

**Central Electricity Regulatory Commission
New Delhi**

Petition No. 009/SM/2015

Coram:

Shri A. K. Singhal, Member

Shri A. S. Bakshi, Member

Dr. M.K. Iyer, Member

Date of order: 26th March, 2018

In the matter of

Following up actions on the recommendations of CAC Sub-Committee on Congestion in Transmission.

And

In the matter of

1. Central Electricity Authority
Sewa Bhawan,
R.K. Puram, New Delhi - 110 066
2. Forum of Regulators (FoR)
Secretary, Forum of Regulators,
C/O Central Electricity Regulatory Commission (CERC)
3rd Floor, Chanderlok Building
36, Janpath, New Delhi 110 001
3. Central Transmission Utility
Powergrid Corporation of India Limited
Plot No. 2, Sector-29,
Near IFFCO Chowk, Gurgaon-122001
4. Powergrid Corporation of India Limited
Plot No. 2, Sector-29,
Near IFFCO Chowk, Gurgaon-122001
5. Power System Operation Cooperation Limited
National Load Despatch Centre
B-9, Qutab Institutional Area,



- Katwaria Sarai, New Delhi-110016
6. Member Secretary,
Southern Regional Power Committee
29, Race Course Cross Road,
Bangalore-560 009
 7. Member Secretary,
Western Regional Power Committee
Plot No. F-3, MIDC Area,
Marol, Opp : SEEPZ,
Andheri (East), Mumbai-400093
 8. Member Secretary,
Northern Regional Power Committee,
18-A Shaheed Jeet Singh Marg,
Katwaria Sarai, New Delhi-11
 9. Member Secretary,
Eastern Regional Power Committee
14, Golf Club Road,
Tollygunge, Kolkata-700 033 (W.B.)
 10. Member Secretary,
North-Eastern Regional Power Committee
NERPC Complex,
Dong Parmaw,
Lapalang, Shillong-793006

... Respondents

Parties present:

Shri S.S. Barpanda, NLDC
Ms. Jyoti Prasad, PGCIL
Shri Ashok Pal, PGCIL
Shri Swapnil Verma, PGCIL
Shri Jaresh Kumar, NRPC

Order

1. The commission had vide order dated 5.8.2015 observed as under:

“The Central Advisory Committee (CAC) had in its meeting held on 12.5.2014 decided to constitute a sub-committee from amongst the Members of the CAC to examine issues connected with congestion in



transmission. The Sub-Committee on Congestion in Transmission was constituted by CERC vide letter dated 11.7.2014, with the following composition:

Members:

1. Shri R.V. Shahi, Former Secretary, Ministry of Power-Chairman
2. Shri Ashok Khurana, Director General, Association of Power Producers
3. Shri Hemant Sharma, CMD, GRIDCO
4. Shri R.N. Nayak, CMD, POWERGRID
5. Shri Vijayanand, CMD, APTRANSCO
6. Prof. S.C. Srivastava, IIT Kanpur
7. Shri Pankaj Batra, Chief Engineer (I/C)- FC&A, CEA
8. Shri Ravinder Gupta, Director (SP & PA), CEA
9. Shri A.K. Saxena, Chief (Engg.), CERC- Convenor

Special Invitees:

1. Shri S.K. Sonnee, CEO, POSOCO
2. Prof. S.A. Soman, IIT Bombay
3. Shri A.M. Khan, Member, MERC

2. The Sub-Committee has submitted the report on Congestion in Transmission on 8.6.2015 which is available on CERC website (<http://www.cercind.gov.in/2015/Reports/congestion.pdf>).

3. The Sub-Committee has recommended measures to reduce congestion in transmission for which actions need to be taken by CEA, NRCE, CTU, POSOCO, POWERGRID, RPCs as well as CERC. The Commission has considered the report and accepted its recommendations.

4. The recommendations of the Committee with regard to the actions to be taken by the various agencies along with the timelines as decided by the Commission for various action points are as under:

(A) Actions to be taken by POSOCO:

- (1) CTU, POSOCO, and CEA to provide regular guidance to the State Utilities and authorities, and more importantly devise a mechanism to monitor to ensure that the matching systems at State level are in place to coincide with the overall requirement as well as for the provisions related to SPS and dynamic control mechanism including SVCs, STATCOMs etc. in the State sector. (Para 2.4)



- (2) *Fluctuating load/generation in renewable and its impact on transmission planning needs to be taken care. POSOCO to identify balancing capacity to manage the fluctuations. (Para 8.4.2). POSOCO to identify balancing capacity within 3 months of issue of the order.*
- (3) *CEA, CTU and POSOCO to create a Task Force to identify exhaustively all possible areas of transmission capacity enhancement in the existing systems within 6 months of issue of the report. This exercise should cover not only the Central transmission systems, but also the State level transmission and sub-transmission systems. (Para 2.4)*
- (4) *POSOCO should in coordination with and full support of concerned SLDCs and DISCOMs prepare islanding schemes for major cities and towns (considering the criticality) which will aim at matching the local supply with important and emergency loads. (Para 1.19.9). POSOCO to complete action in this regard within 6 months of issue of the order.*
- (5) *Revisiting the methodology for computation of ATC/TTC in the light of inputs from international consultant being engaged by CTU. (Para 2.1.5). POSOCO to complete action in this regard within 3 months from the date of receipt of report of consultant.*
- (6) *POSOCO to take steps to develop Interpreter as a suitable interface between SCADA and PSSE to enable revision of TTC in real-time and declaration of TTC/ATC on hourly/ weekly/monthly basis as done by PJM. (Para 3.1.9)*
- (7) *Loop flows, transit flows and counter flows should be considered for TTC / ATC calculations as considered appropriate by POSOCO. Congestion in real time to be handled in accordance with the provisions in CERC Congestion Regulations.*
- (8) *SPS planned needs to be installed within 3 months and the same be considered by POSOCO in calculation of ATC as deemed appropriate. (Para 3.2.1)*
- (9) *POSOCO to commence use of dynamic line rating within 1 month, after taking a confirmation from the equipment owner regarding the facility ratings. (Para 3.2.2)*
- (10) *POSOCO being the apex organisation in regard to system operation & market operation in the country would take steps to make the*



*information governing market operation as transparent as possible.
(Para 5.4)*

- (11) There is a need for developing a common electronic platform with access to all market participants. Necessary protocols for information sharing and dissemination needs to be finalized by POSOCO in consultation with stakeholders. (Para 5.3). POSOCO to complete action in this regard within 3 months of issue of the order.*
- (12) Requisite exposure in regards to calculation of TTC / ATC will be an added strength and exposure be provided to CTU, CEA and NLDC / RLDCs/ SLDCs. (Para 3.1.7)*

(B) Actions to be taken by CTU:

- (1) Probabilistic load forecasts and Mixed Integer Linear Programming (MILP) based optimisation tool need to be considered for network planning. CEA and CTU need to explore the use of aforementioned tools. NRCE may look into suitable timeframe for including probabilistic load forecasting. (Para 2.4.3)*
- (2) CTU, POSOCO, and CEA to provide regular guidance to the State Utilities and authorities, and more importantly devise a mechanism to monitor to ensure that the matching systems at State level are in place to coincide with the overall requirement as well as for the provisions related to SPS and dynamic control mechanism including SVCs, STATCOMs etc. in the State sector. (Para 2.4)*
- (3) CTU should constitute a group to provide first-hand information in regard to status of implementation of generation and transmission projects in the States and conduct meetings every 6 months to monitor gaps in execution and re-plan accordingly. (Para 2.4)*
- (4) CEA, CTU and POSOCO to create a Task Force to identify exhaustively all possible areas of transmission capacity enhancement in the existing systems within 6 months of issue of the report. This exercise should cover not only the Central transmission systems, but also the State level transmission and sub-transmission systems. (Para 2.4)*
- (5) There is need for co-ordination of development of intra-state transmission system by CTU. CTU to submit quarterly report on augmentation of transmission system in the Country to CERC. (Para 2.4.7)*



- (6) *In the context of a major shift in the Government's Policy for a quantum jump in developing renewable power generation systems, it would require short and medium term solutions, but more importantly, it needs a long term planning fully integrated with the future plans of MNRE. In these cases, organizations like POWERGRID would need to be supported in view of the pattern of utilization of these transmission systems, by way of VGF/ PSDF (Para xvii). Long term planning would require development of transmission systems in a manner that they are normally underutilized in the initial years but later utilized well. Here again commercial organizations would need to be financially supported through instruments like Viability Gap Funding/ PSDF (Para 7.2). CTU needs to take-up appropriate steps in this regard.*
- (7) *Sample audit of relays/protection system to be undertaken by CTU for States within 1 year and heavy fine should be imposed for non-adherence to standards. Unallocated power may be suspended in such cases. (Para 1.18.5)*
- (8) *CTU to use controlling devices such as FACTS controllers and damping controllers. Expedious installation of Dynamic reactive power compensation devices such as SVCs, STATCOMs already planned by CTU (22 nos.). (Para 3.2.6)*
- (9) *Revisiting the methodology for computation of ATC/TTC in the light of inputs from international consultant being engaged by CTU. (Para 2.1.5). CTU may accordingly keep NRCE posted with the inputs/ recommendations of international consultant, within 15 days of submission of the report by consultant.*
- (10) *Keeping in view the necessity for transparency in declaration of TTC/ATC in planning horizon, the results of long term studies carried out by CTU should be made available on their website. (Para 2.2.3)*
- (11) *Requisite exposure in regards to calculation of TTC / ATC will be an added strength and exposure be provided to CTU, CEA and NLDC / RLDCs/ SLDCs. (Para 3.1.7)*

(C) Actions to be taken by CEA:

- (1) *Probabilistic load forecasts and Mixed Integer Linear Programming (MILP) based optimisation tool need to be considered for network planning. CEA and CTU need to explore the use of aforementioned*



tools. NRCE may look into suitable timeframe for including probabilistic load forecasting. (Para 2.4.3)

- (2) CTU, POSOCO, and CEA to provide regular guidance to the State Utilities and authorities, and more importantly devise a mechanism to monitor to ensure that the matching systems at State level are in place to coincide with the overall requirement as well as for the provisions related to SPS and dynamic control mechanism including SVCs, STATCOMs etc. in the State sector. (Para 2.4)
- (3) CEA, CTU and POSOCO to create a Task Force to identify exhaustively all possible areas of transmission capacity enhancement in the existing systems within 6 months of issue of the report. This exercise should cover not only the Central transmission systems, but also the State level transmission and sub-transmission systems. (Para 2.4)
- (4) Reliability standards need to be planned for Indian Power System. To start with, NRCE may bring out Standards for "Protection System" and "Communication System". (Para 6.3). CEA may within two months initiate process for training of standards.
- (5) Revisiting the methodology for computation of ATC/TTC in the light of inputs from international consultant being engaged by CTU. (Para 2.1.5). CEA may complete action in this regard within 3 months of receipt of the report of consultants to them.
- (6) NRCE in consultation with POSOCO and CTU may explore alternative methods of calculation of TRM as suggested and provide to Commission for its consideration. (Para 3.1.9). NRCE may complete action in this regard within 3 months of issue of the order.
- (7) Requisite exposure in regards to calculation of TTC / ATC will be an added strength and exposure be provided to CTU, CEA and NLDC / RLDCs/ SLDCs. (Para 3.1.7)

(D) Action to be taken by PGCIL:

- (1) POWERGRID may carry out a comprehensive study jointly with CEA and NLDC for siting and sizing of Phase Shift Transformer (PST). (Para 3.2.3)

(E) Action to be taken by Member Secretary (RPCs):



(1) *Protection Sub-committee of RPC should bring out a protocol for checking the settings, ensuring healthiness of existing protection system and periodicity of carrying out this exercise. (Para 6.8)*

(F) Secretary, Forum of Regulators:

(1) *TTC/ATC to be declared by STUs for state network in planning horizon as well as operating horizon (Para 5.3.2). Operational feedback by SLDCs to STUs be made mandatory through appropriate Regulations (Para 8.4.5).*

5. All organizations/entities as noted above shall take necessary follow up actions in a time bound manner on the points shown under them and submit quarterly „action taken report“ to the Commission within 15 days from the end of the quarter to which the report pertains.

Submission by POSOCO:

2. POSOCO has vide letter dated 7.12.2015 submitted as under:

(a) The quarterly operational feedback given by NLDC on to CEA/CTU and CERC contains the improvements required at Intra State Transmission level. This is also discussed in the Standing Committee meetings on Transmission Planning where STUs are also members. SVCs and STATCOMs in different regions were approved in the standing committee meetings in 2012 and 2013 and are under implementation by POWERGRID. RLDCs are in continuous interaction with the SLDCs in working out TTCs at state level so that the intra state level constraints are clearly identified.

(b) POSOCO prepared a preliminary document on ‘Flexibility requirement’ for Indian power system and sent to CEA and CERC on 17th September 2015. Report of CERC committee on Spinning Reserves was approved by the Commission vide order dated 13th Oct., 2015 and a roadmap was drawn out for the same. POSOCO is working out further details which would be submitted to the Commission for approval. Based on the CERC regulation on Ancillary Services notified on 13th August, 2015, POSOCO prepared the Detailed Procedure on Ancillary Services and sent to CERC on 4th Nov., 2015 after obtaining stakeholders comments through regional level workshops held in October, 2015.

(c) Though a formal Task Force has not been created as yet, the quarterly operational feedback of NLDC, POSOCO to CEA and CTU as well as the Standing Committee on Transmission Planning are the formal framework in place. Transmission system construction monitoring is done on a monthly basis by CEA through its Power System Project Monitoring (PSPM) division which puts this monthly status on CEA’s website.



(d) The region wise islanding schemes as finalized in RPC forums is enclosed at Annexure-1 of the submission. For successful islanding, need for core generation in the island, which is firm, is essential. Many of the cities like Bangalore, Chandigarh, Pune and Bhubaneswar lack internal generation but are well connected with the grid and are therefore poor candidates for islanding.

(e) CTU engaged an international consultant M/s Powertech Inc., CANADA for revisiting the methodology of ATC/TTC computation. M/s Powertech visited POSOCO and CTU between 23.11.2015 and 27.11.2015 for initial discussion and exchange of technical documents. The engagement is for a period of 60 weeks.

