

# पावर सिस्टम ऑपरेशन कॉरपोरेशन लिमिटेड

(पावरग्रिड की पूर्ण स्वामित्व प्राप्त सहायक कंपनी)

## POWER SYSTEM OPERATION CORPORATION LIMITED

(A wholly owned subsidiary of POWERGRID)



पंजीकृत एवं केन्द्रीय कार्यालय: बी-9, प्रथम तल, कुतुब इंस्टीट्यूशनल एरिया, कटवारिया सराय, नई दिल्ली-110 016  
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Exhibit-VII

POSOCO/TTC

12<sup>th</sup> January 2013

To,

The Chief Operating Officer,  
Central Transmission Utility,  
Power Grid Corporation of India Limited,  
'Saudamini', Sector-29, Gurgaon

**Sub: Details of long transmission lines whose loadability could be enhanced through suitable measures**

Sir,


This is with reference to the Record of Proceedings (ROP) of the hearing on 20<sup>th</sup> Dec 2012 in petition no 188/SM/2012 before the Hon'ble Central Electricity Regulatory Commission (CERC) uploaded on the Commission's website on 2<sup>nd</sup> January 2013. As per this ROP, POSOCO has been directed by the Hon'ble Commission to submit the list of lines where reactors could be removed in terms of Regulation 2.2j of the Indian Electricity Grid Code (IEGC) to the CTU.

In compliance with this order, please find attached a brief note in the matter along with the list of lines for further necessary action.

Thanking you,

Yours faithfully,

Encl: as above

  
(A. Mani) 12.1.2013

Additional General Manager

Copy to:

- 1) Member (Power Systems), CEA, Sewa Bhawan, R.K. Puram, New Delhi

**Power System Operation Corporation Limited  
National Load Despatch Centre  
New Delhi**

12<sup>th</sup> January 2013

**Sub: Calculation of Total Transfer Capability (TTC), Available Transfer Capability (ATC) and Transmission Reliability Margin (TRM)**

**Ref: Record of Proceedings (ROP) of hearing on 20<sup>th</sup> Dec 2012 before the Central Electricity Regulatory Commission (CERC) in petition no 188/SM/2012.**

**1.0 Introduction:**

The Hon'ble CERC vide the above ROP had directed as under:

Quote

*10. After hearing the parties, the Commission directed the following:*

*(a) POSOCO shall conduct the load flow and stability studies for calculation of TTC/ATC/TRM and shall submit the results to CEA who shall study the results and file its comments before the Commission with copy to POSOCO and CTU by 10.1.2013;*

*(b) CTU shall submit on affidavit by 10.1.2013 with copy to POSOCO and CEA the details of STU lines requiring review of zone-3 settings alongwith its suggestions for proper implementation at RPC level;*

*(c) POSOCO shall submit to the CTU the details of the lines on which reactors need to be removed in terms of Regulation 2.2(j) of the Grid Code;*

*(d) POSOCO shall file its response to the submission of CEA and CTU in terms of (a) and (b) above by 15.1.2013.*

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

Unquote

The above ROP was uploaded on the Commission's website on 2<sup>nd</sup> January 2013.

**2.0** The Manual on Transmission Planning Criteria issued by CEA in June 1994 has a section on permissible line loading limits specified at Section 4.0. The following considerations affect the permissible line loading as per this section and the Surge Impedance Loading (SIL) has to be suitable multiplied by these factors:

- Shunt compensation in the form of line reactors (factor k1) which reduces the loadability
- Series compensation in the form of series capacitors which increases the line loadability (factor k2)
- St Clair curve which specifies the loadability in terms of line length and SIL (factor k3).

It is presumed that CTU and CEA have considered these factors specified in the Manual of Transmission Planning Criteria while planning for the transmission system so far.

**3.0** Based on the above stipulations in the Transmission Planning Criteria, a committee comprising of CTU, CEA and POSOCO had between August to October 2012 worked out the maximum loadability limits for nearly 800 transmission lines of 400 kV and above and close to 3000 lines at 220 kV.

The following observations emerged for the 400 kV and above lines.

- Ninety-eight (98) lines have maximum loadability value less than SIL (list at Annexe-1).
- Two hundred and twenty two (222) lines have maximum loadability between SIL and thermal limit (list at Annexe-2).

**4.0** The following options may be examined by the CTU to improve loadability of the above lines to thermal limit.

- Average line length of Annexe-1 lines is 297 kms. with maximum length of 485 kms. and minimum length of 84 kms. Out of the 98 Annexe-1 lines, 91 lines have a line reactor at both ends and 10 of these 91 lines also have series compensation. Loop-In-Loop-Out (LILO) of these lines at an intermediate point which is a load centre can be considered so that the line lengths are reduced. Based on studies, the shunt reactors on these lines can either be converted to bus reactors or removed altogether.
- In case LILO of the lines at Annexe-1 is not feasible, the lines may be series compensated to improve loadability. As stated above, 10 lines out of 98 already have series compensation.
- There are a few lines like 400 kV Palakkad-Trichur D/C, 400 kV Sterlite-Rourkela D/C which are 84 km and 113 km respectively but which have line reactors at one end. These could possibly be either removed or converted as bus reactor after studies.
- In respect of Annexe-2 lines, the average line length is 203 kms. with a maximum line length of 397 kms. and minimum length of 80 kms. 26 out of the 222 Annexe-2 lines are series compensated. The following lines have very poor loadability vis-à-vis thermal limit and needs examination by the CTU. (of the order of 50% of thermal limit)
  - 400 kV Biharsharif-Balia D/C.....Quad
  - 400 kV Patna-Balia D/C.....Quad
  - 400 kV Barh-Balia D/C (now LILO at Patna and therefore Patna-Balia circuits 3 and 4)...Quad

- d. 400 kV Balia-Sasaram.....Quad
  - e. 400 kV Gwalior-Agra D/C.....would be upgraded to 765 kV....Quad
  - f. 765 kV Moga-Bhiwani.....Quad
  - g. 400 kV Bareilly (PG)-Meerut D/C despite 30% series compensation.
  - h. 400 kV Purnea-Muzaffarpur D/C despite series compensation and Quad
  - i. 400 kV Kaithal-Meerut D/C.....HSIL
  - j. 400 kV Koteswar-Meerut D/C.....would be upgraded to 765 kV.....Quad
  - k. 400 kV Baripada-Mendhasal D/C
  - l. 400 kV Barh-Patna 2 x D/C.....Quad
  - m. 400 kV Kahalgaon-Barh D/C.....Quad
  - n. 765 kV Seoni-Wardha D/C.....Quad
  - o. 400 kV Bachau-Ranchodpura D/C.....Triple Snowbird
  - p. 400 kV Bina-Gwalior D/C.....would be upgraded to 765 kV.....Quad
- v) For Annexe-2, wherever possible, line reactors, wherever connected, could be converted to bus reactors or made switchable based on studies.
- vi) In respect of Annexe-2 lines, wherever there is no line reactor the lines could be series compensated. (26 lines are already series compensated).

In this regard attention is also invited to the minutes of the meeting taken by Member (PS), CEA on 26<sup>th</sup> Sep 2012 circulated by CEA vide letter dated 3<sup>rd</sup> Oct 2012. Para 5.1 and 5.2 of the minutes is reproduced below.

- 5.1 For lines of length less than 200 km having shunt compensation, the possibility of disconnection of shunt reactors or making them switchable may be explored so that VAR consumption by the line could be reduced - action by POWERGRID.
- 5.2 The reactive power consumption by lines at higher loading levels suggests the urgent need for suitable reactive power compensation. As already advised by CEA, action to be taken by POWERGRID.

**5.0** Zone-3 settings also need to be examined so that they do not come in the way of line loadability, particularly wherever the lines can be safely loaded to thermal limit. The following issues are also relevant for better system operation.

- Line reactors for 765 kV lines as well as some 400 kV lines have been made switchable. Under what conditions can the operator switch off the line reactor or must necessarily keep the line reactor in service? What are the precautions to be taken while switching in/out the line reactor?

- In case of fixed line reactor under what all conditions can we disconnect the line reactor after switching off the line? There are also instances when Loop-In-Loop-Out (LILO) at intermediate point results in short lines. Are the fixed line reactors still required at this stage or can be removed?
- Generally 40% series compensation is planned in a number of transmission lines. However Loop-In-Loop Out (LILO) of the lines at intermediate locations might render the series capacitors redundant. In many cases, due to less power flow on the line, the series capacitor is either automatically switched off or kept off by the sub-station operator. Guidelines in this regard would be helpful.

