Chapter 2

Operation and maintenance of Generating Plants

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2.1 Generation of Power

The performance of the plants was evaluated on various operational parameters of Generation - Plant Load Factor (PLF), Auxiliary Consumption and Station Heat Rate. Performance parameters in respect of power plants of the Company were analysed during the audit. Detailed analysis of generation of power, parameter wise is discussed below.

Table 2.1: Unit wise power generated by the Company during 2016-21

Sr. No.	Plant	Unit No.	Installed Capacity in Mega Watt (MW)	Generation (in MUs)				
				2016-17	2017-18	2018-19	2019-20	2020-21
1	Normative Generation[1] for Thermal Units (in MUs)			18,413.52	18,413.52	18,413.52	18,413.52	17,769.66
	Actual Generation Thermal (A)							
2	Panipat Thermal Power Station (PTPS)	V	210	169.22	140.77	176.75	Decommissioned[2]	
		VI	210	219.54	373.69	324.00	0	51.93
		VII	250	1,126.89	1,277.64	1,308.75	884.46	619.48
		VIII	250	690.27	787.37	1,569.40	1,088.33	547.08
3	Deen Bandhu Chhotu Ram Thermal Power Plant (DCRTPP)	I	300	1,841.43	1,441.36	1,346.78	1,574.14	1,316.67
		II	300	1,582.78	2,006.76	1,974.87	1,166.89	1,294.75
4	Rajiv Gandhi Thermal Power Plant (RGTPP)	I	600	1,988.50	2,361.50	1,622.71	768.95	1,230.98
		II	600	1,816.83	2,319.51	2,229.48	1,547.17	405.92
5	**Total[3] Thermal (A)**		**2,510**	**9,266.24**	**10,567.83**	**10,375.99**	**7,029.94**	**5,466.81**
6	Shortfall in percentage to normative generation			**49.68**	**42.61**	**43.65**	**61.82**	**69.24**
7	Western Yamuna Canal Hydel Project		62.40	205.28	176.75	237.68	300.03	242.91
8	Solar PTPS Panipat		10	5.14	16.17	16.25	15.55	16.86
9	**Total Renewable (B)**		**72.40**	**210.42**	**192.92**	**253.93**	**315.58**	**259.77**
10	**Grand Total (A+B)**		**2,582.40**	**9,476.66**	**10,760.75**	**10,629.92**	**7,345.52**	**5,726.58**

Source: Information supplied by the Company.

The generation at power plants declined from 10,567.83 MUs in 2017-18 to 5,466.81 MUs in 2020-21. The generation was below the normative generation approved by the Haryana Electricity Regulatory Commission (HERC) and ranged between 42.61 to 69.24 *per cent* during 2017-21. The main reason for low generation was higher variable cost of thermal power stations which resulted in plants not getting schedule and resultant backing down[4] of plants.

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1 Normative generation is the quantum of power generation based on Plant Load Factor determined by HERC every year keeping in view the capacity of the Unit.

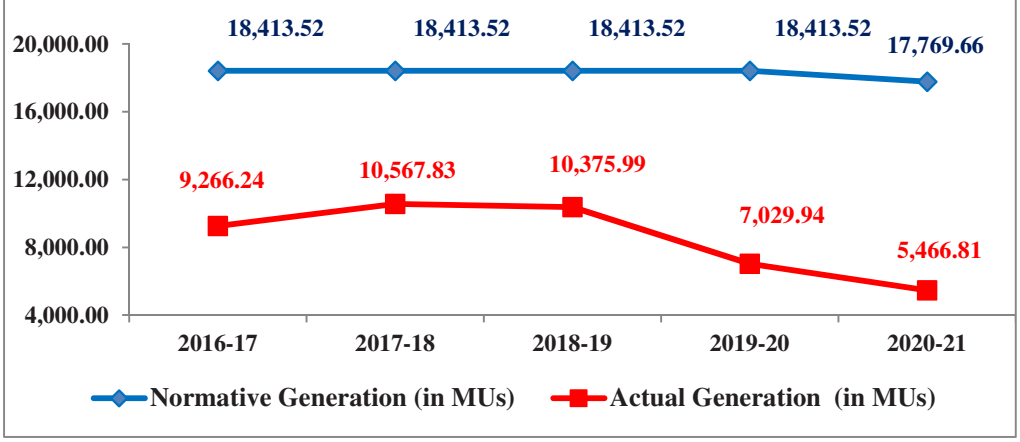
2 Unit V was decommissioned during March 2020. However, unit remained shut down during 2019-20 also.

3 Generation data of Unit V of PTPS is excluded from total generation given at row number 5 and 10.

4 A backing down refers to shut down of the unit due to availability of cheaper power elsewhere or less demand.

Comparison of actual generation *vis-à-vis* normative generation approved by HERC is depicted in the chart below:

Chart 2.1: Comparison of normative thermal generation approved by HERC *vis a vis* Actual generation



2.2 Plant Load Factor

Plant Load Factor (PLF) represents percentage of actual generation to generating capacity of the plant. PLF for subsequent period is assessed by the Company and assessment is approved by Haryana Electricity Regulatory Commission (HERC) considering all the factors affecting generation. The recovery of fixed cost from the DISCOMs depends upon achievement of PLF approved by HERC and in case of lower PLF, the fixed cost is recovered on *pro-rata* basis. The table below indicates the PLF determined by HERC *vis-à-vis* actual achievement by all the units of the Company during 2016-21:

Table 2.2: PLF approved by the HERC *vis-à-vis* actual PLF of the units

Year	PLF approved by HERC (in *per cent*)	Actual PLF (in *per cent*)						PLF approved by HERC for Unit V & VI of PTPS (in *per cent*)	Actual PLF of PTPS (in *per cent*)	
		DCRTPP		RGTPP		PTPS				
		Unit I	Unit II	Unit I	Unit II	Unit VII	Unit VIII		Unit V	Unit VI
2016-17	85	70.07	60.23	37.83	34.57	51.46	31.52	35	9.2	11.93
2017-18	85	54.85	76.36	44.93	44.13	58.34	35.95	35	7.65	20.31
2018-19	85	51.25	75.15	30.87	42.42	59.76	71.66	82.5[5]	9.61	17.61
2019-20	85	59.74	44.28	14.59	29.36	40.28	49.56	35	0	0
2020-21	85	50.10	49.27	23.42	7.72	28.29	24.98	35	0	2.82

Source: Information supplied by the Company and Tariff orders approved by the HERC for the year 2016-17 to 2020-21.

