(Computer No. 2071)

भारत सरकार/Government of India
विद्युत मंत्रालय/Ministry of Power
केंद्रीय विद्युत प्राधिकरण/ Central Electricity Authority
तापीय अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग
Thermal Engineering & Technology Development Division
****

Dated: 15.03.2024

The Secretary,
Central Electricity Regulatory Commission,
3rd Floor, Chanderlok Building, 36, Janpath,
New Delhi – 110 001.

विषय: 01.04.2024 से शुरू होने वाली अवधि के लिए टैरिफ के सी.ई.आर.सी. नियम और शर्तें - थर्मल पावर स्टेशनों के लिए परिचालन मानदंडों को निर्दिष्ट करना - के संबंध में।
Subject: CERC Terms and Conditions of Tariff for the period starting from 01.04.2024 – specifying of Operational Norms for thermal power stations -reg.

Ref: (i) CERC letter No. L-1/268/2022/CERC dated 19.05.2023.
ii. CEA vide letter No CEA-TH-17-13/1/2019-TETD Division dated 19.12.2023.
iii. CEA e-mails on 20.12.2023, 03.01.2024 and 16.02.2024.
iv. CERC DO No. L-1/268/2022/CERC dated 27.02.2024.

Sir,

With reference to the above, CEA has forwarded "Recommendations for operation norms in respect of Thermal Power stations for the tariff period starting 01.04.2024".These recommendations have been made based on the technical analysis of performance data for the last 5 years (2018-19 to 2022-23) received from various utilities through CERC. Subsequently, the Commission forwarded to CEA the comments of various stakeholders submitted during the public hearing conducted on 15.02.2024. These comments have been examined and the revised copy of CEA's recommendations including all necessary corrections for operation norms in respect of Thermal Power stations for the tariff period starting 01.04.2024 is enclosed. The points where revision is recommended are marked in RED color. The Explanatory Memorandum for the operating norms is also enclosed.

Various stakeholders suggested that the degradation factors in respect of Heat rate and Auxiliary Energy Consumption due to part load operations and additional

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Secondary Fuel Oil Consumption due to loading below 55% may be included in the Operational norms. Accordingly, it is suggested that the same may be included in the Operational norms.

Further, it is observed that as per the CERC Tariff Regulation, 2019, when a power station (generator) performs better than normative heat rate, profit sharing between generator and beneficiaries exists. However, in the case of part load operation, as per the existing compensation mechanism it is understood that the profit sharing is not applicable. It is felt that the profit sharing in part load operation may help the generator to improve their performance and consequently could result in win-win situation to both the generator and the beneficiary. Hence, it is suggested that profit sharing between generator and beneficiaries in case of part load operation may also be considered.

This issues with the approval of competent authority.

Encl: (i) Revised Recommendations for operation norms in respect of Thermal Power stations for the tariff period starting 01.04.2024.
(ii) Explanatory Memorandum with Annexures.

15/08/24

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Recommendations

Reference: Regulation 49 under Chapter 12 in CERC (Terms and Conditions of Tariff) Regulations, 2019:

The recommendations of Central Electricity Authority on plant operation norms in respect of thermal generating stations for the tariff period 2024- 2029 are as below:

A. Normative Annual Plant Availability Factor (PAF)

i) All thermal(coal, lignite and gas based) generating stations, except those covered under clause ii), iii) & iv) : - 85 %

ii) Lignite fired generating stations using circulatory fluidized bed combustion (CFBC) technology and generating stations based on coal rejects:

a) First Three years from Commercial Operation Date (COD): 68.5%

b) For next year after completion of three years of COD : 75%

iii) For following Lignite-fired Thermal generating stations of NLC India Ltd:

a) TPS- II Stage- I & Stage- II : 80%

b) Barsingsar (CFBC) : 75%

c) TPS-II Expansion (CFBC) : 70%

iv) M/s NEEPCO's gas fired thermal generating station:

a) Assam Gas Based Plant : 70%

B. Normative Secondary Fuel Oil Consumption (SFOC)

i) Coal-based generating stations other than stations at (ii) & (iii) below: 0.50 ml/kWh

ii) For coal based generating stations with wall (front/rear/sides) fired boilers: 1.0 ml/kWh

iii) Coal-based generating station of DVC:

