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A Trend Analysis of Cost in Thermal Power Station: A Special reference to Rayalaseema Thermal Power Station

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Abstract:
Indian power sector has a phenomenal growth since Independence. The installed power generation of the nation in 1947 was 1,362 MW, which was increased to 4,17,668 MW as on 31-05-2024.Thermal power generation is contributing the maximum share among the various power generations in India. The installed capacity of thermal power stations in India is 2,05,228 MW as on 31-05-2024.Though there is a lot of growth and expansion in the renewable energy source in India but the coal based thermal power generation is occupies 49.1%, which is a lion's share in the installed capacity. The power generation at the time of Independence was 4,073 GW, this is raised to 13,83,417 GW. The Per Capita consumption of electricity is 16 Kwh in 1947, the same has been reached to 1,208 Kwh at the end of 31-03-2020. This indicates that there is a massive growth in the sector since Independence. Still 15 million houses are away from electricity. The tariffs of power have been increasing significantly during the last decade because of increasing the cost of power generation. The present paper explains various expenditures involved in thermal power generation and offer suggestions to reduce the cost of power generation.

Keywords: Fixed costs, Variable costs, Total cost and Cost analysis.

Introduction

Power sector plays a prominent role in the growth and development of any country. It is a crucial infrastructure element that require for the smooth functioning of the industry and also economy of the nation. So, the sector is called as "Mother Sector" of all other sectors. An efficient, resilient and financially healthy power sector is needed for the growth of the economy and poverty reduction. The availability of reliable, quality and affordable power helps in the rapid growth of agriculture, industry and overall economic development of the country.

There has been significant growth in the power sector since Independence. The installed power generation of the nation in 1947 was 1,362 MW, which was increased to 3,70,106 MW as on 31-03-2020. This is increased by 272 times, and the power generation at the time of Independence was 4,073 GW, this is raised to 13,83,417 GW. The Per Capita consumption of electricity is 16 Kwh in 1947, the same has been increased by 76 folds, and it reached to 1,208 Kwh at the end of 31-03-2020. This indicates that there is a massive growth in the sector since Independence. Still 15 million houses are away from electricity and the world average per capita consumption of electricity is 3,152 Kwh in 2017 but the same in India is 1,149Kwh, which is lagging behind by 2,003 Kwh per annum.

1. Review of Literature:

Energy Statistics (2020) examines on the various types of power generations with installed capacity, power generation, distribution and consumption of power. Prachee Mishra (2019) "Overview of the Power Sector in India" discussed about the issues and challenges in power sector in India. The Government of Andhra Pradesh (2014) "White Paper on Power Sector in Andhra Pradesh" explained various challenges faced by the power sector in Andhra Pradesh due to bifurcation of the state and analysed proactive measures to address the issues plugging the A.P Power Sector. Sankar Rao. N (2013) "Impact of Power Sector Reforms in Andhra Pradesh and Causes of Continuing Power Crisis". In this the researcher made an attempt to evaluate the causes for power crisis in Andhra Pradesh. Subhash Mallah (2009) "Electricity Demand Forecasting and Market Allocation for Energy Sources in India" in this study the researcher examines the growth of power sector in India from the point of view of cost benefit analysis. Madhu Kumar. K.R (2006) "The impact of power sector reforms in Andhra Pradesh on the welfare and motivation levels of the employees of APGENCO: A case study at Vijayawada Thermal Power Station". In his study he explains the motivation levels of the employees. Viswanathan. N (1998) explains in detail the position of Hydro power in India. According to him hydroelectric power is the best and cheapest way of power production among all other power productions. Amulya K.N. Reddy and Sumithra (1997) in their study on "Karnataka Power Sector: Some Revolutions". In their paper they critically examined the present situation of Karnataka power sector. It is observed from the above earlier studies that a few research studies have been conducted in the area but they have not provided sound theoretical and empirical explanation as to why the cost of power generation have been increasing. The present study is an improvement over the earlier studies.