[5] It has been noted from HERC tariff order dated 31 October 2018. PLF of 82.5 *per cent* was determined on the basis of actual PLF (86 to 87.79 *per cent*) achieved by Unit V & VI of PTPS during April to May 2018. During this period, units of one of major power suppliers (M/s Adani Power Limited) remained shut down.

Due to non-availability of power plants owing to planned and forced outages resulting in non-achievement of normative PLF, Company could not recover fixed cost of ₹ 390.94 crore during 2016-21 from DISCOMs[6]. The plant wise details for forced outages, planned outages and Backing Down Instructions for the five years 2016-21 is given in ***Appendix 2.1***.

The main reasons for low PLF were forced outages[7] due to various technical problems, poor planning in execution of works pertaining to capital overhauling which resulted into prolonged shutdown of plants and Backing Down Instructions (BDIs) of Units due to their higher variable cost. Out of total outages of 1,94,580 hours (56.92 *per cent* of total available 3,41,832 hours), as much as 47.76 *per cent* outages were due to backing down of plants at the instructions of the DISCOMs.

Audit observed that had all the units been run on the PLF approved by HERC, additional 49,559.73 MUs of power valuing ₹ 15,576.80 crore could have been generated. Thus, Company lost the opportunity to earn potential revenue of ₹ 15,576.80 crore during 2016-21. Issues pertaining to non-recovery of fixed cost are discussed subsequently.

The Management replied (May 2022) that effective steps have been taken to minimise the forced outages and reduce backing down of plants by minimizing the cost of power. However, the fact remains that actual PLF of each HPGCL unit was on decreasing trend during 2016-2021.

2.3 Auxiliary Power Consumption

Auxiliary Power Consumption (APC) is power consumed by units themselves for running their equipments and common services. APC is expressed as a percentage of the gross energy generated by generating unit of the plant. HERC approves percentage of normative APC for each unit every year. The norms fixed by HERC ranged from six to ten *per cent* in respect of units of the Company during the period 2016-17 to 2020-21. Unit wise auxiliary power consumption is discussed below:

[6] Uttar Hayana Bijli Vitran Nigam Limited and Dakshin Hayana Bijli Vitran Nigam Limited.

[7] Forced outages is the period when the generating unit is not available for production of power due to unexpected breakdown of the unit.

Table 2.3: Auxiliary Power Consumption approved by the HERC *vis-à-vis* actual thereagainst

Auxiliary Power Consumption[8] (*per cent*)											
Name of Plant	Year	2016-17		2017-18		2018-19		2019-20		2020-21	
	Unit No.	HERC Norms	Actual	HERC Norms	Actual	HERC Norms	Actual	HERC Norms	Actual	HERC Norms	Actual
PTPS	V	10.00	15.95	10.00	16.12	10.00	14.81	De-commissioned			
	VI	10.00	12.52	10.00	10.61	10.00	10.54	10.00	NA[9]	9.00	18.52
	VII	8.50	9.20	9.00	8.97	9.00	8.65	8.50	9.29	8.50	9.93
	VIII	8.50	10.00	9.00	9.48	9.00	8.30	8.50	8.91	8.50	10.04
DCRTPP	I	8.50	8.67	8.50	8.62	8.50	8.69	8.50	8.41	8.50	8.37
	II	8.50	8.90	8.50	8.36	8.50	8.35	8.50	8.78	8.50	8.27
RGTPP	I	6.00	6.03	6.00	5.92	6.00	6.54	6.00	7.84	6.00	6.29
	II	6.00	6.12	6.00	5.89	6.00	5.89	6.00	6.18	6.00	8.49

Source: Information supplied by the Company and Tariff orders approved by the HERC for the year 2016-17 to 2020-21.

The APC in DCRTPP ranged between 8.37 to 8.69 *per cent* in respect of Unit-I and 8.27 to 8.90 *per cent* in respect of Unit-II against the norm of 8.50 *per cent* of both the Units. The APC in the units of RGTPP ranged between 5.92 to 7.84 *per cent* in respect of Unit-I and 5.89 to 8.49 *per cent* in respect of Unit-II against the norms of 6.00 *per cent* of both the Units. In addition, APC in the units of PTPS remained more than the norms fixed by HERC and it ranged between 8.3 *per cent* and 18.52 *per cent* during 2016-21, except during 2017-18 (for Unit VII – 8.97 *per cent*) and 2018-19 (for unit VII – 8.65 *per cent* and VIII- 8.30 *per cent*) It is seen from the table above that in eight units of three thermal power plants for five years, the APC was beyond HERC norms in 27 out of 38 combinations of units and years and within APC norms in remaining 11. APC beyond norms is a direct loss to the Company as it is not recoverable through tariff. Thus, due to higher APC (than norms), the Company suffered a loss of ₹ 49.45 crore on 140.33 MUs of power consumed in excess during 2016-21. The APC remained higher due to less running of plants which resulted in lesser generation and proportionately higher APC.

The Management replied (May 2022) that the APC remained higher due to frequent starts/stops, backing down and running of units on partial load. Further, efforts have been made to reduce the APC by replacing conventional lights, installation of Variable Frequency Drives (VFDs) and reduction in Induced Drought fans & compressors. Audit is of the view that APC should be kept within norms determined by HERC. However, while calculating the excess consumption of APC, Audit has adjusted the APC when the units were boxed up/shut down.

[8] Auxiliary Power Consumption data in the table is after adjustment of APC during shut down period.

[9] Auxiliary Power Consumption is calculated as percentage of total generation. During 2019-20 unit-VI of PTPS remained boxed up (shut down). Therefore, Auxiliary consumption cannot be calculated as percentage of total generation. However, total auxiliary power consumption in terms of Units was 5.10 MUs during 2019-20.

