सत्यमेव जयते

Report of the Comptroller and Auditor General of India

on

Operational Performance and Productivity of the Refinery and Smelter Plants of National Aluminium Company Limited

लोकहितार्थ सत्यनिष्ठा

Dedicated to Truth in Public Interest

Union Government (Commercial)
Ministry of Mines
No. 6 of 2019
(Performance Audit)

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Laid on the table of Lok Sabha and Rajya Sabha on …….

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PREFACE

The Performance Audit has been carried out in line with the Regulations on Audit and Accounts, 2007 and Performance Auditing Guidelines 2014 of the Comptroller and Auditor General of India.

National Aluminium Company Limited (NALCO), a Central Public Sector Enterprise was incorporated on 7 January 1981, with its Registered Office at Bhubaneswar, Odisha. The Company, which functions under the administrative control of Ministry of Mines, Government of India acquired Navratna status in April 2008.

The Mines and the Refinery are located at Damanjodi, while the Smelter and the Captive Power Plant are located at Angul, Odisha. The present Performance Audit was undertaken to see whether the Company was utilising the capacity of Mines, Refinery, Smelter and Captive Power Plant optimally and to bring out the reasons for sub-optimal performance.

Audit wishes to acknowledge the co-operation extended by the Management of NALCO and the Ministry of Mines at each stage of the audit process.

EXECUTIVE SUMMARY

Key Facts			
Date of Incorporation of the Company		7 January 1981	
Corporate Office		Bhubaneswar, Odisha	
Details of Major Units of the Company			
Plant	**Location**	**Average Production/ Installed Capacity during last five years ending 2016-17**	**Average Production during last five years ending 2016-17**
Mines (In lakh tonnes)	Damanjodi, Odisha	67.20	61.23
Refinery (In lakh tonnes)	Damanjodi, Odisha	22.40	19.26
Smelter Plant (In lakh tonnes)	Angul, Odisha	4.60	3.62
Captive Power Plant (In Million Units)	Angul, Odisha	10,512.00	6,356.70

Key Findings

Alumina Refinery

The actual production of Alumina Hydrate during the period from 2012-13 to 2016-17 was 96.31 lakh tonnes against the target of 107.35 lakh tonnes, resulting in shortfall of 11.04 lakh tonnes. The shortfall in production of Alumina Hydrate in the Refinery was primarily due to under-performance of mining and allied activities.

(**Para No. 2.1**)

The Company was unable to maintain the required stock level of Bauxite at Refinery end due to lower production in the Mines. This constrained the Company in blending the Bauxite for feeding the same with even silica content to the Refinery, leading to excess consumption of 1.46 lakh tonnes of Caustic Soda in the Refinery during the period 2012-13 to 2015-16, for which the Company had to incur additional expenditure of ₹426.27 crore.

(Para No. 2.1.4)

Despite realising the requirement for installation of High Rate Decanter and Deep Cone Washer for handling increased mud load in the Refinery since May 2011, which could have accrued an approximate annual savings of ₹75.45 crore, the Company awarded the work order for processability study in February 2016, i.e. after 57 months.

(Para No. 2.2)

Smelter Plant

The capacity utilisation of Smelter Plant remained lower than the installed capacity primarily due to non-availability of adequate power from the Captive Power Plant. The Company was not able to develop the Coal Blocks allotted by Government of India for supply of coal to the Captive Power Plant for generation of required power for Smelter Plant. There was shortfall in production of 4.93 lakh tonnes of Aluminium in the Smelter Plant during the period 2012-13 to 2016-17, for which the Company lost the opportunity of earning incremental contribution amounting to ₹1,086.63 crore, due to selling of intermediate product (Calcined Alumina) instead of selling the value added product (Aluminium metal).

(Para No. 3.1)

The Company incurred additional expenditure of ₹326.62 crore towards excess consumption of coal in the Captive Power Plant during the period from 2012-13 to 2016-17 due to high dry flue gas and un-burnt carbon loss in ash, resulting in higher Station Heat Rate as compared to the norms.

(**Para No. 3.4)**

As the Company did not avail the facility of joint sampling of coal at the loading point, the Company could not detect slippage of quality of coal, resulting in avoidable expenditure of ₹239.23 crore towards coal procured during the period 2012-13 to 2016-17.

(Para No. 3.5)

Environmental Issues

The transportation of excavated Bauxite in South Block Mines by dumpers to the crushers in Central and North Block Mines, instead of transporting the same through the conveyor belt, was not in conformity with the conditions of Environmental Clearance granted for operation of South Block Mines.

(Para No. 4.1)

The discharge of Red Mud which ranged from 6,723 tonnes per day to 8,741 tonnes per day, as well as discharge of Red Mud Pond Effluent which ranged from 5,425 kilo litres (KL) per day to 6,854 KL per day, during the period 2012-13 to 2016-17, was consistently higher than the corresponding limits of 6,087 tonnes per day and 5,200 KL per day as specified by the Odisha State Pollution Control Board.

(Para No. 4.2)

Recommendations:

1. The Management may constantly monitor the position and deployment of skilled Heavy Earth Moving Machine operators so that, in future, production from Mines is not affected.
2. Balance pre-production drilling activity may be completed expeditiously so that quality and quantity of Bauxite are properly assessed before preparing annual and monthly mine production plan.
3. Removal of the top soil and the laterite overburden may be carried out as per the Indian Bureau of Mines (IBM) approved mining plan. Clearance of the backlog would help to get more options for quality control and blending of Bauxite.
4. The Management may maintain adequate level of Bauxite in stockpile to reduce the variation in Bauxite quality before feeding to the Refinery.
5. The allotted Coal Blocks may be developed at the earliest to ensure supply of coal to the Captive Power Plant.

CHAPTER 1:
INTRODUCTION AND AUDIT APPROACH

Chapter 1: INTRODUCTION AND AUDIT APPROACH

1.1 About the Company

National Aluminium Company Limited (Company) was incorporated on 7 January 1981, with its Registered Office at Bhubaneswar, Odisha. The Company acquired Navratna status in April 2008. The Company has its Bauxite Mines at Panchpatmali Hill, Odisha and Alumina Refinery for production of Alumina near to the Mines in Damanjodi. A Smelter Plant was established in Angul, Odisha near the Talcher coal deposits to produce Aluminium from Calcined Alumina along with a Captive Power Plant to ensure continuous supply of electricity. The Company is also the first Indian company in the Aluminium sector to venture into the International Market with London Metal Exchange (LME) registration since May 1989.

1.2 Details of production process

1.2.1 Mines

The Company mined Bauxite, the principal raw material for production of Aluminium, from its Panchpatmali Mines at Damanjodi, Odisha. The Company is required to prepare a Mining Plan for five years and get it approved by the Indian Bureau of Mines (IBM) prior to commencement of mining operations. The entire mining operations are to be carried out as per the approved Mining Plan. Deviations, if any, from such approved Mining Plan also required prior approval from the IBM. During mining operations, the overburden is removed to expose the Bauxite, which after excavation is transported through Dumpers to the Primary Crusher at the Mines, where the same is crushed for transportation to the Alumina Refinery through a 14.6 km long cable belt conveyor.

1.2.2 Alumina Refinery

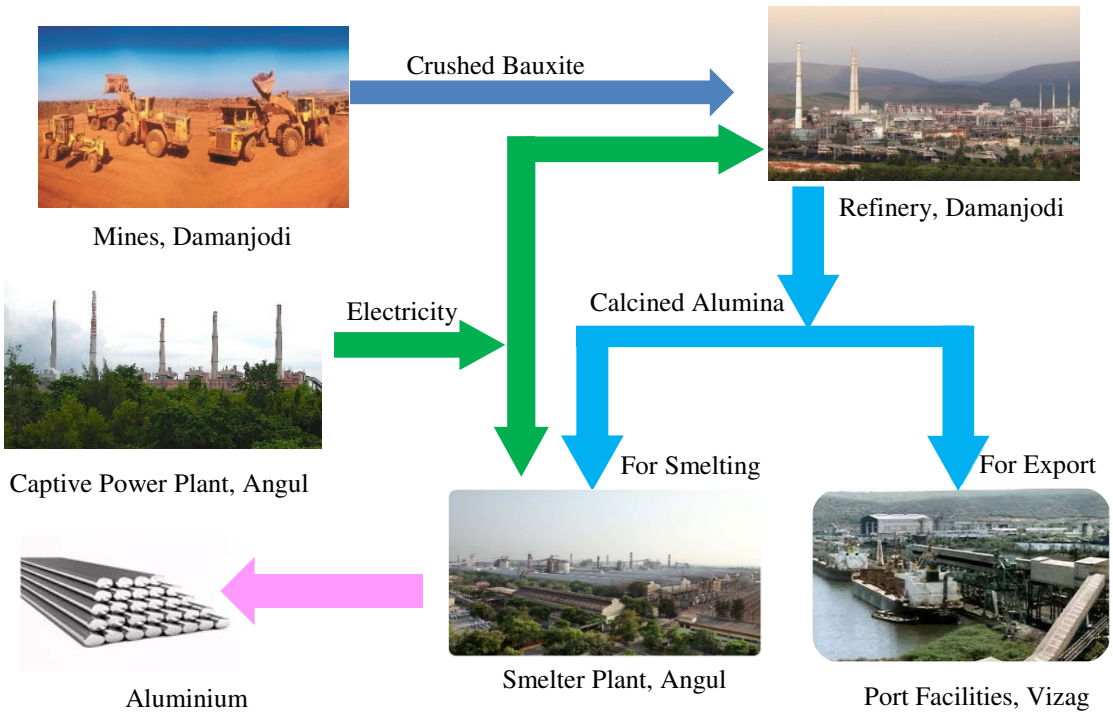
The Bauxite received from the Mines is processed in the Refinery with Caustic Soda and other chemicals for production of Alumina Hydrate. The same is further processed as Calcined Alumina in the Calciner Plants (Calciners) of the Refinery. A portion of the Calcined Alumina is exported and the remaining portion is sent to the Smelter Plant of the Company at Angul for production of Aluminium.

1.2.3 Smelter Plant

The Smelter Plant of the Company at Angul, Odisha produces Aluminium products like Aluminium Ingots, Billets etc. from the Calcined Alumina received from the Refinery. The Company also has a Rolled Product Unit in the Smelter Plant for production of different value added rolled products like Rolled Coil[1], Chequered Sheet[2] etc.

1.2.4 Captive Power Plant

Aluminium smelting being a highly power consuming process, the Company set-up a coal based Captive Power Plant (CPP) at Angul, Odisha, which is in close proximity to the Talcher Coal deposits, for supply of uninterrupted and reliable power to the Smelter Plant. CPP also provided a part of the power required by the Refinery at Damanjodi. A diagrammatic presentation is given below:



Picture 1: Diagrammatic representation of key units and processes

[1] *Rolled coils are used in commercial and general engineering applications like bus bodies, fan blades, cladding in buildings, aluminium composite panels etc.*

[2] *Chequered sheets are mostly used in flooring and cladding (covering for protection) work in automobile and railways.*

1.3 Production performance of the Company

The table below indicates the production data as well as capacity utilisation of different units of the Company during the five years ending 2016-17.

