ATC-TTC for March'2015

I. Background:

While planning transmission system under Long term Access, some inherent margins become available. These margins are generally utilized for transfer of power under STOA/MTOA. However margins are dependent on many factors including generation scenario, load profile, network configuration etc. and accordingly value of TTC/ATC may vary time to time depending on these factors. For calculating the value of TTC/ATC studies have been carried out and for base case, LTA and MTOA already granted and operationalised upto that period has been taken into account and despatch considered accordingly.

II. Major assumptions for Base case :

1. Studies have been carried out for 1st March, 2015 condition.
2. Regionwise loads have been taken based on peak load data published by POSOCO for March 2015, as these data are more close to the present power supply scenario in comparison with CEA LGBR report of 2014-15 (which was published in May 2014). Further, export/import in various regions has been considered based on various LTAs/MTOAs which are operationalized as per allocations to various regions.
3. Rihand-III (2x500MW) and one unit of Vindhyachal-IV (1x500MW) have been considered to be directly connected to NR as they are envisaged to get connected with Vindhyachal Pool substation of WR only after the commissioning of Gwalior-Jaipur 765kV lines.
4. In the study, for working out TTC/ATC, presently operational 1250MW limit on Agra-Gwalior 765kV line has been considered. The loading limits of rest of the lines are thermal limits.
5. Reverse flow from NR to WR & SR corridor has not been considered.

The summary of load generation balance used for base case after considering all LTA & MTOA upto March 2015 is as given below:

Table-1 : Load Generation Balance

Sl. No.	Name of Area	Generation availability (MW)	Peak Load (MW)	Export/ Import	LTA/MTOA
1	**Northern Region**	31058	39041	(-)8000	(-)2431- ER (-) 4768 –WR
2	**Western Region**	54706	48170	6500	4768-NR (-)874 ER 1350-SR
3	**Eastern Region**	21909	15358	6505	874-WR 2431-NR 2650-SR 210-NER
4	**Southern Region**	29866	34637	(-)4750	(-)2650-ER (-) 1350- WR
5	**North-Eastern Region**	962	1220	(-)250	(-)210-ER

Allocation and TRM assumed is given in Annexure-I

III. SIMULATION STUDIES

TTC/ATCacross regional flow gates has been simulated. Maximum feasible power transfer through regional flow gates has been calculated as described below.

Southern region and North Eastern regions are synchronously connected to one region only, on the other hand ER, NR and WR are synchronously connected to more than one Region leading to loop flows.

Transmission Interchange Limit Calculation function (TLTG) in PSS/E has been used for estimating the maximum allowable power transfer through the flow gates. The function TLTG works by uniformly increasing generation in one area (study system) and decreasing generation in the other area (opposing system). The incremental allowed capacity over and above base case is determined.

WR-NR & ER-NR Flow Gates

Table-2 summarises inter-area power flows and region wise surplus/deficits in the base case as well as WR-NR and ER-NR limiting cases. In both conditions limiting condition was the loading on Gwalior-Agra line.

Table-2

	Inter-Regional Flow					Total Import(-)/ Export(+)				
	WR->NR	ER->NR	WR->ER	ER->SR	WR->SR	NR	WR	ER	SR	NER
BASE CASE (Based on LGB as given in Table-1)	4154	3840	260	2650	2121	(-)7994	(+)6536	(+)6489	(-)4771	(-)250
MAX WR EXPORT TO NR-Limit hit with WR Gen increased by 1040 MW	4919	4116	548	2650	2121	(-)9034	(+)7588	(+)6477	(-)4771	(-)250
MAX ER EXPORT TO NR Limit hit with ER Gen increased 2215 MW	4939	5238	-556	2650	2091	(-)10177	(+)6474	(+)8704	(-)4741	(-)250

From the table above, it is inferred that with an increase of generation in WR and corresponding decrease in NR by about 1040MW, Agra-Gwalior 765kV line loading reaches to 1250MW/Ckt (In the base case, the loading on Agra-Gwalior 756kV line is 982MW/Ckt). Similarly, with an increase of generation in ER by about 2215MW and corresponding decrease in NR, constraint is again observed on Agra-Gwalior 765kV line.

Since, incremental export of 1040MW in WR and the incremental export of 2215MW in ER cannot co-exist without hitting limiting constraint on Agra-Gwalior 765kV line, the capacity of WR-NR and ER-NR corridor is worked out as follows.

