

**CENTRAL ELECTRICITY REGULATORY COMMISSION  
NEW DELHI**

**Petition No. 188/SM/2012  
With I.A.No. 11/2013**

**Coram:  
Shri V.S.Verma, Member  
Shri M. Deena Dayalan, Member**

**Date of Hearing: 11.07.2013  
Date of Order : 11.12.2013**

**In the matter of**

Calculation of total transfer capacity, available transfer capacity and transmission reliability margin.

**And in the matter of**

Jindal Power Limited  
Tamnur, District Raigarh,  
Chhattisgarh

National Load Despatch Centre  
B-9, Qutab Institutional Area,  
Katwaria Sarai,  
New Delhi- 110016.

Sterlite Energy Limited  
1<sup>st</sup> Floor, City Mart Complex,  
Baramunda,  
Bhubaneshwar-751003,  
Orissa

.....Respondents

**Following were present:**

Shri Kumar Mihir, Advocate, JPL  
Shri Vikas Saxsena, JPL  
Shri S.R. Narasimhan, POSOCO  
Ms. Jyoti Prasad, POSOCO



## ORDER

The Commission in its order dated 31.8.2012 had observed that as a result of revised methodology being implemented by NLDC w.e.f 1.8.2012, Total Transfer Capability (TTC), Available Transfer Capability (ATC) has been reduced giving rise of market prices and splitting in the Power Exchange between the Western Region and Northern Region on certain days. The Commission directed NLDC as under:

"4. In view of the above, we direct NLDC to explain the reason for changing methodology for calculation of TTC/ATC in deviation of the Regulations of the Commission. Pending such clarification and decision of the Commission thereon, the existing methodology for calculation of TTC/ATC should be continued, as per the CERC Regulations. It is however, made clear that NLDC has the liberty to approach the Commission through appropriate application for relaxation / deviation from the methodology of calculation of TTC/ ATC, as specified in the Regulations, with justification."

2. During the hearing on 6.9.2012, NLDC requested the Commission that till the various issues related to line loading limits, such as protective relay settings (in particular Zone-3 in light of recent grid disturbances) are examined in detail after obtaining information from all Utilities, the interim procedure for computation of TTC/ATC implemented by NLDC since 1.8.2012, be allowed to continue for four weeks from the point of view of system security.

3. The Commission vide Record of Proceeding dated 6.9.2012 granted POSOCO four weeks time to review procedure in consultation with CEA and CTU and submit the same to the Commission. However, the Commission directed POSOCO to calculate the TTC and ATC in accordance with the CERC Regulations.



4. Meanwhile, Jindal Power Limited (JPL) filed IA No. 48/2012 seeking stay with regard to the change in the methodology sought to be implemented by NLDC in regard to the transfer of power under the Short Term Open Access (STOA) and permit it to transfer the power from its generating units in the State of Chhattisgarh in the same manner as was allowed prior to 20.9.2012. JPL has further submitted that despite Commission's directions dated 20.9.2012, Western Regional Load Despatch Centre (WRLDC) has unilaterally drastically reduced the available transmission capacity under STOA from its plant from 750 MW to 850 MW to about 200 to 400 MW, causing bottling of power and serious financial and other implications to it. The above drastic reduction has been given effect to despite the fact that the capacity of the transmission system in the Western Region and the terms on which the Open Access is allowed, remained the same. This is despite the fact that NLDC is showing the margin available for W-3 Export Zone for the Short Term Open Access as 1884 MW and is not allowing Short Term Open Access even to the extent mentioned above. NLDC has not given any reason for the deviation from the methodology adopted. Further, there is also no reason whatsoever for clubbing the Sterlite Units of 3 x 660 MW with W-3 Export Zone when such units of Sterlite are in the Eastern Region and Sterilite is a part of the Regional Entity of Eastern Region. JPL has submitted that in deviation from the methodology, NLDC further reduced the margin available for W-3 Export Zone for the Short Term Open Access to 1100 MW for the months of October, November and December, 2012.