Table 1: Production details

Year	Particulars	Bauxite from Mines	Alumina Hydrate from Alumina Refinery	Aluminium from Smelter Plant	Electricity from Captive Power Plant
		(in lakh tonnes)	(in lakh tonnes)	(in lakh tonnes)	(in Million Units)
2012-13	Production Capacity	63.00	21.00	4.60	10,512.00
	Actual Production	54.19	18.02	4.03	6,855.27
	Capacity Utilisation (in Percentage)	86.02	85.81	87.61	65.21
2013-14	Production Capacity	68.25	22.75	4.60	10,512.00
	Actual Production	62.93	19.25	3.16	5,644.07
	Capacity Utilisation (in Percentage)	92.21	84.62	68.70	53.69
2014-15	Production Capacity	68.25	22.75	4.60	10,512.00
	Actual Production	57.39	18.51	3.27	5,805.81
	Capacity Utilisation (in Percentage)	84.09	81.36	71.09	55.23
2015-16	Production Capacity	68.25	22.75	4.60	10,512.00
	Actual Production	63.40	19.53	3.72	6,609.15
	Capacity Utilisation (in Percentage)	92.89	85.85	80.87	62.87
2016-17	Production Capacity	68.25	22.75	4.60	10,512.00
	Actual Production	68.25	21.00	3.90	6,869.18
	Capacity Utilisation (in Percentage)	100.00	92.31	84.78	65.35
Average	Production Capacity	67.20	22.40	4.60	10,512.00
	Production	61.23	19.26	3.62	6,356.70
	Capacity Utilisation (in Percentage)	91.12	85.98	78.70	60.47

Source: Cost Statement of respective units

1.4 Performance of the Company in the domestic Aluminium Sector[3]

The principal producers of Aluminium in India are National Aluminium Company Limited (the Company), Hindalco Industries Limited (Hindalco) and Vedanta Limited (Vedanta). While the Company is a Central Public Sector Enterprise, both Hindalco and Vedanta are functioning as private sector entities. The comparative performance of the Company in the production of Alumina and Aluminium with the above two domestic peers is discussed below:

1.4.1 Production Performance:

(A) Alumina: The installed capacity and actual production of Alumina in the Refinery by the above Aluminium producers during the period from 2012-13 to 2016-17 was as follows:

Table 2: Comparison of Alumina Production

(Figures in lakh tonnes)

Period	NALCO		Vedanta		Hindalco		Total	
	Capacity	Production	Capacity	Production	Capacity	Production	Capacity	Production
2012-13	21.00	18.02	12.00	5.27	15.00	13.20	48.00	36.49
2013-14	22.75	19.25	12.00	5.24	15.00	16.00	49.75	40.49
2014-15	22.75	18.51	12.00	9.77	30.00	23.00	64.75	51.28
2015-16	22.75	19.53	12.00	9.71	30.00	27.00	64.75	56.24
2016-17	22.75	21.00	12.00	12.08	30.00	29.00	64.75	62.08
Average	22.40	19.26	12.00	8.41	24.00	21.64	58.40	49.31
Average capacity utilisation (*per cent*)		86		70		90		84

It may be seen from the above table that the average capacity utilisation in respect of Alumina Refinery of the Company during the above period was 86 *per cent*, whereas the same of Vedanta and Hindalco was 70 *per cent* and 90 *per cent* respectively. It may also be observed that though the annual production of Alumina of the Company increased from 18.02 lakh tonnes to 21.00 lakh tonnes during the period 2012-13 to 2016-17, the share of the Company in total domestic production of Alumina had slided down from 49 *per cent* (2012-13) to 34 *per cent* (2016-17). This was mainly due to 100 *per cent* increase in capacity of Hindalco to 30 lakh tonnes during 2014-15 from earlier capacity of 15 lakh tonnes. Further, Hindalco not only increased its capacity but also achieved production to the extent of 97 *per cent* of extended capacity in 2016-17.

[3] ***All figures are obtained from the published annual reports of the above three aluminium producing companies and Indian Minerals Yearbooks published by the Indian Bureau of Mines.***

The Management while accepting the above stated (March 2019) that:

- Due to severe cyclonic HUDHUD during October 2014, production had been affected with consequential lesser than production level of previous financial year.
- Using Bauxite with higher Silica content in compliance with revised guidelines of IBM had lowered output i.e. Alumina even with handling same volume of Bauxite as input.
- The three aluminium producers were operating at different geographical locations having independent Bauxite mines with varied alumina and silica content. Hence, comparative analysis in such situation would not reflect a logical relation between different miners.
- Average capacity utilisation of NALCO during said five years was higher than that of the National average.

The Ministry endorsed (March 2019) the above views of the Management.

The above reply of the Management may be viewed in the light of the following:

- The impact of HUDHUD cyclone (October 2014) as stated by the Management was negligible with reference to the performance of the Company for five years ending 2016-17.
- The revised IBM guideline of using Bauxite having higher Silica content was applicable to the industry as a whole.
- Bauxite deposit being heterogeneous in nature, its quality varied from face to face in the same mines.
- The average capacity utilisation of the Company was lower than that of Hindalco during the five years ending 2016-17.

(B) Aluminium: The installed capacity and actual production of Aluminium in the Smelter by the above producers during the period from 2012-13 to 2016-17 were as follows:

Table 3: Comparison of Aluminium Production

(Figures in lakh tonnes)

Period	NALCO		Vedanta		Hindalco		Total	
	Capacity	Production	Capacity	Production	Capacity	Production	Capacity	Production
2012-13	4.60	4.03	8.45	7.74	5.62	5.42	18.67	17.19
2013-14	4.60	3.16	8.45	7.94	5.62	6.13	18.67	17.23
2014-15	4.60	3.27	8.45	8.77	12.82	8.34	25.87	20.38
2015-16	4.60	3.72	23.20	9.23	12.80	11.00	40.60	23.95
2016-17	4.60	3.87	23.20	12.13	12.80	13.00	40.60	29.00
Average	4.60	3.61	14.35	9.16	9.93	8.78	28.88	21.55
Average capacity utilisation (in *per cent*)	79		64		88		75	

It may be seen from above table that the average capacity utilisation in respect of Aluminium Smelter of the Company during the above period was 79 *per cent*, whereas the same of Vedanta and Hindalco was 64 *per cent* and 88 *per cent* respectively. The average installed capacity of smelter of the Company for production of Aluminium was 16 *per cent* of the total domestic smelting capacity and the share of the Aluminium production of the Company was 17 *per cent* of the total domestic Aluminium production during the above period.

The Management while accepting the above, contended (March 2019) that the production of aluminium was regulated to optimise the profitability keeping in view the market price of aluminium and higher cost of production due to sourcing of coal from the other sources. The Management further stated that the average capacity utilisation of its smelter plant was higher than that of national average. The Ministry also endorsed (March 2019) the above views.

Audit would, however, like to point out that the lower production of Aluminium in Smelter Plant was due to sub optimal operation of the Captive Power Plant of the Company. This was primarily attributed to delay in development of Captive Coal Block by the Company as discussed in Para 3.1. Further the average capacity utilisation of the Company was lower than that of Hindalco during the five years ending 2016-17 and has scope for improvement.

1.4.2 Cost of production:

The Cost of production of Alumina and Aluminium of NALCO and Vedanta for the years 2012-13 to 2016-17 was as follows:

Table 4: Comparison of Cost of Production of Alumina and Aluminium

Period	Alumina			Aluminium		
		Vedanta			Vedanta	
	NALCO (₹ per tonne)	(₹ per tonne)	($ per tonne)	NALCO (₹ per tonne)	(₹ per tonne)	($per tonne)
2012-13	13,793	19,241	353	111,375	102,300	1,879
2013-14	14,404	21,700	358	120,992	100,400	1,658
2014-15	14,212	21,800	356	114,355	Not Available	1,755
2015-16	13,033	Not Available	315	108,718		1,572
2016-17	13,629		282	113,204		1,463

Note: The above information was not available in report of Hindalco.

The Management as well as the Ministry accepted (March 2019) the above facts.

1.4.3 Profitability:

(A) EBITDA Margin: The Revenue from operations and EBITDA[4] in respect of Aluminium business include sale of both Alumina and Aluminium of the above three entities during period from 2012-13 to 2016-17, which were as follows:

Table 5: Comparison of Revenue from operation and EBITDA

(₹in crore)

Period	NALCO			Vedanta			Hindalco		
	Revenue	EBITDA	EBITDA margin (*per cent*)	Revenue	EBITDA	EBITDA margin (*per cent*)	Revenue	EBITDA	EBITDA margin (*per cent*)
2012-13	6,809	1,417	20.81	10,024	1,272	12.69	8,776	1,423	16.21
2013-14	6,649	1,443	21.70	10,779	1,716	15.92	10,050	1,568	15.61
2014-15	7,262	2,527	34.80	12,726	2,517	19.78	14,105	2,084	14.77
2015-16	6,703	1,528	22.80	11,091	655	5.90	18,363	2,009	10.94
2016-17	7,438	1,448	19.47	13,686	2,306	16.85	19,983	3,473	17.38
Average	6,972	1,673	23.99	11,661	1,693	14.52	14,255	2,111	14.81

It may be seen from the above table that the average EBITDA margin of the Company was higher than the other Aluminium producers in the domestic market.

[4] ***Earnings Before Interest, Tax, Depreciation & Amortisation***

(B) Return on Capital Employed (ROCE): The following statement indicated the performances of the above three Aluminium producers to measure their efficiency of generating profit with reference to the Capital employed and Equity investments. However, these performance indicators did not reflect exclusively the efficiency in Aluminium business of Vedanta and Hindalco as they were also engaged in the business of other metals in addition to Aluminium.

Table 6: Comparison of ROCE and ROE

(figures in *per cent*)

	Return on Capital Employed (ROCE)			Return on Equity (ROE)	
Period	NALCO	Vedanta	Hindalco	NALCO	Hindalco
2012-13	5.91	17.00	4.22	4.97	5.00
2013-14	5.98	17.00	4.34	5.29	3.85
2014-15	10.89	16.00	5.22	10.33	2.48
2015-16	6.04	7.40	4.30	5.66	1.31
2016-17	7.12	14.40	5.89	6.55	3.29

Note: The figures of Return on Equity of Vedanta Limited were not available.

It may be seen from the above table that both the ROE and ROCE of the Company was highest during the year 2014-15 mainly on account of higher EBITDA (Table 5).

The Management as well as the Ministry accepted (March 2019) the above facts.

1.5 Audit Scope and Objectives

The operations of the Alumina Refinery depend on the supply of the desired quality of Bauxite in adequate quantity from the Mines, while the Smelter Plant needs uninterrupted power supply, which is met from the Captive Power Plant. From the table 1 it could be seen that the production performances of the Mines, Alumina Refinery, Smelter Plant and Captive Power Plant were lower than their respective production/ installed capacities. In this background, a Performance Audit was taken up. The Performance Audit covered the production performances of the Mines, Alumina Refinery, Smelter Plant and Captive Power Plant during the period 2012-13 to 2016-17. However, matters relating to earlier years and subsequent to 2016-17 have also been included, wherever pertinent.

The objectives of the Performance Audit were to assess whether:

- Mines were producing required Bauxite of desired quality for optimum capacity utilisation of the Alumina Refinery.
- Alumina Refinery was operating at full capacity for production of Alumina Hydrate in a cost effective manner.
- Smelter Plant was producing Aluminium of desired quality as per its design capacity in a cost effective manner.
- Different casting facilities were utilised upto their optimum capacities.
- Captive Power Plant was operating efficiently for supplying the required power to the Smelter Plant and Refinery in a cost effective manner.

1.6 Audit criteria

The audit criteria were derived from the following sources:

- Mining Plans of the Company.
- Norms specified by the Indian Bureau of Mines relating to mining operations.
- Norms prescribed by the Process Licensor[5] (M/s RIO Tinto Alcan) for the operations of the Refinery and Smelter Plant.
- Norms fixed by the Company for consumption of input materials.
- Fuel supply agreements.

1.7 Audit methodology

The audit examination commenced with an Entry Conference with the Management on 28 July 2017 wherein the scope of audit, audit objectives and criteria thereof were discussed. At the end of field audit, the draft Performance Audit Report was issued (31 January 2018) to the Management and an Exit Meeting was also held on 23 April 2018. The draft Performance Audit Report after incorporating the replies and views of the Management was issued (16 May 2018) to the Ministry of Mines. After receipt of the Ministry's reply, an Exit Conference was held with the Ministry on 13 August 2018, where in the broad audit observations as well as the recommendations thereon were discussed. The views of the Ministry/ Management have been duly incorporated in this Report.

[5] ***Process Licensor is the party which by an agreement allows the Licensee (here the Company) to use a technological intellectual property in exchange of consideration. The Licensor further guides the Licensee from time to time during application of the said technology***.

1.8 Structure of the Report

This Report contains Chapters covering the performance of the Refinery and Mines, Smelter and Captive Power Plants, Environmental Issues, Conclusion and Recommendations. The Report also contains seven Annexures and a List of Abbreviations.

1.9 Audit Acknowledgement

Audit acknowledges the cooperation extended by the Management and the Ministry for timely completion of the above audit.

