
3	Extra ordinary Income	-	-	79.29	-	-	-	
4	Profit before prior period adjustment	136	279.23	637.39	538.19	626.13	344.16	674.41
5	Prior period expenditure (-)/ income	20.72	20.94	(22.82)	17.72	(0.70)	(6.94)	6.59
6	Provision for taxation	-	-	0.01	64.15	78.46	88.97	169.47
7.	Profit after tax	156.72	300.17	614.56	491.76	546.97	248.25	511.53
8	Earning per share **(Rs.)**	1.22	2.33	4.77	3.82	4.24	3.85	7.94
9	Net worth per rupee of paid-up capital **(Rs.)**	1.37	1.40	1.86	2.15	2.47	4.40	4.97
10	Percentage of Profit after tax to -							
	i) Capital employed	4.14 %	8.21 %	17.41 %	14.38 %	14.63 %	8.24 %	18.47 %
	ii) Sales	12.99 %	20.30 %	35.20 %	27.60 %	29.35 %	15.66 %	22.90 %
	iii) Net worth	8.87 %	16.61 %	25.70 %	17.74 %	17.21 %	8.76 %	16.00 %

The net profit of the Company jumped from Rs.156.72 crore during 1993-94 to Rs.614.56 crore during 1995-96 due to increase in sales realisation and write back of provision (Rs.79.29 crore) for relining expenses by changing the Company's accounting policy. Thereafter, the profit declined to Rs.491.75 crore during 1996-97 and to Rs.546.97 crore during 1997-98 mainly due to introduction of minimum alternate tax (MAT). Further, the profit declined to Rs.248.25 crore in 1998-99 due to lower volume of aluminium production and lower average sales price realisation. However, profit increased to Rs.511.53 crore in 1999-2000 on account of higher volume of aluminium production and better average sales price realisation. The total sale value and the profit for the seven years ending March 2000 are depicted in the graph.



4.3 Costing System:

The Company had adopted process costing for determining the cost of its major products, viz., bauxite, alumina, power and aluminium. Bauxite mines, alumina refinery, captive power plant and aluminium smelter were regarded as major cost centre for this purpose. Budgeted cost sheet was prepared for each year based on the estimated production target.

The normal process losses formed part of cost of production whereas abnormal process losses were reflected separately in the reconciliation between costing and financial profit & loss accounts. Cost sheet was prepared every year but standard costing system had not yet been introduced to identify the controllable factors. Abnormal loss was not analysed to work out the impact of each abnormal feature like stoppage of work due to industrial unrest or breakdown of equipment.

Management stated (May 1997) that the budgeted cost determined prior to the commencement of the year served as the standard cost against which various analysis were made. It was, however, observed that budgeted costs were determined on the basis of the past data without any scientific analysis to determine the optimal cost (standard cost) towards labour, material and overheads. Therefore, budgeted costs adopted by the Company could not serve as standard costs. Management further stated that in a process plant, the breakdown of equipment could arise on account of several factors working simultaneously, it was, therefore, not possible to determine the impact of abnormal features like stoppage of work on account of industrial unrest or breakdown of equipment separately. But the fact remains that in the absence of the standard costs, controllable factors and their impact were not properly identifiable.

4.4 Internal Audit:

The internal audit set up of the Company was decentralised with each unit having a separate cell. The audit units were under the administrative control of the head of the unit and functioned under the control of General Manager (Finance). In terms of Internal

Audit Manual of the Company, the internal audit team was to work to a plan and time bound program duly approved by Director (Finance) and Chairman-cum-Managing Director and all major points arising out of the internal audit report were to be communicated to Director (Finance).

The strength of Internal Audit Wing as on June 1998 was as follows:

Unit	Officers	Audit Assistants/ Accountants
Corporate Office	2	Nil
Smelter & Power Complex	3	1
Mines & Refinery Complex	2	Nil
Total	**7**	**1**

It emerges from the above that as against 7 officers, there was only one assistant in the Internal Audit Wing spread over three units. With this depleted strength the audit work was limited to checking of tenders, purchase orders, equipment utilisation, advances and other establishment audit etc. No appraisal or review regarding soundness, adequacy, effectiveness and application etc. of the internal control systems as laid down in the Internal Audit Manual had been prepared by this wing.

