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केंद्रीय विद्युत प्राधिकरण
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वेबसाइट / Website: www.cea.nic.in



[ISO 9001:2008]

संख्या: 3/एनआरसीड/रविस/केविप्रा/2016/ 698-709

दिनांक: 14-10-2016
17

विषय: NRCE का पुनर्गठित उप-ग्रुप की पहली बैठक के कार्यवृत्त के सम्बन्ध में।

उपरोक्त विषय से सम्बन्धित दस्तावेज आपकी जानकारी एवम आवश्यक कार्यवाही हेतु संलग्न है।

संलग्नक : यथोपरि

(डी.कु.श्रीवास्तव)
निदेशक

सेवा में :

1. श्री प्रदीप जिंदल, मुख्य अभियंता PSP&A- 2, (अध्यक्ष NRCE के उप समूह) केंद्रीय विद्युत प्राधिकरण, नई दिल्ली -110 066	2. डॉ ए आर अभ्यंकर, सह - प्रोफेसर, इलेक्ट्रिकल इंजीनियरिंग। विभाग, आईआईटी दिल्ली, नई दिल्ली -110016
3. श्री अवदेश कुमार यादव, निदेशक PSP&A-I, केंद्रीय विद्युत प्राधिकरण नई दिल्ली -110 066	4. श्री सथ्यनारायण, अधीक्षन अभियंता, पश्चिम क्षेत्रीय विद्युत समिति, मुम्बई-400093
5. श्री बी लिंगखोई, अधीक्षन अभियंता उत्तर पूर्वी क्षेत्रीय विद्युत समिति शिल्लोंग - 793 006	6. श्री नरेश कुमार, कार्यपालक अभियंता, उत्तर क्षेत्रीय विद्युत समिति, नई दिल्ली -110016.
7. श्री गणेश राव जड़ा, कार्यपालक अभियंता, पूर्वी क्षेत्रीय विद्युत समिति , कोलकता - 700 033	8. श्री एन.आर.एल.के. प्रसाद, कार्यपालक अभियंता, दक्षिण क्षेत्रीय विद्युत समिति, बेंगलुरु-560 009
9. श्री मुकेश खन्ना, एजीएम (CTU- Plg.), पावर ग्रिड, गुरुगाव -122001.	10. श्री डी रवि चंद्रन, अधीक्षन अभियंता (प्रणाली के अध्ययन) TANGEDCO, चेन्नई-600002.
11. डॉ. संजय कुलकर्णी, मुख्य अभियंता (STU) एम.एस.इ.टी.सी.एल, मुम्बई-400051	12. श्री के. वी. एस .बाबा कार्यकारी निदेशक, उ म प्र, रा भा प्रे के, नई दिल्ली -110 016



भारत सरकार/Government of India
विद्युत मंत्रालय/Ministry of Power
केंद्रीय विद्युत प्राधिकरण/Central Electricity Authority
राष्ट्रीय विद्युत समिति/National Power Committee
कटवारिया सराय/Katwaria Sarai, नई दिल्ली / New Delhi – 110016
वेबसाइट / Website: www.cea.nic.in



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No. 3/NRCE/NPC/CEA/2016/ 698-709

Date: 14th October 2016
17thTo:
(As per address list)

Subject: First Meeting of the reconstituted Sub-Group of NRCE for finalizing the methodology for computation of TTC/ATC/TRM- Minutes of the Meeting

Sir,

The first meeting of the reconstituted sub-group of NRCE was held on 19th September 2016 in CEA Conference Hall, Sewa Bhawan, R.K.Puram, New Delhi. The Minutes of the meeting is enclosed for kind information and necessary action please. The same is also available on CEA website (www.cea.nic.in).

Encl: as above

Yours faithfully,

(D.K.Srivastava)

Director (NPC) / Member Convener

Address List:

1. Shri Pardeep Jindal, Chief Engineer PSP&A- 2, (Chairperson Sub Group of NRCE) Central Electricity Authority Sewa Bhawan, R.K.Puram, New Delhi-110066	2. Dr. A. R. Abhyankar, Associate Professor, Electrical Engg. Department, IIT Delhi, New Delhi-110016
3. Shri Awdesh Kumar Yadav, Director PSP&A-I, Central Electricity Authority Sewa Bhawan, R.K.Puram, New Delhi-110066	4. Shri Sathyanarayan, Superintending Engineer, Western Regional Power Committee, Plot No. F-3, MIDC Area Marol, Andheri (East), Mumbai-400093
5. Shri B.Lyngkhoi, Superintending Engineer North Eastern Reg. Power Committee NERPC Complex, Dong Parmaw, Lapalang, Shillong-793006	6. Shri Naresh Kumar, Executive Engineer, Northern Regional Power Committee, 18-S.J.S. Marg, Katwaria Sarai, New Delhi-110016.

<p>7. Shri Ganesh Rao Jada, Executive Engineer, Eastern Regional Power Committee, 14, Golf Club Road, Tolly Gunge, Kolkata- 700033.</p>	<p>8. Shri N.R.L.K.Prasad, Executive Engineer Southern Regional Power Committee No.29, Race Course Cross Road, Bengaluru-560009</p>
<p>9. Shri Mukesh Khanna AGM (CTU- Plg.), Power Grid Corporation of India Ltd., Saudamini, Plot No.2, Sector-29, Gurgaon-122001.</p>	<p>10. Shri D. Ravi Chandran, Superintending Engineer, System Studies TANGEDCO, Eastern Wing, 4th Floor NPKRR Maaligai, 144, Anna Salai, Chennai-600002.</p>
<p>11. Dr. Sanjay Kulkarni Chief Engineer (STU) MSETCL Prakashganga Plot NO. C-19, E-Block, Bandra-Kurla Complex, Bandra(E), Mumbai-400051</p>	<p>12. Shri K.V.S.Baba Executive Director, NLDC, POSOCO, B-9, Qutub Institutional Area Katwaria Sarai, New Delhi-110016.</p>

Minutes of first Meeting of the Sub Group of NRCE held on 19th September 2016 at CEA (HQ), New Delhi.