CHAPTER 2: REFINERY AND MINES

Chapter 2: REFINERY AND MINES

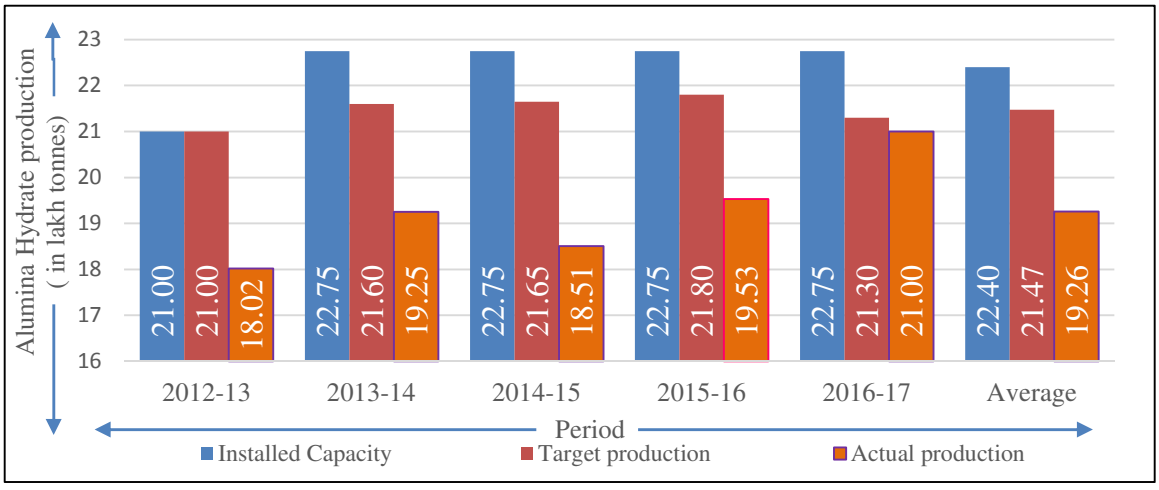
The Alumina Refinery (Refinery) was commissioned (February 1987) with a production capacity of 8 lakh tonnes per annum (TPA) of Alumina Hydrate and the same was gradually increased to 22.75 lakh TPA. The Bauxite Mines (Mines) at Panchpatmali, Damanjodi was commissioned (November 1985) with a production capacity of 24 lakh TPA. The capacity of the Mines was gradually increased to 68.25 lakh TPA in line with the enhanced capacity of the Refinery. The governing factor for mining of Bauxite ore was the content of Aluminium and Silica therein. The quality of Bauxite is directly related to the content of Aluminium and inversely related to the Silica content. As per the Mining Plan of the Company submitted to the Indian Bureau of Mining (IBM) the mineable Bauxite deposit as on 31 March 2014 in Panchpatmali has an average Aluminium content of 42.65 *per cent* and Silica content of 3.82 *per cent*.

Picture 2: Alumina Refinery at Damanjodi

2.1 Production performance of the Refinery

The installed capacity of the Refinery, target fixed for production of Alumina Hydrate and the actual production during the period 2012-13 to 2016-17 are indicated in the following chart.

Chart 1: Target and Actual production of Alumina Hydrate



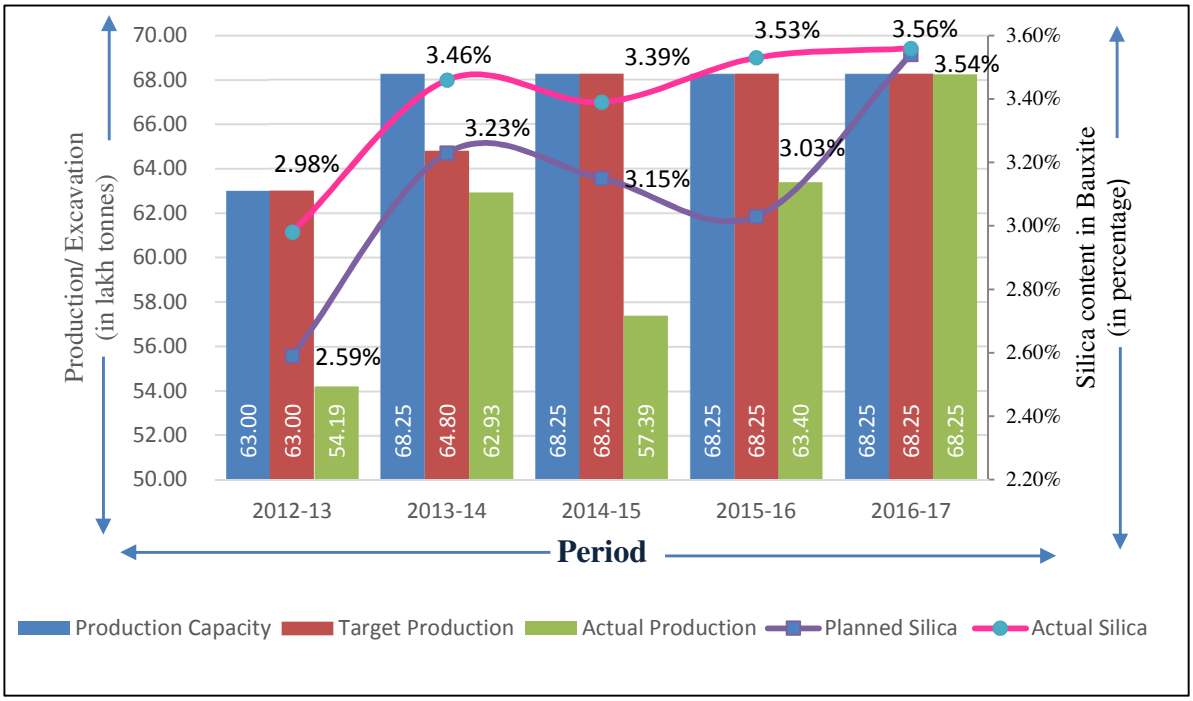
It may be seen that during the period 2013-14 to 2016-17 the Company fixed the annual production target of Alumina Hydrate lower than the installed capacity. This was considering the rising trend of silica content in the Bauxite received from the Mines. Even then the targeted production for the respective years could not be achieved. The actual production of Alumina Hydrate during the period 2012-13 to 2016-17 was 96.31 lakh tonnes against the target of 107.35 lakh tonnes, resulting in shortfall of 11.04 lakh tonnes.

Audit further observed that the shortfall in production of Alumina Hydrate in the Refinery was primarily due to under-performance of Mining and allied activities. The delay in carrying out processability study and upgradation of mud handling equipment in the Refinery for processing of higher silica content in Bauxite also contributed to lower production of Alumina Hydrate. These findings are enumerated below:

2.1.1 Under-performance of Mining and Allied activities

The Company, in its Annual Mine Production Plan, brings out the quantity of Bauxite to be excavated along with the total silica content therein, and mining is conducted accordingly. It may be seen from the chart below that actual production of Bauxite from the Mines during the period 2012-13 to 2016-17 was lower than the targets fixed, both in terms of quantity and quality (in terms of silica content).

Chart 2: Target and actual production of Bauxite



The reasons for non-achievement of the production target in terms of quantity and slippage in the quality of Bauxite are brought out in the Paras No. 2.1.2 and 2.1.3 respectively.

2.1.2 Non-achievement of production target of Bauxite

The primary reasons for the lower production of Bauxite during the period 2012-13 to 2016-17 are discussed in the following paragraphs:

2.1.2.1 Inordinate delay in appointment of HEMM operators

The Mines of the Company were fully mechanised open cast Mines wherein mining operations were carried out by deployment of various types of Heavy Earth Moving Machineries (HEMM) brief description of which is given in **Appendix.**

The Company carried out the excavation of Bauxite and transportation of the same to the Refinery in A and B shifts[6]. It was decided (March 2010) to recruit 58 HEMM operators by March 2011 to start Night shift (C Shift) operation to facilitate transportation of crushed Bauxite from Mines to Alumina Refinery. However, only 12 operators were recruited till April 2011. C Shift operation (transportation only) was commenced from September 2011 by diverting operators from A and B Shifts. The requirement of operators increased to 64 by December 2012 against which 53 operators were recruited in two batches in October 2016 and July 2017. The delay in inducting HEMM operators affected the excavation of Bauxite and removal of overburden during the period 2012-13 to 2015-16.

Picture 3: Dumper and Wheel Loader in operation

The Management while accepting the audit observations stated (April 2018) that there was a proposal to induct Substantially Affected Persons (SAPs) since 2011-12. However, the same got inordinately delayed due to some unavoidable reasons, specifics

[6] *A Shift operates from 6 am to 2 pm and B Shift operates from 2 pm to 10 pm.*

of which were, however, not elaborated by the Management. The Ministry also endorsed the reply of the Management.

2.1.2.2 Inadequate availability as well as under-utilisation of HEMM

The Company fixed the norms for availability of HEMM for each year in its 'IMS Objectives and Targets'[7]. Audit, however, observed that the Company did not consider such norms while evaluating the actual availability of HEMM in its Monthly Progress Report (MPR).

Norms vis-a-vis actual availability of major HEMM used for excavation of Bauxite and overburden for the last five years are as follows (Table 7):

Table 7: Actual Availability of HEMM

Type of HEMMs[8]	Norms for availability (as percentage of total hours)	Actual availability of HEMM (as percentage of total hours)					
		2012-13	2013-14	2014-15	2015-16	2016-17	Average
Dumpers	70	70	56	58	66	67	63
Wheel Loaders	80	80	80	77	67	82	77
Ripper Dozers	80	77	68	49	44	62	60
Back Hoe Excavators	80	82	77	81	90	79	82
Blast Hole Drills	70	72	64	57	74	66	66
Exploratory Drills	75	90	70	68	79	84	78

Source: IMS Objectives and Targets and Monthly Progress Reports

As illustrated in the Table above, scrutiny of Monthly Progress Reports for the period 2012-13 to 2016-17 revealed that out of six types of HEMMs operated by the Company for Bauxite mining, the actual average availability of four types of HEMMs were lower than the respective norms as per 'IMS Objectives and Targets'.

Further, scrutiny of records revealed that the actual average utilisation of all the six types of HEMMs ranged from 14 *per cent* to 57 *per cent* only during the period

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[7] ***An Integrated Management System or IMS integrates all of an organisations's systems and processes like Quality Management System (ISO 9001), Environment Management System (ISO 14001), Safety Management System (OHSAS 18001), Information Security Management System (ISO 27000) etc. into one complete framework, enabling an organisation to work as a single unit with unified objectives.***

[8] ***Dumpers-used for haulage of excavated overburden and Bauxite; Wheel Loaders-used for loading of overburden and Bauxite on Dumpers; Ripper Dozers-used for loosening of overburden and Bauxite; Back Hoe Excavators-used for excavation and loading of Bottom Bauxite; Blast Hole Drills-used for drilling and blasting for loosening of overburden and Bauxite and Exploratory drills-used for drilling of pre-production boreholes.***

2012-13 to 2016-17. Audit observed that lower availability of such HEMMs coupled with under-utilisation of the same adversely affected the production of Bauxite from Mines.

The Management while accepting non-considering of norms for availability of HEMM for evaluation in MPR stated the same was being revised accordingly. The Management while accepting under-availability and under-utilisation of HEMM stated that under-availability of HEMM had not affected the quality or quantity of Bauxite production. The Ministry also endorsed the views of the Management.

Picture 4: Back hoe and Dumper in operations

The contention of the Management and the Ministry with regard to the under availability of Dumpers not affecting the production of Bauxite needs to be seen in the light of the position that under-availability of Dumpers was indicated as one of the constraints for excavation of Bauxite in the MPRs of 15 months, out of 60 months reviewed by Audit.

2.1.2.3 Under-utilisation of Semi Mobile Crusher Plant and Fixed Long Distance Conveyor

Semi Mobile Crusher Plant (SMCP) along with Fixed Long Distance Conveyor (FLDC) was installed (January 2015) in the Mines to transport Bauxite from North Block Mines to the Primary Crusher & Conveyor. SMCP was not operating at its targeted capacity due to constraints such as slow loading of Bauxite, oversized boulders, late start and early stoppage of loading. Audit observed that the actual utilisation of SMCP-FLDC during the period 2014-15 to 2016-17 ranged from 45 *per cent* to 68 *per cent* of the target fixed. As a result, during the above period, 19.74 lakh tonnes of excavated Bauxite had to be transported through Dumpers from the various faces of the Mines to the Primary Crusher, covering an additional lead distance ranging from 3.17 km to 3.9 km. Further, due to travelling of extra distances by the Dumpers, the Company had to incur additional expenditure of ₹8.26 crore towards cost of diesel during the above period, which adversely impacted the production activity of Bauxite.

The Management stated (April 2018) that it took two years to stabilize a plant which was normal in any bulk material handling system. The Ministry also endorsed the views of the Management.

The above reply of the Management may be viewed in light of the position that the performance of SMCP-FLDC was evaluated by Audit with reference to the target fixed by the Company itself. Further, the Management had fixed these target already lower than the installed capacity considering constraints associated with operation of SMCP-FLDC.