**6.0** CTU may kindly study the above suggestions.

X-----X-----X

## 11. Transmission Lines having Maximum Loadability Less than SIL (Sorted Regionwise and in order of Revised Allowable Loading)

Sl. No.	Name of the Line	kV	Length in ckt km	Type of conductor	Configuration	Series Cap (%)	Shunt - 1 (MVar)	Shunt - 2 (MVar)	SIL (MVA) "A"	Limit as per CEA TPC (MVA) "B"	Stability Limit (MW) "C"	Thermal Limit, (MVA) "D"	Max. Loadability "E= Min(B,D)"	Revised Allowable Loading "F" (MVA)	Reactive Power Absorb(+)/ Genrtd(-) at Revised loading "G"	Zone-3 End-1 (MVA)	Zone-3 End-2 (MVA)	
<b>Inter-Regional</b>																		
1	Gaya - Sasaram-Fatehpur	765	485	Bersimis	Quad	0	405	495	2194	1128	2113	4855	1128	2194	810			
2	Sipat-Ranchi - I	400	406	ACSR Moose	Twin	40	80	80	517	434	990	1093	434	517	54	866		
3	Sipat-Ranchi - II	400	406	ACSR Moose	Twin	40	80	80	517	434	990	1093	434	517	54	866		
4	Zerda - Kankroli	400	234	ACSR Moose	Twin	0	50	50	517	448	1031	1093	448	517	90	1435	1504	
<b>Northern Region</b>																		
5	Agra - Fatehpur	765	335	Bersimis	Quad	0	240	330	2194	1600	3055	4855	1600	2194	513		4713	
6	Anpara C -Unnao-I	765	409	Bersimis	Quad	0	240	240	2194	1754	2505	3752	1754	2194	432			
7	Lucknow - Ballia	765	319	Bersimis	Quad	0	240	240	2194	1823	3213	4855	1823	2194	432	4858	4904	
8	Agra - Bassi-I	400	211	ACSR Moose	Twin	0	50	50	517	416	1140	852	416	517	90	1400	1194	
9	Agra - Bassi-II	400	217	ACSR Moose	Twin	0	50	50	517	427	1108	1093	427	517	90	1400	1194	
10	Agra - Jaipur	400	254	ACSR Moose	Twin	0	50	50	517	461	949	1093	461	517	90	1505		
11	Agra Up-Unnao-I	400	279	ACSR Moose	Twin	0	50	50	517	467	863	852	467	517	90			
12	Akal-Jodhpur-I	400	230	ACSR Moose	Twin	0	50	50	517	444	1048	852	444	517	90			
13	Bhilwara-Chabra-I	400	285	ACSR Moose	Twin	0	50	50	517	467	845	852	467	517	90			
14	Gorakhpur - Lucknow III	400	264	ACSR Moose	Twin	30	63	63	517	425	1304	1093	425	517	69	1004	1188	
15	Gorakhpur - Lucknow IV	400	264	ACSR Moose	Twin	30	63	63	517	425	1304	1093	425	517	69	1004	1188	
16	Hindaun-Chabra-I	400	305	ACSR Moose	Twin	0	50	50	517	465	790	852	465	517	90			
17	Kankroli - Bhinmal	400	202	ACSR Moose	Twin	0	50	50	517	393	1194	1093	393	517	90	1523	1664	
18	Kanpur - Agra	400	240	ACSR Moose	Twin	0	50	50	517	453	1004	852	453	517	90	1056	1212	
19	Kanpur - Ballabgarh	400	386	ACSR Moose	Twin	27	80	80	517	388	856	852	388	517	86	844	796	
20	Kanpur - Ballabgarh II	400	371	ACSR Moose	Twin	40	80	80	517	422	1083	1093	422	517	62	903	907	
21	Kanpur - Ballabgarh III	400	371	ACSR Moose	Twin	40	80	80	517	422	1083	1093	422	517	62	903	907	
22	Kota - Merta-I	400	256	ACSR Moose	Twin	0	50	50	517	462	942	1093	462	517	90	1025		
23	Lucknow - Balia-I	400	316	ACSR Moose	Twin	40	63	63	517	510	1270	1093	510	517	43	911	887	
24	Lucknow - Bareilly-I	400	256	ACSR Moose	Twin	0	50	50	517	462	943	1093	462	517	90	1203	1302	
25	Moga - Bhiwadi I	400	351	ACSR Moose	Twin	0	63	63	517	400	687	1093	400	517	113	887	889	
26	Moga - Bhiwadi II	400	351	ACSR Moose	Twin	0	63	63	517	400	687	1093	400	517	113	887	889	
27	Muzaffarnagar-Vishnuprayag-I	400	280	ACSR Moose	Twin	0	50	50	517	467	861	852	467	517	90			
28	Muzaffarnagar-Vishnuprayag-II	400	280	ACSR Moose	Twin	0	50	50	517	467	861	852	467	517	90			
29	Panki-Obra-I	400	388	ACSR Moose	Twin	0	50	0	517	514	622	852	514	517	45			
30	Rajwest -Jodhpur-I	400	220	ACSR Moose	Twin	0	50	50	517	431	1095	852	431	517	90			
31	Rajwest -Jodhpur-II	400	220	ACSR Moose	Twin	0	50	50	517	431	1095	852	431	517	90			
32	Singrauli - Fatehpur	400	331	ACSR Moose	Twin	0	0	80	517	502	728	852	502	517	72	3785	1041	
33	Singrauli - Lucknow	400	409	ACSR Moose	Twin	0	0	63	517	483	590	852	483	517	57	2616		
34	Moga - Kishenpur-I (at 400 kV)	400	275	Bersimis	Quad	0	63	63	600	506	1017	1965	506	600	113	1345	1462	

Column-B: CEA TPC:CEA Transmission Planning Criteria;

Column-C: Stability Limit =  $V1*V2*\sin(\delta)/X$ , considering  $V1=V2=1$  PU,  $\delta=30$ ;

**11. Transmission Lines having Maximum Loadability Less than SIL (Sorted Regionwise and in order of Revised Allowable Loading)**

Sl. No.	Name of the Line	kV	Length in ckt km	Type of conductor	Configuration	Series Cap (%)	Shunt - 1 (MVar)	Shunt - 2 (MVar)	SIL (MVA) "A"	Limit as per CEA TPC (MVA) "B"	Stability Limit (MW) "C"	Thermal Limit, (MVA) "D"	Max. Loadability "E= Min(B,D)"	Revised Allowable Loading "F" (MVA)	Reactive Power Absorb(+)/ Genrtd(-) at Revised loading "G"	Zone-3 End-1 (MVA)	Zone-3 End-2 (MVA)
35	Moga - Kishenpur-II (at 400 kV)	400	287	Bersimis	Quad	0	63	63	600	510	976	1965	510	600	113	1306	1454
	<b>Eastern Region</b>																
36	Indravati - Rengali	400	356	ACSR Moose	Twin	0	50	50	517	452	677	852	452	517	90	970	847
	<b>Western Region</b>																
37	Bilaspur - Seoni I	765	337	Bersimis	Quad	0	240	240	2194	1819	3040	4855	1819	2194	432	1380	4418
38	Bilaspur - Seoni II	765	338	Bersimis	Quad	0	240	240	2194	1819	3028	4855	1819	2194	432	1539	4418
39	Satna - Bina I	765	274	Bersimis	Quad	0	240	240	2194	1777	3737	4855	1777	2194	432	4491	4460
40	Satna - Bina II	765	276	Bersimis	Quad	0	240	240	2194	1781	3717	4855	1781	2194	432	4491	4460
41	Seoni - Bina	765	292	Bersimis	Quad	0	240	240	2194	1808	3508	4855	1808	2194	432	4568	5211
42	Akola - Aurangabad I	400	241	ACSR Moose	Twin	0	50	50	517	454	999	1093	454	517	90		
43	Akola - Aurangabad II	400	241	ACSR Moose	Twin	0	50	50	517	454	999	1093	454	517	90		
44	Bhadrawati - Parli I	400	379	ACSR Moose	Twin	0	63	63	517	399	636	1093	399	517	113	1039	1022
45	Bhadrawati - Parli II	400	379	ACSR Moose	Twin	0	63	63	517	399	636	1093	399	517	113	1039	1022
46	Bhilai - Bhadrawati	400	322	ACSR Moose	Twin	0	80	50	517	385	748	852	385	517	117	2317	2512
47	Bhilai - Koradi	400	272	ACSR Moose	Twin	0	50	50	517	466	886	852	466	517	90	1200	
48	Dehgam - Nagda-I	400	331	ACSR Moose	Twin	0	50	50	517	460	727	1093	460	517	90	875	
49	Dehgam - Nagda-II	400	331	ACSR Moose	Twin	0	50	50	517	460	727	1093	460	517	90	875	
50	Indore - Asoj ckt-I	400	289	ACSR Moose	Twin	0	50	50	517	467	834	852	467	517	90	1339	
51	Indore - Asoj ckt-II	400	273	ACSR Moose	Twin	0	50	50	517	466	883	852	466	517	90	1278	
52	Itarsi - Indore ckt-I	400	207	ACSR Moose	Twin	0	50	50	517	406	1164	852	406	517	90	1655	1128
53	Itarsi - Indore ckt-II	400	214	ACSR Moose	Twin	0	50	50	517	421	1126	852	421	517	90	1655	1137
54	Jabalpur - Itarsi-III	400	234	ACSR Moose	Twin	0	50	50	517	448	1030	852	448	517	90	1376	1402
55	Jabalpur - Itarsi-IV	400	234	ACSR Moose	Twin	0	50	50	517	448	1030	852	448	517	90	1376	1402
56	Jabalpur-Sasan I	400	370	ACSR Moose	Twin	0	63	0	517	508	651	852	508	517	57		
57	Jabalpur-Sasan II	400	370	ACSR Moose	Twin	0	63	0	517	508	651	852	508	517	57		
58	Khandwa - Dhule-I	400	262	ACSR Moose	Twin	0	50	50	517	464	920	852	464	517	90	1403	
59	Khandwa - Dhule-II	400	262	ACSR Moose	Twin	0	50	50	517	464	920	852	464	517	90	1403	
60	Korba - Birsinghpur I	400	227	ACSR Moose	Twin	0	50	50	517	440	1063	1093	440	517	90		
61	Korba - Birsinghpur II	400	227	ACSR Moose	Twin	0	50	50	517	440	1063	1093	440	517	90		
62	Parli-Chndrapur-I	400	357	ACSR Moose	Twin	0	50	50	517	452	675	852	452	517	90		
63	Parli-Chndrapur-II	400	371	ACSR Moose	Twin	0	50	50	517	447	649	852	447	517	90		
64	Parli-Chndrapur-III	400	371	ACSR Moose	Twin	0	50	50	517	447	649	852	447	517	90		
65	Raipur - Bhadravati-I	400	333	ACSR Moose	Twin	0	80	50	517	388	724	852	388	517	117	1005	1044
66	Raipur - Bhadravati-II	400	346	ACSR Moose	Twin	0	63	63	517	400	697	852	400	517	113	1040	1158
67	Raipur - Bhadravati-III	400	346	ACSR Moose	Twin	0	63	63	517	400	697	852	400	517	113	1040	1158