5. During the hearing on 27.9.2012, the representative of POSOCO submitted that in compliance with the Commission's order dated 31.8.2012, TTC/ATC and Transmission Transfer Margin (TTM) are presently being calculated as per procedure issued under the Central Electricity Regulatory Commission (Grant of Connectivity, Long-term Access and Medium Term Open Access in inter-State Transmission and related matters) Regulations, 2009 (Connectivity Regulations) as amended from time to time.

6. NLDC in its reply dated 15.10.2012 has submitted that it has been evaluating TTC/ATC as per Connectivity Regulations. This is notwithstanding the fact that the following operational uncertainties exist making the system insecure which are considered while calculating TTC/ATC:

(i) Absence of primary response leading to large fluctuations in frequency with the attendant fluctuations in system voltages and line flows which is not factored in TTC computations.

(ii) Absence of any form of ancillary services such as frequency support, voltage support etc.

(iii) Addition of large generating stations with merchant capacity having only connectivity to the grid and which transact power through the STOA route leading to a shift in problems from the planning to the operating horizon.

(iv) High levels of Unscheduled Interchange (UI) by some market players and virtually high response time for manual corrective actions in case of an emergency in the system.

(v) Failure of defense mechanisms such as automatic under-frequency related load shedding, Under Voltage Load shedding all of which were evident during the disturbances of 30th and 31st July 2012.

7. On 15.10.2012, NLDC explained to the Staff of the Commission the methodology adopted in TTC/ATC determination. NLDC was further intimated that feedbacks from RLDCs are obtained before calculating and revising TTC/ATC values. The staff made certain suggestions with respect to transparency of data with stakeholders and RLDCs agreed to give the assumptions made during the study in their ATC/TTC declaration. RLDCs also gave information about the practices being followed worldwide with respect to sharing of proprietary information of system operators and possible abuse of information by the market players.

8. POSOCO, during the hearing on 27.9.2012, submitted that a Committee had been constituted to implement the recommendations of Enquiry Committee which held meeting on 26.9.2012 and in accordance with decision in the Committee, the loading on the lines were considered for calculation of TTC.

9. During the hearing on 20.12.2012, the representative of the Central Transmission Utility (CTU) submitted that the loadability of a transmission system depends upon three factors, namely (a) thermal limit; (b) Voltage Regulation limit; and (c) Stability limit. He explained that Surge Impedance Loading (SIL) is a characteristic of a transmission line, in which the reactive power generated by the transmission line equals the reactive power consumed by the line and is not a loading criteria which should be considered in calculation of TTC/ATC. For short lines, particularly for 220 kV line level, the loading of line could go up to their thermal rating. For short 400 kV line also thermal limit should be considered. However, for long 400 kV lines due to limitation of voltage regulation, lower loading than the thermal limits would need to be considered. The representative of the Central Electricity Authority (CEA) submitted that after the grid disturbances on 30/31.7.2012, three meetings of the Committee comprising Member (PS) of CEA, Director (Operation) of PGCIL, and CEO, POSOCO were held to improve the reliability in the national grid. In the said meetings, the line loadings of the transmission lines were reviewed and it was found that limiting the line loading in certain cases had caused under-utilization of the transmission systems. Hence, there was a consensus in the Committee to improve the loadability of the transmission lines based on conditions of minimum of thermal loading, voltage regulation and stability limit. It was decided that the stability limit would be ascertained through system studies to be undertaken by CTU/POSOCO. The representative of CEA submitted that in the absence of system study, the SIL loading was considered as the limit of the transmission line loading in the first

instance which needed to be reviewed based on the System Stability Studies. The representative of POSOCO submitted that immediately after the grid disturbance, as precautionary measures, POSOCO reverted to SIL limit on transmission lines. The representative of POSOCO explained that the whole situation can be seen under three time periods, namely (a) situation before 31.7.2012, (b) situation from 1.8.2012 till 20.9.2012, and (c) situation beyond 20.9.2012. He further submitted that only for the second situation, the line loading was limited to SIL. At present, POSOCO is calculating TTC/ATC as per procedure prescribed in the CERC Regulations. Only due to zone-3 malpractice detection, POSOCO had brought the line loadings up to SIL till all lines were checked for their zone setting. In Record of Proceedings dated 20.12.2012, POSOCO and CTU were directed as under:

- (i) POSOCO shall conduct the load flow and stability studies for calculation of TTC/ATC/TRM and shall submit the results to CEA who shall study the results and file its comments before the Commission with copy to POSOCO and CTU by 10.1.2013.
- (ii) CTU shall submit on affidavit by 10.1.2013 with copy to POSOCO and CEA the details of STU lines requiring review of zone-3 settings alongwith its suggestions for proper implementation at RPC level.
- (iii) POSOCO shall submit to the CTU the details of the lines on which reactors need to be removed in terms of Regulation 2.2(j) of the Grid Code.
- (iv) POSOCO shall file its response to the submission of CEA and CTU in terms of (i) and (ii) above by 15.1.2013.

(v) POSOCO shall file its response to the submissions of the representatives of M/s Jindal Power Limited by 10.1.2013 including the opinions of Shri Bhanu Bhushan, Ex-Member, CERC and Shri Ramakrishna, Ex-Member, CEA. The response shall make a reference to the system stabilization study carried out by POSOCO along with CEA.

### **Issues raised by Experts and WRPC**

10. Jindal Power Limited, in its affidavit dated 8.1.2013 has submitted that JPL have sought the opinion of Shri S.R.Malviya, a former Chief Engineer, M.P. Electricity Board who has in-depth knowledge on the subject and Shri Malviya as part of consultancy service to Jindal Power Ltd. in his opinion dated 26.12.2012 on TTC/ATC calculation W3 area, has suggested loading of line up to their thermal limits, removing of reactors and supply of reactive power by the generating units. Further, it has suggested that the phase shifting transformers (PSTs) be used for improving the performance of the EHV system, as has been done in the inter-connected Canadian-American system.

11. Further, JPL vide its affidavit dated 20.12.12 enclosed opinions of experts, namely Shri Bhanu Bhushan and Shri Ramakrishna and letter of MS WRPC to WRLDC. Both of the experts have opined that SIL loading cannot be a measure of power transfer capability of a transmission line.

12. Member-Secretary, WRPC in its letter dated 1.11.2012 address to NLDC has submitted as under:



"The W3 bid area was made operational w.e.f. 00:00 hrs of 18<sup>th</sup> September,2012 and the Total Transfer Capability calculations were made available on the NLDC website. Following observations are made on the data published by NLDC for the month of October' 2012:

I. The Total Transfer Capability for October-2012 (Revision-14) published by NLDC on website for W3 Zone (export) is as follows:

(i)	TTC	7000MW
(ii)	Reliability Margin	200MW
(iii)	ATC	6800MW
(iv)	LTA/MTOA	6100MW
(v)	Margin available for STOA	700MW

II. The Ex Bus Share of Chhattisgarh from generators of W3 bid area is as follows:

(i)	Korba Stage-1&2	194.86MW
(ii)	Korba Stage-3	140.25MW
(iii)	Sipat-1	292.66MW
(iv)	Sipat-2	147.73MW
(v)	NSPCL	194.00MW (Out of Ex Bus Capacity of 460MW, 170MW LTA to DD & DNH, 86MW MTOA to DD & DNH and 10.92MW MTOA to VISL-SR)
	<b>Total</b>	<b>969.50MW</b>

As per the NLDC data, LTA/MTOA export commitment considered for W3 Bid area 6100MW which includes the share of Chhattisgarh from the above generators of W3 Bid area. The above share of Chhattisgarh totaling to 969.5MW would be absorbed in W3 Bid area itself. Hence, it would not be appropriate to include 969.5MW in the total LTA/MTOA export from this zone.