Mejia TPS 210 MW Unit- 1 to 4: 1.0 ml/kWh

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iv) Lignite-fired generating stations (Pulverised and CFBC): 1.0 ml/kWh

v) Generating stations based on coal rejects : 2.0 ml/kWh

C. Gross Station Heat Rate:

1. Existing Thermal Generating Stations (COD achieved before 1.4.2009):

i) The normative gross station heat rate for coal based thermal generating units/ stations other than those relaxed norms covered under clause (ii) below shall be as under:

200-300 MW sets (sub-critical)	2415 kcal/kwh
500-600 MW sets (sub-critical) (TDBFP)	2375 kcal/kwh

Note:

In respect of 500 MW and above units where the boiler feed pumps are electrically operated, the gross station heat rate shall be 40 kcal/kWh lower than the gross station heat rate specified above.

ii) NTPC's coal based thermal generating stations:

Tanda TPS (4x110MW)	2750kcal/kWh

(Note for (i) & (ii) : Normative gross station heat rate has been arrived at considering storage loss of 85 kcal/kg in GCV i.e GCV as received basis (ARB)-85 kcal/kg for coal based stations)

iii) Lignite fired thermal generating stations:

The gross heat rate norms in respect of NLCIL lignite based thermal generating stations shall be as below:

NLC TPS-I (Expansion) (2x210MW)	2710 kcal/kWh
NLC TPS-II Stage I (3x210MW) and NLC TPS-II Stage II (4x210MW)	2880 kcal/kWh

iv) Open cycle gas turbine/ combine cycle thermal generating stations:

The operation norm for existing open cycle gas turbine/ combine cycle thermal generating stations given at CERC Regulation 49(C)(a)(vi) are proposed to be retained.

2. Thermal Generating Stations (coal & lignite) having COD achieved on or after 1.4.2009:

i) The normative gross station heat rate# of coal-based and lignite-fired thermal generating stations other than those relaxed norms covered under clause (ii) & (iii):

For 200-300 MW sets= 1.05 X Design Heat Rate (kcal/kWh)

For 500 MW sets & above= 1.04 X Design Heat Rate (kcal/kWh)

(Note: Normative gross station heat rate has been arrived at considering storage loss of 85 kcal/kg in GCV i.e GCV as received basis (ARB)-85 kcal/kg for coal based stations)

Where the Design Heat Rate of a generating unit means the unit heat rate guaranteed by the supplier at conditions of 100% MCR, zero percent make up, design coal and design cooling water temperature/back pressure.

Provided that depending upon the pressure and temperature ratings of the units, the maximum design turbine cycle heat rate and minimum design boiler efficiency shall be as per the table below.

In case designed turbine cycle heat rate and boiler efficiency are better than these values, the same shall be considered for calculation of unit heat rate.

Pressure Rating (kg/ cm^2)	*150*	*170*	170
SHT / RHT (^{0} C)	535/535	537/537	537/565
Type of BFP	Electrical Driven	Turbine Driven	Turbine Driven
Max Turbine Heat Rate (kcal/kWh)	1955	1950	1935
Minimum Boiler Efficiency*(Percentage)			
Sub-Bituminous Indian Coal (%)	86	86	86

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Bituminous imported coal (%)	89		89	89

Pressure Rating (kg/ cm^2)	247	247	260	270	270
SHT / RHT (^{0} C)	537/ 565	565/ 593	593/ 593	593/ 593	600/ 600
Type of BFP	Turbine Driven	Turbine Driven	Turbine Driven	Turbine Driven	Turbine Driven
Max Turbine Heat Rate(kcal/kWh)	1900	1850	1814	1810	1790
Minimum Boiler Efficiency*(Percentage)					
Sub-Bituminous Indian coal (%)	86	86	86	86.5	86.5
Bituminous imported coal (%)	89	89	89	89.5	89.5

* For lignite fired thermal generating station, the minimum boiler efficiency shall be 76% (for pulverised) and 80 %(for Fluidised bed) based boilers. Further, it may be noted that as the lignite fired thermal generating station has been provided with lower minimum boiler efficiency in consideration of higher moisture content, any further moisture content factor is not applicable over and above the design heat rate.

In case pressure and temperature parameters of a unit are different from ratings given in the above table, the maximum design turbine cycle heat rate & minimum boiler efficiency of the nearest class shall be taken.

For units based on dry cooling system, the maximum turbine cycle heat rate shall be considered as per the actual design or 6% higher than the values given in the table above, whichever is lower.

