

**DEPARTMENT OF COAL**

**CHAPTER I**

**Central Coalfields Limited**

**Rajrappa Project**

***Highlights***

Concurrent mining of various sections was not carried out in accordance with the mining scheme as laid out in the Detailed Project Report (DPR). Selective mining from upper seams with favourable stripping ratio in the initial years led to sharp deepening of the quarry profile and rise in stripping ratio to the current adverse level of 4.71.

***(Para 1.4.1.1)***

The aggregate of reported over-burden (OB) removal was 146.37 Mcum\* and outstanding OB reserves would be 53.79 Mcum at the end of 2005-06. These two together exceeded the projected OB reserves of 165.25 Mcum as per DPR. This indicated a clear possibility of over reporting of OB removal.

***(Para 1.4.1.1)***

Formation of unplanned and scattered internal and external dumps led to rehandling of OB and avoidable expenditure of Rs.58.57 crore during 1997-98 to 2005-06. The left over 0.7 Mcum of OB would also need rehandling at an expenditure of Rs.15.96 crore.

***(Para 1.4.1.3)***

The utilisation of Heavy Earth Moving Machinery (HEMM) during 2001-02 to 2005-06 was 19 per cent to 25 per cent of total shift hours envisaged in the DPR.

***(Para 1.4.2.1)***

The Project Management had not properly attended to preventive maintenance of equipment and did not adhere to the norms of overhaul leading to high incidence of breakdown of critical equipment.

***(Para.1.4.2.2)***

The Regional Stores did not carry out any analysis of critical stores and as such, non moving items valued at Rs.6.55 crore had piled up at the end of March 2006.

***(Para 1.4.2.3)***

The Company failed to provide documentary evidence on diversion of 510.82 hectares of forest land for mining purposes prior to 1980 and paid Rs.68.59 crore towards compensatory afforestation, penal charges, etc.

***(Para 1.4.3.4)***

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\* Million cubic metres

Despite excess manpower of 169 in 2001-02 to 72 in 2005-06, the Area Management did not initiate any action towards rationalisation of the workforce and paid Rs 4.80 crore towards idle salary and wages to different categories of surplus employees during the above period. Further, though annual production was below norm during the said period, on an average, overtime allowance of Rs.3.76 crore per annum was paid.

*(Paras 1.4.4.1 and 1.4.4.2)*

### ***Gist of recommendations***

- Quarry profile needs to be developed in a manner which is suitable for smooth deployment and operation of HEMM. A detailed section wise bench formation should be prepared every year in advance.
- Avoidance of scattered OB dumping in an unplanned manner would reduce operational cost.
- Mismatch among different categories of critical equipment should be immediately corrected to maintain balance between excavation and haulage capacity and raise the operational efficiency of the Project.
- The Area Management should adhere to the Preventive Maintenance Schedules to reduce the extent of unplanned downtime.
- The HEMM workshop should improve the Depot agreements with equipment manufacturers for supply of spares on 'as and when required' basis.
- The Management should strengthen internal control to check over provisioning of spares.
- Replacement requirement of tyres for dumpers should be reassessed, and provided promptly as an one time measure to improve haulage capacity of the mine.
- The Company should vigorously pursue acquisition of land in Block II and forest clearance for the high-level bridge over Damodar to sustain the continuity of Rajrappa Opencast Project (OCP). More emphasis needs to be laid on early solution of land acquisition issues.
- Overtime norms should be fixed for operational and support staff separately with reference to production.

## ***1.1 Introduction***

***1.1.1*** Rajrappa Opencast Project of Central Coalfields Limited (Company), a subsidiary of Coal India Limited (CIL), is situated in the Hazaribagh District of Jharkhand. The Government of India (GOI) approved the draft project report (DPR) for Rajrappa OCP in June 1983 at an estimated capital cost of Rs.91.46 crore with targeted output of three MMT\* of coal and 8.5 Mcum of overburden (OB) removal per annum. The Cost Estimates were revised (September 1989) to Rs.133.63 crore by the GOI. Rajrappa OCP was envisaged as a capital-intensive mechanised mine. Rajrappa OCP is divided into four major blocks. Blocks I and IV are located on the southern bank of the river Damodar and Blocks II and III are located on the northern bank. Blocks I, IV and the eastern part of Block II contained medium coking coal and were included in the DPR. In terms of

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\* MMT-million metric ton, Mcum- million cubic metres

geological factors, the mining scheme, stripping ratio, etc these blocks were further sub divided into sections. Blocks I and IV comprise sections 1, 1a, 1b, 2, 2a, 2b and 3 and Block II was divided into 4, 5, 6 and 7 sections having seams VII (B), VII (T) and VIII (A). The total mineable reserve of coal was estimated as 127.99 MMT with a corresponding volume of OB of 373.47 Mcum and the stripping ratio<sup>♥</sup> was estimated as 2.91. Block I and IV were envisaged to be worked first. The OCP was declared complete in 1989-90 as coal production reached 2.57 MMT (86 per cent of the target capacity) during that year.

**1.1.2** As coal production was below target and the backlog of OB removal was accumulating, the World Bank agreed to fund this project in view of the high potential for profit and large reserves under the Coal Sector Rehabilitation Project (CSRP) scheme as a 'Replacement project' with the main emphasis on procurement of Heavy Earth Moving Machinery (HEMM) and clearing the arrears of over burden removal. The loan amounting to Rs.91.56 crore was disbursed during the period 1998-99 to 2001-02 and equipment under CSRP was in operation since 1998-99.

Details of HEMM thus procured were as under:

**Table -1**

Sl No.	Equipment	Specification	Nos.	Cost of equipment (Rs. in crore)
1	Shovel/Excavator	6.1 cubic metre	1	3.09
2	Dumper	85 MT	16	58.42
		50 MT	15	
3	Drills	160 mm	1	2.17
		250 mm	1	
4	Dozers	D 355 Dozer	6	9.92
		Wheel Dozer	2	
5	Spares			17.96
	Total			91.56

### **1.2. Audit objectives**

The objective of this review was to evaluate the activities under the Project, their impact on profitability and to find out the reasons for the gradual decrease of production and profitability in spite of sizeable investment on equipment with the support of the World Bank. The audit objectives were to evaluate and assess whether:

- (i) The Area Management put in place adequate system of controls to address the risks associated with mining, operation of HEMM and rehabilitation issues;
- (ii) Land problems were effectively tackled so that required land was available in time to carry out mining activities;
- (iii) Utilisation of HEMM in the area was adequate with reference to CMPDIL's<sup>♣</sup> norms of working hours;

<sup>♥</sup> *Stripping Ratio- It is the ratio between coal and OB extracted and stands for the volume of OB (in cubic metres) to be removed for extraction of one tonne of coal. It is expressed in cubic metres per tonne.*

<sup>♣</sup> *Central Mine Planning and Design Institute Limited*

(iv) Departmental capacity was fully utilised in transportation of coal and OB.

The period covered in audit was 2001-02 to 2005-06. Prior periods were also included wherever found necessary.

### 1.3 Audit methodology and acknowledgement

1.3.1 An entry level discussion was held with the Management at the Company's Headquarters at Ranchi in April 2006 which was followed by a detailed questionnaire on the performance of Rajrappa Area in May 2006. Fieldwork was undertaken at Rajrappa during May to July 2006. Detailed audit involved examination of documents relating to project report, mining, project formulation, planning, production, operational plan, survey reports, HEMM utilisation, log books, transport contract files, compensation for land, stock position of coal, over time (OT) payment, cost sheet data, etc. The audit team also made a number of visits to the quarry sections to make on-site observations. The audit findings are based on the documents so collected and the observations made by the audit team.

1.3.2 Audit takes this opportunity to thank the Management and the staff of the Rajrappa OCP and the Headquarters of the Company for their co-operation and assistance in the conduct of this Performance audit.

### Audit findings

#### 1.4. Financial results of the project

Financial results of the project for the five years between 2001-02 and 2005-06 are shown below:

**Table-2**

Year		2001-02	2002-03	2003-04	2004-05	2005-06
SI No.	Particulars					
1.	Coal Production (MMT)	1.47	1.3	1.4	1.5	0.72
2.	OB removal Production (Mcum)	6.32	5.98	5.81	5.29	3.22
3.	Manpower (Nos.)	1997	1972	1929	1913	1819
4.	Man shifts (000')	330.98	299.06	314.34	360.21	283.62
5.	OMS* (in MT)	4.45	4.50	4.46	4.19	2.56
6.	Cost of Production (Rs./MT)	699.01	790.38	791.14	842.86	1337.55
7.	Average Selling Price (Rs./MT)	755.97	791.96	860.67	974.77	993.38
8.	Profit/Loss(-) (Rs./MT)	27.15	27.55	59.87	133.64	(-) 344.19
9.	Profit (Rs. in crore)	8.34	0.21	9.73	19.89	(-) 24.94

The table above includes various items of the operations that were done by contractors. Frequent breakdown of departmental HEMM, delays in repairing work and poor maintenance resulted in non-availability of adequate departmental equipment. For this

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\* OMS- Out put per Man Shift

private transporters were engaged for loading and transportation of coal (0.58 MMT annually on an average between 2001-02 and 2004-05) from the quarry face to the washery. Examination of records in Audit revealed that the project never achieved the production level as per DPR. In the last 30 years, it produced a maximum of 2.84 MMT of coal in 1992-93 as against the projected production of three MMT per year and removed a maximum of 7.31 Mcum of OB in 1999-2000 against the projected 8.5 Mcum per year. While there was a profit of Rs.65.09 crore in 1996-97 prior to availing of the World Bank loan, it turned into a loss of Rs.24.94 crore in 2005-06 despite purchase and induction of HEMM valued at Rs.91.56 crore. It would be observed from the above table that during the five years 2001-02 to 2005-06, the average annual production was only 1.29 MMT of coal (50 per cent of target) and removal of 5.32 Mcum of OB (65 per cent of target). Profits generated from the area were below the target of Rs.156 per MMT. Some improvements were noticed in overall profit during 2003-04 and 2004-05. The profit of the area shot up due to a sharp upward revision in coal prices (by 20 per cent) in 2004-05. However, during 2005-06, the OCP suffered loss of Rs.24.94 crore which was due to shortfall in production. The reasons for such poor performance of the OCP are analysed in the succeeding paragraphs.