III. Chhattisgarh have following Ex Bus allocations from other bid areas

(i)	VSTPS-III	98.18MW
(ii)	TAPS 3&4	43.68MW
(iii)	Kahalgaon-II	28.05MW
(iv)	Hirakud	1.82Mw

The above allocation would be treated as import commitment of 171.73MW by W3 bid area from other bid areas, hence it may have been treated as counter flow commitment by W3 bid area and it would be appropriate to deduct the import commitment of 171.73MW from the LTA/MTOA considered for export from W3 bid area.

In view of the above, it is seen that the margin available for STOA of 700MW declared by NLDC is short by 969.5MW (as indicated at Sl.No. 2) and 171.73MW

*(as indicated at Sl.No. 3) and thus the total margin available for STOA shall be 1841.23MW.*

*It is, therefore, requested to revise the computations of declaring the margin available for STOA so that the stranded capacity on account of misinterpretation may be utilized and there would not be unnecessary bottle-ling of generation in W3 bid area."*

13. In response to the said letter dated 1.11.2012, WRLDC vide its letter dated 4.11.2012 had submitted that such situation would have implication on the Grid security. In case the beneficiaries, having allocation in reverse direction do not schedule their power due to reduction in load, the flow out of W3 area will increase and leading to insecurity of the system. Even in today's scenario there could be a situation where Chhattisgarh does not requisition its entitlement in Sipat, Korba or NSPCL. In case any other beneficiaries want this Un-Requisitioned Surplus (URS) without STOA, it would lead to network overloading, as the export from W3 would increase beyond 6000-6200 MW. Hence, the whole issue is an involved one and not amenable to a quick fix solution.

14. POSOCO vide its reply dated 14.1.2013 submitted their observations with respect to opinion of a third expert Shri R. S. Malviya, furnished by M/s Jindal Power Limited vide its affidavit dated 8.1.2013 as under:

(a) It is not clear from this opinion as to the nature of query posed to the expert, the input data given by M/s Jindal Power Limited and the simulation studies, if any, carried out by the expert.

(b) A few pertinent points of Reactive capability of generators, need of Phase Shifting Transformers (PSTs), Swing Blocking feature mentioned by the expert in his report however deserve mention.

(c) It is also pertinent to mention at this stage that 1270 MW generation at JPL and JSPL plants at Tamnar, Chhattisgarh together are getting evacuated through a 400 kV D/C Twin Moose line which is not adequate considering N-1 security. On 31st May 2011 when the power plant was evacuating 700 MW on the D/C line, 400 kV Circuit-1 to Raipur tripped on fault. Within minutes, the second circuit also tripped and the entire power station tripped. The third expert's opinion is silent on this aspect of immediate evacuation arrangements from the power plant which is inadequate and is currently operating with a System Protection Scheme (SPS) at the power plant.

15. In response to Commission's direction dated 17.1.2013 regarding expert opinion, NLDC has submitted that the expert opinion is essentially a restatement of axioms related to SIL. The opinion does not present a complete perspective due to the fact that the opinion presumes that NLDC considers only SIL as a measure of power transfer capability of a transmission line. NLDC has been considering line loading up to the permissible limit by considering other parameters as voltage drop, reactive power requirement under dynamic situation.

### **Issue of Zone 3 settings**

16. CTU in its affidavit dated 9.1.2013 has submitted that zone-3 settings of all



lines owned by Power Grid terminated at Power Grid sub-stations have been reviewed and the adopted settings have been verified. There are total of 50 Utilities where Power Grid lines are terminated at sub-stations of other utilities either at one end or both ends of the lines. On 26.9.2012, such utilities were requested by individual communication to forward the adopted zone-3 settings of Line Protection Relays at their sub-stations for calculating the loadability limits. Zone-3 settings in respect of such Power Grid owned lines have been obtained from only 22 Utilities out of total 50 Utilities. Discrepancies observed from the information provided by these 22 Utilities have been brought to the notice of respective utilities for necessary rectification.