2.4 Station Heat Rate

Station Heat Rate (SHR) indicates the amount of fuel (heat) required to generate one unit of electricity. It is measured in kcal[10] per kWh[11]. Plant's efficiency is measured on the basis of its SHR. A Plant with higher SHR will consume more fuel in comparison to other plants with lower SHR. HERC has fixed normative SHR for each unit of the Company. The following table indicates HERC norms *vis-à-vis* actual SHR for each unit for the period 2016-17 to 2020-21:

Table 2.4: Station Heat Rate approved by the HERC *vis-à-vis* actual Station Heat Rate of the units

Station Heat Rate (Kcal/kWh)										
Year	**2016-17**		**2017-18**		**2018-19**		**2019-20**		**2020-21**	
Unit No.	**HERC Norms**	**Actual**	**HERC Norms**	**Actual**	**HERC Norms**	**Actual**	**HERC Norms**	**Actual**	**HERC Norms**	**Actual**
PTPS										
V	2,550	2,499	2,550	**2,721**	2,550	**2,566**	0	0	0	0
VI	2,550	2,519	2,550	**2,653**	2,550	2,540	2,550	0	2,550	2,537
VII	2,500	2,478	2,500	**2,562**	2,500	2,473	2,500	2,476	2,500	2,476
VIII	2,500	2,465	2,500	**2,551**	2,500	2,468	2,500	2,471	2,500	2,480
DCRTPP										
I	2,344	2,315	2,344	2,321	2,344	2,327	2,344	2,328	2,344	2,341
II	2,344	2,317	2,344	2,317	2,344	2,319	2,344	2,333	2,344	2,342
RGTPP										
I	2,387	**2,589**	2,387	**2,523**	2,387	**2,461**	2,387	**2,476**	2,387	**2,431**
II	2,387	**2,573**	2,387	**2,505**	2,387	**2,419**	2,387	**2,442**	2,387	**2,461**

Source: Information supplied by the Company and Tariff orders approved by the HERC for the year 2016-17 to 2020-21

The SHR in RGTPP remained higher than HERC norms in all the five years while in DCRTPP it was within norms during the period 2016-21. The SHR at PTPS was higher than HERC norms in 2017-18 in respect of all the units and higher in 2018-19 in respects of unit V. Higher SHR eventually led to higher consumption of coal resulting in higher variable cost and the unit not getting schedule.

The Management replied (May 2022) that SHR remained higher than norms due to backing down of plants and low quality of coal. However, in MYT Regulation 2019, HERC has made provision for compensation on degradation of station heat rate due to low Plant utilization factor. The fact remains that SHR norms should have been adhered to. The Company did not adhere to the capital overhauling schedules as discussed in paragraphs 2.6.1 and 2.6.2 which was essential to maintain the operational parameters of the plant. Further, Management should take action to upgrade the technology of the plants and efforts should be made to improve the quality of coal and achieve the Station Heat Rate (SHR) norms as approved by Haryana Electricity Regulatory Commission.

[10] Kcal- Kilo calories is the amount of heat required to raise the temperature of one kg of water to one degree Celsius.

[11] KWh- Kilo watt per hour, it is a unit of energy measurement.

2.5 Backing down of plants due to higher variable cost

As per Regulation 59 of HERC Multi Year Tariff (MYT) Regulation, 2012 titled 'Cost of power Purchase', distribution licensees (DISCOMs) are bound to schedule power in accordance with the principles of merit order schedule and purchase power on the basis of ranking of all approved sources of supply in the order of their variable cost. Merit order[12] is decided every month on the basis of variable cost (generation cost) and Point of Connection (POC) charges (transmission losses) of electricity by the generation stations. Most expensive generator is kept at the top of merit order and gets the least opportunity to supply the power to DISCOMs. The details of BDI issued by DISCOMs on account of low demand during 2016-17 to 2020-21 were as under:

Table 2.5: Details of total operating hours and shut down period due to BDIs during 2016-21

Year	Total Operating hours		Shut down period due to BDI (in hours)			Shut down period due to BDI (in percentage)		
DCRTPP Yamuna Nagar								
	Unit-I	**Unit-II**	**Unit-I**	**Unit-II**		**Unit-I**	**Unit-II**	
2016-17	8,760	8,760	1,347	1,459		15.38	16.66	
2017-18	8,760	8,760	1,291	806		14.74	9.20	
2018-19	8,760	8,760	1,065	1,206		12.16	13.77	
2019-20	8,784	8,784	2,906	1,350		33.08	15.37	
2020-21	8,760	8,760	3,289	3,280		37.55	37.44	
Total	**43,824**	**43,824**	**9,898**	**8,101**		**22.59**	**18.49**	
RGTPP Hisar								
2016-17	8,760	8,760	4,123	3,245		47.07	37.04	
2017-18	8,760	8,760	3,290	2,531		37.56	28.89	
2018-19	8,760	8,760	3,961	3,550		45.22	40.53	
2019-20	8,784	8,784	3,681	5,197		41.91	59.16	
2020-21	8,760	4,104[13]	5,189	3,240		59.24	78.95	
Total	**43,824**	**39,168**	**20,244**	**17,763**		**46.19**	**45.35**	
PTPS, Panipat			**Unit-VI**	**Unit-VII**	**Unit-VIII**	**Unit-VI**	**Unit-VII**	**Unit-VIII**
2016-17	8,760	8,760	7,541	3,550	5,559	86.08	40.52	63.46
2017-18	8,760	8,760	5,368	2,759	3,714	61.28	31.50	42.40
2018-19	8,760	8,760	7,067	2,941	1,795	80.67	33.57	20.49
2019-20	8,784	8,784	8,784	4,303	3,847	100.00	48.99	43.80
2020-21	8,760	8,760	7,588	5,038	6,236	86.62	57.51	71.19
Total	**43,824**	**43,824**	**36,348**	**18,591**	**21,151**	**82.94**	**42.42**	**48.26**

Source: Information supplied by the Company for the year 2016-17 to 2020-21

Deen Bandhu Chhotu Ram Thermal Power Plant (DCRTPP)

The BDI increased from 1,347 hours to 3,289 hours and from 1,459 to 3,280 hours in case of Unit-I and Unit-II respectively during 2016-21. Scrutiny of Merit Order prepared by the Haryana Power Purchase Centre (HPPC) on behalf of Haryana DISCOMs, revealed that Variable Cost (VC) at DCRTPP increased from ₹ 3.100 to ₹ 3.484 per unit from April 2016 to March 2021. As per merit order, DCRTPP was one of expensive plants amongst the 33 Power plants for which merit order is prepared. Its Rank[14] in merit order ranged

[12] In this Performance Audit, the issue of preparation of merit order by Haryana Power Purchase Centre on behalf of both the DISCOMs has not been examined and no Audit opinion is formed on Merit order.

[13] Operating hours of Unit-II (RGTPP) has been reduced to 4,104 hours due to damage of HIP Rotor on 19 September 2020 resulted into shutdown of unit till date (January 2022).

[14] 1st rank means most expensive and 32nd rank means most economical.

between 1st and 12th during 2016-17 to 2020-21 ***(Appendix 2.2)***. We noticed that due to its high rank in merit order, DCRTPP did not get schedule and lost the opportunity to earn potential revenue of ₹ 1,557.26 crore by not generating 4,589.75 MUs of power ***(Appendix 2.3)***.