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ii) NTPC's coal based thermal generating stations:

Kanti TPS (2x195 MW)	2500 kcal/kWh

(Note: Normative gross station heat rate has been arrived at considering storage loss of 85 kcal/kg in GCV i.e GCV as received basis (ARB)-85 kcal/kg for coal based stations)

iii) The impact of change of BFP drive from steam turbine driven to electric motor driven on unit heat rate shall be mentioned as below:

"In respect of generating units where the boiler feed pumps are electrically operated, the maximum design unit heat rate shall be 40 kcal/kWh lower than the maximum design unit gross heat rate with turbine driven BFP."

The normative heat rate values are arrived after applying the degradation factors given in table at F(1)(i) for coal/lignite based generating stations. In case degradation factors given in table at F(1)(i) are modified, the normative heat rate values need to be corrected accordingly and vice-versa.

3. Gas-based/ Liquid-based thermal generating unit(s)/ block(s) having COD on or after 01.04.2009:

For Natural Gas and RLNG = 1.05 x Design Heat Rate of the unit / block (kCal/kWh),
For Liquid Fuel = 1.071 x Design Heat Rate of the unit / block (kCal/kWh),

Where, the Design Heat Rate of a unit shall mean the guaranteed heat rate for a unit at 100% MCR and at site ambient conditions; and the Design Heat Rate of a block shall mean the guaranteed heat rate for a block at 100% MCR, site ambient conditions, zero percent make up, design cooling water temperature/back pressure.

4. **Applicability of Heat Rate Norms**

i) The Station Heat Rate (SHR) norms of the coal/lignite based units commissioned till 31.03.2024 (before 2009 and after 2009) is to be fixed based on the recommended operating norms for the control period 2024-29, for the lifetime of the respective units. ***However, this shall not be applicable for units with relaxed norms.***

ii) The units commissioned from 01.04.2024 till 31.03.2029 will adopt recommended operating norms for the control period 2024-29. However, the same will be reviewed and SHR norms will be fixed for the life time in the next control period i.e 2029-34 and so on based on the actual performance.

iii) The commission may review the SHR norms for the life time of the units in case it desires so, for situations like change in law, improvement in efficiency like R&M or any other valid reasons on case-to-case basis.

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D. Auxiliary energy consumption

1. Coal Based Thermal Generating Stations:

i) Coal-based thermal generating stations except at (ii) & (iii) below:

	(Auxiliary energy consumption ## as % of gross generation) With NDCT/Once-through
200-300 MW sets	8.5%
500-600 MW sets with TDBFP (sub-critical)	5.25%
660-800 MW with TDBFP (Super-critical)	5.25%

In case of thermal units of 500 MW and above with electrically driven Boiler Feed Pumps, the auxiliary energy consumption allowed shall be 8.0%.

In case of thermal generating stations provided with Induced Draft Cooling Tower (IDCT), the additional auxiliary energy consumption allowed shall be 0.5%.

In addition, thermal generating stations provided with ball and tube mills, the additional auxiliary energy consumption allowed shall be 0.8%.

In case of thermal generating stations provided with Dry Cooling Systems, the additional auxiliary energy consumption allowed shall be as below:

Type of dry cooling system	(% of gross generation)
Direct cooling air cooled condensers with mechanical draft fans	1.0%
Indirect cooling system employing jet condensers with pressure recovery turbine and natural draft tower	0.5%

ii) NTPC's coal based thermal generating stations:

Tanda Thermal Power Station (440 MW)	12%

iii) DVC's coal based thermal generating stations:

Chandrapur Thermal Power Station (2x250 MW)	9.50%

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2. Lignite Based Thermal Generating Stations:

i) For all pulverised lignite fired thermal generating stations with 200 MW sets and above, the auxiliary energy consumption norms shall be 0.5 percentage point more than the auxiliary energy consumption norms of coal-based generating stations except at (ii) below.

ii) M/s NLCIL's pulverised lignite fired generating stations:

TPS-II stage- I (630 MW)	10%
TPS- II stage- II (840 MW)	10%

iii) For lignite fired thermal generating stations using CFBC technology, the auxiliary energy consumption norms shall be 1.5 percentage point more than the auxiliary energy consumption norms of coal-based generating stations except at (iv) below.

iv) M/s NLCIL's CFBC technology based lignite fired generating stations:

Barsingsar TPS (2x125 MW)	12.5 %
TPS-II Expansion (2x250 MW)	12.5 %

The Auxiliary energy consumption values are arrived after applying the degradation factors given in table at F(1)(ii) for coal/lignite based generating stations. In case degradation factors given in table at F(1)(ii) are modified, the Auxiliary energy consumption values need to be corrected accordingly and vice-versa.