#### **1.4.1 Mine Geometry and improper planning**

##### **1.4.1.1 General mining scheme**

Major project parameters like mine geometry, dimension of coal and OB benches, HEMM specifications and requirements were drawn up as per the DPR. In view of frequent occurrence of faults and complex geological formation, simultaneous working of seams (VIII A, VIIT and VIIB) was envisaged under the scheme that would maintain a fixed ratio of coal extracted from seams to avoid sharp increase in the running stripping ratio (from the average value of 2.91). Extraction from the VIIB seam was proposed to be 36 per cent of the annual quarry output. To facilitate such an extraction pattern, making horizontal slices across the strike of the seams, from the roof of VIIT to the floor of VIIB was recommended for development of coal seams VIIT and VIIB. However, the operating practices deviated from the scheme as no systematic pattern of extraction was followed in spite of the objections raised by CMPDIL in its operational plans (1999-2000, 2003-04, 2004-05). The Management adopted defective mining practices such as selective mining from upper coal seams with less extraction of OB in the earlier years with a considerable variation of coal extracted from the lowest seam. This resulted in accumulation of OB for the later period.

The benches<sup>♦</sup> were to be laid as per the working plan in the DPR, with the width of each bench to be more than its height. It was also found in Audit that the mining profile of every working section was vertical with most of the benches having a non-workable width and height. The benches were narrow at many places with varying dimensions in sections I and III in contravention to dimensions of 13 metre height and 20 metre width as approved by Director General of Mines Safety (DGMS). Poor mining practices led to vertical benching with the result that equipment were unable to cope with the slope of the seams. The height of each bench was more than the maximum reach of shovels, making

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<sup>♦</sup> *Benches: Tier roads running all round the mine where excavation work and movement of vehicles go on simultaneously. These are crucial in the mine for ensuring stability of sides and slopes.*

extraction difficult. Such improper benching severely restricted the available working space for equipment.

These operational deviations resulted in sharp increase in the stripping ratio from 3.17 to 4.71. While the extraction schedule laid out in the Calendar Plan envisaged that mining in Blocks I and IV would be over by 2000-01, the backlog of coal extraction was 20 *per cent* of the reserves as on March 2006.

Further, scrutiny of internal survey reports regarding balance reserves in blocks I and IV revealed that 146.37 Mcum of OB had been removed till March 2006 and the required OB removal for the remaining life of the mine would be 53.79 Mcum. However, total OB in these mining blocks as per Project Report should have been 165.25 Mcum only. Thus, over reporting of OB removal of 34.91 Mcum could not be ruled out. This required urgent re-evaluation.

The Management stated (October 2006) that variation in volume of OB was due to numerous faults encountered during actual operation that were not anticipated in the DPR.

The Management's reply is not acceptable because occurrence of major and minor faults was extensively surveyed and incorporated in the DPR and a few more minor faults encountered during mining could not have had a major impact on the total volume of OB as confirmed by the CMPDIL. At the instance of Audit (May 2006), the matter of re-evaluation of remaining reserves of coal and OB was referred to CMPDIL in June 2006.

### ***Recommendations***

- Keeping in view the experience of working in Block I and IV, strict adherence to the mining scheme would be essential for economic operation in Block II. Further, quarry profile needs to be developed in a manner suitable for smooth deployment and operation of HEMM.
- A detailed section-wise bench formation plan should be prepared every year in advance and implemented strictly.

#### ***1.4.1.2 Haul roads \****

Haul road alignment plays a vital role in determining the cost of operation and in ensuring safer working conditions. Audit observed that the haul road network had not been constructed and maintained in a proper manner. Since 2001-02, only one haul road had been developed in the area at a cost of Rs.2.87 lakh. The main haul road in Section I was in poor condition with inadequate drainage. Poor condition of haul roads and improper OB benching prompted Director General Mine Safety (DGMS) to prohibit mining operation in Section I since April 2003. The preparation and upkeep of the haul roads also suffered due to minimal expenditure on haul roads and poor condition and lack of maintenance of equipment. Work suffered due to low availability (44 *per cent* of shift hours were lost per annum on an average due to breakdown) and poor utilisation (21 to 22 *per cent* of shift hours) of dozers and breakdown of all the three graders<sup>♥</sup> since 2003-04.

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\* *Haul roads are constructed for moving mined coal to the coal receiving pits and overburden to dump yard and are designed based on predetermined parameters.*

♥ *Grader: equipment used for grading, leveling and fine-finish of haul roads after preparatory work was done by dozers.*

Further, due to the formation of a network of too many haul roads against the DGMS norm of 1:16 for haul road gradients, the gradient was up to 1:6 at various places. As Dumpers often failed to negotiate the slopes they were pushed by Dozers to cope with the gradient. Such faulty operations resulted in stress on the engines and abnormal wear and tear of tyres. Against the norm of 5500 hours, the actual average life of tyres for 85 MT dumpers was only 3875 hours (i.e. 70 *per cent*) between 2000-2001 and 2005-2006. Further, many Dumpers were in breakdown condition for want of tyres. In March 2006 the area had projected a one-time requirement of 108 tyres for making the available dumpers functional. The total shift hours lost exclusively due to want of tyres was about 42686 hours during 2005-06.

The Management stated (October 2006) that adequate haul road gradient could not be maintained as sufficient land was not available and numerous faults were present that were not envisaged in the DPR. It was, however, observed in Audit that the land problem was limited to a part of Section III where no mine working had been done. Further, the frequent occurrence of major and minor faults had been extensively identified and incorporated in the DPR and haul road alignment could be planned accordingly.

#### ***Recommendations***

- A detailed study on the condition of the existing haul roads should be undertaken for improvement. The Management accepted this and proposed a study.
- Higher capacity Graders along with Dozers were urgently required for haul road preparation. The equipment under breakdown needed to be urgently attended to. The Management replied (October 2006) that one dozer, water sprinkler and grader had been provided for the purpose as recommended and every additional help necessary would be provided on an urgent basis.

#### ***1.4.1.3 Planning of OB Dumps***

The DPR envisaged that the scope of internal dumping of OB was limited and could be done only in mined out areas of Block I and IV at a later stage. However, the Management resorted to internal dumping of OB on coal faces, e.g. over VII B seam. This led to re-handling of OB for further extraction of coal. Audit noticed that during the nine years (between 1997-98 and 2005-06) the project Management had re-handled 3.69 Mcum of OB incurring an extra expenditure of Rs.58.57 crore. The Management further assessed (July 2006) that 0.7 Mcum of OB also needed rehandling. This would entail a further expenditure of Rs 15.96 crore. It was also envisaged that bulk of the initial overburden was to be transported mostly to external rock dumps close to the quarry sections. Accordingly, the Management identified four major external dumps with a total area of 735.9 hectares with a detailed section-wise dump linkage plan. However, it failed to adhere to this plan and continued to dump OB in an unsystematic manner. While one planned external dump could not be formed as physical possession of land could not be obtained in village Koihara (129.6 hectares), external dumping was carried on in as many as 13 locations in an irregular manner. The Management did not even lay emphasis on the proper formation of these dumps, as suggested by CMPDIL, and they were left highly uneven resulting in sub-optimal utilisation of space.

The Management stated that actual dumping had been done as per the plan envisaged in the DPR and only 2.85 *per cent* of the total OB removed till 2005-06 was rehandled. The

issue of internal dumping on coal bearing areas leading to rehandling was linked to the non-availability of the northern dump.

The reply was not acceptable as internal dumping was not restricted to the worked out area of Section I as proposed and was taking place on coal faces in each section. Further, many external dumps were formed in a scattered manner. The percentage of rehandling between 2001-02 and 2005-06 was substantial (6.10 to 7.72 *per cent*) and the expenditure incurred was avoidable.

### ***Recommendations***

- Scattered OB dumping in an unplanned manner should be avoided and predetermined dump locations should be adhered to.
- The Management should expedite settlement of land issues with the villagers and obtain clearance from the forest Department for OB dumping so that longer lead for transportation may be avoided.

The Management stated (October 2006) that dumping of OB in future would be done in a planned manner.

### ***1.4.2 Performance of HEMM***

As per DPR, annual production of coal should be three MMT and OB removal should be 8.5 Mcum. One of the stated objectives of the World Bank funding for replacement of equipment was clearing the backlog of OB as arrears of OB removal reached 35.1 Mcum by 1997-98. It was noticed in Audit that the OB removal during 1997-98 was 6.05 Mcum which increased to 7.53 Mcum in 2000-01. Thereafter it started declining and was 5.29 Mcum in 2004-05. During 2005-06, it was as low as 3.19 Mcum. The production of coal also indicated a similar trend. The low production of coal and OB removal was attributable to poor availability and utilisation of HEMM due to mismatch of equipment, high breakdown hours, delay in acquisition of land and payment of compensation to villagers, etc.

