

**CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI**

Petition No. 278/MP/2019

Coram:

Shri Jishnu Barua, Chairperson

Shri I. S. Jha, Member

Shri Arun Goyal, Member

Shri Pravas Kumar Singh, Member

Date of Order: 28th September, 2023

In the matter of

Petition under Sections 62 and 79 (1) (a) of the Electricity Act, 2003 read with Regulations 54 and 55 of CERC (Terms and Conditions of Tariff) Regulations 2014 and Regulations 111 and 115 of the Central Electricity Regulatory Commission (Conduct of Business) Regulations, 1999 for Relaxation/Modification of the provisions of the Indian Electricity Grid Code (Fourth Amendment) Regulations, 2016 and the Central Electricity Regulatory Commission (Deviation and Settlement Mechanism and related matters) (Fourth Amendment) Regulations, 2018 in respect of the schedule for operation of the (2x363.3 MW) Palatana Project of ONGC Tripura Power Company Limited.

And

In the matter of

ONGC Tripura Power Company Limited,
6th Floor, 'A' Wing, IFCI Tower, 61, Nehru Place,
New Delhi-110019.

...Petitioner

Vs

1. Assam Power Distribution Company Limited,
Bijulee Bhawan, Paltan Bazar,
Guwahati – 781001
2. Department of Power,
Government of Arunachal Pradesh,
Bidyut Bhawan, Itanagar – 791111.
3. Department of Power,
Government of Nagaland,
Kohima – 797001.



4. Manipur State Power Distribution Company Limited,
Government of Manipur
Keishampat, Imphal – 795001

5. Power & Electricity Department,
Govt. of Mizoram,
Aizawl – 796001.

6. Meghalaya Power Distribution Corporation Limited,
Short Round Road, Lumjingshai, Shillong – 793001

7. Tripura State Electricity Corporation Limited,
“Bidyut Bhawan”, Banamalipur, Agartala – 799001

...Respondents

Parties Present:

Shri Parinay Deep Shah, OTPCL

Shri Arup Sarmah, OTPCL

Shri Amit Dabas, OTPCL

Shri Alok Mishra, NLDC

Shri Ashok Rajan, NLDC

Order

The Petitioner, ONGC Tripura Power Company Limited (in short “OTPCL”) has filed this petition for relaxation of the Technical Minimum for the OTPC Palatana Project from 55% as specified in the IEGC to 65% of the installed capacity. The Petitioner is seeking the revision of the Technical Minimum of Palatana CCGT Power mainly on the grounds of (i) plant stability problem (Combustion Mode Changeover) at lower loads, and (ii) Non-compliance of NOx emissions at lower loads.

2. The generating station with an installed capacity of 726.6 MW comprises two Gas Turbine (GT) units of 232.39 MW each and two Steam Turbine (ST) units of 130.91 MW each. The Petitioner is a joint venture of ONGC (Oil and Natural Gas Corporation), IL&FS (through its affiliate IEDCL) and the Government of Tripura with the major shareholding by ONGC (50%), IEDCL (26%), Govt. of Tripura (0.5%) and Residual Equity (23.5%) for setting up the project. The beneficiaries of the North Eastern States have been allocated a capacity of 628 MW from the generating station and the balance capacity of 98 MW is towards merchant sale.



Hearing dated 12.12.2019

3. The matter was taken up for hearing on 12.12.2019 and the learned counsel for the Petitioner requested to issue notice to the Respondents. After hearing the learned counsel for the Petitioner, the Commission admitted the Petition. The Commission directed the Petitioner to implead all the distribution licensees/beneficiaries who are procuring power from the Petitioner's Palatana Project and North Eastern Regional Power Committee (NERPC) as a party to the Petition and file a revised memo of parties and also directed the staff to refer the matter to CEA and obtain its expert opinion in the matter.

4. As per the aforesaid direction, vide e-mail dated 22.6.2020 enclosing the instant Petition the matter was sent to CEA for their expert opinion on the said aspect. Based on the findings, CEA vide letter dated 22.7.2020 has sent a letter to the Petitioner to furnish some additional information. In compliance, OTPC vide letter dated 21.8.2020 has submitted the said details to CEA.

5. Thereafter, the matter was delayed due to the COVID outbreak for a substantial period of time as CEA wanted to undertake a plant site visit.

Reply by POSOCO

6. The Respondent POSOCO on behalf of NLDC vide its affidavit dated 10.1.2020 has mainly submitted as under:

(a) The demand of a typical day in the North Eastern Region (NER) varies from 1248 MW to 2767 MW, where the minimum demand is about 45% of the maximum demand.

