सत्यमेव जयते

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
विद्युत प्रणाली योजना एवं मूल्यांकन -। प्रभाग
Power System Planning & Appraisal - I Division

To

-As per list enclosed-

Subject: 5th meeting of Northern Region Standing Committee on Transmission (NRSCT) – Minutes of Meeting

Sir/ Madam,

The 5th meeting of Northern Region Standing Committee on Transmission was held on 13th September, 2019 at Katwaria Sarai, New Delhi. Minutes of the meeting are available on CEA website: www.cea.nic.in (path to access – Home Page – Wing - Power System-PSPA-I-Standing Committee on Power System Planning- Northern Region).

Yours faithfully,

(Goutam Roy)
Chief Engineer

1.	Chairperson, CEA, Sewa Bhawan, RK Puram Sector-1, New Delhi-11006	2.	Member, Secretary, NRPC, 18-A Shajeed Jeet Singh Sansanwal Marg, Katwaria Sarai, New Delhi - 110016 (Fax-011-26865206)	3.	Director (Projects) PTCUL, Vidhyut Bhawan, Near ISBT -Crossing, Saharanpur Road, Majra, Dehradun-248002. Uttrakhand Fax-0135-2645744
4.	Director (Technical), Punjab State Transmission Corporation Ltd. (PSTCL) Head Office The Mall Patiala -147001 Fax-0175-2304017	5.	Member (Power) BBMB, Sectot-19 B Madhya Marg, Chandigarh-1 60019 (Fax-01 72-2549857	6.	Director (Operation) Delhi Transco Ltd. Shakti Sadan, Kotla Marg, New Delhi-110002 (Fax-01123234640)
7.	Director (PP&D) RVPN, 3rd Floor, Room no 330, Vidhyut Bhawan, Janpath, Jaipur-302005. Fax-:0141-2740794 ce.ppm@rvpn.co.in	8.	Director (Technical) HVPNL Shakti Bhawan, Sector-6 Panchkula-134109 Fax-0172-256060640	9.	Director (Technical) HPSEB Ltd. Vidut Bhawan, Shimla -171004 Fax-0177-2813554
10.	Managing Director, HPPTCL, Barowalias, Khalini Shimla-171002 Fax-0177-2623415	11.	Chief Engineer (Operation) Ministry of Power, UT Secretariat, Sector-9 D Chandigarh -161009 Fax-0172-2637880	12.	Development Commissioner (Power), Power Department, Grid Substation Complex, Janipur, Jammu, Fax: 191-2534284
13.	Director (Projects) POWERGRID Saudamini Plot no. 2, Sector - 29. Gurgaon-122 001 (Fax-0124-2571809)	14.	CEO, POSOCO B-9, Qutab Institutional Area, Katwaria Sarai New Delhi – 110010 (Fax:2682747)	15	COO (CTU) POWERGRID, Saudamini, Plot no. 2, Sector -29, Gurgaon-122 001 (Fax-0124-2571809)
16.	Director (W &P) UPPTCL, Shakti Bhawan Extn,3rd floor, 14, Ashok Marg, Lucknow - 226 001 (Fax:0522-2287822)				

Minutes of 5th Meeting of Northern Region Standing Committee on Transmission (NRSCT) held on 13.09.2019

List of participants is enclosed as Annexure –I.

1.0 **Confirmation of the Minutes of the 4th meeting of Northern Region Standing Committee on Transmission held on 25.07.2019.**

1.1 CEA stated that 4th meeting of Northern Region Standing Committee on Transmission (NRSCT) was held on 25.07.2019 and the minutes of the meeting were issued vide CEA letter no. CEA-PS-11-21(19)/2/2019-PSPA-I Division dated 9.8.2019.

1.2 CEA further stated that, POSOCO vide its letter NLDC/SO/NRSCT/RE/126 dated 27.8.2019 has forwarded their observations on the Agenda item no 3 of the minutes of the meeting, wherein POSOCO has made few suggestions in context of transmission planning studies of RE, which they indicated has not been incorporated in the minutes. The suggestions made by POSOCO are as under:

a) *In the planning study case, thermal generation in some of the cheaper pit head plants like Talcher, Sipat, Rihand, Vindhyachal etc. is reduced significantly in the study case while keeping generation at load centre plants like Talwandi Saboo and Dadri TPS on the higher side. Merit order dispatch and PLF may be taken in consideration while reducing the thermal generation in the study cases so as to get a better idea of the probable inter –regional flows and fault levels in 2022 scenario.*

b) *The LGBR taken in the study case is stated to be of 2022 monsoon daytime period but same is not matching with the typical monsoon period LGBR.*
For e.g., high hydro generation is usually observed in the monsoon period but same is found to be very less in the study case. Further, HVDC APD-BNC-AGRA flow has been taken as 1,000 MW only while same is usually more than 2,000 MW in the high hydro season.

c) *Network behaviour under low RE and other generation scenarios needs to be studied and the results may be shared with all stakeholders.*
POSOCO representative also stressed on the need to carry out studies on the all India snapshot with high RE generation in Northern, Western and Southern Region simultaneously (a likely scenario) in order to assess the need for strengthening in other parts of the network and minimize congestion and RE curtailment in future."

1.3 CEA stated that the observations made by POSOCO were related to the studies carried out for transmission system for must run RE generations under Phase-II and as such no reduction in the RE generation have been considered.

1.4 CTU stated that under point 7.3 of the minutes, implementation of the 2 no of 400 kV bays(GIS) at 765/400 kV Varanasi (PGCIL-GIS) substation for Jaunpur-Varanasi (PGCIL) 400 kV D/c line under ISTS with the implementation schedule of January 2021 was agreed. However, the implementation of the GIS bays won't be feasible in the given time schedule. Therefore, CTU is exploring the option of hybrid bays. If feasible, CTU would implement hybrid bays which can be installed in open space that in turn would save the time required for extension of GIS building in case of GIS bays. Members agreed for the same.

1.5 RVPNL stated that following is mentioned under point no. 3.9 of the minutes:

"3.9 HVPNL suggested that even though the alternative involving VSC based HVDC system was costly, but has many advantages over AC systems for RE integration. Therefore, Govt of India may be approached for some financial support to the extent of cost difference between AC and DC option." RVPNL further stated that not only HVPNL, but all the constituents were having the same opinion.

Accordingly, para no 3.9 is modified as below:
"*3.9 All the constituents of NRSCT were of the view that even though the alternative involving VSC based HVDC system was costly, but has many advantages over AC systems for RE integration. Therefore, Govt of India may be approached for some financial support to the extent of cost difference between AC and DC option."*

1.6 Chief Engineer PSPA-1 stated that the present meeting has been convened to discuss the option of AC alternative over DC alternative as HVDC alternative is costly and also cannot be implemented within the timeframe of Phase II system i.e. March 2022, therefore, except the transmission system for SEZ in Rajasthan (8.1 GW under Phase II), all other items discussed and agreed in last Meeting can be approved.