17. POSOCO vide its reply dated 14.1.2013 has submitted that the list of lines requiring removal of line reactors and/or other measures with a view to improve the loadability of the line has been submitted to CTU under letter dated 12.1.2013

18. During the hearing on 17.1.2013, CTU was directed to collect and submit the zone-3 setting from all States expeditiously by 10.2.2013. CTU was further directed to respond to the suggestions of POSOCO to remove/ replace shunt compensation on LILO line to reduce length of line to improve loadability by 10.2.2013. POSOCO was directed to reply to expert opinion of Sh. Bhanu Bhushan and Shri V. Ramakrishna by 10.2.2013.

19. POSOCO in its submission dated 16.1.2013 has submitted that as per CTU's



affidavit, as on date there are 171 lines belonging to Power Grid 132 kV and above for which information in respect of Zone-3 is not complete as the lines terminate at a sub-station belonging to different utility. 79 lines out of these are of 400 kV and above. Further, there are 306 lines of 400 kV and above which belong to different utilities other than Power Grid for which Zone-3 information is not complete. Thus, in respect of 400 kV and above, out of nearly 800 lines, 385 lines Zone-3 setting are not available. As per Grid Code, the function of protection relay coordination has been assigned to RPCs. There must be a system evolved for monitoring of the relay setting as well as availability of settings to all related parties. POSOCO has further submitted that these issues need to be addressed immediately in view of line loadability perspectives and grid security.

20. CTU vide letter dated 11.2.2013 regarding suggestion of POSOCO to remove / replace shunt compensation on LILO line to reduce the length of line to improve loadability submitted as under:

(a) Maximum loadability limits for the transmission lines has been calculated considering the effects of SIL (Surge Impedance Loading), shunt compensation (Factor k-1), series compensation (Factor k-2) and St. Clair curve (Factor k-3) as referred in the transmission planning criteria by CEA published in June 1994. POSOCO has suggested to review the reactive compensation so as to enhance the loadability of the transmission lines.

(b) Power Grid has already taken several actions towards modification of



the existing reactive compensation of transmission lines, the same is being reviewed once again by CEA/Power Grid and would be taken up in the Standing Committee/RPC meetings for concurrence of the constituents.

(c) Further CTU also mentioned that the loadability of the transmission system primarily depends upon thermal limit, voltage regulation limit and stability limit which could be determined through studies. It is indicated to dispense with St. Clair curve as a general guidance for transmission lines loading.

(d) The line reactors are provided to facilitate charging of EHV line controlled power frequency temporary over voltage. In addition, line reactors are also useful in reduction of secondary arc current though NGR, successful single- pole auto reclosing, improvement in transient stability, reduction of trap charges etc and are planned taking into consideration all the above aspects which is an integral part of reactive power planning being carried out by Power Grid and CEA on regular basis.

(e) Decision was taken to installed switchable line reactor of 80 MVAR and higher rating in order to contain electrical stress and transient recovery voltage which are high for lower rated reactor due to chances of current chopping. The same is being reviewed as 400 kV circuit breakers are now available with controlled switching device.

21. CTU in its affidavit dated 8.3.2013 has submitted that the Zone-3 settings of all lines owned by Power Grid terminated at Power Grid sub-stations have been reviewed and the adopted settings have been verified for calculating loadability limits. There are total 50 Utilities where Power Grid lines are terminated at sub-stations of other utilities either at one end or both ends of the lines. Discrepancies observed from the information provided by 28 utilities have been brought to the notice of respective Utility for rectification. Further follow up with 22 Utilities is in progress. As regards lines owned by STU, the data from Southern Region, Eastern Region and Western Region has been collected. However, major amount of data is yet to be received from Utilities under Northern Region. Since the complete data of Zone-3 settings could not be obtained from respective utilities / STUs, necessary direction be given to utilities and RPCs to provide desired information.

#### **Validation of ATC /TTC computation by CEA**

22. POSOCO in its reply dated 14.1.2013 has submitted that in compliance with the Commission`s direction dated 20.12.2012, the Report on load flow and stability studies for calculation of TTC/ATC/TRM has been submitted to CEA on 12.1.2013.