3. Gas Turbine/ Combined Cycle Generating Stations:

i) Gas turbine/ combined cycle generating stations, except those at (ii) below:

a) Combined cycle generating stations : 2.75%

b) Open cycle generating stations : 1.0%

In case of Combine Cycle Generating Stations using electric motor driven Gas Booster Compressor, the Auxiliary Energy Consumption shall be 3.30% (including impact of air-cooled condensers for Steam Turbine Generators).

Further additional Auxiliary Energy Consumption of 0.35% shall be allowed for stations having direct cooling air cooled condensers with mechanical draft fans.

ii) a) NEEPCO's Tripura gas based station (101 MW) : 3.5%

b) OTPC Palatana CCPP (726.6 MW) : 3.5%

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E. Annual Plant Load Factor (PLF) for Incentive

The level of Annual Plant Load Factor (PLF) for Incentive is recommended **at the same level** of Normative Annual Plant Availability Factor (NAPAF) for the station for the year.

F. Impact of Part Load Operation on Performance of Thermal Generating Stations:

1. Coal/ lignite based thermal generating stations:

i) Impact on station heat rate:

The applicable factors for unit heat rate degradation at part loading for sub-critical and super- critical units are proposed as follows:

Unit HR degradation (%)			
Sl No	Unit loading (%)	Sub-critical units	Super-critical units
1	85-100	Nil	Nil
2	80 - <85	2.1	1.8
3	75 - <80	3.0	2.5
4	70 - <75	4.0	3.3
5	65 - <70	5.1	4.1
6	60 - <65	6.1	4.9
7	55 - <60	7.6	6.0
8	50 - <55	9.2	7.1
9	45 - <50	11.3	8.3
10	40 - <45	13.8	9.9

ii) Impact on auxiliary energy consumption:

The admissible additional auxiliary energy consumption values at part loading of coal/ lignite based thermal generating stations are proposed as follows:

Sl. No.	Module/ plant loading as % of installed capacity	Admissible % degradation in auxiliary energy consumption **(% point)**
1.	85 -100	Nil
2.	80 - < 85	0.5
3.	70 - < 80	1.1
4.	60 - < 70	1.8

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5.	50 - < 60	2.5
6.	40 - < 50	3.2

iii) Impact on SFOC:

Considering flexible operation requirement of coal based thermal stations in view of capacity addition from renewable sources, additional specific oil consumption of 0.2 ml/kWh is proposed to be provided for units operating in 40-55% average loading.

2. Gas/ liquid fuel based thermal generating stations:

i) Impact on station heat rate:

The degradation of module/ plant gross heat rate for gas/ liquid fuel based thermal generating stations in CCGT mode of operation are proposed to be considered as below:

Sl. No.	Module/ plant loading as % of installed capacity	Increase in module/ plant heat rate (%)
1.	85 -100	Nil
2.	80 - < 85	2.5
3.	70 - < 80	5
4.	60 - < 70	8
5.	50 - < 60	12

ii) The degradation of module/ plant heat rate for gas/ liquid fuel based thermal generating stations in Open cycle mode of operation are proposed to be considered as below:

Sl. No.	Module/ plant loading as % of installed capacity	Increase in module/ plant heat rate (%)
1.	85 -100	Nil
2.	80 - < 85	3
3.	70 - < 80	7
4.	60 - < 70	11
5.	50 - < 60	16

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iii) Impact on auxiliary energy consumption:

The additional auxiliary energy consumption admissible at part loading of gas/ liquid fuel based thermal generating station is proposed to be considered as below:

Sl. No.	Plant/ module loading as % of installed capacity	Admissible % additional auxiliary energy consumption (% point)
1.	85 -100	Nil
2.	80 - < 85	0.25
3.	70 - < 80	0.50
4.	60 - < 70	0.80
5.	50 - < 60	1.20

G. Transit losses of coal:

For coal and lignite, the transit and handling losses shall be as per the following norms:-