1.7 The minutes of 4th meeting of NRSCT along with the modifications mentioned at 1.4 and 1.5 above were confirmed by the constituents.

2.0 Transmission System Strengthening for potential solar energy zones –Phase -II in Northern Region.

2.1 CEA stated that transmission system strengthening for solar potential of 8.1 GW (**Ramgarh/Kuchheri (1.9 GW), Bikaner (2.95 GW), Bhadla (1.05GW) & Fatehgarh (2.2GW**) was discussed in the 4th meeting of NRSCT held on 25.7.2019, wherein two alternatives were proposed; Alternative 1: with EHVAC system, Alternative 2: with EHVAC and VSC based HVDC system, wherein most of the constituents agreed for alternative 2 as that steady state and dynamic reactive power support is required for the AC transmission system due to integration of large quantum of Renewable Energy and VSC based HVDC system can provide reactive power support just like STATCOM and may also take care of the dynamic reactive power support for renewable integration. Also, the uncertainty of adequate short circuit level due to intermittent & variable nature of Renewable Energy can also be addressed by VSC based HVDC in comparison to LCC based HVDC.

2.2 Based on the deliberations in the meeting, following Transmission schemes were agreed for Solar Energy Zones (SEZs) in Rajasthan (8.1 GW) under Phase-II

A. EHVAC Portion

i) Establishment of 400/220kV, 4x500 MVA pooling station at suitable location near Ramgarh/Kuchheri in Distt Jaisalmer (Ramgarh-II PS)
ii) Establishment of 400/220kV, 6x500MVA pooling station at suitable location near Bikaner (Bikaner-II PS) with suitable bus sectionalisation at 400 and 220 kV level.
iii) Establishment of 765/400kV, 3x1500MVA substation at suitable location in Narela (near delhi)
iv) Augmentation with 765/400kV, 2x1500MVA transformer (5th & 6th) at Fatehgarh-II PS.
v) Augmentation with 400/220kV, 4x500MVA transformer at Fatehgarh-II PS with suitable bus sectionalisation at 400 and 220 kV level

vi) Augmentation with 400/220kV, 3x500MVA transformer at Bhadla-II PS with suitable bus sectionalisation at 400 and 220 kV level.
vii) Augmentation with 765/400kV, 1x1500MVA (3rd) transformer at Bikaner(PG)
viii) Ramgarh-II PS –Fatehgarh-II PS 400 kV D/c Line (Twin HTLS$)
ix) Ramgarh-II PS – Jaisalmer-II (RVPN) 400 kV D/c Line (Twin HTLS$)
x) Fatehgarh-II PS – Bhadla-II PS 765kV D/c line (2nd)
xi) Bikaner-II PS – Khetri 400kV 2xD/c line (*Twin HTLS$ line on M/c tower*)
xii) Khetri - Bhiwadi 400kV D/c line (Twin HTLS$)**
xiii) Removal of LILO of one circuit of Bhadla-Bikaner(RVPN) 400kV D/c(Quad) line at Bikaner(PG). Extension of above LILO section from Bikaner(PG) upto Bikaner-II PS to form Bikaner-II PS – Bikaner (PG) 400kV D/c(Quad) line
xiv) Khetri - Narela 765kV D/c line
xv) LILO of 765kV Meerut – Bhiwani S/c line at Narela S/s
xvi) Removal of LILO of Bawana – Mandola 400kV D/c(Quad) line at Maharani Bagh/Gopalpur S/s. Extension of above LILO section from Maharani Bagh/Gopalpur upto Narela S/s so as to form Maharanibagh – Narela 400kV D/c(Quad) and Maharanibagh -Gopalpur-Narela 400kV D/c(Quad) lines.
xvii) LILO of both circuits of Bawana – Mandola 400kV D/c(Quad) line at Narela S/s
xviii) Power reversal on ±500kV, 2500MW Balia – Bhiwadi HVDC line upto 2000MW from Bhiwadi to Balia
xix) 220kV line bays for interconnection of solar projects at Bikaner-II PS (10 nos.), Ramgarh-II PS (7 nos), Fatehgarh-II PS (8 nos) & Bhadla-II PS (4 nos)
xx) 1x125 MVAr (420kV), 2x240 MVAr (765kV) Bus Reactor at Narela Substation
xxi) 2x125 MVAr (420kV) Bus Reactor each at Bikaner-II & Ramgarh-II PS
xxii) 1x240 MVAr Switchable line reactor for each circuit at each end of Fatehgarh-II – Bhadla-II 765kV D/c line (2nd)
xxiii) 1x80 MVAr Switchable line reactor for each circuit at each end of Bikaner-II – Khetri 400kV 2xD/c line
xxiv) 1x240 MVAr Switchable line reactor for each circuit at each end of Khetri – Narela 765kV D/c line