1. Introduction

- 1.1 The first meeting of the reconstituted sub-group of NRCE was held on 19th September 2016 in CEA Conference Hall, 2nd Floor, Sewa Bhawan, R.K.Puram, New Delhi-110066. The list of the participants is enclosed at **Annexure-I**.
- 1.2 Chief Engineer (PSP&A-II), CEA & Chairperson Sub Group of NRCE welcomed all Members of reconstituted Sub Group and other participants to the meeting. He briefed about the background and the objective of the formation of the sub-group. He said that NRCE in its first meeting had constituted a Sub-Group for examination of the system studies for the purpose of TTC, ATC and TRM on monthly basis. Further, in its 6th meeting held on 17th March 2016, the NRCE re-constituted this Sub-Group. He said that the methodology being followed by POSOCO and CTU needed to be examined by the Sub-Group so that methodology/(ies) could be evolved for computation of TTC/ATC/TRM. The methodology finalized by the Sub-Group would then be put up to NRCE for recommendation for CERC approval.

2. Methodology & Procedure of computation of TTC/ATC/TRM being followed by POSOCO & CTU

- 2.1 Chairperson Sub Group of NRCE requested POSOCO and CTU to present the methodology & procedure of computation of TTC/ATC/TRM being followed by them. He requested POSOCO to furnish a copy of the approved procedure to the Sub-Group, and may also be made available to their websites. He also mentioned that there is difference in the TTC computations by CTU and POSOCO for the same period, which needs to be examined.
- 2.2 POSOCO informed that the approved procedure is available on the SRLDC website and they would upload the same in all the RLDC websites. However, a copy of the same would be furnished to the Sub Group.
- 2.3 POSOCO and CTU presented the methodology being followed by them for the computation of TTC/ATC/TRM. A copy of the presentations is at **Annexure-(A) and Annexure-(B)** respectively.
- 2.4 SE, WRPC opined that the procedure should be transparent and the computation details, assumptions etc. needed to be shared. It was observed sometimes addition of generating station and transmission elements were not considered in study and also nodal demand data does not match with actual data. The loop flow of power in the network is also an area that needed to be addressed appropriately.

- 2.5 POSOCO informed that ATC computation is being carried out taking separate base cases for export & import, and also for both peak & off-peak scenarios. The network topology data is taken from CTU/STU, the unit availability is based on the latest LGBR and also considering actual generation as per trend/anticipated. The MVAR demand is based on CEA manual on transmission planning criteria for building the base cases assuming power factor of 0.95. POSOCO informed that they were considering the latest LGBR data and only the assets both transmission and generation declared on commercial operation are considered in the study/computation. The units under maintenance or outage are kept out of calculation. Revision of TTC/ATC/TRM are also being carried out in view of any change in maintenance schedule etc. Based on the available legacy data, apportioning of MW on modelled nodes were being carried out.
- 2.6 CTU informed that the legacy data were being updated in consultation with STUs. There was no set procedure for collecting the data from STUs and the same being done on interaction.
- 2.7 Chairperson Sub Group of NRCE, requested POSOCO to share all the assumptions and legacy data with the Sub Group.
- 2.8 Associate Professor, IIT Delhi said that distribution of nodal MW is the crux of the problem. There was no rational procedure for distribution of MW & MVAR on 'n' buses in the system. Statistical analysis of metered data for all the nodes modelled needed to be carried out to arrive percentage loading on all buses. This percentage could be used for MW apportionment to modeled nodes for computation of TTC/ATC/TRM. MVAR range of the generating stations should be based on the capability curve of the machines. The assumed power factor of 0.95 also needed to be reviewed.
- 2.9 POSOCO informed that as per CERC approved procedure, thermal limit of the lines is to be considered and confirmed that same was being followed by them. SRPC were of the view that minimum of thermal limit, voltage limit and stability limit is to be adopted.
- 2.10 Chairperson Sub Group of NRCE pointed out that OLTC operation is another important issue and requires more deliberation. He added that setting of ICT tap position for peak and off peak needed to be looked into. The inherent features provided by the manufacture needed to be tested while commissioning and used during normal operation of the grid. Director, NPC stated that in general there is apprehension by utilities to operate OLTC on frequent basis for voltage control. This issue could be flagged for deliberation by RPCs in OCC meetings. Representatives of NRPC, ERPC, WRPC and SRPC agreed to take up this matter in OCC meetings. CTU stated that the limiting constraint was only due to line loading and not due to the voltage and as such OLTC may not be of much relevance in case of TTC.
- 2.11 During the course of deliberation, it was observed that the computation of TRM (2% of anticipated peak demand(MW)), size of the largest generating unit, size of largest

anticipated infeed) requires further study. The Sub Group were of the view that this could be deliberated in the next meeting.