2.1.2.4 Delay in adopting the IBM guidelines regarding revision in cut-off grade of Bauxite

The Company estimated Bauxite reserve considering cut-off grade of total Silica[9] content at four *per cent* (maximum). In the meantime, Indian Bureau of Mines (IBM) notified (October 2009) revised threshold value[10] of Bauxite wherein cut-off grade of reactive Silica was fixed at five *per cent* (maximum) for mining, beyond which the Bauxite obtained after mining could be discarded as waste. In pursuance of the above IBM guidelines the Company determined the cut-off limit of total Silica at seven *per cent* for mining considering past performance. The Company, however, initiated the proposal to change the cut-off grade of total Silica at seven *per cent* (maximum) in May 2011 and switched over to mining as per the aforesaid cut-off grade only from October 2015, i.e. after a delay of about six years from the IBM notification.

Audit, therefore, observed that due to delay in switching over to mining as per the revised threshold limit, the Company treated the Bauxite having total Silica content between four *per cent* and seven *per cent* as non-ore grade and backfilled the mined-out areas with the same, leading to wastage of natural resources during the intervening period between October 2009 and October 2015. Audit also observed that implementation of the revised guidelines required only a change of value for cut-off grade from four *per cent* to seven *per cent* in the existing 'SURPAC' mining software for which the data was already available with the Company.

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[9] ***The Silica in Bauxite is of two types-Reactive Silica and Non-Reactive Silica. Non-Reactive Silica is that which does not participate in the chemical process during processing of Bauxite and it only adds to the waste burden as red mud. Reactive Silica is that which participates during the chemical process and forms a compound with Alumina, soda and silica. This Compound also forms a part of red mud reject and causes loss of recovery of Caustic soda and Alumina.***

[10] ***'Threshold Value of Minerals' is the limit prescribed by the IBM from time to time based on the beneficiability and/or marketability of a mineral for a given region and a given time, below which a mineral obtained after mining can be discarded as waste.***

The Management stated (April 2018) that the IBM guidelines could not be implemented immediately as studies were to be conducted to exactly establish adverse impact on the Refinery as well as on the cost of production alongwith suggestions for necessary modifications in the Refinery Plant, which took time up to the middle of 2015 and the Company finally implemented and switched over to mining as per the IBM guidelines in October 2015. The Ministry also endorsed (July 2018) the above views of the Management.

The reply of the Management/ Ministry was not acceptable because the implementation of the revised IBM guidelines was not dependent on such studies as is evident from the fact the implementation of revised guidelines was started from October 2015, i.e. before the work for such study was entrusted to M/s RIO Tinto Alcan (February 2016).

2.1.2.5 Shortfall in production due to delay in filing application for renewal of Forest Clearance

As per the guidelines prescribed by the Hon'ble Supreme Court of India, application for renewal of Forest Clearance (FC) was to be made to the concerned State Government, 24 months prior to the expiry of the existing FC. It was also prescribed that in case FC got delayed for any reason, the user agency may apply for grant of a Temporary Work Permit (TWP). However, the said application can be made after the expiry of 13 months from the date of filing application for renewal of FC but not later than nine months prior to the expiry of existing FC.

It was seen that the Company applied for renewal of FC of Central-North Block Mine to the Government of Odisha in January 2011 which was 21 months and 18 days prior to the expiry of the existing FC. However, the renewal of FC got delayed and the Company had to apply (February 2012) for Temporary Work Permit (TWP) to run the Mines. Due to delay in filing application for renewal of FC, the application for TWP was also got delayed. As a result, the Company could not obtain TWP/FC within the validity of the lease period. In absence of TWP, the Company had to suspend all the mining activities from 17 November 2012, which commenced on 17 December 2012 only after receiving TWP.

Audit observed that due to delay in filing application for renewal of FC with consequential delay in applying for TWP, the mining activities of the Company was

suspended for a month resulting in lower production of Bauxite in the Mines with consequential loss of production of 1.06 lakh tonnes of Alumina Hydrate in the Refinery.

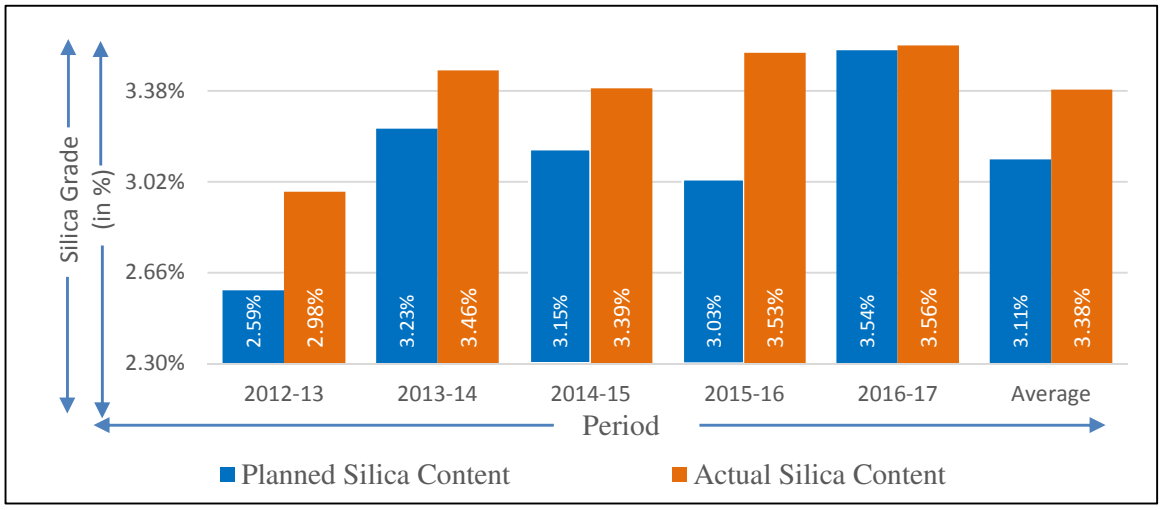
The Management stated (April 2018) that the Company filed applications for FC and TWP as per the timelines prescribed under Forest Conservation Act, Forest (Conservation) Rules and Guidelines issued by the Ministry of Environment, Forest and Climate Change (MoEF & CC) and not as per the guidelines prescribed by the Apex Court, as no notification/guidelines was circulated by the Government in this regard. Ministry also endorsed (July 2018) the views of the Management.

The reply of the Management/Ministry is not tenable because the Management was aware of the directions of the Apex Court since 2009, as it was conveyed to them while granting TWP for South Block of the Mines.

2.1.3 Slippage in Bauxite Quality

Presence of higher silica content in Bauxite was not desirable as it adversely affects the product (Aluminium) purity and causes higher consumption of Caustic Soda. The Company planned annually the quantum of Bauxite to be excavated along with the total Silica content in such Bauxite. The planned Silica grade and actual Silica grade in Bauxite so excavated during the period 2012-13 to 2016-17 were as follows (Chart 3):

Chart 3: Planned and Actual Total Silica content in Bauxite



It may be seen from the above that the actual silica content was higher than the planned in all the above five years. The salient reasons for non-achievement of planned Silica content are discussed in the succeeding paragraphs.

2.1.3.1 Non-compliance with Blending Scheme of Monthly Mine Production Plan

The Company prepared a 'Blending Scheme' in the Monthly Mine Production Plan indicating the quantum of Bauxite with varied Silica content from multiple faces to be mined, with the objective to produce Bauxite of desired Silica content. Audit observed that the Company did not follow such Blending Scheme while mining, during all the 60 months (2012-13 to 2016-17) covered in audit.

During Exit Conference with the Ministry, the Management, however, stated (August 2018) that corrective actions have been implemented.

2.1.3.2 Non-implementation of measures to improve Bauxite quality

The Company planned the following measures in its Mining Plan approved by the IBM with the objective to minimise mixing of extraneous materials in Bauxite ore and to ensure improvement in blending and grade control of Bauxite.

- Pre-production drilling at 25 metres interval with an average depth of 25 meters each to assess the quantum of overburden to be removed prior to extraction of Bauxite ore.
- Transportation and feeding of top Bauxite and bottom Bauxite in the crusher in the ratio of 3:1.

Scrutiny of records revealed that the Company deviated from the IBM approved mining plan as the Company drilled only 1,123 boreholes towards pre-production drilling against the target of 1,280 boreholes during the period 2012-13 to 2016-17. Moreover, the average depth of boreholes was about 22 meters against the required depth of 25 meters. The Company also neither planned nor adhered to transportation and feeding of top Bauxite and bottom Bauxite proportionately in the crusher as required in the IBM approved mining plan.

The Management contended (April 2018) that the progress of drilling drops drastically in clay zone which restricted the yearly performance in drilling and the extent of drilling would continue depending upon the extent of the ore body and not 25 meters.

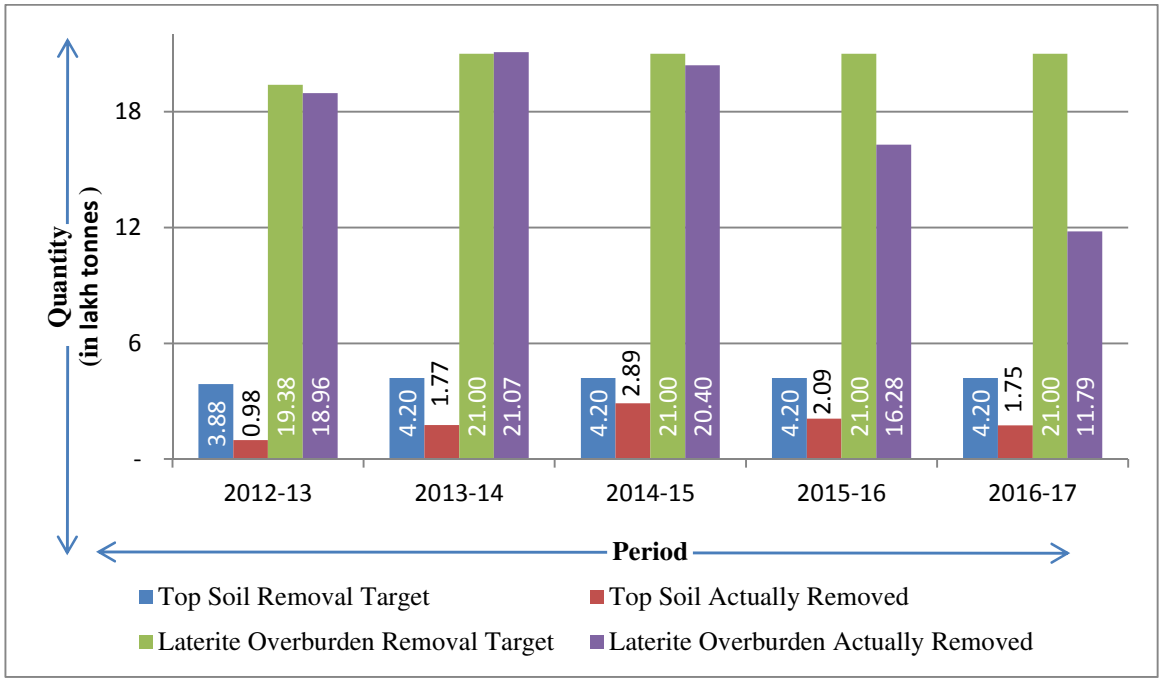
The Ministry further added (July 2018) that the apprehensions of shortfall in achieving pre-production drilling during the period 2012-17 would impact production quality and quantity in future years were not correct. The Management further stated (April 2018) that the ratio of 3:1 was a broad guideline and not a sacrosanct figure. The Ministry also endorsed (July 2018) the same view.

The above contentions of the Management/Ministry may be viewed in light of the position that as per Section 22A of the Mineral Conservation Rules, 1960 mining operations should be undertaken in accordance with the duly approved Mining Plan. Modifications of the same, if any, should also have been got approved by the IBM in advance.

2.1.3.3 Inadequate removal of overburden

As per the IBM approved mining plan, the Company was required to remove 20.68 lakh tonnes of Top Soil and 103.38 lakh tonnes of laterite overburden during the period 2012-13 to 2016-17. Audit, however, observed that the actual removal of Top Soil was only 46 *per cent* (9.48 lakh tonnes); and the same for Laterite Overburden was 86 *per cent* (88.51 lakh tonnes) of the required quantity during the above period. The position is depicted in the following chart.