(b) Therefore, the need for flexibility is very much essential to cater to a low (45% of the maximum demand) minimum demand and keep adequate spinning reserves with optimum scheduling of generation. The largest renewable capacity (175 GW by 2022) expansion programme in the world is being taken up by the Government of India. It requires flexible operation of conventional generation, including gas based generation to accommodate generation from renewable energy.

(c) In NER, the limited number of generators which can provide flexibility are Storage based Hydro (Loktak-NHPC, Doyang-NEEPCO, Khandong-NEEPCO), Gas Thermal



(Palatana-OTPC, AGBPP-NEEPCO and AGTCCPP-NEEPCO) and Coal Thermal plants (BgTPP-NTPC).

(d) Palatana being one of the cheapest plants in the merit order in the North Eastern Region is rarely operated below its technical minimum level. During the period of Jan'19 to Dec'19 there were only 3 (three) occasions wherein OTPC, Palatana, was operated at its technical minimum level.

(e) From the duration curve of scheduling of OTPC, Palatana for the year 2019, it is seen that it has operated above 55% of its declared capability for 98% of the time and above 65% of its declared capability for 97.5 % of the time in the year 2019. Further, the balance of 2% of the time in the year 2019 when the plant was operated below 55%, it was due to unit synchronization or desynchronization only.

7. In view of the above submissions, the Respondent prayed that the Commission may pass such order(s) as it may deem fit and proper in the facts and the circumstances of the case.

Additional Information by the Petitioner

8. The Petitioner, vide affidavit dated 24.2.2020, has submitted additional information, mainly reiterating its submissions. The petitioner had earlier submitted their comments regarding clause 6.3B of the IEGC (fourth) Amendment describing the difficulties faced by the petitioner in conforming to operate the machines at Palatana Project at such technical minimum levels of 55% & also presented the issue in Operation Co-ordination Committee Meeting of NERPC held on 8.6.2017 & 16.6.2017. The Petitioner has mainly submitted as under:

Plant Stability (Combustion Mode Changeover)

9. Stable operation zone for the Palatana Project at loads below a certain technical minimum level of Installed Capacity is difficult due to state of art automatic fuel supply changeover from Pilot Pre-Mix (PPM) mode to Pre-Mix (PM) mode and vice versa. Such fuel supply mode changeovers hamper the machine stability and may lead to tripping of the plant.

10. The Gas turbine PG9351FA which uses a DLN2.0+ combustion system can run on four different mode changeover logics as described below:



- (a) Diffusion Mode - from ignition to combustion reference temperature of 800 ° F or L14HS (95% of rated speed) whichever comes earlier.
- (b) Sub piloted Premix (SPPM) - from combustion reference temperature of 800 ° F to 1750° F. (with a dead band of 30° F, i.e. while unloading the band will operate at 1720° F)
- (c) Piloted premix (PPM) - from combustion reference temperature of 1750 ° F to 2330° F. (with a dead band of 50° F, i.e. while unloading the band will operate at 2280° F)
- (d) Premix (PM) - combustion reference temperature above 2330° F.

11. The mode change over depends upon combustion reference temperature and combustion profile. The tuning of the combustor is done by OEM to optimize combustion profile and emissions. The plant operator tries to prevent the operation of the machines in the mode changeover region by jumping to higher or lower loads than as prescribed by the schedule to avoid the operation of machines in the mode changeover region. However, operation in PPM mode will lead to higher NOx emissions. Hence the machines are operated in PM mode as advised by the OEM to avoid tripping machines.

12. OEM recommended the Premix mode (PM) operation, failing which instability may creep into the plant operations and lead to degradation of Hardware. While increasing load, mode changeover takes place from PPM to PM mode at around a GT load of 140 MW (corresponds to a combustion reference temperature of 2330°F). Corresponding ST generation is around 90 MW. Thus, the total unit generation is around 230 MW. For stable operation of the station, it is always desirable to run the gas turbines in PM mode and mode changeover from PM to PPM mode must be avoided to achieve Stable Plant operations, lowest possible emissions coupled with maximum part life.

13. From the Palatana power station ST generation cannot be reduced like other combined cycle power plants as the Palatana Project can only operate in combined cycle mode. If we divert part of the steam to the condenser through a bypass, it will add up heat load to the condenser and the vacuum will deteriorate. In such cases ST may trip due to high exhaust pressure or HPT exhaust high temperature. The bypass system is used only during unit start up and shutdown. Also by diverting the steam directly to the condenser, the exhaust temperature will increase which in turn has a damaging effect on the Steam turbine LP side blades.