- 2.12 Chairperson Sub Group of NRCE requested POSOCO to provide the computation details of TTC/ATC/TRM for the month of December 2016 to the Sub-Group along with the assumptions and historical values used in the computation. POSOCO agreed for the same.
- 2.13 Chairperson Sub Group of NRCE opined that CTU is granting LTA for Solar Plants on RTC basis. Since evacuation of power from solar plants are not on RTC, the LTA allocated to solar plants needed to be considered appropriately while computing ATC. CTU representative agreed to look into this aspect and revert on this issue within next two weeks.
- 2.14 The Sub Group decided further deliberation on computation of TRM, methodology and procedure to be adopted for computation of TTC and assessment of spatial distribution of load to various nodes.

3. Review of earlier decisions of NRCE on TTC/ATC/TRM – Status of implementation of decisions

- 3.1 A copy of the earlier decisions of NRCE & Sub Group of NRCE as submitted by NPC representative is given at **Annexure –II**. These earlier decisions were discussed with respect to their compliance and following emerged:
- 3.2 Regular computation/validation of TTC, ATC and TRM for each month: SRPC informed that computation of TTC/ATC at individual level has been carried out for a particular month in which S1-S2 flow was checked, However, these computations could not be presented to NRCE.
- 3.3 Awareness should be brought to all states in the OCC meetings on the need for accurate data at all generation and demand nodes of the power system in the State: Awareness to all states has been brought to in the OCC meetings. WRPC, NRPC, ERPC informed that they would revert back on the follow up action after again taking up in OCC.
- 3.4 Sub-group of NRCE would study whether outage of Fixed Series Compensation on a line could be treated as a contingency and give recommendation to the concerned divisions of CEA for modification of CEA Planning Criteria, if required. Outages of fixed series compensation was not taken up further by NERC. Therefore, it was decided to deliberate the same in next meeting of the sub-Group.
- 3.5 Ambient adjusted thermal rating to be used by POSOCO to calculate TTC and ATC: POSOCO informed that presently, TTC of only S1-S2 is being declared based on the ambient temperature. After deliberation it was decided that a report would be submitted by POSOCO on the status of implementation of ambient adjusted thermal rating.

4. Thermal limit of transmission lines being used by POSOCO for determining TTC:

- 4.1 Chairperson Sub Group of NRCE requested CTU to provide the ratings of terminal equipment of transmission lines of 400kV and 765kV. POSOCO highlighted the issues

experienced with the terminal equipment. One of the issue was melting of Isolator at Dhanaunda. A survey of ISTS Line and Equipment ratings should be conducted, mainly for 400 kV lines.

- 4.2 CTU agreed to provide the details to POSOCO (with a copy to PSPA-II Div, CEA). Based on which POSOCO would prepare a list of thermal loading limits (after duly considering constraint due to terminal equipment ratings) and send the same to Member Convener, Sub-Group and CEA (PSPA-II Div).

5. Other issues:

- 5.1 TANTRANSCO informed that they were facing evacuation issues in respect of wind generation in view of non-availability of transmission corridor. The excess wind generation could be made available to other regions. Therefore, TANTRANSCO suggested that corridor needed to be reserved for wind evacuation. Chairperson Sub Group of NRCE said that matter may be taken up with CERC.
- 5.2 SRPC sought clarification on criteria for deciding upstream / downstream in case of ATC violation on inter regional corridor. It was opined that this matter is not in the purview of the Sub-Group. This, however, may be discussed with the power system planning Division of CEA.

6. Summary of decisions in the Meeting:

- 1) POSOCO to provide the computation details of TTC/ATC/TRM for the month of December 2016 to the Sub-Group along with the assumptions and historical values used in the computation.
 - 2) Further deliberation on computation of TRM, methodology and procedure to be adopted for computation of TTC and assessment of spatial distribution of load to various nodes.
 - 3) Report(s), as discussed above, would be submitted by POSOCO/CTU/RPCs on the status of implementation of the earlier decisions of NRCE.
 - 4) CTU would provide the terminal equipment ratings to POSOCO and CEA. A survey of ISTS Line and Equipment ratings should be conducted, mainly for 400 kV.
 - 5) Utilization of LTA granted for solar power plants to be explored in the next meeting. Members are requested to present their views/observations to the member convener of the Sub-Group.
 - 6) RPCs to take up the issue related to using ICT tap changer for voltage control in OCC meetings and forward the outcome to the member convener, sub-group.
 - 7) Outage treatment of FSC for contingencies to be taken up in next meeting
7. **Next Meeting:** It was decided that the next meeting of Sub Group would be held in November 2016. The date and venue of the meeting would be intimated in due course.

List of Participants

CEA

1. Shri Pardeep Jindal, Chief Engineer (PSP&PA-2) & Chairperson Sub Group NRCE
2. Shri D.K. Srivastava, Director(NPC) & Member Convener, Sub Group NRCE
3. Shri A.K. Yadav, Director(PSP&PA-1)
4. Shri K.P.Madhu, Deputy Director(NPC)
5. Ms Shivani Sharma, Deputy Director(PSP&PA-2)
6. Shri Saurabh Mishra, Assistant Director -I (NPC)
7. Shri Himanshu Lal, Assistant Director -I(NPC)
8. Shri Ajay Kumar, Assistant Director (PSP&PA-2)
9. Ms Kanchan Chauhan, Assistant Director (PSP&PA-2)
10. Shri Suyash Ayush Verma, Assistant Director (PSP&PA-2)