Table-3

	Case	WR->NR	ER->NR	Total Export to NR
i	Base Scenario (Ref Annexure -I) including TRM : Export to NR from WR & ER	5268	2731	7999
ii	Corridor loading under base case (Ref Table-2)	4154	3840	7994
iii	Corridor loading under Max WR export to NR (Ref Table-2)	4919	4116	9035
iv	Corridor loading under Max ER export to NR (Ref Table-2)	4939	5238	10177
v	Increment over base case in the corridor when 1040 MW exported from WR (iii)-(ii)	4919-4154 = 765	4116-3840 = 276	-
vi	Increment over base case in the corridor when 2215 MW exported from ER (iv)-(ii)	4939-4154 = 785	5238-3840 = 1398	-
vii	Proposed Total feasible export over corridor (i) +(v/vi) (Considering Minimum value)	5268+765 = 6033	2731+276 =3007	9040

WR-ER Flow Gate

WR-ER TTC has been calculated on the base case. In the base case, a power flow of 260 MW was observed from WR to ER. Transfer of additional 1500MW was only feasible over this corridor due to constaint observed in 400 kV Raigarh- Raigarh Kotra 400 kV D/c line in N-1 contingency. The TTC between WR- ER works out to 1760 MW. Further, as mentioned above, additional 1040 MW from WR to NR can be transferred due to constraint observed over Agra- Gwalior 765 kV corridor. As such, the loading on WR-ER corridor would depend on WR export to NR and ER. Accordingly simultaneous export capacity of WR to ER and NR would be 6300MW (5268+1040MW).

ER-WR Flow Gates

As per simulation studies on the base case, power flow from WR to ER is 260 MW. For working out the TTC, generation increase of about 2900 MW was feasible in ER with corresponding decrease in WR due to constaint in loading of 400 kV Chandrapur II - Warora in N-1 contingency. Further, as mentioned above, over Base case additional 2215 MW from ER to NR can be transferred due to constraint observed over Agra- Gwalior 765 kV corridor. Thus TTC between ER to WR is 2640 MW. However, the loading on ER-WR corridor would depend on ER export to NR & WR. Accordingly simultaneous export capacity of ER to WR and NR would be about 4950MW (2731+2215 MW).

ER-NER Flow Gates

As per simulation studies on the base case, power flow from ER to NER 250 MW. For working out the TTC, generation increase of about 960 MW was feasible in ER with corresponding decrease in NER due to constaint in loading of 400 kV Farakka – Malda in N-1 contingency. The TTC from ER to NER works out to about 1200 MW.

The table below summarises the TTC (rounded off) over the various regional Flow gates .

Table-4 : TTC/ATC Regional Flow Gate wise

Corridor	Total Transfer Capability (TTC)	Transmission Reliability Margin (TRM)	Available Transfer Capability (ATC)
WR-NR	6030	500	5530
ER-NR	3010#	300	2710
WR-ER	1760	300	1460
ER-WR	2640	300	2340
WR-SR[1]	2100	750	1350

ER-SR[1]	2650	0	2650
ER-NER	1200	40	1160

[#]The ER-NR TTC is likely to increase substantially with the commissioning of Barh, North Karanpura etc. in the northern part of ER whose power would directly be evacuated over the ER-NR corridor instead of ER-WR-NR corridor.

1. Presently declared TTC has been indicated as no addition in transmission system is envisaged from New Grid to SR up in Feb' 2015.

Table-5 : Export /Import Capacity Region Wise

Region	Export(+)/Import(-) Capacity
WR	(+)6300[@]
ER	(+)4950[@]
NR	(-)9040
SR[1]	(-)4750

[@]Excluding power transfer to Southern Region

Note: The above values are indicative. Based on studies carried on receipt of LTA Applications or MTOA application, margins beyond this capacity may occur depending upon *the injection and drawl points. Accordingly, the LTA/MTOA shall be dealt with to assess the margins beyond this declared capacity.*

Annexure – I

LTA/MTOA					
	ER	NR	WR	SR	NER
ER	0	2431	874	2650	210
NR					
WR		4768		1350	
SR					
NER					
TRM (As declared by POSOCO)					
	ER	NR	WR	SR	NER
ER		300			40
NR					
WR		500		750	
SR					
NER					
LTA/MTOA + TRM					
	ER	NR	WR	SR	NER
ER		2731	874	2650	250
NR					
WR		5268		2100	
SR					
NER					