Column-B: CEA TPC:CEA Transmission Planning Criteria;

Column-C: Stability Limit =  $V1*V2*\sin(\delta)/X$ , considering  $V1=V2=1$  PU,  $\delta=30$ ;

**11. Transmission Lines having Maximum Loadability Less than SIL (Sorted Regionwise and in order of Revised Allowable Loading)**

Sl. No.	Name of the Line	kV	Length in ckt km	Type of conductor	Configuration	Series Cap (%)	Shunt - 1 (MVar)	Shunt - 2 (MVar)	SIL (MVA) "A"	Limit as per CEA TPC (MVA) "B"	Stability Limit (MW) "C"	Thermal Limit, (MVA) "D"	Max. Loadability "E= Min(B,D)"	Revised Allowable Loading "F" (MVA)	Reactive Power Absorb(+)/ Genrtd(-) at Revised loading "G"	Zone-3 End-1 (MVA)	Zone-3 End-2 (MVA)
68	Raipur -Jin4-B1 -I	400	258	ACSR Moose	Twin	0	63	63	517	346	934	852	346	517	113		
69	Raipur -Jin4-B1 -II	400	258	ACSR Moose	Twin	0	63	63	517	346	934	852	346	517	113		
70	Satna - Bina-I	400	276	ACSR Moose	Twin	0	50	50	517	466	873	852	466	517	90	1508	1325
71	Satna - Bina-II	400	276	ACSR Moose	Twin	0	50	50	517	466	873	852	466	517	90	1508	1325
72	Satna - Bina-III	400	273	ACSR Moose	Twin	0	50	50	517	466	884	1093	466	517	90	1403	1325
73	Satna - Bina-IV	400	273	ACSR Moose	Twin	0	50	50	517	466	884	1093	466	517	90	1403	1325
74	Starlite - Rourkela	400	113	ACSR Moose	Twin	0	0	63	517	385	2132	852	385	517	57		
75	Vindhyachal - Korba-II	400	289	ACSR Moose	Twin	0	50	50	517	467	834	1093	467	517	90		
76	Jabalpur - Itarsi-I	400	232	ACKC	Twin	0	50	50	524	463	1044	737	463	524	90	1241	1543
77	Jabalpur - Itarsi-II	400	232	ACKC	Twin	0	50	50	524	463	1044	737	463	524	90	1122	1439
78	Bina - Indore (at 400 kV)	400	311	Bersimis	Quad	0	63	80	600	465	900	2543	465	600	129	1386	
79	Mundra - Limbdi I	400	314	ACSR Snowbird	Tripple	0	63	63	636	563	942	1623	563	636	114		1287
80	Mundra - Limbdi II	400	314	ACSR Snowbird	Tripple	0	63	63	636	563	942	1623	563	636	114		1287
81	Seoni - Khandwa-I	400	352	AAAC	Quad	40	80	80	646	641	1414	2186	641	646	46	1181	1154
82	Seoni - Khandwa-II	400	352	AAAC	Quad	40	80	80	646	641	1414	2186	641	646	46	1181	1154
83	Wardha - Parli I	400	337	ACSR Moose	Quad	0	63	63	681	616	939	2186	616	681	114	1346	1274
84	Wardha - Parli II	400	337	ACSR Moose	Quad	0	63	63	681	616	939	2186	616	681	114	1346	1274
85	Bina - Shujalpur-I	400	330	ACSR Moose	Twin	0	63	50	517	430	730	1093	430	1060	368	1559	
86	Bina - Shujalpur-II	400	330	ACSR Moose	Twin	0	63	50	517	430	730	1093	430	1060	368	1559	
	<b>Northeastern Region</b>																
87	Balipara - Bongaigaon-I	400	290	ACSR Moose	Twin	0	63	50	517	426	832	852	426	517	102	939	1195
88	Balipara - Bongaigaon-II	400	290	ACSR Moose	Twin	0	63	50	517	426	832	852	426	517	102	939	1195
	<b>Southern Region</b>																
89	Khammam -Kalpakka-I	400	364	ACSR Moose	Twin	0	63	63	517	400	662	852	400	517	113		
90	Khammam -Kalpakka-II	400	364	ACSR Moose	Twin	0	63	63	517	400	662	852	400	517	113		
91	Nagarjunasagar - Gooty	400	308	ACSR Moose	Twin	0	50	50	517	465	781	852	465	517	90	874	1167
92	Pallakad - Trichur I	400	84	ACSR Moose	Twin	0	0	50	517	269	2870	852	269	517	45	2632	2628
93	Pallakad - Trichur II	400	84	ACSR Moose	Twin	0	0	50	517	269	2870	852	269	517	45	2632	2628
94	Udumalpet - Thirunelveli I	400	265	ACSR Moose	Twin	0	63	63	517	357	909	1093	357	517	113	1218	1331
95	Udumalpet - Thirunelveli II	400	265	ACSR Moose	Twin	0	63	63	517	357	909	1093	357	517	113	1218	1331
96	Vijayawada - Gazuwaka	400	317	ACSR Moose	Twin	0	63	63	517	395	760	852	395	517	113	1092	894
97	Vijayawada - Nellore-I	400	341	ACSR Moose	Twin	0	50	50	517	457	707	852	457	517	90	891	891
98	Vijayawada - Nellore-II	400	341	ACSR Moose	Twin	0	50	50	517	457	707	852	457	517	90	891	891

Column-B: CEA TPC:CEA Transmission Planning Criteria;

Column-C: Stability Limit =  $V1*V2*\sin(\delta)/X$ , considering  $V1=V2=1$  PU,  $\delta=30$ ;



**12. Transmission Lines having Max. Loadability between SIL and Thermal Limit (Sorted Regionwise and in order of Revised Allowable Loading)**