IIT, Delhi

11. Shri A.R. Abhyankar, Associate Professor

WRPC

12. Shri Satynarayana S., Superintending Engineer

NRPC

- 13 Shri Naresh Kumar, Executive Engineer

SRPC

14. Shri Anil, Executive Engineer

ERPC

15. Shri J. Ganeswara Rao, Executive Engineer

POWERGRID

16. Shri Mukesh Khanna, AGM(CTU-Plg)

17. Shri V.Thiagarajan, DGM(CTU-Plg)
18. Shri Pratyush Singh, Engr. (CTU-Plg.)

TANTRANSCO

19. Shri D. Ravi Chandran, SE(System Studies)
20. Shri S. Murali, SE (LDGO)
21. Shri M.Sudarsan, EE (System Studies)
22. Shri K.Kamaraju, EE (ATC)
23. Shri S.Senthil Kumar, AEE (ATC)

POSOCO

24. Shri N.Nallarasn, DGM
25. Shri M.Pradeep Reddy, Sr. Engr.
26. Shri Phanisankar Chilukuri, Engr.

ANNEXURE – A

(copy of the presentations of POSOCO)

Transfer Capability

POSOCO

Outline

- Input Data and Source
- Power System model
- TTC Assessment
- Transmission Reliability Margin (TRM)
- Summary
- NRCE recommendation
- Some other important aspects

Guidelines for assessment of TTC/ATC

- Central Electricity Regulatory Commission (Measures to relieve congestion in real time operation) Regulations, 2009.
 - Regulations issued on 22nd Dec 2009
 - Procedure approved by CERC on 11th June 2010
 - Amendments to procedure approved on 22nd April 2013

Input Data for Base Case Preparation...1

• **Network Topology:**

- As per network data obtained from CTU and STUs.
- New transmission elements considered only after declaration of commercial operation of that asset.

• **Unit Availability:**

- As per the maintenance schedule finalized by RPC.
- New generating units considered only after declaration of commercial operation of new units.

• **Coal Fired Thermal Despach:**

- As per the anticipated ex-bus generation of the thermal generating units

• **Gas/ Nuclear Despach:**

- As per past trend of Plant Load Factor available

Input Data for Base Case Preparation...2

- **Hydro Despatch:**

- As per the past trend available at RLDCs/ SLDCs.
- The day corresponding to the median value of daily consumption of the same month last year would be chosen.

- **Reactive power capability of generating units:**

- As per the generator capability curve
- (or) based on the assumption recommended in CEA's Manual on Transmission Planning Criteria, Jan 2013.

- **Nodal MW and MVAR demand :**

- Legacy data and assumed power factor

Input Data and Source

S No.	Input Data	Suggested Source
1	Planning Criteria	Manual on Transmission Planning Criteria (TPC) issued by CEA, Jan 2013
2	Network Topology	Existing network with full elements available (CTU)
3	Transmission line limits	Minimum of thermal limit, stability limit and voltage limit (CEA TPC)
4	Thermal unit availability	Load Generation Balance report, Maintenance schedule (RPC)
5	Thermal despatch	Ex bus after deducting the normative auxiliary consumption Output
6	Gas based thermal despatch	Past trend, PLF (CEA)
7	Hydro despatch	Peak and off peak actual hydro generation on median consumption day of same month last year (RLDCs)
8	Load	Anticipated load (CEA LGBR / RLDCs)
9	Credible contingencies	Planning criteria (CEA TPC)

Power System model considered for simulation studies

- EHV transmission network normally modelled down to 132 kV
- All generating units greater than 50 MW and connected at 132 kV and above are modelled
- Load is generally lumped at 132 kV or below
- Separate base cases
 - corresponding to both peak and off- peak load
 - export and import capability

TTC Assessment

- Total Transfer Capability between two areas assessed by
 - TLTG function in PSS/E
 - Increase generation in exporting area and decrease generation in importing area.
 - Repeated full AC Power flow
 - Increasing the load in the importing area and increasing the generation in the exporting area
 - till any constraints are hit for a credible contingency

Limiting constraints for various corridors

- POSOCO/NLDC Website Sheet
- [http://posoco.in/WebsiteData/Market/MonthlyATC/InterRegional/2016-2017/September%202016/ATC NLDC Sep%2716 Rev4.pdf](http://posoco.in/WebsiteData/Market/MonthlyATC/InterRegional/2016-2017/September%202016/ATC%20NLDC%20Sep%2716%20Rev4.pdf)