Management stated (December 1998) that Internal Audit was playing an important role in not only auditing various aspects i.e. purchase & sales contract etc., but also in the area of operational efficiency of various units and that the manpower of audit wing was being reviewed from time to time for reinforcement.

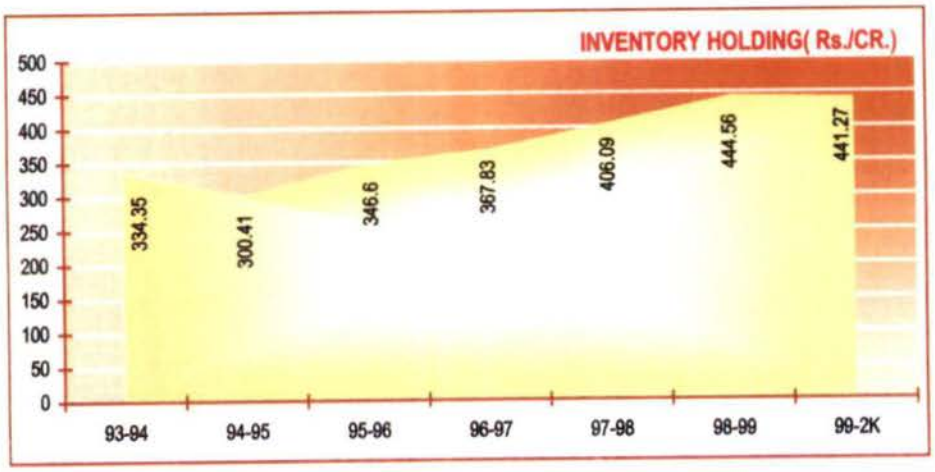
Ministry stated (May 2000) that the Internal Audit Department had since been strengthened to 13, which was considered adequate.

Chapter 5 : Inventory Management

Computerised inventory management in the Company became functional in April 1987 (in Smelter in February 1987). But the Company had not yet prepared the comprehensive manual on material management. The Management stated (October 1997) that the draft stores manual was in the advance stage of scrutiny and compiled report was expected to be put up to Board shortly. However the manual had not yet been finalised (September 2000).

5.1 Inventory Holdings:

The following graph indicates the overall inventory status of the Company during the period from 1993-94 to 1999-2000. The overall inventory accumulation had been substantially high during the last seven years. The inventory accumulation reached a very high level in 1999-2000.



The Management attributed (January 1999) the following reasons for high level of inventory:

1) Aging of the plant & equipment, which were installed 10-12 years ago.

2) The increased frequency of replacement.

3) General inflation.

4) Depreciation of Indian Rupee vis-à-vis foreign currencies in case of equipment of imported origin.

A further analysis in audit of stock of stores & spares showed that inventory holding of stores & spares was significantly high and actual holding of stock in terms of month's

consumption ranged between 18.29 (1998-99) and 36.90 (1993-94) as detailed below:

Year	Consumption during the year (Rs. in crore)	Closing stock (Rs. in crore)	Stock in terms of no. of month's consumption
1993-94	59.88	184.17	36.90
1994-95	79.57	200.60	30.26
1995-96	114.05	225.60	23.75
1996-97	128.27	225.20	21.07
1997-98	115.44	232.12	24.13
1998-99	149.41	227.72	18.29
1999-2K	137.60	211.39	18.44

The Company had not fixed any level of stock holding. Absence of a well considered level of stock holding led to procurement of stores and spares on an adhoc basis and consequent high level of stock holding.

Ministry stated (May 2000) that a norm of 14 to 17 months' consumption had since been fixed for stock holding of imported and indigenous spares.