2. Objectives of the Study:

1. To analyse the structural distribution of the costs of power generation of the selected organisation.
2. To analyse the inter stage, intra stage comparative analysis of cost performance in the selected units of the study.
3. To forecast the trend of various costs, total cost per unit, stage wise as well as the entire organisation for the year 2025-26.
4. To offer suggestions for the effective working of the selected organisation in specific and the power generation stations in general.

2.1 Methodology of the Study:

The study is based on the secondary data, which is obtained from the cost reports of the selected organization. The period of the present study is selected from 2013-14 to 2018-19. The collected data is analyzed with the financial and also relevant statistical tools like averages, percentages, etc. and it is interpreted basing on the idea and standards identified by the various institutions.

2.2 Profile of RTPPS:

Rayalaseema Thermal Power Station is located at Kadapa in Andhra Pradesh. The power plant is one of the coal based power plants of APGENCO. Nameplate Capacity of the selected organisation is 1650 MW consists of 5 units of 210 MW each and 1 units of 600 MW. The following table depicts the installed generating capacity and the year of commencement of the stages.

Table-1 Installed Generating Capacity of the Selected Organisation

Stage	Installed Capacity (MW)	Year of Commencing
I	2X210	1994
II	2X210	2007
III	1X210	2010
IV	1X600	2018

Source: Compiled from the records of RTPP.

Rayalaseema Thermal Power Plant was developed under 3 stages namely stage I,II and III. The station is performing well in the recent years by achieving high plant load factor. It stood first in country during 98–99, 2002–03, 2003–04 and second during 1999–2000, 2001–02. The station has received meritorious productivity awards for six consecutive years and Incentive award for seven consecutive years. BHEL commissioned stage IV unit 1x600MW in March 2018 leading to total installed capacity of RTPP to 1650MW.

2.3 Cost Analysis of the selected unit of the Study:

An attempt is made to analyze per unit cost of power generation in the selected units of the study and also to find out its trend during the period of study. The cost performance of any productive unit can be examined by calculating the cost per unit of production. It requires the contribution of various expenditures to generate one unit of power. This includes various fixed and the variable costs. According to Chartered Institute of Management Accountants "unit of product, service or time in relation to which cost may be ascertained or expressed". Various costs of the selected organization are calculated in this study as well.

2.3.1 Total Fixed Cost: Fixed cost is mainly based on time. This cost remains constant in total amount though increase or decrease in the volume of output for a period of time. Fixed cost per unit decreases as the production increases and the same has to be increased as the production declines. Total fixed cost of RTPP includes repairs and maintenance cost, employees cost, administrative expenses, depreciation and interest and financial charges. This cost examines the amount of fixed cost to generate one unit of power. This ratio is calculated as below.

$$\text{Consolidated Total Fixed Cost} = \frac{\text{Total Fixed Expenses}}{\text{No of Units Generated}}$$

Table-2.1: Stage-wise Total Fixed cost per unit of RTPP during 2013-14 to 2018-19 CPU in Rupees.

Year	**Stage-I**	**Stage-II**	**Stage-III**	**Stage-IV**	**Total**
2013-14	1.17	0.66	0.83	-	0.88
2014-15	1.15	0.74	0.99	-	0.95
2015-16	1.04	0.73	1.01	-	0.91
2016-17	1.15	0.82	0.95	-	0.98
2017-18	0.55	0.91	1.51	19.37	0.89

2018-19	1.32	0.84	1.15	5.49	1.82
Average	**1.06**	**0.78**	**1.07**	**12.43**	**1.07**

Source: Compiled from the cost records of RTPP.

Stage	1	2	3	4	CPU Total
Trend for 2025-26	0.78	1.23	2.00		2.44

Table-2.1 explicit the Total Fixed Cost of the selected organization during 2013-14 to 2018-19. The total fixed cost of the organization includes employees cost, cost of repairs and maintenance, operating cost, depreciation, interest and financial charges and administration and general expenditures. The total fixed cost of RTPP is fluctuating during the period of study. Stage II is generating more power; hence the fixed cost per unit of power of this stage is low i.e. 78 paise per unit while compared to the other stages. Stage IV commences its operation in the month of March 2018, hence the fixed cost per unit of power generation in 2017-18 is so high i.e. Rs. 19.37 per unit. The same is reduced to Rs.5.49 per unit in the year 2018-19 because of an increase in power generation. The average fixed cost per unit of power of the stages is 1.06 paise, 0.78 paise and 1.07 paise respectively during the period of study. The station average is Rs.1.07 per unit during the study period**.** The trend for the year 2025-26 for stage 1 will be decrease, because there is a possibility of increase power generation by the stage. The total fixed cost of stage 2 and 3 will be increase. The Average CPU estimation is almost more than double.