#### ***1.4.2.1 Availability and utilisation of HEMM***

As per the Project Report, the quarry was to be operated for 330 working days in a year round the clock with three eight-hour shifts per day. 35 days per year was the norm for idle time for equipment. Audit scrutiny of records revealed that during the five years ending 2005-06, HEMM deployed in the quarry could only work for 19 to 25 *per cent* of total shift hours envisaged in the DPR. Low utilisation of equipment was on account of high incidence of breakdown and idling as indicated in the table.



Table-3

Year	Shift hrs. as per DPR for HEMM on roll (no.*330 days*24 hrs)	Actual Shift hrs for working equipment (shift hours *no. of equipment in actual use)	Actual idle hours	Actual Worked hrs	Idle hours to actual shift hours (in percentage) (4/3)	Percent age of worked hrs to DPR shift hrs (5/2)	Worked hrs to actual shift hrs (in percentage) (5/3)
1	2	3	4	5	6	7	8
2001-02	752400	742566	275096	185509	37	25	25
2002-03	760320	702406	385755	176943	55	23	25
2003-04	768240	666524	182441	181663	27	24	27
2004-05	752400	677517	174185	166700	26	22	25
2005-06	673200	555266	127804	125083	23	19	23

Actual idle hours ranged between 23 and 55 *per cent* of shift hours which was above the idle hour norms of the principal equipment (*viz.* 22 *per cent* for dumpers). Part of the high idling of equipment could be attributed to theft of overhead line conductor, pole, HSD and other lubricants. Absenteeism was also a contributing factor. Besides, there was mismatch between actual availability and requirement of equipment of different specifications. This was a major factor for low utilisation of HEMM. It was noticed in Audit that mismatch existed between different categories of shovels, and between shovels and dumpers prior to World Bank funding under CSR and this was further aggravated after the procurement of HEMM under the replacement project funded by the World Bank. The table below gives the number and design specifications of major equipment held, proposed for procurement under CSR, actual receipt thereagainst and HEMM on roll in April 2006.

Table 4

Particulars	Size/ Capacity	Provision as per RPR/RCE	Actual as on 31 March 1988 (prior to preparation of RCE)	Provision kept in Staff Appraisal Report (World Bank)	Actual receipt	On roll as on 1 April 2006
Elect. Rope Shovel	10 cubic metre	4	4	0	6.1 cubic metre - 1	6
	4.6 cubic metre	7	3	5 cubic metre - 2 3.5 cubic metre - 1	0	3
Dumper	29 MT (BDCH)	19	0	0	0	0
	50 MT	29	25	41	15	14
	85 MT	45	38	28	16	40

As per the DPR, small shovels were suitable for extraction from partings\* and coal bearing areas. However, only three small shovels against seven envisaged in the RCE were available to the project Management while there were six big shovels on roll as against the sanctioned strength of only four. Besides, the 29 MT Bottom Discharge Coal Haulers (BDCH) recommended for transportation of coal from seams were never indented.

The Management stated (October 2006) that the BDCH were not indented due to absence of matching equipment and probable low effectiveness in the absence of levelled haul roads. However, the haul road condition was a factor controllable by the Management. Besides, due to the poor availability of small shovels and dumpers the Management faced great difficulty in extracting coal from VII B and VII T seams.

Further, while formulating the equipment requirements for CSR in 1997, the Management had enhanced the number of 50 MT dumpers from 29 to 35. However, only 15 dumpers were received by the area leading to a shortfall of haulage capacity as compared with the digging capacity that was critical to the performance of the project. As a result, the working hours of shovels were low and showed a declining trend due to shortage of dumpers. The Area Management estimated (2006) an immediate shortage of nine 85 MT Dumpers to match the digging capacity of the Project.

The Management stated (October 2006) that all possible efforts were being made to minimize the capacity mismatch and four 85 MT Dumpers had already been provided to the project to reduce the mismatch. The reply is not acceptable since the equipment mismatch had only been addressed in a partial manner and the Project was suffering from shortage of 50 MT Dumpers for extraction of coal for which private contractors were engaged. Moreover, small size Shovels had not been indented.

Low utilisation of equipment could also be attributed to adoption of wrong mining practices that created regular shortage of working space on the benches and haul roads for which the available HEMM could not be deployed optimally.

An equipment-wise analysis of major machinery in use at Rajrappa showed the following:-

### ***Shovels***

The equipment mismatch among small and big shovels was not corrected. A 6.1 cubic metre shovel was procured and commissioned against requirement of two 5 cubic metre shovels. This shovel was unsuitable for the area and was transferred to Piparwar Area. Though availability of big shovels (10 cubic metres) was more than the requirement, poor maintenance led to high incidence of breakdown. Out of six big shovels, actual availability was only two. Out of 10 shovels on roll, two remained out of work round the year on an average. Among the shovels in working condition, availability\* of shovels ranged between 58 and 75 per cent during 2001-02 to 2005-2006 against the CMPDIL norm^ of 80 per cent availability. Similarly, utilisation^ percentage varied from 51 in

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\* *Parting: The OB layer separating two coal seams; viz. between VII T and VII B seam.*

\* *Availability: Equipment availability is calculated in percentage as (worked hours +Idle hours)/ available shift hours*

^ *CMPDIL has laid down availability and utilisation norms for each category of equipment*

^ *Utilisation: Equipment utilisation is calculated in percentage as worked hours/available shift hours*

2002-03 to 34 in 2005-06, against the norm of 58 *per cent* utilisation. The high incidence of breakdown hours (20 to 38 *per cent* during 2001-02 to 2005-06) registered by working shovels pointed to the low emphasis on preventive maintenance. As against the minimum maintenance period (15 *per cent* of shift hours) recommended under CSRP, actual maintenance hours for working shovels ranged between four and six *per cent* over the last five years upto 2005-06 as indicated in the table below:

Table 5

Year	Actual worked hours	Shift hrs for working shovels	Idle hours actual	Idle hours in percentage (norm 27) (4/3)	Maintenance hours	Maintenance hours to actual shift hours in percentage (norm 15) (6/3)	Breakdown hours	Breakdown Hrs in percentage (8/3)
1	2	3	4	5	6	7	8	9
2001-02	36397	90795	25509	28	4858	5	24031	26
2002-03	34110	67388	16209	24	3497	5	13571	20
2003-04	32459	67068	12125	18	3468	5	19016	28
2004-05	31602	70114	18893	27	3932	6	15679	22
2005-06	23182	67872	16008	28	3037	4	25645	38

Audit noticed that idling of shovels was mainly due to inadequate number of dumpers.

The Management stated (October 2006) that old age of the equipment had been a major factor for low availability and utilisation of the system as a whole. Four out of six big (10 cubic metre) shovels were old and close to their rated life of 80,000 hours. However, orders had been placed with Original Equipment Manufacturers (OEMs) to improve the operational reliability of these old shovels by replacing or overhauling different sub-assemblies.

The justification was not acceptable as there was mismatch due to procurement of higher capacity shovels while the requirement was for small (4.6/5 cubic metre) shovels. Further, shovels had been lying idle for 18 to 28 *per cent* of the time as the digging capacity of the Project remained consistently above the hauling capacity.

### **Dumpers**

As many dumpers were lying in breakdown condition for more than three months, the effective availability of dumpers was far below the norm of 67 *per cent*. The working and breakdown position of dumpers on roll during 2001-02 to 2005-06 was as under: -

**Table-6**

Year	No. on roll			Actual working			No. of Breakdown Dumpers			Breakdowns in percentage
	85 MT	50 MT	Total	85 MT	50 MT	Total	85 MT	50 MT	Total	
2001-02	43	15	58	28	14	42	15	01	16	28
2002-03	44	15	59	27	13	40	17	02	19	32
2003-04	46	15	61	24	14	38	22	01	23	38
2004-05	46	15	61	26	08	34	20	07	27	45
2005-06	40	14	54	16	09	25	24	05	29	54

It would be observed from above table that incidence of breakdown of working dumpers increased from 28 *per cent* to 54 *per cent* since 2001-02. This was due to low emphasis on preventive maintenance. It was noticed in Audit that maintenance hours ranged from three to six *per cent* of the net shift hours against the CMPDIL norm of 28 *per cent*. Dumpers repaired under one-time overhauling were again kept under repair for replacement of brakes and other spares within a short period, thereby adding to the breakdown time of the equipment. It was noticed that 11 Dumpers remained in breakdown condition for a prolonged period for want of tyres and batteries only. Smooth operation of HEMM and overall hauling capacity of the project continued to suffer due to an acute shortage of tyres for dumpers. Among the dumpers in working condition during the year, there was high idle time ranging between 22 and 47 *per cent* against the norm of 22 *per cent* signifying poor control and management of available resources that was critical to the efficiency and effectiveness of the Project. This reduced the working hours to between 21 and 25 *per cent* against the norm of 50 *per cent*. Shortage of dumpers and their poor utilisation imposed severe constraint on production and transportation of coal necessitating deployment of private dumpers and pay loaders in the project. This led to avoidable extra expenditure of Rs.6.73 crore during 2001-02 to 2005-06.

***Other equipment***

The availability of dozers was found to be low as six out of 15 dozers on roll were lying under breakdown for more than three months during 2005-06. During the five years 2001-02 to 2005-06, the dozers registered a high incidence of breakdown hours (40-53 *per cent* of shift hours). Utilisation of dozers was only between 21 and 22 *per cent* of shift hours. Further, the availability of cranes was also very poor (only one out of five was working) due to which attending to HEMM under breakdown was delayed. This ultimately delayed the production process. Communication facility between supervisors of equipment and the control room was poor as 36 out of 51 walkie-talkies on roll were out of order as on August 2005. The shortfall in production of coal in the area was directly related to the dismal performance of the HEMM.