Chart 4: Top Soil and Laterite Overburden Removal



The annual targets fixed by the Company for removal of Top Soil and Laterite Overburden were lower than the quantity required as per IBM approved Mining Plan.

Due to non-removal of adequate quantity of Top Soil and Laterite Overburden the Company could not expose sufficient area of top Bauxite which affected mine production quantitatively and also limited the options for grade control and blending of Bauxite. Further, there was also an instance (February 2016) where the Company was getting inferior quality Bauxite even from available good quality Bauxite faces/trenches because the Company carried out blasting of Bauxite in those trenches without removing full overburden or without maintaining the adequate gap between overburden and Bauxite faces.

The Management stated (April 2018) that the Top Soil and Laterite Overburden targets given in IBM approved Mining plan were based on 100 meters borehole drilling while the target for the same in the Annual/Monthly Mine Production Plans were based on 25 meters pre-production drilling. The Management further stated after increase in cut off Silica in threshold value of Bauxite by IBM, the quantity of Laterite Overburden became less and was now re-classified as ore. The Ministry further stated (July 2018) that there was no possibility of mining Bauxite ore without removal of adequate quantity of overburden.

The above contentions of the Management are not acceptable as the data of pre-production drilling were already available with the Management at the time of preparation of Mining Plan for submission to IBM. The further contention of the Management is also not acceptable as the Modified Mining Plan for the period 2014-15 to 2016-17 was prepared considering higher cut off silica in the revised threshold value of Bauxite as notified by IBM.

The reply of the Ministry is also not tenable as the Company removed only 46 *per cent* and 86 *per cent* of the required top soil and laterite overburden respectively during the period 2012-13 to 2016-17.

2.1.3.4 Discrepancy in Monthly Deviation Report of Mines

In order to monitor the actual mining, the Company prepared Monthly Deviation Reports, wherein trench-wise quantity of Bauxite planned to be excavated and actually

excavated was compared. Scrutiny of Monthly Deviation Reports of 53 months as available out of 60 months for the period 2012-13 to 2016-17 revealed the following discrepancies:

- Out of 53 months, data of 47 months for excavation of bauxite as per Monthly Deviation Report was not matching with the same as per Monthly Progress Report.
- In its Monthly Mine Production Plans, the Company indicated the trench-wise quantity and quality of Bauxite to be excavated. The Company, however, did not mention the trench-wise quality of Bauxite actually excavated in its Monthly Deviation Report. The Company was, therefore, was not in a position to ascertain the trench-wise deviations in quality of Bauxite excavated. Recording of trench-wise actual quality of Bauxite excavated would have also facilitated the Company in preparing more realistic blending schemes of Bauxite mining in the subsequent months for improvement of grade control.

The Management stated (April 2018) that:

- These differences were seen in the initial stages when the Deviation Report was introduced and over the months these were resolved and addressed.
- The Company had a set practice of collecting samples from blast hole drills and mine faces for quality control, but comparison of trench-wise quality of Bauxite excavated against the planned was technically not correct.

The reply of the Management may be viewed in the light of the position that:

- available data of all 41 months (for the period from 2013-14 to 2016-17, excluding the period of initial 12 months pertaining to 2012-13) did not match. Hence, the discrepancies were not addressed by the Management.
- the practice of collection of samples from blast hole drill/mine faces for quality control would be purposeful when the trench-wise sample so collected was compared with the trench-wise planned Bauxite quality data.

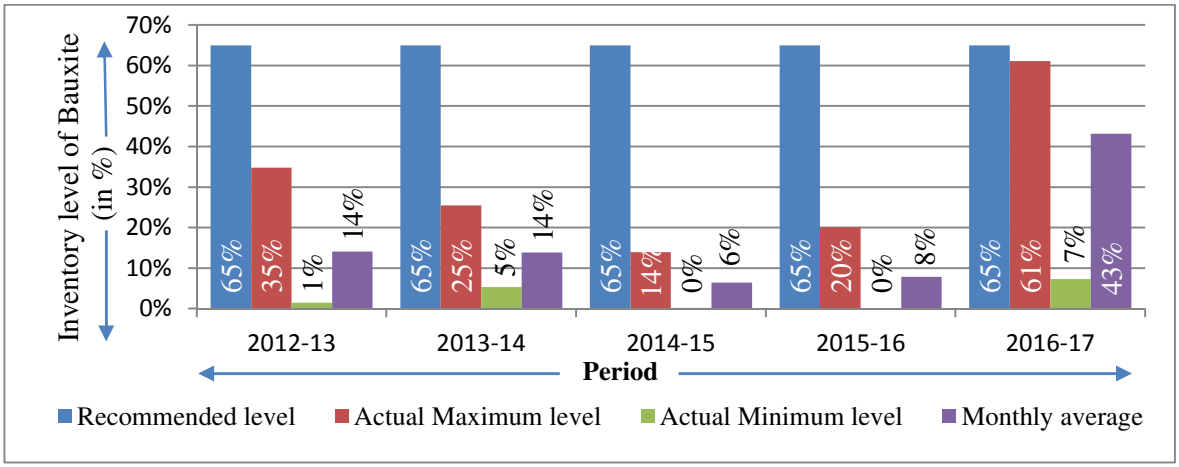
The Ministry further stated (July 2018) that these differences were due to unintentional wrong entry of the figures and informed that necessary care is being taken and figures are being cross checked to avoid aforesaid differences

2.1.4 Inadequate blending of Bauxite at Refinery

The stockyard of Bauxite at Refinery consisted of five stockpiles with a maximum capacity of 1.65 lakh tonnes each. The Bauxite with variant silica content received at Refinery from the Mines was stacked in the stockyard in horizontal layers. In order to minimise the variations in silica content in the Bauxite to be fed to the Refinery, the stacked Bauxite was reclaimed vertically for proper blending. An ideal stock of about 65 *per cent* of the stockpile capacity (1.07 lakh tonnes) was required to be maintained to facilitate the above process of blending.

Audit, however, observed that due to lower production of Bauxite in the Mines, the required stock level of 65 *per cent* could not be maintained in the Refinery stockyard during the period 2012-13 to 2016-17. The position of stock level at the Refinery end is depicted below:

Chart 5: Year-wise inventory level of Bauxite at Refinery stockyard.



The actual average stock level ranged from 6 *per cent* (2014-15) to 43 *per cent* (2016-17) only with the minimum monthly average stock level of only 41 tonnes (April 2015) in all the five stockpiles as a whole. Thus, the Company was unable to blend the Bauxite with variant silica content for feeding Bauxite to the Refinery with even silica content. As a result, the consumption of Caustic Soda during the period 2012-13 to 2014-15 ranged from 87.36 kg per tonne to 102.82 kg per tonne against the norms of 72 kg per tonne. The consumption of Caustic Soda during the year 2015-16 was 106.05 kg per tonne against the norms of 100 kg per tonne. This led to excess consumption of 1.46 lakh tonnes of Caustic Soda in the Refinery during the

period 2012-13 to 2015-16 for which the Company had to incur additional expenditure of ₹426.27 crore **(Annexure I)**.

Moreover, such continuous feeding of Bauxite with variant silica content to the Refinery also resulted in lower extraction of Alumina Hydrate from the Bauxite than norms and the un-extracted portion of Bauxite was passed to the Red Mud pond. This led to higher consumption of 12.76 lakh tonnes of Bauxite in the Refinery for production of 96.31 lakh tonnes of Alumina Hydrate during the period 2012-13 to 2016-17. In this connection it is worth mentioning that the Process licensor had also indicated (November 2015) that non-maintenance of required stock level at the Refinery end resulted in almost zero blending. This caused continuously varying grade of Bauxite being fed to the Refinery and could be one of the main reasons for higher consumption of Bauxite and Caustic Soda.

The Management stated (April 2018) that blending of Bauxite at low stock situation was not a problem and moreover, the primary blending takes place before primary crushing at Mines itself. The Management further stated that the apprehension of high consumption of Caustic Soda and Bauxite as a result of improper blending was totally wrong and unfounded as there was no change in chemical composition of Bauxite during blending. The Ministry also endorsed (July 2018) the above views of the Management.

The reply of the Management/Ministry regarding blending of Bauxite in the Mines itself was not tenable because there was very limited blending capacity in the Mines and the Process Licensor (M/s RIO Tinto Alcan) had advised for achieving the blending in the Refinery. The Management's further reply on excess consumption of Caustic Soda and Bauxite was also not acceptable as the Process Licensor had already brought out that the main reason for higher consumption was non-maintenance of required stock level at the Refinery end.

2.1.5 Excess consumption of fuel oil in Calciners

The Aluminium Hydrate produced from the Bauxite was further processed in the Calciner Plant (Calciners) of the Refinery for production of Calcined Alumina[11]. It was

[11] ***Calcined Alumina is produced by heating Alumina Hydrate wherein it losses moisture to form Alumina crystals.***

seen that the Calciners were operated with lower load due to corresponding lower production of Alumina Hydrate in the Refinery. This low load operation of Calciners resulted in higher consumption of Fuel Oil than the norms. The actual consumption of Fuel Oil ranged between 77.56 litres per tonne and 78.88 litres per tonne against the norms of 77 litres per tonne. The excess consumption of Fuel Oil worked out to 11,719 kilo litres during the period 2012-13 to 2016-17, for which the Company incurred additional expenditure of ₹34.73 crore[12] **(Annexure II).**

The Management stated (April 2018) that reason for low capacity utilisation of Calciners was because of increased demand for Alumina Hydrate before calcination as well as unsteady off-take of Calcined Alumina leading to abrupt load restrictions and stoppages of Calciners. The Ministry also endorsed the above views of the Management.

The reply of the Management/ Ministry is not tenable as sale of Alumina Hydrate was negligible as it was ranging between 0.63 *per cent* (2013-14) and 1.11 *per cent* (2016-17) of the total production for the above period.

2.2 Delay in Technology Upgradation

In view of deteriorating Bauxite quality over the years, the Company felt (May 2011) that existing mud handling equipment of the Refinery were inadequate to meet the production requirement and thereby reducing the refining capacity. It was, therefore, envisaged (May 2011) to suitably upgrade the existing mud handling equipment with old ball mills and install High Rate Decanter and Deep Cone Washer (HRD&DCW). It was also proposed to carry out a detailed study/ re-engineering in this regard with the help of an engineering consultant to identify the upgradation required. The matter was discussed (November 2014) with the Process Licensor for a processability study with a view to assess the Refinery performance with the future Bauxite feed. The work order for such study was accordingly awarded to the Process Licensor in February 2016 and the study Report was submitted in December 2016. The Company in the meantime estimated (December 2015) that the proposed installation of HRD&DCW in the three out of four streams of the Refinery at an investment of ₹355 crore would accrue an annual savings of ₹75.45 crore. It was, however, seen that the order for consultancy

[12] ***On the basis of annual average purchase price of Fuel Oil per kilo litre.***

services for installation of HRD&DCW was awarded in April 2017 with a completion schedule of 50 months.

Audit observed that the Management was well aware since May 2011 that installation of HRD&DCW was required in the three streams of the Refinery to overcome the problems associated with the mud handling activities in view of deteriorating Bauxite quality. However, the Company took 57 months [13] for placement of order for processability study. Thus, there was inordinate delay in taking a final decision for carrying out processability study for installation of HRD&DCW and this was not justified considering the magnitude of financial savings that could have been accrued.

The Management stated (April 2018) that even without HRD&DCW, streams 1, 2 and 3 had exceeded the rated capacity in several years with the conventional settlers. It was also stated that there has been no delay and actions were taken with best economic interest and with minimum specific consumption of Caustic Soda and hence, the losses indicated did not actually occur.

The reply of the Management is not tenable as the Company itself felt and proposed (May 2011) for installation of HRD&DCW in the three streams of the Refinery which would have led to accruing of financial savings. The Process licensor had also opined (February 2014 and November 2014) for installation of HRD&DCW in the Refinery.

Audit Summation

The production of Alumina Hydrate in the Refinery was lower than the targets primarily due to corresponding lower production of Bauxite in the Mines. The Silica content in the Bauxite was higher than planned, which had adverse impact in the quality of Bauxite fed to the Refinery. The Company did not maintain required stock level of Bauxite at Refinery due to lower production of Bauxite at Mines. This led to inability of the Company to feed Bauxite with even Silica content to the Refinery and resulted in excess consumption of Bauxite as well as Caustic Soda. The Company also made inordinate delay in taking decision for carrying out processability study and technological upgradation.