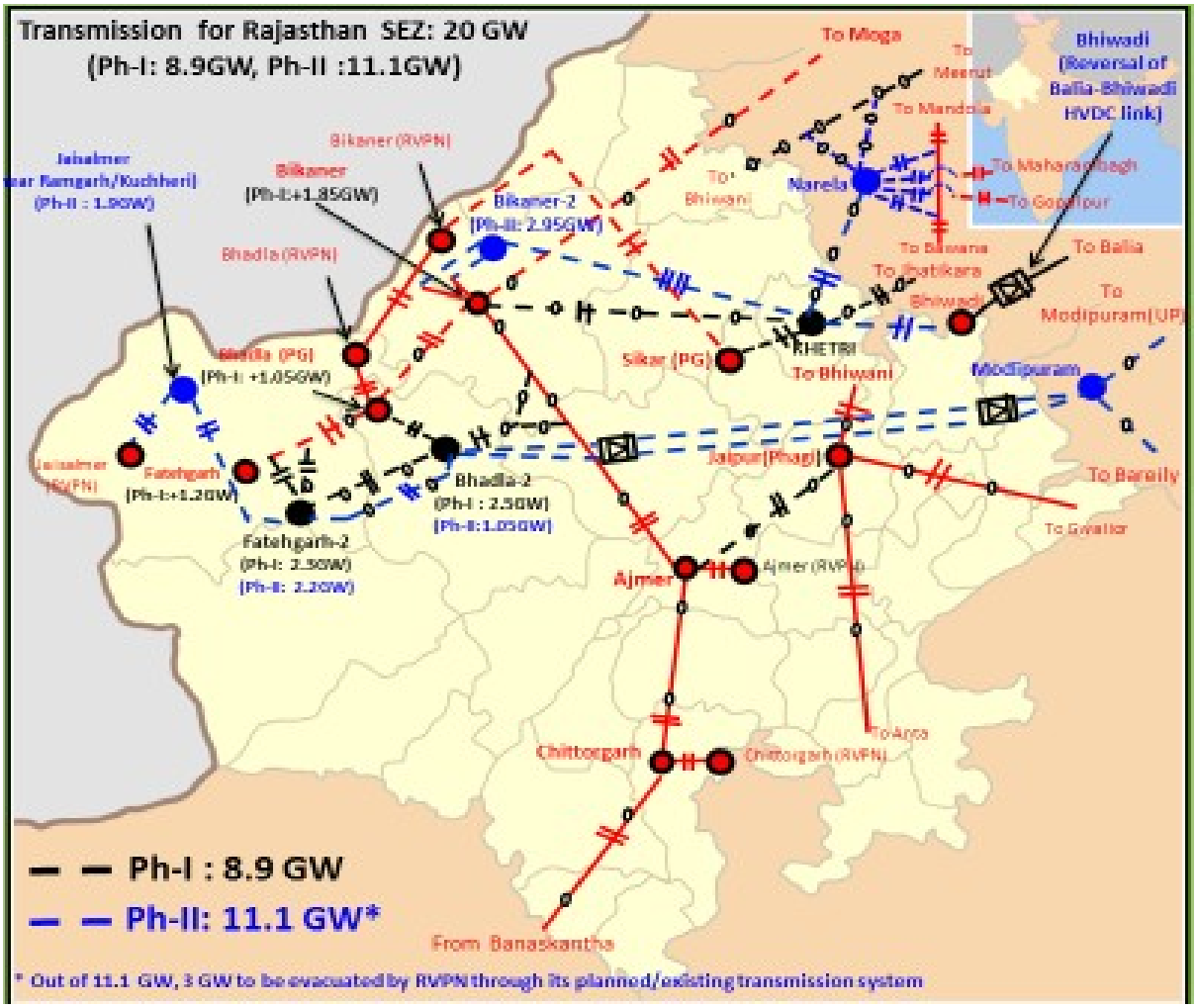
** *Due to space constraints 400kV bays at Bhiwadi S/s to be implemented as GIS*
$ *with minimum capacity of 2200 MVA on each circuit at nominal voltage*

B. HVDC Portion

1) VSC based HVDC system between Bhadla-II PS and suitable location near Modipuram
   i) ±400kV, 5000 MW HVDC terminal at Pooling point near Bhadla-II PS
   ii) ±400kV, 5000 MW HVDC terminal at Pooling point in suitable location near Modipuram
   iii) ±400kV HVDC line (Quad) between Bhadla-II PS and suitable location near Modipuram (on M/c tower)

AC interconnection at Pooling point in suitable location near Modipuram

2) 5x1500MVA transformer at suitable location (near modipuram)



2.3 CEA further stated that the detailed cost worked out for Alternative 2 (with EHVAC and VSC based HVDC system) were of the order of 17000 Crore. It was also observed that the Phase II system of Northern Region would be required in the time frame of 2021-22, as most of the generations are likely to be added in the same time frame, therefore, it would be difficult to implement VSC based HVDC transmission system in the desired timeframe.

2.4 SECI stated that more developers are coming in Rajasthan in comparison to other states, therefore, the transmission system would be required by Dec2021.

2.5 CEA stated that considering the high cost of the HVDC system and difficulty in implementation of the VSC based HVDC transmission system by 21-22, it was decided to review the transmission system agreed in the 4th NRSCT for evacuation of power from solar potential of 8.1 GW (Ramgarh/Kuchheri (1.9 GW), Bikaner (2.95 GW), Bhadla (1.05GW) & Fatehgarh (2.2GW).

2.6 Load flow studies had been carried out and 3 different options were worked out with HVAC system. It has also been found that dynamic reactive power support would be required for such a huge RE additions in Northern Regions. Therefore, provision of STATCOM has also been considered in the various alternatives proposed for transmission system under Phase-II. Further, LILO of Bawana – Mandola 400kV D/c(Quad) at Narela 765/400kV S/s was part of the system agreed earlier in 4th NRSCT meeting. However, due to high fault levels in Delhi Ring, especially at Bawana & Narela the same has been removed. The 3 alternatives are :

Alternative -1 (Modipuram)

1. Establishment of 400/220kV, 4x500 MVA pooling station at suitable location near Ramgarh/Kuchheri in Distt Jaisalmer (Ramgarh-II PS) with 2x125 MVAr bus reactor.
2. Ramgarh-II PS –Fatehgarh-II PS 400 kV D/c Line (Twin HTLS).
3. Ramgarh-II PS – Jaisalmer-II (RVPN) 400 kV D/c Line (Twin HTLS)
4. Establishment of 400/220kV, 6x500MVA pooling station at suitable location near Bikaner (Bikaner-II PS) with 2x125 MVAr bus reactor
5. Bikaner-II PS – Khetri 400kV 2xD/c line (Twin HTLS line on M/c tower)
6. Removal of LILO of one circuit of Bhadla-Bikaner(RVPN) 400kV D/c(Quad) line at Bikaner(PG). Extension of above LILO section from Bikaner(PG) upto Bikaner-II PS to form Bikaner-II PS – Bikaner (PG) 400kV D/c(Quad) line)
7. 1x80 MVAr Switchable line reactor for each circuit at each end of Bikaner-II – Khetri 400kV 2xD/c line
8. Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Sikar (Sikar-II Substation) with 1x125 MVAr & 2x330 MVAr bus reactor at Sikar-II
9. Sikar-II – Modipuram 765kV D/c line
10. Bhadla-II PS – Sikar-II 765kV 2xD/c line
11. Sikar-II – Neemrana 400kV D/c line (Twin HTLS)*
12. 1x330 MVAr Switchable line reactor for each circuit at Sikar end of Bhadla-II – Sikar-II 765kV 2xD/c line
13. 1x240 MVAr Switchable line reactor for each circuit at Bhadla-II end of Bhadla-II – Sikar-II 765kV 2xD/c line
14. 1x330MVAr Switchable line reactor for each circuit at each end of Sikar-II – Modipuram 765kV D/c line
15. Augmentation with 765/400kV, 2x1500MVA transformer (5th & 6th) at Fatehgarh-II PS
16. Fatehgarh-II PS – Bhadla-II PS 765kV D/c line (2nd)
17. 1x240 MVAr Switchable line reactor for each circuit at each end of Fatehgarh-II – Bhadla-II 765kV D/c line
18. Augmentation with 400/220kV, 4x500MVA transformer at Fatehgarh-II PS
19. Augmentation with 765/400kV, 1x1500MVA transformer (4th) at Bhadla-II PS
20. 1x240 MVAr Switchable line reactor for each circuit at Bhadla-II end of Bhadla-II – Sikar-II 765kV D/c line
21. Augmentation with 400/220kV, 3x500MVA transformer at Bhadla-II PS
22. Khetri - Bhiwadi 400kV D/c line (Twin HTLS)*
23. Power reversal on ±500kV, 2500MW Balia – Bhiwadi HVDC line upto 2000MW from Bhiwadi to Balia
24. 220kV line bays for interconnection of solar projects at Bikaner-II PS (10 nos.), Ramgarh-II PS (7 nos), Fatehgarh-II PS (7 nos) & Bhadla-II PS (4 nos)
25. Establishment of 765/400 kV, 3X1500 MVA substation at Narela with 765 kV (2x330 MVAr) bus reactor and 400kV (1x125 MVAR) bus reactor.
26. Khetri – Narela 765 kV D/c line
27. 2 nos. of 765 kV line bays at Khetri for Khetri – Narela 765 kV D/c line.
28. 1x330 MVAr Switchable line reactor for each circuit at Narela end of Khetri – Narela 765kV D/c line