14. It is evident from the above facts that the Palatana Project is most stable in the load range of 230 MW and above for a single unit of 363.3 MW. It is nearly 63.3% of the installed capacity for a single unit. So keeping a safety margin, it is assumed that the safe operation for the Palatana Project will be in the range of 241.5 MW i.e. nearly 65-66% of the load range of the total installed capacity of the project.

15. Considering a 5% safe margin (as a gas turbine is an ambient air breathing machine, mode changeover load is not always fixed) to the total generation of 230 MW, the technical minimum can be considered as $230 \times 1.05 = 241.5$ MW for one block i.e. 66.5% of Installed Capacity.

NOx Emissions:

16. The guaranteed emission parameters with DLN2+ burners and natural gas as fuel are:

(a) Nitrogen Oxides (NOx) - 25 PPMVD @ 15% O₂.

(b) Carbon monoxide (CO) - 25 PPMVD

(c) Unburnt Hydro carbons - 7 PPMVD

17. The guaranteed values correspond to the PM mode of operation of the gas turbine. If the gas turbine runs in PPM mode, the NOx value exceeds 50 PPM and thus it is not desirable to run the unit in PPM mode for an extended period of operation.

18. BHEL guarantees a NOx emission of 50 PPM or below only at 60% to 100% of the GT Load Range. NOx level permitted by the Central Pollution Control Board (CPCB) is 50 PPM and the same is also mentioned in "Consent to Operate" issued by Tripura State Pollution Control Board under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981.

19. The GE (OEM) O&M manual clearly shows that with the DLN2+ system at lower loads (PPM mode of operation), the NOx value will cross 50 PPM. Also, the NOx data available with us substantiates the same. It can be seen that the NOx emissions are above 50 PPM when the GT load is below 140 MW and the NOx emissions reduce drastically as the GT load increases beyond this 140 MW range.

20. Hence, all the references provided here clearly bring out an operational range of 65-66% or above of the installed capacity of the project (keeping a safety margin of 5%), for the safe operation of the Palatana Project within the environmental norms.



21. Further, it is pertinent to mention here that Palatana is not the sole project experiencing difficulties while operating at a technical minimum of 55%. Other gas projects like Ratnagiri Gas Power Station have expressed the problems faced at such low loads and have submitted a petition 8/MP/2019 to the Commission for relaxation/modification of the provisions of the Indian Electricity Grid Code (Fourth Amendment) Regulations, 2016 and the Central Electricity Regulatory Commission (Deviation and Settlement Mechanism and related matters) (Fourth Amendment) Regulations, 2018 in respect of the schedule for operation of the Ratnagiri Gas Power Station.

OTPC Operating Experiences

22. Further, the Petitioner has also submitted the actual operating experiences of the Palatana Project during mode changeover when the schedule was in the vicinity of 56-57%.

- (a) In 2016, the unit tripped 4 times [on 2nd Feb, 14th June (both units) and 4th Sep] during the process of mode changeover.
- (b) 16th May 2017: OTPC was asked to operate at the schedule of 388 MW (gross 410 MW) for blocks 25 to 32.
 - (i) While reducing load, mode change over happened. But the plant faced a problem to maintain load which led to the instability of the gas turbines.
 - (ii) Minimum NOx limit breached in violation of consent to operate
- (c) 30th May 2017: OTPC was asked to operate at the technical minimum schedule of 385MW (gross 407 MW) for blocks 74 to 78
 - (i) Palatana could not go to 385 MW to avoid tripping and instability
 - (ii) Palatana was compelled to run 15MW more (gross 422 MW) than the technical minimum schedule to avoid instability and tripping of machines.
 - (iii) Palatana over-generated and loss absorbed as DSM penalty
- (d) 11th June 2017: 1500 Hrs - 14th June 1530 Hrs: OTPC was asked to maintain the technical minimum SG as 385MW (gross 407 MW).
 - (i) Palatana was compelled to operate at a load 15-20MW (gross 422 MW) higher than the technical minimum SG.
 - (ii) Palatana lost on account of DSM regulations.

23. The Petitioner vide letter reference No OTPC/COMML/T-13/2022-23/013 dated 12.8.2022 to CERC has mentioned that the matter was delayed due to the COVID outbreak, and it has pursued the



matter with CEA. The Petitioner in the letter has informed that the TETD division of CEA has raised some fresh queries in July 2022. OTPC is in the process of replying to them. The Petitioner has further submitted that CEA has indicated that it will soon undertake a long pending site visit.