(f) Interface between SCADA and PSS/E has been developed in-house at RLDCs/NLDC. Interfacing software dumps the SCADA real time data snapshot in MS-EXCEL and with the help of Python software scales the 'state wise' load demand and own generation in the PSS/E case and the 'plant wise' generation at all ISGS. Offline studies personnel at NLDC/RLDCs are using TLTG option in PSS/E to quickly calculate the TTC for trunk line tripping. TTC revisions for network changes and load/generation changes are now being done on an as and when needed basis. Ready references for WR-SR, WR-NR, ER-SR TTC revisions are being provided in the NLDC/RLDCs control room as ready reference for corrective actions for credible contingencies like different line /ICTs tripping etc. in case it happens during real time operation.. Real Time Security Desk (RTSD) operating in NLDC/RLDCs provide sensitivity simulation outputs to system operating engineers when forced outage requests are received in the real time. A python program is developed at NLDC to cut short the time taken for sensitivity analysis.

(g) With all this experience, attempts are being made for hourly calculation of TTC. Convergence of state estimator is one crucial requirement at NLDC/RLDCs and it needs support from different stakeholders providing uninterrupted data from the RTUs/SAS. POSOCO had in consultation with all SLDCs/ RLDCs/ NLDC prepared a detailed report on State Estimation in India under the guidance of Dr. N D R Sarma, expert from ERCOT Texas. This report had been forwarded to the Commission in June, 2015. For weekly and monthly TTC calculation process, load forecast is one inputs and NLDC/RLDCs are continuously trying to improve in generating forecast and in applying the forecasted data to TTC assessment.

(h) Present TTC/ATC assessment and open access administration methodology considers Loop flows, transit flows and counter flows.



(i) SPS has been planned on several inter regional corridors and implemented. Risk assessment (a triggering event happening in real time and SPS not operating leading to cascading) becomes important in this context. In the cases of HVDC Talcher – Kolar and HVDC Mundra – Mohindergarh SPS was suitably factored in the TTC assessment considering the heavy power demand in SR and NR. Of course this has been done after many years of experience with the SPS and trying to ensure that it operates in a fool proof manner (notwithstanding the 31st July 2012 when Talcher-Kolar SPS did not operate as the logic was not foreseen). Philosophically, SPS is not to be considered in TTC estimation, deliberately keeping system reliance of the SPS at its minimum (as in some cases logic for an unforeseen circumstance may miss out, SPS may act counter productively after a supposed half operation etc.) for system reliability.

(j) Communication has been sent to owners of critical lines/equipment. Confirmation has been received from SR constituents, POWERGRID (SR), NTPC Dadri, Adani Power Ltd, and WRTPL. Presently seasonal ratings are being used in computation of TTC/ATC in S1-S2 flow gate.

(k) Monthly Load generation balance report is being uploaded along with TTC/ATC declaration on NLDC website. Quarterly PoC PSS/E case is uploaded on NLDC website. Continuous improvements are being made in the POSOCO NLDC/RLDCs websites giving utmost priority to transparency and information dissemination.

(l) A stake holder meeting has been organized by POSOCO at New Delhi. A Region specific stake holder meeting is being planned. Inputs will be taken from the stake holders to improve sharing of information through common electronic platform.

Submission by SRPC:

3. SRPC has, vide letter dated 14.1.2016, submitted as under:

(a) With reference to petition no. 95/MP/2015 dated 9.4.2015, it had been directed to submit bi-monthly report of the audit remarks to the Commission. In this regard, we are in line with periodic protection audit check in Southern Region and submit the report to the Commission bimonthly.

(b) As per the MoP order dated 16.7.2014, M/s Tractebel Engineering has been appointed as the Consultant to carry out two Tasks, viz., to review the status of implementation of the recommendations of the Enquiry Committee



(Task-1) and to carry out actual protection audit check for 10% (76 nos.) of 762 substations across the country (Task-2).

(c) Under Task-2, 15 Stations have been identified from SR for protection audit-check by the Consultant. Various inputs (relating to relay settings, protection parameters, etc.) sought by the Consultant in this regard have been collected from respective SR-Constituents, and furnished to the Consultant. Based on the data furnished, Consultant is to provide a set of recommended settings based on the model setting calculations submitted by the Ramakrishna Committee Report of March, 2014 covering various relays for each of the 15 Stations, and to carry out physical protection audit of the same.

(d) The schedule of activities carried out at each of these stations is given below:

Day 1

- (1) Presenting of the Client representative the scope of our visit in the substation,
- (2) Request for last operational SLD (single line diagram) existing in the substation,
- (3) Verifying in the substation if it was implemented, the requests of last protection audit,
- (4) Verifying the status and completing the audit format for Bus Bar Protection, AC & DC System, df/dt, Under Frequency relay & Special Protection Scheme (SPS)
- (5) Verifying the status of each CBs, CVTs, VTs and CTs in the substation
- (6) Questions regarding some faults that occurred between last protection audit and our visit in substation.

Day 2

- (1) Verifying status of Disturbance Recorder, Event Logger & Communication system.
- (2) Verifying the status and completing the audit format for OHL protection, (70% of the number of bays)
- (3) Presentation of the settings for OHL bays, (70% of the number of bays) in the substation.

Day 3

- (1) Verifying the status and completing the audit format for OHL protection, (30% of the number of OHL bays)
- (2) Presentation of the settings for OHL bays, (30% of the number of bays) in the substation.
- (3) Verifying the status and completing the audit format for ICT



protection and reactor protection

(4) Presentation of the settings for ICT and reactor bays

(5) Presentation of final audit report

(e) Currently, the protection audit check is being carried out in a periodic manner. Out of 15 Stations, 4 stations have been completed. The list of substations as audited as follows:

Sl. No.	Name of the Substation	Date of Protection Audit Conducted
1	Hosur (400/230 kV) Sub-station of PGCIL (SR-II)	9-11 December, 2015
2	Gajuwaka (HVDC & 400/220 kV) Sub-station of PGCIL (SR-I)	28-30 December, 2015
3	Alamathy (400/230 kV) Sub-station of TANTRANSO	4 th -6 th January, 2016
4	Tirunelveli (400 /230 kV) Sub-station of PGCIL (SR-II)	8 th , 9 th & 11 th January, 2016

(f) The schedule of Audit for this month is submitted below:

S. No.	Substation	Proposed Date of Audit
1.	NLC SS (400 & 220 kV of NLC)	18 th , 19 th & 20 th January, 2016
2.	220kVofEdamonSSof ECSEB	18 th , 19 th & 20 th January, 2016

(g) After the protection audit check of the 15 stations in SR, the Consultant shall evolve the procedures and systems to carry out the relay settings and shall also evolve the procedures / formats for reporting that the relay settings have been carried out as per the laid procedures. They shall suggest the regulatory framework to ensure that relay settings has been carried out as per the laid procedures and actions required to be taken in case of non adherence to these procedures. They will impart training in SRPC and we will follow the procedure laid by them. The healthiness of the batteries as submitted by the stations is monitored on monthly basis at SRPC Secretariat. The periodicity of carrying out of the audit exercise in Southern Region will be 3-4 stations bimonthly after the Consultant audit check.

NRPC submission:

4. NRPC has, vide letter dated 15.1.2016, submitted as under:

(a) Formulation of Protection Philosophy: NRPC has formulated and adopted Uniform Protection Philosophy to be followed by member utilities of the Region for achieving protection coordination in the region.



(b) Protection Audit: Consequent to twin grid disturbances on 30th and 31st July 2012, POWERGRID and CPRI had carried out Basic Protection Audit of 131 sub-stations in the Northern Region. NRPC is monitoring action taken by utilities for rectification of deficiencies observed. The matter is deliberated regularly in the Sub-Committee and NRPC meetings. The Commission, in its order dated 21.2.2014 in Petition No. 220/MP/2012 had directed RPCs to submit quarterly report on rectification of protection related deficiencies. NRPC has been submitting these quarterly reports regularly.

(c) In the 24th TCC & 27th NRPC meeting held on 30.11.2012, it was decided to conduct 3rd Party Protection Audit at additional sub-stations not covered in the Basic Protection Audit undertaken by POWERGRID and CPRI. Some of the member utilities had decided to get the protection audit done through CPRI while in other cases protection audit was conducted by team of experts drawn from list of protection experts in various utilities in Northern Region. In the 23rd meeting of Protection sub-committee held on 5th September, 2013, modalities and check list for third party protection audit were also finalized. 164 numbers of sub-stations (134 by CPRI and 30 by NRPC team of protection experts) have been covered in the 3rd Part Protection Audit. The status of rectification of deficiencies identified in 3rd Party Protection Audit is being closely monitored at NRPC forum.

However, it is observed that still there are apparent deficiencies like non-availability of Bus bar protection, non-numerical relays for distance protection, non-functional auto-reclosing on transmission lines, etc. These issues are regularly deliberated in the NRPC forum with a view to expedite rectification of such deficiencies. However, utilities were citing lack of funds as major bottleneck. Now, with the operationalization of PSDF, utilities are submitting proposals for funding from PSDF for up gradation of sub-stations including replacement of obsolete protection related equipment. This is likely to lead to major improvement in reliability of protection systems.

(d) System Protection Schemes (SPS) - Formulation, monitoring and mock testing: Based on the need observed during grid operation, SPS are proposed and deliberated 1st in the sub-committees and later in NRPC. SPS are implemented after approval of NRPC. As a corollary, when it is observed that any of the implemented SPS is no longer required due to network changes, etc., the issue is deliberated in the sub-committee and approval of NRPC is obtained for its removal. From time to time, mock testing of SPS of two important inter-regional transmission links namely (i) 765 kV Agra-Gwalior Ckt- I & II and (ii) Mundra-Mahendergarh HVDC system is being coordinated



by NRPC Secretariat. It may be mentioned that the issues observed during mock testing of 765 kV Agra-Gwalior Ckt- I & II are subject matter of petition no. 8/SM/2015, wherein the Commission had decided to take up the matter on the basis of a report submitted by NRPC Secretariat.

(e) Tripping analysis: The Protection Sub-committee of NRPC undertakes analysis of tripping incidents in the region with a view to identify reasons for the tripping and to identify remedial measures. If repeated tripping incidents are observed at a particular location or in case of tripping which are considered critical, Member Secretary, NRPC constitutes separate group for analysis.

CTU submission:

5. CTU has, vide letter dated 15.1.2016, submitted that the recommendations of CAC Sub-committee are being implemented so as to integrate with existing planning forums. Various measures like conversion of fixed line reactors to switchable line reactors for improving line loadability and appointments of international consultant for TTC/ATC calculation, protection system review have been already taken up. Similarly, actions have been initiated on other recommendations. The detailed Action taken report is as under:

a. Probabilistic load forecast: The load forecasting is carried out by CEA and the same is available in the Electric Power Survey (EPS) Report. At present, 18th EPS is available. The 19th EPS is under preparation by CEA with the help of consultations and inputs from States as well as various stakeholders and experts. The action in this regard may therefore be taken by CEA/NRCE.

b. MILP based optimization: At present study for transmission planning is carried out using PSS/E which is an internationally acclaimed cutting-edge electric transmission system analysis and planning software. The software is utilized for electric transmission modeling and simulation and is presently used in over 115 countries worldwide. The transmission planning process in a deregulated environment is a large-scale, highly non-linear exercise that shall have major financial implications. As per the present planning process, the objective is to minimize the line investment cost. However, recently trend has been to minimize the cost of energy along with the total line investment cost. Another important factor being considered is the cost of Expected Energy not Supplied (EENS), i.e. failure to meet long term access commitments.



As per the available information, in Mixed Integer Linear Programming (MILP), the non-linear problem is decomposed into a set of linear programming problem which is solved for minimizing an objective function. The Indian Grid is one of the largest in the world and under-going tremendous growth, as such the transmission planning process is quite complex. The feasibility of MILP based approach to transmission for Indian Power Sector needs to be deliberated with CEA, Stakeholders and other experts. Further, for use of MILP in the transmission planning, the planning process may also be reviewed for development of transmission system for market operation and inclusion of functions like cost of energy, cost of expected energy not served, etc.

c. Guidance to the State utilities on power system analysis is already being provided by CTU on regular basis. In this regard, to carry out capacity building of the State utilities, in year 2012 CTU had provided internationally acclaimed power system analysis tool (PSS/E software) at no cost to all the STUs, SLDCs, RPCs, SERC, CERC and CEA. The software was coupled with a 15 nos. of basic, 20 nos. of intermediate and 2 nos. of advance trainings. In this exercise, CTU facilitated imparting training and guidance to almost 750 nos. of power system executives across the country. This exercise also included software maintenance for 5 years which means that all the users of the software are getting latest version as soon as these are released and also have access to on-line help at any point of time. Apart from this, in this year a user group meeting was also organized where the officials of STUs and SLDCs were provide with the opportunity to get abreast with the latest development and to address any problem that they are facing in carrying out power system analysis.