29. LILO of 765 kV Meerut- Bhiwani S/c line at Narela
30. Removal of LILO of Bawana – Mandola 400kV D/c(Quad) line at Maharani Bagh/ Gopalpur S/s. Extension of above LILO section from Maharani Bagh/Gopalpur upto Narela S/s so as to form Maharanibagh – Narela 400kV D/c(Quad) and Maharanibagh -Gopalpur-Narela 400kV D/c(Quad) lines.
31. STATCOM:
    Fatehgarh – II S/s : STATCOM : ± 600 MVAr, 4x125 MVAR MSC , 2x125 MVAr MSR
    Bhadla – II S/s : STATCOM : ± 600 MVAr, 4x125 MVAR MSC , 2x125 MVAr MSR
    Bikaner – II S/s : STATCOM : ± 300 MVAr, 2x125 MVAR MSC , 1x125 MVAr MSR

* *with minimum capacity of 2200 MVA on each circuit at nominal voltage*

Estimated Cost: 12770 Cr.

Alternative -2 (Kadarpur)

1. Establishment of 400/220kV, 4x500 MVA pooling station at suitable location near Ramgarh/Kuchheriin Distt Jaisalmer (Ramgarh-II PS) with 2x125 MVAr bus reactor.
2. Ramgarh-II PS –Fatehgarh-II PS 400 kV D/c Line (Twin HTLS)
3. Ramgarh-II PS – Jaisalmer-II (RVPN) 400 kV D/c Line (Twin HTLS)
4. Establishment of 400/220kV, 6x500MVA pooling station at suitable location near Bikaner (Bikaner-II PS) with 2x125 MVAr bus reactor
5. Bikaner-II PS – Khetri 400kV 2xD/c line (Twin HTLS line on M/c tower)
6. Removal of LILO of one circuit of Bhadla-Bikaner(RVPN) 400kV D/c(Quad) line at Bikaner(PG). Extension of above LILO section from Bikaner(PG) upto Bikaner-II PS to form Bikaner-II PS – Bikaner (PG) 400kV D/c(Quad) line.
7. 1x80 MVAr Switchable line reactor for each circuit at each end of Bikaner-II – Khetri 400kV 2xD/c line.
8. Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Sikar (Sikar-II Substation) with 1x125, MVAr& 2x240 MVAr bus reactor at Sikar (II)
9. Sikar-II – Kadarpur-II 765kV D/c line
10. Bhadla-II PS – Sikar-II 765kV 2xD/c line
11. Sikar-II – Neemrana 400kV D/c line (Twin HTLS).
12. 1x330 MVAr Switchable line reactor for each circuit at Sikar end of Bhadla-II – Sikar-II 765kV 2xD/c line
13. 1x240 MVAr Switchable line reactor for each circuit at Bhadla-II end of Bhadla-II – Sikar-II 765kV 2xD/c line.
14. 1x330MVAr Switchable line reactor for each circuit at each end of Sikar-II – Kadarpur-II 765kV D/c line.
15. Establishment of 765/400kV, 2x1500MVA substation at suitable location near Kadarpur (Kadarpur-II substation) with 1x125 MVAr & 2x330 MVAr bus reactor at Kadarpur-(II)
16. LILO of 765kV Jhatikara – Agra S/c line at Kadarpur-II
17. Kadarpur-II – Bareilly 765kV D/c line.
18. Kadarpur-II – Prithala 400kV D/c line (Twin HTLS)*
19. 1x330MVAr Switchable line reactor for each circuit at Kadarpur-II end of Kadarpur-II – Bareilly 765kV D/c line

20. 1x240 MVAr Switchable line reactor for each circuit at Bareilly end of Kadarpur-II – Bareilly 765kV D/c line
21. Augmentation with 765/400kV, 2x1500MVA transformer (5th & 6th) at Fatehgarh-II PS
22. Fatehgarh-II PS – Bhadla-II PS 765kV D/c line(2nd)
23. 1x240 MVAr Switchable line reactor for each circuit at each end of Fatehgarh-II – Bhadla-II 765kV D/c line
24. Augmentation with 400/220kV, 4x500MVA transformer at Fatehgarh-II PS
25. Augmentation with 765/400kV, 1x1500MVA transformer (4th) at Bhadla-II PS
26. 1x240 MVAr Switchable line reactor for each circuit at Bhadla-II end of Bhadla-II – Sikar-II 765kV D/c line
27. Augmentation with 400/220kV, 3x500MVA transformer at Bhadla-II PS
28. Khetri - Bhiwadi 400kV D/c line (Twin HTLS)
29. Power reversal on ±500kV, 2500MW Balia – Bhiwadi HVDC line upto 2000MW from Bhiwadi to Balia
30. Establishment of 765/400 kV, 3X1500 MVA substation at Narela with 765 kV (2x330 MVAr) bus reactor and 400 kV (1x125 MVAR) bus reactor
31. Khetri – Narela 765 kV D/c line
32. 2 nos. of 765 kV line bays at Khetri for Khetri – Narela 765 kV D/c line.
33. 1x330 MVAr Switchable line reactor for each circuit at Narela end of Khetri – Narela 765kV D/c line
34. LILO of 765 kV Meerut- Bhiwani S/c line at Narela
35. Removal of LILO of Bawana – Mandola 400kV D/c(Quad) line at Maharani Bagh/ Gopalpur S/s. Extension of above LILO section from Maharani Bagh/Gopalpur uptoNarela S/s so as to form Maharanibagh – Narela 400kV D/c(Quad) and Maharanibagh -Gopalpur-Narela 400kV D/c(Quad) lines.
36. 220kV line bays for interconnection of solar projects at Bikaner-II PS (10 nos.), Ramgarh-II PS (7 nos), Fatehgarh-II PS (7 nos) & Bhadla-II PS (4 nos)
37. STATCOM:
    Fatehgarh – II S/s : STATCOM : ± 600 MVAr, 4x125 MVAR MSC , 2x125 MVAr MSR
    Bhadla – II S/s : STATCOM : ± 600 MVAr, 4x125 MVAR MSC , 2x125 MVAr MSR
    Bikaner – II S/s : STATCOM : ± 300 MVAr, 2x125 MVAR MSC , 1x125 MVAr MSR

    ** with minimum capacity of 2200 MVA on each circuit at nominal voltage*

Estimated Cost: 13660 Cr.