[13] *May 2011 to February 2016*

CHAPTER 3:
SMELTER AND CAPTIVE POWER PLANTS

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The Calcined Alumina produced in the Refinery was processed[14] in the Smelter Plant at Angul for production of metallic Aluminium. The Smelter Plant was commissioned (1987) with an installed capacity of 2.18 lakh tonnes per annum (TPA) for production of Aluminium. The capacity of the Smelter Plant was enhanced to 3.45 lakh TPA (2003-04) and finally to 4.6 lakh TPA (2009-10) in two phases.

Picture 5: Captive Power Plant at Angul

Production of Aluminium in the Smelter Plant required continuous and uninterrupted power supply on a sustainable and reasonable cost basis. The Company, therefore, setup a coal based Captive Power Plant (CPP) at Angul, Odisha with an installed capacity of 600 Mega Watt (MW). The capacity of the CPP was also increased to 960 MW (2004-05) and subsequently to 1200 MW (2010-11) in two phases to meet the enhanced power requirement of the Smelter Plant.

3.1 Lower Capacity utilisation of Smelter Plant

The Government of India (GoI) allotted (August 2004) Utkal-E block at Talcher, Odisha to the Company to meet the additional requirement of coal for CPP towards its capacity expansion from 960 MW to 1200 MW. Complete synchronisation between the captive coal mining operations and the development of end use plants (Smelter Plant) was one of the major conditions for allocation of the coal block to the Company. It was also mentioned that in the event of unsatisfactory progress in implementation of the coal mining project or the proposed end user projector both, the allocation might be cancelled. The production of coal from the above captive coal block was scheduled to be commenced from February 2008 in line with the projected capacity expansion of the CPP and Smelter Plant.

[14] *Aluminium is produced by extracting Aluminium from Calcined Alumina through an electrolytic process.*

Audit observed that the development of the captive coal block got delayed due to various reasons like delay in submission of modified mining lease map to the concerned Authorities, delay in deputation of surveyor and non-appointment of Mining Developer-cum-Operator. Due to such delays, the scheduled date of coal production was revised from February 2008 to June 2012. However, the Company failed to adhere to the revised target date of coal production and the above captive coal block was ultimately de-allocated in September 2014. The same was again re-allotted by the GoI along with another coal block (Utkal-D) to the Company in September 2015. It was, however, seen that both the above captive coal blocks were yet to be developed for production of coal therefrom (March 2018).

The Smelter Plant comprised of 960 pots[15] in 4 potlines and generally 935 pots were operated at a time. It was observed that the average number of pots in operation ranged from 648 pots to 842 pots during the period 2012-13 to 2016-17, due to non-availability of adequate power supply from the CPP for want of required coal. As indicated in Table 1 Para 1.3, the capacity utilisation of the CPP ranged from 54 *per cent* to 65 *per cent.*

Picture 6: Smelter Plant at Angul

It was seen that the annual production of Aluminium in the Smelter Plant was lower than its installed capacity of 4.60 lakh TPA and the production ranged from 3.16 lakh tonnes to 4.03 lakh tonnes during the period 2012-13 to 2016-17.

Thus, there was lower production of 4.93 lakh tonnes of Aluminium during the above period for which the Company lost the opportunity of earning contribution[16] amounting to ₹1086.63 crore[17] (**Annexure III**). Moreover, the Company could not reap the full benefits of the capacity expansion of CPP[18] and Smelter Plant[19] after investing ₹2,986 crore.

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[15] ***An Aluminium Smelter mainly consists of a large number of cells or pots in which molten Aluminium is produced from Calcined Alumina through the electrolysis process.***

[16] ***Sales minus variable cost.***

[17] ***Loss of contribution calculated in the methodology adopted by the Management for the same in its letter no. NBC/ED (P)/2014/741 dated 04.08.2014 addressed to Ministry of Mines.***

[18] ***Capacity expansion from 960 MW to 1200 MW.***

[19] ***Capacity expansion from 3.45 lakh TPA to 4.60 lakh TPA.***

The Management while accepting the delay in development of captive coal blocks stated (April 2018) that continuous follow up and monitoring was being done for opening of coal blocks. It was also stated that production of Aluminium in Smelter Plant was restricted keeping in view the availability of economical power from CPP. Ministry also endorsed (July 2018) the views of the Management.

3.2 Excess consumption of Calcined Alumina in production of Aluminium

As per the norms fixed by the Process Licensor, 1,924 kg of Calcined Alumina was required for production of one tonnes of hot metal of Aluminium. It was seen that during 2012-13, 2013-14 and 2016-17 the actual consumption of Calcined Alumina was more than the above norms which led to excess consumption of 16,522 tonnes of Calcined Alumina valuing ₹31.13 crore (**Annexure IV**). The major reason for such excess consumption of Calcined Alumina was operation of pots in lower amperage[20] due to inadequate power supply.

Both the Management and the Ministry while accepting the higher consumption of Calcined Alumina stated (August 2018) that the same was due to fluctuation/ disturbance of power during potline operations.

3.3 Consumption of Fuel oil in the Bake oven plants

Fuel Oil (FO) was used in Bake Oven plants of Smelter Plant for baking[21] of anodes. There were three Bake Oven plants and for each plant the Company had fixed norms for consumption of Fuel Oil. It was seen in audit that the actual specific consumption of Fuel Oil in all the three Bake Oven plants was higher than their respective norms during the period 2012-13 to 2016-17, excepting for the Bake Oven Plant-1 in 2012-13. This led to excess consumption of 3,619 kilolitres of FO valuing ₹10.71 crore (**Annexure V**). The major reason for higher specific consumption of FO in Bake Oven plants was higher rejection of baked anode due to deteriorated flue wall condition of Bake Oven plants.

The Management (April 2018) and Ministry (July 2018) accepted the audit observation.

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[20] ***The strength of electrical current needed to make a piece of electrical equipment work properly***

[21] ***Anodes made up of petroleum coke and coal-tar-pitch needs to be baked in a Bake Oven Plant before using the same in the Potlines for electrolysis process.***

3.4 Loss due to excess Station Heat Rate in CPP

Station Heat Rate (SHR) indicates quantum of heat energy (Kcal[22]) required to generate one unit (KWh[23]) of electrical energy at generator terminals of a thermal power plant. Audit observed that during the period 2012-17 the actual SHR of the CPP of the Company was higher than the SHR norms of 2,615 Kcal per KWh resulting in excess consumption of coal valuing ₹326.62 crore **(Annexure VI).** The higher SHR was mainly due to high dry flue gas loss and un-burnt carbon loss in ash.

The Management (April 2018) and the Ministry (July 2018) while accepting the audit observation stated that despite taking various proactive measures the actual SHR was 2,689 Kcal per KWh in May 2018.

3.5 Loss due to Grade slippage of coal

The Company entered into Fuel Supply Agreements (FSAs) with Mahanadi Coalfields Limited (MCL) for procurement of coal for its CPP at Angul and Refinery at Damanjodi. As per the provisions of the FSAs the Company could avail the facility of joint sampling of coal at the colliery siding/ loading point for determination of grade of coal. It was seen that in absence of any joint sampling of coal at such loading point, the grade of coal supplied was determined on the basis of sampling done by MCL at the loading point and the invoices for supply of coal were raised accordingly. Scrutiny of the records revealed that the actual grades of coal received were inferior to the grades invoiced by MCL and the Company had to bear an additional expenditure of ₹239.23 crore **(Annexure VII)** towards grade slippage of coal procured during the period 2012-13 to 2016-17. Audit observed that in absence of joint sampling of coal at the loading point, the Company could not ensure that the invoices of coal were raised for the grades actually delivered by MCL.

Picture 7: Coal Stacker cum reclaimer

[22] *Kilo Calories*
[23] *Kilo Watt Hour*

The Management while accepting the fact of grade slippage stated (April 2018) that there was no provision in the FSA for claiming any compensation towards deviation in quality of coal supplied.

The reply of the Management is not relevant as the question of claiming any compensation towards grade slippage does not arise, if grade slippage was arrested through joint sampling of coal as per the provisions of FSA.

The Ministry, however, stated (July 2018) that third party sampling has been started since April 2018.

Audit Summation

The Company could not develop the coal blocks allotted, leading to underutilisation of Captive Power Plant, which further caused sub-optimal operations of potlines in the Smelter. Due to such sub-optimal operation of Smelter, there was lower production of 4.93 lakh tonnes of Aluminium during the period 2012-13 to 2016-17 with consequential loss in opportunity to earn contribution amounting to ₹1086.63 crore. Moreover, the Company could not reap the full benefits of the capacity expansion of CPP and Smelter despite having made a substantial investment. The actual consumption of Calcined Alumina in the potlines and Fuel oil in the Bake Oven Plants was higher than the respective norms for consumption. Further, the actual Station Heat Rate of the CPP was higher than the norms, which resulted in excess consumption of coal. The Company also did not exercise its option for joint sampling of coal, due to which it could not arrest grade slippage of coal supplied to the Refinery and Captive Power Plant.

CHAPTER 4: ENVIRONMENTAL ISSUES

Chapter4: ENVIRONMENTAL ISSUES

4.1 Non-compliance of the Environmental conditions during transportation of Bauxite

The Company during submission of application for Environmental Clearance (EC) of South Block Mines proposed (October 2010) that there would be an in-pit crusher and conveyor system to crush the Bauxite to be produced from the South Block Mines within the working area and transport the crushed Bauxite to long distance/downhill cable belt conveyor, through a dedicated conveyor system. It was further clarified that in-pit transportation of overburden and Bauxite will be done by Dumpers, whereas the conveyor will transport crushed Bauxite from the in-pit crusher. In the above proposal the mining operation was to commence from the year 2019-20 with the removal of overburden, whereas excavation of Bauxite was to commence from the year 2021-22. Based on the proposal, EC was granted (February 2011) by the Ministry of Environment, Forest and Climate Change (MoEF & CC) the Company for operation of South Block Mines. In the meantime, Consent to Establish (CTE) was granted (October 2010) by Odisha State Pollution Control Board (OSPCB) for production of Bauxite from South Block Mines with a condition that the Bauxite would be transported by cable conveyor belt from South Block Mines to the Refinery. The condition of transportation of Bauxite by conveyor to the Refinery was again reiterated (December 2016) by the OSPCB while granting Consent to Operate (CTO) for South Block Mines. In this context it may be stated that use of Dumpers instead of Conveyor belt would increase pollution by emitting excess dust, smoke and sound in comparison to the Dumpers.

In the meantime, due to increase in silica content in the Bauxite the specific consumption of Bauxite for production of one tonnes of Alumina Hydrate had increased from 3 tonnes to 3.25 tonnes. This required excavation of additional 6 lakh tonnes of Bauxite per annum to meet the requirement of Alumina Refinery. The Company decided to prepone the excavation of Bauxite from the South Block Mines to the year 2016-17 instead of the planned timeline of 2021-22.

Audit, observed that this decision to prepone excavation from South Block mine compelled the Company to transport (December 2017) excavated Bauxite from the

mine faces to the adjoining Central and North Block Mines by Dumpers for crushing and onward transportation to the Alumina Refinery, as the conveyor was not ready. This was a non-compliance of the conditions of EC granted by MoEF & CC and CTE/CTO granted by OSPCB. Further, for transportation of Bauxite from South Block Mines, the Company awarded the contract of ₹3.90 crore for deployment of Dumpers for six months and the deployment is still continuing. Against the contract, the Company had already incurred an expenditure of ₹3.48 crore for the period January 2018 to June 2018.

The Management stated (April 2018) that although it was envisaged in Environment Impact Assessment (EIA) report to crush and transport excavated Bauxite from South Block to the crusher house of Central and North Block by a semi-mobile crusher and a dedicated conveyor system, transportation of Bauxite from Mines to Refinery through cable conveyor belt has only been mentioned in the EC, CTE and CTO granted for South Block mine, which has been approved by IBM. The Ministry also endorsed (July 2018) the views of the Management.

The reply of the Management/Ministry is not acceptable as the IBM is not the authority for waiver of the conditions specified in the EC, CTE and CTO clearances.