2.3.2 Employees Cost: Employees are the major strength to any organization. The credibility of the organization depends on the performance of the employees. RTPP takes a lot of care about its employees. They are paying adequate monetary benefits and also other benefits to its employees that include salaries, allowances, bonus, perquisites, etc. Calculation of employees' cost per unit generation of power is given below.

$$\text{Employees' Cost} = \frac{\text{Total amount spent on Employees}}{\text{No. of Units generated}}$$

Table-2.2: Stage-wise Employee cost per unit of RTPP during 2013-14 to 2018-19 CPU in Rupees.

Year	**Stage-I**	**Stage-II**	**Stage-III**	**Stage-IV**	**Total**
2013-14	0.21	0.11	0.13	-	0.15
2014-15	0.28	0.17	0.23	-	0.23
2015-16	0.27	0.17	0.22	-	0.22
2016-17	0.34	0.22	0.26	-	0.28
2017-18	0.21	0.27	0.35	15.53	0.27
2018-19	0.50	0.32	0.43	0.51	0.43
Average	**0.30**	**0.21**	**0.27**	**8.02**	**0.26**

Source: Compiled from the cost records of RTPP.

Stage	1	2	3	4	CPU Total
Trend for 2025-26	0.69	0.63	0.84		0.73

Table-2.2 shows the Stage-wise Employee cost per unit of power generation of RTPP for the selected period. Total employee cost per unit is increased significantly in the year 2018-19 due to implementation of pay revision to its employees by APGENCO. There is an inverse relationship between per unit employees cost and power generation. Stage II is generating more power, the cost per unit of the stage is less. The average cost of power generation of the stage during the period of study is 0.21 paise per unit, followed by Stage III and Stage I. The station average employee cost per unit of power generation during the period is 0.26 paise per unit. The trend for the year 2025-26 shows that the cost per unit will be increase for stage 1, stage 2 and 3 is to be increase to 0.69 paise, 0.63 paise and 0.84 paise respectively. It is estimated that the Average Cost per unit of the station is to be increased by three times.

2.3.3 Cost of Repairs and Maintenance: It is necessary to any manufacturing companies to repair and maintain the plant and machinery properly for its smooth functioning of the units. RTPP is maintaining its power generation plants properly. The organization is taking a lot of care on these plants and every year they are properly maintaining schedules for overhauling of the plants and repairs. This takes place at regular intervals. The station allocates a noticeable portion of funds every year for the repairs and maintenance of the plants. Calculation of repairs and maintenance cost is given below.

$$\text{Cost of Repairs and Maintenance} = \frac{\text{Repairs \& Maintenance}}{\text{No of Units Produced}}$$

Table-2.3: Stage-wise Repairs & Maintenance per unit of RTPP during 2013-14 to 2018-19 CPU in Rupees.

Year	**Stage-I**	**Stage-II**	**Stage-III**	**Stage-IV**	**Total**
2013-14	0.10	0.04	0.06	-	0.07
2014-15	0.14	0.04	0.07	-	0.08
2015-16	0.16	0.05	0.08	-	0.10
2016-17	0.18	0.06	0.06	-	0.11
2017-18	0.10	0.05	0.09	0.02	0.08
2018-19	0.17	0.10	0.15	0.07	0.13
Average	**0.14**	**0.06**	**0.09**	**0.05**	**0.09**

Source: Compiled from the cost records of RTPP.