Hearing dated 15.11.2022

24. After hearing the learned counsel for the Petitioner, the Commission observed that it would be appropriate and necessary to have CEA's independent technical report. Accordingly, the Commission directed the CEA to furnish its report on the subject matter and accordingly directed the Petitioner to pursue the said matter with CEA including providing all the requisite details as called for by CEA for the above purpose in a timely manner. It was decided that the Petition shall be listed for hearing after the CEA filed its report on the subject matter.

Hearing dated 16.5.2023

25. Learned counsel for the Petitioner submitted that pursuant to the direction of the Commission, Central Electricity Authority (CEA) has furnished its comments on the subject matter. Learned counsel further circulated a brief note of submission. The representative of the Respondent, NLDC submitted that the Respondent has already filed its limited reply in the matter and the same may be considered while passing the order. After hearing learned counsel for the Petitioner and the representative of the Respondent, NLDC, the Commission reserved the matter for order.

Analysis and Decision

26. We have perused all the replies rejoinders and documents available on record.

27. On 28.4.2010, the Commission notified IEGC Regulations, 2010 which came into force from 3.5.2010, superseding the Indian Electricity Grid Code, 2006. On 6.1.2014, the Commission notified DSM Regulations, 2014 which came into force from 17.2.2014. Further, on 6.4.2016, the Commission notified the Central Electricity Regulatory Commission (Indian Electricity Grid Code) (Fourth Amendment) Regulations, 2016 (hereinafter referred to as 'IEGC 4th Amendment Regulations, 2016'). On 20.11.2018, the Commission notified the Central Electricity Regulatory Commission (Deviation Settlement Mechanism and related matters) (4th Amendment) Regulations, 2018 which came into force from 1.1.2019. In terms of the IEGC 4th Amendment Regulations, 2016, the Commission has specified



the technical minimum for operation in respect of a unit or units of a Central Generating Station or inter-State Generating Station as 55% of MCR loading or installed capacity of the unit of a generating station, subject to other terms and conditions as provided in the Regulations. In terms of the DSM 4th Amendment Regulations, the Commission has provided for the modified charges for deviation and also specified norms for sign change by the entities connected to ISGS. In terms of these Regulations, penal charges are leviable for not adhering to the stipulations.

28. The Petitioner had submitted that subsequent to IEGC 4th amendment, it faced technical difficulties in adhering to the provisions of a technical minimum of 55% and made a presentation at the 133rd Operation Coordination Committee Meeting of NERPC held on 8.6.2017 at Guwahati. As per the advice of the Member Secretary, NERPC, a presentation was made to CERC on 16.6.2017 highlighting the difficulties faced in operating the generating station at a technical minimum of 55%.

29. A visit of CEA officials was also arranged by the Petitioner to the Palatana site in June 2019 and subsequently the instant Petition was filed in the Commission. The matter was referred to CEA by the Commission. CEA vide e-mail dated 22.2.2023 to CERC has informed that it has examined the matter on the basis of requisite data/inputs submitted by the Petitioner and also submitted the comments/observations on the subject petition.

30. The data/ inputs as provided by the Petitioner OTPC and the observations made by CEA are as under:

(A) Regarding Plant Stability problem (Combustion Mode Changeover) at lower loads:

OTPC in this regard has submitted that:

31. A stable operation zone for the Palatana Project at loads below a certain minimum level of Installed Capacity is difficult due to the combustion mode changeover from Premix (PM) to Pilot Premix (PPM) mode and vice versa. Such fuel supply mode changeovers hamper the machine stability and may lead to tripping of the plant.” (ref. Para 7 of the above-mentioned petition). The Gas Turbine of OTPC Palatana Project is equipped with DLN2.0+ combustion system, which can run on four different fuel mix modes. The modes are Diffusion, Sub-Piloted Premix (SPPM), Piloted Premix (PPM) and Premix (PM). As such the above machine is designed for these modes change overs as per the



requirement (logic based on Combustion reference temperature). Also, OTPC's contention that fuel supply mode changeovers hamper the machine stability is not substantiated by any of the documents from OEM (i.e. M/s GE).

32. OTPC in this regard has further submitted that:

- (i) "The operation of gas-based generation projects is recommended by the OEM in Premix mode (PM), failing which instability may creep in the plant operations"; and
- (ii) Our Original Equipment Manufacturer M/s GE also does not recommend non-PM combustion mode of operation for extended period of time, as it will accelerate combustion hardware degradation leading to reduction in GT maintenance intervals. Cyclic operation between piloted premixed and premixed modes puts variable thermal loads on the combustion liner and transition piece similar to the loads encountered during the startup/shutdown cycle and finally leads to the early failure of the combustion internals. The DLN combustion mode recommended for continuous mode operation is the premixed combustion mode (PM), as it ensures stability of machine and achieves lowest possible emissions coupled with maximum part life."