Alternative -3 (Aligarh)

1. Establishment of 400/220kV, 4x500 MVA pooling station at suitable location near Ramgarh/Kuchheri in Distt Jaisalmer (Ramgarh-II PS) with 2x125 MVAr bus reactor.
2. Ramgarh-II PS –Fatehgarh-II PS 400 kV D/c Line (Twin HTLS).
3. Ramgarh-II PS – Jaisalmer-II (RVPN) 400 kV D/c Line (Twin HTLS)
4. Establishment of 400/220kV, 6x500MVA pooling station at suitable location near Bikaner (Bikaner-II PS)) with 2x125 MVAr bus reactor
5. Bikaner-II PS – Khetri 400kV 2xD/c line (Twin HTLS line on M/c tower)
6. Removal of LILO of one circuit of Bhadla-Bikaner(RVPN) 400kV D/c(Quad) line at Bikaner(PG). Extension of above LILO section from Bikaner(PG) upto Bikaner-II PS to form Bikaner-II PS – Bikaner (PG) 400kV D/c(Quad) line)

7. 1x80 MVAr Switchable line reactor for each circuit at each end of Bikaner-II – Khetri 400kV 2xD/c line
8. Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Sikar (Sikar-II Substation) with 1x125 MVAr & 2x330 MVAr bus reactor at Sikar (II)
9. Sikar-II – Aligarh 765kV D/c line
10. Bhadla-II PS – Sikar-II 765kV 2xD/c line
11. Sikar-II – Neemrana 400kV D/c line (Twin HTLS)*
12. 1x330 MVAr Switchable line reactor for each circuit at Sikar end of Bhadla-II – Sikar-II 765kV 2xD/c line
13. 1x240 MVAr Switchable line reactor for each circuit at Bhadla-II end of Bhadla-II – Sikar-II 765kV 2xD/c line
14. 1x330MVAr Switchable line reactor for each circuit at each end of Sikar-II –Aligarh 765kV D/c line
15. Augmentation with 765/400kV, 2x1500MVA transformer (5^{th} & 6^{th}) at Fatehgarh-II PS
16. Fatehgarh-II PS – Bhadla-II PS 765kV D/c line (2^{nd})
17. 1x240 MVAr Switchable line reactor for each circuit at each end of Fatehgarh-II – Bhadla-II 765kV D/c line
18. Augmentation with 400/220kV, 4x500MVA transformer at Fatehgarh-II PS
19. Augmentation with 765/400kV, 1x1500MVA transformer (4^{th}) at Bhadla-II PS
20. 1x240 MVAr Switchable line reactor for each circuit at Bhadla-II end of Bhadla-II – Sikar-II 765kV 2xD/c line
21. Augmentation with 400/220kV, 3x500MVA transformer at Bhadla-II PS
22. Khetri - Bhiwadi 400kV D/c line (Twin HTLS)
23. Power reversal on ±500kV, 2500MW Balia – Bhiwadi HVDC line upto 2000MW from Bhiwadi to Balia
24. 220kV line bays for interconnection of solar projects at Bikaner-II PS (10 nos.), Ramgarh-II PS (7 nos), Fatehgarh-II PS (7 nos) & Bhadla-II PS (4 nos)
25. Establishment of 765/400 kV, 3X1500 MVA substation at Narela with 765 kV (2x330 MVAr) bus reactor and 400kV (1x125 MVAR) bus reactor.
26. Khetri – Narela 765 kV D/c line
27. 2 nos. of 765 kV line bays at Khetri for Khetri – Narela 765 kV D/c line.
28. 1x330 MVAr Switchable line reactor for each circuit at Narela end of Khetri – Narela 765kV D/c line
29. LILO of 765 kV Meerut- Bhiwani S/c line at Narela
30. Removal of LILO of Bawana – Mandola 400kV D/c(Quad) line at Maharani Bagh/ Gopalpur S/s. Extension of above LILO section from Maharani Bagh/Gopalpur upto Narela S/s so as to form Maharanibagh – Narela 400kV D/c(Quad) and Maharanibagh -Gopalpur-Narela 400kV D/c(Quad) lines.
31. STATCOM:

    Fatehgarh – II S/s : STATCOM : ± 600 MVAr, 4x125 MVAR MSC , 2x125 MVAr MSR

    Bhadla – II S/s : STATCOM : ± 600 MVAr, 4x125 MVAR MSC , 2x125 MVAr MSR

    Bikaner – II S/s : STATCOM : ± 300 MVAr, 2x125 MVAR MSC , 1x125 MVAr MSR

* *with minimum capacity of 2200 MVA on each circuit at nominal voltage*

Estimated Cost: 12442 Cr.

2.7 RVPN stated that though costly, VSC based HVDC system can provide reactive power support and may take care of the dynamic reactive power support for renewable integration. The grid stability is also enhanced on account of active and reactive modulations. RVPN also stated that with HVDC transmission system, the power flows can be controlled, however, in case of AC alternatives, more RE power is likely to flow into intra state system of Rajasthan due to inter-connection of intra-State with inter-State network and it would result in increase their POC charges. RVPNL also raised the concern about high voltages in their intra-state grid during the no solar scenario.

RNPN also suggested that in reference to proposed HVDC system, it is suggested that uni – directional HVDC may be considered instead bidirectional HVDC system, as there are no load Centre in and around Jaisalmer / Bhadla, so power flow from Modipuram (UP) may not be required. RVPN has already a strong existing inter-state EHV AC transmission lines in Northern Rajasthan. This arrangement would reduce the cost terminal stations at both Bhadla and Modipuram.

2.8 PSTCL stated that with such a huge injection of RE power in the State grids, CTU should also work out the requirement of system strengthening as well as provision of reactors under Intra-State.

2.9 CTU stated that with the above interconnections, no overloading has been observed in the State's network. Also, adequate reactive power support has also been worked out with the proposed scheme. Regarding, suggestion made by RVPNL for considering uni – directional HVDC instead bidirectional HVDC system, CTU clarified that there is little cost difference between the two configurations.

2.10 CEA also clarified that to take care of the dynamic reactive power support, provision of STATCOMs has been kept in the EHVAC schemes. Also, from the load flow studies, it has been observed that power flow in the intra state transmission system of Rajasthan with the EVHAC transmission system is almost same when compared with power flow with VSC based transmission system.