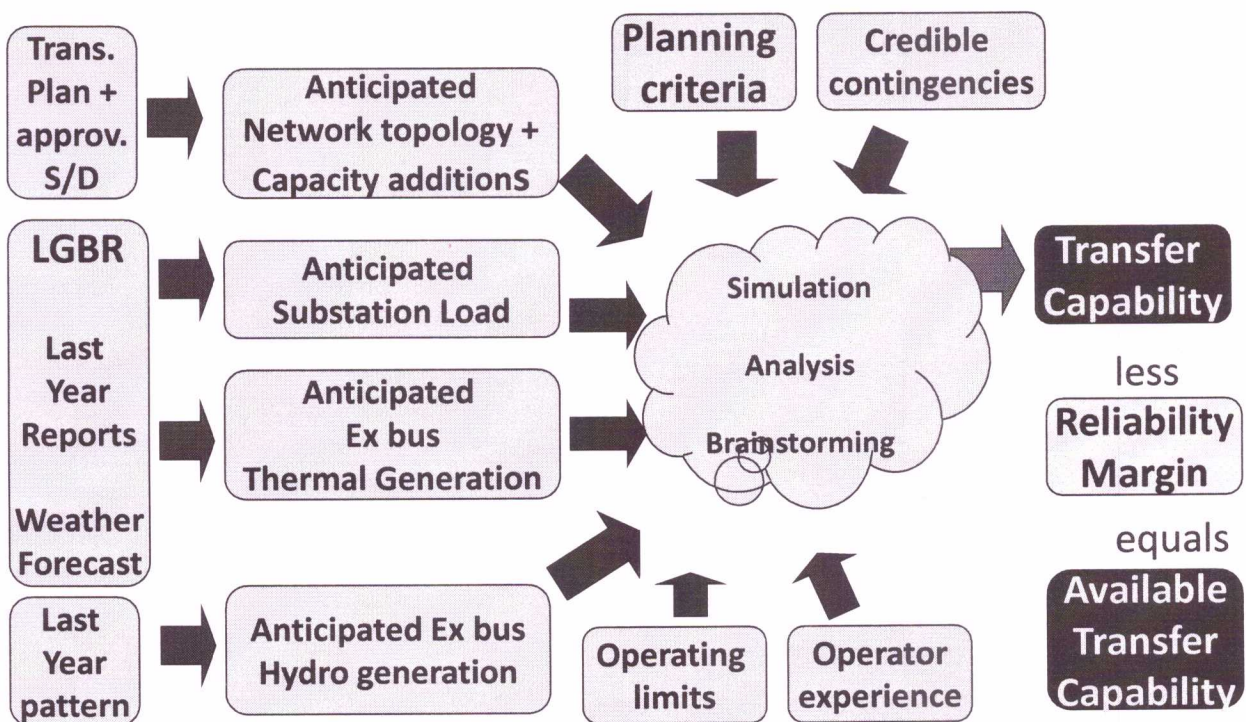
Credible contingencies considered while assessing TTC

- Outage of single transmission element (N-1) in the transmission corridor or connected system
- Outage of a largest unit in the importing control area station
- Violation of grid voltage operating range
- Violation of transmission element loading limit in n-1 contingency case
- Violation of emergency limit in the n-1-1 contingency case
- Angular difference of 30 degrees between adjacent buses under n-1 contingency

Transmission Reliability Margin (TRM)

- Two percent (2%) of the total anticipated peak demand met in MW
 - Of the control area/group of control area/region
 - To account for forecasting uncertainties
- Size of largest generating unit in the control area/ group of control area/region

Transfer Capability assessment



Permissible Normal and Emergency Loading Limits

- The loading limit for a transmission line is its thermal loading limit.
- The loading limit for an ICT is its name plate rating

Steady State Voltage Limits

Voltage (kV rms)		
Nominal	Maximum	Minimum
765	800	728
400	420	380
220	245	198
132	145	122

NRCE recommendation

- To assess TTC considering the temperature dependent thermal ratings of the lines and terminal equipment.
 - POSOCO received certification from some equipment owners
 - S1-S2 TTC declared by considering ambient temperature compensation
 - Historical maximum temperature of the month as per IMD
 - 5 degrees added as margin as per NRCE guidelines
 - $\Delta T\%$ increase in ampacity considered from the design specifications

Some other important aspects

- Power flow database
- Load modeling
 - Node wise data / State Estimator model
 - Voltage dependency data
- Dynamic data of Power Plants
 - Generator
 - PSS
 - Exciter
- Validation of Power flow and Dynamic data
 - using SCADA data
 - using PMU data
- Sequence data

Terminal equipment surprises

- Dhanaunda
- Nevada
- Sorang
- Teesta-III
- NTPL
- Parbati-iii

Simultaneous import of NR...1

- Base case is set up
- Will include the LTA/MTOA contracts operationalized
- WR regional power surplus in the base case
 - Sum of LTA/MTOA contracts of WR generators with other regions.
- Similar is the case with ER
- These base case flows after running the Power flow
 - Would approximately match with the LTA/MTOA contracts on WR-NR path and ER-NR path
 - 100% of LTA/MTOA can requisitioned daily

Simultaneous import of NR...2

- For assessing WR-NR TTC
 - Generation in WR and Load in NR are increased in the base case
 - Power flow is run till constraints are observed in the grid.
 - WR – NR transfer limit is obtained.
 - These changes are generally made considering the merit order.
- For instance, in case of WR-NR
 - Generation is most likely to increase in Chhattisagr, Vindhyachal and Sasan or CGPL
 - While reduction is most likely at Jhajjar, Dadri (T).

Simultaneous import of NR...3

- The real time flow pattern on WR-NR, ER-NR and the ratio of WR-NR flow with respect to the total NR import
 - Observed from the historical data.
- This will contain the inherent but indirect 'information'
 - Regarding which all generators are being dispatched and the seasonal weather pattern.
- Day Ahead Power Exchange, STOA market, Ancillary Services
 - All influence the schedules in addition to the LTA/MTOA contracts.
- Seasonal and present weather patterns influence the requisitions of the drawl entities (States/DISCOMS).

Simultaneous import of NR...4

- It may be noted that Costly plants (like Jhajjar, Barh etc.) get rarely scheduled but might influence TTC.
- POSOCO keeps a mid-way stand on this
 - Usually Jhajjar, Barh generations will never be dispatched full while calculating the limit
 - Done looking at the requisition trends.
- Simultaneous import of NR is then calculated
 - By dividing the WR-NR TTC limit with the real time ratio trend of WR-NR flow with respect to the total NR import

Thank You

ANNEXURE – B

(copy of the presentations of CTU)

**TTC Computation
by Central Transmission Utility –
Planning**

By
CTU – Planning Group, POWERGRID

19th September 2016

OBJECTIVE

OBJECTIVE-Methodology Should

- To see that commitments are met-LTA & MTOA
- Power flow scenario should be similar to simulation
- Come up with a value – Without any intervention