Further, joint studies with the STUs at CTU office is a regular affair, recently studies for states like Bihar, Telangana, Andhra Pradesh, Karnataka, States in North Eastern Region, Daman & Diu, DNH (Dadra & Nagar Haveli) etc. have been / are being carried out. The development of the matching transmission system at the State level is one of the most important aspect for the effective utilization of ISTS as well as Intra-State transmission system. The progress of ISTS as well as Intra-State transmissions systems is regularly taken up at RPC meeting. However, keeping in view the importance of the issue, matter has been discussed with CEA to include a special agenda in the Standing Committee Meeting where the matching development of the transmission system of the states affecting the power flow in the ISTS system would be monitored. In regard to the dynamic control mechanism including SVC and STATCOM's in the state sector, the guidance and support shall be extended by CTU to assess the need of the same based on the



request by respective states. Regarding SPS it may be mentioned that it is an operational requirement. Accordingly, the same is being reviewed and allowed by POSCO and RPC's. However if any assistance is required CTU can extend the same.

d. In CEA, there is already a mechanism for monitoring of Generation and Transmission, the progress of generation and transmission on monthly basis are available on the CEA website. Therefore, creation of another group for this purpose may be futile. Nevertheless, based on the above status, gaps can be identified. CEA would be requested for inclusion of a special agenda in the Standing Committee Meeting where the gaps in State Transmission System would be discussed and the remedial measure, if any, would be planned.

e. There already exists a forum viz. standing committee on power system planning where all the proposals pertaining to augmentation of inter-state as well as intra-state systems are studied, discussed and finalized. These meetings are held on regular basis, therefore creation of one more task force may not be a fruitful proposition. To further improve upon state level standing committee meetings may be held at regional level, in this regard, such exercise has already been initiated in eastern region which may be extended to other regions also. Further, above details are appropriately recorded in National Electricity Plan which covers short term and long term demand forecast for different regions and transmission system required under inter-State and intra-state. Here it may be mentioned NEP is being prepared for 13th plan for which a committee has been constituted on 28/8/2015, with representatives from CEA, MOP, NTPC, NHPC, POSOCO, CTU etc. Draft report in this regard is expected by April, 2016.

f. The Intra state transmission system is planned by respective state utilities as per provision under Section 39 of Electricity Act. The same is discussed in the standing committee meeting with CEA and CTU. As mentioned above, the monitoring of the implementation of intra state transmission is being carried out by CEA. Accordingly the quarterly report on Augmentation of transmission in the country may be submitted to CERC by CEA.

g. Integration of Renewable Energy (RE) sources into the grid is one of the top priority of Govt. of India towards energy security and environmental sustainability. In this direction, POWERGRID has evolved Green Energy Corridors comprising intra state and inter-state transmission infrastructure to facilitate integration of envisaged renewable capacity addition of about 33 GW in 12th plan in RE resource rich states at an estimated cost of about Rs.



38,000 Cr. Implementation of ISTS as part of Green Energy Corridors has already been initiated. Further, POWERGRID has also evolved transmission schemes for integration of proposed ultra mega solar power parks of about 22,000 MW in various states as part of Green Energy Corridors-II. Govt. of India also assigned POWERGRID to develop ISTS for nine (9) solar parks of capacity about 10,000 MW in seven (7) states. Implementation of transmission scheme for one (1) solar park in Andhra Pradesh is under progress. Considering lesser utilization of transmission system associated with renewable generation projects, there is a requirement of rationalization of transmission tariff of these assets. To address this, innovative financing Strategy was adopted in Green Energy Corridors; for intra state systems financing is proposed to have 40% of the capex through NCEF Grant, 40% debt component through concessional/soft loan, 20% through state equity, similarly, for the ISTS portion which is being developed by POWERGRID, the financing is proposed to be done having 70% Debt Component as concessional/soft loan and balance 30% through POWERGRID equity. Debt component for ISTS may also be supported through other modes like Viability Gap funding/PSDF in additional to concessional/soft financing.

h. Based on the advisory of MoP in August, 2012 independent 3rd party audit was carried out for EHV substations of various utilities in NR where in 131 sub-stations were audited by CPRI. Subsequently, the exercise was extended in other regions viz. southern, western, eastern and north eastern region by respective Regional Power Committees. Under this exercise, total of 762 sub-stations were audited in all the regions. Subsequently, based on the recommendations of the task force on Power System Analysis and directions of MoP in July, 2014, an international consultant (M/s. Tractebel, Romania/Tractebel India, Lahmeyer International, India) has been appointed to (i) study the protection audit carried out earlier for 762 no. of substations (ii) conduct on site protection audit check of the works already carried out subsequent to the previous audit. These checks have to be carried out for atleast 10% of substations i.e. 76 substations (including both of POWERGRID and State utilities). POSOCO is the nodal Agency in this regard. The 76 substations where audit check is to be carried out are already been identified and audit work have already started in November, 2015 and work at about 9 no. of substations of various utilities have already been completed. The audit is likely to be completed in next 6 months.

i. The installation of FACTS devices has been under taken based on the requirement since long in Indian power system. These FACTS devices are equipped with damping controller to mitigate power oscillations. In this regard six numbers of Thyristor Controlled Series Capacitors (TCSC) are in service for more than 5 years. These devices have been installed on major



inter regional links that are prone to such Power System Oscillations. Further, SVC at Kanpur has been provided during 1990's. Additionally, there are a number of HVDC links which also have inherent Power System Oscillation Damping (POD) feature. In addition, about 16 nos. of SVC/STATCOM have already been planned/ under implementation at strategic locations in consultation with CEA, POSOCO and regional constituents. The same has also been vetted by Dr Narain Hingorani, a consultant of international repute. SVCs in NR (viz. Ludhiana, Kankroli & New Wanpoh) are expected to commission by August, 2016. Similarly, STATCOMs in WR (viz. Solapur, Satna & Aurangabad) have already been awarded and balance shall be awarded shortly.

j. The international consultant i.e. POWERTECH labs, Canada has been appointed for computation of ATC/TTC & other associated studies. A kick off meeting was held on 23rd to 27th November, 2015, wherein CTU, CEA & POSOCO were involved in interaction with consultant. The consultant has already been given a brief presentation on method of ATC/TTC calculation being followed by CTU & POSOCO. Necessary data and documents have already been supplied to consultant for carrying out various studies. The final report of the consultant is expected in early 2017. Upon the submission of the report by POWERTECH, CTU shall inform the recommendation of the consultant to NRCE.

k. TTC/ATC for 2014-15, 2015-16 and 2016-17 time frame has already been declared and the same is available in POWERGRID Web site. The procedure adopted has been shared on the POWERGRID Website. For calculation of ATC/TTC for 2017-18 and 2018-19 required information has been sought from various state utilities. Upon receipt of the required information the same would be declared on POWERGRID web site which is likely to be completed by March, 2016. Further based on the consultant recommendation the methodology and declared ATC/TTC would be revisited.

6. During the course of hearing held on 19.1.2016, following were submitted:

6.1. The representative of POSOCO submitted that

- (a) As regards providing guidelines to STUs, quarterly operational feedback is given by NLDC to the planners and the Commission. This is also discussed in the Standing Committee meetings on Transmission Planning where STUs are also members.
- (b) SVCs and STATCOMs in different regions have been approved. RLDCs are in continuous interaction with SLDCs in working out TTCs at State level so that the intra-State level constraints are clearly identified.



(c) With regard to fluctuating load/generation in renewable and its impact on transmission planning, a preliminary report on 'Flexibility Requirement' for Indian power system has been sent to CEA and the Commission on 17.9.2015 for consideration.

(d) The Commission vide order dated 13.10.2015 approved the report of the committee on Spinning Reserves. A roadmap has been drawn out. POSOCO is working out further details which would be submitted to the Commission for approval.

(e) POSOCO has submitted the Detailed Procedure on Ancillary Services to the Commission for approval.

6.2. The representative of CTU submitted that it has already filed reply as per the Commission's direction. He further submitted that the recommendations are being implemented so as to integrate the existing planning forums. The representative of CTU submitted that the details of intra-State generation and transmission are also available in the website of CEA.

6.3. In response to the Commission's query as to whether CTU is sharing reports in RPCs, the representative of POSOCO submitted that the operational feedback submitted by POSOCO is put in public domain and it can be accessed by RPCs.

6.4. The Commission directed Central Electricity Authority to file action taken report in respect of the points concerning CEA. The Commission further directed CEA depute officers well acquainted with the facts of the case on the next date of hearing to assist the Commission.

6.5. The Commission observed that there is a need to institute a mechanism for monitoring of the implementation of the recommendation of the CAC Sub-Committee on Congestion in Transmission in accordance with the time line specified in the Commission's order dated 5.8.2015. The Commission further observed that National Reliability Council (NRC) be entrusted with the task of monitoring the implementation of the direction given in order dated 5.8.2015 and submit periodical report to the Commission for information/further direction.

CEA submission vide letter dated 7.9.2016:

7. CEA vide affidavit dated 7.9.2016 submitted that

(a) The actions recommended in the CAC Sub -Committee pertain to various functions that CEA is carrying out as per its duties and functions given in the Act.



(b) The NRCE was constituted by CEA vide its letter no. CEA/NRCE/RA/2014 dated 21.2.2014 to compute the TTC of each transmission corridor in the grid and coordinate the protection of grid on an All India basis. Many of the actions recommended by the Sub-Committee are common to CEA, POSOCO, CTU and PGCIL and are to be performed together by CEA, CTU and POSOCO in coordination with each other. It is, therefore, suggested that actions being taken on recommendations of the CAC sub-committee may be jointly monitored by CEA and CERC.

8. Action Taken and Observations/suggestions on the order dated 5.8.2015 are as under:

8.1. Load Forecasting: Medium and long term load demand (peak as well as energy) forecast is carried out by Electric Power Survey Committee steered by CEA. Periodicity of the EPS forecast report is once in five years, however, an annual or bi-annual review of the forecast is also being considered. Presently, work for 19th EPS report is under advanced stage. Feasibility of using probabilistic load forecasting techniques can be considered while reviewing the 19th EPS and for next EPS demand forecasts.

8.2. Use of MILP based optimization tool for Network Planning:

(i) Network planning for Indian transmission network is complex due to – (i) it has two layers i.e. ISTS and Intra-state, (ii) the States are self-dispatch entities and they dispatch as per their own economic considerations, (iii) the CERC regulation on LTA does not provide option for choosing between transmission addition viz-a-viz meeting load from local generations without transmission addition. The MILP based techniques are used to optimize total cost of energy at drawal point by optimizing both production cost and transmission cost including transmission losses and investment in transmission.

(ii) As such, uses of MILP for expansion of transmission network in Indian context have to be discussed in detail with STUs, regulatory commissions and academia before adopting the same.

(iii) The transmission planning, as per the Electricity Act 2003 (u/s 3, 38, 39 and 73) is responsibility of CEA, CTU and STUs and not of NRCE. Similarly, load forecast is a subject matter of CEA, which CEA has been doing traditionally even prior to the Electricity Act of 2003 and also as part of National Electricity Plan (u/s 3). Load forecasting is not a function of NRCE.

8.3. On regular guidance: While planning transmission schemes of the states and also for some of the ISTS scheme, system studies are jointly carried out by CEA, CTU and the respective STUs. This regular interaction of



STUs with CEA and CTU help in mutual strengthening. There is need to build quality team at STUs. This was also one of the recommendations of the enquiry committee on grid disturbance of July 2012 –

“There is need to reinforce system study groups in power sector organisations to analyse the system behaviour under different network status/ tripping of lines/outage of generators. Where these do not exist, these should be created.”

The State regulators can also sensitize the STU management on importance of strong system study group/division/department in each STU.

8.4. Monitoring of State transmission system: CEA carries out monitoring of power system projects of state, center and private utilities and licensees under provisions of sec 73(f) of the Act. A monthly report in this regard is prepared by CEA on regular basis and is also available at CEA website.

8.5. SVC/ STATCOM in the state sector: Presently 14 numbers of STATCOMs have been planned at various strategic grid locations in ISTS. These are under various stages of implementation by PGCIL. These STATCOMs are expected to provide dynamic support to both ISTS and Intra-State grids, as both are inter-connected. After commissioning of these STATCOMs and analyzing their response, planning for next set of such devices would be commenced and at that stage the feasibility of planning these devices at 220kV and 400kV locations of State grids would also be considered.

8.6. Transmission planning is always carried out as an augmentation/ addition/ enhancement to existing network. Transmission planning is a continuous process and is carried out on regular basis by CEA, CTU and STUs based on new information about possible generation addition, load variation, congestion etc on medium to long-term (3-6 year) horizon. As transmission is a continuous process, CEA has already firmed up enhancements in the transmission system in coordination with CTU and STUs through the forum of Standing Committee on Power System Planning. Eleven (11) number of such enhancements have been planned during 2015-16 and up to June 2016. These enhancements include strengthening for both ISTS and Intra-state transmission system in all the five electrical regions of the country.



8.7. A Subgroup has been formed to finalize the reliability standards. Further consequent to reconstitution of NRCE, Sub-Group has also been reconstituted who shall approve the methodology for computation of TTC/ATC/TRM on monthly basis or calculate TTC/ATC/TRM if necessary, as per the CERC order dated 11-12-2013

8.8. Under directions of Ministry of Power, PGCIL had appointed a consultant (M/s Powertech Labs, Canada) and assigned Tasks which *inter-alia* include the following:

Task-I: Examination and recommendation of methodology for optimum calculation of Transfer Capability (TTC/ATC/TRM) in the Planning and the Operational Horizons.

Task -II: Calculation of Transfer Capability (TTC/ATC/TRM) for entire country.

The final report of the consultant is expected by March 2017. CEA, CTU and POSOCO have regular interaction with M/s Powertech Labs on progress of their report. The report of the consultant would be analysed for its adoption in the Indian context.

8.9. It was decided in the 4th meeting of National Power Committee (NPC) that to begin with, power system study for assessment of operational limits / power transfer capability for each state will be done by the concerned RLDC in association with concerned SLDC. Monthly TTC/ATC will be uploaded by the SLDCs at their respective websites and also communicated to concerned RLDC & NLDC subsequently.

Hearing held on 11.1.2018:

9. The Commission vide RoP of the hearing held on 11.1.2018 observed that CEA, NRCE, CTU, POSOCO, PGCIL and RPCs should file their replies on or before 9.2.2018, giving the current status of action taken on the recommendations of the CAC Sub-committee on Congestion in transmission.

Submission by CTU, POSOCO and SRPC:

10. CTU has vide letter dated 19.2.2018 submitted the current update on the action taken by it on the recommendations of the CAC Sub-Committee. CTU has submitted that

10.1. The load forecasting is carried out by CEA in consultation with and inputs from States as well as various other stakeholders. Result/corroboration is reflected in the 19th Electric Power Survey (EPS) Report of CEA. Further, the feasibility of MILP based approach for network planning of Indian Power System is yet to be explored.