Rajiv Gandhi Thermal Power Plant (RGTPP)

The shut down period due to BDI increased from 4,123 hours to 5,189 hours and from 3,245 to 5,197 hours in case of Unit-I and Unit-II respectively during 2016-21. Unit-II was under forced shut down due to damage of High Intermediate Pressure (HIP) Rotor since 19 September 2020.

Scrutiny of Merit Order prepared by the Haryana Power Purchase Centre (HPPC) showed that Variable Cost of RGTPP increased from ₹ 3.190 to ₹ 3.622 per unit from April 2016 to March 2021. RGTPP was one of expensive plants among all 33 Power plants for which merit order was prepared. Its rank in merit order ranged between 1st and 13th during 2016-17 to 2020-21 ***(Appendix 2.2)***. Due to the high rank in merit order, RGTPP lost the opportunity to earn potential revenue of ₹ 6,666 crore by not generating 19,383.57 MUs of power ***(Appendix 2.3)***.

Panipat Thermal Power Station (PTPS)

During 2016-21, shut down period due to BDI ranged between 61.28 to 100 *per cent* of available hours for Unit VI, 31.50 to 57.51 *per cent* for Unit VII and 20.48 to 71.19 *per cent* for Unit VIII. The plant was given further BDI by Haryana Power Purchase Centre (HPPC) due to its higher Variable Cost (VC). In merit order, its position ranged between 1st and 7th for Unit VI, 2nd and 13th for Unit VIII and 2nd and 10th for Unit VIII ***(Appendix 2.2)***.

This resulted in lost opportunity to earn potential revenue of ₹ 5,226.35 crore by not generating 14,889.09 MUs of power ***(Appendix 2.3)***.

The net effect of this non-getting of schedule is loss of potential revenue of ₹ 13,449.61 crore ***(Appendix 2.3)***.

The Management contended (May 2022) the issue of backing down of plants due to higher variable cost. They stated that HPGCL plants were backed down on not being scheduled by DISCOMs due to erroneous Merit order Dispatch (MoD). The DISCOMs were not evaluating the power cost on cost to consumer or landed basis which impacted HPGCL scheduling. They added that HERC in its order dated 18 February 2021 had adjudicated that HPGCL don't have any liability of Point of Connection (PoC) Charges, whereas the charges of wheeling electricity to state has been considered as fixed cost and thus level playing field has not been provided for HPGCL units. The matter of erroneous MoD has been challenged at APTEL and outcome of the same was awaited (May 2022).

Inherent Locational disadvantages to HPGCL Plants

The variable cost for a generating plant (thermal) consists of fuel cost i.e., cost of coal and its transportation cost. The main reason for higher variable cost was transportation cost of coal. Coal is transported through Railways from collieries located at Jharkhand, West Bengal, Madhya Pradesh having distance of more than 1,200 kms. In case of plants located at pitheads (coal mining sites), transportation cost of fuel remains minimum. Due to this, units of the Company could not compete with pithead plants in terms of variable cost. Comparison of fuel cost with its transportation/freight cost is given in the table below:

Table 2.6: Average coal cost, average transportation cost and average distance from colliery thermal plant wise for the period 2018-19 to 2020-21.

Sr. No.	Name of the Plant	Average coal cost (₹ Per MT)	Average Transportation cost (₹ Per MT)	Total Coal cost (₹ Per MT)	Percentage of transportation cost to total coal cost	Average distance from colliery (in KMs)
1	RGTPP	2,577	2,831	5,408	52.35	1,418
2	PTPS	2,393	2,712	5,105	53.12	1,303
3	DCRTPP	2,684	2,520	5,204	48.42	1,265

Source: Information supplied by the Company for the year 2018-19 to 2020-21

The transportation cost of coal at RGTPP and PTPS was more than the cost of coal, at 52.35 *per cent* and 53.12 *per cent* respectively. Due to comparatively lower average transportation cost of coal at DCRTPP, the plant got more chances of scheduling of power, which resulted in better PLF.

Further analysis showed instances of incorrect booking of expenditures in coal accounting (Coal Price Store Ledger) due to which variable cost was depicted higher than cost to be booked as discussed below:

2.5.1 Increase in variable cost due to incorrect booking of Operation & Maintenance (O&M) expenses in variable coal cost

The generation tariff of the Company is determined by HERC every year as per Multi-Year Tariff (MYT) Regulations, 2012. The generation tariff consists of two parts - Annual fixed charges (Capacity charges) and Variable charges (Energy Charges). The fixed cost includes Return on equity, Interest and financing charges on loan capital, Interest on working capital, Depreciation and Operation & Maintenance expenses (O&M). The Energy Charges/ variable charges comprise mainly the primary fuel (coal) cost. The landed cost of fuel for the month includes price of coal corresponding to the grade of coal inclusive of royalty, taxes and duties as applicable, transportation cost by rail/road or any other means. The fuel cost also includes normative transit/ moisture losses and handling losses as percentage of the quantity of coal dispatched by the coal supply company during the month.

The power generated from DCRTPP, RGTPP and PTPS is sold to DISCOMs of Haryana. Haryana Power Purchase Centre (HPPC), on behalf of both the

DISCOMs, prepares a merit order of variable cost of available generators and accordingly releases the generation schedule to generators on the basis of variable cost of power. Therefore, it is essential for the Company to control its variable costs to get schedule for generation of power.

At RGTPP and PTPS, the landed cost of coal for 2016-21 also included cost of internal transportation of coal amounting to ₹ 72.69 crore and ₹ 9.12 crore respectively as detailed below:

Table: 2.7: Cost of internal transportation and its handling cost

(₹ in crore)

Period	Cost of internal transportation of coal	Cost of internal coal handling (Handling Charges)	Total
RGTPP			
2016-17	1.97	24.57	26.54
2017-18	1.95	13.37	15.33
2018-19	9.05	3.98	13.02
2019-20	16.73	0.00	16.73
2020-21	1.07	0.00	1.07
Total	**30.77**	**41.92**	**72.69**
PTPS			
2016-17	2.89	0.00	2.89
2017-18	2.18	0.00	2.18
2018-19	3.04	0.00	3.04
2019-20	1.01	0.00	1.01
Total	**9.12**	**0.00**	**9.12**

Source: Information supplied by the Company for the year 2016-17 to 2020-21

The expenditure on internal transportation of coal, which was a part of Operation and Maintenance (O&M) cost of coal handling plant and therefore it was to be charged to the fixed cost in O&M expenses, was treated as a variable cost. This resulted in a higher depiction of monthly Variable Cost ranging between ₹ 0.007 to ₹ 0.40 and ₹ 0.002 to ₹ 0.045 per unit at RGTPP and PTPS respectively during 2016-21. At the same time, DCRTPP, Yamuna Nagar correctly treated O&M expenses as part of fixed cost. Had O&M cost been excluded from the variable cost at RGTPP and PTPS, they would have been better placed in merit order in respective months and avoided/ reduced backing down.