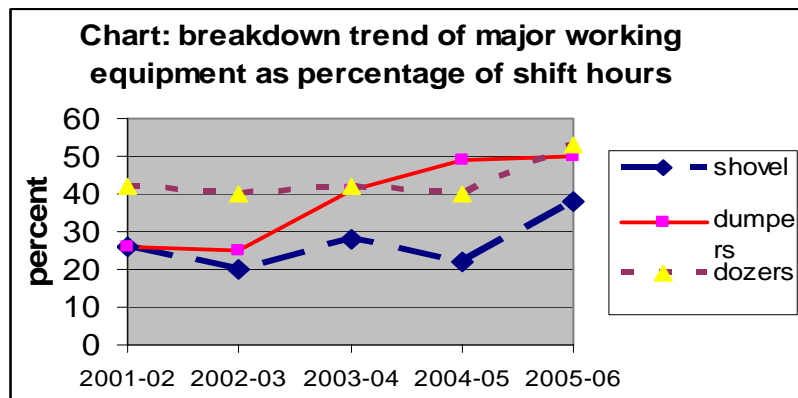
***Recommendations***

- The Management should devise a coordinated strategy immediately to correct the equipment mismatch, and maintain a balance between excavation and haulage capacity.

- Mine geometry in the currently operated quarry sections needed to be corrected by widening of working benches for better deployment of equipment.
- The Management should put adequate emphasis on maintaining haul road gradient to avoid high stress on equipment engines and tyres.
- Haulage capacity should be increased by meeting the requirement of tyres immediately.
- Quality of maintenance needs to be improved for raising the reliability level of each individual HEMM and reduce downtime.
- Supervision in HEMM workshop should be strengthened and communication facilities should be established between the supervisors and the control room.

**1.4.2.2 Maintenance schedules and operating issues**

Despite the average expenditure of Rs.20.33 crore per annum on repair and maintenance of HEMM, the reliability of major equipment working in the mine remained low due to neglect of routine maintenance of working equipment and poor quality of overhauling work. While CMPDIL recommended adherence to a time-bound programme for scheduled preventive maintenance (as laid down by the OEMs) for change or repair of assemblies, parts, oils for every equipment at regular intervals of 250/500/1000 hours, etc.) audit scrutiny of HEMM logbooks revealed that the schedules were not adhered to. Besides, there was failure in complying with the weekly maintenance schedules for shovels. These deficiencies in maintenance led to rising trend in breakdown of major equipment as shown below:



It would be seen from the chart that downtime for dumpers shot up since 2003-04 and remained at that level mainly for want of tyres and batteries. The total working hours lost exclusively due to dumper downtime for want of tyres was 42686 hours (16 per cent of actual shift hours) in 2005-06. Dumpers repaired under one-time overhauling were again kept under repair schedule for replacement of brakes and other spares within a short period. The dumpers lost 132574 hours (i.e. 29 per cent of shift hours) in 2005-06 for want of spares. Down time for shovels was 25645 hours (38 per cent of shift hours) and for dozers the same was 50089 hours (53 per cent of shift hours) during 2005-06 due to non-availability of critical spares.

The project Management had not undertaken any ABC analysis relating to necessity of critical spares and was not adhering to the norm of minimum inventory levels resulting in

delay in procurement of critical spares and consequent delay in repairing of breakdown equipment. In spite of the lacunae in maintenance as enumerated above, the project Management did not consider entering into maintenance contracts, even for the equipment bought from OEMs in 1998-1999, with World Bank loans. However, it was noticed that HEMM received under World Bank loans were running smoothly by entering into an Annual Maintenance Contract (AMC) with Bharat Earth Movers Limited (BEML) at a cost of Rs.14 to Rs.16 crore per annum in Kedla Hesalong (KDH) Project. The availability and utilisation of HEMM at KDH was much higher\* during 2004-05 and 2005-06.

The Management stated (October 2006) that the preventive maintenance of equipment had been as per the recommendations of the OEMs and there was a Condition Monitoring Cell for supervision of maintenance. The Management's reply was not correct as even in cases when equipment was put under preventive maintenance for change of oils or repair of assemblies, etc. at recommended intervals of 250/500/1000 hours, jobs were not carried out completely. This resulted in rise in the incidence of breakdown of the equipment from 28 *per cent* of total shift hours in 2001-02 to 49 *per cent* in 2005-06. Besides, documents that could substantiate effective functioning of the Condition Monitoring Cell at Rajrappa were not in evidence before Audit.

### ***Recommendations***

- The Company needed to review the HEMM requirement for the project in a consolidated manner and arrange for immediate supply of necessary spares for raising the haulage capacity of the project.
- The Area Management should adhere to the OEM's norms for preventive maintenance and complete jobs need to be carried out in each case.
- Annual repair action plan for equipment lying under breakdown for more than three months should be chalked out and adhered to.

#### ***1.4.2.3 Inventory management and control***

Rajrappa Regional Stores kept inventory in the form of HEMM spares, E&M spares, POL, Explosives, etc. Audit scrutiny revealed that the Regional Stores did not carry out any analysis of critical stores through a VED (Vital, Essential, and Desirable) analysis. Further, Audit observed that while stock of non-moving items valued at Rs. 6.55 crore had piled up as on March 2006, many HEMM were lying in breakdown condition for want of petty spares. The area failed to take advantage of the easy terms and conditions offered by equipment suppliers following the procurement of HEMM through World Bank loan. Area directly placed orders for decentralized requirement through depot agreement and rate contracts. Test check of records revealed that response time for fast moving spares that were required to be available off the shelf extended up to four months, making the system inefficient. Fast moving items/spares were not identified which further compounded the problem and defeated the purpose of depot agreements.

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\* *Shovel availability was above 80 per cent and utilisation was above 50 per cent.  
Dumper availability was above 65 per cent and utilisation was above 35 per cent.*

It was further noticed that many stores and spares procured during 2003-04 to 2004-05 were not issued till date (July 2006). Some of the indenters had not lifted the material. Material procured but not issued amounted to Rs.2.08 crore. Material was procured despite the availability of the same in unmoved stock. The total value of unmoved stock in Regional store at Rajrappa was Rs.14.06 crore. Out of this, inventory remaining unmoved for less than three years valued at Rs.5.29 crore, three to five years Rs.2.22 crore and more than five years amounted to Rs.6.55 crore as on 31 March 2006. The area had, however, written off unmoved stores valuing Rs.2.84 crore due to obsolescence of inventory remaining unused for a prolonged time.

The Management stated (October 2006) that the identification of fast-moving spares of each category of equipment had been done. However, the Management could not justify procurement of stores which were already available in the stock.

#### ***Recommendations***

- The HEMM workshop should improve the depot agreements with equipment manufacturers for supply of spares on 'as and when required' basis.
- Management should strengthen internal control to monitor over provisioning of spares.

#### ***1.4.2.4 Control mechanisms***

Audit noticed poor and ineffective control mechanism at the area level with regard to consumption of diesel and lubricants used in dumpers. The Company norms for diesel consumption in dumpers at Rajrappa was 0.77 litre/cubic metre. Actual consumption during 2001-02 to 2005-06 ranged between 0.84 and 1.11 litres/cubic metre. This resulted in excess consumption of 36.47 lakh litres of diesel for five years (upto August 2005) valued at Rs.7.98 crore. Even with high diesel consumption, some of the dumpers, dozers and drills were regularly getting air locked due to empty fuel tanks which not only affected their performance but also hampered production. Further, on a number of occasions, dumpers under breakdown condition were noticed to have been issued diesel regularly. In some cases such cumulative issue of diesel to the dumper stranded at the workshop due to want of tyres, was more than its tank capacity. Repeated cases of theft of diesel were reported. 30260 litres of diesel and 7940 litres of Hydraulic Oil valuing Rs.11.46 lakh were reported to be stolen from the HEMMs working in the mine during last two years (2004-05 and 2005-06). This indicated that internal control mechanism was weak.

As against the minimum norm of 50 *per cent* fixed by the Company for recovery of burnt oil, the actual recovery for the period between 2001-02 and 2005-06 was less than 25 *per cent* of the quantity of lubricants issued to equipment. During the five years upto 2005-06, out of 16.71 lakh litres of lubricants issued, 3.55 lakh litres was recovered and the short recovery of the lubricants, as per norm, worked out to 4.81 lakh litres whose disposal value was Rs.52.90 lakh.

The Management stated (October 2006) that short recovery of burnt oil was due to high incidence of leakage. This again underlined the poor condition of the equipment and poor control mechanism.

### **1.4.3 Land related issues**

#### **1.4.3.1 Delay in creation of infrastructure to carry out mining**

The Management had not taken any action for acquisition of 1512.69 hectares of land for Blocks II and III even after passage of 30 years (since operations began in 1977-78). In 2004, an application for diversion of only 59.04 hectares of forest land of Block II was submitted to Divisional Forest Officer, Bokaro for which even phase I clearance had not been obtained till date (October 2006). Survey work for non-forest land in the said Block had also not been completed as yet. Management could not undertake any action for construction of approach roads as no land had been acquired.