2.11 PSTCL opined that the solar power would be available for limited hours in the day time only and for optimum utilization of the same, storage facility in generating plants may be explored, which would help in less requirements for transmission corridors.

2.12 RVPN emphasised that there should be installation of battery banks of capacity equivalent to 1/3rd capacity of Solar Power Projects, so that variability is not injected into the State's transmission system.

2.13 On this, SECI informed that they have already floated a tender regarding development of co-located storage facility.

2.14 RVPN and HVPN raised the issue of increase in the fault level in the their Intra state transmission system due to interconnection with the proposed ISTS transmission system for evacuation of power from solar potential of 8.1 GW under phase II. RVPN also stated that since a large quantum of power is expected to flow towards Phagi, 400kV outlet at Phagi may be planned. It was agreed that while studying the all India scenarios with RE integration of all regions, the requirements of 400 kV outlets from Phagi would also be studied and proposed, if required.

2.15 CEA stated that the fault level at various nodes in NR is high. We had earlier carried out the studies for reducing the fault levels and the schemes were taken up for implementation in three pockets of Northern region. Separate studies would be carried out shortly to reduce the fault level at these nodes.

2.16 All the constituents including Rajasthan expressed their concern regarding increase of POC charges with implementation of the above transmission system associated with

RE generations. It was informed by CTU that POC mechanism is under review & the matter is likely to be resolved in near future. As the transmission system is associated with RE Generation capacity addition plan of GoI is a national project, all the constituents requested to explore for some financial assistance for the subject scheme through Govt. of India funding.

2.17 RVPN and HVPN suggested that a recommendation/ suggestion must be submitted to GoI from NRSCT so that the approved transmission system may be developed through Viability Gap Funding (VGF) mode or Government may provide funding from Central assistance so that its impact through PoC mechanism is reduced on the Discoms.

2.18 POSOCO enquired that normally the STATCOMs are placed at the load side, however in the present scheme, the STATCOMs are proposed near the generating station/s.

2.19 CTU stated that as per technical standards of CEA, Renewable Generators shall be capable of supplying dynamically varying reactive power support so as to maintain power factor within limits of 0.95 lagging to 0.95 leading. Assuming length of 50 km, reactive power loss of about 30 MVAr is envisaged for 300 MW on 220kV S/c line. Accordingly, in the absence of proper reactive power support to transmission system, compensation is required to be provided near RE Generation Pooling Stations.

2.20 During fault conditions in the absence of conventional generator & low short circuit levels in close proximity, grid/voltage stability would be a major concern. Due to persistence of low voltage in the network, there could be cascading effect of multiple RE generation tripping due to breach of LVRT triggers. This could lead to further fall in system voltage due to generation loss and may lead to voltage collapse in the system. In view of above, dynamic reactive power support is required to maintain Grid parameters within acceptable limits with variation in generation.

2.21 Further, during 4th NRSCT meeting POSOCO informed that Short Circuit Ratio(SCR) of 3 nos of 220kV buses i.e Fatehgarh-II(about 4), Bhadla(about 5) and Bhadla-II(about 5) is low. STACOMs also provide support in this regard.

2.22 It is also observed from simulation studies that many line & bus reactors are required to be switch off to operate the grid in high RE scenario. Considering huge volume of Renewables Energy (both State & ISTS) expected to be available in Western Rajasthan, Ramp up/down of generation is envisaged to be very fast. In such a scenario, manual switching ON/OFF of Reactors may not be practically feasible & STATCOM controllers may be used for switching in/out nearby Reactors.

2.23 Accordingly, STATCOMs have been proposed considering anticipated generation at various complexes of Western Rajasthan is as given below:

Anticipated Generation

	Earlier (MW)	**Ph-I (MW)**	**Ph-II (MW)**	**Total (MW)**
Fatehgarh	1000	1200		2200
Fatehgarh-II		2300	2200	4500
Ramgarh			1900	1900
			Sub Total	**8600**
Bhadla	2330	1050		3380
Bhadla-II		2500	1050	3550
			Sub Total	**6930**

Bikaner		1850		1850
Bikaner-II			2950	2950
				4800
			Sub Total	**20330**

2.24 It was discussed that Alternative-1 involves Modipurm(UPPTCL) which is presently under tendering. Accordingly, commissioning of Modipuram(UPPTCL) by December, 2021 is uncertain. Regarding, Alternative-2, HVPNL opined the option includes additional 765/400kV S/s at Kadarpur, hence costlier that alternative 1 & 3.

2.25 After deliberations, looking into techno-cost economics and the implementation time period, the constituents of NRSCT preferred the 3rd Alternative (Aligarh) for transmission System Strengthening scheme for potential solar energy zones –Phase -II (Ramgarh/Kuchheri (1.9 GW), Bikaner (2.95 GW), Bhadla (1.05GW) & Fatehgarh (2.2GW) in Northern Region. RVPN agreed for the 3rd alternative subject to following conditions:

1) No reactive power injection should occur in the intra State Transmission System, so as to avoid voltage excursions.

2) There should not be excessive increase in fault levels of State owned Grid Sub-station, due to present system strengthening scheme for 8.1 GW RE generations. In case of high fault level beyond the limits, the solutions/ schemes worked out for reduction of fault level would be implemented under ISTS.

3) Since in AC transmission system the power flow of solar generation would also increase the slab rate of PoC for host state i.e. Rajasthan. Hence, the host state should be given relief from such-additional financial burden. therefore, RVPN requested CEA/PGCIL to forward their recommendation to appropriate forum constituted by Govt. of India. Also, CERC in order dated 09.08.2019 in Petition No. 23/ MP/2019 regarding grant of regulatory approval for execution of transmission system for SEZ in Rajasthan has directed PGCIL/ CTU to seek grant and subsidies from GOI / State Governments so that the cost of implementation is not passed on to the consumers.

4) Furthermore, CEA would have to explore to split bus arrangement of existing CTU's buses so that no solar power exchange occurs with STU system as these solar generators are Inter State generators getting connected at Solar Parks viz. Bhadla Fathegarh, Ramgarh/ Kuchheri and Bikaner and the Discom's of Rajasthan would have no commercial agreement with these solar generators.

Regarding point no.(1), it was informed that adequate compensation has been provided for ISTS system for reactive power support & to contain high voltages. Further, STATCOMs have been proposed for dynamic stability enhancement. Accordingly, it was envisaged that reactive power exchange with state system would be minimal.

Regarding point no.(2) , CEA stated that the fault level at various nodes in NR is high. We had earlier carried out the studies for reducing the fault levels and the schemes were taken up for implementation in three pockets of Northern region. Separate studies would be carried out shortly to reduce the fault level at these nodes.