The Management replied (May 2022) that as per MYT Regulations, 2012, Energy Charge Rate (ECR) is calculated on the basis of GCV of coal on 'fired basis'. It means that it included all expenditures incurred till Boiler front. Now, as per 2nd amendment in MYT Regulations, GCV on 'As Received basis' will be considered and all the expenditure on account of same will be booked under O&M. The point stays that expenditure incurred on internal transportation of coal which should have been part of O&M of plant as booked by DCRTPP to minimize the variable cost and backing down of plants was not done at RGTPP and PTPS.

2.5.2 Loading of transit gain into monthly coal cost resulted into higher variable cost

Regulation 32 (i) of Multi Year Tariff (MYT) Regulations, 2012 provides that 'for working out the landed cost of fuel for thermal power plants, the normative transit/moisture and handling losses as percentage of the quantity of coal dispatched by the coal supply company shall be less than or equal to 1.5 *per cent'*.

Clause 10.2.1 of Coal Accounting Manual under which Coal Price Stores Ledger (CPSL) is prepared, provides that the CPSL forms an important element of coal accounting, whereby all adjustments of coal quantities (received, consumed, lost in transit and handling, etc.) as well as adjustment related to all coal payments and receipts on account of claims raised are summarised. Clause 10.2.3 provides that CPSL preparation includes adjustments on account of transit and handling loss. Clause 10.5.2 provides that actual transit loss if less than the normative transit loss, should be adjusted in the CPSL.

Scrutiny of CPSL of all the plants of the Company revealed that wherever there was transit gain or the actual transit loss was less than the normative level, the thermal plants of the Company had booked the proportionate cost of it in the CPSL despite the fact that this cost was not paid by the Company. This has resulted in increase in variable cost for such months and thus adversely impacted the schedule for generation. These plants, however, at the end of the year (in March) adjusted the net impact of such transit gain/loss lesser than normative, which reduced the variable cost of March only every year. This led to increase in monthly weighted average variable cost by ₹ 0.040 in DCRTPP, ₹ 0.051 in PTPS and ₹ 0.021 in RGTPP during the months when transit gain was noticed or transit loss was less than normative level.

The Management replied (May 2022) that whole benefit of transit gain is transferred to the DISCOMs at the end of financial year. If Company follows the process of booking of actual gain/losses on monthly basis, then it will not be beneficial either for DISCOMs or for HPGCL. The reply is not tenable because the Company gets schedule as per merit order prepared on monthly basis. Therefore, any impact of transit gain should be accounted for on monthly basis to reduce the monthly variable cost and backing down of plants.

Impact of incorrect booking of transit gain and O&M expenditure on internal transportation of cost

Audit analyzed the impact of incorrect booking of transit gain and treatment of O&M expenditure on internal transportation of cost as Variable cost and scheduling of power to HPGCL Plants as per merit order. Due to increase in

Variable Cost as a result of above wrong bookings, HPGCL plants deprived themselves of scheduling of power during 20 months which translates into loss of revenue amounting to ₹ 1,505.90 crore for generation of 4,582.41 MUs to HPGCL. Further, this also resulted into increase in power purchase cost to Haryana DISCOMs by ₹ 99.62 crore for 4,582.41 MUs.

2.6 Repair and Maintenance of Power Plants

Efficiency of the plant and equipment and their availability for power generation is dependent on adherence to annual maintenance and equipment overhauling schedules. Failure to adhere to these schedules results in higher consumption of coal, fuel oil and higher forced outages and resultant increase in the cost of power generated. These issues also have an impact on variable cost and consequently on merit order as well as impact on operationality in view of provisions of backing down and impact of the same could not be quantified in Audit. Audit findings in respect of overhauling works at Company's plants are discussed in succeeding paragraphs:

(A) Rajiv Gandhi Thermal Power Plant (RGTPP)

RGTPP has installed capacity of 1200 MW having two Units of 600 MW each which were commissioned on 24 August 2010 and 1 March 2011 respectively. As per Operational Manual of Original Equipment Manufacturer (OEM) of the plant, Class-A service i.e., Capital overhauling was required to be conducted within an interval of four to six years depending upon the operating status of the concerned unit. Audit noticed:

2.6.1 Poor execution of capital overhauling works

OEM suggested (January 2017) for capital overhauling of Turbine and Generator of Unit-I to overcome the operational problems of higher heat rate, high vibration, leakage of hydrogen from Generator.

The Company also decided (March 2017) to revive two Electro Static Precipitators (ESPs) (nos. A1 and A9) of Unit-I which were out of order due to their damaged internals. The Company accorded (April 2017) administrative approval for revival of the two damaged ESPs and overhauling of remaining 62 ESPs on open tender basis to make the plant meet the new environmental norms and also decided to carry out suggested capital overhauling.

The Board of Directors (BoDs) of the Company approved (July 2017) the capital overhauling of Unit-I to be done during January to March 2018 for a period of 60 days at an estimated cost of ₹ 43.40 crore.

The Company issued NIT for revival of two ESPs and overhauling of remaining 62 ESPs fields in October 2017 but the work order was issued only by August 2018. Thus, due to delay in award of work of ESPs, the Company had to reschedule (September 2018) the planned capital overhauling to February 2019.

The Unit suffered from technical defects repeatedly during January 2018 to December 2019 but the Company persisted with operating the plant against technical advice leading to forced outages for 92 days resulting in loss of generation of 1,124.55 MUs equivalent to ₹ 379.28 crore.

In the meantime, Company decided to schedule the Cooling Tower repair also along with capital overhauling of Unit I and awarded (23 October 2019) work for repair of cooling tower. Due to this, Capital overhauling was rescheduled to October 2019 and thereafter from 15 February 2020 to 29 April 2020 (75 days).

Audit observed that the Unit-I was under forced shut down from 23 November 2019 due to technical faults. During this forced shut down period, the Company advanced the preponed Capital Overhauling schedule (15 February 2020 to 29 April 2020) for 75 days to 16 December 2019 to 28 February 2020. However, this capital overhauling could be completed by 4 May 2020, a delay of 65 days. The Unit-I was synchronized on 7 May 2020 (by taking 143 days).