33. CEA in this regard has submitted as under:

- (a) Though OEM provides that in GT equipped with DLN 2+ combustion system, the recommended mode for continuous mode of operation is the Premixed Mode (PM), as it achieves lowest possible emissions and maximum possible part life, no document of M/s GE (OEM) states that "Nonoperation in PM Mode, may creep instability in plant operations".
- (b) As per GE's document, extended Piloted Premixed (PPM) operation results in a maintenance factor of 10 and Continuous mode operation in lean-lean (L-L), sub-piloted premixed (SPPM), or piloted premixed (PPM) modes is not recommended as it will accelerate combustion hardware degradation, the document does not mention any stability issue for non-PM combustion mode as claimed by the OTPC in their petition.

34. CEA has further submitted that as per para 21 of the above petition, M/s OTPC has submitted that "In 2016, unit tripped 4 times [on 2nd Feb, 14th June (both units) and 4th Sep] during the process of



mode changeover.” M/s OTPC has provided detailed reasons for these trippings. On perusal of the reasons provided for these tripping, it is observed that tripping of the units has occurred in various instances due to many other reasons viz. low pressure of gas supply, high exhaust spread of the machine due to many factors, grid disturbances, malfunctioning of one or the other equipment etc. The details/document provided by OTPC has not indicated any tripping events attributed to stability issues due to mode changeover.

35. Data regarding the unit start-up and shut-down were provided by M/s OTPC from the year 2020 to 2022 for unit#1 and from the year 2019 to 2022 for unit #2. No case of unit tripping due to instability during mode changeover has been indicated by M/s OTPC in their above data. It is to mention here that whenever the units (GT) are getting started (loading) or shutdown (unloading), it inevitably goes through the mode change over from diffusion to SPPM to PPM to PM or vice-versa as the case may be. Had there been the case of instability during mode change as claimed by OTPC, it would not have been feasible for the plant to operate.

36. Further, as per OTPC's reply vide email dated 28.12.2022, M/s OTPC has never run any unit in non-PM mode continuously for a few hours at lower loads. So, the claim made by M/s OTPC regarding the stability issue is not justifiable without an actual trial run in a non-PM mode of operation at lower loads for a longer period, say for a few hours.

(B) Observations regarding Non-compliance of NOx emissions at lower load:

37. M/s OTPC in this regard has mentioned that “50 PPM of NOx is the limit within which station is to be operated as per the guideline of Central Pollution Control Board (CPCB). The limit of 50 PPM of NOx is also mentioned in the “Consent to Operate” provided by the Tripura State Pollution Control Board. This NOx emission level of 50 PPM or below is applicable for the complete 726.6 MW project.” It appeared to be low and therefore clarification was sought from M/s OTPC regarding the matter whether NOx emission limit of 50 ppm is for the entire project or stack wise. OTPC vide their reply dated 15.12.2022 has clarified that the NOx Limit is stack wise (Unit-wise), i.e. 50 ppm for Unit-1 and 50 ppm for Unit-2 in the Palatana Project.

38. Further, NOx emissions are above 50 PPM when the GT load is below 140 MW and the NOx emissions reduce drastically as the GT load increases beyond 140 MW range. The same effect of GT



load on NOx emissions can also be observed where the NOx emissions drastically reduce as GT load increases above 140 MW.”

39. CEA in this regard has mentioned that M/s OTPC has already clarified that they have never run any unit in non-PM mode continuously at lower loads. Therefore, all the data w.r.t. to Non-PM mode, as submitted by M/s OTPC, is of either during start-up or during shutdown of units.

40. CEA has further submitted that the start-up and shutdown data of both units were sought from OTPC from the date of commissioning of each unit. However, OTPC has provided the start-up and shut down data from year 2020 to 2022 for unit#1 and from year 2019 to 2022 for unit #2. These data have been analyzed and based on this, starting and shutdown data at different dates has been compiled.

41. The Maximum loads during starting (i.e. increasing the GT load and corresponding ST and Unit load) till the NOx limit of 50 ppm is maintained, on different dates are shown in table-1 (for Unit #1) and table-2 (for Unit #2) and Minimum loads during shutdown/unloading (i.e. decreasing the GT load and corresponding ST and Unit load) till NOx limit of 50 ppm is maintained, on different dates, are shown in table-3 (for Unit #1) and table-4 (for Unit #2).