- CEA may take a lead role in this regard in association with CTU, POSOCO and other stakeholders.
- 10.2. Guidance to the STUs are provided on regular basis in the regional Standing Committee forum on planning with participation from CEA, RPC, CTU, STUs POSOCO and other stake holders. In addition, review of the progress/status of matching system at State level is also carried out in the above regional Standing Committee forum. Further specific guidance to the State utilities on power system planning is provided on regular basis by CTU. In this process representatives of STUs are invited to the POWERGRID office to guide them in planning STU network and on certain occasions CTU officials visit the STU offices for the same.
 - 10.3. The issues regarding the review of gaps in planning & implementation of the generation/transmission projects in the States are discussed regularly in the Regional Standing Committee forum and accordingly re-plan of system is carried out, if required.
 - 10.4. All the possible areas of transmission capacity enhancement in the existing systems are being discussed regularly in the regional Standing Committee for transmission planning
 - 10.5. The co-ordination of development of intra-state transmission system is already being carried out by CEA and the details of the same are available at CEA website.
 - 10.6. Ministry of New and Renewable Energy provides Central Financial Assistance (CFA) for development of Solar Park and its external transmission system. As per the MNRE guidelines, the CFA for development of solar park and for development of external transmission system is being apportioned in the ratio of 60:40 i.e. Rs 12 lakh per MW or 30% of the project cost, whichever is lower to the Solar Power Park Developers (SPPDs) towards development of solar parks and Rs. 8 lakh per MW or 30% of the project cost, whichever is lower to the CTU or STU towards development of external transmission system
 - 10.7. 76 substations (including both of POWERGRID and State utilities) have been audited by International consultant (Powertech Labs Inc., Canada) and final report has been submitted. The final report of the consultant was put up before the Grid Study Committee during its meeting held on 16.01.18.
 - 10.8. As reported earlier 3 (three) nos. of SVC and 14 (fourteen) nos. of STATCOM were planned to provide dynamic reactive power support to the Grid. Out of this, 3 (Three) nos. of SVC in NR and 1 (one) no. of STATCOM in SR have already been commissioned and 12 (twelve) nos. of STATCOMs in different regions are in various stages of



implementation and likely to get commissioned progressively from Apr'18.

- 10.9. The reports of the international consultant i.e., POWERTECH labs, Canada for computation of ATC/TTC has already been submitted to the National Power Committee / NRCE.
- 10.10. The estimated TTC/ATC for future periods are being regularly posted on CTU website.

11. POSOCO has vide letter dated 8.2.2018 submitted the current update on the action taken by it on the recommendations of the CAC Sub-Committee. POSOCO has submitted that due to various interventions by the CERC and Ministry of Power based on the operational feedback of NLDC, several new transmission system reinforcements have taken place. This has minimized the congestion in transmission which would be evident from Annexure-I (submitted with the affidavit dated 8.2.2018) indicating the reduction in congestion in Power Exchanges (PX) over the years. Planned outages in the transmission system do lead to congestion at times which is unavoidable. Further, the high level of vulnerability that the grid is exposed to on account of equipment failures and mis-operation of protective systems. These have led to some 'incredible' contingencies far beyond any Transmission Planning or Operating Criteria. As the coverage of such incidents is widespread, there are limitations as to how these risks can be mitigated through System Protection Schemes (SPS) alone. If the grid has survived all these incidents without any cascading, it is only because the antecedent power flows on different corridors have been well below the respective Total/Available Transfer Capability (TTC/ATC). Such incidents would fall in the category of 'near miss', a term widely used in the aviation industry. The actions taken by POSOCO for achieving the objectives of the CAC sub-Committee recommendations are as under:

- 11.1. RLDCs are undertaking active efforts in knowledge sharing with State utilities and authorities to ensure matching systems at state level are in place. A number of workshops on transfer capability and congestion management issues have been conducted in all regions by respective RLDCs. A few states like Uttar Pradesh, Punjab, and Madhya Pradesh are also uploading TTC/ATC figures on their respective website.
- 11.2. POSOCO is continuously working to identify balancing resources to take care of the variability in load / generation to stabilize the frequency profile. Based on CERC Regulations on Ancillary Services, the tertiary frequency control through the Reserve Regulation Ancillary Service (RRAS) was implemented w.e.f. 12.4.2016.



The 4th amendment to the IEGC specifying 55% technical minimum for thermal stations came into effect from 15th May, 2017 after the CERC approved the procedure for Reserve Shut Down (RSD) of units prepared by NLDC after a consultative process.

POSOCO has undertaken a number of studies for optimization of available resources to operate the grid in a more economic and reliable manner.

Under 'Greening the Grid' Program of USAID and Ministry of Power, Government of India for RE Integration analysis in Indian grid, POSOCO performed production cost modeling and optimization under high RE integration scenario. A report titled "Pathways to Integrate 175 Gig watts of Renewable Energy into India's Electric Grid" was also released in June, 2017.

POSOCO is association with the Forum of Load Dispatchers (FOLD) published a report on 'Operational Analysis for Optimization of Hydro Resources & facilitating Renewable Integration in India in June, 2017. The report analyses the operational constraints faced by hydro power plants today. The report indicates scope of additional peaking support from hydro generating stations.

POSOCO has undertaken a pilot project on Automatic Generation Control (AGC) at NTPC Dadri Stage-II to bring in secondary control in Indian power system operation. This marks a landmark event in Indian power sector. The pilot was commissioned on 4.1.2018 based on CERC order dated 6.12.2017 in petition no 79/RC/2017 filed by NLDC. The Commission has also ordered implementation of the same in power plants located in each region and CTU has also been directed to provide dedicated communication to the power plants listed in the detailed procedure submitted by POSOCO.

The Commission has also recently in Jan, 2018 uploaded on its website '*Report of Expert Group to review and suggest measures for bringing power system operation closer to National Reference Frequency, Vol-I, Nov., 2017*' which lists out the issues involved in inertial response, primary, secondary and tertiary frequency control in the Indian context and performance metrics thereof. POSOCO had contributed to this report.

- 11.3. POSOCO is sending feedback on quarterly basis to CEA and CTU in regard to transmission constraints and other operational constraints. Specific feedbacks are also provided to CEA / CTU / Ministry of Power as and when required. A formal Task Force is yet to be set up in this regard.



- 11.4. As per recommendations of "Taskforce on Power System Analysis under Contingencies", PowerTech Labs Inc. was appointed as consultant to conduct study/analysis to ensure secure & reliable operation of National Grid of India. Task-III of the consultancy involved working on guidelines for developing and implementing system protection schemes and islanding schemes, and review of existing schemes. Accordingly, PowerTech Labs, conducted review of 78 SPS schemes and 32 Islanding schemes in India, and recommended complete re-assessment of 37 SPS schemes and 10 islanding schemes. The report also gives several recommendations in the implementation of defense mechanisms, and periodic review of the schemes. Besides this, POSOCO periodically reviews the grid defense mechanisms whenever there is any major change in network conditions. As per section 5.2 (n), the under frequency and df/dt load shedding and islanding schemes have to be finalized by the concerned Regional Power Committee (RFC).
- 11.5. Powertech Labs. Inc. has submitted the report of Task-1 and Task-2. The reports have been finalized after discussions amongst CEA, CTU and POSOCO. The reports were also presented before CERC on 8.8.2017 during a meeting of a committee headed by Member, CERC. The same will be further discussed with the stakeholders in 4th Grid Study Committee (GSC) meeting to be taken by Member (GO&D), CEA on 16.1.2018.
- 11.6. NLDC and all RLDCs use the Ready Reckoner on transfer capability to manage contingency situations in the grid in real-time to effect faster revisions of transfer capability in real-time.

The revisions are done by POSOCO in case of any major network changes, outages in the grid, contingency situations like coal shortage or fog related tripping etc. The number of revisions of TTC/ATC has been as under:

2015-16: 337

2016-17: 264

2017-18: 253 (up to December, 2017)

RLDCs/NLDC are also taking steps to improve the analog and digital real time data from the field so that the Network Application such as State Estimator (SE) and Real Time Contingency Analysis(RTCA) work well and their results can be more meaningful for real time operation. Frequent revisions in transfer capability figure will have more meaning only if a dynamic market mechanism is in place to take advantage of the real-time revision in margins in inter-control area transfer of power.



- 11.7. Presently TTC/ATC assessment and open access administration methodology considers Loop flows, transit flows and counter flows.
- 11.8. Complied using seasonal line ratings as recommended by NRCE. DLR involves real time data from several points on the transmission line which is currently unavailable.

The inter-regional transfer capabilities declared by POSOCO are on the basis of stability limits, voltage limits or thermal limits of transmission elements, whichever is less. The inter-regional flows face wide variation due to seasonality as well as diurnal variations. Seasonal line ratings have been used in computation of TTC/ATC in S1-S2 flow gate where thermal limits are hit first, as per communication on seasonal ratings as per NRCE subcommittee decisions.

Notwithstanding the need for adopting seasonal as well as DLR in the long run, equipment reliability continues to be a source of concern. The CERC had vide its order dated 22.6.2017 in Petition No. 114/MP/2017 directed that 1700 MW power be evacuated from Sikkim hydro projects over the 2 x 400 kV Rangpo-Binaguri D/C with a System Protection Scheme (SPS) in place. The 400 kV Rangpo-Binaguri lines were loaded well below the thermal limit of 1100 MVA; @ 850 MVA each circuit. Despite this, there were eleven (11) occasions from July to Sep 2017 when either one of the lines had to be taken out due to hot spot on the lines or at the substation. So the chances of a transmission line tripping during such high loadings remains very high. This would cause a cascading failure.

- 11.9. The monthly TTC/ATC and revisions thereof are uploaded periodically on NLDC website. An application titled 'MERIT' (Merit Order Despatch of Electricity for Rejuvenation of Income and Transparency) has been developed by POSOCO in co-ordination with MoP and CEA and launched in July 2017. Information available in the portal will help State DISCOMs to optimize their power procurement in more efficient way leading to lower cost of power to end consumers. POSOCO had developed and launched an app titled 'Vidyut Pravah' in March 2015 that provides real time information about electricity prices on pan-India basis. The Vidyut PRAVAH mobile application provides data pertaining to market price of power and volume (MW) purchased/sold from/to power exchange by each state, value of current all India demand in GW and all India and State shortage including peak hour and total energy shortage. These are endeavors of POSOCO to bring in more transparency in information concerning system operation and market operation functions.



11.10. POSOCO is working on National Open Access Registry, on the basis of concept paper brought out by CERC. This will provide a common electronic platform for ensuring ease of use and transparency to all market participants, and also include necessary protocols for information dissemination.

12. SRPC has vide letter dated 2.2.2018 submitted the current update on the action taken by it on the recommendations of the CAC Sub-Committee. SRPC has submitted that

12.1. National Reliability Council for Electricity (NRCE) constituted Sub-Group for Preparation of the Reliability Standards for Protection system and Communication system for Indian Power System w.r.t. CERC Order dated 5.8.2015. The Sub-Group after convening five meetings had brought out a Draft Report in October, 2017 on Reliability Standards for Protection System for Indian Power System covering, among other things, the following:

- Protection System Mis-operation Reporting and Monitoring of Corrective Action:
- System Protection Scheme Review Procedure

Protection Sub-Committee (PSC) representatives of SRPC had participated in all the meetings of the Sub-Group, and contributed to development of procedures detailed under above topics that deal with co-ordination & review of Relay settings, and ensuring healthiness of protection systems in place. Presently, the said draft is under finalization by National Power Committee (NPC) for submission to CERC. After their approval & notification by CERC, PSC of SRPC will follow the laid-down procedures.

12.2. MoP vide their Order dated 16.07.2014 directed POWERGRID to appoint Consultants to follow-up certain recommendations of Task Force on Power System Analysis under Contingencies constituted in the aftermath of Grid Disturbances in July, 2012. Accordingly, M/s Tractabel Engineering has been appointed as the Consultant for Package-A to carry out the following two Tasks:

Task-I: To study and review the status of implementation of Recommendations of the Enquiry Committee.

Task-II: To study the protection audit report of 762 substations across the country carried out after grid failure of July, 2012 and conduct on site Protection audit check of the works already carried out, for 10% (i.e. 76 nos.) of 762 Substations.

Under Task-II, the Consultant has been tasked with, among other things, the following: Review the practices being followed for relay



settings (at the level of 220kV and above and 132kV and above in NER) by different utilities in the Indian grid and prepare guidelines based on best international practices on protection coordination: Evolve the procedures and systems to carry out the relay settings. The consultant shall evolve the procedures / formats for reporting that the relay settings have been carried out as per the laid procedures; Shall suggest the regulatory framework to ensure that relay settings has been carried out as per the laid procedures and actions required to be taken in case of non-adherence to these procedures. The final report of the Consultant is under consideration by Grid Study Committee (GSC) constituted for coordinating Consultant's work. Based on GSC directions, PSC of SRPC will take appropriate action.

- 12.3. Protection Sub-Committee (PSC) of SRPC: The Committee conducts monthly meetings, in which the tripping of previous month are discussed and analyzed with a view to identify their root cause and scrutinize the correctness of operation of protection systems put in place and the integrity of the settings employed by the concerned Constituents. In the process, appropriate measures required to be taken for system improvement are suggested/ recommended for compliance by concerned Constituents. Further, PSC teams are also conducting protection audit of various stations in SR regularly in line with CERC Order dated 27.4.2015 in respect of APTRANSCO Petition No.95/MP/2015 dated 9.4.2015. In these protection audits comprehensive review of healthiness of protection systems puts in place, correctness of relay settings employed & their coordination in line with prevailing protection standards and industry best practices are undertaken. The frequency of these audits varies from one to two in a two-month period
- 12.4. Implementation of Protection Management System (PMS) for Southern Region: In pursuance of the recommendations of Task Force on Power System Analysis under Contingencies constituted in the aftermath of Grid Disturbances in July, 2012 regarding the need to maintain protection database at regional level, this project has been conceived by PSC of SRPC to accomplish the following tasks: Maintaining up-to-date Protection Database of all settings of all protection relays being used in the Power System Network; Maintaining up-to-date Power System Network modeled in Protection Setting Calculation Tool; Computing various settings for each protection relay modeled by creating an interface between Protection Setting Calculation Tool and Protection Database; Verifying and fine-tuning various settings for each protection relay by performing analysis of the faults/ disturbances simulated in the network modeled in Protection Setting



Calculation Tool using the existing Protection Database relay settings. This Project, which employs hierarchical Role-based access control to ensure accountability in carrying out above tasks, is also supported by built-in reporting procedures for relay settings. This project is presently under implementation, and will fulfill CAC Sub-Committee's above recommendation when fully implemented (expected completion time: February, 2019).