Thus, the Capital overhauling was carried out after two years and took 68 extra days than the scheduled plan. The delay in finalisation of work order for revival and overhauling of ESPs and inclusion of the repair work of cooling tower which was finalized in October 2019 were the contributing factors for the delay in scheduling the Capital Overhaul. The delay and excess time taken in overhauling had led to identifiable generation loss of 832.32 MUs valuing ₹ 296.64 crore for 68 days of Unit-I due to extra days taken in Capital Overhauling, loss of generation of 1,124.55 MUs valuing ₹ 379.28 crore due to forced shutdowns during January 2018 to December 2019. Besides, due to excess time taken in capital overhauling, the Company could not recover fixed cost of ₹ 98.34 crore from the DISCOMs.

The Management replied (May 2022) that the work was delayed due to multiple problems in Turbine and inclusion of revival work of damaged ESP & cooling towers. Further, due to Covid-19, there was delay in supply of spares from China. The reply is not tenable as Original Equipment Manufacturer (OEM) suggested for capital overhauling during 2017 itself and Management took more than two years to commence the work. The capital overhauling works should have been planned and executed in a coordinated and timely manner which could have minimized the loss of fixed cost.

2.6.2 Delay in repair of High Intermediate Pressure Rotor of Unit-II of RGTPP

The Capital overhauling of the Unit-II was scheduled from 15 February 2021 to 30 April 2021. The Unit-II was backed down from 13 September 2020 to 18 September 2020. On obtaining schedule, it was lighted up (19 September 2020) when it developed technical fault. The OEM on inspection recommended (13 October 2020) shutting down the unit and overhauling of Turbine Generator set and repair of High Intermediate Pressure Rotor (HIP Rotor).

OEM submitted (December 2020) an offer for ₹ 27.80 crore which included ₹ 9.74 crore for overhauling of the Unit and ₹ 3.08 crore for repair while ₹ 14.08 crore was for transportation of Rotor to China based OEM. The Company placed (20 February 2021) a work order to OEM for ₹ 11.25 crore (excluding transportation).

OEM after dismantlement and inspection of the damaged turbine and HIP Rotor concluded that the equipment was not repairable and suggested (March 2021) for replacement. To bring the unit operational at the earliest, the Company decided (June 2021) to procure one old HIP Rotor also.

Audit observed that Unit-II of RGTPP which was commissioned in March 2011 had remained under forced shutdown during 2013-14 also when the HIP Rotor was sent to OEM in China for repair. At that time, Rotor was within Guarantee/ warranty period, so the repair cost was borne by the Contractor. This time the same HIP Rotor was damaged but was out of warranty. The Company had however, not carried out any cost benefit analysis either go for repair or purchase a new rotor in view of high transportation cost against a very small component of repair cost and loss of fixed cost of ₹ 0.97 crore per day as well as that of generation of 12.24 MUs per day.

Company placed (July 2021) a purchase order for procurement of two HIP Rotors at a value of US $ 48.50 lakh (one fully bladed new HIP Rotor at US $ 37.50 lakh and one fully blades old HIP Rotor at US $11 lakh) i.e., at ₹ 47.74 crore[15] inclusive of taxes and duties. OEM was required to ship new HIP Rotor within 13 Months from the date of issue of PO and the old HIP Rotor was to be shipped within six Months from the date of issue of PO and after receipt of 30 *per cent* advance payment of old Rotor. HIP Rotor has been received during January 2022 but unit could not be commissioned due to non-receipt of associated spares.

Thus, fixed cost of ₹ 396.77 crore[16] could not be recovered from DISCOMs apart from loss of potential revenue for forced shutdown period.

The Management replied (May 2022) that work was delayed due to covid-19 restrictions and the HIP Rotor has been received during January 2022 but unit could not be commissioned due to non-receipt of necessary associated spares from China due to lock down restrictions. The reply is not tenable as Management should have assessed the requirement of associated spares at the time of placing purchase order for HIP Rotor so that associated material would be received along with HIP Rotor.

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15 Based on $1 = ₹ 74.05 as on 29 April 2021 as per RBI rates.

16 ₹ 132.07 crore for period 20 September 2020 to March 2021 and ₹ 264.70 crore for the period April 2021 to December 2021.

(B) Deen Bandhu Chhotu Ram Thermal Power Plant (DCRTPP)

Unit I and Unit II of DCRTPP, Yamuna Nagar were commissioned in April 2008 and June 2008 respectively. The overhauling of these units was carried out by the OEM during 2012-13 and Units were re-commissioned on 5 February 2013 and 5 September 2013 respectively. The OEM had specified that Capital overhauling period for turbine ranged between four to six years. Accordingly, the Company planned for Capital overhauling of both Units during 2016-17 to 2017-18. The administrative approval of Capital Overhauling of both the Units were granted (December 2016) by Board of Directors (BoDs). The Company had also included work of revival and repair of Electrostatic Precipitators (ESP) during Capital Overhauling to comply with the environment norms.

The Company issued work order on OEM for capital overhauling of Turbine and Generator of both the Units with a contract cost of ₹ 9.19 crore in January 2018. Audit observed:

2.6.3 Capital overhauling of Unit I

Capital Overhauling works of Unit I, planned for 12 March 2016 to 10 May 2016, could not be finalised timely and the work order could be issued only on 9 January 2018. At the same time the work of revival and repair of ESP was decided to be executed. The Company awarded (October 2017) this work to a firm at a cost of ₹ 27.61 crore which took about four months for arranging the ESP spares from the time of issue of letter of intent (September 2017) further delaying the Overhauling schedule. The Capital Overhauling time of Unit-I was re-scheduled from 1 February 2018 to 1 April 2018.

Thus, the delay of 22 months in awarding the Capital Overhauling work of Unit I and ESP Revival and repair work pushed the Capital overhauling scheduled date from May 2016 to February 2018.

Further, insulation and cladding works at Turbine Generator I and II, Boiler Maintenance Division I and II, areas and their auxiliaries' area were awarded on 14 March 2018 (after 41 days from the start of Capital Overhauling of Unit-I) with a schedule completion period of 60 days. This contributed to overall delay in capital overhauling work which was eventually completed on 5 May 2018 by taking extra 34 days than planned.

Company noticed (May 2018) other technical abnormalities in Unit-I subsequent to overhauling which required shutting down of the Unit-I for 30 days. After shutdown undertaken (8 October 2018), the Unit-I was synchronised on 19 December 2018 after repairs. The Unit-I remained shut for further 72 days (i.e., 8 October 2018 to 19 December 2018) after Capital overhauling w.e.f. 1 February 2018 to 5 May 2018 (94 days).

Thus, Capital Overhauling of Unit-I carried out after delay of 22 months and taking 34 extra days than planned resulted in generation loss of 208.08 MUs equivalent to ₹ 70.96 crore for 34 days of Unit-I. The Company also could not recover fixed cost of ₹ 39.03 crore from the DISCOMs.