Table-1 Maximum loads during starting loading till NOx limit of 50 ppm is maintained Unit #1

Start-up Date	GT-1 Load (MW)	GT-1 % Load	ST-1 Load (MW)	ST-1 % Load	Total Load (MW)	Total % Load
24-Apr-20	98.82	42.6%	72.59	55.8%	171.41	47.2%
2-Jul-20	98.47	42.4%	77.67	59.7%	176.14	48.5%
24-Nov-20	82.06	35.4%	69.39	53.4%	151.45	41.7%
27-Jan-21	90.49	39.0%	71.36	54.9%	161.84	44.6%
11-Mar-21	79.32	34.2%	70.16	54.0%	149.48	41.2%
1-Apr-21	87.13	37.6%	74.32	57.2%	161.45	44.5%
21-Jul-21	98.70	42.5%	69.65	53.6%	168.35	46.4%
24-Aug-21	83.82	36.1%	795.55	58.1%	159.38	43.9%
21-Oct-21	83.94	36.2%	73.01	56.2%	156.96	43.2%
22-Oct-21	89.19	38.4%	73.87	56.8%	163.06	44.9%
3-Nov-21	74.73	32.2%	66.05	50.8%	140.78	38.8%
5-Nov-21	74.53	32.1%	73.24	56.3%	147.77	40.7%
5-Mar-22	79.48	34.3%	67.96	52.3%	147.45	40.6%
14-May-22	79.64	34.3%	67.42	51.9%	147.06	40.5%
19-May-22	93.94	40.5%	74.32	57.2%	168.27	46.4%
8-Jun-22	74.38	32.1%	63.70	49.0%	138.08	38.0%
11-Jun-22	79.40	34.2%	49.13	37.8%	128.53	35.4%



Table-2- Maximum loads during starting/loading till NOx limit of 50 ppm is maintained, Unit#2

Start-up Date	GT-2 Load (MW)	GT-2 % Load	ST-2 Load (MW)	ST-2% Load	Total Load (MW)	Total % Load
3-Jan-19	93.98	40.5%	72.32	55.6%	166.30	45.8%
9-Mar-19	135.47	58.4%	62.14	47.8%	197.61	54.4%
3-Apr-19	102.54	44.2%	67.96	52.3%	170.49	47.0%
20-Apr-19	92.58	39.9%	74.36	57.2%	166.94	46.0%
13-Jul-19	113.25	48.8%	74.11	57.0%	187.36	51.6%
2-Sep-19	86.58	37.3%	59.34	45.6%	145.92	40.2%
6-Sep-19	91.49	39.4%	64.57	49.7%	156.07	43.0%
7-Oct-19	92.43	39.8%	75.95	58.4%	168.38	46.4%
12-Oct-19	92.91	40.0%	62.07	47.7%	154.97	42.7%
24-Dec-19	97.51	42.0%	74.54	57.3%	172.05	47.4%
31-Dec-19	87.22	37.6%	62.82	48.3%	150.04	41.3%
29-Feb-20	81.01	34.9%	51.26	39.4%	132.27	36.4%
12-Mar-20	75.77	32.7%	67.40	51.8%	143.17	39.4%
29-Mar-20	102.29	44.1%	65.70	50.5%	167.99	46.3%
4-Jul-20	97.49	42.0%	75.05	57.7%	172.54	47.5%
15-Jul-20	95.32	41.1%	74.93	57.6%	170.25	46.9%
11-Oct-20	77.55	33.4%	62.79	48.3%	140.34	38.7%
21-Jul-21	140.52	60.6%	79.65	61.3%	220.16	60.7%
8-Oct-21	81.63	35.2%	74.93	57.6%	156.55	43.1%
21-Oct-21	101.30	43.7%	74.31	57.2%	175.60	48.4%
12-Nov-21	102.15	44.0%	74.09	57.0%	176.24	48.6%
12-Feb-22	76.54	33.0%	71.88	55.3%	148.42	40.9%
22-Feb-22	71.35	30.8%	68.35	52.6%	139.70	38.5%
5-Jul-22	81.30	35.0%	72.53	55.8%	153.83	42.4%
7-Jul-22	91.77	39.6%	68.48	52.7%	160.24	44.1%
16-Oct-22	91.15	39.3%	75.08	57.8%	166.23	45.8%
21-Dec-22	90.85	39.2%	72.57	55.8%	163.41	45.0%
15-Oct-22	96.38	41.5%	87.88	67.6%	184.26	50.8%

Table-3- Minimum loads during unloading till NOx limit of 50 ppm is maintained, Unit#1