The DPR did not elaborate section-wise calendar plan for mining activity in Block II. Therefore, the Company asked CMPDIL to prepare a DPR for Block II including OB Dump Management plan, as forestry laws did not permit extensive OB dumping on forest land. Considering the limited availability of space, CMPDIL proposed that OB removed in Block II might be used to backfill the void created by opencast mining in quarries of Block I and IV on the other side of the river. It maintained that the dump management plan for Block II could only be prepared when the floor space available following extraction of VII B seam in the presently operated quarries was ascertained. Hence due to absence of OB dump management plan and mining plan for Block II the Management could not undertake land acquisition for operations in Block II in a systematic manner. Since the reserves in presently mined blocks are low and difficult to extract due to increasingly adverse stripping ratio, the continuity of the project might be under serious threat leaving aside profitability.

Further, to access Block II, the construction work of a High level Bridge over River Damodar was awarded to the U.P. state Bridge Corporation (UPSBC) in December 2001 for Rs.7.06 crore. The scheduled date of completion (May 2004) was extended up to June 2006 because the Company could not provide encumbrance free land of 1.52 hectares to the contractor as the property belonged to the Forest Department and needed to be regularised as per the Forest Conservation Act 1980. Even after incurring expenditure of Rs.5.80 crore, construction remained incomplete (June 2006) and UPSBC intimated that if the present situation continued, they would leave the site without completing the work. Thus, due to delay in completion of the Bridge, Block II (having coal reserve of more than 70 MMT worth Rs.6650 crore) remained inaccessible.

The Management stated (Oct 2006) that the remaining reserves of coal in Blocks I and IV were about 11 MMT, of which about eight MMT of coal could be extracted in a span of four years without shifting of Chilamtongri and Dhatuatand villages. It was also stated that the Company had taken all possible steps for physical possession of land in Block-II as well as for clearance of forest land, completion of the high level bridge and other ancillary activities so as to ensure continuity of production from the Rajrappa OCP.

The Management's reply can not be accepted as the DPR envisaged beginning of mining work in Block II in the 17 year of operation when 10.48 MMT of coal would still remain in Blocks I and IV. Though only eight MMT of coal remained to be extracted from Block I and IV, even stage I clearance of 59.04 hectares land was yet to be obtained for Block II.



### **Recommendations**

- The Company should ensure early preparation of mine planning for Block II by CMPDIL.
- Preparatory activities in Block II along with regularisation of acquired land with the Forest department needed to be immediately taken up.
- Efforts were urgently needed to obtain forest clearance for completion of the high-level bridge over Damodar and its approach roads to sustain the continuity of Rajrappa OCP.

#### **1.4.3.2 Failure to take possession of acquired land**

As per assessment in the Project Report, the total land requirement for the project was 3812.96 hectares. The land required (1512.69 hectares) in Blocks II and III has not been physically possessed even after passage of 30 years (since operations began in 1977-78). Out of the land acquired (2018 hectares) in Blocks I and IV forest area comprised 775 hectares of which only 484 hectares was in physical possession. Non-regularisation (under Forest Conservation Act 1980) by the Forest Department resulted in shortage of working space and dumping locations compelling deviations in operation from the project-mining plan.

#### **1.4.3.3 Resettlement of villages**

The Area Management acquired land measuring 77.11 acres in two villages, Chilamtongri and Dhatwatand. The Company settled compensation for only 66 acres of land and paid compensation for 26 houses and employed 22 people in 1981-82 as per the Company norm. However, the Company did not take physical possession at that time. This intensified the dispute with the villagers who demanded employment against each of the present 57 houses for any vacation of land. As a result, production in Section III, having 2.9 MMT coal reserves valued at Rs.287.97 crore, was virtually abandoned (July 2006). Further, Rs.3.87 crore had been paid towards salaries and wages of people employed who could not be gainfully utilised. It could have been avoided if the Management had taken physical possession of land against compensation and employment given in 1981-82 itself. Resettlement had also failed in village Koihara, adjacent to Section I, resulting in non-availability of a planned external OB dump site.

The Management stated (October 2006) that employments were provided to the land oustees as per the approved rehabilitation policy of the Company. It was also stated that though meetings were held several times to settle the dispute with villagers, resolution of disputes took a long time.

### **Recommendations**

- The Company should review its rehabilitation and resettlement policy and settle the disputes with the help of local administration in a time-bound manner to avoid interruption of mining work in future.
- The Company should expeditiously take physical possession of acquired land.

#### **1.4.3.4 Acquisition of forest land**

The forest land of Rajrappa OCP Phase-I (Block I and IV) was acquired under sanction orders issued by the Forest Department after making due payments. Accordingly, 510.82

hectares were broken and cleared before 1980 to undertake mining and allied activities. However, poor documentation and record keeping of these transactions with the Forest Department activities formed the basis for new disputes with the State Government regarding diversion of forest land. As per Section (2) of the Forest Conservation Act 1980, diversion of forestry land for non-forestry use required prior approval of the GOI and compensatory afforestation charges were payable. In case approval had not been taken all users of such land needed to comply with the Act by obtaining *post facto* approval. In 1993 a dispute arose between forest department and the Company regarding identification of diverted forest land and the Company failed to provide documentary evidence that the land in question (510.82 hectares) had been acquired and diverted before 1980. Resultantly, the Company had to make payments amounting to Rs.68.59 crore towards compensatory afforestation, penal charges, etc. upto January 2006. Thus, lack of proper documentation led to payment of Rs.68.59 crore to Forest Department and needed investigation, and fixing of responsibility against the delinquent officials.

The guidelines associated with mining usage of forestry land allowed minimum volume of OB dumping on acquired forest land. However, the Company could not get regularised with the Forest Department the usage of 155.13 hectares of forest land for the purpose. Thus OB dumping in forest area was treated as an irregularity by the Forest Department. Besides, diversion of 41.68 hectares of forest land towards construction of residential colony was also treated as an irregularity. A penalty of Rs.6.38 crore was paid by the Company in June 2004 for the entire forest land utilised earlier as per penal provision of Forest Conservation Act 1980.

### ***Recommendation***

- The Company should take up the issue of treatment of dumps with the Forest Department at an appropriate level.

### ***1.4.4 Manpower***

***1.4.4.1 Availability of manpower and deployment-*** As per Project Report, the manpower requirement of Rajrappa area was assessed to be 1630 for peak production levels. However, despite the average annual coal production being 1.42 MMT and the OB removal far below the targets the Management continued to deploy full strength of manpower required to achieve the target of three MMT coal and 8.5 Mcum of OB. It failed to rationalise the workforce leading to excess expenditure. Manpower deployed in the area in the last five years upto 2005-06 vis-à-vis requirements in different categories, as worked out by the OCP, was as under:

Table-7

Year	Existing manpower					Assessed manpower					Excess
	Rajrappa GM Unit	AFM Unit	R/Stores	Rajrappa OCP	Total Manpower	Rajrappa GM Unit	AFM Unit	R/Stores	Rajrappa OCP	Total Assessed	
1	2	3	4	5	6	7	8	9	10	11	12(6-11)
2001-02	345	20	76	1556	1997	256	22	84	1466	1828	169
2002-03	329	20	69	1554	1972	252	21	79	1459	1811	161
2003-04	318	20	75	1516	1929	246	21	79	1422	1768	161
2004-05	312	18	61	1522	1913	241	21	74	1505	1841	72
2005-06	299	21	62	1437	1819	211	20	63	1335	1629	190

It would be seen from above that the excess manpower was mainly deployed in OCP and GM unit. The overall excess of 169 persons in 2001-02 was reduced to 72 in 2004-05. The excess manpower was mainly in daily rated non-excavation category on which a sum of Rs.4.80 crore was paid as wages during 2001-02 to 2005-06. Apart from surplus manpower availability, the deployment of the workforce was not rationalised.

The Management stated (October 2006) that in view of the production plan of Rajrappa OCP, it was premature to declare the surplus manpower. Furthermore, it was not possible to adjust the manpower against frequently fluctuating output.

The Management's reply was not acceptable in view of the fact that actual departmental production was far below the target and remained static. Besides, the bulk of surplus manpower was in the daily-rated non-excavation category. Under such circumstances, the Management should conduct a detailed study for rationalisation of the workforce.

#### **1.4.4.2 Payment of overtime allowance**

Though the average annual production of 1.42 MMT for the five years between 2001-02 and 2005-06 fell consistently below the target of three MMT, overtime (OT) was being paid regularly (Rs 3.76 crore per annum on average). For the five years 2001-02 to 2005-06 actual payment of OT allowance per MT of production remained higher than the budgeted allotment. In 2004-05, overtime payment was made at the rate of Rs.20.76 per MT. This shot up to Rs 46.67 per MT in 2005-06 although the production fell to less than 50 per cent of 2004-05. Thus, instead of reducing the burden of OT corresponding to the fall in production, the total amount of OT payment had increased by Rs.39 lakh. Payment also exceeded the OT allowance budget by 18 per cent despite fall in production.