5.2 Non-moving Inventory :

The position of stores and spares not moving for more than 3 years compared to the total stores and spares at the end of year from 1993-94 to 1999-2000 is indicated below:

(Rs. in crore)

As on 31 March	Value of Inventory of stores & spares	Value of non-moving stores & spares for more than three years	Percentage (%) of non-moving inventory to total inventory
1994	184.17	30.67	16.65
1995	200.60	47.11	23.48
1996	225.60	52.25	23.16
1997	225.20	64.22	28.52
1998	232.12	70.70	30.46
1999	227.72	57.67	25.32
2000	211.39	60.57	28.65

It may be observed from above that the value of non-moving items was showing an increasing trend and it had doubled during the last 7 years. The Management stated (December 1998) that the main reason for increase in non-moving items was technological development. The Management further stated that constant efforts were being made to dispose of these items and that they were also reviewing the position of alternative uses of these items. However, the non-moving items were still high and increasing continuously. The reduction in value of the non-moving items in 1998-99 and 1999-2000 was due to the fact that the Company had written off the stores & spares valuing Rs.51.51 crore in the books of accounts during the two years ending March 2000.

Chapter 6 : Other Topics of Interest

6.1 Extra financial burden of Rs.40.60 lakh due to delay in obtaining board's approval:

As per a decision taken in CMD's monthly review meeting (16 February 1996), the Company invited offers for supply of 20 BTCS wagons for transportation of caustic soda from Vizag. Braithwaite & Co. Ltd. and Burn Standard & Co. Ltd. submitted their offers on 4 March 1996 and 8 April 1996 respectively. Their offers were valid upto 23 May 1996 and 8 June 1996 respectively. Both the offers were found to be technically acceptable.

But when a proposal for purchase of 15 BTCS wagons was placed before the Board on 12 April 1996 it did not mention that offers from two parties for 20 BTCS wagons had already been received. Without apparent knowledge of the above facts, the Board accorded its approval for floating of tenders and resubmission of the case to them before placing order.

On 13 August 1996, the Management placed the complete facts of the case including the offers prior to Board's approval on 12 April 1996. By July 1996 validity period of both the offers had expired and the lowest offer of Braithwaite & Co. Ltd. had gone up from Rs.15,83,630 to Rs.17,46,300 per wagon. The Board approved (August 1996) the purchase proposal of 20 BTCS wagons from the lowest tenderer (viz. Braithwaite & Co. Ltd.) @ Rs.17,46,300 per wagon.

Failure of the Management to bring the complete case to the notice of the Board in its meeting on 12 April 1996 led to unnecessary re-tendering and the Company lost the chance of placing orders for wagons at a lower price with reference to earlier offer. This resulted in an extra financial liability of Rs.40.60 lakh on the Company.

Ministry admitted (May 2000) the omission.

6.2 Grant/Donation to various Institutions:-

(i) The Board of Directors approved (November 1996), the creation of a chair in the name of the Company in the Management Development Institute (MDI), Gurgaon and kept (October 1997) an amount of Rs.20 lakh in fixed deposit with SBI. Interest @ 10.5 per cent per annum earned from the above deposit was to be utilised for meeting the salary and other expenditure for the chair.

The above proposal was routed through Human Resource Development (HRD) Department headed by Director (P&A) who subsequently joined the said Institution after retirement (September 1997) from NALCO. Thus, it appeared

that such investment was made for the benefit of a retired executive (who took part in the decision making process) at the cost of the Company's interest.

(ii) The Company approved (April 1997) a donation of Rs.20 lakh for construction of a sports complex at Mangaldai, Assam with the object of promoting sports in the North-East Region. It was also decided that the donated amount would be payable in instalments after assessing the progress made from time to time. But without assessing the actual progress of the sports complex, the Company had already remitted Rs.15 lakh. It may be observed that though the Board approved the decision for donation to MDI, the Company had not sought approval of the Board for donation to sports complex at Mangaldai, Assam.