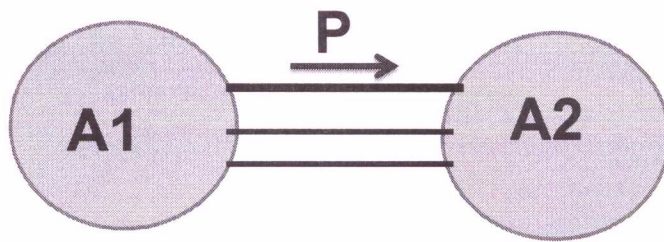
Methodology used world over

Rated System Path method

Area Inter Change method

Flow Gate method

Rated System Path method



Increase the power transfer among the regions till constraint is hit. **Measure the powerflow over identified Transmission lines.**

This method is ideal for a system which does not consist of meshed network and there exist well-defined interfaces between them, or there are good controls on the flows of the paths

Rated System Path method

Advantage

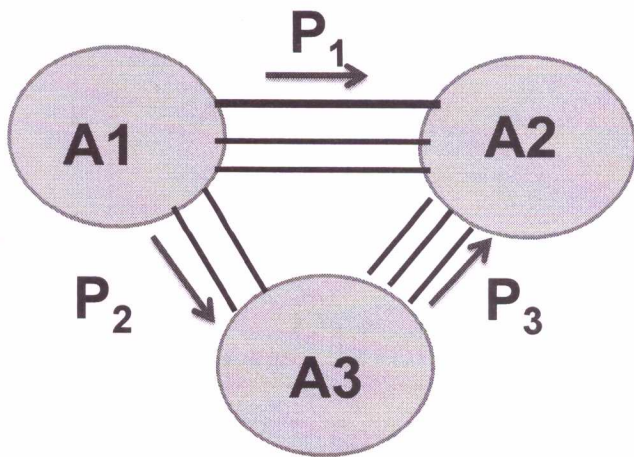
- Simple and straight forward
- Gives almost fixed value

Disadvantage

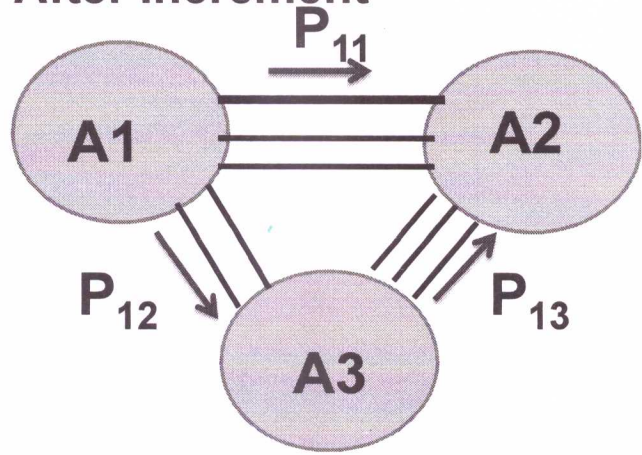
- Not suitable for meshed network

As corridor loading is monitored, the loading on parallel path is added to calculate ATC

Base Case



After Increment



Power Transfer as per RSP= $(P_{11})-(P_1)$

Actual Allowed Power Transfer = $(P_{11}+P_{A12})-(P_1+P_2)$

Allowed Power transfer from A1 to A2 would also depend upon P_2 and P_3 in addition to P_1

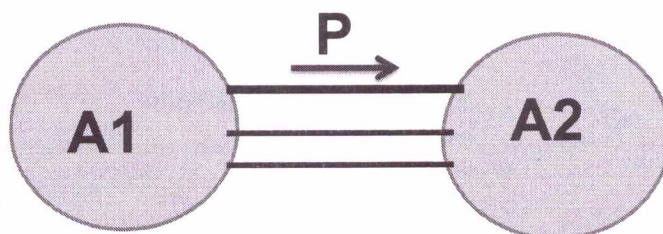
LGBR- Jun'2015

Sl. No.	Name of Area	Generation availability (MW)	Peak Load (MW)	Export/Import	LTA/MTOA
1	Northern Region	41650	49220	(-)10941	(-)4351- ER (-) 6590 -WR
2	Western Region	58100	50860	7307	6590-NR (-)1383 ER 2100-SR
3	Eastern Region	26070	21520	8052	1383-WR 4351-NR 1808-SR 510-NER
4	Southern Region	39520	43450	(-)3908	(-)1808-ER (-) 2100- WR
5	North-Eastern Region	1366	2383	(-)510	(-510)-ER

	Inter-Regional Flow				
	WR->NR	ER->NR	WR->ER	ER->SR	WR->SR
BASE CASE	6226	4714	223	2607	1304
MAX WR EXPORT TO NR-Limit hit at WR GEN INCR by 565 MW	6645	4857	-74	2607	1307

- With 6590MW WR-NR TRANSFER FLOW ON WR-NR IS 6226MW
- WITH 7155MW WR-NR TRANSFER FLOW ON WR-NR IS 6645MW
- IF RSP IS USED THEN WR-NR IS 6645MW WOULD BE DESPATCHED AND RESULTING FLOW WOULD BE LESS THAN 6226MW. CAPACITY NOT UTILISED OPTIMALLY

Area Interchange method



- Increase the power transfer among the regions till constraint is hit.
- Measure the quantum of Export and imports of the region
- This method can be used for meshed networks as we are measuring regional increase and decrease

Inter Area method

Advantage

- Output in area export/import

Disadvantage

- Does not give a single value.