It was further noticed in Audit that out of 144 daily-rated workers declared surplus in 2005-06, 143 were in the non-excavation category. The project Management failed to properly utilise this surplus workforce and as a result OT payment for working on Sundays and Holidays could not be reduced. Further, OT hours on Sundays were much higher as compared to normal working hours during 2005-06. For the project as a whole,

details of coal produced, OB removed and OT Allowance paid (for MR\* and DR\*) since 2001-02 were as under:

**Table-8**

Year	Coal production MMT	OB removal in cubic metres	Category	OT hours		OT payment (Rs. in lakh)		OT rate (Rs./MT)
				Normal	Sunday	Normal	Sunday	
2001-02	1.47	6.32	MR	47923	13007	38.96	41.22	27.43
			DR	178303	62904	134.85	188.24	
2002-03	1.30	5.98	MR	38637	12291	27.39	41.38	25.29
			DR	88102	59557	71.09	189.02	
2003-04	1.407	58.18	MR	19654	12117	14.39	43.12	20.92
			DR	746 97	54076	55.92	180.85	
2004-05	1.507	52.80	MR	14838	11970	11.69	44.64	20.76
			DR	68867	56537	57.26	199.32	
2005-06	0.72	32.19	MR	18257	11757	15.46	51.52	46.67
			DR	39062	55826	38.93	230.11	
Total						465.94	1209.42	

From the above table it would be observed that while production in 2005-06 was less than 50 per cent as compared to 2004-05, OT hours fell by 18 per cent only.

The Management stated (October 2006) that the OT Budget was being prepared with reference to the production programme. Idle operators, if any, would be deployed for gainful utilisation. The Management's reply was not acceptable in view of the fact that though the OT budget was fixed based on available surplus fund and budgeted production target, payment could be regulated based on the actual production, the previous rates and not on the budgeted amount only.

**Recommendations**

- Surplus manpower should be transferred to needy areas so that payment of idle salary and wages could be reduced.
- OT norms should be fixed for operational and support staff separately with reference to linkage with production. To minimize the OT, the idle operators should be gainfully utilized for production in the section where there was acute shortage like Section II.

\* MR=Monthly Rated workers

\* DR= Daily Rated workers

#### 1.4.4.3 Output per Man Shift (OMS)

Productivity of Rajrappa OCP fell far below the projected OMS of eight MT. OMS remained almost half its DPR projection during 2000-01 to 2004-05 and fell to almost a quarter to 2.56 MT in 2005-06. Continuous shortfall in production to 50 *per cent* of the target and excess manpower were the prime reasons for the decline in OMS.

#### 1.4.5 Contractual transportation of coal

Utilisation of a mine capacity is an important factor affecting the production and profitability of mining operation. As per DPR coal was to be produced and transported by departmental means to the Rajrappa Washery. Considering the load factor\* of opencast mine, transportation distance and actual population of HEMM available in the project, CMPDIL assessed the digging (excavation) capacity and hauling (transport) capacity of the project for the year. The lower of the above two becomes the mine capacity of the project. The table below indicates the departmental capacity, actual production, contractual production and payments made to the contractors since 2001-02:

**Table-9**

Year	Capacity of departmental Production (in MMT)	Actual departmental production of coal (in MMT)	Contractual production of coal (in MMT)	Total payment made to private contractor (Rs. in crore)
2001-02	1.75	1.08	0.40	1.57
2002-03	1.95	0.89	0.45	1.56
2003-04	1.62	0.72	0.68	1.32
2004-05	1.98	0.72	0.79	2.03
2005-06	1.81	0.63	0.10	0.25

It would be observed from the table that in spite of adequate departmental capacity for production private contractors were engaged for coal production spending Rs.6.73 crore during 2001-02 to 2005-06. It was mainly the absence of matching equipment and not shortage of departmental capacity that necessitated contractual production of coal. In June 2006, the contractors refused to work at the quarry sections as their equipment were suffering heavy damage due to steep gradients and poor condition of the haul roads from coalfaces. As the Management failed to improve utilisation of departmental capacity to cover the production deficit, the total coal production drastically fell in 2005-06 leading to financial loss for the OCP.

The Management accepted (October 2006) the audit observations and stated that because of various problems besetting the project, the actual availability and utilisation of equipment remained low. In order to compensate for the loss in production arising out of the low availability and utilisation of equipment, contractors were engaged for transportation of coal.

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\*Actual volume of OB material extracted during each operation is less than the bucket capacity of extraction equipment due to volumetric expansion of OB following blasting. While calculating the digging capacity of a mine this constraint is factored in as the 'load factor'. It depends, inter alia, on the type of material extracted.

***Conclusion***

From the audit review, it was clear that due to improper planning, lack of managerial control, heavy downtime of principal machinery, land problems, etc. the Project could not achieve the production as per the target. Audit also noticed that the very purpose of heavy investment on procurement of equipment as a replacement project under the World Bank sponsored CSRP was defeated. Coal production and overburden removal were on a declining trend. The problem areas as identified by Audit needed urgent attention of the Management.

The matter was reported to the Ministry in December 2006; reply was awaited (January 2007).

## CHAPTER II

### Neyveli Lignite Corporation Limited

#### Performance of Thermal Power Stations

##### *Highlights*

The Plant Availability Factor achieved was consistently higher than 75 *per cent*, the norm fixed by the CERC for recovering capacity charges. However, the Corporation declared lower availability during 2004-05 and 2005-06 because of the anticipated shortfall in lignite production. Due to this, it could not realise the capacity charges of Rs.16.59 crore in TPS II.

*(Para 2.6.1.4)*

The actual generation fell short of potential generation by 7623 million units during 2001-02 to 2005-06.

*(Para 2.6.2.1)*

Forced outages caused a loss of generation of 2520 million units during 2001-02 to 2005-06.

*(Para 2.6.3.2)*

The Corporation suffered loss of generation of 3141 million units due to non-availability of lignite.

*(Para 2.6.4.1)*

The Corporation incurred additional expenditure of Rs.32.87 crore on transportation of lignite from Mine I and Mine IA to meet the lignite shortage in TPS II.

*(Para 2.6.5.1)*

The Corporation incurred Operation and Maintenance charges amounting to Rs.77.29 crore in excess of CERC norms during 2001-02 to 2005-06.

*(Paras 2.6.9.1 and 2.6.9.2)*

##### *Gist of recommendations*

- The Corporation should review the hours allotted for planned maintenance and revise its targets for generation based on the experience over the years.
- The Corporation should make further efforts to minimise forced outages due to controllable causes.
- The Corporation should review the consumption of lignite considering the actual boiler efficiency achieved and take appropriate measures for controlling consumption.
- The Corporation should take adequate steps to control the Operating and Maintenance expenses and maintain it within the CERC norms.

## **2.1 Introduction**

Neyveli Lignite Corporation Limited (Corporation) was incorporated in November 1956. The Corporation is an integrated power generating facility consisting of three lignite mines viz. Mine I, Mine IA and Mine II and three Thermal Power Stations (TPS) viz., TPS I (600 MW)\*, TPS I Expansion (420 MW)† and TPS II (1470 MW)‡. Power generated from TPS I including Expansion is entirely supplied to Tamil Nadu Electricity Board (TNEB). Power from TPS II is supplied to the Southern Electricity Boards (SEBs).

## **2.2 Audit objectives**

A Performance audit of TPS I and TPS II was carried out with a view to critically evaluate capacity utilisation and cost of generation and to ascertain that:

- (i) there was no underutilisation of capacity of generating units due to forced outages or lignite shortage; and
- (ii) the Corporation was able to control the cost of generation by keeping the Gross Station Heat Rate (GHR) and the Operation and Maintenance (O&M) expenses within the norms fixed by the Central Electricity Regulatory Commission (CERC).

## **2.3 Scope of Audit**

The audit covered the period 2001-02 to 2005-06. While TPS I and TPS II were studied, TPS I Expansion was not covered as its commercial operations commenced only in 2003-04. A comprehensive appraisal on the working of the Corporation was initially attempted during October 2003 to March 2004 and the report on the Thermal Power Stations was updated as a Performance audit during July 2006 to September 2006.

## **2.4 Audit criteria**

Audit of the operation of the power stations was conducted with reference to the norms/guidelines laid down by CERC and the Central Electricity Authority (CEA). The annual maintenance and periodical overhaul of the generating plant and equipment were reviewed with reference to the CEA guidelines. GHR and operation and maintenance expenditure were compared with norms fixed by CERC. Generation of power was compared with the targets fixed by the Corporation in its Annual Action Plan.

## **2.5 Audit methodology and acknowledgement**

The audit included examination of the agenda and minutes of meetings of Board of Directors, Annual Action Plan, data maintained at various production units and costing records. Discussions were also held with the unit heads as well as other field personnel at various levels.

Audit thankfully acknowledges the co-operation and assistance extended at different levels of the organisation at various stages of this audit.

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\* Six units of 50 MW and three units of 100 MW each commissioned between May 1962 and February 1970.

† Two units of 210 MW each commissioned during 2003-04.

‡ Three units of 210 MW each in Stage I and four units of 210 MW each in Stage II commissioned between March 1986 and January 1993.



## 2.6 Audit findings

### 2.6.1 Capacity utilisation

2.6.1.1 Table 1 details the generation of power in hours and million units (MUs) and the Plant Availability Factor (PAF) for the years from 2001-02 to 2005-06.