Stage	1	2	3	4	CPU Total
Trend for 2025-26	0.22	0.16	0.23		0.19

Table-2.3 explains the stage wise and total repairs and maintenance charges of the selected organization per unit of power generation. This cost is also playing a prominent role in the power generation. Repairs and maintenance of stage I is more per unit i.e. 0.14 paise per unit because the stage is completed more than 25 years of service in power generation. Though the stage is completed more than 25 years still it is working effectively in power generation because of high quality of maintenance by RTPP. Stage III and

II are recorded 0.09 paise and 0.06 paise respectively. The cost of repairs per unit is fluctuating during the study period. The average cost per unit of repairs and maintenance of the selected organization during the period of study is 0.09 paise. The trend for the year 2025-26 for stage 1, stage 2 and 3 will be increase. The Average CPU estimation is near to double.

2.3.4 Operating cost: Operating expenditure is very essential for any manufacturing organization. The power generation station has to spend more amount on this. Other operating expenditure of RTPP includes cost of water, expenditure of dozers, lubricants, consumables and consumables of water treatment plant. This ratio explains that how much operating cost has to be incurred for one unit of power generation. The expenses per unit calculated like this.

$$\text{Operating cost} = \frac{\text{Total Other Operating Expenses}}{\text{No. of Units generated}}$$

Table-2.4: Stage-wise Operating Expenses per unit of RTPP during 2013-14 to 2018-19 CPU in Rupees.

Year	Stage-I	Stage-II	Stage-III	Stage-IV	Total
2013-14	0.03	0.01	0.01	-	0.02
2014-15	0.04	0.01	0.01	-	0.02
2015-16	0.04	0.01	0.01	-	0.02
2016-17	0.04	0.01	0.01	-	0.02
2017-18	0.04	0.01	0.01	0.00	0.02
2018-19	0.04	0.01	0.02	0.001	0.02
Average	**0.04**	**0.01**	**0.01**	**0.00**	**0.02**

Source: Compiled from the cost records of RTPP.

Stage	1	2	3	4	CPU Total
Trend for 2025-26	0.05	0.01	0.03		0.02

Table-2.4 shows the total operating cost per unit as well as stage wise operating cost for a unit of power generation. Stage IV consumes less operating expenditure, which is less than paise per unit. Among the four stages, stage I is consuming more expenditure per unit i.e. 0.04 paise and less in the case of stage IV. The average operating cost per unit of the selected organization is 0.02 paise per unit during the period of study. The trend of operating cost per unit for the year 2025-26 for stage 1 and stage 3 will be increase, where as in the case of stage 2 and the entire station will be the same will be constant. The Average operating cost per unit of the entire station will be 0.02 paise per unit.

2.3.5 Depreciation per unit: Every company has to calculate depreciation on their fixed assets and deduct the same out of profits for acquiring the same type of asset in future. This ratio indicates the amount of depreciation incurred for a unit of power generation. RTPP calculates the depreciation on diminishing balance method. This ratio is calculated in the following manner.

$$\text{Depreciation per unit} = \frac{\text{Total Depreciation}}{\text{No of Units Generated}}$$

Table-2.5: Stage-wise Depreciation per unit of RTPP during 2013-14 to 2018-19
CPU in Rupees.

Year	Stage-I	Stage-II	Stage-III	Stage-IV	Total
2013-14	0.10	0.47	0.60	-	0.36
2014-15	0.06	0.48	0.66	-	0.35
2015-16	0.05	0.46	0.66	-	0.34
2016-17	0.14	0.48	0.58	-	0.36
2017-18	0.13	0.44	0.67	0.00	0.35
2018-19	0.33	0.37	0.48	1.70	0.59
Average	**0.13**	**0.45**	**0.61**	**0.85**	**0.39**

Source: Compiled from the cost records of RTPP.

Stage	1	2	3	4	CPU Total
Trend for 2025-26	0.57	0.27	0.41		0.74

Table-2.5 examines the depreciation per unit of the selected organization for the selected period. After the coal cost, depreciation plays a vital role in the cost of power generation. The average cost of depreciation of stage I is less, while comparing to other stages. The amount of investment incurred on stage I is less when compared with the other stages of the selected organization, hence the depreciation of the stage is less, followed by stage II and III. Stage IV is commenced in the year 2017-18. So, the depreciation per unit of the stage is 0.85 paise per unit. The station average depreciation per unit of power generation is 0.39 paise during the period of study. The trend of depreciation cost per unit will be decrease in the case of stage II and stage III because these stages are estimated to increase its power generation for the year 2025-26 The Average CPU estimation is increasing.