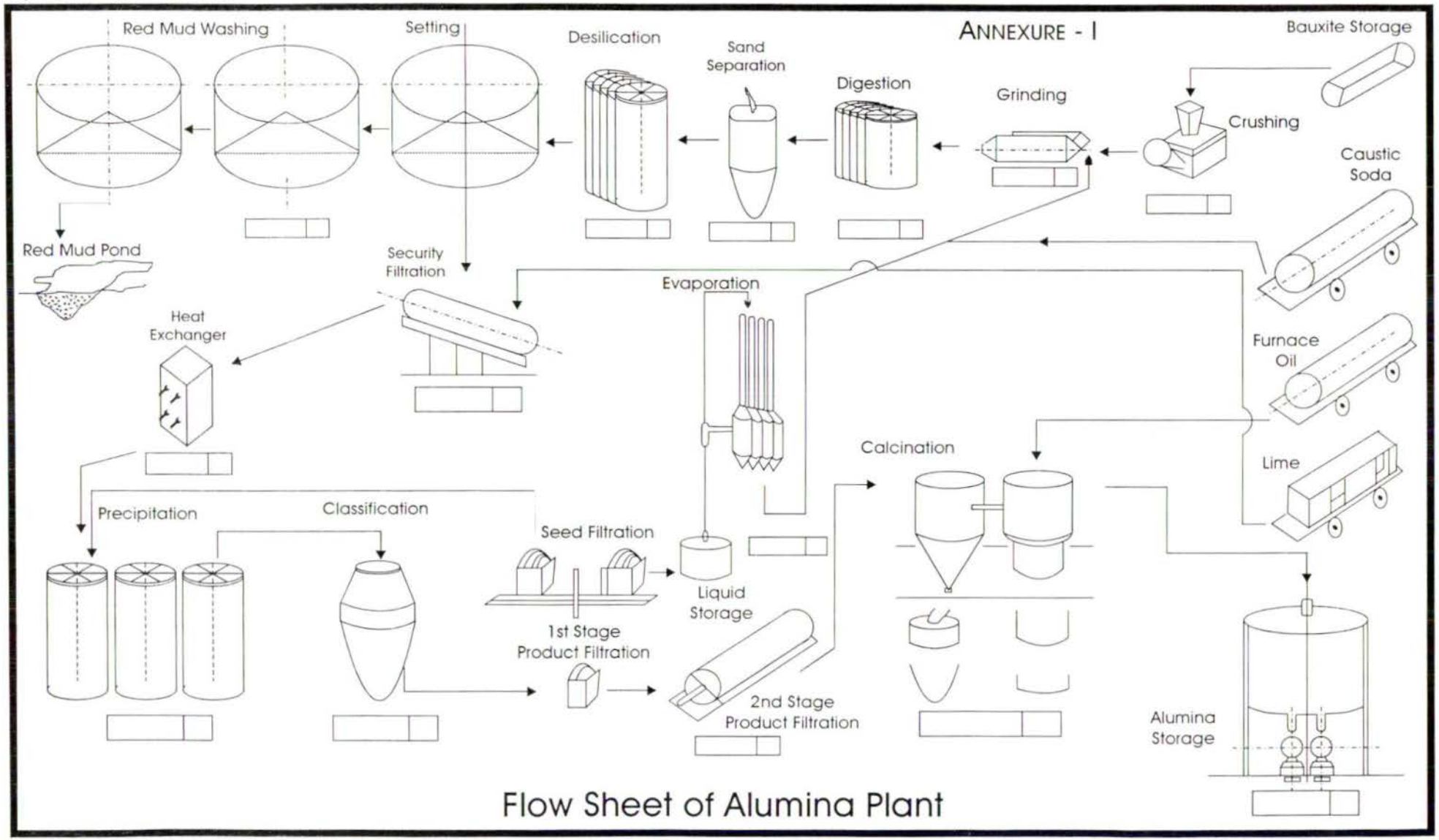
(A.K.CHAKRABARTI)
Deputy Comptroller and Auditor General
Cum Chairman, Audit Board