**Table 1**  
**Generation of power and plant availability**

Particulars	Unit	2001-02	2002-03	2003-04	2004-05	2005-06
<b>TPS I</b>						
Planned Generation	Hours	61596	62552	62510	63036	63036
Actual Generation	Hours	71584	73893	72407	71106	71591
Planned PAF	<i>per cent</i>	78.13	79.34	79.07	79.95	79.95
Actual PAF	<i>per cent</i>	90.80	93.73	91.59	90.19	90.81
Planned Generation	MU	3680	3680	3680	3680	3784
Actual Generation	MU	4182	4379	4400	4259	3990
<b>TPS II Stage I</b>						
Planned Generation	Hours	21581	21688	21569	21559	21370
Actual Generation	Hours	23346	24083	20946	20594	20702
Planned PAF	<i>per cent</i>	82.12	82.53	81.85	82.04	81.32
Actual PAF	<i>per cent</i>	88.84	91.64	79.48	78.36	78.77
Planned Generation	MU	3864	3864	3864	3864	3974
Actual Generation	MU	4524	4605	4110	3948	3856
<b>TPS II Stage II</b>						
Planned Generation	Hours	28803	28880	28845	28860	28385
Actual Generation	Hours	30045	30312	30048	28024	29056
Planned PAF	<i>per cent</i>	82.20	82.42	82.10	82.34	81.01
Actual PAF	<i>per cent</i>	85.75	86.51	85.52	79.98	82.92
Planned Generation	MU	5151	5151	5151	5151	5298
Actual Generation	MU	5746	5898	5895	5300	5318

In TPS I, actual generation of power (both in hours and MUs) and PAF exceeded the planned levels in all five years. In TPS II Stage I, the units worked fewer hours than planned during the years 2003-04 to 2005-06 but generation in MUs was more than planned in 2003-04 and 2004-05. In TPS II Stage II, the units worked more hours than planned in all the years except 2004-05 and the generation in MUs exceeded the planned level in all five years.

2.6.1.2 Hours planned for annual maintenance and actual utilisation in TPS I and TPS II Stage I and II are given below:

**Table 2****Hours provided and utilised for planned maintenance**

Unit		2001-02	2002-03	2003-04	2004-05	2005-06
TPS I	Planned hours	9360	9000	8640	7920	7920
	Actual utilised hours	3904	3982	5880	4553	5208
TPS II Stage I	Planned hours	2256	2088	3528	1920	1560
	Actual utilised hours	1427	911	4019	1679	1149
TPS II Stage II	Planned hours	2976	3648	2208	3456	3744
	Actual utilised hours	2368	3348	1942	2708	2861

It can be seen from the table that the hours provided for the planned maintenance were not utilised to the full extent in any of the years except during 2003-04 in TPS II-Stage I.

**2.6.1.3** The Management stated (September 2006) that the audit findings in respect of TPS I were based on targets communicated to CEA and SEBs. These targets had a safety margin to ensure that annual generation planning and grid management did not suffer. The norms adopted for planned maintenance for internal purposes were of lower duration. In respect of TPS II, a conservative approach was maintained while formulating the Annual Action Plan, which was communicated to external agencies and the maximum duration that would be required for inspection, rectification and replacement of components of the generator, boiler and turbine and auxiliaries was adopted.

They added that reduction in planned maintenance hours was only due to completion of maintenance works in less than the anticipated time without any compromise on the health of the unit and this could not be construed as being against the concept of preventive maintenance.

**2.6.1.4** The generation by TPS II came under the Availability Based Tariff (ABT) system introduced by CERC with effect from January 2003. The ABT system in power stations contemplates planning the generation and drawal of power through a process of scheduling. The Generator declares to the Regional Load Despatch Centre (RLDC) the energy that can be exported to the grid. Based on the availability declared by the Generator, the Electricity Boards give their requirement to the RLDC. Taking into consideration the declared availability and the requirement by Electricity Boards, the RLDC prepares a generation and drawal schedule. The 'declared availability' by the generator forms the basis for payment of capacity charges (fixed cost) and the 'scheduled generation' prepared by the RLDC forms the basis for payment of energy charges (variable cost). Any deviation from the schedule in the actual generation or drawal of power is liable to Unscheduled Interchange charge (UI) payable / receivable depending upon who has deviated from the schedule. According to the operational parameters of CERC with effect from April 2004, recovery of full capacity charges depended upon declaration of availability equal to 75 per cent of its installed capacity. However, in spite of higher PAF in TPS II, the declared capacity ranged from 71.29 per cent to 72.75 per cent during 2004-05 and 2005-06 and was less than the CERC norms of 75 per cent. So the Corporation could not realise capacity charges amounting to Rs.16.59 crore. While accepting the under recovery, the Management stated (November 2006) that less capacity was because of the anticipated lignite shortage since advancement of Mine II could not be carried out due to non-availability of land.

### **Recommendation**

- The Corporation needed to review the hours allotted for planned maintenance based on its experience over the years and provide for them realistically.

#### **2.6.2 Shortfall in generation due to low load operations**

**2.6.2.1** Although both the thermal power stations were in service for more hours than planned, the actual generation in TPS I fell short of potential generation\* by 2821 MU, in TPS II Stage I by 1987 MU and in TPS II Stage II by 2815 MU during the period under review (**Annexure-1**). This was due to the low load operations by the units. The Management stated (September 2006) that due to various internal factors like sudden breakdown of critical equipment, poor quality of fuel and external factors such as low system demand, partial load loss was inevitable. However, it was observed in Audit that the primary reasons for partial load loss were forced outages and insufficient availability of lignite.

#### **2.6.3 Shortfall in generation due to forced outages**

**2.6.3.1** Units of the thermal power stations were shut down due to forced outages leading to underutilisation of capacity. Shutdown of units resulting in stoppage of generation due to reasons other than planned maintenance is called “forced outage”. The hours lost in TPS I due to forced outages that were controllable ranged from 1065 to 3287 hours, in TPS II Stage I from 516 to 1286 hours and in TPS II Stage II from 758 to 2389 hours during the five years ending March 2006 (**Annexure-2**).

**2.6.3.2** Some of the causes of forced outages viz. economiser puncture, water wall puncture, electrical/mechanical faults, etc. occurred repeatedly. Repetition of the causes over the years indicate that these faults were not attended to properly during the planned maintenance. These outages caused loss of generation of 485 MU valued at Rs.88.83 crore in TPS I, 857 MU valued at Rs.104.65 crore in TPS II Stage I and 1178 MU valued at Rs.206.87 crore in TPS II Stage II during the five year period ending March 2006. The forced outages due to these reasons reflected a declining trend during the period of audit but began to increase from 2004-05 in TPS I and from 2005-06 in TPS II.

**2.6.3.3** The Management stated (September 2006) that in TPS I forced outages like tube punctures, etc. could not be totally avoided since power plants run on different loads corresponding to demand and hence are subjected to variations in temperature and pressure. Variations in fuel quality, moisture and ash content also cause variation in furnace conditions. As regards TPS II, owing to fluctuating load, the units were subjected to stress leading to occurrence of forced outages. The mined lignite had some aberrations in quality and was contaminated with ash causing erosion of boiler tubes. They added (November 2006) that the nature of fuel and fluctuations in demand were taken into account at the design stage and it was not possible to provide for all variations that might occur during actual operations of the plant.

It was, however, observed that forced outages occurred repeatedly due to the same causes over several years.

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\*Potential generation is the power that can be generated at full capacity for the actual hours the plants were operated

**Recommendation**

- The Corporation needed to take appropriate measures to minimise occurrence of the forced outages due to repeated causes that are controllable.

**2.6.4 Shortfall in generation due to lignite shortage**

**2.6.4.1** The installed capacity of Mine II was 10.5 MMTPA<sup>▼</sup>. The lignite requirement of generation units of TPS II for the planned hours of operations is given below:

Year	TPS II Stage I (MMT*)	TPS II Stage II (MMT)	Total (MMT)
2001-02	4.287	5.719	10.006
2002-03	4.312	5.749	10.061
2003-04	4.312	5.749	10.061
2004-05	4.312	5.749	10.061
2005-06	4.356	5.807	10.163

\* MMT – Million metric tonnes

Audit observed a shortfall in generation on a number of occasions due to non-availability of lignite and the consequent loss of generation of 3141 MU during the five year period ended March 2006 (**Annexure 3**). Two factors viz., inadequate capacity of Mine II and shortfall in overburden removal mainly contributed to the shortage of lignite extraction in Mine II. These are briefly discussed in the following paragraphs.

**2.6.5 Inadequate capacity of Mine II**

**2.6.5.1** The total requirement of lignite in TPS II was 12.775 MMTPA for operation at 100 per cent plant load factor (PLF), which was to be met from Mine II. As the capacity of Mine II was only 10.5 MMTPA, it was unable to meet the lignite requirements of TPS II for operating beyond 74 per cent PLF (**Annexure-4**). The actual PLF and the lignite consumption in TPS II Stage I and II and the production of lignite by Mine II are given below:

Year	Actual PLF (per cent)	Lignite consumption (in MMT)	Lignite production by Mine II (in MMT)
2001-02	79.8	11.29	10.71
2002-03	81.6	11.44	10.60
2003-04	77.5	10.95	8.71
2004-05	71.8	9.94	7.83
2005-06	71.2	10.00	6.43

Though the lignite requirement of TPS II could not be met by Mine II in any of the years during 2001-02 to 2005-06, the shortfall drastically increased since 2003-04 onwards due to difficulties in land acquisition. The Corporation could not acquire any land since 2000 mainly due to delays in acquisition procedures, displaced persons approaching the courts, etc. The shortfall was met by road transportation of lignite from Mine I and Mine IA

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▼ Million metric tonnes per annum

involving an expenditure of Rs.32.87 crore. The Management was of the view (November 2006) that this was a temporary phenomenon and lignite transportation compulsions would not arise once the teething problems in Mine II were resolved.

**2.6.5.2** Mine II was originally designed based on 68.5 per cent PLF for thermal power stations. With the subsequent increase in performance levels of TPS-II, the lignite from Mine-II was found to be insufficient. Given that the cumulative performance of the mines had not exceeded 85 per cent of the mine capacity, the design of Mine II should have provided for such capacity as could meet the normative performance levels of TPS II. The Management stated (July 2004) that steps had been taken to commission an additional system in Mine II to augment lignite production. The augmentation work was still in progress (September 2006).