2.3.6 Administrative & General Expenses: This ratio indicates how much amount is incurred by the management to generate one unit of power in a year. Office related expenses and general expenditure come under this head. RTPP also promotes research and development activities and allocates significant portion of funds on these activities, and these charges also included in this cost. This ratio is computed as.

$$\text{Administrative \& General Expenses Cost} = \frac{\text{Total Administrative \&General Expenses}}{\text{No of Units Generated}}$$

Table-2.6: Stage-wise Administrative and General Expenses per unit of RTPP from 2013-14 to 2018-19

CPU in Rupees.

Year	Stage-I	Stage-II	Stage-III	Stage-IV	Total
2013-14	0.04	0.03	0.03	-	0.03
2014-15	0.04	0.03	0.04	-	0.04
2015-16	0.04	0.04	0.04	-	0.04
2016-17	0.05	0.05	0.05	-	0.05
2017-18	0.04	0.04	0.05	-	0.04
2018-19	0.03	0.04	0.04	0.10	0.05
Average	**0.04**	**0.04**	**0.04**	**0.05**	**0.04**

Source: Compiled from the cost records of RTPP.

Stage	1	2	3	4	CPU Total
Trend for 2025-26	0.03	0.07	0.07		0.07

Table-2.6 examines stage-wise as well as total administrative and general expenditure per unit of power generation of the selected organization. The expenditure of all the stages is fluctuating during the period. The average expenditure of stage I, II and III are 0.04 paise per unit during the period of study. More amount of administrative has been incurred on stage IV in the year 2018-19 because the stage was commenced in the month of 2018. The average total administrative expenditure of the entire station during the period of study is 0.04 paise per unit. The expenditure of all the stages is fluctuating during the period. The estimated trend in administrative and general expenditure for the year 2025-26 for stage I is decreasing, stage II is increasing, and stage III is increasing. The estimation of average administrative cost per unit for the entire station will be increase to 0.07 paise.

2.3.7 Total Variable Cost: These costs are varying in total in the direct proportion to the volume of output. This cost plays an important role in the fixation of prices of the products. The variable costs per unit remain constant though there is a change in production. These costs fluctuate in total amount but tend to remain constant per unit as production activities changes. Coal cost, oil cost and operating costs are included in the variable costs of RTPP. This ratio explains the total amount of variable cost spent to generate one unit of power. This ratio is calculated as given below.

$$\text{Total variable Cost} = \frac{\text{Total Variable cost}}{\text{No of Units generated}}$$

Table-2.7: Stage-wise total variable cost per unit of RTPP during 2013-14 to 2018-19

CPU in Rupees.

Year	Stage-I	Stage-II	Stage-III	Stage-IV	Total
2013-14	3.13	2.94	2.88	-	3.00
2014-15	3.17	3.02	3.07	-	3.08

2015-16	3.11	3.00	3.00	-	3.05
2016-17	3.26	3.12	3.10	-	3.17
2017-18	3.36	3.25	3.23	3.05	3.29
2018-19	3.55	3.41	3.54	3.74	3.53
Average	**3.26**	**3.12**	**3.14**	**3.40**	**3.19**

Source: Compiled from the cost records of RTPP.

Stage	1	2	3	4	CPU Total
Trend for 2025-26	4.11	4.07	4.30		4.21

Table-2.7 shows the stage wise and total variable cost per unit of the selected RTPP during 2013-14 to 2018-19. Variable cost plays a predominant role in the total cost of thermal power generation, this cost occupies major portion in the total cost of any manufacturing organizations. The total variable cost of the selected organization has been increasing gradually during the period of study. Among the four stages stage II consuming less variable cost per unit of power generation i.e. Rs.3.12 per unit, and high in the case of stage IV i.e. Rs. 3.40 per unit due to initialization of the stage. The total average variable cost per unit of the entire station during the period is Rs. 3.19. There is an increasing trend in the variable cost per unit of power generation for all stages. Among these three stages, per unit power generation will be less while compare with the other stages for the year 2025-26. The estimated Average variable cost of the selected organization will be Rs. 4.21 per unit.