	Inter-Regional Flow				
	WR->NR	ER->NR	WR->ER	ER->SR	WR->SR
BASE CASE	6226	4714	223	2607	1304
MAX WR EXPORT TO NR-Limit hit at WR GEN INCR by 565 MW	6645	4857	-74	2607	1307
MAX ER EXPORT TO NR Limit hit at ER Gen-INCR 650 MW	6587	5005	--565	2607	1272

- With 6590MW WR-NR & 4351MW ER TO NR ON WR-NR IS 6226MW
- WITH 7155MW WR-NR TRANSFER FLOW ON WR-NR IS 6645MW
- WITH 5001MW ER-NR TRANSFER FLOW ON WR-NR IS 6587MW
- HOWEVER BOTH 7155MW WR-NR AND 5001MW ER-NR CANNOT OCCUR AT SAME TIME

Hybrid Methodology used by CTU

Proposed hybrid methodology tries to capture the advantages of both methods to arrive at the optimum value

- Base case established considering all LTA, MTOA and inter-area Govt allocations. These are base values- **Inter Area methodology**
- On this base value incremental values are calculated -**Rated System path method**

Example – Import to NR

- Initial contracts scheduled & considered in base case:
 - WR-NR : x
 - ER-NR : y
- WR MAX Case: Generation in WR is increased and Generation in NR is decreased globally in the base case till constraints are observed. Flows are noted
- ER MAX Case: Generation in ER is increased and Generation in NR is decreased globally in the base case till constraints are observed. Flows are noted

Example – Import to NR

- Possible incremental transfer with respect to base case in WR MAX CASE:
 - WR-NR : Δx_1 & ER-NR : Δy_1
- Possible incremental transfer with respect to base case in ER MAX CASE:
 - WR-NR : Δx_2 & ER-NR : Δy_2

WR – NR TTC : In order to be conservative in calculating WR-NR TTC values, $\min(\Delta x_1, \Delta x_2)$ is added with x (base case WR-NR transaction)

ER – NR TTC : In order to be conservative in calculating ER-NR TTC values, $\min(\Delta y_1, \Delta y_2)$ is added with y (base case ER-NR transaction)

$$\text{NR Import Capability} = \text{WR-NR TTC} + \text{ER-NR TTC}$$

Case	WR->NR	ER->NR
i Base case export (Ref Table-1)	6590	4351
ii Corridor loading under base case (Ref Table-2)	6226	4714
iii Corridor loading under Max WR export to NR (Ref Table-2)	6645	4857
iv Corridor loading under Max ER export to NR (Ref Table-2)	6595	4961
v Increment over base case in the corridor when 565 MW exported from WR [(iii)-(ii)]	6645-6226 =419	4857-4714 =143
vi Increment over base case in the corridor when 650 MW exported from ER [(iv)-(ii)]	6587-6226 =361	5005-4714 =291
vii Proposed Total feasible export over corridor (i) + (vi) (Considering Minimum value)	6590+361 =6951	4351+143 =4494

Corridor	Time Period	Total Transfer Capability (TTC)	Reliability Margin	Available Transfer Capability (ATC)	Long Term Access (LTA)/MTOA by June'15	Margin Available
WR-NR	June 2015	6951	500	6451	6090	361
ER-NR	June 2015	4494	500	3994	3851**	103

**LTA/MTOA already provided

Flow Gate Methodology

Define flow gates and ensure that powerflow are within limits. Presently inter regional links are acting as natural flow gates.

Some examples includes Flow gates identified for S1-S2 and Kerala. Similar flow gates for other regions need to be identified. As we do TLTG the same is ensured

Soon load drawl limit would also act as additional flow gates

CTU Methodology

The strengths of all three methods have been used to meet our requirements.

The methodology takes care of simultaneous and Counter flow etc



Discussion.....

NRCE Decisions on TTC/ATC/TRM

A. Sub-Group of NRCE: Three Meetings held

Meeting	Date	Decisions Taken in the Sub-Group Meetings
First	23.05.2014	<p>POSOCO presented the methodology of calculation of TTC/ATC and TRM of the transmission corridors/flow gates.</p> <ul style="list-style-type: none"> i. The time being too, short, the values of TTC, ATC and TRM could not be examined this time, since the System Studies and data could not be examined in detail. Therefore, the TTC, ATC and TRM could not be certified by the Sub-Group for June, 2014. Moreover, the methodology of calculation of TTC, ATC and TRM by POSOCO had to be examined before certifying the same. ii. It was suggested, that in the Note under the TTC, ATC and TRM between Western and Northern Regions given in the web-site, a line may be added after the line on "Loop flows", in order to clarify the same and also justify the System Protection Scheme (SPS) setting on 765 KV Agra-Gwalior 765 KV line. iii. The Sub-Group would have to meet again a few times to give their recommendations to NRCE on methodology and modalities of calculation of TTC, ATC and TRM, within the frame work of the CERC Regulations, for approval. iv. POSOCO was requested to carry out the study of decreasing the relevant generation in the importing region/ Control Area as per realistic terms, rather than increase of demand, to see if this results in a more realistic determination of TTC, ATC and TRM. v. It was decided to put the issue of approval of SPS settings of the entire national grid before the NRCE.
Second	10.06.2014	<ul style="list-style-type: none"> i. Awareness should be brought to all states in the OCC meetings on the need for accurate data at all generation and demand nodes of the power system in the State. ii. System Protection Schemes have been put in place as contingency measures. All the RPCs would take this up as agenda item in the OCC meetings to ensure that the relays of these schemes are not bypassed. iii. In order to check the actual power flow vis-a-vis the ATC, it was decided that the power flows in certain critical transmission corridors would be studied, like the S1-S2