Regarding point no.(3), it was discussed that POC mechanism is under review & the matter is likely to be resolved in near future.

Regarding point no.(4), bus sectionalisation at Fatehgarh-II, Bhadla-II & Bikaner-II have already been envisaged in the present scope. Requirement of further splitting buses shall be studied alongwith separate joint studies mentioned above.

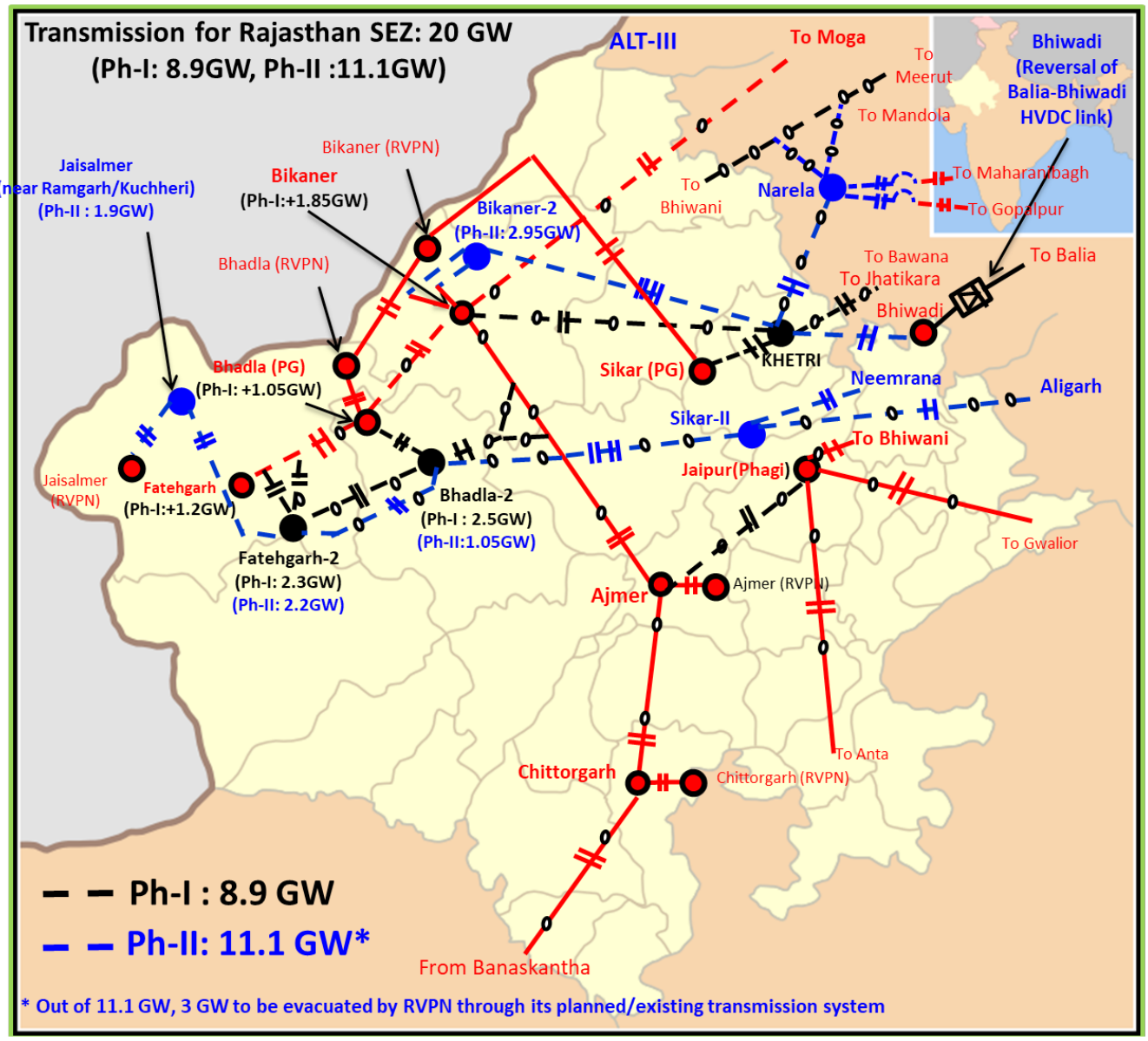
2.26 CTU pointed out that Narela is located in NCR/Delhi where finding land for substation is difficult, hence it should be implemented as GIS substation.

2.27 Based on the deliberations in the meeting, following was agreed for Transmission schemes for Solar Energy Zones (SEZs) in Rajasthan (8.1 GW) under Phase-II

1. Establishment of 400/220kV, 4x500 MVA pooling station at suitable location near Ramgarh/Kuchheri in Distt Jaisalmer (Ramgarh-II PS) with 2x125 MVAr bus reactor.
2. Ramgarh-II PS –Fatehgarh-II PS 400 kV D/c Line (Twin HTLS*)
3. Ramgarh-II PS – Jaisalmer-II (RVPN) 400 kV D/c Line (Twin HTLS*)
4. Establishment of 400/220kV, 6x500MVA pooling station at suitable location near Bikaner (Bikaner-II PS) with 2x125 MVAr bus reactor and with suitable bus sectionalisation at 400 and 220 kV level.
5. Bikaner-II PS – Khetri 400kV 2xD/c line (Twin HTLS* line on M/c tower)
6. Removal of LILO of one circuit of Bhadla-Bikaner(RVPN) 400kV D/c(Quad) line at Bikaner(PG). Extension of above LILO section from Bikaner(PG) upto Bikaner-II PS to form Bikaner-II PS – Bikaner (PG) 400kV D/c(Quad) line)
7. 1x80 MVAr Switchable line reactor for each circuit at each end of Bikaner-II – Khetri 400kV 2xD/c line
8. Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Sikar (Sikar-II Substation) with 1x125 MVAr & 2x330 MVAr bus reactor at Sikar -II
9. Sikar-II – Aligarh 765kV D/c line
10. Bhadla-II PS – Sikar-II 765kV 2xD/c line
11. Sikar-II – Neemrana 400kV D/c line (Twin HTLS*)
12. 1x330 MVAr Switchable line reactor for each circuit at Sikar II end of Bhadla-II – Sikar-II 765kV 2xD/c line
13. 1x240 MVAr Switchable line reactor for each circuit at Bhadla-II end of Bhadla-II – Sikar-II 765kV 2xD/c line
14. 1x330MVAr Switchable line reactor for each circuit at each end of Sikar-II –Aligarh 765kV D/c line
15. Augmentation with 765/400kV, 2x1500MVA transformer (5^{th} & 6^{th}) at Fatehgarh-II PS
16. Fatehgarh-II PS – Bhadla-II PS 765kV D/c line (2^{nd})
17. 1x240 MVAr Switchable line reactor for each circuit at each end of Fatehgarh-II – Bhadla-II 765kV D/c line
18. Augmentation with 400/220kV, 4x500MVA transformer (6^{th} to 9^{th}) at Fatehgarh-II PS with suitable bus sectionalisation at 400 kV & 220 kV
19. Augmentation with 765/400kV, 1x1500MVA transformer (4^{th}) at Bhadla-II PS.
20. Augmentation with 400/220kV, 3x500MVA transformer (6^{th} to 8^{th}) at Bhadla-II PS with suitable bus sectionalisation at 400 kV & 220 kV
21. Khetri - Bhiwadi 400kV D/c line (Twin HTLS*)#
22. Power reversal on $\pm$500kV, 2500MW Balia – Bhiwadi HVDC line upto 2000MW from Bhiwadi to Balia in high solar generation scenario
23. 220kV line bays for interconnection of solar projects at Bikaner-II PS (10 nos.), Ramgarh-II PS (7 nos), Fatehgarh-II PS (7 nos) & Bhadla-II PS (4 nos)
24. Establishment of 765/400 kV, 3X1500 MVA GIS substation at Narela with 765 kV (2x330 MVAr) bus reactor and 400kV (1x125 MVAR) bus reactor.
25. Khetri – Narela 765 kV D/c line