Analysis and decision:

Tasks common to CEA, CTU and POSOCO:

Task-1: CTU, POSOCO, and CEA to provide regular guidance to the State Utilities and authorities, and more importantly devise a mechanism to monitor to ensure that the matching systems at State level are in place to coincide with the overall requirement as well as for the provisions related to SPS and dynamic control mechanism including SVCs, STATCOMs etc. in the State sector.

13. CAC sub-committee vide its report on congestion in transmission observed as under:

“It may not be correct to conclude that the transmission constraints being experienced are only because of transmission system Report of the Sub-Committee on Congestion in Transmission v development by POWERGRID lagging behind or because of POSOCO being too conservative for ensuring a totally safe operation. One of the main reasons of the constraint is also the inadequacies of State level transmission and sub-transmission systems. There are examples that power could be reached through National Grid into the State, but such transmission would be handicapped because the State level transmission and/or sub-transmission system may not be able to absorb. There is, therefore, a need for CTU, POSOCO, and CEA, to provide regular guidance to the State Utilities and authorities, and more importantly there needs to be a mechanism to monitor to ensure that the matching systems at State level are in place to coincide with the overall requirement. This is equally true for provisions related to SPS and dynamic control mechanism including SVCs, STATCOMs etc. in the State sector.”

14. CEA has submitted as follows :

(a) While planning transmission schemes of the states and for ISTS scheme, system studies are jointly carried out by CEA, CTU and the respective STUs.



- (b) This regular interaction of STUs with CEA and CTU help in mutual strengthening.
- (c) There is need to build quality team at STUs which was also one of the recommendations of the Enquiry Committee on grid disturbance of July, 2012.
- (d) The State Regulators can also sensitize the STU management on importance of strong system study group/division/ department in each STU.

15. CTU has submitted that (a) guidance to the State utilities on power system analysis is already being provided by CTU on regular basis. (b) Further, to carry out capacity building of the State utilities, in year 2012 CTU had provided power system analysis tool (PSS/E software) at no cost to all the STUs, SLDCs, RPCs, SERC, CERC and CEA. (c) The software was coupled with a 15 basic, 20 intermediate and 2 advance trainings. In this exercise, CTU facilitated imparting training and guidance to almost 750 power system executives across the country. Apart from this, a user group meeting was also organized where the officials of STUs and SLDCs were provided with the opportunity to get abreast with the latest development and to address any problem that they are facing in carrying out power system analysis. (d) Further, joint studies with the STUs at CTU office is a regular affair, recently studies for states like Bihar, Telangana, Andhra Pradesh, Karnataka, States in NER, Daman & Diu, Dadra & Nagar Haveli, etc., have been carried out. (e) The progress of ISTS as well as intra-State transmissions systems is regularly taken up at RPC meeting. Keeping in view the importance of the issue, matter has been discussed with CEA to include a special agenda in the Standing Committee Meeting where the matching development of the transmission system of the states affecting the power flow in the ISTS system would be monitored. (f) In regard to the dynamic control mechanism including SVC and STATCOM's in the state sector, the guidance and support shall be extended by CTU to assess the need of the same based on the request by respective states. (g) Regarding SPS it is an operational requirement and the same is being reviewed and allowed by POSOCO and RPC's. However if any assistance is required CTU can extend the same.

16. POSOCO has submitted that the quarterly operational feedback given by NLDC to CEA/CTU and CERC contains the improvements required at intra-State transmission level. This is also discussed in the Standing Committee meetings on Transmission Planning where STUs are also members. SVCs and STATCOMs in different regions were approved in the standing committee meetings in 2012 and 2013 and are under implementation by POWERGRID. RLDCs are in continuous interaction with



the SLDCs in working out TTCs at state level so that the intra-State level constraints are clearly identified. POSOCO has also submitted that RLDCs are undertaking active efforts in knowledge sharing with State utilities and authorities to ensure matching systems at state level are in place. Further, a number of workshops on transfer capability and congestion management issues have been conducted in all regions by respective RLDCs. As per POSOCO, a few states like Uttar Pradesh, Punjab, and Madhya Pradesh are also uploading TTC/ATC figures on their respective website.

17. We have considered the submission of CEA, CTU and POSOCO. The CAC sub-committee vide its report had emphasized the need for providing guidance to State Utilities and authorities and to devise a mechanism to monitor to ensure matching system development at State level as well as inter-State level because it emerged during deliberations of the Committee that deficiencies in the State Network are the major bottleneck causing hindrance in absorption of power by the State. CTU have submitted in the instant petition that they are already providing regular guidance to States by providing software, training to staff of STUs, discussion in Standing Committees and that matching development of intra-State and inter-State systems are also being monitored in Standing Committee on Transmission Planning.

18. We find that in actual scenario the Commission has received many petitions filed by CTU wherein the ISTS system has been commissioned but the associated intra-State Transmission System are inordinately delayed. We find that the actions as indicated by CTU and CEA are not yielding the desired results in development of matching State network. As such there is need for hand holding of States so that State network should be developed commensurate with ISTS. The issue of matching of State system with ISTS system has been included for stakeholders comments in CERC draft (Grant of Connectivity and General Network Access to the inter-State transmission system and other related matters) Regulations, 2017 notified on 14.11.2017. We observe that CEA, under PSPM division is monitoring progress of transmission lines under Central Sector as well as State Sector for 220 kV and above systems. There is a need to institutionalize a mechanism to monitor ISTS along with the matching State network to ensure that both are developed in matching time frame for adequate utilization of the transmission system.

19. CTU is directed to take up the issue of matching ISTS with State Systems at Standing Committee of Transmission Planning in coordination with CEA. CTU should consider the status report of execution of



transmission system as available with CEA. CTU is directed to make exception reports in case of mismatch and submit 6 monthly exception report to CEA and Commission in this regard. We direct that the importance of matching systems at State level may also be raised at Forum of Regulators so that necessary action may be taken by State Commissions.

20. With regards to the issue of SPS and dynamic control mechanism including SVCs, STATCOMs, etc., CTU is directed to carry out a nationwide study to assess the requirement of these devices including within the State Sector and its proposed funding mechanism and submit a report within 6 months of issue of this Order to CEA and Commission.

Task-2: CEA, CTU and POSOCO to create a Task Force to identify exhaustively all possible areas of transmission capacity enhancement in the existing systems within 6 months of issue of the report. This exercise should cover not only the Central transmission systems, but also the State level transmission and sub-transmission systems.

21. The CAC sub-committee vide its report on congestion transmission observed as under:

Long term strategy would include assimilation of new technologies, and retrofitting of transmission lines and sub-stations to enhance their capacity, strengthening of transmission towers and conductors, apart from the new transmission systems with higher capacities to take care of right-of-way issues. CEA CTU and POSOCO could create a Task Force to identify exhaustively all possible areas of transmission capacity enhancement in the existing systems. This exercise should cover not only the Central transmission systems, but also the State level transmission and sub-transmission systems.

22. CEA has submitted that transmission planning is always carried out as an augmentation/ addition/ enhancement to existing network. Transmission planning is a continuous process and is carried out on regular basis by CEA, CTU and STUs based on new information about possible generation addition, load variation, congestion, etc., on medium to long-term (3-6 year) horizon. As transmission is a continuous process, CEA has already firmed up enhancements in the transmission system in coordination with CTU and STUs through the forum of Standing Committee on Power System Planning. Eleven (11) numbers of such enhancements have been planned during 2015-16 and up to June 2016. These enhancements include strengthening for both ISTS and Intra-state transmission system in all the five electrical regions of the country.



23. POSOCO has submitted that though a formal Task Force has not been created as yet, the quarterly operational feedback of NLDC, POSOCO to CEA and CTU as well as the Standing Committee on Transmission Planning are the formal framework in place. Specific feedback is also provided to CEA/CTU/MoP as and when required. Transmission system construction monitoring is done on a monthly basis by CEA through its Power System Project Monitoring (PSPM) division which puts this monthly status on CEA's website.

24. CTU has submitted that there already exists a forum viz. Standing Committee on Power System Planning where all the proposals pertaining to augmentation of ISTS as well as intra-state systems are studied, discussed and finalized. These meetings are held on regular basis and therefore, creation of one more task force may not be a fruitful proposition. To further improve upon state level standing committee meetings may be held at regional level, in this regard, such exercise has already been initiated in eastern region which may be extended to other regions also. Further, above details are appropriately recorded in National Electricity Plan which covers short term and long term demand forecast for different regions and transmission system required under inter-State and intra-state.

25. We have considered the submission of CEA, CTU and POSOCO. The purpose behind the observation of CAC sub-committee for creation of a Task Force was to identify all possible areas of transmission capacity enhancement in the existing systems. Further, the Task Force was supposed to carry out study on regular interval in order to identify such augmentations.

26. We are of the view that the task of identification all possible areas of transmission capacity enhancement in the existing systems is very important. CTU is directed to take up the agenda of transmission capacity enhancement in the existing systems (Central as well as State Sector) at next Standing Committee and submit a report to the Commission within 6 months of issue of this Order. The issue of up-gradation of existing system has also been included in draft CERC (Transmission Planning and other related matters) Regulations, 2017 notified on 26.4.2017 and shall be considered based on comments received from stakeholders. Further the issue of up-gradation shall be taken up in each Standing Committee and report to this effect be filed with NRCE by CTU within 1 month of Standing Committee meeting.



Task-3: Revisiting the methodology for computation of ATC/TTC in the light of inputs from international consultant being engaged by CTU. CTU may accordingly keep NRCE posted with the inputs/recommendations of international consultants, within 15 days of submission of the report by consultant. CEA may complete action in this regard within 3 months of receipt of report of consultants to them. POSOCO to complete action in this regard within 3 months of receipt of report of consultants.

27. CEA has submitted that consequent to reconstitution of NRCE, a subgroup has also been reconstituted under Chief Engineer (PSPA-2). CEA has also submitted that the subgroup shall approve the methodology for computation of TTC/ATC/TRM on monthly basis or calculate TTC/ ATC/ TRM if necessary, as per the CERC order dated 11.12.2013.

28. CTU has submitted that the reports of the international consultant for computation of ATC/TTC has already been submitted to the National Power Committee / NRCE.

29. POSOCO has submitted that the international consultant i.e. Powertech labs, Canada has submitted its report in respect of Task-I and Task-II. The said reports have been finalized after discussions amongst CEA, CTU and POSOCO.

30. We have considered the submission of CEA, CTU and POSOCO. It is noted that the concerned consultant has submitted its report in respect of Task-I and Task-II. CTU has submitted that recommendations of the consultant have been submitted to NPC/ NRCE. NRCE is directed to examine the report and submit its recommendations to Commission within 3 months of this Order making suggestions on changes required in methodology of calculation of ATC/TTC.

Task-4: Requisite exposure in regards to calculation of TTC / ATC will be an added strength and exposure be provided to CTU, CEA and NLDC / RLDCs/ SLDCs.

31. CEA has submitted that it has been decided in the 4th meeting of National Power Committee (NPC) that power system study for assessment of operational limits / power transfer capability for each state will be done by the concerned RLDC in association with concerned SLDC. Monthly TTC/ATC will be uploaded by the SLDCs at their respective websites and also communicated to concerned RLDC & NLDC subsequently.



32. CTU has submitted that TTC/ATC for 2014-15, 2015-16 and 2016-17 time frame has already been declared and the same is available in POWERGRID Web site. The procedure adopted has been shared on the POWERGRID Website. For calculation of ATC/TTC for 2017-18 and 2018-19 required information has been sought from various state utilities. Upon receipt of the required information the same would be declared on POWERGRID web site which is likely to be completed by March, 2016. Further based on the consultant recommendation the methodology and declared ATC/TTC would be revisited.

33. We have considered the submissions of CEA and CTU. The CAC sub-committee had recommended this task to CEA, CTU and POSOCO collectively with objective that they will provide timely training to State Authorities and utilities to get the right skills and information for assessment of transfer capability in planning and operational horizon. CTU is directed to conduct workshops on TTC/ATC for States at regular intervals and submit a 6 monthly report to NRCE in this regard.

Tasks common to CEA and CTU:

Task-1: Probabilistic load forecasts and Mixed Integer Linear Programming (MILP) based optimisation tool need to be considered for network planning. CEA and CTU need to explore the use of aforementioned tools. NRCE may look into suitable timeframe for including probabilistic load forecasting.

34. Regarding probabilistic load forecasting, CEA has vide letter dated 7.9.2016 submitted that medium and long term load demand (peak as well as energy) forecast is carried out by Electric Power Survey Committee steered by CEA once in five years, however, an annual or bi-annual review of the forecast is also being considered. Presently, work for 19th EPS report is under advanced stage and feasibility of using probabilistic load forecasting techniques can be considered while reviewing the 19th EPS and for next EPS demand forecasts. Further, transmission planning is responsibility of CEA, CTU and STUs and not of NRCE. Similarly, load forecast is a subject matter of CEA and the same has been carried out by CEA even prior to the Act and also as part of National Electricity Plan. Load forecasting is not a function of NRCE.

35. Regarding probabilistic load forecasting, CTU has submitted that load forecasting is carried out by CEA in consultation with and inputs from States as well as various stakeholders and result of the same is available in the 19th Electric Power Survey (EPS) Report of CEA.



36. We have considered the submission of CEA and CTU in respect of probabilistic load forecasting. Whereas CEA is not averse to probabilistic load forecasting, CTU has stated that action in this regard is to be taken by CEA/NRCE. We observe that currently probabilistic load forecasting is not being carried by CEA. Keeping in view that a new methodology is being proposed, NRCE was entrusted with the task of deciding the timeframe in which the methodology of Probabilistic based load forecasting may be introduced in consultation with stakeholders. Accordingly, we direct NRCE to submit a report in this regard to Commission within 3 months of issue of this Order.

37. Regarding use of Mixed Integer Linear Programming (MILP) based optimization tool for Network Planning, CEA has submitted that network planning in Indian transmission network is complex due to the fact that

- (i) it has two layers i.e. ISTS and intra-State,
- (ii) the States are self-dispatch entities and they dispatch as per their own economic considerations,
- (iii) the CERC regulation on LTA does not provide option for choosing between transmission addition viz-a-viz meeting load from local generations without transmission addition.