		<p>corridor and the corridor between Western and Northern Regions.</p> <p>iv. The matter of issuing guidelines for load ability of line taking into consideration the ambient temperature would be put up to the NRCE for decision.</p> <p>v. The matter of having reserves and Automatic Generation Control(AGC) in each state to control the variation of flows on inter-state lines would be put up to the NRCE for decision.</p>
Third	08.09.2014	<p>i. Feasibility of using the auto insertion of the FSC in on Bolangir- Jeypore section in Eastern Region may be explored.</p> <p>ii. FACTS Devices like phase shifters should be used to transfer power from heavily loaded lines to lightly loaded lines in a corridor, for optimum utilization of existing assets.</p> <p>iii. The possibility of adding another circuit in parallel with 400 KV Maithon RB-Maithon D/C line, with Eastern Region, may be explored, keeping in view the Overall transmission system development.</p> <p>iv. Since power flow fluctuates in the tie lines, the SPS, which is used for preventing thermal overloading of the tie-line, should not operate instantaneously but with a time delay, considering the operational emergency rating.</p> <p>v. It was decided that the SPS of Gwalior-Agra 765 KV D/C line, should be set in accordance with tripping of one circuit of Gwalior-Agra 765 KV line, rather than loading of the line. This would be put up to NRCE for vetting. Moreover, since this is a critical line, a redundant SPS could be provided with separate CT input, separate communication channel and separate loads for load reduction.</p>

B. National Reliability Council for Electricity (NRCE): Six Meetings held

Meeting	Date	Decisions Taken in the Meetings
First	20.03.2014	<p>i. Constituted a sub-group for examination of the system studies for the purpose of TTC, ATC and TRM on monthly basis.</p> <p>ii. POSOCO to be a special invitee to NRC</p> <p>iii. National Reliability Council would be named National Reliable Council for Electricity (NRCE).</p> <p>iv. Member secretary, NRCE would explore the possibility of signing of MoUs with other National</p>

		Reliability Organizations of developed countries for assimilating best practices.
Second	26.05.2014	i. Decided that the sub-group would interact with NLDC to find out the methodology of determination of TTC.ATC and TRM, sometime between 10 th and 15 th June 2014.
Third	01.08.2014	<p>i. Representatives of private players, M/s. JPL & M/s Sesa Sterlite Ltd were co-opted as members of NRCE.</p> <p>ii. The proposal of reserves and AGC by each state would be put up in all the RPCs for discussion and approval.</p> <p>iii. Decided that ambient adjusted thermal rating would be used by POSOCO to calculate the TTC & ATC. Directions for the same be issued by the NRCE to POSOCO, after approval of the Authority.</p>
Fourth	15.10.2014	<p>i. It was agreed that certification may be taken by POSOCO from the owners of lines where the current is enhanced beyond the normal ampacity rating of the line due to ambient adjusted loading for emergency loading, that enhanced current carrying capacity of the terminal equipments is available. Certification also to be taken for the relay settings in the sub-stations so that enhanced current can flow smoothly. Necessary changes in the operational guidelines would be carried out accordingly.</p> <p>ii. NRCE would attach a table to the operational guidelines for loading of lines at different ambient temperatures, at an interval of 2^o C, to prevent dispute between beneficiaries and POSOCO.</p> <p>iii. CTU should furnish such information to POSOCO like multi-circuit tower portion in a transmission corridor, and other such information which may affect system operation, for it to take appropriate decisions.</p> <p>iv. Sub-group of NRCE would study whether outage of Fixed Series Compensation on a line could be treated as a contingency and give recommendation to the concerned divisions of CEA for modification of CEA Planning Criteria, if required.</p>

Fifth	09.02.2015	<p>i. The Operational Guidelines for the System Operator for calculation of TTC and ATC in the short term horizon of 0 to 3 months would be issued.</p> <p>ii. It was proposed that consultants would be hired for calculation of TTC, ATC and TRM on a monthly basis. Conducting a three yearly audit of the entire grid w.r.t. angular stability, voltage stability, recommendation of appropriate SPS etc. by an international specialist consultant and also interaction with other international reliability agencies and capacity building. The proposal of NRCE would be sent for approval of the MoP.</p>
Sixth	17.03.2016	<p>i. Implementation of CERC order dated 05.08.2015 – Preparation of reliability Standards for “Protection System” and “Communication System” for Indian Power System - <i>A Subgroup has been formed to finalize the standards.</i></p> <p>ii. Proposals for budgetary provision from MoP for hiring international consultant to conduct three yearly audit of the entire grid as well as hiring consultant to do monthly system study for calculation of TTC/ATC/ TRM has been postponed for three years as PGCIL has appointed Consultant B (M/s Powertech Labs) to conduct the study / analysis to ensure secure & reliable operation of National Grid. They are also carrying out the system studies for the entire grid along with analyzing the issue of Protection Coordination.</p> <p>iii. The Sub Group of NRCE reconstituted for finalizing the methodology for computation of TTC/ATC/TRM as per the decision in the first meeting has been reconstituted with Chief Engineer (PSP&A-2), CEA as Chairperson and members from PSP&A-1 (CEA), all RPCs, CTU, TANTRANSCO, MSETCL and IIT-Delhi. The Sub Group would decide the methodology for monthly calculation of TTC/ATC/TRM or calculate TTC/ATC/TRM if necessary, for monthly approval. Sub-group would also explore alternate methods of calculation of TRM.</p>