Sl. No.	Name of the Line	kV	Length in ckt km	Type of conductor	Configuration	Series Cap (%)	Shunt - 1 (MVA)	Shunt - 2 (MVA)	SIL (MVA) "A"	Limit as per CEA TPC (MVA) "B"	Stability Limit (MW) "C"	Thermal Limit, (MVA) "D"	Max. Loadability "E= Min(B,D)"	Revised Allowable Loading "F" (MVA)	Reactive Power Absorb(+)/ Genrtd(-) at Revised loading "G"	Zone-3 End-1 (MVA)	Zone-3 End-2 (MVA)
<b>Inter-Regional</b>																	
1	New Siliguri - Bongaigaon-I	400	217	ACSR Moose	Twin	0	0	63	517	617	1109	852	617	617	108	753	1133
2	New Siliguri - Bongaigaon-II	400	217	ACSR Moose	Twin	0	0	63	517	617	1109	852	617	617	108	752	1133
3	Raigarh - Rourkela-I	400	212	ACSR Moose	Twin	0	0	63	517	619	1134	852	619	619	108	1548	1489
4	Sasaram - Allahabad	400	212	ACSR Moose	Twin	0	63	0	517	619	1137	852	619	619	108	1454	1436
5	Chandrapur-Ramagundam - I	400	178	ACSR Moose	Twin	0	0	50	517	707	1357	852	707	707	131		1086
6	Chandrapur-Ramagundam - II	400	178	ACSR Moose	Twin	0	0	50	517	707	1357	852	707	707	131		1086
7	Zerda-Bhinmal	400	143	ACSR Moose	Twin	0	0	50	517	717	1687	1093	717	717	118	2183	1910
8	Jeypore - Gazuwaka-I	400	220	AAAC	Twin	50	0	80	524	783	2201	852	783	783	87	888	1432
9	Jeypore - Gazuwaka-II	400	220	AAAC	Twin	50	0	80	524	783	2201	852	783	783	87	888	1432
10	Raigarh - Rourkela III	400	209	ACSR Moose	Twin	0	0	0	517	867	1151	1093	867	867	210	1570	1460
11	Raigarh - Rourkela IV	400	209	ACSR Moose	Twin	0	0	0	517	867	1151	1093	867	867	210		1969
12	Biharshariff - Balia- I	400	242	Bersimis	Quad	0	50	0	692	918	1326	2538	918	918	182	1803	1274
13	Biharshariff - Balia- II	400	242	Bersimis	Quad	0	50	0	692	918	1326	2538	918	918	182	1803	1274
14	Barh - Balia - I	400	243	ACSR Moose	Quad	0	0	0	681	1040	1304	2186	1040	1040	237		1317
15	Barh - Balia - II	400	243	ACSR Moose	Quad	0	0	0	681	1040	1304	2186	1040	1040	237		1317
16	Muzaffarpur-Gorakhpur-I	400	261	ACSR Moose	Quad	40	63	0	681	1074	2021	1704	1074	1074	151	1470	1656
17	Muzaffarpur-Gorakhpur-II	400	261	ACSR Moose	Quad	40	63	0	681	1074	2021	1704	1074	1074	151	1470	1656
18	Patna - Balia-I	400	195	Bersimis	Quad	0	0	0	692	1212	1641	2538	1212	1212	302	1567	1800
19	Patna - Balia-II	400	195	Bersimis	Quad	0	0	0	692	1212	1641	2538	1212	1212	302	1567	1800
20	Balia - Sasaram (at 400 kV)	400	140	Bersimis	Quad	0	0	0	600	1281	2001	2543	1281	1281	320	3067	
21	Gwalior-Agra - I (at 400 kV)	400	129	Bersimis	Quad	0	0	0	600	1339	2164	2543	1339	1339	331	2291	1972
22	Gwalior-Agra - II (at 400 kV)	400	128	Bersimis	Quad	0	0	0	600	1348	2190	2543	1348	1348	333	2309	2536
<b>Northern Region</b>																	
23	Moga - Bhiwani	765	273	Bersimis	Quad	0	240	0	2194	2529	3753	4855	2529	2529	427	5375	5375
24	Bhiwani-Jhatikara	765	178	Bersimis	Quad	0	0	0	2194	4066	5756	4855	4066	4066	1018		
25	Uri I - Wagoora -I	400	95	ACSR Moose	Twin	0	50	0	517	521	2537	852	521	521	46		
26	Uri I - Wagoora -II	400	95	ACSR Moose	Twin	0	50	0	517	521	2537	852	521	521	46		
27	Bareilly - Meerut-I	400	249	ACSR Moose	Twin	30	50	50	517	548	1381	1093	548	548	60	1592	
28	Bareilly - Meerut-II	400	249	ACSR Moose	Twin	30	50	50	517	548	1381	1093	548	548	60	1592	
29	Dadri - Malerkotla	400	297	ACSR Moose	Twin	0	0	63	517	560	811	852	560	560	85		1014
30	Dehar -Bhiwani -I	400	312	ACSR Moose	Twin	0	0	50	517	576	772	852	576	576	87		
31	Dehar -Panipat -I	400	262	ACSR Moose	Twin	0	0	63	517	587	920	852	587	587	99		
32	Rihand - Allahabad-I	400	279	ACSR Moose	Twin	0	0	50	517	607	863	852	607	607	104	1754	1166
33	Rihand - Allahabad-II	400	279	ACSR Moose	Twin	0	0	50	517	607	863	852	607	607	104	1754	1166
34	Lucknow(UP) - Bareilly	400	279	ACSR Moose	Twin	0	0	50	517	608	864	852	608	608	104	1203	1079
35	Moga - Fatehabad	400	179	ACSR Moose	Twin	0	0	63	517	626	1344	852	626	626	103	1510	1719
36	Bhiwadi - Bassi-I	400	235	ACSR Moose	Twin	0	0	50	517	652	1025	852	652	652	122	1230	1359
37	Panki-Murd Fsc-I	400	397	ACSR Moose	Twin	40	50	0	517	655	1012	852	655	655	37		

Column-B: CEA TPC:CEA Transmission Planning Criteria;

Column-C: Stability Limit =  $V1*V2*\sin(\delta)/X$ , considering  $V1=V2=1$  PU,  $\delta=30$ ;

**12. Transmission Lines having Max. Loadability between SIL and Thermal Limit (Sorted Regionwise and in order of Revised Allowable Loading)**