The MILP based techniques are used to optimize total cost of energy at drawal point by optimizing both production cost and transmission cost including transmission losses and investment in transmission. As such, use of MILP for expansion of transmission network in Indian context has to be discussed in detail with STUs, regulatory commissions and academia before adopting the same.

38. Regarding use of Mixed Integer Linear Programming (MILP) based optimization tool for network planning, CTU has submitted that at present study for transmission planning is carried out using PSS/E which is an internationally acclaimed electric transmission system analysis and planning software. The software is utilized for electric transmission modeling and simulation and is presently used in over 115 countries worldwide. The transmission planning process in a deregulated environment is a large-scale, highly non-linear exercise that shall have major financial implications. As per the present planning process, the objective is to minimize the line investment cost. However, recent trend has been to minimize the cost of energy along with the total line investment cost. Another important factor being considered is the cost of Expected Energy not Supplied (EENS), i.e. failure to meet long term access commitments. As per the available information, in Mixed Integer Linear Programming (MILP), the non-linear



problem is decomposed into a set of linear programming problem which is solved for minimizing an objective function. The feasibility of MILP based approach to transmission needs to be deliberated with CEA, Stakeholders and other experts. Further, for use of MILP in the transmission planning, the planning process may also be reviewed for development of transmission system for market operation and inclusion of functions like cost of energy, cost of expected energy not served, etc.

39. We have considered the submissions of CEA and CTU. It is noted that both CEA and CTU have submitted that transmission planning in Indian context is complex and feasibility of MILP based approach to transmission planning needs to be deliberated among CEA, CTU, STUs, Regulatory Commissions, academia and other experts. CTU is directed to deliberate along with CEA on the issue of MILP based transmission planning or any other formal optimization tool to be used for network planning along with POSOCO, STUs and other stakeholders at RPCs and CTU to file the conclusions at RPC providing suggestion on optimization tool for network planning to be used in the Indian context within 6 months of date of issue of this order.

Task assigned to POSOCO:

Task-1: Fluctuating load/generation in renewable and its impact on transmission planning needs to be taken care. POSOCO to identify balancing capacity to manage the fluctuations within 3 months of issue of the order.

40. POSOCO has submitted that

- (a) They have prepared a preliminary document on 'Flexibility requirement' for Indian power system and sent to CEA and CERC on 17.9.2015.
- (b) Based on CERC Regulations on Ancillary Services, the tertiary frequency control through the Reserve Regulation Ancillary Service (RRAS) was implemented w.e.f. 12.4.2016.
- (c) Technical Minimum of 55% for thermal generating station has been specified by 4th Amendment to the IEGC w.e.f. 15.5.2017.
- (d) POSOCO has performed production cost modeling and optimization under high RE integration scenario in association with USAID and MoP.
- (e) A report titled "Pathways to Integrate 175 Gig watts of Renewable Energy into India's Electric Grid" was also released in June, 2017.
- (f) A report on 'Operational Analysis for Optimization of Hydro Resources & facilitating Renewable Integration in India' was published in June, 2017 by POSOCO in association with Forum of Load Despatcher



(FOLD) which analyses the operational constraints faced by hydro power plants today.

- (g) A pilot project on AGC at NTPC Dadri Stage-II to bring in secondary control has been commissioned on 4.1.2018.

41. It is observed that POSOCO has submitted the report on 'Flexibility requirement' for Indian power system. We appreciate the prompt action by POSOCO in this regard. CERC vide Order dated 13.10.2015 has notified Roadmap to operationalise Reserves in the country. Further actions in this regard are being taken by the Commission

Task-2: POSOCO should in coordination with and full support of concerned SLDCs and DISCOMs prepare islanding schemes for major cities and towns (considering the criticality) which will aim at matching the local supply with important and emergency loads. POSOCO to complete action in this regard within 6 months of issue of the order.

42. POSOCO has submitted that the region wise islanding schemes as finalized in RPC forums as under:

Northern Region:

- 1) NAPS Islanding Scheme (Implemented)
- 2) RAPS 'A' & 'B' (Proposed)
- 3) Islanding Scheme of Delhi (Implemented)
- 4) Scheme for revival and operation of Kshmir valley in island after its collapse (Proposed)

Western Region:

- 1) Mumbai (TPC & REL) Power System
- 2) GIPCL islanding Scheme in Gujarat
- 3) Kakrapara islanding Scheme of NPCIL
- 4) The formation of islanding scheme for Sugan TPP (Proposed)
- 5) TAPS islanding (Proposed)
- 6) Islanding Scheme for JP Bina (Proposed)

Southern Region:

- 1) Hyderabad area. The islanding scheme of Ramagundum with about 1800MW of loads at Ramagundum (Commissioned)
- 2) Chennai City islanding scheme
- 3) Modified S1-S2 islanding scheme (commissioned)
- 4) Neyveli - MTPS - Kundah - Erode - Coimbatore - Palakkad islanding scheme
- 5) Kudankulam-Tuticorin-Trivandrum islanding scheme

Eastern Region:

- 1) Rourkela Steel Plant islanding system (CCP in Orrisa system)



- 2) Aryan ISPAT and power Ltd. (CPP in Orissa system)
- 3) Maithon ISPAT Ltd. (CPP in Orissa system)
- 4) Indian Farmers Fertiliser Cooperative Ltd (IFFCO) (CPP in Orissa system)
- 5) NALCO (CPP in Orissa system)
- 6) Hindalco (CPP in Orissa system)
- 7) Islanding scheme for Narbheram power & steel pvt. Ltd. (Dhenkanal)
- 8) IMFA (Choudwr, Cuttak) (CPP in Orissa system)
- 9) Islanding Scheme for NBVL
- 10) IBTPS (not yet implemented)
- 11) VAL (CPP in Orissa system)
- 12) Chandrapura TPS (DVC)
- 13) Bakreshwar TPS (West Bengal)
- 14) Tata Power CPP (West Bengal)
- 15) Farakka STPS (not yet implemented)

North Eastern Region:

- 1) Island-1: Comprising of getting units of AGBPP, NTPS & LTPS and loads of Upper Assam system & Deomali area
- 2) Island-2: Comprising of generation of AGTPP, Rikhia, Baramura & Gumti with loads of Tripura system and Dullavcherra load of South Assam.

43. POSOCO has further submitted that for successful islanding, need for core generation in the island, which is firm, is essential. Many of the cities like Bangalore, Chandigarh, Pune and Bhubaneshwar lack internal generation but are well connected with the grid and are therefore poor candidates for islanding.

44. POSOCO has also submitted that PowerTech Labs Inc. was appointed as consultant to conduct study/analysis to ensure secure & reliable operation of National Grid of India. Task-III of the consultancy involved working on guidelines for developing and implementing system protection schemes and islanding schemes, and review of existing schemes. PowerTech Labs has conducted review of 78 SPS schemes and 32 Islanding schemes in India, and recommended complete re-assessment of 37 SPS schemes and 10 islanding schemes. The said consultant has also given several recommendations in the implementation of defense mechanisms, and periodic review of the schemes. Further, as per section 5.2 (n) of the IEGC, the under frequency and df/dt load shedding and islanding schemes have to be finalized by the concerned Regional Power Committee (RFC).

45. We have considered the submission of POSOCO. We observe that POSOCO has submitted the identified islanding Schemes at RPC forums. It



is noted that the consultant has conducted review of 32 Islanding schemes in India, and recommended complete re-assessment of 10 islanding schemes. As per IEGC, RPCs are responsible to ensure functioning of the under frequency and df/dt load shedding and islanding schemes, RPCs should ensure the reassessment and implementation of identified islanding schemes after deliberation with stakeholders on the recommendations of the consultant and identify additional schemes, if required periodically.

Task-3: POSOCO to take steps to develop Interpreter as a suitable interface between SCADA and PSSE to enable revision of TTC in real-time and declaration of TTC/ATC on hourly/ weekly/monthly basis as done by PJM.

46. The CAC sub-committee vide its report on congestion in transmission observed as under:

“Revision of TTC/ATC: At present due to non-availability of suitable interface between SCADA and PSS/E, the revision of TTC in real time is a tedious task. For this purpose, an interpreter has to be developed before going for hourly or frequent revision of TTC.

Further, such frequent revision of TTC and posting the balance ATC left at any point of time in public domain would be meaningful once we have an intra-day or intra hourly market.”

47. POSOCO has submitted that interface between SCADA and PSSE has been developed in-house at RLDCs/NLDC. Interfacing software dumps the SCADA real time data snapshot in MS-EXCEL and with the help of Python software scales the 'state wise' load demand and own generation in the PSS/E case and the 'plant wise' generation at all ISGS. Offline studies personnel at NLDC/ RLDCs are using TLTG option in PSSE to quickly calculate the TTC for trunk line tripping. TTC revisions for network changes and load/generation changes are now being done on an as and when needed basis. Real Time Security Desk (RTSD) operating in NLDC/RLDCs provide sensitivity simulation outputs to system operating engineers when forced outage requests are received in the real time. A python program is developed at NLDC to cut short the time taken for sensitivity analysis. With all this experience, attempts are being made for hourly calculation of TTC. Convergence of state estimator is one crucial requirement at NLDC/RLDCs and it needs support from different stakeholders providing uninterrupted data from the RTUs/SAS. POSOCO had in consultation with all SLDCs/ RLDCs/ NLDC prepared a detailed report on State Estimation in India under the guidance of Dr. N D R Sarma, expert from ERCOT, Texas. This report had been forwarded to the Commission in June, 2015 is also available on



POSOCO website. For weekly and monthly TTC calculation process, load forecast is one input and NLDC/RLDCs are continuously trying to improve in generating forecast and in applying the forecasted data to TTC assessment.

48. POSOCO has also submitted that NLDC and all RLDCs use the Ready Reckoner on transfer capability to manage contingency situations in the grid in real-time to effect faster revisions of transfer capability in real-time. Further, ATC/TTC are revised by POSOCO in case of any major network changes, outages in the grid, contingency situations like coal shortage or fog related tripping, etc.

49. POSOCO has stated that frequent revisions in transfer capability figure will have more meaning only if a dynamic market mechanism is in place to take advantage of the real-time revision in margins in inter-control area transfer of power.

50. We have considered the submission of POSOCO. According to POSOCO, they are making attempts for hourly calculations of TTC and for this convergence of state estimator is one of the crucial requirement at NLDC/ RLDCs. POSOCO has also submitted a report on 'Improvements on Usage of State Estimation in Load Dispatch Centers in India'. We have also perused the said report submitted by POSOCO. The said report has proposed inter alia following action items to improve the usage of State Estimation at all load despatch centers in India:

- (a) The RTU/SAS connectivity analysis should be done to establish if sufficient measurements are available (system is observable) to perform state estimation.
- (b) Daily/ Monthly status reports of RTU/SAS to be uploaded in the website and circulated with concerned authorities for immediate action so that its performance could be monitored and action will be taken by RLDCS/NLDC.
- (c) A formal process of chasing the telemetry issues should be drafted, approved and followed. This is crucial in handling telemetry issues in timely manner.
- (d) Monthly reports on SE results should be published and circulated with concerned authorities for immediate action.
- (e) A user group on State Estimation should be formed in order to develop team-building among the people working in this specialized field. Bi-monthly conference call shall be organized for this group.
- (f) The matter regarding non-satisfactory output of State Estimator to be put up to CERC and corresponding enforcement of regulation to be



done on priority basis as non-functioning of SE could lead to poor Visualization and Situational Awareness which could hamper operator actions during emergencies. Similar action should also be taken by SERCs.

51. POSOCO has stated that there is a need for dynamic market mechanism to make use of frequent revisions of ATC/TTC. We observe that the requirement of hourly declaration of ATC/TTC is important to facilitate power market. We observe that adequate transparency in declaration of ATC/TTC and its frequent revision is a prerequisite to enable the dynamic market. Although POSOCO is making attempts to facilitate the same, the same needs to be implemented in a definite time frame. We direct NRCE to discuss the implementation framework for hourly declaration of ATC/TTC and submit a 6 monthly progress report to Commission. Further POSOCO to file the referred “Ready Reckoner on transfer capability to manage contingency situations in the grid in real-time to effect faster revisions of transfer capability in real-time” within 15 days of issue of this Order.

Task-4: Loop flows, transit flows and counter flows should be considered for TTC / ATC calculations as considered appropriate by POSOCO. Congestion in real time to be handled in accordance with the provisions in CERC Congestion Regulations.

52. CAC sub-committee vide its report on congestion in transmission observed as under:

“3.1.9..... Further loop flows, transit flows and counter flows should be considered for TTC / ATC calculations as considered appropriate by POSOCO.....”

53. POSOCO has submitted that the present TTC/ATC assessment and open access administration methodology considers Loop flows, transit flows and counter flows.

54. We have already directed NRCE to assess the methodology of ATC/TTC in the light of report of international consultant. NRCE is directed to consider the aspect of loop flows and counter flows also while submitting its suggestions to the Commission as directed at para no. 30 of this Order.

Task-5: SPS planned needs to be installed within 3 months and the same to be considered by POSOCO in calculation of ATC as deemed appropriate.



55. POSOCO has submitted that SPS has been planned and implemented on several inter-regional corridors. Risk assessment i.e. a triggering event happening in real time and SPS not operating leading to cascading becomes important in this context. In cases of HVDC Talcher – Kolar and HVDC Mundra – Mohindergarh, SPS was suitably factored in the TTC assessment considering the heavy power demand in SR and NR. This has been done after many years of experience with the SPS and trying to ensure that it operates in a full proof manner (notwithstanding the 31st July, 2012 when Talcher-Kolar SPS did not operate as the logic was not foreseen). Philosophically, SPS is not to be considered in TTC estimation, deliberately keeping system reliance of the SPS at its minimum (as in some cases logic for an unforeseen circumstance may miss out, SPS may act counter productively after a supposed half operation etc.) for system reliability.