New Delhi
Dated : 29 NOV 2000

Countersigned

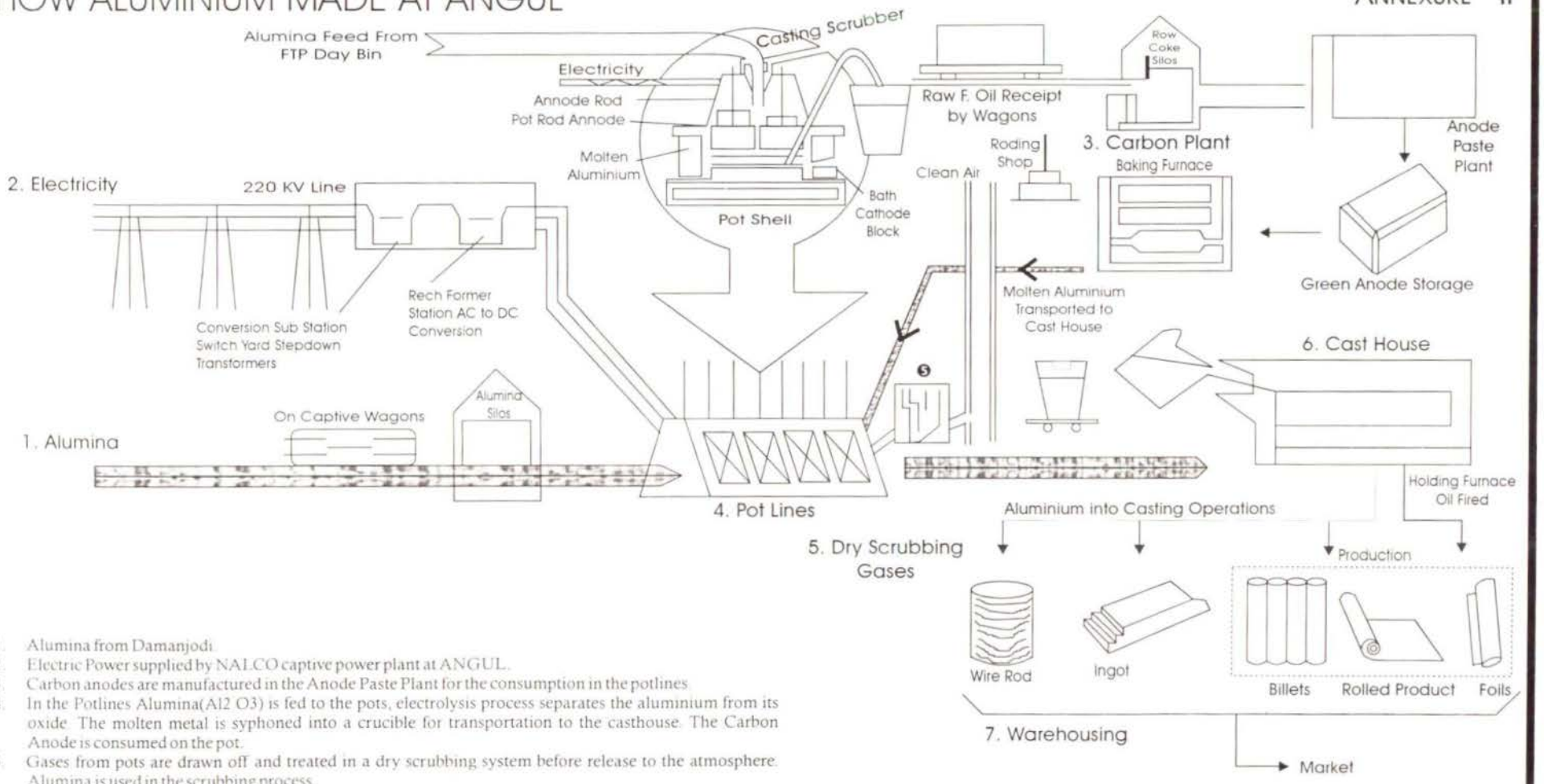
(V.K. SHUNGLU)
Comptroller and Auditor General of India

New Delhi 29 NOV 2000
Dated :