23. CEA in its letter dated 14.3.2013 has submitted that it has studied the information of POSOCO regarding the declaration of TTC and comments of CEA are as under:

*"(i) The methodology of calculation of TTC for the month of January, 2013 is in order.*



(ii) The load assumption enclosed with the TTC declaration was found to be slightly at variance with those considered in the load flow model. It is suggested that while revising the TTC (as in this case, rev. no.9), POSOCO may also declare **the revised load/ generation for the base** case as taken in the studies. The variance has found is given below:

S.No.	Region	Load as per TTC declaration, MW	Load as per load flow, study model, MW
1	Northern	36970	37600
2	Eastern	13070	12560
3	Western	37070	33500
4	Southern	31860	32300
5	North-Eastern	1720	1850

(iii) For W-3 zone injection, POSOCO has stated that the limiting constraint is overvoltage under the contingency of outage of one circuit of Raipur-Wardha 400 kV line. POSOCO had submitted that line side voltage of Wardha crosses 437 kV and there is a risk of the line tripping on overvoltage (440kV).

After studying the load flow model of POSOCO, it was observed that the line reactors at Wardha end on the Raipur- Wardha line were not properly modeled, which was causing over voltage on the line side in the simulation studies. If the line reactor is modeled properly i.e. after the series capacitor and before the circuit breaker, the line side voltage reduces by 6-8 kV in the simulation studies.

*It is suggested that POSOCO may model reactors as per actual configuration."*

24. POSOCO in its submission dated 15.3.2013 has submitted that in its response assured that CEA suggestion would be considered while computing TTC and ATC.

25. JPL has further filed IA No. 11/2013 with request to provide all document submitted by NLDC/POSOCO, CTU and CEA to submit its view on the same. During the course of hearing on 11.7.2013, JPL/other stakeholders were directed to interact with CEA for documents. The representative of JPL further submitted that he has met the officials in CEA, who have expressed inability to share the document with them stating lack of specific directions from CERC. JPL has however had inspected



the entire record of present petition on 22.3.2013 and obtained all relevant documents from the registry of CERC in accordance with Central Electricity Regulatory Commission (Conduct of Business) Regulations, 1999 .

26. We have considered the submissions of CEA, CTU, POSOCO, WRLDC and JPL regarding methodology of calculation of Total Transfer Capability, Available Transfer Capability and Transmission Reliability Margins. However, we have also considered the CEA's report regarding load flow and stability studies being conducted by POSOCO for calculation of TTC and ATC. According to CEA, the methodology adopted by POSOCO is correct. CEA has suggested that POSOCO should declare information on load generation balance considered for load flow study and model the reactors correctly in load flow study as per actual configuration. We direct POSOCO to adhere to the advice of CEA in modeling of the network.

27. Meanwhile, the Commission vide its order dated 22.4.2013 had approved the amendments to detailed procedure for relieving congestion in the real time operation. The revised Transmission Planning Criteria issued by CEA in January, 2013 has also been taken into consideration. In accordance with its procedure, while declaring ATC/TTC for a month, specific reason for change in quantum of ATC/TTC w.r.t last revision is also required to be mentioned in Format-I prescribed therein.

28. We find that in view of new market players, merchant generators, untied capacity of many IPPs in absence of Case –I biddings and tendency of States to use



short term power for their requirements in case of delay in capacity addition, this type of apprehensions in regard to computation of TTC , ATC by market participants may continue. We are of opinion that it would be better that a mechanism is evolved to make this process of TTC, ATC computation more broad based and transparent. Therefore, CEA is directed to constitute a National Reliability Council with participation from CTU, CEA, RPCs/ State Representatives and IITs which shall approve computation of TTC for the month and further revisions shall be done by POSOCO.

29. The Petition No. 188/SM/2012 and IA No. 11/2013 are disposed of with the above directions.

Sd/-

**(M. Deena Dayalan)**  
**Member**

sd/-

**(V. S. Verma)**  
**Member**