56. We have considered the submission of POSOCO. It is noted that during deliberations of the CAC sub-committee, POSOCO had suggested that congestion may be mitigated in short term i.e. within 3 months time frame by installing various system protection schemes. They had also presented an overview of number of System Protection Schemes in service, schemes to be made operational and the schemes under discussion. However, they had expressed their concern over using SPS as a substitute for transmission would lead to insecure operating conditions. Further, the in report submitted by the Consultant in respect of Task-III, they have reviewed 78 SPS schemes and suggested complete re-assessment of 37 SPS schemes.

57. We are of the view that in order to remove congestion in short term, SPS needs to be implemented and considered by POSOCO for TTC calculation. The reliability percentage of an SPS Scheme to be considered while calculating TTC may be discussed at RPC forum. Effective measures should be taken to expedite ISTS and associated intra-State Transmission System to reduce dependency on SPS for safe and reliable system operation. Further, as recommended by the Consultant, RPCs should re-assess the 37 SPS in consultation with stakeholders at RPC Forum.

Task-6: POSOCO to commence use of dynamic line rating within 1 month after taking a confirmation from the equipment owner regarding the facility ratings.

58. CAC sub-committee vide its report on congestion in transmission observed as under:



“3.2.2 Dynamic Line Rating:

*(1) CEA suggested that dynamic line rating may be used to enhance loadability of lines. Dynamic line rating enable system operator to determine capacity and apply line ratings in real time, based on actual operating conditions. In many power systems, static ratings are adjusted to account for significant differences in maximum ambient temperature. Line ratings may be adjusted daily, hourly, or even more frequently to reflect the maximum ambient temperature predicted during a particular period of time. The method of periodically adjusting a line’s rating based on ambient air temperature is called ambient adjusted rating.
.....*

(2) It was agreed that necessary action would be taken by POSOCO at the earliest as per advice of NRCE.”

59. POSOCO has submitted that they are using Dynamic Line Rating (DLR) using seasonal line rating as recommended by NRCE. POSOCO has also submitted that DLR involves real time data from several points on the transmission line which is currently unavailable. Further, the inter-regional transfer capabilities declared by POSOCO are on the basis of stability limits, voltage limits or thermal limits of transmission elements, whichever is less. The inter-regional flows have wide variation due to seasonality as well as diurnal variations. Seasonal line ratings have been used in computation of TTC/ATC in S1-S2 flow gate where thermal limits are hit first, as per communication on seasonal ratings as per NRCE subcommittee decisions.

60. We have considered submission of POSOCO. It is observed that seasonal ratings are being used only for S1-S2 flow gate. It is observed that usage of dynamic line rating shall help in relieving congestion. Dynamic Line rating is not only “seasonal rating” but daily / hourly/more frequently rating based on variations in temperature. NRCE should monitor the implementation of dynamic line rating for all corridors and submit six monthly progress reports to the Commission.

Task-7: POSOCO, being the apex organisation in regard to system operation & market operation in the country, would take steps to make the information governing market operation as transparent as possible.

&

Task-8: There is a need for developing a common electronic platform with access to all market participants. Necessary protocols for information sharing and dissemination needs to be finalized by POSOCO in consultation



with stakeholders. POSOCO to complete action in this regard within 3 months of issue of the order

61. CAC sub-committee vide its report on congestion in transmission observed as under:

5.4 The Sub-Committee was of the view that transparency of data to stakeholders would not only help the utilities to plan their operation but would also avoid disputes and litigations. POSOCO being the apex organisation in regard to system operation & market operation in the country would take steps to make the information governing market operation as transparent as possible.

8.4.4 Information dissemination to facilitate stakeholders

*1)
(4) There is a need for developing a common electronic platform with access to all market participants. Necessary protocols for information sharing and dissemination needs to be finalized by POSOCO in consultation with stakeholders.*

62. POSOCO has submitted that monthly Load Generation Balance Report (LGBR) is being uploaded along with TTC/ATC declaration on NLDC website. Quarterly PoC PSS/E case is uploaded on NLDC website. Continuous improvements are being made in the POSOCO NLDC/RLDCs websites giving utmost priority to transparency and information dissemination. POSOCO has further submitted that a stakeholder meeting has been organized by POSOCO at New Delhi and a region specific stakeholder meeting is being planned. Inputs will be taken from the stake holders to improve sharing of information through common electronic platform.

63. POSOCO has also submitted that they are working on National Open Access Registry, on the basis of concept paper brought out by CERC. This will provide a common electronic platform for ensuring ease of use and transparency to all market participants, and also include necessary protocols for information dissemination.

64. It is observed that POSOCO is taking steps to make the requisite data available through its website and is also working on National Open Access Registry. It is directed that further improvements with regards to availability of data and its format to be discussed at NRCE and submit report to Commission within 6 months of issue of this Order.

Task assigned to CTU:



Task-1: CTU should constitute a group to provide first-hand information in regard to status of implementation of generation and transmission projects in the States and conduct meetings every 6 months to monitor gaps in execution and re-plan accordingly.

65. The CAC subcommittee in its report on congestion transmission observed as under:

8.4.1 To mitigate transmission congestion due to inadequacy of state network and delay in commissioning of generating unit

The gap between TC (Transmission Capacity) & ATC attributable to States should be found and needs to be communicated to them through appropriate discussions with States. The gestation period of transmission being generally shorter than generation, transmission planning needs to be sensitive to dynamic conditions unfolding in regard to generation. A mechanism should be institutionalised, (may be) by involving consultants to provide first hand information in regard to status of implementation of generation and transmission projects in the States. This would provide realistic data about gaps in execution so that one could navigate and re-plan. CTU should constitute a group for this purpose and conduct meetings every 6 months to monitor gaps in execution and replan accordingly.

66. CTU has submitted that in CEA, there is already a mechanism for monitoring of Generation and Transmission, the progress of generation and transmission on monthly basis are available on the CEA website. Therefore, creation of another group for this purpose may be futile. Nevertheless, based on the above status, gaps can be identified. CEA would be requested for inclusion of a special agenda in the Standing Committee Meeting where the gaps in State Transmission System would be discussed and the remedial measure, if any, would be planned.

67. We have considered the submission of CTU. The objective of the Committee observation was to base transmission planning sensitive to dynamic conditions unfolding in regard to generation and institutionalized a mechanism to provide first hand information to planner in regard to status of implementation of generation and transmission projects in the States so that realistic data about gaps in execution is available with transmission planner and the system can be re-planned, if needed. We observe that CEA under PSPM division is monitoring the status of generation projects and transmission system above 220 kV level. We have already directed CTU to make exception reports in case of mismatch and submit 6 monthly



exception report to CEA and Commission in this regard at para 19 of this Order. CTU shall also monitor mismatch between generation and associated transmission system and submit 6 monthly exception report to CEA and Commission in this regard

Task-2: There is need for co-ordination of development of intra-state transmission system by CTU. CTU to submit quarterly report on augmentation of transmission system in the Country to CERC.

68. CTU has submitted that the intra state transmission system is planned by respective state utilities as per provision under Section 39 of Electricity Act. The same is discussed in the standing committee meeting with CEA and CTU. As mentioned above, the monitoring of the implementation of intra-State transmission is being carried out by CEA and the details of the same are available at CEA website. CTU has suggested that the quarterly report on Augmentation of transmission in the country may be submitted to CERC by CEA.

69. We have considered the submission of CTU. As per Section 38 and Section 39 of the Electricity Act, 2003, the responsibility of planning and co-ordination relating to inter-State transmission system and to intra-State transmission system has been entrusted with CTU and STUs respectively to ensure development of an efficient, co-ordinated and economical system for smooth flow of electricity from generating stations to the load centres.

70. We have received many petitions wherein it has been brought to the notice of the Commission that inter-State transmission system has been developed by ISTS licensees but the matching intra-State transmission systems are not ready leaving the ISTS unutilized. In this regard we have already directed CTU to make exception reports in case of mismatch and submit 6 monthly exception report to CEA and Commission in this regard at para 19 of this Order.

Task-3: In the context of a major shift in the Government's Policy for a quantum jump in developing renewable power generation systems, it would require short and medium term solutions, but more importantly, it needs a long term planning fully integrated with the future plans of MNRE. In these cases, organizations like POWERGRID would need to be supported in view of the pattern of utilization of these transmission systems, by way of VGF/PSDF. Long term planning would require development of transmission systems in a manner that they are normally underutilized in the initial years but later utilized well. Here again commercial organizations would need to be



financially supported through instruments like Viability Gap Funding/PSDF. CTU needs to take-up appropriate steps in this regard.

71. CTU has submitted that integration of Renewable Energy (RE) sources into the grid is one of the top priorities of Govt. of India towards energy security and environmental sustainability. In this direction, POWERGRID has evolved Green Energy Corridors comprising intra-State and inter-State transmission infrastructure to facilitate integration of envisaged renewable capacity addition of about 33 GW in 12th plan in RE resource rich states at an estimated cost of about Rs. 38,000 Cr. Implementation of ISTS as part of Green Energy Corridors has already been initiated. Further, POWERGRID has also evolved transmission schemes for integration of proposed ultra mega solar power parks of about 22,000 MW in various states as part of Green Energy Corridors-II. Govt. of India also assigned POWERGRID to develop ISTS for nine (9) solar parks of capacity about 10,000 MW in seven (7) states. Implementation of transmission scheme for one (1) solar park in Andhra Pradesh is under progress. Considering lesser utilization of transmission system associated with renewable generation projects, there is a requirement of rationalization of transmission tariff of these assets. To address this, innovative financing Strategy was adopted in Green Energy Corridors; for intra state systems financing is proposed to have 40% of the capex through NCEF Grant, 40% debt component through concessional/soft loan, 20% through state equity, similarly, for the ISTS portion which is being developed by POWERGRID, the financing is proposed to be done having 70% Debt Component as concessional/soft loan and balance 30% through POWERGRID equity. Debt component for ISTS may also be supported through other modes like Viability Gap funding/PSDF in addition to concessional/soft financing. CTU has further submitted that MNRE also provides Central Financial Assistance (CFA) for development of Solar Park and its external infrastructure.

72. We have considered the submission of CTU. It is noted that POWERGRID has submitted the financing strategy adopted for intra-State Transmission System and ISTS under the Green Energy Corridors. However, POWERGIRD has not mentioned anything about pattern of utilization/underutilization of transmission lines developed under the Green Energy Corridors.

73. Since POWERGRID has filed many petitions viz. 29/MP/2015, 228/MP/2015, 1/MP/2016, 36/MP/2016, 143/MP/2016, seeking regulatory approval for execution of ISTS for evacuation of power from solar power parks being developed in different parts of the country. We, direct CTU to file a report in respect of pattern of utilization of transmission system



developed for integration of renewable power into the grid within 6 months of the issue of this order.

Task-4: Sample audit of relays/protection system to be undertaken by CTU for States within 1 year and heavy fine should be imposed for non-adherence to standards. Unallocated power may be suspended in such cases.

74. CTU has submitted that based on the advisory of MoP in August, 2012 independent 3rd party audit was carried out for EHV substations of various utilities in NR where in 131 sub-stations were audited by CPRI. Subsequently, the exercise was extended in other regions viz. southern, western, eastern and north eastern region by respective Regional Power Committees. Under this exercise, total of 762 sub-stations were audited in all the regions. Subsequently, based on the recommendations of the task force on Power System Analysis and directions of MoP in July, 2014, an international consultant (M/s. Tractebel, Romania/Tractebel India, Lahmeyer International, India) has been appointed to (i) study the protection audit carried out earlier for 762 no. of substations and (ii) conduct on site protection audit check of the works already carried out subsequent to the previous audit. Further, 76 substations (including both of POWERGRID and State utilities) have been audited by International consultant (Powertech Labs Inc., Canada). The final report submitted by the consultant was put up before the Grid Study Committee during its meeting held on 16.01.18.

75. We have considered the submission of CTU. We observe that periodic audit is being carried out at RPCs. We direct RPCs to ensure that periodic audit is being carried out and file 6 monthly exception reports to Commission.

Task-5: CTU to use controlling devices such as FACTS controllers and damping controllers. Expedient installation of Dynamic reactive power compensation devices such as SVCs, STATCOMs already planned by CTU (22 nos.).

76. CTU has submitted that the installation of Flexible Alternating Current Transmission System (FACTS) devices has been undertaken based on the requirement since long in Indian Power System. These FACTS devices are equipped with damping controller to mitigate power oscillations. In this regard six numbers of Thyristor Controlled Series Capacitors (TCSC) are in service for more than 5 years. These devices have been installed on major inter regional links that are prone to such Power System Oscillations. Further, SVC at Kanpur has been provided during 1990's. Further, 16 nos. of SVC/STATCOM have already been planned/ under implementation at



strategic locations in consultation with CEA, POSOCO and regional constituents. CTU has also submitted that out of 3 (three) nos. of SVC and 14 (fourteen) nos. of STATCOM planned to provide dynamic reactive power support to the Grid, 3 (Three) nos. of SVC in NR and 1 (one) no. of STATCOM in SR have already been commissioned and 12 (twelve) nos. of STATCOMs in different regions are in various stages of implementation and likely to get commissioned progressively from April, 2018.

77. We have considered the submission of CTU. CTU has not spelt out the commissioning schedule of STATCOMs clearly. It is directed that the status of installation of planned SVCs and STATCOMs be taken up at Standing Committee and 6 monthly exception report to be filed to the Commission by CTU.

Task-6: Keeping in view the necessity for transparency in declaration of TTC/ATC in planning horizon, the results of long term studies carried out by CTU should be made available on their website.

78. CTU has submitted that TTC/ATC for 2014-15, 2015-16 and 2016-17 time frame has already been declared and the same is available in POWERGRID website along with procedure adopted. For calculation of ATC/TTC for 2017-18 and 2018-19 required information has been sought from various state utilities. Upon receipt of the required information the same would be declared on POWERGRID website. Further, based on the consultant recommendation, the methodology and declared ATC/TTC would be revisited.

79. We have considered the submission of CTU. We have perused the CTU website to ascertain whether CTU is complying direction of the Commission in regard to publishing TTC/ATC in planning horizon and results of long term studies on their website. It is observed from website of CTU, that CTU is publishing ATC/TTC, revisions in ATC/TTC, assumptions for ATC/TTC and list of ISTS lines considered for revision of ATC/TTC. However there is a need to make the system transparent whereby the details of long term studies are made available to stakeholders. We, therefore, direct CTU to make the system transparent by making the long term studies carried out by it on their website available for stakeholders. The issue of transparency is also under consideration in draft CERC (Transmission Planning and other related matters) Regulations, 2017 published on 26.4.2017.