2.3.8 Coal Cost: Coal based thermal power generation plays a crucial role in power generation in India as well as in the World. In India more than 50 per cent of the electricity needs are met by the coal based thermal power generation stations. RTPP is also one among them. Coal is the major expenditure for the coal based thermal power generation stations. Coal cost occupies lion's share in the total cost, that is affected by the power generation and cost of acquisition of coal. Calculation of coal consumption cost per unit of power generation is given below.

$$\text{Coal Cost per unit} = \frac{\text{Total Coal consumption Cost}}{\text{No of Units Generated}}$$

Table-2.8: Stage-wise Coal cost per unit of RTPP during 2013-14 to 2018-19
CPU in Rupees.

Year	Stage-I	Stage-II	Stage-III	Stage-IV	Total
2013-14	3.02	2.90	2.82	-	2.93
2014-15	3.00	2.98	3.01	-	2.99
2015-16	3.06	2.99	2.99	-	3.02
2016-17	3.23	3.11	3.09	-	3.16
2017-18	3.33	3.24	3.22	2.94	3.27
2018-19	3.51	3.39	3.51	3.47	3.47
Average	**3.19**	**3.10**	**3.11**	**3.21**	**3.14**

Source: Compiled from the cost records of RTPP.

Stage	1	2	3	4	CPU Total
Trend for 2025-26	4.27	4.11	4.36		4.25

Table-2.8 shows the stage-wise cost of coal to generate one unit of power during 2013-14 to 2018-19. The coal cost includes the procurement of coal. During the period of study, the total coal cost is raised by .54 paise per unit. Stage IV is commenced during 2017-18 and generates only 7.81 MU in that year, so coal cost of the stage during the period is less i.e. 2.94 per unit while compared with the other stages. Though the total production of the organization is fluctuating during the study period but the coal cost per unit is increasing significantly because of raising of the procurement of coal cost. The average coal cost of the selected RTPP is 3.14 paise per unit during the study period. The coal cost per unit of power generation trend for the year 2025-26 is increasing and the estimated average Coal cost per unit of power will be Rs. 4.25.

2.3.9 Oil Cost: Oil plays an important role in coal based thermal power generation stations. RTPP is consuming Furnace oil and HSD oil to burn the coal for power generation. Cost of oil is a variable expenditure. Oil cost varies based on power generation and market conditions. This ratio provides the information as to the amount that the organization has spent on oil to generate one unit of power. Total cost of oil is to be calculated through this formula.

$$\text{Oil Cost per unit} = \frac{\text{Total Oil Cost}}{\text{No of Units Generated}}$$

Table-2.9: Stage-wise Oil cost per unit of RTPP during 2013-14 to 2018-19
CPU in Rupees.

Year	**Stage-I**	**Stage-II**	**Stage-III**	**Stage-IV**	**Total**
2013-14	0.12	0.03	0.06	-	0.07
2014-15	0.17	0.04	0.06	-	0.09
2015-16	0.06	0.01	0.01	-	0.03
2016-17	0.03	0.01	0.01	-	0.02
2017-18	0.03	0.01	0.01	0.11	0.02
2018-19	0.04	0.02	0.03	0.26	0.07
Average	**0.08**	**0.02**	**0.03**	**0.19**	**0.05**

Source: Compiled from the cost records of RTPP.