ANNEXURE - I
Red Mud Washing
Setting
Desilication
Sand Separation
Digestion
Grinding
Crushing
Bauxite Storage
Caustic Soda
Red Mud Pond
Security Filtration
Evaporation
Heat Exchanger
Furnace Oil
Lime
Calcination
Precipitation
Classification
Seed Filtration
Liquid Storage
1st Stage Product Filtration
2nd Stage Product Filtration
Alumina Storage
Flow Sheet of Alumina Plant

HOW ALUMINIUM MADE AT ANGUL

ANNEXURE - II



1. Alumina from Damanjodi.
2. Electric Power supplied by NALCO captive power plant at ANGUL.
3. Carbon anodes are manufactured in the Anode Paste Plant for the consumption in the potlines.
4. In the Potlines Alumina(Al_2O_3) is fed to the pots, electrolysis process separates the aluminium from its oxide. The molten metal is syphoned into a crucible for transportation to the casthouse. The Carbon Anode is consumed on the pot.
5. Gases from pots are drawn off and treated in a dry scrubbing system before release to the atmosphere. Alumina is used in the scrubbing process.
6. In the cast molten, Aluminium is transferred to holding furnaces where it is alloyed into many grades. The molten metal is then transferred to wire rod mills and ingot casting machines to produce ingots / wire rods.
7. The cast Aluminium in various forms is stored and prepared for shipment to customers.

ANNEXURE--III

AFFORESTED AREA

[refer para 2.1.(a)]

Area plantation	Total Area (in hectare)	Free Area Available	Afforested area
i) Conveyor carrier	132	90	90
ii) Explosive Magazine	66	35	35
iii) Mining area including barrier	450	450	149.6
iv) Mines Approach Road	20	15	15
v) Mining Complex & Auxiliary facilities	53	33	33
vi) Water Supply & Pipeline	05	03	03
vii) Outside surface right within mining leasehold	-	-	57
viii) Outside leasehold acquired for conveyor corridor & approach road	169	120	120
Grand Total	**895**	**746**	**502.6**

ANNEXURE-IV

AVAILABILITY AND UTILISATION

OF MINING EQUIPMENT.

[refer para: 2.1.(c)]

Availability hours and percentage availability of equipment over the last seven years

Equipment	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00
	Hours(%*)	Hours(%*)	Hours(%*)	Hours(%*)	Hours(%*)	Hours(%*)	Hours(%*)
Exploratory Drills	3661(72)	3633(75)	2288(47)	2357(46)	2946(56)	5071(86)	5577(77)
Blasthole Drills	7128(29)	4358(30)	4230(29)	5250(34)	10319(41)	10753(37)	18381(51)
Excavators	9319(38)	6451(26)	6907(28)	7905(32)	10263(35)	15726(63)	18315(54)
Wheel Loaders	16055(49)	14710(49)	14011(47)	14521(48)	20383(57)	21123(50)	26767(59)
Hauling Eqpts	37931(51)	35114(41)	35180(40)	38700(42)	52253(57)	44997(47)	46081(48)
Grader	1285(49)	817(33)	860(35)	447(18)	1328(50)	1795(67)	1780(72)
D10	1465(30)	560(12)	37(1)	2861(56)	24(0.1)	1240(23)	735(15)
Other Dozers	12107(49)	10782(40)	8928(32)	11191(43)	17063(53)	13885(48)	17367(47)

Note: Availability hours have been worked out by excluding maintenance/break down hours from the total schedule hours.

*Percentage *Availability = (available hours) 100/schedule hours.*

Utilisation hours and utilisation against availability of equipment over last seven years.