#### **2.6.6 Shortfall in Over Burden (OB) removal\***

**2.6.6.1** The shortage of lignite from Mine II was also due to shortfall in OB removal during 2002-03 leading to less lignite exposure. The shortfall in removal of OB was due to less working hours of Bucket Wheel Excavators (BWE) No 1420 and 1421 in the surface bench due to frequent breakdowns caused by dislocation of overhaul schedule of these machineries. The Corporation accepted (September 2006) the point made by Audit. It further stated during discussion (November 2006) that in addition to the shortfall in OB removal by the above BWEs, Mine II had entered the deeper lignite zone during the period under review and the non-availability of MAN BWEs for OB removal resulted in less lignite exposure and less production of lignite during 2003-04 and 2004-05.

#### **2.6.7 Cost of generation**

**2.6.7.1** Cost of lignite and Operation and Maintenance (O&M) expenses constitute the main elements of the cost of power. Therefore, controlling the consumption of lignite and O&M charges would reduce the cost of power considerably.

#### **2.6.8 Controlling consumption of lignite**

**2.6.8.1** GHR, measured in kilo calories (kcal), is the input heat energy required to generate one kwh of electricity. CERC has prescribed norms for GHR with effect from April 2004. Three factors viz. the quantity of lignite (weight in tonnes), the quality of lignite (calorific value) and the boiler efficiency determine the GHR.

#### **2.6.8.2 Quantity of lignite**

The quantity of lignite consumed by both the TPS did not tally with the quantity of lignite transferred from the Mines (**Annexure-5**). The difference in TPS I during 2001-02 to 2005-06 ranged from 0.435 MMT to 0.635 MMT. In TPS II Stage I and II it ranged from 0.319 MMT to 0.363 MMT and 0.395 MMT to 0.455 MMT respectively during 2001-02 to 2003-04. The Management stated (July 2004) that lignite was accounted on volumetric basis in Mine I, while in TPS I the consumption was accounted for taking a derived<sup>♥</sup> figure using the GHR norms fixed by CERC. The difference was attributed to the loss of moisture during storage. However, no norms for such variations have been fixed.

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\* *The under performance of Bucket Wheel Excavators (BWE) and the consequent shortfall in lignite production having effect on generation was commented upon in the Performance audit Report on Bucket Wheel Excavators printed in Report No 8 of 2006 of Comptroller and Auditor General of India*

♥ *Derived lignite consumption = GHR as per CERC norms/GCV of lignite adopted by CERC x units produced*

### 2.6.8.3 Quality of lignite

Gross Calorific Value (GCV) of lignite adopted by TPS I to arrive at GHR was 2756 kcal/kg and 2754 kcal/kg during 2004-05 and 2005-06 respectively. Another consumer of lignite from Mine IA, STCMS, stated that the GCV of lignite supplied from Mine IA was 2946 kcal/kg. As Mine I and Mine IA are in the same location, the Management could not explain the difference. Similarly, the GCV of lignite stated by TPS II is 2662 kcal/kg and 2630 kcal/kg for the years 2004-05 and 2005-06 respectively whereas the Mine II laboratory reported them as 2794 and 2942 kcal/kg.

### 2.6.8.4 Boiler efficiency

The GHR of TPS I was fixed by CERC at 3900 kcal/kwh with effect from April 2004 giving allowances for deterioration in the life of the station, unit size and boiler efficiency. The actual efficiency of boilers ranged from 84.39 per cent to 88.08 per cent during 2004-05 and 2005-06 as against the boiler efficiency of 67.6 per cent adopted by the CERC for fixing the GHR. Taking into account the calorific value of lignite adopted by the Corporation and the average efficiency of the boilers, the actual quantity of lignite consumed (the Management adopted the quantity transferred from Mine I as consumption) exceeded the required quantity of lignite by 1.37 MMT during 2004-05 and 1.27 MMT during 2005-06 as given below.

Year	GCV of Lignite adopted by TPS I (kcal)	Lignite required kg/kwh @	Gross generation (MU)	Required lignite (MT) (3x4)	Actual lignite consumption (MT)	Difference (MT)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2004-05	2756	1.112	4259.00	47,36,008	61,03,319	13,67,311
2005-06	2754	1.118	3990.00	4460820	5731242	1270422

@ Lignite required per kwh considering average boiler efficiency at 86.06 per cent (2004-05) and 85.66 per cent (2005-06) and GHR at 3900 kcal/kwh

**2.6.8.5** CERC fixed GHR at 2850 kcal/kwh for TPS II with effect from April 2004. Boiler efficiency of the generating units of TPS II Stage I was not available. Boiler efficiency of TPS II Stage II ranged from 69.86 per cent to 75.96 per cent during 2004-05 and 2005-06 and the Corporation could not achieve the boiler efficiency of 77 per cent adopted by CERC for fixing the GHR during the above two years. Taking into account the calorific value of lignite adopted by the Management and the average efficiency of the boilers as achieved, the quantity of lignite required for TPS II Stage II for the actual gross generation of power was 5.99 MMT and 6.06 MMT during 2004-05 and 2005-06 respectively while the actual quantity of lignite consumed was 5.67 MMT and 5.78 MMT indicating an inconsistency as given below:

Year	GCV of lignite adopted by TPS II (kcal)	Lignite required kg/kwh	Gross generation (MU)	Required lignite (MT) (2x3)	Actual lignite consumption (MT)	Difference (MT)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2004-05	2662	1.131	5300.34	5994685	5672699	-321986
2005-06	2630	1.140	5318.16	6062702	5789266	-273436

Average boiler efficiency at the rate of 72.91 per cent (2004-05) and 73.18 per cent (2005-06) at GHR of 2850 kcal/kwh

**2.6.8.6** The GHR of TPS II was 2930 kcal, 2939 kcal and 2930 kcal during 2001-02 to 2003-04 respectively. However, after introduction of norms for GHR by CERC with effect from April 2004, GHR was 2864 kcal and 2871 kcal during 2004-05 and 2005-06 nearer to the CERC norms of 2850 kcal. The factors contributing to this improvement in GHR were not on record.

**2.6.8.7** In view of the above inconsistencies in the quantity of lignite consumed, its quality and the GHR, the factors contributing to the increased/reduced consumption of lignite were not ascertainable. The Management did not agree (November 2006) with the consumption figures arrived at by Audit based on the actual boiler efficiency. Boiler efficiency is one of the critical parameters in fixing the norms for the GHR. CERC had adopted a norm of 67.6 per cent for boiler efficiency while calculating the GHR for TPS I and 77 per cent for TPS II. As such, the consumption worked out by the Management did not depict the advantage or otherwise of higher or lower boiler efficiency.

### **Recommendations**

- The Corporation should fix norms for loss of lignite due to moisture.
- The Corporation should review the consumption of lignite considering the actual boiler efficiency achieved and take appropriate measures for controlling consumption.

### **2.6.9 Control over Operation and Maintenance expenses**

**2.6.9.1** According to the Bulk Power Supply Agreement (BPSA) in respect of TPS-I entered into with TNEB for the period 1997-98 to 2001-02, the O&M expenses for 2001-02 were Rs.75.61 crore. This continued in 2002-03 and 2003-04. CERC prescribed (March 2004) O&M expenses for tariff purposes for 2004-05 at Rs.0.152 crore per MW amounting to Rs.91.20 crore and at Rs.0.1581 crore per MW for 2005-06 amounting to Rs.94.86 crore. The actual O&M expenses incurred and norms as per BPSA/CERC are given in Table 1 of **Annexure-6**. It can be seen that the Corporation was not able to keep the actual O&M expenditure within the norms during 2001-02 to 2005-06 and the excess O&M expenses that could not be recovered from TNEB amounted to Rs.58.45 crore.

**2.6.9.2** The O&M expenses for the period from 2001-02 to 2003-04 in respect of TPS II were yet to be determined by CERC. According to CERC notification of March 2004, the O&M expenses allowable for tariff purposes for TPS-II were Rs.10.40 lakh per MW in 2004-05 and Rs.10.82 lakh per MW for 2005-06. The Corporation had incurred Rs.6.89

crore and Rs.11.95 crore towards O&M expenses in excess of the CERC norms in TPS II Stage I and Stage II respectively (Table 2 of **Annexure-6**), which could not be recovered from SEBs.

**2.6.9.3** The Management stated (September 2006) that the reasons for excess O&M expenses in TPS I were increase in labour rates, general charges including insurance premium and common charges. In respect of TPS II, price escalation of spare parts and escalation of payment to contractors contributed to the excess O&M expenses. The Management further stated that an objection was put forth to CERC before finalisation of tariff but it was in vain. The Management contended (November 2006) that during the years 2002-03 and 2003-04, full capacity charges beyond the normative generation in TPS I were recovered by way of incentive and that there was no significant loss. The reply is not acceptable as the incentive earned is not adjustable against the O&M expenses and as such the expenses amounting to Rs.77.29 crore incurred in excess of the norms need immediate attention.

***Recommendation***

- The Corporation should initiate action to contain the O&M expenses within the norms.

**2.7 Conclusion**

Power plants operated for more hours than planned. Hours provided for annual maintenance were not utilised to the full extent and surplus hours were available for generation. Despite higher availability of plants the Corporation did not revise the generation targets upward. Higher availability of hours did not translate into higher generation. The Lignite production capacity of Mine II was insufficient to meet the requirements of TPS II. The O&M expenses were in excess of the norms.

The matter was reported to the Ministry in December 2006; reply was awaited (January 2007).