Stage	1	2	3	4	CPU Total
Trend for 2025-26	0.18	0.022	0.06		0.09

Table-2.9 explains the stage-wise oil consumption to generate power. Oil cost of stage I is 0.12 paise and 0.17 paise in 2013-14 and 2014-15 respectively due to more shortage of plants of the stage. Among the four stages, stage II was consuming less oil compared to stages I and III, so this cost was less than the other stages i.e. 0.02 paise per unit of power generation. Oil cost per unit of the four stages is fluctuating during the period of study. In the initial year of stage IV oil cost to generate a unit of power is more,

because more oil is required for the initial commencement of the power plant. In the later years it consumed less oil for generation of power. The average oil consumption of all stages during the period of study is 0.05 paise per unit of power generation. The cost to generate a unit of power trend for the year 2025-26 shows that the significant change is to be possible in stage I, it is not in the case of stage II and III. The estimated station average oil cost per unit of power generation will be 0.09 paise.

2.3.10 Total cost: The total cost is the amount which is spent by the organization to produce a product. The total consolidated cost is the combination of total fixed costs and total variable costs of RTPP. This cost examines the total amount incurred by the organization to generate one unit of power. Total cost per unit of power generation is calculated as:

$$\text{Total Cost} = \frac{\text{Consolidated total Cost}}{\text{No of Units generated}}$$

Table-2.10: Stage-wise total cost per unit of RTPP during 2013-14 to 2018-19
CPU in Rupees.

Year	Stage-I	Stage-II	Stage-III	Stage-IV	Total
2013-14	4.30	3.60	3.71	-	3.88
2014-15	4.31	3.75	4.06	-	4.03
2015-16	4.16	3.74	4.01	-	3.96
2016-17	4.41	3.94	4.05	-	4.15
2017-18	3.91	4.16	4.74	22.42	4.18
2018-19	4.87	4.25	4.69	9.23	5.35
Average	**4.33**	**3.91**	**4.21**	**15.83**	**4.26**

Source: Compiled from the cost records of RTPP.

Stage	1	2	3	4	CPU Total
Trend for 2025-26	4.90	5.31	6.30		5.50

Table - 2.10 indicates that the stage-wise consolidated total cost as well as the entire station from 2013-14 to 2018-19. The total cost of the selected organization is significantly increasing during the period of study except 2015-16 due to increase of fixed and variable cost of RTPP. Among the all stages the total cost per unit of stage IV is more because huge investment on the stage and also more variable costs are to be incurred to initiate the stage, the output of the stage is very less in the initial years of production, hence the total cost per unit of the stage is very high when compared with other stages followed by stage I and III. Total cost per unit of power is to be reduced with the increase of power production, so it is less in the case of stage II of the selected organization. The trend for the year 2025-26 for stage I, stage II and stage III will be increase and the station average cost per unit of power generation is to be estimated as Rs. 5.50.

The estimated trend of various expenditures with respect to the stages and the entire station for the production of one unit of power generation for the year 2026-27 is depicted.

Trend summary of various expenditures for the year 2026-27

Type of cost	Stage1	2	3	Total
Fixed	0.781333	1.233333	2.00333	2.448667
Employee	0.694667	0.63	0.84	0.737333
Repairs & Maintenance	0.216667	0.158667	0.232	0.188
Operating Expenses	0.053333	0.01	0.02667	0.02
Depreciation	0.57	0.27	0.41333	0.742667
Administrative & General Expenses	0.028	0.065333	0.06867	0.074667
variable cost	4.109333	4.071333	4.30067	4.206667
Coal Cost	4.274667	4.106667	4.36067	3.838
Oil Cost	-0.18	-0.022	-0.06	0.022667
Total cost	4.896667	5.310667	6.304	6.655333

3.0Findings of the study:

These findings are drawn based on the study.