4.2 Discharge of Red Mud and Red Mud Pond Effluent beyond norms

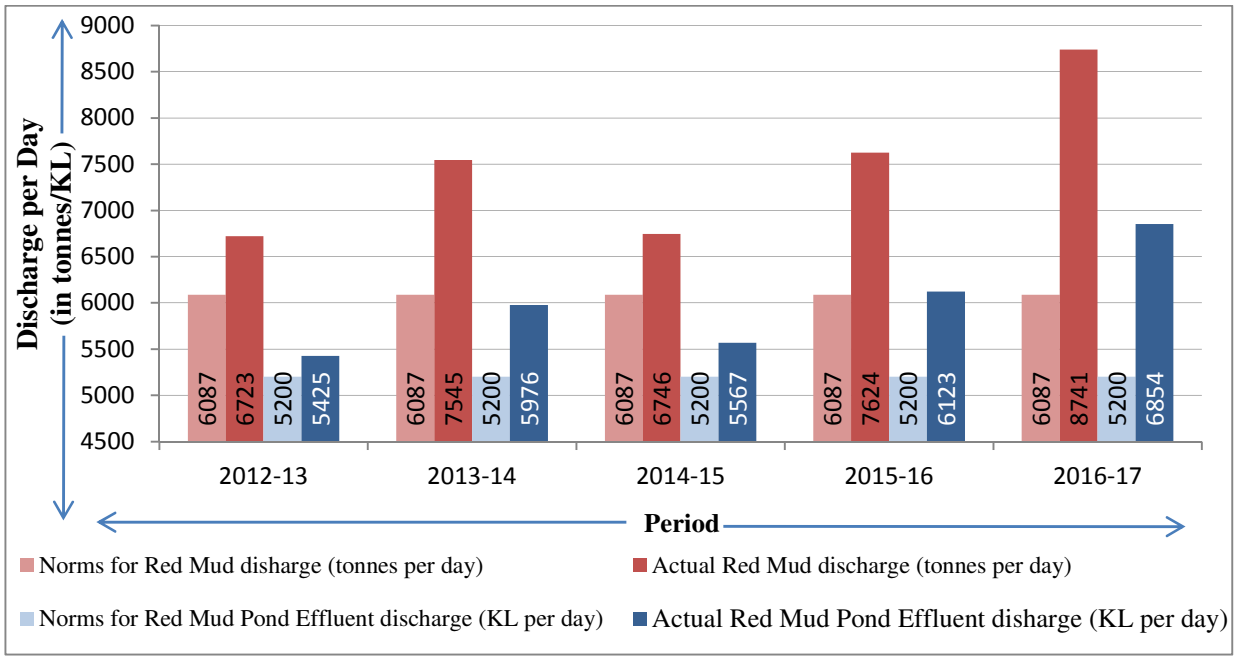
The Company was granted (May 2010) EC for enhancing the production capacity of the Refinery from 21 lakh tonnes per annum (TPA) to 22.75 lakh TPA of Alumina Hydrate. Bauxite (68.25 lakh TPA), Caustic Soda (1.62 lakh TPA), Coal (14.35 lakh TPA), Heavy Fuel Oil (1.84 lakh kilo litres per annum) and Lime (0.46 lakh TPA) was to be used as a raw material, as specified in the EC.

Audit, however, observed that during 2016-17 the Company had produced 21 lakh tonnes of Alumina Hydrate by processing 69.30 lakh tonnes of Bauxite against approved quantity of 68.25 lakh tonnes. Thus, the Company has violated the EC norms by utilising Bauxite more than the permitted level.

Audit also observed that during the period 2012-13 to 2016-17, OSPCB while granting CTO stipulated the limit of daily disposal of Red mud and Red mud pond effluent from the Refinery. As per CTO, the Company cannot change or alter either the quality or

quantity of the rate of discharge without the previous approval of the OSPCB. In case of non-compliance of any order/directive of the OSPCB and/or violation of the terms and conditions of the CTO, the Company would be liable for legal action as per the provisions of the Law/Act. Audit observed that during the period 2012-13 to 2016-17, the actual discharge of Red Mud ranged from 6,723 tonnes per day to 8,741 tonnes per day against the permitted limit of 6,087 tonnes per day. Similarly, the actual discharge of Red Mud Pond Effluent ranged from 5,425 kilo litres (KL) per day to 6,854 KL per day during the above period against the permitted limit of 5,200 KL per day. Year wise actual discharge of Red Mud and Red Mud Pond Effluent is presented the following Chart. Thus, the Company violated the conditions of CTO by consistently discharging Red Mud and Red Mud Pond Effluent higher than the limit specified by the OSPCB.

Chart 6: Red Mud Pond discharge



Source: CTO from OSPCB ad Monthly Progress Report of Company

The Management while accepting that the consumption of Bauxite was more than that permitted in EC during 2016-17 contended (April 2018) that the raw material quantity specified in the EC may vary due to change in quality but the production quantity and pollution parameters should not be breached.

The reply of the Management is not tenable as EC does not include any such provision regarding flexibility in increasing the permissible limit of usage of Bauxite. The Management was however, silent about higher discharge of red mud pond effluent.

While endorsing the view of the Management, the Ministry stated (July 2018) that the CTO conditions outlines the mode of disposal of red mud which were strictly adhered to. The Ministry further stated that the Company has been submitting the actual quantities of red mud disposed to the OSPCB by filing annual returns.

The contention of the Ministry is not tenable because the CTO conditions not only outlined the mode of disposal of red mud, but the quantity of effluent to be discharged was also specified, which the Company could not comply with. Moreover, submission of annual returns to OSPCB does not absolve the Company from the responsibilities of complying with the pollution control norms.

4.3 Excess consumption of Fluoride in the Smelter Plant

Under Corporate Responsibility for Environment Protection (CREP), the MoEF & CC, in order to reduce the emission of Fluoride, fixed (December 2005) the target of consumption of Fluoride[24] for Smelter Plant as 10 kg per tonne of Aluminium produced. Test check of half yearly reports of the Company, during the period 2012-13 to 2016-17, revealed that consumption of Fluoride ranged between 12 kg per tonne and 12.9 kg per tonne which was more than the CREP target of 10 kg per tonne. Thus, the Company continuously failed to achieve the target of Fluoride consumption.

Also as required under CREP, forage Fluoride[25] content was to be maintained within 40 ppm[26] (annual average) and 60 ppm (average for two consecutive months). It was, however, observed that the Company was taking and analyzing the samples for forage Fluoride only on quarterly basis. The reports of such quarterly samples showed that the results ranged from 42.83 ppm to 72.33 ppm, which were above the norms for annual average. Moreover, it could not be appreciated how the bi-monthly averages could be worked out if the Company was only taking the readings on quarterly basis. The reasons for not taking monthly samples were not found on record.

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[24] ***Fluoride as elementary Fluorine (F)***

[25] ***Forage and grasses growing near industrial areas are often contaminated by fluoride-rich industrial effluents or by windblown or rain-splashed soil having a high fluoride concentration.***

[26] ***ppm stands for parts per million***

The Management in its reply (April 2018) stated that achievement of Fluoride consumption target was not technically feasible with their present setup. Since April 2004, sampling of forage Fluoride is being done on quarterly basis by Smelter Plant and reports of the same are submitted regularly to the OSPCB who did not object.

The Ministry while endorsing the view of the Management further added (July 2018) that monthly sample analysis of forage Fluoride has been started from April 2018.

4.4 Under-utilisation of fly ash in the Captive Power Plant

As per the notification of November 2009 issued by MoEF & CC, the target of utilisation of fly ash generated by the CPP of the Company was fixed so as to progressively[27] increase from 50 *per cent* to 100 *per cent* within a period of the five years from the date of the notification, i.e. by October 2014. The notification further stipulated that the unutilised fly ash in relation to the target during a year, if any, shall be utilised within next two years in addition to the targets stipulated for those years and the balance unutilised fly ash which accumulated during first five years (the difference between the generation and the utilisation target) shall be utilised progressively over the next five years in addition to 100 *per cent* utilisation of current generation of fly ash.

Picture 8: Ash Pond of Captive Power Plant at Angul

Audit, however, observed that the actual utilisation of fly ash generated during the period 2012-13 to 2016-17 was lower than the target and ranged between 24 *per cent* and 72 *per cent*. The OSPCB charged water cess at a higher rate due under utilisation of fly ash and the Company incurred additional expenditure of ₹0.82 crore during the above period towards payment of such higher water cess.

[27] ***First year- At least 50 per cent, Second year – at least 60 per cent, Third Year at least 75 per cent, Fourth year – at least 90 per cent and Fifth year – 100 per cent.***

The Management while accepting the audit observation stated (April 2018) that various steps had been taken to maximize ash utilisation. The Ministry also endorsed (July 2018) the views of the Management.

Audit Summation

The transportation of excavated Bauxite in South Block Mines by dumpers to the crushers in Central and North Block Mines, instead of transporting the same through the conveyor belt was not in conformity with the conditions of Environmental Clearance granted for operation of South Block Mines.

The discharge of Red Mud and Red Mud Pond Effluent at the Alumina Refinery were consistently higher than the corresponding limits specified by the Odisha State Pollution Control Board during the period 2012-13 to 2016-17.

The Company continuously failed to achieve the Corporate Responsibility for Environment Protection (CREP) target of Fluoride consumption of 10 kg per tonne at the Aluminium Smelter.

The actual utilisation of fly ash generated during the period 2012-13 to 2016-17, at the Captive Power Plant was lower than the target and ranged between 24 *per cent* and 72 *per cent*.

CHAPTER 5:
CONCLUSION AND RECOMENDATIONS

Chapter 5: CONCLUSION AND RECOMENDATIONS

The production from the Refinery, Smelter and Captive Power Plant of the Company remained lower than the respective capacities throughout the period 2012-13 to 2016-17. The lower capacity utilisation of the Refinery was due to corresponding lower production of Bauxite from the Mines, coupled with slippage in the quality of the Bauxite so excavated. There was a shortfall of production of 11.04 lakh tonnes of Alumina Hydrate in the Refinery during the above period. Lower production of Bauxite in the Mines was mainly attributed to (a) Inadequate operations of Heavy Earth Moving Machineries, (b) Under-utilisation of Semi Mobile Crusher Plant and Fixed Long Distance Conveyor, (c) Delay in adopting the IBM guidelines regarding revision in cut-off grade of Bauxite and (d) Delay in filing application for renewal of Forest Clearance of Mines. Slippage in quality of Bauxite so excavated was primarily due to (a) Non-compliance with the Blending scheme of Monthly Mine Production Plan, (b) Non implementation of measures to improve Bauxite quality, (c) Inadequate removal of overburden and (d) Discrepancy in Monthly Deviation Report of Mines.

Due to lower production of Bauxite in the Mines, the company could not maintain the required stock level of Bauxite in the Refinery Stockyard during the period 2012-13 to 2016-17. The Company, therefore, was not able to blend the Bauxite with varying Silica content for feeding to the Refinery with even Silica content. This led to excess consumption of 1.46 lakh tonnes of Caustic Soda in the Refinery during the period 2012-13 to 2015-16, for which the Company had to incur additional expenditure of ₹426.27 crore.

The Company was not able to develop the captive coal block allotted to it for supply of required coal to its Captive Power Plant towards generation of power. Due to shortfall in generation of power at Captive Power Plant, the actual number of pots in operation ranged from 648 pots to 842 pots against 935 pots generally operated. As a result, the production of Aluminium in the Smelter Plant was lower by 4.93 lakh tonnes than the target during the period 2012-13 to 2016-17. The Company, therefore, lost the opportunity of earning contribution of ₹1086.63 crore for such lower production of Aluminium during the above period.

There were deviations in complying with the Environmental norms prescribed by MoEF & CC and OSPCB in the following areas, such as (a) discharge of excess red mud and red mud pond effluent in the Refinery than permitted, (b) consumption of excess fluoride per unit of Aluminium produced and excess emission of forage Fluoride in the Smelter Plant, and (c) lower utilisation of fly ash generated in the Captive Power Plant.

Recommendations

1. The Management may constantly monitor the position and deployment of skilled Heavy Earth Moving Machine operators so that, in future, production from Mines is not affected.
2. Balance pre-production drilling activity may be completed expeditiously so that quality and quantity of Bauxite are properly assessed before preparing annual and monthly mine production plan.
3. Removal of the top soil and the laterite overburden may be carried out as per the IBM approved mining plan. Clearance of the backlog would help to get more options for quality control and blending of Bauxite.
4. The Management may maintain adequate level of Bauxite in stockpile to reduce the variation in Bauxite quality before feeding to the Refinery.
5. The allotted Coal Blocks may be developed at the earliest to ensure supply of coal to the Captive Power Plant.

Response of the Ministry of Mines on the audit recommendations:

The Ministry of Mines was in agreement with all the Recommendations.