26. 1x330 MVAr Switchable line reactor for each circuit at Narela end of Khetri – Narela 765kV D/c line
27. LILO of 765 kV Meerut- Bhiwani S/c line at Narela
28. Removal of LILO of Bawana – Mandola 400kV D/c(Quad) line at Maharani Bagh/ Gopalpur S/s. Extension of above LILO section from Maharani Bagh/Gopalpur upto Narela S/s so as to form Maharanibagh – Narela 400kV D/c(Quad) and Maharanibagh -Gopalpur-Narela 400kV D/c(Quad) lines.
29. STATCOM:
    Fatehgarh – II S/s : STATCOM : ± 600 MVAr, 4x125 MVAR MSC , 2x125 MVAr MSR
    Bhadla – II S/s : STATCOM : ± 600 MVAr, 4x125 MVAR MSC , 2x125 MVAr MSR
    Bikaner – II S/s : STATCOM : ± 300 MVAr, 2x125 MVAR MSC , 1x125 MVAr MSR

** with minimum capacity of 2200 MVA on each circuit at nominal voltage*
 # Due to space constraints 400kV bays at Bhiwadi S/s to be implemented as GIS



3.0 Agenda by PTCUL: Interim Power evacuaton arrangement for under construction Tapovan Vishnugarh and Singoli Bhatwari HEP:

3.1 CEA stated that PTCUL vide their letter dated 12.9.2019 has proposed to LILO one circuit of Vishnuprayag –Muzzafarpur 400kV D/c line at Srinagar HEP as an interim arrangement due to delay in Kandulkhal –Rampura (Srinagar –Kashipur) 400kV D/c line. As no participant from UPPTCL was present in the meeting, so it was decided to convene a separate meeting to discuss the issue.

Meeting ended with the thanks to chair.

Annexure I

List of Participants of 5th meeting of NRSCT held on 13.09.2019

S.No.	Name Shri	Designation	Contact No.	Email ID
I	**CEA**			
1.	P.S Mhaske	Chairman		
2.	Goutam Roy	CE	8376817933	Goutamroy.715@gmail.com
3.	Manjari Chaturvedi	Director	9810502209	Manjari.cea@gmail.com
4.	Priyam Srivastava	AD-I	9717650473	Priyam.cea@gmai.com
5.	Kanhaiya Singh Kushwaha	AD-II	8334951500	kanhaiyasinghk@gmail.com
6.	Komal Dupare	AD-II	9425618454	Komal.dupare16@gmail.com
II	**NRPC**			
7	Naresh Bhandari	MS	9899061449	nbnareshbhandari@gmail.com
III	**POWERGRID**			
8.	Subir Sen	Coo(CTU-plg.)	9650293185	subir@powergridindia.com
9.	Mukesh Khanna	CGM(CTU-plg.)	9910378098	mkhanna@powergridindia.com
10.	Rajesh Varma	Sr.DGM	9599192320	rvarma@powergridindia.com
11.	Ankita Singh	Manager(CTU-plg.)	9560050234	ankita@powergridindia.com
12.	VMS Prakash	Manager	9560890042	yumsprakash@powergridindia.com
13.	Sandeep Behera	Dy. Manager(CTU_plg.)	7042396729	sandeep.behera@powergridindia.com
14.	Narendra Sathvik R.	Dy.Manger	7042195056	rnsathvik@powergridindia.com
15	Roushan Kumar	Engineer (TI plg.)	7546075385	roushan.k@powergridindia.com
IV	**POSOCO**			
16.	S.R Narasimhan	Director	9971117022	srnarasimhan@posoco.in

17.	S.S Barpanda	ED NRLDC	9717296928	ssbarpanda@posoco.in
18.	Rajeev Porwal	GM	9871581133	rk.porwal@posoco.in
19.	Riza Naqvi	Manager(SO)	9650480505	riza.naqvi@posoco.in
20.	Priyam Jain	Dy. Manager (SO)	9599951686	Priyam.jain@posoco.in
21	Suruchi Jain	Dy.Manager	9971038956	suruchi.jain@posoco.in
V	**PSTCL**			
22.	Sanjeev Gupta	CE/TS	9646100864	Ce-ltepstcl.org
23	Paramjit Singh	SE/Plg & Comm	9646118769	Se-planning@pstcl.org
24	Nitin Kumar	AEE/Plg.	9646112826	
VI	**HVPNL**			
25	M.M Matte	SE/Plg.	9316369281	seplg@hvpn.org.in
26.	B.S Malik	XEN	9315353618	xenplgss@hvpn.org
27	Amit Maan	AEE	9315315619	mpccggn@gmail.com
VII	**HPPTCL**			
28	K.S.Attri	Director	9418488710	directorpchpptcl@.com
29	Sandeep Sharma	AGM	9816628734	agmplgit@hpptcl.com
VIII	**HPPC**			
30	Manish Kumar	AE	9599574250	Mani.iit2011@gmail.com
IX	**SECI**			
31	S.K Mishra	Director	9717890222	Sk.mishra@secl.com.in
X	**PTCUL**			
32	S.P. Arya	SE(Projects)	7088117925	Sp_arya@ptcul.org
33	Ashok Kumar	EE(SS)	7088117939	Ashok-kumar@ptcul.org
XI	**RVPN**			
34	Sona Shishodia	XEN (P&P)	9414030303	Xen2.pp@rvpn.co.in
35	M.P. Sharma	AEN (Design)	94133826	Mahavir_sh@rediffmail.com

			17	
36	S.K.Baswal	AEE	9141333095	ee.ppm@rvpn.co.in