- Average fixed cost of Stage II is low because the stage stood in the first position in power generation followed by Stage I and III. The average fixed cost per unit of power is 0.78 paise, 1.06 paise and 1.07 paise respectively. The station average is Rs.1.07 per unit during the study period.
- Total employee cost per unit is increased more than 50 per cent in the year 2018-19 due to implementation of pay revision to its employees by APGENCO. The station average employee cost per unit of power generation during the period is 0.26 paise per unit.
- The Repairs and maintenance of stage I is more per unit i.e. 0.14 paise per unit because the stage is completed more than 25 years of service in power generation. Though the stage is completed more than 25 years still it is working effectively in power generation because of high quality of maintenance by the RTPP. The average cost per unit of repairs and maintenance of the selected organization during the period of study is 0.09 paise.
- Among the four stages, stage I is consuming more operating expenditure per unit i.e. 0.04 paise and less in the case of stage IV. The average operating cost per unit of the selected organization is 0.02 paise per unit during the period of study.
- The amount of investment incurred on stage I is less when compared with the other stages of the selected organization, hence the depreciation of the stage is less, followed by stage II and III. Stage IV is commenced in the year 2017-18. So the depreciation per unit of the stage is 0.85 paise per unit.
- The average expenditure of stage I, II and III are 0.04 paise per unit during the period of study. The average total administrative expenditure of the entire station during the period of study is 0.04 paise per unit.
- Among the four stages, stage II consuming less variable cost per unit of power generation i.e. Rs.3.12 per unit, and high in the case of stage IV i.e. Rs. 3.40 per unit due to initialization of the stage. The total average variable cost per unit of the entire station during the period is Rs. 3.19.

- Though the total production of the organization is fluctuating during the study period but the coal cost per unit is increasing significantly because of raising of the procurement of coal cost. The average coal cost of the selected RTPP is 3.14 paise per unit during the study period.
- Stage II is consuming less oil per unit i.e. 0.02 paise due to less shortages of the stage. In the initial year of stage IV oil cost to generate a unit of power is more, because more oil is required for the initial commencement. The average oil consumption of all stages during the period of study is 0.05 paise per unit of power generation. It is suggested to the authorities of the selected organization to take necessary measures to minimize the shortages of the stages because more oil has to consume to restart the plants.
- It is evident that the total cost per unit has been increasing from Rs. 3.88 to Rs. 5.35 during the selected period. The average total cost per unit of the selected RTTP is Rs. 4.26 per unit. This shows that the organization is not utilizing its resources properly. Hence it is suggested to the authorities of the organization to reduce the fixed and variable costs as much as possible and enhance the power generation up to its deemed Plant Load Factor.

4.0 Suggestions:

- There is no possibility to reduce the total fixed cost of the selected organisation, where as there is a chance to cut down the fixed cost per unit by increasing the power generation. So it is suggested to the authorities of RTPP to enhance the power generation so as to reduce fixed cost per unit.
- It is suggested to the authorities of the selected organization to organize various training programs to its employees to improve their skills and make use of the efficiency of the employees into the optimum levels to increase the power generation.
- It is suggested to the management of the RTPPS to continue the same on repairs and maintenance activities and also mobilize more funds to research activities.
- Depreciation per unit can be reduced by increasing the power generation; hence it is suggested to the management of the selected RTPPS to enhance its power production to reduce per unit cost of depreciation.
- It is suggested to the authorities of the selected RTPPS to increase the power generation to its nameplate capacity levels, to reduce the administrative and general expenses.
- The total variable cost of the RTPPS has been increasing during the period of study. So, it is suggested to the authorities of the organisation to reduce total variable cost by the way of purchasing the quality coal and oil at reasonable prices.
- It is suggested to the management of the selected organisation to procure quality coal at reasonable price from the coal fields and also reduce wastage.
- Due to the breakdowns of plants more oil is to be consumed to restart the same. So it is suggested to reduce breakdown of plants, so as to cut down the fuel cost per unit of power generation.
- It is suggested to the authorities of the selected organisation to reduce the total fixed and variable costs as much as it is possible and also utilize the plants up to the optimum levels, to reduce the cost per unit of power generation.

5.0 Conclusion:

Power sector plays a key role in the growth and development of any nation as well as the human society.

The living standards of the human beings have been increased when they are able to access the power at affordable prices. It is the duty of the Governments to provide the power to the common man and also to the industries at reasonable prices. Thermal power generation is contributing major share in the power generation in India since Independence. So, it is the responsibility of the Central Governments to develop the sector by reducing the GST on coal and also supply the quality coal to the public sector undertakings at reasonable prices as well as giving tax holiday to the sector. Since the public sector undertakings have been working for the welfare of the Society, Governments should take care of these organisations.

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