Task assigned to CEA:

Task-1: Reliability standards need to be planned for Indian Power System. To start with, NRCE may bring out Standards for "Protection System" and



"Communication System". CEA may within two months initiate process for training of standards.

80. CEA has submitted that a subgroup has been formed to finalize the reliability standards for Indian Power System. CEA has also submitted that the 1st meeting of subgroup was held on 3rd June, 2016 and commenced preparation of protection standards.

81. SRPC has submitted that sub-group constituted by NRCE has brought out a draft Report on Reliability Standards for Protection System for Indian Power System *inter alia* covering Protection System Mis-operation Reporting and Monitoring of Corrective Action and System Protection Scheme Review Procedure. Further, the said draft is under finalization by National Power Committee (NPC) for submission to CERC. After their approval & notification by CERC, PSC of SRPC will follow the laid-down procedures.

82. We have considered the submission of CEA and SRPC in respect to planning of reliability standards for Indian Power System. It is noted that the sub-group constituted by NRCE for preparation of reliability standards for 'Protection System' and 'Communication System' has brought out Draft report on Reliability Standards for Protection System for Indian Power System and the said report is under finalization by NPC. It is directed that the 'Protection Standards' be finalized in NPC at the earliest and the copy of the finalized Standard be placed on record of the Commission.

83. Further, the issue of technical standards for communication systems have also been issued vide Central Electricity Regulatory Commission (Communication System for inter-State transmission of electricity) Regulations, 2017 dated 15.5.2017, wherein following is provided:

1. "7.1 Role of CEA

(i) CEA shall formulate communication planning criterion and guidelines for development of reliable communication system for power system of India duly considering requisite route redundancy, capacity, as well as requirements of smart grid and cyber security.

(ii) CEA shall formulate and notify technical standards, cyber security requirements in accordance with the Cyber security Policy of the Govt. of India from time to time, protocol for the communication system for Power Sector within the country including the grid integration with the grid of the neighbouring country.



(iii) CEA shall constitute and notify a Standing Committee for Communication System in Power Sector. The Standing Committee shall be responsible to:

a. prepare perspective plan for communication duly considering optimal utilization of transmission assets for communication purposes having regards to the transmission planning carried out by CEA through Standing Committee on Power System Planning.

b. carry out periodic review of the perspective plan.

c. monitor and facilitate timely completion of schemes and projects for improving and augmenting the associated communication system along with transmission system in the power sector.”

84. According to above, CEA shall formulate technical standards for communication system. CEA is requested to share the standards for ‘communication system’ with the Commission within a week of its finalization.

Task-2: NRCE in consultation with POSOCO and CTU may explore alternative methods of calculation of TRM as suggested and provide to Commission for its consideration. NRCE may complete action in this regard within 3 months of issue of the order.

85. CEA has submitted that under directions of Ministry of Power, PGCIL has appointed a consultant (M/s Powertech Labs, Canada) and assigned Tasks which inter-alia include the following:

Task-I: Examination and recommendation of methodology for optimum calculation of Transfer Capability (TTC/ATC/TRM) in the Planning and the Operational Horizons.

Task -II: Calculation of Transfer Capability (TTC/ATC/TRM) for entire country.

86. CEA has also submitted that the final report of the consultant is expected by March 2017. The report of the consultant would be analysed for its adoption in the Indian context.

87. We have considered the submission of CEA. We have already observed at para 30 of this Order that the international consultant appointed by POWERGRID, as per direction of Ministry of Power has submitted its report in respect to Task-1 and Task-II to POWERGRID in the month of January, 2017 and April, 2017. As directed at para 30, NRCE shall submit a report to Commission within 3 months of submission by CTU making suggestions on changes required in methodology of calculation of TRM.



Task assigned to PGCIL:

Task-1: POWERGRID may carry out a comprehensive study jointly with CEA and NLDC for siting and sizing of Phase Shift Transformer (PST).

88. The CAC sub-committee vide its report on congestion in transmission observed as under:

“3.2.3 Use of Phase Shifting Transformer:

Prof. Soman of IIT Mumbai submitted that phase shifting transformers may be used to improve power flow. He mentioned that a study was conducted for Tata Power 2 X315 MVA 1:1 phase shifting transformers on the 220 kV -MSETCL Tata Power line at Trombay. Mumbai transmission corridor is congested and there is reverse power flow from Mumbai to MSETCL. It was seen that import ability could be improved from 1800 MW to 3000 MW with angle of 12 degrees with phase shifting transformers. During 3rd meeting of the sub-committee, POWERGRID was asked to submit corridor-wise details of phase shifting transformers (PSTs) installed/ planned to be installed. POWERGRID subsequently communicated that it had proposed a Phase shifting Transformer on Sholapur-Raichur line for increasing the loadability of the line. The scheme was discussed in the 37th SCM held on 31st July 2014. However the same was not approved. POWERGRID proposed that a comprehensive study could be carried out jointly by CEA, POWERGRID and NLDC for siting and sizing of PSTs. CTU stated that use of Phase Shifting Transformer gets limited once generation comes up in the area. Prof. Soman indicated that as studies conducted by them for Mumbai revealed that Phase Shifting Transformer may be effective in enhancing ATC but if grid topology changes over a period of time and its effectiveness comes down, the transformer can be used as contingency measure.”

89. It is noted that POWERGRID had, during the deliberations of the CAC subcommittee meeting, proposed that a comprehensive study could be carried out jointly by CEA, POWERGRID and NLDC for siting and sizing of PSTs. The Commission also vide order dated 5.8.2015 in petition no. 009/SM/2015 directed POWERGRID to file status quarterly action report in this regard. However, POWERGRID has not filed any action taken report in this regard till date. CTU is directed to file the comprehensive study carried out jointly by CEA, CTU and NLDC for siting and sizing of PSTs within 3 months of issue of this Order.

Task assigned to RPCs:



Task-1: Protection Sub-committee of RPC should bring out a protocol for checking the settings, ensuring healthiness of existing protection system and periodicity of carrying out this exercise.

90. The CAC sub-committee vide its report on congestion in transmission observed as under:

“6.8 Sub-committee noted that the need for proper monitoring and strict compliance of existing regulations. The Sub-Committee opined that Protection Sub-committee of RPC should bring out a protocol for checking the settings, ensuring healthiness of existing protection system and periodicity of carrying out this exercise.”

91. Accordingly, the Commission vide order dated 5.8.2015 in Petition No. 009/SM/2015 directed Protection Sub-committee of RPC to bring out a protocol for checking the settings, ensuring healthiness of existing protection system and periodicity of carrying out this exercise.

92. NRPC and SRPC have submitted that they are already taking measures at RPC forum for ensuring healthiness of protection systems.

93. We have considered the submission of NRPC and SRPC. We observe that protection audit is being carried out at NRPC and SRPC. However there is a need to bring out a protocol for checking the relay setting, ensuring healthiness of existing protection system and periodicity of carrying out this exercise. All RPCs are directed to create such protocol and file compliance report in this regard within 3 months of issue of this order.

Task assigned to Secretary, FoR

Task-1: TTC/ATC to be declared by STUs for state network in planning horizon as well as operating horizon. Operational feedback by SLDCs to STUs be made mandatory through appropriate Regulations.

94. The CAC sub-committee vide its report on congestion in transmission observed as under:

5.3.2 Further refinement of the process and extending it to intra hourly basis would necessitate the following:

(1)

(2) Another issue is the role of State Load Despatch Centres (SLDCs) in working out the TTC/ATC for their respective control areas as specified in the procedure approved by the CERC in June 2010 under the CERC Congestion Regulations. There are numerous intra state constraints which are rarely highlighted as there are no TTC/ATC postings by SLDCs. This gives an impression that constraints exist only in the Inter-



State Transmission System (ISTS). There are many intra state generators which have been commissioned without the requisite intra-state transmission system; however as any restriction on such generation impacts the DISCOM of the state adversely, SLDCs remain passive rather than playing an active role and taking care of system security. This has potential to seriously endanger the network security.

.....

8.4.4 Information dissemination to facilitate stakeholders

(1)

(3) TTC/ATC to be declared by STUs for state network in planning horizon as well as operating horizon.

.....

8.4.5 Operational feedback by SLDCs to STUs be made mandatory through appropriate Regulations.

95. The Commission vide order dated 5.8.2015 in Petition No. 009/SM/2015 entrusted this task to Secretary, Forum of Regulators (FoR) for discussion during FoR meeting to bring consensus among all State Regulators to make regulatory intervention in their respective jurisdiction so that SLDCs starts providing operational feedback to STUs and STUs to start the process for TTC/ATC declaration for State network in planning as well as operating horizon.

96. It has come to our notice that FoR in its 59th meeting held on 21.4.2017 discussed these issues. The relevant portion of the said meeting of FoR held on 21.4.2017 is reproduced as under:

AGENDA ITEM NO. 5 DIRECTIONS TO SECRETARIAT OF "FOR"

.....

B. Need for appropriate regulatory framework stipulating mandatory requirement for operational feedback by SLDCs to STUs

C. Declaration of TTC/ATC by STUs for State network in planning as well as operating horizon

The Forum noted the need for determination of permissible power transfer limits on inter-regional corridors and making it available publicly for the market players in order to facilitate Short Term Open Access (STOA) through the inter-State Transmission System (ISTS). The Forum further underlined the need for TTC/ATC computations by STU for the planning horizon, TTC/ATC computations by SLDC for the operating horizon, besides providing the operational feedback by SLDCs to respective STUs and its discussion in the State Power Committees or Grid Coordination Committees.

The Forum decided that SERCs may take up the matter at their end for suitable action.



97. **Summary of our Findings**

- a. CEA is requested to expedite formulation of technical standards for “Communication System” as per Central Electricity Regulatory Commission (Communication System for inter-State transmission of electricity) Regulations, 2017.
- b. NPC to expedite formulation of Standards for Protection System for Indian Power system.
- c. CTU is directed to take up the issue of matching ISTS with State Systems at Standing Committee of Transmission Planning in coordination with CEA to ensure coordinated action for implementation of both ISTS and associated intra-state system. CTU is directed to submit 6 monthly exception reports in case of mismatch to CEA and Commission.
- d. The importance of matching systems at State level to be raised at Forum of Regulators so that necessary action may be taken at their level also.
- e. CTU is directed to carry out a nationwide study to assess the requirement of SPS and dynamic control mechanism including SVCs, STATCOMs, etc., including within the State Sector and its proposed funding mechanism and submit a report within 6 months of issue of this Order to CEA and Commission.
- f. CTU is directed that the agenda of transmission capacity enhancement in the existing systems (Central as well as State Sector) to be taken up at next Standing Committee and submit a report to the Commission within 6 months of issue of this Order. Further the issue of up-gradation shall be taken up in each Standing Committee and report to this effect be filed with NRCE by CTU within 1 month of Standing Committee meeting. CTU is also directed to carry out studies with regards to methods of up-gradation of existing system, introduction of new technology in consultation with CEA and CERC within 3 months of issue of this Order.
- g. NRCE is directed to submit suggestions on changes required in methodology of calculation of ATC/TTC based on recommendations of the consultant within 3 months of this order. NRCE is also directed to consider the aspect of loop flows and counter flows also while submitting its report to the Commission.



- h. CTU is directed to conduct workshops on TTC/ATC for States at regular intervals and submit a 6 monthly report to NRCE in this regard. NRCE to submit yearly exception report to Commission.
- i. CTU is directed to make available the long term studies carried out by it while calculating ATC/TTC on their website for stakeholders.
- j. CTU is directed to file a report on respect of pattern of utilization of transmission system developed for integration of renewable power into the grid within 6 months of issue of this order.
- k. CTU to submit comprehensive study jointly with CEA and NLDC for siting, sizing and implementation prioritization of Phase Shift Transformer (PST) within 3 months of the issue of this order.
- l. CTU to deliberate along with CEA on the issue of MILP based transmission planning or any other formal optimization methodology to be used for network planning along with POSOCO, STUs and other stakeholders at RPCs and CTU to file the conclusions at RPC providing suggestion on optimization tool for network planning to used in the Indian context within 6 months of date of issue of this order.
- m. NPC to explore the use of probabilistic based load forecasting in Indian context and submit a report to the Commission within 6 months of issue of this Order.
- n. Improvements with regards to availability of data and its format to be discussed at NRCE and report in this regard is to be submitted Commission within 6 months of issue of this Order.
- o. NRCE is directed to discuss the implementation framework for hourly declaration of ATC/TTC and submit a 6 monthly progress report to Commission.
- p. NRCE should ensure the implementation of dynamic line rating within six months of the date of issue of this Order and submit a report to the Commission within 15 days thereafter.
- q. POSOCO to file the referred "Ready Reckoner on transfer capability to manage contingency situations in the grid in real-time to effect faster revisions of transfer capability in real-time" within 15 days of issue of this Order.
- r. The reliability percentage of a SPS Scheme to be considered while calculating TTC shall be discussed at RPC forum. Effective measures should be taken to expedite ISTS and associated intra-State



Transmission System to reduce dependency on SPS for safe and reliable system operation.

- s. RPCs should ensure the reassessment and implementation of identified islanding schemes after deliberation with stakeholders on the recommendations of the consultant. RPCs to identify additional islanding schemes, as required, periodically.
- t. RPCs are directed to ensure that periodic audit of relays/protection system is being carried out and file 6 monthly exception reports to Commission. RPCs are directed to bring out a protocol for checking the relay setting, ensuring healthiness of existing protection system and periodicity of carrying out this exercise and file compliance report in this regard within 3 months of issue of this order. RPCs to take up the issue of protection audit and relay setting in transmission system/distribution system within States. The issue should also be raised at Forum of Regulators so that necessary action may be taken at their level also. RPCs should re-assess the existing SPS in consultation with stakeholders at RPC Forum.

98. With these observations and direction, the petition No. 009/SM/2015 is disposed of herewith.

Sd/-
(Dr. M. K. Iyer)
Member

Sd/-
(A. S. Bakshi)
Member

Sd/-
(A.K. Singhal)
Member