Sl. No.	Name of the Line	kV	Length in ckt km	Type of conductor	Configuration	Series Cap (%)	Shunt - 1 (MVar)	Shunt - 2 (MVar)	SIL (MVA) "A"	Limit as per CEA TPC (MVA) "B"	Stability Limit (MW) "C"	Thermal Limit, (MVA) "D"	Max. Loadability "E= Min(B,D)"	Revised Allowable Loading "F" (MVA)	Reactive Power Absorb(+) / Genrtd(-) at Revised loading "G"	Zone-3 End-1 (MVA)	Zone-3 End-2 (MVA)
38	Obra-Sultanpur-I	400	230	ACSR Moose	Twin	0	0	50	517	657	1046	852	657	657	123		
39	Bassi - Bhiwadi-II	400	220	ACSR Moose	Twin	0	50	0	517	668	1094	852	668	668	127	1451	1448
40	Roja - Bareilly	400	116	ACSR Moose	Twin	0	0	50	517	672	2079	1093	672	672	89		1745
41	Bhiwadi - Hissar	400	212	ACSR Moose	Twin	0	0	50	517	677	1139	852	677	677	129	1623	1434
42	Moga - Hisar I	400	209	ACSR Moose	Twin	0	0	50	517	679	1151	852	679	679	129	1510	1286
43	Rapp - Kankroli-I	400	199	ACSR Moose	Twin	0	0	50	517	689	1214	1093	689	689	130		1292
44	Rapp - Kankroli-II	400	199	ACSR Moose	Twin	0	0	50	517	689	1214	1093	689	689	130		1292
45	Fathepur - Mainpuri-I	400	260	ACSR Moose	Twin	40	0	80	517	690	1544	852	690	690	82	1328	1233
46	Fathepur - Mainpuri-II	400	260	ACSR Moose	Twin	40	0	80	517	690	1544	852	690	690	82	1328	1233
47	Agra-Jaipur South-I	400	196	ACSR Moose	Twin	0	50	0	517	692	1231	852	692	692	131	1505	
48	Agra-Jaipur South-II	400	196	ACSR Moose	Twin	0	50	0	517	692	1231	852	692	692	131	1505	
49	Wagoora - Kishenpur-I	400	183	ACSR Moose	Twin	0	50	0	517	703	1320	1093	703	703	131	1640	1640
50	Wagoora - Kishenpur-II	400	183	ACSR Moose	Twin	0	50	0	517	703	1320	1093	703	703	131	1640	1640
51	Agra - Ballabgarh	400	181	ACSR Moose	Twin	0	0	50	517	705	1330	852	705	705	131	1696	1238
52	Balia-Lucknow-II	400	316	ACSR Moose	Twin	40	0	63	517	705	1270	852	705	705	77		911
53	Lucknow - Roja	400	170	ACSR Moose	Twin	0	50	0	517	712	1419	1093	712	712	129	1303	887
54	Rosa-Tpp-Luck4-Pg-I	400	170	ACSR Moose	Twin	0	0	50	517	712	1417	852	712	712	129		
55	Agra - Auriya-I	400	166	ACSR Moose	Twin	0	50	0	517	715	1453	852	715	715	129	1696	
56	Agra - Auriya-II	400	166	ACSR Moose	Twin	0	50	0	517	715	1453	852	715	715	129	1696	
57	Allahabad - Fathepur I	400	140	ACSR Moose	Twin	0	50	0	517	716	1724	852	716	716	116	2077	1928
58	Allahabad - Fathepur II	400	140	ACSR Moose	Twin	0	50	0	517	716	1724	852	716	716	116	2077	1928
59	Anpara-Mau-I	400	262	ACSR Moose	Twin	0	0	0	517	751	919	852	751	751	161		
60	Gorakhpur-Lucknow-I	400	246	ACSR Moose	Twin	0	0	0	517	783	980	852	783	783	176	1108	1188
61	Gorakhpur-Lucknow-II	400	246	ACSR Moose	Twin	0	0	0	517	783	980	852	783	783	176	1108	1188
62	Mainpuri - Ballabgarh-I	400	236	ACSR Moose	Twin	0	0	0	517	804	1021	852	804	804	186	1635	1423
63	Mainpuri - Ballabgarh-II	400	236	ACSR Moose	Twin	0	0	0	517	804	1021	852	804	804	186	1635	1423
64	Purnea-Muzaffarpur-I	400	240	ACSR Moose	Quad	40	63	63	681	805	2198	1704	805	805	85	1562	1565
65	Purnea-Muzaffarpur-II	400	240	ACSR Moose	Quad	40	63	63	681	805	2198	1704	805	805	85	1562	1565
66	Allahabad - Kanpur-I	400	225	ACSR Moose	Twin	0	0	0	517	829	1071	852	829	829	196	1362	1306
67	Bareilly-Unnafsc1-I	400	271	ACSR Moose	Twin	45	50	0	517	830	1617	852	830	830	108		
68	Bareilly-Unnafsc2-II	400	271	ACSR Moose	Twin	45	50	0	517	830	1617	852	830	830	108		
69	Singrauli - Allahabad-I	400	224	ACSR Moose	Twin	0	0	0	517	831	1076	852	831	831	197	4829	832
70	Agra - Bhiwadi II	400	210	ACSR Moose	Twin	0	0	0	517	867	1150	1093	867	867	211	1406	1401
71	Agra - Bhiwadi I	400	209	ACSR Moose	Twin	0	0	0	517	868	1153	1093	868	868	211	1502	1400
72	Lucknow - Sultanpur	400	209	ACSR Moose	Twin	0	0	0	517	868	1152	1093	868	868	211	1519	
73	Kankroli - Jodhpur	400	188	ACSR Moose	Twin	0	0	0	517	927	1282	1093	927	927	231	1594	
74	Panchkula - Naptha Jhakri I	400	165	ACSR Snowbird	Tripple	0	50	0	636	956	1793	1623	956	956	187	1270	1244
75	Panchkula - Naptha Jhakri II	400	165	ACSR Snowbird	Tripple	0	50	0	636	956	1793	1623	956	956	187	1270	1244
76	Neemrana - Sikar I	400	176	ACSR Moose	Twin	0	0	0	517	965	1370	1093	965	965	242	1156	1775
77	Neemrana - Sikar II	400	176	ACSR Moose	Twin	0	0	0	517	965	1370	1093	965	965	242	1156	1775

Column-B: CEA TPC:CEA Transmission Planning Criteria;

Column-C: Stability Limit =  $V1*V2*\sin(\delta)/X$ , considering  $V1=V2=1$  PU,  $\delta=30$ ;

**12. Transmission Lines having Max. Loadability between SIL and Thermal Limit (Sorted Regionwise and in order of Revised Allowable Loading)**

Sl. No.	Name of the Line	kV	Length in ckt km	Type of conductor	Configuration	Series Cap (%)	Shunt - 1 (MVar)	Shunt - 2 (MVar)	SIL (MVA) "A"	Limit as per CEA TPC (MVA) "B"	Stability Limit (MW) "C"	Thermal Limit, (MVA) "D"	Max. Loadability "E= Min(B,D)"	Revised Allowable Loading "F" (MVA)	Reactive Power Absorb(+)/ Genrtd(-) at Revised loading "G"	Zone-3 End-1 (MVA)	Zone-3 End-2 (MVA)
78	Nallagarh - Nathpa-Jhakri-I	400	144	ACSR Snowbird	Tripple	0	50	0	636	984	2055	1270	984	984	182	1612	1211
79	Nallagarh - Nathpa-Jhakri-II	400	144	ACSR Snowbird	Tripple	0	50	0	636	984	2055	1270	984	984	182	1612	1211
80	Bikaner-Suratgarh-I	400	162	ACSR Moose	Twin	0	0	0	517	1014	1487	1093	1014	1014	256		
81	Kaithal - Meerut I	400	164	ACSR Moose	Quad	0	50	0	681	1049	1933	2186	1049	1049	210	2585	2158
82	Kaithal - Meerut II	400	164	ACSR Moose	Quad	0	50	0	681	1049	1933	2186	1049	1049	210	2585	2158
83	Koteshwar - Meerut I (at 400 kV)	400	179	Bersimis	Quad	50	0	50	600	1223	3135	2543	1223	1223	169	2002	2359
84	Abdullapur - Bawana-I	400	167	ACSR Snowbird	Tripple	0	0	0	636	1226	1775	1270	1226	1226	309	1921	
85	Abdullapur - Bawana-II	400	167	ACSR Snowbird	Tripple	0	0	0	636	1226	1775	1270	1226	1226	309	1921	
86	Koteshwar - Meerut II (at 400 kV)	400	176	Bersimis	Quad	50	0	50	600	1229	3190	2543	1229	1229	169	2002	2400
87	Abdullapur - Sonapat I	400	146	ACSR Snowbird	Tripple	0	0	0	636	1328	2033	1623	1328	1328	334	1961	2354
88	Abdullapur - Sonapat II	400	146	ACSR Snowbird	Tripple	0	0	0	636	1328	2033	1623	1328	1328	334	1961	2354
89	Binaguri-Purnea-I	400	160	ACSR Moose	Quad	0	0	0	681	1345	1978	1704	1345	1345	340		2004
90	Binaguri-Purnea-II	400	160	ACSR Moose	Quad	0	0	0	681	1345	1978	1704	1345	1345	340		2004
91	Karcham-Abdullapur-I	400	108	ACSR Moose	Quad	0	0	0	681	1678	2930	1704	1678	1678	401	1346	
92	Karcham-Abdullapur-II	400	108	ACSR Moose	Quad	0	0	0	681	1678	2930	1704	1678	1678	401	1346	
	<b>Eastern Region</b>																
93	Bolangir - Meramundali	400	212	ACSR Moose	Twin	0	80	0	517	536	1139	852	536	536	81		
94	New Siliguri - TALA-IV	400	140	ACSR Moose	Twin	0	63	0	517	574	1721	1093	574	574	75	1534	
95	Baripada - Mendhasal I	400	273	ACSR Moose	Twin	0	0	63	517	579	882	1093	579	579	95		
96	Baripada - Mendhasal II	400	273	ACSR Moose	Twin	0	0	63	517	579	882	1093	579	579	95		
97	New Siliguri - TALA-I	400	145	ACSR Moose	Twin	0	63	0	517	588	1662	852	588	588	80	1572	
98	New Siliguri - TALA-II	400	145	ACSR Moose	Twin	0	63	0	517	588	1662	852	588	588	80	1569	
99	Biharshariff - Sasaram-I	400	210	ACSR Moose	Twin	0	0	63	517	620	1147	852	620	620	108	1587	1223
100	Biharshariff - Sasaram-II	400	210	ACSR Moose	Twin	0	0	63	517	620	1147	852	620	620	108	1997	1223
101	Malda - Newpurnea-I	400	167	ACSR Moose	Twin	0	63	0	517	620	1443	852	620	620	97	1659	1449
102	Malda - Newpurnea-II	400	167	ACSR Moose	Twin	0	63	0	517	620	1443	852	620	620	97	1659	1449
103	Binaguri - Newpurnea - I	400	168	ACSR Moose	Twin	0	63	0	517	621	1434	852	621	621	98	1208	1646
104	Subhashgram - Sagardighi	400	258	ACSR Moose	Twin	0	50	0	517	629	934	852	629	629	114	1257	
105	Baripada - Rengali	400	240	ACSR Moose	Twin	0	50	0	517	647	1004	852	647	647	120		1011
106	Farakka - Jeerut-I	400	238	ACSR Moose	Twin	0	0	50	517	649	1012	852	649	649	121		
107	Kahalgaon - Biharshariff-I	400	201	ACSR Moose	Twin	0	0	50	517	687	1199	852	687	687	130		1286
108	Kahalgaon - Biharshariff-II	400	201	ACSR Moose	Twin	0	0	50	517	687	1199	852	687	687	130		1286
109	Maithon RB - Ranchi I	400	188	ACSR Moose	Twin	0	0	50	517	699	1284	1093	699	699	131		1621
110	Maithon RB - Ranchi II	400	188	ACSR Moose	Twin	0	0	50	517	699	1284	1093	699	699	131		1621
111	Bakreshwar-Arambagh-I	400	130	ACSR Moose	Twin	0	50	0	517	706	1854	852	706	706	107		
112	Kahalgaon - Maithon-I	400	172	ACSR Moose	Twin	0	0	50	517	711	1401	852	711	711	130		1142
113	Kahalgaon - Maithon-II	400	172	ACSR Moose	Twin	0	0	50	517	711	1401	852	711	711	130		1142
114	Jeerat-Bakreshwar-I	400	162	ACSR Moose	Twin	0	50	0	517	716	1487	852	716	716	127		
115	Jamshedpur - Rourkela-I	400	153	ACSR Moose	Twin	0	0	50	517	719	1575	852	719	719	124	1291	1760