New Delhi
Dated: 24 June 2019

(VENKATESH MOHAN)
Deputy Comptroller and Auditor General
(Commercial)

Countersigned

New Delhi
Dated: 24 June 2019

(RAJIV MEHRISHI)
Comptroller and Auditor General of India

APPENDICES

Appendix
(Refer Para No. 2.1.2.1)
Major HEMM used in the Mines of the Company

Sl. No.	Name of HEMM	Utility	Pictorial representation
1.	Dumpers	Haulage of excavated overburden and Bauxite	
2.	Wheel Loaders	Loading of overburden and Bauxite on Dumpers	
3.	Ripper Dozers	Loosening of overburden and Bauxite	
4.	Back Hoe Excavators	Excavation and loading of Bottom Bauxite	
5.	Blast Hole Drills	Drilling of bore hole for blasting for loosening of overburden and Bauxite	
6.	Exploratory drill	Drilling of pre-production boreholes	

ANNEXURES

Annexure I

Statement showing additional expenditure towards Caustic Soda

Year	Production of Hydrate (tonnes)	Total caustic soda consumption (kg/tonne)			Total excess consumption (in tonnes)	Purchase price of caustic soda (₹/tonne)	Extra Expenditure (₹ in crore)
		Norms	Actual	Excess over norms			
(A)	(B)	(C)	(D)	(E)=(D-C)	(F)=(E*B)/1000	(G)	(H)=(F*G)/10^7
2012-13	1,802,000.00	72.00	87.36	15.36	27,678.72	29,650.00	82.07
2013-14	1,925,000.00	72.00	97.70	25.70	49,472.50	30,360.00	150.20
2014-15	1,851,000.00	72.00	102.82	30.82	57,047.82	28,160.00	160.65
2015-16	1,953,000.00	100.00	106.05	6.05	11,815.65	28,230.00	33.36
Total					**146,014.69**		**426.27**

Annexure II
(Refer Para No. 2.1.5)

Statement showing additional expenditure towards Fuel Oil

Year	Consumption of fuel oil (litre/tonne)		Excess Consumption over norms (ltr/tonne)	Production of Calcined Alumina (in tonnes)	Total Excess consumption (KL)	Average purchase price of fuel oil (₹/KL)	Extra Expenditure (₹ in crore)
	Norms	Actual					
(A)	(B)	(C)	(D)=(C-B)	(E)	(F) = (E*D)/1000	(G)	(H) =(E*F)/10^7
2012-13	77.00	77.56	0.56	1,762,700.00	987.11	40,344.80	3.98
2013-14	77.00	77.76	0.76	1,912,600.00	1,453.58	40,783.01	5.93
2014-15	77.00	78.88	1.88	1,826,500.00	3,433.82	34,943.29	12.00
2015-16	77.00	78.11	1.11	1,910,000.00	2,120.10	20,997.14	4.45
2016-17	77.00	78.83	1.83	2,032,500.00	3,719.48	22,505.28	8.37
Total					**11,714.08**		**34.73**

Annexure III

(Refer Para No. 3.1)

Calculation of loss of opportunity to earn contribution due to lower operation of Smelter Plant

Sl. No.	Particulars	2012-13	2013-14	2014-15	2015-16	2016-17	Total (₹ in crore)
(A)	Sales Realisation from Auminium Metal (Ingot) (in ₹ per tonne)	122,925.59	125,329.31	140,592.61	115,783.54	122,783.72	
	Variable Cost (₹ per tonne)						
(B)	Variable cost of Hot Metal used	96,774.01	95,170.00	91,559.62	88,965.89	91,977.88	
(C)	Cost of other input materials	659.28	1,650.11	1,396.83	717.03	681.45	
(D)	Fuel	534.00	521.97	430.47	268.68	321.85	
(E)	Utilities	162.02	206.11	173.50	149.54	141.29	
(F)	Direct Expenses	104.17	96.02	108.59	46.33	45.51	
(G)	Packaging Cost	298.09	294.26	65.94	75.07	61.80	
(H)=(B+C+D +E+F+G)	Total variable cost of Ingot (in ₹ per tonne)	98,531.57	97,938.47	93,734.95	90,222.54	93,229.78	
(I)=(A-H)	Contribution (in ₹ per tonne)	24,394.02	27,390.84	46,857.66	25,561.00	29,553.94	
(J)	Sales Margin on Calcined Alumina (in ₹ per tonne)	4,327.75	4,569.11	6,466.04	5,217.73	5,397.12	
(K)	Specific Consumption of Alumina (in tonne)	1.972	1.940	1.931	1.937	1.945	
(L)=(J*K)	Margin of Alumina in Aluminium metal produced (in ₹ per Tonne)	8,534.32	8,864.07	12,483.34	10,106.74	10,497.40	

(M)=(I-L)	Incremental (in ₹ per Tonne)	15,859.70	18,526.77	34,374.32	15,454.26	19,056.54	
(N)	Total capacity (in tonnes)	460,000.00	460,000.00	460,000.00	460,000.00	460,000.00	
(O)	Capacity utilisation (in tonnes)	403,384.00	316,492.00	327,070.00	372,183.00	387,422.00	
(P)=(N-O)	Shortfall in production (in tonnes)	56,616.00	143,508.00	132,930.00	87,817.00	72,578.00	
(Q)=(P*M)/ 10^7	**Loss of Contribution (₹ in crore)**	**89.79**	**265.87**	**456.94**	**135.71**	**138.31**	**1,086.63**

Notes:

Loss of contribution calculated in the methodology adopted by the Management for the same in its letter no. NBC/ED(P)/2014/741 dated 04.08.2014 addressed to Ministry of Mines.

Annexure IV

(Refer Para No. 3.2)

Statement showing excess consumption of Calcined Alumina

Year	Actual Production of hot metal (tonnes)	Total consumption of Alumina (tonnes)	Actual Specific Consumption of Alumina (tonnes)	Norms for consumption of Alumia per Tonnes of hot metal (tonnes)	Excess consumption over norms per Tonnes of hot metal (tonnes)	Total excess consumption (tonnes)	Sales price of alumina (₹ per tonne)	Loss due to excess consumption (₹ in crore)
(A)	(B)	(C)	(D)	(E)	(F)=(D-E)	(G)=(F*B)	(H)	(I)=(G*H)/10^7
2012-13	406,482	795,387	1.957	1.924	0.033	13,315.63	18,612.38	24.78
2013-14	318,544	613,943	1.927	1.924	0.003	1,064.34	19,539.62	2.08
2014-15	329,511	631,453	1.916	1.924	-	-	21,399.93	-
2015-16	374,903	720,880	1.923	1.924	-	-	19,093.87	-
2016-17	390,467	753,401	1.929	1.924	0.005	2,142.49	19,896.12	4.26
Total						**16,522.47**		**31.13**

Annexure V
(Refer Para No. 3.3)

Excess consumption of FO over Norms in 'Bake Oven' Plants

Plant	Particulars		2012-13	2013-14	2014-15	2015-16	2016-17	Total
Bake Oven-1	Production (tonnes)	(A)	86,793.00	61,962.00	60,969.00	90,918.00	94,019.76	
	FO consumption Norms (ltrs/Tonne)	(B)	65.00	65.00	65.00	65.00	65.00	
	Actual consumption (ltrs/tonne)	(C)	65.00	68.00	66.00	72.00	68.80	
	Excess consumption (ltrs/tonne)	(D)=(C-B)	-	3.00	1.00	7.00	3.80	
	Excess consumption (KL)	(E)=(D*A)/1000	-	185.89	60.97	636.43	357.28	**1,240.56**
Bake Oven-2	Production (tonnes)	(F)	76,060.00	66,014.00	68,141.00	81,401.00	103,734.00	
	FO consumption Norms (ltrs/tonne)	(G)	54.00	54.00	54.00	54.00	54.00	
	Actual consumption (ltrs/tonne)	(H)	60.00	59.00	56.00	59.00	58.70	
	Excess consumption (ltrs/tonne)	(I)=(H-G)	6.00	5.00	2.00	5.00	4.70	
	Excess consumption (KL)	(J)=(I*F)/1000	456.36	330.07	136.28	407.01	487.55	**1,817.27**
Bake Oven-3	Production (tonnes)	(K)	77,065.00	65,796.00	67,867.00	50,944.00	34,982.00	
	FO consumption Norms (ltrs/tonne)	(L)	54.00	54.00	54.00	54.00	54.00	

	Actual consumption (ltrs/tonne)	(M)	56.00	56.00	54.00	57.00	57.50	
	Excess consumption (ltrs/tonne)	(N)=(M-L)	2.00	2.00	-	3.00	3.50	
	Excess consumption (KL)	(O)=(N*K)/1000	154.13	131.59	-	152.83	122.44	**560.99**
Sub Total Bake Oven	Total loss(KL)	(P)=(E+J+O)	610.49	647.55	197.25	1,196.26	967.26	**3,618.81**
	Cost of FO (₹ per KL)	(Q)	40,660.00	40,530.00	35,298.00	22,880.00	22,410.00	
	Loss due to excess consumption (₹ in crore)	(R)=((P*Q)/10^7	2.48	2.62	0.70	2.74	2.17	**10.71**

Annexure VI
(Refer Para No. 3.4)
Additional expenditure towards coal due to higher Station Heat Rate

Year	Actual Coal Consumption (In MT)	Coal Consumption as per the Norms (in MT)	Excess Coal Consumption (in MT)	Rate of coal (₹ per MT)	Value of excess coal consumed (₹ in crore)
2012-13	4,933,458	4,646,763	286,695	1,769.48	50.73
2013-14	4,788,392	4,128,477	659,915	1,534.37	101.26
2014-15	4,432,389	4,113,444	318,945	1,455.05	46.41
2015-16	5,264,941	4,919,874	345,067	1,719.16	59.32
2016-17	5,479,306	5,130,762	348,544	1,976.86	68.90
Total					**326.62**

Annexure VII

(Refer Para No. 3.5)

Excess expenditure due to slippage in grade of coal received

Period	Quantity of coal purchased (in tonnes)	Grade Billed	Grade actually received	Difference in Base Price (₹ per tonne)	Excess expenditure (₹ in crore)
Alumina Refinery					
2012-13	1,261,207.65	E	D	-190.00	-23.96
2013-14	1,209,624.20	G11	G12	60.00	7.26
2014-15	1,254,863.34	V(I)	V(III)	90.00	11.29
2015-16	1,359,803.25	V(I)	V(III)	70.00	9.52
2016-17	1,372,849.95	G12	G14	130.00	17.85
Sub Total					21.95
Captive Power Plant					
2012-13	5,679,459.65	E	F	210.00	119.27
2013-14	5,043,189.94	V(I)	V(II)	60.00	30.26
2014-15	4,601,367.14	V(II)	V(III)	70.00	32.21
2015-16	5,077,103.26	V(II)	V(III)	70.00	35.54
2016-17	5,453,426.72	G13	G13	-	-
Sub Total					**217.28**
Grand Total					**239.23**

List of Abbreviations

Sl. No.	Abbreviation	Description
1.	CPP	Captive Power Plant
2.	CREP	Corporate Responsibility for Environment Protection
3.	CTE	Consent To Establish
4.	CTO	Consent to Operate
5.	EC	Environmental Clearance
6.	EIA	Environmental Impact Assessment
7.	FC	Forest Clearance
8.	FLDC	Fixed Long Distance Conveyor
9.	FO	Fuel Oil
10.	FSA	Fuel Supply Agreement
11.	HEMM	Heavy Earth Moving Machines
12.	HRD&DCW	High Rate Decanter & Deep Cone Washer
13.	IBM	Indian Bureau of Mines
14.	IMS	Integrated Management System
15.	ISO	International Organization for Standardisation
16.	Kcal	Kilo Calories
17.	KL	Kilo Litres
18.	KLD	Kilo Litres Per day
19.	KWH	Kilo watt Hour
20.	LME	London Metal Exchange
21.	MCL	Mahanadi Coalfields Limited
22.	MoEF & CC	Ministry of Environment, Forest and Climate Change
23.	MoU	Memorandum of Understanding
24.	MU	Million Units
25.	MW	Mega Watt
26.	OSPCB	Odisha State Pollution Control Board
27.	ppm	parts per million
28.	RTA	RIO Tinto Alcan
29.	SAP	Substantially Affected Persons
30.	SHR	Station Heat Rate
31.	SMCP	Semi Mobile Crushing Plant
32.	TPA	Tonnes Per Annum
33.	TWP	Temporary Work Permit