Equipment	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00
	Hours(%*)	Hours(%*)	Hours(%*)	Hours(%*)	Hours(%*)	Hours(%*)	Hours(%*)
Exploratory Drills	564(15)	659(18)	457(20)	564(24)	962(33)	1426(28)	1305(23)
Blasthole Drills	3519(49)	2675(61)	2537(60)	3418(65)	3793(37)	3825(36)	4167(23)
Excavators	4637(50)	3011(47)	3574(52)	4342(55)	5194(51)	6447(41)	5441(30)
Wheel Loaders	10083(63)	10200(69)	9756(70)	10435(72)	11822(58)	12899(61)	13575(51)
Hauling Eqpts	24824(65)	23433(67)	23884(68)	27006(70)	33726(65)	29623(66)	28929(63)
Grader	188(14)	166(20)	148(17)	76(17)	229(17)	301(17)	365(21)
D10	774(53)	308(55)	21(58)	1501(52)	9(38)	638(51)	247(34)
Other Dozers	4686(39)	4961(46)	3602(40)	4212(38)	5345(31)	5649(41)	6393(37)

*Percentage of *Utilisation = (Utilisation hours)100/Available hours.*

ANNEXURE – V

Consumption of alumina fluoride

[refer para: 2.3.1 (iv)]

Year	Actual consumption per MT of hot metal (Kg.)	Total actual consumption (MT)	Standard consumption @ 20.6 Kg per MT of hot metal (MT)	Excess Consumption (MT)	Rate of aluminium fluoride (Rs./Kg.)	Value of excess consumption (Rs in crore)
(1)	(2)	(3)	(4)	(5)=(3)-(4)	(6)	(7)=(5)X(6)
1993-94	25.87	5081	4046.046	1034.954	36.53	3.78
1994-95	32.32	5823	3711.317	2111.683	37.80	7.98
1995-96	30.59	5928	3992.198	1935.802	35.45	6.86
1996-97	29.50	6107	4264.777	1842.223	34.40	6.34
1997-98	30.40	6168	4179.925	1988.075	37.11	7.38
1998-99	35.00	5161	3037.594	2123.406	38.18	8.11
1999-00	26.35	5716	4468.655	1247.345	37.35	4.66
						45.11

ANNEXURE-VI

NUMBER OF POTS PRODUCING ELECTRICAL CONDUCTOR GRADE QUALITY OF ALUMINIUM

[refer to in para : 2.3.1(vi)]

Year	Month	Number of Pots with (EC) quality	Total Pots in Operation	Percentage of pots with EC quality to total pots in operation
1991	May	339	400	84.75
	Nov	360	398	90.45
1992	May	337	401	84.04
	Nov	159	400	39.75
1993	May	370	421	87.89
	Nov	136	418	32.54
1994	May	59	335	17.61
	Nov	321	399	80.45
1995	May	299	400	74.75
	Nov	268	392	68.36
1996	May	229	444	51.58
	Nov	112	432	25.93
1997	May	113	431	26.22
	Nov	81	415	19.52
1998	May	6	316	1.90
	Nov	87	328	26.52
1999	May	141	420	33.57
	Nov	328	455	72.09

73

Annexure-VII

Average rate of production per hour

(refer para: 2.3.3.1)

INGOT CASTING MACHINE

Year	Total hours	Available hours	Idle hours	Actual production hours	Production (MT)	Average rate of production (MT per hour)
1993-94	17520	11260	3442	7818	90337	11.56
1994-95	17520	10142	3842	6300	76092	12.07
1995-96	17520	10698	3442	7256	87766	12.10
1996-97	17520	10150	3115	7035	83384	11.85
1997-98	17520	9810	3147	6663	75246	11.29
1998-99	17520	10770	5661	5109	53666	10.50
1999-2000	17520	11440	4010	7430	81871	11.02

WIRE ROD MILL

Year	Total hours	Available hours	Idle hours	Actual production hours	Production (MT)	Average rate of production (MT per hour)
1993-94	17520	8567	3761	4806	36337	7.56
1994-95	17520	8420	1337	7083	43330	6.12
1995-96	175	9769	1146	8623	50553	5.86
1996-97	17520	10740	1172	9568	55735	5.83
1997-98	17520	9272	1200	8072	43248	5.36
1998-99	17520	9289	3327	5962	30996	5.20
1999-2000	17520	9174	1866	7308	35932	4.92

Note: The difference between total hours and available hours was due to non-availability of the machine on account of maintenance/break-down hours.