Thermal Generating Station	**Transit and Handling losses (%)**
Pit-head [using Rail / Road]	0.20 %
Non-pit head [All Rail Route (ARR) – where loading into railway rakes is done by Coal company]	0.80 %
Non-pit head [Road Cum Rail (RCR) Route – where coal is lifted from mines, transported to good shed /other siding by road and then loading into railway rakes is done by generating company or other multi-modal transportation system involving multiple trans-shipments]	1.00 %

Provided that in the case of any combination of the above modes of transportation, the transit and handling losses shall be calculated on pro-rata basis using the formula given below:

"Transit loss of coal/lignite based stations (%) = 0.2% x (percentage of coal transported through Pit-head source) + 0.8% x (percentage of coal transported through ARR) + 1.0% x (percentage of coal transported through RCR route or other multi-modal transportation system involving multiple trans-shipments)."

Provided further that in case of imported coal, the transit and handling losses applicable for pit-head station shall apply.

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H. Reagent and auxiliary energy consumption due to implementation of DeSOx system and DeNOx system:

The recommendations of CEA on admissibility of reagent consumption and auxiliary energy consumption on account of implementation of DeSOx system and DeNOx system towards compliance of new environmental emission norms are as below:

1. Reagent consumption:

i) Limestone consumption of wet limestone based FGD system:

Specific limestone consumption (g/kWh) on gross generation basis =

[K x SHR x S/CVPF] *x [85/ LP]*

Where,

S = Sulphur content in percentage,

LP = Limestone Purity in percentage,

SHR= Gross station heat rate, in kCal per kWh;

CVPF = (a) *Weighted Average Gross calorific value of coal considering GCV as per Regulation 60, in kCal per kg for coal based stations less 85 Kcal/Kg on account of variation during storage at generating station;*

(b) Weighted Average Gross calorific value of lignite as received, in kCal per kg, as applicable for lignite based thermal generating stations:

Provided that value of K shall be equivalent to (35.2 *x Design SO2 Removal Efficiency/96%)* for units to comply with SO2 emission norm of 100/200 mg/Nm3 or (26.8 *x Design SO2 Removal Efficiency/73%)* for units to comply with SO2 emission norm of 600 mg/Nm3;

Provided further that the limestone purity shall not be less than 85%.

ii) Lime consumption of lime spray dryer/ semi dry FGD system:

Specific consumption 90% purity lime (CaO) on gross generation basis = [6 x 90 / LP] g/kWh

iii) Sodium bicarbonate consumption of dry sorbent injection system:

Specific consumption of 100% sodium bicarbonate on gross generation basis = 12 g/kWh

iv) Limestone consumption of CFBC power plants (furnace injection):

Specific limestone consumption on gross generation basis =

[62.9 x S x SHR /CVPF] x [85/ LP]

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Where,

S = Sulphur content in percentage,

LP = Limestone Purity in percentage,

SHR = Gross station heat rate, in kCal per kWh,

CVPF = Weighted Average Gross calorific value of lignite as received, in kCal per kg as applicable for lignite based thermal generating stations.

v) Urea consumption of SNCR system:

Specific consumption of 100% urea on gross generation basis = 1.2 g/kWh

vi) Ammonia consumption of SCR system:

Specific consumption of 100% ammonia on gross generation basis = 0.6 g/kWh

2. **Auxiliary energy consumption:**

i) Wet limestone based FGD system:

Normative auxiliary energy consumption for wet limestone FGD system= 1% of gross generation of the power plant.

ii) Sea water based FGD system:

Normative auxiliary energy consumption for sea water based FGD system= 1% of gross generation of the power plant.

iii) Lime spray dryer/ semi dry FGD system:

Normative auxiliary energy consumption for lime spray dryer/ semi dry FGD system= 1% of gross generation of the power plant.

iv) Additional auxiliary energy consumption for provision of Gas-Gas Heaters (GGH):

For FGD envisaged with GGH, additional auxiliary energy consumption= 0.2% of gross generation of the power plant/ unit.

v) Additional auxiliary energy consumption for provision of SCR:

Normative auxiliary energy consumption for installation of SCR system= 0.2% of gross generation of the power plant/ unit.

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The above proposed norms for reagent consumption and auxiliary energy consumption in respect of DeSOx systems and DeNOx systems are suggested to be reviewed after sufficient operational data is available in due course of time.

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