The Management replied (May 2022) that work was delayed due to late award of capital overhauling/ESP works because some works were awarded on propriety basis and some through NITs. Further, for awarding the contract lots of procedures/approvals were required. The reply is not tenable as Management was aware about the time required/necessary approvals for tendering/propriety basis and issue of Work orders.

2.6.4 Capital overhauling of Unit II

Capital Overhauling work of Unit II was planned during 12 May 2017 to 10 July 2017 (60 days). The schedule was revised multiple times and finally 1 November 2019 to 14 January 2020 (75 days). The capital overhauling work was eventually carried out between 1 November 2019 and 10 February 2020 (102 days) taking 42 days more than the planned period. The work of revival and repair of ESP was also included in Capital Overhauling work. The delay was attributed to:

- Capital overhauling work of Unit I was delayed up to February 2018 which delayed start of Capital Overhauling of Unit II.
- The Company had planned Capital Overhauling during peak summer/ paddy season of April-June and July-September during 2018 and 2019 respectively which was not allowed by Haryana Power Purchase Centre (HPPC). Accordingly, Capital Overhauling of Unit-II was delayed.
- Insulation and cladding work at Turbine Generator I and II, Boiler Maintenance Division I and II areas and their auxiliaries' area was also required to be carried out during Capital overhauling of these units. The work was awarded on 14 March 2018 with a schedule completion period of 60 days. The validity of the rates was for one year i.e. up to March 2019. The Company could not start work of Capital Overhauling of Unit II during the period in which rate of insulation and cladding work was valid. Accordingly, Company floated a new NIT and re-awarded (19 December 2019) (after a delay of 49 days from planned Capital Overhauling of Unit II).

Thus, Capital Overhauling of Unit II was carried out after delay of 29 months and took 42 extra days than original planned 60 days and 27 days extra from revised plan due to awarding of various works[17] of Capital Overhauling and related works at different time intervals and planning of overhauling during

[17] Award of Capital Overhauling work, re-awarding of Insulation & Cladding work to and non-availability of shut down from HPPC during paddy/summer season.

peak season due to ill planning by the Company. This resulted in generation loss of 165.24 MUs equivalent to ₹ 55.19 crore for 27 days of Unit-II of 300 MW due to extra days taken in Capital Overhauling. The Company could not recover fixed cost of ₹ 48.82 crore also from the DISCOMs.

The Management replied (May 2022) that work was delayed due to latein award of ESP revival work and delay in completion of capital overhauling of Unit-1. Reply is not tenable as reasons for delay could have been avoided had the Company awarded the works as per capital overhauling plan.

(C) Panipat Thermal Power Station

2.6.5 Avoidable expenditure due to deficient terms and conditions of the Operation and Maintenance contract

The Company awarded (July 2014) work for complete operation and maintenance of two Coal Handling Plants (CHP-II for Units V & VI and CHP-III for Units VII & VIII) along with other allied works at Panipat Thermal Power Station (PTPS) for the period of three years from August 2014 to July 2017 at the following rates:

Table 2.8: Details of period and cost of O&M contract

Sr. No.	Year	Period	Rate per annum (excluding taxes) (₹ in crore)
1	First Year	1 August 2014 to 31 July 2015	22.00
2	Second Year	1 August 2015 to 31 July 2016	23.10
3	Third Year	1 August 2016 to 31 July 2017	24.20
Total amount for three years (exclusive of taxes)			**69.30**

Source: Compiled from the records of company.

Haryana Electricity Regulatory Commission in its tariff order for the year 2016-17, reduced the normative PLF from 60 to 35 *per cent* and normative O&M expenses by considering the low level of PLF achieved by Unit V and VI. The Company, therefore, decided (June 2016) to foreclose the contract to keep the O&M cost within norms and also float fresh NIT with revised scope of work. Accordingly, the Company reduced the scope of work[18] as per HERC norms with an estimated value ₹ 14.08 crore p.a. (41.80 *per cent* less than the contract value of ₹ 24.20 crore p.a.). Thereafter, NIT was floated (October 2016) and offered rate of L-I firm of ₹ 13.14 crore p.a. was received. Audit scrutiny revealed that as there was no clause for foreclosing the contract in the existing work order and the Company did not issue fresh work order during January 2017 to July 2017.

The Company held negotiations with the firm for reduction in existing rates who offered (September 2016) a rebate of ₹ 4.20 crore per annum as per

[18] By taking 35 *per cent* PLF of Units V and VI and 85 *per cent* PLF of Units VII and VIII.

revised scope of work with the condition that the existing work order may be extended for further two years (4th and 5th year) at the revised offered rate i.e. ₹ 20 crore (₹ 24.20 crore minus rebate of ₹ 4.20 crore). The Company analysed offered rates were still on higher side and decided not to accept the revised offer.

Audit observed that while deciding the terms and conditions of a contract, Company had not inserted the enforceable clauses of reduction in scope of work and foreclosure. Accordingly, Company had to pay at higher rates (₹ 24.20 crore p.a.) to the firm despite receipt of reduced rates of ₹ 13.14 crore p.a. in January 2017.

Thus, due to deficient terms and conditions of the O&M Contract, the Company could not foreclose the contract and had to pay ₹ 13.48 crore to the firm during February to July 2017 against ₹ 7.39 crore as per lowest rates discovered. This has resulted in avoidable expenditure of ₹ 6.09 crore and the ultimate burden was passed to the consumers

The Management replied (May 2022) that there was no clause in the contract to close the contract intermittently. Further, the contract was made considering the power deficit scenario in the State. Audit is of the view that suitable clauses for short closure/reduction in scope of work should have been incorporated keeping in view the scenario of decreasing PLF and age of Units V and VI of PTPS.

(D) Western Yamuna Canal Hydro Electric Project

2.6.6 Delay in overhauling work of machines due to acceptance of non-interchangeable blades resulted into loss of green energy

The Company had commissioned four Power Houses namely A, B, C and D during 1986, 1987, 1989 and 2004 respectively at Western Yamuna Canal (WYC) Hydro Electric project at Bhudkalan, Yamuna Nagar with a total capacity of 62.4 MW. The Machines B1, C1 and C2 were running on partial load and to improve their efficiency, the Company placed (October 2015) a Purchase Order (PO) for purchase of four sets of runner blades on the OEM[19] at a cost of ₹ 8.48 crore for the capital overhauling of Machines. The supplied material was to be identical and interchangeable amongst the different machines. The Guarantee/warranty period was 12 months from the date when the product was put to use or 18 months from the date of dispatch whichever was earlier. The material supplied during July & September 2016 certified that all the components and equipments were identical in construction, interchangeable and suitable to the equipments already installed at WYC, Hydel Yamuna Nagar. The following was observed:

[19] M/s Voith Hydro Pvt limited.