Column-B: CEA TPC:CEA Transmission Planning Criteria;

Column-C: Stability Limit =  $V1*V2*\sin(\delta)/X$ , considering  $V1=V2=1$  PU,  $\delta=30$ ;

**12. Transmission Lines having Max. Loadability between SIL and Thermal Limit (Sorted Regionwise and in order of Revised Allowable Loading)**

Sl. No.	Name of the Line	kV	Length in ckt km	Type of conductor	Configuration	Series Cap (%)	Shunt - 1 (MVAr)	Shunt - 2 (MVAr)	SIL (MVA) "A"	Limit as per CEA TPC (MVA) "B"	Stability Limit (MW) "C"	Thermal Limit, (MVA) "D"	Max. Loadability "E= Min(B,D)"	Revised Allowable Loading "F" (MVA)	Reactive Power Absorb(+)/ Genrtd(-) at Revised loading "G"	Zone-3 End-1 (MVA)	Zone-3 End-2 (MVA)
116	Jamshedpur - Rourkela-II	400	153	ACSR Moose	Twin	0	0	50	517	719	1575	852	719	719	124	1760	
117	Biharshariff - Sasaram III	400	199	ACSR Moose	Quad	0	50	50	681	729	1591	2186	729	729	111	1997	2039
118	Maithon - Ranchi-I	400	200	ACSR Moose	Twin	0	0	0	517	893	1206	1093	893	893	220	1477	1425
119	Maithon - Ranchi-II	400	200	ACSR Moose	Twin	0	0	0	517	893	1206	1093	893	893	220		1425
120	Biharshariff - Gaya	400	80	ACSR Moose	Quad	0	50	0	681	941	3956	2186	941	941	98		
121	Andal - Jamshedpur I	400	157	ACSR Moose	Twin	0	0	0	517	1033	1537	1093	1033	1033	260		1766
122	Andal - Jamshedpur II	400	157	ACSR Moose	Twin	0	0	0	517	1033	1537	1093	1033	1033	260		1766
123	Barh - Patna-I	400	93	ACSR Moose	Quad	0	0	50	681	1057	3399	2186	1057	1057	141		2831
124	Barh - Patna-II	400	93	ACSR Moose	Quad	0	0	50	681	1057	3399	2186	1057	1057	141		2831
125	Ranchi - Rourkela I	400	145	ACSR Moose	Twin	0	0	0	517	1082	1663	1093	1082	1082	272	1928	1879
126	Ranchi - Rourkela II	400	145	ACSR Moose	Twin	0	0	0	517	1082	1663	1093	1082	1082	272	1928	1879
127	Kahalgaon - Barh-I	400	217	ACSR Moose	Quad	0	0	0	681	1118	1460	2186	1118	1118	269		
128	Kahalgaon - Barh-II	400	217	ACSR Moose	Quad	0	0	0	681	1118	1460	2186	1118	1118	269		
	<b>Western Region</b>																
129	Seoni - Wardha I	765	268	Bersimis	Quad	0	0	240	2194	2548	3825	4855	2548	2548	435	5772	5539
130	Seoni - Wardha II	765	261	Bersimis	Quad	0	0	240	2194	2574	3929	4855	2574	2574	446	5772	5539
131	Vindhyachal - Jabalpur-I	400	360	ACKC	Twin	0	0	63	524	524	673	737	524	524	57		
132	Vindhyachal - Jabalpur-II	400	360	ACKC	Twin	0	0	63	524	524	673	737	524	524	57		
133	Koradi-Bhusawal-II	400	343	ACSR Moose	Twin	0	0	50	517	549	703	852	549	549	69		
134	Boisar - Padghee	400	101	ACSR Moose	Twin	0	0	50	517	586	2386	852	586	586	61	3076	
135	Karad-Sholapur-Pg -I	400	299	ACSR Moose	Twin	0	50	0	517	588	806	852	588	588	94		1275
136	Lonikhand-Parli-II	400	285	ACSR Moose	Twin	0	50	0	517	602	845	852	602	602	101		
137	Lonikhand-Parli-I	400	284	ACSR Moose	Twin	0	50	0	517	603	848	852	603	603	102		
138	Vindhyachal - Satna-I	400	267	ACSR Moose	Twin	0	0	50	517	619	902	852	619	619	109		1178
139	Vindhyachal - Satna-II	400	267	ACSR Moose	Twin	0	0	50	517	619	902	852	619	619	109		1178
140	Vindhyachal - Satna-III	400	258	ACSR Moose	Twin	0	0	50	517	628	933	1093	628	628	113		1332
141	Vindhyachal - Satna-IV	400	258	ACSR Moose	Twin	0	0	50	517	628	933	1093	628	628	113		1332
142	Bhusawal-Aurangabad-I	400	238	ACSR Moose	Twin	0	0	50	517	649	1012	852	649	649	121		
143	Bhilai-Seoni-I	400	230	ACSR Moose	Twin	0	50	0	517	658	1048	852	658	658	124		
144	Damoh - Birsinghpur I	400	228	ACSR Moose	Twin	0	50	0	517	659	1055	1093	659	659	124	1263	
145	Damoh - Birsinghpur II	400	228	ACSR Moose	Twin	0	50	0	517	659	1055	1093	659	659	124	1263	
146	Damoh - Bhopal-I	400	214	ACSR Moose	Twin	0	0	50	517	674	1124	1093	674	674	128	1537	
147	Damoh - Bhopal-II	400	214	ACSR Moose	Twin	0	0	50	517	674	1127	1093	674	674	128	1537	
148	Bhilai-Korba West-I	400	199	ACSR Moose	Twin	0	50	0	517	689	1211	852	689	689	131		
149	Korba - Bhilai-I	400	197	ACSR Moose	Twin	0	0	50	517	691	1223	852	691	691	131		1267
150	Korba - Bhilai-II	400	192	ACSR Moose	Twin	0	0	50	517	695	1255	852	695	695	131		1267
151	Pathadi - Raipur	400	189	ACSR Moose	Twin	0	0	50	517	698	1275	852	698	698	131		
152	Bhusawal-Akola-I	400	182	ACSR Moose	Twin	0	50	0	517	704	1324	852	704	704	131		
153	Parli-Sholapur-I	400	182	ACSR Moose	Twin	0	50	0	517	704	1324	852	704	704	131	2001	2148

Column-B: CEA TPC:CEA Transmission Planning Criteria;

Column-C: Stability Limit =  $V1*V2*\sin(\delta)/X$ , considering  $V1=V2=1$  PU,  $\delta=30$ ;

**12. Transmission Lines having Max. Loadability between SIL and Thermal Limit (Sorted Regionwise and in order of Revised Allowable Loading)**