Start-up Date	GT-1 Load (MW)	GT-1 % Load	ST-1 Load (MW)	ST-1 % Load	Total Load (MW)	Total % Load
8-Apr-21	89.24	38.5%	89.40	69%	178.65	49.2%
21-Oct-21	79.55	34.3%	83.64	64.3%	163.18	45.0%
3-Mar-22	89.80	38.7%	89.38	68.8%	179.18	49.4%
13-May-22	84.97	36.6%	87.40	67.2%	172.36	47.5%

Table-4- Minimum loads during unloading till NOx limit of 50 ppm is maintained, Unit#2

Start-up Date	GT-2 Load (MW)	GT-2 % Load	ST-2 Load (MW)	ST-2% Load	Total Load (MW)	Total % Load
3-Jan-19	96.51	41.6%	96.28	74.1%	192.79	53.1%



6-Mar-19	76.87	33.1%	92.56	71.2%	169.44	46.7%
15-Aug-19	92.19	39.7%	90.47	69.6%	182.66	50.3%
23-Dec-19	87.38	37.7%	91.42	70.3%	178.80	49.3%
3-Mar-20	92.04	39.7%	92.35	71.0%	184.40	50.8%
11-Nov-21	106.52	45.9%	89.87	69.1%	196.39	54.1%
19-Feb-22	62.30	26.9%	90.31	69.5%	152.61	42.0%
23-May-22	102.15	44.0%	85.32	65.6%	187.47	51.6%

42. The inference drawn by CEA from above data are as under:

- (i) During Starting, the minimum GT load (and corresponding ST and Unit load can be seen from tables-1 & 2) for which NOx limits are in compliance, varies from 32.1 % to 42.6% for Unit #1 and 30.8 % to 60.6% for Unit #2, depending on the site and ambient conditions. Based on this, it can be stated that during start-up, till the GT load reaches 30.8 % (taken as a conservative figure), NOx limits can be maintained within the stipulated limit.
- (ii) During Shutdown (or unloading/decreasing GT, ST and Unit load), NOx limits are maintained within the limit till the GT load is reduced to 38.5% for Unit #1 and 45.9% for Unit #2. Further, there is a variation of these GT loads for Unit #1 from 38.5% to 34.3% (for Unit #1) and 45.9% to 26.9% (for Unit #2), depending on the site and ambient conditions. Based on this, it can be stated that during unloading, till the GT load reaches 45.9 % (taken as a conservative figure), NOx limits can be maintained within the stipulated limit.
- (iii) Therefore, from the above it can be stated that during the loading and unloading of units, the NOx compliance GT loads are different. GT load is of the order of around 30-35% while loading whereas GT load is of the order of around 40-45% during unloading.
- (iv) It is also mentioned here that for these load limits, the corresponding Mode of combustion (i.e. whether, PM, PPM or SPPM) are not available. However, based on the understanding of data and documents provided by OTPC, the corresponding mode at these loads in both cases i.e. loading and unloading should be PPM or SPPM.
- (v) As above, data (i.e. 4 tables) have been compiled for the loads, where the NOx limit is compiled during loading and unloading. It is inferred here that NOx limits are maintained till 30-35% (absolute value 70-81 MW) of GT load during loading and after that, there will be a rise in NOx values and once the PM mode is achieved, NOx values will be within the limits.



Similarly, during un-loading, the NOx values are within the limit till 40-45 % (absolute value 93-104 MW) of GT load.

(C) Comments of CEA on Petition of M/s OTPC:

43. Based on the data submitted by the Petitioner to CEA and observation made by CEA above, the comments of the CEA regarding the issue in the Petition, seeking the revision of the Technical Minimum of their Palatana CCGT Power Station from 55% to 65% of the installed capacity on the grounds of (i) Plant Stability problem (Combustion Mode Changeover) at lower loads, and (ii) Non-compliance of NOx emissions at lower loads are as under:

“3.1 M/s OTPC’s request for revision of Technical Minimum of their Palatana CCGT Power Station from 55% to 65% of the installed capacity on the grounds of Plant Stability issue (Combustion Mode Changeover) at lower loads and non-compliance of NOx emissions at lower load appears to be unsubstantiated in view of following:

(a) As such, no stability issue, associated with mode changeover from PM (high load) to PPM (low load) mode, has been found in the various documents/data as provided by M/s OTPC to CEA with regard to the claims in their petition. Further, no stability issues in the GT during transition from PM to PPM mode of operation has been indicated in any of the documents of GE (OEM).

(b) As regards the issue of higher NOx emission at lower loads is concerned, OTPC submission that “NOx emissions are above 50 PPM when GT load is below 140 MW” seems to be true in GT load range of 70 to 140 MW during loading only. However, during un-loading, NOx values are within the limit till 45% of GT load i.e. 104 MW.