Overhauling of Machine B-1

The Company issued work order (November 2017) for Capital overhauling of Machine B-1 to a contractor which was carried out from 8 December 2017 to 7 March 2018. The Company observed (March 2018) that despite Capital Overhauling, the Machine could achieve load of six MW only against the desired load of 7.5 MW. The low generation was taken up (March 2018) with contractor who attributed it to fault in new runner blades supplied by OEM. It was then observed that new blades procured from OEM were not identical/inter-changeable as certified and needed technical adjustment from the supplier/ OEM. As a result, despite its capital overhauling, the desired load could not be achieved and machine B-1 kept running on partial load of six MW.

Audit observed that despite knowing this fact, Company did not make any efforts to get the blades of Machine B-1 replaced from the OEM and let the machine B-1 to perform at lower load (April 2018 to June 2021) which resulted in generation loss of 27.336 MUs of green energy.

Overhauling of Machine C-1

Thereafter, during December 2017, the Company issued another work order for Repair Modernisation and Upgradation (RM&U) of turbine and generator of Machines C1 and C2 to a firm. The machine C1 was given to the firm on 13 March 2018 with scheduled date of completion as 12 September 2018. As the blades were not inter-changeable, the Company sent (May 2018) them to OEM for carrying out technical adjustment which were received back in December 2018. Due to this reason, C-1 Machine could be commissioned on 25 January 2019 with a delay of 134 days. It was observed that after overhauling the Machine successfully achieved the desired load level of 7.5 MW, but the delay in commissioning of machine resulted in generation loss of 15.44 MUs of green energy.

Overhauling of Machine C-2

Audit noticed that despite successful completion of RM&U work at Machine C-1 in January 2019, the Company took almost one year for providing site for overhauling work of C-2 machine. The work of overhauling of C-2 Machine was started by 17 January 2020 with scheduled date of completion as 16 July 2020. However, the work of overhauling was yet to be completed (July 2021). The main reasons for delay were extra repair work carried out by the firm on the non-inter-changeable blades supplied by OEM and spread of Covid-19 pandemic.

Table 2.9: Details of period of capital overhauling contract

Reasons for delay	Period	Period
Total period from the commencement of work	17 January 2020 to 17 July 2021	18 months
Delay on account of COVID	March to May- 2020 March to May- 2021	6 Months
Period allowed to firm		6 months
Delay till July 2021		**6 months**

Source: Compiled from the records of company.

Delayed completion of overhauling work of machine C-2 resulted in loss of generation 21.0275 MUs of green energy.

Therefore, there was total generation loss of 63.80 MUs of green energy valuing ₹ 30.73 crore in respect of all the three Machines due to acceptance of non-inter-changeable blades and delay in completion of overhauling work in Machine B-1, C-1 and C-2. Further, the Company had to bear higher inventory carrying cost due to delayed utilisation of runner blades. It was further observed that although fixed cost of hydel project was recovered by the Company by achieving the normative PLF, but due to lesser generation, DISCOMs had to purchase 63.80 MUs of power from other sources which resulted into extra burden to the extent of ₹ 30.73 crore[20] on the state consumers.

The Management replied (May 2022) that the matter was pursued with the OEM and correction work on blades in all three machines has now been completed and machines are running at full load. The reply is not tenable as Management took more than two years in taking corrective action after detection of fitment issues during March 2018 which resulted in generation loss of green energy.

2.7 Conclusion

The generation of the Company declined from 10,567.83 MUs in 2017-18 to 5,466.81 MUs in 2020-21, even far below the normative generation approved by the HERC and the shortfall ranged between 42.61 to 69.24 *per cent* during 2017-21. The main reason for low generation was higher variable cost of thermal power stations which resulted in backing down of plants.

The Plant Load Factor in respect of all units of the Company decreased substantially due to forced outages on account of various technical problems, poor planning in execution of works pertaining to capital overhauling. Due to non-achievement of normative PLF, Company could not recover fixed cost of ₹ 390.94 crore during 2016-21 from the DISCOMs. The Company lost the opportunity to earn potential revenue of ₹ 15,576.80 crore on non-production

[20] Calculated on the basis of DPR data 42.055 MUs per year @ 7.5 MW Load of machine B-1, C-1 and C-2 and average power purchase cost of respective years.

of 49,559.73 MUs of power during 2016-21 due to non-achievement of normative PLF.

As per merit order, plants of the Company were one of expensive plants amongst the 33 Power plants for which merit order is prepared by DISCOMs. Their ranks in merit order ranged between 1st and 13th during 2016-17 to 2020-21 Thus, the position of the thermal plants in merit order deteriorated due to which the Company lost opportunity of earning potential revenue of ₹ 13,449.61 crore by not generating 38,862.43 MUs of power. Further, due to higher transportation cost of coal the units of the Company could not compete with Pithead plants in terms of variable cost. The deficiency in coal accounting and O&M further accentuated the adverse impact on merit order. The consistent poor performance on O&M processes by the Company and deficient coal accounting carries the risk of it being by design in place of inefficiencies as competitors in the merit order include six private entities.

The HIP Rotor of Unit-II of RGTPP got damaged (September 2020) due to irregular loading pattern, frequent start and stop operations. The Company had however, not carried out any cost benefit analysis either go for repair or purchase a new rotor in view of high transportation cost against the small amount on repair cost and loss of fixed cost of ₹ 0.97 crore per day besides loss of generation of 12.24 MUs per day. The HIP Rotor has not been replaced as yet (December 2021) resulting in non-recovery of fixed cost of ₹ 396.77 crore from the DISCOMs.

The Company has suffered generation loss of 63.80 MUs of green energy valuing ₹ 30.73 crore in respect of Western Yamuna Canal Hydro Electric Project due to acceptance of non-inter-changeable blades and delay in completion of overhauling work of Machines. Due to lesser generation, DISCOMs had to purchase 63.80 MUs of power from other sources which resulted into extra burden to the extent of ₹ 30.73 crore on the State consumers.

2.8 Recommendations

- The Company needs to control variable cost of its thermal plants for generation of power to get schedule for generation of power from the DISCOMs.
- The overhauling of the generating plants may be planned in accordance with recommendations of original equipment manufacturers and scheduled in a manner as to minimise forced outages.
- The Company must carry out cost benefit analysis to decide whether to go for repair of its capital equipments or purchase new equipment.