Sl. No.	Name of the Line	kV	Length in ckt km	Type of conductor	Configuration	Series Cap (%)	Shunt - 1 (MVar)	Shunt - 2 (MVar)	SIL (MVA) "A"	Limit as per CEA TPC (MVA) "B"	Stability Limit (MW) "C"	Thermal Limit, (MVA) "D"	Max. Loadability "E= Min(B,D)"	Revised Allowable Loading "F" (MVA)	Reactive Power Absorb(+) / Genrtd(-) at Revised loading "G"	Zone-3 End-1 (MVA)	Zone-3 End-2 (MVA)
154	Bhopal-Bina-I	400	135	ACSR Moose	Twin	0	0	50	517	712	1785	852	712	712	112		
155	Bhopal-Bina-II	400	135	ACSR Moose	Twin	0	0	50	517	712	1785	852	712	712	112		
156	Raipur - Raigarh-I	400	217	ACSR Moose	Twin	25	63	0	517	712	1480	852	712	712	107	1527	1524
157	Raipur - Raigarh-II	400	217	ACSR Moose	Twin	25	63	0	517	712	1480	852	712	712	107	1527	1524
158	Satpura-Seoni-I	400	156	ACSR Moose	Twin	0	50	0	517	718	1545	852	718	718	125		
159	Raipur - Raigarh IV	400	220	ACSR Moose	Twin	20	50	0	517	747	1369	1093	747	747	127	1523	1502
160	Raipur -Raigarh III	400	220	ACSR Moose	Twin	20	50	0	517	747	1369	1093	747	747	127	1523	1502
161	Bachau - Ranchodpura I	400	283	ACSR Snowbird	Tripple	0	0	50	636	770	1046	1623	770	770	135	1429	
162	Bachau - Ranchodpura II	400	283	ACSR Snowbird	Tripple	0	0	50	636	770	1046	1623	770	770	135	1429	
163	Mundra-Sami-I	400	282	ACSR Moose	Twin	40	0	50	517	780	1424	852	780	780	102		
164	Mundra-Sami-II	400	282	ACSR Moose	Twin	40	0	50	517	780	1424	852	780	780	102		
165	Bina - Gwalior-I (at 400 kV)	400	235	Bersimis	Quad	0	0	50	600	784	1192	2543	784	784	152	1596	1790
166	Bina - Gwalior-II (at 400 kV)	400	234	Bersimis	Quad	0	0	50	600	786	1199	2543	786	786	153	1621	1618
167	Koradi-Akola-I	400	244	ACSR Moose	Twin	0	0	0	517	787	988	852	787	787	178		
168	Mundra-Hadala -I	400	233	ACSR Moose	Twin	0	0	0	517	810	1034	852	810	810	188		
169	Bhilai - Seoni (LILO portion)	400	230	ACSR Moose	Twin	0	0	0	517	817	1048	1093	817	817	191		1524
170	Khandwa - Rajgarh-I	400	221	ACSR Moose	Twin	0	0	0	517	839	1092	1093	839	839	200	1371	1376
171	Khandwa - Rajgarh-II	400	221	ACSR Moose	Twin	0	0	0	517	839	1092	1093	839	839	200	1371	1376
172	Bhusawal-Bableshtar-I	400	220	ACSR Moose	Twin	0	0	0	517	840	1095	852	840	840	200		
173	Kolhapur-Sholapur-Pg -I	400	216	ACSR Moose	Twin	0	0	0	517	850	1116	852	850	850	204		1324
174	Kolhapur-Sholapur-Pg -II	400	216	ACSR Moose	Twin	0	0	0	517	850	1116	852	850	850	204		1324
175	Korba - Raipur IV	400	213	ACSR Moose	Twin	0	0	0	517	858	1132	1093	858	858	207		1458
176	Korba - Raipur III	400	212	ACSR Moose	Twin	0	0	0	517	861	1137	1093	861	861	208		1458
177	SSP - Rajgarh-I (LILO portion)	400	178	ACSR Moose	Twin	0	0	0	517	958	1354	1093	958	958	240		1626
178	SSP - Rajgarh-II (LILO portion)	400	178	ACSR Moose	Twin	0	0	0	517	958	1354	1093	958	958	240		1626
179	Wardha - Akola-I	400	162	ACSR Moose	Twin	0	0	0	517	1014	1489	1093	1014	1014	256	1337	
180	Wardha - Akola-II	400	162	ACSR Moose	Twin	0	0	0	517	1014	1489	1093	1014	1014	256	1337	
181	Satpura - Seoni (LILO portion)	400	156	ACSR Moose	Twin	0	0	0	517	1036	1545	1093	1036	1036	261		
182	Raipur - Sipat-I	400	149	ACSR Moose	Twin	0	0	0	517	1064	1616	1093	1064	1064	268	2139	
183	Raipur - Sipat-II	400	149	ACSR Moose	Twin	0	0	0	517	1064	1616	1093	1064	1064	268	2139	
184	Karad-Jaigad -I	400	111	ACSR Moose	Quad	0	0	0	681	1654	2851	1704	1654	1654	399		
185	Karad-Jaigad -II	400	111	ACSR Moose	Quad	0	0	0	681	1654	2851	1704	1654	1654	399		
186	Indore - Indore D/C	400	99	ACSR Moose	Quad	0	0	0	681	1753	3182	2186	1753	1753	410		
	<b>Northeastern Region</b>																
187	Balipara - Ranganadi-I	400	166	ACSR Moose	Twin	0	50	0	517	714	1449	852	714	714	129	1750	
188	Balipara - Ranganadi-II	400	166	ACSR Moose	Twin	0	50	0	517	714	1449	852	714	714	129	1750	
	<b>Southern Region</b>																
189	Chittoor - Chennai	400	95	ACSR Moose	Twin	0	0	50	517	523	2533	852	523	523	46		1651

Column-B: CEA TPC:CEA Transmission Planning Criteria;

Column-C: Stability Limit =  $V1*V2*\sin(\delta)/X$ , considering  $V1=V2=1$  PU,  $\delta=30$ ;

**12. Transmission Lines having Max. Loadability between SIL and Thermal Limit (Sorted Regionwise and in order of Revised Allowable Loading)**

Sl. No.	Name of the Line	kV	Length in ckt km	Type of conductor	Configuration	Series Cap (%)	Shunt - 1 (MVar)	Shunt - 2 (MVar)	SIL (MVA) "A"	Limit as per CEA TPC (MVA) "B"	Stability Limit (MW) "C"	Thermal Limit, (MVA) "D"	Max. Loadability "E= Min(B,D)"	Revised Allowable Loading "F" (MVA)	Reactive Power Absorb(+) / Genrtd(-) at Revised loading "G"	Zone-3 End-1 (MVA)	Zone-3 End-2 (MVA)
190	Karaikudi - Madurai	400	130	ACSR Moose	Twin	0	0	63	517	531	1857	852	531	531	61	1936	1924
191	Kolar - Bangalore	400	97	ACSR Moose	Twin	0	0	50	517	551	2474	852	551	551	52	5868	1287
192	Salem - Udumalpet-II	400	138	ACSR Moose	Twin	0	0	63	517	567	1747	852	567	567	72	1799	1886
193	Thirunelveli - Thiruvananthapuram-I	400	160	ACSR Moose	Twin	0	0	63	517	614	1502	852	614	614	93	1700	2077
194	Neelmangla-Talaguppa -I	400	354	ACSR Moose	Twin	0	0	0	517	615	681	852	615	615	81	2274	3966
195	Neyveli TS-II - Trichy-I	400	164	ACSR Moose	Twin	0	0	63	517	618	1468	852	618	618	96	4138	1273
196	Ramagundam - Nagarjunasagar-I	400	267	ACSR Moose	Twin	0	0	50	517	619	902	852	619	619	109		1051
197	Ramagundam - Nagarjunasagar-II	400	267	ACSR Moose	Twin	0	0	50	517	619	902	852	619	619	109		1051
198	Raichur - Munirabad	400	172	ACSR Moose	Twin	0	63	0	517	623	1397	852	623	623	100		1008
199	Vijayawada - Vemagiri-IV	400	195	ACSR Moose	Twin	0	63	0	517	625	1234	852	625	625	107	1494	
200	Nagarjunasagar - Mahaboobnagar	400	184	ACSR Moose	Twin	0	63	0	517	626	1307	852	626	626	104	1206	
201	Kolar - Kalivandhapattu	400	241	ACSR Moose	Twin	0	0	50	517	646	999	852	646	646	120	1302	1460
202	Warangal - Khamman	400	117	ACSR Moose	Twin	0	0	50	517	676	2058	852	676	676	91	2174	2085
203	Neyveli TS II - Pugalur II	400	200	ACSR Moose	Twin	0	0	50	517	688	1207	1093	688	688	130		1428
204	Neyveli TS II - Pugalur I	400	198	ACSR Moose	Twin	0	0	50	517	690	1217	1093	690	690	131	3470	1759
205	Vijayawada - Vemagiri-III	400	195	ACSR Moose	Twin	0	50	0	517	692	1234	852	692	692	131	1494	
206	Bangalore - Salem	400	181	ACSR Moose	Twin	0	0	50	517	704	1329	852	704	704	131	1604	5788
207	Trichy - Madurai-I	400	130	ACSR Moose	Twin	0	0	50	517	707	1847	852	707	707	108	1591	2018
208	Neyveli - Salem-I	400	175	ACSR Moose	Twin	0	0	50	517	709	1377	852	709	709	130	3862	1663
209	Neyveli TS-I Extension - Trichy	400	172	ACSR Moose	Twin	0	0	50	517	711	1401	852	711	711	130		1253
210	Salem - Udumalpet-I	400	151	ACSR Moose	Twin	0	0	50	517	719	1601	852	719	719	123	1633	1318
211	Gooty-Somanahalli-I	400	301	ACSR Moose	Twin	40	63	0	517	720	1334	852	720	720	84		
212	Hassan - Neelamangal	400	265	ACSR Moose	Twin	0	0	0	517	746	909	1093	746	746	159	1633	
213	Neelmangla-Hassan -I	400	265	ACSR Moose	Twin	0	0	0	517	746	909	852	746	746	159	3178	
214	Vts-Iv -Malkaram-I	400	262	ACSR Moose	Twin	0	0	0	517	752	920	852	752	752	162		
215	Vts-Iv -Malkaram-II	400	262	ACSR Moose	Twin	0	0	0	517	752	920	852	752	752	162		
216	Talaguppa - Hassan	400	260	ACSR Moose	Twin	0	0	0	517	755	927	1093	755	755	163	3786	1179
217	Nagarjunasagar - Kadapa-II	400	279	ACSR Moose	Twin	40	0	50	517	785	1441	852	785	785	104	923	1266
218	Nagarjunasagar - Kadapa-I	400	277	ACSR Moose	Twin	40	0	50	517	786	1448	852	786	786	104	923	1266
219	Gooty - Neelamangala	400	256	ACSR Moose	Twin	40	0	50	517	814	1568	852	814	814	114	1156	
220	Hyderabad - Kurnool	400	227	ACSR Moose	Twin	0	0	0	517	825	1064	852	825	825	194	1362	1517
221	Gooty - Raichur-I	400	147	ACSR Moose	Quad	0	0	0	681	1415	2157	2186	1415	1415	357	1793	1793
222	Gooty - Raichur-II	400	147	ACSR Moose	Quad	0	0	0	681	1415	2157	2186	1415	1415	357	1793	1793