3.2 There are possibilities of higher maintenance factor and accelerated combustion hardware degradation upon continuous operation at lower loads. However, in a scenario of getting dispatch schedule of lower load, the possibility of operating different modules of the OTPC plant at different modes may be explored by M/s OTPC, taking in to consideration the maintenance factor, hardware degradation, NOx emission etc.

3.3 Further, considering the future requirements of providing stability to the grid on account of variable Renewable Energy (RE) integration, the gas based power plants,



which are inherently considered much more flexible than the coal based plants, would be expected to run at minimum possible load for prolonged period. Therefore, as per the OEM's (i.e. G.E.) documents, the following possibilities may further be explored by M/s OTPC to address the issue of higher NOx emission, if observed, at stable lower loads:

3.3.1 Lowering the allowable minimum IGV angle, exhaust temperature control operation for extended Premix Mode of operation at part loads, and

3.3.2 M/s OTPC may consider upgrading their GT combustion system from DLN 2.0+ to DLN 2.6+ to support better emission, turndown, & operational flexibility.”

44. Further, the Commission in the case of Ratnagiri Gas and Power Private Limited, have relaxed the technical minimum of the generating station based on the recommendation of CEA, which is using GE to make 9FA gas turbines, the same machine as the Petitioner. The Commission vide order dated 21.1.2020 in Petition No. 8/MP/2019 with respect to Ratnagiri Gas and Power Private Limited while relaxing the upward revision of technical minimum has observed as under:

56. After consideration of the above observations based on the technical issues as brought out by the Petitioner and recommendations as submitted by CEA in its report, the Commission is of the view that technical minimum of 55% as per the IEGC 4th Amendment Regulations, 2016 is not sustainable for CCGT plant modules at Dhabol, having GE make 9FA machines provided with DLN 2/2+ combustion system for MPCB stipulated NOx emission compliant operation.

57. Accordingly, the Commission, in line with the recommendation of CEA, is inclined to agree that technical minimum of 62% (corresponding to 52% GT loading) CCGT rated load may be allowed for RGPPL's CCGT plant modules at Dhabol, having GE make 9FA machines provided with DLN 2/2+ combustion system.

58. The Commission, in exercise of its powers to relax under Part 7 (4) of IEGC Regulations, 2010, hereby allows Technical Minimum loading of the Gas Turbines of the Petitioner at 62% of the MCR/capacity in place of 55% provided in the Indian Electricity Grid Code (Fourth Amendment) Regulations, 2016.

45. However, in the case of the instant generating station of the Petitioner M/s OTPC, it is clear that CEA has not recommended for upward revision of the Technical Minimum for 726.6 MW Palatana Combined Cycle Gas Turbine (CCGT) Project of M/s OTPC as the Petitioner could not furnish reports pertaining to unit tripping due to mode changeover. Since the Petitioner has never run any unit in non-



PM mode continuously at lower loads, all the data w.r.t. Non-PM mode, as submitted by M/s OTPC, is either during start-up or during shutdown of units. CEA in this regard has also inferred that NOx limits are maintained till 30-35% (70-81 MW) of GT load during loading and after that, there will be a rise in NOx values and once the PM mode is achieved, NOx values will be within the limits. Similarly, during un-loading, the NOx values are within the limit of 40-45 % (93-104 MW) of GT load.

46. CEA has also suggested that the Petitioner should explore the possibility of operating the modules at different modes considering the maintenance factor, hardware degradation NOx emission etc. CEA has further observed that considering the future requirements of providing stability to the grid on account of variable Renewable Energy integration, the gas-based power plants would be expected to run at the minimum possible load for a prolonged period. To address the issue of higher NOx emission, at stable lower loads, CEA has advised the Petitioner to further explore the possibilities of lowering the allowable minimum IGV angle, exhaust temperature control operation for extended Premix Mode of operation at part loads and upgrading their GT combustion system from DLN 2.0+ to DLN 2.6+ to support better emission, turndown, & operational flexibility.

47. Considering the above, we are not inclined to allow the upward revision of the technical minimum for the 726.6 MW Palatana Combined Cycle Gas Turbine (CCGT) Project of M/s OTPC. However, in future, if the plant undertakes all the recommendations made by CEA and faces the problem of higher NOx emission, at stable lower loads, the Petitioner is at liberty to approach the Commission with all the data, reports and justifications.

48. The Petition No. 278/MP/2019 is disposed of in terms of the above.

sd/-
(Pravas Kumar Singh)
Member

sd/-
(Arun Goyal)
Member

sd/-
(I. S. Jha)
Member

sd/-
(Shri Jishnu Barua)
Chairperson