Column-B: CEA TPC:CEA Transmission Planning Criteria;

Column-C: Stability Limit =  $V1*V2*\sin(\delta)/X$ , considering  $V1=V2=1$  PU,  $\delta=30$ ;

# पावर ग्रिड कारपोरेशन ऑफ इंडिया लिमिटेड

(भारत सरकार का उद्यम)

## POWER GRID CORPORATION OF INDIA LIMITED

(A Government of India Enterprise)



पावरग्रिड

केन्द्रीय कार्यालय : "सौदामिनी" प्लॉट सं. 2, सेक्टर-29, गुडगाँव-122 001, हरियाणा  
फोन : 2571700 - 719, फैक्स : 2571760, 2571761 तार 'नेटग्रिड'  
Corporate Office : "Saudamini" Plot No. 2, Sector-29, Gurgaon-122 001, Haryana  
Tel. : 2571700 - 719, Fax : 2571760, 2571761 Gram : 'NATGRID'

संदर्भ संख्या/Ref. Number

C/ENG/E/00/SEF/PLG

Date: 11-02-2013

Addl. General Manager  
Power System Operation Corporation Ltd  
B-9, 1<sup>st</sup> Floor, Qutub Institutional Area  
Katwaria Sarai, New Delhi – 110 016

### Sub: Loadability of Transmission Lines

Sir,

We write with reference to the letter dated 12<sup>th</sup> January, 2013 from POSOCO enclosing a note on loadability of transmission lines. CERC in Record of Proceedings of hearing dated 17-01-2013 regarding calculation of total transfer capacity, available transfer capacity and transmission reliability margin has directed CTU to respond to the suggestions of POSOCO to remove/replace shunt compensation on LILO lines to reduce the length of line to improve loadability.

In the referred note by POSOCO, maximum loadability limits for the transmission lines has been calculated considering the effects of SIL (Surge Impedance Loading), shunt compensation(factor k1), series compensation(factor k2) and St. Clair curve(factor k3) as referred in the Transmission Planning Criteria by CEA published in June, 1994. POSOCO has suggested to review the reactive compensation so as to enhance the loadability of the transmission lines.

In this regard, it may be mentioned that the loadability of a transmission system primarily depends upon thermal limit, voltage regulation limit and stability limit which could be determined through the studies. The same has also been discussed while preparation of the new transmission planning criteria. In the explanatory notes of the Planning Criteria, it is indicated to dispense with St. Clair curve as a general guidance for transmission line loading and carry out the same based on the studies.

As you are aware, the line reactors are provided in order to facilitate charging of EHV line as well as to control power frequency temporary over-voltage(TOV). In addition, line reactors are also useful in reduction of secondary arc current through NGR, successful single-pole auto reclosing, improvement in transient stability, reduction of trap charges etc. Accordingly, line reactors are planned taking into consideration all the above aspects which is an integral part of reactive power planning being carried out by POWERGRID and CEA on regular basis.

It may also be mentioned here that a decision was taken earlier to install switchable line reactor of size 80MVAR and higher rating only in order to contain the electrical stresses and transient recovery voltages which are high for lower rated reactors due

पंजीकृत कार्यालय : बी-9, कुतब इंस्टीट्यूशनल एरिया, कटवारिया सराय, नई दिल्ली-110016 दूरभाष : 26560121 फैक्स : 011-26560039 तार 'नेटग्रिड'  
Registered Office : B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi-110016 Tel. : 26560121 Fax : 011-26560039 Gram : 'NATGRID'

स्वहित एवं राष्ट्रहित में ऊर्जा बचाएं

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to chances of current chopping. The same is being reviewed as 400kV Circuit Breakers are now available with controlled switching device.

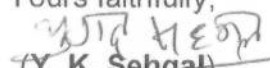
Accordingly, the modification of the existing line reactors viz. from fixed to switchable/bus reactor or removal of the same for various lines would require detailed examination considering the above aspects as well as the availability of space etc in the existing substation. POWERGRID has already taken action on various reactors in this regard, some of which are listed below :

- Conversion of Line reactor(50 MVAR) at Bangalore end on Cudappa – Bangalore 400kV S/c line from fixed to switchable one after LILO at Kolar.
- Conversion of Line reactors(2x50 MVAR) at N. Trichur end on Udumalpet – N. Trichur 400kV D/c line from fixed to switchable one after LILO at Pallakkad.
- Conversion of Line reactors(2x63 MVAR) at Bina and Nagda ends to switchable one after LILO of Bina-Nagda 400kV D/c line at Shujalpur.
- Conversion of Line reactors at Pune(AIS) (4x50MVAR) end to switchable one after LILO of Aurangabad-Pune and Parli-Pune 400kV D/c lines at Pune(GIS)
- Shifting of both line reactors(2X63 MVAR) at Mendhasal end to Pandiabil as switchable line reactors after LILO of Baripada-Mendhasal 400 kV D/c line at Pandiabil.
- Shifting of 2x50 MVAR line reactors from Patna end to Balia end after LILO of 400kV Kahalgaon/Barh – Balia D/c line at Patna.
- Shifting of Line reactors(2x63 MVAR) at Lucknow end to Sohawal end as bus recators after LILO of Balia – Lucknow 400kV D/c line at Sohawal.
- Conversion of Line reactors(2x50 MVAR) at Dehradun end to bus reactors after LILO of Dehradun – Bagpat 400kV D/c line at Saharanpur.
- Shifting of Line reactors(2x50 MVAR) at Bareilly end to Sohawal end after LILO of Lucknow – Bareilly 400kV D/c line at Shahjahanpur.
- Shifting of Line reactors(2x50 MVAR) at Bassi end to Jaipur(South) end after LILO of Agra – Bassi 400kV D/c line at Jaipur(South).
- Conversion of Line reactors(2x50 MVAR) at Wagoora end as bus reactors after LILO of Kishenpur-Wagoora 400kV D/c line at New Wanpoh.

While POWERGRID has already taken several actions towards modification of the existing reactive compensation of transmission lines, the same is being reviewed once again by CEA/POWERGRID and would be taken up in the Standing Committee/RPC meetings for concurrence of the constituents.

Thanking You,

Yours faithfully,

  
(Y. K. Sehgal)

Chief Operating Officer (CTU)

Copy to :

**The Secretary**  
**Central Electricity Regulatory Commission (CERC)**  
**3<sup>rd</sup> & 4<sup>th</sup> Floor, Chanderlok Building**  
**36, Janpath Road,**  
**New Delhi-110 001**